“Looking Forward”

Nina Link

President and Chief Executive Officer

Magazine Publishers of America

PaperCon 2010

Hyatt Regency, Atlanta
May 2, 2010

Looking Forward

Going the way of…

Magazine Readership

92% of U.S. Adults Read Print Magazines

Magazine Readers – Adults 18+	2005	2009
Number of Readers (Millions)	181,595	189,487
Index	100	**104**

Magazine Readers – Ages 18-34	2005	2009
Number of Readers (Millions)	58,916	60,306
Index	100	**102**

Source: Experian Simmons; Mediamark Research & Intelligence

Assessing Ad Impact of Multiple Media

New Analysis from Dynamic Logic

- Overall, magazines drove consumer behavior more effectively and efficiently than TV or online among consumers who were reached by each medium.
  - For effectiveness, magazines were the most consistent performer across all three media, contributing significant lift overall and at each stage of the consumer purchase decision process.
  - This held true for the consumer packaged goods category as well as non-packaged goods.
  - Magazines were the most efficient medium at driving consumer behavior, both individually as well as in combination with other media.

Source: Dynamic Logic

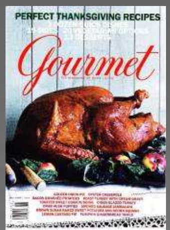
75% of Teens Read Magazines

Launches, Closings and Resurrections

LAUNCHES

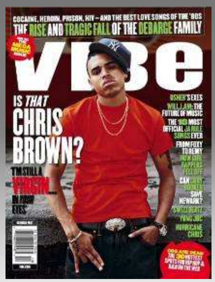
2009	2008	Change
734	685	7.2%

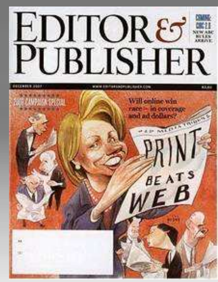
CLOSINGS



2009	2008	Change
67	54	24.1%

RESURRECTIONS





Source: Mr.Magazine; Ulrich's Pubs, Serial Solutions

Readers Enjoy ALL Magazine Content: the Edit and the Ads

Magazines ≠ Newspapers

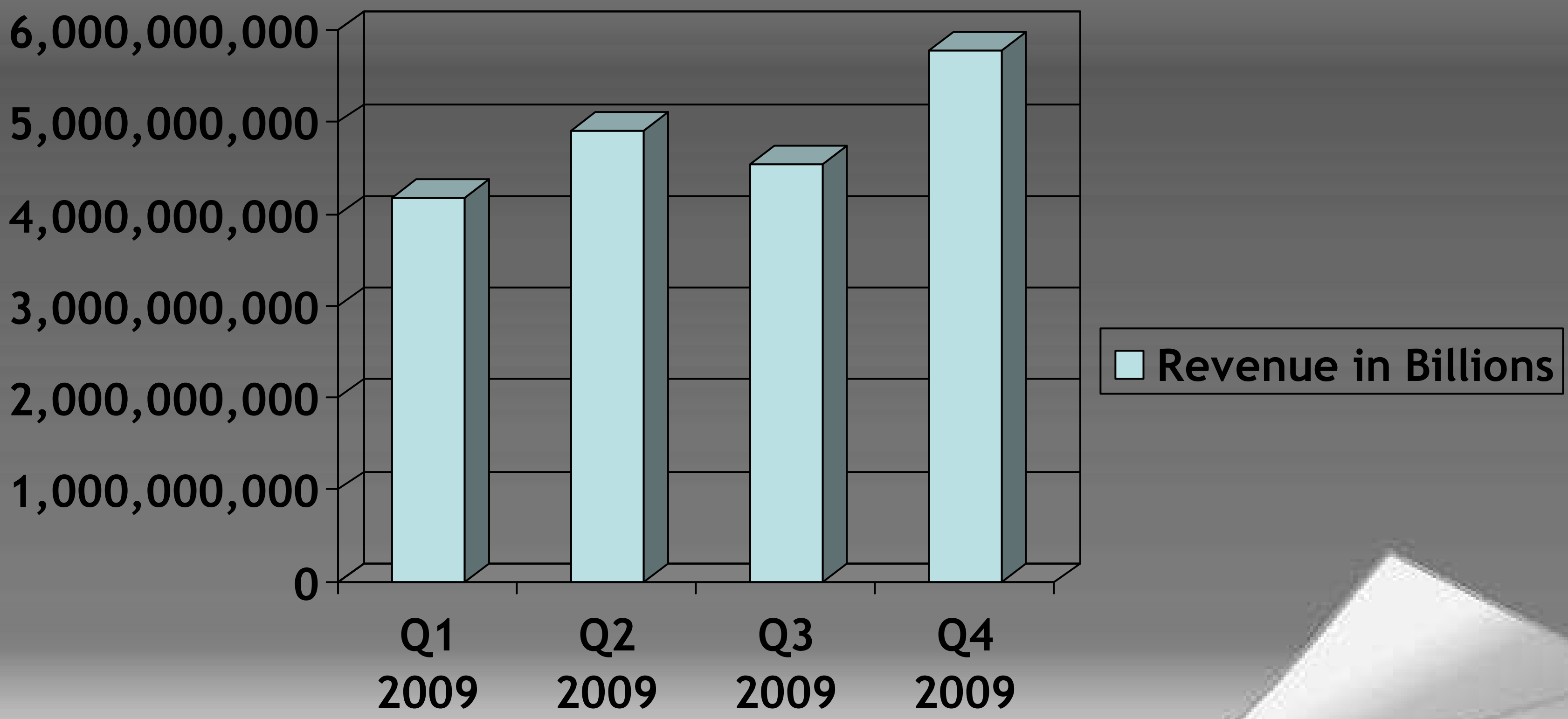
Effects of the Economic Recession on Magazines

MPA

FY 2009 Magazine Print Advertising

Ad Spending Uptick in Fourth Quarter

MAGAZINE 2009 TOTAL AD REVENUE: $19.5 BILLION → -18%



Source: Publishers Information Bureau

MPA

Q1 2010 Magazine Print Advertising

More Individual Titles Show Growth

# OF MAGAZINES THAT POSTED AD PAGE GAINS	
Q1 2010	**Q1 2009**
86	15

Source: Publishers Information Bureau

MPA

Circulation

	FY 2009	FY 2008	CHANGE
ABC-Audited Magazines	346,571,912	368,363,773	-5.9%

- Total average circulation declines for the first time
- Softness partly driven by the reduced number of audited titles
- Other factors are magazine closings and rate base reductions

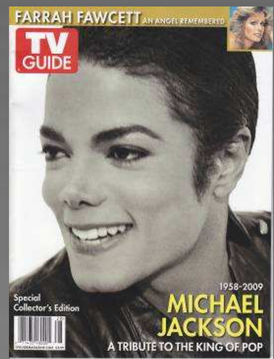
Source: Audit Bureau of Circulations

Newsstand Circulation

- **Challenges**
  - Recession
  - Shift in shopping patterns
  - Distribution disruption in first half

All Magazines	FY 2009	vs. 2008
Dollar Sales	$4.44 billion	-8.1%
Unit Sales	1.11 billion	-12.6%

- **Major News Events**
  - Michael Jackson on covers: extra $55 million in sales



Source: Harrington Associates; Advertising Age

Circulation Winners

HEALTH MAGAZINES

WOMEN'S MAGAZINES

MPA


NATIONAL GEOGRAPHIC
Photograph by Cesare Naldi
VISIONS OF EARTH. MAY 2010
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“Magazines, The Power of Print”

Goals of Industry Ad Campaign

- Reshape conversations about magazines
- Challenge misperceptions about magazine relevancy
- Reinforce cultural role of magazines

“Magazines, The Power of Print”

Jim Fiscus *for* ESPN The Magazine

We surf the Internet.
We swim in magazines.

The Internet is exhilarating. Magazines are enveloping. The Internet grabs you. Magazines embrace you. The Internet is fleeting. Magazines are immersive. And both media are growing.

Barely noticed amidst the thunderous Internet clamor is the simple fact that magazine readership has risen over the past five years. Even in the age of the Internet, even among the groups one would assume are most singularly hooked on digital media, the appeal of magazines is growing.

Think of it this way: during the 12-year life of Google, magazine readership actually increased 11 percent.

What it proves, once again, is that a new medium doesn't necessarily displace an existing one. Just as movies didn't kill radio. Just as TV didn't kill movies. An established medium can continue to flourish so long as it continues to offer a unique experience. And, as reader loyalty and growth demonstrate, magazines do.

Which is why people aren't giving up swimming, just because they also enjoy surfing.

MAGAZINES
The *Power* of *Print*

MPA

“Magazines, The Power of Print”

MPA

“Magazines, The Power of Print”

MPA

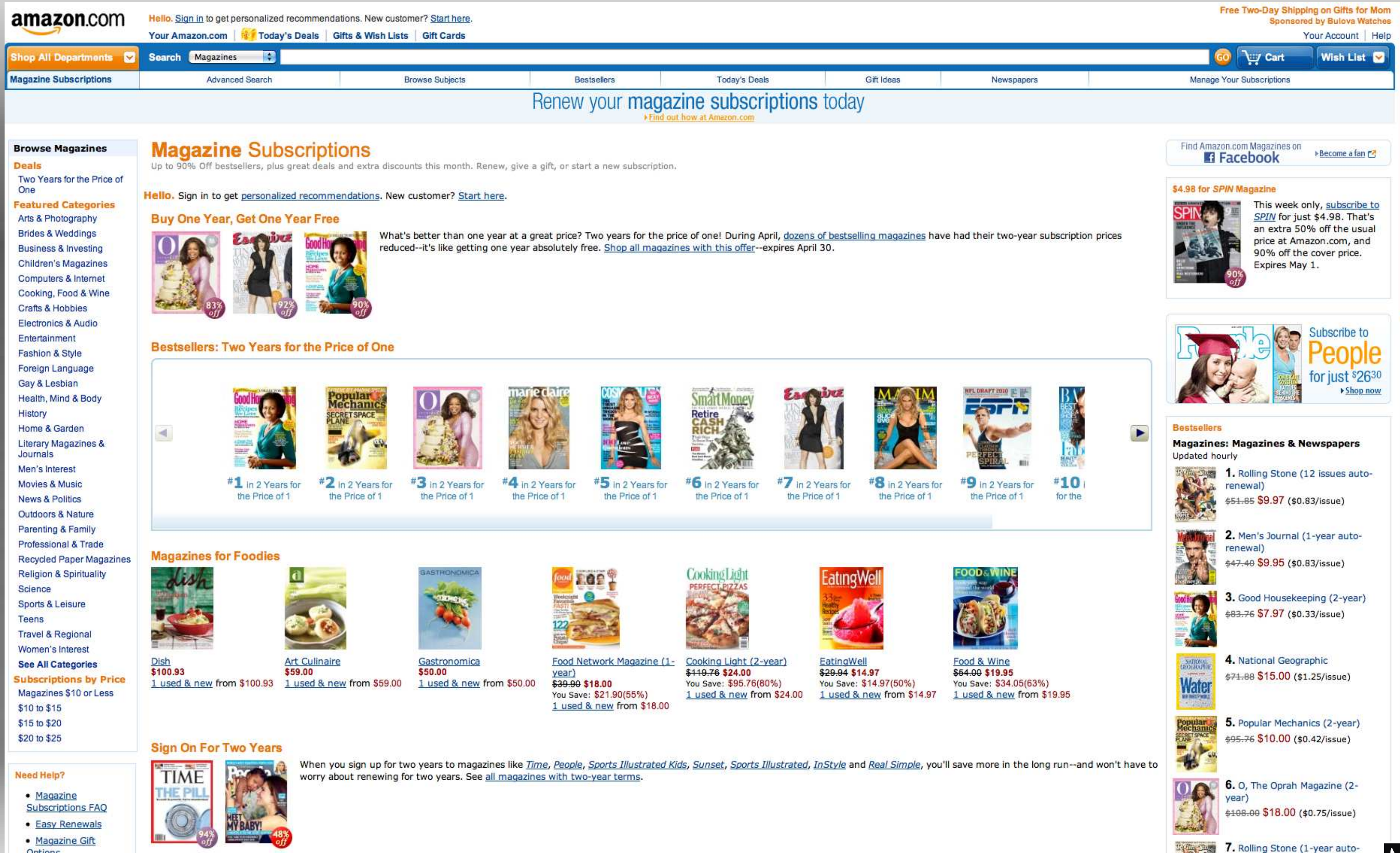
The Digital Connection

PRINT → WEB

TAG | MOBILE CODES

AUGEMENTED REALITY | 3D

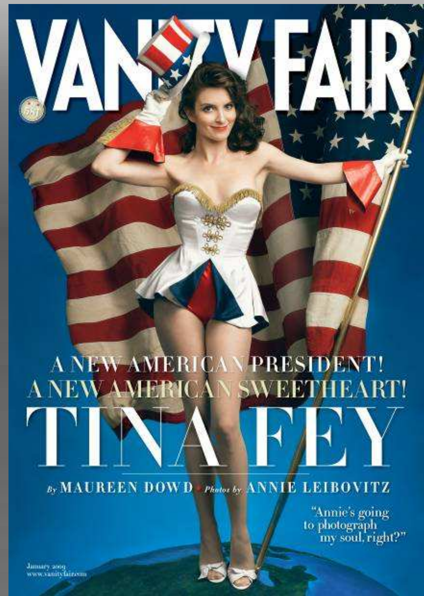
Amazon.com Partnership



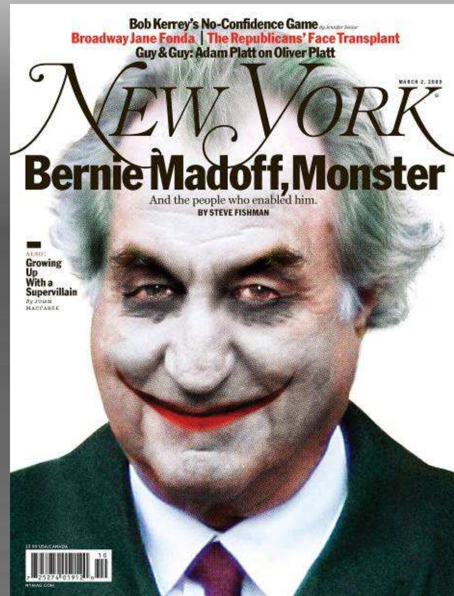
MPA

Magazine Covers of the Year

Cover of the Year



Best Entertainment|
Celebrity Cover



Best News Cover

2009 Best Covers of the Year

MPA

Industry Retail Promotion

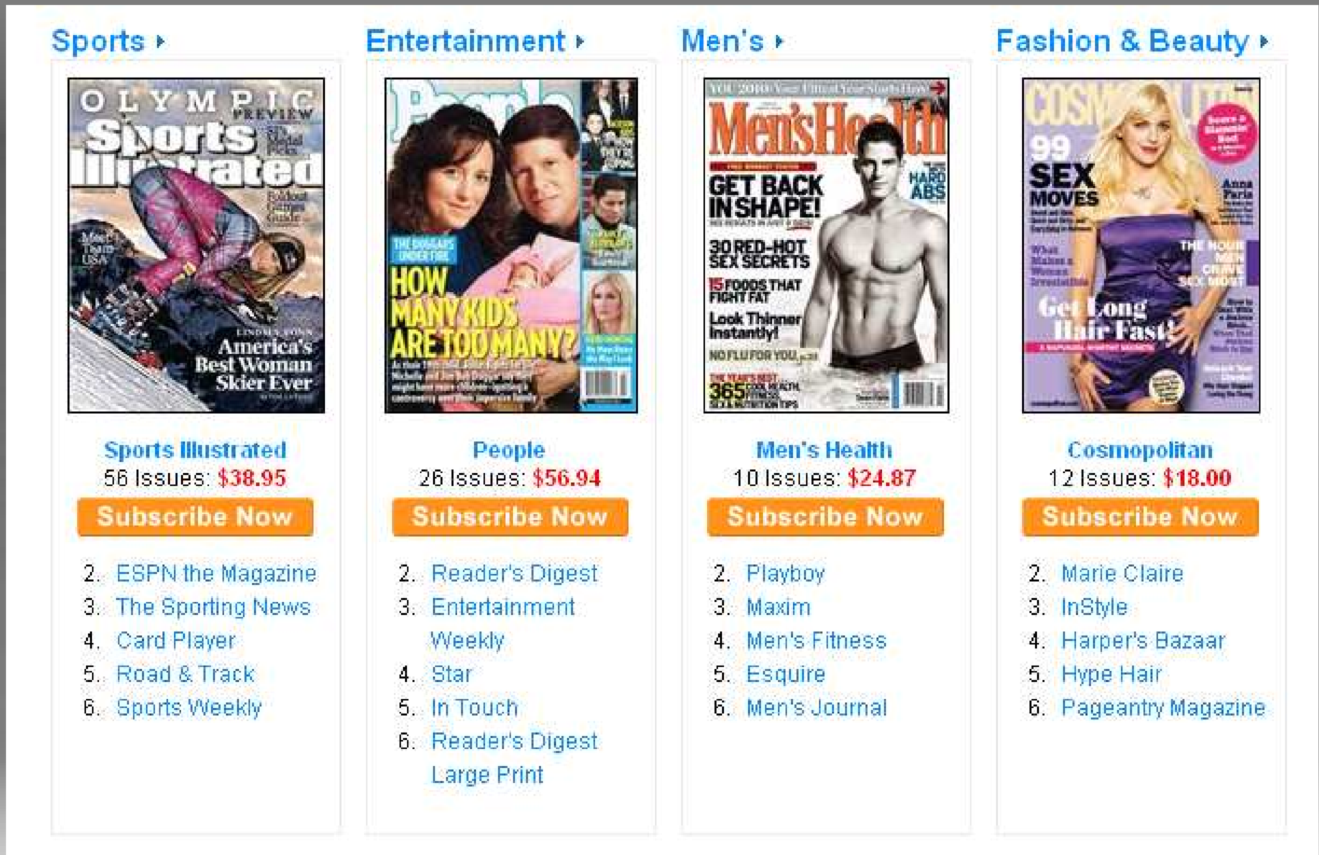
Magazine Industry + Harrisburg News

- 15% rise in magazine category sales and up to 60% lift in sales for special-display titles

MPA

Web-Sourced Subscriptions

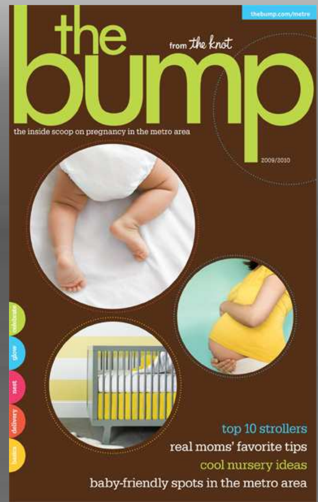
20% of magazine subscriptions come from online



Web → Print


the knot
850+ wedding gowns
best dresses under $2000
details you've never seen
plus the prettiest bridesmaid dresses
the new wedding colors p. 69
THE FASHION ISSUE
the ultimate LOOKBOOK FOR BRIDES
*8 hot hairstyles
from the website you love most:
theknot.com


from the knot
[the nest]
63 chic home style tips + tricks
get organized for 2007
are you mismanaging your money?
holiday survival guide


the bump
from the knot
the inside scoop on pregnancy in the metro area
top 10 strollers
real moms' favorite tips
cool nursery ideas
baby-friendly spots in the metro area


The WAITING ROOM COMPANION Created for Your Doctor's Office
WebMD
webmd.com
the Magazine
26 beauty
36 diet
41 sex
42 parenting
50 heart
58 diabetes
59 sleep
60 allergies
61 cancer
62 mind
Cold war
Doctors' own tactics for battling the bug
54
Ticker tune-up
12 smart heart tips
50
Stand-up mom
Comedienne Julia Louis-Dreyfus is serious about putting family first and inspiring you to go green
44


BabyCenter
you said it!

Magazine Content on Any Platform

Magazines in a Multi-Platform World

Thank You

Nina Link
President and Chief Executive Officer
Magazine Publishers of America

TAPPI
people resources solutions

Sustainability Forum
@PaperCon 2010

May 4, 2010

Hyatt Regency Hotel - Atlanta

Tribute

A Special Thanks

To

Rock Tenn's Rich Hall

TAPPI
people resources solutions

Session 1

Standards, Metrics & Labeling

Laura Rowell, MWV, Session Chair

Joan Pierce, Colgate Palmolive

Victor Bell, Environmental Packaging Int'l.

Anne Bedarf, GreenBlue

Laura Rowell, MWV

TAPPI Sustainability Forum

ISO Packaging Standards &

Global Packaging Project

May 4, 2010

J. Pierce

Colgate-Palmolive Company

3 Major Activities

- **Global Packaging Project**
- **International Standards Organization (ISO)**
- **Packaging Research & Sustainability by Design (SbD)**

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Packaging Sustainability

a global project by The Consumer Goods Forum

The Consumer Goods
FORUM
The Global Network Serving Shopper & Consumer Needs

Where did the project start?

Global CEO Forum
Paris, 15th November 2008

"Different businesses, whether they are manufacturers or retailers, judge the sustainability of their products/packaging from different perspectives. Many focus on weight reduction whilst others focus on the complete life cycle of the product. The development of standardised industry criteria would ensure greater benefit to consumers and higher recycling/recovery rates."

(Paul Polman)

Note: The Global CEO Forum has now been incorporated into The Consumer Goods Forum

Reasons for the project

Sustainability is an essential element of business strategy

- *But…*
- *Varying perspectives and levels of understanding of sustainability*
- *Use of different metrics to measure sustainability*

Packaging is critical to this strategy

- *Packaging protects, preserves, promotes the product.*
- *But…*
- *Consumers perceive over-packaging as a key concern*
- *NGOs and Government view packaging as a key focus area when targeting potential gains to sustainability and a positive impact on the environment*

Consistent measures of sustainability reduce complexity, costs & enable better results

- *Better co-ordinated industry action to address the issues around packaging takes out unnecessary costs, inefficient responses and potential consumer confusion*
- *Consumers want consistency of information*
- *Industry needs a **common business language and commonly used metrics** to address packaging sustainability*

Who’s involved - the team

Consultant support
- Quantis
- GreenBlue

Academic participation
- University of Arkansas
- University of Minnesota
- University of Manchester
- Rochester Institute of Technology

Retailers

Manufacturers

Associations

Packaging manufacturers

Our deliverable (1)

Guidance on how to improve sustainability of packaging, covering…

Role of Packaging

Common understanding of packaging's contribution to sustainability

Common definitions and principles

Common understanding of what sustainability means for packaging

Packaging sustainability indicators and metrics

Common language to measure the sustainability of packaging

…enabling

- *Better internal decision making*
- *Better trading partner dialogue on packaging improvements*

The Global Packaging Project based its work on the indicators and metrics framework of the Sustainable Packaging Coalition (SPC) and the ECR Europe/EUROPEN guide « Packaging in the Sustainability Agenda – a guide for corporate decision-makers »

Our deliverable (2)

The Principles

Effective sustainability should embrace…

- *all 3 pillars of sustainability:*
  - *Economic*
  - *Social*
  - *Environmental*

Packaging design should consider…

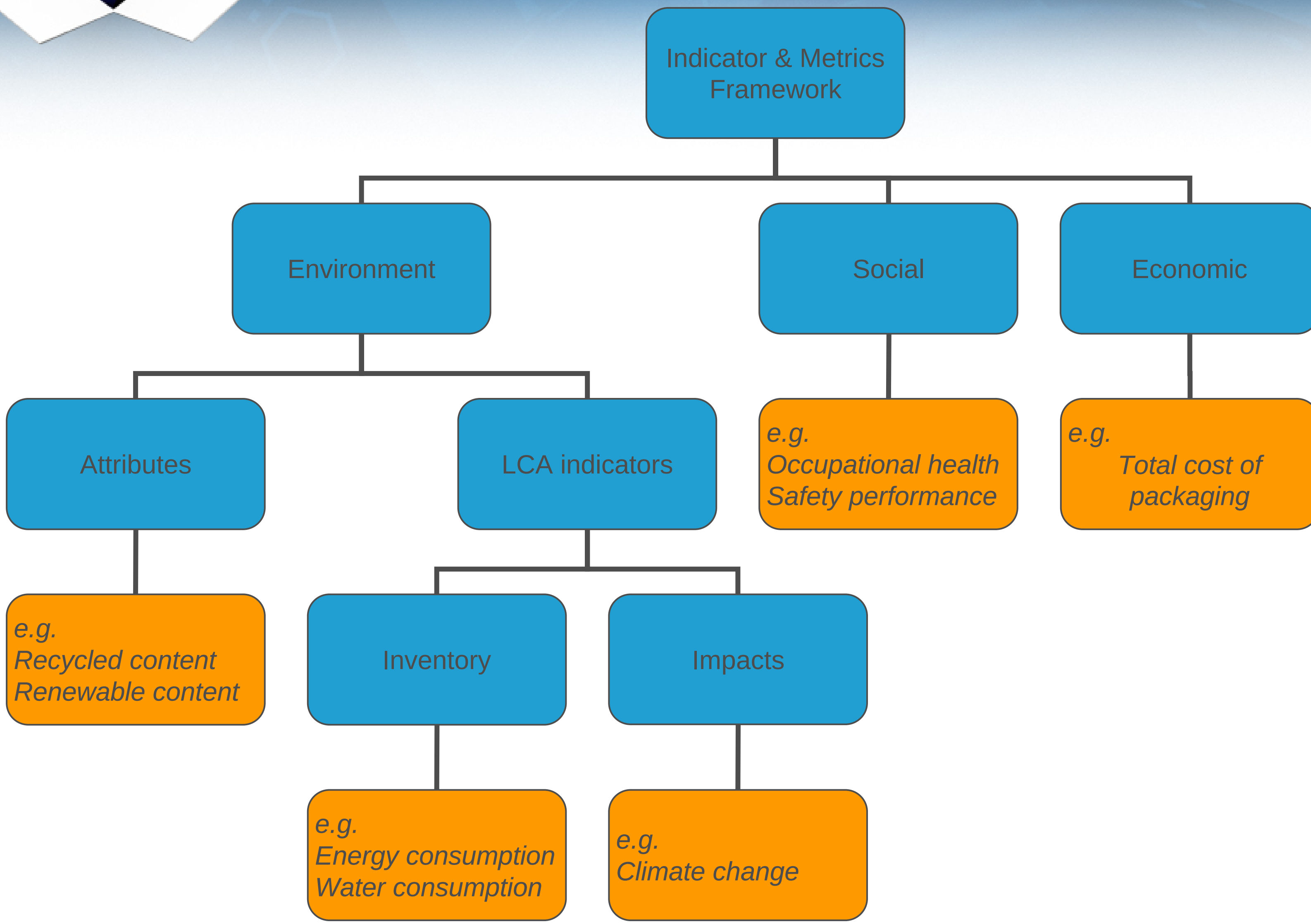
- *Packaging in the context of the entire packaged product*
- *The complete packaging system i.e. Primary, Secondary and Tertiary packaging*
- *The complete packaging life cycle i.e. cradle to grave*

More consistent and impactful industry action through common definitions and metrics

- *Metrics should be:*
  - *Relevant to company and societal needs*
  - *Representative to avoid unintended burden shifting*
  - *Developed, used and communicated in compliance with applicable international standards*

Our Deliverable (3)

GPP draft indicators and metrics framework



Our timelines

Fine tune indicators & metrics

- *Agree on final categorisation/definition/protocols of indicators and metrics and issue guidance for use by Q1 2010*

Publish framework report

- *By Q1 2010*

Pilot the metrics

- *From April to September 2010*
- *Pilot findings to be integrated into framework*

Communication to the industry

- *At all stages of delivery*

Recap: So why are we doing this?

Clear definition of sustainability

Holistic approach to Packaging

Globally applicable definition of common packaging sustainability indicators and metrics

- Unified approach from industry to sustainability metrics
- Cost reduction
- Reduced sustainability impacts
- Improved consumer perception
- Improved decision making
- Demonstrate industry-wide leadership for:
  - Others to emulate
  - Applying the model to achieve other common goals

3 Major Activities

- **Global Packaging Project**
- **International Standards Organization (ISO)**
- **Packaging Research & Sustainability by Design (SbD)**

ISO/TC 122/SC 4
Packaging and Environment

International Standards Organization

Sub Committee 4

Packaging and the Environment

Standards will provide the packaging value chain with guidance and environmentally responsible approach to packaging production, use and post-use management.

- Based on existing environmental standards
  - European
  - Asian

- Anders Linde, Chairman

ISO/TC 122/SC 4
Packaging and Environment

Members

- Belgium
- Denmark
- Germany
- Italy
- Jordan
- Korea, Rep of
- Spain
- Thailand
- USA
- China
- France
- India
- Japan
- Kenya
- Netherlands
- Switzerland
- United Kingdom

ISO/TC 122/SC 4
Packaging and Environment

Working Group	Chairman	Project Lead
1. General Requirements	Mr. Wang Yuande (China)	Mr. Wang Yuande (China)
2. Package Optimization	Mr. Michael Nieuwesteeg (Netherlands)	Ms. Laura Rowell (United States)
2. Reuse	Mr. Wang Weishan (China)	Mr. Jongkyong Kim (Korea)
4. Material Recycling	Mr. Takehiro Kaneko (Japan)	Ms. Marilyn Baker (United States)

Working Group	Chairman	Project Lead
5. Energy Recovery	Mr. Seung-Jin Choi (Korea)	Mr. Seung-Jin Choi (Korea)
6. Chemical Recovery	Dr. Myung-Hoon Lee (Korea)	Dr. Shunji Kojima (Japan)
7. Organic Recovery	Dr. Ramani Narayan (United States)	Mr. Bruno De Wilde (Belgium) and Mr. Kazunori Miura (Japan)

- First meeting in Stockholm - December 2009
- Next meeting in Beijing - June 2010
- Draft standards expected late 2010
- Final standards scheduled for publication - 2012

Benefits

- Aligns with existing standards
- Common reference for all stakeholders debating the environmental impact of packaging
  - Prevent ad-hoc regional requirements
  - Platform for communications with regulatory authorities
- Global approach for global market
- Harmonized packaging requirements
- Supports free trade

US Proposed - Formal Liaisons

- Consumer Goods Forum
- ISTA

ISO/TC 122/SC 4
Packaging and Environment

US Delegation

Marilyn Baker, The Coca Cola Company - Head of Delegation

Mike Ogle, Material Handling Industry of America - Secretary, MH10 and USTAG to TC122

WG 1 - General Requirements

- Fred Hayes, PMMI
  - Joan Pierce, Colgate Palmolive
  - Marilyn Baker, The Coca Cola Co.
  - Rob Clarke, Michigan State University
  - Ed Getz, 3M

WG 2 - Package Optimization

- Laura Rowell, MeadWestvaco
  - Joan Pierce, Colgate Palmolive, ISTA
  - Ed Church, ISTA
  - Karen Proctor, RIT, ISTA
  - Bill Armstrong, Sealed Air Corp, ISTA
  - Pat Nolan, DDL, ISTA
  - Fred Hayes, PMMI
  - Leon Venech, SGS U.S. Testing, ISTA
  - Elisabeth Comere, Tetra Pak
  - Brian O'Banion, Fiber Box Association
  - Eric Carlson, Adalis Pkg Solutions Grp.

ISO/TC 122/SC 4
Packaging and Environment

US Delegation

WG 3 – Reuse

- Paul Rankin, Reusable Industrial Packaging Association
  - Paul Singh, M S U, ISTA
  - Ralph Rupert, Virginia Technology

WG 4 - Material recycling

- Marilyn Baker, The Coca Cola Company
  - Jeff Wooster, Dow Chemical
  - Amy Schaffer, A F & P A
  - Karel Wendl, The Coca Cola Co.
  - Brian O'Banion, Fiber Box Assoc
  - Paul Rankin, Reusable Ind Pkg

WG 5 - Energy Recovery

- Jeff Wooster, Dow Chemical
  - Bill Armstrong, Sealed Air Corp
  - Brian O'Banion, Fibre Box Association

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Packaging and Environment

US Delegation

WG 6 - Chemical Recovery

- Jeff Wooster, Dow Chemical
  - Scott Steele, PTI
  - Marilyn Baker, The Coca Cola Co.

WG 7 - Organic Recovery

- Ramani Narayan, Michigan State Univ.
  - Steve Mojo, BPI
  - Paul Singh, M S U, ISTA
  - Bill Armstrong, Sealed Air, ISTA

ISO/TC 122/SC 4
Packaging and Environment

US Delegation

- First face-to-face meeting in April
- Regular conference calls
- Need support, volunteer effort
  - Packaging system design, holistic view
  - Understand end of life management systems
  - Specific knowledge of packaging materials or systems

3 Major Activities

- **Global Packaging Project**
- **International Standards Organization (ISO)**
- **Packaging Research & Sustainability by Design (SbD)**

Packaging Research

MICHIGAN STATE UNIVERSITY

The Center for Packaging Innovation & Sustainability will be a global leader in research and outreach related to packaging innovation and sustainable systems, resulting in positive environmental affects on the global footprint of packaging and related systems across the supply chain

MICHIGAN STATE UNIVERSITY

Founding Members

The Coca Cola Company

ConAgra

Abbott Labs

Dow

Academic Organizations

University of Michigan (sustainability center)

University of Massachusetts at Lowell (NSF funding for bio-polymers)

Rutgers University (bio-material center)

Ohio State University

University of Toledo

Eastern Michigan University

Academic Organizations

University of Arkansas

European Funds (consortium of grants)

Clemson University

California Polytechnic State University

Fashion Institute of Technology

Indiana State University

Academic Organizations

San Jose State University

School of Military Packaging Technology

University of Florida

University of Illinois

University of Missouri - Rolla

University of Wisconsin-Stout

Virginia Tech

Western Michigan University

Sustainability by Design

SbD

Sustainability by Design

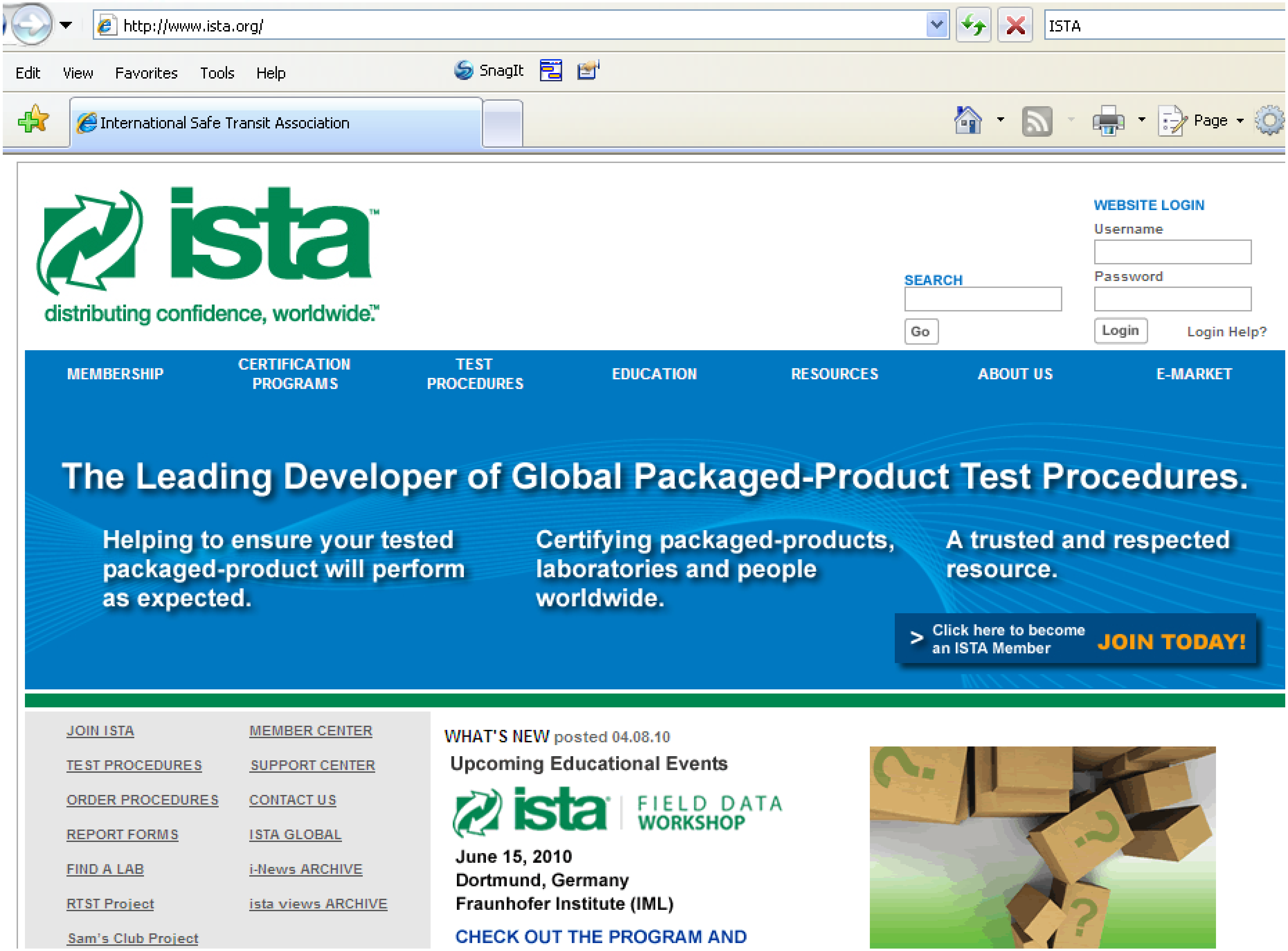
International Safe Transit Association

- Recognized for transport packaging
- Publishes international recognized test methods and protocols
- Largest data base for distribution hazards

ISTA

Expanding technical breath and depth into package sustainability

Creating design manual for package sustainability by design


http://www.ista.org/
ISTA
Edit View Favorites Tools Help
SnagIt
International Safe Transit Association
Page
ista
distributing confidence, worldwide.
WEBSITE LOGIN
Username
Password
SEARCH
Go
Login
Login Help?
MEMBERSHIP
CERTIFICATION PROGRAMS
TEST PROCEDURES
EDUCATION
RESOURCES
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Helping to ensure your tested packaged-product will perform as expected.
Certifying packaged-products, laboratories and people worldwide.
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ISTA GLOBAL
FIND A LAB
i-News ARCHIVE
RTST Project
ista views ARCHIVE
Sam's Club Project
WHAT'S NEW posted 04.08.10
Upcoming Educational Events
ista FIELD DATA WORKSHOP
June 15, 2010
Dortmund, Germany
Fraunhofer Institute (IML)
CHECK OUT THE PROGRAM AND

In Summary

Monitor industry news for updates on:

- **Consumer Goods Forum**
- **International Standards Organization (ISO)**
- **Packaging Research & Sustainability by Design (SbD)**

Thank You

Joan L. Pierce
Vice President, Package Sustainability
Colgate-Palmolive Company
Joan_L_Pierce@colpal.com

SUSTAINABLE PACKAGING COALITION®

Anne Bedarf
May 4, 2010
TAPPI Sustainability Forum

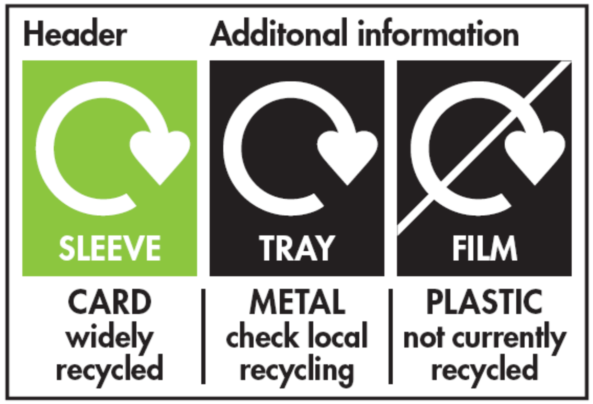
Recycling Claims Issues

Source: teenormous.com

Stakeholders

- **Industry:** lower the barrier for appropriate and consistent messaging regarding recyclability; benchmark current infrastructure; meet ISO 14021 and FTC requirements
- **Recyclers:** increase recyclables and decrease contamination
- **Consumer:** clarity on what to do with the package; better understand their local system
- **Government:** all of the above
- **NGOs:** serve the public interest

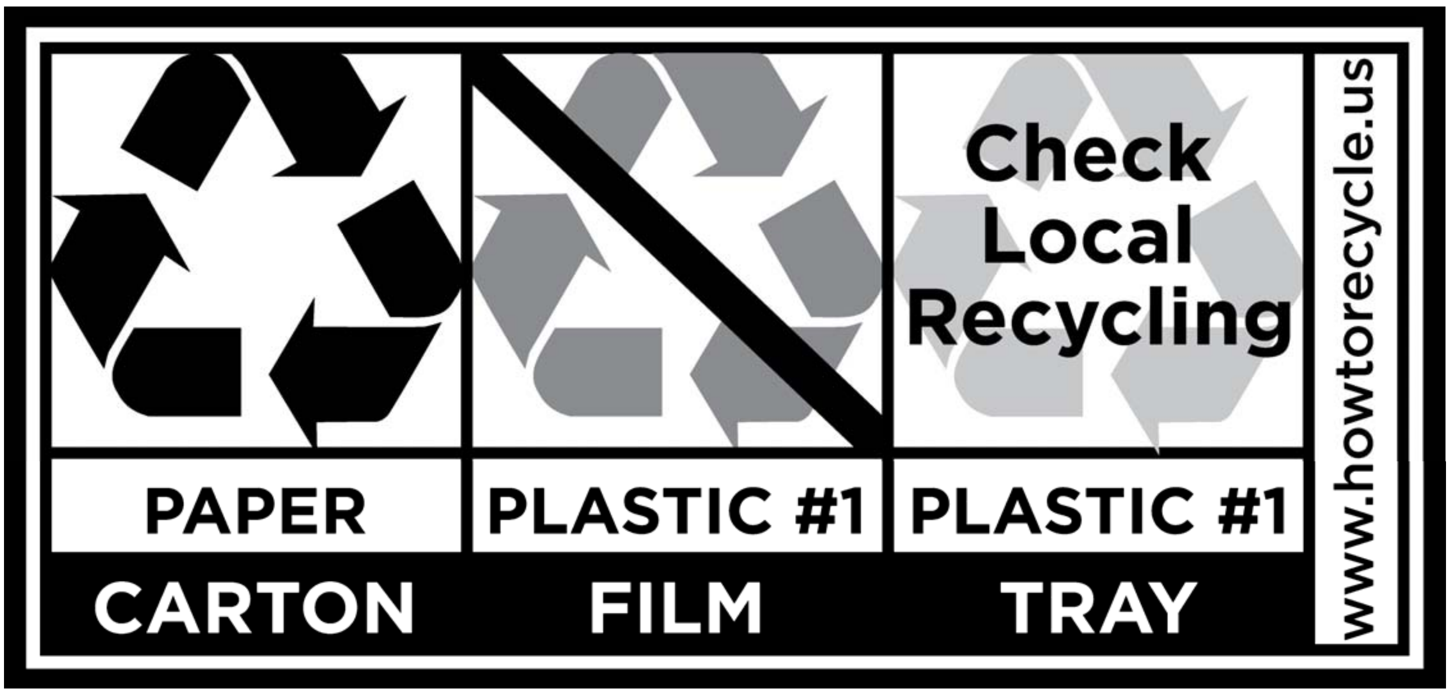
OPRL System in the U.K.



- **Initial design & data collection by WRAP**
- **Piloted by Marks & Spencer (and others)**
- **Now adopted through the British Retail Consortium as a subsidiary company OPRL Ltd.**

Label Categories

- Widely Recycled (U.K.: 65% or more access)
- Check Local Recycling (U.K.: bw 15% and 65%)
- Not Yet Recycled (U.K.: less than 15%)



Data is Paramount

- **Reach Data** – percent of the community having access to recycling: different from Rate.
- Access is the beginning of the recycling supply chain; doesn't cover the entire recovery system
- FTC compliance
- Material Recovery Facility and reprocessing issues taken into account

Current Reach Data Sources

- American Forest & Paper Association (AF&PA) bi-annual Survey
- American Beverage Association Survey
- Earth911.com
- Re-Trac
- Others: municipal/state sources; smaller studies

Earth911®.com
News & Lifestyle
The latest in green
Recycling 101
Reduce, Reuse, Recycle
Business Solutions
Answering your sustainability needs
LISTINGS
ARTICLES
EVENTS
Find recycling centers for
aluminum cans, computers, paint
Near
zip or address, city, state
Search
Rebuilding a Sustainable Haiti
On the ground with green organizations in Haiti
FULL STORY
Reduce? Reuse? Recycle?
Learn the Basics
Advertise with us
FEATURED ARTICLES
The Next Wave in Composting
The Lowdown on Lithium-ion
Rebuilding a Sustainable Haiti
Ultimate Reuse Challenge 3
Cheat Sheet: Solar Power
How Kids Are Saving the Planet
More Earth911.com Exclusives
Join Today
Get Our Weekly Newsletter
E-Mail Address
SIGNUP

Current Efforts

- Established partnership with Keep America Beautiful (KAB)
- Finalizing data requirements
- MOU with KAB and Earth911.com for gap analysis and implementation proposal
- Parallel effort: potential to partner with industry on current survey work

Project Team Data Subcommittee Members

- American Chemistry Council
- Association of Postconsumer Plastic Recyclers
- EPA Office of Resource Conservation & Recovery
- CalRecycle
- Esteé Lauder Companies
- International Paper
- Kraft
- MWV
- North Carolina State Recycling Program
- Stopwaste.org
- Target
- Waste Management

Materials matrix

The following matrix provides a list of standardised reference names for packaging components and material types. It also shows the appropriate recycling status of each combination.

Key	
widely recycled	W
check local recycling	C
not currently recycled	N
not applicable	–

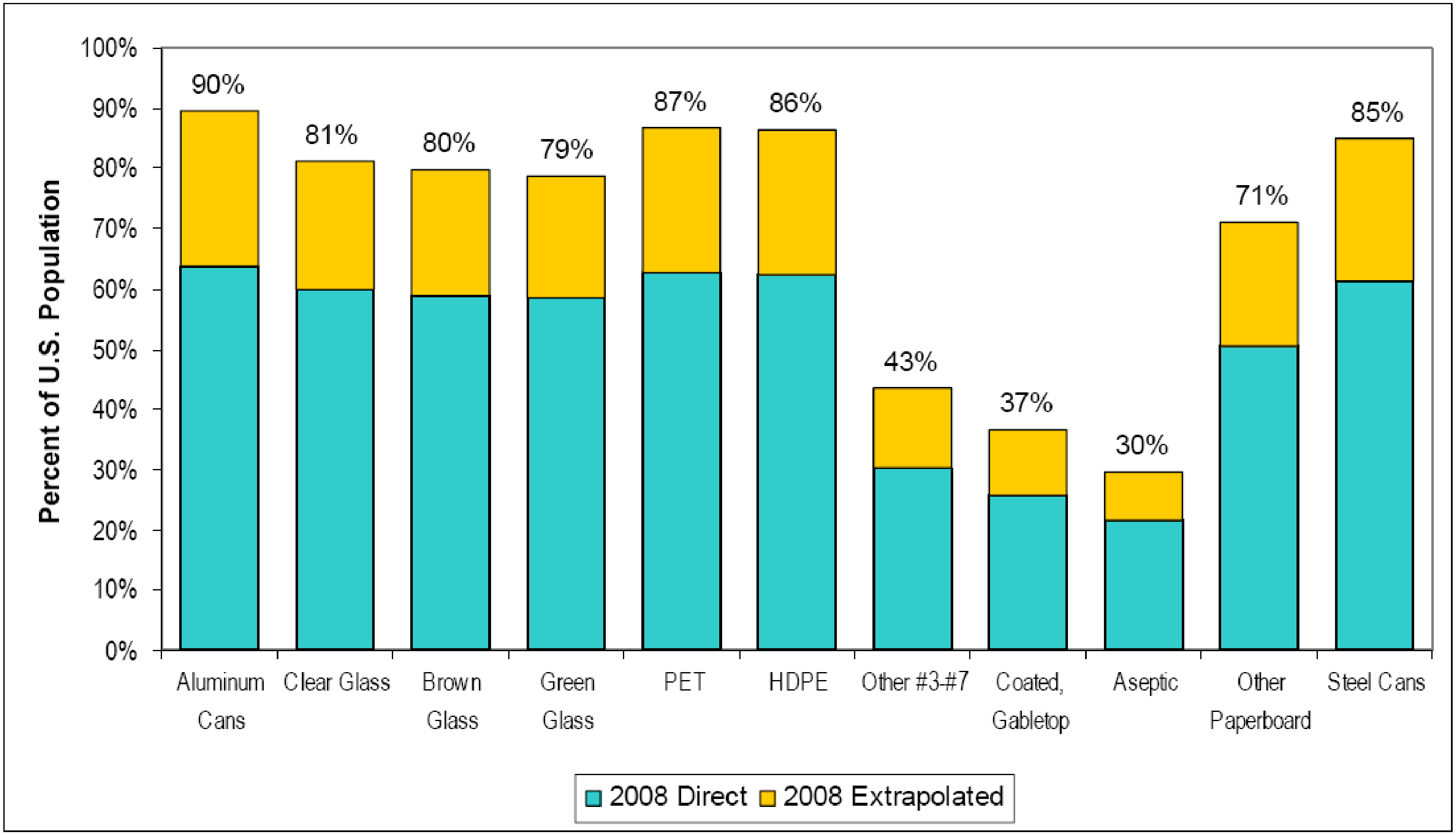
Use appropriate standard packaging **component** reference name as shown in bold

Use appropriate standard **material** reference name as shown in bold

Material / **Component**	**Aerosol**	**Bag**	**Band**	**Base**	**Blister**	**Booklet**	**Bottle**	**Box**	**Bucket**	**Can**	**Cap**	**Card**	**Carton**	**Clip**	**Closure**	**Collar**	**Cork**	**Cover**	**Film**	**Liquid Carton**[1]	**Handle**	**Insert**	**Jar**[2]	**Label - loose**
Glass	–	–	–	–	–	–	W	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	W	–
Metal (inc. aluminium Foil)	W	–	–	–	–	–	W	W	W	W	C	–	W	C	C	C	–	–	–	–	N	–	W	–
Paper (inc. paper pulp e.g. egg boxes)	–	W	–	W	–	W	–	W	–	–	–	W	W	–	–	W	–	W	–	–	W	W	–	W
Card (inc. cartonboard & corrugate)	–	W	–	W	–	W	–	W	–	–	–	W	W	–	–	W	–	W	–	–	W	W	–	W
Plastic (PET)	–	N	N	C	C	–	W	C	C	–	C	–	C	C	C	C	–	N	N	–	C	N	W	N
Plastic (HDPE)	–	N	N	C	C	–	W	–	C	–	C	–	–	C	C	C	–	N	N	–	C	N	W	N
Plastic (LDPE)	–	N	N	–	–	–	–	–	C	–	C	–	–	C	C	C	–	N	N	–	C	N	–	N
Plastic (PP)	–	N	N	C	C	–	W	C	C	–	C	–	C	C	C	C	–	N	N	–	C	–	W	N
Plastic (PS)	–	N	N	C	C	–	–	–	C	–	C	–	–	C	C	C	–	N	N	–	C	N	–	N
Plastic (PVC)	–	N	N	C	C	–	W	C	C	–	C	–	C	C	C	C	–	N	N	–	C	N	W	N
Plastic (Other)	–	N	N	C	C	–	W	C	C	–	C	–	C	C	C	C	–	N	N	–	C	N	W	N
Biodegradable & **Compostable** (e.g. PLA)	–	N	N	N	N	–	N	N	N	–	N	–	N	N	N	N	–	N	N	–	N	N	N	N
Degradable (e.g. Oxy-degradable plastic)	–	N	N	N	N	–	N	N	N	–	N	–	N	N	N	N	–	N	N	–	N	N	N	N
Composite (e.g. Liquid food and drink cartons)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	W	–	–	–	–
Mixed Material (e.g. complex laminates)[3]	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	–	N	N	N	N

Material / **Component**	**Label - glued**	**Leaflet**	**Lid**	**Net**	**Pad**	**Packing**	**Pot**	**Pouch**	**Pump**	**Sleeve**	**Tag**	**Tape**	**Tin**	**Tissue**	**Tray**	**Trigger**	**Tub**	**Tube**	**Window**	**Wrap**
Glass	Do not include in labelling	–	W	–	–	–	W	–	–	–	–	–	–	–	–	–	W	–	–	–
Metal (inc. aluminium Foil)		–	C	–	–	–	C	–	–	–	C	–	W	–	C	–	C	C	–	C
Paper (inc. paper pulp e.g. egg boxes)		W	W	–	–	W	W	–	–	W	W	–	–	W	W	–	W	W	–	W
Card (inc. cartonboard & corrugate)		W	W	–	–	W	W	–	–	W	W	–	–	W	W	–	W	W	–	W
Plastic (PET)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (HDPE)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (LDPE)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (PP)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (PS)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (PVC)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Plastic (Other)		–	C	N	N	N	C	N	–	N	N	N	–	–	C	–	C	N	N	N
Biodegradable & **Compostable** (e.g. PLA)		–	N	N	N	N	N	N	–	N	N	N	–	–	N	–	N	N	N	N
Degradable (e.g. Oxy-degradable plastic)		–	N	N	N	N	N	N	–	N	N	N	–	–	N	–	N	N	N	N
Composite (e.g. Liquid food and drink cartons)		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mixed Material (e.g. complex laminates)[3]		–	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Figure ES-1
Percentage of Population with Access to Container Materials Collection



From: 2008 ABA Community Survey, R.W. Beck, 9/09

SUSTAINABLE PACKAGING COALITION®

a project of GreenBlue

Data Issues to Consider

- Data Maintenance
- Quality Assurance
- Categorization
- Exceptions list
- Funding
- Proper Use and Long-term Ownership

Next Steps

- Finalize Data Categories
- Initiate Data Collection
- Consumer Test to Finalize Label Design
- Pilot (working with local government)

ENVIRONMENTAL LABELING GUIDELINES FOR PACKAGING

May 4, 2010

Victor Bell
Environmental Packaging International

Environmental Packaging International

- Specialists in global environmental packaging & product stewardship requirements
- Offices
  - Rhode Island, US
  - New Hampshire, US
  - Toronto, CA
- Our clients include:

As Eco-Seals Proliferate, So Do Doubts APRIL 2, 2009

By GWENDOLYN BOUNDS

THE WALL STREET JOURNAL.

It's too easy to be green Recently, Kevin Owsley went searching for a reputable organization that could validate the eco-friendly traits of his company's carpet-cleaning fluid. But after canvassing a dozen competing groups hawking so-called "green certification" services -- including one online outfit that awarded him an instant green diploma, no questions asked

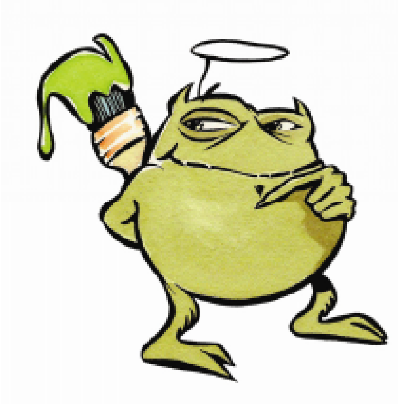
5th Annual Walmart Stores Inc., Sustainable Packaging Exposition

- EPI audited Environmental Claims for all packaging vendors at the Walmart Sustainable Packaging Expo
- EPI audited both the Packaging Success Story and the 7R's handout
- About 70% were rejected in the first review
- Most were approved in the end

Third-Party Review of Packaging Sustainability Data

- GreenerPackage.com database will offer optional, third-party reviews for suppliers that list their product information in the database
- The database is linked to Walmart's Sustainable Packaging Scorecard Modeling tool
- Guidelines available: http://www.GreenerPackage.com/guidelines or at www.enviro-pac.com

Beware the Seven Sins of Greenwashing™



1. Sin of the Hidden Trade-Off
2. Sin of No Proof
3. Sin of Vagueness
4. Sin of Worshipping False Labels
5. Sin of Irrelevance
6. Sin of Fibbing
7. Sin of Lesser of Two Evils

- In 2007 study, of 1,018 consumer products that make environmental claims found that "all but one made claims that are demonstrably false or that risk misleading intended audiences."
- In the 2009 report, over 98% of the 2,219 products surveyed in North America committed at least one of the Sins of Greenwashing.

Source: www.terrachoice.com

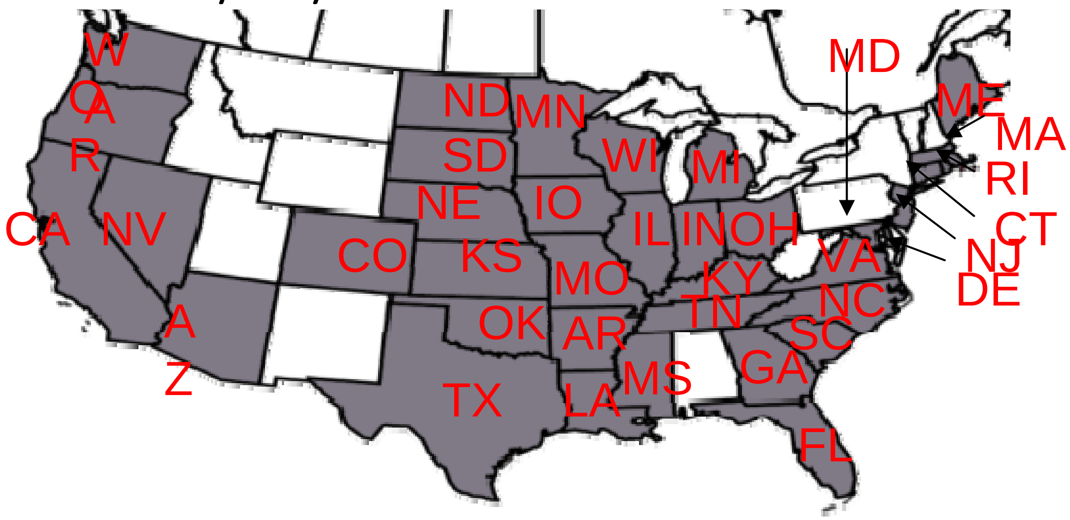
Seven Virtues of Green Labeling:

1. Tell the truth
2. Use specific claims - do not make broad environmental claims
3. Don't overstate a product's attributes
4. Use clear and prominent qualifications
5. Have competent and reliable evidence to back up claims
6. Distinguish between product, package or service
7. Make sure a reasonable consumer can CLEARLY understand the meaning behind the claims

Source: www.terrachoice.com

Environmental Labeling Requirements

- FTC "Green Guides" (Part 260 -- GUIDES FOR THE USE OF ENVIRONMENTAL MARKETING CLAIMS)
- SPI Code (39 US States) (not recycling code!!)
- Use of the trademarked Green Dot
- ASTM/ISO/CEN Standards



COMPOSTABLE

epi

Overstated General Environmental Benefit Claims

Criteria:

- NO unqualified claims. Claims limited to specific environmental attributes are favored.
- FTC Guidelines for Environmental Labeling :
  - Maintain clarity of qualifications and disclosures (through appropriate language, type size, context, avoiding contradictions)
  - Distinguish between product, package, service
  - Qualify claims about benefits (avoid claims of general environmental benefits)
  - Make only those claims which you can substantiate
- The following types of general environmental benefit claims are discouraged unless accompanied by qualifying text:
  - Sustainable
  - Eco-friendly
  - Green
  - Natural
  - Environmentally safe

Overstated General Environmental Benefit Claims

Examples (from the FTC)

- A brand name like "Eco-Safe" would be deceptive if, in the context of the product so named, it leads consumers to believe that the product or package has environmental benefits which cannot be substantiated by the manufacturer.

- A wrapper is labeled "Environmentally Friendly because it was not chlorine bleached, a process that has been shown to create harmful substances." This claim is deceptive if the production of the paper wrapper created other harmful substances.

Recyclable Claims

Criteria:

- A basis for the claims (e.g. study or survey results of municipal recycling facilities) must be stated when making 'recyclable' claims on packaging that is not traditionally accepted for recycling, e.g. plastic clamshells.
  - You must consider both the material <u>and</u> the packaging type (i.e. PET Bottle versus a PET Clamshell)
  - You must review both what is collected by communities <u>and</u> what is accepted by the recycling facilities
  - Must be available to a substantial majority of consumers or communities (60%)
  - Closed recycling systems are OK if well qualified (e.g., in-store plastic bag collection programs)
- Meeting Fiber Box Association repulpability/recyclability protocol establishes that the paper item is technically recyclable, but does not establish that the item will be accepted for recycling by municipal recycling programs.

Recyclable Claims

Plastic PP (5) bottle (if accepted at recycling facilities in 15% of US communities)

Deceptive Label:

- "Recyclable"
- "Recyclable where facilities exist"

These claims are deceptive because, unless evidence shows otherwise, reasonable consumers living in communities not served by programs may conclude that recycling programs for the bottle are available in their area.

Acceptable Label:

- "This bottle may not be recyclable in your area"
- "This bottle is recyclable in 15% of US communities"

These claims are acceptable because they state the limited availability of recycling facilities for the bottle.

Blister pack (paper backing, plastic front)

Deceptive Label:

- "Recyclable"

The claim should be qualified to apply to just the paper portion of the package. The plastic portion will not be accepted for recycling.

Acceptable Label:

- "Paper portion of this packaging is recyclable."

This claim is acceptable if the company has data to prove that the substantial majority of recycling facilities (60%) will take the paper that is used.

The Availability of Facilities for Recycling

Recyclable in the US (substantial majority of recycling facilities (60%)* (FTC)





- Glass Bottles and Jars (Clear, Green and Brown)
- PET Bottles with necks (Clear, light Green and very light Blue)
- HDPE Bottles with necks (All colors, but some issues with black)
- Aluminum Cans
- Steel Cans
- Steel Aerosols
- Newspaper
- Corrugate (non waxed)
- Paperboard (boxes and sheet w/limited bling)
- Paper (sheet w/ limited bling)
- *Based on EPI research



The Availability of Facilities for Recycling

Not presently recyclable by 60%* (FTC) (not available to a substantial majority of consumers or communities)

•Glass (other than Clear, Green or Brown)

•PET bottles (other than Clear, light green and very light blue)

• All other PET, i.e. Clamshells, blisters, trays, lids)

•HDPE (Black bottles and all other non-bottle HDPE)

•All Plastic films and bags

•Plastic (All SPI 3 – 7)

•Paperboard (w/bling)

•Paper (w/bling)

•Waxed Corrugate

•Packaging with food contamination

•Laminates

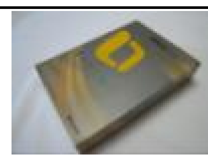
•Poor designs (Plastic glued to corrugate)

•*Based on EPI research

The Availability of Facilities for Recycling

Things that are close but need backup studies (FTC) (?% available to a substantial majority of consumers or communities)

- Wet Strength Board
- Level of bling on paperboard
- Molded Pulp
- **Recent informal survey by EPI**

	Percent of communities in sample that would accept box for recycling	Percent range of total US communities that would accept box for recycling*
	73%	50-55%
	40%	25-30%

Recyclable Claims: Use of the Möbius Loop (three chasing arrow symbol)

Criteria:

- Any use of the Möbius Loop (three chasing arrow symbol) must have text as to whether you're claiming recycled content (with %) or 'recyclable.'

Under US FTC Guidelines, the use of the Möbius Loop (with no other text) constitutes a claim that the packaging and product are made of 100% recycled materials and universally recyclable – deceptive unless the claim can be substantiated!

Appropriate Use Of SPI Plastic Resin Identification Code

Criteria:

- SPI code use should follow the strictest state law interpretation (39 states have SPI code laws).
- The SPC code should not be used as an Environmental Claim (FTC)
- SPI code should be keep away from other environmental claims (FTC)

Predominant Material Resin Coding

- Some states may allow this on a case-by-case basis with evidence of the container's recycling compatibility and endorsement by local recyclers
    - Kentucky law allows predominant code with written approval by Association of Postconsumer Plastic Recyclers (APR)
- Some states interpret their laws to mean that predominant resin coding is not allowed
- Some states have no known position on predominant resin coding

Recycled Content Claims

Criteria:

- It is recommended that all recycled content claims include a percentage, even if it is 100%.
- Any use of the Möbius Loop (three chasing arrow symbol) must have text as to whether you're claiming recycled content (with %) or making a 'recyclable' claim.

Key points:

- Must meet FTC definition of recycled content:
- Both pre and post-consumer material are considered recycled content.
- Claim must be able to be substantiated.
- Percentage of recycled content by weight should be identified
- Distinctions **may** be made between pre-consumer and post-consumer materials.
- Under US FTC Guidelines, the use of the Möbius Loop (three chasing arrow symbol) alone with no qualifying text constitutes a claim that the packaging and product are made of 100% recycled materials and are universally recyclable

Recycled Content

Under FTC Guides, this logo may only be used if the package contains 100% recycled material. But we would prefer using a %

Is this 100% Recycled content?

Degradable/Biodegradable/Photodegradable Claims

Criteria:

- Compostable claims are favored over degradability, biodegradability, oxo-biodegradation or photodegradability claims. Because most product packaging ends up in landfills, unqualified claims in this area will not be accepted at this time.
- Only compostability claims were accepted for plastic bags or food and beverage containers if met ASTM D6400. No other degradable claims were accepted.

Key points:

- Unqualified claims of degradability, biodegradability or photodegradability should be substantiated by competent and reliable scientific evidence that the entire product or package will completely break down and return to nature
- Oxo-biodegradable claims will likely be considered by consumers to be equivalent to a biodegradable claim; therefore, must meet the same criteria.

Degradable/Biodegradable/Photodegradable Claims

Key points:

- Most landfills are fundamentally anaerobic, which severely limits/prevents photodegradation and oxo-biodegradation from occurring.
- Claims of degradability, biodegradability, oxo-biodegradable or photodegradability should be qualified to the extent necessary to avoid consumer deception about:
  - (1) the product or package's ability to degrade in the environment where it is customarily disposed (Note that 'customary disposal' of most packaging is in a landfill); and
  - (2) the rate and extent of degradation.
- Testing to back up degradability, biodegradability or photodegradability claims should be based on the finished package/components, NOT the finished material that is used.

Compostable Claims

Criteria:

•Compostability claims should be sufficiently qualified as to ability to compost in home, municipal or industrial composting facilities.

•Claims involving materials that can only be composted in municipal and institutional composting facilities must have text regarding the limited availability of these facilities.

•Compostable plastics must meet at a minimum the ASTM D6400 Standard Specification for Compostable Plastics.

•Plastic coatings must meet the ASTM D6868 Standard Specification for Biodegradable Plastics Used as Coatings on Paper and Other Compostable Substrates.

Composting does not take place in a landfill!

FTC Guidelines specify different requirements for making "biodegradable" and "compostable" claims.

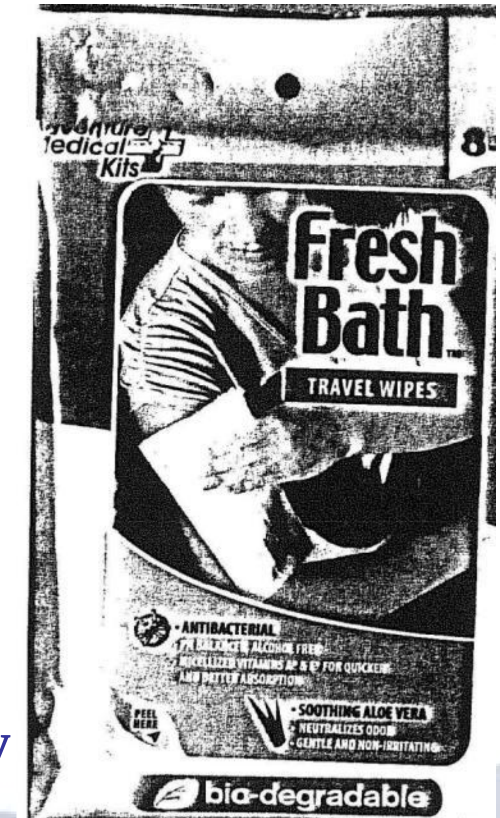
FTC Enforcement (2009)- Biodegradable Claims

Several companies made claims their paper products were "biodegradable"

Kmart paper plates

Dyna-E (compressed dry rayon towels)

Tender Corp moist wipes



Comparative Claims

Criteria:

- Comparative claims should be able to be substantiated. Claims using words like “better” and “most” cannot be quantified. Claims using words such as “larger/smaller,” or “more/less” can be quantified using purchasing or manufacturing records or historical data.
- Claims should be sufficiently qualified and clear as to what is being compared.

Example:

- A claim that a “box contains 10% more recycled content” is too ambiguous. It is unclear whether they are referring to 10% more compared to their previous package or a competitor’s product. The claim should be sufficiently qualified to say “box contains 10% more recycled content than our previous package.”

Comparative Claims

Unclear Claim:

Successes/Savings :

- Material:
  - 9,000 fewer boxes
  - 350 less pallets
- Transportation
  - 37% less fuel needed to distribute to the clubs

Better Claim:

Successes/Savings :

- For every box of wine sold (and 4 bottles eliminated):
- Reduced landfill discards by 1.24 pounds
- Reduced greenhouse gases by 1.05 pounds
- Reduced energy consumption for the manufacture of the packaging materials by 6,483 BTUs

Assumptions: glass recovered at 20%, paperboard recovered at 30% per Feb. 2007 ULS Report. . No recycle content. Data sources: Paper: www.papercalculator.org, Glass & Plastic: Boustead Model V5

Use Of Green Dot

Criteria:

- Use of Green Dot is only allowed with a valid trademark license
- Size and placement must follows license agreement

The Green Dot should not be used to make any environmental claims. It is a protected trademark. Use of the Green Dot on packaging in North America requires a signed license agreement with CSR North America. http://www.greendot.ca/

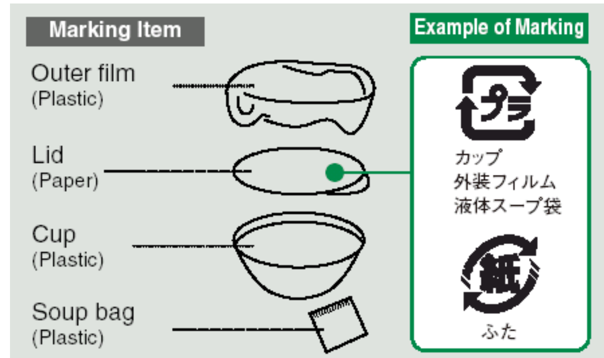
- Should only be on outer sales packaging

- No “Der Grüne Punkt”

DO YOU HAVE A LICENCE TO USE IT????

Labeling Requirements

- Japan

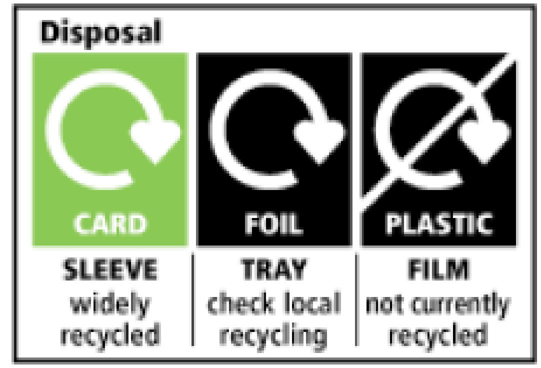


- South Korea
  - on all packaging of certain product types, including foods & beverages, dairy & fish, agricultural produce, and foamed resin packaging of electronic equipment

- Other material coding by country

UK Voluntary Recycling Labeling - WRAP

Packaging Material	Widely recycled	Check local recycling	Not currently recycled
Glass	Bottles and Jars		
Metal	Cans and Aerosols	Lids and trays Foil packaging	
Paper and Card	All paper and card packaging		
Plastics (All Types)	Bottles	Pots, trays, tubs and lids	Bags, films, pouches and windows
Biodegradable/ Compostable			All types
Composite Material	Liquid drink and food cartons i.e. Tetra Pak, Elopack and SIG		
Mixed Materials e.g. card and metal spiral tubes or complex laminates			All types



- Alliance Boots
- ASDA
- B&Q
- Marks & Spencer
- Sainsbury's Supermarkets
- Tesco Stores Ltd
- The Co-Operative Group
- Waitrose

UK WRAP

- It states clear guidelines for three levels of packaging recycling:
  - Widely recycled: 65% or more of local authorities have collection facilities for that packaging type in their area
  - Check local recycling: 15% to 65% of local authorities have collection facilities for that packaging type in their area
  - Not currently recycled: Less than 15% of local authorities have collection facilities for that packaging type in their area

- SPC drafting similar scheme for possible voluntary use in US
- Greater divergence between labeling for each market?

Questions?

Contact EPI at:

Environmental Packaging International
41 Narragansett Avenue
Jamestown, RI, 02835 USA
Tel: (401) 423 2225
Fax: (401) 423 2226
www.enviro-pac.com

vbell@enviro-pac.com

Green Products Roundtable

Laura Rowell

Director, Sustainable Packaging

Green Products Roundtable

A project of the Keystone Center

The Keystone Center

- Established in 1975
- Collaborative approach to problem-solving through Keystone Dialogues
- Center for Science & Public Policy focuses on energy, environment and health

Green Products Roundtable

- Project of Keystone Center; organized by Weyerhaeuser and SC Johnson Family Foundation
- Brings together cross-sectoral group to develop consensus-based guidance on green product marketing and eco-labeling cross-cutting principles

The Keystone Center

Green Products Roundtable

- Projects include
  - Input to the Federal Trade Commission on needed changes to the environmental marketing claims guide
  - Creation of a map of actor-groups
  - Purchaser survey on green purchasing
  - Framework to allow for comparisons and differentiation of different eco-labels / certifications and the structure behind them
  - Guidance on the role of government and private/civic sector involvement in greening the marketplace
  - Identification of current, emerging and anticipated conflicts over green marketing products/claims and recommendations on mechanisms to manage them

- Actual work plan still being developed

Green Products Roundtable

FTC Guidance – Key Elements

- Specific terms:
  - Recyclability – give us a number, please
  - Biodegradability – provide clarity, testing; require disclosure of disposal environment
  - Sustainability – require similar substantiation as other general environmental terms
  - Saving natural resources (e.g., “saving trees”) – discourage as methodology not well established

Green Products Roundtable

FTC Guidance – Key Elements

- Other areas of concern:
  - Enforcement (or lack thereof)
  - Alignment to ISO 14021
    - Recyclable and renewable (new)
  - Communicating recyclability (labels)
  - Third-party labels, seals, certifications and endorsements (credibility, transparency)

Session 2

Scorecards, Databases & Tools

Wil Cote, IP, Session Chair

Greg Norris, Sustainability Consortium

David Newcorn, Greener Packaging

Paul Schutes, Recycled Paperboard Alliance

Reid Miner, NCASI

Minal Mistry, GreenBlue

Scorecards, Databases, and Tools, pt. 1:

New Database Coordination Efforts

Sustainability Forum @ PaperCon 2010
Atlanta
4 May

Gregory A. Norris

Harvard / Univ of Arkansas
Sylvatica / New Earth

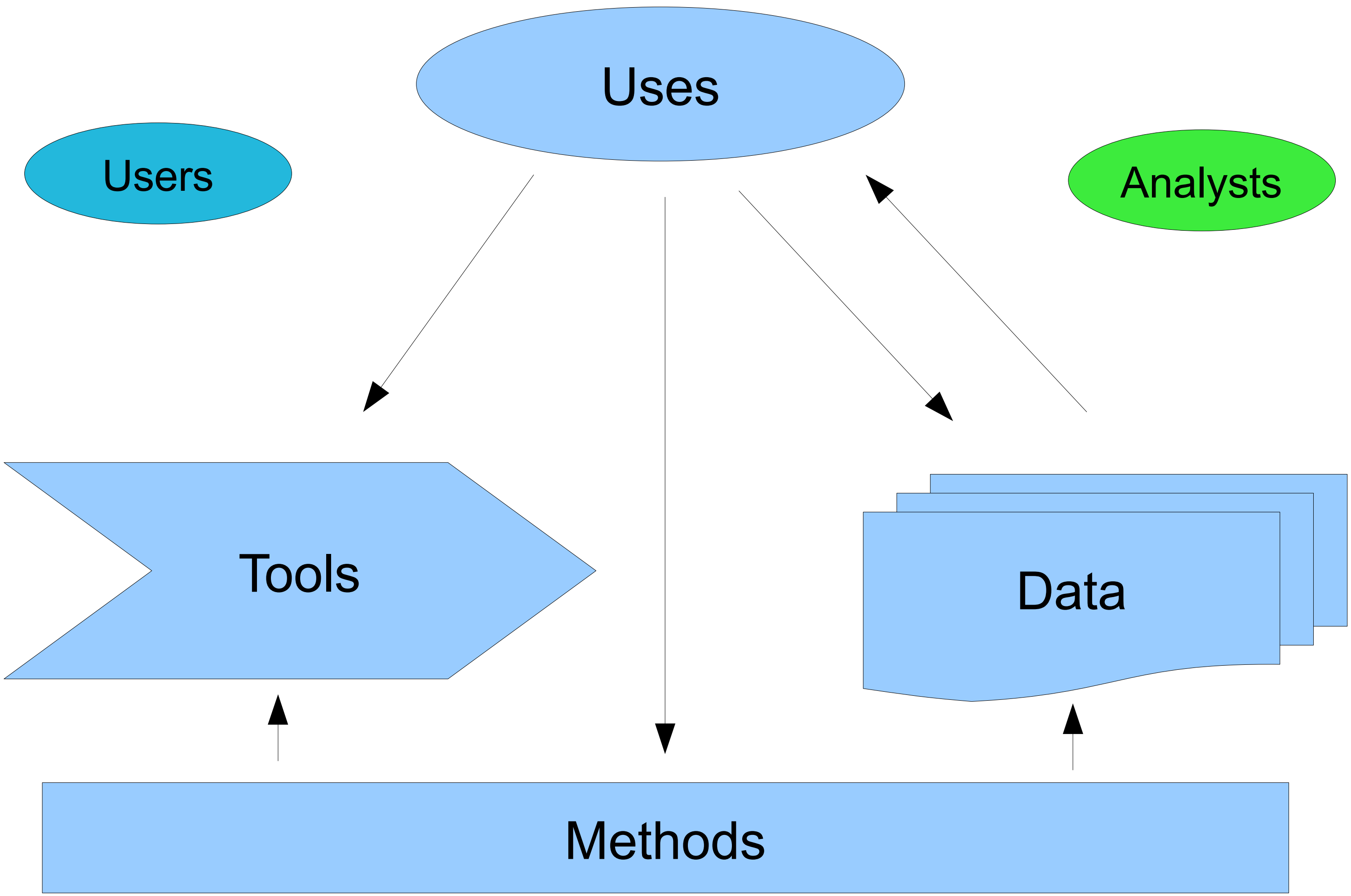
Overview

- Drivers of data development
- LCA Basics
- Driver Update
- Database Status Summary
- Data and Tool Projections

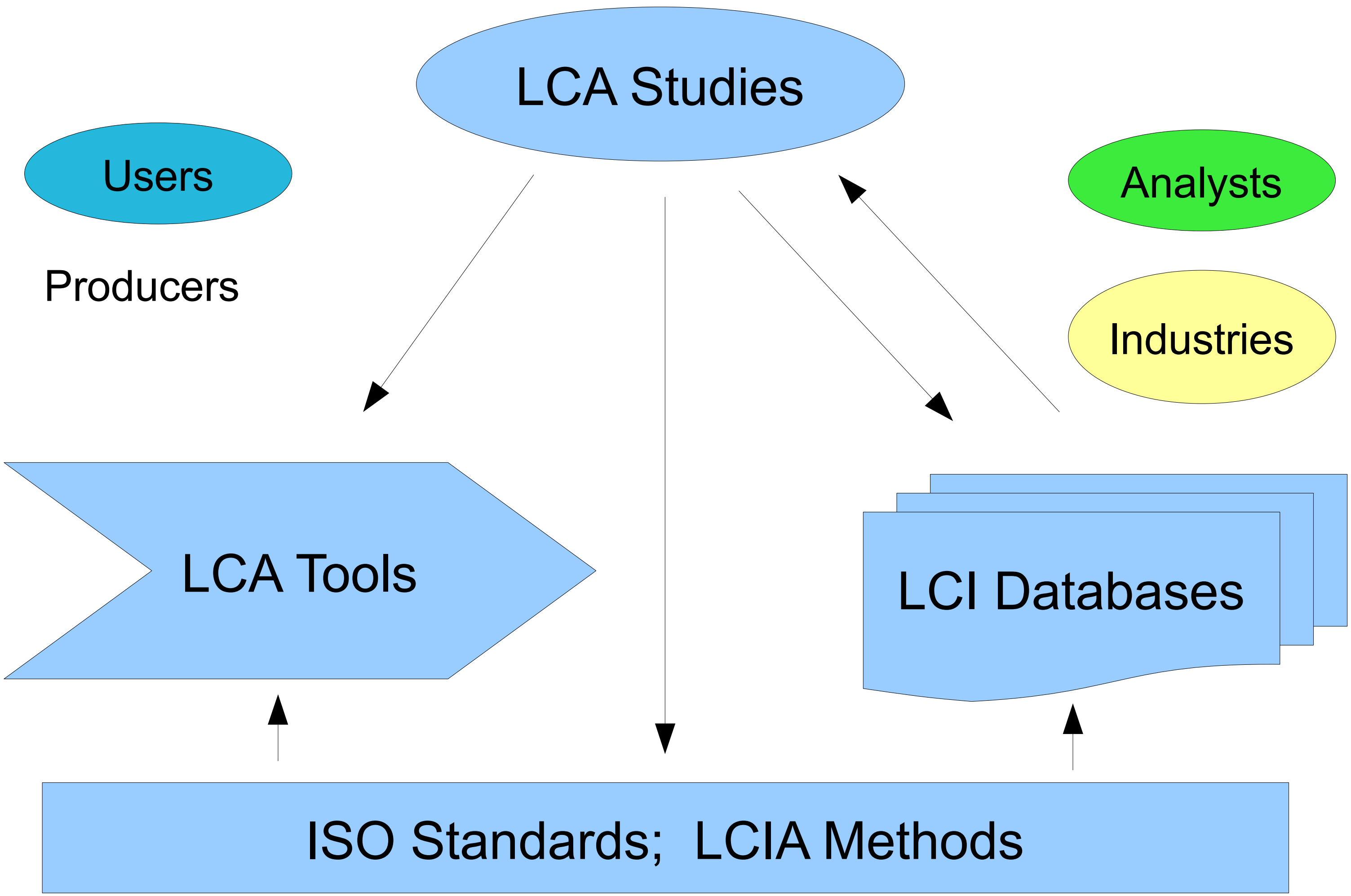
This Session:

- “Scorecards, Databases, and Tools”

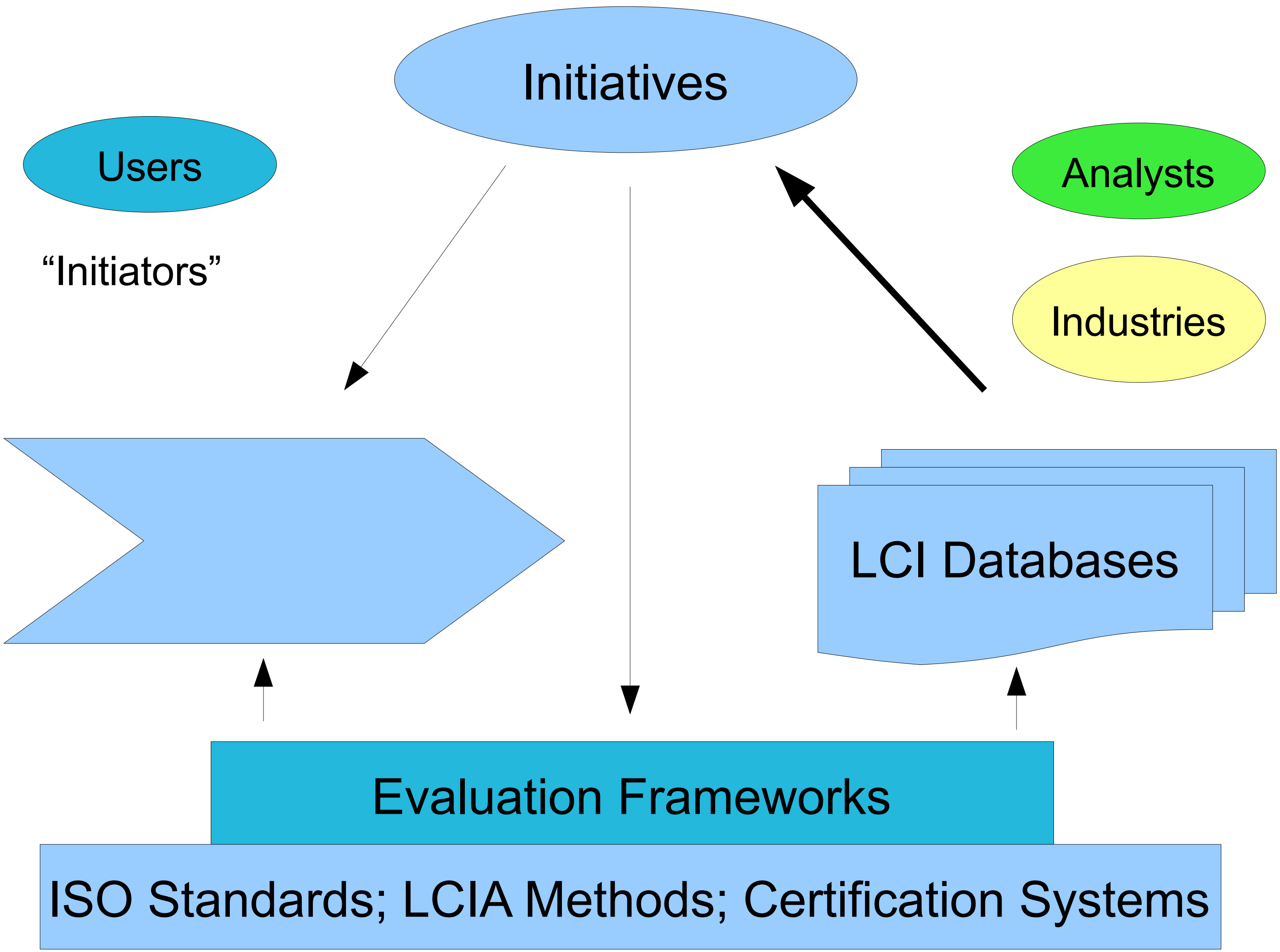
General Relationships



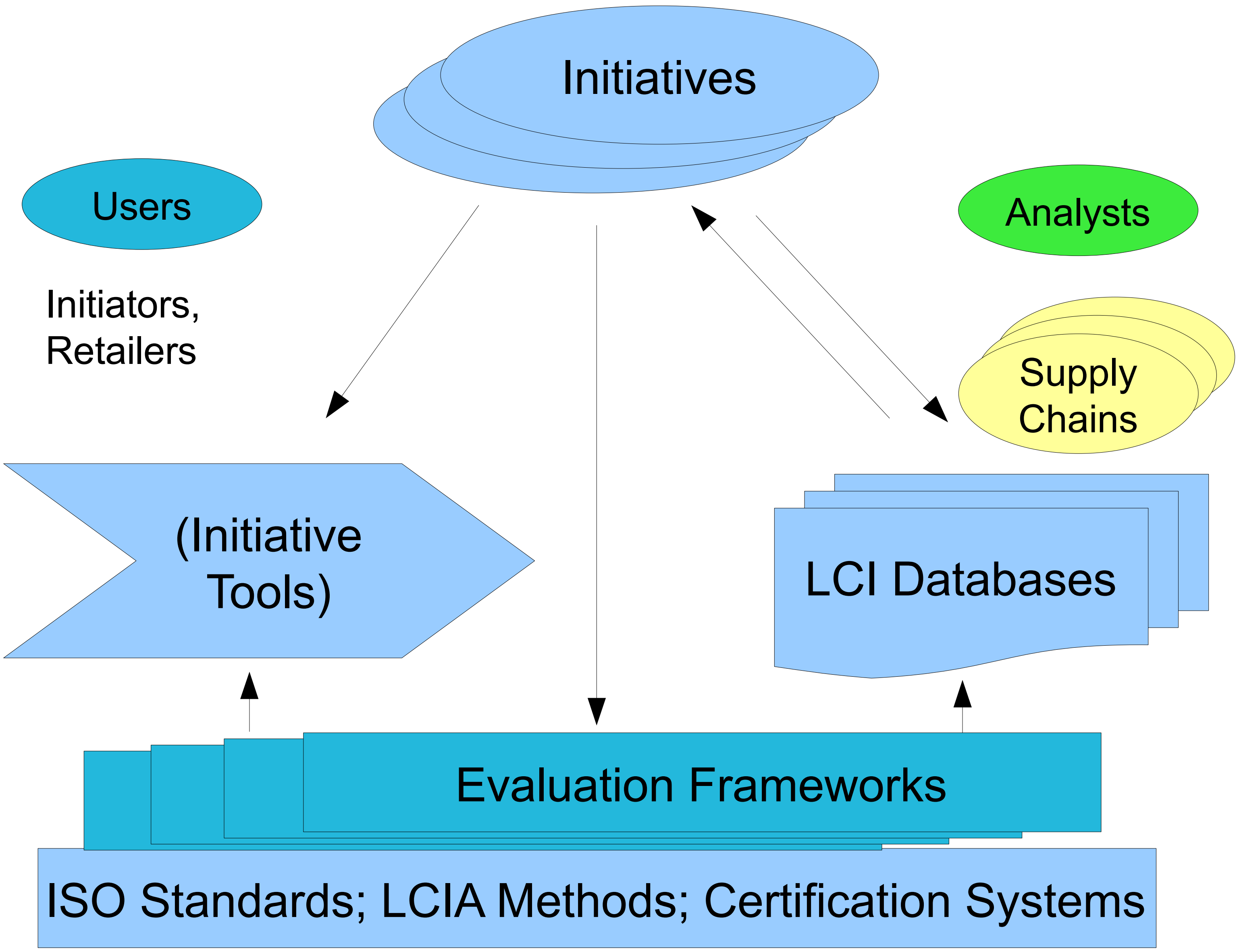
General Relationships: LCA 1970 - 2010



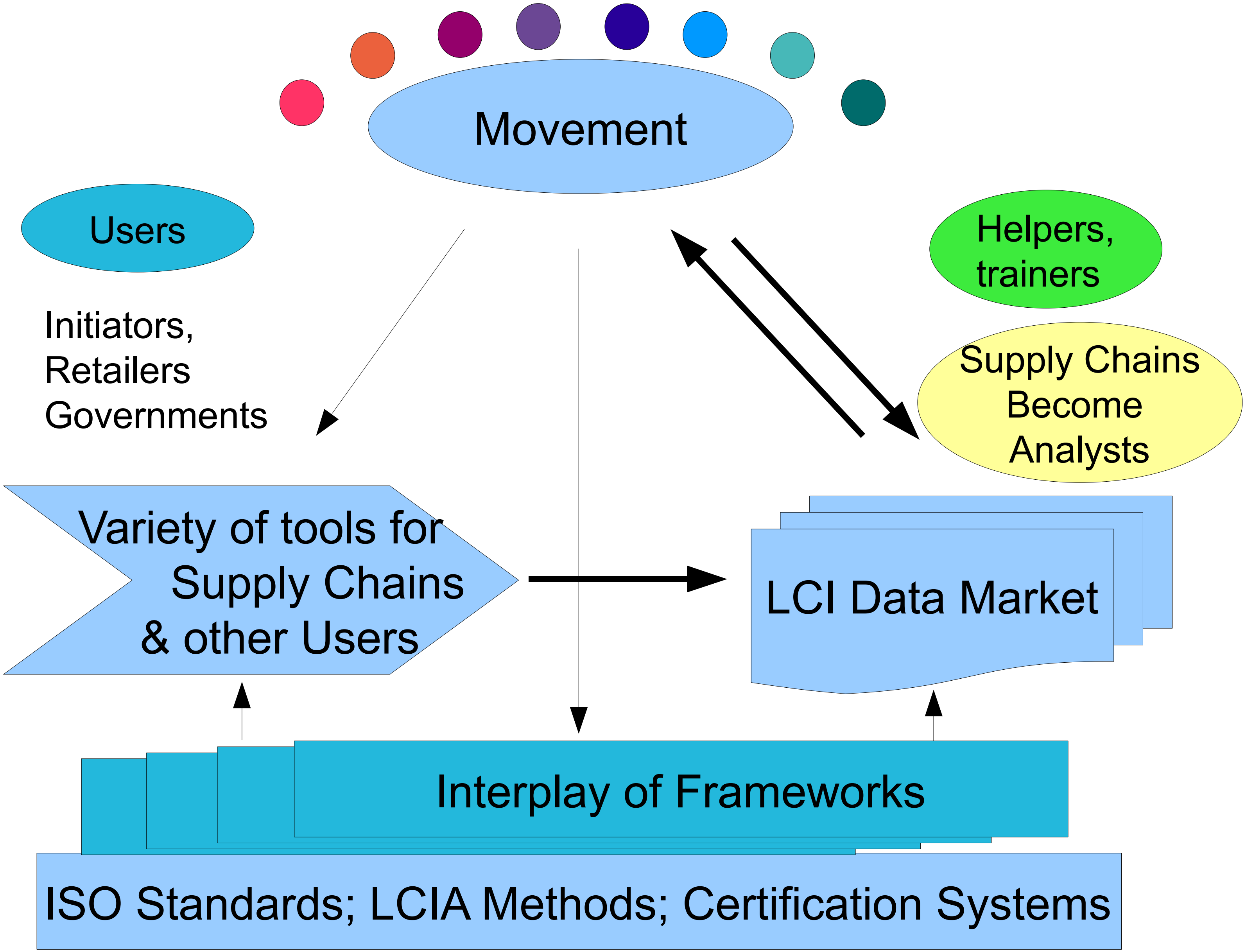
General Relationships: LC Sustainability 2000 - 2010



General Relationships: LC Sustainability circa 2010



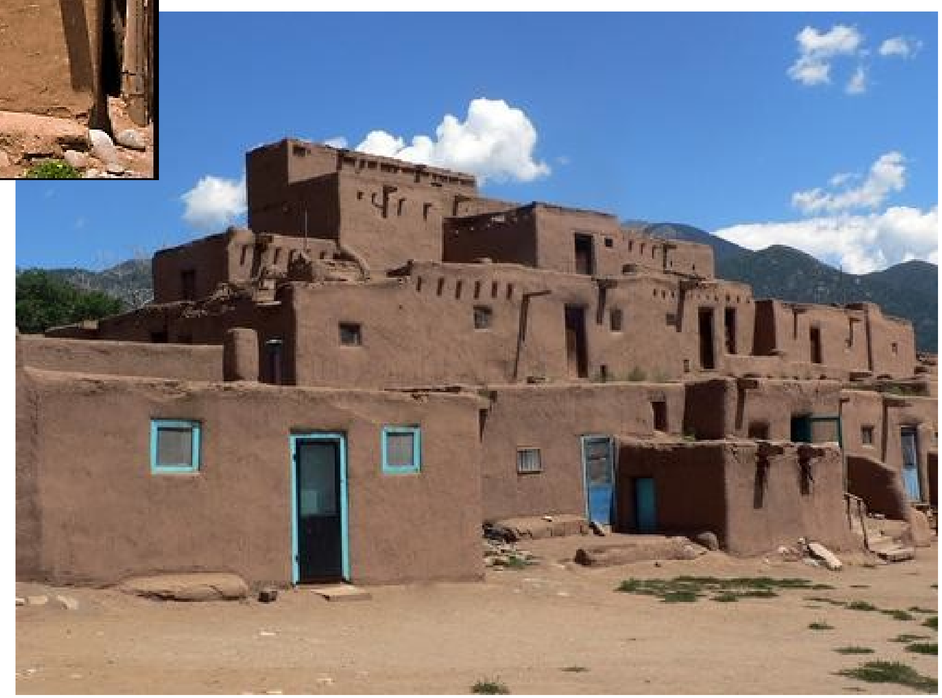
General Relationships: LC Sustainability next few years




Demand → Breaking Point
Solution: technology and market supporting win-win behavior that is cumulative & scalable

Current System

Cumulative, Scalable, Evolving



Technology Analogy?

Picture this:
Open Street Map
Being widely applied for
Journey Planning & Storytelling

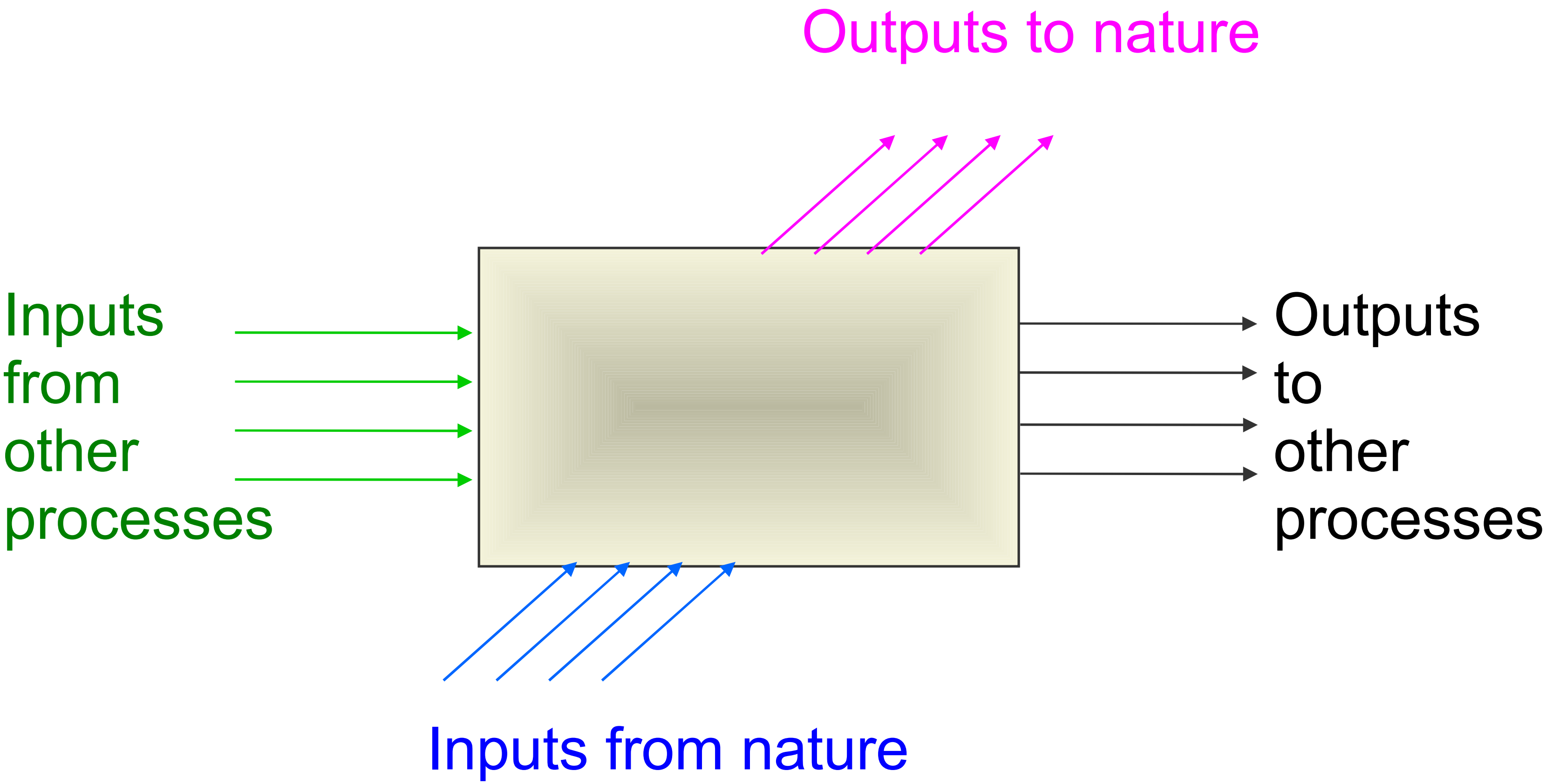
Overview

- Drivers of data development
- LCA Basics
- Driver Update
- Database Status Summary
- Data and Tool Projections

Building Block Concepts for the new vision

- Unit processes
  - **Input-output / Process models**
- Life cycle inventory results (“footprints”)
- Life cycle Impact Assessment Results
- Industry Average / Product-specific
- Databases
- Software

Building Block of Footprint Computation: Unit Process



Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2*SD	Min
Aluminium, production mix, at plant/RER U	0.1688	kg	Lognormal	1.3286	
Battery, LiIo, rechargeable, prismatic, at plant/GLO U	0.273	kg	Lognormal	1.323	
Battery, NiMH, rechargeable, prismatic, at plant/GLO U	0.008	kg	Lognormal	1.323	
Cable, network cable, category 5, without plugs, at plant/GLO U	0.156	m	Lognormal	1.2366	
CD-ROM/DVD-ROM drive, laptop computer, at plant/GLO U	1	p	Lognormal	1.323	
Chromium steel 18/8, at plant/RER U	0.5546	kg	Lognormal	1.323	
Copper, at regional storage/RER U	0.0135	kg	Lognormal	1.323	
Corrugated board, recycling fibre, double wall, at plant/RER U	0.837	kg	Lognormal	1.323	
Electricity, medium voltage, production UCTE, at grid/UCTE U	1.6667	kWh	Lognormal	1.323	
Extrusion, plastic pipes/RER U	0.42395	kg	Lognormal	1.323	
HDD, laptop computer, at plant/GLO U	1	p	Lognormal	1.323	
LCD module, at plant/GLO U	0.328	kg	Lognormal	1.323	
Magnesium-alloy, AZ91, at plant/RER U	0.2832	kg	Lognormal	1.3286	
Magnesium-alloy, AZ91, diecasting, at plant/RER U	0.2832	kg	Lognormal	1.323	
Packaging film, LDPE, at plant/RER U	0.051	kg	Lognormal	1.323	
Photovoltaic cell factory/DE/I U	3.038E-8	p	Lognormal	3.1039	
Plugs, inlet and outlet, for network cable, at plant/GLO U	1	p	Lognormal	1.2366	
Polystyrene foam slab, at plant/RER U	0.089	kg	Lognormal	1.323	
Polystyrene, high impact, HIPS, at plant/RER U	0.42395	kg	Lognormal	1.323	
Power adapter, for laptop, at plant/GLO U	1	p	Lognormal	1.323	
Printed wiring board, mounted, Laptop PC mainboard, at plant/G	0.204	kg	Lognormal	1.323	
Printed wiring board, surface mounted, unspec., solder mix, at p	0.19795	kg	Lognormal	1.323	
Section bar extrusion, aluminium/RER U	0.1688	kg	Lognormal	1.3286	
Sheet rolling, aluminium/RER U	0.2832	kg	Lognormal	1.323	
Sheet rolling, copper/RER U	0.0135	kg	Lognormal	1.323	
Sheet rolling, steel/RER U	0.5546	kg	Lognormal	1.323	
Tap water, at user/RER U	1620	kg	Lognormal	1.323	
Transport, freight, rail/RER U	0.6368	tkm	Lognormal	2.1084	
Transport, lorry >16t, fleet average/RER U	0.3184	tkm	Lognormal	2.1084	
Transport, transoceanic freight ship/OCE U	67.819	tkm	Lognormal	2.1084	

(Insert line here)

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %
HDD, laptop computer, at plant/GLO U	1	p	Amount	100 %
(Insert line here)				

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribu
(Insert line here)			

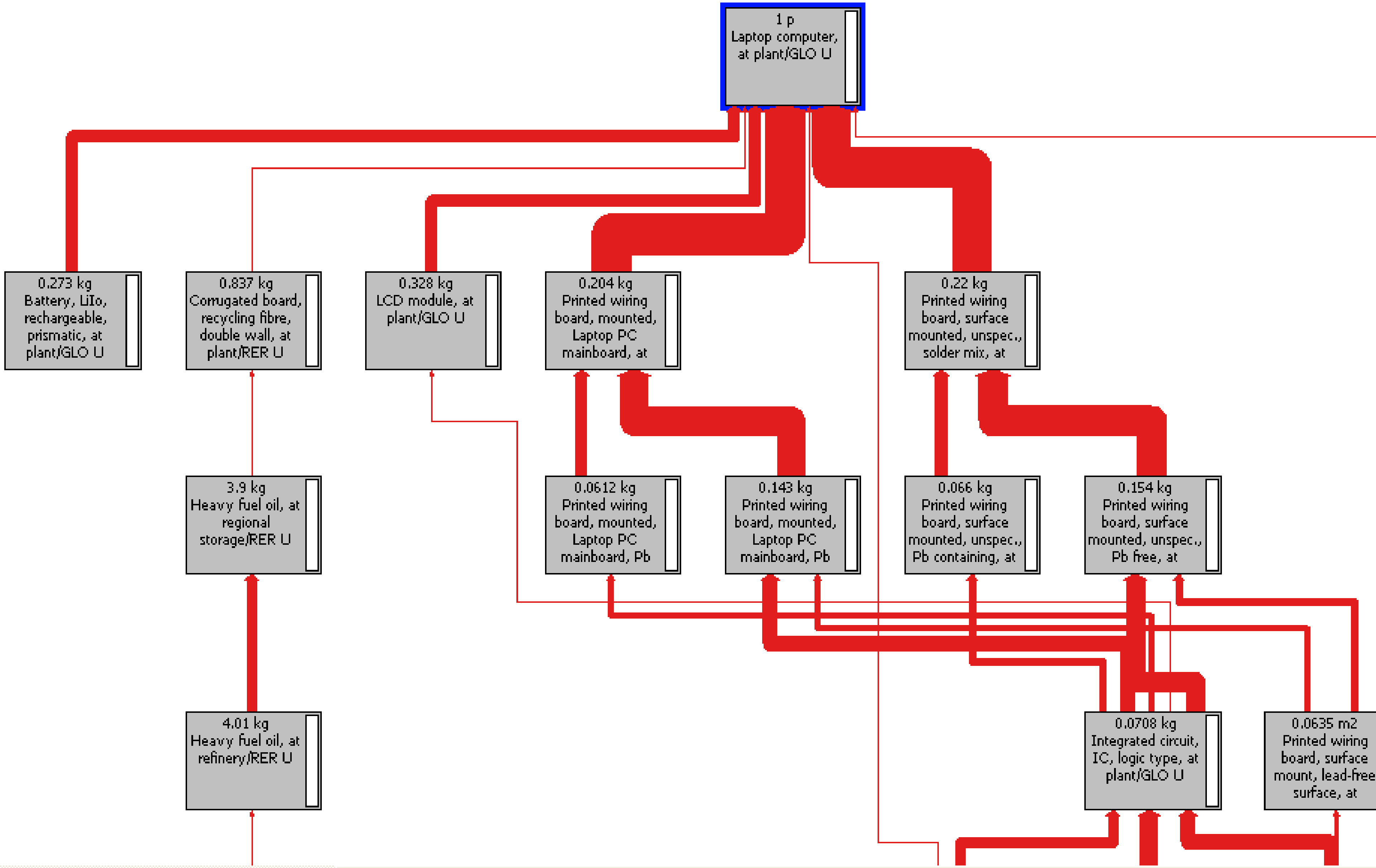
Inputs

Known inputs from nature (resources)

Name	Sub-compartment	Amount	Unit	Distribu
(Insert line here)				

Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2*SD	Min
Acrylonitrile-butadiene-styrene copolymer, ABS, at plant/RER U	0.0005102	kg	Lognormal	1.2366	
Aluminium, production mix, at plant/RER U	0.091439	kg	Lognormal	1.2366	
Chromium steel 18/8, at plant/RER U	0.0024	kg	Lognormal	1.2366	
Electricity, medium voltage, production UCTE, at grid/UCTE U	1.7125	kWh	Lognormal	1.2366	
Hot rolling, steel/RER U	0.0024	kg	Lognormal	1.2366	
Powder coating, aluminium sheet/RER U	0.0063337	m2	Lognormal	1.344	
Printed wiring board mounting plant/GLO/I U	3.3333E-8	p	Lognormal	3.1071	
Printed wiring board, mixed mounted, unspec., solder mix, at pl	0.0083276	kg	Lognormal	1.2366	
Section bar extrusion, aluminium/RER U	0.087357	kg	Lognormal	1.2366	
Sheet rolling, aluminium/RER U	0.0040816	kg	Lognormal	1.2366	
Sheet rolling, steel/RER U	0.015069	kg	Lognormal	1.2366	
Steel, low-alloyed, at plant/RER U	0.015069	kg	Lognormal	1.2366	
Stretch blow moulding/RER U	0.0005102	kg	Lognormal	1.323	
Transport, freight, rail/RER U	0.024816	tkm	Lognormal	2.1017	
Transport, lorry >16t, fleet average/RER U	0.012408	tkm	Lognormal	2.1017	



1 p
Laptop computer, at plant/GLO U
0.273 kg
Battery, LiIo, rechargeable, prismatic, at plant/GLO U
0.837 kg
Corrugated board, recycling fibre, double wall, at plant/RER U
0.328 kg
LCD module, at plant/GLO U
0.204 kg
Printed wiring board, mounted, Laptop PC mainboard, at
0.22 kg
Printed wiring board, surface mounted, unspec., solder mix, at
3.9 kg
Heavy fuel oil, at regional storage/RER U
0.0612 kg
Printed wiring board, mounted, Laptop PC mainboard, Pb
0.143 kg
Printed wiring board, mounted, Laptop PC mainboard, Pb
0.066 kg
Printed wiring board, surface mounted, unspec., Pb containing, at
0.154 kg
Printed wiring board, surface mounted, unspec., Pb free, at
4.01 kg
Heavy fuel oil, at refinery/RER U
0.0708 kg
Integrated circuit, IC, logic type, at plant/GLO U
0.0635 m2
Printed wiring board, surface mount, lead-free surface, at

Life Cycle Inventory: Cradle-To-Gate "Footprint"

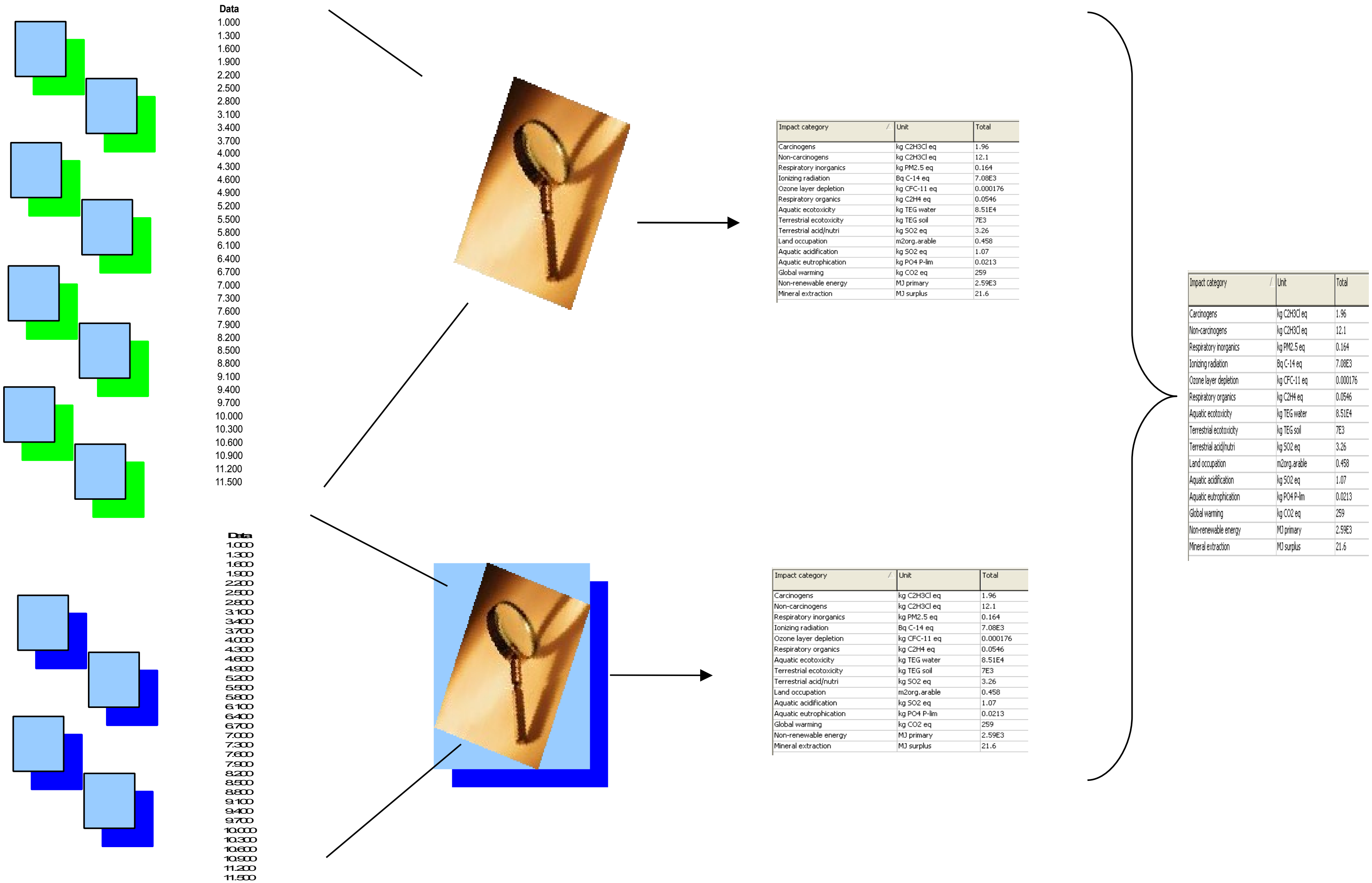
No	Substance	Compa	Unit	Total
1	Aluminium, 24% in bauxite, 11% in crude ore, in ground	Raw	g	319
2	Anhydrite, in ground	Raw	mg	12
3	Barite, 15% in crude ore, in ground	Raw	g	25.6
4	Basalt, in ground	Raw	mg	22.1
5	Borax, in ground	Raw	mg	21.5
6	Cadmium, 0.30% in sulfide, Cd 0.18%, Pb, Zn, Ag, In, in ground	Raw	mg	-1.01
7	Calcite, in ground	Raw	kg	27.6
8	Carbon dioxide, in air	Raw	kg	5.93
9	Carbon, in organic matter, in soil	Raw	mg	84.1
10	Cerium, 24% in bastnasite, 2.4% in crude ore, in ground	Raw	g	3.16
11	Chromium, 25.5% in chromite, 11.6% in crude ore, in ground	Raw	g	209
12	Chrysotile, in ground	Raw	mg	52
13	Cinnabar, in ground	Raw	mg	5.77
14	Clay, bentonite, in ground	Raw	g	13.4
15	Clay, unspecified, in ground	Raw	kg	9.05
16	Coal, brown, in ground	Raw	kg	27.9
671	Titanium	Soil	mg	5.48
672	Vanadium	Soil	µg	157
673	Zinc	Soil	mg	22.5

LCI -- LCIA method -- LCIA Results

Data
1.000
1.300
1.600
1.900
2.200
2.500
2.800
3.100
3.400
3.700
4.000
4.300
4.600
4.900
5.200
5.500
5.800
6.100
6.400
6.700
7.000
7.300
7.600
7.900
8.200
8.500
8.800
9.100
9.400
9.700
10.000
10.300
10.600
10.900
11.200
11.500

Impact category	Unit	Total
Carcinogens	kg C2H3Cl eq	1.96
Non-carcinogens	kg C2H3Cl eq	12.1
Respiratory inorganics	kg PM2.5 eq	0.164
Ionizing radiation	Bq C-14 eq	7.08E3
Ozone layer depletion	kg CFC-11 eq	0.000176
Respiratory organics	kg C2H4 eq	0.0546
Aquatic ecotoxicity	kg TEG water	8.51E4
Terrestrial ecotoxicity	kg TEG soil	7E3
Terrestrial acid/nutri	kg SO2 eq	3.26
Land occupation	m2org.arable	0.458
Aquatic acidification	kg SO2 eq	1.07
Aquatic eutrophication	kg PO4 P-lim	0.0213
Global warming	kg CO2 eq	259
Non-renewable energy	MJ primary	2.59E3
Mineral extraction	MJ surplus	21.6

Beyond LCA: Extensible Data Standards for reporting on unit processes and supply chains



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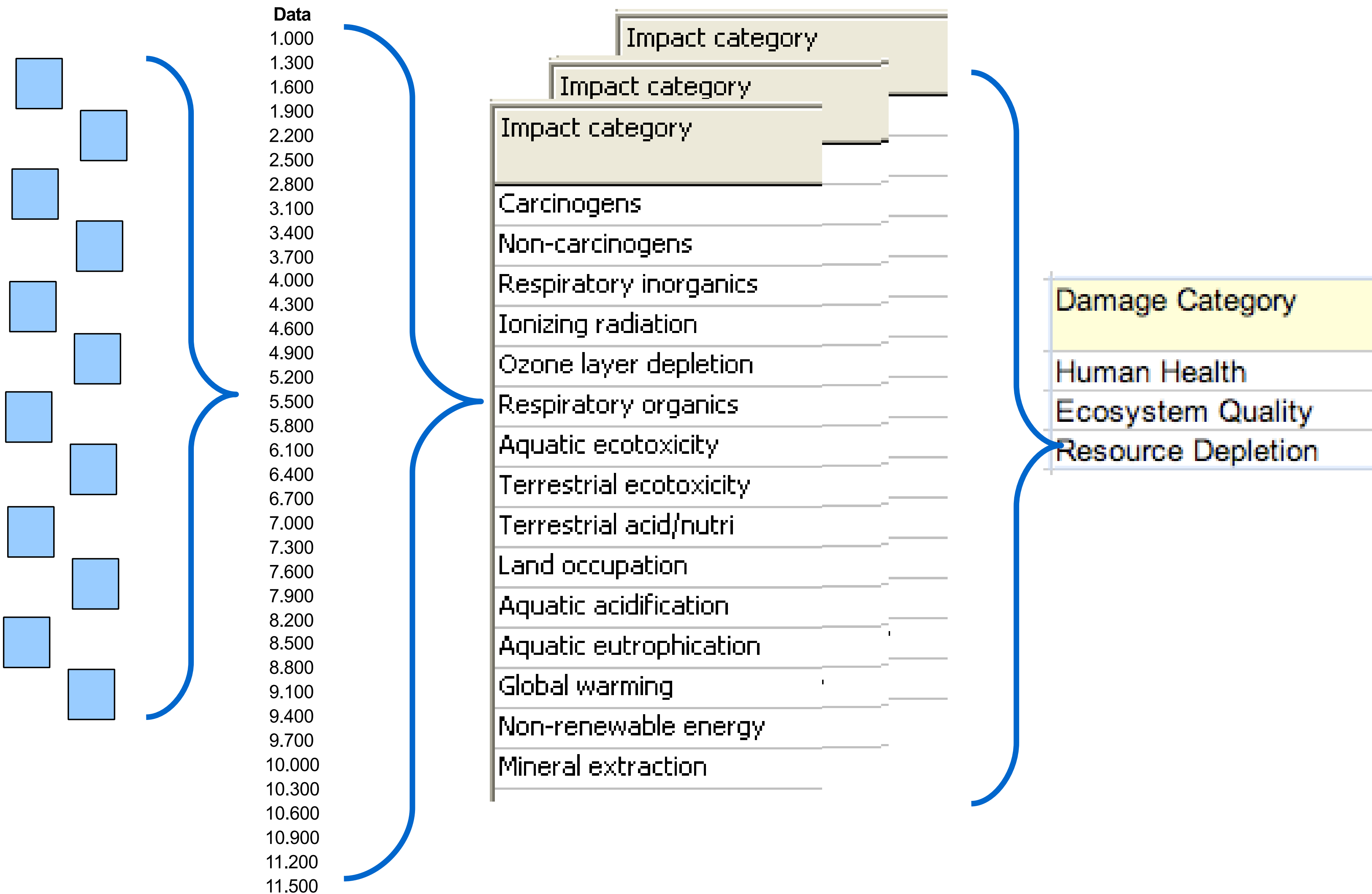
Impact Assessment Methods are mult-stage; and multiple



Overview

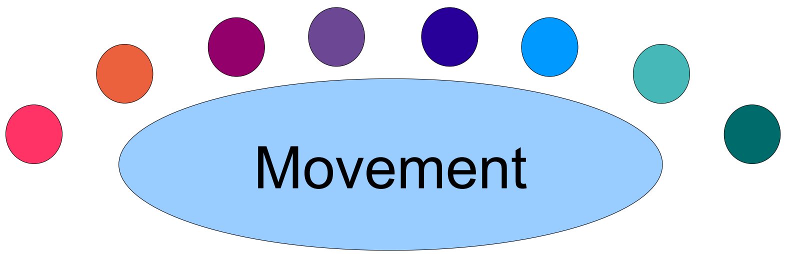
- Drivers of data development
- LCA Basics
- Driver Update
- Database Status Summary
- Data and Tool Projections

Driver Update: Emergence of the Movement

- Data ROLES have changed (increased)
- Data SCOPE is changing, as a result
  - In (at least) Two Ways
- Data NAKEDNESS has changed (and it ain't pretty yet)
- The data DEADLINE has changed (and it's not later)
- The Data PRICE TAG has changed (and it didn't go up)
- Data EXPECTATIONS on supply chains are changing
  (and they aren't going down)

- The necessary data future:
  Feedback Loops & Network Effects

Data ROLES are changing (increasing)



- Scorecards
- Sustainability Measurement & Reporting Standards
- Consumer-facing Web-based systems
- Footprinting
- Attempts to Harmonize/Consolidate Certification Systems
- Government Sustainable Purchasing

Things Have Changed

The Washington Post

washingtonpost.com > Nation > Green

A NEW SPECIAL REPORT
The Climate Agenda
Explore news and resources & debate policy with our expert panel. Full Report »

Wal-Mart presses vendors in China to meet higher st

By Steven Mufson
Friday, February 26, 2010; 3:34 PM

SLIDESHOW

SHENZHEN, CHINA -- Benny Fung, the head of Hong Kong-based soap and cosmetics maker Lutex, seems to have an eye for detail. The meeting room at his factory here in southern China is lined with neatly packed gift baskets. His jacket has a thin purple velvet accent around the lapel to match his purple tie.

"For those who may still be on the sidelines, I want to be direct," Wal-Mart chief executive Lee Scott said sternly. "Meeting social and environmental standards is not optional. I firmly believe that a company that cheats on overtime and on the age of its labor, that dumps its scraps and its chemicals in our rivers, that does not pay its taxes or honor its contracts will ultimately cheat on the quality of its products. And cheating on the quality of products is the same as cheating on customers. We will not tolerate that at Wal-Mart."

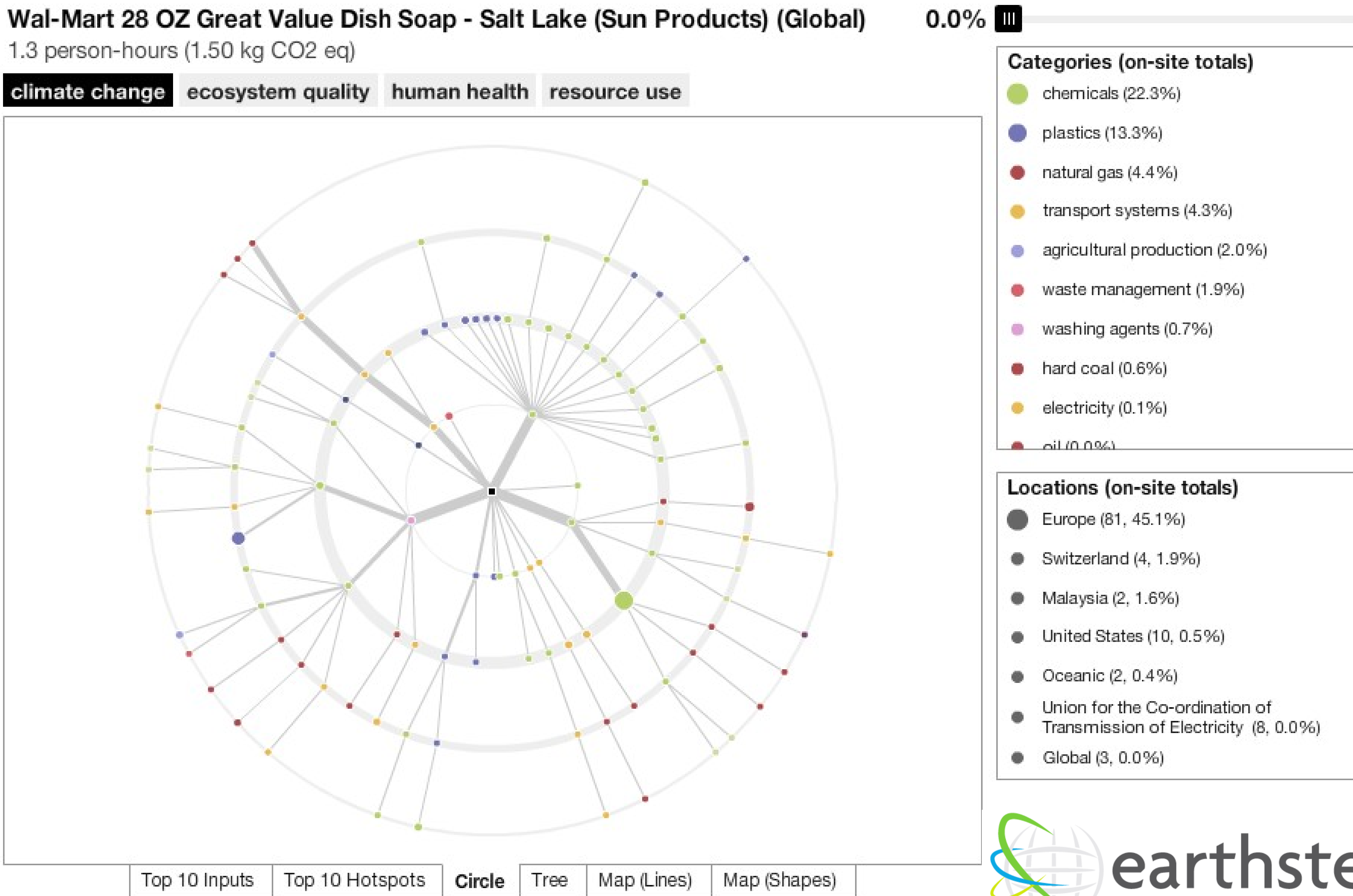
Data SCOPE is changing

- e.g., China
- e.g., “Social and Environmental”

When a Goal is Visibility Into Supply Chains...

- ***...Transparency Becomes a <u>Deliverable.</u>***

Visibility: Supply Chain Risk/Opportunity/Costs



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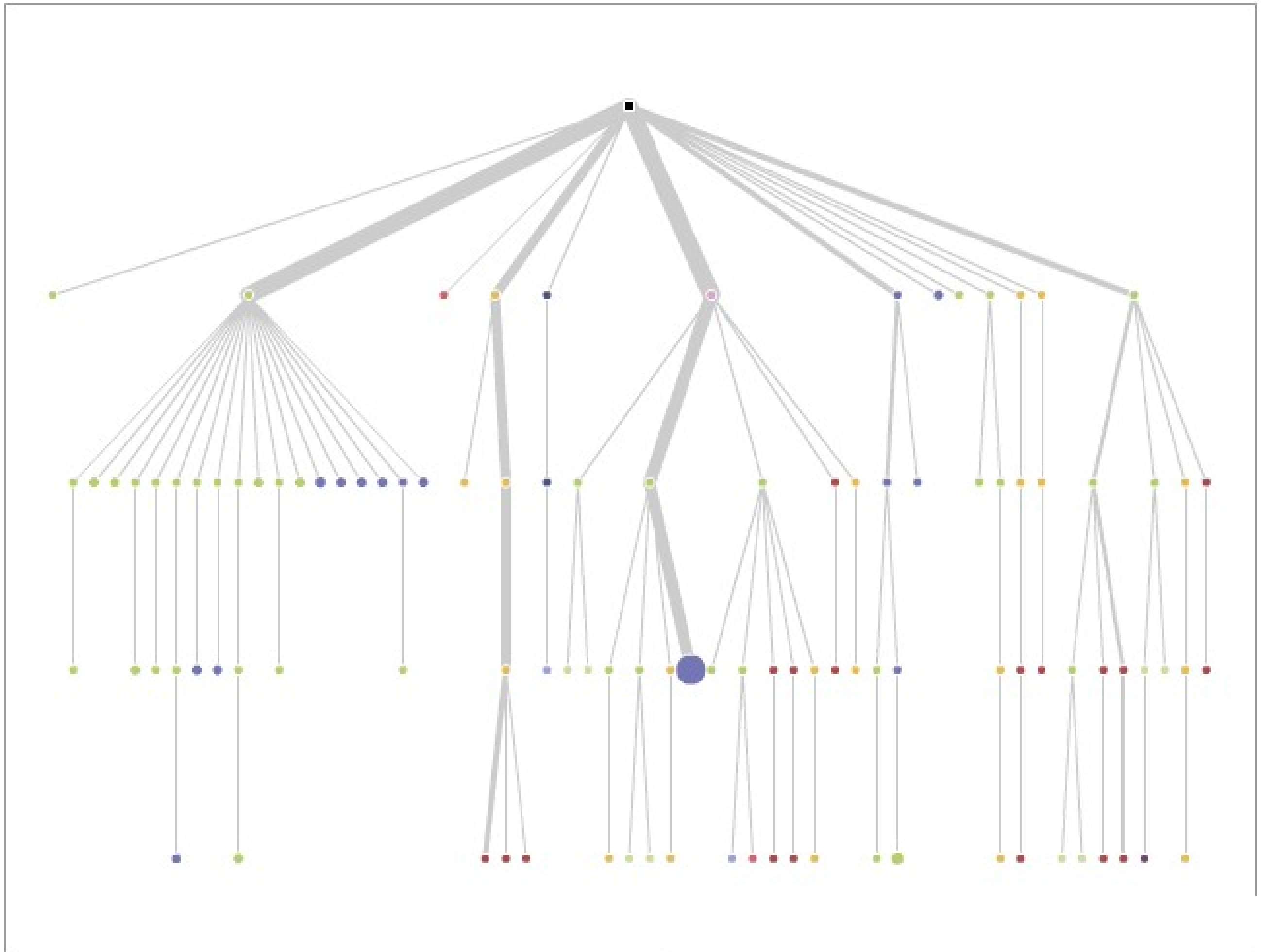
Visibility: Supply Chain Risk/Opportunity/Costs

Wal-Mart 28 OZ Great Value Dish Soap - Salt Lake (Sun Products) (Global) 0.0%

12.5 person-hours (2.21e+1 MJ Primary)

climate change | ecosystem quality | human health | **resource use**



Top 10 Inputs | Top 10 Hotspots | Circle | **Tree** | Map (Lines) | Map (Shapes)

Categories (on-site totals)

- plastics (31.3%)
- chemicals (11.9%)
- natural gas (0.0%)
- waste management (0.0%)
- transport systems (0.0%)
- agricultural production (0.0%)
- washing agents (0.0%)
- hard coal (0.0%)
- electricity (0.0%)
- oil (0.0%)

Locations (on-site totals)

- Europe (81, 43.3%)
- Switzerland (4, 0.0%)
- Malaysia (2, 0.0%)
- Oceanic (2, 0.0%)
- United States (10, 0.0%)
- Union for the Co-ordination of Transmission of Electricity (8, 0.0%)
- Global (3, 0.0%)

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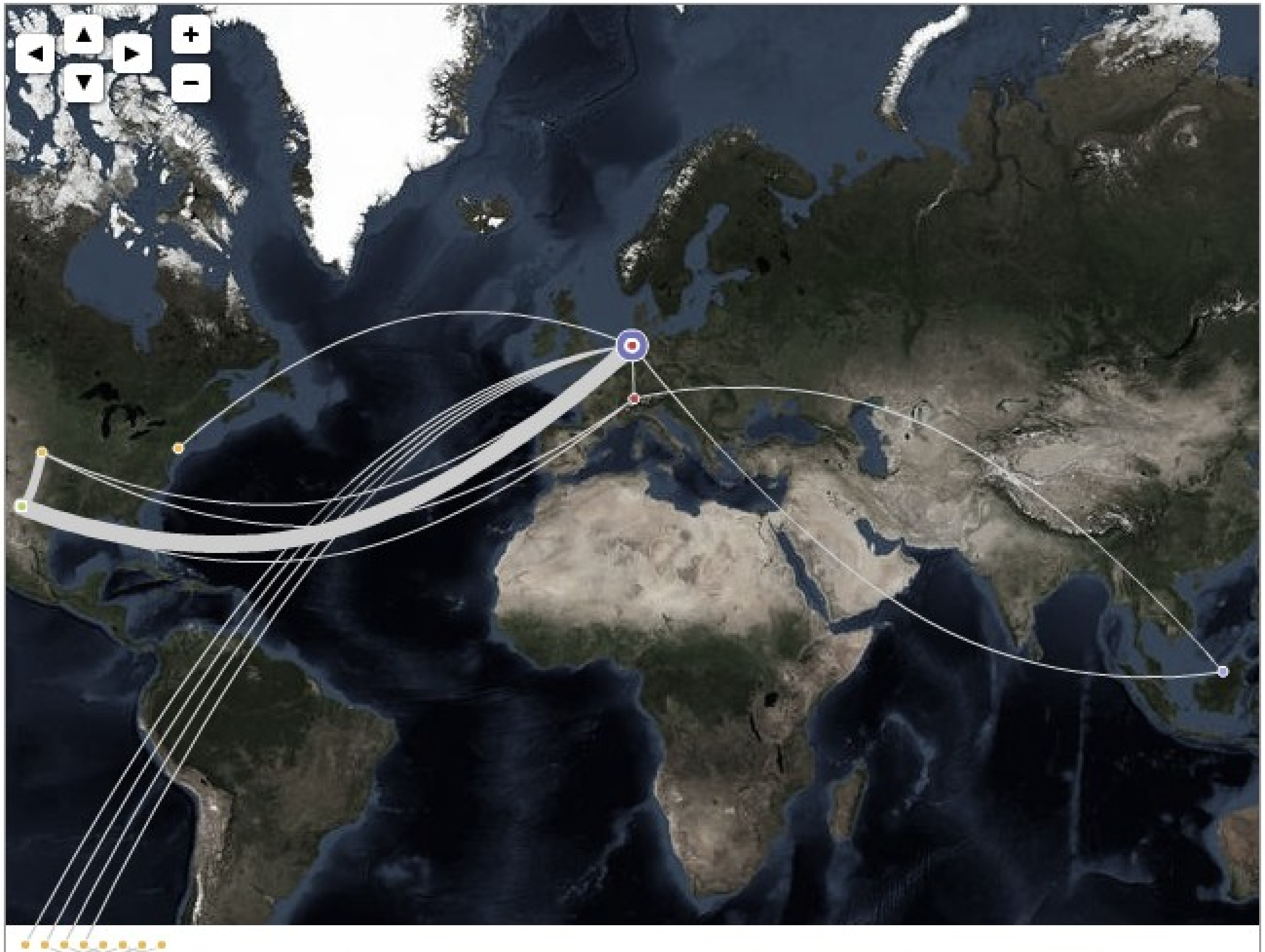
Visibility: Supply Chain Risk/Opportunity/Costs

Wal-Mart 28 OZ Great Value Dish Soap - Salt Lake (Sun Products) (Global) **0.0%**

12.5 person-hours (2.21e+1 MJ Primary)

climate change | ecosystem quality | human health | **resource use**



Top 10 Inputs | Top 10 Hotspots | Circle | Tree | **Map (Lines)** | Map (Shapes)

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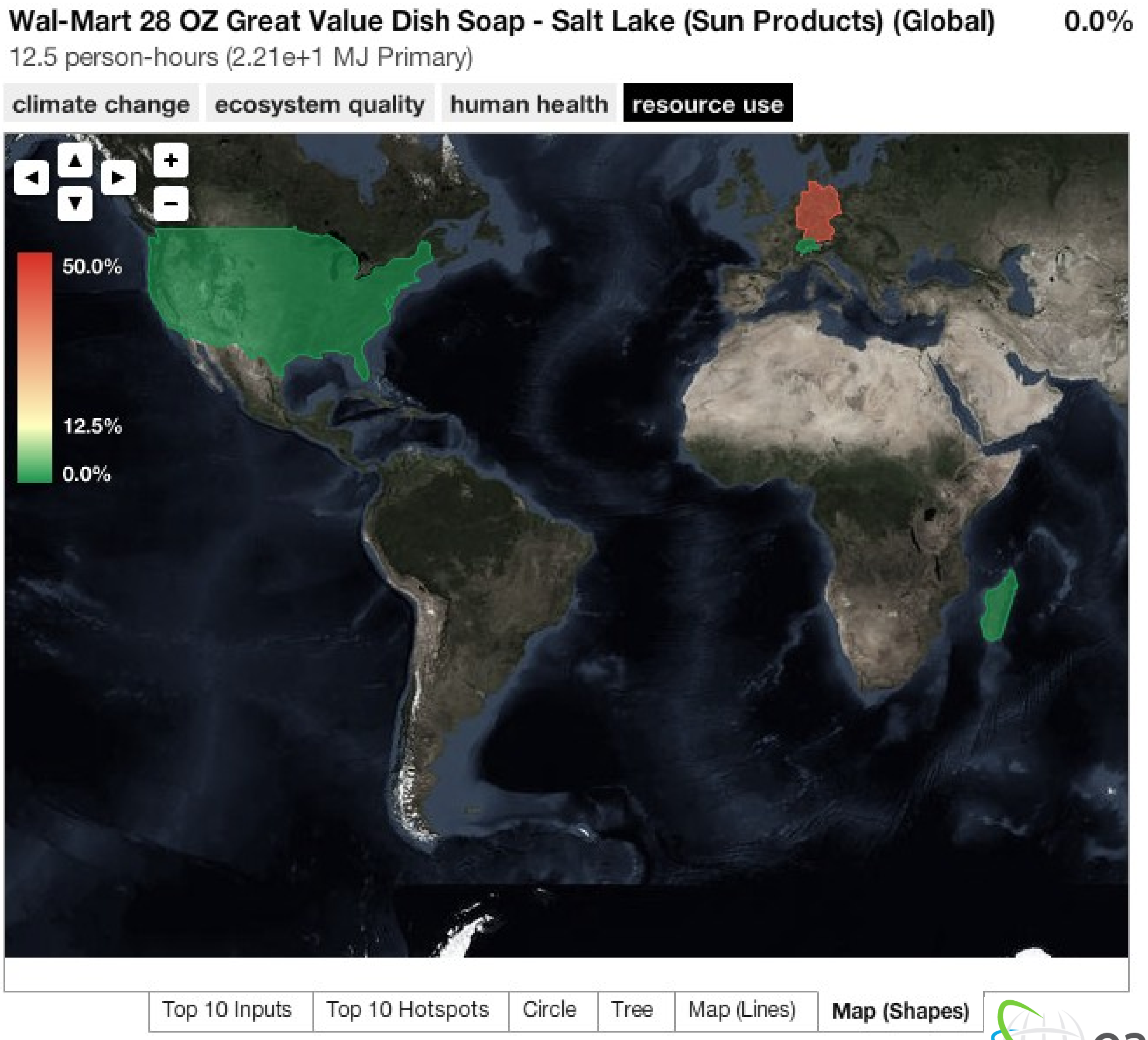
Visibility: Supply Chain Risk/Opportunity/Costs



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Responses to our Data in the Buff

1. "Wait a minute...   are you telling me...?...
   Get that *out* of here!"

1. Get some better (more appropriate, more precise) data!
   a) **Supplier-specific**
   b) **Industry Average**

1. Help me understand, and *use*, uncertainty:
   a) **Influence of data imperfections**
   b) **Priority data refinements**

The Deadline Has Changed...

The Price Tag Has Changed...

ALWAYS LOW PRICES.

Always.

Expectations on Supply Chains are Changing

- Compliance as a requirement
- Risk reduction as a requirement
- Innovation as a requirement – Track and report progress
- Transparency as a requirement – “What have you done for my visibility lately?”

Supply Chain as Data Users and Data Co-Developers

“Timeout”: Database Status Summary

- US LCI: 10 years, 200 unit processes)
- ILCD: Handbooks, network
- Ecoinvent: 5000+ unit processes
  - **Data-as-document becoming freely available**
- Finally becoming explicit (in Ecospold 2, database 3) about global supply chains, and trade
  - **Introducing *markets***
- Canadian Ecoinvent project launching
  - **Make all obvious and possible replacements up front**
  - **Re-calibrate uncertainties throughout database**
  - **Develop new data for most important uncertainties**
  - **Continually improve quality (reduce uncertainty)**

Uncertainty as the window onto upstream data

- Inherent uncertainty
- Application uncertainty
- Find and use lowest-uncertainty data
- Capture uncertainty's influence
- Register data needs in web
- Interaction of needs and uncertainty reduction becomes driver of a market for LCI data.

Expectations on Supply Chains are Changing

- Compliance as a requirement
- Risk reduction as a requirement
- Innovation as a requirement – Track and report progress
- Transparency as a requirement – “What have you done for my visibility lately?”

Supply Chain as Data Users and Data Co-Developers

Forecast: Crowd-Sourcing Data and Tool Development

The data, and tools with which we create, share, & use it

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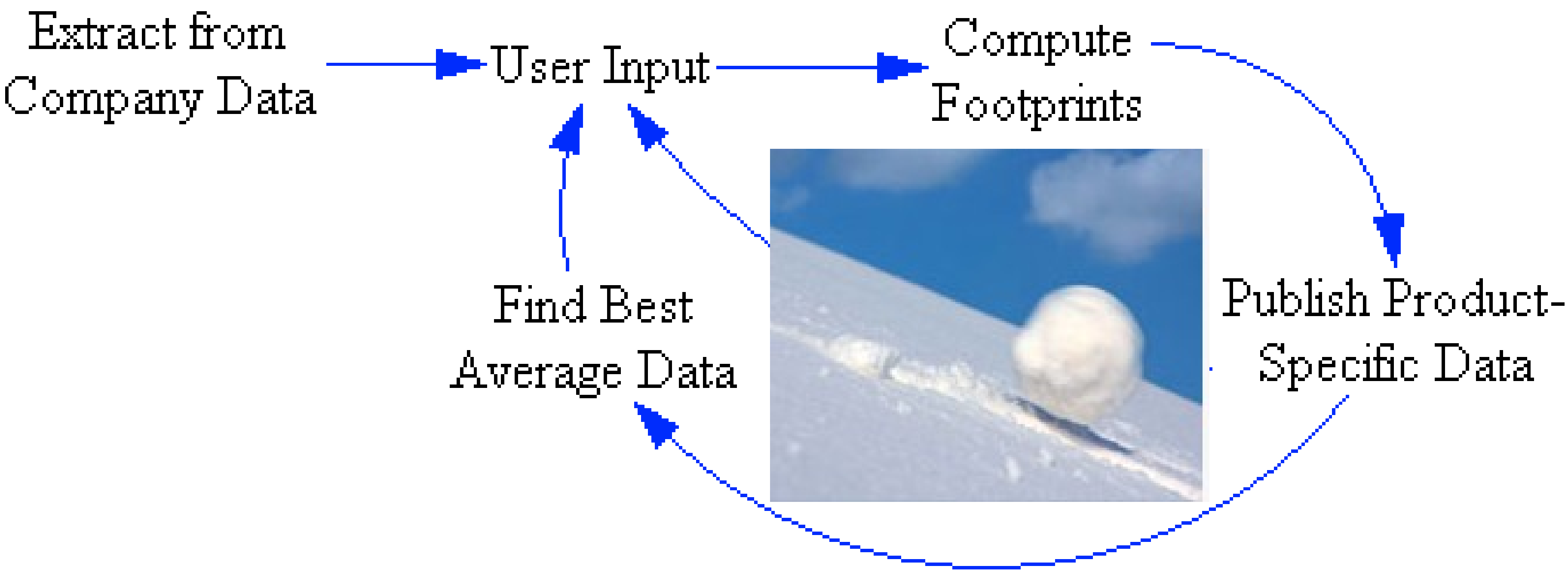
Data Feedback loops: Positive



Product-specific information:
*** Site-level validation;**
*** Aggregate 3 or more to grow the resource of industry average unit processes.**

The Semantic Web

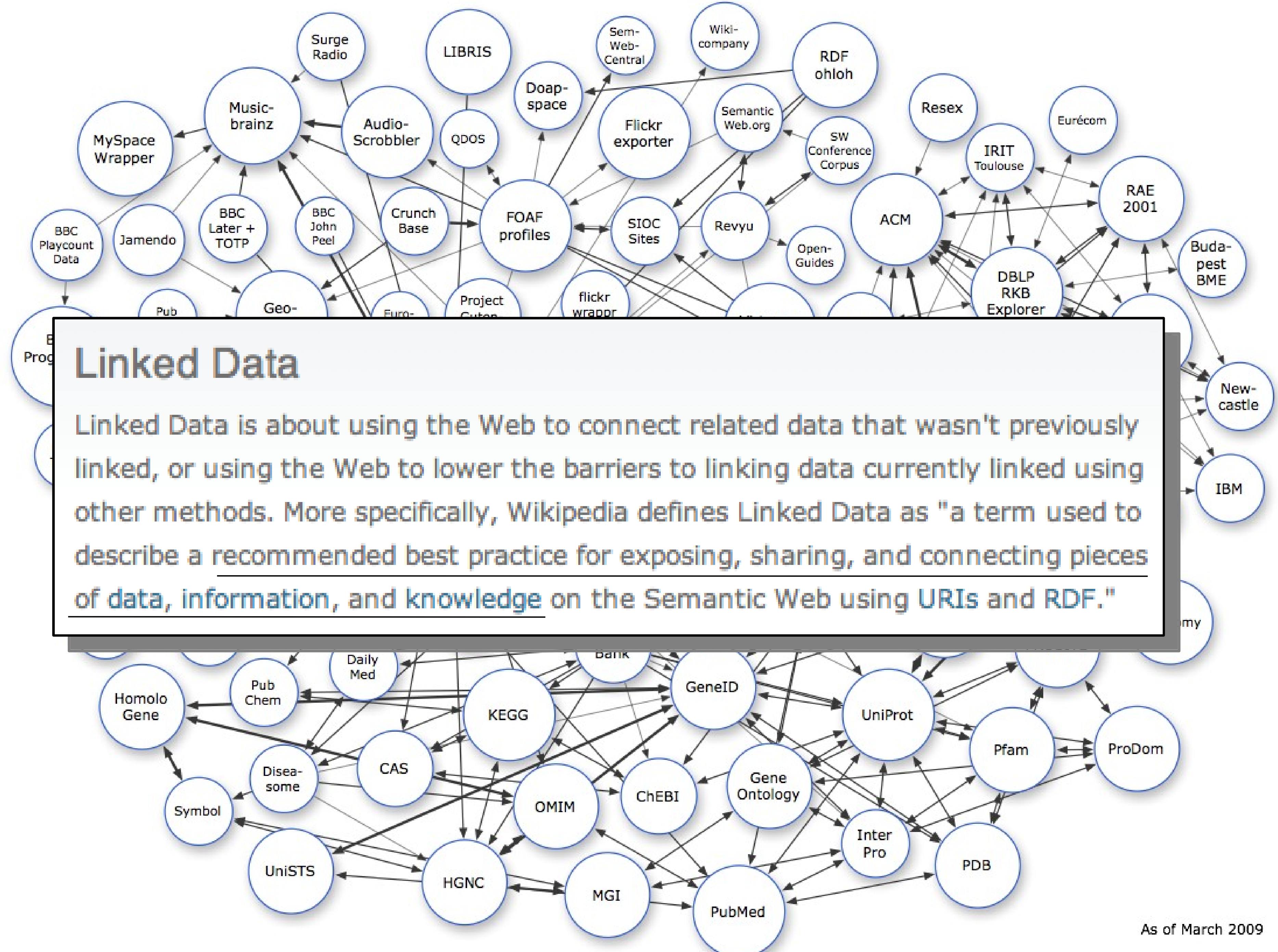
- Use the web as a global, open-ended, database
- Publish data, with metadata, so machines can read it
  - **Crowd-source this (and open-source it)**
- Publish models of data relationships (“Ontologies”)
  - **Document evaluation frameworks**
  - **Enable data to serve multiple frameworks**
  - **Enable users to compare frameworks**
    - → Marketplace for frameworks
- → ***Linked Open Data***

  → Agile data usage development

  → Flexible data usage evolution

Linked Data

Linked Data is about using the Web to connect related data that wasn't previously linked, or using the Web to lower the barriers to linking data currently linked using other methods. More specifically, Wikipedia defines Linked Data as "a term used to describe a recommended best practice for exposing, sharing, and connecting pieces of data, information, and knowledge on the Semantic Web using URIs and RDF."



As of March 2009

Linked Open Data: Agility, and Evolve-ability

“ We are seeing real benefits of having gone down the semantic technology path. This manifests itself primarily in flexibility and speed of development.

We can incorporate new data sources, whether structured, semi-structured or unstructured...

and build and change applications at a pace that I could only dream of in previous corporate incarnations.”

Tom Ilube is **Chief Executive Officer of Garlik**, a consumer company pioneering a range of services to help give people real power over their personal information in the digital world.

Until recently, Tom Ilube was **Chief Information Officer (CIO) of the world's largest pure online bank**, Egg PLC. Egg PLC was launched in 1998, and Tom was the original Launch Programme Manager. Today Egg is one of the world's largest online banks, with over 4 million customers.

Discussion

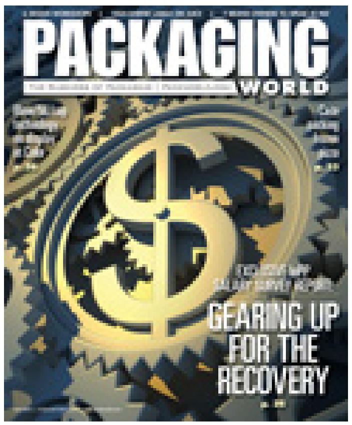
Understanding the Greener Package Database

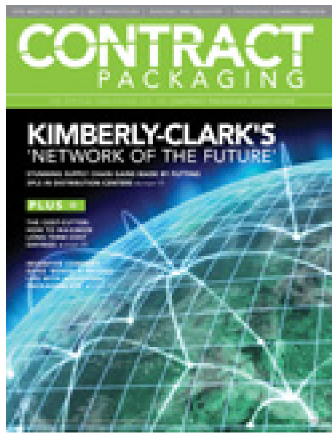
By David Newcorn
VP/eMedia
Greener Package

Greener Package™

Who we are

Summit Publishing





Specializing in packaging media since 1993

Greener Package™

Before Greener Package

- Lots of questions on sustainability
- Few answers
- No silver bullet
- Lots of confusion
- Murkiness

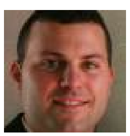
Sandra Keil
VP Gov't & Industry A
Earth911.com
Washington, DC, United Stat
Role: Media

David Padula
Owner, P Design Lab
Los Angeles, CA, United Stat
Industry: Non-food
Role: Packaging Materials Su

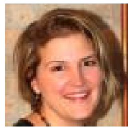
Cynthia Forsch
President, Eco-Logic St
St. Ignatius, Montana, USA
Role: Consultant

Dean Bellefleur
President, D-Idea
Kingston, Ontario, Canada
Role: Consultant

M. Scott Carpente
New Products Division Team, SC Johnson
Racine, WI, United States
Industry: Non-food
Role: Packager



Michael Larocca
Packaging Developmen GlaxoSmithKline
Pittsburgh, PA, United States
Industry: Pharmaceutical
Role: Packager



Lisa Baer
President, Baer Design Group
Evanston, IL, United States
Role: Designer

Thomas Oris
Procurement Manager, Morton
Chicago, IL, United States
Industry: Food
Role: Packager

Tom Szaky
CEO, TerraCycle
Trenton, NJ, United States
Industry: Non-food
Role: Recycler

Emma Dawley
Project Manager, Environment Packaging International
Jamestown, RI, United States
Role: Consultant

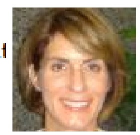
Alexis Stassinopoulos
President, AGMPM
Athens, Attiki, Greece
Role: Consultant

Adam Pawlick
Corporate Engineering Manag Palermo's Pizza
Milwaukee, Wisconsin, USA
Industry: Food
Role: Packager

Julie Wachler
President, Wachler Engin
Decatur, GA, United States
Role: Consultant

Frank Perkowski
Founder and President, B DEVELOPMENT ADVIS
Atlanta, GA, United States
Role: Consultant

Robert Lilienfeld
Editor, The Use Less Stuf
Rochester, MI, United States
Role: Media



Karen Greene
Vice President of Sales an Life Packaging Technolog
Carlsbad, CA, USA
Industry: Medical Device
Role: Consultant

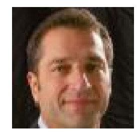
Scott Dyvig
Engineering Manager, Pr Packaging, Sears Holding
Hoffman Estates, IL, United Sta
Role: Retailer

Rita Schenck
Executive Director, Institu Environmental Research &
Vashon Island, WA, United Stat
Role: Not-for-profit

Stephanie Baker
Dir of Market Development, KW Plastics Recycling
Troy, AL, United States
Role: Recycler

Brad Rodgers
R&D Manager of Sustainable Packaging & Advanced Materials Research, Frito-Lay
United States
Industry: Food
Role: Packager

Pamela Long
Partner, Little Big Brands
Nyack, NY, United States
Role: Designer

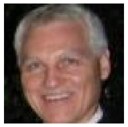


Eric Hartman
Director | Technology & Development, Product Ventures
Fairfield, CT, United States
Role: Designer

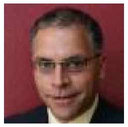
Paul Earl-Torniainen
Sr Packaging Engineer, General Mills Inc
Minneapolis, MN, United States
Industry: Food
Role: Packager

Andy Williams
Vice President of Business Development, M33 Integrated Solutions
Greenville, SC, United States
Role: Consultant

GreenerPackage™



Larry Dull
Partner, Packaging Knowledge Group, LLC
Greensboro, NC, United States
Role: Consultant



John Bernardo
President, Sustainable Innovations LLC
Boise, ID, United States
Role: Consultant

Jonathan Ford
Creative Partner, Pearlfisher
London, England
Role: Designer

Sukhdev Singh Saini
Packaging Design & Innovation, GlaxoSmithKline Consumer Healthcare Ltd.
Gurgaon, Haryana, India
Industry: Food
Role: Packager

Patrick Nolan
President, DDL, Inc.
Eden Prairie, MN, United States
Role: Consultant

Scott Boboltz
President, HBInnovations International, LLC
MI, United States
Role: Consultant

Humberto Garcia
Packaging Manager Environmental Sustainability, Unilever
Trumbull, CT, United States
Industry: Personal Care
Role: Packager

Gerald Lefebvre
President, ECOscore6
Germany
Role: Consultant

Barry Sanel
Principal, Barry Sanel Packaging Advisors
Carmel, NY, United States
Industry: Beverage
Role: Consultant

John Delfausse
Vice President, Global Package Development, Estee Lauder
New York, New York, United States
Industry: Non-food
Role: Packager

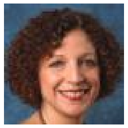
Amitabh Sheth
Environmental Policy Analyst, Environmental Packaging International
Jamestown, RI, United States
Role: Consultant

Tanja Carroll
Project Manager, Environmental Packaging International
Jamestown, RI, United States
Role: Consultant

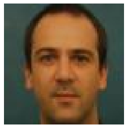
Mitch Hill
Business Development Manager, H.E. Butt Grocery Company
San Antonio, Texas, United States
Role: Retailer

Patrick Moschitto
(Director of Packaging Development, Victoria's Secret Beauty
New York, NY, United States
Industry: Personal Care
Role: Packager

Victor Bell
President, Environmental Packaging International
Jamestown, RI, United States
Role: Consultant



Sharon Reiter Lindberg
Senior Design Manager, Visual Branding, Unilever North America
Englewood Cliffs, NJ, United States
Industry: Food
Role: Designer



Mark Caul
Senior Packaging Technologist, Marks and Spencer
London, United Kingdom
Role: Retailer

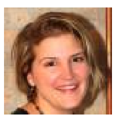
Rudradev Dasgupta
Head - Packaging Development, European Perfume Works
United Arab Emirates
Industry: Non-food
Role: Packager

Greener Package™

Step 1: We gave people a voice

Green Packaging Machinery: What's your definition?
Posted by Nikki from FoxJet, Marketing & Customer Service Manager, FoxJet, an ITW Company 55 minutes ago | **Role:** Packaging Machinery Supplier | See 1 comment

Molded Pulp Clamshell for Soap
Posted by Scott Carpenter, New Products Division - New Ventures Team, SC Johnson April 15, 2010 | **Role:** Packager | See 6 comments



Looking for Great Examples of Sustainable Packaging?
Posted by Lisa Baer, President, Baer Design Group March 31, 2010 | **Role:** Designer | See 2 comments

What is greener? Biodegradable or 100% recycled?
Posted by mike lyons, President, Simpak International March 16, 2010 | **Role:** Packaging Materials Supplier | See 51 comments

Packaging LCA's (Life Cycle Analysis) & Environmental Impact Studies
Posted by Jeff Plank, Lean Six Sigma Black Belt March 4, 2010 | **Role:** Packager | See 12 comments

Home > Discuss > Compost & Biodegrade

ARTICLE TOOLS
Print | Email | SHARE

What is greener? Biodegradable or 100% recycled?

Filed in: Flexible packaging, Corporate strategy, Compost & Biodegrade, Recycled content, Non-food

mike lyons
President, Simpak International
Industry: Non-food
Location: Louisville, Kentucky, USA
Role: Packaging Materials Supplier

We make a protective packaging pad. It is comprised of foam beads vacuum packed in a plastic envelop. Right now our product is made of 100% recylced foam beads and can be reused. With it's cushion curves we can reduce the amount of packaging and provide equal or better protection. It can also be recylced again at end of life.

My question is from a corporate strategy perspective, what is greener?

Product A - made of biodegradable foam beads and packe
envelop.

Comments: 51

Greener Package™

Step 2: We gave the conversation a structure

Greener Package™

Step 3: We standardized how sustainability claims are reported

Sustainability Claims

These claims were reviewed by a third party. (What's this?)

Please see important disclaimers and definitions at the bottom of this page.

Source	Post-consumer content: 50 - 74% Pre-consumer content: 25 - 49% Sustainable forestry certification? No Source reduced? No
Manufacture	Renewable energy? No Greenhouse gas reduction: No
Use	CONEG documentation? Yes Shipping efficiency? No
End of life	Reusable? No Recyclable? Recycling is limited for this material/product (10-59% or under) Compostable? No Waste-to-energy? Yes

Greener Package™

Step 4: We created a mechanism to weed out greenwashing

Sustainability Claims

These claims were reviewed by a third party. (What's this?)

Please see important disclaimers and definitions at the bottom of this page.

Source	Post-consumer content: 50 - 74% Pre-consumer content: 25 - 49% Sustainable forestry certification? No Source reduced? No
Manufacture	Renewable energy? No Greenhouse gas reduction: No
Use	CONEG documentation? Yes Shipping efficiency? No
End of life	Reusable? No Recyclable? Recycling is limited for this material/product (10-59% or

Greener Package™

When Walmart speaks. . .

- We planned on launching a database of packaging products
- ECRM already had its Packaging Marketgate database
- Walmart suggested Greener Package and ECRM combine forces...so we did!

Months of work

- Members of Greener Package advisory board (end users AND suppliers) drove database design
- Revamped the look, feel and underlying data structure of ECRM
- Months spent on packaging sustainability questions, guided by independent consultancy EPI.

Greener Package™

Combatting greenwashing

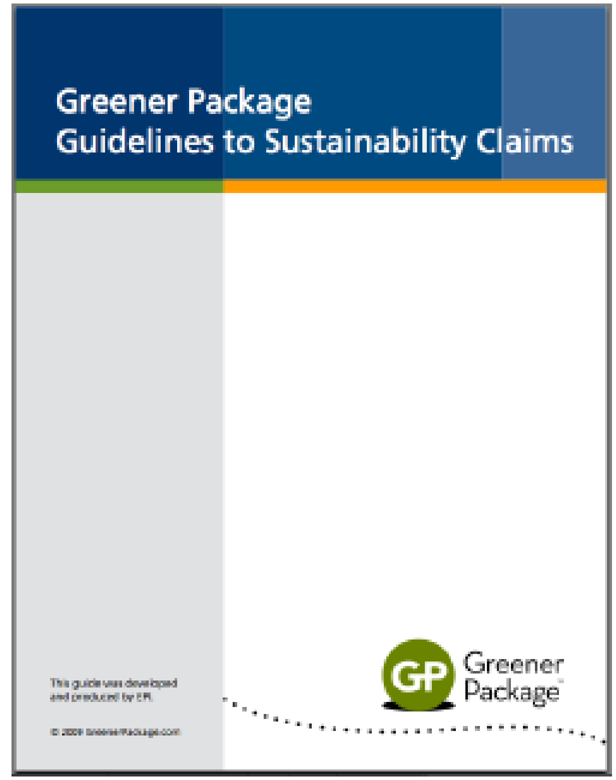
- Most greenwashing is inadvertent!
- Introducing voluntary third-party review of sustainability claims
- Credibility for suppliers, saves time for buyers

Greener Package™

“Bible” of sustainability claims

- Industry’s first guidelines for packaging sustainability claims
- Starts where FTC green guidelines leave off
- Released Fall 2009
- Updated 3x since then –

GreenerPackage.com/guidelines



Download today!

Greener Package™

Over 1,200 downloads!

- Abbott Nutrition--Program Manager
- Arlafoods--Packaging Engineer
- Avon Products Inc--Pgm Mgr
- Becton Dickinson--Packaging Engineer
- Bimbo Bakeries--Sr
- Cadbury--Packaging Project Team Membe
- Cardinal Health--Packaging Superintendent
- Castrol India Ltd--Sr Executive Pkg
- Clorox--Associate Research Fellow
- Colgate-Palmolive Co--Vice President
- Conagra Foods--VP, Sustainable Development
- Del Monte--Packaging R&d
- Diebold--Packaging Commodity Manager
- Disney Consumer Products--Director, Sustainable Business Practices
- Domino Sugar--Packing Engr
- Ford Motor Co Mp&l Div--Sr Packaging Engineer
- Frito Lay--R&d Manager
- Frucor Beverages Ltd--Packaging Manager
- GE Lighting--Brand Manager
- Glaxosmithkline--Packaging Dev Mgr

Database: a Quick Tour

Search by Package Type

Start your search

This section is required.

- (selected) **Converted packages or packaging components**
  (bags, bottles, closures, flexible packaging films, labels, etc.)
- **Raw materials**
  (resin, coatings, inks, unprinted board or films, etc.)
- **Company name** (see all companies)

Package Type

All package types will be returned unless you restrict the search to any package types checked below.

- Aerosol (1)
- Bag, pre-formed (9)
- Blister card (5)
- Blister pack (12)
- Bottle (11)
- Bulk container (3)
- Can (1)
- Carton, folding (24)
- Case, corrugated, primary retail pack (6)
- Clamshell (9)
- Closure - for flexibles (3)
- Cup (4)
- Film, rigid (8)
- Flexible packaging (12)
- Food Service Container, Deli/Bakery (1)
- Jar (2)
- Label (2)
- Multi-pack/carrier (9)
- POP display (4)
- Pouch, pre-formed (4)
- Protective packaging (14)
- Secondary/transport packaging (18)
- Skin pack (1)
- Strapping (2)
- Stretch wrap (1)
- Tray/Bowl (15)
- Tub (2)

. . . or by Raw Material

Start your search

This section is required.

- ○ **Converted packages or packaging components**
  (bags, bottles, closures, flexible packaging films, labels, etc.)
- ◉ **Raw materials**
  (resin, coatings, inks, unprinted board or films, etc.)
- ○ **Company name** (see all companies)

Material type

At least one checkbox must be selected.

- **Additives**
- **Adhesives, Coatings & Inks**
- **Blends**
- **Mixed Materials**
- **Polymers**
- **Wood/Paper**
  - [x] Corrugated: Unbleached (1)
  - [x] Molded Pulp Packaging (1)
  - [x] Paperboard: Coated Recycled (3)
  - [x] Paperboard: Uncoated Unbleached Kraft (2)

. . . or by company

Start your search

This section is required.

- ○ **Converted packages or packaging components**
  (bags, bottles, closures, flexible packaging films, labels, etc.)
- ○ **Raw materials**
  (resin, coatings, inks, unprinted board or films, etc.)
- ◉ **Company name** (see all companies)
  Georgia-Pacific

Search

Search by Sustainability Criteria

Sustainability Criteria

All sustainability types will be returned unless you restrict the search to any sustainability criteria checked below

Source

- ☐ Post-consumer content (73)
- ☐ Pre-consumer content (60)
- ☐ Source reduced (58)
- ☐ Sustainable forestry certified (46)

Manufacture

- ☐ Greenhouse gas reduction (43)
- ☐ Renewable energy (31)

Use

- ☐ CONEG documentation (116)
- ☐ Shipping Efficiency (70)

End of Life

- ☐ Compostable (44)
- ☐ Recyclable (107)
- ☐ Reusable/refillable (32)
- ☐ Waste-to-energy (59)

Application-specific criteria

- ☐ Only return materials FDA-compliant for food contact (102)

Greener Package™

Detailed search results

REGULAR SEARCH RESULTS

Material type: Wood/Paper: Corrugated - Pre-Printed

Description	Sustainability Claims	Company Info

High Graphics Litho Lam Corrugated -- High Graphics Corrugated Packaging ...

Accurate Box Company produces high graphics litho-lam corrugated packaging providing the graphical reproduction our customers require coupled with the necessary maximum product protection that contains less wood fiber than traditional folding cartons and is fully recyclable in every municipality in the United States that recycles.

Package Type: Case, corrugated, primary retail pack
Sizes: Various
Styles: Various, including RT, ST, RSC, Tuck Top auto bottom, Full Seal End, and many others
Conversion Process: Flat Bed Die, Printing Capabilities - Litho-Lam,
FDA compliant for food-contact: No

Temperature Capabilities: Refrigerated, Frozen, Microwavable, Ice-packed
Product States: Solid

Claims: 3rd party reviewed

Source
- Post-consumer content: 10 - 24%
- Pre-consumer content? No
- Sustainable forestry? Yes
- Source reduced? No

Manufacture
- Renewable energy? No
- Less greenhouse gas? No

Use
- CONEG documentation? Yes
- Shipping efficiency? No

End of life
- Reusable? No
- Recyclable? Yes
- Compostable? No
- Waste-to-energy? Yes

Accurate Box Company, Inc.
(Patterson, NJ)

Company Size
$20 to 100 million
1 plant(s)

Other Products
Converted Packages (1)

Material type: Wood/Paper: Corrugated - Pre-Printed

Description	Sustainability Claims	Company Info

High Graphics Corrugated -- High Graphics Corrugated

Color-Box high graphics corrugated packaging solutions are certified by the Sustainable Forestry Initiative for responsible fiber sourcing.

Claims: not reviewed*

Source
- Post-consumer content: No
- Pre-consumer content? No
- Sustainable forestry? Yes
- Source reduced? No

Manufacture
- Renewable energy? No

Georgia-Pacific
(Atlanta, GA)

Company Size
$1 billion or more
7 plant(s)

Other Products
Converted Packages (3)

Drill down on a listing

High Graphics Litho Lam Corrugated (Accurate Box Company, Inc.) EMAIL

Product Overview

Product	High Graphics Litho Lam Corrugated
Generic Description	High Graphics Corrugated Packaging (Litho-Lam)
Company	Accurate Box Company, Inc. Click for detailed company profile, capabilities and contact info
Conversion Stage	Converted Package
Package type	Case, corrugated, primary retail pack
Material Type	Wood/Paper: Corrugated - Pre-Printed
Package features	Reclosable, Easy-open, Handled, Other: Tamper evident packaging
FDA-compliant for food-contact	No
Claims Third party review	Yes Feb 25 2010
Summary	Accurate Box Company produces high graphics litho-lam corrugated packaging providing the graphical reproduction our customers require coupled with the necessary maximum product protection that contains less wood fiber than traditional folding cartons and is fully recyclable in every municipality in the United States that recycles.
Manufacturer's description	Accurate Box Company produces a wide range of high graphics corrugated litho-lam boxes and Point of Purchase Displays and/or Point of Sale Displays. Our printing expertise and roots in the folding carton industry coupled with our state of the art high graphics equipment combine for eye catching branding on unusual styles of packaging. Our prepress graphics equipment is AGFA state of the art computer to plate equipment. In addition, we make all of our own tooling (pre-press proofs, printing plates, and cutting dies) which offers tremendous flexibility in this time of rapid change. Our 300,000 square foot facility is equipped with state of the art technology and equipment. Each phase of producing our high graphic boxes is controlled under one roof with KBA

product jump off the shelf in a highly competitive retail environment. Our high graphics corrugated boxes contain 15 percent less fiber than 30 pt. folding cartons. A carton made from 30 point virgin SUS board has a normal basis weight of 114 pounds whereas a high graphics corrugated box has a normal basis weight of 97 pounds consisting of a top sheet, medium, and liner. This equates to a 15% fiber reduction in using our constructed boxes. In the case of recycled fiber, our boxes represent a 19% fiber reduction.
We make stronger boxes using less material. For example, our Research and Development department perpetually evaluates and tests new high performing and lighter weight substrates in order to be on the leading edge of environmental stewardship (fiber reduction and increased recyclables) without compromising customer product performance.
Accurate Box Company can ship nationwide cost effectively without adding to the carbon footprint. Our east coast location permits us to arrange backhauls to virtually all customer locations, thus avoiding incremental CO2s being emitted into the atmosphere.
Product page on supplier's site

Sizes	Various
Styles	Various, including RT, ST, RSC, Tuck Top auto bottom, Full Seal End, and many others
Geographic availability	North America

Photographs

(Click photos to enlarge)

Product Detail: Converted Package

Conversion process	Flat Bed Die Printing Capabilities - Litho-Lam Other: Specialty and creative finishing
Added treatments	Other: We have the capability to add grease resistance and MVTR to our

Product Detail: Converted Package

Conversion process	Flat Bed Die Printing Capabilities - Litho-Lam Other: Specialty and creative finishing
Added treatments	Other: We have the capability to add grease resistance and MVTR to our packaging
Target markets	Cosmetic Fragrance and Bath >> Bath Accessories Cosmetic Fragrance and Bath >> Bath Specialty Cosmetic Fragrance and Bath >> Cosmetics Cosmetic Fragrance and Bath >> Cosmetic Accessories Cosmetic Fragrance and Bath >> Fragrances Cosmetic Fragrance and Bath >> Prestige Beauty Food and Beverage >> Beverage Food and Beverage >> Beverage >> Beer Food and Beverage >> Beverage >> Bottled water Food and Beverage >> Beverage >> Coffee Food and Beverage >> Beverage >> Drinks Food and Beverage >> Beverage >> Juice Food and Beverage >> Beverage >> Soft drinks Food and Beverage >> Beverage >> Spirits Food and Beverage >> Beverage >> Wine Food and Beverage >> Dry Grocery Food and Beverage >> Dry Grocery >> Bakery Food and Beverage >> Dry Grocery >> Canned Preserved and Dried Food Food and Beverage >> Dry Grocery >> Confectionery and Snack Food and Beverage >> Dry Grocery >> Dairy Food and Beverage >> Dry Grocery >> Deli Food and Beverage >> Dry Grocery >> Frozen Food and Beverage >> Dry Grocery >> Grain Seed and Nut Food and Beverage >> Dry Grocery >> Grocery Perishable Food and Beverage >> Dry Grocery >> Meat Food and Beverage >> Dry Grocery >> Pasta and Noodle Food and Beverage >> Dry Grocery >> Produce General Merchandise >> Automotive General Merchandise >> Electronics General Merchandise >> Hardware General Merchandise >> Home Entertainment General Merchandise >> Housewares General Merchandise >> Infant Accessories General Merchandise >> Lawn and Garden General Merchandise >> Pet General Merchandise >> Seasonal General Merchandise >> Stationery: School and Office General Merchandise >> Toys Healthcare & pharmaceutical >> Allergy Healthcare & pharmaceutical >> Allergy >> Allergy Liquids Healthcare & pharmaceutical >> Allergy >> Allergy Sprays Healthcare & pharmaceutical >> Allergy >> Allergy Tabs/Caps/Gels Healthcare & pharmaceutical >> Analgesics

	Personal Care >> Hair Care and Accessories Personal Care >> Oral Care Personal Care >> Shaving and Toiletries Personal Care >> Skin Care Personal Care >> Soaps Gels and Sanitizers Personal Care >> Sun Care Personal Care >> Travel Kits Other: Wherever the need for high graphics corrugated packaging is necessary to protect the product and provide shelf presence graphics
Temperature capabilities	Refrigerated, Frozen, Microwavable, Ice-packed
Product state	Gel
Food-contact compliance for other countries	N/A
Manufacturing locations	Accurate Box Company, Inc. (Paterson, NJ, United States of America)
Subcontract any production?	No

Sustainability Claims

These claims were reviewed by a third party. (What's this?)

Please see important disclaimers and definitions at the bottom of this page.

Source	✓ Post-consumer content: 10 - 24% Pre-consumer content: No ✓ Sustainable forestry certification? Sustainable Forestry Initiative (SFI) Source reduced? No
Manufacture	Renewable energy? No Greenhouse gas reduction: No
Use	✓ CONEG documentation? Yes Shipping efficiency? No
End of life	Reusable? No ✓ Recyclable? The material/product in this element is accepted for recycling in the majority of the communities in the US (60% or more) Compostable? No ✓ Waste-to-energy? Yes

Company Overview: Diamond Packaging

Address: 111 Commerce Drive, Rochester, NY, 14623

Website: http://www.diamondpackaging.com/green

Main phone: +1 (800) 333-4079

Sales contact: Dennis Bacchetta, +1 (585) 334-8030

EMAIL

Products

Packaging Services

Manufacturing locations

Company Details

Company Type	Converter or Converted Packaging Materials Supplier Packaging Service Provider
Ownership	*Company size:* $20 to 100 million Incorporated Woman-owned and certified by WBENC
Transportation system(s):	Ship on own trucks Coordinate 3rd party source Shipped in trucks in these formats: *Palletized* Primary carrier: *We have developed a solid working knowledge in both domestic and international transportation and movement of materials. Our traffic personnel have a good understanding of the requirements needed for shipping materials and work closely with our internatio* Possess U.S. custom clearace and freight forwarding abilities: *Yes*
Order fulfillment system(s):	EDI Capable Dedicated Customer Service Representative Supplier Managed System

Products: Converted Packages

Package Type: Carton, folding

Description

Zotos hair color products -- folding cartons

The cartons were converted from solid bleached sulfate (SBS) paperboard to .016 WCCN recycled board, resulting in saving 2725 pulp trees. All cartons were manufactured using 100% wind energy.

Package Type: Carton, folding
Material type: Wood/Paper: Paperboard: Coated Recycled
Sizes: .016 WCCN
Styles: French reverse tuck
Conversion Process: Flat Bed Die, Printing Capabilities - Pre-Print, Printing Capabilities - Direct Print, Folding carton manufacturing,
FDA compliant for food-contact: No

Sustainability Claims

Claims: not reviewed*

Source
Post-consumer content: 25 - 49%
Pre-consumer content? No
Sustainable forestry? No
Source reduced? No

Manufacture
Renewable energy? Yes
Less greenhouse gas? No

Use
CONEG documentation? No
Shipping efficiency? No

End of life
Reusable? No
Recyclable? Yes
Compostable? No
Waste-to-energy? No

Package Type: Carton, folding

Description

Biolage therapies -- folding cartons

The gifts sets were produced utilizing KapStone Kraftpak, a high-yield, low density paperboard which offers a significant source reduction advantage compared to regular-density paperboard grades.

Package Type: Carton, folding
Material type: Wood/Paper: Paperboard: Uncoated Unbleached Kraft
Sizes: .024 Kraftpak

Sustainability Claims

Claims: not reviewed*

Source
Post-consumer content: No
Pre-consumer content? No
Sustainable forestry? No
Source reduced? No

Manufacture
Renewable energy? Yes
Less greenhouse gas? No

Use

Packaging Services: Contract packaging services

Assembly/pack-out	Assembly â€" Clamshell / Blisterpack Break-pack fulfillment (Pick & Pack) Cartons Co-packing / Repackaging Filling â€" Clamshell/ Blisterpack Holding Inventory Labeling / Printing Logistics Palletizing Sealing Shrink Wrapping
Consulting	Package design consulting Project management Cost savings Environmental sustainability
POP/Merchandising	Floor Displays Counter Displays Shelf Talkers Mailings Support Materials Poly bagging Other: Assembly, packing, distribution *Provide design vs. production/fulfillment for above services:* Design services Production capabilities
Package design/development	Artwork Development/Package Design Display Design Mock-Ups / Prototypes Plastic Component Design Materials Sourcing Package Design Structure
Secondary packaging	Cartons Displays Labels Shrink Outerwraps Hang Tags Other: Blister cards, physician sample packaging
Package performance testing	Simulated Distributing testing Compression testing Sutherland rub

Packaging Services: Folding carton manufacturing

Consulting	Innovation Scorecard consulting Package design consulting Project management Cost savings Environmental sustainability
Package design/development	Artwork Development/Package Design Display Design Mock-Ups / Prototypes Plastic Component Design Materials Sourcing Package Design Structure
Secondary packaging	Cartons Displays Hang Tags Other: Blister cards, sample packaging
Package performance testing	Simulated Distributing testing Compression testing Sutherland rub Drop testing Random vibration
Printing	Flexo Type of printing presses: Heidelberg Speedmaster XL 105 (1+8+2), Heidelberg Speedmaster CD 102 (7+2); Heidelberg Speedmaster CD 102 (6+1); Man Roland 700 Series (7+2); Komori Lithrone 40 (5+1) Maximum number of colors run in a single pass: 8 Describe the width of equipment in inches: 40"" Describe the speed of the equipment: Varies List any other printing equipment: Equipment list available upon request
Other product/service	*Do you provide an ancillary product or service to packaging converters or suppliers that enables them to produce packaging more environmentally sustainably?* The core of Diamonds greenbox initiative initiative designs, materials, and methods represents a comprehensive approach to packaging that minimizes environmental impact throughout the supply chain. Visit www.diamondpackaging.com/green for more info.
Other capabilities	Maintain own tools and dies Accommodate custom die lines *Converting capabilities:* Rotary Die-Cutter | Flat Bed Die | Printing Capabilities - Pre-Print | Printing Capabilities - Direct Print | Printing Capabilities - Litho-Lam | Folding carton manufacturing | Other: Taping, windowing, gluing, inserting *Direct-print capabilities: Color range:* Full range of colors *Litho-Lam capabilities: Color range:* Lamination available

Manufacturing plant locations and details

Diamond Packaging (folding carton manufacturing plant)
Rochester, NY, 14623
United States of America

Ownership:

Products

Carton, folding

Services

Consulting

Package design/development

Secondary packaging

Package performance testing

Printing

Other product/service

Other capabilities

Facility certifications

ISO 9001 (Issued by: NSF International Strategic Registrations | Date issued: 9-2-09)

Diamond Contract Manufacturing (DCM) - contract manufacturing and contract packaging services
Rochester, NY, 14623
United States of America

Ownership:

Products

Services

Assembly pack-out

Consulting

POP/Merchandising

Package design/development

Secondary packaging

Package performance testing

Printing

Other product/service

Other capabilities

Facility certifications

FDA (Issued by: FDA inspector last checked for compliance on 4-30-2008. | Date issued: DCM first registered on 2-4-2000. FDA inspector last checked for compliance on 4-30-2008.)

ISO 9001 (Issued by: NSF International Strategic Registrations | Date issued: 9-2-2009)

cGMP (Issued by: Checked by NSF-ISR | Date issued: cGMP compliant)

AIB (American Insititute of Baking) (Issued by: | Date issued:)

Many fiber-specific options

- Cellophane, Cellulose film - processed cellulose, often from wood, cotton or hemp
- Coated Freesheet (e.g., high-end magazine)
- Coated Groundwood (e.g., standard magazine)
- Corrugated - Moisture Resistant - Wax Alternative
- Corrugated - Moisture Resistant - Waxed
- Corrugated - Pre-Printed
- Corrugated: Bleached
- Corrugated: Semi-bleached
- Corrugated: Unbleached
- Dimensional Lumber
- Medium-density Fiberboard
- Molded Pulp Packaging
- Paper: Uncoated Unbleached Kraft
- Paperboard: Coated Recycled
- Paperboard: Coated Unbleached Kraft (CUK)
- Paperboard: Solid Bleached Sulfate (SBS)
- Paperboard: Uncoated Bleached Kraft
- Paperboard: Uncoated Recycled (URB)
- Paperboard: Uncoated Unbleached Kraft
- Recycled Folding Boxboard
- Supercalendered (e.g., newspaper inserts)
- Uncoated Freesheet (e.g., copy paper)
- Uncoated Groundwood (e.g., newsprint)

Applicable sustainability claims in the Greener Package database for fiber-based packaging

Source
- Post-consumer content
- Pre-consumer content
- Sustainble forestry certified (SFI, PEFC, FSC, CSA, ATFS)
- Source reduced

Manufacture
- Renewable energy
- Greenhouse gas reduction

Use
- CONEG/heavy metals
- Shipping efficiency

End of life
- Recyclable
- Compostable
- Waste-to-energy

Greener Package™

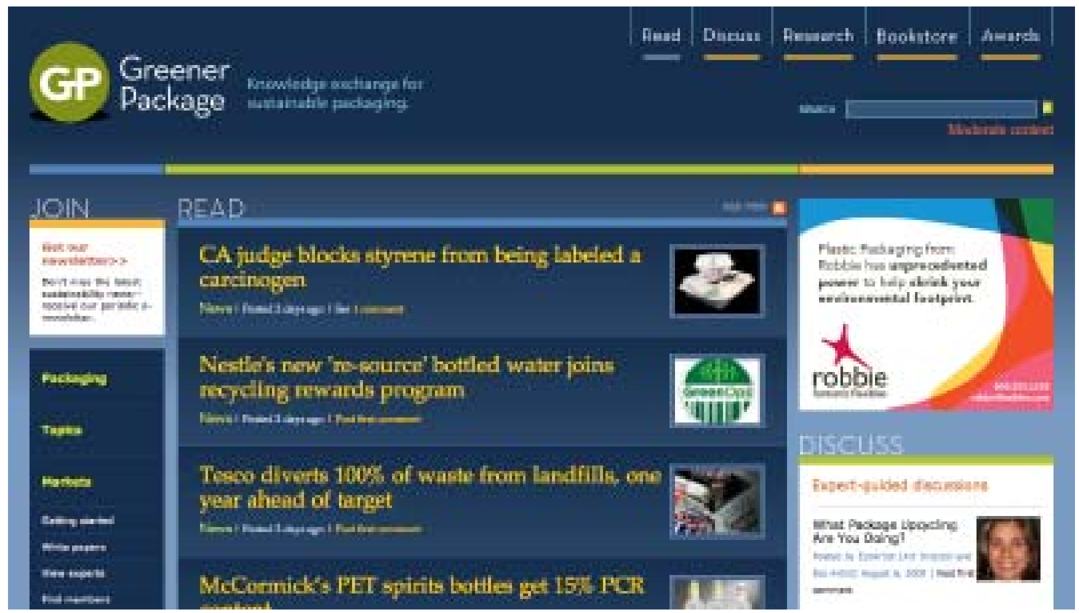
Third-party review

- Neutral traffic cop that examines paperwork
- Ensures claims are backed up by proper supporting docs
- Standardizes what paperwork is necessary to prove claim
- A document review, not an audit
- Two authorized third-party review firms: EPI and PKG
- More info on third-party review:

http://www.greenerpackage.com/gd/3rdparty_explained.pdf

Benefits for participating

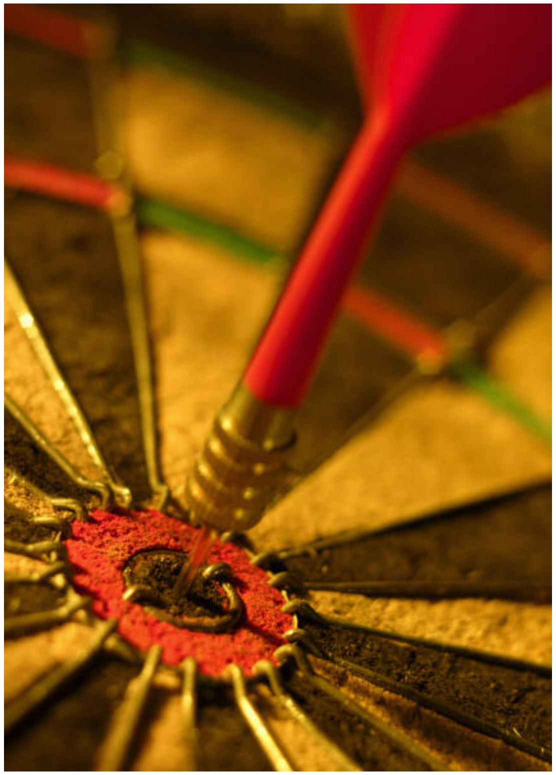
- Disseminate your product info to targeted audience
- Consolidate feedback to market in one place
- Submit as many products as you want
- No fee to submit!
- (Optional fee for 3rd party review)



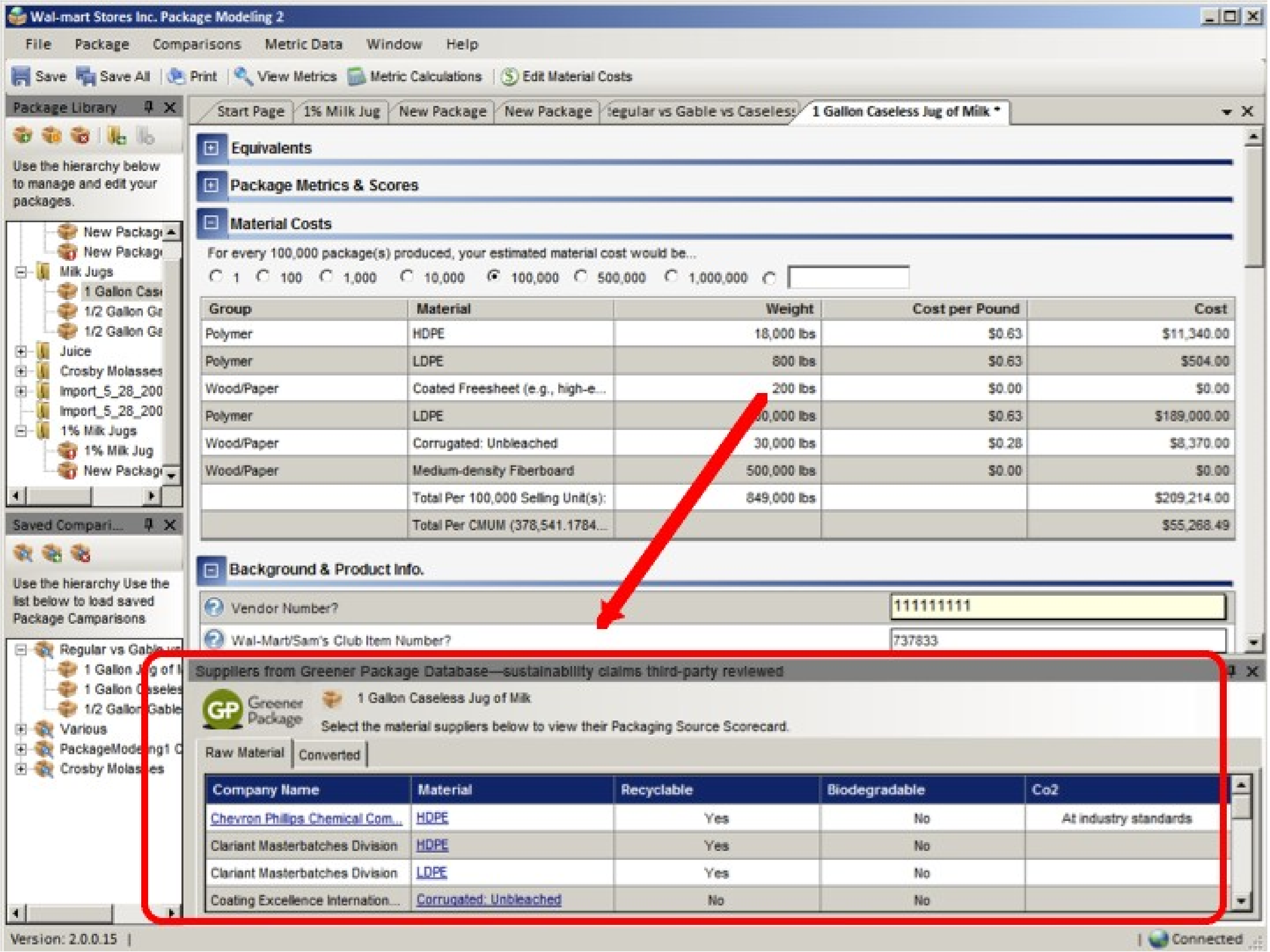
Greener Package™

Benefits for 3rd party reviewed listings

1. Credibility
2. Favorable position in search
3. Favorable graphical treatment
4. *Visible within Walmart Scorecard Modeling Software!*



Greener Package™


Wal-mart Stores Inc. Package Modeling 2
File
Package
Comparisons
Metric Data
Window
Help
Save
Save All
Print
View Metrics
Metric Calculations
Edit Material Costs
Package Library
Use the hierarchy below to manage and edit your packages.
Start Page
1% Milk Jug
New Package
New Package
1 Gallon Caseless Jug of Milk *
Equivalents
Package Metrics & Scores
Material Costs
For every 100,000 package(s) produced, your estimated material cost would be...
1
100
1,000
10,000
100,000
500,000
1,000,000
Group
Material
Weight
Cost per Pound
Cost
Polymer
HDPE
18,000 lbs
$0.63
$11,340.00
Polymer
LDPE
800 lbs
$0.63
$504.00
Wood/Paper
Coated Freesheet (e.g., high-e...
200 lbs
$0.00
$0.00
Polymer
LDPE
$0.63
$189,000.00
Wood/Paper
Corrugated: Unbleached
30,000 lbs
$0.28
$8,370.00
Wood/Paper
Medium-density Fiberboard
500,000 lbs
$0.00
$0.00
Total Per 100,000 Selling Unit(s):
849,000 lbs
$209,214.00
$55,268.49
Background & Product Info.
Vendor Number?
111111111
Wal-Mart/Sam's Club Item Number?
737833
Milk Jugs
1 Gallon Cas
1/2 Gallon
Juice
Crosby Molasses
1% Milk Jugs
1% Milk Jug
New Package
Saved Compari...
Use the hierarchy Use the list below to load saved Package Campanisons
Regular vs Gable
Various
Suppliers from Greener Package Database—sustainability claims third-party reviewed
Greener Package
1 Gallon Caseless Jug of Milk
Select the material suppliers below to view their Packaging Source Scorecard.
Raw Material
Converted
Company Name
Material
Recyclable
Biodegradable
Co2
Chevron Phillips Chemical Com...
HDPE
Yes
No
At industry standards
Clariant Masterbatches Division
HDPE
Yes
No
Clariant Masterbatches Division
LDPE
Yes
No
Coating Excellence Internation...
Corrugated: Unbleached
No
No
Version: 2.0.0.15
Connected

Recap so far…

- Industry-standard database of sustainable packaging
- One-of-a-kind partnership with world's largest retailer
- In talks with second large retailer . . .
- Advised by 40+ packaging experts
- Third-party review combats greenwashing
- Industry's first independent guidelines to packaging sustainability claims

Next step: Membership

- Introducing membership for suppliers
- Blanket third party review (5-star verified)
- Database listings disseminated to prospects
- Influence direction of database development
- Written letters of third-party review
- Discounts on educational content
- Discounts on lead-generation and branding programs
- Discounts on consulting and private workshops
- Underwriting support for this database

How do you get started?

- Participate in discussions—your expertise is needed!
- Submit your products
- Become a member!

Questions?

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Greener Package™

TAPPI Papercon 2010

Sustainability Forum

May 4th , 2010

Introduction

Non-Profit

Represent North America’s Largest CRB/URB Producers

Exist to promote the benefits of 100% recycled paperboard

Work with and consult to top CPG’s and retailers

License the RPA-100% Symbol to Brand Owners

Agenda

Organization

Context & Perspective

Limitations

Overall Goals

Current State

Success Metrics

Challenges

What Does it Mean to the Paperboard Industry

WMT Sustainability Organization

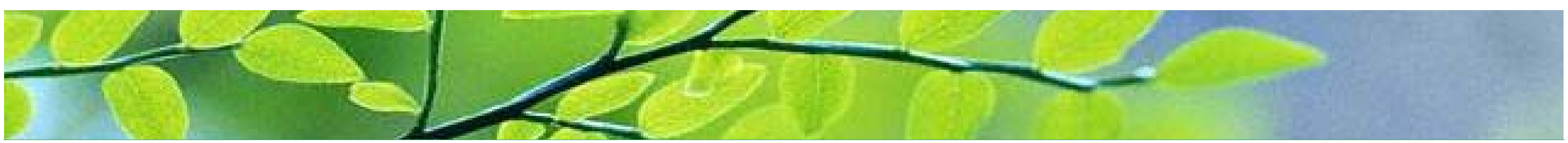
WMT Sustainability Team

Sustainability Value Networks

Greenhouse Gas
Sustainable Buildings
Alternative Fuels
Logistics
Waste
Packaging
Wood & Paper
Agricultural & Seafood
Textiles
Jewelry
Electronics
Chemical Intensive Products

Jeff Karp
Diana Ramos
Chet Rutledge
Ron Sasine*
Amy Zettlemoyer-Lazar*

Steering Committee



Context & Perspective

EPAT informing environmental decisions

OUTDOOR INDUSTRY ASSOCIATION ECO WORKING GROUP

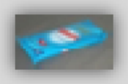
Compass

GPP

CPG

Limitations

Walmart Scorecard Comparison

Walmart Metric	Weight Factor %	*Swiffer ® Dry Sweeping Cloths* 	*Wet Ones ® Moist Wipes* 	*Clorox ® Disinfecting Wipes* 	*Windex ® Glass & Surface Wipes* 	*Endust ® Anti-Static Wipes* 
Greenhouse gas emissions from package production	15% ↓	0.00000471	0.000001671	0.00000162	0.000000384	0.000001325
Evaluation of material type	15% ↓	0.00547022	0.00293215	0.00284249	0.00076721	0.00228336
Average distance to transport material	10% ↓	0.00547022	0.00293215	0.00284249	0.00076721	0.00228336
Product to package ratio	15% ↓	0.005470022	0.00293215	0.00284249	0.00076721	0.00228336
Cube utilization	15% ↓	0.19	0.3759	0.3759	0.2775	0.3759
Recycled content	10% ↓	0.00547022	0.00263893	0.00255824	0.00076721	0.00207329
Recovery	10% ↓	0.02188088	0.0172859	0.01136997	0.003068835	0.00922792
Renewable energy to power each facility	5% ↓	0.00547022	0.00547022	0.002842493	0.000767209	0.002283359
Innovation different from energy standard	5% ↓	0	0	0	0	0
Final Normalized Score	↑	2	3.7	5.3	9.40	6.9

* * *Number in **green** denotes a better score, and number in **red** denotes a worse score*

EPI 108

Overall Goals / Current State / Success Metrics

Overall Goal:

A comparison tool for WMT Merchandisers

Current State:

SKU based, CPG dependent

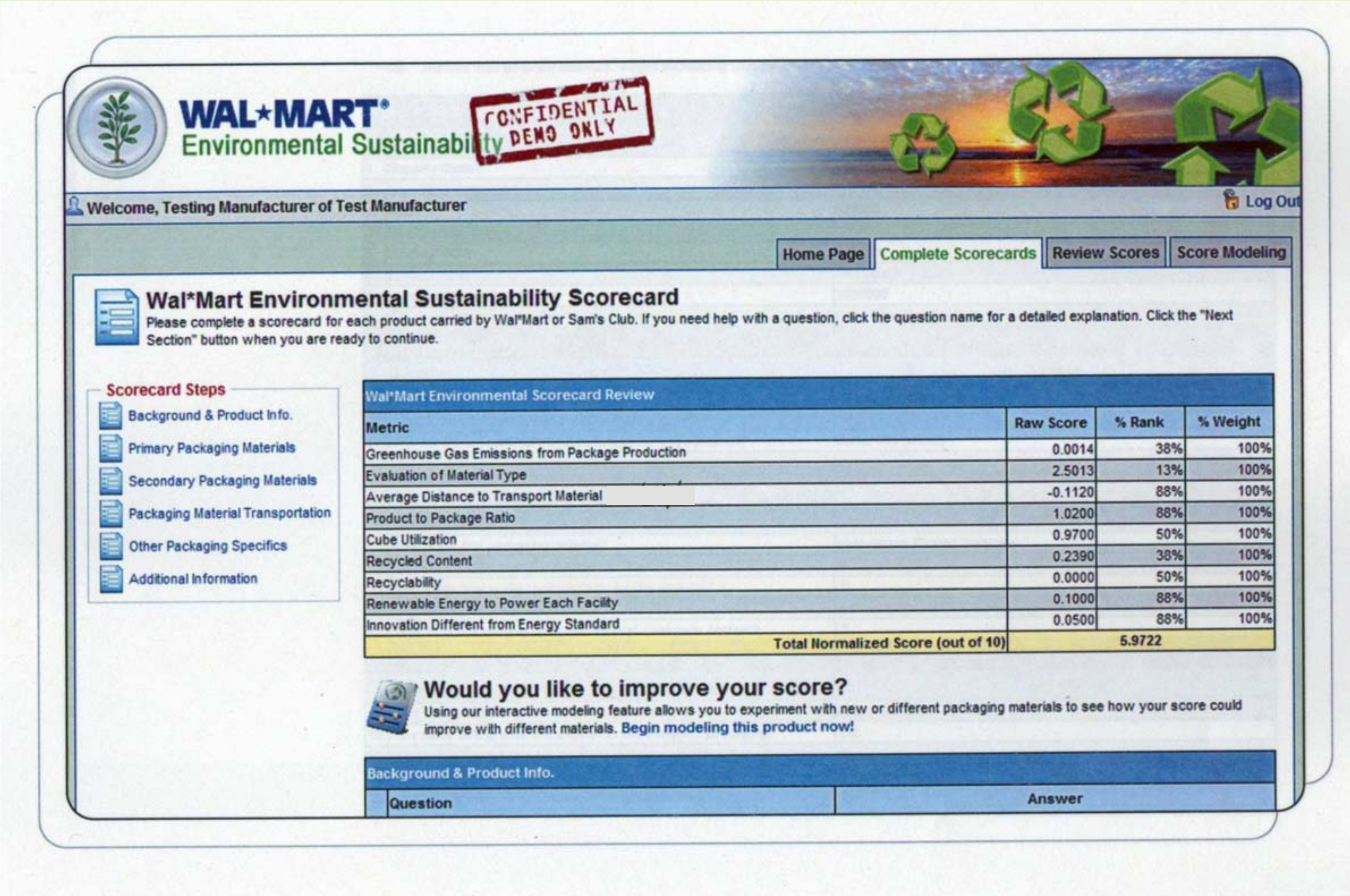
Success Metrics:

Number of SKU's uploaded

Reduction of packaging (weight)

Reduction of GHG's

Near Term Challenges - Weight



WAL*MART®
Environmental Sustainability
CONFIDENTIAL DEMO ONLY

Welcome, Testing Manufacturer of Test Manufacturer

Log Out

Home Page | Complete Scorecards | Review Scores | Score Modeling

Wal*Mart Environmental Sustainability Scorecard

Please complete a scorecard for each product carried by Wal*Mart or Sam's Club. If you need help with a question, click the question name for a detailed explanation. Click the "Next Section" button when you are ready to continue.

Scorecard Steps
- Background & Product Info.
- Primary Packaging Materials
- Secondary Packaging Materials
- Packaging Material Transportation
- Other Packaging Specifics
- Additional Information

Wal*Mart Environmental Scorecard Review

Metric	Raw Score	% Rank	% Weight
Greenhouse Gas Emissions from Package Production	0.0014	38%	100%
Evaluation of Material Type	2.5013	13%	100%
Average Distance to Transport Material	-0.1120	88%	100%
Product to Package Ratio	1.0200	88%	100%
Cube Utilization	0.9700	50%	100%
Recycled Content	0.2390	38%	100%
Recyclability	0.0000	50%	100%
Renewable Energy to Power Each Facility	0.1000	88%	100%
Innovation Different from Energy Standard	0.0500	88%	100%
Total Normalized Score (out of 10)	5.9722		

Would you like to improve your score?

Using our interactive modeling feature allows you to experiment with new or different packaging materials to see how your score could improve with different materials. Begin modeling this product now!

Background & Product Info.

Question	Answer

Near Term Challenges - Data

Corrugated: Bleached	Corrugated
Corrugated: Mini Flute	Corrugated
Corrugated: Moisture Resistant - Wax Alt.	Corrugated
Corrugated: Waxed	Corrugated
Corrugated: Pre-Printed	Corrugated
Corrugated: Semi-bleached	Corrugated

Molded Pulp Packaging	Mixed Paper
Paperboard: Coated Recycled	Coated recycled
Paperboard: (CUK)	Corrugated
Paperboard: (SBS)	Office paper
Paperboard: Uncoated Bleached Kraft	Office paper
Paperboard: Uncoated Recycled (URB)	Coated Recycled
Paperboard: Uncoated Unbleached Kraft	Corrugated
Recycled Folding Boxboard	Coated Recycled

What does it mean to the Paperboard Industry

Paperboard – What the Future Holds

Contact Information

Recycled Paperboard Alliance

Paul Schutes, Executive Director

1156 15th Street, N.W.

Suite 1020

Washington, DC 20005-1754

770-753-8173

Carbon Footprint Tools

REID MINER, NCASI

WITH CONTRIBUTIONS FROM
CAROLINE GAUDREAULT, JAY UNWIN, KIRSTEN VICE, BARRY MALMBERG, BRAD UPTON – ALL WITH NCASI

PRESENTED TO THE

2010 TAPPI SUSTAINABILITY FORUM

ATLANTA, GEORGIA

What is a carbon footprint?

- No single official definition
- Generally, a picture of the overall greenhouse gas impact (not just CO2) of a product over its lifecycle (cradle-to-grave)
  - Cradle-to-*gate (i.e. cradle-to-shipping dock)* footprints are also quite common. Especially suited to business-to-business communications
- You can do footprints at different levels
  - Carbon footprint of a product, often defined via a functional unit
  - Carbon footprint of a mill
  - Carbon footprint of a company
  - Carbon footprint of a sector

Carbon footprint vs. "normal" GHG inventory

- The difference is in the Scope of reporting
- Often regulatory reporting is limited to "Scope 1" emissions (the emissions sources are under the ownership or control of reporting entity)
- A footprint covers much more
  - Scope 2 emissions associated with purchased electricity, steam and heat
  - Scope 3 emissions – All other upstream and downstream emissions that your activities "cause"
  - For forest products – carbon sequestration and storage
- Footprint boundary conditions are critical

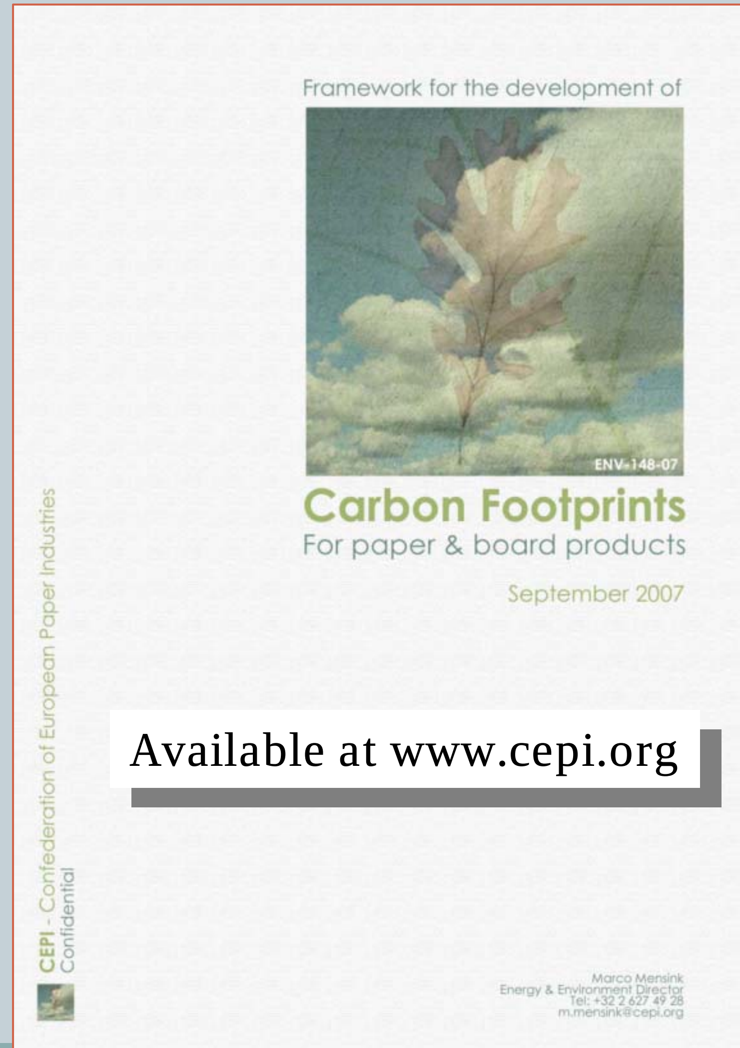
Carbon footprint activities of note

- Confederation of European Paper Industries (CEPI) Framework for paper products
- British Standards Institute “specification”
- World Resources Institute “supply chain standard”
- International Organization for Standardization (ISO)
- International Finance Corporation
- Others

CEPI Carbon Footprint Framework

The Ten Footprint Elements

1. Carbon sequestration in forests
2. Carbon stored in forest products
3. Greenhouse gas emissions from forest product manufacturing facilities
4. Greenhouse gas emissions associated with producing wood
5. Greenhouse gas emissions associated with producing other raw materials/fuels
6. Greenhouse gas emissions associated with purchased electricity, steam and heat and hot and cold water
7. Transport-related greenhouse gas emissions
8. Emissions associated with product use
9. Emissions related to product end-of-life
10. Avoided emissions and offsets



Available at www.cepi.org

British Standards Institute PAS 2050

- Designed for product-level carbon footprints
- Essentially a lifecycle study (cradle-to-grave) on GHGs and carbon
- Allows cradle-to-*gate* footprints for business-to-business communications
- Carbon sequestration
  - Forest ecosystem carbon not included
  - Allows product carbon storage to be considered for some products (100 year average, including landfills)
- Does not allow purchased offsets, etc.
- Must include at least 95% of all emissions including upstream emissions associated with producing purchased electricity, chemicals and fuels.

World Resources Institute

- New project to develop a “Product and Supply Chain GHG Accounting & Reporting Standard”
- Separate standards for product-level footprints and supply change (Scope 3) footprints
- June 2008 to Late 2010
- Will likely look a lot like an LCA standard

ISO Carbon footprint standard

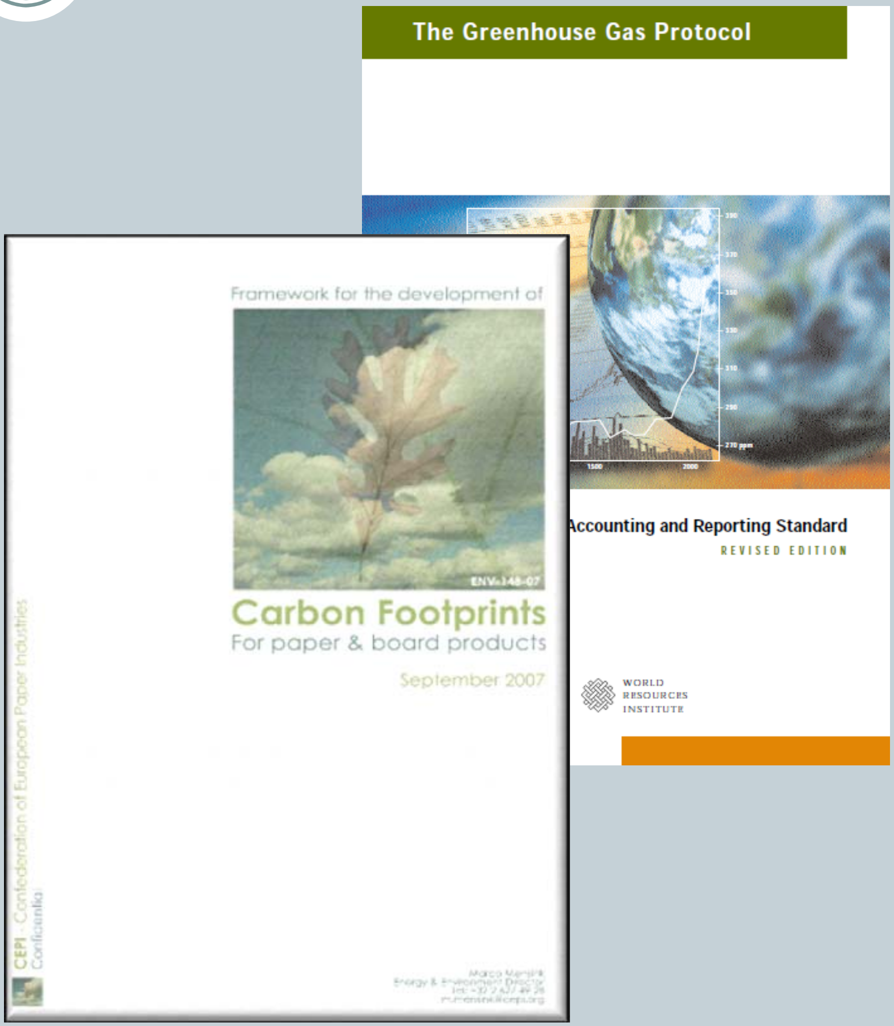
- ISO has launched a carbon footprint standard
  - Focused on product-level footprints
  - Two parts: Quantification and Communication
- Likely to look a lot like ISO life cycle assessment standards
- Target completion date 2011

International Finance Corp. (IFC)

- IFC is part of the World Bank Group
- IFC needed a tool to assist it in screening its forest sector-related projects for GHG and carbon issues
- The result: the “Forest Industry Carbon Assessment Tool” (FICAT)
- FICAT is available without charge
- In many cases, it will be suitable for developing mill and company footprints
- Less suited to product-level footprints

FICAT structure

- Organized according to the Carbon Footprint Framework developed by the Confederation of European Paper Industries (CEPI)
- Output also shown according to WRI/WBCSD GHG Protocol Scopes

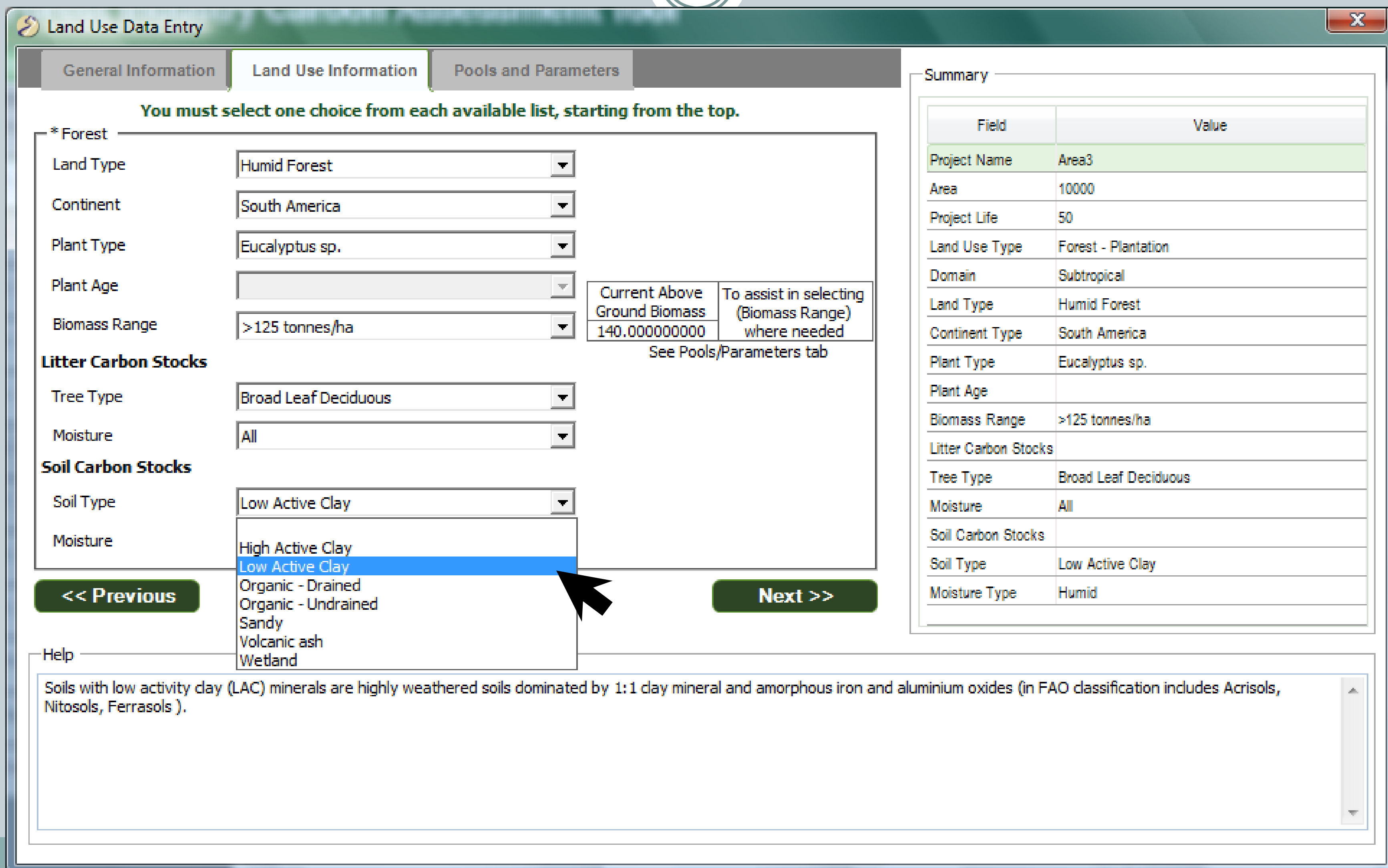


FICAT Basics

- Calculations based on IPCC and WRI/WBCSD GHG Protocol calculation tools and other public sources
- If use only defaults, estimates are highly uncertain
  - *User encouraged to override defaults*
- Available at http://www.FICATmodel.org

FICAT is menu driven

www.FICATmodel.org



FICAT results shown by Footprint Element

www.FICATmodel.org

Forest Industry Carbon Assessment Tool

reid test 5

File

- Welcome
- 1. Land Based Carbon
- 2. Carbon in Products
- 3. Manufacturing
- 4. Wood Production
- 5. Other Raw Material/Fuels
- 6. Electricity, Steam and Heat
- 7. Transportation
- 8. Product Use
- 9. End-of-Life
- 10. Avoided
- Summary
- Uncertainty

Summary

Forest Carbon Results

1. Land Based Carbon	Net transfers of CO2 to the atmosphere: tonnes CO2 eq./yr **-91667**
2. Carbon in Products	Net transfers of CO2 to the atmosphere from carbon stored in products: tonnes CO2 eq./yr **-135123**
	Net overall transfers of forest carbon to the atmosphere: tonnes CO2 eq./yr
Forest Carbon Flux Totals	**-226790**

Emissions Results

	Direct	Indirect	Total
3. Emissions - Manufacturing	499228	50000	549228
4. Emissions - Fiber Production	6150	8850	15000
5. Emissions - Other Raw Materials/Fuels (only indirect)		93170	93170
6. Emissions - Purchased Electricity, Steam and Heat (only indirect)		27822	27822
7. Emissions - Transportation	5400	70905	76305
8. Emissions - Product Use	0	760	760
9. Emissions - End-of-Life	102450	681016	783466
Total Emissions	**613228**	**932523**	**1545751**

Scope 1 = 613228 Scope 2 = 25295 Scope 3 = 907228

Avoided Emissions Results

	Direct	Indirect	Total
10. Avoided Emissions (Tonnes CO2 eq.)	0	1361490	1361490

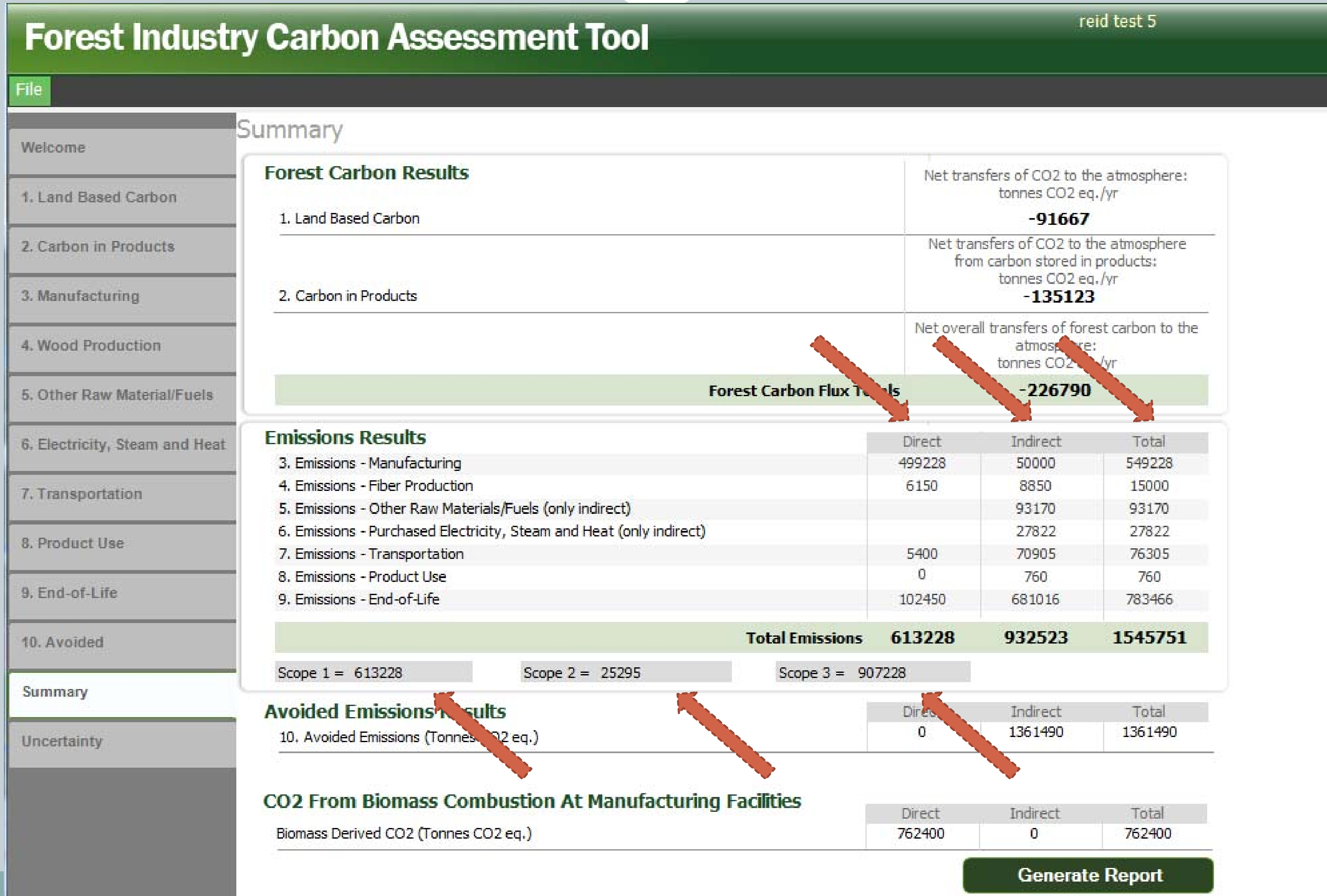
CO2 From Biomass Combustion At Manufacturing Facilities

	Direct	Indirect	Total
Biomass Derived CO2 (Tonnes CO2 eq.)	762400	0	762400

Generate Report

FICAT results shown by Reporting Scope

www.FICATmodel.org



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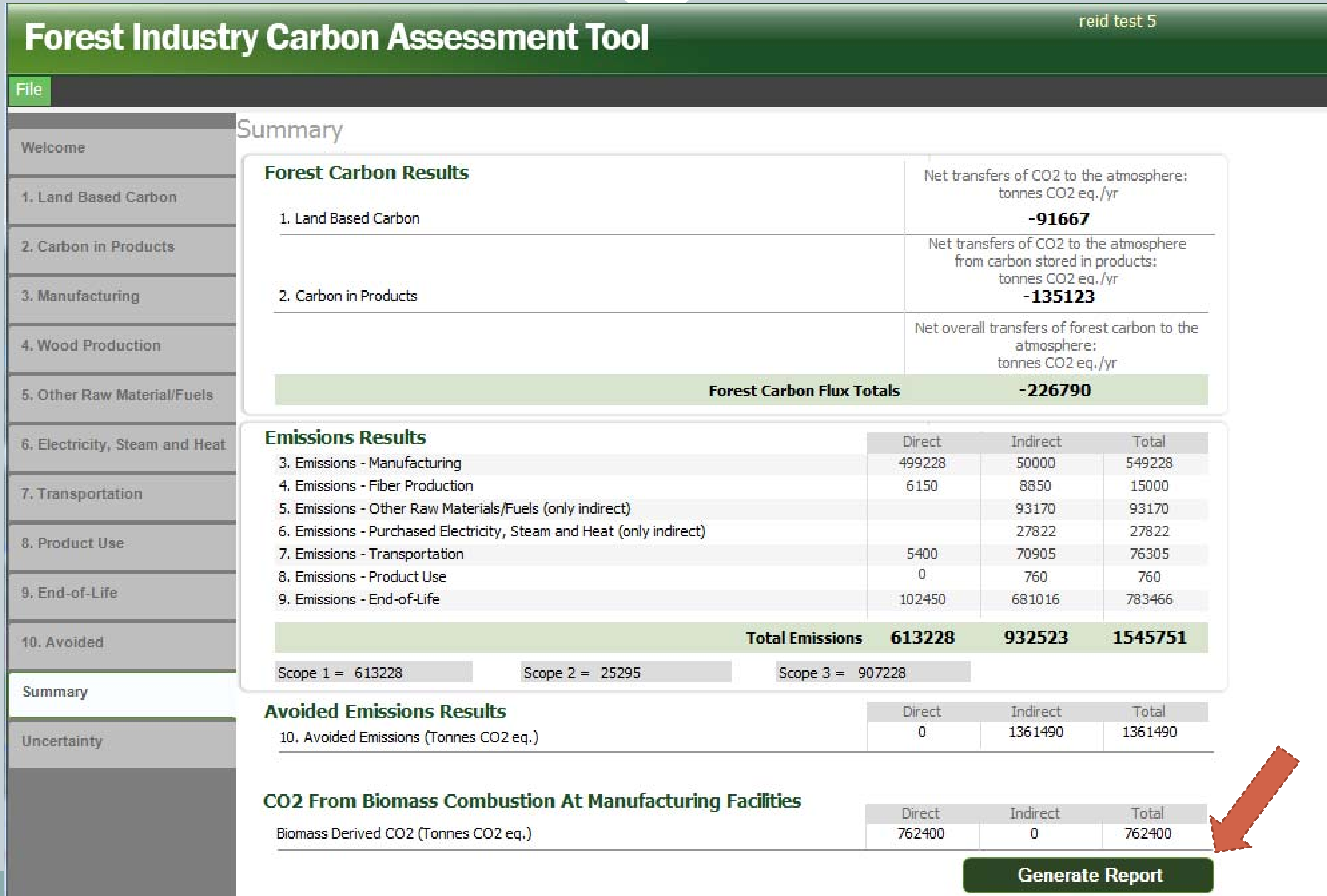
CO2 From Biomass Combustion At Manufacturing Facilities

	Direct	Indirect	Total
Biomass Derived CO2 (Tonnes CO2 eq.)	762400	0	762400

The complete assessment is captured in a pdf report

www.FICATmodel.org



A few words about avoided emissions

- These only exist against a hypothetical alternative
- Their calculation and use can be controversial
- But they can be *very* important in some cases
  - Avoided landfilling associated with using recovered fiber
  - Avoided fossil fuel use associated with burning non-recyclable products at end-of-life
  - Avoided fossil fuel-related emissions from power plants associated with exporting “green” power to the grid
  - Avoided emissions in steel and concrete manufacturing associated with using wood-based building materials in place of concrete or steel
  - Many other possible examples
- What is allowed is very program-specific

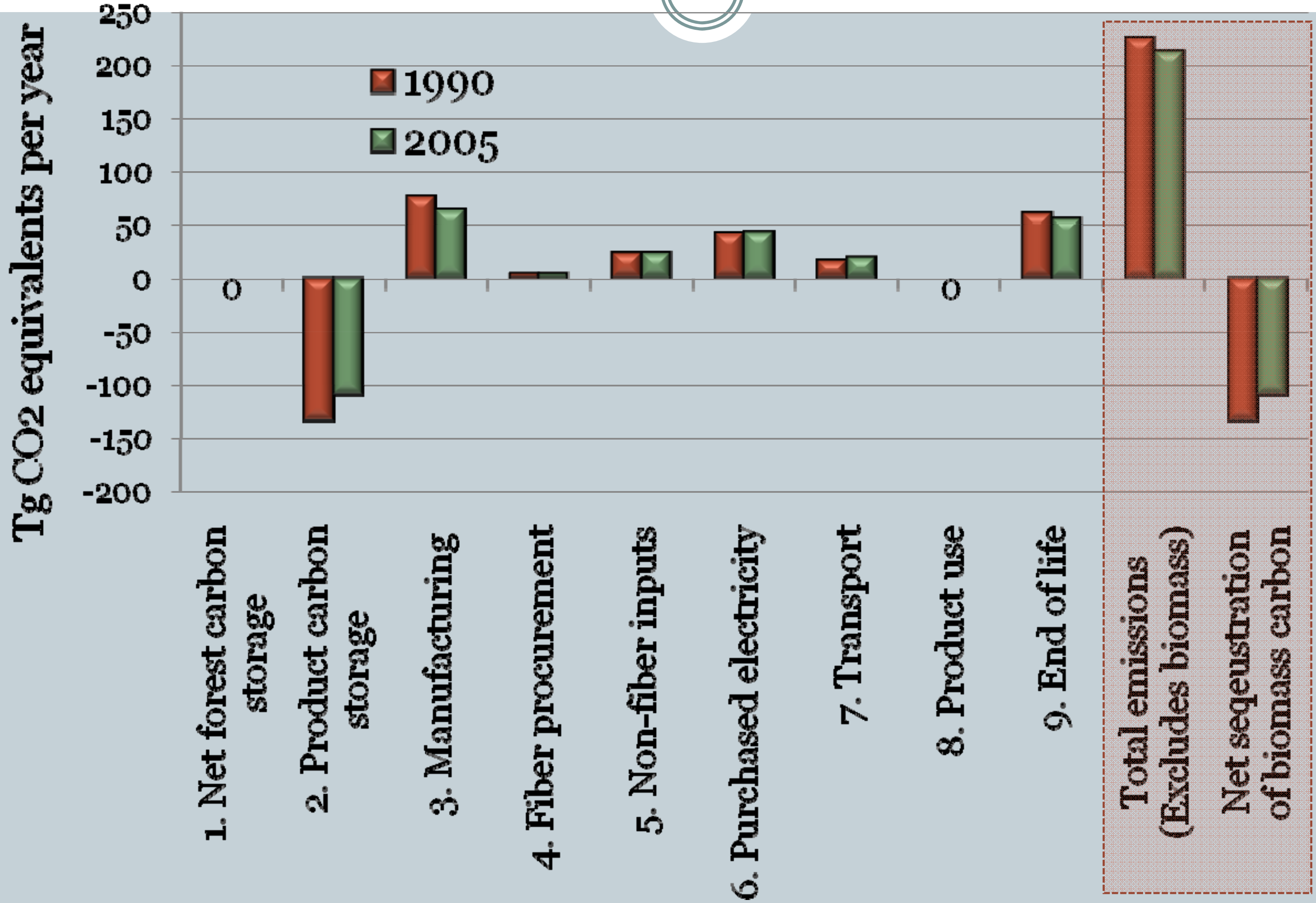
Other carbon footprint activities

- Carbon footprints using LCA software
  - This is commonly done and completely valid
- Many footprint tools being marketed
  - Costs vary
  - Some are focused on specific issues/sectors
  - Some are extensions of existing enterprise or environmental management system software.
- Until footprint standards are available, buyer beware.
  - Unless your interest is cradle-to-gate, look for tools that are clearly life cycle based
  - Consider the need to address elements of the footprint that may be sector-specific (e.g. forest carbon and carbon sequestration)

What factors are usually most important to the carbon footprints of forest products?

- Manufacturing emissions from fossil fuel combustion
- Emissions associated with generating purchased electricity
- Activities that impact long-term average carbon stocks in the forest ecosystem
  - E.g. new plantations, forest conversion, deforestation
- Product time-in-use (affects carbon storage)
- The fate of products in landfills
  - Carbon storage and methane release are both important
  - Impacted by product characteristics and waste management practices
- Whether/how avoided emissions are included
- Boundary conditions and allocation rules used in the assessment can have large impacts on results
- Many of these factors are outside of the company's control

Sector Footprints: e.g. of the U.S. Forest Products Industry



From data in “Greenhouse gas and carbon profile of the U.S. forest product industry value chain” published in the journal *Environmental Science and Technology*, 2010

Difficult footprint issues: Recycling

- Recycling
  - LCA has also struggled with this issue for years
  - Basic issue: If recovered material is used that originates in a different product system, should the recovered material carry some of the burdens from the original system that were generated by processes responsible for making the material usable as a raw material?
    - Example: Should OCC used in boxboard production carry some of the environmental burdens associated with converting the tree into pulp?
    - In LCA, wastes are treated differently than recovered materials that have value as raw materials
    - Many different approaches used. Can impact results

Difficult footprint issues: Forest Carbon

- Impacts on carbon in forests and forest products
  - Normal LCA practice has been to assume that the carbon in the wood was simply recycled to the atmosphere having no net impact on the atmosphere
  - But we know that when forested land is converted to other uses (deforestation), there is a net transfer of carbon to the atmosphere.
    - Not normally an issue in the developed countries, but...
    - When/how should this be accounted for in a carbon footprint?
  - Also questions about how/whether to give credit for carbon stored for long periods of time but not "permanently" out of the atmosphere.
    - Example: The carbon in lumber used in long-lived structures

Forest carbon: The importance of scale

- Investments are not made based on a single-year's wood supply
  - So, forest carbon assessments should not be made based on individual plots
  - These assessments must extend, at a minimum, to the complete supply area
- Although carbon is lost from the plots harvested this year, at the same time, the plots supplying future year's wood are adding carbon (removing it from the atmosphere).
  - Where the objective across the supply area is to maintain a constant output of wood, the amount of carbon lost during the harvest each year is equal to the total amount of carbon added to plots that will supply wood in the future
  - In other words, the net impact on the atmosphere of this sustainable forest management activity is zero
- A simple concept but one that is frequently overlooked

Difficult footprint issues: Type of analysis

- Should the footprint calculations be "attributional" or "consequential"
  - Attributional: Consider only the impacts within the system being studied to develop as accurate a picture as possible of the system as it is. Essentially a snapshot of the *attributes* of the system as it currently exists.
  - Consequential: Also consider the impacts that occur outside of the system and that occur relative to other scenarios. Often used to examine the *consequences* of activities or policies.
- There are uncertainties associated with both, but consequential analysis requires many more assumptions.

Carbon Footprints – What to Expect

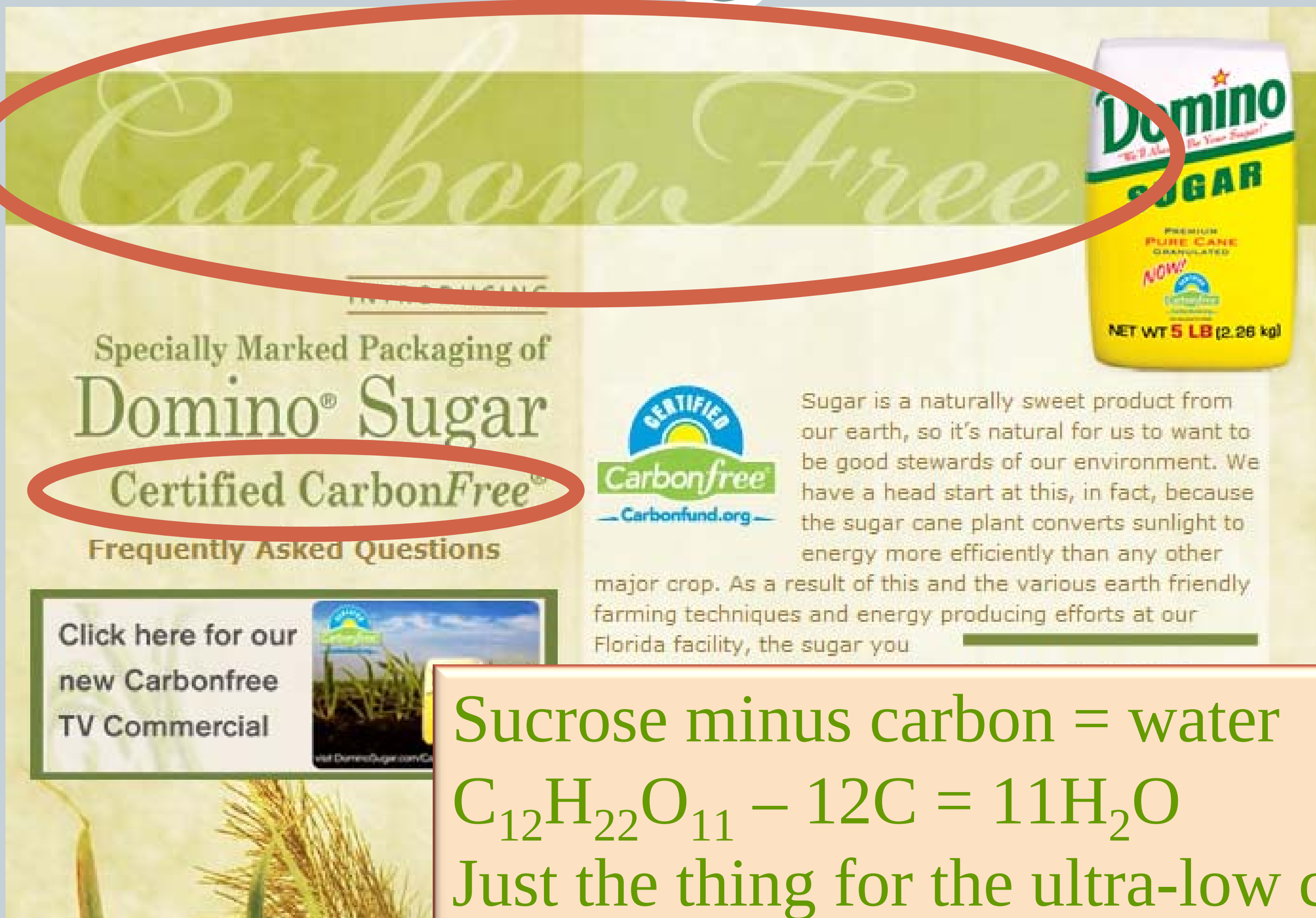
- Footprints will have many of the same attributes as life cycle assessment (LCA) studies
  - Important to remember that carbon is only one of many important environmental and resource endpoints
  - Even LCA, which includes a much broader array of endpoints than carbon footprinting, is limited in its ability to characterize the actual environmental attributes of products
- Carbon footprints will be most useful for identifying opportunities and tracking improvements
- But footprints are likely to be compared
  - Need for scrutiny regarding comparable assumptions, etc.
  - Transparency will be critical

Carbon footprints are NOT like nutrition labels

- Nutrition labels
  - They show results of actual testing of representative samples
  - Labels on two products are easily compared
- Carbon footprints
  - The results are the outputs of models
    - Boundary conditions can vary (e.g. do you consider the off-site benefits of exports of “green” power?)
    - Modeling approaches can vary (e.g. how do you model recycling?)
    - Assumptions can vary (e.g. do you assume that end-of-life management practices are static?)
    - Data sources can vary (e.g. are you using primary data from chemical suppliers or using commercial databases for these data?)
    - All of these can have very large impacts on the results of a comparison
    - Upcoming standards are likely to allow flexibility in many of these
  - Consequently, carbon footprints are not easily compared, especially if the modeling was done in different studies

In spite of the known limitations, expect some pretty silly claims about carbon footprints

Carbon-free sugar?
You can't make this stuff up



Sucrose minus carbon = water

$C_{12}H_{22}O_{11} – 12C = 11H_2O$

Just the thing for the ultra-low carb diet

Question?
Comments?

THANK YOU

COMPASS®
COMPARATIVE PACKAGING ASSESSMENT

Minal T. Mistry
Sustainable Packaging Coalition

Sustainability Forum @PaperCon 2010

GreenBlue®

A non-profit organization focused on engaging industry to advance sustainability initiatives.

- Sustainable Packaging Coalition® (SPC)
- CleanGredients® – "green" ingredients
- MetaFore – environmentally preferable wood and paper products
- Closing the Loop
- Advisory Services

www.greenblue.org | www.sustainanblepackaging.org | www.cleangredients.org | www.metafore.org

COMPASS®

COMPARATIVE PACKAGING ASSESSMENT

Redefining Industrial Design

- technical performance
- cost
- appearance
- regulatory compliance

CONVENTIONAL

- optimizing resources
- responsible sourcing
- material health
- resource recovery

EXPANDED

Basic Life Cycle Thought

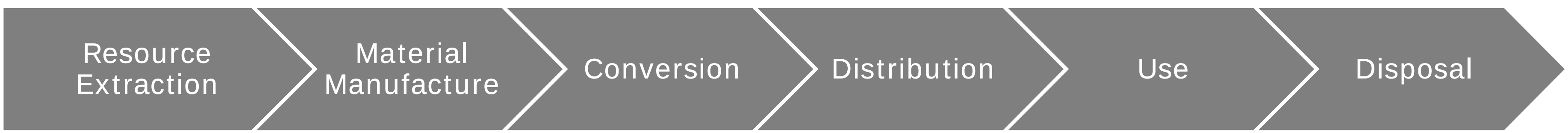
CRADLE-to-GATE

Includes data for inputs and emissions from raw material acquisition (the cradle) through final manufacturing (the factory gate). This is a partial environmental profile of a material.

Expanded Life Cycle View

CRADLE-to-GRAVE

Includes data for inputs and emissions from raw material extraction (the cradle) to use phase and disposal phase (the grave). This provides the basis of life cycle assessment.



Systems Thinking

CLOSED LOOP SYSTEM

Refers to a product's environmental footprint from raw material acquisition (the cradle) through disposal treatment and eventual recycling of the material (the cradle).

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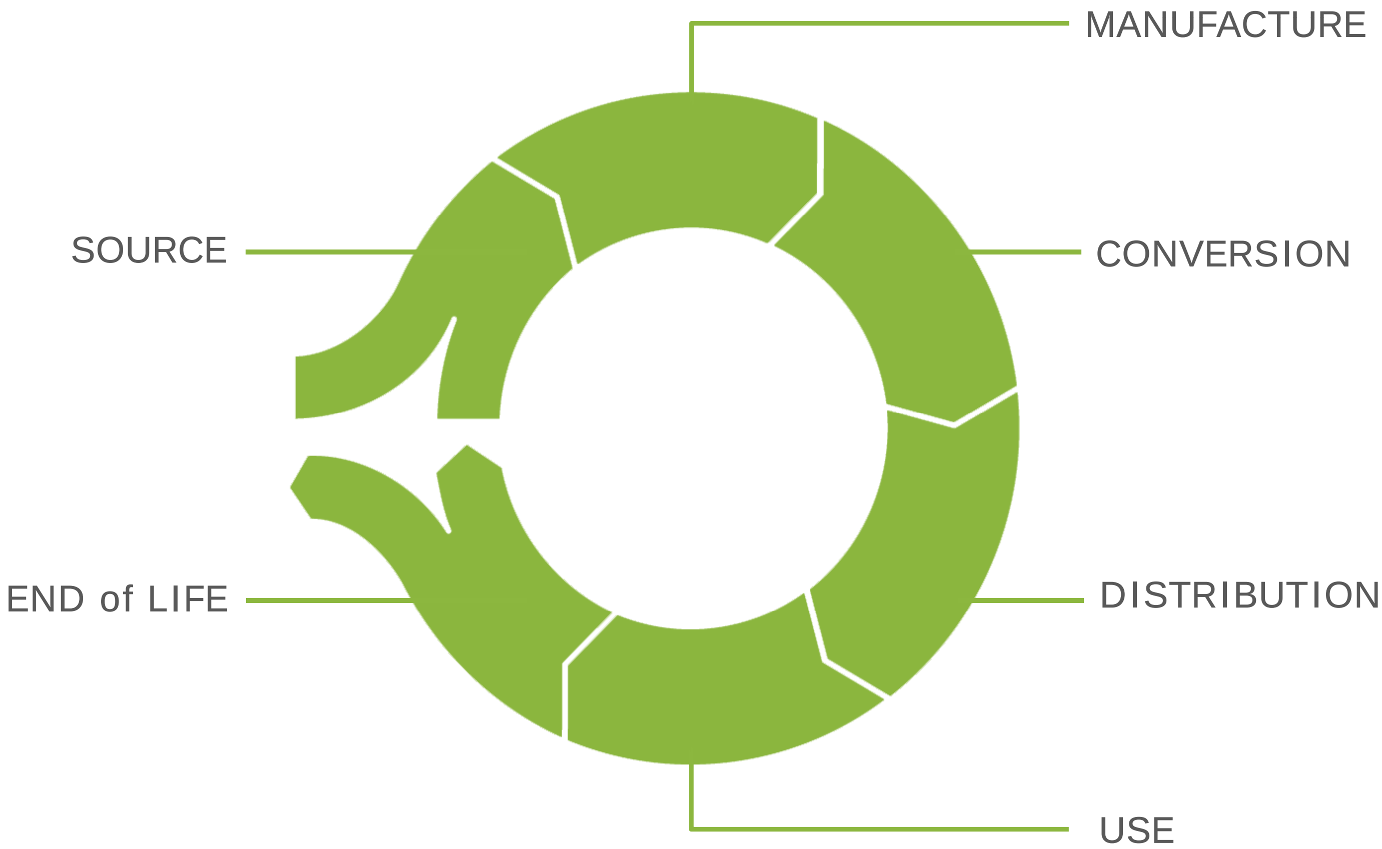
Life Cycle of Packaging



Influence of Design (downstream →)

BRANDS
- image
- perception

DISTRIBUTION
- transport efficiency,
- rate of product loss

RETAIL
- on shelf differentiation
- shelf life

CONSUMER
- product appeal,
- safety,
- satisfaction,

WASTE DISCARD
- Effective recovery,
- Reduce disposal

Influence of Design (🡐 upstream)

BRANDS
- image
- perception

DISTRIBUTION
- transport efficiency,
- reduced product loss

RETAIL
- on shelf differentiation
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CONSUMER
- product appeal,
- safety,
- satisfaction,

WASTE DISCARD
- Effective recovery,
- Reduce disposal

SUSTAINABLE PACKAGING COALITION®

a project of GreenBlue

COMPASS®

COMPARATIVE PACKAGING ASSESSMENT

a design-phase web application that provides comparative environmental profiles of packaging alternatives based on life cycle assessment metrics and attributes

Design Phase Guidance

Post Market Eco-Footprint or Score

concept → graphics → prototype → market → eco footprint

Design Phase Guidance

Benchmark Packaging Portfolio

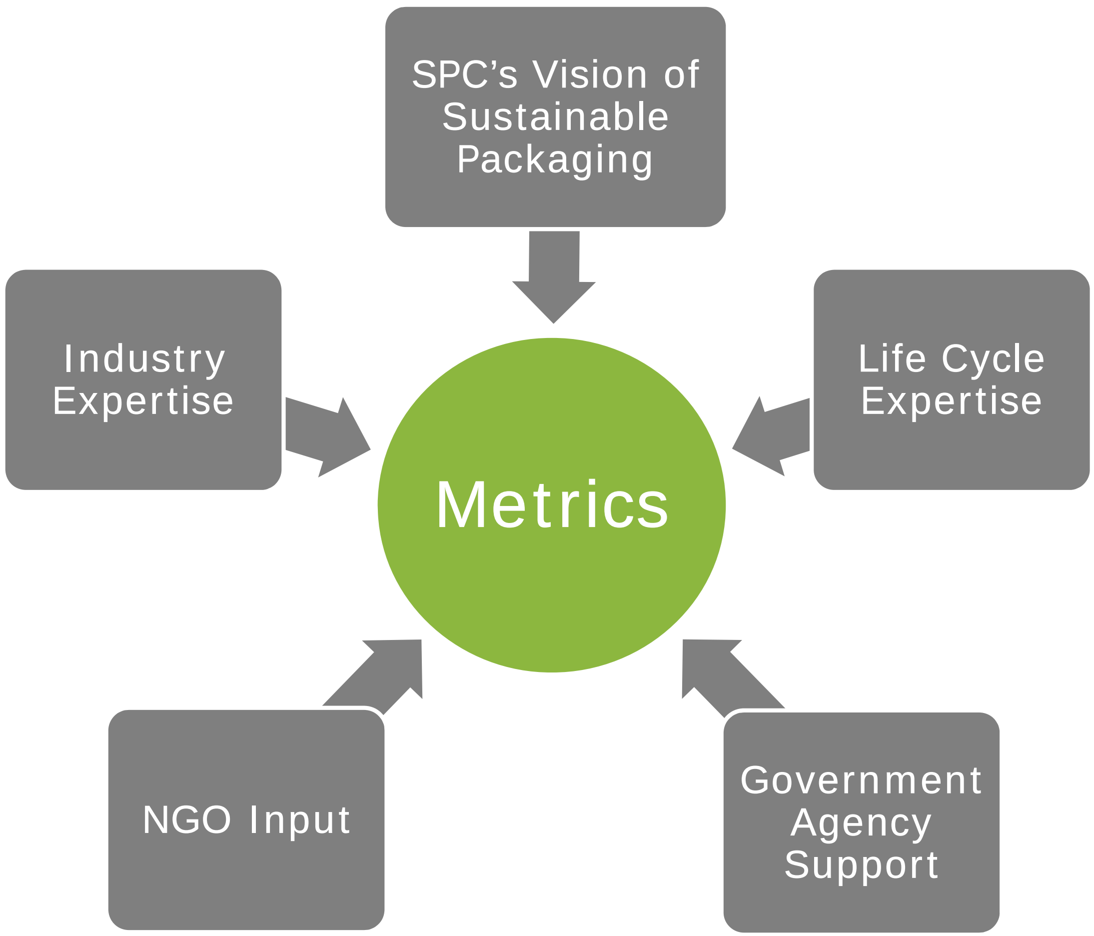
concept → graphics → prototype → market → COMPASS

Design Phase Guidance

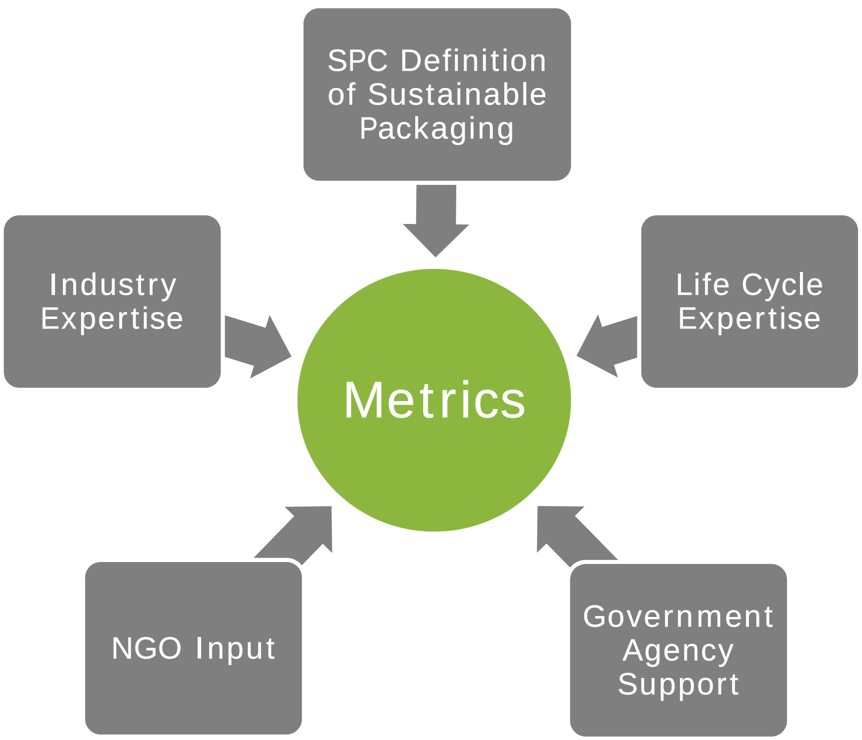
Inform New Design

COMPASS → CAD → graphics → prototype → market

Consensus Based Development



Metrics Relevant to Packaging



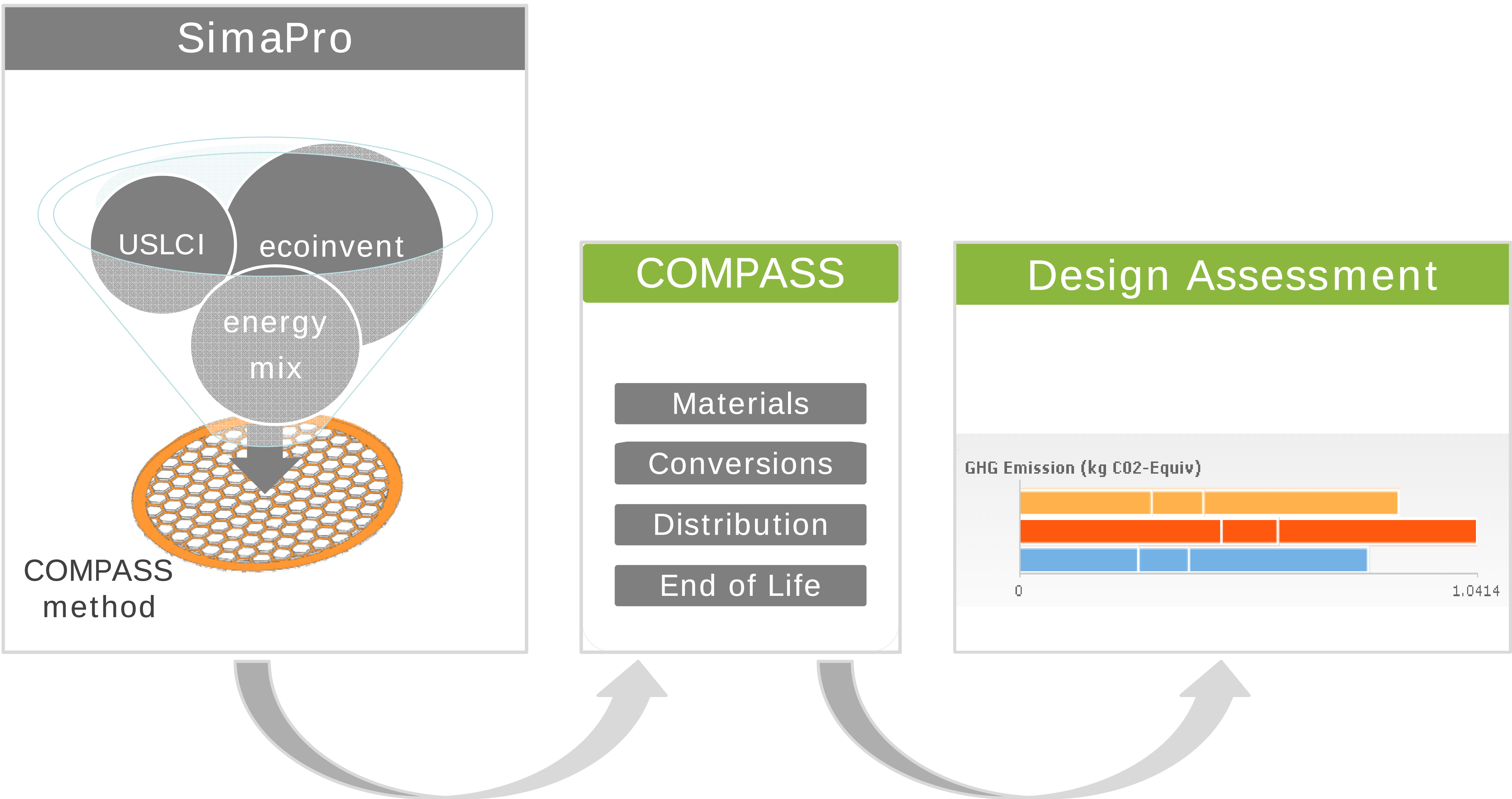
CONSUMPTION METRICS
- FOSSIL FUEL
- WATER
- BIOTIC RESOURCES
- MINERAL RESOURCES

EMISSION METRICS
- GREENHOUSE GASES
- HUMAN HEALTH
- AQUATIC TOXICITY
- EUTROPHICATION

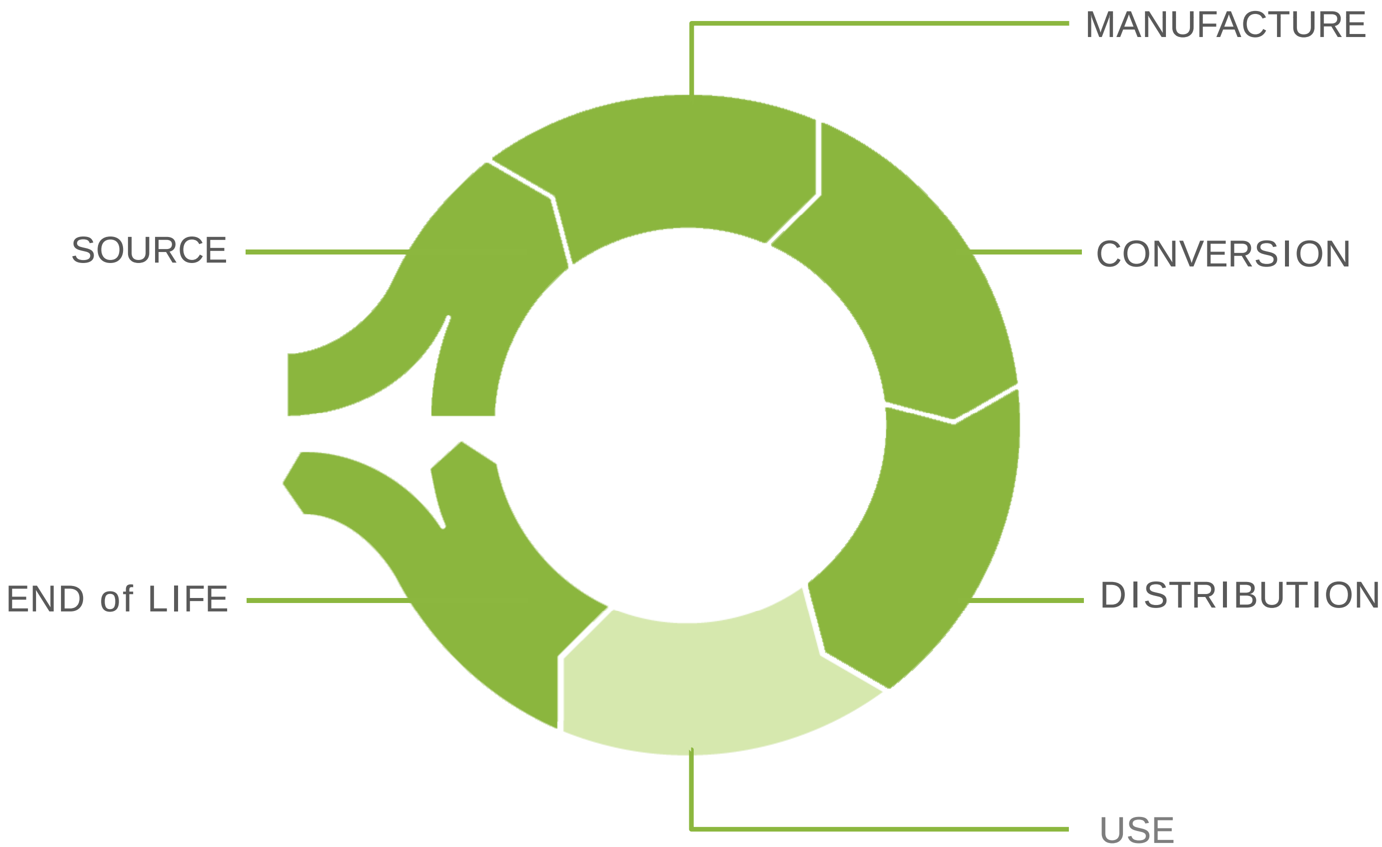
PACKAGING ATTRIBUTES
- CONTENT
- SOURCE
- SOLID WASTE

MATERIAL HEALTH

Life Cycle Data Processing



Life Cycle Model in COMPASS



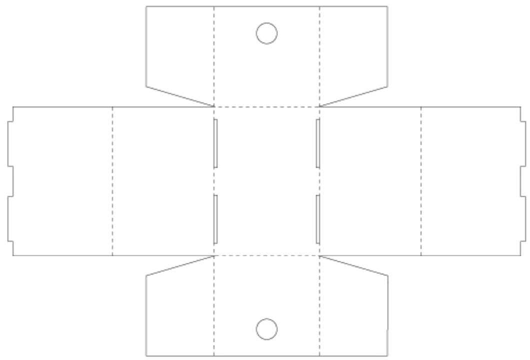
Distribution modeling is anticipated to be available in mid-2010.

Build Scenarios Using Components

SUSTAINABLE PACKAGING
COALITION®

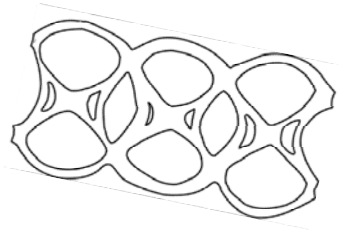
a project of GreenBlue®

Multi-Pack Scenario



COMPONENT A **x 6**
- Bottle
- Label
- Cap

COMPONENT B **x 1**
- Carry case



COMPONENT A **x 6**
- Can

COMPONENT B **x 1**
- six-pack rings

Refill Scenario

APPLICATIONS: liquid soap, cosmetics, wipes and cleansers, etc.

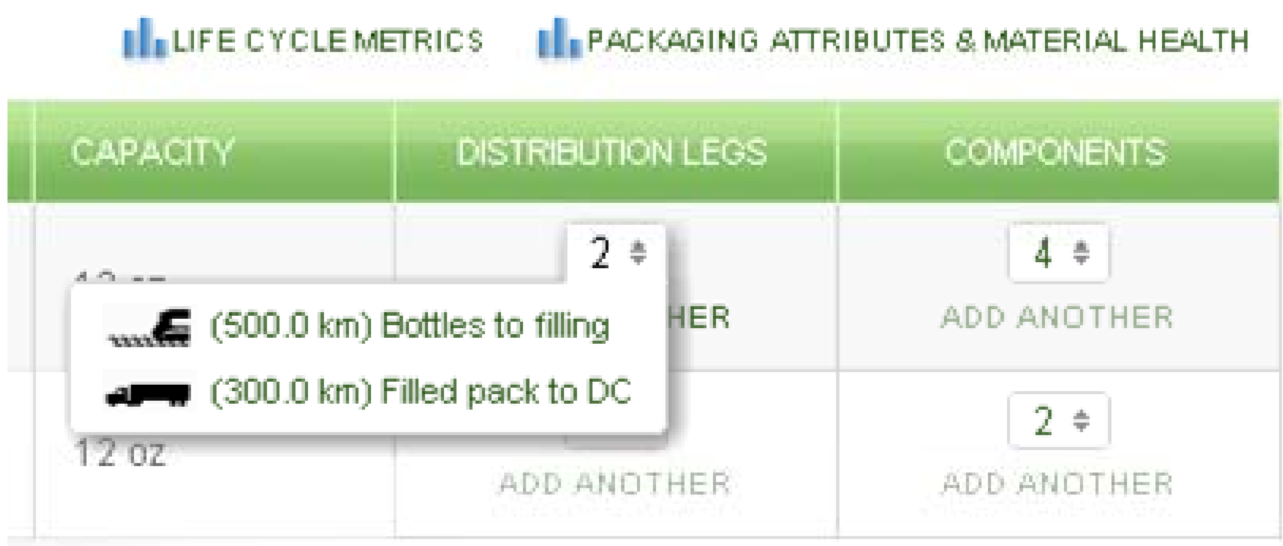
Waste Reduction Model
The entire package is reused and is refilled from another package (forms and capacity can vary).

Extended Life Model
A critical component(s) is reused while the reset of the components are discarded and replaced with a refill package.

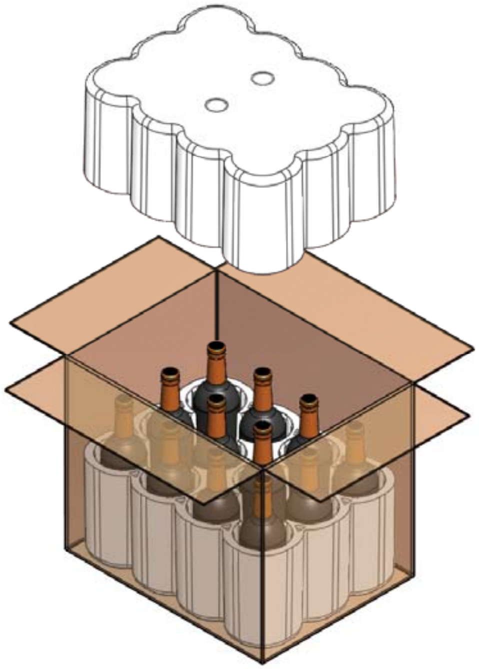
Refill scenarios requiring washing or industrial cleaning are excluded.

Track Transport for Distribution

MODE	VEHICLE	DISTANCE: km and m
Road Rail Sea Air	- relevant trucks to the region - freight train - barge and transoceanic freight ship - cargo plane	**FUEL:** diesel, gasoline, kerosene , other as available **DATA:** USLCI and ecoinvent



Packaging System



PRIMARY PACKAGE

SECONDARY PACKAGE

PACKAGING SYSTEM

Add distribution related transport for components, packages and shipping the system out to the DC

PROJECT OVERVIEW:

SOUP SAMPLES

DELETE PROJECT

NAME

SOUP SAMPLES

DESCRIPTION

COMPARES 3 READY-TO-EAT SOUPS

UPDATE

NOTES

MICROWAVABLE SOUP
LAMINATED ASEPTIC PACK
STEEL CAN

BASE UNIT serving size

PRIMARY PACKAGES + NEW

LIFE CYCLE METRICS | PACKAGING ATTRIBUTES & MATERIAL HEALTH

NAME	DESCRIPTION	CAPACITY	DISTRIBUTION LEGS	COMPONENTS
LAMINATED ASEPTIC PACK EDIT | COPY | DELETE Data : US	Carton (c): 75g SBS board, 20g PE, 5g Al foil Cap and Pour Spout: 4g PP Foil Seal: 0.5g Al	4 serving size	(None Yet) ADD FIRST	3 ADD ANOTHER
MICROWAVABLE SOUP EDIT | COPY | DELETE Data : US	SINGLE SERVING Cup (printed on label): 25g PET, 4g fused-on Al pull tab Lid:: 8g PS	1 serving size	(None Yet) ADD FIRST	2 ADD ANOTHER
STEEL CAN EDIT | COPY | DELETE Data : CA	CAN, PULL TOP, LABEL	2 serving	2 (450.0 km) Can Blanks to Filling (200.0 km) Filling to DC …HER	3 ADD ANOTHER

SECONDARY PACKAGES + NEW

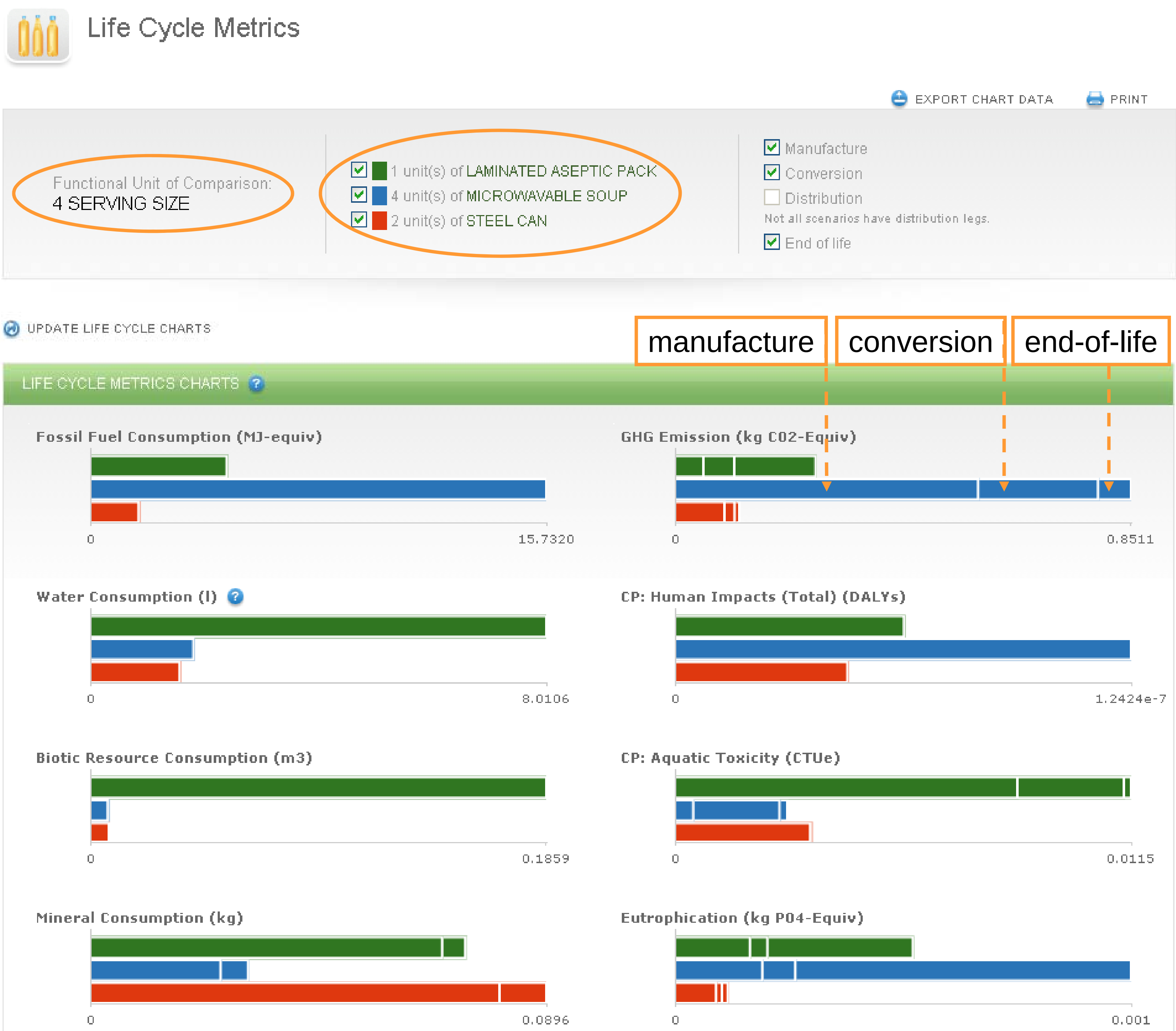
LIFE CYCLE METRICS | PACKAGING ATTRIBUTES & MATERIAL HEALTH

NAME	DESCRIPTION	DISTRIBUTION LEGS	COMPONENTS
CORRUGATED TRAY EDIT | COPY | DELETE Data : US	TRAY AND PP WRAP	(None Yet) ADD FIRST	2 ADD ANOTHER

PACKAGING SYSTEMS + NEW

LIFE CYCLE METRICS | PACKAGING ATTRIBUTES & MATERIAL HEALTH

NAME	PRIMARY PACKAGE	SECONDARY PACKAGE	CAPACITY
Microwavable Soup in Corrugated Tray EDIT | COPY | DELETE	MICROWAVABLE SOUP	CORRUGATED TRAY	12 x 1 serving size


Life Cycle Metrics
EXPORT CHART DATA
PRINT
Functional Unit of Comparison:
4 SERVING SIZE
1 unit(s) of LAMINATED ASEPTIC PACK
4 unit(s) of MICROWAVABLE SOUP
2 unit(s) of STEEL CAN
Manufacture
Conversion
Distribution
Not all scenarios have distribution legs.
End of life
UPDATE LIFE CYCLE CHARTS
manufacture
conversion
end-of-life
LIFE CYCLE METRICS CHARTS
Fossil Fuel Consumption (MJ-equiv)
0
15.7320
GHG Emission (kg C02-Equiv)
0
0.8511
Water Consumption (l)
0
8.0106
CP: Human Impacts (Total) (DALYs)
0
1.2424e-7
Biotic Resource Consumption (m3)
0
0.1859
CP: Aquatic Toxicity (CTUe)
0
0.0115
Mineral Consumption (kg)
0
0.0896
Eutrophication (kg P04-Equiv)
0
0.001

PRIMARY PACKAGE OVERVIEW:

STEEL CAN

EXPORT | DELETE PACKAGE

NAME

STEEL CAN

DESCRIPTION

CAN, PULL TOP, LABEL

CAPACITY 2 serving size

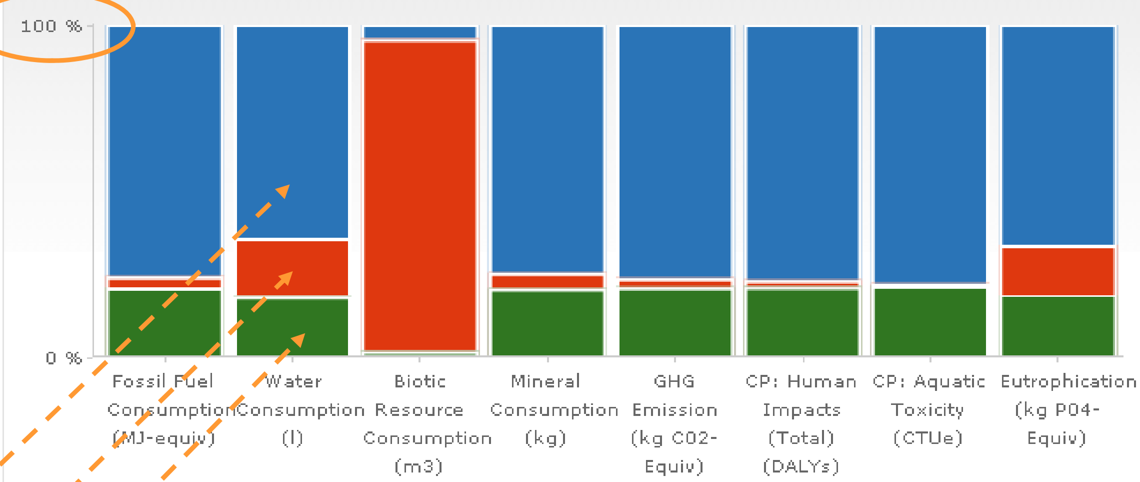
DATA SET US

ADD DISTRIBUTION LEG

LIST DISTRIBUTION LEGS

UPDATE

COMPONENT CONTRIBUTION



COMPONENT DETAILS

+ NEW

ADD EXISTING COMPONENT

NAME	MATERIAL AND CONVERSION	% PCR	% CERT.	DISTRIBUTION LEGS	COMPONENTS
CAN EDIT | COPY | DELETE Data : US	25.0 g of Steel converted using Steel Sheet Rolling	37.0	0.0	(None Yet) ADD FIRST	(None Yet) ADD FIRST
LABEL EDIT | COPY | DELETE Data : US	2.5 g of Liquid Packaging Board converted using Paper Cutting	0.0	0.0	(None Yet) ADD FIRST	(None Yet) ADD FIRST
Pull tab seal EDIT | COPY | DELETE Data : US	7.0 g of Steel converted using Steel Sheet Rolling	37.0	0.0	(None Yet) ADD FIRST	(None Yet) ADD FIRST

Packaging Attributes & Material Health

EXPORT CHART DATA PRINT

Functional Unit of Comparison:
4 SERVING SIZE

- 1 unit(s) of LAMINATED ASEPTIC PACK
- 4 unit(s) of MICROWAVABLE SOUP
- 2 unit(s) of STEEL CAN

UPDATE PACKAGING ATTRIBUTES CHARTS

MATERIAL HEALTH

Material Health	Weight	C	R	PBT
1.0 unit(s) of LAMINATED ASEPTIC PACK	104.50g	4	0	0
4.0 unit(s) of MICROWAVABLE SOUP	148.00g	5	1	0
2.0 unit(s) of STEEL CAN	69.00g	2	0	0
CAN	25.00g	0	0	0
LABEL	2.50g	2	0	0
Liquid Packaging Board	2.50g	2	0	0
Heavy fuel oil *Burned in industrial furnace; not present in final materia*	0.10g	1	0	0
Sulphuric acid	0.03g	1	0	0
Pull tab seal	7.00g	0	0	0

C: Carcinogen
R: Reproductive Toxicant
PBT: Persistent, Bioaccumulative, and Toxic

SUSTAINABLE PACKAGING COALITION®

a project of GreenBlue

Summary

- Design is a powerful leverage point to redefining established norms of industrial design to include environmental parameters
- As with financial parameters, environmental indicators can be incorporated at the concept and design stages
- “Green” and “Sustainable” can be elusive, yet they can be quantified

To this end, COMPASS can help …

- Evaluate alternatives during early design steps
- Benchmarking of current portfolio to set informed targets
- Design decisions that can optimize the life cycle profile of a package
- Holistic understanding of packaging impacts using multi-attribute assessment to implement a company’s overall sustainability goals

Online Packaging Assessment

FEATURES

- Compare up to 4 packaging scenarios simultaneously
- Assess impact categories based on common functional units
- View each component's impact in relation to the package
- Assess consumption and emission metrics
- Assess solid waste profile of design
- Include distribution impacts (coming soon).
- Easy to use web-based secure application

COMPASS®
COMPARATIVE PACKAGING ASSESSMENT

https://www.design-compass.org/

MINAL T. MISTRY
PROJECT MANAGER
minal.mistry@greenblue.org
www.sustainablepackaging.org
https://www.design-compass.org

Session 3

Sustainable
Inks, Coatings & Adhesives

Suresh Cherukuri, New Page, Session Chair

Minal Mistry, GreenBlue

Mike Hayden, Color Resolutions

John Moore, DaniMer Scientific

Paul Meizanis, Imerys

Mechanisms for Data Sharing

Sustainability Forum @PaperCon

4 May 2010

Minal T. Mistry

On behalf of Topher Buck
GreenBlue

a project of GreenBlue

GreenBlue®

A non-profit organization focused on engaging industry to advance sustainability initiatives.

- Sustainable Packaging Coalition® (SPC)
- CleanGredients® – “green” ingredients
- MetaFore – environmentally preferable wood and paper products
- Closing the Loop – a study of end of life scenarios for California
- Advisory Services

www.greenblue.org | www.sustainanblepackaging.org | www.cleangredients.org | www.metafore.org

CLEANGREDIENTS

CleanGredients is an online database of ingredient chemicals used in cleaning products.

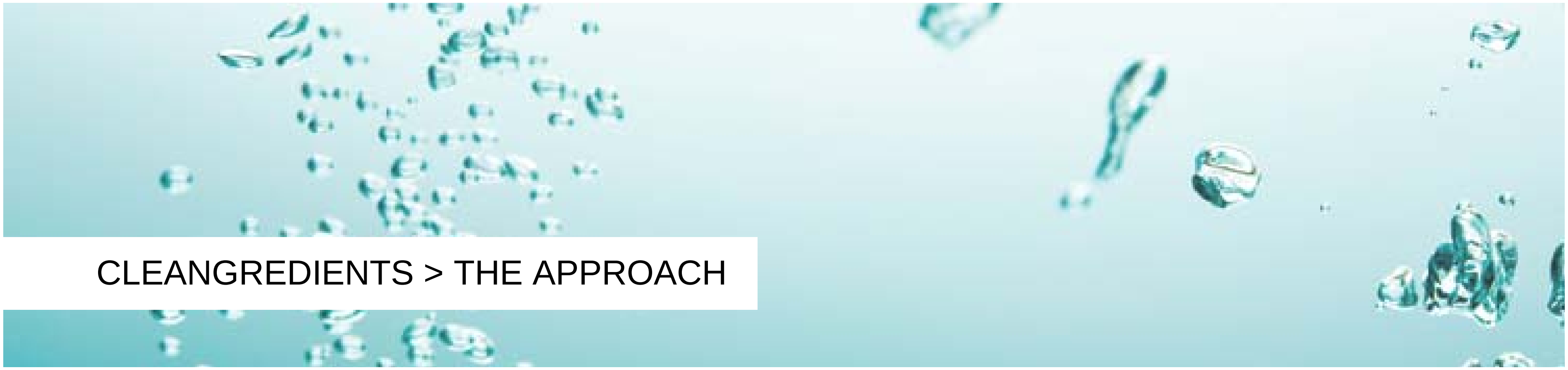
cleangredients®

a project of GreenBlue®

Encourage innovation in chemical product formulation and green chemistry.

Transparency promotes innovation.

"How can we share toxicological data without compromising proprietary business information?"



Share data at a resolution that is precise enough to indicate hazard or benefit, but not precise enough to reveal proprietary information.

CleanGredients – Browse

cleanGredients®

Welcome, Topher Buck
GreenBlue

search | list | ingredient modules | news | about | resources | account | Log out

home > search > item details

AIR PRODUCTS

+ Company Information
+ General
+ Physical-Chemical
+ Human Health
- Environmental
  - Acute Aquatic Toxicity
  - Additional Aquatic Toxicity
  - Biodegradation
  - Degradation Products of Concern
  - DfE Screen
  - Life Cycle Assessment
  - Origin of Feedstock
  - Other Product Features
+ Regulatory
+ Tier 1
+ Tier 2
+ Tier 3

Components

Environmental attributes for Tomadol 91-8

Edit

Acute Aquatic Toxicity

Reviewed Category	
Reviewed category	10–100 mg/L
Algae	
IC_{50}	10–100 mg/L
Invertebrate	
EC_{50}	10–100 mg/L
Fish	
LC_{50}	10–100 mg/L

Biodegradation

% degraded in 28 days	≥60% ThOD/ThCO2 (≥70% DOC)
10-day window	Meets 10-day window
Test Method	OECD 301 series test

Degradation Products of Concern

Degradation Products of Concern	None known

DfE Screen

Passes DfE Screen	Yes

Additional Aquatic Toxicity

Life Cycle Assessment

Origin of Feedstock

CLEANGREDIENTS > APPROACH

Provide information needed by companies to design better products.

Neither a simple list, ranking system, nor a certification program.

CleanGredients is designed and intended to be as open and transparent as possible, not a black box.

Focus on hazard and information relevant to environmental purchasing, eco-labeling, and sustainability.

CleanGredients facilitates U.S. EPA DfE recognition by listing chemicals that are “pre-screened” against the DfE’s human and environmental health criteria.

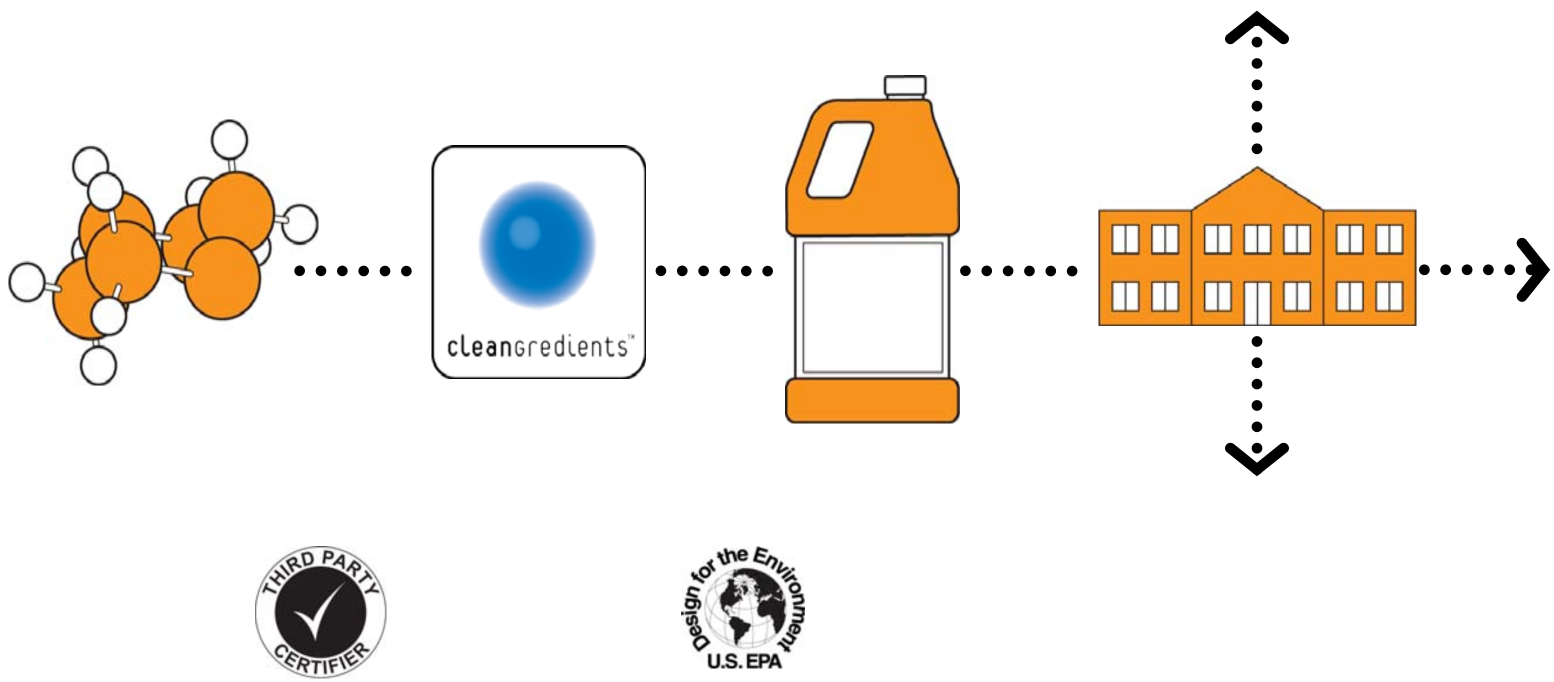
Design for the Environment
U.S. EPA

CleanGredients helps…

formulators to identify the ingredients for improved products that will meet U.S. EPA DfE requirements and

chemical manufacturers (suppliers) to market ingredients with positive human and environmental health attributes.

CLEANGREDIENTS > HOW IT WORKS



cleangredients®

a project of GreenBlue®

Because key ingredient data are verified by independent third parties, CleanGredients is recognized as a trusted source of chemical product information.

General (Technical and Sales)

Physical-Chemical

Human Health

Environmental Fate and Toxicity

Regulatory

Currently available:

Solvents

Surfactants

Soon to be released:

Chelating Agents & Sequestrants (non-polymeric)

Fragrances

CleanGredients will soon accept listings for all ingredient classes using the DfE Master Criteria set (formerly the DfE General Screen).

Expand to other formulated product categories:

- inks, coatings, adhesives
- personal care products
- phthalates and alternative plasticizers
- Incorporate screens for additional product recognition or certification programs

The primary focus of CleanGredients is chemical hazards.

Increasingly, we recognize a need to incorporate additional attributes related to green chemistry and life cycle assessment into the database. For example:

- Atom economy
- Embodied energy
- Feedstock

cleangredients®

a project of GreenBlue®

CLEANGREDIENTS > SPONSORS

Thank you to our 2010 Sponsors

Design for the Environment U.S. EPA

ISSA® The Worldwide Cleaning Industry Association

Henkel

rb Reckitt Benckiser

LANXESS Energizing Chemistry

STAPLES® Advantage

cleanGredients®

a project of GreenBlue®

Thank you.

Minal T. Mistry
minal@greenblue.org

On behalf of:
Topher Buck
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434.817.1424 x301
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cleangredients®

a project of GreenBlue®

Beyond the Binder

Color Resolutions International

Topics Discussed

- Metrics of Sustainability
- Why Sustainability?
- What's in an ink?
- Product and Process Improvements?
- Sustainability at CRI

Metrics of Sustainability

Sustainability ≠ Environmentally Correct

- Sustainable = Derived from renewable resources
- Environmentally Correct = Best for the environment
- Green = ?

Metrics of Sustainability

- Official Definitions
  - EPA – “strategies that meet society’s present needs without compromising the ability of future generations to meet their own needs”
  - TAPPI

Why Sustainability?

- Government Driven?
- Industry Driven?
- Customer Driven?

What’s in an ink

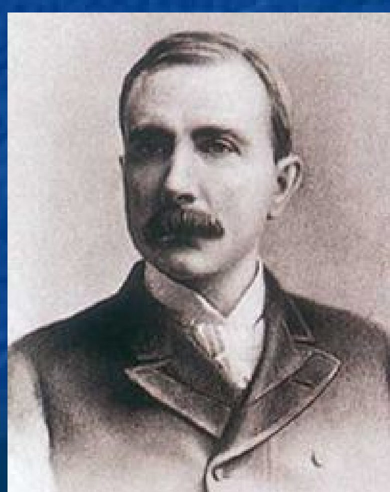
- Resins
- Solvents
- Colorants
- Additives
  - Defoamers
  - Surfactants
  - Preservatives

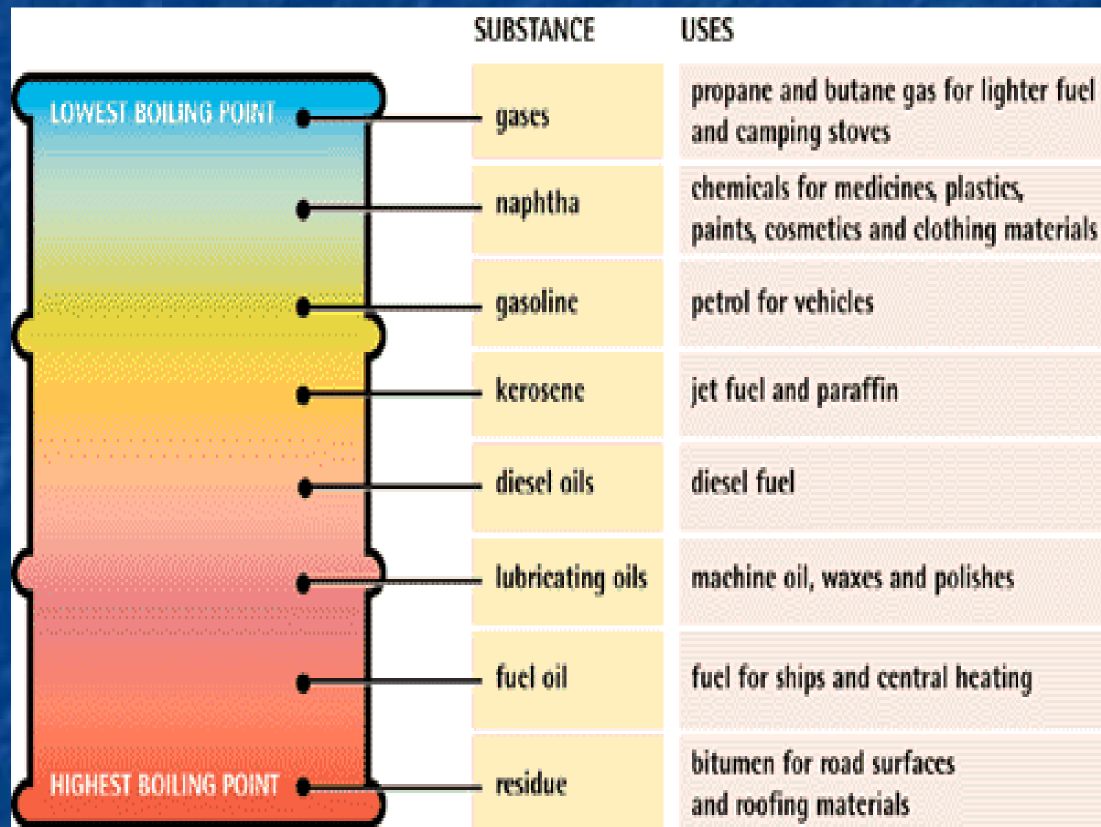
Solvents

- Water
- Solvents
  - EPA study results
- UV/EB

Solvents

- What to do with the other stuff?





Solvents

Make gasoline, vasoline, etc.

- What to do with the other stuff?

Colorants

- Natural
  - Properties
  - Economics (indigo example)
- Bio-Derived
  - Bio Mass Syntheses
- Pigment Process Improvements
  - Low Salt diazotizations

Fillers

- Bio-Derived
  - Cellulose, sugars, etc.
- Waste Reallocation
  - Waste stream sharing, landfill reduction, etc
  - State programs

Additives

- Impact of Additives
- Defoamers, waxes, plasticizers
- Drying Rate
  - Propylene Glycol Renewable
    - Commercial Joint Venture failed 2008
    - Other sources currently available
  - Alcohols – Fermentation processes

Additives

- Impact of Additives
- Defoamers, waxes, plasticizers
- BIOCIDES
  - Types and Quantities
  - Impact of natural binders on biocide use

Waxes

- Carnuba
- Parrafin
- Bio-derived polypropylene
  - Commercialization Expected 2013

Process Improvements

- Lean Manufacturing
  - Energy efficiency
- Supply Chain Simplifications
  - Local Sourcing

Sustainability at CRI

- Reclaiming: Reprocess to a usable state

- Ink Work Off and Reclamation Services
- Reclaiming Process Water
- Reclaiming Packaging of Raw Materials

Sustainability (cont.)

- Recycling: Remake into another form or product
- Use five gallon and 55 gallon containers from 100% recycled polyethylene
- Re-use of customer containers
- Recycling of corrugated container board

Sustainability (cont.)

- Renewable: Using Renewable Resources from plant and animal life.

- Re-Use of Pallets
- Ink Formulated from renewable sources
  - SPx 6
  - Earthflex
  - Soy Inks: Why?

CRI Color Resolutions International
The formula for printing success

Sustainability Scorecard

	ITEM	UNIT						YEAR		PREVENTED DEPLETION OF NATURAL RESOURCES
		Pound	*Drum*	*Bag*	*Tote*	*Pallet*	*Unit*	*2007*	*2008*	
Reclaim To reprocess to a usable state	Water	√						2,224,000		268,000 Gallons of Water
	Dormant Water Based Ink	√						500,000		6,250 Barrels of Oil
	PE 55 gal. Drums		√					5,712		691 Barrels of Oil
	PP Fabric Bags			√				3,442		186 Barrels of Oil
	PE Totes				√			2,274		500 Barrels of Oil
	Hardwood Pallets					√		11,000		1,000 Virgin Trees
Recycle To remake into another form or product	Corrugated	√						34,000		306 Trees
	PE 5 gal. Pails	√						90,116		Sent to Secondary Recycling
	Electronics						√	57		Sent to Secondary Recycling
Renewable Ink formulated from renewable sources	Ink Formulated From Renewable Sources	√						26,900		161 Barrels of Oil

Calculations of depleted natural resources courtesy of The Sierra Club website (www.sierraclub.org/bags), www.walmartfacts.com, and other industry sources. For details, please contact CRI at 800-346-8570.

INKCHEMISTRY® for a cleaner future

Conclusions

- What does the future hold?
- Sustainability as growth business?
- What do we do with it?

THANK YOU

Mike Hayden
Color Resolutions International
mhayden@colorresolutions.com

Challenges
of
Bio Polymers

The DaniMer Approach

Product Development

DaniMer Objectives

- Improve Sustainability Footprint
  - Reduce dependence on petroleum derived resins
  - Compostable- ASTM D6400
  - Favorable life cycle analysis (LCA)
  - Repulpable when used with paper pkg
- Increase brand recognition with earth friendly message
- Select projects with little opposition within the recycling community

The Challenge of Bio Polymers

- Availability of bio resins
  - Polylactic Acid (PLA) most available
  - NatureWorks added capacity in 2008 to support demand
- Modifying Properties
  - Melt strength
  - Melt curtain stability
  - Adhesion to paper
  - Heat Deflection
  - Barrier Properties

The Challenges of Bio Polymers

- Material Handling
  – Dry material (below 400 ppm)
  – Minimal openings in foil liners to reduce exposure to atmosphere
  – Moisture management during processing
  – Re-sealing bags when finished to reduce exposure to moisture
  – Use of dryers in some environments

The Challenges of Bio Polymers

- Processing
  - Designed for use on existing equipment
  - Lower processing temperatures
    - Lower Melt temperatures
    - Temperature Sensitivity & Degradation
  - Susceptible to Shear
    - Screw Design Important
    - May not be suitable for high compression ration screw designs

The Challenges of Bio Polymers

- Price
  - – Currently, higher than commodity resins
  - – Less volatile price fluctuations
- The Right Partner/Brand Owner

Primary Markets

- Extrusion Coating
  - Coffee and fountain drink cups
  - Take Out Containers
  - Frozen food and dairy containers
- Thermoformed Sheet
  - Food Service
  - Horticulture
- Injection Molding
  - Cutlery
- Films
  - Agricultural Films
  - Compostable Waste Bags
  - Snack Food Packaging

Current Bio Polymer Solutions

- PLA based extrusion coatings
  - Commercial since 2006
    - First to market - International Paper & Green Mountain Coffee
    - Over 1 billion cups produced to date
    - Several commercial projects in various stages of development

Current Bio Polymer Solutions

– Thermoformed Sheet
- Modified for Melt Strengh
- Enhance heat tolerance
- Stiffer material allows for down guaging

Current Bio Polymer Solutions

– Injection Molding - Cutlery
    - Modified for High Heat Tolerance
    - No Annealing required
    - Marginal increase in cycle times
    - FDA approved

Current Bio Polymer Solutions

- Films
  - Modified for:
    - Higher melt strength
    - Toughness
    - Tensile elongation
    - Heat Tolerance

New Products

- Hot Melt Adhesives
  - Developed from DaniMer’s proprietary Seluma technology
  - Renewable content up to 93%
  - All products are compostable and re-pulpable
  - ASTM and Secondary FDA food contact certifiable

On the Near Term Horizon

- Wax Replacement
  - Drop in replacement for wax
  - 98% renewable materials
  - Lower coat weights than wax
  - Provides additional stiffness
  - More consistent product than wax
  - No residuals resulting from repulping process (deinking conditions)
  - Compostable
  - Competitively priced

Future Solutions

- PHA Polymers (medium to long chain molecular structures)
  - 100% bio based, renewable
  - Food contact, FDA certifiable
  - Suitable for liquid packaging
  - Excellent barrier properties (MVTR, OTR, WVTR)
  - Compostable
  - Biodegradable
    - Will degrade in a cold marine waters, septic tanks, or municipal waste water systems
    - Will degrade both in anaerobic & aerobic conditions
  - Lower cost
  - Broader processing window
  - Commercial quantities available in 12-18 months

DaniMer

Questions?

Imerys' Sustainability Journey & Outcomes

May 4, 2010

Paul Meizanis
Technical Manager
Barrier and Specialty Coatings

IMERYS Sustainable Development Focus

- **Environment:** manage activities with respect for the environment, which implies using mineral reserves responsibly;
- **Health & Safety:** guarantee the health and safety of employees in the workplace;
- **Human Resources:** enable employees to develop professionally, and provide satisfactory social benefits;
- **Community Relations:** act as a full member of the communities where the Group is based;
- **Innovation:** develop and make high quality, environment-friendly products and technologies;
- **Governance:** constantly apply and improve the Group's corporate governance practices to keep pace with best practices.
- **Environmental and social performance is a key component of Imerys' results.**
- **Read more at** www.imerys.com

IMERYS Key Environmental Levers

Internal and External

- Increase carbon & energy efficiency
  - Example: Pressure filtration dewatering for kaolin versus evaporation -10% energy savings
  - Example: Granulated form of Brazilian clays to reduce energy costs and eliminate dusting of spray dried clays
- Reduce air emissions
- Manage water usage
- Minimize waste
- Land reclamation of mine sites
- Develop effective Environment Management Systems
- Develop new products that help our customers' sustainability and energy efficiency
  - BARRISURF™
  - FiberLean™
  - Starch Encapsulated Kaolin (SEK)

Reduce Long Term Environmental Impact through Site Restoration

- **Mining remediation plans are required for all mining projects**
  - Assessment of existing environmental conditions
  - Potential impact of Imerys operations on such existing environmental conditions
  - Recommendations for minimizing these potential impacts

- **Biodiversity preservation**
  - Numerous successful projects around the globe
  - 2008 Outstanding Achievement Award for Land Reclamation presented to Sandersville, GA Operations

I. Engineered Pigments for Barrier Coating

BARRISURF^{TM} Development

BARRISURF™ Development

- **Purpose**
  - Develop a hyper-platy kaolin that can improve the sustainability of packaging grades while maintaining or improving barrier performance
- **Goals**
  - Enable fiber based packaging to compete with poly systems
  - Increase sustainability
    - Use of renewable materials (fiber)
    - Replace fluorochemicals
    - Replace wax
    - Recyclable, compostable packaging

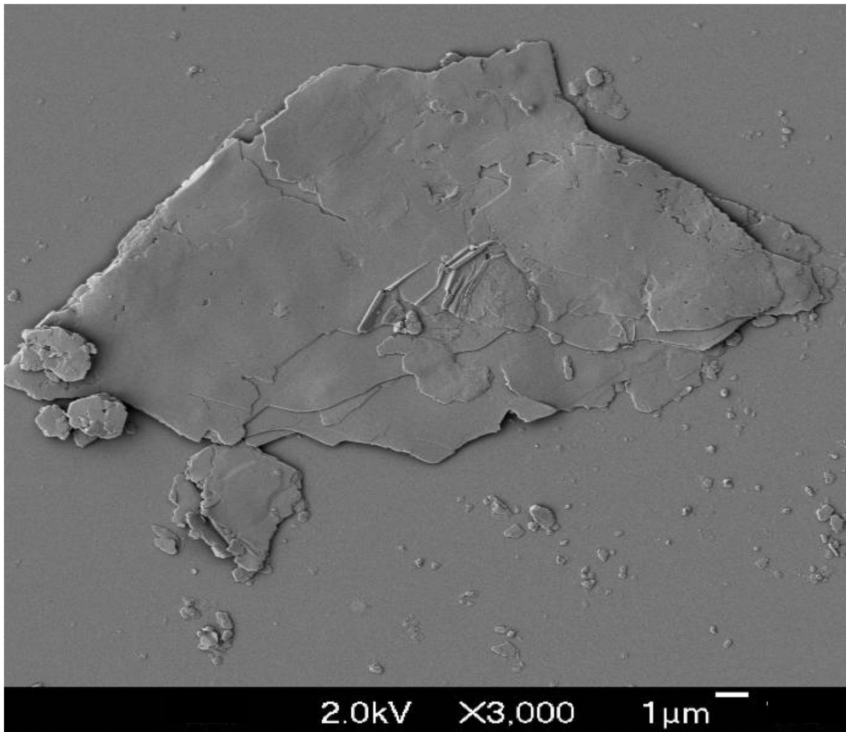
Barrier Target Markets

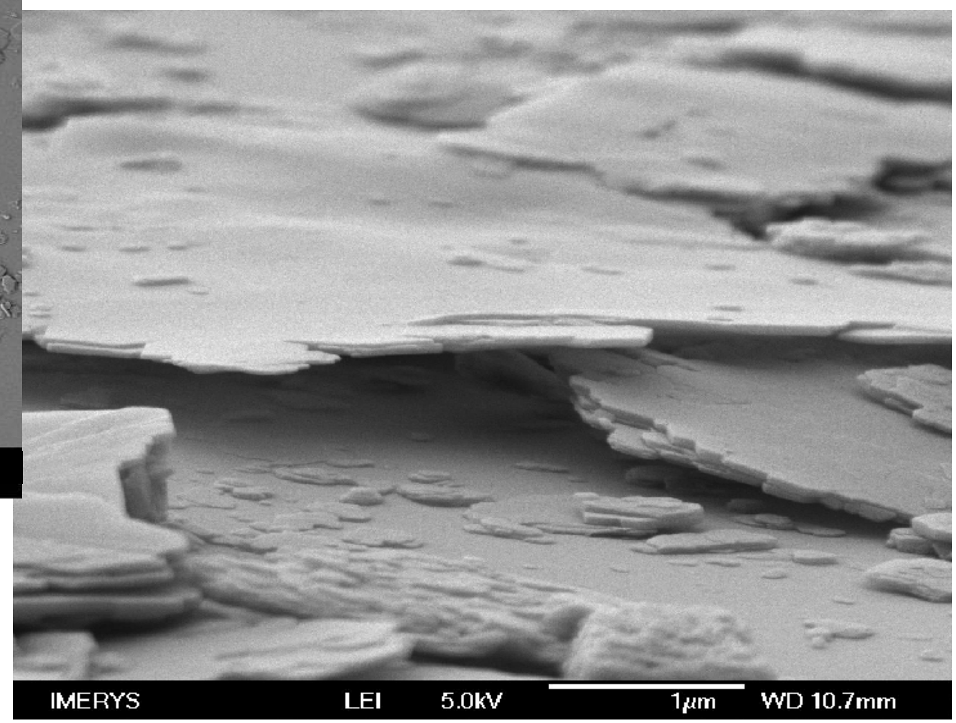
- Oil and Grease Resistance (OGR)
  - Quickserve sandwich wrap, french fry containers etc…
  - Opportunity = Fluorochemical replacement
- Water Resistance
  - Boxes for produce and poultry markets
  - Opportunity = Wax replacement opportunities
- Moisture Vapor Barrier Grades (MVTR)
  - Flexible packaging for dry food and snacks
  - Opportunity = Replace poly materials with renewable fiber based packaging
- Oxygen Resistance (OTR)
  - Aseptic liquid packaging grades that require long shelf life

- ***Some applications require a combination of the above barrier properties!***

Thin crystals make Hyper-Platy Kaolin Unique

BARRISURF™ kaolin



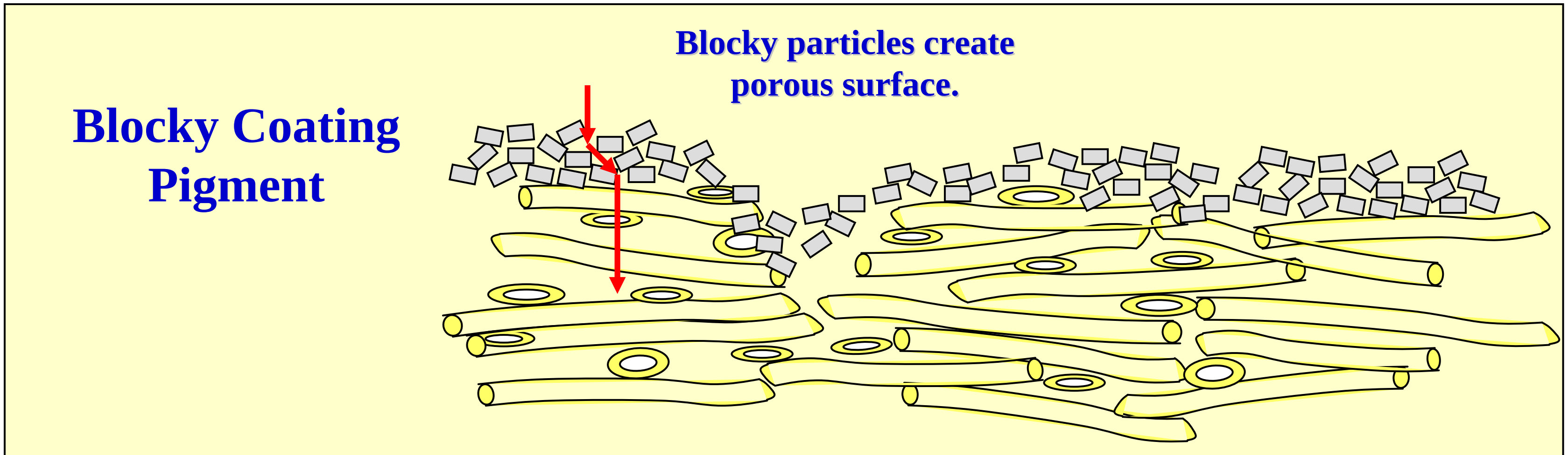


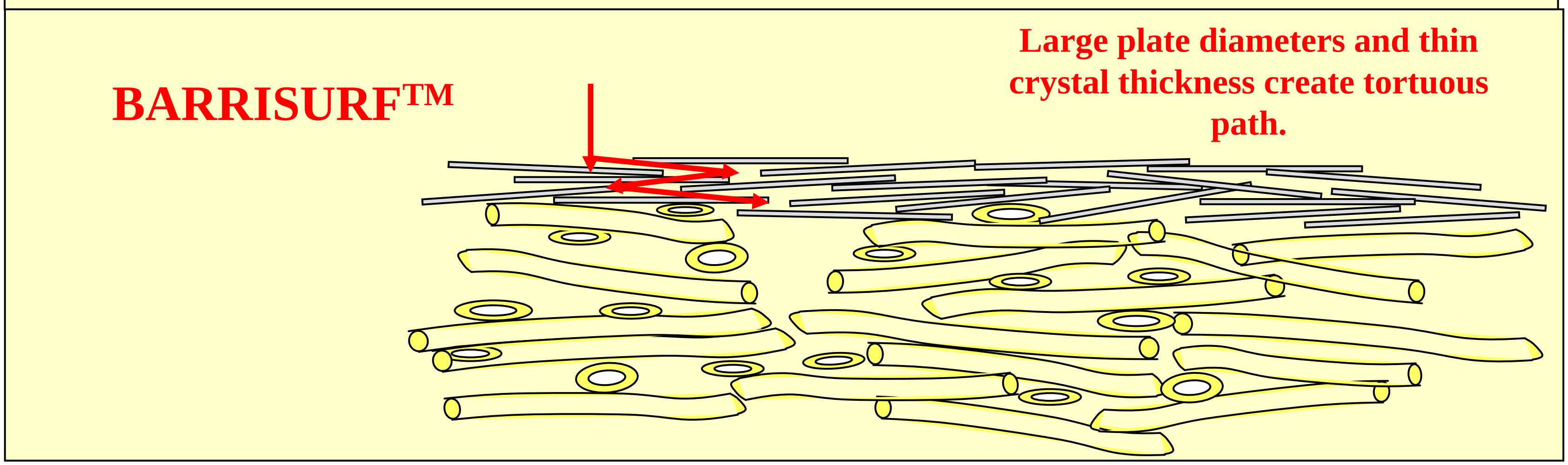
Platy Minerals in Water Based Barrier Coatings

- Effective component in barrier coatings for:
  - Oil and grease
  - Water
  - Moisture vapor
- Potential alternative to fluorochemicals and waxes
- Enabler for renewable paper based technologies
  - Natural aluminosilicate mineral that is neutral to composting
  - Facilitates the recyclability of fiber based products
  - Fiber replacement
    - Kaolin has low carbon footprint
    - Energy reduction
  - Reduces permeability
- Potential to reduce cost
  - Extension of the more expensive barrier polymers
  - Substrate coverage, may reduce coat weight required

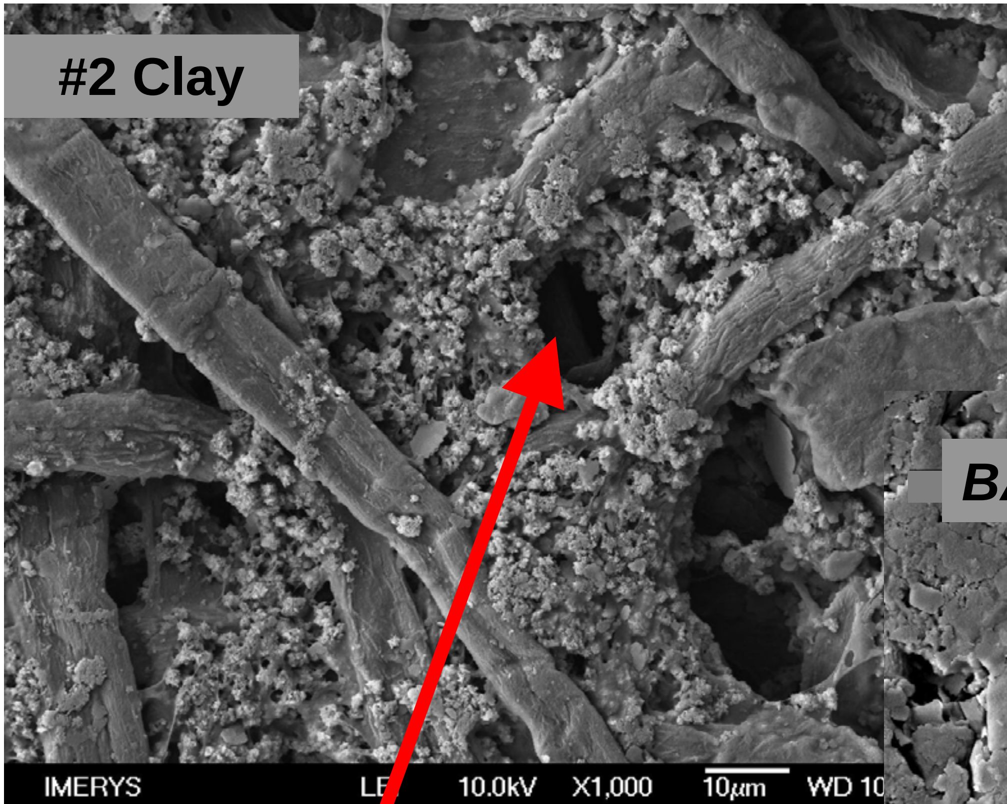
- Technology of using minerals in WBBC is in its infancy
  - Requires a cooperative development between suppliers and end users

How Does Hyper-Platy Clay Work:
High Shape Factor = Tortuous Path



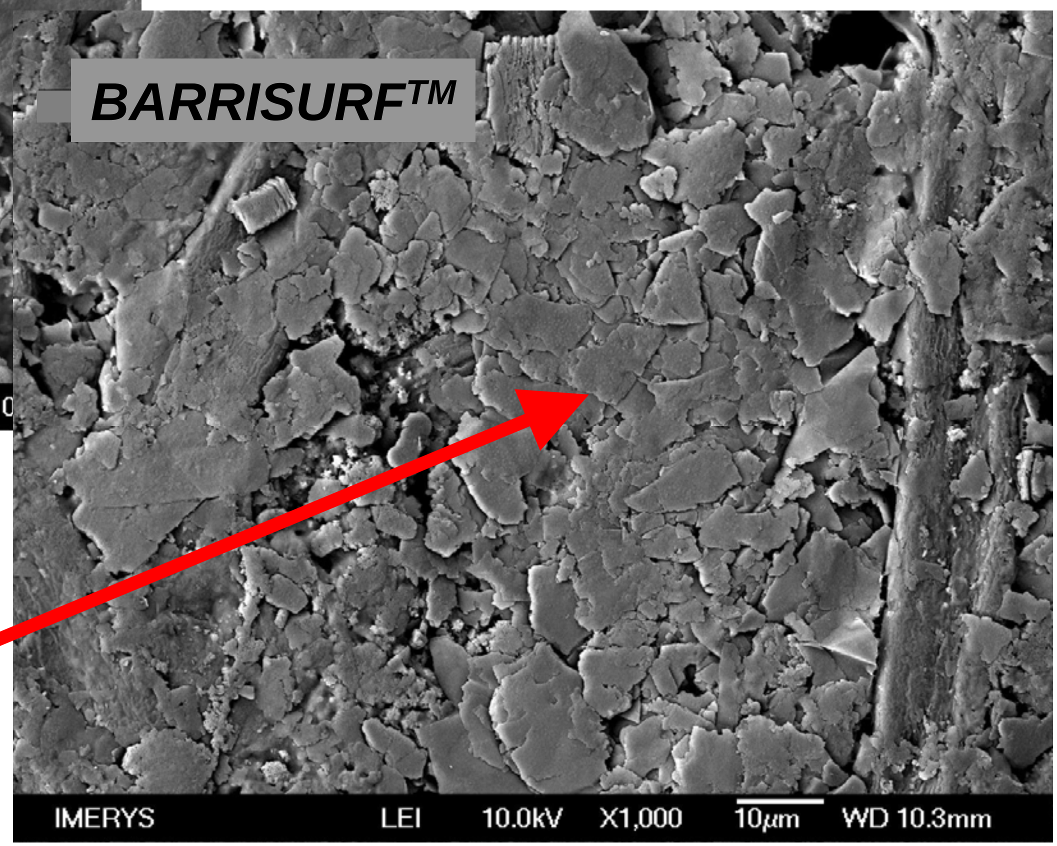


BARRISURF™ in Woodfree Size Press Coating



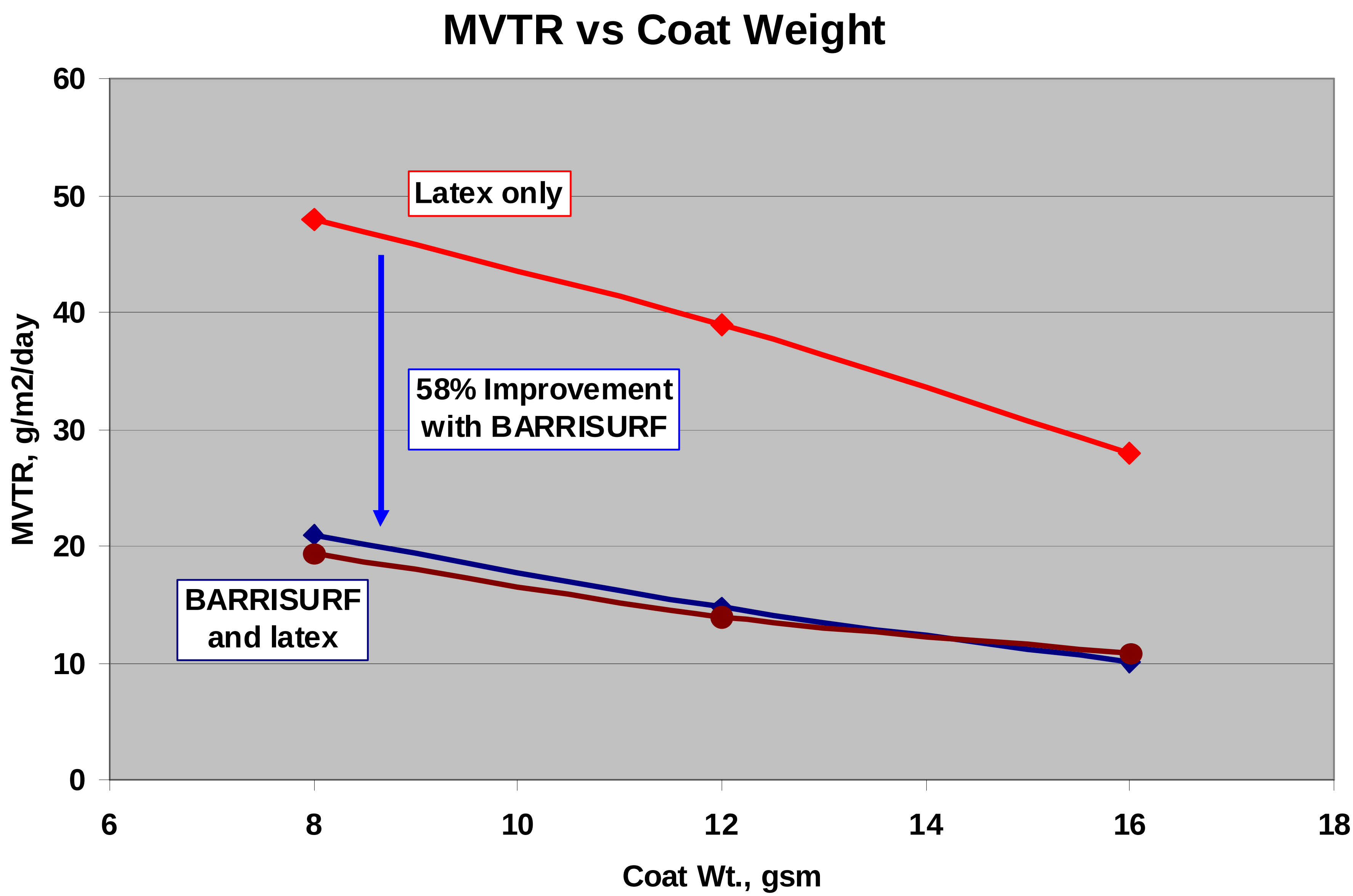
Puddle Size Press

Much better fiber coverage than #2 clay at equivalent coat weight



Finer blocky particles dive into base sheet

Large platy clays stay on paper surface



MVTR vs Coat Weight
MVTR, g/m2/day
Coat Wt., gsm
60
50
40
30
20
10
0
6
8
10
12
14
16
18
Latex only
58% Improvement with BARRISURF
BARRISURF and latex

BARRISURF™ Benefits in Coated Paper & Board

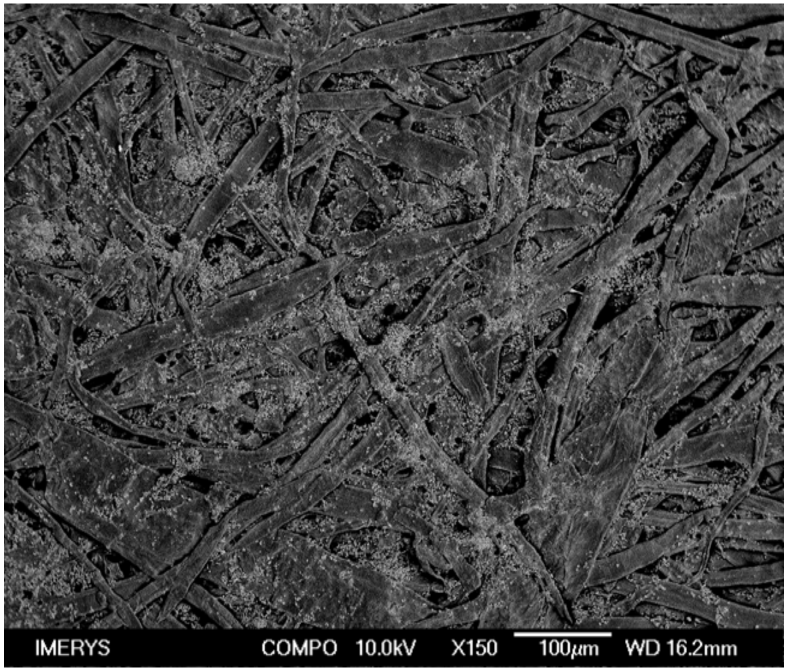
- **Reduce Cost**
  - Extension of polymers
  - Substrate coverage
- **Runs well on all types of coaters**
- ***Commercial coater experience***
    - Blade
    - Rod coater
    - Metered size press
    - Puddle size press
- **Effective Barrier Performance**
  - Water
  - Grease
  - Gas
- **Sustainability**
  - Eliminate fluorocarbons & waxes
  - Aqueous barrier coatings
  - Recyclable
  - De-materialize

II. FiberLean$_{sp}$

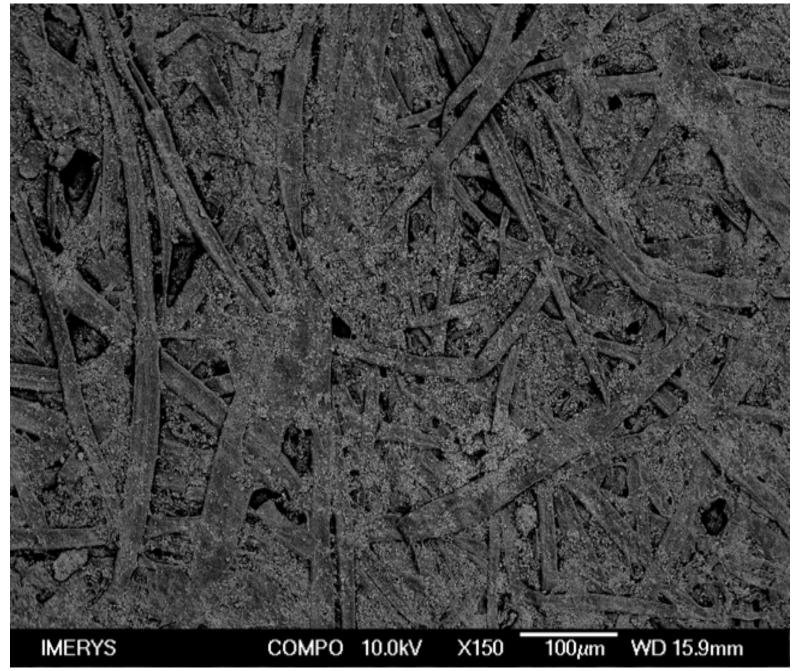
Pigmentation at the Size Press for Uncoated Freesheet (UCFS) Grades

FiberLean$_{sp}$ Concept

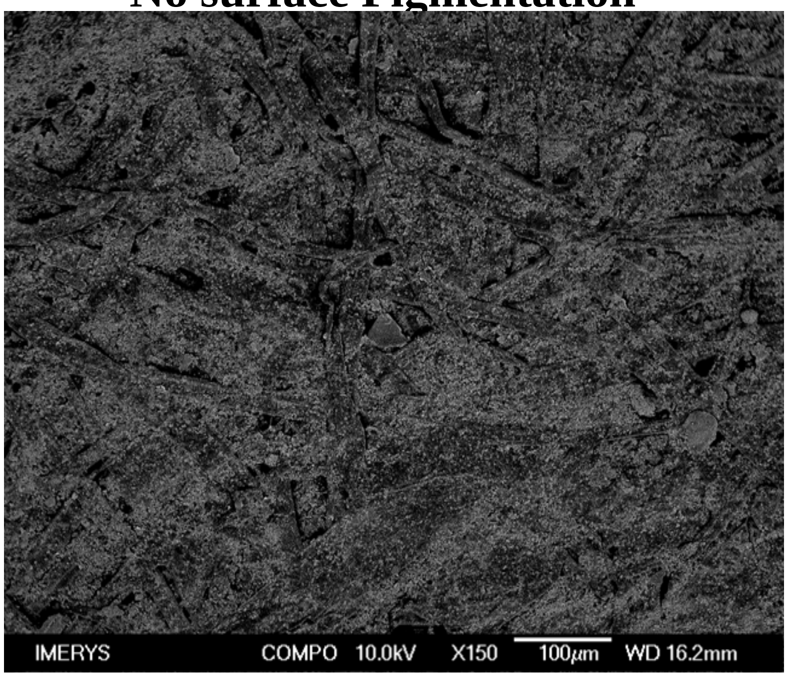
- **Purpose**
  - Develop an engineered size press pigment system for Uncoated Freesheet grades
- **Goals**
  - Replace fiber with coating
  - Improve productivity
  - Reduce energy consumption
  - Reduce cost of manufacturing
  - Maintain stiffness, strength and optics



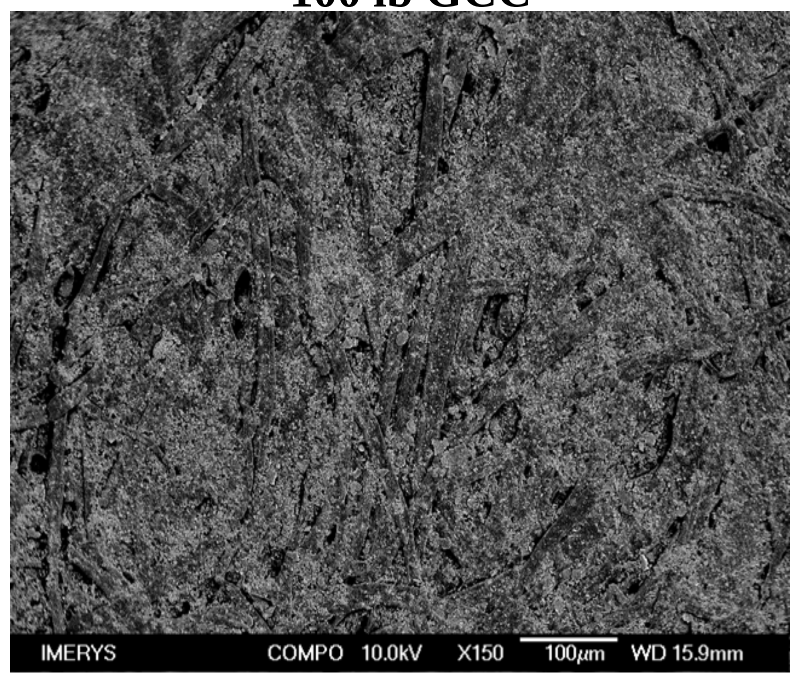
No surface Pigmentation



100 lb GCC

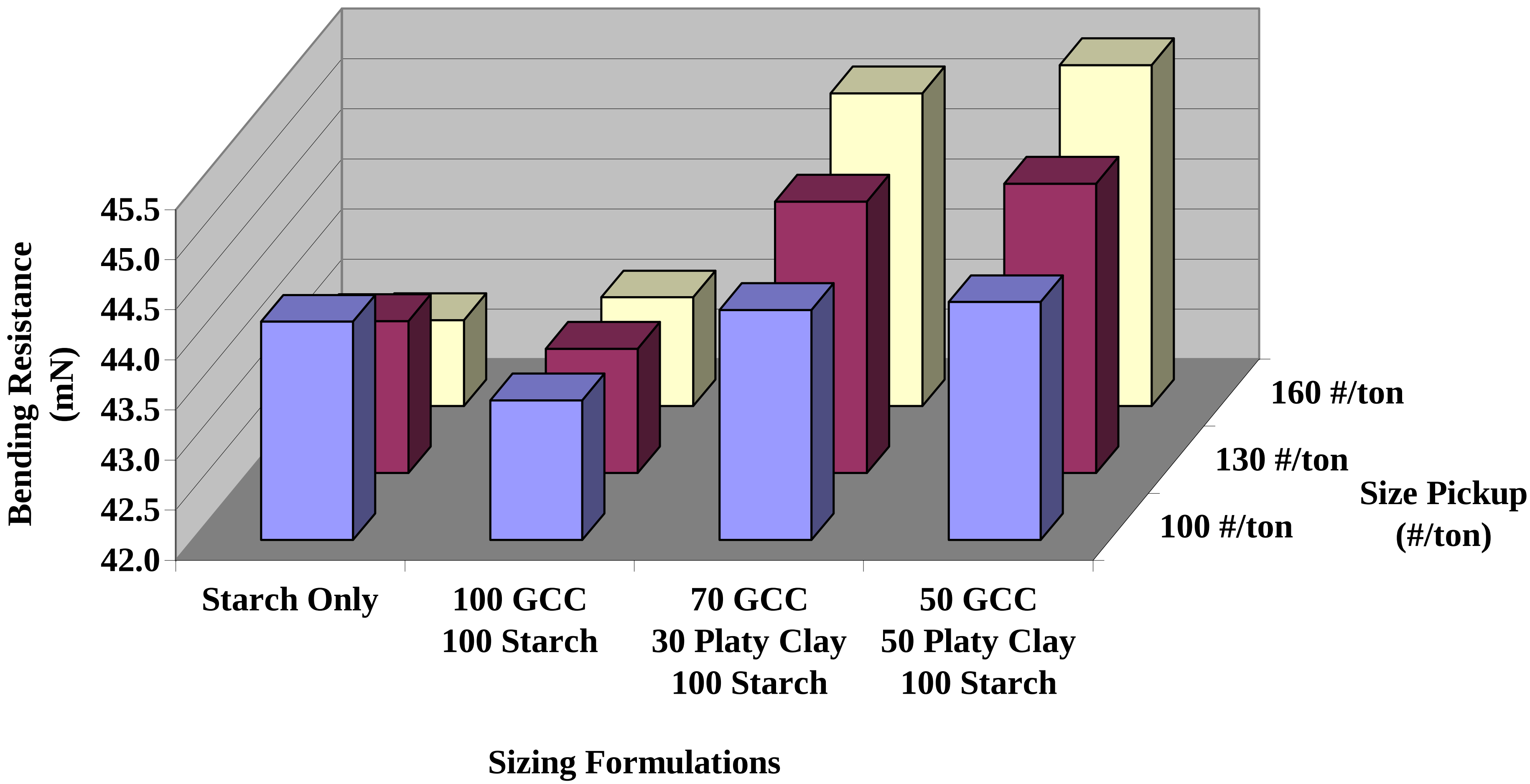


70 lb GCC/ 30 lb Platy Clay



50 lb GCC/ 50 lb Platy Clay

Multi-pigment Combination Improves Stiffness



FiberLean$_{sp}$ Offers:

- **A single product offering a multi-pigment solution**
  - Does not require separate pigment storage tanks/pumps at mill site
- **Significant increases in fiber substitution relative to 100% GCC**
  - Improved Finished Paper Properties
- **Opportunity for reduction in basis weight**
  - Increased stiffness with platy clay addition
- **Dramatic Cost savings**
  - Lower fiber usage at equivalent weight or reduced basis weight at equal strength
    - More sellable pulp for market pulp producers
  - Reduced Energy Demand/ton of paper
    - Main section dryers
      - estimates of 8-12% reduction in steam pressure
    - After main section dryers
      - Increase in solids from 8-11% (starch only) up to 16-20% (pigmented)
- **Other**
  - Improved OBA efficiency may result in additional savings
  - Lower porosity, tighter sheet
  - Increased bulk (less calendering at equal smoothness)

III. Starch Encapsulated Kaolin (SEK)

Fillers in Linerboard

Starch Encapsulated Kaolin (SEK)

- **Purpose**
  - Develop a novel surface treated filler for linerboard that minimizes strength loss, enabling optimum filler loadings for improved drainage and productivity
- **Goals**
  - Improve productivity on linerboard machines that are fiber and or energy limited
  - Provide value through reduced energy cost per ton and increased production rate of linerboard
  - Replace fiber with filler

Fillers in Linerboard

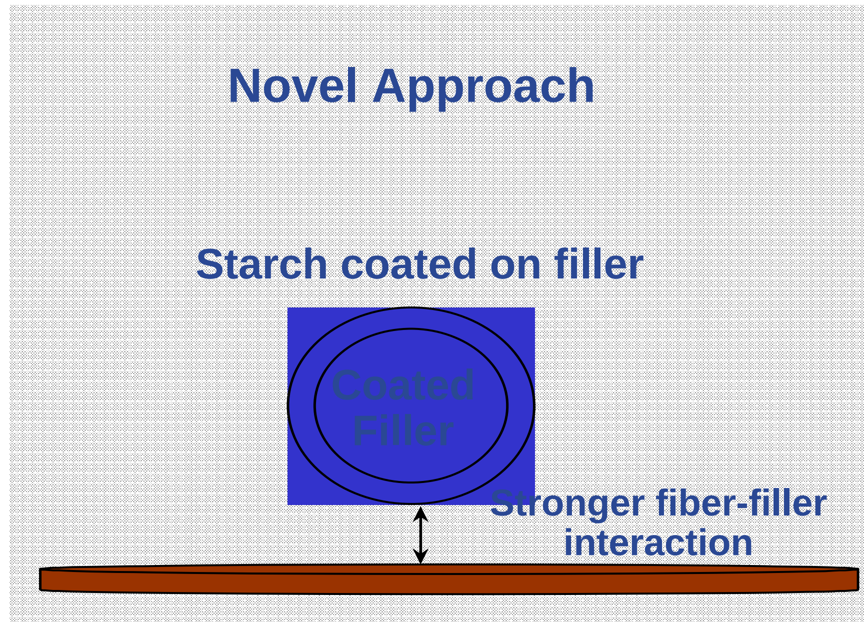
Advantages

- Fiber Reduction
- Improved Drainage
- Improved Drying
- Reduced CD profile variability
- Potential for increased production

Disadvantages

- Strength Reduction
- Difficult to Retain
- Lower Coefficient of Friction
- Requires tanks and handling system (not intrinsic for most linerboard mills)

SEK Concept: Filler Treatment Using Starch

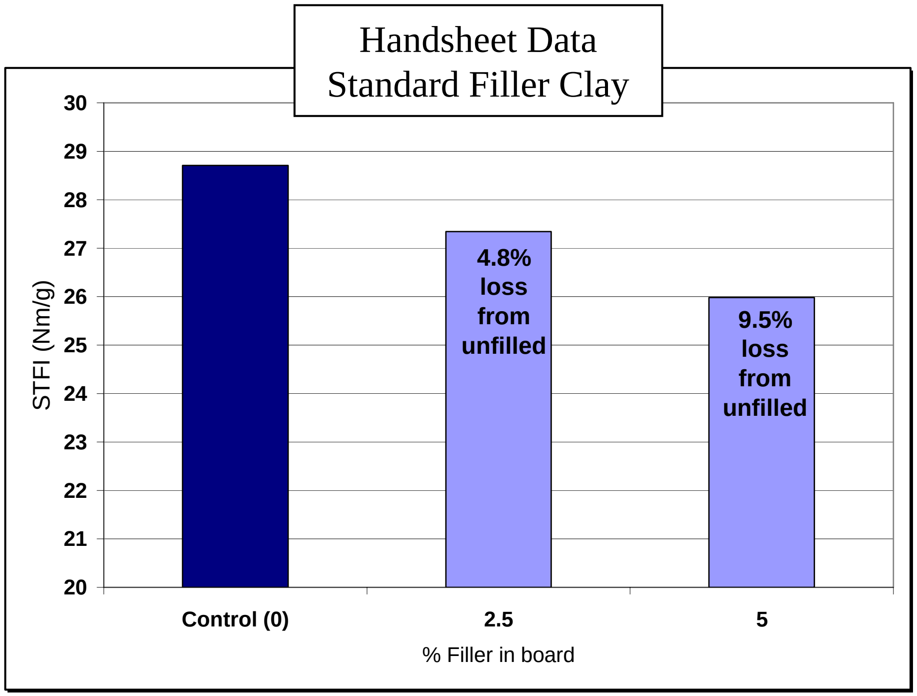


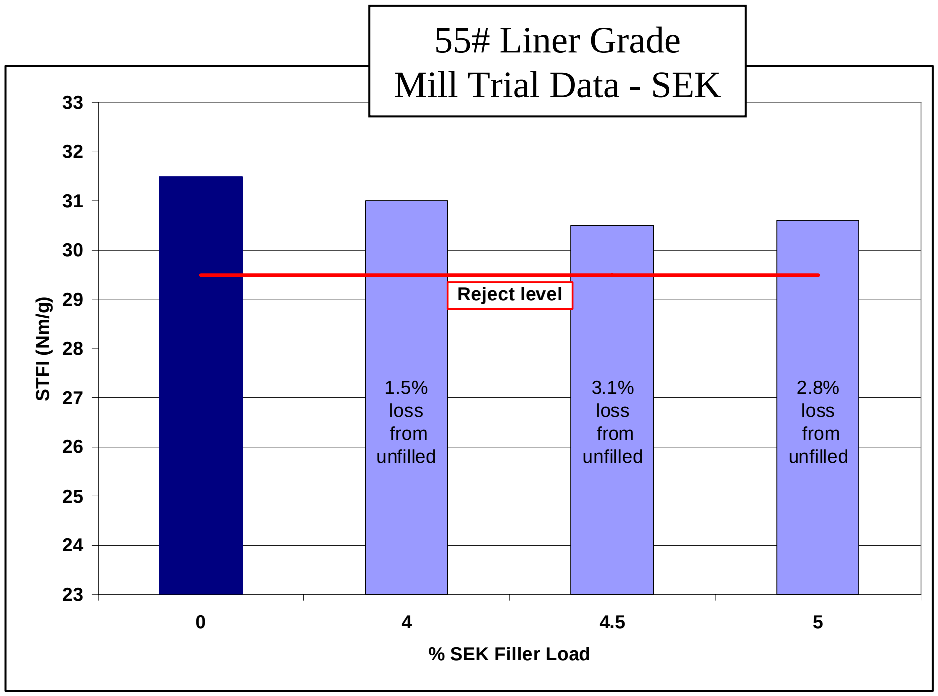
Traditional wet-end starch addition interacts with anionic materials other than filler

SEK is dramatically more efficient at promoting filler/fiber bonding

The concept proposed is a product of joint research by IPST, Imerys and Paper Industry partners as a TIP3 project

Standard Filler Clay vs SEK in Linerboard





Standard fillers have been tried but have significant impact on strength

SEK filler can be added up to 5% filler loading without significant loss in strength

SEK Benefits:

- **Fiber replacement potential**
  - Can substitute or extend OCC and Virgin fiber
- **No statistical impact on strength and slide angle**
- **Faster drainage and drying**
  - Better than Virgin and OCC
- **Potential for speed increase - ~ 100 fpm (or savings in energy usage)**
- **Production rate increase of up to 3 tph on 55 lb liner**
- **Reduced variability in the cross direction**
  - May lead to improved performance at the corrugator

Acknowledgements

- IPST
- David Cummings
- Berenice Everett
- Leslie McLain
- Roger Wygant

Thank You !!!

Paul Meizanis
Technical Manager
Specialty and Barrier Coatings
paulm@imerys.com

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Carbon Management –
Driving Forces, Key Issues, and Evolving Complications

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Jacquie McNutt

- *Program Chair*
- President, Degrees of Excellence
- 35+ Years Industry Experience
  - *University, Company, Line, Staff & Consulting*
  - *Broad Product/Topics Experiences & Global Background*
- BS, Ind. Eng., MBA/MS, Managerial Sciences & Forestry & PhD, Forest Managerial Sciences

Carbon Management Track – Agenda

- *Session 1 – Monday,1:30 – 3:00 PM*
  - ***George Weyerhaeuser Jr.*** *– former Weyco executive and Senior Fellow, World Business Council for Sustainable Development*
    - ***CARBON MANAGEMENT IN THE CONTEXT OF SUSTAINABILITY***
  - ***Tom Rosser*** *– Director General of the Policy, Economics and Industry Branch of the Canadian Forest Service at Natural Resources Canada*
    - ***CARBON MANAGEMENT – A CANADIAN EXPERIENCE IN A GLOBAL PERSPECTIVE***
- *Session 2 – Monday, 3:30 – 5:00 PM*
  - ***Dr. Marilyn Brown*** *– Nobel Laureate and Global Energy Policy Expert*
    - ***THE FOREST PRODUCTS INDUSTRY AT AN ENERGY/CLIMATE CROSSROADS***
  - ***Dr. Ron Brown*** *– Executive Director, Agenda 2020 Technology Alliance, AF&PA*
    - ***THE ROLE OF INNOVATION AND NEW TECHNOLOGIES IN CONTROL OF GHG EMISSIONS***

Carbon Management Track – Agenda

- *<u>Session 3 – Tuesday, 10:30 AM – Noon</u>*
  - ***Don Carli*** *– Director and Senior Research Fellow, The Institute for Sustainable Communication*
    - ***PRINT VERSUS DIGITAL MEDIA – FALSE DILEMMAS AND FORCED CHOICES***
  - ***Ben Thorp –*** *Chairman, Bioenergy Deployment Consortium*
    - ***CARBON MANAGEMENT UNCERTAINTY***

Some Program – Rules of The Road

- Please remember – this session is to be held in strict compliance with Antitrust Policy
  - *Specifically – discussing prices or pricing policy and discussing any restraint on competition of any kind will not be tolerated*
- Q&A/ Attendees interactions reserved to end of each session
- Please remember to join us for all three sessions – They are interrelated and interlinked
- Please Turn Off All Mobile Devices . . .

And Now to the Program . . .

Intent

Explore the current very complex array of carbon management related issues, their import and/or lack of import, and their likely implications for potential future directions for then industry.

Context . . .

The Forest Products Industry's business world is/will be impacted greatly by emerging carbon management related issues

Very high stakes are associated with this dynamic and complex playing field

For certain – business will not be as usual

Also of paramount importance are the evolving complications enmeshed with carbon management …

Key Carbon Management Related Topical Areas

- Altered business sustainability fundamentals
- Carbon footprinting & carbon life cycle analyses
- Changing energy issues and policies
- National energy security
- Global trade & balance of payments
- Print versus digital carbon tradeoffs
- Emergence of biofuels/biochemicals businesses
- Altered or new and sustainable business models…
- The need to transform effectively…

SESSION 1 –
CARBON MANAGEMENT

George Weyerhaeuser, Jr.

- *Carbon Management in the Context of Sustainability*
- Founding Partner, Houghton Cascade
- Remarkable Industry Career
  - *Senior Fellow, World Business Council Sustainable Development*
  - *Long And Distinguished Career With The Weyerhaeuser Company*
- BA Math & Philosophy – Yale and SM Management – MIT

Tom Rosser

- *Carbon Management – A Canadian Experience in a Global Perspective*
- Natural Resources Canada – Canadian Forest Service, Director General, Policy, Economics and Industry Branch
- Diverse & Impacting Career
  - *Chief Economist, Forest Products Association of Canada (FPAC)*
  - *Co-chair, International Council of Forest & Paper Associations (ICFPA) Climate Change Working Group*
- British Chevening Scholar, MS Environmental & Resource Economics – Univ. of London + Degrees – Carleton Univ.

SESSION 2 –
CARBON MANAGEMENT

Marilyn Brown

- *The Forest Products Industry at an Energy/Climate Crossroads*
- Professor Energy & Climate Policy – School of Public Policy, Georgia Tech
- Distinguished Career
  - *Numerous Leadership Roles – U.S. DoE's Oak Ridge National Laboratory*
  - *Co-recipient Nobel Peace Prize – Climate change Intergovernmental Panel*
  - *Anderson Medal of Honor – "Champion of Energy Efficiency"*
  - *Member National Commission on Energy Policy*
- PhD – Ohio State University

Ron Brown

- *The Role of Innovation and New Technologies in Control of GHG Emissions*
- Director, Agenda 2020 Technology Alliance – AF&PA
- Long & Distinguished Career
  - *MeadWestvaco – Manufacturing, Corp R&D, and Corp Engineering + 20 years as an R&D Director*
  - *TAPPI Fellow and former member of the TAPPI Board of Directors*
- BS – NCSU and MS and PhD – Institute of Paper Chemistry (Now IPST)

SESSIONS 1 & 2 – CARBON MANAGEMENT WRAP-UP

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Carbon Management –
Driving Forces, Key Issues, and Evolving Complications

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    - ***CARBON MANAGEMENT UNCERTAINTY***

SESSION 3 –
CARBON MANAGEMENT

Don Carli

- *Print Versus Digital Media – False Dilemmas and Forced Choices*
- Sr. Research Fellow – Institute for Sustainable Communication
- Marketing Research/Technology Advisor to Fortune 1000 brands –
  - *Adobe, Agfa, 3M, DuPont, Hewlett Packard, IBM, Johnson & Johnson, Kodak, Ogilvy & Mather, Sun Microsystems, Time Incorporated and Xerox, etc.*
- Adjunct Prof. Advertising, Design & Graphic Arts NYC College of Technology of the City University of New York

Ben Thorp

- *Carbon Management Uncertainty*
- Chairman – Bioenergy Deployment Consortium
- Extensive Industry Career
  - *Paper Engineering Executive – GP*
  - *Sr. Executive – Chesapeake Corp., James River Corp., BE&K, Pöyry-BEK, and Huyck Corp*
  - *Widely Published Author*
  - *Leader in Renewable Energy*
  - *TAPPI Fellow & PIMA Board*
- BS Physics – Univ. Maryland + Advanced Studies ME, Management, and Marketing

CARBON MANAGEMENT WRAP-UP

Carbon Management . . .

- Very Complex Arena
- Major Implications for the Industry
- Clear Understanding of this Arena is Crucial for Sustainable, Successful Business Futures for Players in this Industry
- There is Great Risk but also Great Reward at Play Here
- Much Left to Be Understood and Learned, but . . .
  - *Waiting to Take Action Carries the Greatest Risk . . .*

Some Clear Cautions…

- Care is needed in basing new transforming business decisions on *sustainable factors*…
  - *Questions still exist on the causative factors of climate change – e.g., are green house gasses the true culprit?*
    - New reports/studies on the role of CO_2, etc…
    - Leveling off past five years of warming trend…
  - *Announcements of new carbon extracting technologies, etc…*
  - *Solar energy has become significantly more cost competitive than it used to be, etc…*

Some Clear Cautions…

- As such - Will CO_2 based strategies even persist long term?
- If not – then can we afford to ignore them?
- If we cannot – then what? – energy security, balance of payments…? – What should drive us to a value-based sustainable future?
- And remember –
  - *our industries' ability to absorb major failures is now substantially constrained…*
  - *Creates very complex risk/reward pathways…*

Some Pressing Decisions…

- What then are sustainable business model factors?
  - *Traditional fossil fuels are limited/declining & far from environmentally clean & the market place is in great flux…*
  - *National security (energy related) has never been more pressing and the consumer is now speaking loudly…*
  - *And – remember the time honored basics –*
    - Captive & sustainable raw materials & other resources…
    - Unique core competencies…
    - Sustainably competitive products (returns/margins)…
    - Major market access and favorable logistics costs, and constraints…
    - Sustainable value creation through all fads and all markets…

Thank You From All of Us . . .

George

Tom

Marilyn

Jacquie

Ron

Don

Ben

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people resources solutions

Carbon Management in the Context of Sustainability

George H. Weyerhaeuser, Jr.
Houghton Cascade
May 3, 2010

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Carbon Management in the Context of Sustainability

- Sustainability and Forest Products
- Specific Challenges of Pulp and Paper

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Business Sustainability

- Sustainability is leaving some logs for your grandchildren.

Sustainability-
Carbon Emissions & Climate Change…a wicked problem

- Climate Change has taken center stage
- Policy
  - Challenges for national leaders
  - It is unlikely that they will produce a global framework for commerce any time soon

Sustainability

- Technology
  - IEA Chief Technology Officers
- The new Green

Sustainability

- Marketplace

Sustainability- A Social Construct

- Is our Industry ready to enter the debate?
- We are not dealing with laws of nature
- Humans are constructing this reality

The Challenges of Pulp & Paper- a carbon based product

- Manufacturing Efficiency
- Entrance to the global debate

Manufacturing Efficiency

- Water
- Energy
- Fossil Fuel
- Raw material

Leaders in the Global debate

- Nebulous problem definition
  - Adaptive Management (Like Best Management Practices in Forestry)
- Vision 2050
  - Business should do its part to lead the transformation
  - Imagine a world of people living well with sustainable resources
  - Be ready for different pricing of inputs and calculation of profits
- Run your enterprise successfully under today's framework
- Engage to shape tomorrow's

The Carbon Opportunity

- Bio-productivity- Land as the scarce resource
- Energy, Water and other services as co-products of our materials
- Protection of carbon stocks

Thank you

ghwjr@houghtoncascade.com

Building Leadership Excellence

Carbon Management and Sustainability – *The Canadian Experience in a Global Context*

Tom Rosser
Natural Resources Canada
May 3, 2010

Natural Resources Canada | Ressources naturelles Canada

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Outline

- Industry Situation and Path Forward
- Climate Policy and Industry Renewal
- Forests, Forest Products and Sustainability: Perceptions, Image and Reality

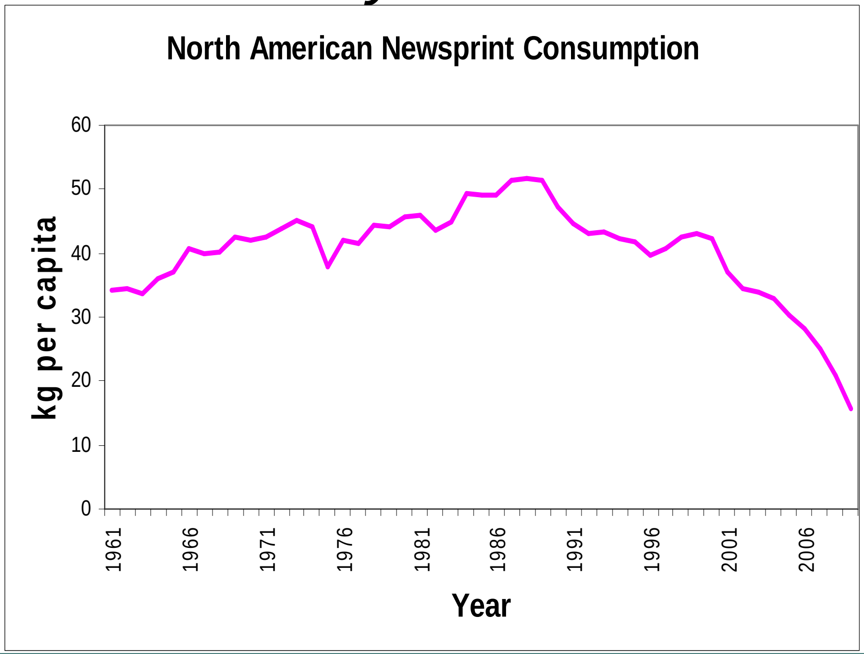
Context: Challenges in Canada's Forest Sector

Structural challenges

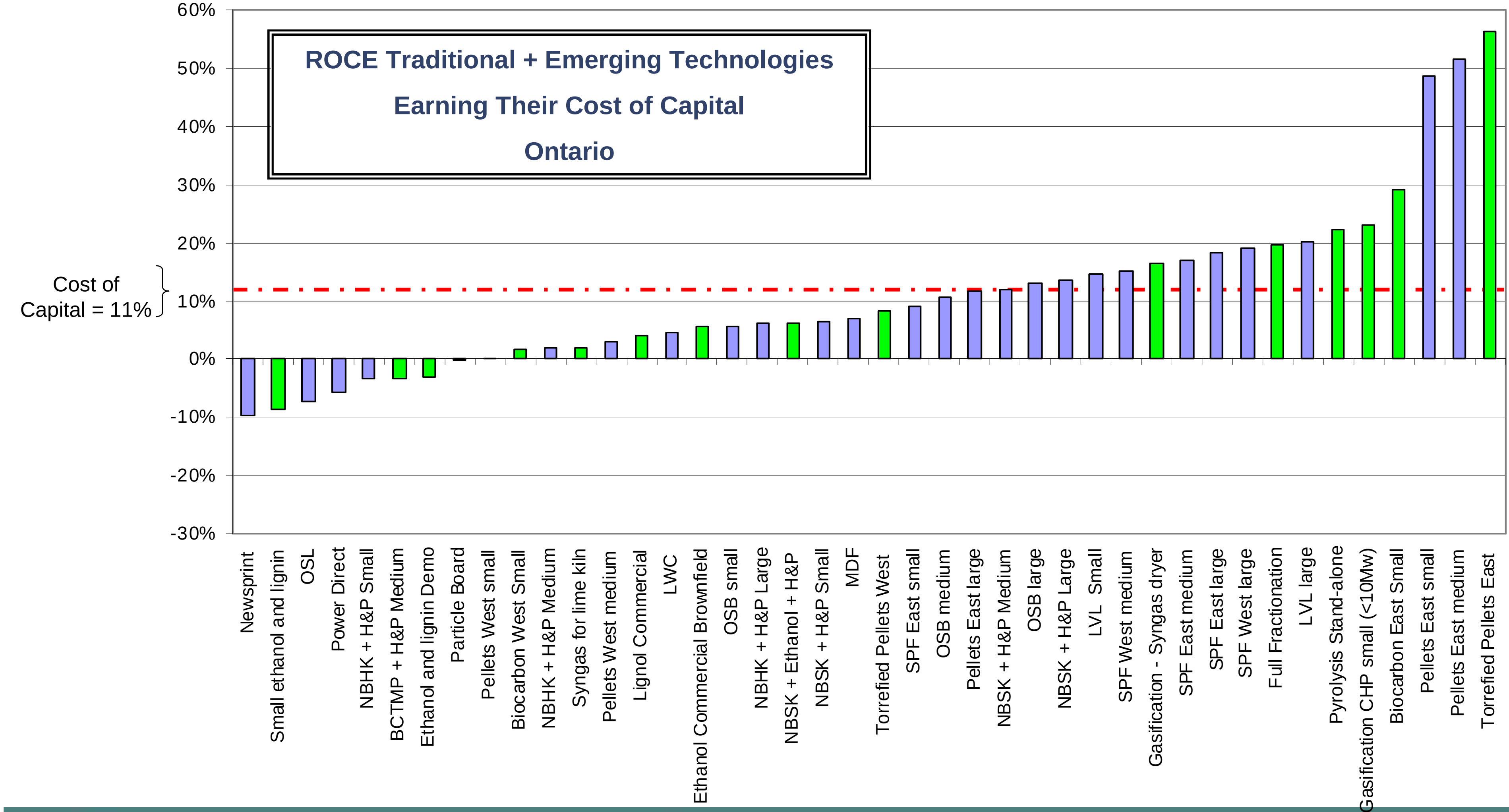
- *Decline in demand for some traditional products*
- *Entrance of new low-cost global competitors*
- *Canadian dollar appreciation and volatility*
- *Increasing input costs*

Short-term challenges

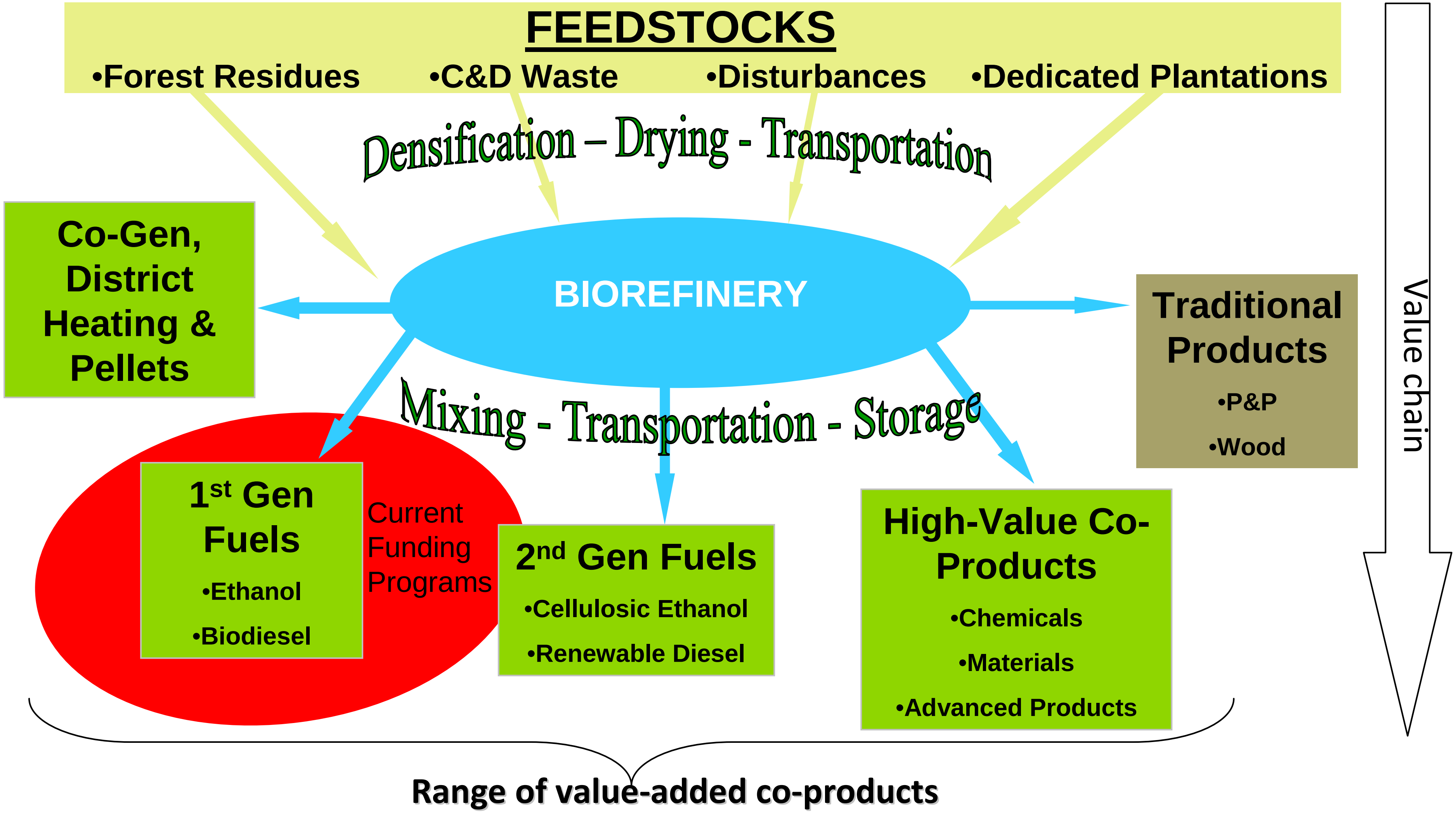
- *Global recession and US housing downturn*
- *Credit/capital availability*
- *Low commodity prices*
- *AFMTC, BCAP*



A Mix of Traditional and Emerging Products Offer a More Promising Future



Investing beyond energy: Example of a forest sector biorefinery



Climate Policy and Industry Renewal

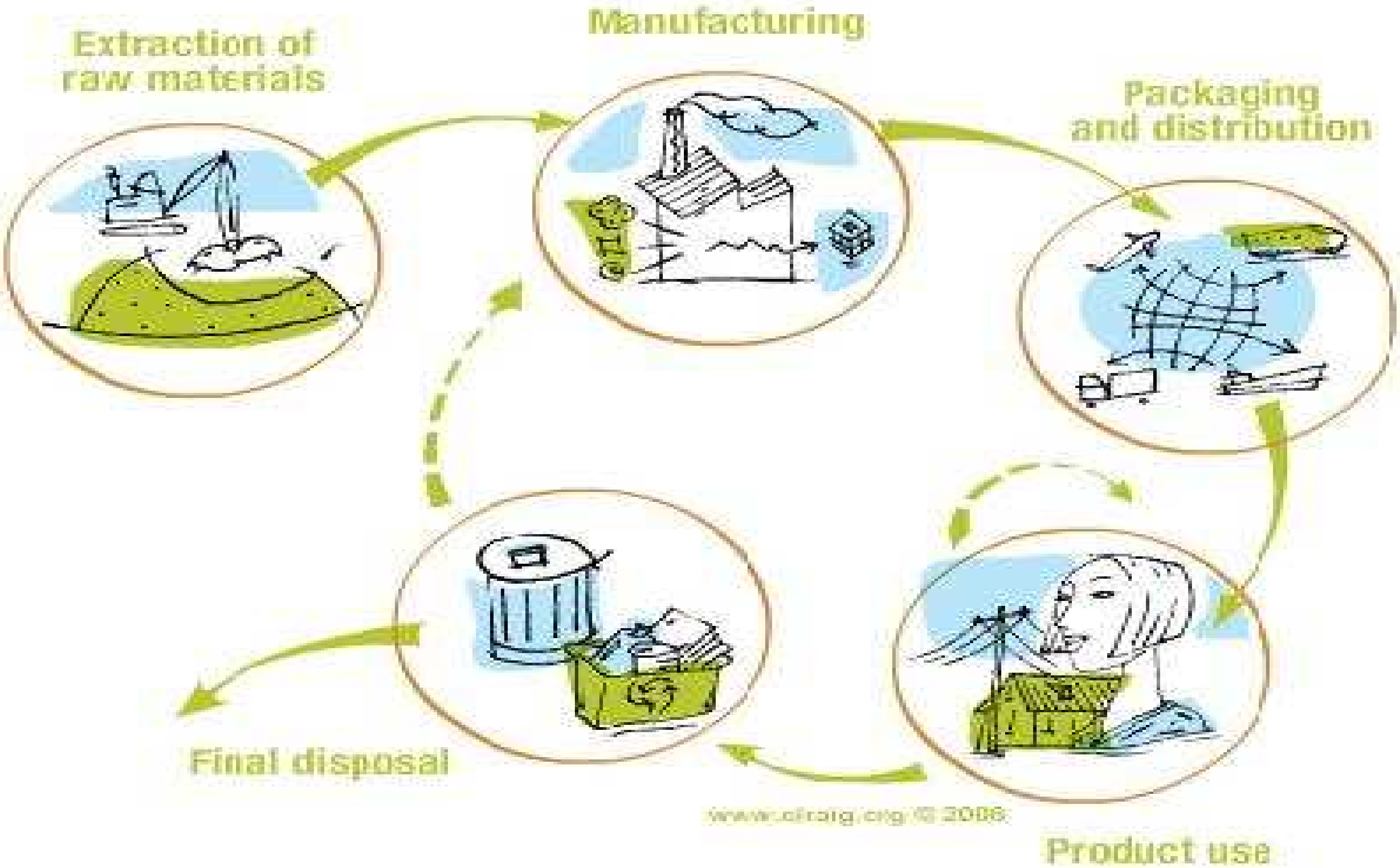
- Climate, renewable energy policy a key driver of biorefining opportunities worldwide
- Carbon Pricing can be material to the economics of many emerging opportunities
- Rising energy prices & other policies can make some opportunities attractive even without an emissions price

Climate Change and Forest Resources

- Biofuels and Biorefining will increase demand for wood fibre
- Growing demand for agricultural products will compete for land base
- Changing climate likely to increase yield & disturbances

Putting a Brave Face on Climate Policy

The life cycle of a product



Comparison of Wall Assemblies

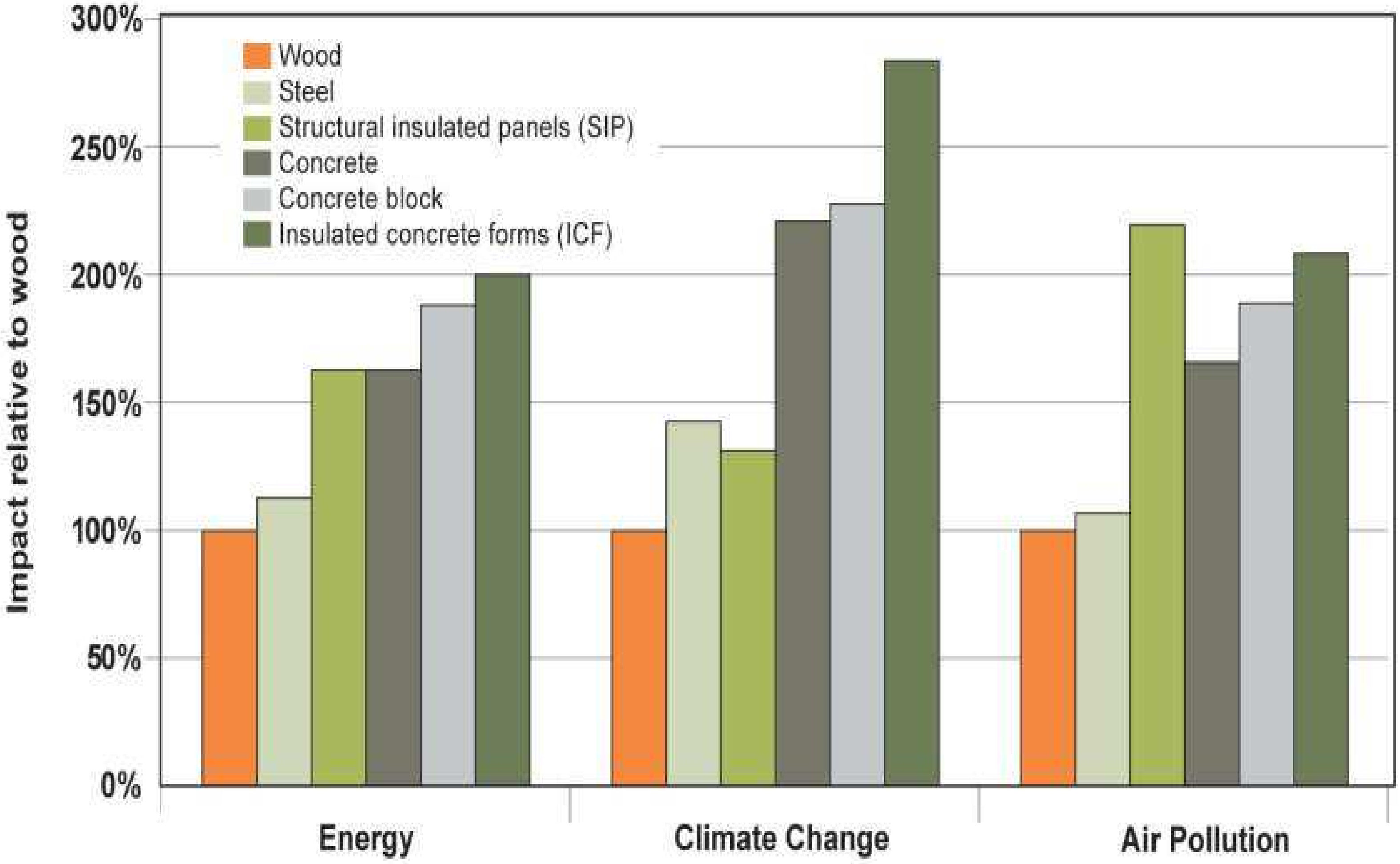


Image from FPInnovations

Embodied environmental impacts of various exterior wall assemblies

Background: Summary of Copenhagen Outcomes

- **Copenhagen outcomes**
  - ✓ *A lot of progress but more time is needed: agreed to continue with negotiations to reach agreement in late 2010*
  - ✓ *While arcane and technical, negotiations on forests significant to industry from regulatory, market reputation standpoint*.

COP15 COPENHAGEN

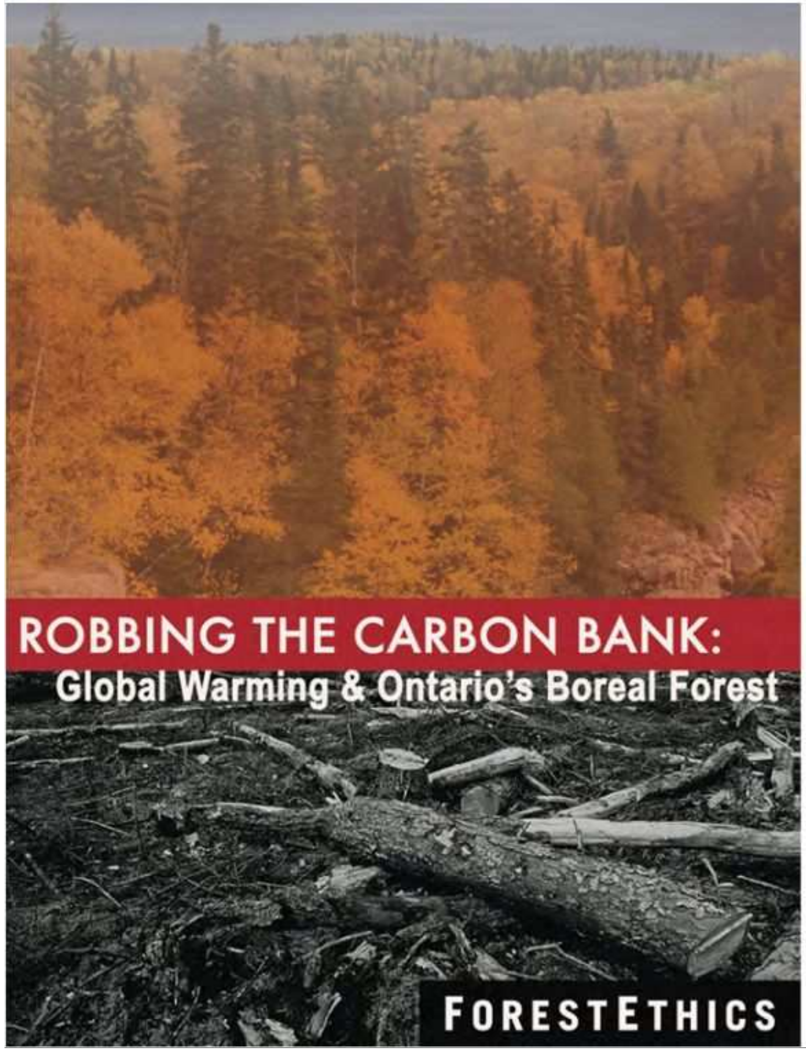
Forests in the Negotiations

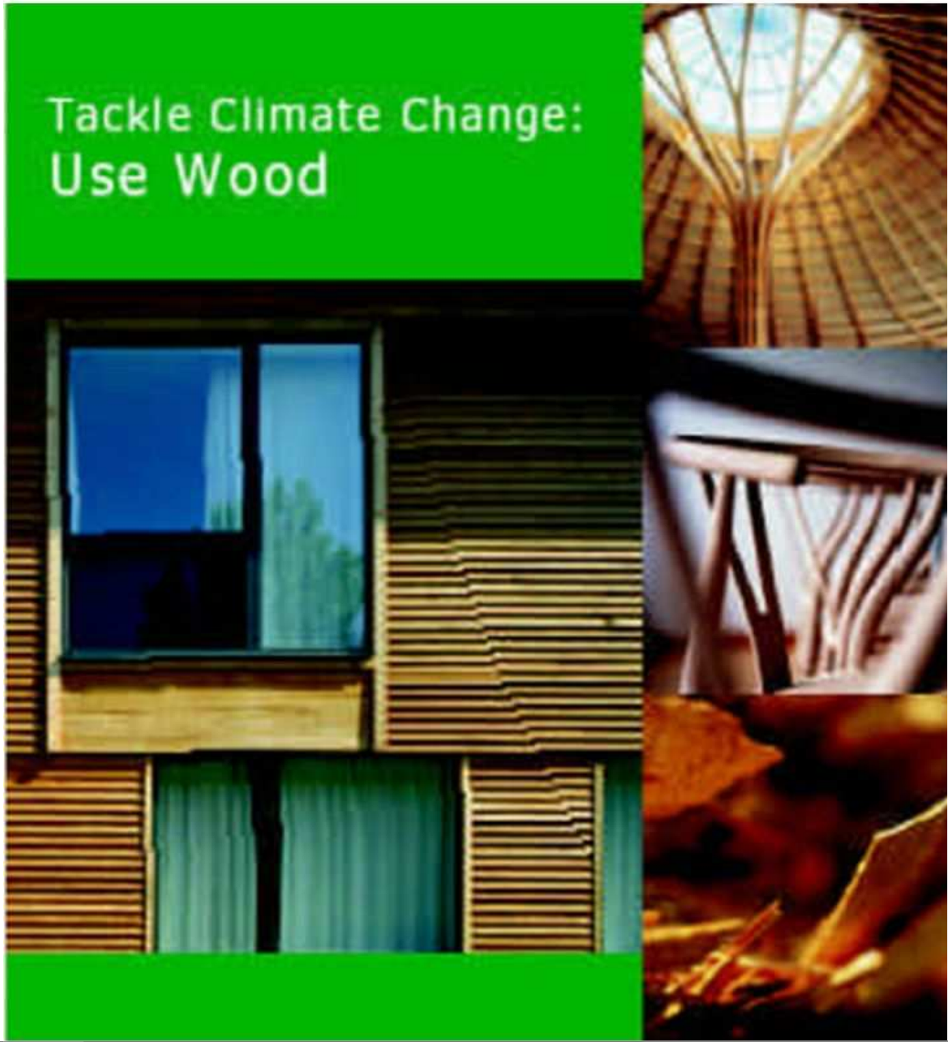
- Forests included in negotiations on land use, land-use change and forestry (LULUCF)
- Forests included in negotiations on reducing emissions from deforestation and forest degradation (REDD)

Climate Change is Shifting the Market Debate on Sustainability Issues

Stop logging .....

... or use wood?






Je touche du bois!
JE CONTRIBUE À LA RÉDUCTION DES ÉMISSIONS DE CO_2
Je choisis le matériau bois!
www.coalitionbois.org
Coalition BOIS
Choisir le bois à la place d'autres matériaux de construction réduit les quantités de CO_2 émises dans l'atmosphère.
L'utilisation d'un mètre cube de bois évite l'émission d'une tonne de CO_2.

Conclusions

- Despite remaining uncertainties, climate change is reshaping the forest sector
- Energy and environmental polices combined with technological innovation are creating significant new market opportunities in non-traditional products areas
- Growing public preoccupation with climate change presents an opportunity to rebrand the sector and its products.
- Global regime critical not just to regulatory framework but also to market reputations issues

THE FOREST PRODUCTS INDUSTRY AT A CROSSROADS –

SCENARIO ANALYSIS OF PORTFOLIO STANDARDS AND CAP AND TRADE POLICIES

Marilyn A. Brown and Youngsun Baek
School of Public Policy
Georgia Institute of Technology
May 3, 2010

Talent, Technology and Transformation

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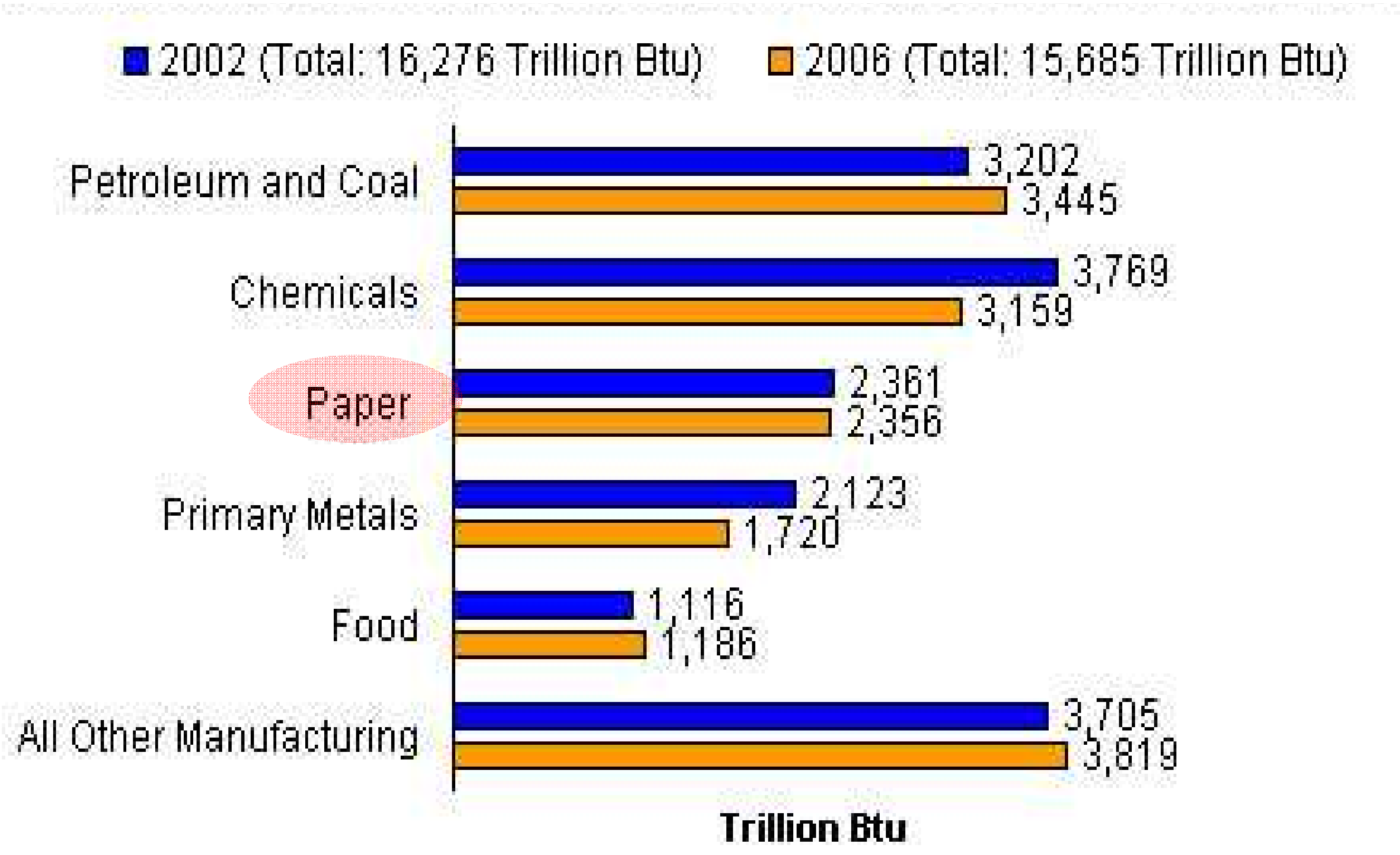
Contents

- The Pulp and Paper Industry
  - *Energy Consumption*
  - *Possible Uses of Biomass Residues*
- Energy and Climate Policies with Impacts on the Industry
  - *Renewable Electricity Standard (RES)*
  - *Carbon Cap and Trade System (CCT)*
  - *Expanded Industrial Energy Efficiency*
- Methodology: National Energy Modeling System (NEMS)
- GT-NEMS results
  - *Impacts on CO_2 Emissions, Electricity Prices, and Biomass Prices*
- Conclusions

Energy Consumption in the Paper Industry



Source: EIA, Manufacturing Energy Consumption Survey, 2002 and 2006

Evolving Energy and Climate Change Policies

- In recent years, the U.S. Congress has proposed hundreds of climate change-related proposals (Pew, 2007).
- However, the long-term operating costs and competitive advantage are uncertain.
- An increasing number of U.S. companies have been participating in voluntary greenhouse gas emissions reduction programs and registries to prepare for eventual federal regulations (Southworth, 2009).
- The existing greenhouse gas emissions reduction registries in the U.S. differ in ways that could affect the provision of credit under future federal legislation (DiMascio, 2007).

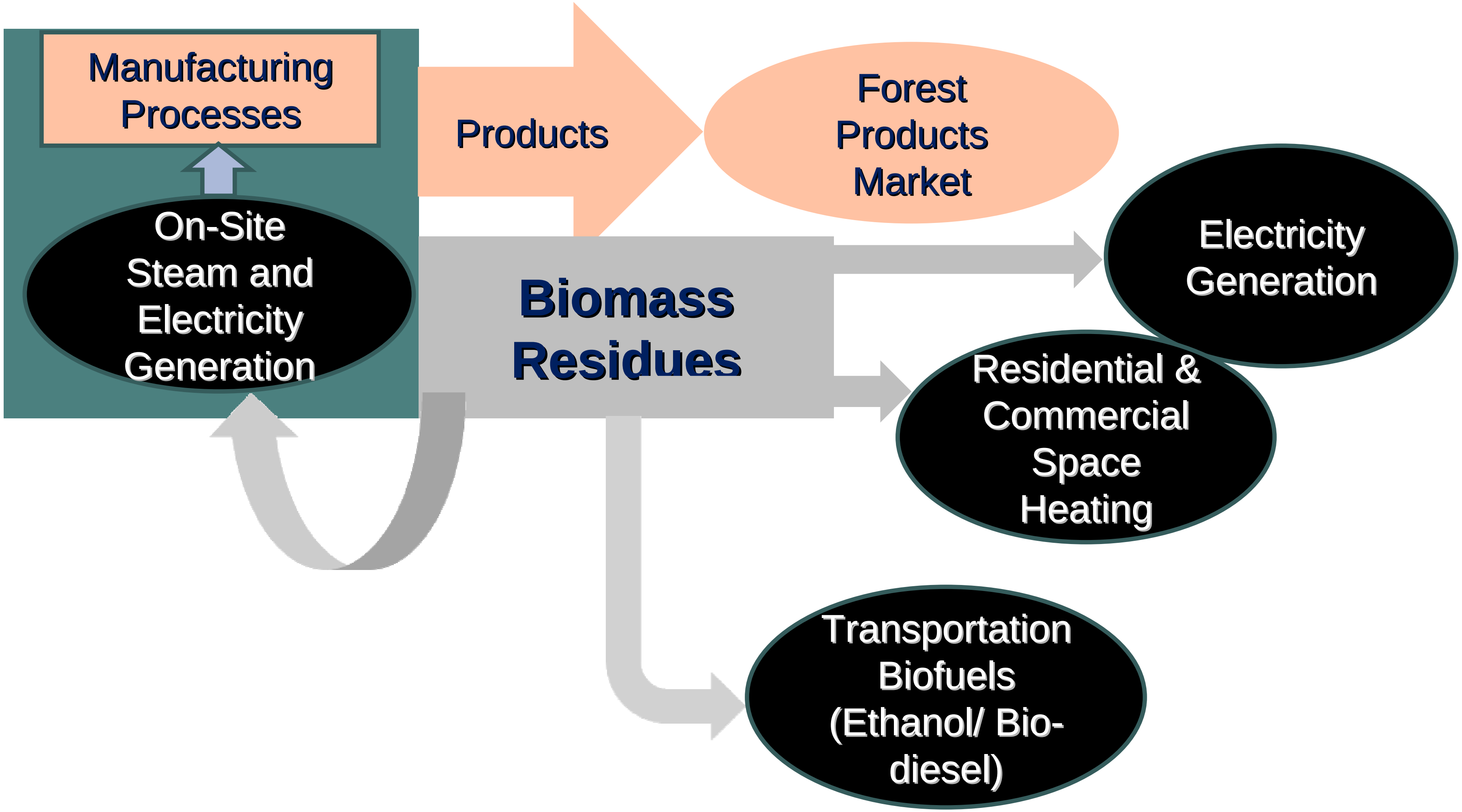
Policies with Potentially Large Impacts on the Pulp and Paper Industry

- A national renewable electricity standard (RES)
- A U.S. greenhouse gas cap and trade system
- Expansion of industrial energy efficiency policies
- Plus, recently strengthened renewable fuels standards (RFS)

→*How might forest products and biomass residues from the pulp and paper industry be utilized ?*

→*What extent would the policy changes affect the industry?*

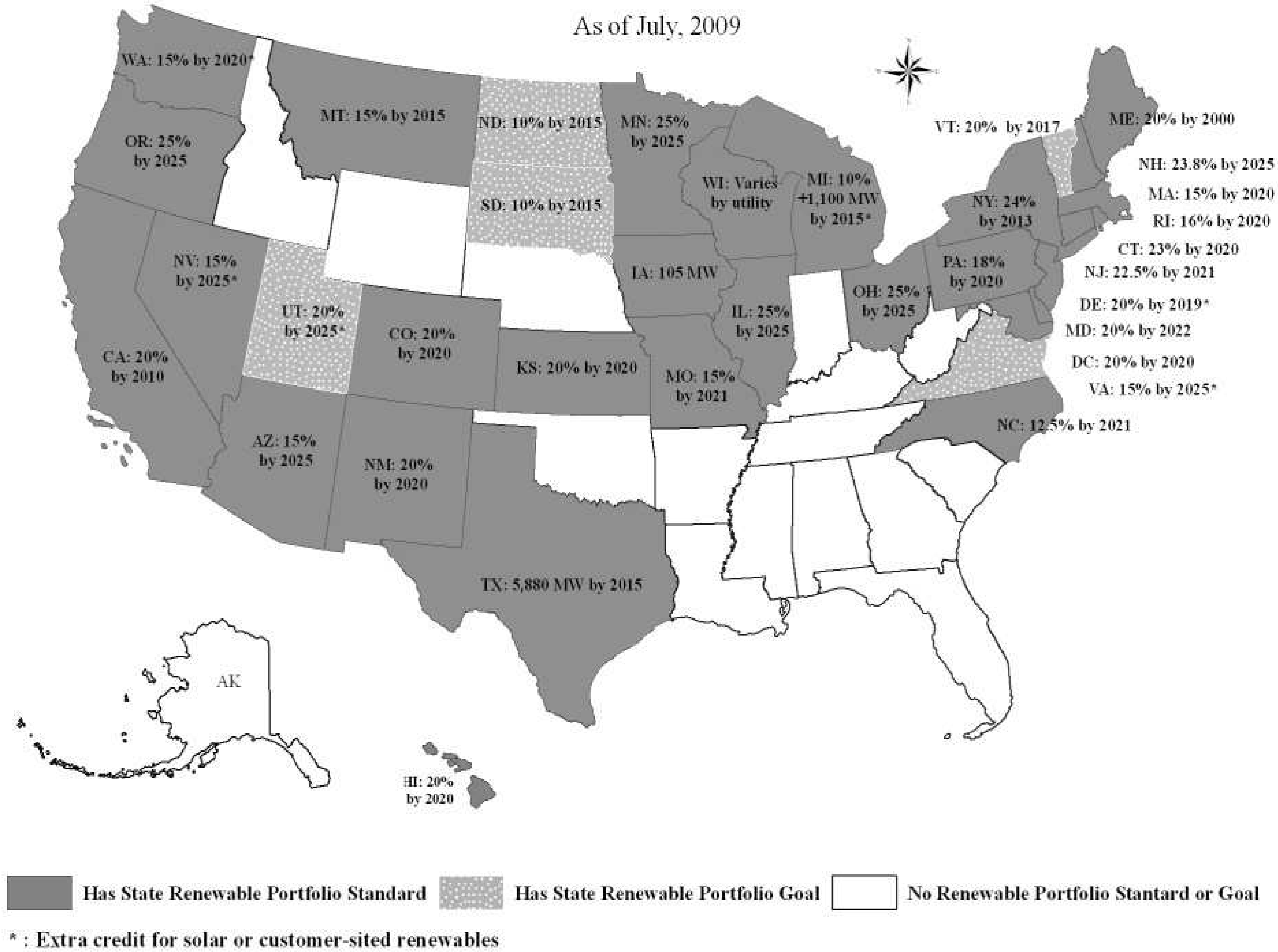
Possible Uses of Biomass Residues from the Pulp and Paper Industry



Renewable Electricity Standard (RES) (1)

- A renewable electricity standard (RES) is a legislative mandate requiring electricity suppliers in a given geographical area to employ renewable resources to generate a certain amount or percentage of renewable power by a target year.
- Typically, electricity suppliers can either produce their own renewable energy or buy renewable energy credits.
- Therefore, this policy blends the benefits of a “command and control” regulatory paradigm with a free market approach to environmental protection.

Renewable Portfolio Standards



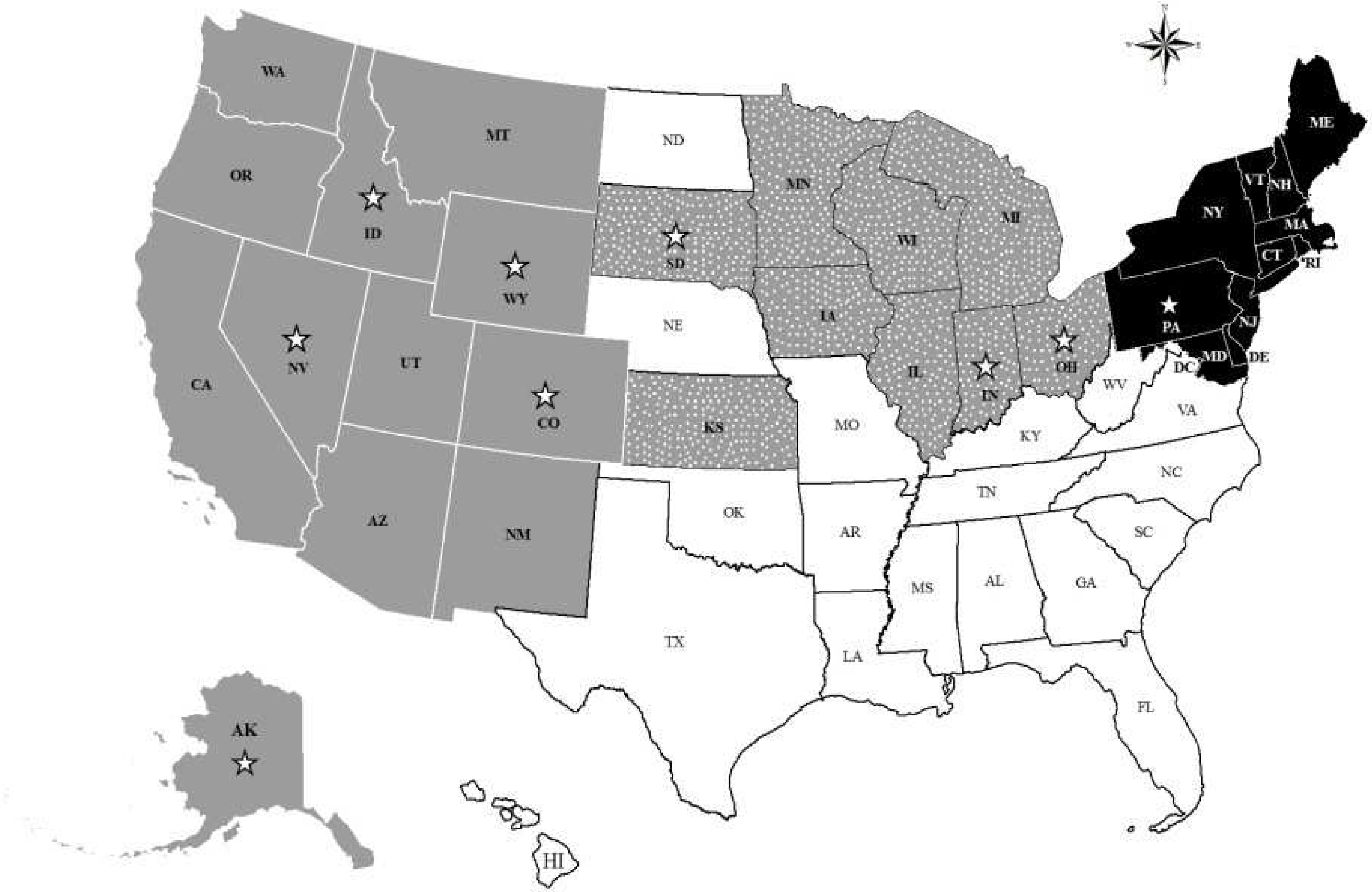
Renewable Electricity Standard (RES) (2)

- Because of the inconsistencies, and the desire to accelerate the growth of renewable power production, the U.S. Congress is considering implementation of a national standard.
- Recent Congressional proposals tend to be consistent with President Obama's campaign platform in 2008 included a commitment to 25% renewable electricity production by 2025.

Carbon Cap and Trade System (CCT) (1)

- CO_2 emissions can be controlled with various policies including energy and carbon taxes and cap-and-trade systems.
- Ten northeastern states are currently participating in the Regional Greenhouse Gas Initiative (RGGI), but more than half of the U.S. states do not even have GHG reduction goals.

Regional Carbon Cap and Trade Initiatives



■ Western Climate Initiative ■ Regional Greenhouse Gas Initiative ☆ Observer

▒ Midwest Greenhouse Gas Reduction Accord □ Not in Regional Program

Carbon Cap and Trade System (CCT) (2)

- Key design features of a cap-and-trade program:
  - *Emission targets*
  - *Point of Regulation*
  - *Price Ceiling and Floor*
  - *Offsets*
  - *Banking and Borrowing*
  - *Allocation of allowances*

Expanded Industrial Energy Efficiency

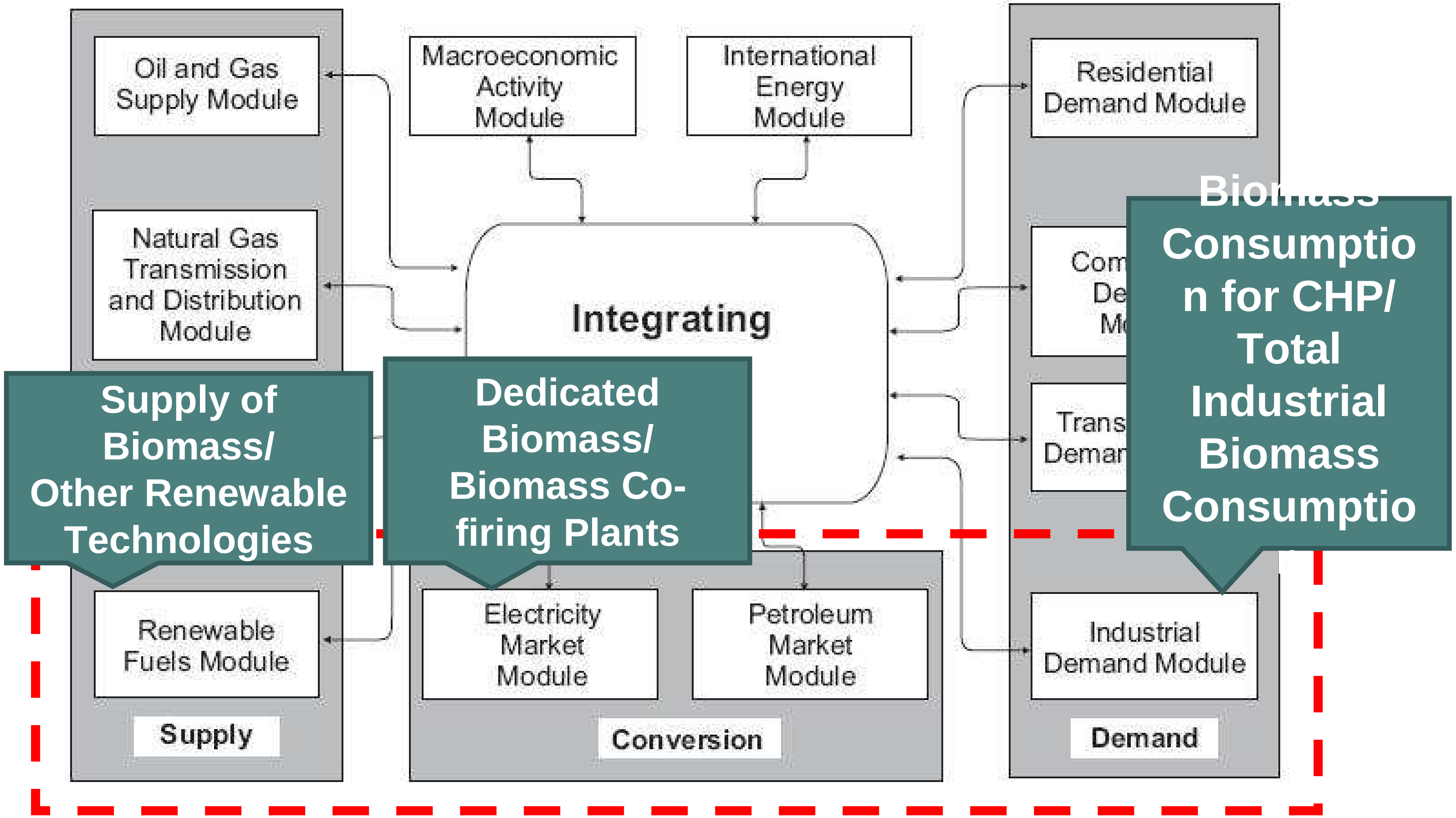
- The pulp and paper industry is able to cut its energy consumption by investing in improved equipment and practices that will pay for themselves through reduced energy bills.
  - *Industrial assessment for upgrading plant utility*
  - *Acceleration of the use of Combined Heat and Power (CHP) equipment*
  - *Manufacturing process improvement*

(Note – We are in the process to model industrial energy efficiency and will have more complete results shortly.)

Renewable Fuels Standard (RFS)

- A renewable fuels standard (RFS) is a policy instrument used to expand the displacement of gasoline and diesel with renewable fuels.
- Such fuels are defined in the Energy Policy Act of 2005 (EISA 2005) as a motor vehicle fuel that is produced from plant or animal products or wastes, as opposed to fossil fuel sources.

Methodology: National Energy Modeling System (NEMS)



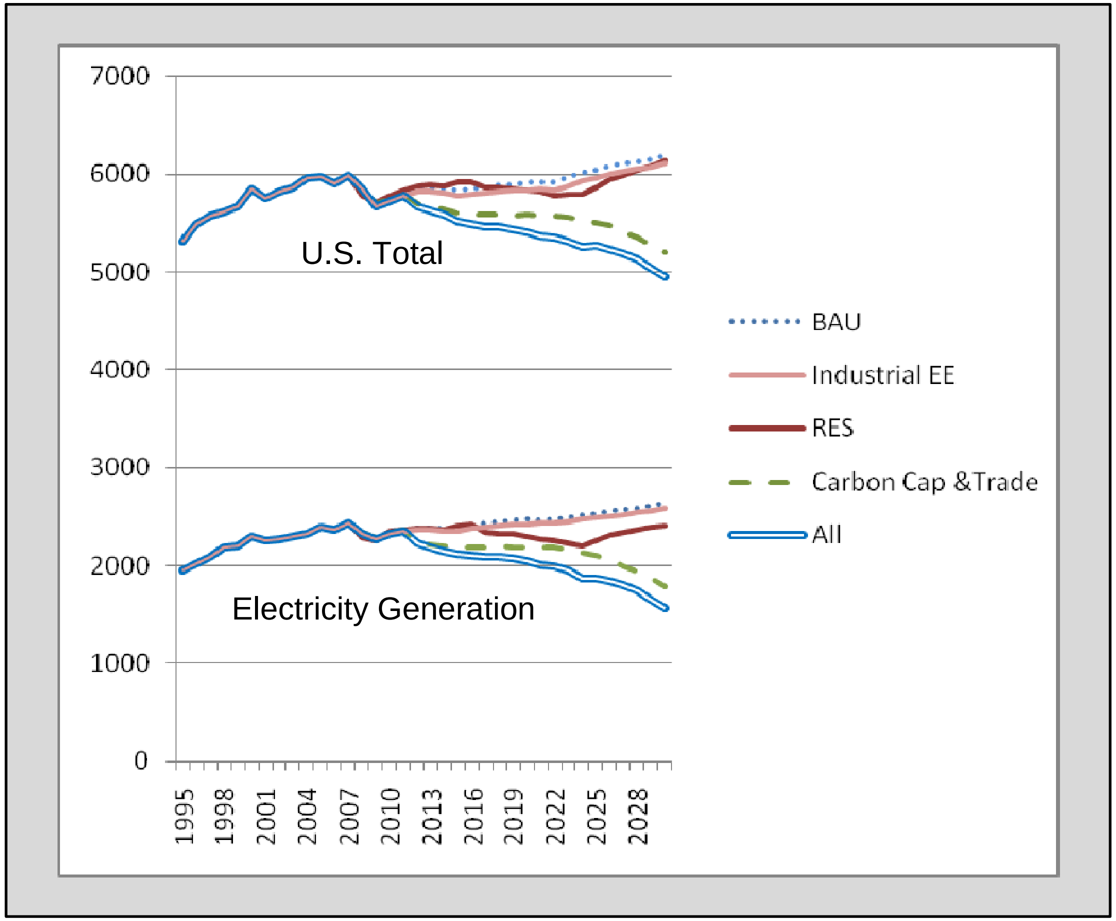
Source: National Energy Modeling System: An Overview 2003, EIA 2003

Detailed Policies modeled in GT-NEMS

- RES (Obama's Pledge)
  - *10 percent of U.S. electricity would come from renewable sources by 2012, and 25 percent by 2025*
- CCT
  - *Carbon tax prices: Start at $15 per ton of CO_2(2005 dollars) in 2012 growing at 7% annually and reach $51per ton in 2030*
  - *Allowance redistribution system: Gives 90% of allowances to electricity load serving entities and 10% to generators*
- Industrial EE
  - *DOE's industrial energy savings assessment programs*
  - *Tax credits and R&D activities focused on the use of combined heat and power (CHP)*
  - *Manufacturing process efficiency improvement*
  - *20% installation subsidy for CHP equipment*
- RFS
  - *Already modeled in a NEMS BAU scenario*

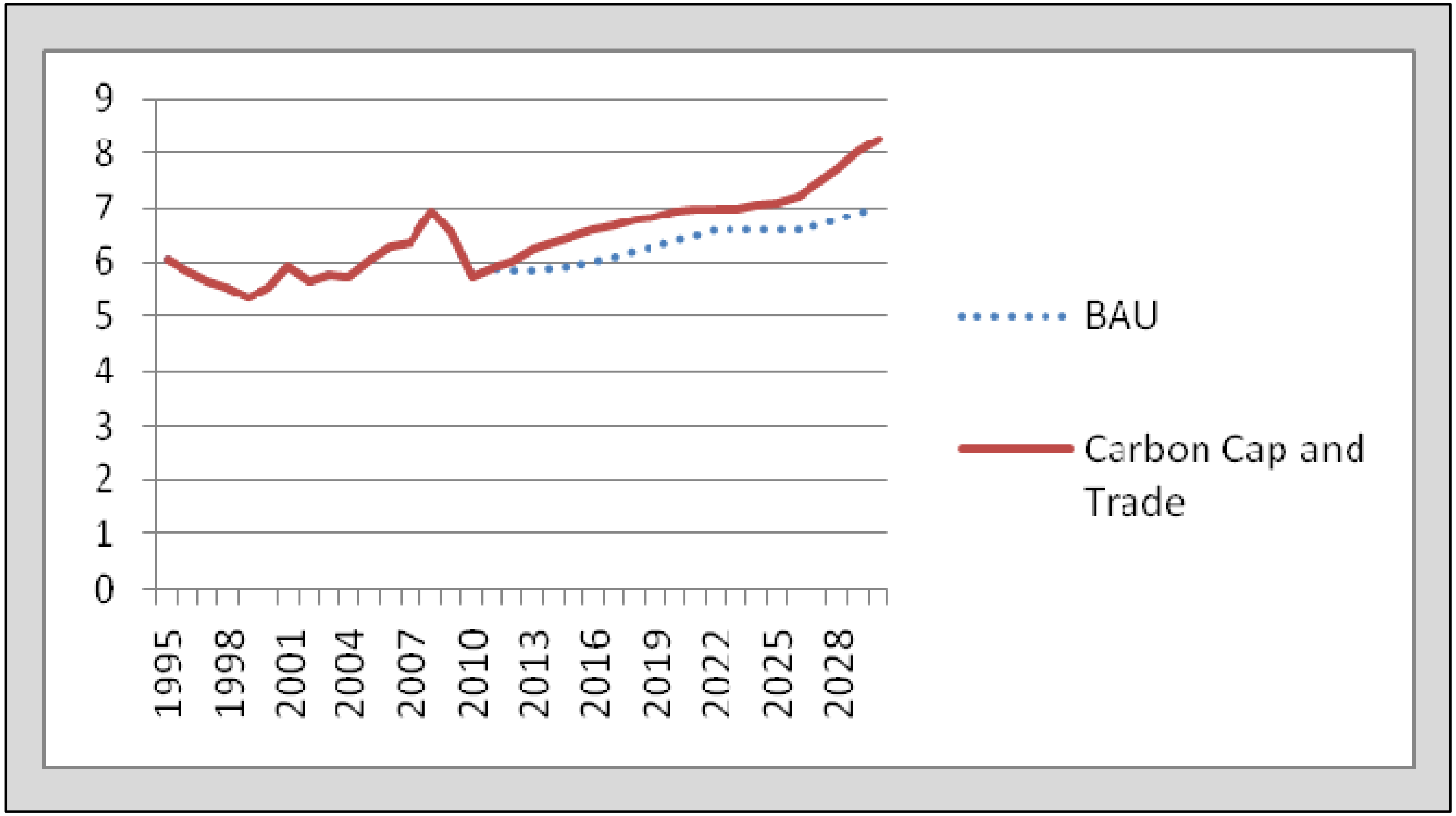
Note – Projections from the GT-NEMS could be different from projections from the original NEMS

CO_2 emissions from electricity generation could decline to pre-1995 levels by 2030



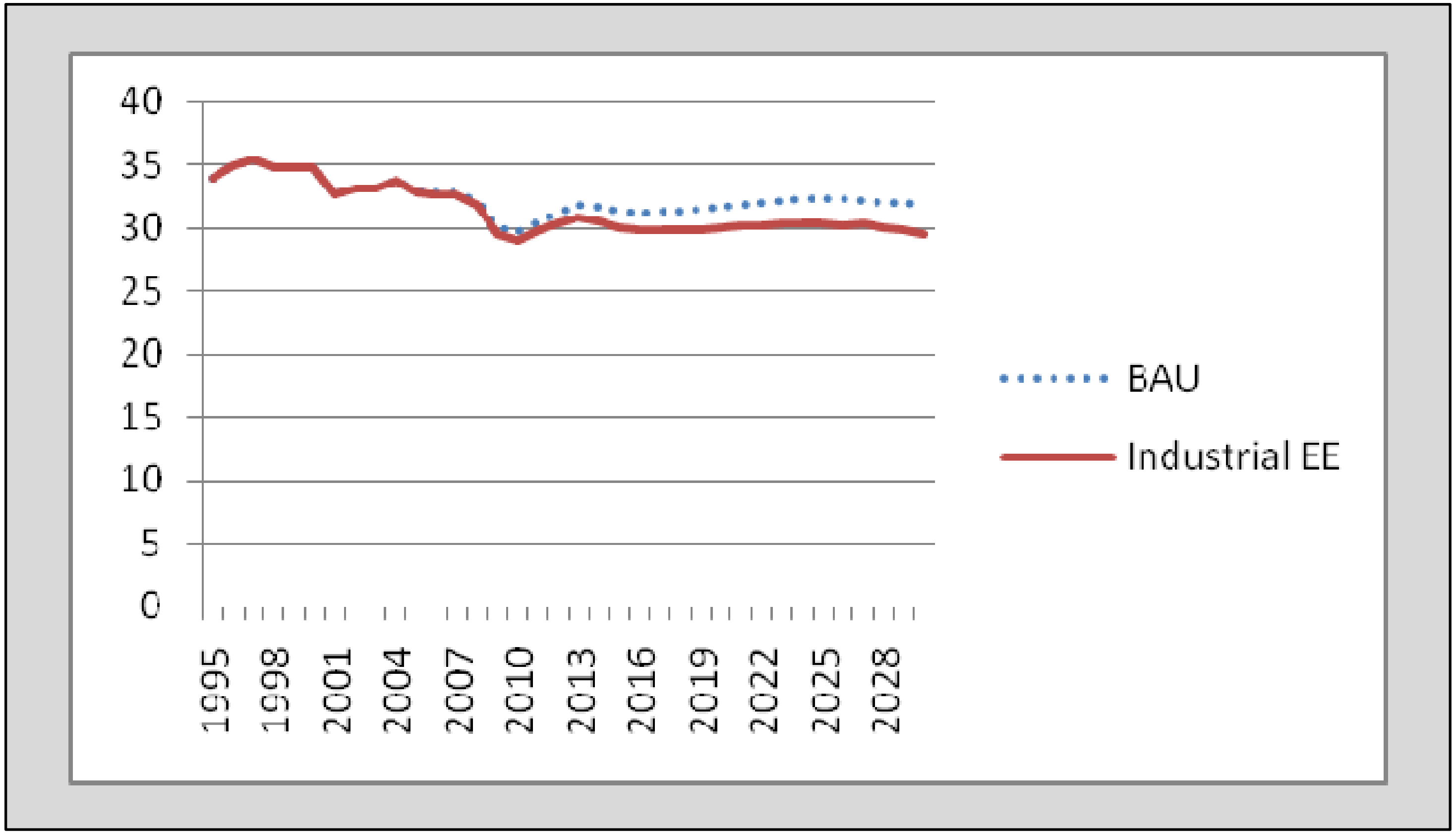
(million metric tons carbon dioxide equivalent)

Carbon Cap and Trade would result in increased industrial electricity prices



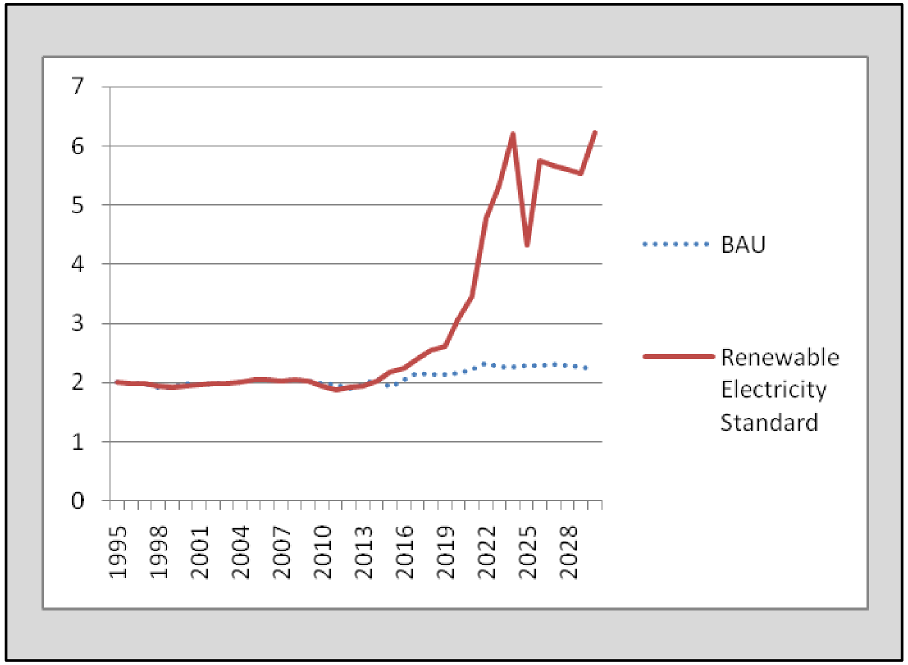
Industrial Electricity Price Projections (2007 cents per kilowatt-hour)

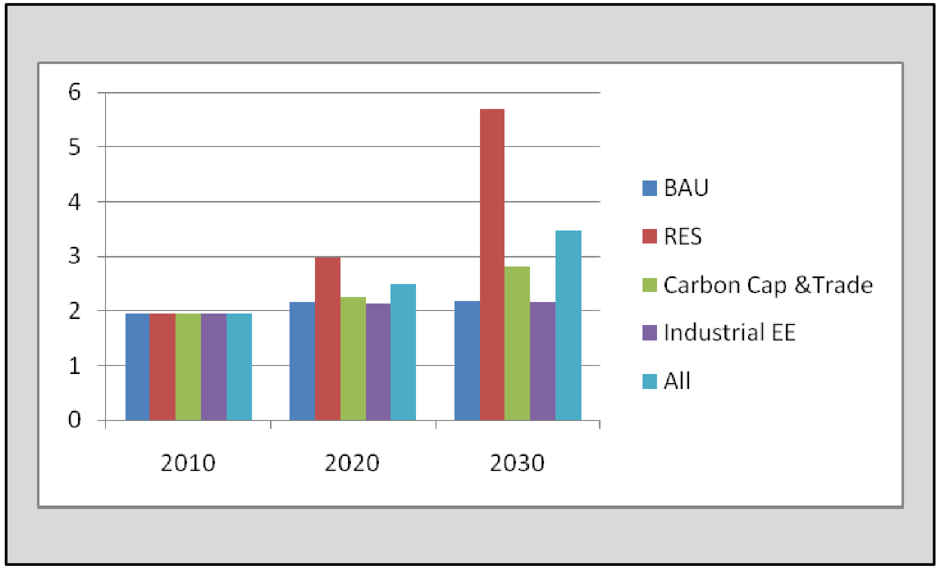
Industrial EE policies would contribute to reducing energy consumption in industry by 5% in 2020 and 7% in 2030



Total Industrial Energy Consumption (quadrillion Btu, unless otherwise noted)

RES leads to higher biomass prices in the electric power sector





Biomass Price Projections in the Electric Power Sector (2007 dollars per million Btu)

Energy and Climate Policy Impacts: Estimated Percentage Changes in 2020 and 2030

	Federal Renewable Electricity Standard	National Policy of Carbon Constraints	Industrial Energy Efficiency Policies	All (Three Combined Policies)
Point of Impact	Electricity Suppliers	Mostly "Upstream" GHG Sources	Industrial Sector Energy End-Users	Upstream Through Downstream
CO_2 Emissions from Electricity Generation	-7% (2020) -9% (2030)	-11% (2020) -32% (2030)	-2% (2020) -2% (2030)	-17% (2020) -41% (2030)
Industrial Electricity Price	+5% (2020) -5% (2030)	+10% (2020) +20% (2030)	-3% (2020) -4% (2030)	+5% (2020) +17% (2030)
Biomass Price in Electric Power Sector	+37% (2020) +160% (2030)	+4% (2020) +28% (2030)	-1% (2020) -1% (2030)	+15% (2020) +58% (2030)
Total Industrial Energy Consumption	-5% (2020) +1% (2030)	-1% (2020) -1% (2030)	-5% (2020) -7% (2030)	-6% (2020) -9% (2030)

Conclusions

- Each policy reduces CO_2 emissions, and as a package, the three policies could cut CO_2 emissions from the electricity sector by estimated 42%.
- The RES and carbon cap and trade policies have the largest effects in this regard.
- These policies would increase the price of timber and other forest-based biomass inputs, relative to a business as usual scenario.

continued

Conclusions – *Continued*

- The carbon cap and trade policy can result in a 10 to 20% increase in the price of industrial electricity, but this increase could be moderated by expanding industrial energy efficiency programs as “complementary policies”.
- These results underscore the value of designing a portfolio of climate policies that can achieve the desired reduction in CO_2 emissions at minimal expense to the economy.

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Supplementary Charts

- S-1. Biopower Supply Changes in 2020 and 2030
- S-2. Biofuel Demand Changes in 2020 and 2030

Biopower Supply Changes in 2020 and 2030

	BAU	Federal Renewable Electricity Standard	National Policy of Carbon Constraints	Industrial Energy Efficiency Policies	All (Three Combined Policies)
Biopower Supply (billion kWh)	92 (2020) 124 (2030)	382 (2020) 637 (2030)	232 (2020) 282 (2030)	92 (2020) 116 (2030)	359 (2020) 565 (2030)
Share of Biopower to Total Electricity (%)	2.00% (2020) 2.46% (2030)	8.25% (2020) 12.39% (2030)	5.12% (2020) 5.82% (2030)	2.00% (2020) 2.34% (2030)	8.00% (2020) 11.92% (2030)

Biofuel Demand Changes in 2020 and 2030

	BAU	Federal Renewable Electricity Standard	National Policy of Carbon Constraints	Industrial Energy Efficiency Policies	All (Three Combined Policies)
E85 Demand (quadrillion Btu)	0.71 (2020) 1.79 (2030)	0.81 (2020) 2.22 (2030)	0.69 (2020) 2.55 (2030)	0.75 (2020) 1.70 (2030)	0.66 (2020) 2.40 (2030)
Share of E85 to Total Transportation Consumption	2.43% (2020) 5.71% (2030)	2.77% (2020) 6.97% (2030)	2.40% (2020) 8.30% (2030)	2.57% (2020) 5.50% (2030)	2.31% (2020) 7.87% (2030)

Carbon Management –
The Role of Innovation and New Technologies

Ron Brown

Agenda 2020 Technology Alliance

May 3, 2010

Talent, Technology and Transformation

PaperCon 2010 may 2 - 5 atlanta ga

The Call For Innovation

PriceWaterhouse Coopers 22nd Annual Global Forest & Paper Industry Conference – Re-energising the forest, paper and packaging industry, May 14, 2009

"Innovation will be key. Forest, paper, and packaging companies must develop new and creative strategies to reduce costs, improve margins, and implement new solutions."

The Call For Innovation – CEO perspectives

PriceWaterhouse Coopers, "CEO Perspectives: Viewpoints of CEOs in the forest, paper & packaging industry worldwide," 2010 Edition

". . . innovation will be necessary to maintain competitiveness in existing core business areas. Companies will need to innovate in nearly every realm – around products, processes, end-uses, and markets."

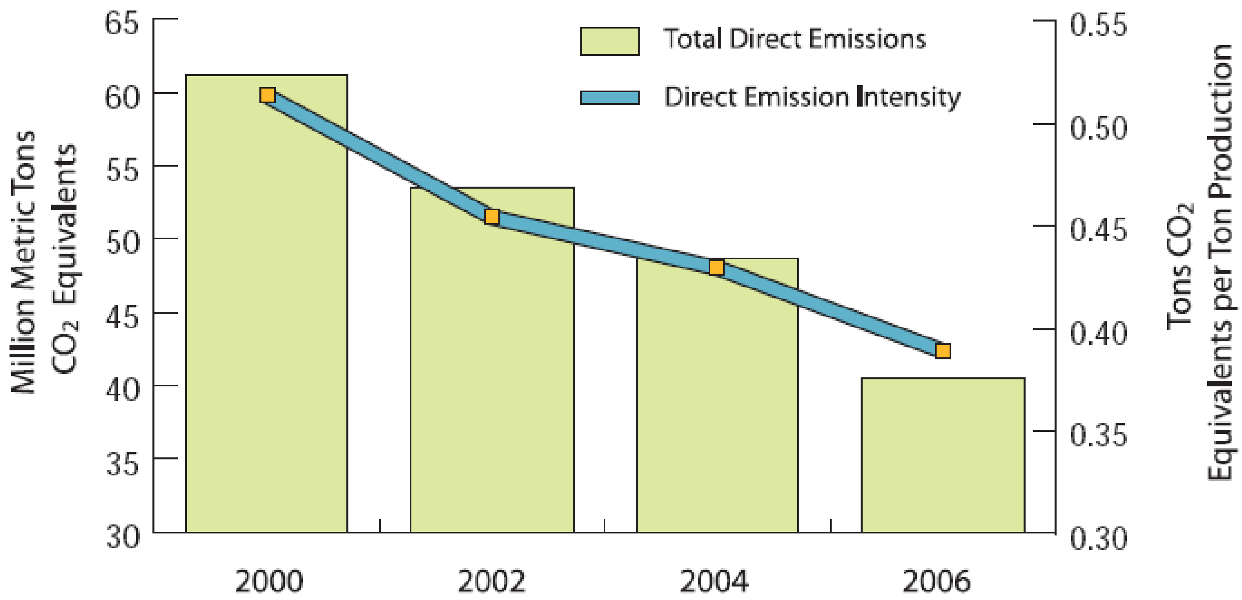
Innovation In Managing Greenhouse Gas Emissions

Achieving large reductions in greenhouse gas emissions in the forest products industry will require substantial innovation and the development of new technologies.

The U.S. forest products industry has made progress in reducing greenhouse gas emissions

AF&PA member companies from 2000 to 2006:

- *Reduced intensity of greenhouse gas emissions by 13.6%*
- *Reduced total emissions by 24.6%*



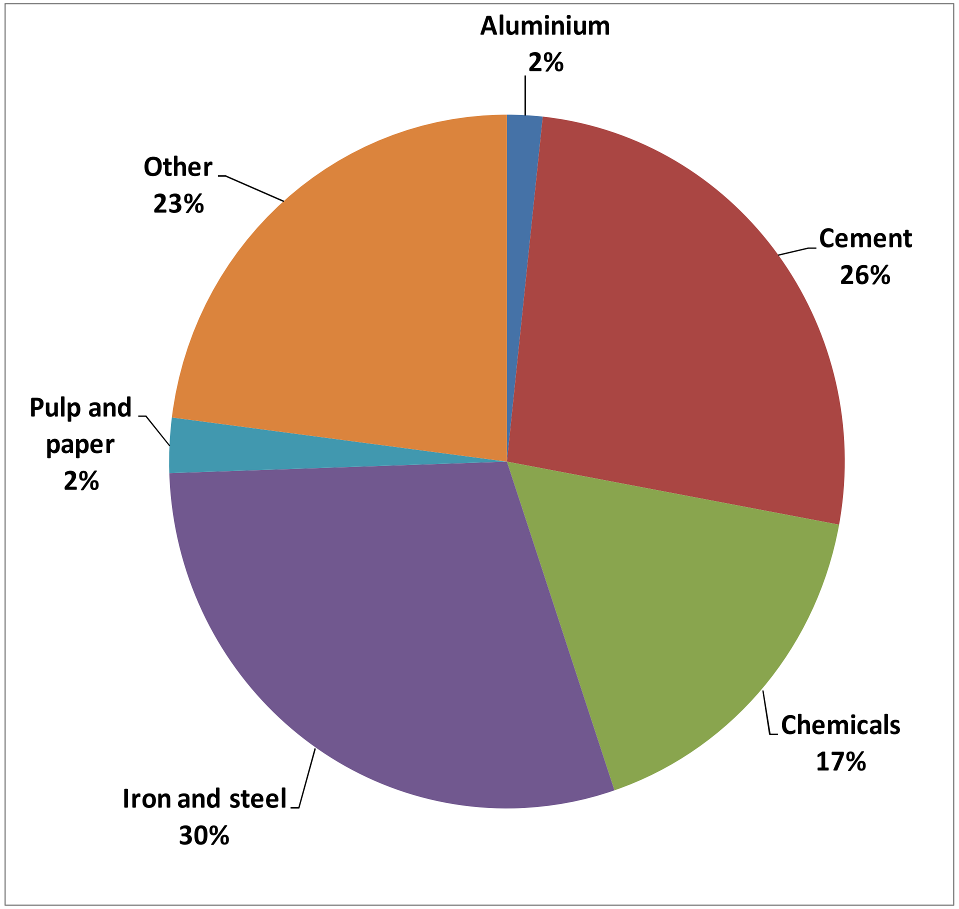
Source: AF&PA Environmental, Health, and Safety Biennial Report 2008

Several Factors Influence GHG Emissions From The Forest Products Industry

- Emissions from fossil fuel use
  - *Direct emissions – 40.5 million metric tons of CO_2 equivalents in 2006*
  - *Indirect emissions – 25.8 million metric tons in 2006*
  - *Fossil fuel consumption down 9.2% from 2004 to 2006, down 56% from 1972 to 2006*
- Reductions in GHG by recycling of paper
  - *21.1 million metric tons of CO_2 equivalents avoided in 2006*
- Removal of GHG through sequestration in forests and carbon storage in products
  - *23.8 million metric tons of CO_2 equivalents stored in products in 2006*

Source: AF&PA Environmental, Health, and Safety Biennial Report 2008

Pulp and paper is a small part of the total direct CO_2 emissions worldwide



Pulp and paper is 2% of world total.

Pulp and paper industry is low in part because of the high levels of biomass energy used

Source: International Energy Agency data for 2007

IEA – Available technologies can reduce GHG emissions and energy consumption

International Energy Agency – industry sector analysis, 2007 data – pulp and paper:

Best available technologies can:

- *Reduce energy consumption 25%*
- *Reduce CO_2 emissions 20%*

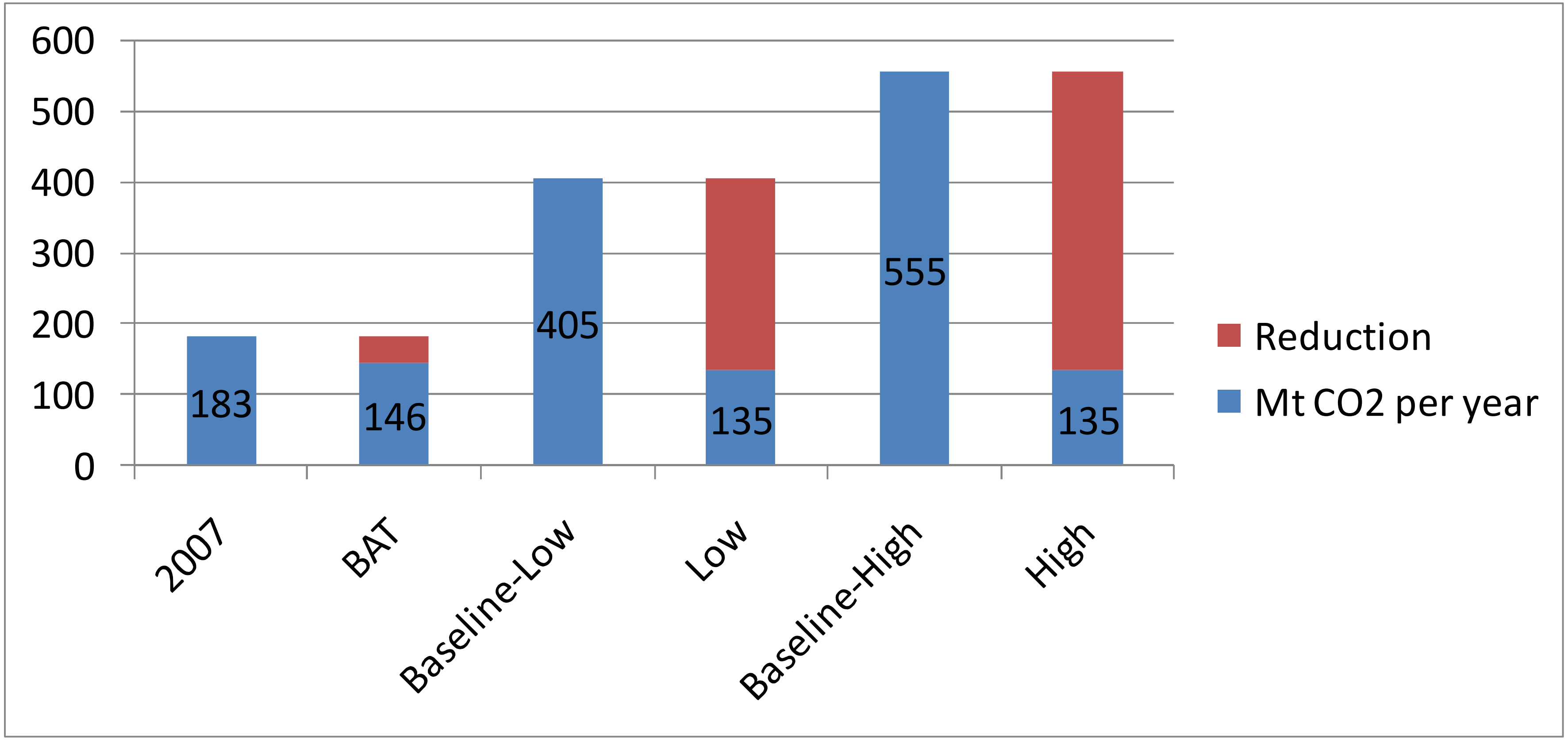
- 64% from improved thermal efficiency
- 18% from higher recycling – raise global average recovery from 54% to 60%
- 18% from greater use of combined heat and power (CHP) systems

IEA Scenarios For Reducing GHG Emissions Through 2050

- Baseline – expected growth through 2050
  - *Low demand – 800 million metric tons of pulp in 2050*
    - Total GHG emissions increase by 100% from 2007
  - *High demand – 1100 million metric tons of pulp in 2050*
    - Total GHG emissions increase by 120% from 2007

- Scenarios – reduce total emissions by 50% and direct emissions by 25% from 2007 levels for all industries combined

New technologies are needed to reduce direct emissions to target 2050 levels in pulp & paper

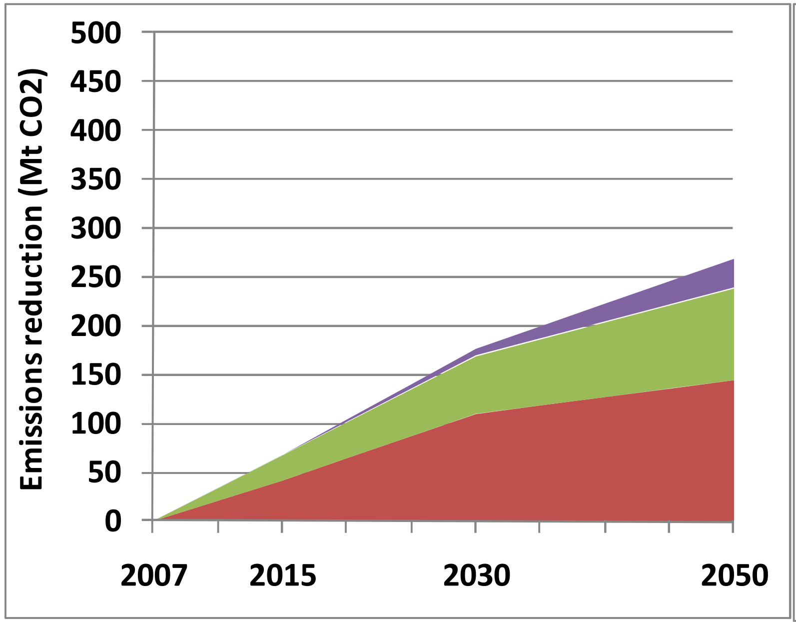


Source: International Energy Agency

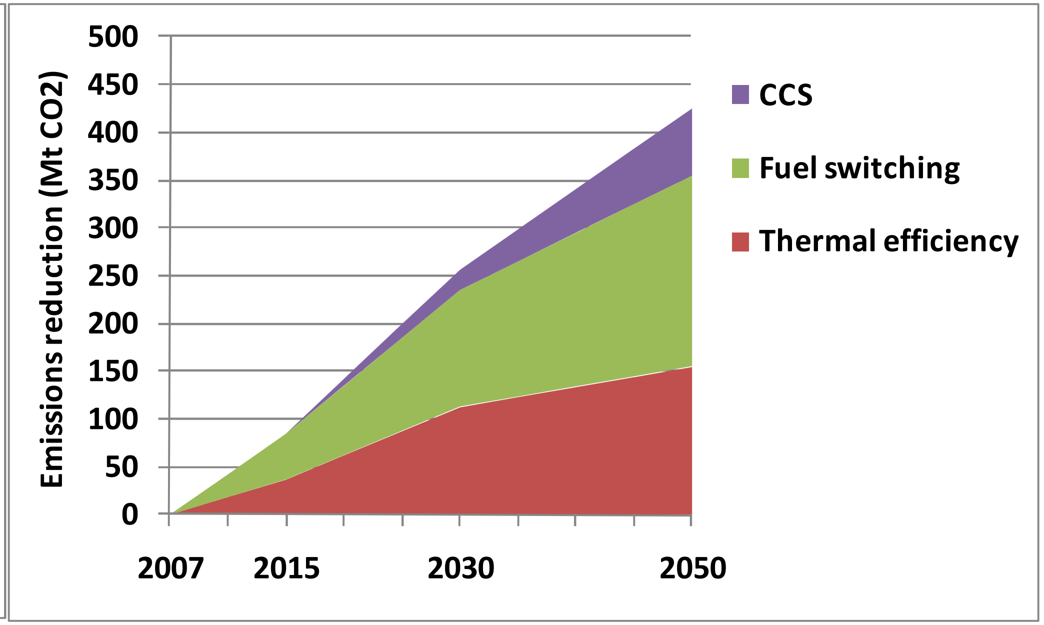
New Technologies Cited By IEA For Pulp & Paper

- Biomass conversion to fuels and chemicals
- Gasification of biomass and black liquor to fuels
- Advanced water removal techniques in papermaking
- Reduced water in pulp washing and papermaking
- Carbon capture and sequestration (combined with gasification)
- Call for other technologies

Reductions in direct emissions from baseline in pulp and paper through 2050



Low-Demand



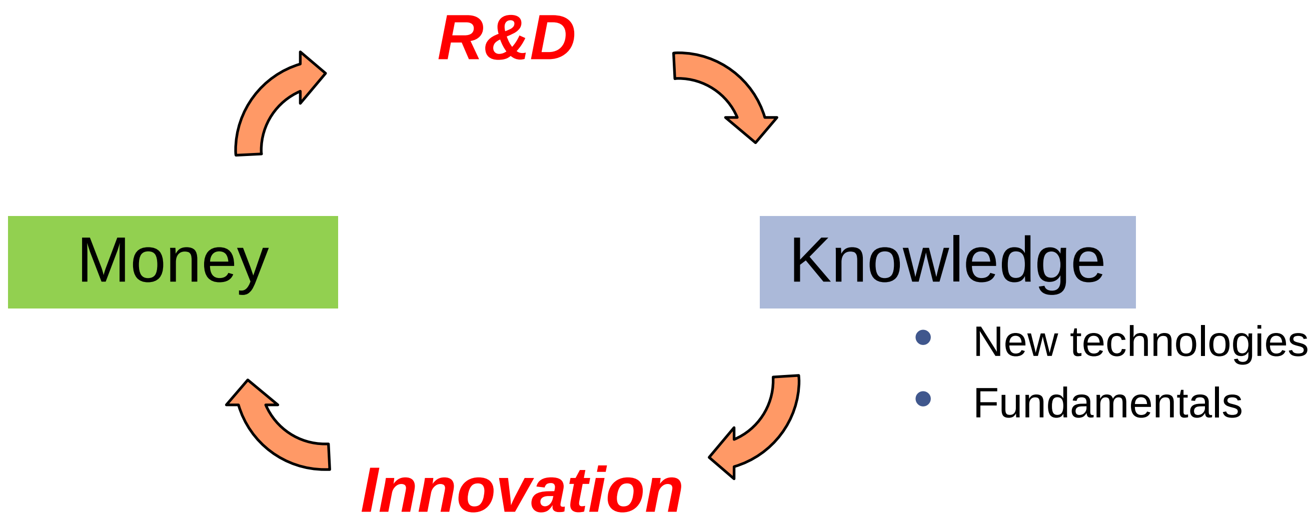
High-Demand

Source: International Energy Agency

To Achieve Target Levels Of GHG Emissions . . .

- Need many innovations
- Need good ideas and new approaches
- Look worldwide for new technologies
- Nurture collaborations among universities, research labs, government agencies, and companies
- Promote commercial demonstrations of new technologies

R&D and Innovation



Innovation is enhanced by the knowledge generated by R&D

What R&D Programs Should Be Pursued?

- *2010 Forest Products Industry Technology Roadmap*
  - *Newly released*
  - *More than 100 experts contributed*
  - *Led by Agenda 2020 in partnership with IPST @ Georgia Tech*
  - *Builds on the success of the 2006 Roadmap*
  - *Calls for R&D programs to address the priority needs*

- Two-stage process for developing the Roadmap
  - *Business and societal issues*
  - *Technology roadmapping*

2010 Forest Products Industry Technology Roadmap – Areas of Focus

- Reduce energy consumption and carbon emissions
- Reduce fresh water intake by 50%
- Increase supply of woody biomass
- Get value from woody biomass in new ways
- Enable new products and product features
- Improve recovery and recycling of waste products

Each of these areas can impact the GHG emissions profile of the industry

Reduce Energy Consumption And Carbon Emissions – 2010 Roadmap Objectives

- Reduce energy intensity in manufacturing by 25%
- Eliminate use of fossil fuels
- Generate power and energy more efficiently with 25% lower GHG emissions
- Reduce CO_2 emissions with novel mill-based capture techniques

Reduce Energy Intensity In Manufacturing By 25%

Potential R&D projects

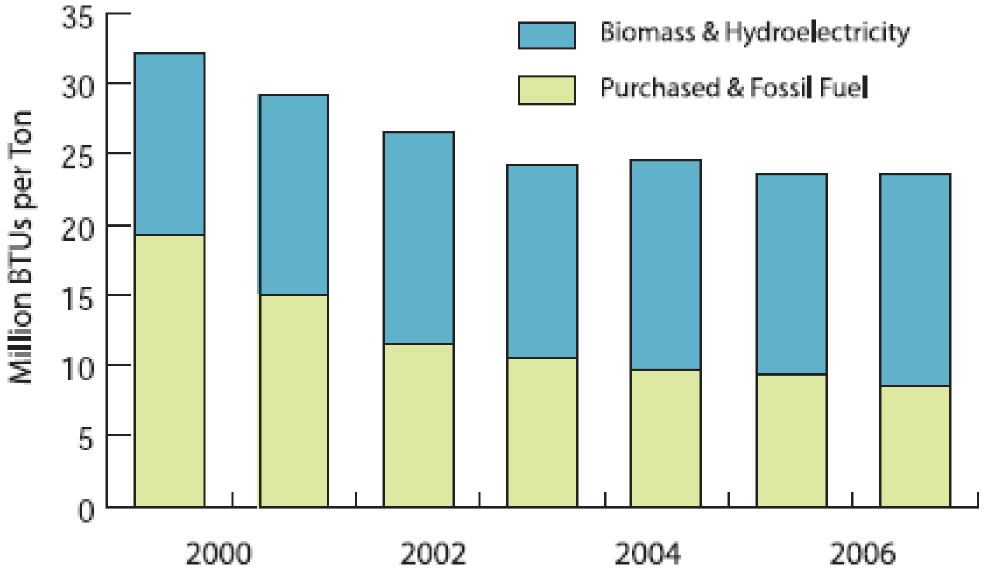
- Deliver a drier sheet to the paper machine dryer section
- Reduce energy for black liquor concentration by 50%
- Reduce pulp washing water usage
- Better recover and utilize waste heat
- Increase pulping consistency to 30% from 15%-16%
- Develop a next-generation refiner for more efficient mechanical pulping
- Reduce energy intensity of pulp refining and fiber preparation
- Use steam more efficiently in manufacturing processes
- Improve lime kiln efficiency
- Reduce energy use in chemical pulping
- Dry wood more efficiently
- Reduce process water needs to that which enters with wood
- Reduce fiber in products

Eliminate Use Of Fossil Fuels

Potential R&D projects

- Use biomass to replace fossil energy – renewable source for non-steam thermal demand
- Eliminate fossil fuel use in lime kiln
- Better utilize lignin as an energy source
- Find waste streams that can be sources of energy
- Use internally generated solid waste streams as fuel

Good Progress In Reducing Fossil Fuel Use With Available Technologies



- Recent and announced projects will further reduce fossil fuel use in the industry.

Source: AF&PA Environmental, Health, and Safety Biennial Report 2008

Generate Power And Energy More Efficiently With 25% Lower GHG Emissions

Potential R&D projects

- Improve energy efficiency of recovery boilers
- Generate more by-product electric power
- Develop new materials to enable high temperature operation of steam-generating boilers (especially recovery boilers)
- Significantly improve fluidized-bed boilers to achieve high steam values and power values
- Develop advanced gasification combined-cycle technologies for black liquor and solid forest-based biomass
- Develop and deploy practical, cost-effective black liquor gasification

Reduce CO_2 Emissions With Novel Mill-based Capture Techniques

Potential R&D projects

- Recover CO_2 from lime kiln stack and use it synergistically in the mill
- Grow algae or other biomass as fuel with CO_2 feed

2010 Roadmap Can Help Reduce GHG Emissions

- R&D programs identified in 2010 Roadmap can be directed at reductions in GHG emissions.
- The IEA data show clearly that best available technologies are not enough – we need many new technologies!
- Need organized approach for developing new technologies for the industry – we need to implement the Roadmap.

Implementing the 2010 Technology Roadmap

- Communicate the R&D priorities
  - *To universities, research institutions, government agencies, industry companies, suppliers, and other stakeholders*
- Gain support of funding agencies
  - *Government funding is essential for the types of programs needed*
  - *Companies can't fund these programs alone*
- Develop and guide collaborative programs to address priorities
  - *Select short list of the most important R&D programs for industry*
  - *Look for best talent, best ideas, and best project partners worldwide*
- Encourage demonstration and deployment of new technologies
  - *Involve suppliers and others – protect intellectual property*

These are objectives of the Agenda 2020 Technology Alliance

Agenda 2020 Technology Alliance

- Develops technology agenda for the industry – e.g., 2010 Technology Roadmap
- Promotes collaborative R&D programs aligned with Roadmap
- Seeks government funding to support R&D programs
- Supported by international group of member companies
- Need more companies to get involved

For more information, see www.agenda2020.org or contact ron_brown@afandpa.org

PIMA
Building Leadership Excellence

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people resources solutions

Print vs. Digital Media: False Dilemmas and Forced Choices

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Senior Research Fellow

The Institute for Sustainable Communication

May 4, 2010

Talent, Technology and Transformation

PaperCon 2010 may 2 - 5 atlanta ga

Guilt About the Use of Paper is on the Rise

Seen this lately?

"Please consider the environment before printing this email."

Or this?

The False Dilemma:

"By using paper to print you are degrading the environment, destroying forests and killing trees."

The Forced Choice:

"Eliminate your use of paper or feel like a guilty hypocrite."

Are these concerns and feelings of guilt about using paper based on rhetoric or realities?

- Is our growing reliance on digital information technology and electronic media sustainable?
- What are some of the real environmental impacts associated with print and digital media?
- What is lifecycle analysis and how can it be used to inform our decisions?
- What are some of the current limitations of lifecycle analysis and eco-labeling?
- What are some of the steps being taken by industry and government to discourage “greenwash” and “treeewash”?
- How can the unsustainable aspects of print and digital media supply chains be eliminated?

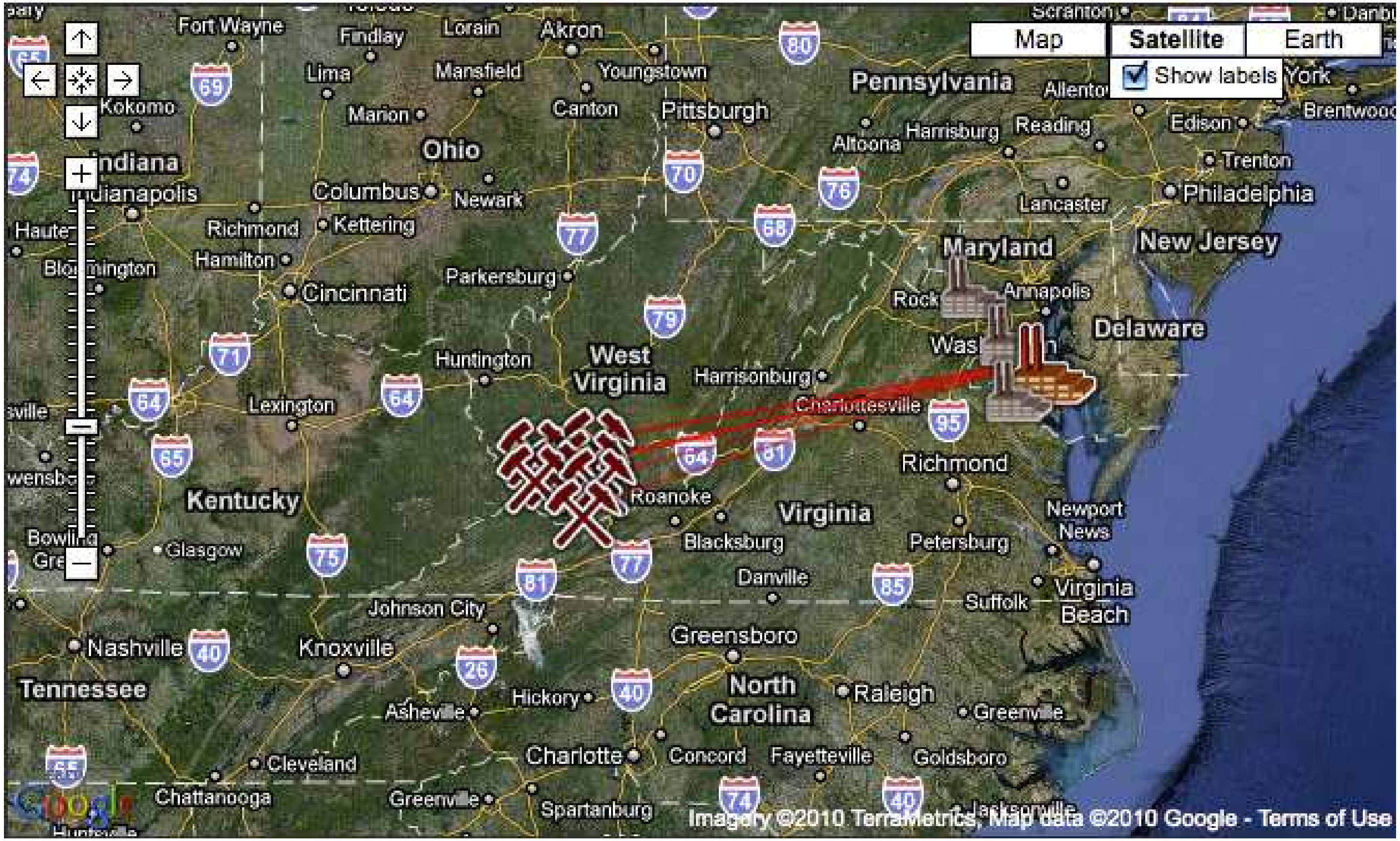
Is our growing reliance on digital information technology and electronic media sustainable?

Is our growing reliance on digital information technology and electronic media sustainable?

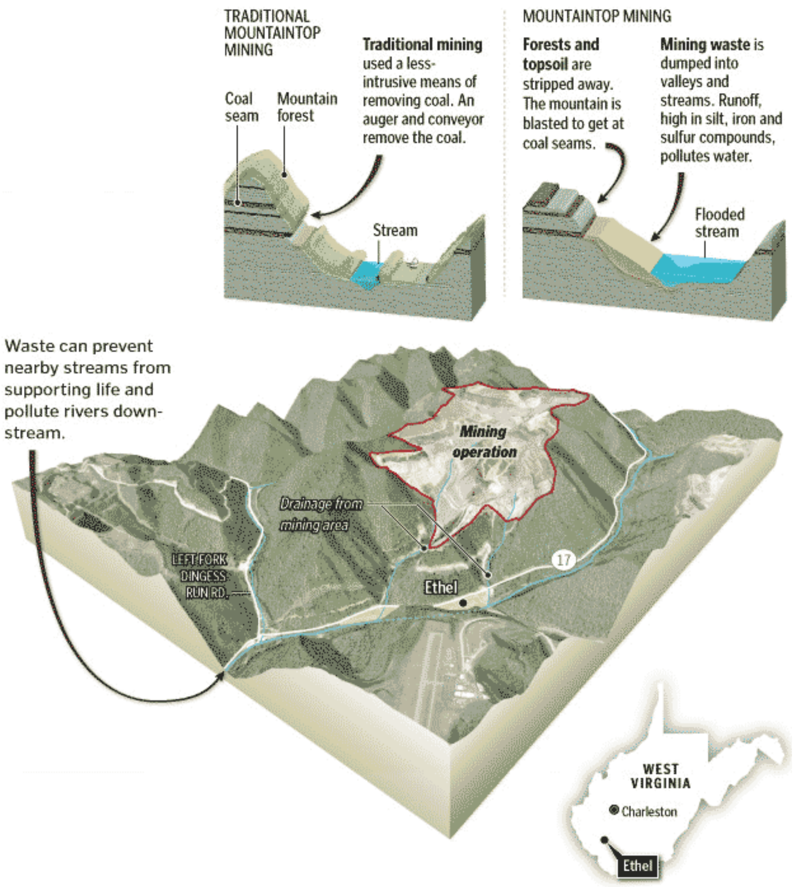
Electricity use rank among U.S. industries	Industry (North American Industry Classification System Code)	Electricity use (billion kWh/year)
1	Chemical manufacturing (325)	151
2	Primary metal manufacturing (331)	137
3	Food manufacturing (311)	79
4	Paper manufacturing (322)	75
5	Plastics and rubber products manufacturing (326)	66
6	Transportation equipment manufacturing (336)	58
7	Fabricated metal product manufacturing (332)	53
8	Petroleum and coal products manufacturing (324)	49
9	Nonmetallic metal products manufacturing (327)	46
10	Computer and electronic product manufacturing (334)	35

U.S. servers and data centers
59 billion kWh/year

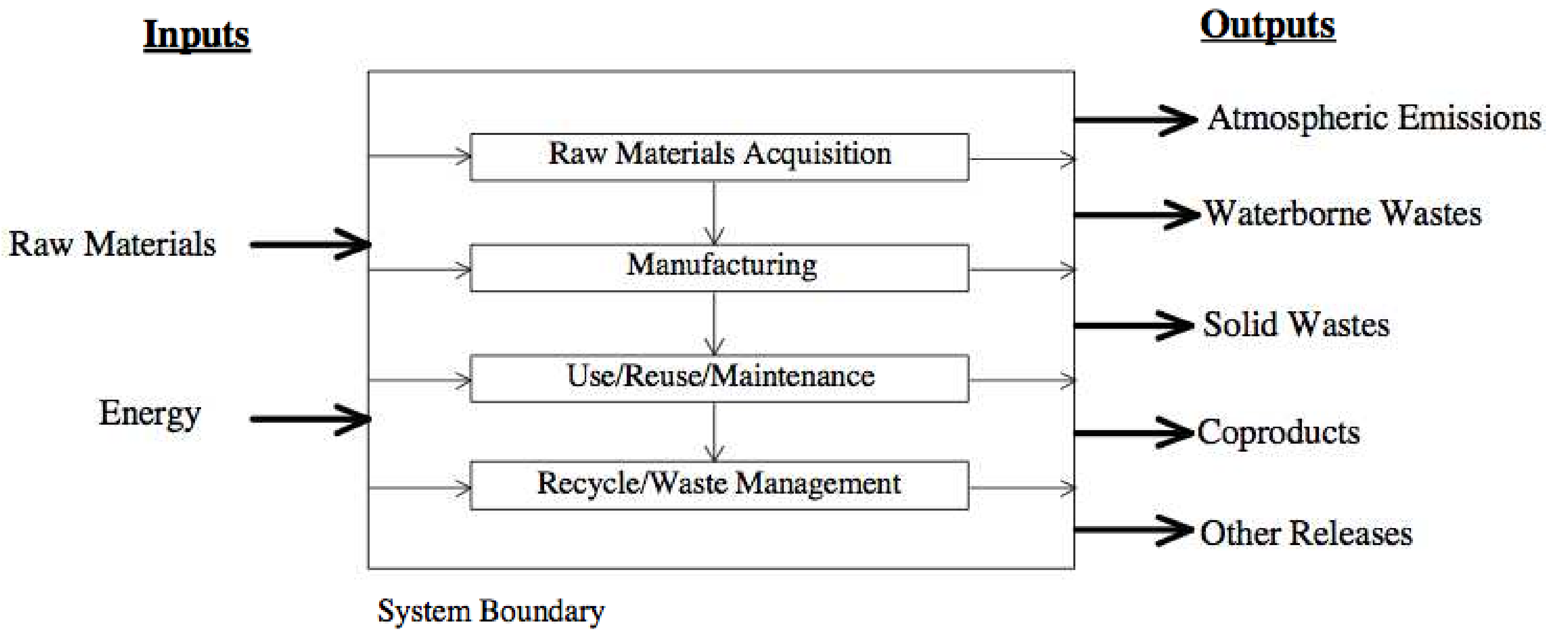
What are some of the real environmental impacts associated with digital media?



What are some of the real environmental impacts associated with digital media?



What is lifecycle analysis and how can it be used to inform our decisions?



A concept and methodology to evaluate the environmental effects of a product or activity holistically, by analyzing the whole life cycle of a particular product, process, or activity (U.S. EPA, 1993).

What are some of the current limitations of lifecycle analysis and eco-labeling?

- Functional Units
- Product Category Rules
- Lifecycle Inventory Boundaries
- Lifecycle Inventory Data
- A lifecycle Inventory Registry

How can you discourage “greenwash” and “treewash?”

NACHA is a not-for-profit association that oversees the Automated Clearing House (ACH) Network used by more than 15,000 depository financial institutions to originate and receive more than 18 billion payments per year.

According to Javelin Strategy & Research and the NACHA “Pay It Green” initiative:

> *“If an additional 20 percent of all American households would switch to electronic bills, statements, and payments, the collective impact per year would save 1,811,275 trees.”*

Would it?

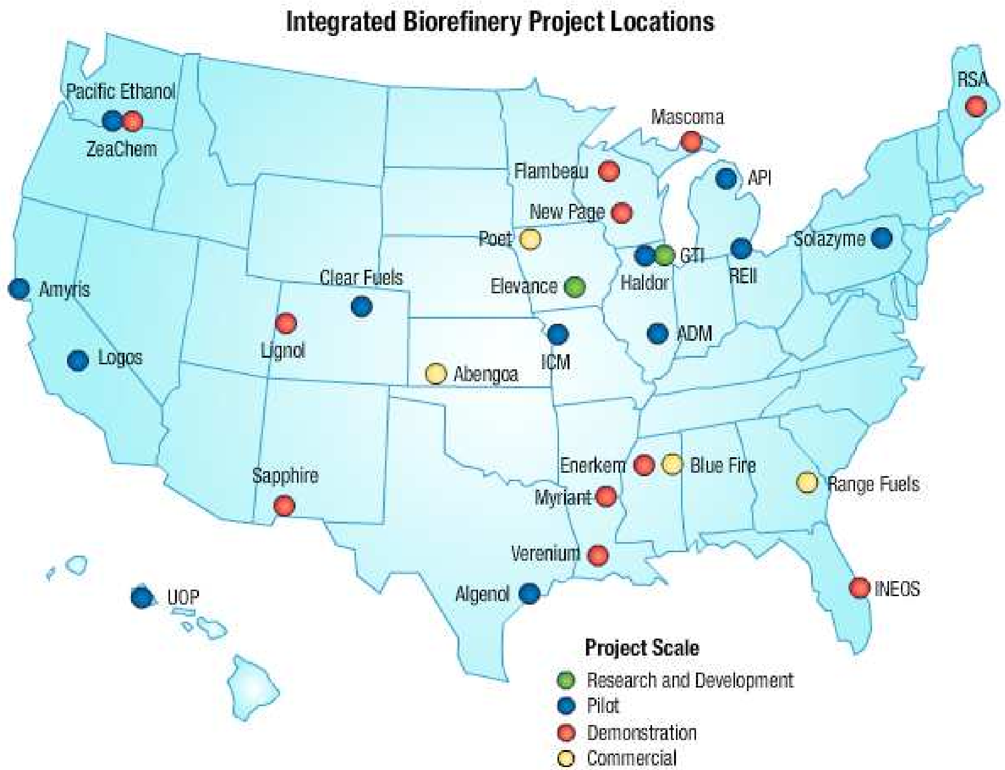
> *It’s one thing to say e-billing saves banks and billing institutions money, uses less paper, or less energy for transportation, but it is quite another matter to claim that e-billing "saves trees.”*

According to the FTC:

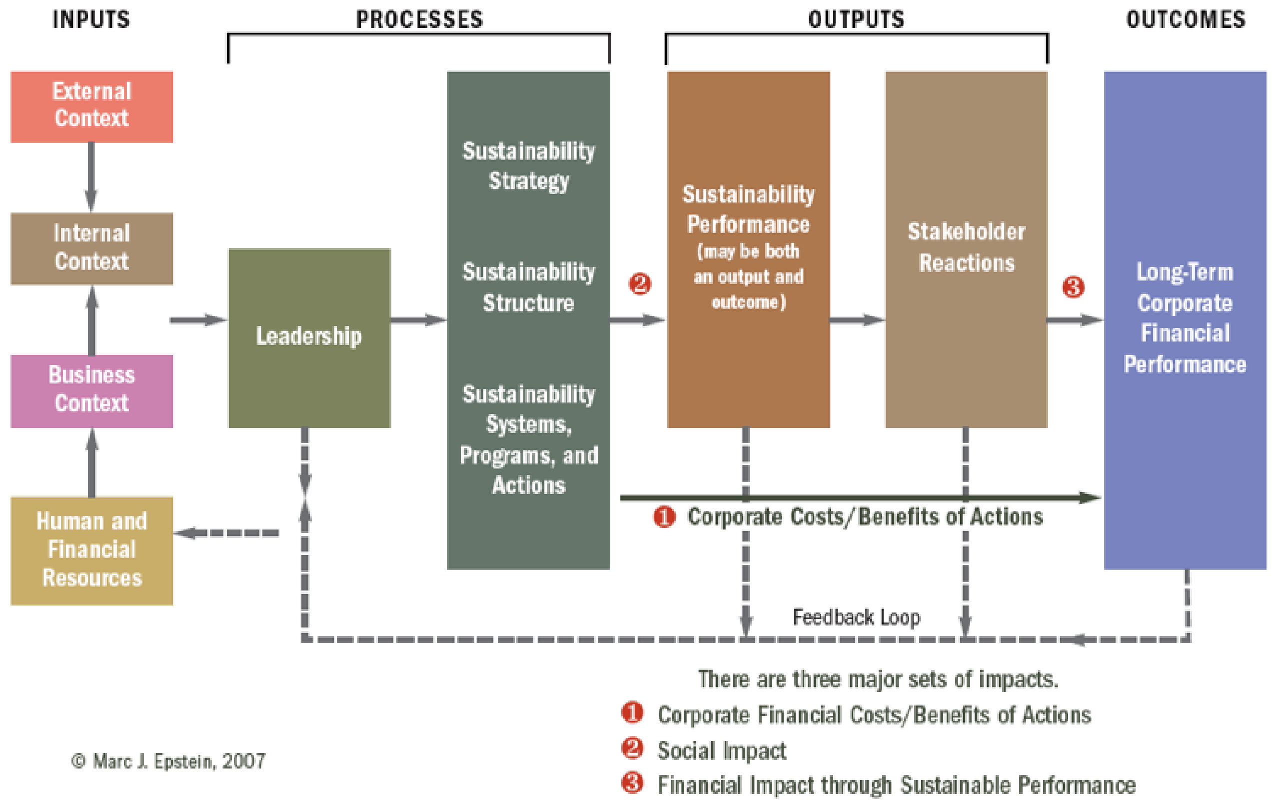
> *"It is deceptive to misrepresent, directly or by implication, that a product, package or service offers a general environmental benefit.*

Which trees?

What are the unsustainable aspects of print and digital media supply chains and how can they become sustainable?



What are the unsustainable aspects of print and digital media supply chains and how can they become sustainable?



Resources:

http://www.sustainablecommunication.org/resources/

http://www.ilovemountains.org

http://www.greengrid.org/

http://www.greentouch.org

Twitter: @dcarli
Email: dcarli@sustaincom.org

Building Leadership Excellence

people resources solutions

Environmental Policy Uncertainty

B.A (Ben) Thorp
Chairman, Bioenergy Deployment Consortium
May 4, 2010

Talent, Technology and Transformation

PaperCon may 2 - 5 2010 atlanta ga

Overview

- Environmental policy is a dominant variable in business
- Establishing an environmental policy requires significant analysis and dialogue with stakeholders
- Options available and a layman's definition of those options follow
- Precise definitions are still evolving

Major Corporate Policy Choices Include

- Being Green, means that business responds to what customers and influential environmental groups emphasize
- Permit compliance is doing what the law requires
- Recycling means that product design, and process design employ high recycled content and the product is recyclable
- Low carbon is the adoption of services, products and processes which have low carbon emissions
- Renewable means that product design and process design use maximum practical renewable materials. There is no criteria that renewable materials be sustainable.
- Sustainable means that the product and process use materials which are available forever and some say for this use

Major Measurement Systems Include

- Direct evaluation which means all critical elements/events "inside the fence line" are modeled, measured and totaled
- Indirect evaluation includes the same for critical items "outside the fence line". Policy helps determine which are critical
- Green House Gas Analysis is a selective analysis of those emission components which are known to interact with the atmospheres "green house" effect
- Life Cycle Analysis is the broadest measurement system and includes the environmental impact of all materials used in the product, service or process. This analysis can be very time consuming and expensive

Policies and Measurement Interaction

	Type of Measurement System				
Type of Policy	**Direct Impact**	**Direct + Indirect Impact**	**Green House Gas impact**	**Life Cycle Analysis**	**NEXT ?**
Green	1962				
Permit Compliance	1970's	N/A	N/A	N/A, until 2007	
Recyclable	1980's	1980's			
Low Carbon	2000's				
Renewable					
Sustainable				2007	
NEXT ?					

Trends

- The US is generally moving from the upper left toward the lower right
- Therefore both the policy and measurement systems are becoming more stringent
- Lets go back and review a few of the dates to illustrate that

Policies and Measurement Interaction

	Type of Measurement System				
Type of Policy	**Direct Impact**	**Direct + Indirect Impact**	**Green House Gas impact**	**Life Cycle Analysis**	**NEXT ?**
Green	1962				
Permit Compliance	1970's	N/A	N/A	N/A, until 2007	
Recyclable	1980's	1980's			
Low Carbon	2000's				
Renewable					
Sustainable				2007	
NEXT ?					

Key Events

- 1962 –Was the publication of “Silent Spring” which provided context for “being green”.
- 1970s-Major U.S. Industry was regulated by air ,water and solid waste permits
- 1980- The US pulp and Paper Industry developed recycled content products and installed deinkng and other facilities
- 2000-Global warming theory caused a focus on low carbon emissions
- 2007-Landmark event was the inclusion of first GHG regulation in the 2007 Energy Security Independence Act (EISA)
- LCA may not be appropriate for all facilities and businesses*

Example-Comparison of CO_2 Emissions in a 175,000 tpy TMP facility

	Direct metric tpy	Direct + Indirect metric tpy
175,000 tpy TMP facility	134,760	1,018,818

A environmental policy based on direct emissions causes a focus to use less fossil fuel for on steam production

An environmental policy based on direct plus indirect causes a focus on electrical reduction

These are very different ways to run the business

Example-Thermal Efficiency highlights difference in renewable verses sustainable policy

Thermal Efficiency Comparison

	Stand Alone Biomass Electricity Plant	Same Boiler in a Combined Heat and Power Application
% Thermal Eff.	18-22%	70-80%

This illustrates that inefficient or improper use of renewable materials may not be sustainable.

Conclusion

- Environmental policy is a critical business element
- Examples show dramatic differences between choices
- Choice must involve interaction with stakeholders and a rigorous analysis
- Environmental policy is increasingly driven by state and federal legislation and regulation
- Damage control is nor longer a viable business or national strategy
- We are either “at the table” or “under the table”
- Major CEO time at the table in state capitals and Washington DC is required….

Questions

- Now, use the cards provided now
- Later, use bathorp@comcast.net

Magnus Pousette, ABB Reliability Services North America, PaperCon 2010

The Reliability Revolution: How implementing reliability basics can transform your plant

Power and productivity for a better world™

Abstract

Forward-thinking leaders understand the need for innovative changes in thoughts or processes to develop more efficient, profitable mills with fewer frustrations. But sometimes, implementing the most basic elements can be revolutionary if it changes the way a plant runs.

Nothing impacts your bottom-line as much as Reliability.

look at how implementing core elements (defining reliability strategy and expectations, etc.) and applying practices that make a reliable foundation work more efficiently (planning and scheduling, etc.) helped customers in the Pulp & Paper industry achieve desired results.

The Reliability Revolution
Agenda

- What is Reliability?
- Cost of Poor Reliability
- Stairway to Reliability Heaven
- Conclusions

Why Reliability?

Operational Excellence is the ONLY controllable contributor to sustainable profit, and Reliability is the foundation.

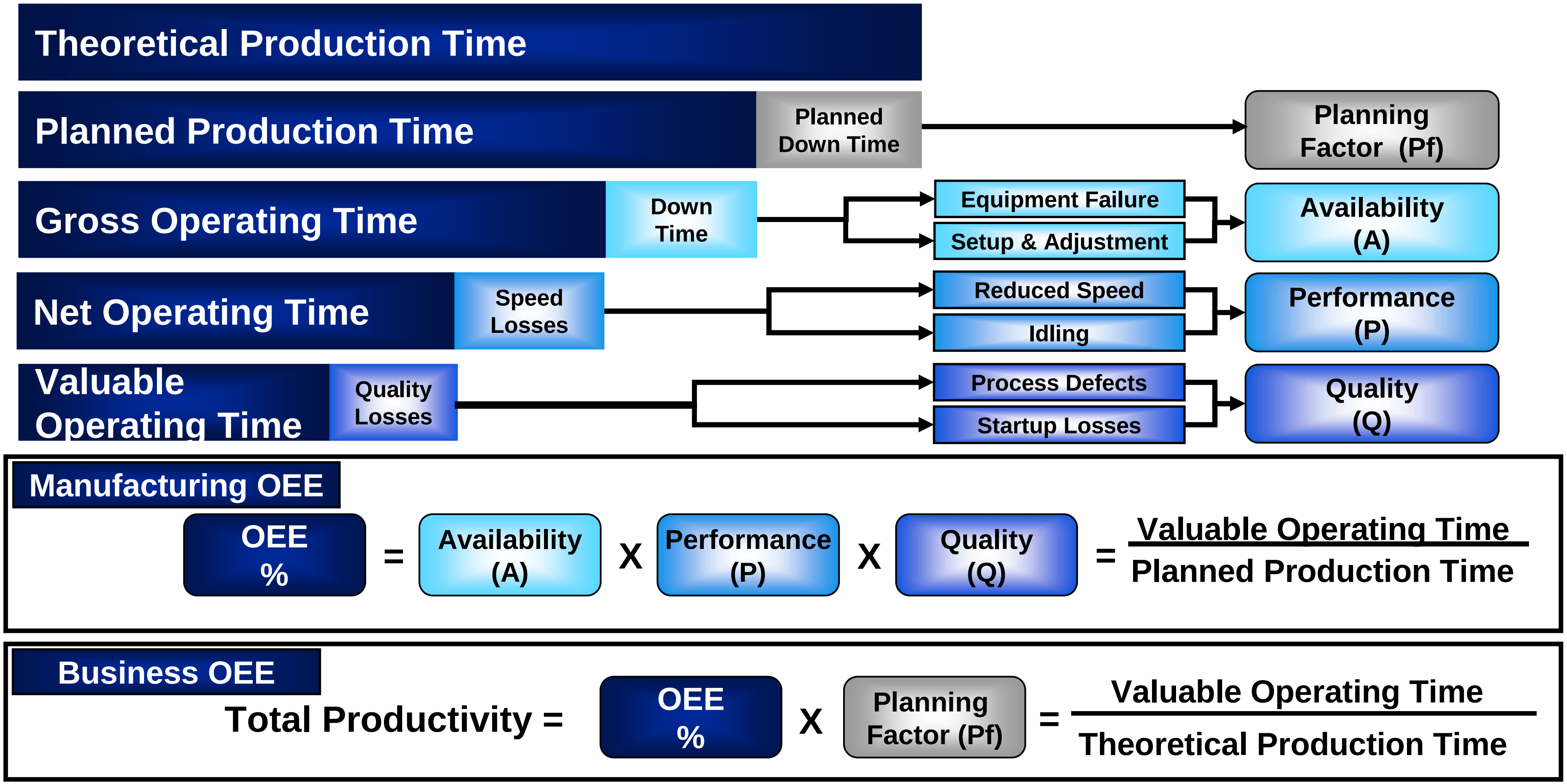
What is Reliability?
Definition

$$\text{Reliability 'by the book'} = R(t) = \frac{1}{e^{\frac{t}{MTBF}}}$$

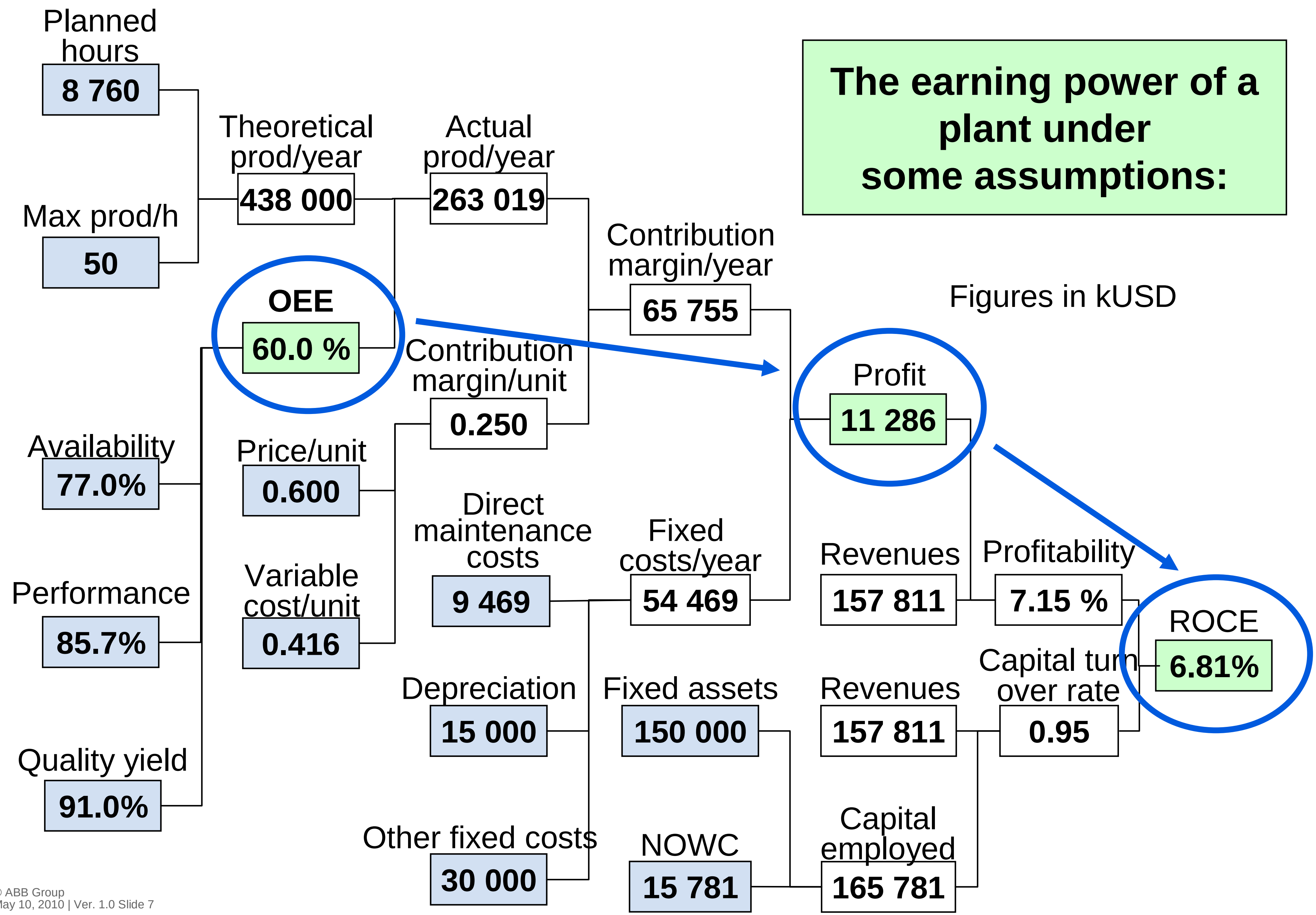
Meaningful definition:

Overall Equipment Effectiveness = Availability X Performance Rate X Quality Rate

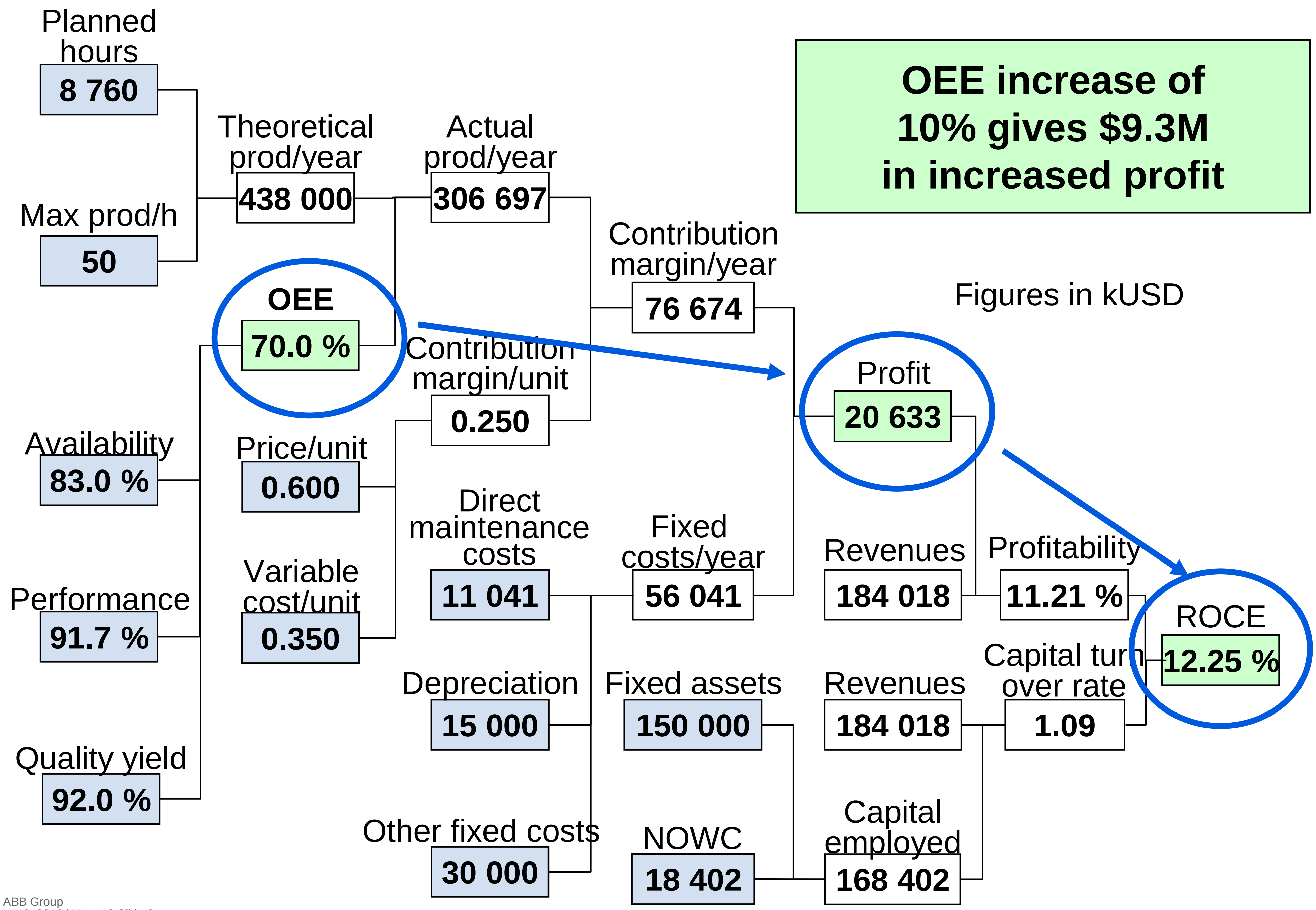
What is Reliability?
Continuous improvement of OEE



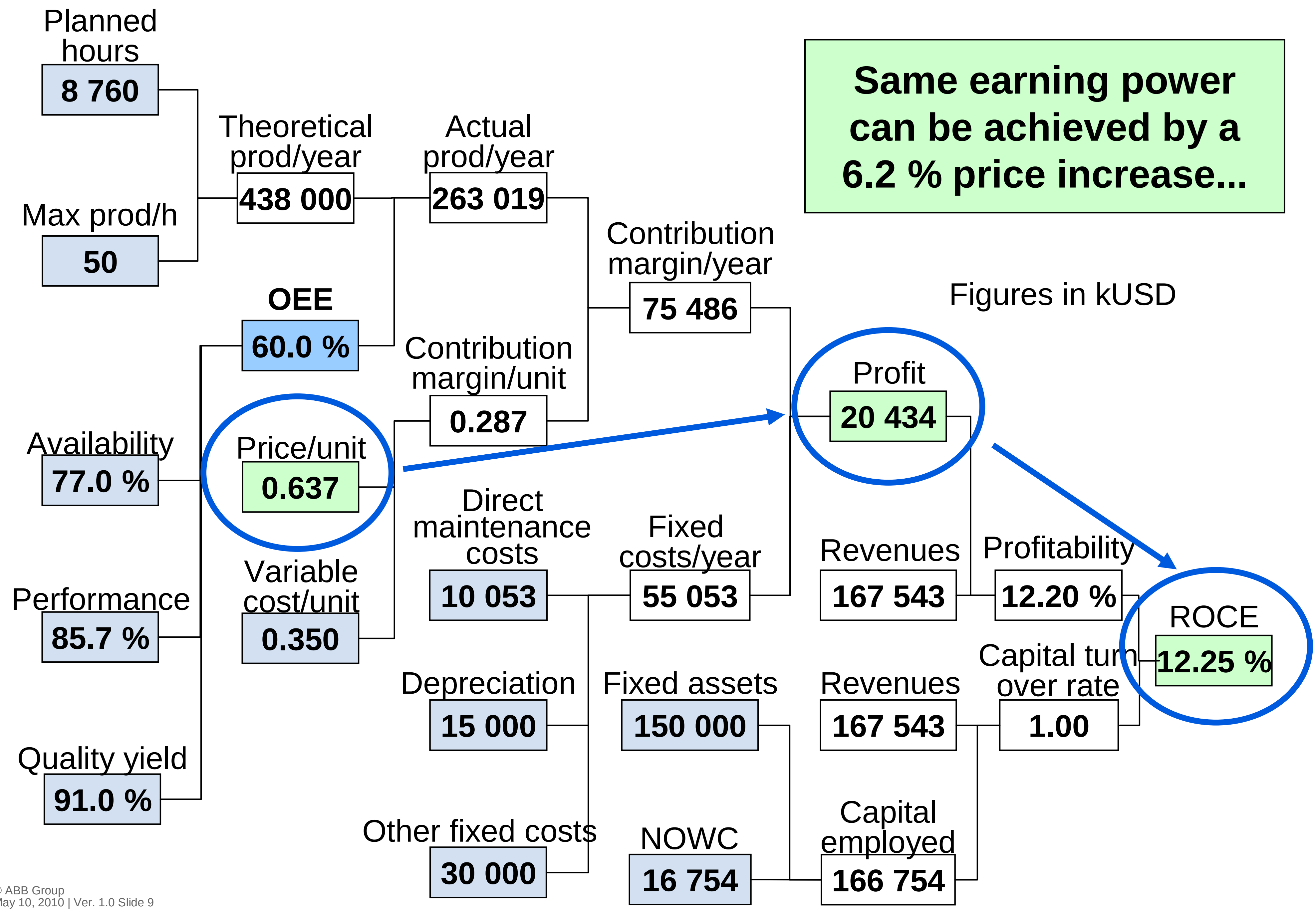
Influence of OEE on earning power



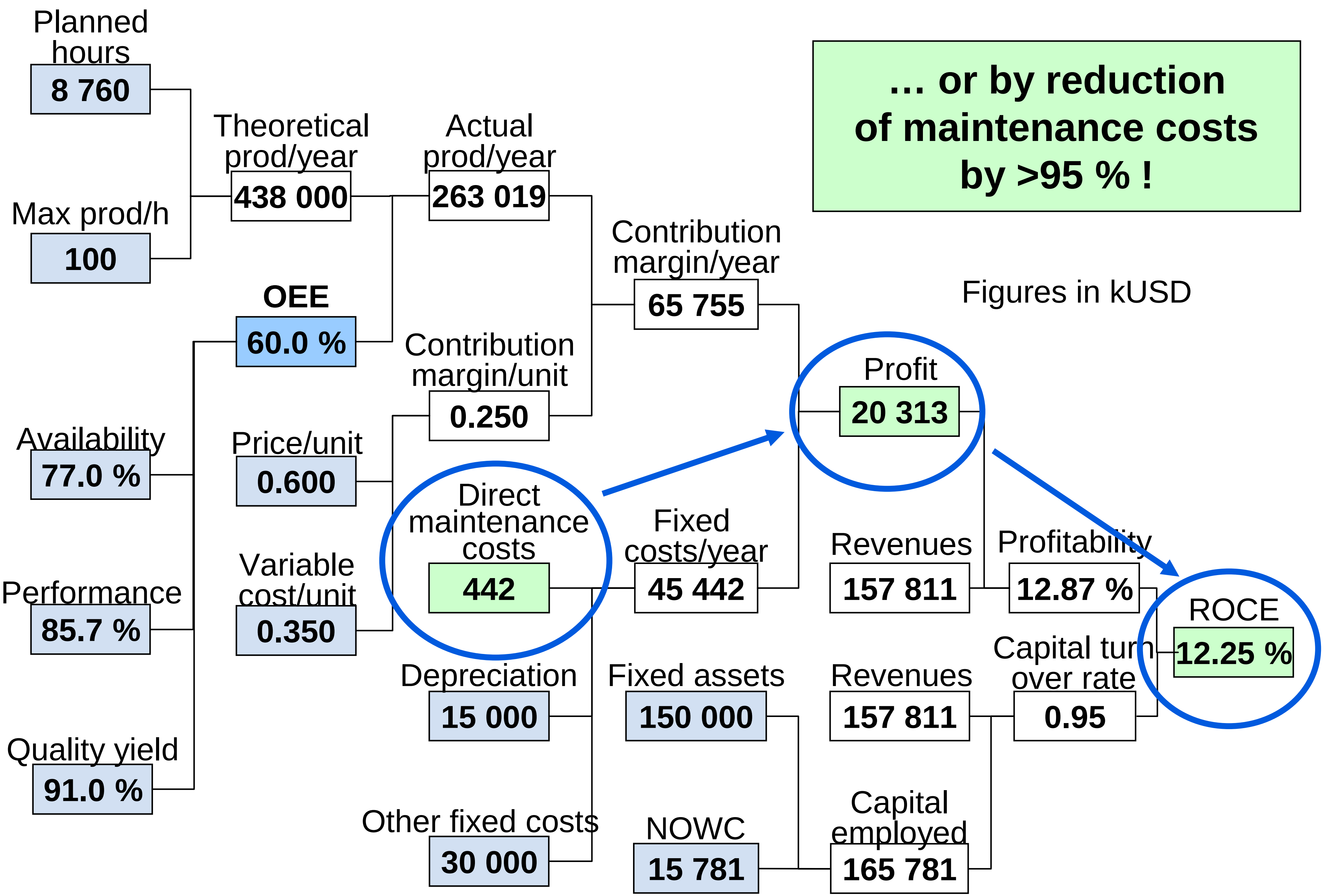
Higher OEE substantially increases earning power



Same earning either requires price increase...



...or reduction in maintenance costs of 95%!



Real World Reliability

Time:	Schedule
7:00 a.m. – 8:00 a.m.	Production meeting
8:00 a.m. – 9:30 a.m.	Staff meeting
9:30 a.m. – 10:30 a.m.	Quality Review meeting
10:30 a.m. – 11:30 a.m.	Customer meeting/Plant Tour
11:30 a.m. – 1:30 p.m.	Lunch with Customer #2
1:30 p.m. – 2:30 p.m.	Budget Review meeting

The probability that you are going to do what you said you were going to do!

The Reliability Revolution
Agenda

- What is Reliability?
- **Cost of Poor Reliability**
- Stairway to Reliability Heaven
- Conclusions

The Cost of Poor Reliability

Example for a facility with $100M revenue

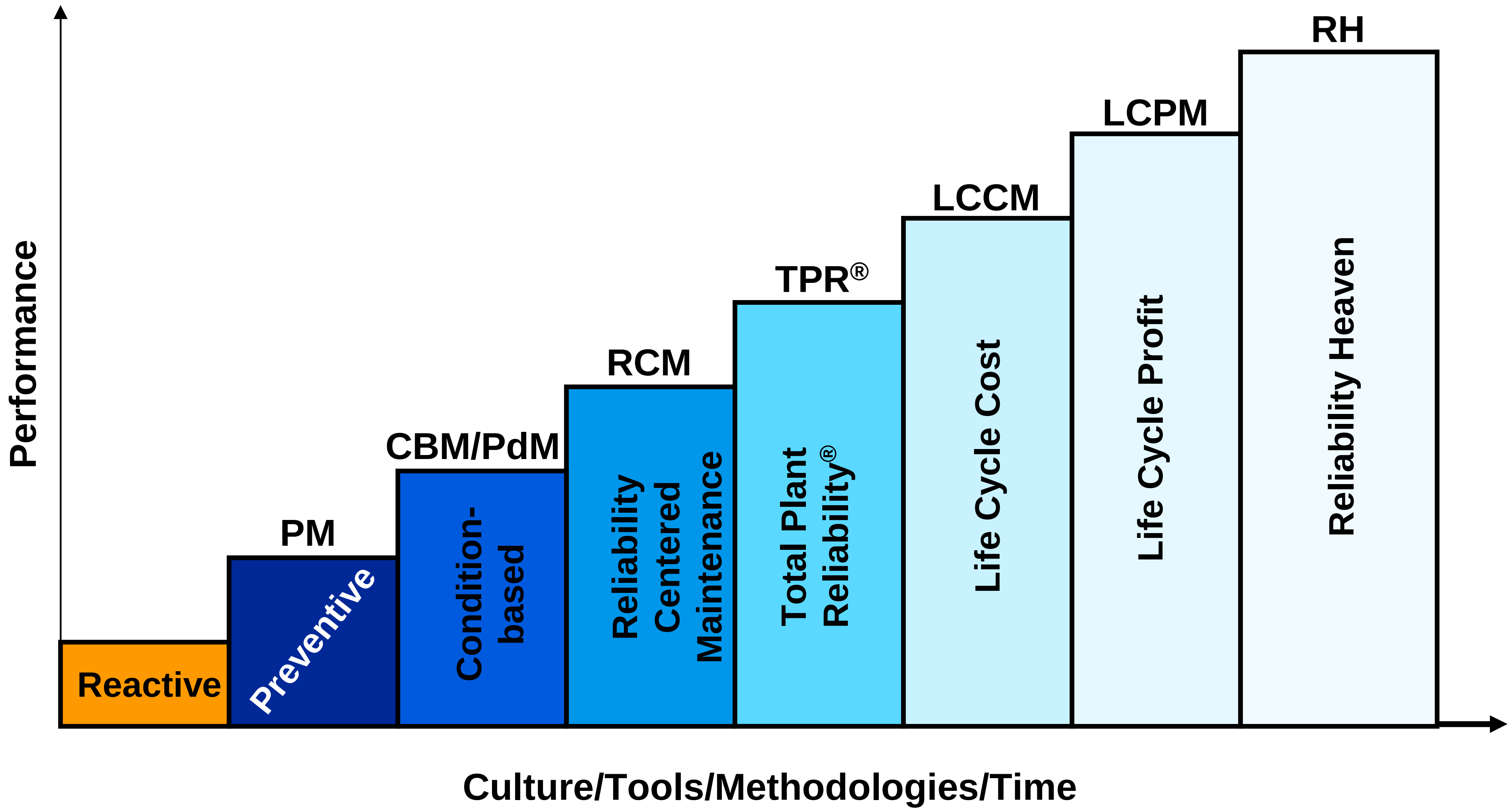
Bottom line opportunity	Average Facility	Good Facility
▪ Cost of low OEE	$10m	$3m
▪ High ops. & maintenance costs	$4m	$2m
▪ Low workforce productivity & output	$2m	$1m
▪ High equipment replacement rates	$2k	$0.5k
▪ Injuries and possible fatalities	$500k	$100k
▪ Litigation issues	$1m	$100k
▪ High inventory costs	$2m	$1m
▪ Process interruptions & yield losses	$3m	$1m
▪ Replacement labor and overtime	$1m	$500k
▪ High energy costs	$500k	$300k
▪ Missed deliveries; customer loss	$2m	$1m
Total	**$15m**	**$5m**

Obvious Costs	▪ Cost of low OEE ▪ High maintenance & operations costs ▪ Low workforce productivity & output ▪ High equipment replacement rates
Hidden Costs	▪ Injuries and possible fatalities ▪ Litigation issues ▪ High inventory costs ▪ Process interruptions & yield losses ▪ Replacement labor and overtime ▪ Unnecessarily high energy costs ▪ Missed deliveries; customer loss

The Reliability Revolution
Agenda

- What is Reliability?
- The Value of Reliability
- Stairway to Reliability Heaven
- Conclusions

The Stairway to Reliability Heaven



The Reliability Revolution
Agenda

- What is Reliability?
- Cost of Poor Reliability
- Stairway to Reliability Heaven
- Conclusions

Conclusions

- Reliability excellence enables better operational decision making, flexibility and operational excellence
- Reliability is a mindset, a culture more than anything, and as with everything, starts at the top
- Maintenance is one, but only one, investment enabling you to be reliable
- If you're going to work on one thing this year, work on Reliability because it will affect your bottom-line the most
- Do the fundamentals first, and do them right

Thank you!

Any Questions??

Coating Presentations

PaperCon 2010 may 2 - 5
atlanta ga

Talent,
Technology and
Transformation

Building Leadership Excellence

people resources solutions

State-Of-The-Art Developments to Save Energy in Coating Drying

Bob Bates, P.Eng

Metso Paper

PaperCon may 2 - 5 2010 atlanta ga

Talent,

Technology and

Transformation

Overview

- Two (2) case studies are presented to illustrate two (2) new developments in coating drying, with a focus toward **saving energy** while maintaining high sheet quality and machine performance (efficiency)

- **Case Study #1** looks at new floatation bar (nozzle) technology for air dryers

- **Case Study #2** presents new air dryer technology aimed at drying the sheet at a high evaporation rate

Case Study #1- Air Dryer Rebuild

Case Study #1- Air Dryer Nozzle Development

- Early nozzles were relatively simple foils with a single air slot. Later nozzles typically included a double slot (float) arrangement to improve sheet floatation and drying performance.

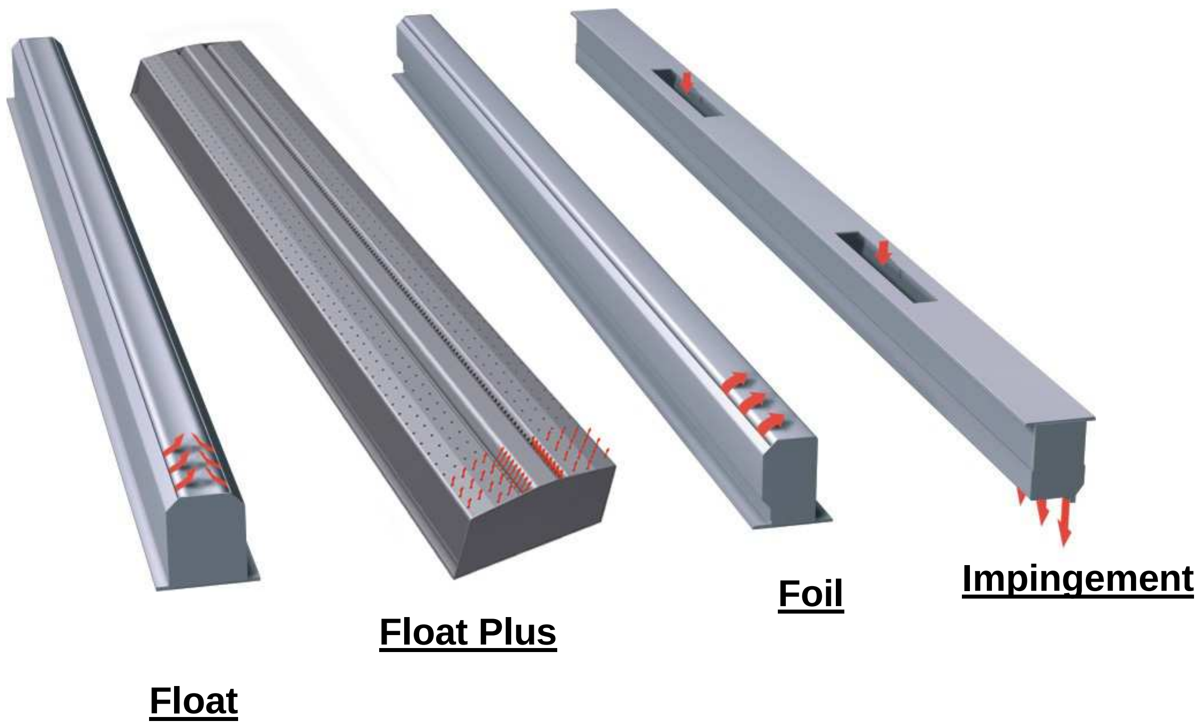
- The most recent, state-of-the-art designs, include a much larger nozzle profile that supports and dries the sheet over a greater area.

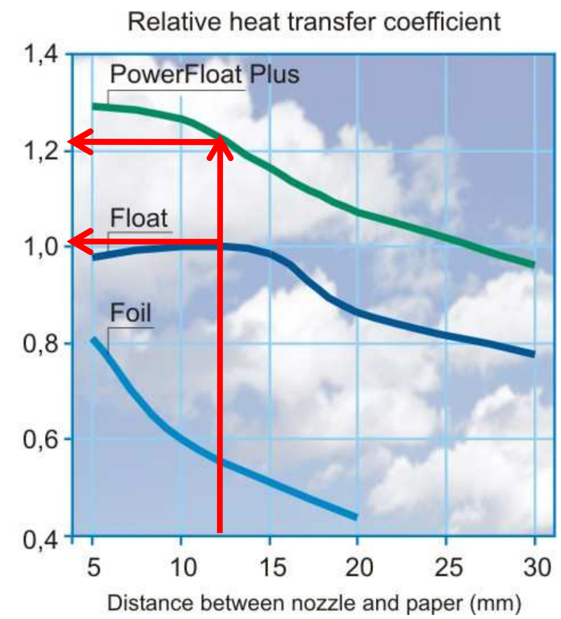
- This improved design has a significant effect on the dryer's ability to deliver energy to the sheet, more effectively; thus saving energy.

Nozzle Development

More drying capacity

- Nozzle designs have evolved to deliver increased energy per unit area thus increasing drying effectiveness
- This in turn enhances drying performance (+25%) and overall runnability

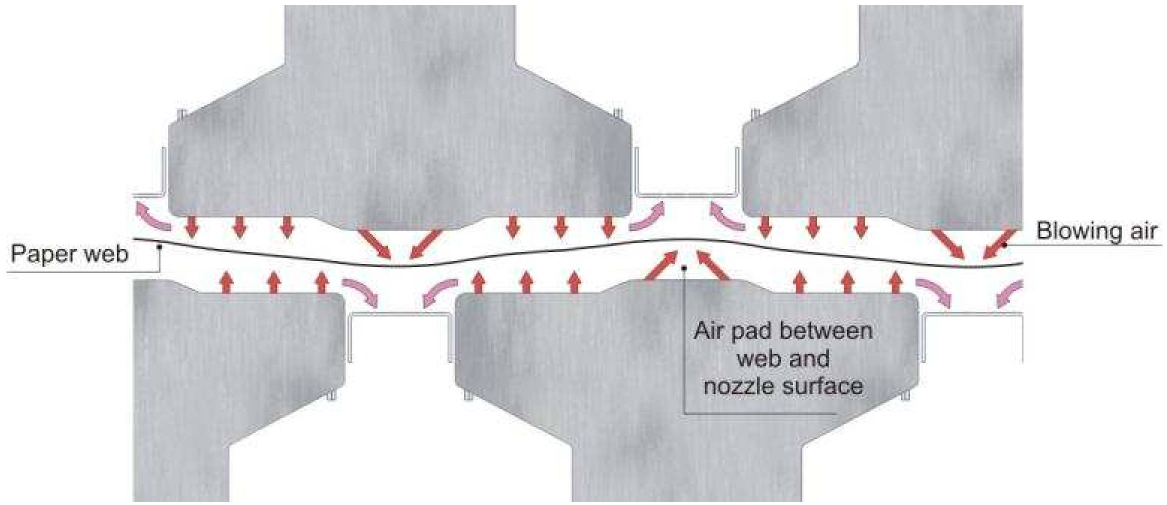




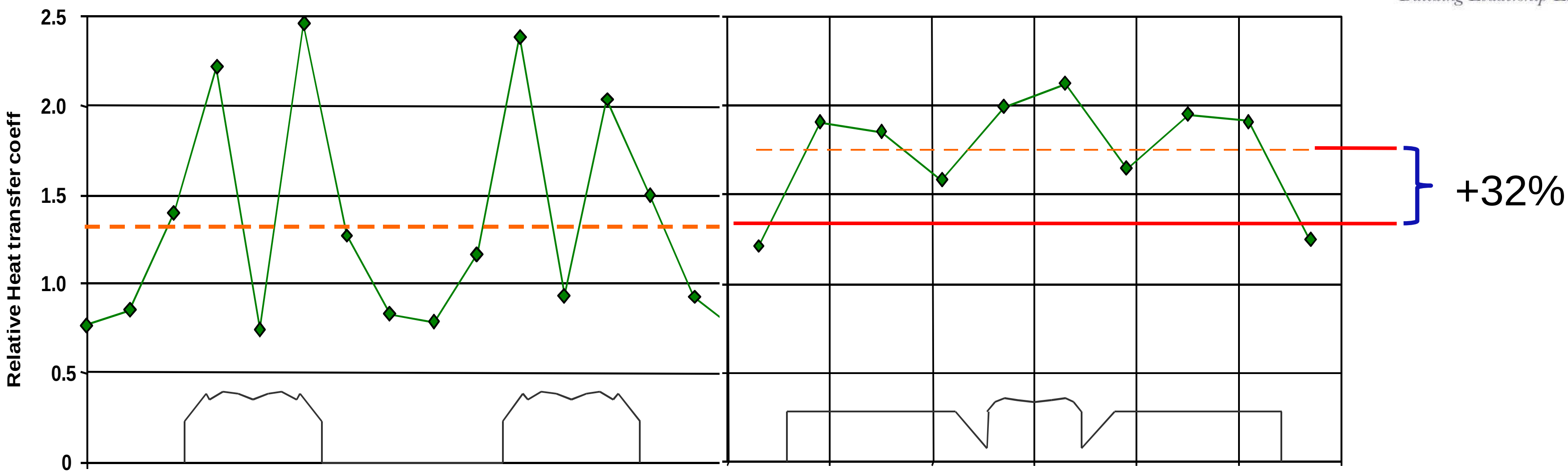
Hi Performance Float Nozzles

Operating principles

- Wide nozzles give more active drying surface
- Direct jets of hot air create high turbulence and high heat transfer coefficient
- Stable air pad in the middle of the nozzle gives stability to the runnability



Nozzle Performance Drying Comparison (heat transfer coefficient)



Typical Double Slotted Nozzle **New "Extended Area" Nozzle**

- Over approximately the same (MD) cross section, with the nozzles operating at the same temperature (200C) and blowing velocities (50 m/s), the new nozzle design performs much better (20- 32%) in terms of average heat transfer coefficient.

Case Study #1- Methodology

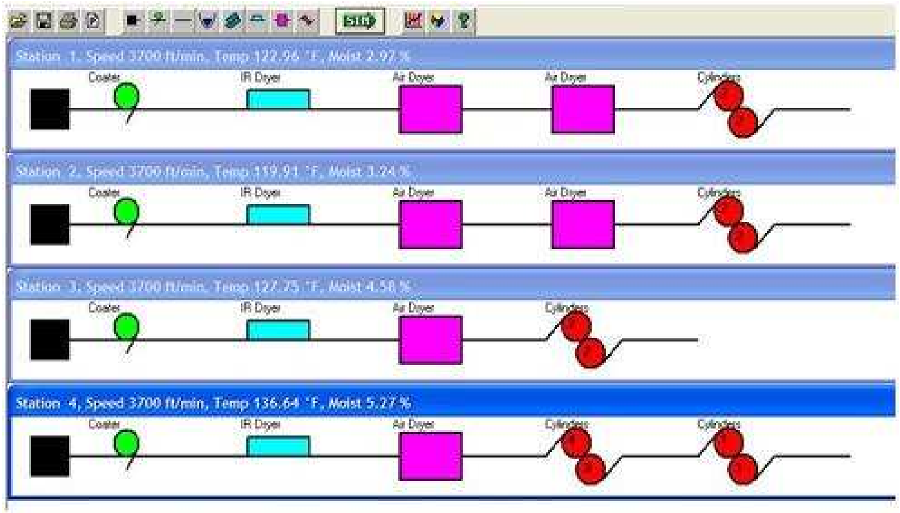
- Based on success of lab results and field trials, new nozzles arrangements were designed to fit an existing production machine.
- Prior to rebuilding existing dryers, benchmark testing was done to develop an accurate drying model and establish current drying rates and energy consumption.
- Drying simulations were run to confirm drying scenarios and predict energy savings.
- Supported by simulation results, two (2) existing dryers were rebuilt with new nozzles.
- "Before and after" comparisons analyzed to confirm performance and energy savings

Case Study #1- Machine Data

Table 1 Machine Data

Machine	*Coater #1 (bottom)*	*Coater #2 (top)*	*Coater #3 (top)*	*Coater #4 (bottom)*
Fine Paper (LWC)	Coat wt: 7.97#/ream @ 63% solids	Coat wt: 8.19#/ream @ 63% solids	Coat wt: 7.16#/ream @ 63% solids	Coat wt: 7.56#/ream @ 63% solids
3700 fpm	Gas IR	Gas IR	Gas IR	Gas IR
150” trim	2 Air Dryers	2 Air Dryers	1 Air Dryer	1 Air Dryer
67.95 #/ream	2 steam cylinders	2 steam cylinders	4 steam cylinders	7 steam cylinders
3.28% moisture (base)				5.35% moisture (final)

Drying Simulation



Energy Calculation Summary --

Simulation projection - All Dryers with Existing Air Bars (data taken 22 April 09)

Speed	3,701 ft/min	Operating days per year= 350
Trim	152.8 in	% Operating efficiency=85

Coater 1

Gas IR		Dryer 1		Dryer 2	
Abs. Energy	792 MBH	Abs. Energy	2,065 MBH	Abs. Energy	1,993 MBH
Evaporation	238 lb/hr	Evaporation	1,217 lb/hr	Evaporation	1,655 lb/hr
		Imp Temp	498 F	Imp Temp	511 F
		Imp Vel	9,820 ft/min	Imp Vel	9,940 ft/min
Gas Cons.	1,898 MBH	Gas Cons.	3,430 MBH	Gas Cons.	3,404 MBH
		Elect Cons	86 HP	Elect Cons	86 HP

Coater 2

Gas IR		Dryer 3		Dryer 4	
Abs. Energy	793 MBH	Abs. Energy	1,939 MBH	Abs. Energy	1,768 MBH
Evaporation	325 lb/hr	Evaporation	1,114 lb/hr	Evaporation	1,699 lb/hr
		Imp Temp	505 F	Imp Temp	519 F
		Imp Vel	8,840 ft/min	Imp Vel	8,070 ft/min
Gas Cons.	1,898 MBH	Gas Cons.	2,973 MBH	Gas Cons.	2,846 MBH
		Elect Cons	71 HP	Elect Cons	57 HP

Coater 3				**Coater 4**			
Gas IR		**Dryer 5**		**Gas IR**		**Dryer 6**	
Abs. Energy	443 MBH	Abs. Energy	1,488 MBH	Abs. Energy	221 MBH	Abs. Energy	1,635 MBH
Evaporation	201 lb/hr	Evaporation	967 lb/hr	Evaporation	157 lb/hr	Evaporation	1,348 lb/hr
		Imp Temp	463 F			Imp Temp	517 F
		Imp Vel	8,720 ft/min			Imp Vel	8,050 ft/min
Gas Cons.	1,253 MBH	Gas Cons.	3,006 MBH	Gas Cons.	633 MBH	Gas Cons.	3,831 MBH
		Elect Cons	59 HP			Elect Cons	45 HP

Total Gas Consumption	***25,173***	***MBH***
Air Dryer Gas Consumption	***19,490***	***MBH***
Total Water Evaporated	***8,922***	***lb/hr***
Gas Energy Consumption	***2,821***	***BTU/ lb H_2O***

TAPPI people resources solutions

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Energy Calculation Projection --
Dryers 5 & 6 with New Hi Performance Nozzles (From Simulation)

Coater 1

Gas IR		Dryer 1		Dryer 2	
Abs. Energy	792 MBH	Abs. Energy	2,065 MBH	Abs. Energy	1,993 MBH
Evaporation	238 lb/hr	Evaporation	1,217 lb/hr	Evaporation	1,655 lb/hr
		Imp Temp	498 F	Imp Temp	511 F
		Imp Vel	9,820 ft/min	Imp Vel	9,940 ft/min
Gas Cons.	1,898 MBH	Gas Cons.	3,430 MBH	Gas Cons.	3,404 MBH
		Elect Cons	86 HP	Elect Cons	86 HP

Coater 2

Gas IR		Dryer 3		Dryer 4	
Abs. Energy	793 MBH	Abs. Energy	1,939 MBH	Abs. Energy	1,768 MBH
Evaporation	325 lb/hr	Evaporation	1,114 lb/hr	Evaporation	1,699 lb/hr
		Imp Temp	505 F	Imp Temp	519 F
		Imp Vel	8,840 ft/min	Imp Vel	8,070 ft/min
Gas Cons.	1,898 MBH	Gas Cons.	2,973 MBH	Gas Cons.	2,846 MBH
		Elect Cons	71 HP	Elect Cons	57 HP

Coater 3 / ***Coater 4***

Gas IR		Dryer 5		Gas IR		Dryer 6	
Abs. Energy	443 MBH	Abs. Energy	1,355 MBH	Abs. Energy	223 MBH	Abs. Energy	1,474 MBH
Evaporation	201 lb/hr	Evaporation	1,010 lb/hr	Evaporation	151 lb/hr	Evaporation	1,337 lb/hr
		Imp Temp	311 F			Imp Temp	342 F
		Imp Vel	8,720 ft/min			Imp Vel	8,050 ft/min
Gas Cons.	1,253 MBH	Gas Cons.	2,159 MBH	Gas Cons.	633 MBH	Gas Cons.	2,753 MBH
		Elect Cons	80 HP			Elect Cons	54 HP

Dryer 5	Before	After	
Abs. Energy	1,488	1,355	MBH
Evaporation	967	1,010	lb/hr
Imp Temp	463	311	F
Imp Vel	8,720	8,720	ft/min
Gas Cons.	3,006	2,159	MBH
Elect Cons	59	80	HP

Dryer 6	Before	After	
Abs. Energy	1,635	1,474	MBH
Evaporation	1,348	1,337	lb/hr
Imp Temp	517	342	F
Imp Vel	8,050	8,050	ft/min
Gas Cons.	3,831	2,753	MBH
Elect Cons	45	54	HP

Total Gas Consumption	***23,248***	***MBH***
Air Dryer ***Gas Consumption***	***17,566***	***MBH***
Total Water Evaporated	***8,947***	***lb/hr***
Gas Energy Consumption per lb	***2,598***	***BTU/ lb H_2O***

= 9.9% decrease in Air dryer energy

= 7.9% in total gas energy

TAPPI people resources solutions

PIMA Building Leadership Excellence

Case Study #1- Rebuild Objectives

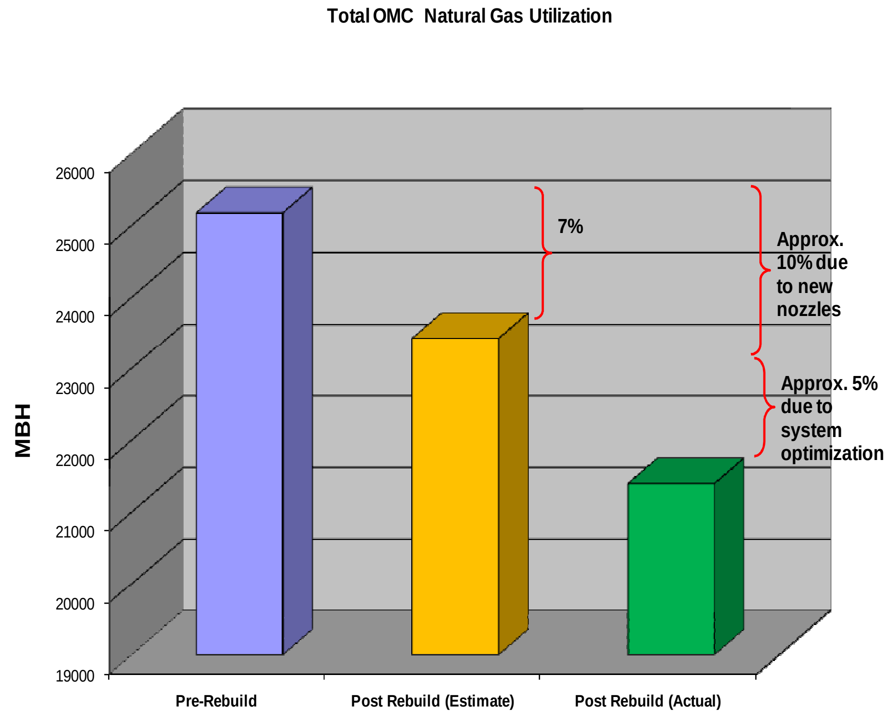
- 8% reduction in natural gas consumption
- Equal or better finished sheet quality
- Equal or better runnability and overall machine efficiency
- Good return on investment (ROI<2yrs)

Nozzle Details

Before-
slotted bars (wide spacing) and large screens

After-
new bars and return screens

Case Study #1- Rebuild Results



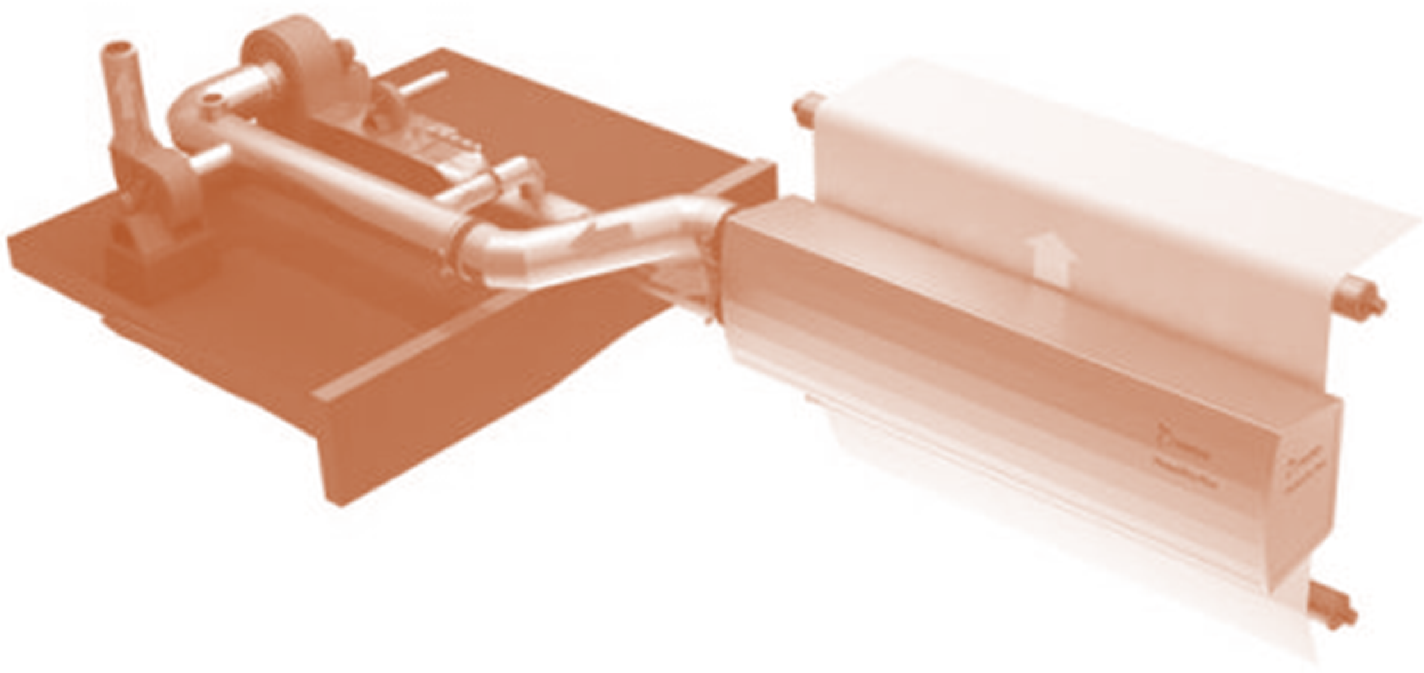
- 10% reduction in natural gas consumption realized due to improved nozzle performance
- plus additional 5% achieved due to optimization of existing equipment (e.g. dryer alignment, air system balancing, instrument tuning, etc.)
- Excellent finished sheet quality
- Equal or better runnability and overall machine efficiency
- <1yr ROI

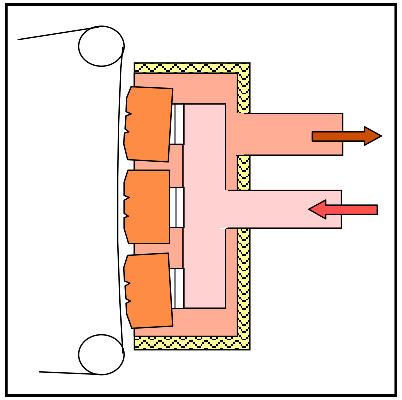
Case Study #1- Conclusions

- New hi performance air bars can deliver energy significantly better than traditional nozzles to promote more efficient drying, while maintaining runnability and sheet quality

- Potential for significant cost savings and reduction in carbon foot print

Case Study #2- Hi Intensity Drying





Case Study #2- Hi Intensity Drying

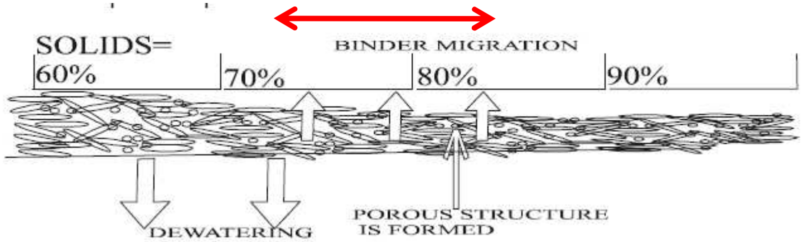
- The most common drying strategy used today is the so-called "high-low-high" theory.
- Given the limitations associated with the earlier studies, a new study [1] was undertaken to see the effects in coating quality and binder gradients if the coating is dried using a single-sided high intensity dryer.
- Utilizing newly developed nozzle designs (see Case Study #1 above), and a hi-intensity dryer system, it is possible to test the "all-high" drying hypothesis using an all air dryer, in place of traditional IR.

Coating Drying

Consolidation 73-85%

Pigment matrix starts to format

3D Matrix is compact



Drying of Coating Layer

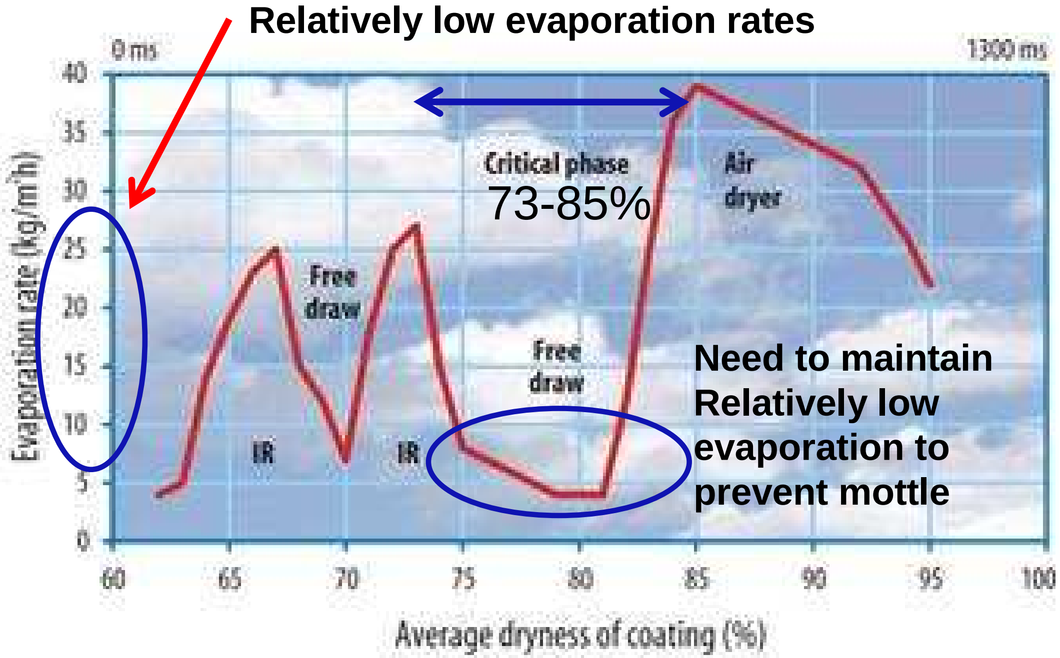
Phase/Average solids	60%	70%	80%
Drying phase	Heating period	Constant rate drying	1st and 2nd falling rate drying
Structure formation	Drainage: thickening, infiltration shrinkage	Consolidation shrinkage	Final structure
Drying strategy	Initial drying	Critical phase	Final drying

Drying Phase Coated Paper

The principal quality parameters that are affected by drying are:
•Mottling (uneven quality of a printed image, e.g. ink absorption)
•Gloss and smoothness, also printed gloss
•Surface strength.

Drying Strategies- Traditional "High-Low-High"

- Introduced in the 1980's
- If part of the coating is consolidated in the early stages (e.g. at a low evaporation rate), then the *__rest of the coating has to be consolidated the same way (e.g. at low evap rate).__*
- This limits the drying strategy in that the low drying rate established

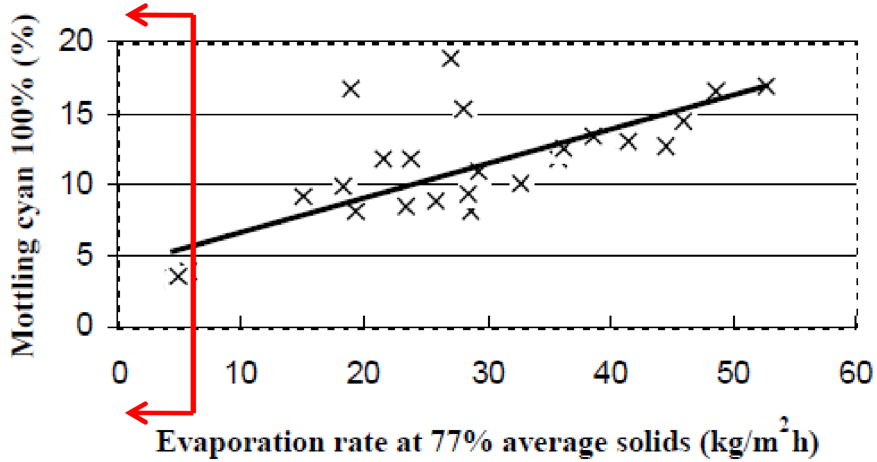


at the beginning needs to be maintained later in the drying section to dry evenly and preserve the coating structure [2]

Effect of the evaporation rate on mottling at 77% average solids [2]

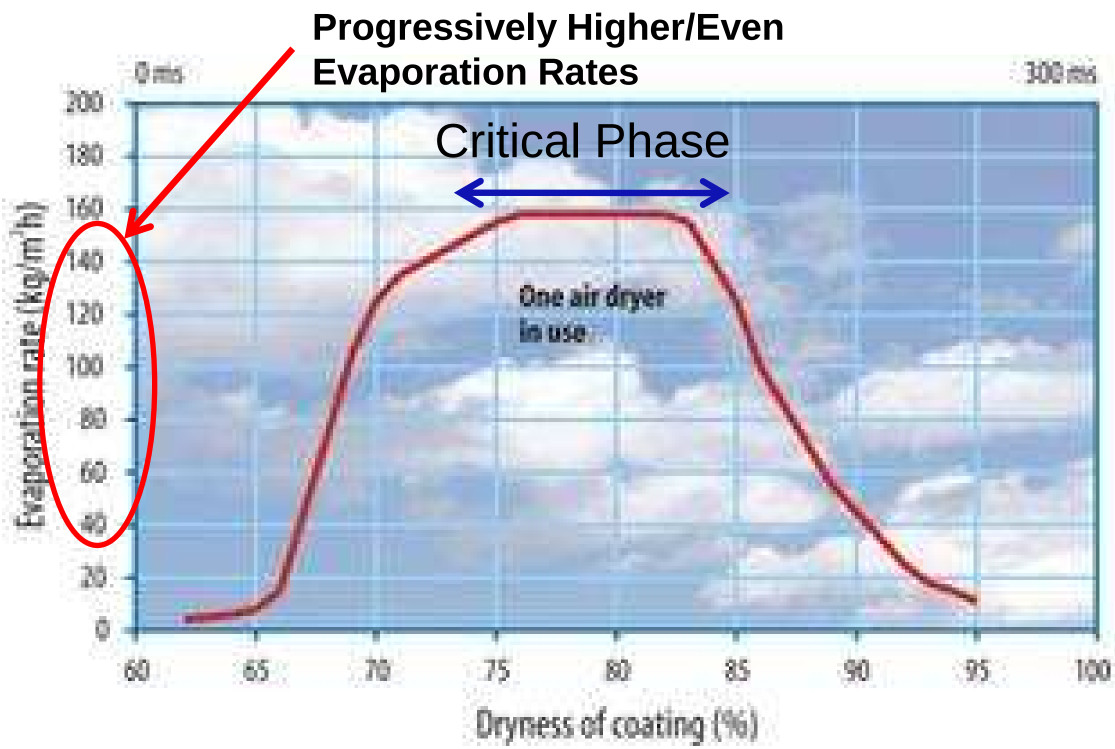
- Summary:
  - Traditional strategy is correct ***if*** part of the coating has been consolidated in the IR dryer or free draw; the rest of the coating also has to be consolidated at the same conditions (evap rate) to reach the same coating structure to prevent mottling.

Max evap. rate +/- to prevent mottle



Drying Strategies- New “All High”

- Alternatively, a new drying strategy allows for high evaporation rates immediately following the coater, and continuing throughout the drying process.
- Very even drying throughout critical phase, resulting in good finish quality



Case Study #2- Methodology

- A broad cross-section of grades and coating colors were tested as part of the coating/drying trials.

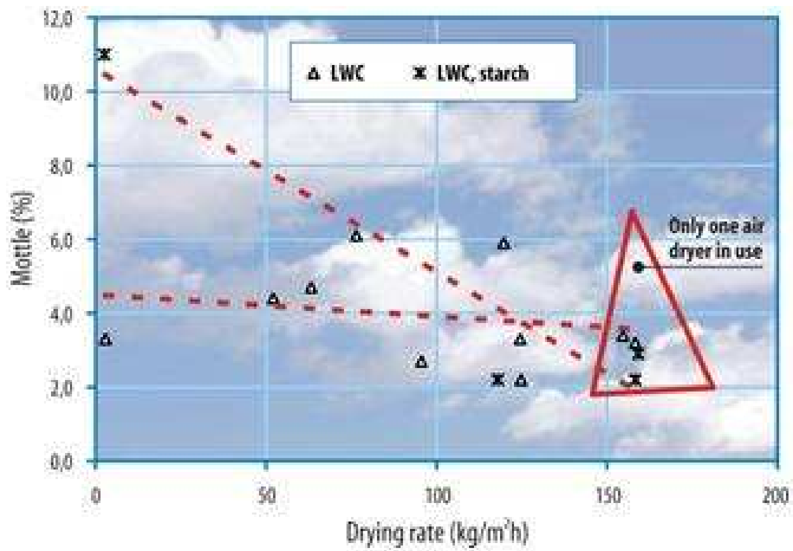
Paper grade	Base paper	Precoating (g/m^2)	Top coating (g/m^2)	Top coat color	Speed (m/min)
Triple coated WF	WF1 80 g/m^2	8+8+12+12	12+12	2	1500
Double coated WF	WF1 80 g/m^2	8+8	12+12	2, 3	1000
LWC	LWC1 40 g/m^2	none	12+12	2, 7	1000
LWC	LWC2 45 g/m^2	none	12+12	8	1000
Double coated board	Board 190 - 215 g/m^2	10 (TS)	12 (TS)	5, 6	500

- Study criteria:
  - Sheet quality
  - Drying capacity and efficiency
  - Runnability

Color	2	3	4	6	7	8
Fine clay (HG 90)	70	70	30	70		
Ground fine carbonate (HC 90)	30	30	70	30		
Delaminated clay (Astraplate)					100	100
SB latex A, Tg +10	12		12		12	6
SB latex B, Tg +15						
SB latex C, Tg +0		12				
VinAcetAcrylic latex D, Tg +15				14		
CMC	0.8	0.8	0.8	0.8	0.8	0.8
Oxidized Starch						6
Hardener	0.1	0.1	0.1	0.1	0.1	0.1
Lubricant	0.5	0.5	0.5	0.5	0.5	0.5
Optical brightener	0.2	0.2	0.2	0.2	0.2	0.2
Solids	62	62	62	63	60	60

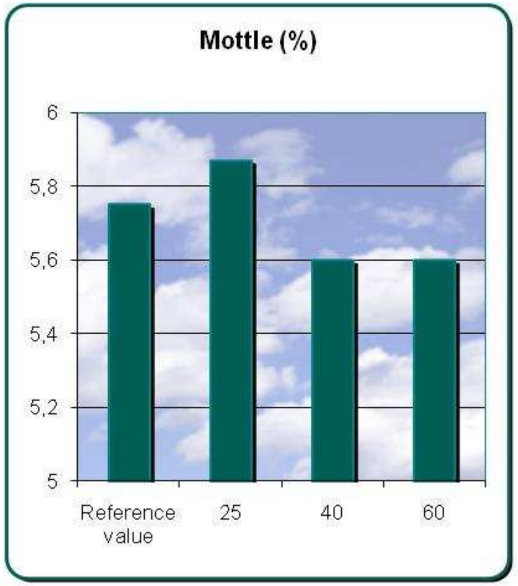
Trial Results

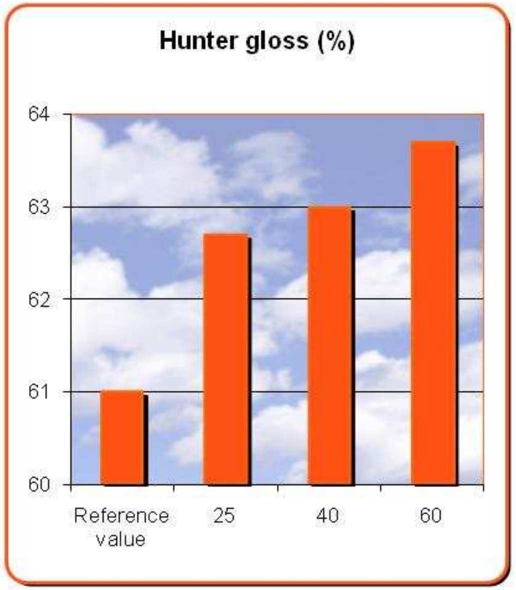
- The pilot trials on LWC, WF and board were conclusive in confirming that a single hi-intensity air dryer (400C, 60 m/s), in place of IR, could net excellent results including:
  - higher drying (evaporation) rates
  - mottle, gloss and smoothness improved when effective air drying is included immediately following the coating station
  - air drying is equal or superior to IR in terms of paper quality

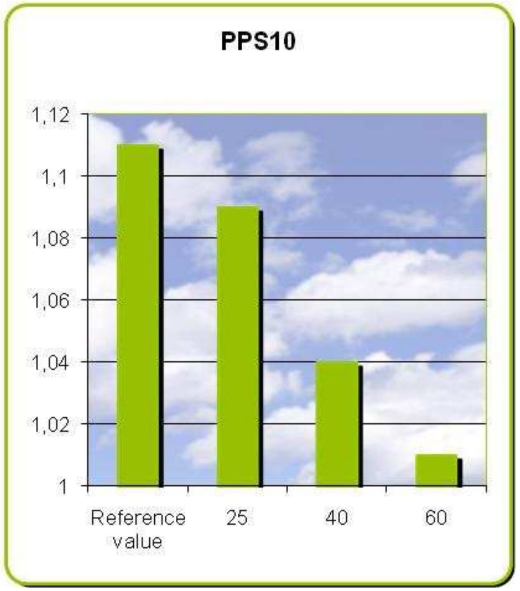


Reduced Mottle

Test Results: Mottle, Gloss, Smoothness







Reference value = Gas IR

25, 40, 60 m/s nozzle velocity

Less mottle

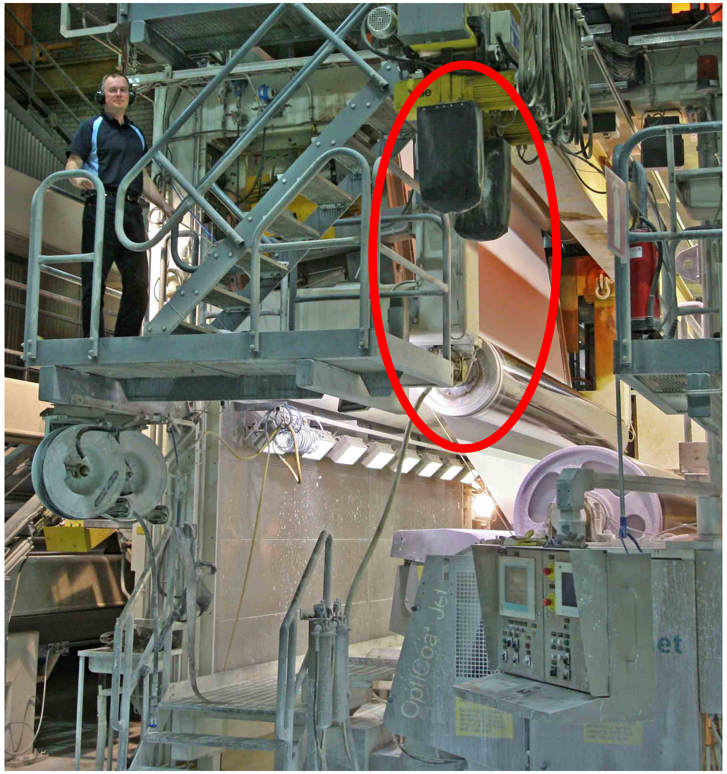
Improved gloss

Better smoothness

This series of pilot trials confirmed that a very uniform surface porosity distribution was possible using extremely high evaporation rates and a single dryer, resulting in better print characteristics. From this, it was possible to prove that a “high-high-high” air drying strategy could produce very even porosities resulting in less mottling, better gloss, and increased smoothness.

Case Study #2- Rebuild

- Building on the success of the pilot trials, this new high-high-high drying strategy was implemented on a production machine.
- Two (2) existing gas fired IR dryers were replaced with two (2) new hi-intensity air dryers.
- Utilizing new nozzle designs, the single sided hi-intensity dryer system is very similar to a traditional air dryer configuration including, a supply fan, burner, air dryer, combustion fan, make-up air and exhaust (heat recovery optional),



Case Study #2- Results

- Operating at approximately 450deg C, 60 m/s (840F, 11800 fpm) the hi-performance dryers can deliver a significant amount of energy to the sheet. This increase results in approximately 20% more evaporation per square meter compared to traditional gas IR dryers; while maintaining runnability and sheet quality. In terms of drying efficiency (e.g. energy costs), the hi-performance air dryer operates at close to 80% efficiency, compared to traditional IR at approximately 35% (BTU/#H_2O evaporated).

Case Study #2- Conclusions

- Equal or better paper quality (mottle, gloss, smoothness) compared to IR
  - Lower web temperature
  - Less water penetration
  - Higher binder content on the paper surface

- Higher drying capacity (more production potential)

- Energy savings e.g. 60-80% drying efficiency with air drying, 25-40% with IR drying and reduced carbon footprint (50% less fuel burned= 50% less CO_2 formed)

Cont'd……..

Case Study #2- Conclusions (cont'd)

- Low maintenance costs

- Improved operating conditions, e.g. lower machine hall moisture and heat loads

- Low investment costs/evaporation ($\$/H_2O/ft^2h$) compared to IR

- Greatly reduced operating hazards (e.g. fires)

Summary

- Two (2) new developments in air drying technology were presented offering opportunities to improve coating drying efficiency.
- New air bar designs provide increased evaporation rates leading to higher drying capacity.
- Coupled with these new nozzles, new hi-intensity dryers have proven successful in providing an “all high” drying strategy, resulting in increased drying with less mottling, better gloss, and increased smoothness.

Acknowledgements & References

- I wish to acknowledge Messrs Pertti T Heikkila and Richard Solin for their research in coating drying and the development of new nozzle and dryer technologies. Also thanks to Don Cesario and Tom Puukila for their work in dryer rebuilds (Case Study #1).

1. Heikkila, P, Rajala, P (2004), The effect of high temperature air drying on evaporation, runnability and coated paper properties, Proceedings 14th International Drying Symposium (IDS 2004), Sao Paulo Brazil, pp 1295-1302
2. Heikkila, P, Rajala, P (2002), International Ph.D Programme in Pulp and Paper Science and Technology (PaPSaT), *Pigment Coating Technology*

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Life Cycle Assessment and Packaging

Quantis
Sustainability counts

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PaperCon 2010
may 2 - 5
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Talent,
Technology and
Transformation

Life Cycle Assessment and Packaging

- Why LCA?: case study with polystyrene peanuts

Packaging sustainability measurement and LCA:

- What's the function?
- What packaging to consider?
- Industry guidance
- LCA and design
- LCA and communication
- The packaging context: end-of-life considerations

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What's Really "Green?"

- **An increasing number of claims:**
  - **100% Recycled**
  - **Recyclable**
  - **Energy Efficient**
  - **Organic**
  - **XYZ-Free**
  - **Reduced packaging**
  - **Bio-based**
  - **"Greener!"**
- **How do we make sense of this?**
  - **We need a system to weigh all the competing factors.**

Case Study: Packing with Popcorn?

Quantis

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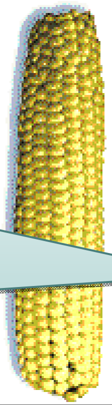
Example LCA of packaging material: Polystyrene and Corn Popcorn

Polystyrene: *Non-renewable* and *non-biodegradable* material

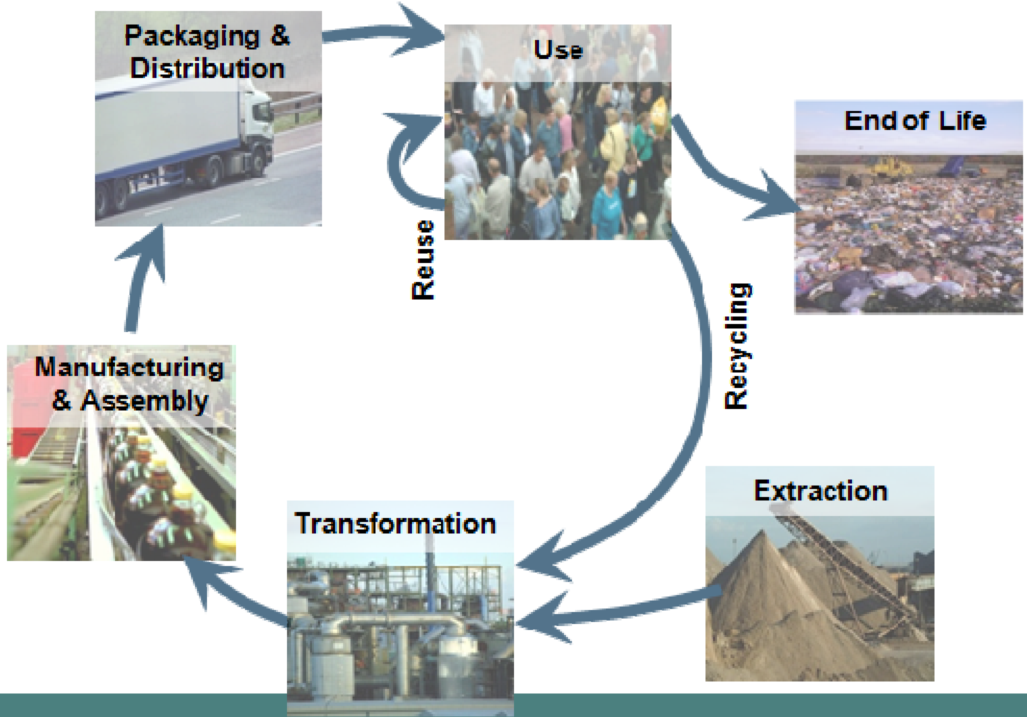
What about real pop-corn? *Renewable* and *biodegradable*



How can we know which is really a better environmental choice? How do we measure this? What are the key factors to consider?

Defining LCA

Comprehensive evaluation of the environmental and human health impacts of a product, process, or service



LCA is the only ***internationally accepted method*** for substantiating a claim or decision that one product, service or technology is ***environmentally preferable*** to another.

(ISO 14040 series)

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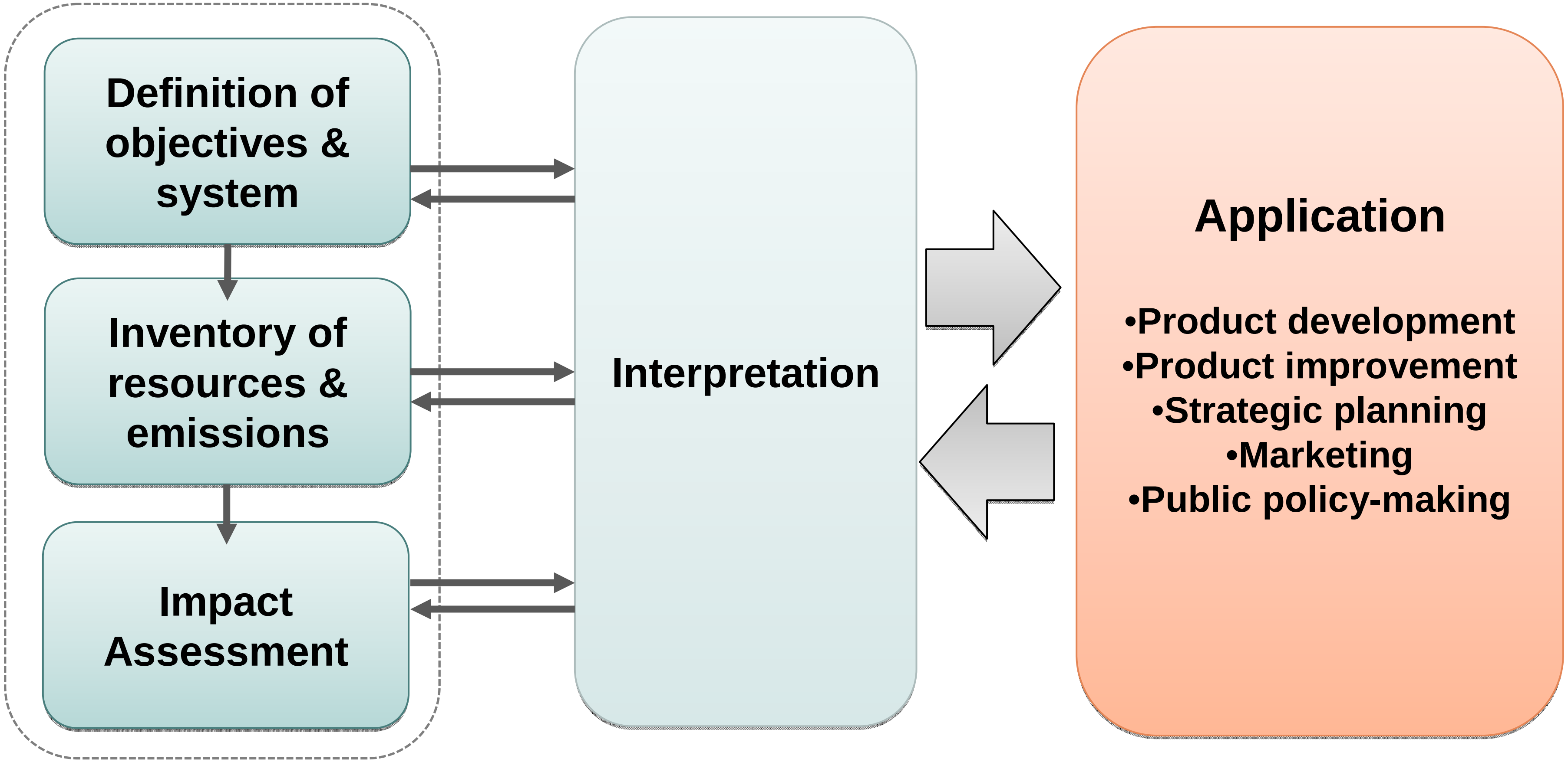
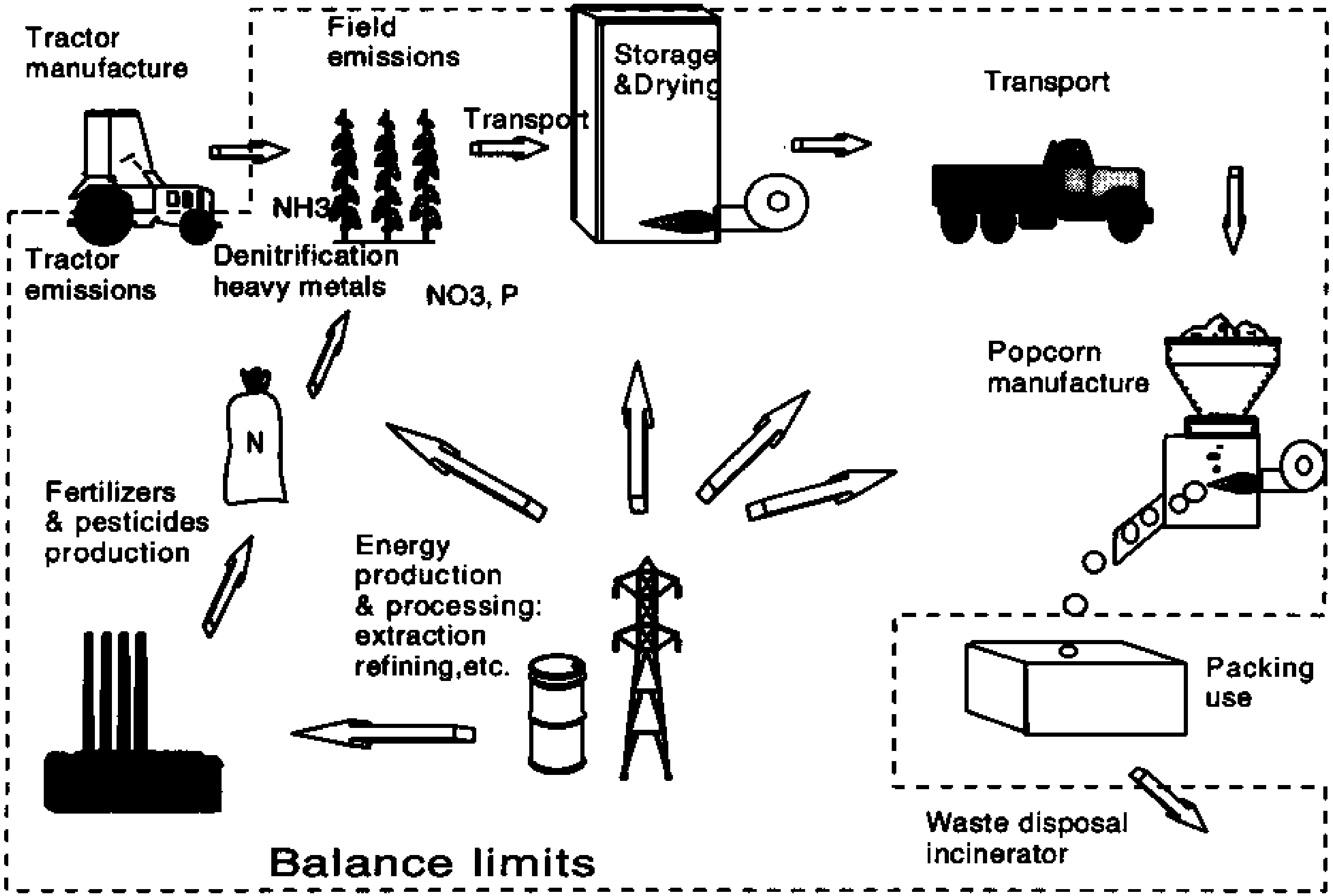
LCA phases and process



Renewable packing materials: system boundaries



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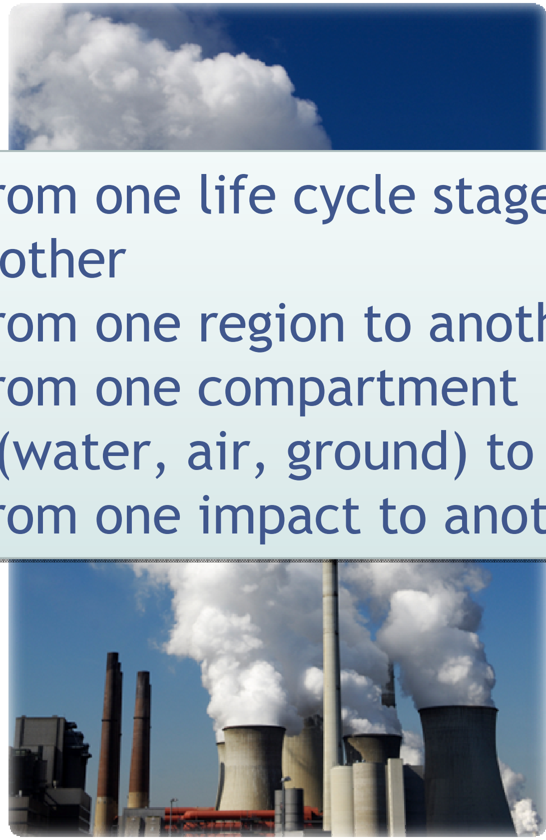
Advantage of LCA: See the whole picture

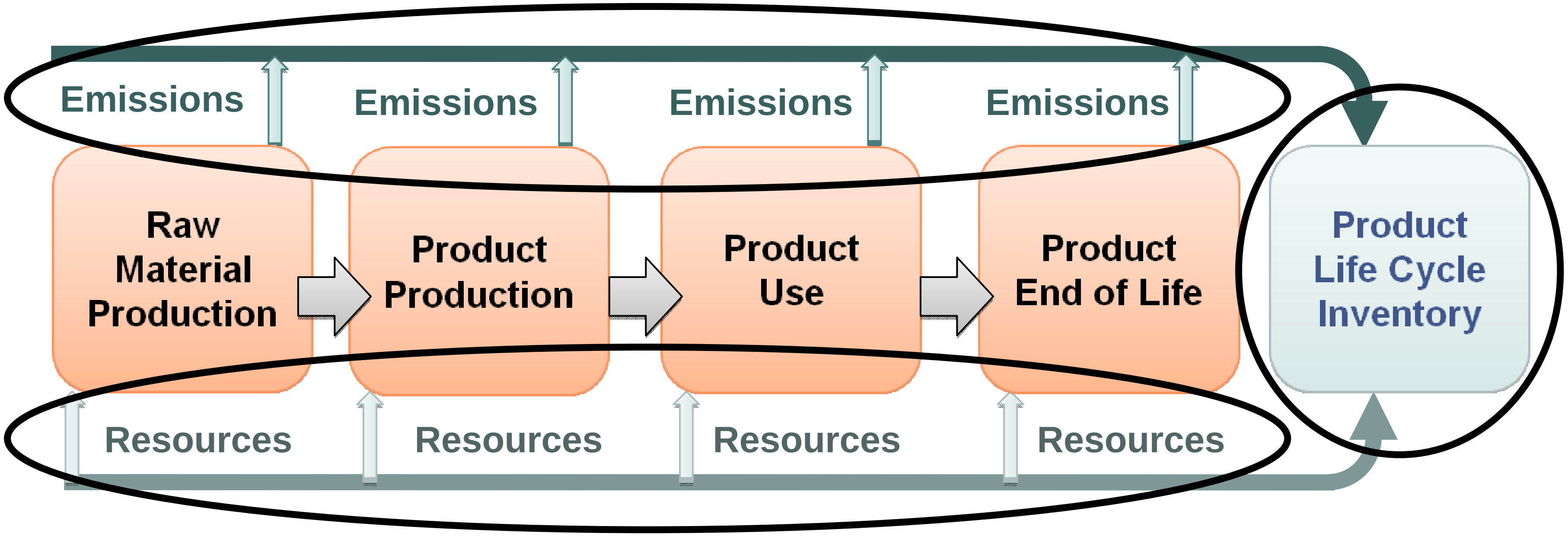
LCA prevents burden-shifting

Emissions displaced, not eliminated



- From one life cycle stage to another
- From one region to another
- From one compartment (water, air, ground) to another
- From one impact to another ...

LCA Inventory



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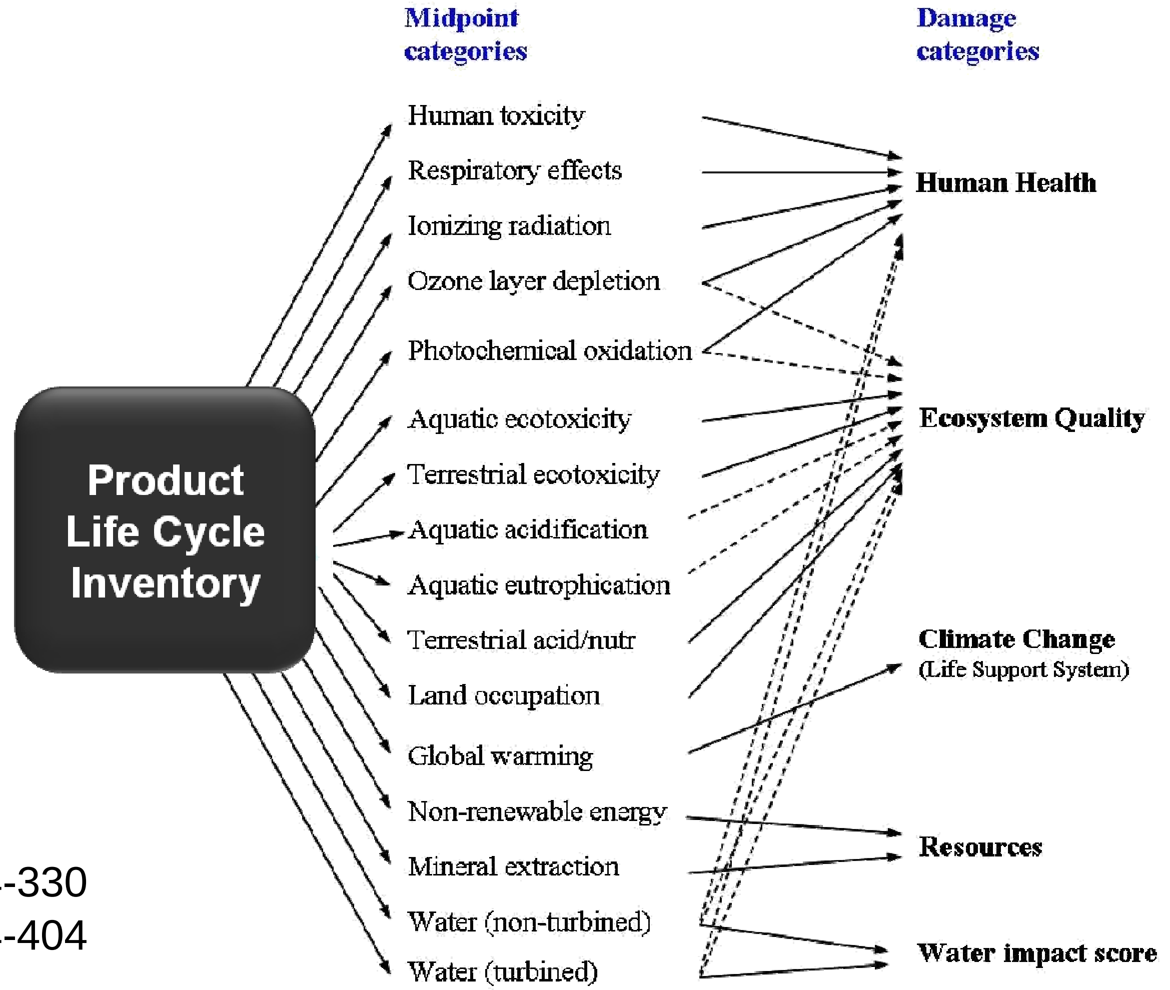
Life Cycle Inventory Results

Emissions	Popcorn g/kg	Polystyrene g/kg
Air		
CO_2	620	5480
Particles	0.2	1.3
CO	1.0	3.4
NH_3	3.1	0.0
Water		
Nitrates	31	0.0
Extractions	MJ/kg	MJ/kg
Energy non renouv.	7.2	81.3

Which is better?

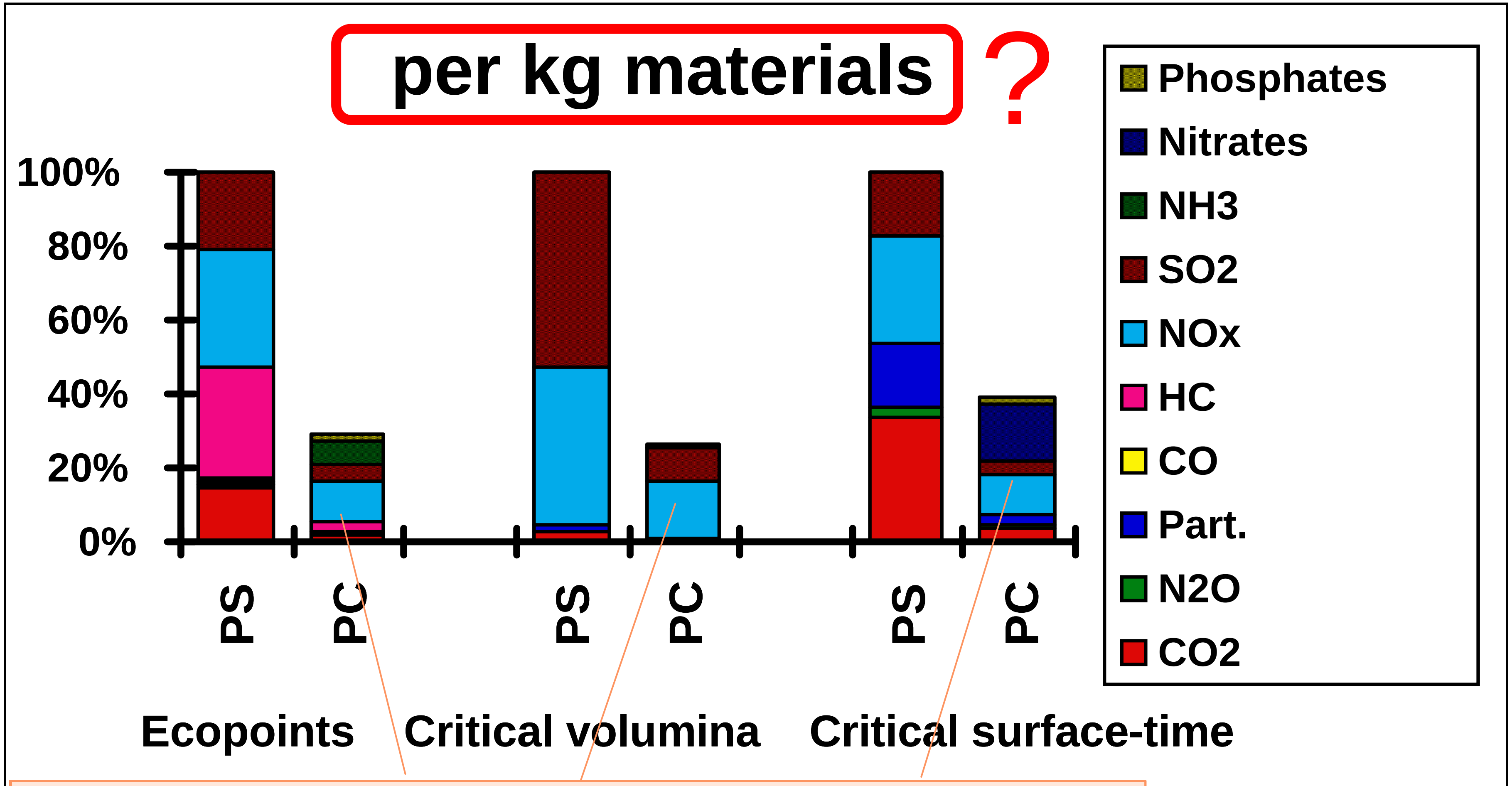
LCA Impact Assessment: Midpoint and Endpoint



e.g.
IMPACT 2002+

Int J LCA 8 (6), 324-330
Int J LCA 9 (6), 394-404

Popcorn impacts compared to Polystyrene impacts



Popcorn is clearly the better choice for the environment

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Is this the right comparison to make?

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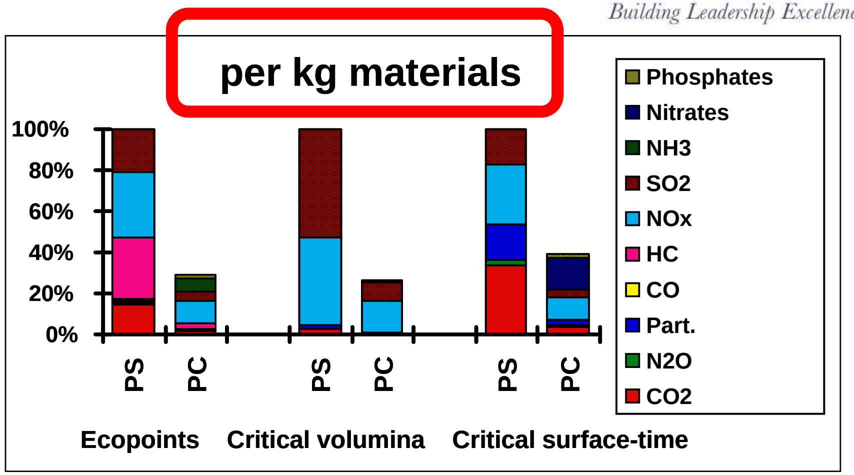
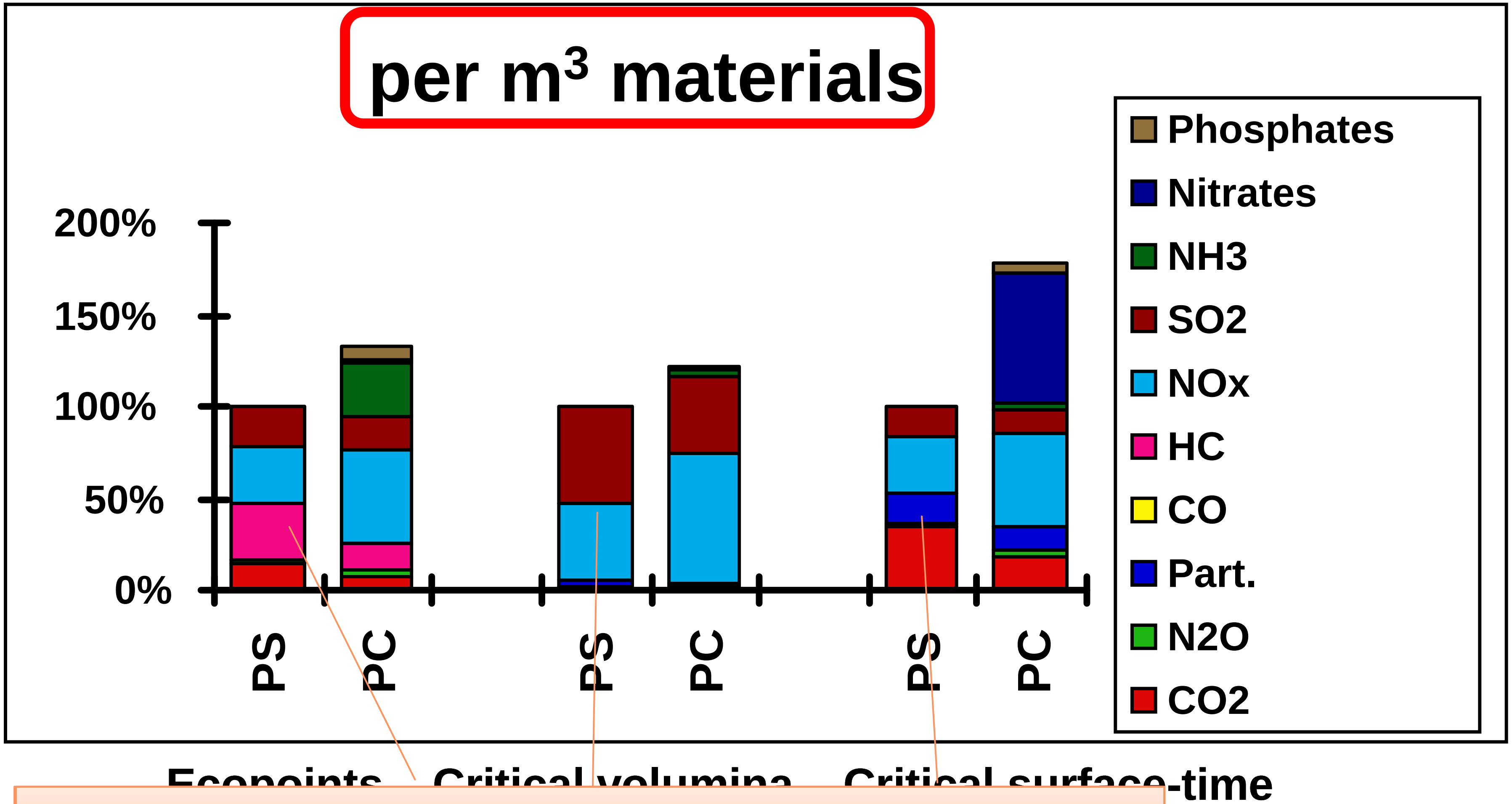
- Is a comparison per *kilogram* relevant?
- What is the packing trying to achieve? Adding mass?
- We need to define a "*functional unit*", which gives us a proper basis for comparison



- To be effective, packing material must take up space and have properties to cushion against movement
- So our comparison is more relevant based on *volume* rather than mass

Popcorn impact compared to polystyrene impacts



By volume, polystyrene is the better choice for the environment

Conclusions:
Popcorn vs Polystyrene

- "Natural" is different from "environmentally friendly"
- Must consider whole life cycle and range of environmental impacts
- Impact assessment allows interpretation of results
- Key parameters from an environmental point of view : density, number of reuse
- Material function or service is essential

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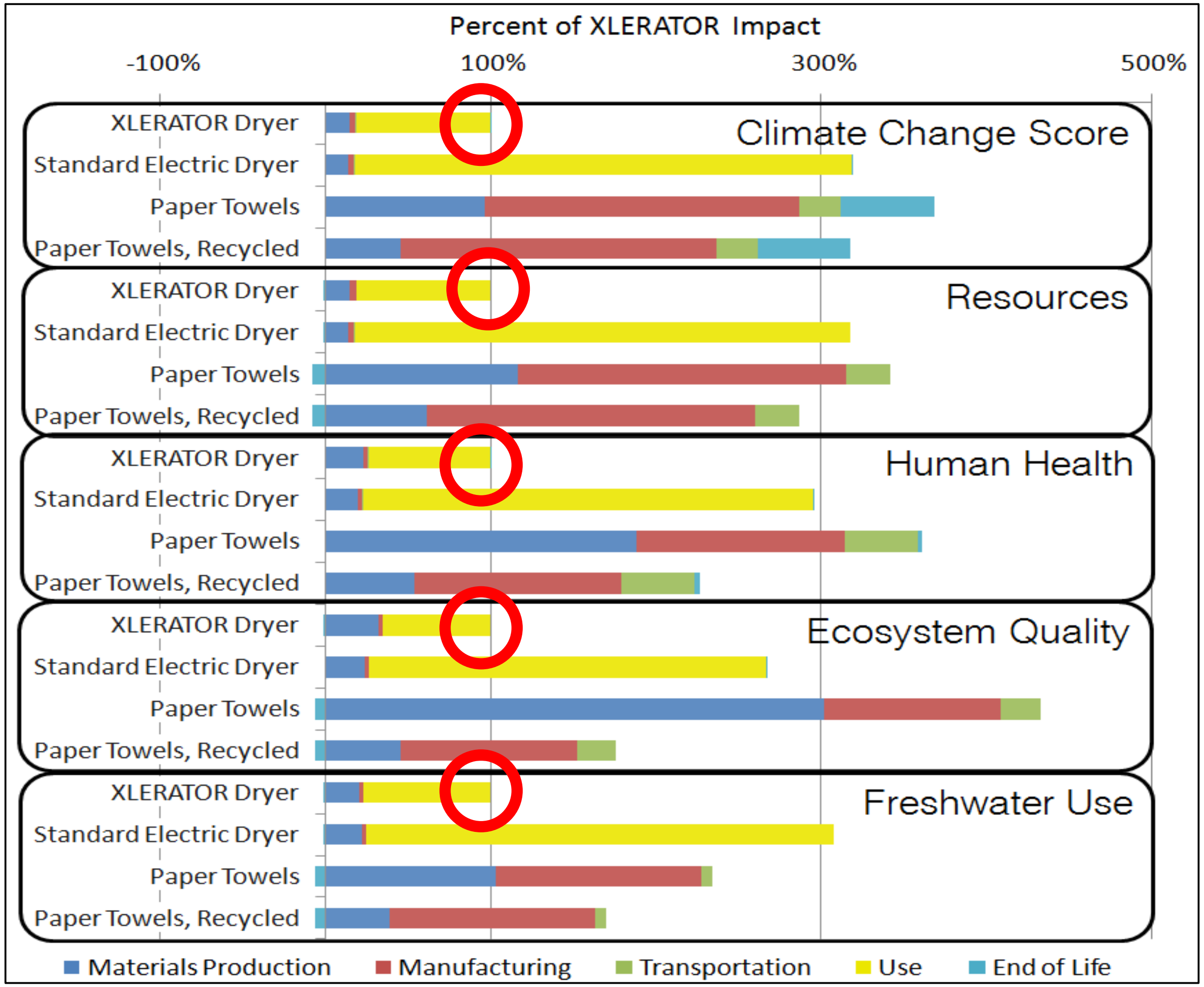
LCA of Hand Drying Alternatives



LCA and Packaging

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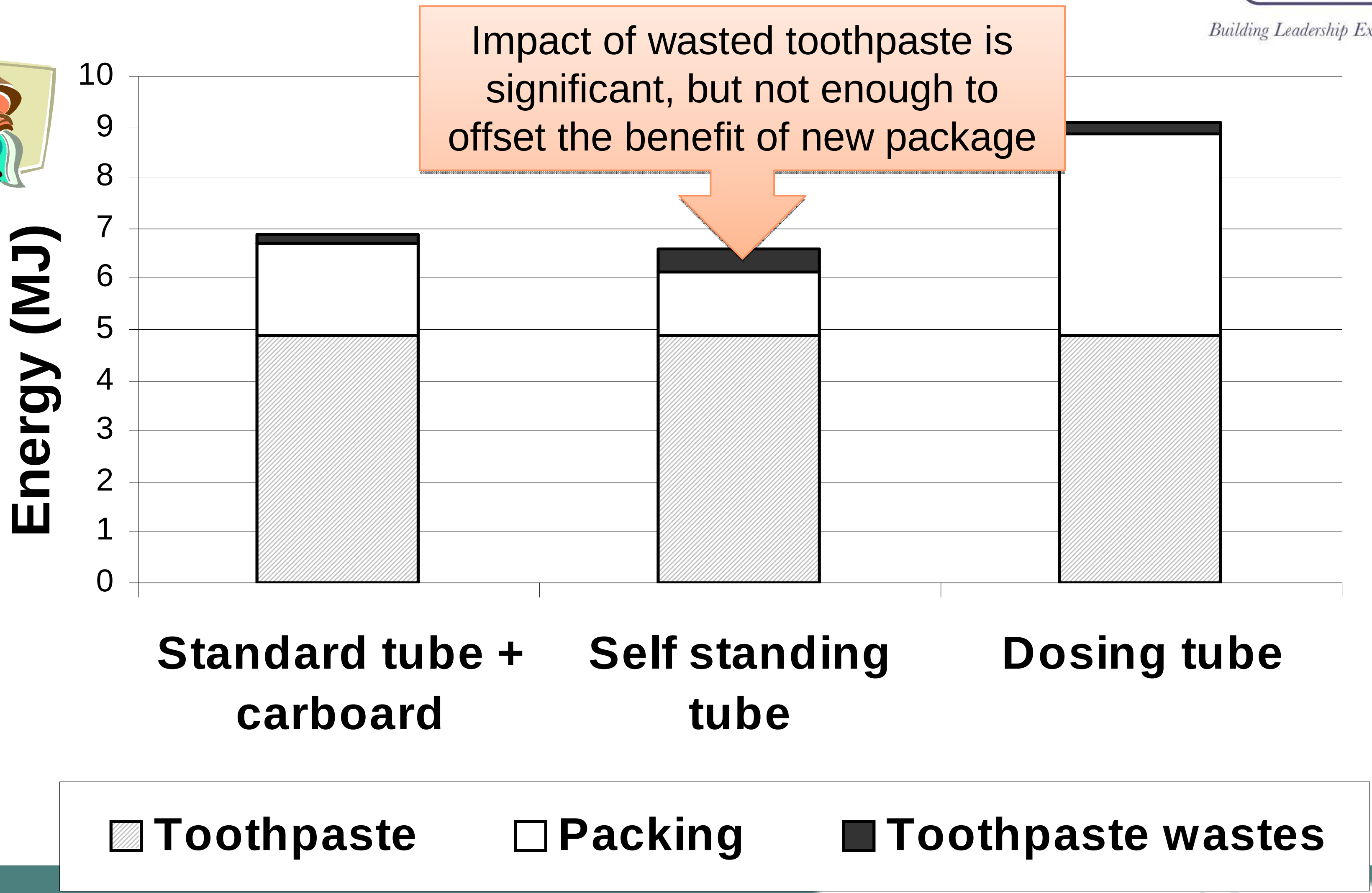
What is the Function of Packaging?

- To protect the product and deliver it to its site of use
  - It is therefore linked to the product amount / function
  - If product is lost, more packaging *and product* must be produced to replace the function
  - It is therefore necessary to consider the product's life cycle when the rate of product lost might be altered
- Packaging can also have other functions (e.g. to act as a drinking container)

Indirect impacts of packaging on product may matter: toothpaste



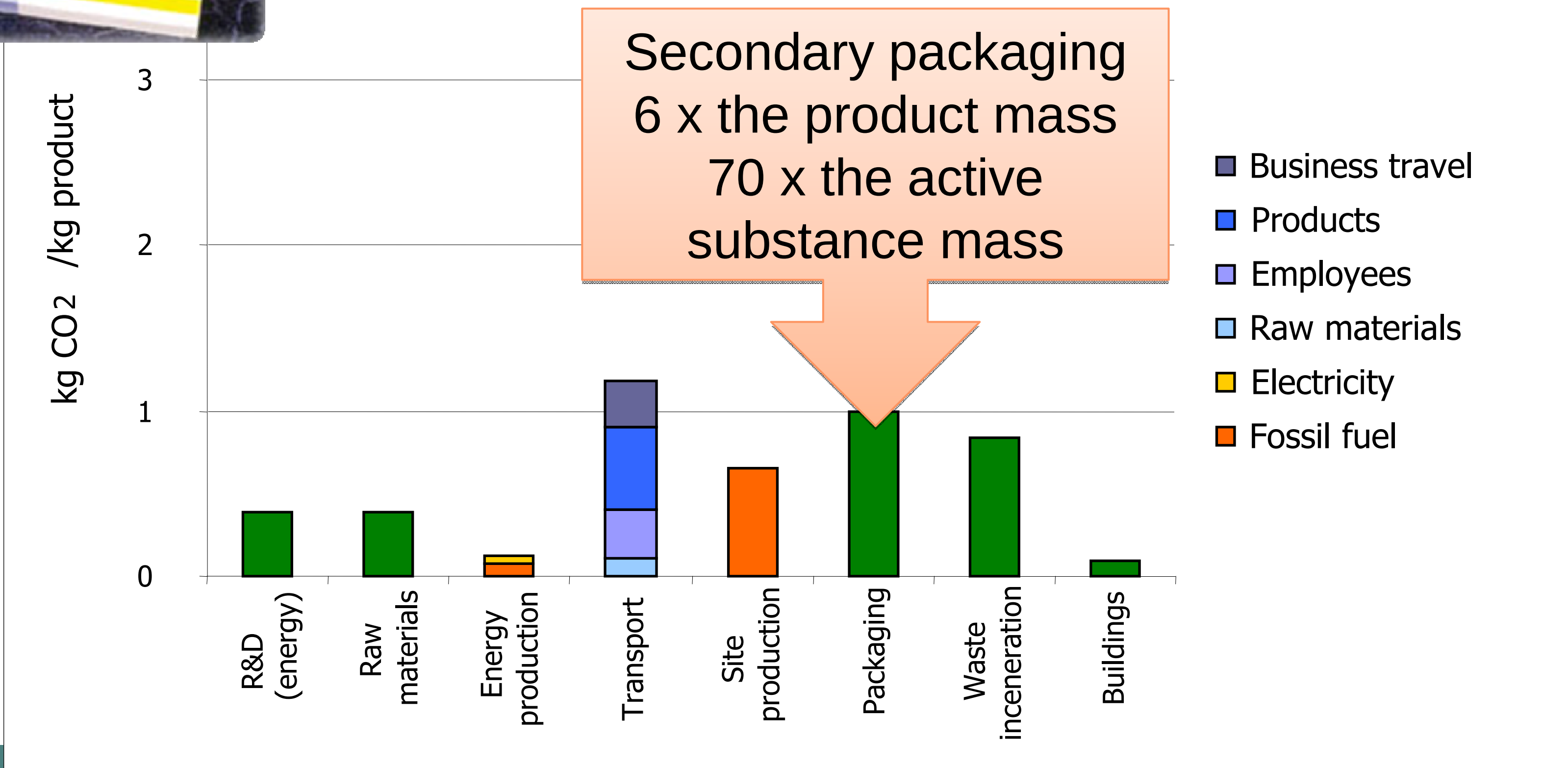
Which Packaging to Consider?

Primary Packaging Switch

Causes Secondary Packaging Switch

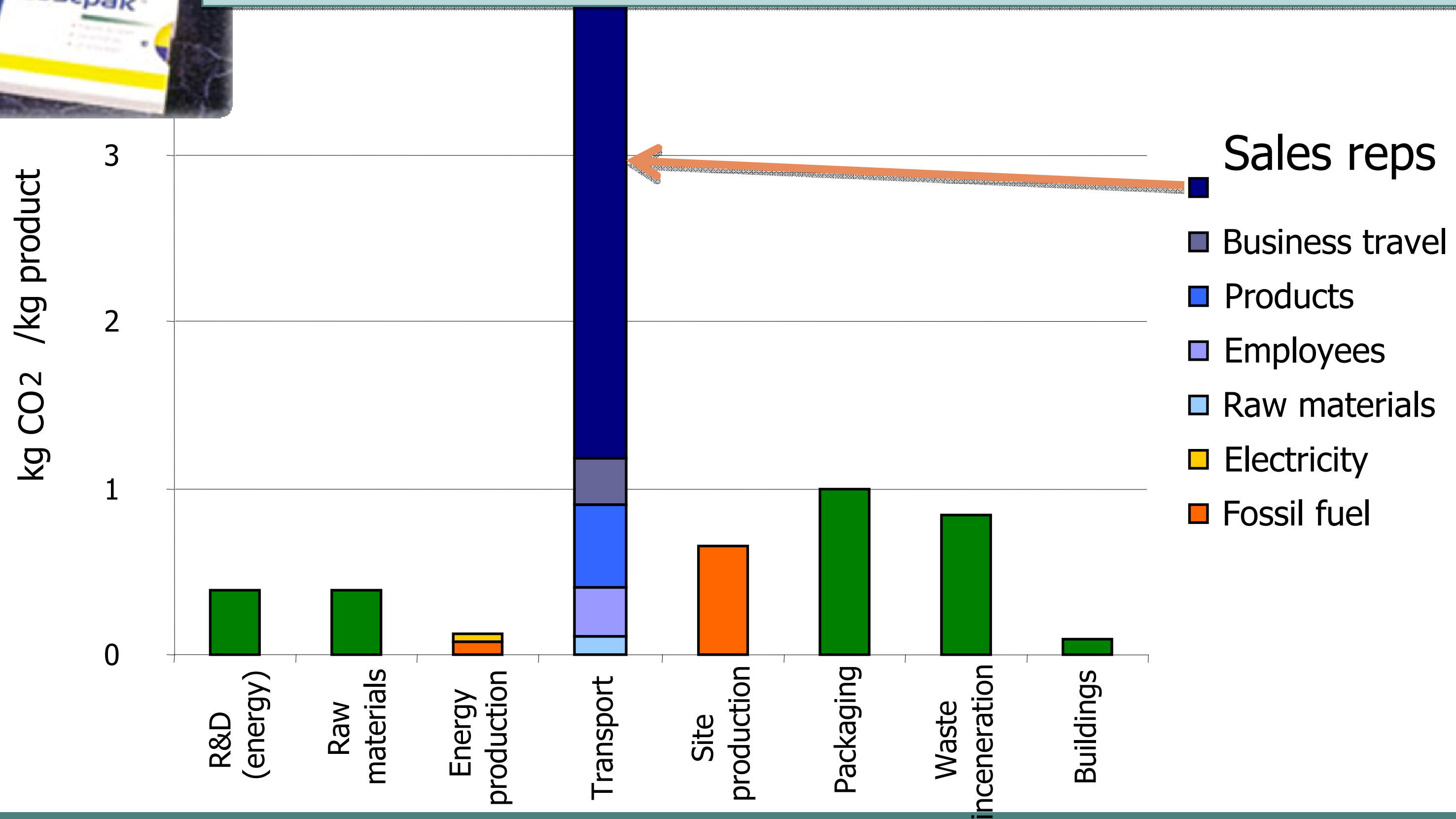
Which Packaging to Consider?

CO2 Emissions at different life cycle stages Pharma Industry



Life Cycle Boundary:
Are you seeing the whole picture?

CO2 Emissions at different life cycle stages Pharma Industry



What do we measure, is there industry guidance?

- The Global CEO Forum has convened a "Global Packaging Project" in 2009-2010 with a focus on establishing common sustainability metrics for packaging
- Based heavily on Sustainable Packaging Coalition's metrics, with heavier emphasis on LCA for environment
- Process now in a pilot phase with 18 value-chain pilots now underway
- Final output from the process planned for later in 2010
- Wal-Mart's Scorecard and Sustainability Consortium will also continue to set industry-wide focus

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Package design: Where do we focus?

Choice of materials ?

Supply chain operations ?

Form and features ?

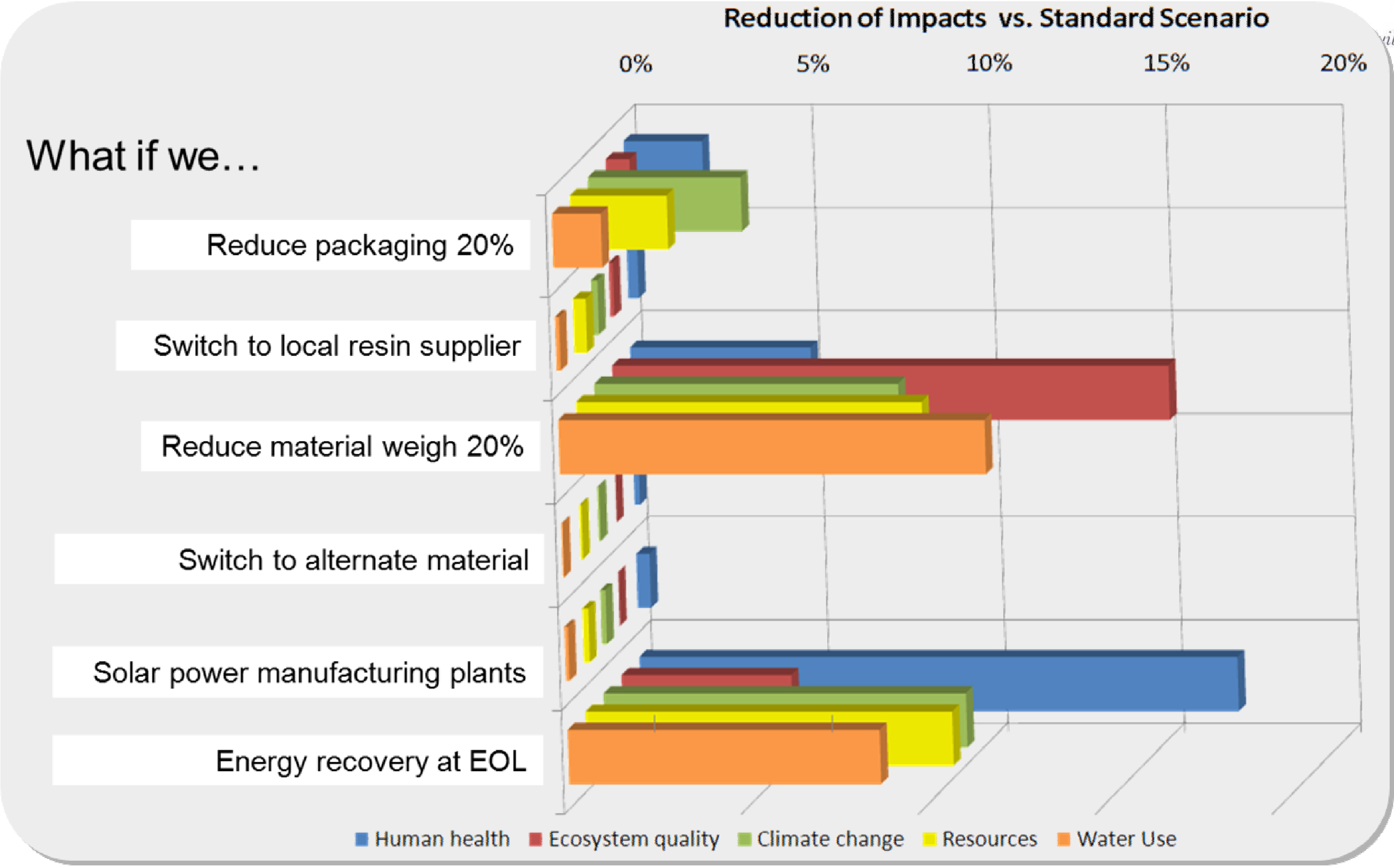
Material weight ?

Packaging ?

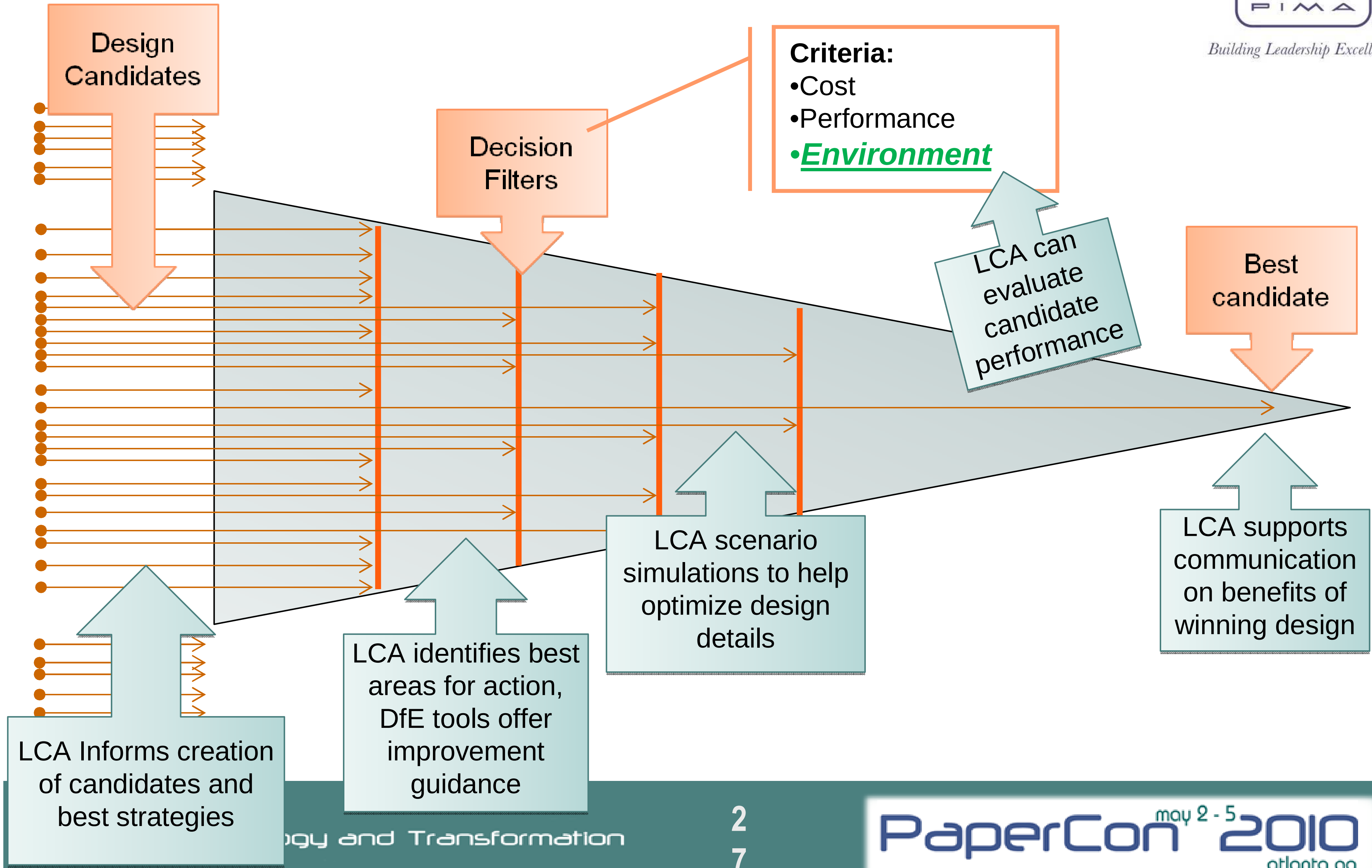
Impact of logistics ?

End-of-life Management ?

Where Should We Focus our Design and R&D?



Idea & concept filtration w/ LCA



Communication Example: NatureNes Baby Food

- Nestlé develops new baby food for European market
  - Includes:
    - freshest ingredients
    - new steam processing and preservation technology

There is a desire to communicate on environmental benefits of new packaging (switched from glass):

Unique Steam Cooking Process

"Respect the environment: Packaging reduces use of energy and emissions of CO_2"

Simple Natural Recipes

The NaturNes Case Study

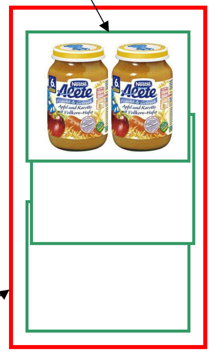
Glass Jar components

Steel PT Cap
PT = Press and Twist
(Electrolytical tin plate, ETP)

Paper Label

White glass Jar

Cardboard Cluster
(to group 2 jars, optional)



Cardboard Tray
(to group 3 clusters
or 6 non-clustered jars)

Plastic Pot components

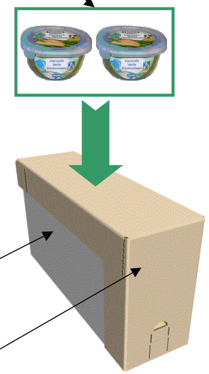
Plastic (PP) Cap

(Inside) Lidding film
(PET-SiOx-OPA-PP Lid)

2 pieces of PP label

Plastic (PP) Pot

Cardboard Cluster
(to group 2 pots)



Cardboard Tray
(to group X clusters*)

Cardboard Hood
(covering the Tray)

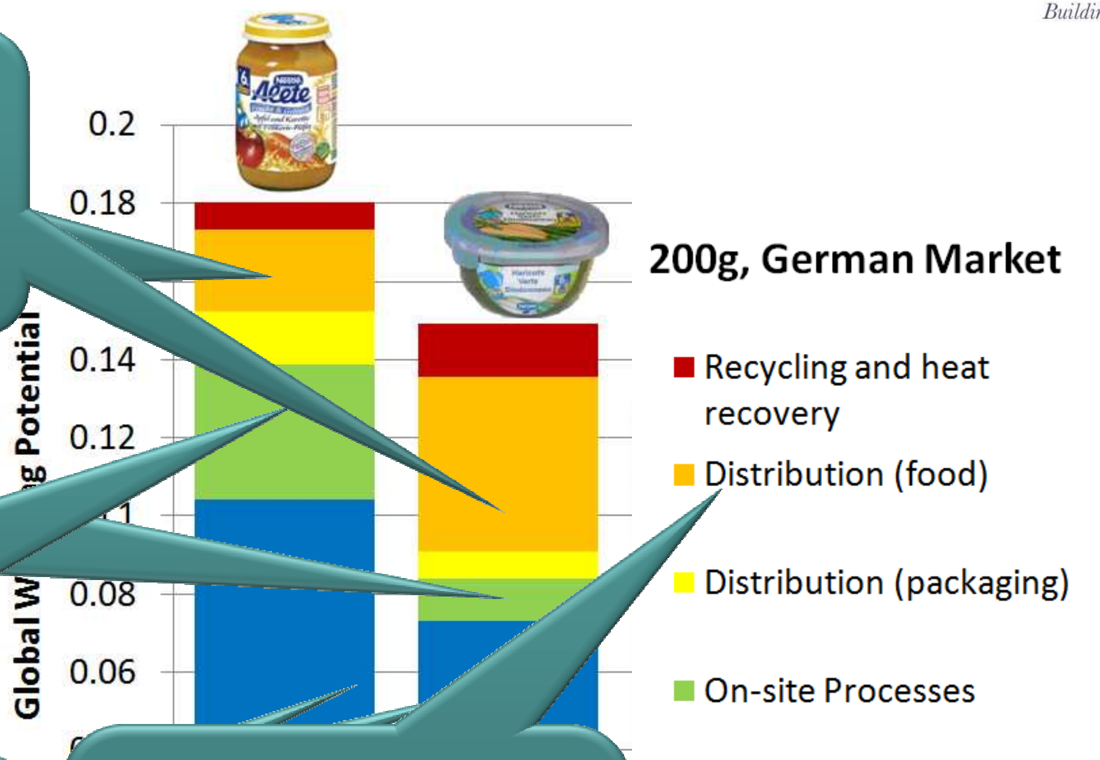
* The number "X" of clusters per tray varies according to size and marke

Main Contributors to Global Warming: Packaging Material and Distribution

Plastic pot system with current logistics has longer transport distances

Plastic pot system used more efficient UHT stream process

Plastic has lesser impacts to produce (for weight in package)

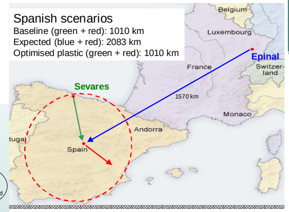


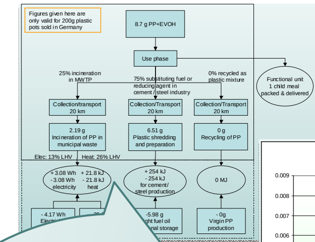
With "optimized" logistics network, the plastic would have an even greater advantage

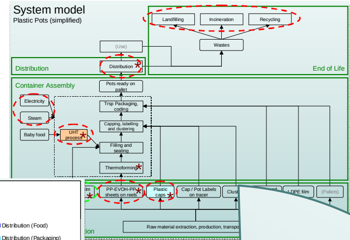
How can we communicate this?

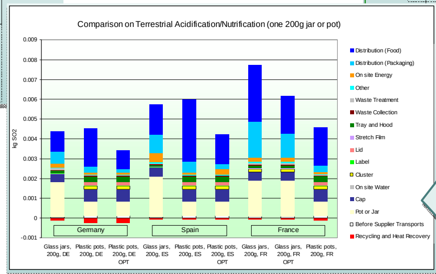
Development

LCA



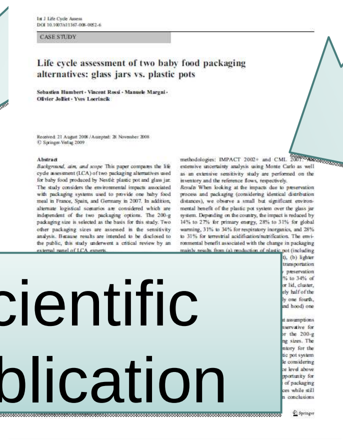






Review Panel,

ISO 14040



Scientific Publication

Labeling: "Reduces Energy Use and CO_2"

What is the geography and context of the packaging?

- Consumer behavior and public policy can influence environmental performance
- A packaging that is “environmentally friendly in one country may not be in another
  - Consumers may recycle at very different rates
  - Infrastructure may not exist to handle recycled materials in some locations
  - Policies effect rates of recycling and incineration vs. landfill

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Is it better to recycle or recover energy?

	Avoided mtrl	Avoided heat	Avoided electr.	Tot. energy	GWP
Plastic replacing virgin material					
Plastic	virgin plastic	biofuel or fossils	biofuel or fossil	R	R
Plastic replacing other materials					
Plastic	wood	biofuel or fossils	-	I	I
Paper/cardboard replacing cardboard vs biofuels					
Paper	wood	biofuel	biofuels	R	R
Paper/cardboard replacing fossil heat or electricity					
Paper	wood	fossil	fossil	I	I

Whether to recycle can depend on what is replaced

Whether to recovery energy can depend on the alternate fuel

Adapted from Anna Björklund & Göran Finnveden

Example: California's beverage container recovery program

- A successful program has greatly boosted rates of recovery?
- But what do we do with the containers?
- What end-markets should be developed to provide most environmental benefit?
- These end-markets will also determine which packaging options perform best within California

Summary of Key Points:

- To judge environmental performance, we must take a life cycle perspective
  - Categorical information like “recycled” or “bio-based” is not sufficient
- LCA gives a credible and scientific basis to environmental decisions and claims
- Packaging LCAs must consider the function of packaging and perhaps of the product
- The full packaging system should be considered
- Industry standard and coordination are emerging
- LCA can help guide development of better packaging solutions
- LCA can provide credibility to a marketing claim
- The context can be as important as the packaging

Questions?

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Silica Pigments for Use in Commercial Color Inkjet, High-Volume, On-Demand Printing Systems

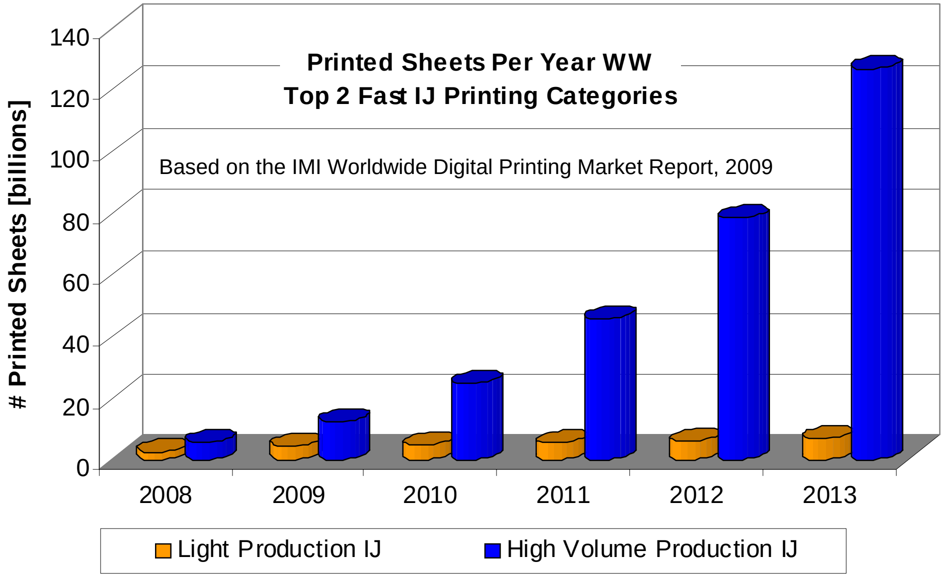
Demetrius Michos, W. R. Grace & Co.
Natalia Krupkin, W. R. Grace & Co.

Talent, Technology and Transformation

PaperCon may 2 - 5 2010 atlanta ga

TRENDS IN DIGITAL MEDIA WORLD

- New installations of high volume production IJ printers are increasing
- Digital printing is replacing traditional technologies
- High speed printing represents fastest growth opportunity:
    - ability to print variable data
    - personalize content and print short color runs (for example TransPromo)



"Current research indicates that consumers in Western Europe spend an average of three to four minutes reviewing transaction documents, making them an optimal communications vehicle to facilitate additional customer messaging"

CapVentures InfoTrends2009

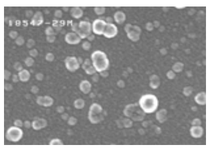
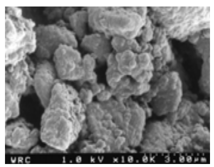
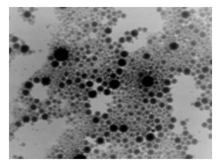
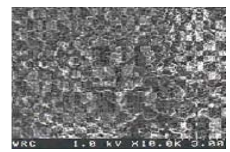
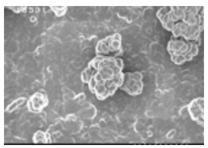
RAPID GROWTH OVER NEXT 3 YEARS!

Materials Technology for IJ Coatings

Amorphous Inorganic Pigments

Silica

Silica / Alumina

	Submicron	Micron. Silica	Colloidal	Precipitated	Sodium Magnesium Aluminum Silicate
					
Key Properties	▪ Particle Size ▪ Surface Area ▪ Pore Size ▪ Concentration	▪ Particle Size ▪ Surface Area ▪ Pore Size ▪ Surface Chemistry	▪ Particle Size ▪ Surface Chemistry ▪ Concentration	▪ Particle Size ▪ Surface Area ▪ Pore Size	▪ Particle Size ▪ Surface Area ▪ Pore Size ▪ Color
Targeted Applications	▪ Smooth surface ▪ Ink Capacity ▪ Dye fixation ▪ Optical Density	▪ Matte finish ▪ Ink Capacity ▪ Dye fixation ▪ Optical Density	▪ Surface Modification ▪ Coating ▪ Film primer ▪ Protective Topcoats ▪ Gloss enhancement	▪ Low cost matte	▪ TiO2 Extender ▪ Base paper ▪ Opacity ▪ Strike-thru
Manufacturing Technologies	▪ Dispersions	▪ Micronized Powder	▪ Dispersions	▪ Micronized Powder	▪ Micronized Powder

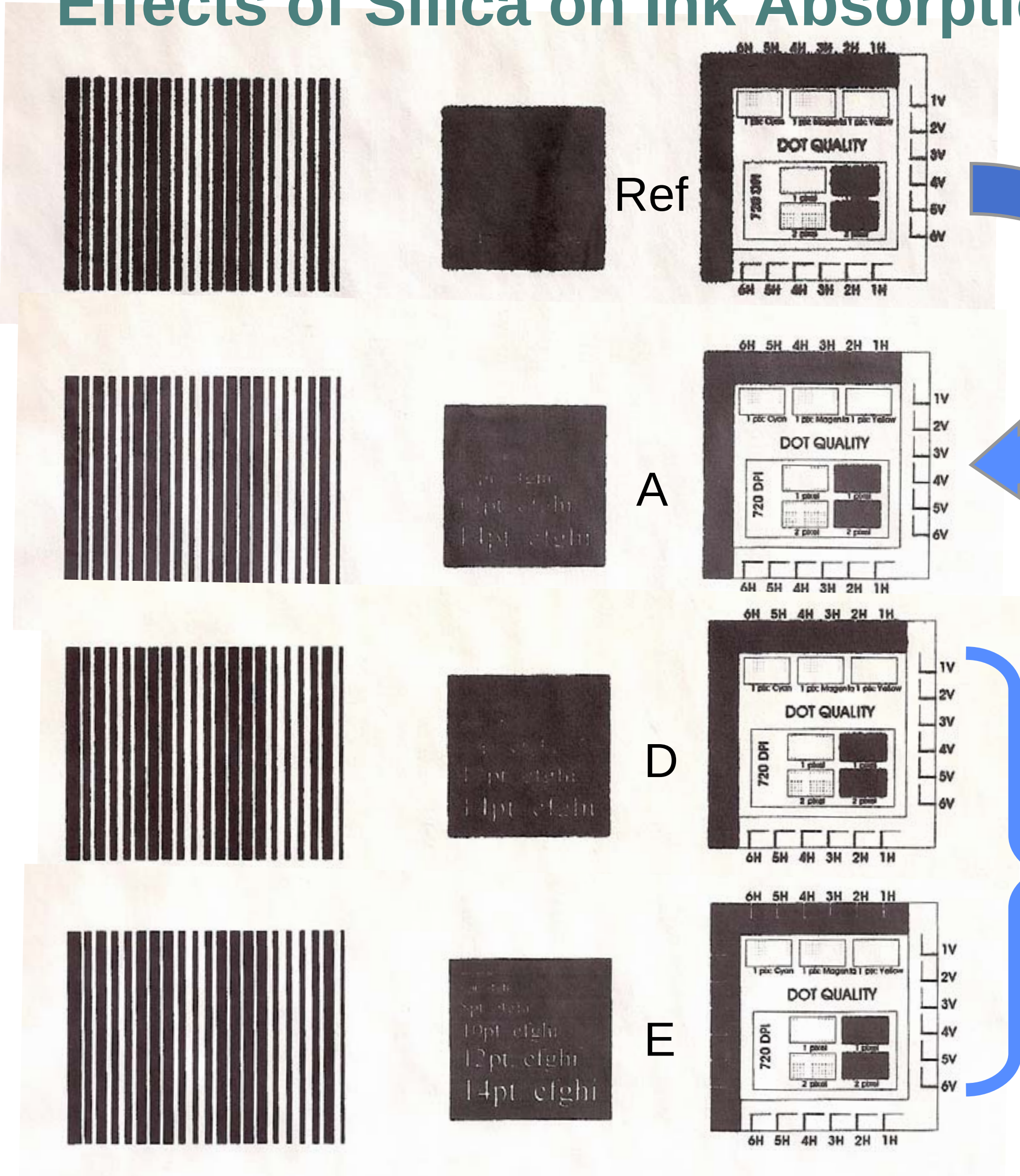
Porous Silica Introduction in Paper Coatings

Experimental Factors:

- Keep total pigment concentration constant.
- Maintain the same weight ratio of GCC to Clay
- Introduce two types of micronized silicas:
  - Particle size of 6 microns & Pore volume of 1.1cc/g
  - Particle size of 5 microns & Pore volume of 2.0cc/g
- Investigate the effect of partial replacement of starch with PVOH
- Coat weight: 6 gsm

	Reference	A	B	C	D	E
GCC	55.7	47.8	47.8	47.8	44.6	44.6
Clay	23.9	20.7	20.7	20.7	19.1	19.1
Silica - PV=1.1cc/g	0.0	11.1	11.1	0.0	15.9	0.0
Silica - PV=2.0cc/g	0.0	0.0	0.0	11.1	0.0	15.9
SBR Latex	9.6	9.6	9.6	9.6	9.6	9.6
Starch	9.6	9.6	4.8	4.8	9.6	9.6
PVOH	0.0	0.0	4.8	4.8	0.0	0.0
Crosslinker	0.5	0.5	0.5	0.5	0.5	0.5
Lubricant	0.6	0.6	0.6	0.6	0.6	0.6
Dispersant	0.2	0.2	0.2	0.2	0.2	0.2

Effects of Silica on Ink Absorption



14% Substitution of [GCC + Clay] with Silica (PV=1.1cc/g)

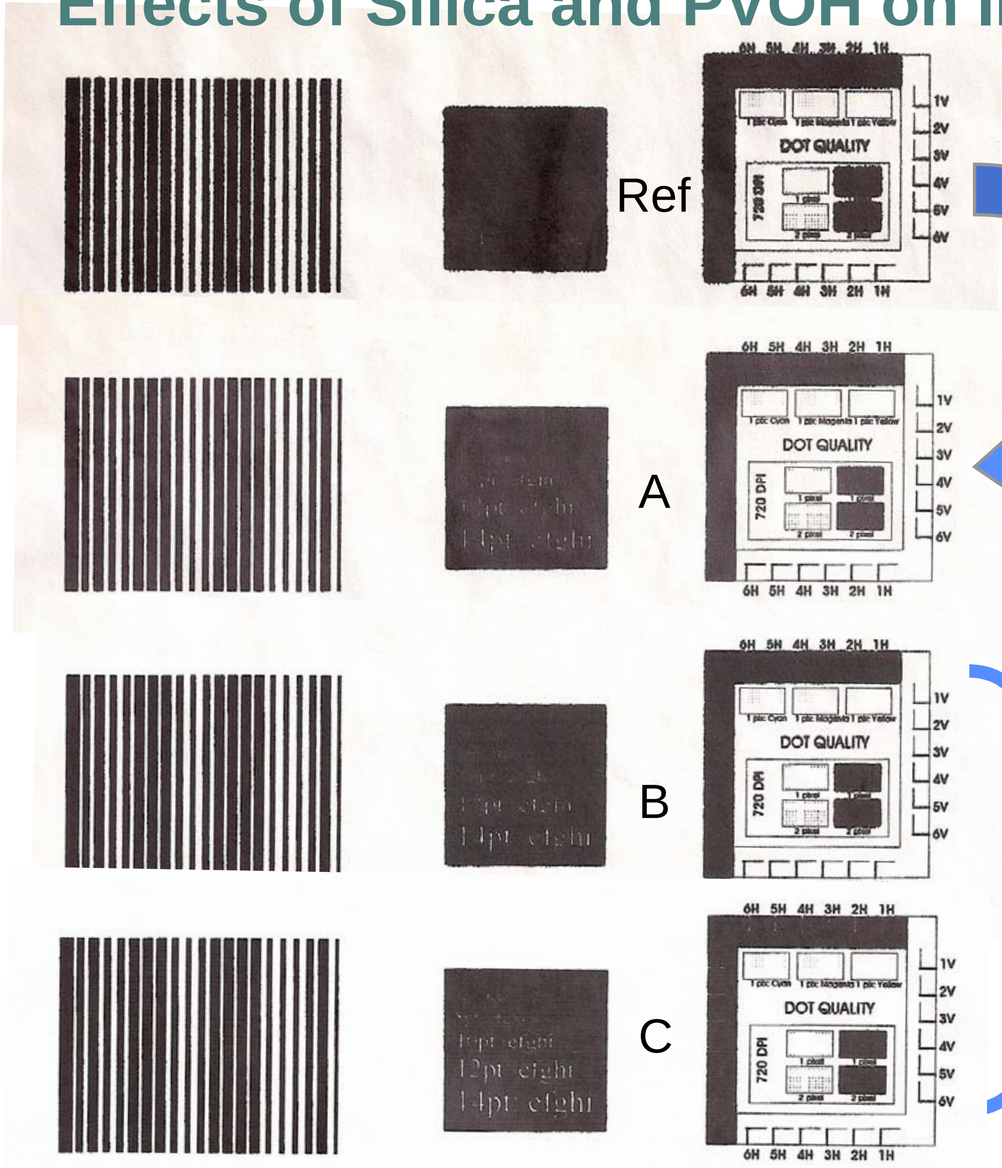
PV=1.1 cc/g

20% Substitution of [GCC + Clay] with Silica

PV=2.0 cc/g

SUBSTRATE: 65gsm base paper
PRINTER: Epson Stylus Photo 870

Effects of Silica and PVOH on Ink Absorption



14% Substitution of [GCC + Clay] with Silica (PV=1.1cc/g)

PV=1.1 cc/g

- 14% Substitution of [GCC + Clay] with Silica
- 50% Substitution of Starch with PVOH

PV=2.0 cc/g

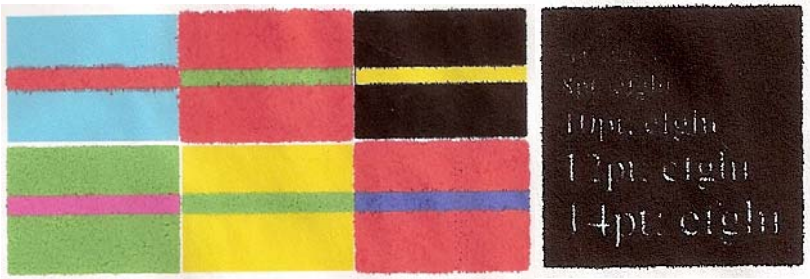
SUBSTRATE: 65gsm base paper
PRINTER: Epson Stylus Photo 870

Porous Silica Introduction in Paper Coatings

Experimental Factors:

- Formulation: Pigment/PVOH/Latex = 80/4.4/15.6
- Keep total pigment [Calcium Carbonate + Silica] concentration constant
- Replace 25% of the calcium carbonate with various silicas:
- Introduce silicas with different particle sizes and pore volumes:
    - Particle size of 0.4 to 9 microns
    - Pore volumes of 0.9 to 2.0cc/g
- Apply the formulations on two substrates and print with two types of printers
- Coat weight: 6 gsm

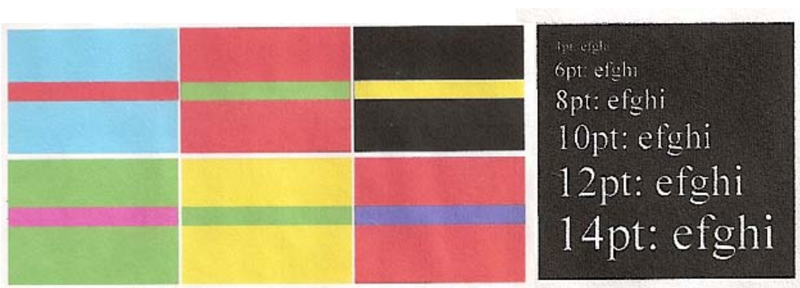
Effect of Porous Silica Introduction in the Coating



Calcium Carbonate / Silica / PVOH / Latex
80 / 0 / 4.4 / 15.6
Silica Pore Volume = -- cc / g
Silica Particle Size = -- microns

25% Substitution of Calcium Carbonate with Silica

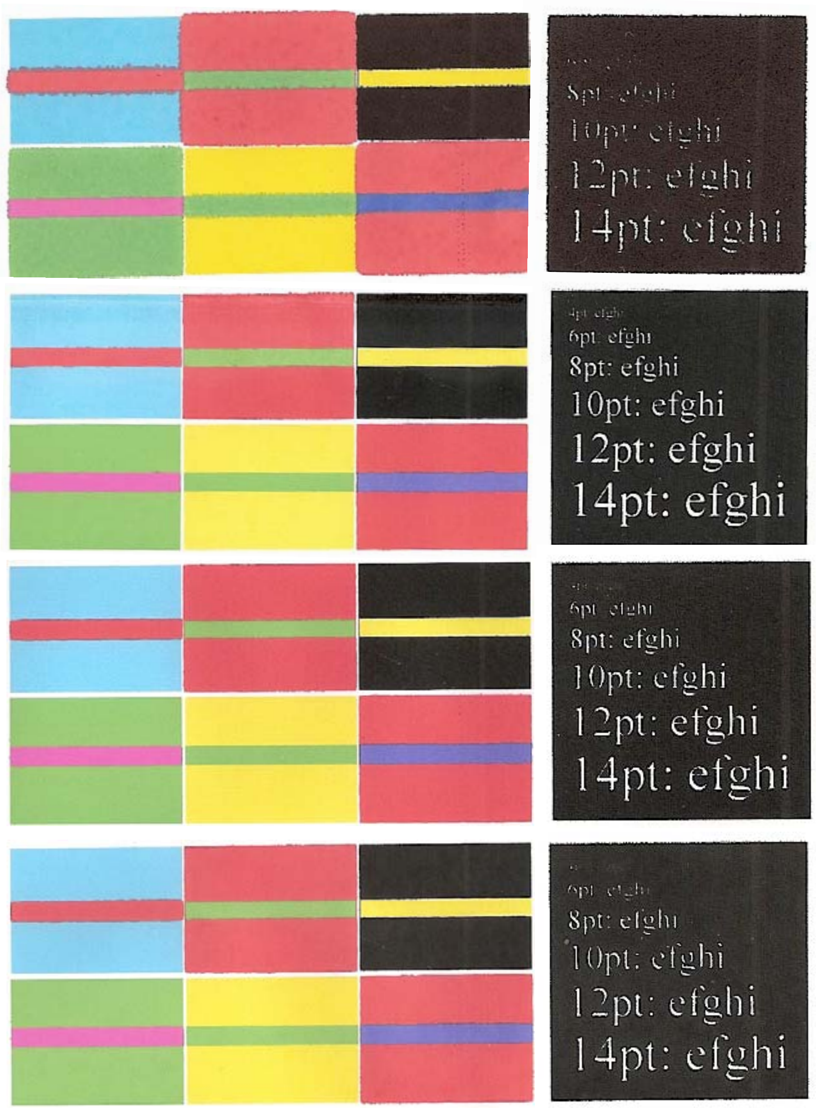
Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.0 cc / g
Silica Particle Size = 2 microns



Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.7 cc / g
Silica Particle Size = 9 microns

SUBSTRATE: 65gsm base paper
PRINTER: Epson Stylus Photo R200

Addition of Porous Silica *POWDERS* in the Coating



Calcium Carbonate / Silica / PVOH / Latex
80 / 0 / 4.4 / 15.6
Silica Pore Volume = -- cc / g
Silica Particle Size = -- microns

25% Substitution of GCC with Silica

Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 2.0 cc / g
Silica Particle Size = 4 microns

Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.7 cc / g
Silica Particle Size = 9 microns

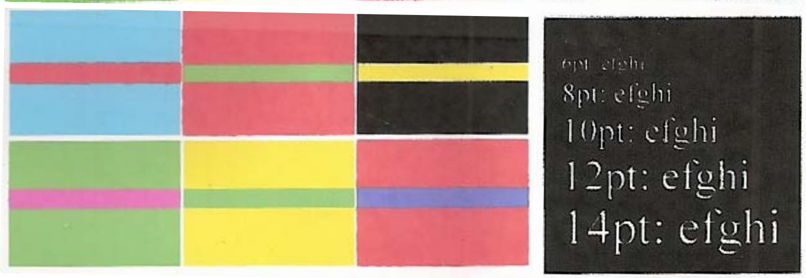
Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.2 cc / g
Silica Particle Size = 6 microns

SUBSTRATE: Glossy (148gsm)
PRINTER: Epson Stylus Photo R200

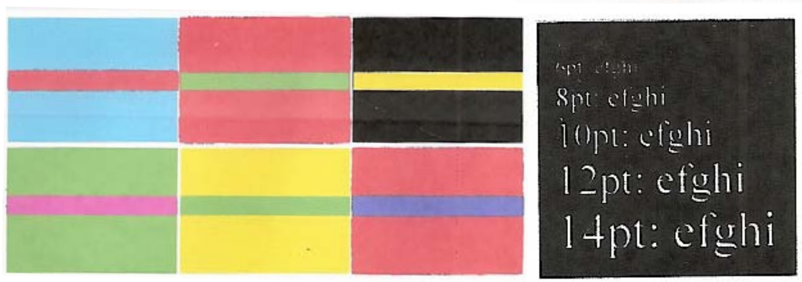
Addition of Porous Silica *DISPERSIONS* in the Coating

Calcium Carbonate / Silica / PVOH / Latex
80 / 0 / 4.4 / 15.6
Silica Pore Volume = -- cc / g
Silica Particle Size = -- microns

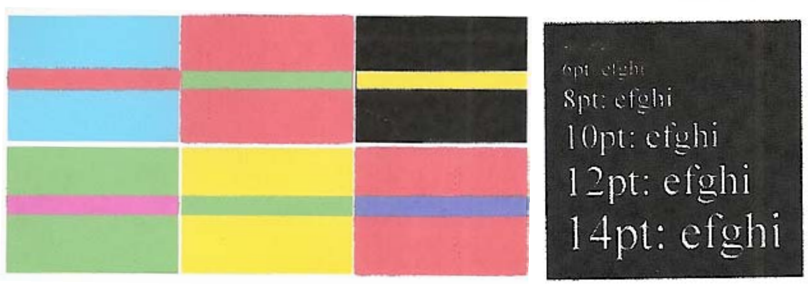
25% Substitution of GCC with Silica



Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.0 cc / g
Silica Particle Size = 2 microns



Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.0 cc / g
Silica Particle Size = 1 microns

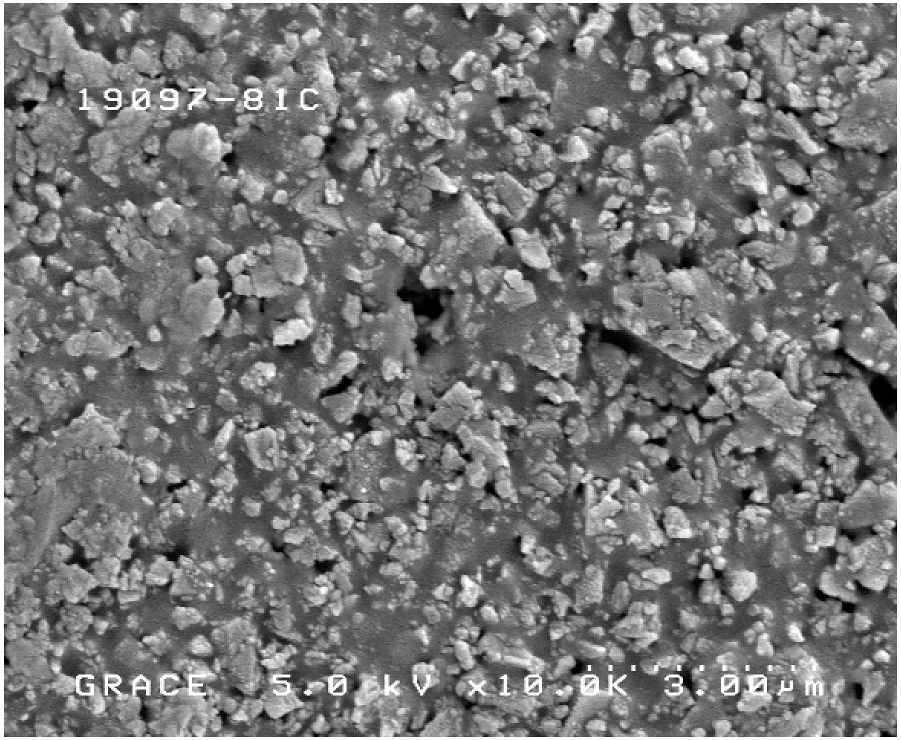


Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 0.7 cc / g
Silica Particle Size = 0.4 microns

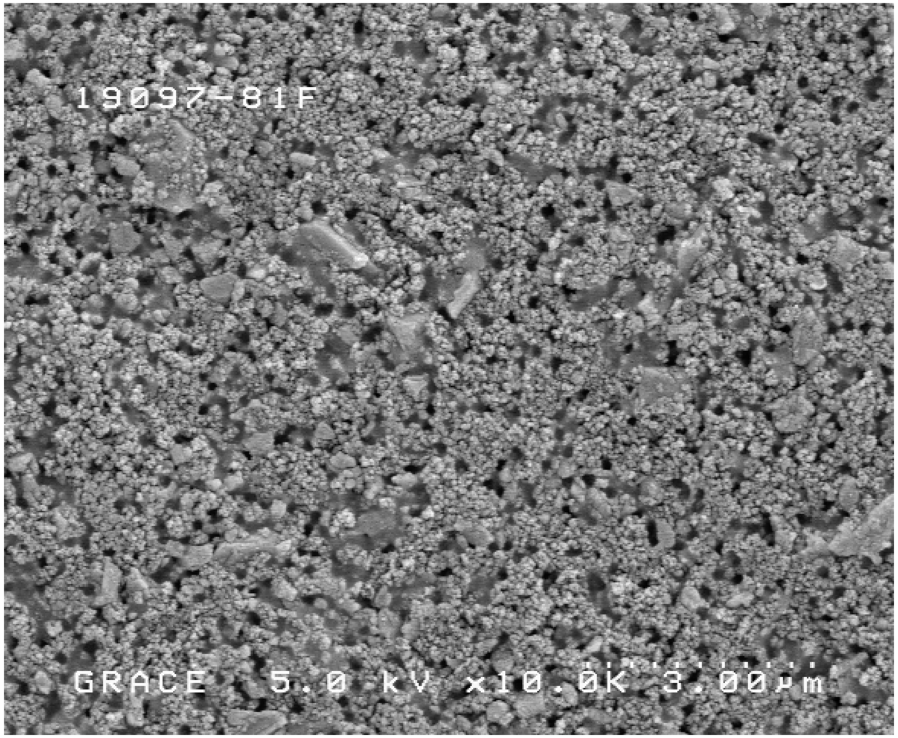
SUBSTRATE: Glossy (148gsm)
PRINTER: Epson Stylus Photo R200

Surface SEM Images of the Coatings

Calcium Carbonate (CC) Only Coating



25% Substitution of CC with 0.4 micron Silica

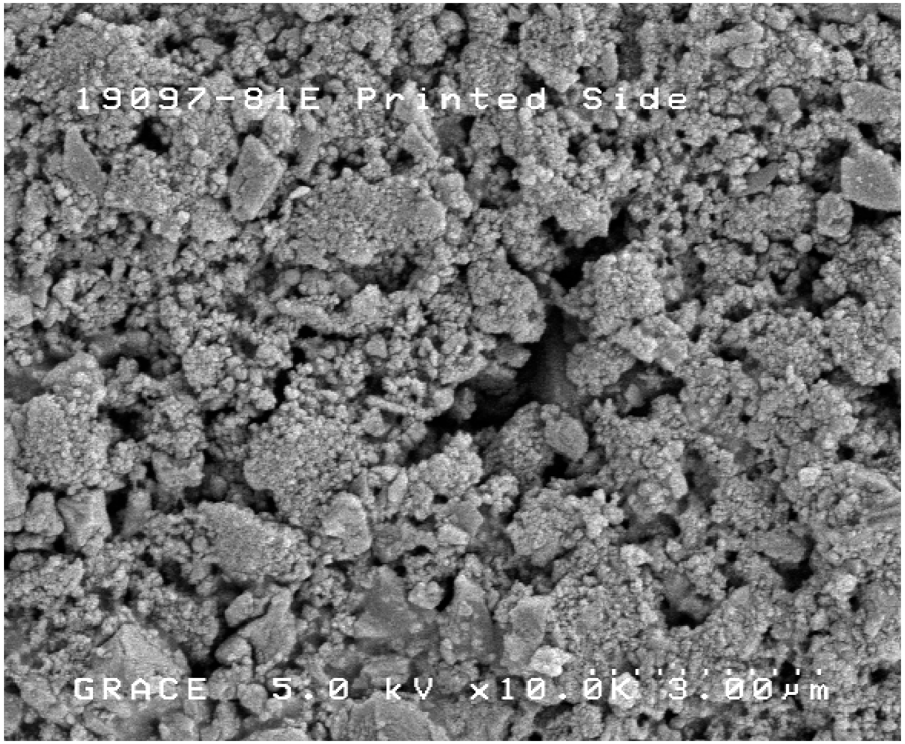


PARTIAL SUBSTITUTION OF CALCIUM CARBONATE WITH SILICA CREATES HIGHER LEVEL OF COATING POROSITY TO IMPROVE INK ABSORPTION CAPACITY

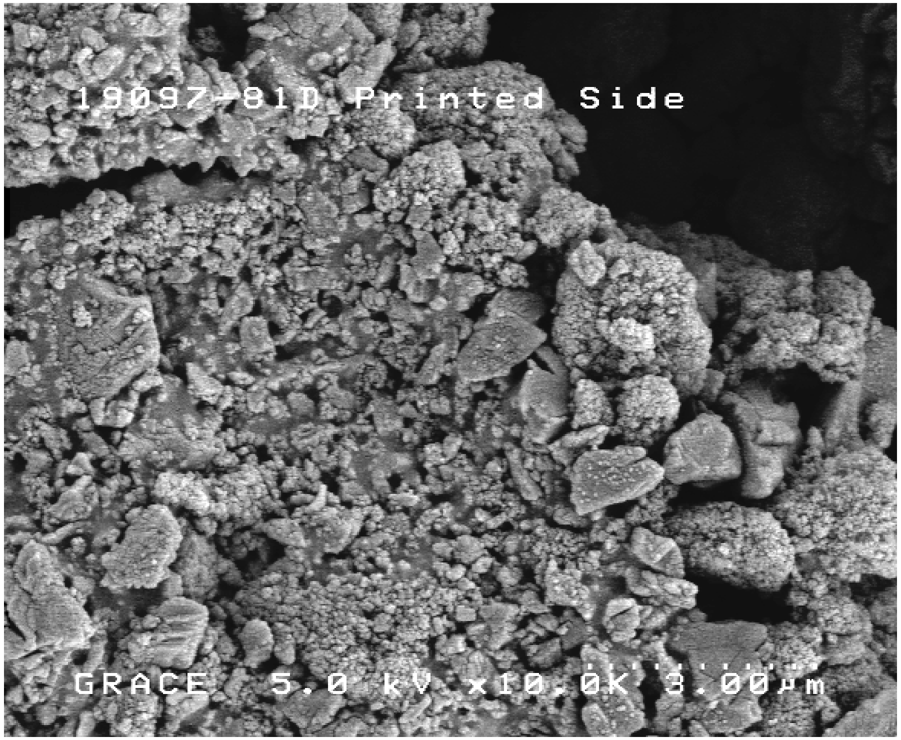
SUBSTRATE: Glossy (148gsm)

Surface SEM Images of the Coatings

25% Substitution of CC with 1.0 micron Silica



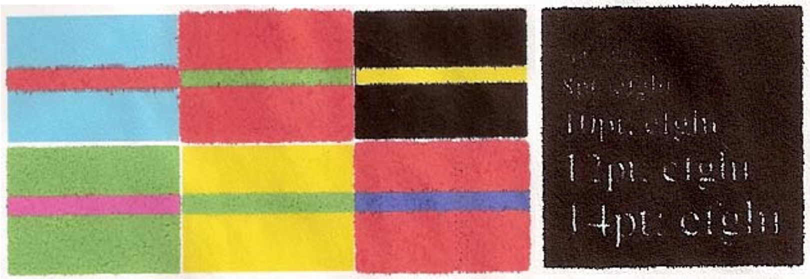
25% Substitution of CC with 4 micron Silica



PARTIAL SUBSTITUTION OF CALCIUM CARBONATE WITH SILICA CREATES HIGHER LEVEL OF COATING POROSITY TO IMPROVE INK ABSORPTION CAPACITY

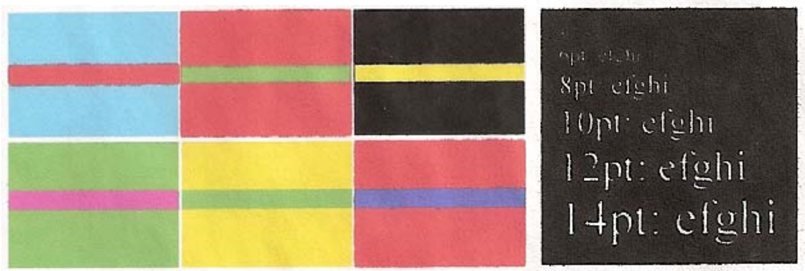
SUBSTRATE: Glossy (148gsm)

"Titration" of Porous Silica in the Coating

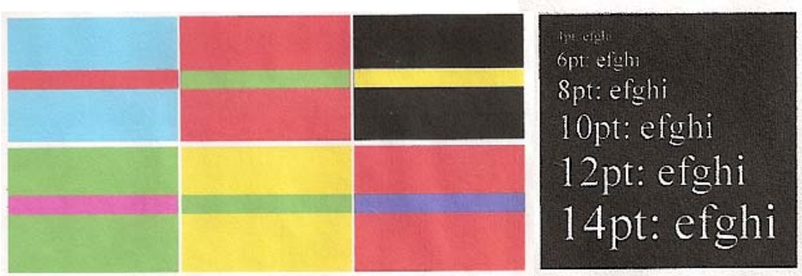


Calcium Carbonate / Silica / PVOH / Latex
80 / 0 / 4.4 / 15.6
Silica Pore Volume = -- cc / g
Silica Particle Size = -- microns

Calcium Carbonate / Silica / PVOH / Latex
75 / 5 / 4.4 / 15.6
Silica Pore Volume = 1.7 cc / g
Silica Particle Size = 9 microns



Calcium Carbonate / Silica / PVOH / Latex
70 / 10 / 4.4 / 15.6
Silica Pore Volume = 1.7 cc / g
Silica Particle Size = 9 microns



Calcium Carbonate / Silica / PVOH / Latex
60 / 20 / 4.4 / 15.6
Silica Pore Volume = 1.7 cc / g
Silica Particle Size = 9 microns

SUBSTRATE: 65gsm base paper
PRINTER: Epson Stylus Photo R200

Conclusions

- Partial substitution of coating pigments with porous silicas (Powders or Dispersions) can improve the overall porosity of the coating.
- This extra porosity can allow for:
  - Faster drying
  - Less bleeding
  - Upgrade the paper to meet the high speed ink-jet printing requirements

- Silica improves the mechanical properties of the coating
  - Dry and wet mar resistance
  - Changes coefficient of friction

Building Leadership Excellence

TAPPI people resources solutions

Using Kaolin to Tune Key Performance Parameters in Future Publication Ink Jet Grades

Ching Chen, Kamin LLC

Doug Carter, Kamin LLC

Talent, Technology and Transformation

PaperCon 2010 may 2 - 5 atlanta ga

Commercial High Speed Ink Jet Web Press

Evolution

SOHO Printer

Speed of Ink Jet Printers Transform From SOHO to Commercial Print Choice

- Speed: Modern commercial inkjet web presses are running at very high print speed. Approaching 1/3-1/2 of heatset web.
  - **Up to 650fpm or 200mpm (>3x of Electrographic printers)**
- Web Width
  - **Up to 30” wide (close to conventional full web)**
- Print heads for printing both sides in one pass
  - 2-8 units/press
- Inter-station NIR Drying Unit is often included in high speed ink jet press for multipurpose functions
  - Speed up ink drying rate
  - Improve Ink adhesion to the substrate
- More Ink Types are Used
  - Pigment Inks, pigmented inks, dye-based inks

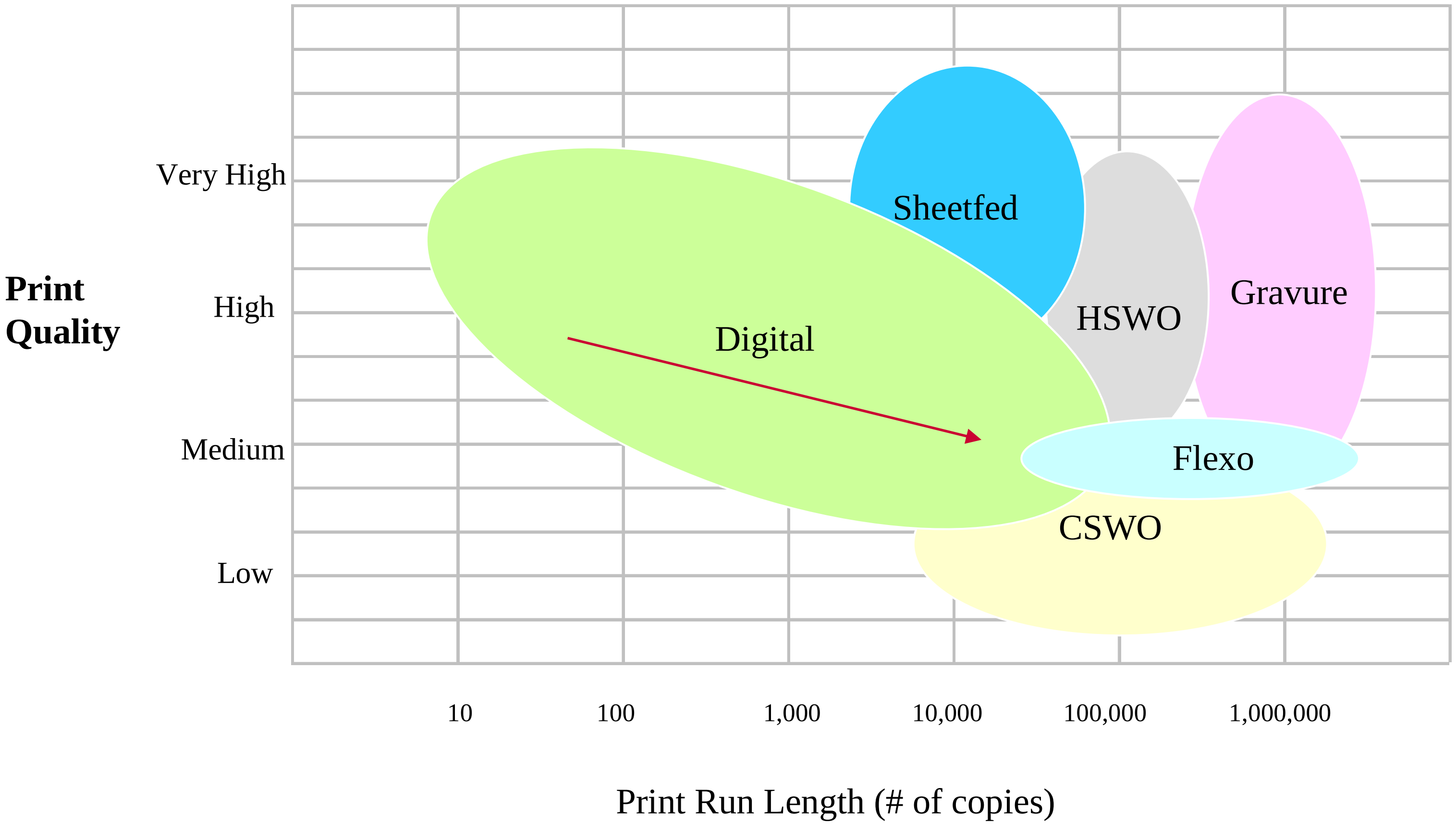
Impacts of Ink Jet Technology Today

- Penetrating to Book Printing (publishers):
  - Publishers are opt for on demand printing because of potential saving on book inventory and waste reduction for unsold volumes. Electronic publishing can supply readers with both paper and non-paper based books plus in-time editing capability.
  - Books can be printed on uncoated paper monochrome printing and matte coated stocks for colors.
  - In-Line Binding capability makes Inkjet Printing a powerful alternative to conventional soft-cover book printing
- Direct mailing (fulfillment service)
  - Ink jet can be a viable printing method for direct mailing application promoting sales and building customer relationship. Coated stocks limitation giving many opportunities to EP at this moment.
- TransPromo Printing (Financial statement + Personalized Marketing)
  - TransPromo combines personalized marketing messages with must-read statements, invoices, and other documents to help you accomplish two important, measurable results: increased revenue and retained customers
  - Surface treated uncoated stocks are often used.
- TransEd Printing (Financial Statement + Education)
  - Another way to promote business relationship through education
- TransInfo Printing

“Ink Jet Technology, The Offset of Tomorrow”

Go Digital !

Digital Is Advancing Quite Rapidly and Ink Jet Is Ready To Take In Sheetfed and Coldset



Impacts of Ink Jet Technology Tomorrow

- Expansion of Book Printing (publishers):
  - Publications can be printed on Gloss coated paper with full-color printing
  - In-Line Binding capability makes Inkjet Printing as a new integrating system a powerful alternative to conventional publication printing
- Customized Catalogs
  - Digitized catalogs based on buying preferences.
  - Each print individualized
- Direct mailing (fulfillment service)
  - Ink jet will be a viable printing method for direct mailing application promoting sales and building customer relation. Coated stocks of varying finishing and basis weight will be available for different applications.
  - Personalized mail continues its growth.
  - Integrating printing system based upon ink jet as a core imaging unit.
- Packaging Printing
  - Labels
  - Display Boxes

What are remaining Barriers to Adoption of Ink Jet Technology?

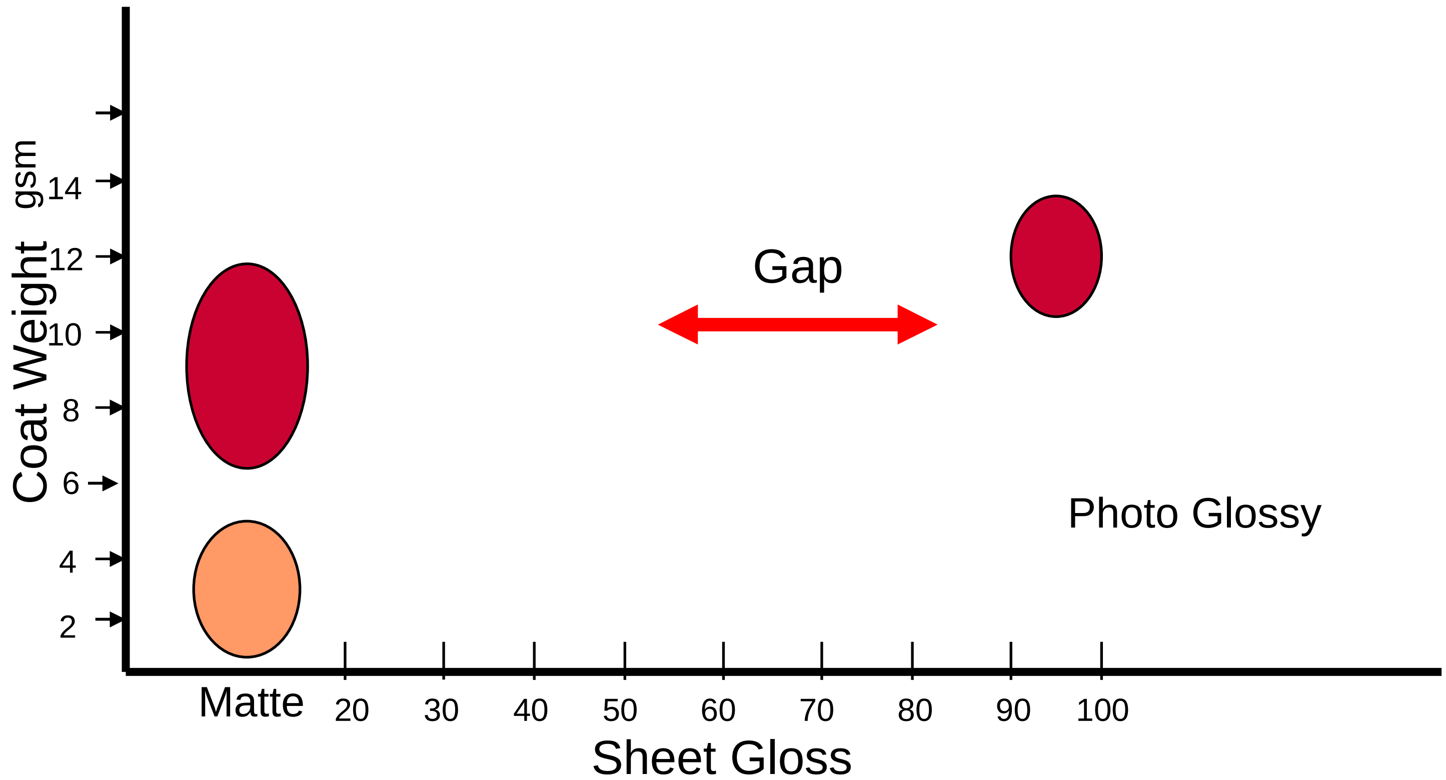
- Coated Paper Substrate Availability
  - Technology Ownership/Partnership
  - Ink and Substrate Interaction
  - Jetting Methods (CIJ, DOD…)
- State of Uncertainty in Paper Industry
- State of Uncertainty in Business Environment (# of Installations)
- Technology Impacts From Computer Industry

Can't solve all the Uncertainty but Can address Making sure Paper is not the Barrier

"Can not score if you don't have the ball".

Where are the Opportunities

Current Ink Jet Paper Availability

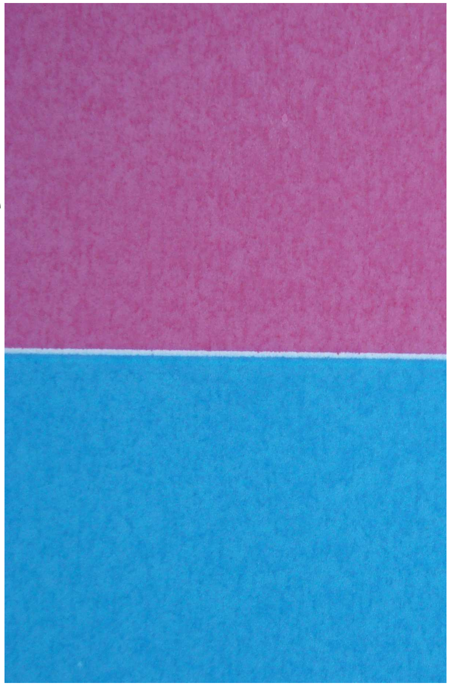


Opportunities in Ink Jet Match Current Offset Grades Produced. But can they be used?

Do Current Coated Paper Grades Work?

No… Why Not?

- Poor Ink Densities
  - A Typical formulation Based upon (80/20 GCC/Clay; 10-12 Parts of SB/SBA/Starch binders)
  - Dm=0.80; Dc=0.88; Dy=0.64; Dk=1.65
- Severe Non-Uniformity in Solid Print Colors or Print Mottle
- Poor Resolution due to ink bleeds or Slow Ink Drying Rate
- Narrow Color Gamut
- Poor Permanence



How do we Address these Challenges?

The Concept Coating Using Specialty Fine Kaolin

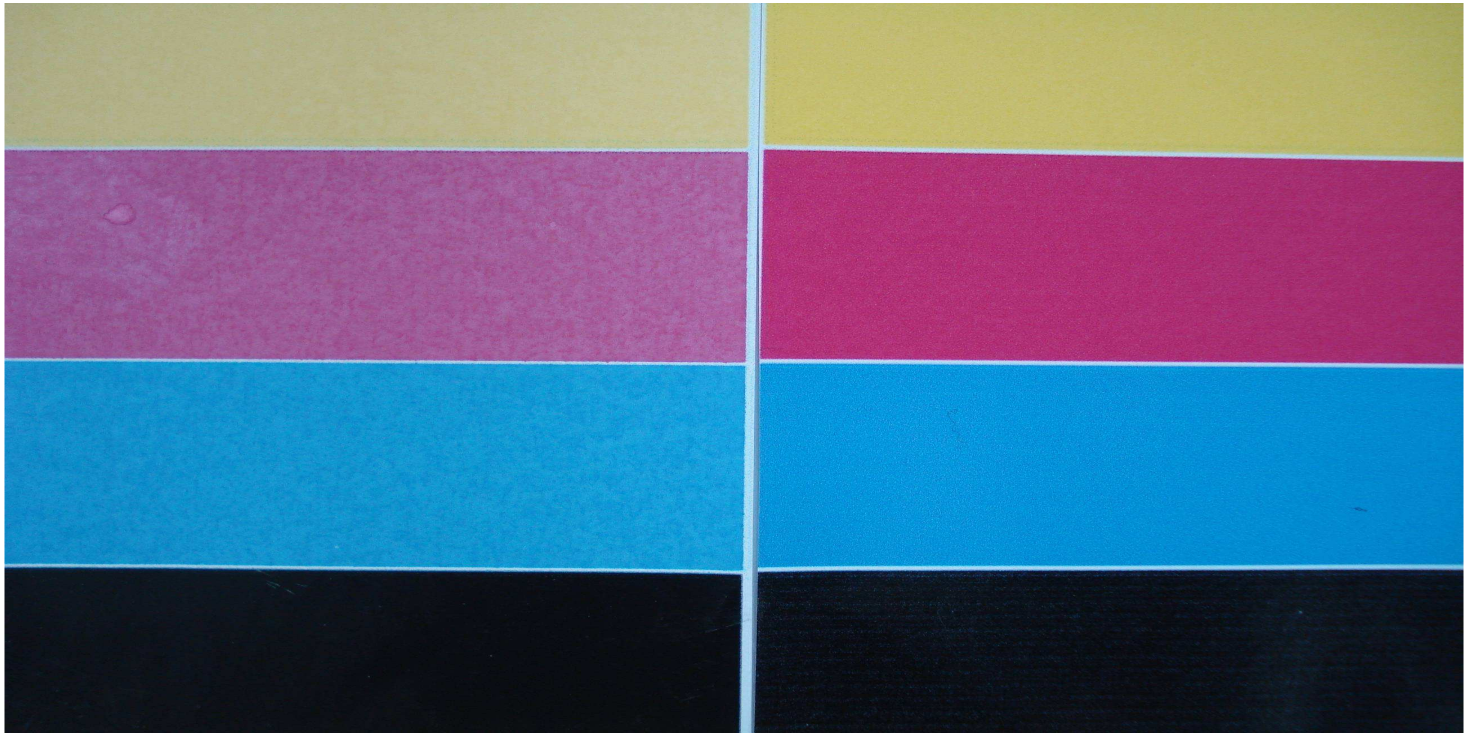
- Publication Gloss Ink Jet Grade Formulation
  - Utilize High Standard Carbonate To maintain cost position
  - Utilize Specialty fine kaolin
    - Generates Gloss and Coater Runnability
    - Ink Interactive to control ink performance.
  - Uses specific latex binder approach for efficient high solids coating.
- Conventional Blade Coating
- Coat Weight: 6-12 gsm
- Formulated to Exhibit Water Fastness
- Formulated to Exhibit Wet Rub Resistance

Why Customize Kaolin?

- Lowest Cost Option for the Overall Coating
  - Bulk of Coating is Carbonate
    - Customizing this pigment makes any changes here have higher cost impact overall.
    - Bulk carbonate provides some key attributes in terms of optical properties and dewatering that need to be maintained.
  - Kaolin's surface chemistry is a platform for modification
    - Amphoteric nature gives good platform to bind different chemicals.
    - Changing nature of surface as function of pH adds to ability to modify
- In High carbonate coatings Fine Kaolin is at the surface
  - Fine Kaolin migrates to the top of the coating surface where it can have the largest impact on:
    - Glossing Properties
    - Surface Smoothness
    - And Ink Interaction – we can leverage this!

Does it Work?

Using Treated Clays as a Performance Enhancer

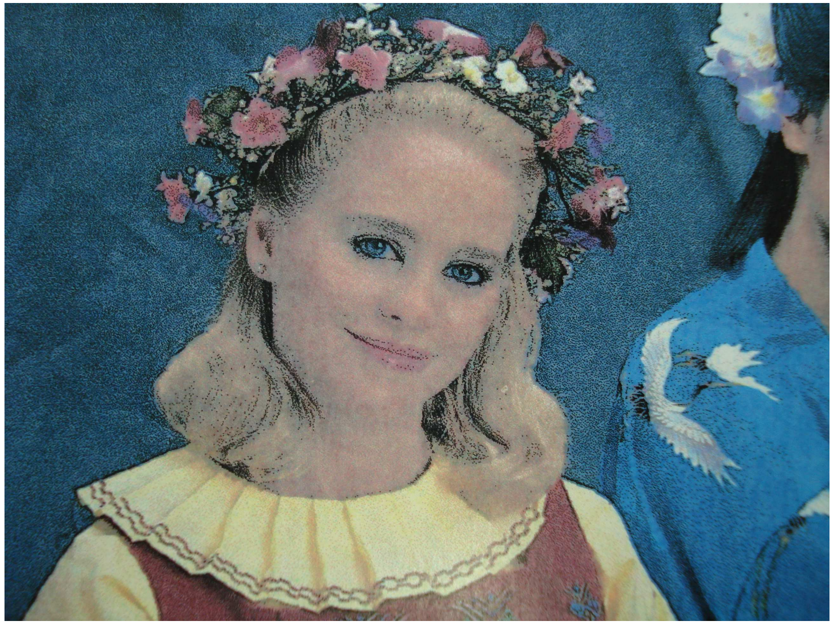


HP950C Printed on Current Coated Paper

Standard Offset Gloss Paper
Pigment: 80/20 Std GCC/ Std Fine Kaolin
Binder: Latex
Coat Weight: 10gsm

Concept Coating
Use of Treated Fine Particle Kaolin
Binder: Latex
Coat Weight: 10gsm

Using Treated Fine Kaolin as a Performance Enhancer



		Solid Ink Density					Permanence	
	Paper Gloss	Yellow	Magenta	Cyan	Black	Uniformity	Water Fastness	Wet Rub
Concept Coating	68	0.82	1.18	1.12	1.62	Smooth	Good	Good
Current Offset Coated Gloss	72	0.64	0.80	0.88	1.65	Mottling	Poor	Poor

Conclusions

- Concept of Using Treated Kaolin Works to Make Offset Grades Viable in Ink Jet Applications!
  - There Is An Opportunity in Producing Various Publication Coated Gloss Ink Jet Paper Grades.
  - Best Cost Position for These Gloss Coated Publication Paper Will be Based Best Coating Practices in Offset Coatings but with specific “tweaks”.
  - Balancing the Ink Jet Print Performance Requirements Can Be Achieved Using Specialty Fine Kaolin As the Additive Pigment that Maintains High Gloss and Coated Runnability but achieves targeted properties for Ink Jet.

Conclusions

Critical to Success is Not Just a good Pigment…it is the Technology Partnership Between Paper Producer and Their Suppliers.

This Partnership will make the Future a Reality

AMERICAN CATALOG MAILERS ASSOCIATION

“Forget the Paper—I’m going to the Web!”

Key Catalog Industry Paper Issues Today

Drivers of increased paper sales into the catalog sector

Hamilton Davison

President & Executive Director

hdavison@catalogmailers.org

Talent, Technology and Transformation

PaperCon 2010 may 2 - 5 atlanta ga

Agenda

- State of the US Catalog industry today
  - Overview
  - Demographic drivers and social trends
- Critical issues and opportunities for suppliers
  - Why mail hard copy anyway?
  - Inputs to cataloger paper demand
  - Other issues that can affect demand
- What catalog buyers are thinking today
- Challenge question: telling our story
- Q&A

State of the Catalog Industry Today

an overview

ACMA
AMERICAN CATALOG MAILERS ASSOCIATION

- Size: $270 billion in 2006 (pre-recession, pre-postal rate hike)
    - Online and offline
    - Catalogs + upstream suppliers
    - B2C, B2B, B2G
- Everything you can buy at retail … & more
- Low margin, high scale, *variable cost* business model
- Highly analytic decision making (test, test, test!)
- Improves people's lives: the social benefits of cataloging (see whitepaper)
- Content value in the mail:
    - Americans like catalogs
    - Drives consumer interest keeping mail powerful for all types of messaging

State of the Catalog Industry Today
an overview (continued)

AMERICAN CATALOG MAILERS ASSOCIATION

Historically growing … *but*

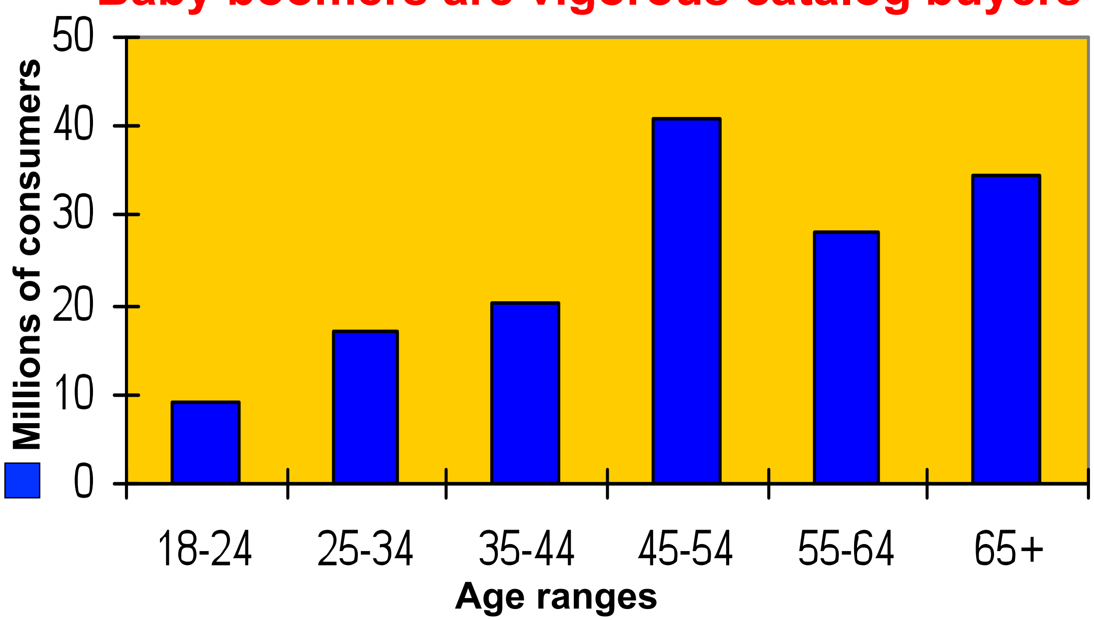
- **2006**:
  - 15,000++ separate catalog publishers
  - 20 billion catalogs mailed
- **2010**:
  - 20-30% fewer publishers (estimates vary)
  - 13 billion catalogs mailed (estimated)
- Unprecedented contraction:
  - The recession
  - Contraction of capital availability
  - Change to business model economics due to 20-40% increase in postage cost

Source: ACMA estimates from various sources

State of the Catalog Industry Today
an overview (continued)

- Huge demographic “tailwind” – this *should* be the golden years…

Baby boomers are vigorous catalog buyers



Catalog buying does up with age: As baby boomers reach their ‘golden’ years, their catalog buying *should* increase

An estimated 49% of all consumers buy from catalogs

Source: MediaMark, 2006, includes catalog, phone and online sales

Catalog marketing is a highly variable cost business model - *Total cost drives total volume*

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Cataloger Example 1:

Components of fixed and variable costs

	Total Average Cost	Incremental Variable Costs
Creative	12%	0%
Marketing	5%	0%
Paper	30%	36%
Print	12%	14%
Postage	41%	50%
	100%	100%

Only 17%* Cataloger 1's costs are 'fixed'

* Some catalogers have much lower fixed costs, in the 7-10% range

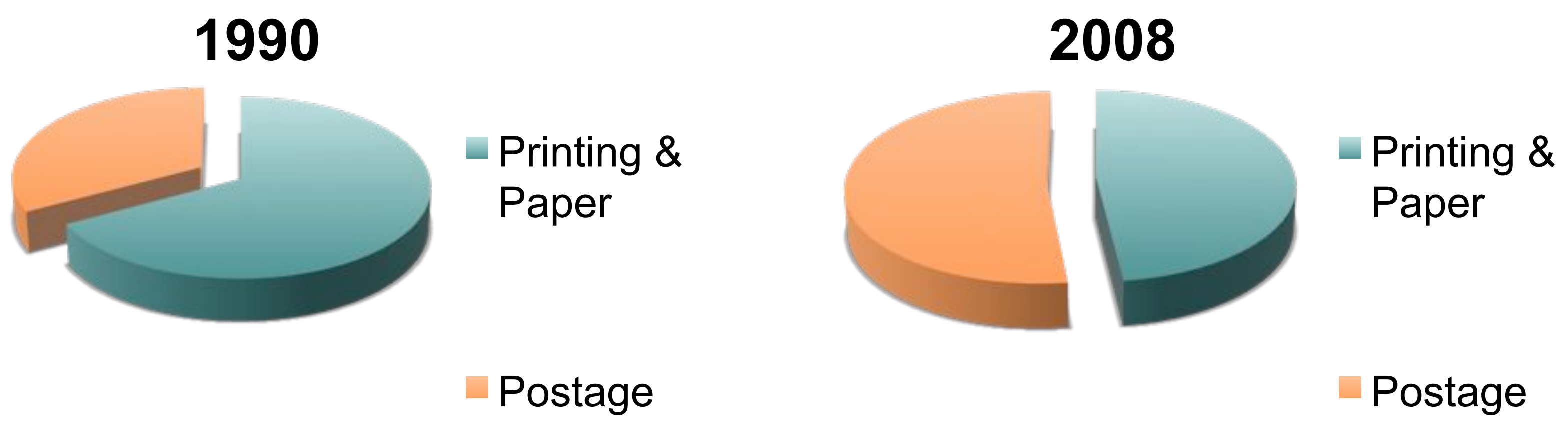
Source: 2009 actual cost data from a successful upscale cataloger

Catalog marketing is a highly variable cost business model - *Total cost drives total volume*

AMERICAN CATALOG MAILERS ASSOCIATION

Cataloger Example 2:

Shift in the mix of cost for a successful catalog



Postage is the <u>largest</u> cost component of mailing an incremental catalog

Source: company records from established catalog brand

Postage trends have far exceeded inflation & other catalog cost components

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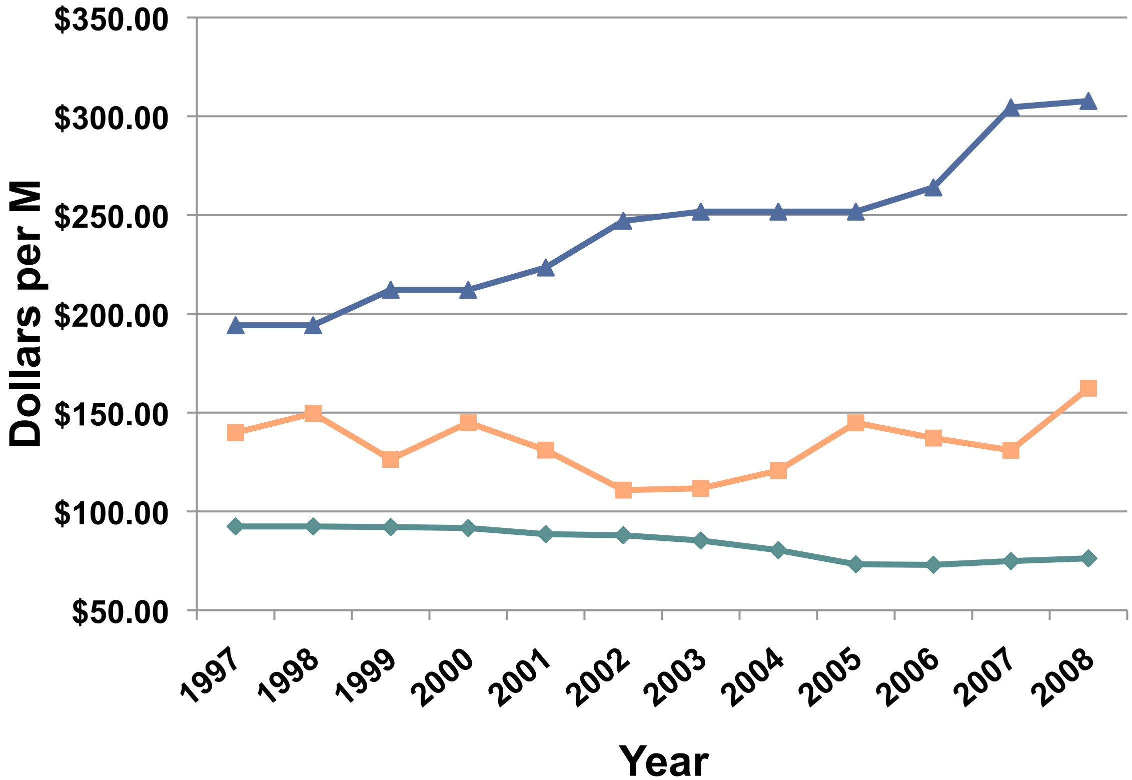
Analysis of historical cost trends by major industry supplier



Between 1997 and 2008:

- Inflation increased 34%
- Postage increased 58%
- Paper increased 16%
- Print *decreased* 18%

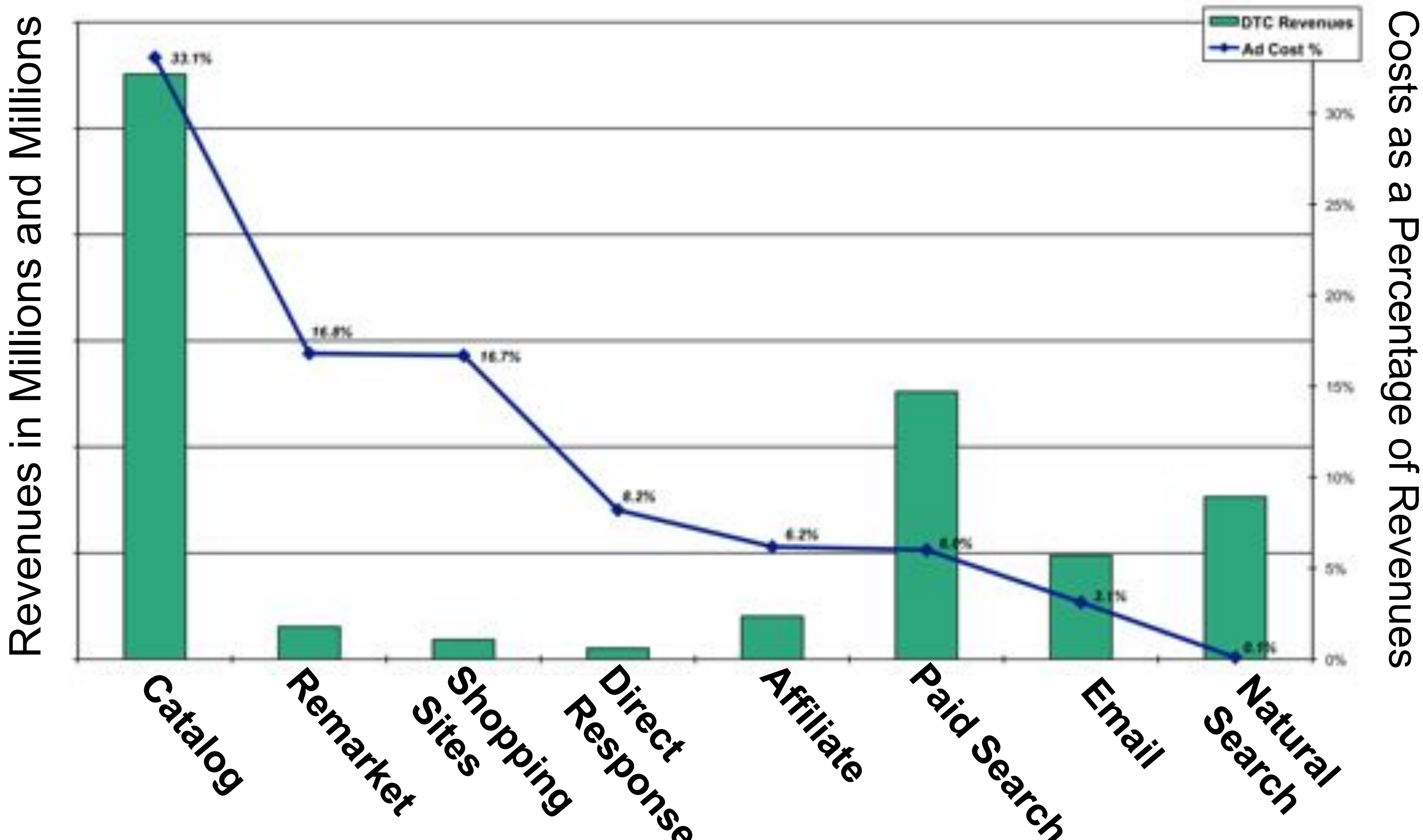
Due to costs, catalogers have increasingly been using to other options

Source: Quad/Graphics analysis of hundreds of catalog clients purchasing history

Catalogers have a Choice on How to Reach Customers

Cataloger Example 3:

2009 Revenue Sources and Respective Costs per Source for large B2C



Why mail a catalog?
The role of mail in the catalog marketing plan:

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- Universal, unparalleled reach and frequency
- Invasive, yet welcome
- High visual profile demands attention … and tells a story
- Speed shopping: catalog versus electronic
- Unmatched color accuracy: apparel, home furnishings, gifts, floral and garden, food, etc.
- Plethora of marketing options, but multichannel is ideal
- Role of Internet reinforces, but does not cannibalize
- Incremental circulation volume decision making
- Mutually reinforcing: mail begets mail

Why catalogs?

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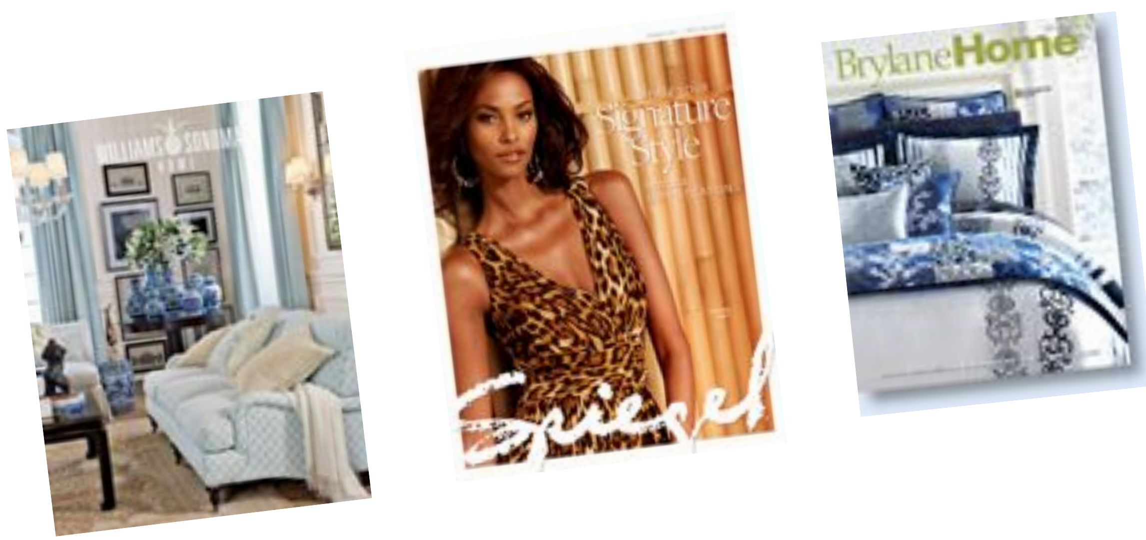
- Long-term growth opportunity due to favorable demographics
- Hard copy has a defendable, sustainable, competitive advantage
- Supply chain issues can be solved if collaboratively approached
- Technology will enhance, not replace paper, if properly managed.

Catalogs are a segment worth focusing on!



What catalogers look for in paper:

- Cost, cost, COST! (& why it matters), plus premium print quality
- Reproduction: white, bright, accurate, low ink absorption
- “Show-thru” and opacity
- High-speed handling during production
- Consistent with brand statement (high perceived value)
- Stiff but smooth (and at low basis weights)

What catalogers look for in a paper supplier:

- Short order lead-times – pressure on date of last change (LCD)
- Consistency from run to run (and mill to mill)
- To be committed to, and knowing about, my business
- Value-added supplier (provide ideas for cost savings, improved effectiveness, etc.)

Environmental issues

- Certified is best, with FSC slightly preferred by catalogers
- High PCW preferred, especially by catalogs with an environmental promise in their brand identity

  ➔ but not all agree with high PCW due to cost or aesthetic issues
- Paper Industry has a great environmental record… but not telling anyone about it

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Environmental issues
(continued)

- Great environmental record but not telling anyone about it

The Plastics Industry has been aggressive at consumer-level advertising and education

Even the generic and store brands have followed this lead.

Food suppliers have picked up on the theme

Even products that are not organic are on message.

The catalog environmental story

AMERICAN CATALOG MAILERS ASSOCIATION

- The importance of telling our story
- 13 billion consumer impressions every year

The catalog environmental story

Catalogs: America's Biggest Carpool

…and…

???

The Paper Industry needs to lead this effort by being aggressive at consumer-level education as today, paper is *not* considered environmentally friendly. This popular sentiment is spreading everywhere in America and threatens to undermine every paper-based segment and product.

What can you do to grow your catalog business?

ACMA
AMERICAN CATALOG MAILERS ASSOCIATION

What happens at the USPS affects your Catalog Sector demand!

Some issues to consider:

- USPS Cost Improvement
  - Headcount reduction
  - Station, Branch & Plant – count, closure, issues
  - Delivery Frequency
- Automation and FSS (Flats Sequencing System)
  - Why droop matters
  - Deflection standards
  - Make it stiff!
- Role of Congress

Paper interests with a significant economic stake in the health of the catalog industry may find it in their self interest to support ACMA's work.

What can you do to grow your catalog business? (continued)

ACMA AMERICAN CATALOG MAILERS ASSOCIATION

- Get involved: ACMA AMERICAN CATALOG MAILERS ASSOCIATION, DMA Direct Marketing Association, PostCom Association for Postal Commerce
- Financially support Mail Moves America
- Unify the impact: Join the broad-based coalition to speak with one voice: COALITION FOR A 21st CENTURY POSTAL SERVICE

What can you do to grow your catalog business? (continued)

COALITION FOR A 21st CENTURY POSTAL SERVICE

- Alliance of Nonprofit Mailers
- American Business Media
- American Catalog Mailers Association
- American Express
- AT&T
- Bowe Bell+Howell
- Datamatx
- Direct Marketing Association
- Domtar
- Eastman Kodak Company
- Envelope Manufacturers Association
- Greeting Card Association
- INg
- International Paper

Magazine Publishers of America
Mailing & Fulfillment Svc Assn
National Newspaper Assn
National Postal Policy Council
NewPage Corp.
NPES
NPTA Alliance
Printing Industries of America
Pitney Bowes Inc.
Quad Graphics
RR Donnelley
Time Warner Inc.
Verizon

For more information

please follow up to see how you can help affect the outcome!

American Catalog Mailers Association, Inc.

a Washington-based 501(c)6 not-for-profit trade group

www.catalogmailers.org

Contacts:

Paul Miller
Vice President & Deputy Director
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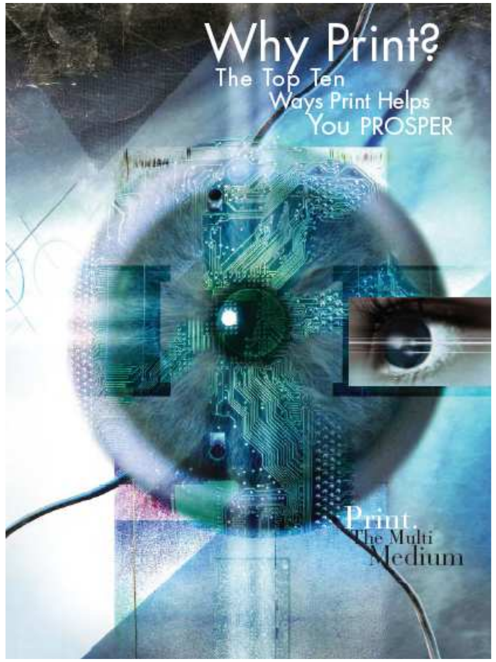
Hamilton Davison
President & Executive Director
hdavison@catalogmailers.org
800-509-9514

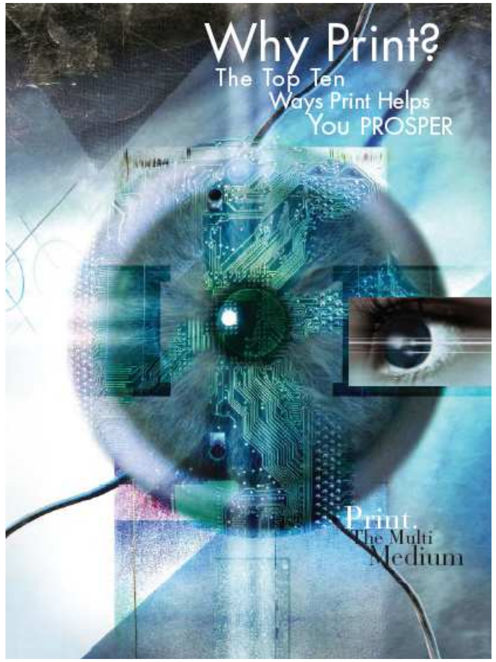
WHAT IS THE PRINT COUNCIL DOING?

- Why Print
- Print in the Mix
- Why Print Is Green
- Agency Presentations



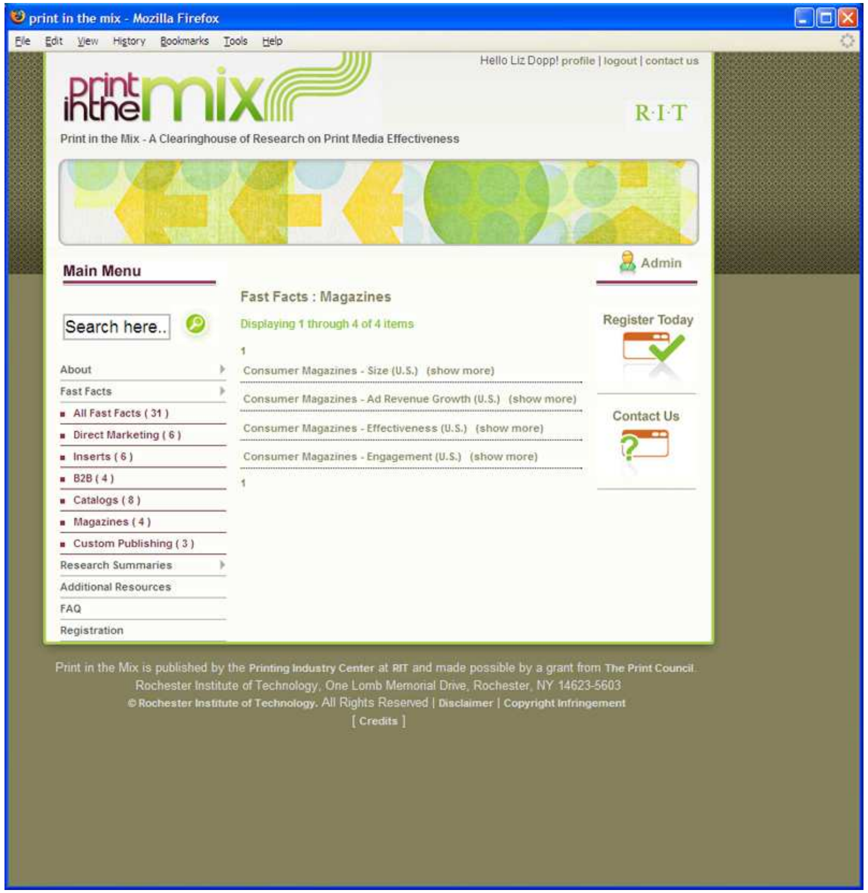
WHY PRINT

- Over 70,000 produced and distributed in three years
- Translated into six languages
- Will be updated in 2010



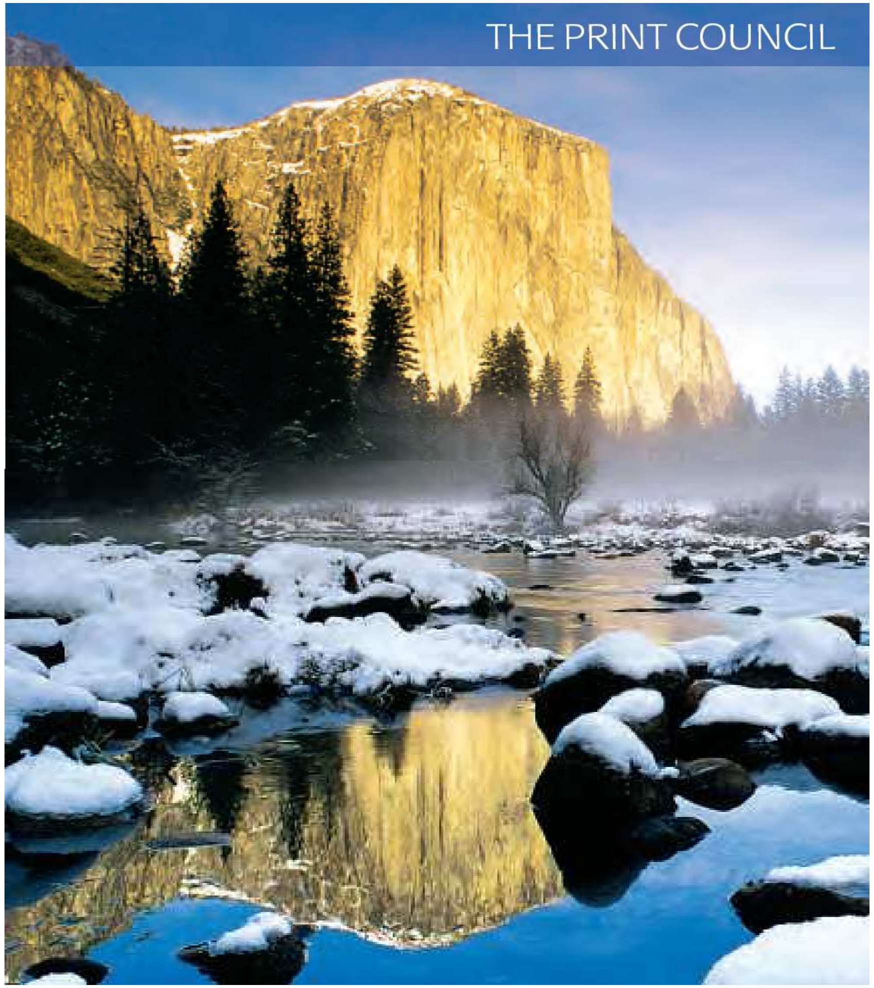
PRINT IN THE MIX

- Developed by the Print Council and the RIT Printing Industry Center
- Over 10,000 users
- Primary open source for print marketing data



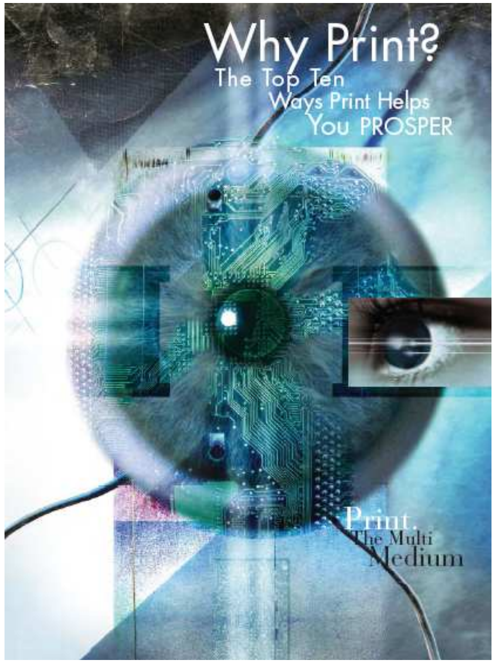
WHY PRINT IS GREEN

- Over 50,000 produced and distributed
- PDF's available for supporters to reproduce



AGENCY PRESENTATIONS

- Starcom
- Campbell Ewald
- Minneapolis Regional Conference
- Washington, DC local event
- Federal Agency Presentation
- New York
- Los Angeles / San Francisco

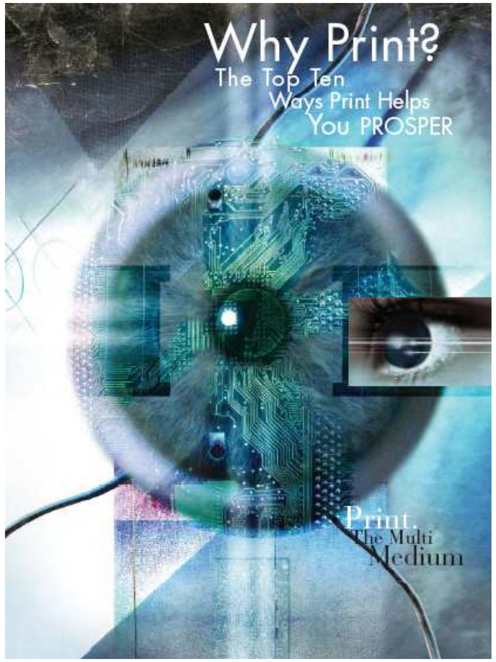


PRINT COUNCIL PARTNERSHIPS

- Suppliers
- Printers
- Associations
- Industry media and public relations pros
- Federal agencies

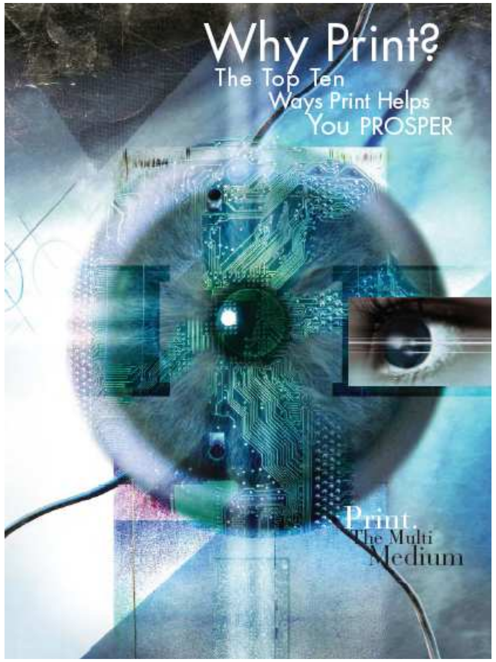
IS IT OK TO PRINT?

- Yes but only if we act like a key component of the advertising and communication industry
- Yes but only if we understand ALL of the supply chain pressures



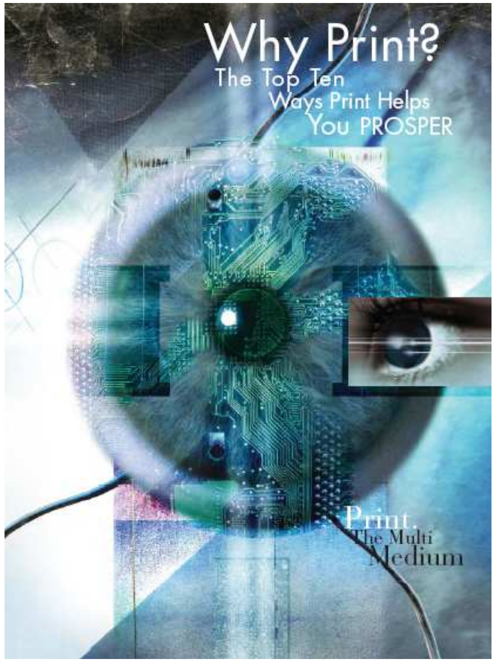
IS IT OK TO PRINT?

- Yes but we must understand that print requires distribution and the USPS is the largest distributor of print
- Yes but only if we have the facts



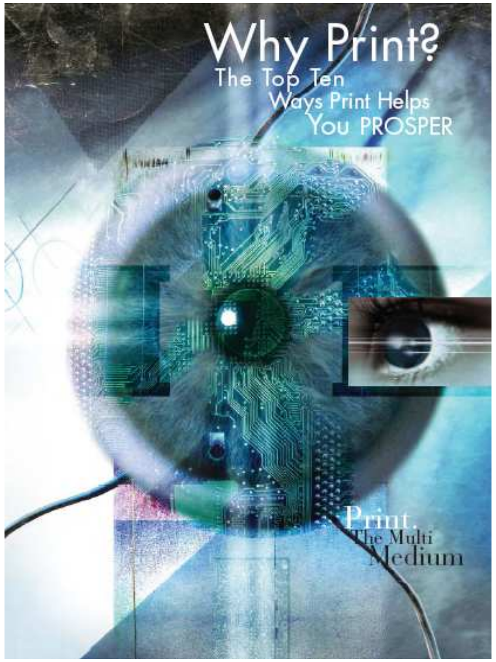
What are the Challenges?

- Fragmented industry
  - Leadership at each level must get to know each other
- Few opportunities to unify the supply chain
  - Industry needs greater interaction
- Need to understand the distribution needs of the industry
  - Print requires distribution and over 50% of print is delivered by the USPS
  - US paper industry needs broader understanding of the USPS



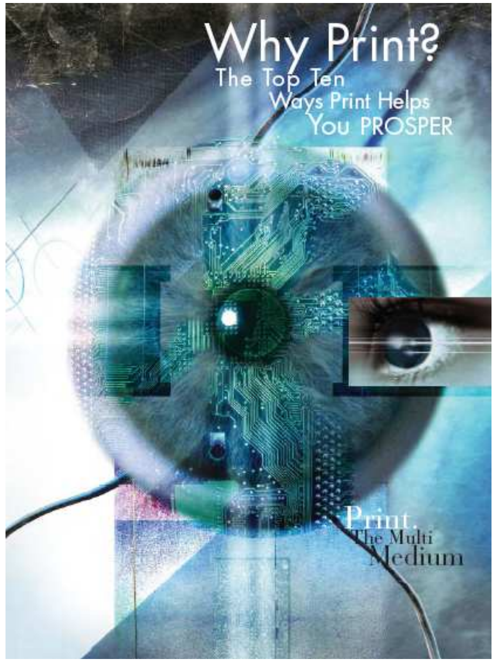
WHAT CAN WE DO?

- Paper and technology industry will have to lead
- Provide broader technical assistance in the supply chain
- Move associations to balance market focus with manufacturing challenges



What is the future?

- Some print markets will be very strong, particularly those with less distribution sensitivity
- Postal markets (periodicals, catalogs, advertising mail) will likely "level off"
- Technology may push industry to strong position



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Development of New Biobased Emulsion Binders

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and Scientific Advisor to ECOSYNTHETIX INC.

Steven Bloembergen, EVP Technology, John van Leeuwen, CEO

ECOSYNTHETIX INC.

PaperCon may 2 - 5 2010 atlanta ga

Talent,
Technology and
Transformation

Development of New Biobased Emulsion Binders

Outline of the Presentation

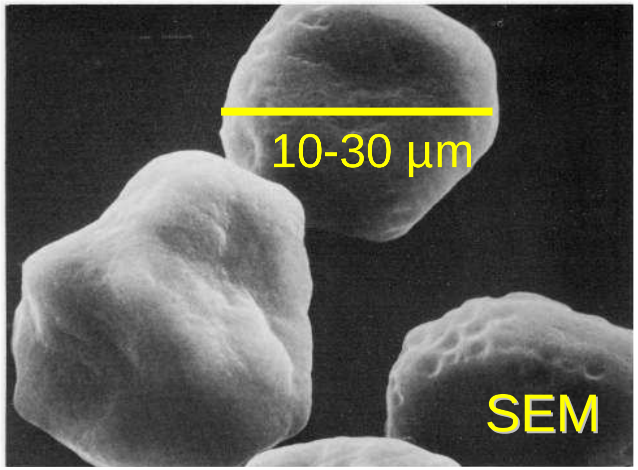
- **INTRODUCTION**
- **THE UNIQUE CHARACTERISTICS AND PROPERTIES OF WATER-SWOLLEN CROSSLINKED BIOBASED LATEX BINDERS**
  - **The De-Swelling of Water-Swollen Crosslinked Biobased Nanoparticles with Increasing Concentration of Dispersions**
  - **The Deformation of Water-Swollen Crosslinked Biobased Nanoparticles under Shear and Pressure**
  - **The Influence of Higher %Effective Solids and Volume Solids of Water-Swollen Biobased Nanoparticles on Coating Immobilization and Coating Holdout**
  - **The Influence of Less Shrinkage of Biobased Latex Binder-Containing Paper Coatings on Coating Gloss, Porosity, and Opacity**

Development of New Biobased Emulsion Binders

Outline of the Presentation (Continued)

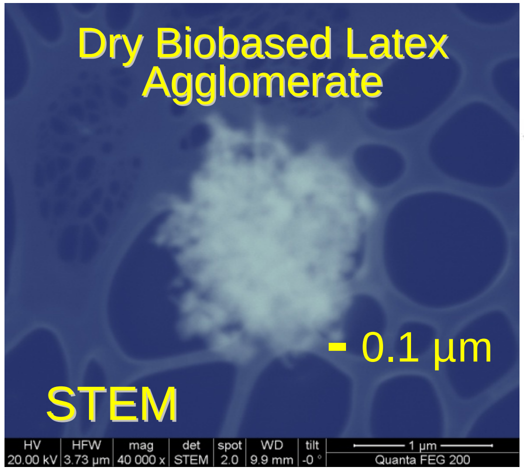
- **EXPERIMENTAL RESULTS AND DISCUSSION**
  - **The Low-Shear Viscosity of Biobased Latex Binder Dispersions**
  - **The Development of High Brightness Biobased latex Binders Made by Co-Extruding TiO_2 Particles**
  - **The Development of High Wet-Strength Biobased Latex Binders Cured by Polymeric Curing Agents**
- **LIFE CYCLE INVENTORY ANALYSIS (LCIA) AND REDUCTION IN CARBON FOOTPRINT TROUGH THE USE OF BIOBASED LATEX BINDERS**
- **SUMMARY**
- **ACKNOWLEDGEMENTS**

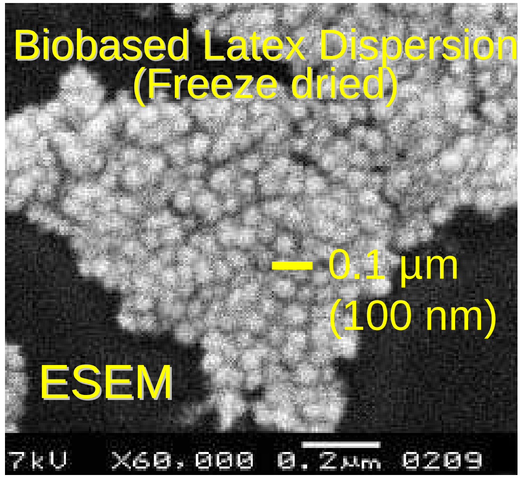
INTRODUCTION - Biobased Latex Production



Native Starch Granules

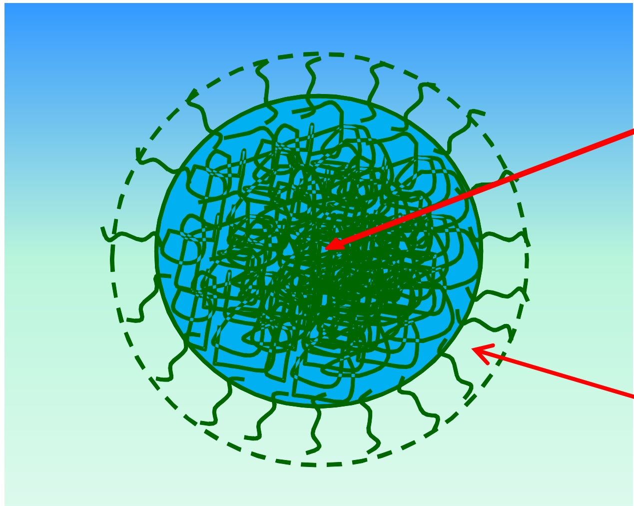
Reactive Extrusion Process





Micrographs obtained by Scanning Electron Microscopy (SEM), Scanning Transmission Electron Microscopy (STEM), and Environmental SEM (ESEM)

INTRODUTION – Morphology of Biobased Latex Nanoparticle



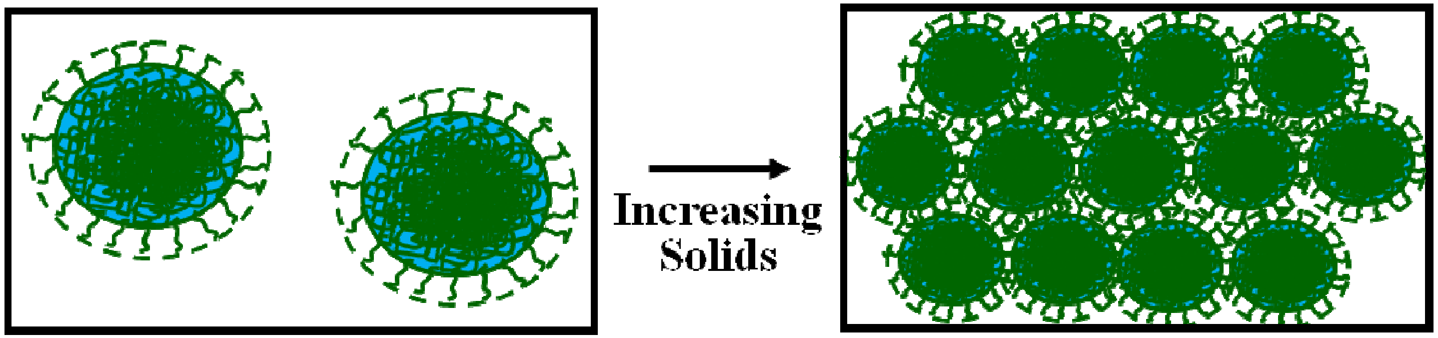
Water-Swollen Crosslinked Biopolymer Nanoparticle Core:
$V_{Core\text{-}swollen}$

Bound and Adsorbed Biopolymer Shell:
V_{Shell}

Total Effective Volume = $V_{Total\ swollen} = V_{Core\text{-}swollen} + V_{Shell}$
Volume Swell Ratio = $V_{Total\ swolllen}/V_0 = (V_{Core\text{-}swollen} + V_{Shell})/V_0$
where V_0 is the volume of unswollen nanoparticle

THE UNIQUE CHARACTERISTICS AND PROPERTIES OF WATER-SWOLLEN CROSSLINKED BIOBASED LATEX BINDERS

- **The De-Swelling of Water-Swollen Crosslinked Biobased Nanoparticles with Increasing Concentration of Dispersions**



Schematics showing de-swelling of water-swollen crosslinked biopolymer nanoparticles with increasing solids.

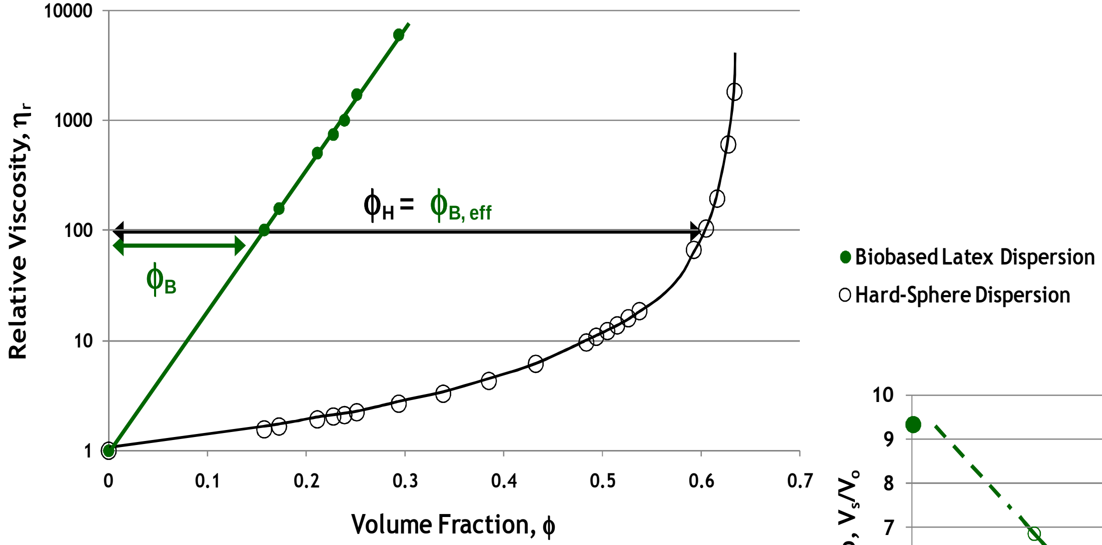
The maximum swelling occurs at extremely low concentrations and the swelling decreases with increasing concentration, then levels off at high concentrations

The Maximum Volume Swell Ratio [Max. SR(V)] of Biobased Latex Nanoparticles *Vs.* Their Crosslink Density

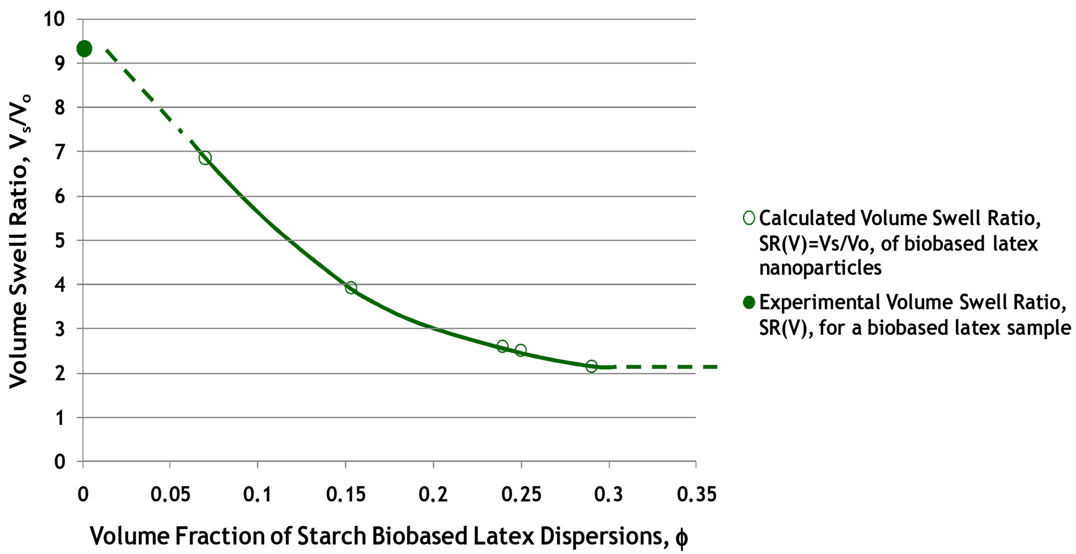
The maximum Effective Volume Factor and Volume Swell Ratio determined by extrapolating to the zero concentration for samples of biobased latex binders with different crosslink densities

Biobased Latex Sample	Relative Crosslink Density	Max. Effective Volume Factor = Max. SR(V)
1	Low	16.0
2	Medium	9.33
3	High	6.67

The De-Swelling of Biobased Nanoparticles Vs. Concentration Can Be Calculated:

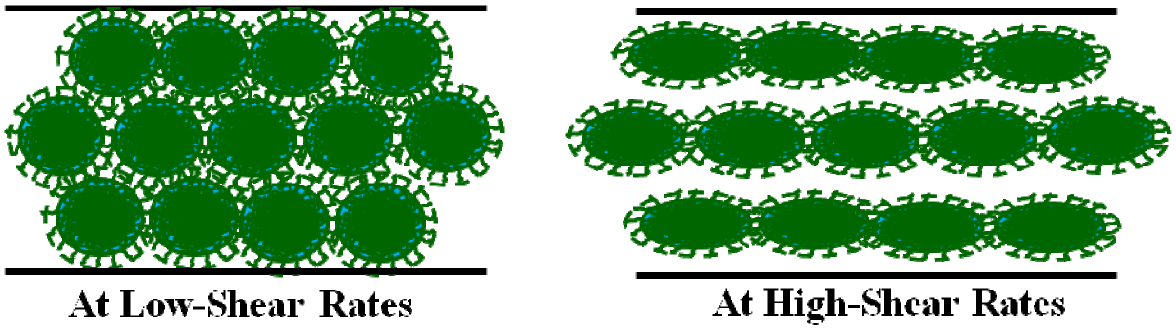


The relative viscosity, ϕ, *vs.* volume fraction

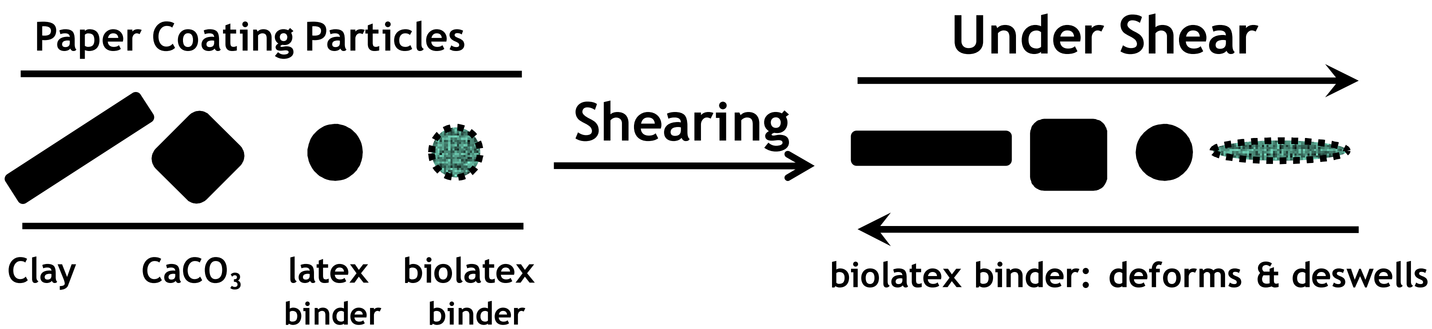


Volume swell ratio, $SR(V)=V_S/V_0$, *vs.* volume fraction

The Deformation of Water-Swollen Crosslinked Biobased Nanoparticles under Shear and Pressure Leading to Less Dilatancy and Better Runnability

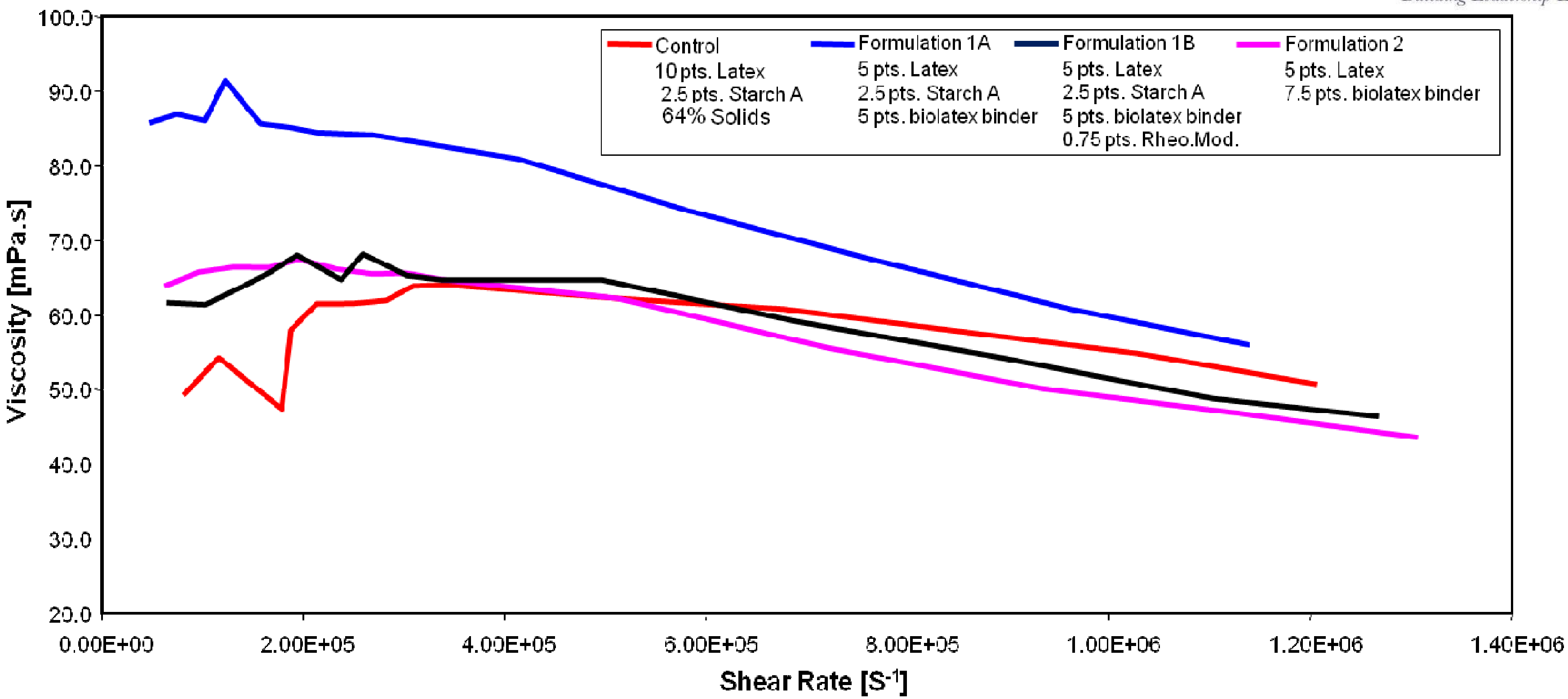


Schematics showing the deformation of water-swollen crosslinked biopolymer nanoparticles under high shear rates



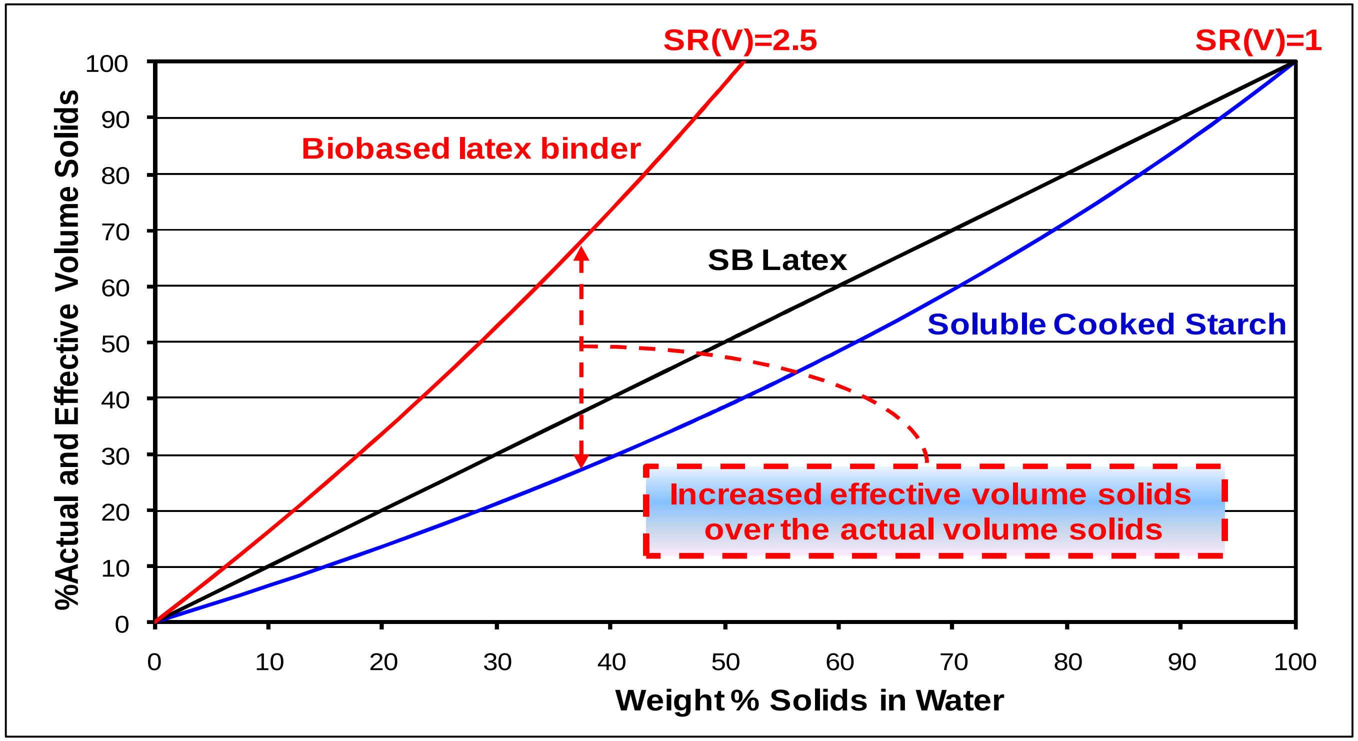
Schematics showing the deformation under high shear rates of biobased latex in the presence of pigment and latex particles

The Effect of Biobased Latex Binder on High-Shear (ACAV) Capillary Rheology



ACAV of a series of paper coating formulations containing synthetic latex, soluble cooked starch, and biobased latex binder

Higher %Effective Solids and Volume Solids of Biobased Latex Binders Leading to Excellent Coating Holdout, Fiber Coverage, and Smoothness



The % effective volume solids of biobased latex nanoparticles, soluble cooked starch, and synthetic SB latex vs. % solids

The Effect of Higher %Effective Solids on Coating Holdout

- **Suppose that a biobased latex binder having a weight swell ratio, SR(W), of 2.5 is used at 5 parts in a paper coating color containing 100 parts pigments and 15 parts binders at 65% solids: since the effective solids of 5 parts biobased latex binder would be 12.5 parts at the SR(W) of 2.5, the effective coating solids would become 65x122.5/115=69.2%, that is 4.2% solids higher**
- **This increase in the effective coating solids enables paper coating colors containing biobased latex binders to get close to their immobilization solids so that they exhibit excellent coating holdout, resulting in excellent fiber coverage and coating smoothness**

Less Shrinkage of Biobased Latex Binder-Containing Paper Coatings Leading to Higher Coating Gloss, Porosity, and Opacity

The gloss of uncalendered paper coatings containing all-SB latex and both SB latex and biobased latex binder on polyester films

Coating Sample	Coat Weight, g/m2	%Gloss at 75º
SB Latex Control	37.6	37.6 +/- 0.20
38% Replacement of SB Latex with Biobased Latex Binder	38.4	46.1 +/- 2.06

As shown by the above coating gloss results, the low degree of coating shrinkage leads to:

1. Nano-cellular void-like internal structure
2. More open coating structure and better opacity which have been observed by numerous CLC, pilot coater, and mill trials

SUMMARY OF THE UNIQUE CHARACTERISTICS AND PROPERTIES OF BIOBASED LATEX BINDERS

- **Swelling and de-swelling responsive to concentration, temperature, etc.**
- **Deformation under shear and pressure, resulting in less dilatancy and better high-speed blade runnability**
- **Higher %effective solids and volume solids leading to better coating holdout, fiber coverage, and coating smoothness**
- **Less shrinkage leading to higher gloss and more open and opaque coatings**

EXPERIMENTAL RESULTS AND DISCUSSION

- **The Low-Shear Viscosity of Biobased Latex Binder Dispersions**
  - **Dry biobased latex powder produced by a reactive extrusion process can be added directly into pigment slurries and dispersed during coating color preparation**
  - **The dry product can also be dispersed on site in GCC or clay dispersions up to ~60% solids under shear**
  - **Alternatively, the dry product can be dispersed on site as a pure dispersion in water at concentrations up to 35-45% solids using certain minor additives**

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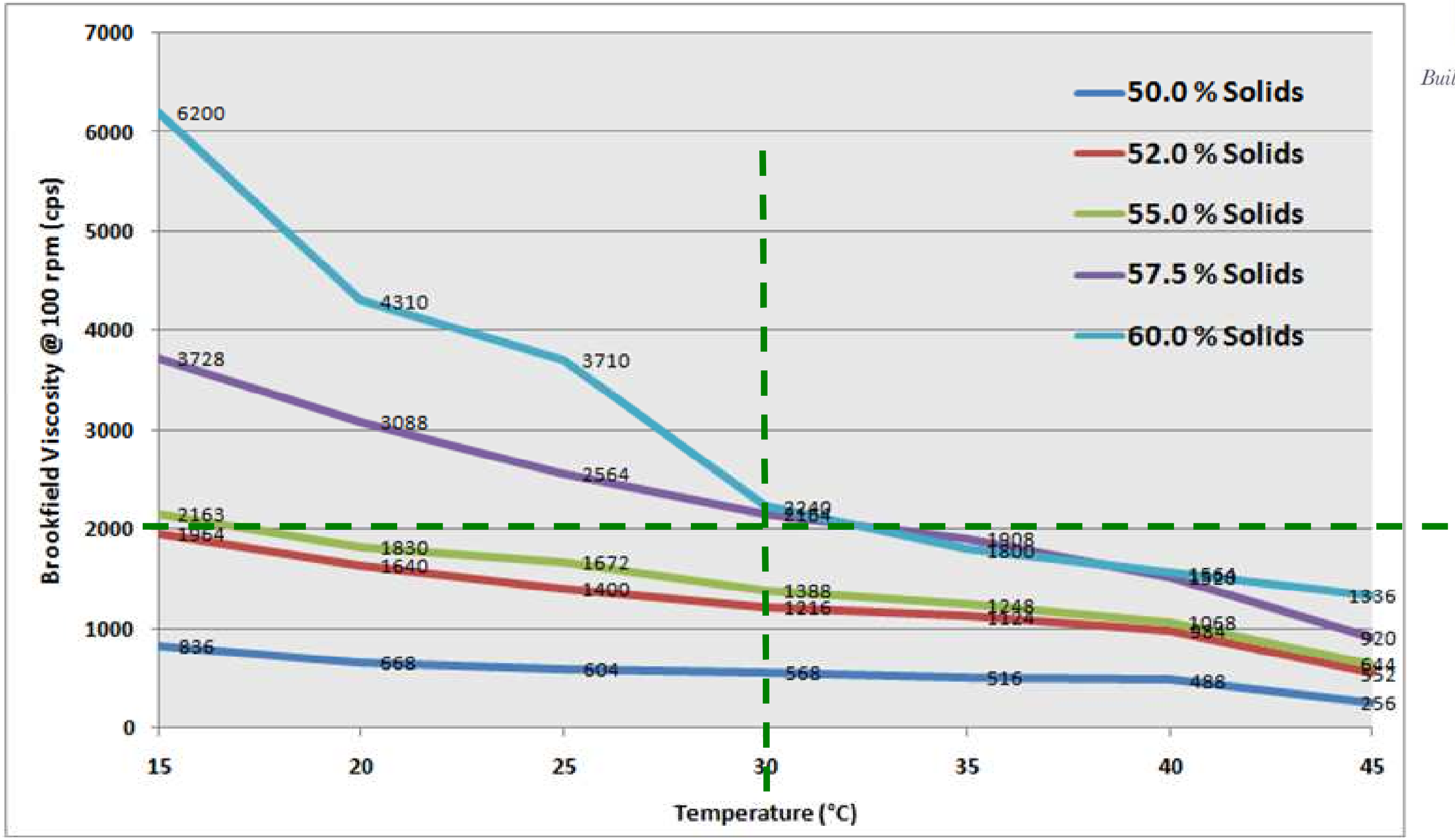
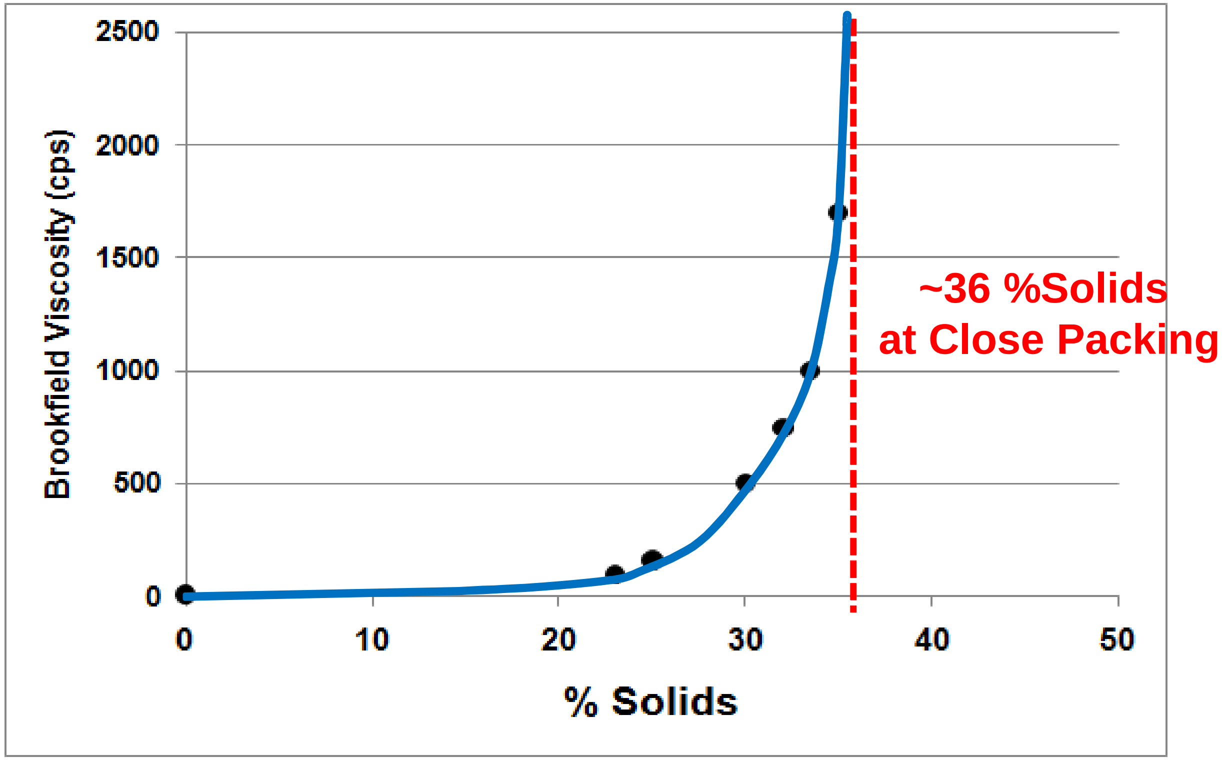
The Brookfield Viscosity of a GCC-Biobased Latex Masterbatch Dispersion



Brookfield viscosity of a GCC-biobased latex masterbatch dispersion (2:1 GCC:biobased latex binder on a dry basis) as a function of % solids at temperatures ranging from 15 to 45 °C (59 to 113 °F)

The Low-Shear Viscosity of a Biobased Latex Binder *vs.* % Solids at 20 ºC



Brookfield viscosity of a pure dispersion of a biobased latex sample in water, as a function of % solids at 20 ºC (no additives)

Volume and Weight Swell Ratios at the Close Packing Concentration

- **The % solids at the point of close packing of a pure dispersion of biobased latex nanoparticles was estimated to be 36%, i.e. the point at which the water-swollen starch nanoparticles touch each other and show a very high viscosity**
- **From this value, we can find both the volume and weight swell ratios of this particular biobased latex binder sample as follow:**

The %Volume Solids at Close Packing

= {[36% solids/ρ(starch)]/[36% solids/ρ(starch)+V(total H2O)]} x 100%

= {(36%/1.6)/[(36%/1.6) + (100%-36%)]} x 100%

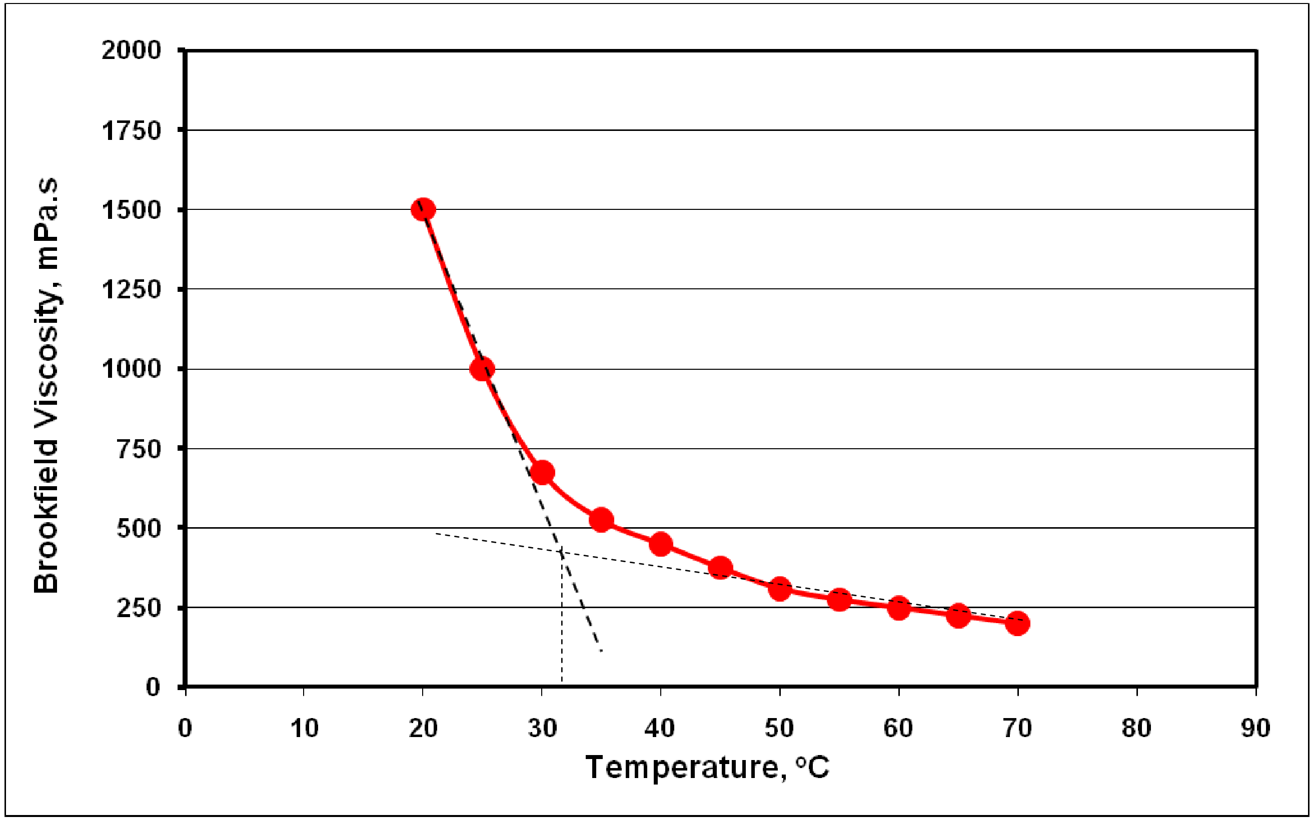
= [22.5/(22.5 + 64)] x 100% = 26.01% volume solids

Thus, <u>SR(V) = 64%/26.01% = 2.46</u>

SR(W) = [36% solids + W(H2O contained in nanoparticles)]/36% solids

<u>SR(W) = [36 + (22.5x2.46-22.5)]/36 = 1.91</u>

The Effect of Temperature on the Low-Shear Viscosity of Biobased Latex Binder

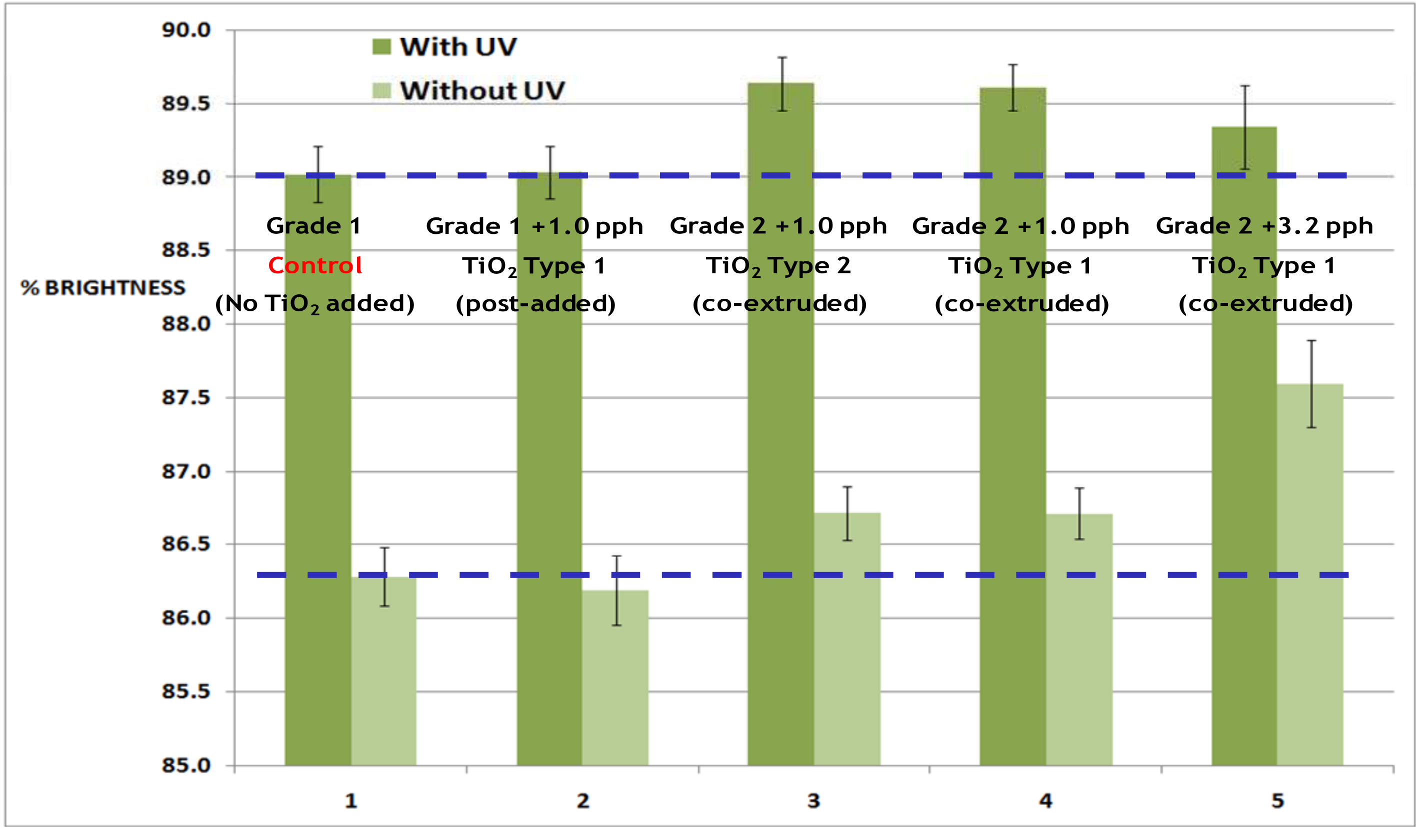


The Brookfield viscosity of a biobased latex dispersion at 30% solids *vs.* temperature in °C.

Findings from the Studies on the Rheology of Biobased Nanoparticle Dispersions alone or with Pigments

- **Biobased latex nanoparticle agglomerates can be dispersed directly into the coating formulation, or alternatively either with pigments as a masterbatch concentrate, or as a pure dispersion in water**
- **The following conditions will help better disperse the dry agglomerate powder:**
  - **High temperature**
  - **High pH**
  - **High shear**

High Brightness Biobased Latex Binders Made by Co-Extruding TiO_2 Particles



% Brightness of paper coatings containing a series of biobased latex binders co-extruded with 1 part TiO_2 each of two types (Type 1: Hydrophilic and Type 2: Hydrophobic) and 3 parts TiO_2 of Type 1 plus two biobased latex binder controls

Effect of TiO_2 Co-Extruded with Biobased Latex Binders on Brightness & Opacity

- **The most striking finding is that a miniscule amount of additional 0.051 part of TiO_2 co-extruded with biobased latex binders made so much impact on the brightness of paper coatings**
- **Whereas post-added 0.051 part TiO_2 did not do anything, as expected**
- **In addition, the % whiteness showed a similar trend**
- **This finding has clearly demonstrated that the efficiency of TiO_2 particles is highly dependent on their uniform distribution in the final dry coatings, as predicted by theory**

High Wet-Strength Biobased Latex Binders Cured by Polymeric Curing Agents

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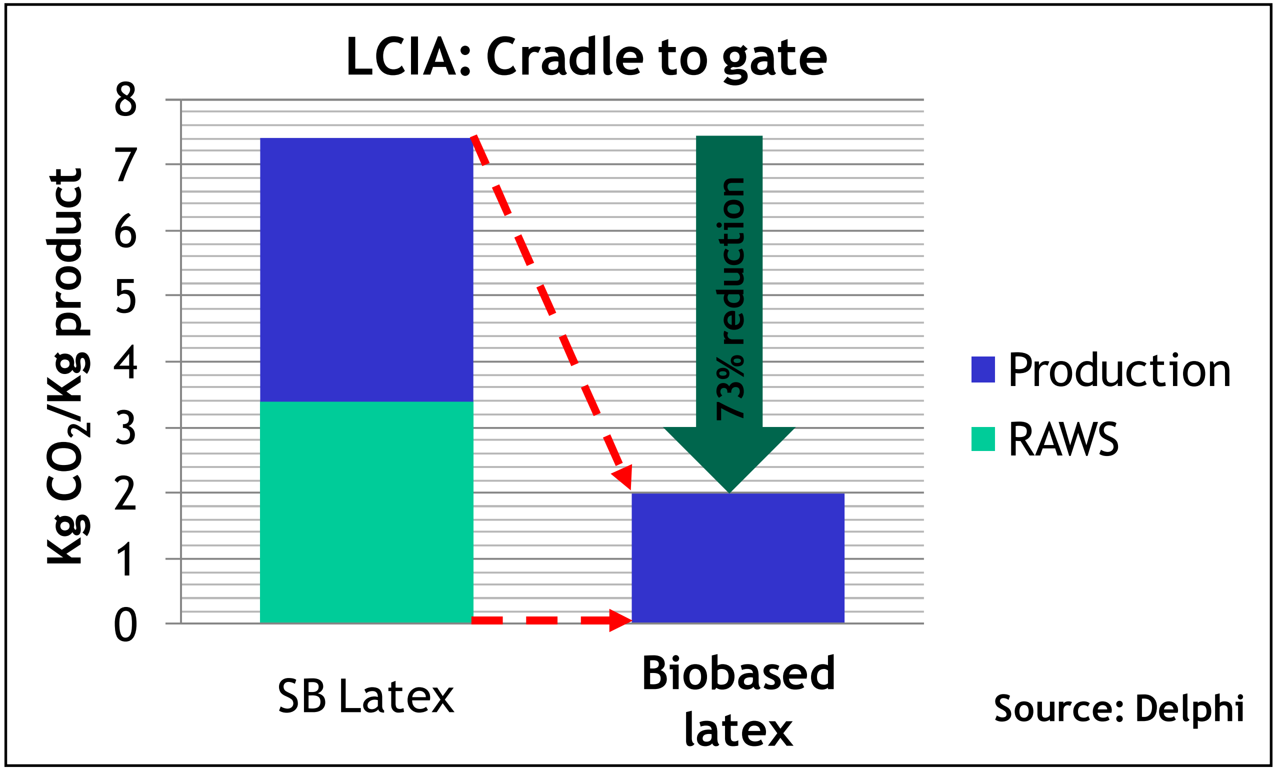
Impact of conventional and polymeric carbohydrate-based insolubilizers on Nancy Plowman wet pick performance

Formulas are in parts-per-hundred											
SB Latex replacement level with biobased latex:			0.0%	37.5%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	62.5%
Material	Comments	Material Solids	Control	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8
Pigment											
Clay		70%	34	34	34	34	34	34	34	34	34
GCC		72%	64	64	64	64	64	64	64	64	64
TiO_2		72%	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Binder											
SB Latex		50%	13.6	8.5	6.8	6.8	6.8	6.8	6.8	6.8	5.1
PVOH		23%	0.50	0.50	0	0	0	0	0	0	0
Biobased Latex, Grade 1	2202, lot PG30908J-6	92%	0	5.1	6.8	6.8	6.8	6.8	6.8	0	8.5
Biobased Latex, Grade 2	92240, lot PG31108-4	92%	0	0	0	0	0	0	0	6.8	0
Additive											
Dispersant		30%	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
OBA		100%	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Thickener		33%	0.13	0	0	0	0	0	0	0	0
Glyoxal insolubilizer	7% b.o. ECOSPHERE	45%	0	0.36	0.48	0	0.48	0	0	0	0.51
Polymeric Insolubilizer 1	5% b.o. ECOSPHERE	10%	0	0	0	0.34	0.34	0	0	0.34	0.43
Polymeric Insolubilizer 2	5% b.o. ECOSPHERE	10%	0	0	0	0	0	0.34	0	0	0
Polymeric Insolubilizer 3	2.3% b.o. ECOSPHERE	10%	0	0	0	0	0	0	0.16	0	0
Defoamer		100%	0.05	0	0	0	0	0	0	0	0
	INK TRANSFER %		90	98	81	96	96	96	97	92	71
	INK REFUSAL %		6	0	0	0	0	0	0	4	0
	WET PICK %		4	2	19	4	4	4	3	3	29

Performance of Polymeric Carbohydrate-based Insolubilizers for Wet Pick Improvement

- **The polymeric carbohydrate-based insolubilizers reduced the wet pick well below 10 at the 50% substitution of the synthetic latex by the Nancy Plowman Wet Pick Test**
- **The wet pick of 10 is generally considered an excellent result that would predict good performance for offset printing**
- **These promising preliminary result warrant their further evaluation by pilot coater and mill trials in the future**

LIFE CYCLE INVENTORY ANALYSIS (LCIA) AND REDUCTION IN CARBON FOOTPRINT TROUGH THE USE OF BIOBASED LATEX BINDERS



Life Cycle Inventory Analysis (LCIA) and reduction of carbon foot print through the use of biobased latex binders

Life Cycle Inventory Analysis from Cradle to Gate

- **The LCIA comparison of SB latex binder to biobased latex binders shows a 73% reduction in carbon footprint on the "Cradle to Gate" basis**
- **Therefore, the use of biobased latex binders has the immediate ability to reduce carbon dioxide emissions by 73%, as compared to the use of a petroleum based latex, such as SB latex binders**

Summary

- Some of the unique characteristics and properties of biobased latex binders have been discussed in terms of paper coating performance
  - De-swelling behavior
  - Deformability under shear and pressure
  - Higher effective solids and volume solids
  - Less coating shrinkage
- Rheological behavior of biobased latexes
- Performance of biobased latex binders co-extruded with TiO_2 particles
- Performance of polymeric carbohydrate curing agents
- Life Cycle Inventory Analysis (LCIA) and reduction of carbon foot print through the use of biobased latex binders

Acknowledgements

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- Special thanks to Prof. Margaret Joyce and Matt Stoops of Western Michigan University, Kalamazoo, Michigan for their helpful advice and assistance in carrying out the CLC paper coating studies

Development of New Biobased Emulsion Binders

Do Ik Lee, Adjunct Professor, Western Michigan University and
Scientific Advisor to ECOSYNTHETIX INC.

and

Steven Bloembergen, EVP Technology,
John van Leeuwen, CEO,
ECOSYNTHETIX INC.

ABSTRACT

Biobased emulsion polymers were first adopted by the industry as coating binders in 2008 with the ability to match the performance of synthetic binders with up to 35% replacement. These new binders for paper coating applications have shown to impart unique rheological, coating holdout, coating structure, and optical properties to wet and dry paper coatings, respectively. The mechanisms for these unique behaviors will be discussed based on the fact that these biobased latex binders are made up of deformable, water-swollen crosslinked biopolymer nanoparticles and tend to shrink less upon coating consolidation during drying. Furthermore, recent breakthroughs in technology have allowed us to develop new grades of biobased latex binders with improved binder properties. These new grades address the initial deficiencies of inferior optical properties and certain strength properties, specifically wet pick, that limited their use in certain coated paper and paperboard applications. A new brightness grade made by co-extruding TiO_2 particles in the production of biopolymer nanoparticles has shown that the co-extruded TiO_2 particles are many times more efficient for both brightness and opacity of paper coatings than those TiO_2 particles post-added either into biobased latex binders or coating formulations. The new wet strength grade blended with polymeric curing agents has shown that substitution levels of up to 75% are achievable in basecoat applications and up to 60% in topcoat and single coat paper and paperboard applications. Finally, Life Cycle Inventory Analysis and the reduction in carbon footprint and green house gas emissions that result through the use of biobased latex binders will be discussed.

INTRODUCTION

Biobased latex binders adopted in the paper industry in 2008 were the first use of biopolymer-based microgels and nanogels for large-scale industrial applications [1-7], although they had been explored and used for drug delivery and other bio-medical applications for a long time [8]. Both biobased latex binders and biopolymer-based microgels and nanogels can be broadly defined as a special class of latexes whose particles are made up of water-swollen crosslinked hydrophilic polymers. Since the biobased latex binders currently used in the paper industry are water-swollen crosslinked starch nanoparticles, their wet and dry properties depend mainly on their particle size and crosslink density. The crosslink density of starch molecules forming the nanoparticles is especially important because it controls the extent of water swelling (swell ratio) [3,4], that is, as the crosslink density increases, the swell ratio of crosslinked starch nanoparticles decreases. Varying swell ratios of the water-swollen starch nanoparticles not only set them apart from conventional starches and synthetic latexes in their rheological behavior, but also differentiate themselves in paper coating performance. Their unique rheological behaviors and paper coating performance will be discussed based on theoretical considerations as well as some laboratory testing, pilot coater and mill trial results.

The current biobased latex binders are manufactured by a continuous reactive extrusion process comprising of solubilizing starch granules, i.e. converting the very high-solids starch paste into a thermoplastic melt phase, and then crosslinking and sizing the solubilized starch molecules into nanoparticles [9,10]. The resulting product from the extruder is nearly dry agglomerates of crosslinked starch nanoparticles which are subsequently pulverized as a final powder product. This process was thought to be a good way to disperse TiO_2 particles uniformly and associate them with starch nanoparticles. This is how we have developed a new brightness grade of biobased latex binders. The performance of this new biobased latex binder grade will be discussed in terms of the brightness and opacity of paper coatings.

The current biobased latex binders are cured by using glyoxal-type curing agents (starch insolubilizers) to improve their wet strength in coated paper and paperboard applications. Although such curing agents have been found to be adequate up to 35% replacement of synthetic latexes for paper coatings, it was thought that polymeric curing agents could be more effective for particulate binders such as our biobased latex binders that consist of crosslinked biopolymer nanoparticles. Preliminary results will be discussed in terms of the substitution levels of synthetic latexes in base and top coatings as well as in single coatings.

THE UNIQUE CHARACTERISTICS AND PROPERTIES OF WATER-SWOLLEN CROSSLINKED BIOBASED LATEX BINDERS: THEIR SWELLING/DE-SWELLING, HIGH-SHEAR RHEOLOGY, HIGHER EFFECTIVE SOLIDS, LESS COATING SHRINKAGE, AND PAPER COATING PERFORMANCE

The De-Swelling of Water-Swollen Crosslinked Biopolymer Nanoparticles as a Function of the Concentration of Dispersions:

Crosslinked biopolymer nanoparticles have very unique wet properties. First, their swelling under conditions of extreme dilution with water achieves the maximum swelling value that is balanced between their elastic constraint due to their crosslinked network and the osmotic pressure [4].

Secondly, they de-swell by addition of water-miscible solvents such as alcohols and many other water-soluble species such as electrolytes. Lastly, they will also de-swell with increasing solids so that their dispersions can be made at higher solids, as shown in Figure 1. This behavior can be understood by the fact that the concentration of starch networks in the particles cannot be lower than the overall dispersion concentration. Therefore, de-swelling will take place when the concentration of the dispersion exceeds that of the starch network in the nanoparticles which is equal to the reciprocal 1/SR(W) of the weight swell ratio, SR(W). For example, if SR(W) is 5, then starch nanoparticles will start de-swelling when the concentration of such a crosslinked starch dispersion approaches or exceeds 20% solids.

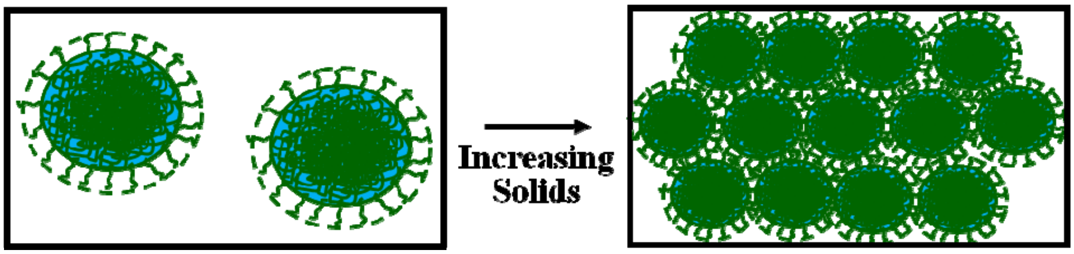

Figure 1. Schematics showing de-swelling of water-swollen crosslinked biopolymer nanoparticles with increasing solids.

Although we have not examined the de-swelling behavior of biobased latex nanoparticles with increasing solids by either transmission or scanning electron microscopy, combined with cryo-techniques for quick freezing and freeze-drying to preserve their respective swollen sizes in the dry state, we have been able to elucidate such behavior from their rheological performance as a function of their volume fractions. It is known from the theories on the viscosity of dispersions that the relative viscosity (η_r) of dispersions of spherical particles depends only on their effective volume fraction (ϕ_{eff}) and close packing volume fraction (ϕ_p) and can be theoretically expressed as a function of ϕ_{eff} and ϕ_p [11-14]. Therefore, if we assume that the water-swollen biobased latex nanoparticles are spherical and monodisperse regardless of their volume fractions, then we can obtain their effective volume fractions by matching their relative viscosities with those of uniform hard-sphere dispersions which can be calculated by using theoretical equations such as the Mooney [12] and Dougherty-Krieger equations [13] with the close random packing volume fraction of uniform hard-spheres equal to 0.64 [15]. From the effective volume fractions obtained as a function of the actual volume fraction (i.e., the volume fraction of dispersed solid particles), we should be able to calculate the volume swell ratios as a function of the actual volume fraction, since the ratio of the effective volume fraction to the actual volume fraction is equal to the volume swell ratio, SR(V).

Figure 2 shows the relative viscosities of biobased nanoparticle dispersions and uniform hard-sphere dispersions plotted against the actual volume fraction of dispersed particles. In Figure 2 the relative viscosity of the nanoparticle dispersions was obtained by dividing the experimentally determined viscosity of the dispersion by the viscosity of water at 20 ^{o}C, while the relative viscosity of a uniform hard-sphere dispersion was calculated by using the Dougherty-Krieger equation, $\eta_r=(1-\phi/\phi_p)^{-2.5\phi p}$, where ϕ_p is the close random packing fraction of uniform spherical particles and taken to be 0.64. As indicated in Figure 2, at a given relative viscosity the volume fraction (ϕ_H) of the hard-sphere dispersion is equal to the effective volume fraction ($\phi_{B,\,eff}$) of the biobased latex dispersion at ϕ_B. Thus, the volume swell ratio SR(V), which is the ratio of the swollen to actual (unswollen) volumes of the biobased latex nanoparticles, can be obtained by dividing the effective volume fraction ($\phi_{B,\,eff}=\phi_H$) by the actual volume fraction (ϕ_B).

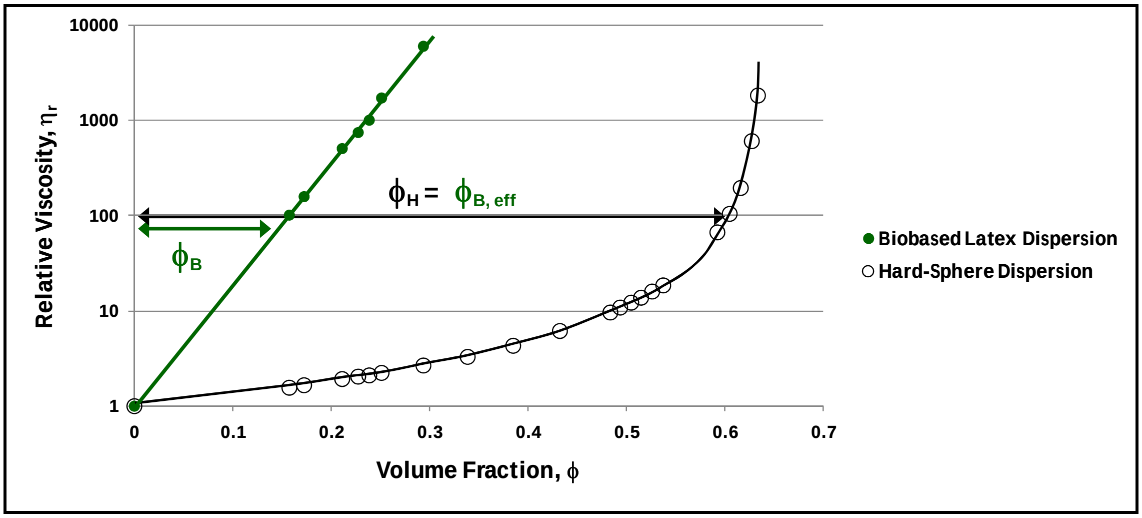

Figure 2. The experimental relative viscosity of a biobased latex compared with the calculated (Dougherty-Krieger Equation) relative viscosity for uniform hard-sphere dispersions as a function of the actual volume fraction of dispersed particles at 20 °C.

The volume swell ratio, V_S/V_O, of biobased latex nanoparticles, which is equal to the ratio of the effective to actual volume fractions, $\phi_{B,\ eff}/\phi_B$, at ϕ_B, was calculated by using both curves in Figure 2 as a function of their actual volume fraction, and then was plotted against the actual volume fraction of a biobased latex dispersion in Figure 3. As shown in Figure 3, it is clear that as the volume fraction of biobased latex dispersion increases, the volume swell ratio decreases, as anticipated from theoretical considerations.

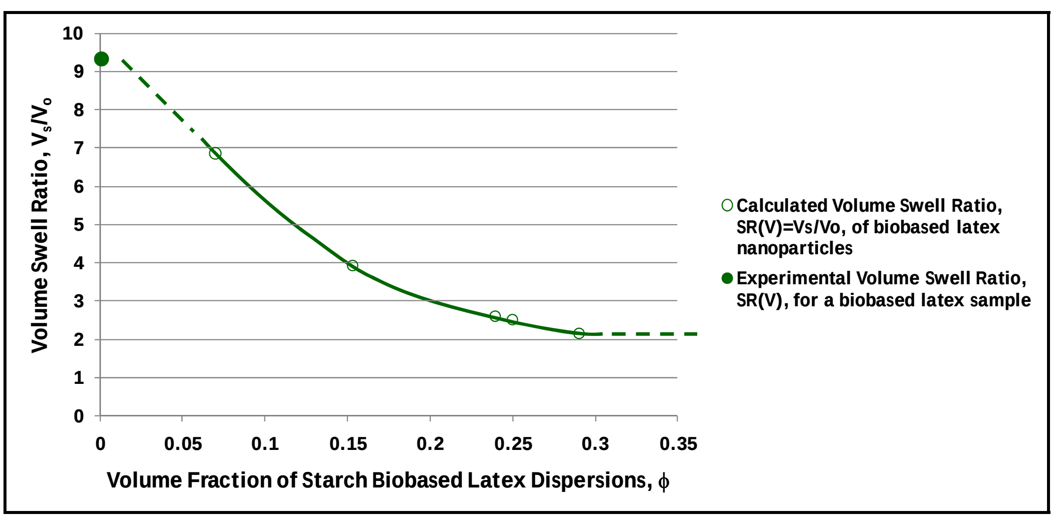

Figure 3. The volume swell ratio, $SR(V)=V_S/V_O$, of biobased latex nanoparticles as a function of volume fraction, where V_O and V_S are the actual (unswollen) and swollen volumes of biobased latex nanoparticles, respectively.

The Deformation of Water-Swollen Crosslinked Biopolymer Nanoparticles under Shear and Pressure:

It is not very difficult to visualize that the water-swollen nanoparticles would deform and de-swell under shear and pressure, as shown in Figure 4.

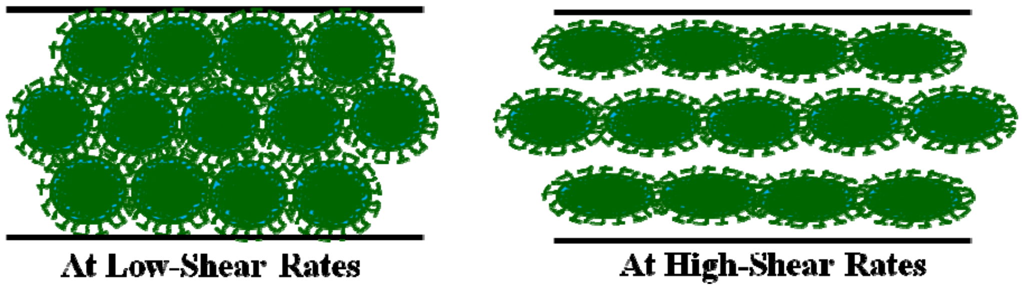

Figure 4A. Schematics showing the deformation of water-swollen crosslinked biopolymer nanoparticles under high shear rates.

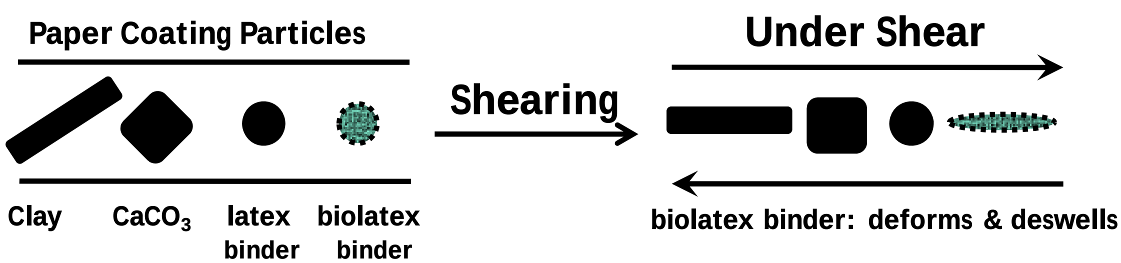

Figure 4B. Schematics showing the deformation under high shear rates of biobased latex in the presence of pigment and latex particles.

This behavior is quite unique because the water-swollen nanoparticles are not only deformable under high shear and pressure, but also de-swell and release water, and then may be able to lubricate jammed solid particles. As a result, it is expected that coating colors containing such biobased latex nanoparticles would be much less dilatant than their counterpart coating colors without such starch nanoparticles. Therefore, they may be considered as unique rheological lubricants.

Although we have not yet systematically studied the effects of starch nanoparticles on apparent slip of paper coating colors [16] and their other rheological properties resulting from the use of coating lubricants [17], numerous pilot coater and mill trials have shown excellent high-speed blade runnability. High-shear measurements with an ACAV capillary viscometer have shown that paper coating colors containing a synthetic latex as the sole binder or with a soluble starch as a co-binder exhibited dilatant behavior to a certain extent, but substituting a portion of the synthetic latex with biobased latex binder tended to moderate the dilatant behavior. This indicates that starch nanoparticles perform better than synthetic latex particles for the rheological properties of paper coating colors, as shown in Figure 5.

Figure 5 illustrates the high-shear capillary viscosities of a series of paper coating formulations as a function of shear rate. It is quite clear from Figure 5 that replacing a portion of the synthetic latex or some of the latex and all of the soluble starch of the control formulation with biobased latex binder has helped to alleviate dilatant behavior of the control formulation. Formulation 1A (Figure 5) showed unusually high interactions between soluble starch molecules and starch based latex nanoparticles and increased its viscosity so that Formulation 1B was modified with a rheology modifier which reduced such interactions.

Although the low-shear viscosity of water-swollen nanoparticle binders is higher than that of their solid particle counterparts such as styrene-butadiene and styrene-acrylic latexes at the same solids, their paper coating formulations are less dilatant at high shear rates, as shown in Figure 5. This result is believed to be attributed to their deformability under high shear. The deformability under high shear and the inherent high water retention performance significantly improve high-speed blade runnability of paper coating formulations containing biobased latex binders. We call this unique attribute "A Self-Lubricating Effect".

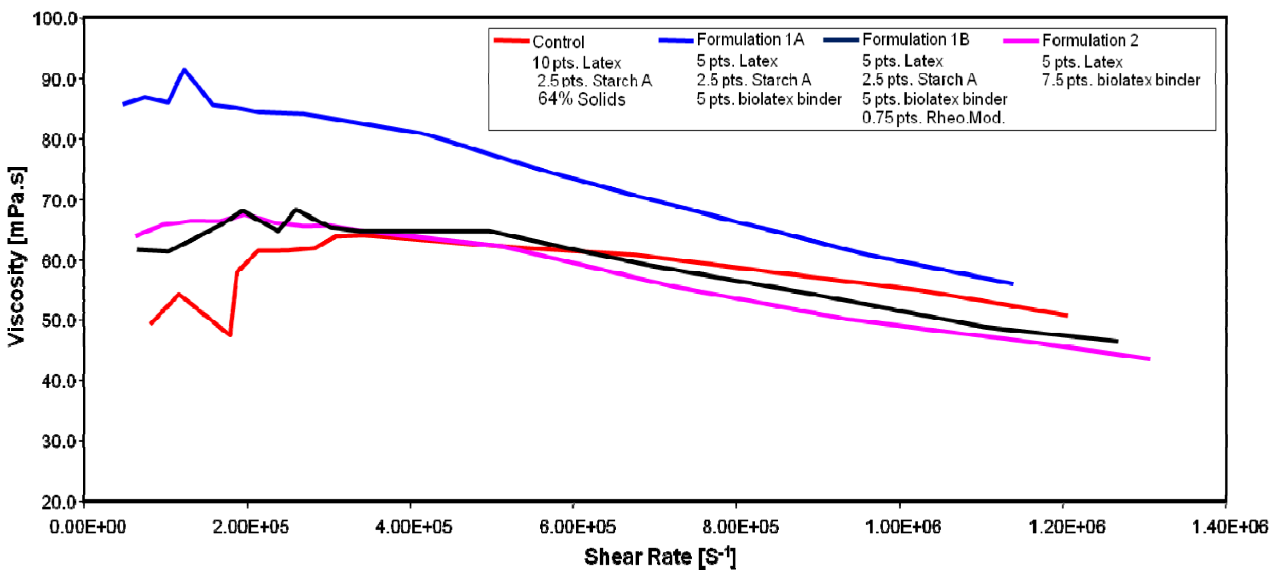

Figure 5. High-shear (ACAV) capillary rheology of a series of paper coating formulations, including a Control containing both synthetic SB latex and soluble starch, Formulations 1A and 1B containing biobased latex binder in place of a portion of the SB latex, and Formulation 2 containing biobased latex binder replacing some of the SB latex and all of the starch.

The Influence of Higher %Effective Solids and Volume Solids of Water-Swollen Biobased Nanoparticles on Coating Immobilization and Coating Holdout:

Since crosslinked hydrophilic nanoparticles in dispersions exist in the form of water-swollen nanoparticles, their effective solids and volume solids will be higher than their actual solids and volume solids. The higher the swell ratio (SR) of nanoparticles, the higher their effective solids and volume solids.

Figure 6 shows the % effective volume solids as a function of the % actual solids of a biobased latex nanoparticle dispersion with a volume swell ratio, SR(V), of 2.5 as a parameter, along with the % volume solids of a starch solution and a synthetic latex for comparison, where the densities of starch, biobased latex and SB latex were taken to be 1.6 g/cm^3 and 1.0 g/cm^3, respectively. As can be seen in Figure 6, the water-swelling of biobased latex nanoparticles significantly increases % volume solids over their % actual volume solids as compared to a typical cooked starch solution and synthetic latex.

The following example illustrates the calculations that yielded Figure 6 (for 100 g of dispersion):

%Actual Volume Solids of a soluble cooked starch at 30% solids

= (total volume of starch/total volume of the dispersion) x 100%

= [(30 g of starch/1.6 g/cc)/(30 g of starch/1.6 g/cc + 70 g of water/1 g/cc)] x 100%

= [(18.75 cc)/(18.75cc + 70 cc)] x 100% = **21.13%**

%Effective Volume Solids of biobased latex binder at 30% solids

= (total volume of water-swollen nanoparticles/total volume of the dispersion) x100%

= [(30 g/1.6 g/cc x 2.5)/(30 g/1.6 g/cc + 70 g of water/1 g/cc] x 100%

= [(18.75 cc x 2.5)/(18.75 cc + 70 cc)] x 100%

= [46.87/88.75] x 100% = **52.82%**

Suppose that a biobased latex binder having a weight swell ratio, SR(W), of 2.0 is used at 5 parts in a paper coating color containing 100 parts pigments and 15 parts binders at 65% solids. Since the effective solids of 5 parts biobased latex binder would be 10 parts at the SR(W) of 2.0, the effective coating solids would become 65x120/115=67.83%, that is 2.83% higher. For a biobased latex binder with an SR(W) of 2.5, the effective coating solids would become 65x122.5/115=69.2%, that is 4.2% higher.

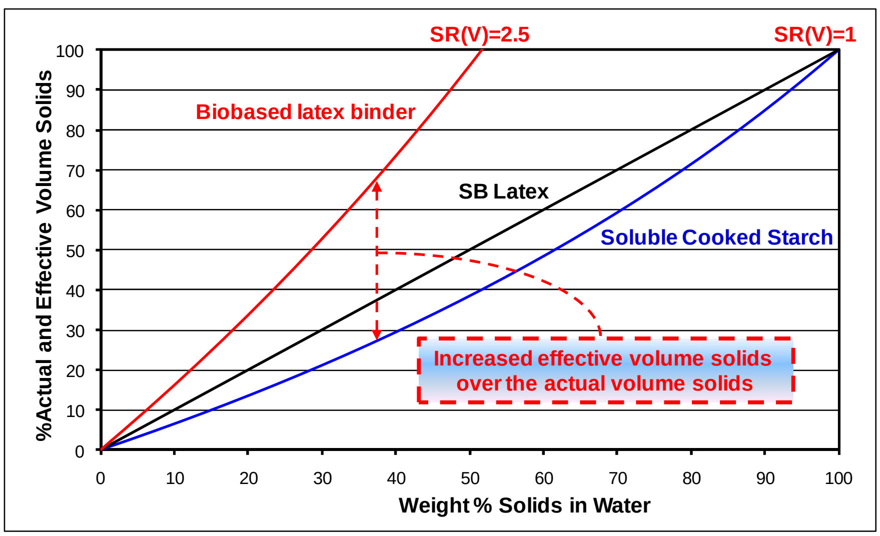

Figure 6. The % effective volume solids of biobased latex nanoparticles, soluble cooked starch, and synthetic SB latex vs. % actual volume solids of starch and latex with the volume swell ratio, SR(V), as a parameter.

This increase in the effective coating solids enables paper coating colors containing biobased latex binders to get close to their immobilization solids [18,19] so that they exhibit excellent coating holdout, resulting in excellent fiber coverage and coating smoothness. This approach to coating holdout is quite different from the previous approaches such as coating structure modifications [20-24], high-solids coating technology [25], etc. Although high-solids coating and high effective coating solids approaches are similar in concept, the latter approach is expected to result in fewer high-speed blade runnability problems due to some of the aforementioned attributes (reduced dilatancy, improved water retention, coating hold-out, fiber coverage, etc.). Moreover, beyond high-solids coating strategies, this new coating holdout technology can be beneficially combined with many existing costing structure modification approaches (20-23) for improving coating holdout and fiber coverage in challenging situations, including applications ranging from light weight coated to high quality fine paper grades to unbleached recycled paperboard.

The Influence of Less Shrinkage of Biobased Latex Binder Containing Paper Coatings on Coating Gloss, Porosity, and Opacity:

One of the most important characteristics of biobased latex binders for paper coatings is that they shrink much less than soluble starches upon coating consolidation during drying. The gloss of biobased latex containing paper coatings on polyester films is equal to or higher than that of synthetic latex containing paper coating controls [26], as shown in Table 1, thus indicating that the coating shrinkage of biobased latex containing paper coatings is equal to or less than that of synthetic latex containing paper coatings. This is unlike that of soluble cooked starch containing paper coatings [27, 28]. It has been postulated that the dry biobased latex nanoparticles within the paper coating would possess a nano-cellular void-like internal structure [4], further supporting a hypothesis that the "virtual density" of the biobased latex binder within the dried paper coating approaches 1.0 g/cm^3. The low degree of coating shrinkage and the nano-cellular void-like internal structure of biobased latex binder containing paper coatings are responsible for more open coating structure and better opacity which have been observed by numerous CLC, pilot coater, and mill trials.

Table 1. The gloss of uncalendered formulated paper coatings containing all-SB latex and both SB latex and biobased latex binder on polyester films [26].

Paper Coating Sample	Coat Weight, g/m2	%Gloss at 75^o
13.6 Pts. SB Latex Control	37.6	37.6 +/- 0.20
38% Replacement of SB Latex with Biobased latex Binder	38.4	46.1 +/- 2.06

EXPERIMENTAL RESULTS AND DISCUSSION

The Low-Shear Viscosity of Biobased Latex Binder Dispersions:

Dry biobased latex powder produced by a reactive extrusion process can be added directly into pigment slurries and dispersed during coating color preparations. The pigment particles act effectively as grinding vehicles to help break up the dry agglomerate powder (ave. particle size of ~300 μm) into the individual biopolymer nanoparticles (ave. particle size of ~100 nm) in order to form the biobased latex dispersion. If direct addition to the coating formulation is not possible, in the event of low shear or inadequate mixing facilities, the biobased latex powders can also be dispersed into GCC or clay to make a masterbatch concentrate. If neither of these is possible at the mill, the dry agglomerate product can be dispersed directly in water. In all cases, the factors affecting the dispersion of biobased latex powders are common in that any additives and conditions reducing the hydrogen-bonding, such as electrolytes, high pH, high temperature, etc. and increased shear are beneficial.

To illustrate this, dry biobased latex agglomerate powder was dispersed under moderate shear conditions at concentrations up to 60% solids into a GCC slurry (Figure 7) and at high shear conditions in pure form in water up to 40% solids (Figure 8). The low-shear viscosity was measured as a function of % solids and temperature using a Brookfield-type viscometer.

For example, Figure 7 illustrates that if a typical mill runs its coating formulations after make-down at temperatures at or above 30 ^{o}C (>85 ^{o}F), it can handle the GCC-biobased latex masterbatch up to 60% solids, provided it can manage pumping viscosities up to about 2200 cps.

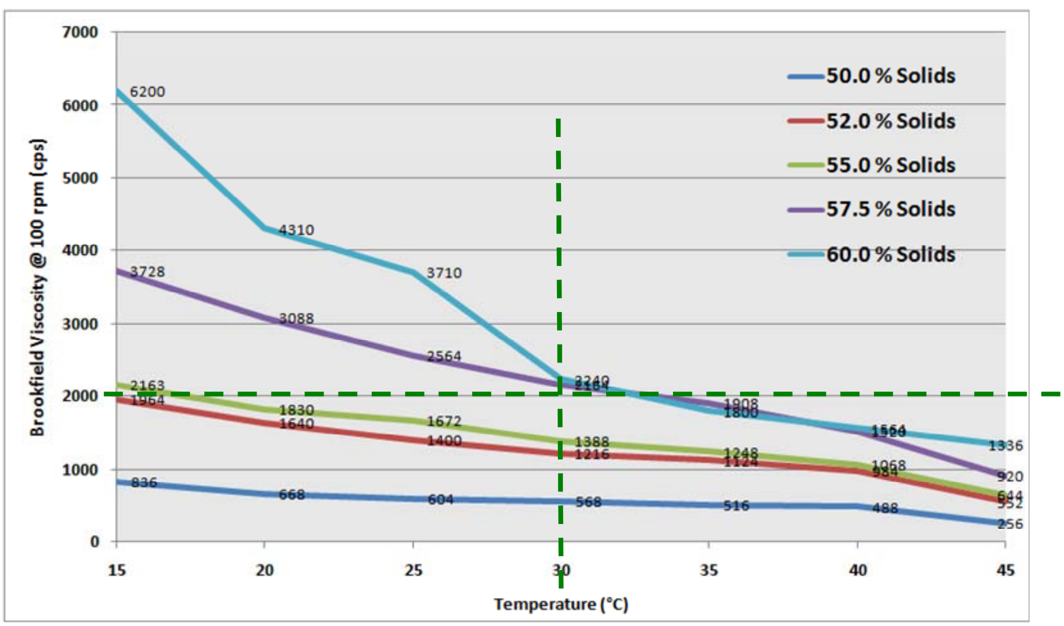

Figure 7. Brookfield visicosity of a GCC-biobased latex masterbatch dispersion (2:1 GCC:biobased latex binder on a dry basis) as a function of % solids at temperatures ranging from 15 to 45 ^{o}C (59 to 113 ^{o}F).

The biobased latex powder was also dispersed at concentrations up to 35% solids under high shear, and the Brookfield viscosity was measured as a function of % solids at 20 ^{o}C and plotted in Figure 8.

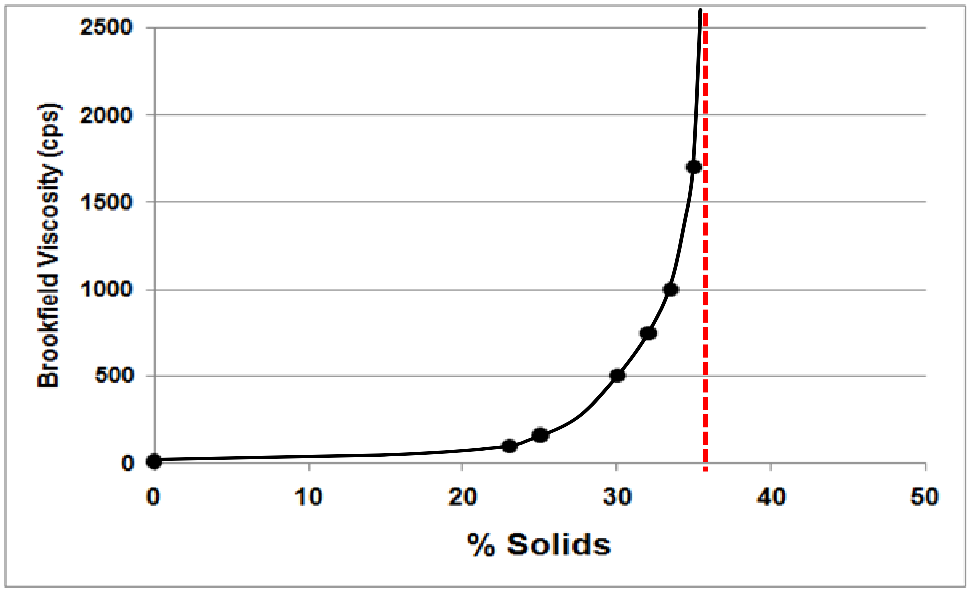

Figure 8. Brookfield viscosity of a biobased latex sample dispersed in water, as a function of % solids at 20 ^{o}C.

As shown in Figure 8, the % solids at the point of close packing of a pure dispersion of biobased latex nanoparticles was estimated to be 36%. This is the point at which the water-swollen starch nanoparticles touch each other and show a very high viscosity. Depending on the crosslink density of the biobased latex, the temperature and certain additives, the maximum solids of the pure dispersion ranges from about 35 to 45%. The close random packing of spherical particles is known to be about 64% solids by volume [15]. Using these values, we can calculate the volume swell ratio, SR(V), of nanoparticles of this particular biobased latex dispersion at the close packing, as follows:

The %Volume Solids at Close Packing

= {[36% solids/ρ(starch)]/[36% solids/ρ(starch)+V(total H_2O)]} x 100%

= {(36%/1.6)/[(36%/1.6) + (100%-36%)]} x 100%

= [22.5/(22.5 + 64)] x 100% = 26.01% volume solids

Thus, **SR(V)** = 64%/26.01% = **2.46**

SR(W) = [36% solids + W(H_2O contained in nanoparticles)]/36% solids

= [36 + (22.5x2.46-22.5)]/36 = 1.91

Although we have not determined the swell ratios of biobased latex binders in actual paper coating formulations, it is expected that they would be more or less similar to the above-calculated values. It is important to note that the swell ratios of biobased latex binders can be controlled as needed, since the reactive extrusion process is capable of controlling the crosslink density of the nanoparticles.

By measuring the relative viscosity, η_r, at low concentrations (i.e. low volume fraction) for a latex (a polymer colloid), one can gather relevant information about the viscosity and swelling behavior of that colloid. The viscosity is a simple measurement that is obtained by measuring the flow time for a given distance (between two demarcations of a glass Ubbelohde viscometer) for the polymer colloid (η) and for the dispersion medium (η_o), which is water. Using the Einstein equation, $\eta_r = 1 + 2.5 f \phi$, where f is the effective volume factor, which is equivalent to the volume swell ratio, and ϕ is the volume fraction, one can gain valuable insight on the fundamental difference in colloidal behavior for different polymer latex dispersions.

Table 2. The Effective Volume Factor determined for samples of biobased latex binder with different crosslink densities.

Biobased Latex Sample	Relative Crosslink Density	Effective Volume Factor
1	Low	16.0
2	Medium	9.33
3	High	6.67

Since different methods to determine the swell ratios of water-swollen crosslinked starch nanoparticles yield either volume or weight swell ratios, it will be convenient to use the following relationship between the volume and weight swell ratios:

$$SR(W) = 0.625 \times [SR(V) + 0.6]$$

The Brookfield viscosity of a biobased latex dispersion at 30% solids was measured as a function of temperature and plotted in Figure 9.

From Figure 9, we can find that a viscosity-temperature transition occurs near 30 ^oC. This viscosity transition temperature agrees well with that of GCC-biobased latex masterbatch dispersions (2:1 GCC:biobased latex binder on a dry basis) shown in Figure 7. Based on these results, it is desirable to disperse biobased latex nanoparticle agglomerates at temperatures above 30 ^oC.

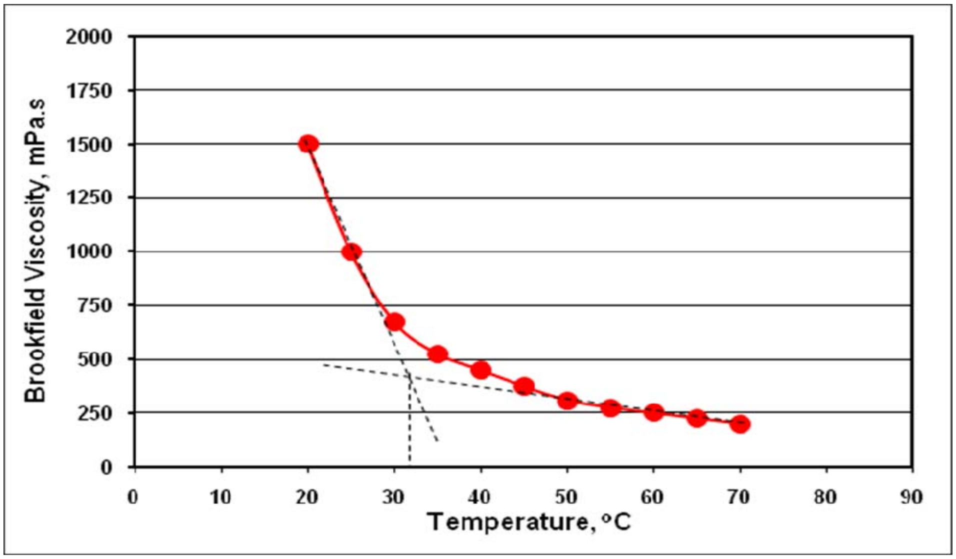

Figure 9. The Brookfield viscosity of a biobased latex dispersion at 30% solids vs. temperature in ^{o}C.

The Development of High Brightness Biobased latex Binders Made by Co-Extruding TiO_2 Particles:

Although a preliminary result on paper coatings containing the high brightness biobased latex binders was reported elsewhere [26], we would like to report some of the exciting findings and provide some insight into the efficiency issue of TiO_2 particles in paper and architectural coatings. A CLC coating study was carried out to test whether or not co-extruded TiO_2 particles would be any different from post-added TiO_2 particles.

A series of biobased latex binders co-extruded with 1 part TiO_2 each from two different types (hydrophilic and hydrophobic) as well as 3 parts hydrophilic TiO_2 was evaluated by using the Western Michigan University CLC coater with a coating formulation of 98 parts clay/GCC pigments and 2 parts TiO_2, 8.5 parts SB latex, 5.1 parts biobased latex binder, and 0.25 part PVOH, 0.9 part OBA, and 0.4 part glyoxal curing agent at pH 8.5-9.5 and 63% solids. The average coat weight was 13.5 ± 0.7 lb/ream. The substitution level of SB latex with biobased latex binders was 37.5%. Their % brightness of the coated paper samples was measured with and without UV (see Figure 10). Note that all of the coated paper samples in Figure 10 had similar % gloss (75°, MD: 72% ± 2%; CD: 68% ± 2%).

The most striking finding is that a miniscule amount of additional 0.051 part of TiO_2 co-extruded with biobased latex binders made so much impact on the brightness of paper coatings, whereas the post-added 0.051 part TiO_2 did not do anything, as expected. In addition, the % whiteness showed a similar trend. This finding has clearly demonstrated that the efficiency of TiO_2 particles is highly dependent on their uniform distribution in the final dry coatings, as predicted by the theory [29]. This motivated us to find better ways to distribute the TiO_2 particles uniformly in dry coatings.

Another important finding is that although the biobased latex binder co-extruded with 3 parts TiO_2 showed much higher brightness measured without UV, as expected, it showed lower brightness measured with UV, thus indicating that TiO_2 particles interfered with the OBA activity by absorbing UV light (referred to as "OBA quenching") in the region where the OBA molecules are most active. This finding indicates that for OBA containing paper coatings the use of anatase TiO_2 particles would be preferred because they are less interfering with OBA than rutile TiO_2 particles.

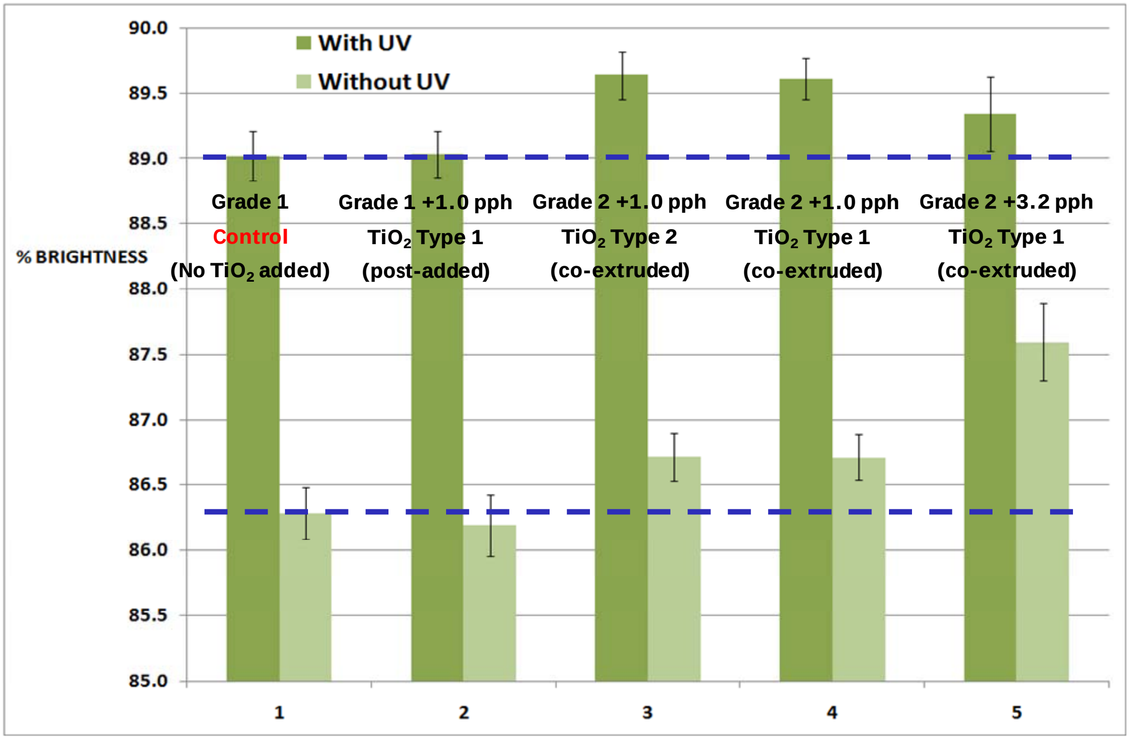

Figure 10. % Brightness of paper coatings containing a series of biobased latex binders co-extruded with 1 part TiO_2 each of two types (Type 1: Hydrophilic and Type 2: Hydrophobic) and 3 parts TiO_2 of Type 1 and two biobased latex binder controls. Measurements were made with and without UV light.

The Development of High Wet-Strength Biobased Latex Binders Cured by Polymeric Curing Agents:

As stated in the abstract and introduction, one shortcoming of biobased latex binders for paper coating applications in terms of lithographic offset printing has been wet pick performance, although glyoxal-type curing agents have been able to improve the wet strength enough to replace synthetic latexes up to about 35%. For this reason, we have attempted to find better curing agents. Since the biobased latex binders are particulate, it was thought that polymeric curing agents would likely form stronger networks even in the wet state.

A series of polymeric carbohydrate-based curing agents (referred to as "Polymeric Insolubilizer" in Table 3) was formulated with two typical grades of biobased latex binder (referred to as "Biobased Latex, Grade 1 and Grade 2" in Table 3). The preliminary results obtained for CLC coated paper are very promising.

The control coating in Table 3 is an "all synthetic" fine paper coating formulation that does not contain either starch or an insolubilizer. Trial 1 in Table 3 shows that at a 37.5% replacement of the SB latex (replaced on a one-for-one basis), the Nancy Plowman wet pick result is similar to the control and well below 10, which is generally considered an excellent result that would predict good performance for offset printing. Without the addition of the glyoxal-based insolubilizer, the wet pick would be in the range of 15-20. At the 50% replacement level, even with the glyoxal-based insolubilizer, the wet pick test result of 19 indicates there is a probability that one might experience performance issues in commercial offset printing.

By using a polymeric carbohydrate-based insolubilizer, the performance at 50% replacement of the petro-latex is reduced to an acceptable level well below a wet pick of 10.

The use of insolubilizers is a conservative approach that provides a level of confidence to a coated paper manufacturer that one should not expect offset print performance issues. However, it is noteworthy that a number of examples exist where biobased latex binder is being used at the 35-50% replacement level even without the use of any insolubilizer, and no commercial print problems have been observed. This suggests that the current wet pick tests may not be directly applicable to the commercial performance of biobased latex binder in paper coatings, and this may be related to the ability for the biobased latex binder to recover in the relatively short exposure cycles to fountain solutions at the high commercial printing speeds [30].

Table 3. Study of the impact of conventional and polymeric carbohydrate-based insolubilizers on Nancy Plowman wet pick performance.

Formulas are in parts-per-hundred											
SB Latex replacement level with biobased latex:			0.0%	37.5%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	62.5%
Material	Comments	Material Solids	Control	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8
Pigment											
Clay		70%	34	34	34	34	34	34	34	34	34
GCC		72%	64	64	64	64	64	64	64	64	64
TiO_2		72%	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Binder											
SB Latex		50%	13.6	8.5	6.8	6.8	6.8	6.8	6.8	6.8	5.1
PVOH		23%	0.50	0.50	0	0	0	0	0	0	0
Biobased Latex, Grade 1		92%	0	5.1	6.8	6.8	6.8	6.8	6.8	0	8.5
Biobased Latex, Grade 2		92%	0	0	0	0	0	0	0	6.8	0
Additive											
Dispersant		30%	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
OBA		100%	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Thickener		33%	0.13	0	0	0	0	0	0	0	0
Glyoxal insolubilizer	7% b.o. ECOSPHERE	45%	0	0.36	0.48	0	0.48	0	0	0	0.51
Polymeric Insolubilizer 1	5% b.o. ECOSPHERE	10%	0	0	0	0.34	0.34	0	0	0.34	0.43
Polymeric Insolubilizer 2	5% b.o. ECOSPHERE	10%	0	0	0	0	0	0.34	0	0	0
Polymeric Insolubilizer 3	2.3% b.o. ECOSPHERE	10%	0	0	0	0	0	0	0.16	0	0
Defoamer		100%	0.05	0	0	0	0	0	0	0	0
	INK TRANSFER %		90	98	81	96	96	96	97	92	71
	INK REFUSAL %		6	0	0	0	0	0	0	4	0
	WET PICK %		4	2	19	4	4	4	3	3	29

LIFE CYCLE INVENTORY ANALYSIS (LCIA) AND REDUCTION IN CARBON FOOTPRINT TROUGH THE USE OF BIOBASED LATEX BINDERS

The type of carbon used in paper coating binders can be determined using an established methodology using ASTM D-6866 [31]. This test measures the amount of radiometric carbon and therefore the amount of fossil based carbon versus biogenic (crop based) carbon. This test has shown that synthetic binders, such as SB latex, contain 99% fossil carbon since they are produced from monomers that are derived from fossil based resources such as oil and gas [7].

At the end of its useful life cycle, coated paper will be burned, land-filled, composted or recycled. During recycling the coated paper will be separated during the various paper recycling, screening, and flotation deinking steps into reusable fiber and ink, pigment and synthetic binder residues that are disposed of. Eventually this disposed residue will decompose and release CO_2 into the environment [31]. Synthetic binders therefore have a positive carbon footprint which in the case of SB latex is equivalent to 7.4 Kg CO_2 per 1 Kg of SB latex binder. This amount is composed of 3.4 Kg CO_2 per 1 Kg of SB latex from the raw materials or monomers: styrene and butadiene, and 4.0 Kg CO_2 per 1 Kg of SB latex from the production processes involved in taking oil and gas out of the ground and all the way to delivering the finished SB latex polymer to the paper mill. These calculations were carried out by an independent organization called Delphi Institute.

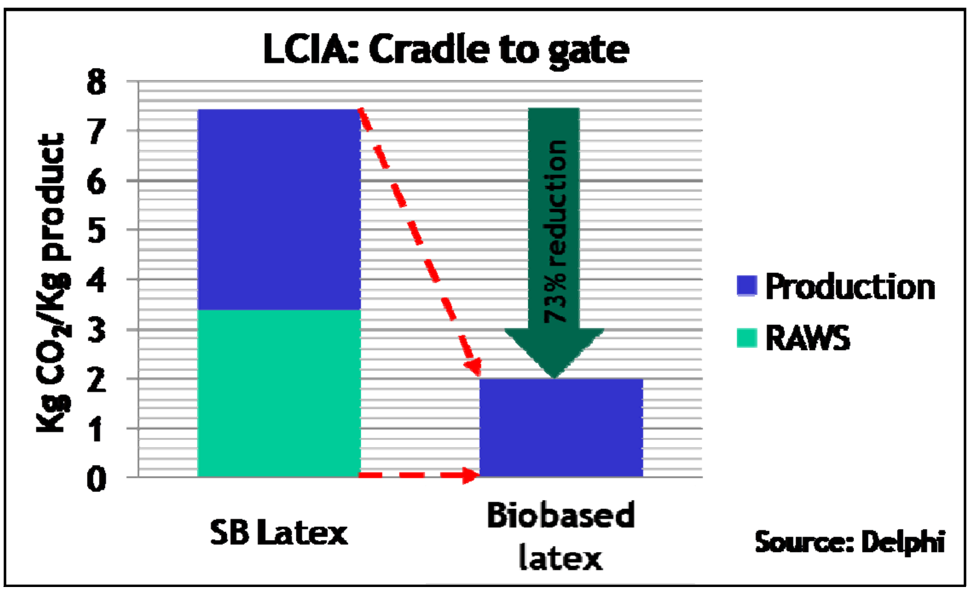

Figure 11. Life Cycle Inventory Analysis (LCIA) and reduction of carbon foot print through the use of biobased latex binders

Biobased latex binders on the other hand are made from renewable raw materials or crops that were grown in a single season by capturing and sequestering CO_2 in the plant via its photosynthesis reaction. At the end of its lifecycle, biobased latex binder will be removed the same way synthetic binders are removed, namely the various paper recycling steps including flotation deinking during the paper recycling process. The difference is that the decomposition of biobased latex binder will only release as much CO_2 as was initially captured by the plant to grow the biopolymer. The biobased latex binders are therefore carbon footprint neutral from a raw material perspective and have a significantly lower carbon footprint when the production process is considered: 2.0 Kg CO_2 per 1 Kg of biobased latex binder. A cradle-to-gate life cycle inventory analysis comparison between SB latex and biobased latex binder is shown in Figure 11.

The LCIA comparison of SB latex binder to biobased latex binders shows a 73% reduction in carbon footprint on the "Cradle to Gate" basis, as shown in Figure 11. The calculation carried out by Delphi Institute took into account a Life Cycle Inventory Analysis (LCIA) by looking at it on a "Cradle to Gate" approach. In other words, the carbon footprint of synthetic and biobased binders up to the gate of the paper mill. It does not take into account the LCIA involved with making the coated paper, its use by the consumer and its eventual end of life, in other words the "Gate to Cradle" portion. Since biobased binders are delivered substantially dry to the paper mill, they can be used to improve coating solids and therefore reduce drying energy required to make the coated paper.

As can be seen from Figure 11, the use of biobased latex binders has the immediate ability to reduce carbon dioxide emissions by 73%, as compared to the use of a petroleum-based latex, such as SB latex binders.

SUMMARY

The unique characteristics and properties of biobased latex binders for paper coatings were presented: Their swelling and de-swelling, deformability under shear and pressure and self-lubricating effect for high-speed blade runnability, higher effective solids for improved coating holdout, fiber coverage, and coating smoothness, and less shrinkage for high coating gloss (uncalendered), porosity, and opacity. These unique characteristics were found to be attributed to the fact that biobased latex binders are made up of water-swollen crosslinked nanoparticles having varying degrees of water swelling (SR) and tend to shrink less upon coating consolidation during drying.

New high brightness biobased latex binders developed by co-extruding TiO_2 particles showed higher brightness, whiteness, and opacity than those of their counterpart biobased latex binders with the post-added TiO_2 particles. A series of new polymeric curing agents was evaluated for the wet strength of biobased latex binder-containing paper coatings. Preliminary results are very promising.

Finally, a cradle-to-gate life cycle inventory analysis was carried out which demonstrated that the use of biobased latex binders has the immediate ability to reduce carbon dioxide emission by 73% as compared to the use of a petroleum-based latex.

ACKNOWLEDGEMENTS

The contributions from Masato Katayama, President of Fimatec Ltd., Japan as well as Dr. Ian McLennan, Senior Scientist, and Omkar Chandorkar, Paper Coating Technologist, ECOSYNTHETIX INC. are gratefully acknowledged. Special thanks to Prof. Margaret Joyce and Matt Stoops of Western Michigan University, Kalamazoo, Michigan for their helpful advice and assistance in carrying out the CLC paper coating studies.

REFERENCES

1. van Leeuwen, J., "Paper Coating - SBR Latex Replacement Technology", 2006 TAPPI Coating and Graphic Arts Conference, Atlanta, GA., April 2006.
2. Klass, C. P., "New Nanoparticle Latex offers Natural Advantage", *Paper360°Magazine*, p. 30-31, January 2007.
3. van Leeuwen, J., "Update on Biopolymer Nanoparticle Latex Development and Applications", 2007 TAPPI Coating and Graphic Arts Conference, Miami, FL., April 22-25, 2007.
4. Bloembergen, S., McLennan, I., Lee, D. I., and van Leeuwen, J., "Paper Binder Performance with Nanoparticle Biolatex™: ECOSYNTHETIX develops ECOSPHERE® biolatex for replacement of petroleum based latex binders", ACFS, Montreal, June 11-13, 2008.
5. Bloembergen, S., McLennan, I. J., Lee, D. I., and van Leeuwen, J., "Paper binder performance with biobased nanoparticles. A starch-based biolatex can replace petroleum-based latex binders in papermaking", *Paper360ºMagazine*, 46-48, Sept. 2008.
6. Figliolino, F.C., Rosso, F., van Leeuwen, J. and Klass, C.P., "Mill Experiences with Biolatex in Brazil", 2009 TAPPI PaperCon Proceedings, Section 19-1, 2009.
7. Figliolino, F.C. and Rosso, F., "Reducing Carbon Footprint with Biolatex", *Paper360ºMagazine*, 25-28, Aug. 2009.
8. Oh, J. K., Lee, D. I., and Park, J. M., "Biopolymer-based microgels/nanogels for drug delivery applications", *Progress in Polymer Science* 34, 1261–1282, 2009.
9. Giezen, F., Jongboom, R. O. J., Feil, H., Gotlieb, R .O. F. and Boersma, A., "Biopolymer Nanoparticles", U.S. Patent 6,677,386, 2004.
10. Wildi, R. H., VanEgdom, E., and Bloembergen, S., "Process for Producing Biopolymer Nanoparticles", U.S. Patent Application 60/837,669, 2006.
11. Einstein, A., *Ann. Physik* 19, 289, 1906; 34, 591, 1911.
12. Mooney, M., *J. Colloid Sci.* 6, 162, 1951.
13. Krieger, I. M. and Dougherty, T. J., *Trans. Soc. Rheology* 3, 137, 1959.
14. Krieger, I. M., "Rheology of Monodisperse Latices," *Advan. Colloid Interface Sci.* 3, 111-136, 1972.
15. Lee, D. I., "Packing of Spheres and Its Effect on the Viscosity of Suspensions," *J. Paint Tech.* 42, 579, 1970.

16. Triantafillopoulos, N., Kokko, A., and Grankvist, T., “Apparent Slip of Paper Coatings and the Influence of Coating Lubricants”, *Tappi J.* 84(7), 58, 2001.

17. Perttula, M., “Additives Tutorial: Coating Lubricants”, TAPPI Coating and Graphic Arts Conference, May 19, 2007.

18. Herbet, A. J., “Review Methods to Measure Coating Immobilization Solids and Associated Coating Dehydration Rates”, TAPPI PRESS, Atlanta, 1988.

19. Herbet, A. J., Gautam, N., and Whalen-Shaw, M. J., TAPPI 1990 Coating Conference Proceedings, TAPPI PRESS, Atlanta, p. 387.

20. Lee, D. I., Louman, H. W., and Moss, M. H., “Development of Total Synthetic Binder for Rotogravure Paper,” *Tappi J.* 58(9), 79, 1975.

21. Baumeister, M. and Kraft, K., *Tappi J.* 64(1), 85, 1981.

22. Lee, D. I., “Coating Structure Modification and Coating Hold-Out Mechanisms,” TAPPI Coating Conference Proceedings, 143 (1981).

23. Lepoutre, P., Coating Structure: A Review, TAPPI PRESS, Atlanta, 1988.

24. Young, T. S., Pivonka, D. E., Weyer, L. G., and Ching, R., “A study of coating water loss and immobilization under dynamic conditions”, *Tappi J.* 76*(*10), 71-82, 1993.

25. Knappich R., Burri, P., Lohmuller, G., and Hunger, P., “Wet and dry coating structure of calcium carbonate pigments with narrow particle size distribution”, *Tappi J.* 83(2), 91-98, 2000.

26. Bloembergen, S., VanEgdom, E., Wildi, R., McLennan, I. J., Lee, D. I., Klass, C. P., and van Leeuwen, J., “Biolatex Binders for Paper and Paperboard Applications”, 7th International Paper and Coating Chemistry Symposium, McMaster, June 2009.

27. Lee, D. I., “A fundamental study on coating gloss”, TAPPI Coating Conference Proceedings, TAPPI PRESS, Atlanta, 97, 1974.

28. Watanabe, J. and Lepoutre, P., “A mechanism for the consolidation of the structure of clay-latex coatings”, *J. Appl. Polym. Sci.*, 27 (11), 4207, 1982.

29. Broun, J. “Crowding and Spacing of Titanium Dioxide Pigments,” *J. Coatings Tech.*, Vol. 60, No. 758, 67-70, 1988.

30. Husband, J. C., Gate, L. F., Preston, J. S., Blair, D., and Norouzi, N., "The effect of water and oils on the strength of latex bound coatings during offset printing", 7th International Paper and Coating Chemistry Symposium, McMaster, June 2009.

31. Narayan, R. “Biobased and Biodegradable Materials, Rationale, Drivers, & Technology Exemplars”, ACS (An American Chemical Society Publication) Symposium Ser 939, Ch. 18, pg 282, 2006.

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Deinking of HP digital commercial prints

Minedys Macías, Hewlett-Packard

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Talent,
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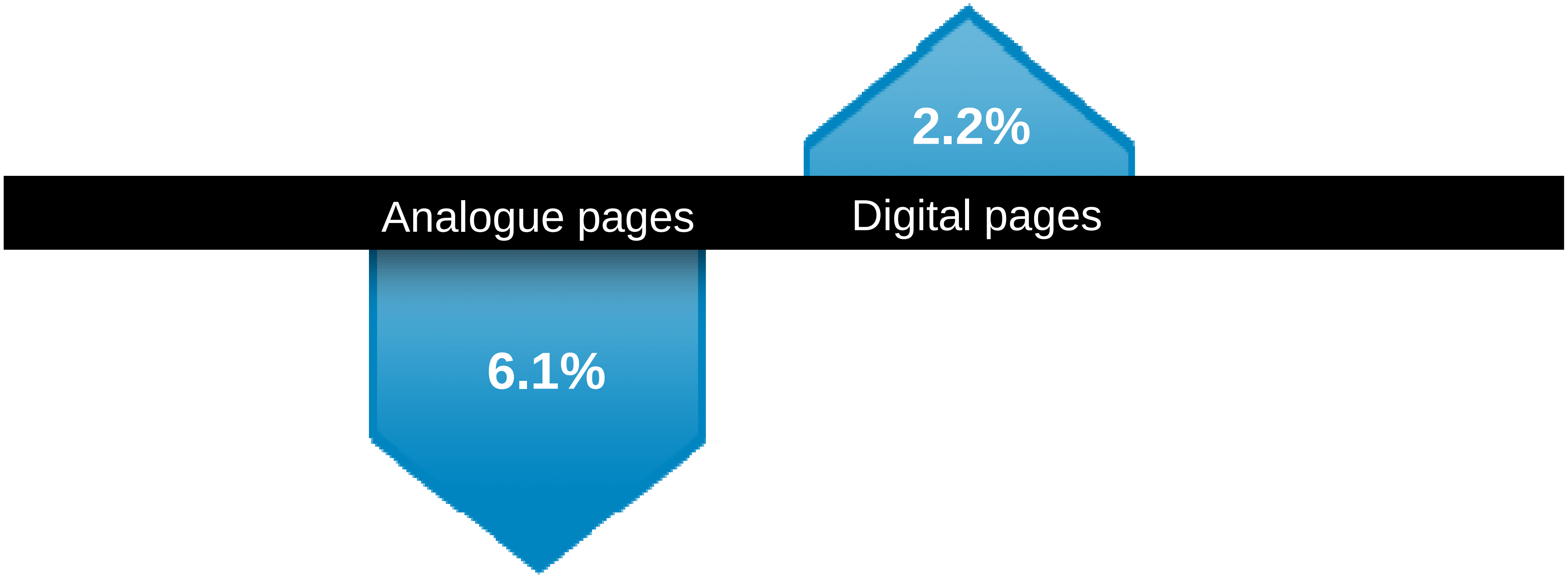
Digital transformation is accelerating

2008-2009 Worldwide page growth for production printing



Source: HP internal analysis based on multiple industry reports

Digital printing
Sustainable growth

- The advantage of digital printing
  - Helps reduce carbon footprint → reduced inventory, spoilage, over-runs
- Digital print recyclability
  - Digital prints are a small percentage of the total paper stream
  - HP is committed to ensuring a smooth transition for the paper recycling industry once the percent of digital prints increases
  - HP conducts internal testing and sponsors independent lab tests
  - These tests show positive deinkability results for HP Indigo Electroink (LEP) and HP Inkjet Webpress pigmented inks

INKJET DEINKABILITY STUDIES

Deinking studies carried out at PTS, Germany

Experimental conditions are similar to those in INGEDE Method11 yet modified to study the effects on inkjet ink deinkability

chemicals: NaOH, Na_2SiO_3, H_2O_2 and soap

Fig. 1: Pulping conditions have a significant impact on deinkability

HP black pigmented ink on Xerox Office paper and M11 chemistry

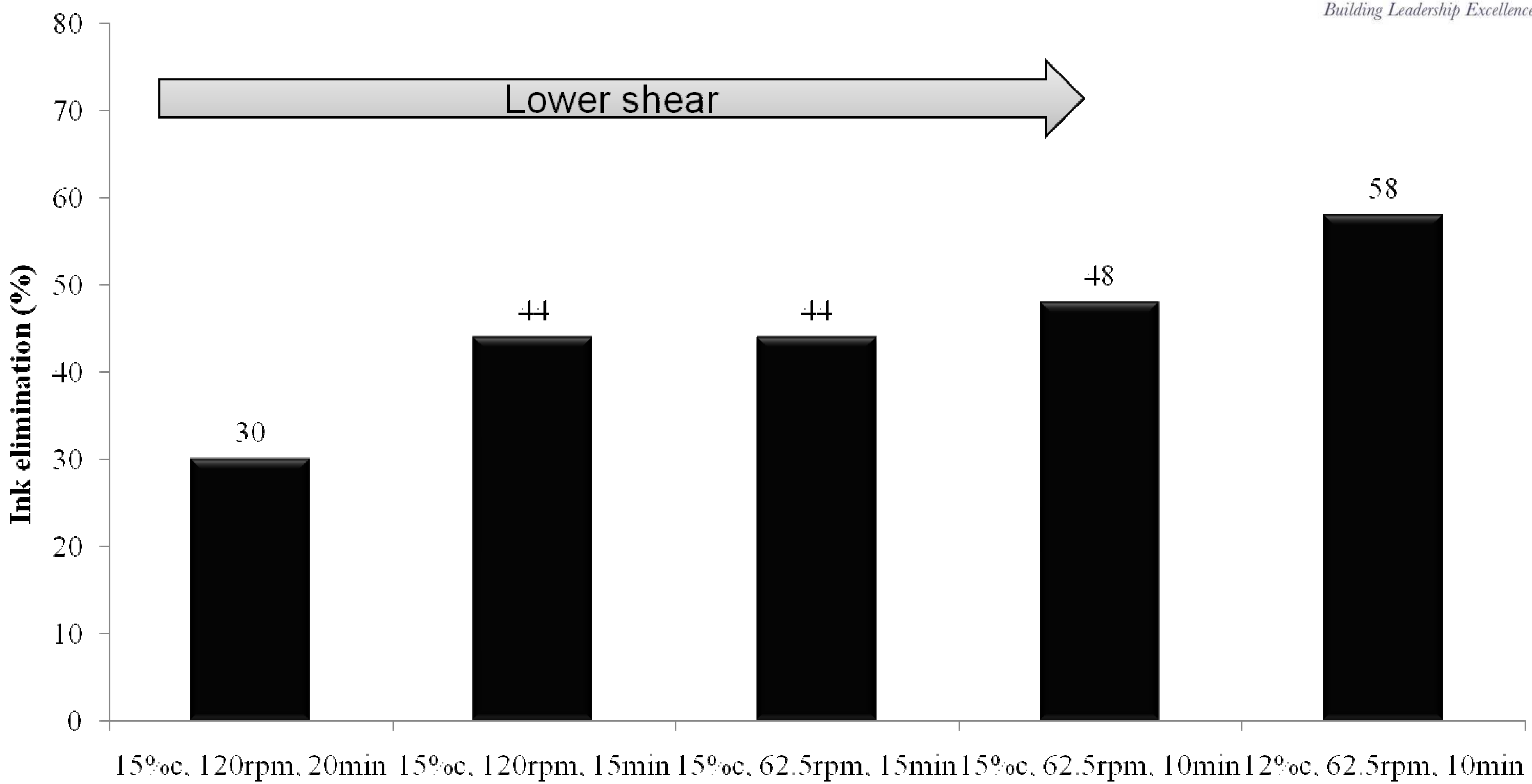
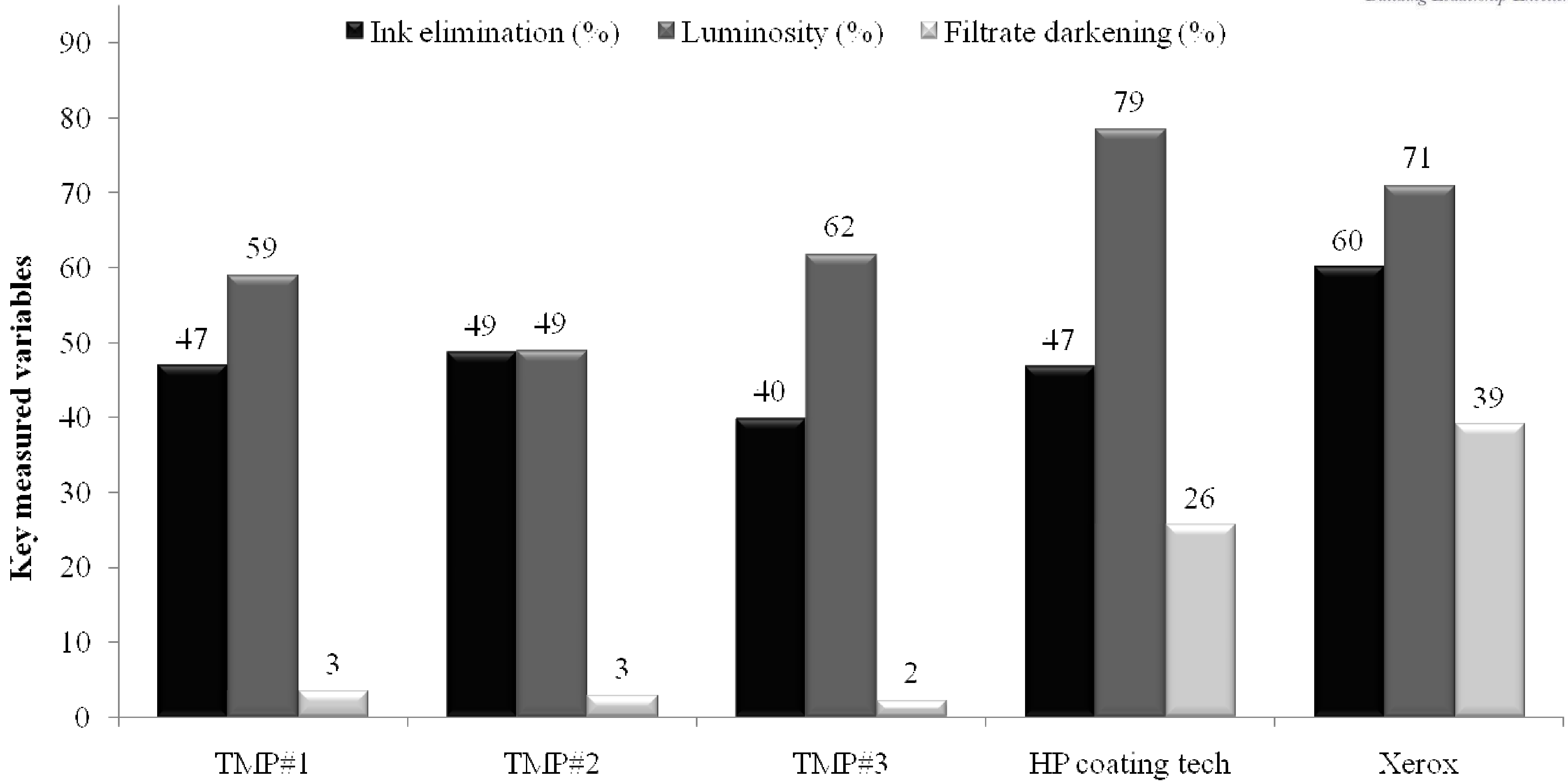


Fig. 2: Enhanced deinkability as a function of printing media

HP black pigmented ink deinked using MM1 conditions



INDIGO LEP DEINKABILITY STUDIES

Deinking studies carried out at WMU

Results for 2 different experimental conditions

1. Pilot scale simulation of standard New Page recycling process
2. Pilot scale study using HP Labs HPES conditions
    - combination of collectors

Fig. 3: Dirt count as a function of flotation process stage

Process Conditions→ Pilot scale simulation of New Page conditions using 5% HP ElectroInk 4.0

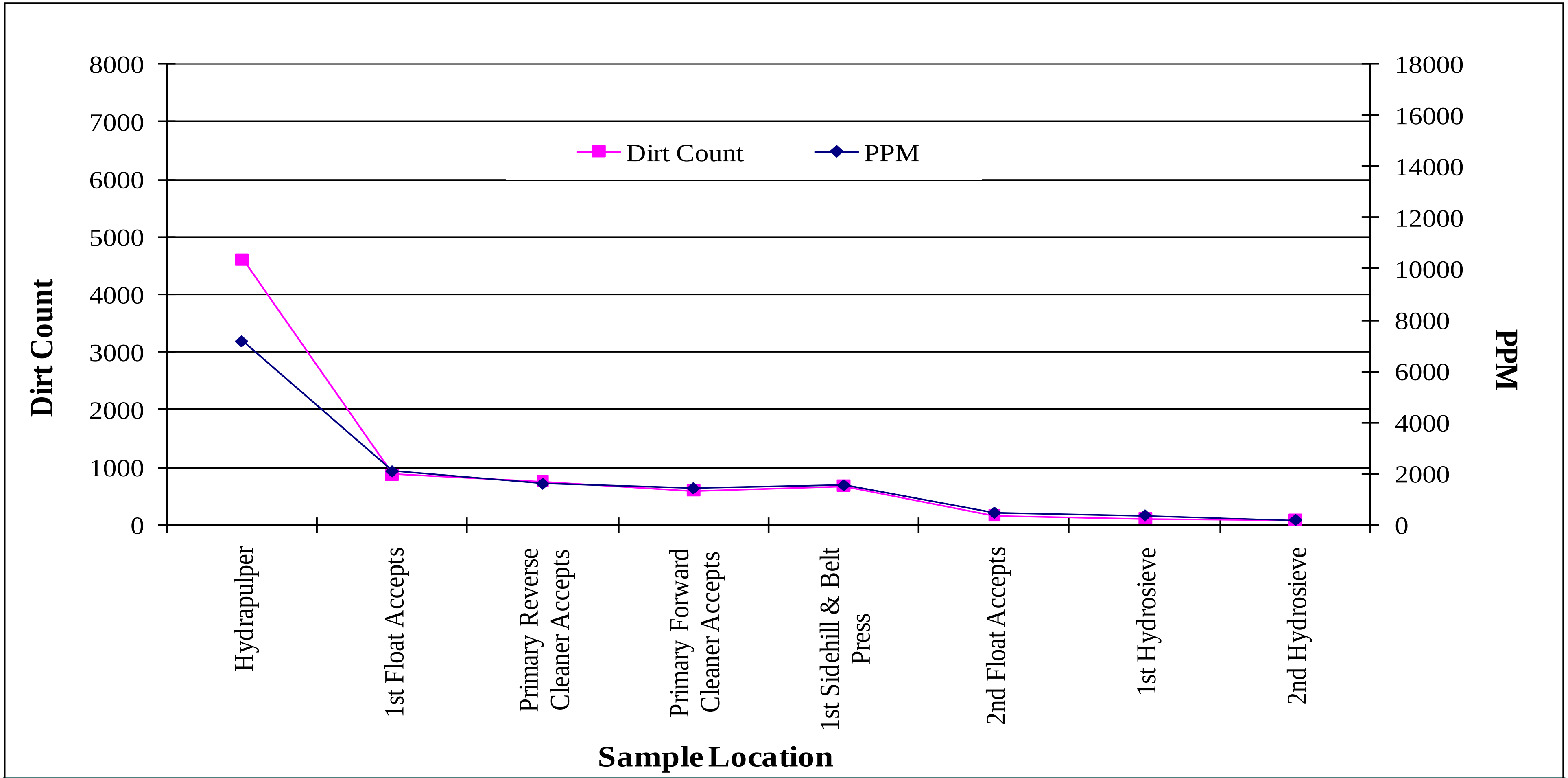
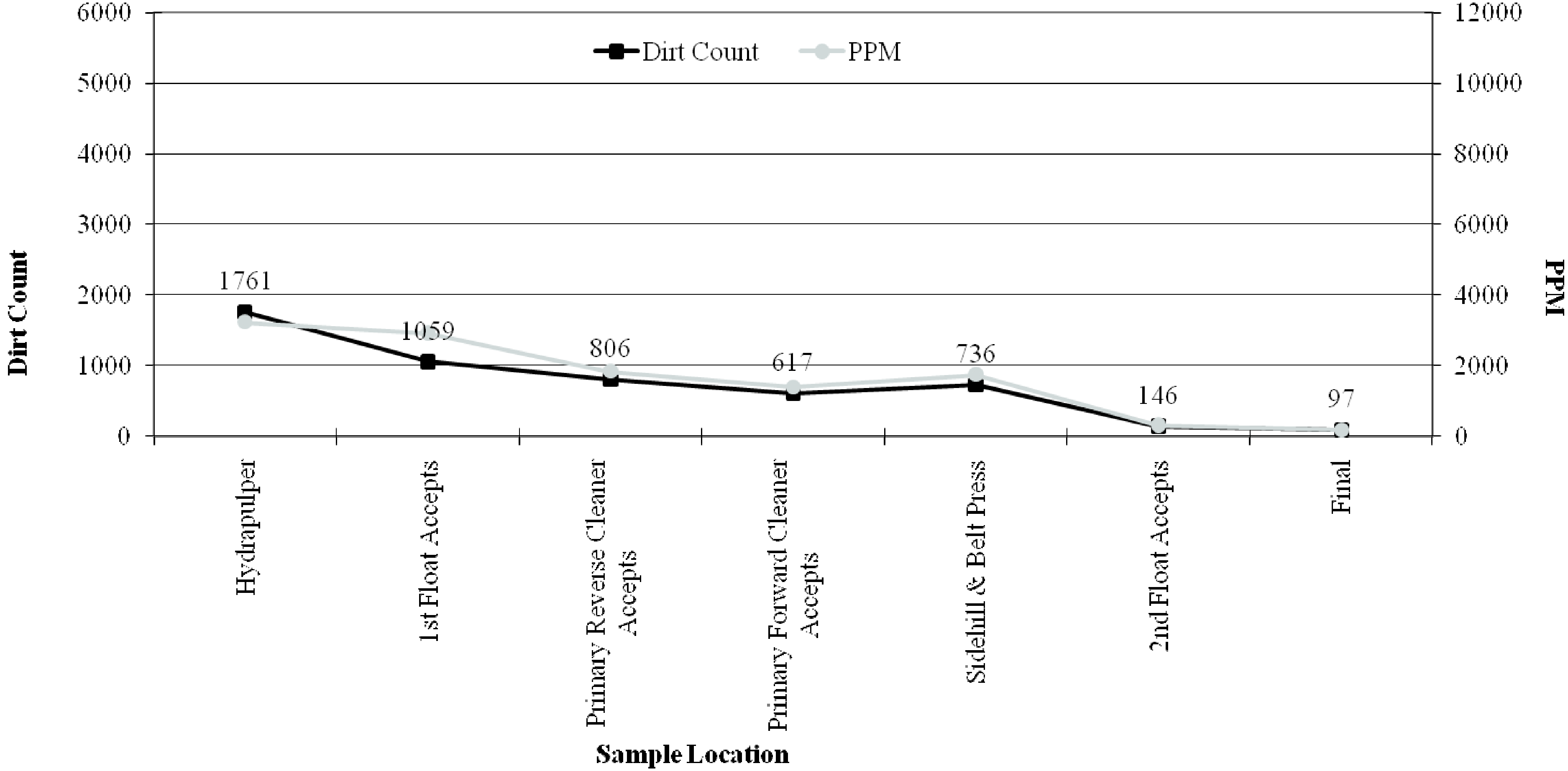
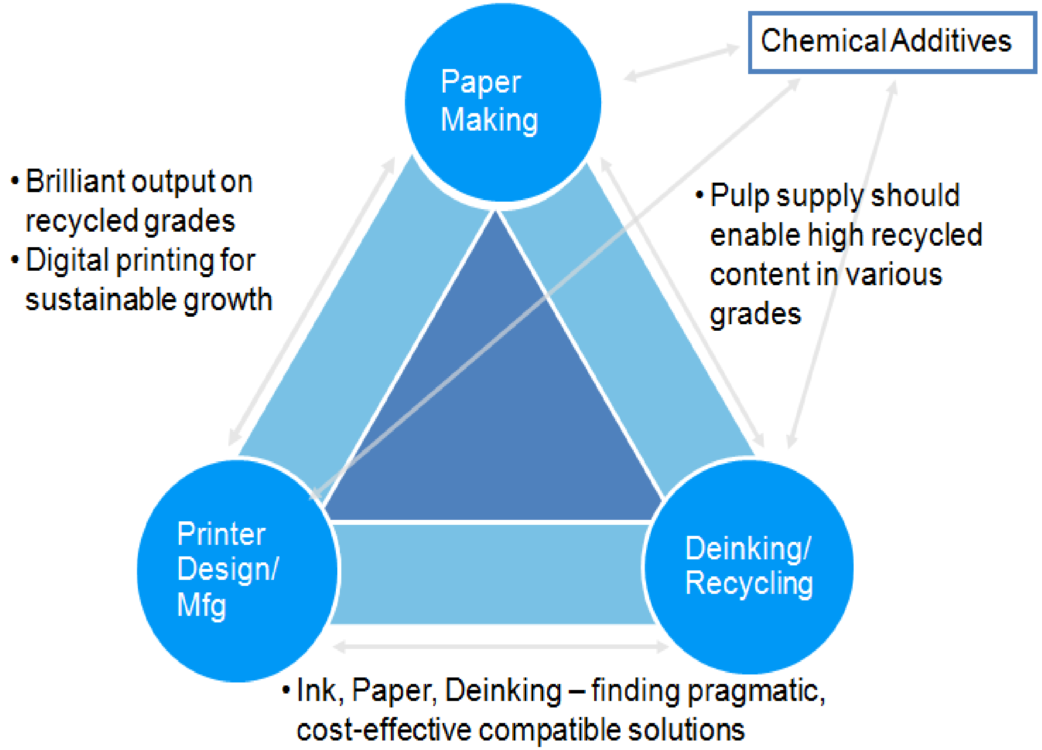


Fig. 4: Dirt count as a function of flotation process stage

Process conditions → Pilot scale HPES conditions using 20% ElectroInk 4.0



Digital printing
Conclusions and path forward



- Data collected at independent labs using commonly available deinking conditions show that LEP and Inkjet inks are deinkable
- Finding an optimum deinking solution requires collaboration
  - Inter-industry cooperation will be key

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Winder Safety Upgrades
Risk Assessment and Solutions

Winder related safety strategies developed by assessing risks and determining the effective solutions - Safety is extremely important on winders do to winder operation being stop and go with the winder operators routinely performing on-machine tasks.

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Risk Assessment – Corrective Actions Form

Risk Assessment - Corrective Actions						
Winder Number:						
Date:						
Assessment Team:						
Operator Task (Interface w/ Winder)	Hazards	Frequency of Exposure	Probability of Injury	Severity of Injury	TOTAL	Remedies
		(1 to 4 - 4 being worst)	(1 to 6 - 6 being worst)	(1 to 10 - 10 being worst)		
Threading						
Slitter Positioning						
Lower Rider Roll						
Core Loading						
Front Drum Splicing						
Cut off Knife Broke Removal						
Eject Roll Set						

Risk Assessment – Corrective Actions Form Completed

Risk Assessment - Corrective Actions

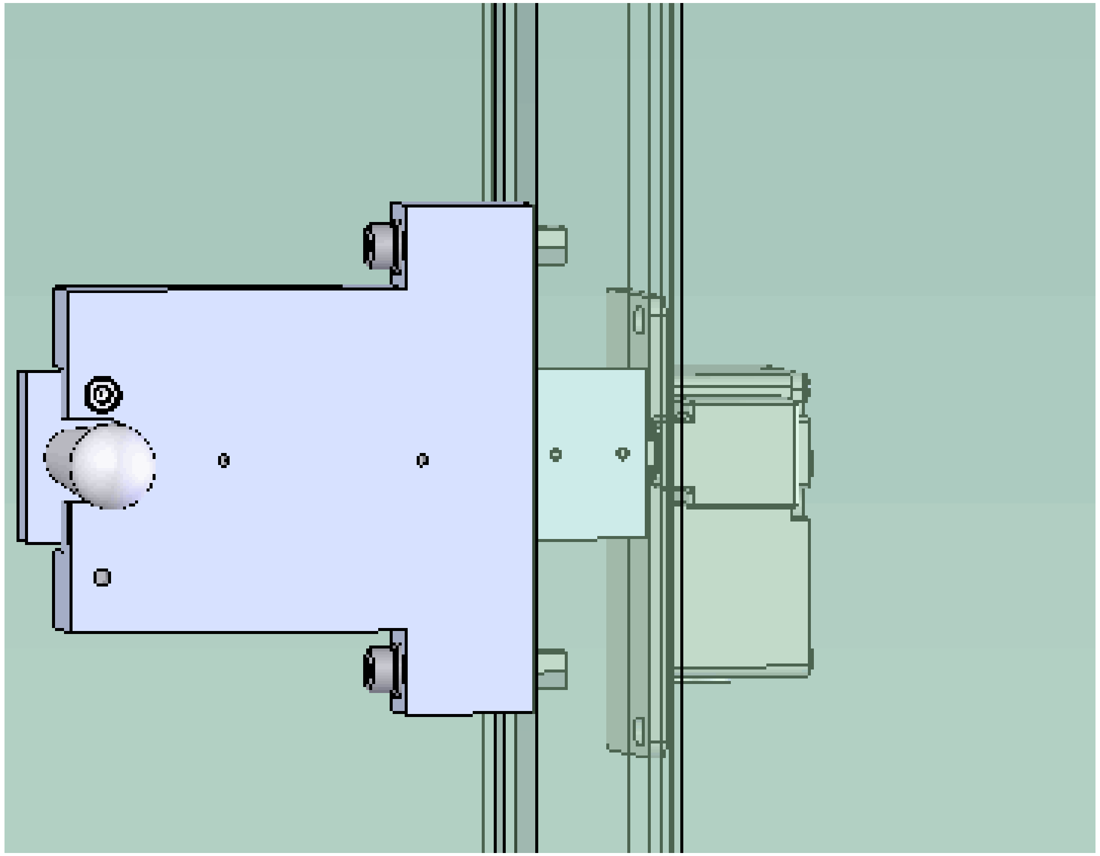
Winder Number: 1

Date:

Assessment Team: Sam Jones, Nelson Parker, Fred Hope, Jimmy Johns, Jane Lander, Travis Williams

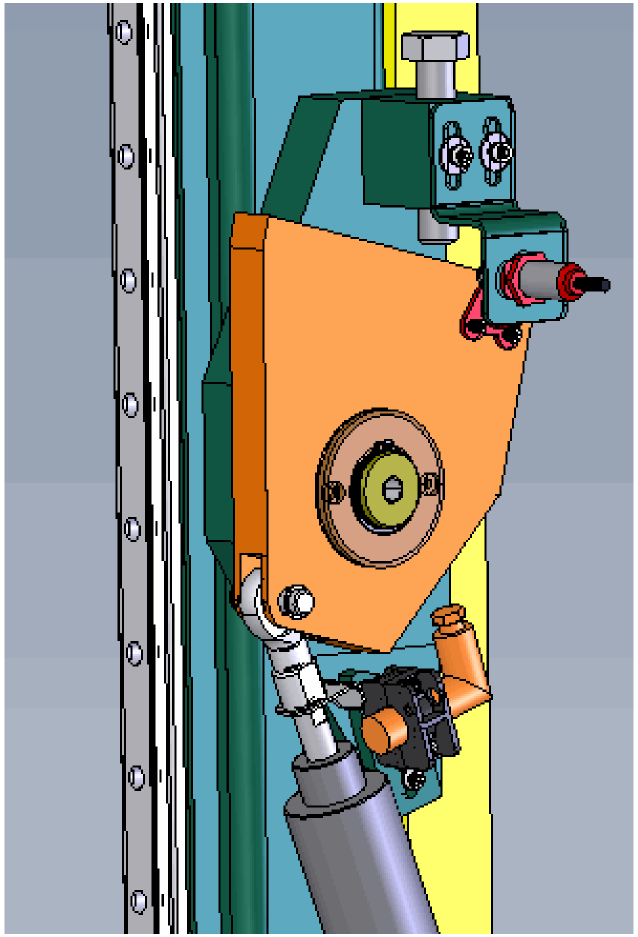
Operator Task (Interface w/ Winder)	Hazards	Frequency of Exposure	Probability of Injury	Severity of Injury	TOTAL	Remedies
		(1 to 4 - 4 being worst)	(1 to 6 - 6 being worst)	(1 to 10 - 10 being worst)		
Threading	Poor ergonomics cauused by hand threading	3	2	4	9	Add automatic threading system
Slitter Positioning	Slitter knifes and pinch points	4	5	3	12	Require gloves / Add knife guards to knife holders
Lower Rider Roll	Chains could break Rider Roll could fall	2	1	10	13	Add Rider Roll safety latches
Core Loading	Pinch point between lowering cradle and drum guard	4	1	10	15	Add automatic core loading system
Front Drum Splicing	In going nip Between roll set and front drum	2	1	10	13	Add splicing nip guard and sensors
Cut off Knife Broke Removal	Pinch point between Knife and Rear Drum	1	1	10	12	Procedure change require lock out before accessing winder pit
Eject Roll Set	Struck by rolling roll set	4	2	10	16	Restrict personel access to winder deck

Sliding Lock Mechanism



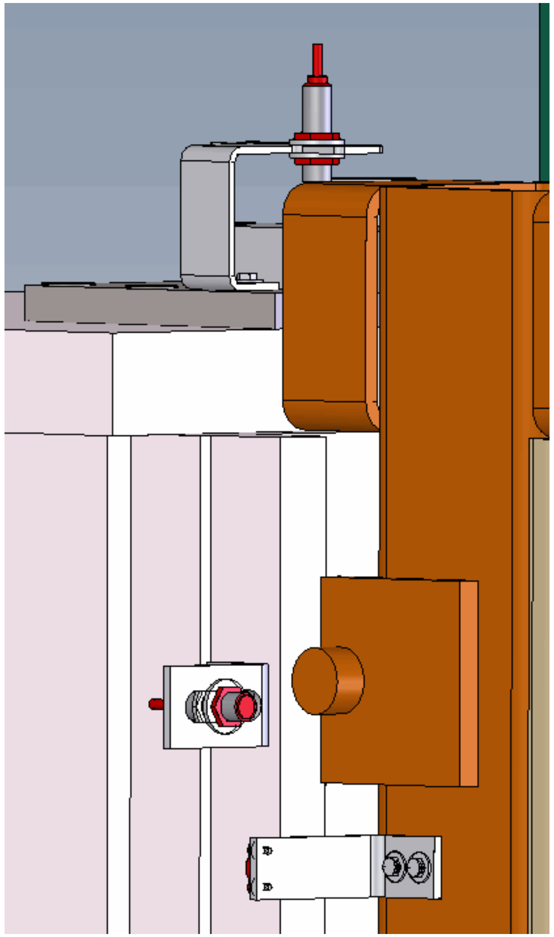
Sliding the handle forward mates the locking key with the Safety Interlocking Control Switch. (on the gate)

The Slitter Raised Locking Mechanism



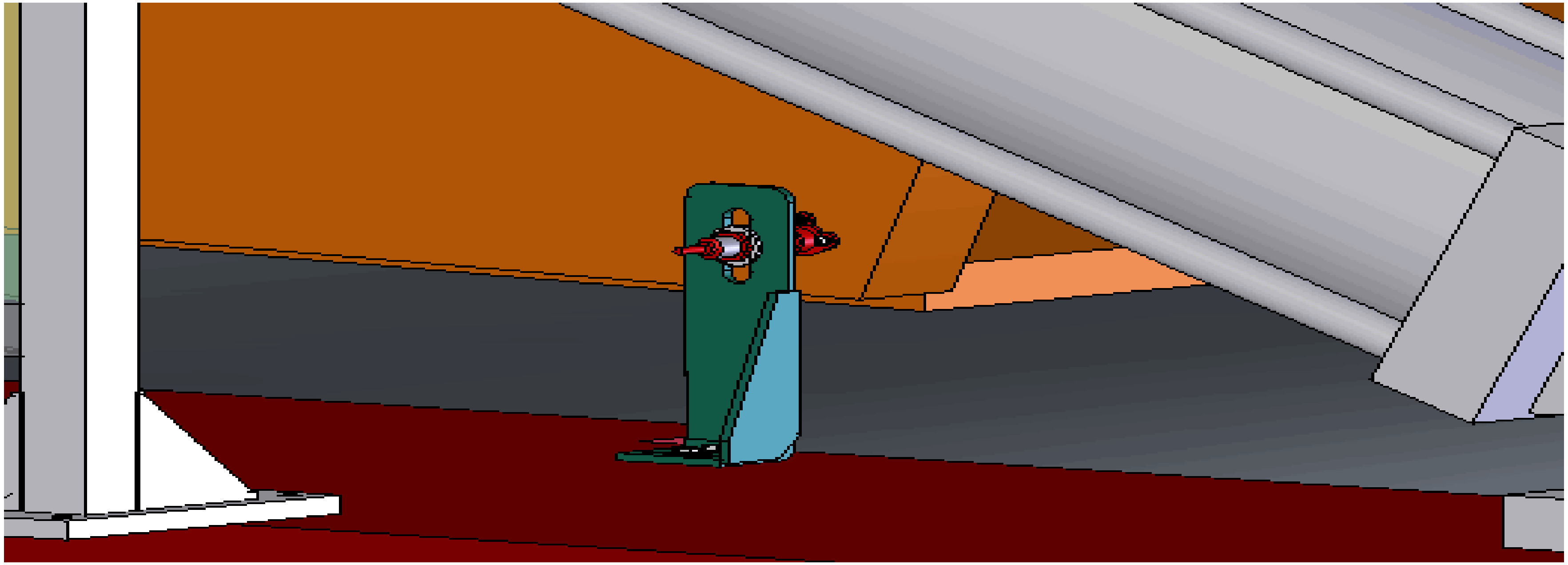
- Locked sensor
- With safety sensor for locked position indication and standard proximity switch for latches released indication.
- Note: There are 2 locking mechanisms; (1) located on each side of the barrier.

The Safety Nip Barrier Locking Mechanism



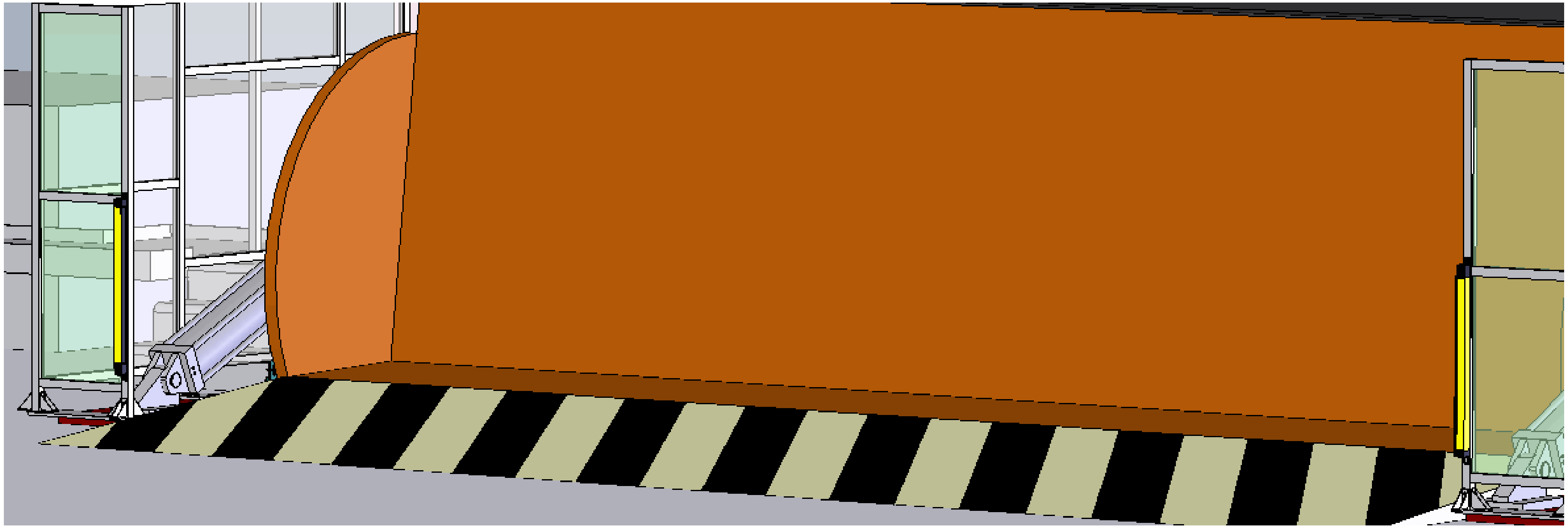
- Safety sensor for locked and raised position indication
- Note: There are 2 locking mechanisms, (1) located on each side of the barrier.

Cradle Sensor For Lowered Position Indication



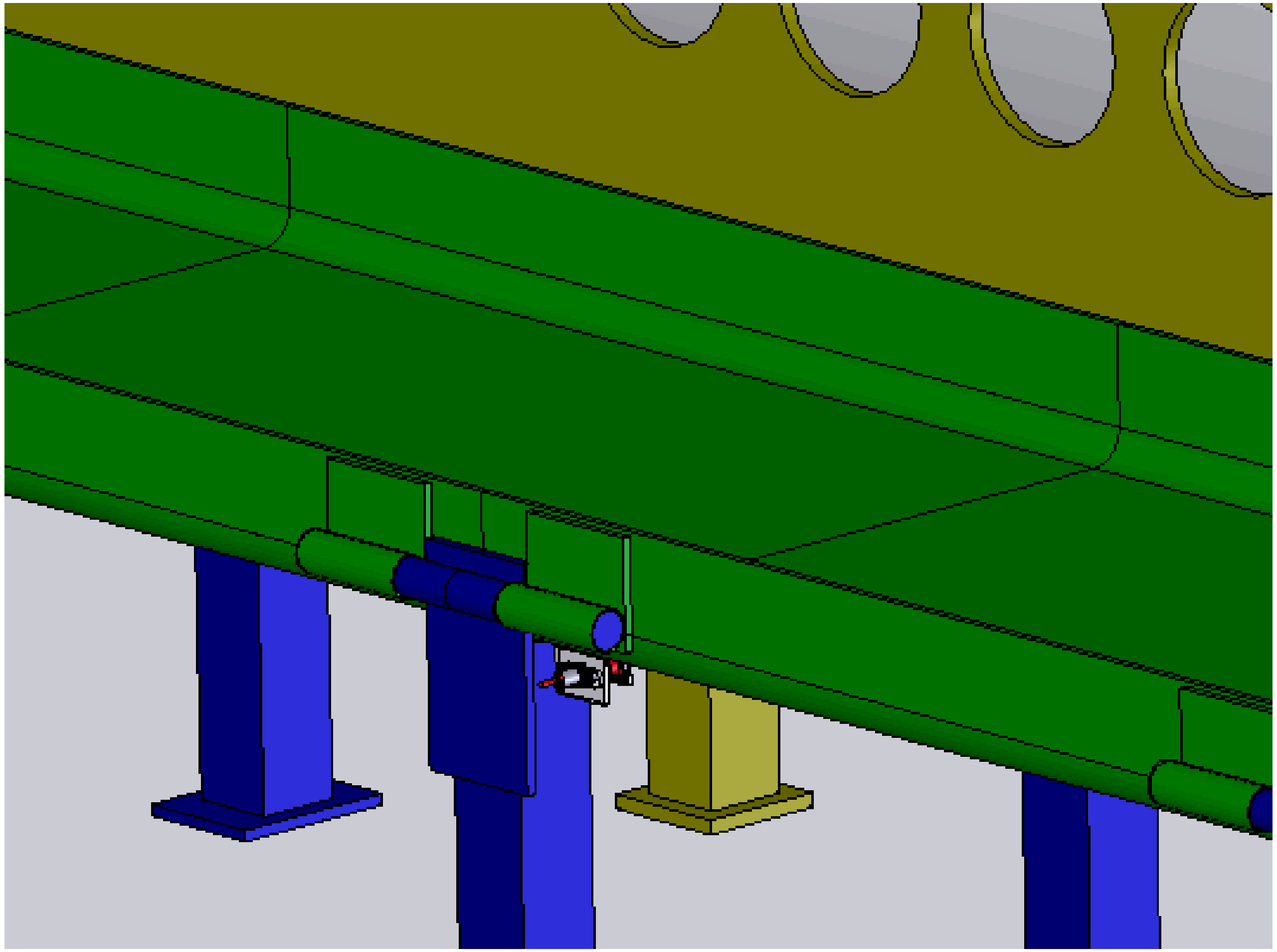
Safety sensor indicates that the cradle is in the lowered position when the sensor detects the lowered cradle

Cradle Discharge Area Light Curtains



Set of Light Curtains (ahead of the Cradle discharge area) are wired Safety Control Relay

Knife Access Deck Cover Sensor



One (1) for each individual deck plate for indication that area is closed off

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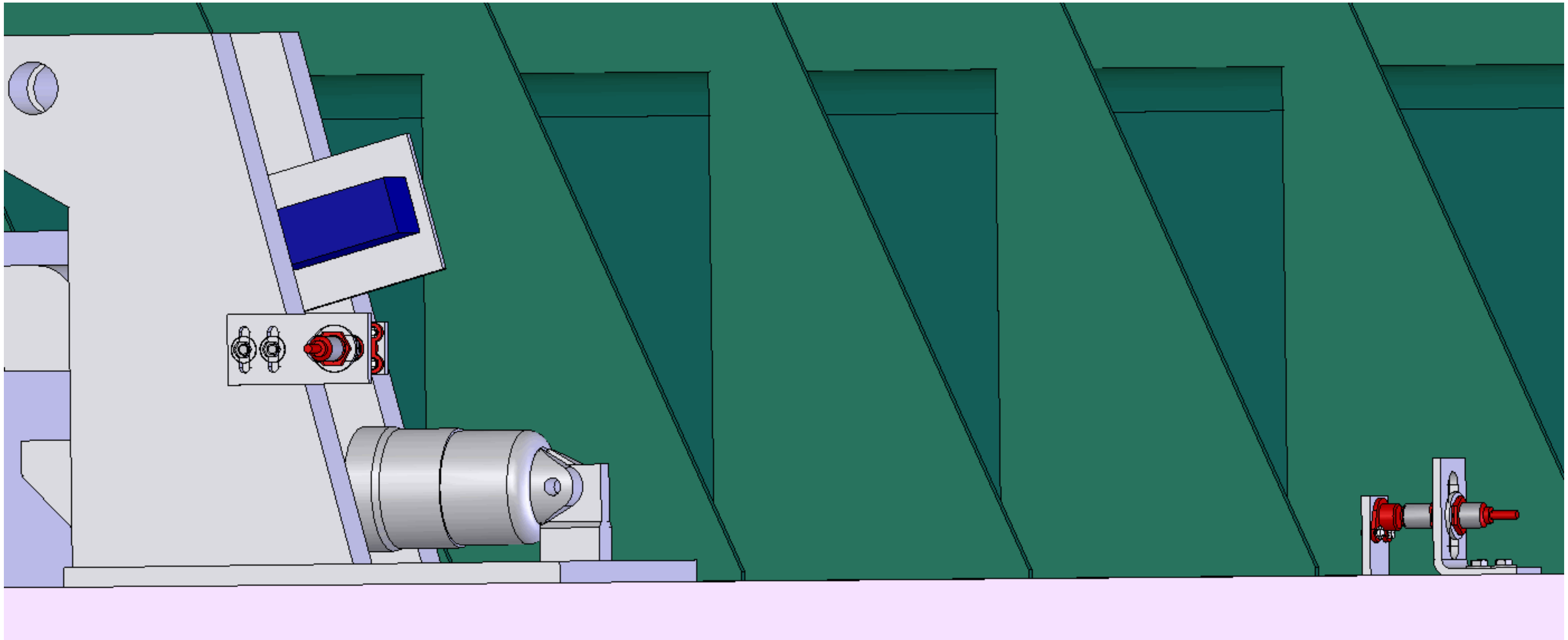
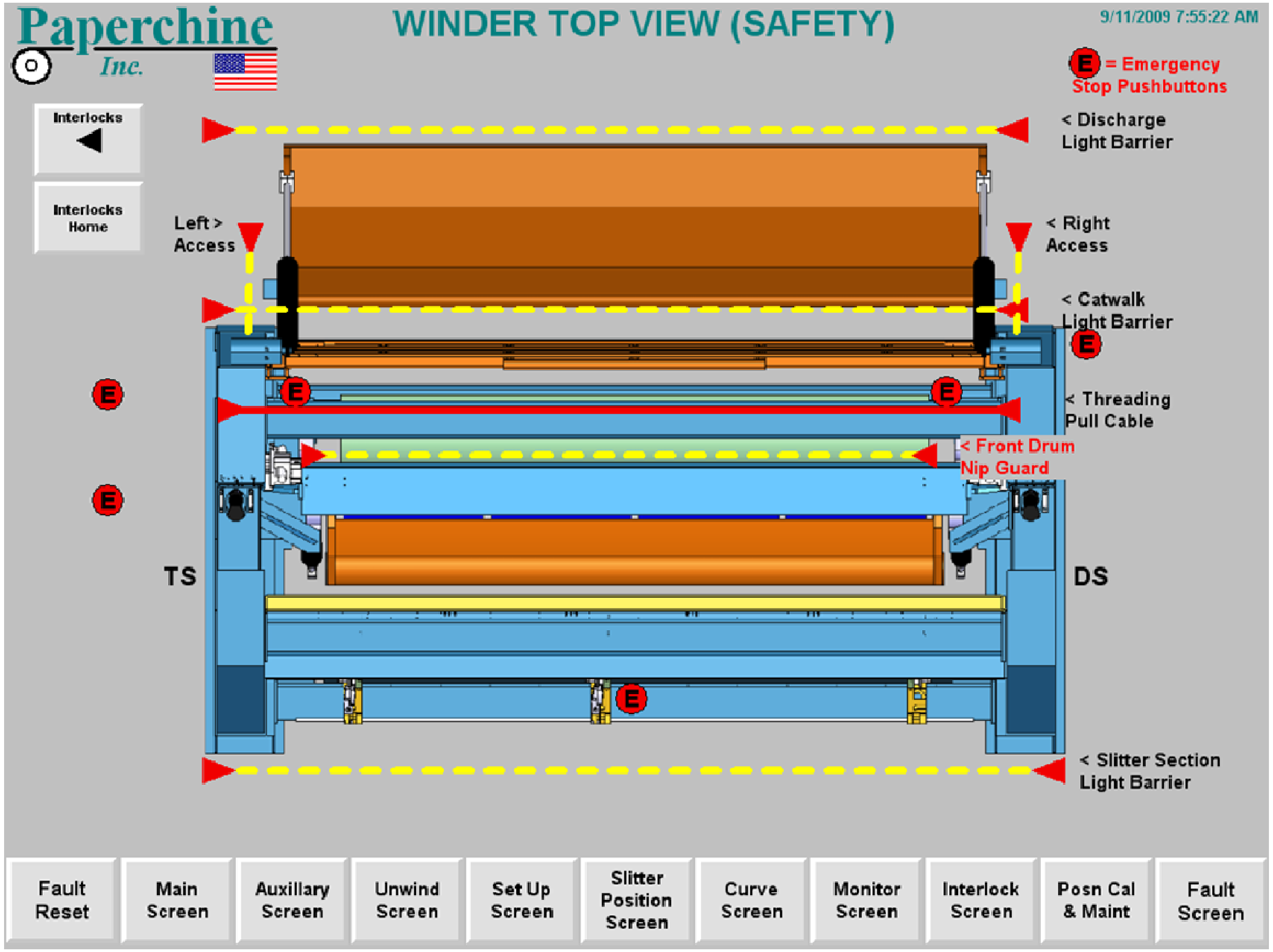
Rider Roll Locking Mechanism



Sensor for Raised and Locked position indication

Typical Winder Safety Screen



- Top View of Winder
- All Safety device locations shown

Winder Safety Upgrades
Risk Assessment and Solutions

Thank You

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INCIDENT INVESTIGATION

"Root Cause Failure Analysis"

Greg. Bates - Six Sigma Master Black Belt - DuPont Soy Polymers/Solae

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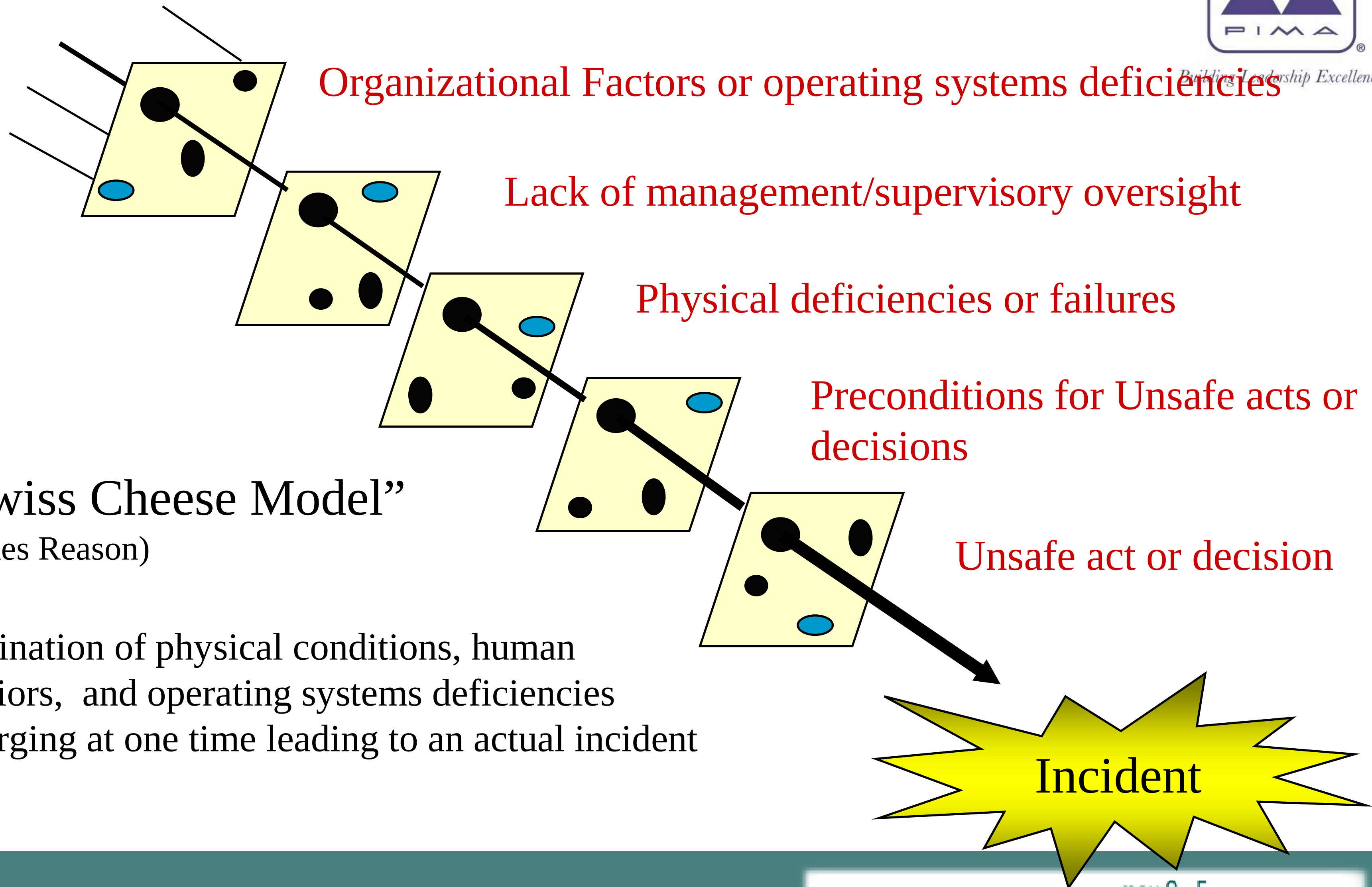
An Incident in the Making……..



"Swiss Cheese Model"
(James Reason)

Combination of physical conditions, human behaviors, and operating systems deficiencies converging at one time leading to an actual incident

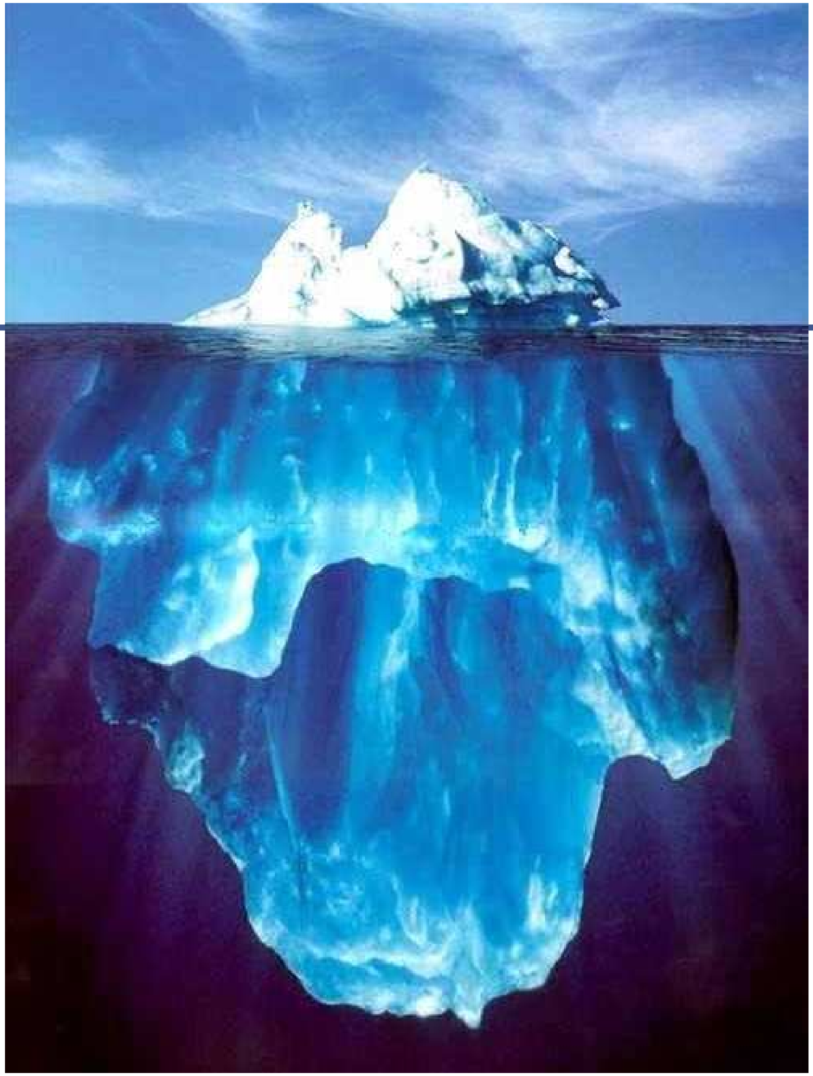
The Incident Investigation Process

1. Make initial response.
2. Form investigation team.
3. Determine the facts.
4. Determine the key factors.
5. Determine systems to be strengthened.
6. Recommend corrective and preventive actions.
7. Document, score and communicate the findings.
8. Follow up.

Discussion Here Will Focus on Steps 4, 5 and 6

Iceberg

Incidents



Key Factors

Physical
Human
Operating Systems

What is a Key Factor?

- Circumstances that contributed to or may be reasonably believed to have contributed to the incident's occurrence even though a clear causal connection may not be found. These circumstances include *human, equipment and/or operating/managing systems* that are found to be deficient or otherwise capable of being improved

Examples of Managing Systems

- Safety Meetings
- Safety Orientations
- Safety Practices
- Safety Procedures
  - Lock Tag & Try
  - Line Breaks
  - PPE
  - Confined Space
- Work Permits
- Process Hazards Analysis
- Quality Assurance
- Pre-Startup Safety Reviews
- Procedures
  - Operations
  - Maintenance
- Training
  - Basic Skills
  - Specific Skills
  - Progression
  - Refresher
- Incident Investigations
- Equipment Inspections & Test
- Emergency Plans & Drills
- Audits
- Employee participation
- Discipline

Incident Investigation Team Members are important!

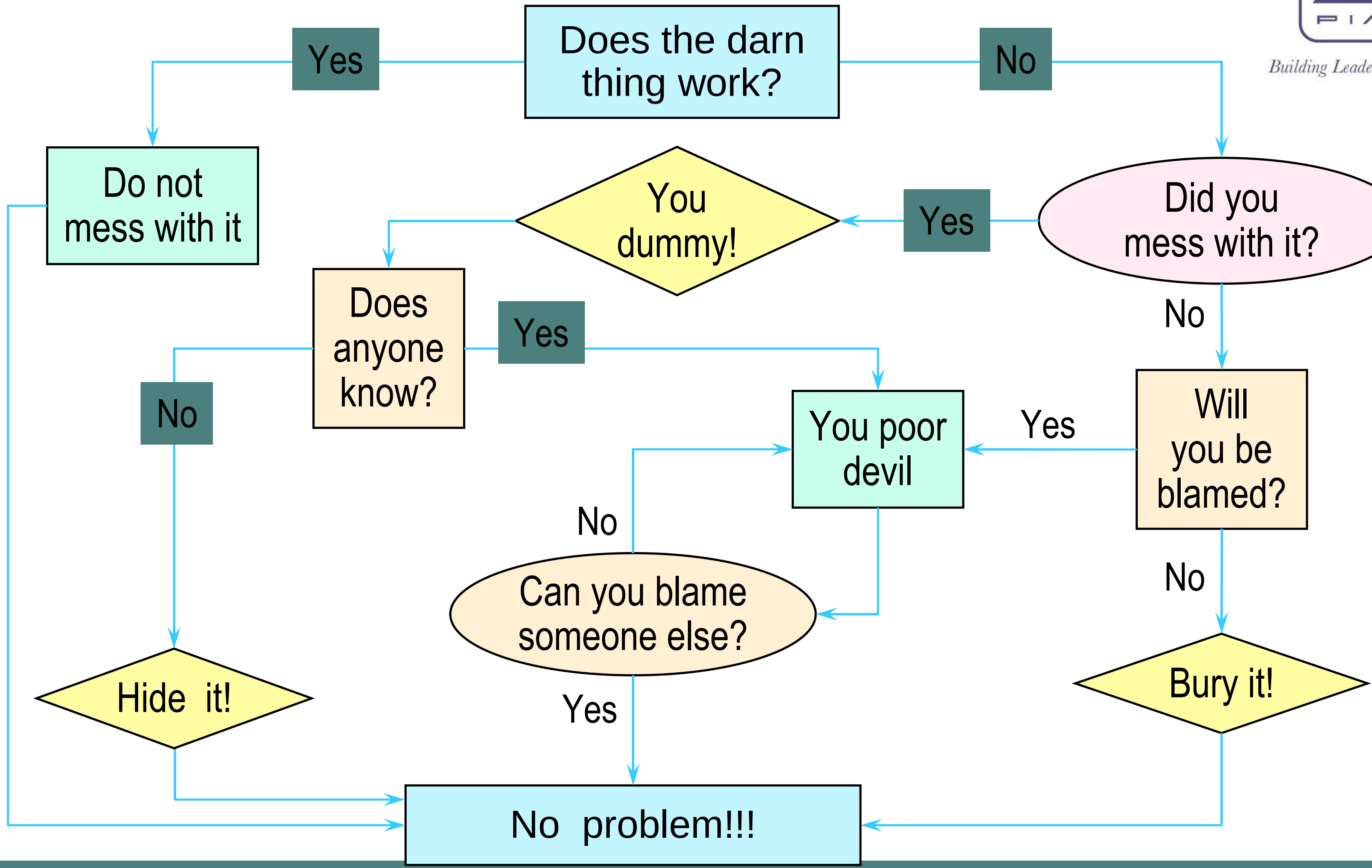
- Managers/supervisors
- S&OH Personnel
- PSM Specialists
- Technicians
- Engineers
- Technical Specialists
- Operation/maintenance personnel
- Contractor Personnel

Root Cause Failure Analysis

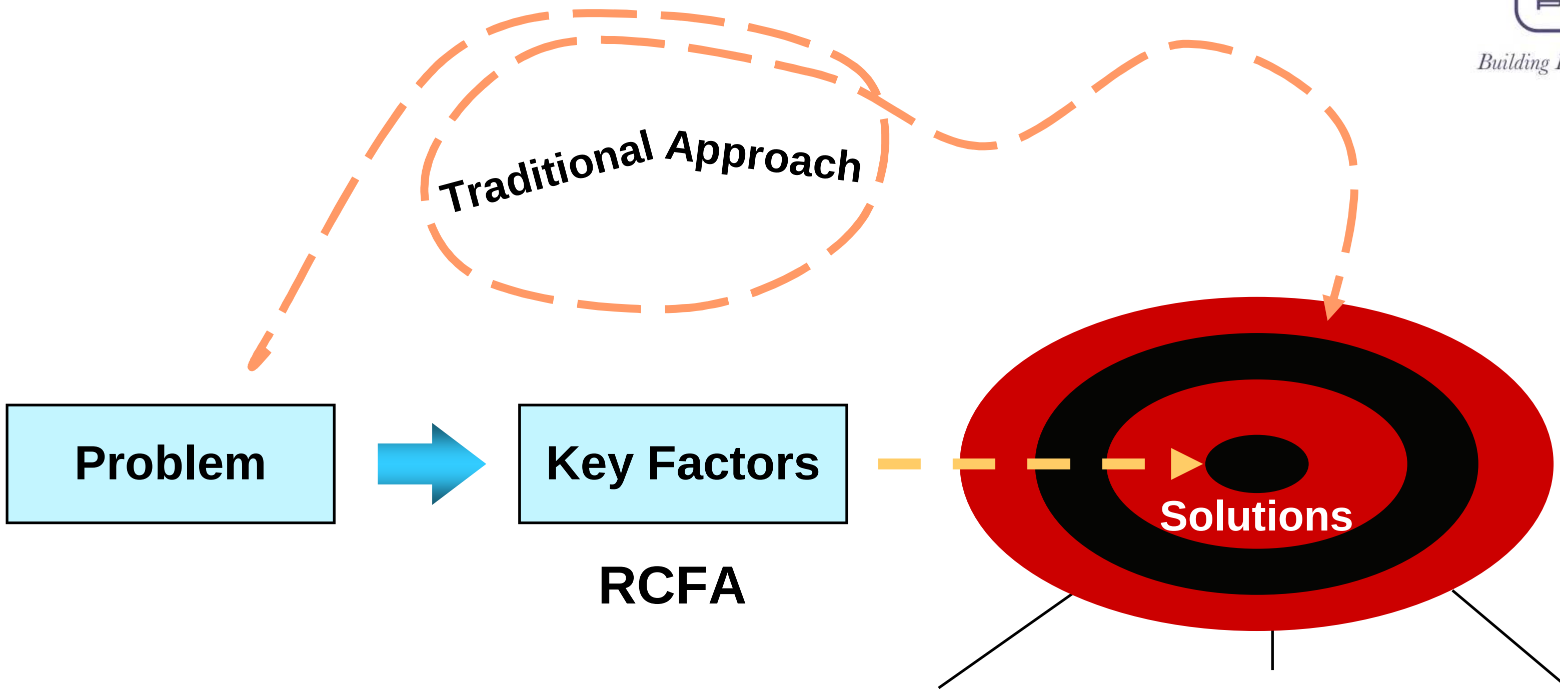
- RCFA is a *systematic approach* to *identify and eliminate* the *failures* that prevent a *business* from achieving its goals (e.g. 100% uptime, zero injuries, meeting cost objectives, etc).

- The RCFA process identifies the causes of failures **(key factors)** at the *equipment, human, and systems levels* and puts In place *corrective measures* to eliminate them resulting in improved, sustainable performance.

Traditional Problem Solving Process



Traditional Problem Solving vs. RCFA



Key Factors Improve Your Aim & Get You Closer To Solutions Than Shoot-From-The-Hip Guessing

RCFA Principles

- Failures typically involve **physical, human** and **systems** components.
- Failures, like weeds, can be stopped by eliminating the **ROOTS**.
- Failure Roots, **like weed roots**, are always part of a system.
- If you area dealing with the **physical effect** of the failures only, ***you have probably not found the KEY FACTOR(S***).
- If you are dealing with the **human error**, the effect you see is "**blaming**" someone for their actions and you have probably still not found the KEY FACTOR(S).
- If you are dealing with the **operating systems** that enabled the failure to occur, **you are likely at the underlying KEY FACTOR(S**).

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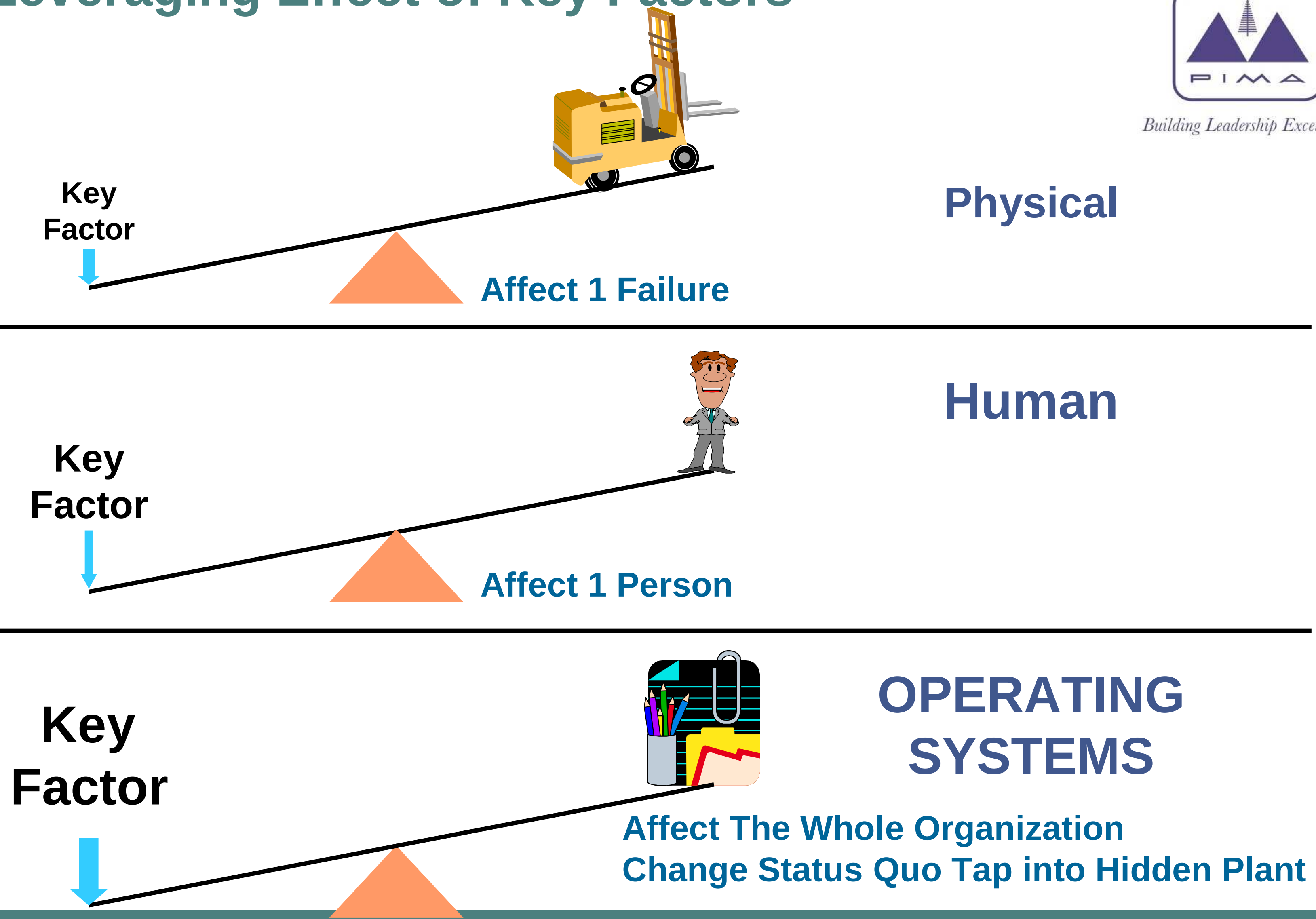
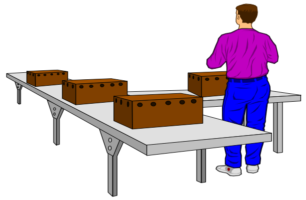
The Leveraging Effect of Key Factors

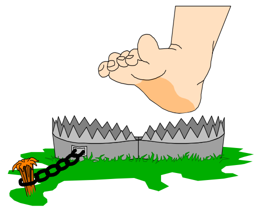


What's a WHY Tree?

- A WHY Tree is a systematic, disciplined approach used in RCFA to uncover **Key Factors** through the identification of:

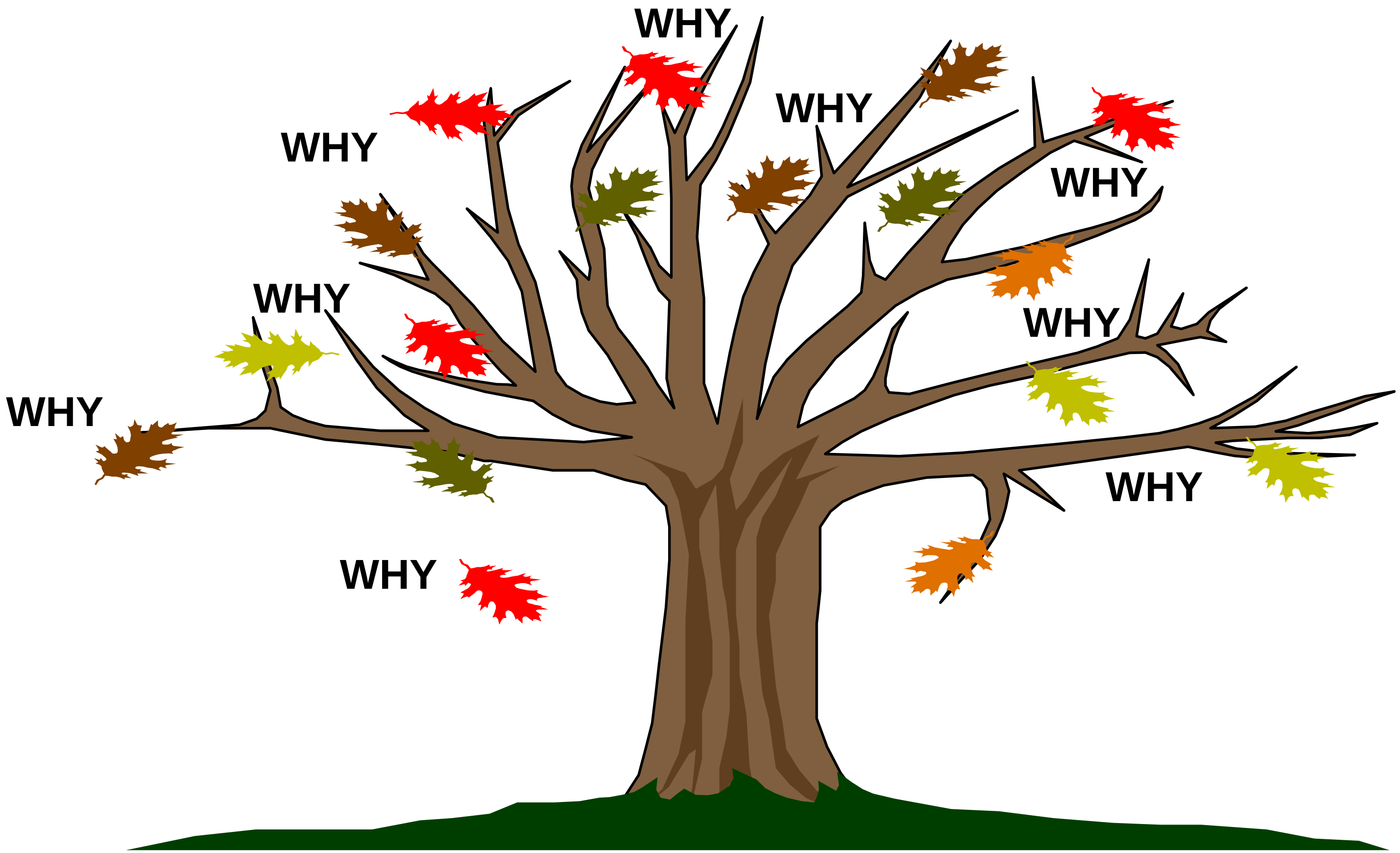
  - A **physical cause** which usually becomes apparent through observations - hardware, machines, vessels, etc
  - Some **human cause**: Acting inappropriately or failing to act, intentional and unintentional behavior, mistakes, lack of awareness, not knowing, etc.
  - Some **system cause**: Communications, procedures, training, documentation, policies, standards of performance, etc.





WHY Tree

It's called a "WHY" tree because we keep asking "WHY?" to get to the key factors. It's also useful to ask "How can?"

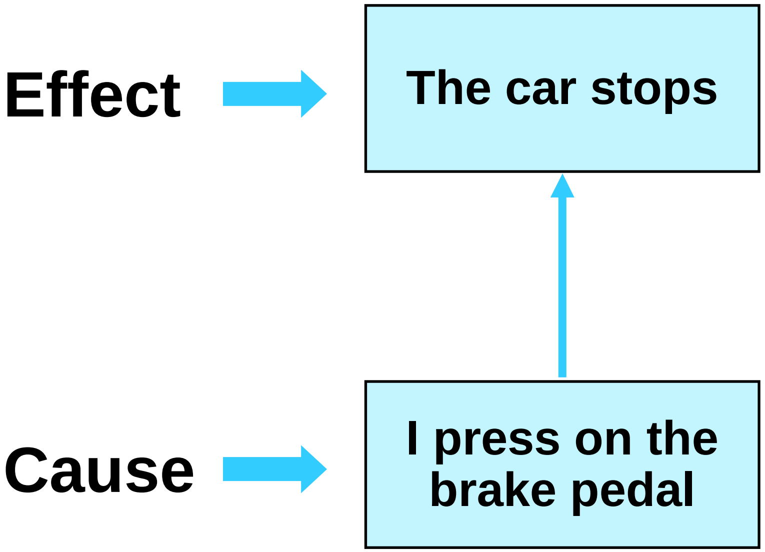


Cause and Effect in WHY Trees

- We apply cause and effect logic in WHY Trees by starting with the effect and asking the question, “Why did it happen?” to arrive at the cause.
- *Why*…(Effect)...*because*...(cause).
- To test your logic read it back as...
  If (effect)… *then* (cause), to see if it makes sense.
- We continue the WHY Tree by making our new cause an effect and asking why again.

Cause and Effect

- WHY Trees use the simple but powerful logic of Cause and Effect:



If I press on the brake pedal *then* the car stops…..

Or to put it another way…

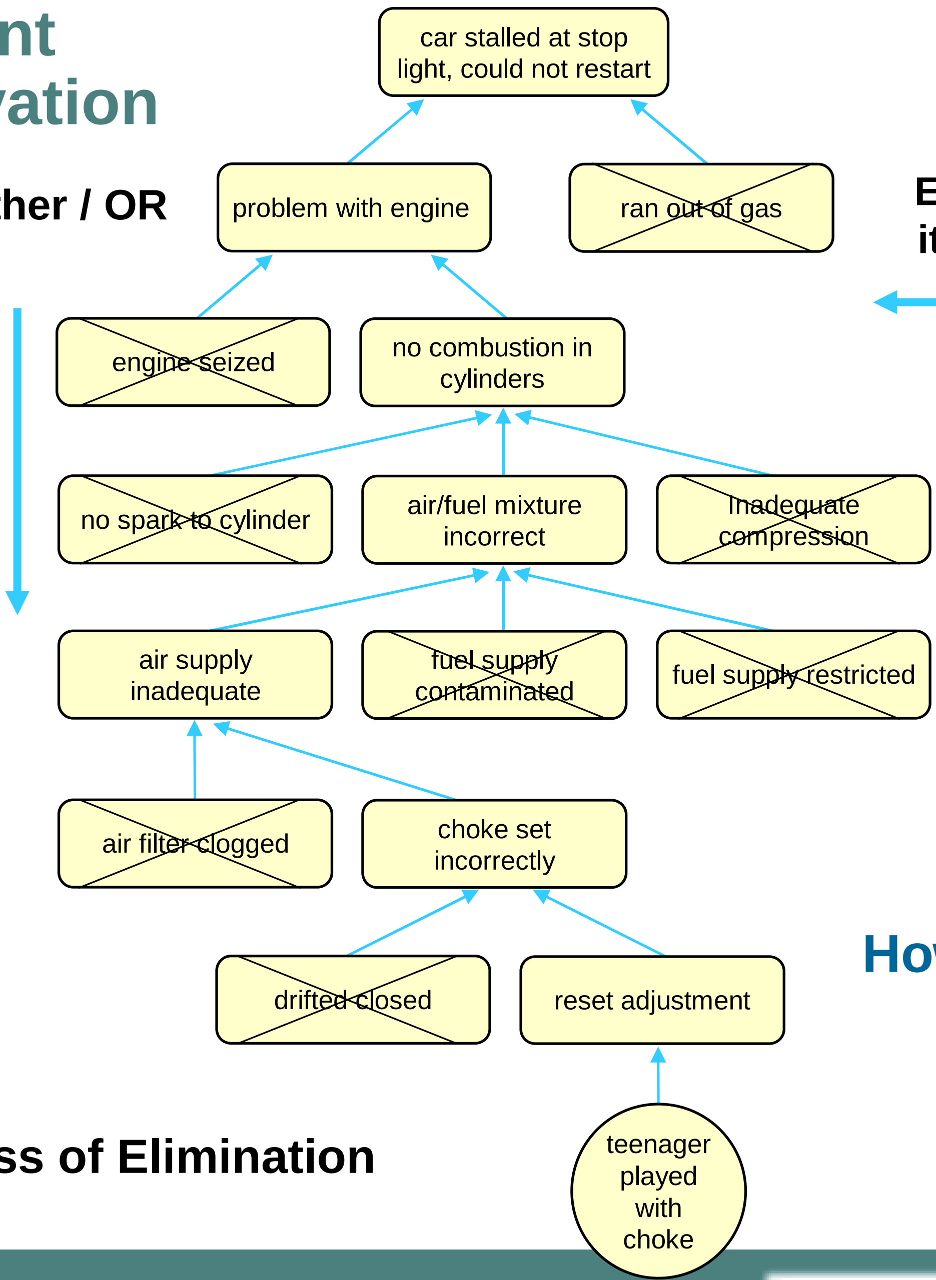
Why did the car stop?
Because I pressed on the brake

Failure Event and Observation

Either / OR

WHY

Everything it could be



How Do We Use WHY Trees?

Use the Process of Elimination

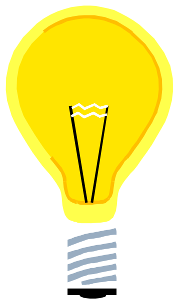
Observation

- Evidence (facts) gathered by the senses at the time or moment of failure and then later by examining the failed part(s).
- What did you hear, feel, see or smell when it failed?

- In the WHY Tree, start with an Observation that is "physical or tangible", not something pertaining to a person's actions or a system such as training, procedures, etc.

Hypothesis

- A possible cause for the event above it. A hypothesis becomes an intermediate cause or key factor once verified.
- Stating the hypotheses in broad, general terms helps insure some causes aren't overlooked or left out of consideration.
- Take small steps of logic; avoid the tendency to jump too far towards a key factor when moving down from one intermediate cause to the next group of hypotheses.
- WHY Tree Leader should write down hypotheses suggested by the team without judging their merit.



Building the "WHY" Tree

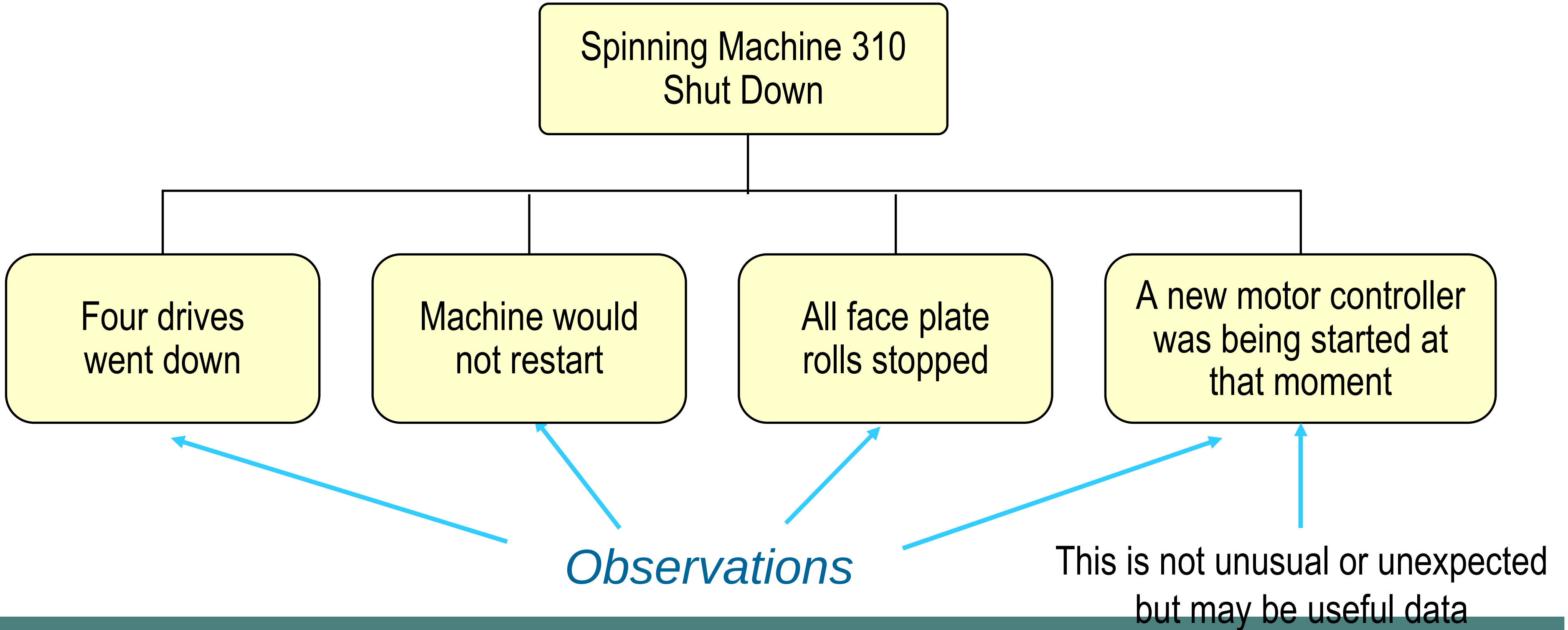
The following pages show the steps to build a WHY Tree using a real plant example.

- **Step 1.** **Define the Significant Event to Investigate**

Significant Event → Spinning Machine 310 Shut Down

Building the “WHY” Tree

- **Step 2. List the observations (facts: what was seen and heard)**
- **Step 3. Choose an observation to pursue first, based on its <u>impact</u> on the failure event or its <u>frequency</u> of occurrence.**

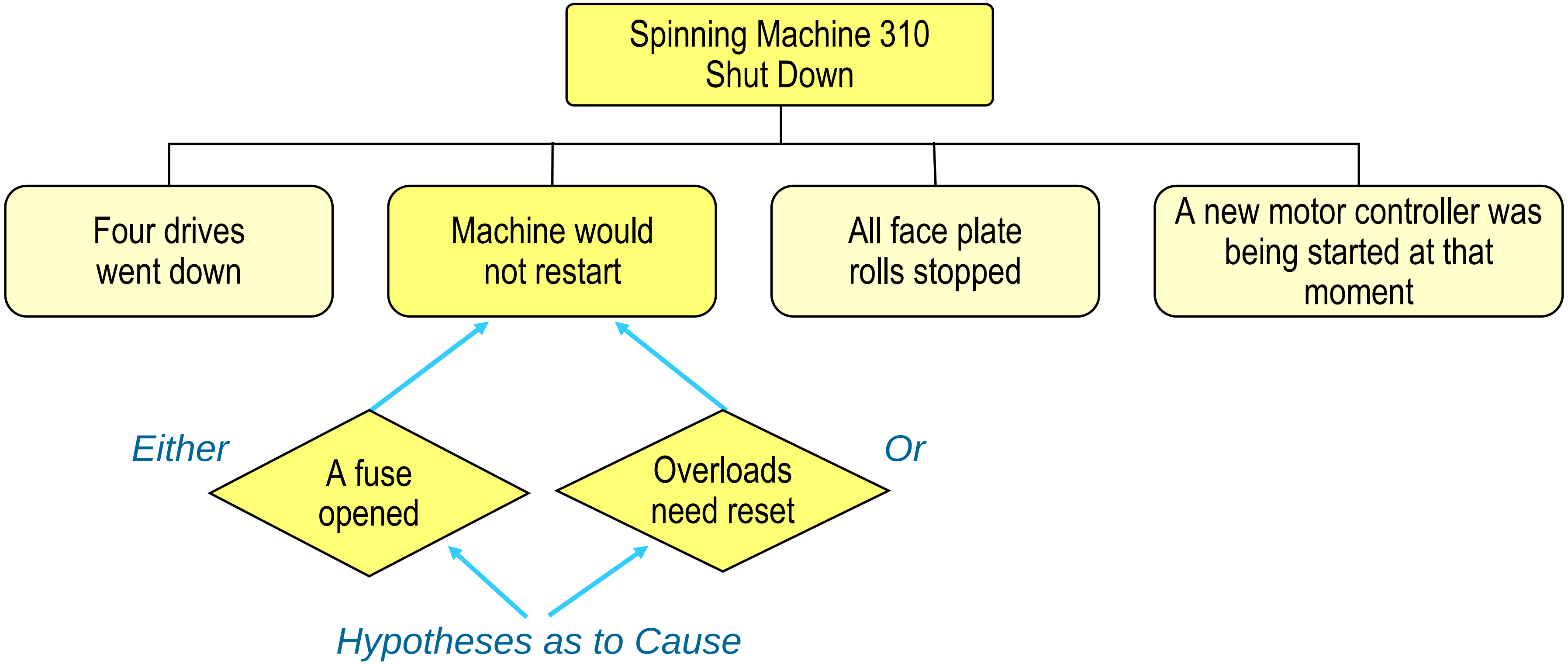


Building the "WHY" Tree

TAPPI people resources solutions
PIMA Building Leadership Excellence

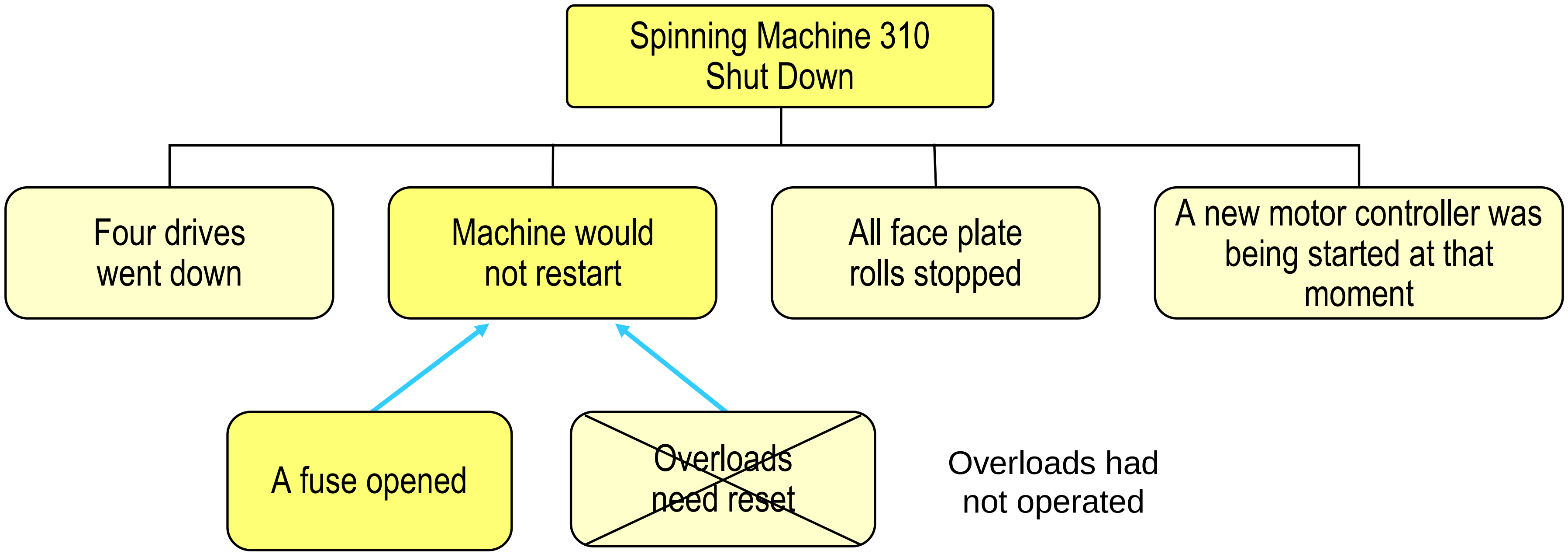
- **Step 4.** **Hypothesize causes of the observation. Ask Why or How Can the observation have happened, using the question that makes the most sense.**

  Include all reasonable possible explanations.



Building the "WHY" Tree

- **Step 5. Verify the hypotheses as true or not.**



Verification is Important

TAPPI people resources solutions

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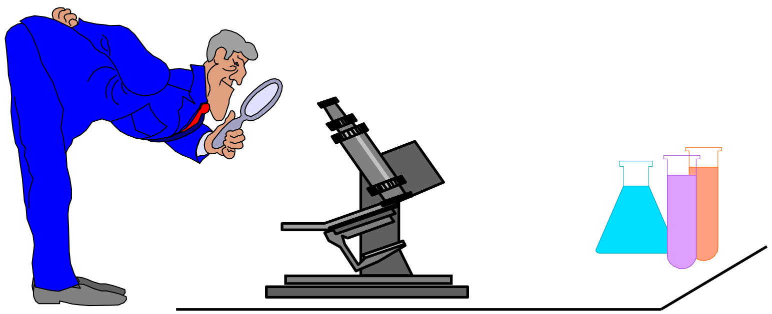
Must verify each hypothesis through:

- ***Testing*** - oil analysis, motor dynamics
- ***Measuring*** - vibration, ultrasonics, infrared
- ***Observing*** - high speed photography, video cameras
- ***Experimenting*** - statistical analysis

SHERLOCK HOLMES:

"When you have eliminated the impossible, whatever else remains, however unlikely, must be true."

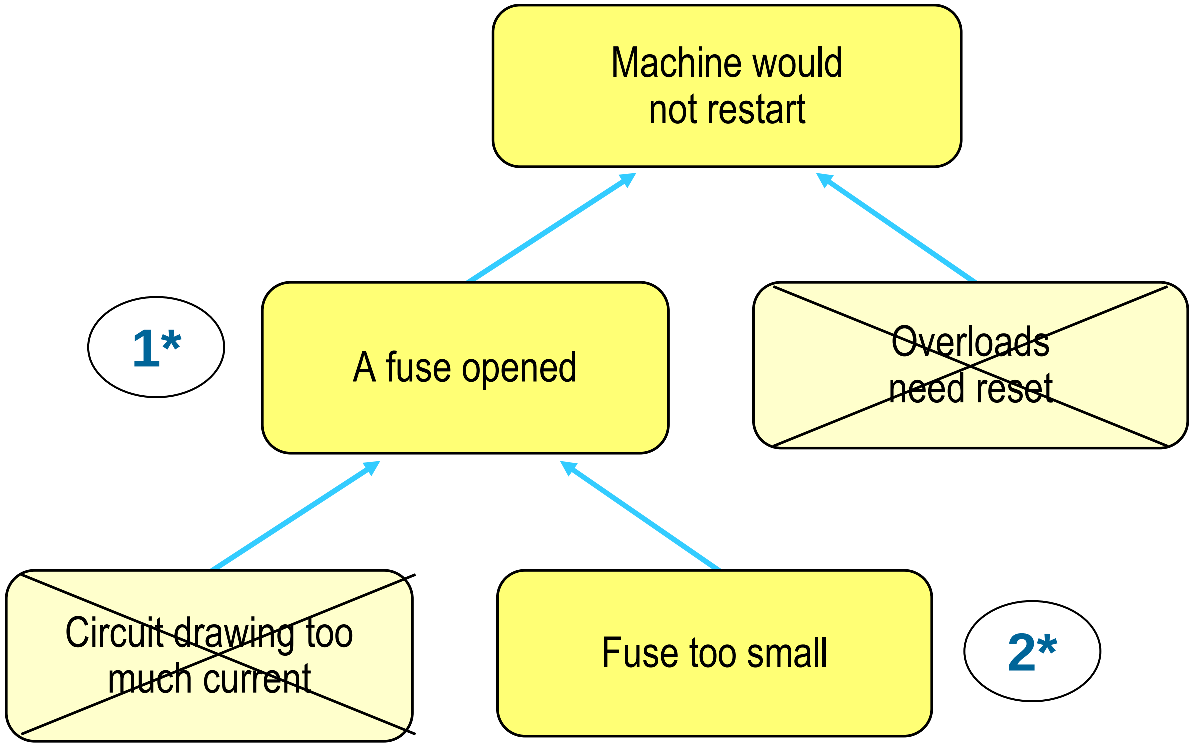


RCFA Verification of Hypotheses

Possible Cause	How To Verify	Who Will Verify	By When	Results

- Use the above form to keep track of how you verify your hypotheses.
- File the form with the WHY Tree for future reference.

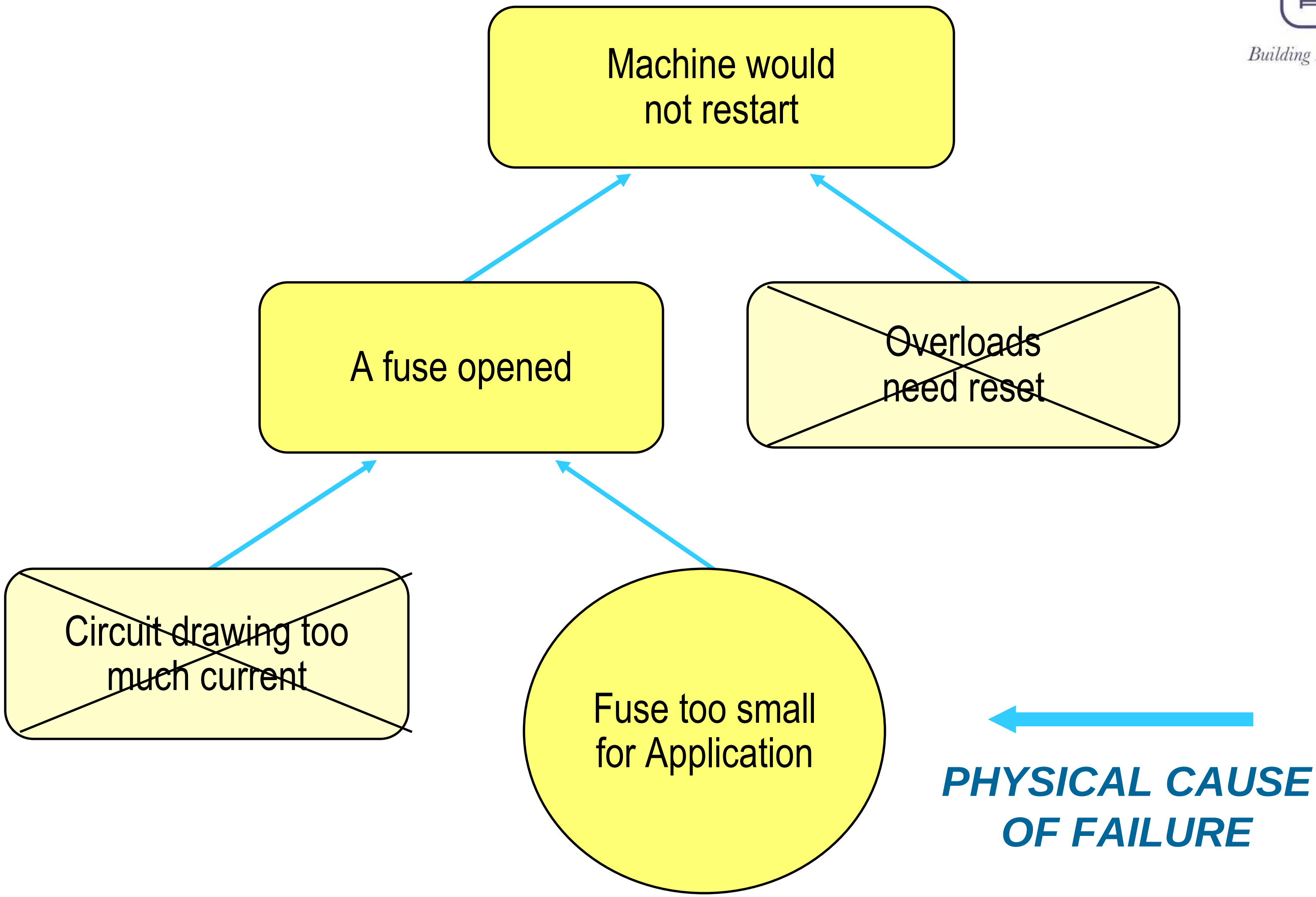
Building the "WHY" Tree



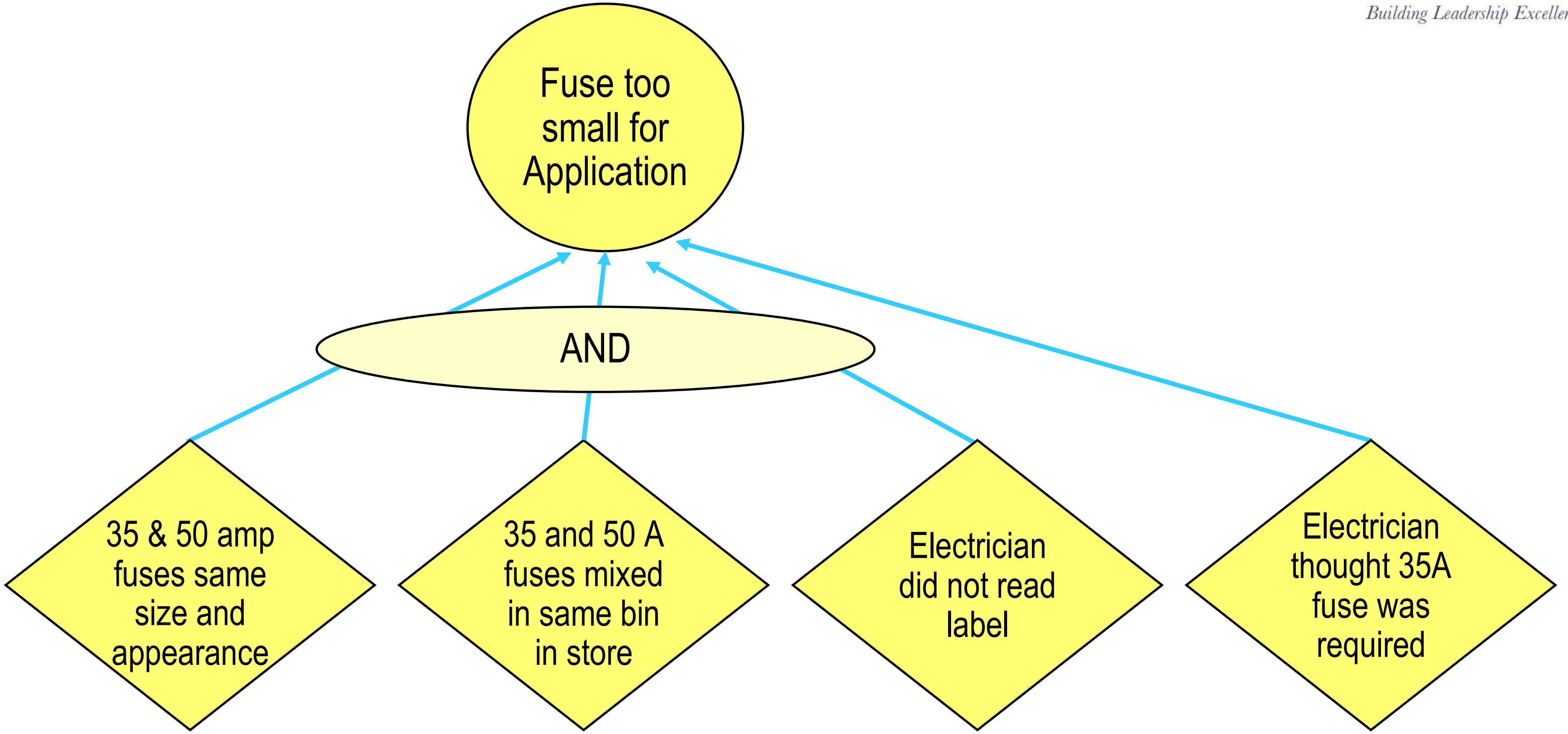
*1) Motor controller was removed from service and the blown fuse was found when being repaired in the shop.

*2) In the shop, the circuit was found to be drawing the proper current. The blown fuse was verified to be a 35 amp fuse. The function required a 50 amp fuse.

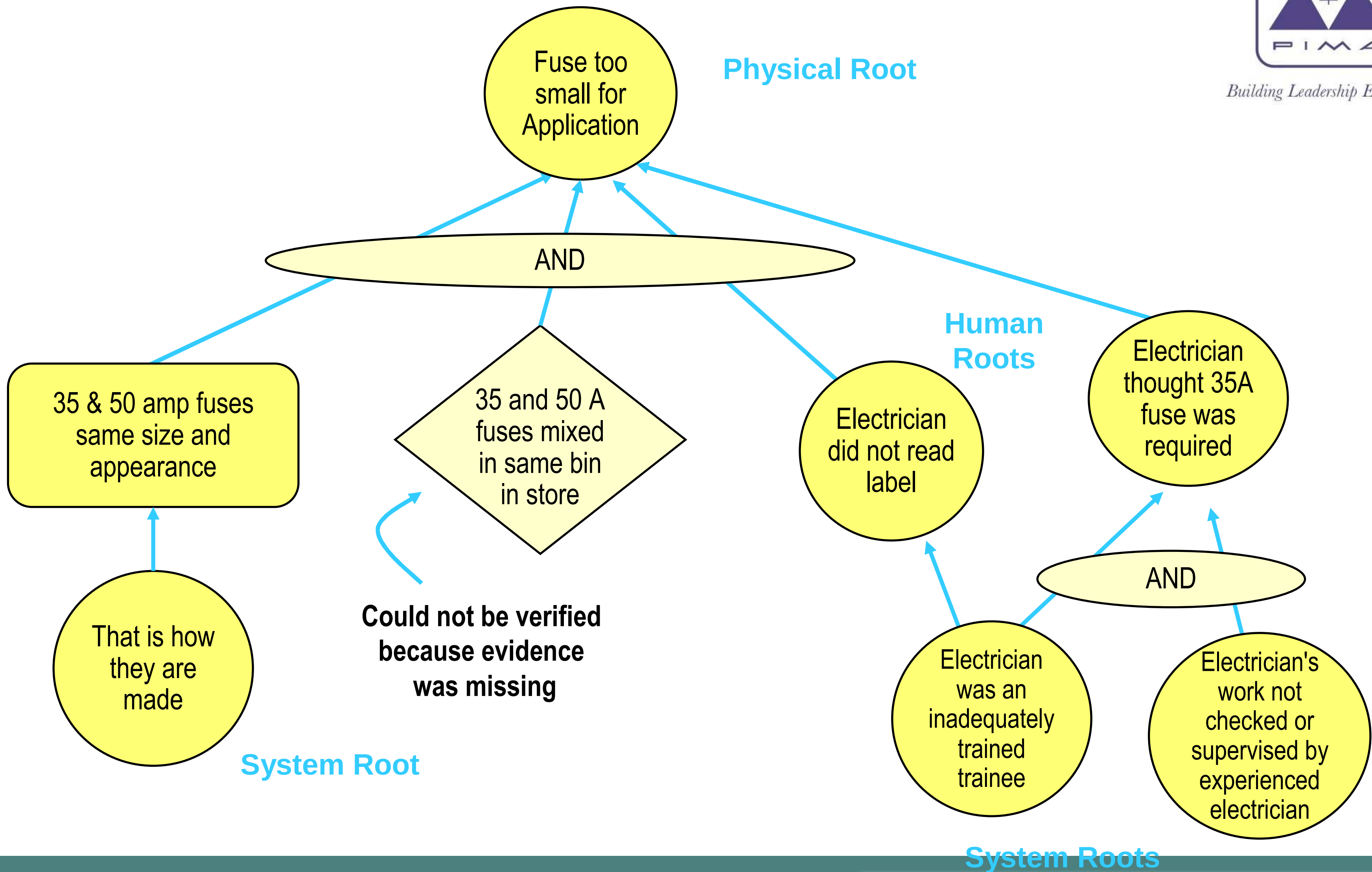
Building the “WHY” Tree



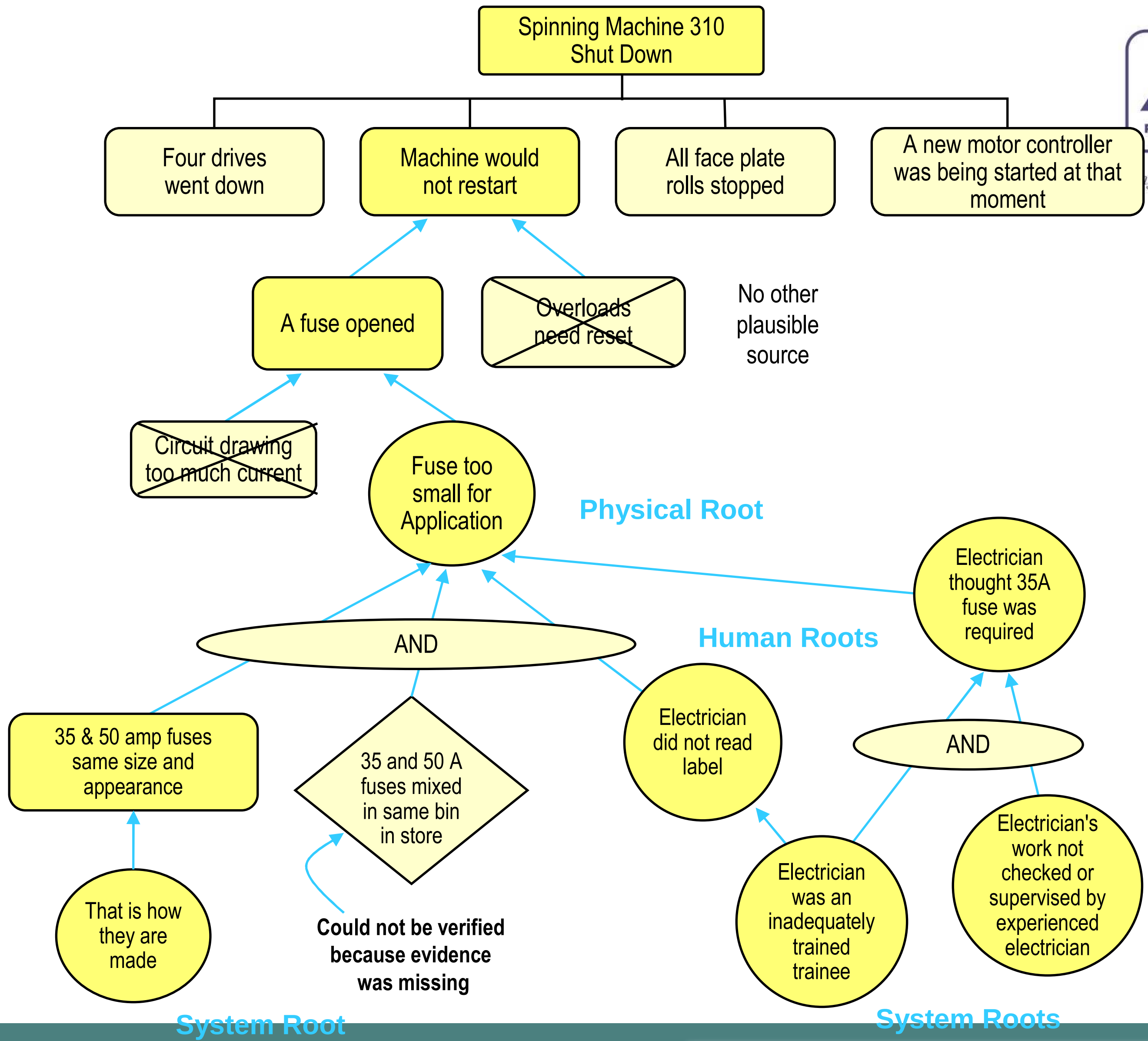
Building the “WHY” Tree



Building the "WHY" Tree



The "WHY" Tree is Built



Determine Causes for All Observations

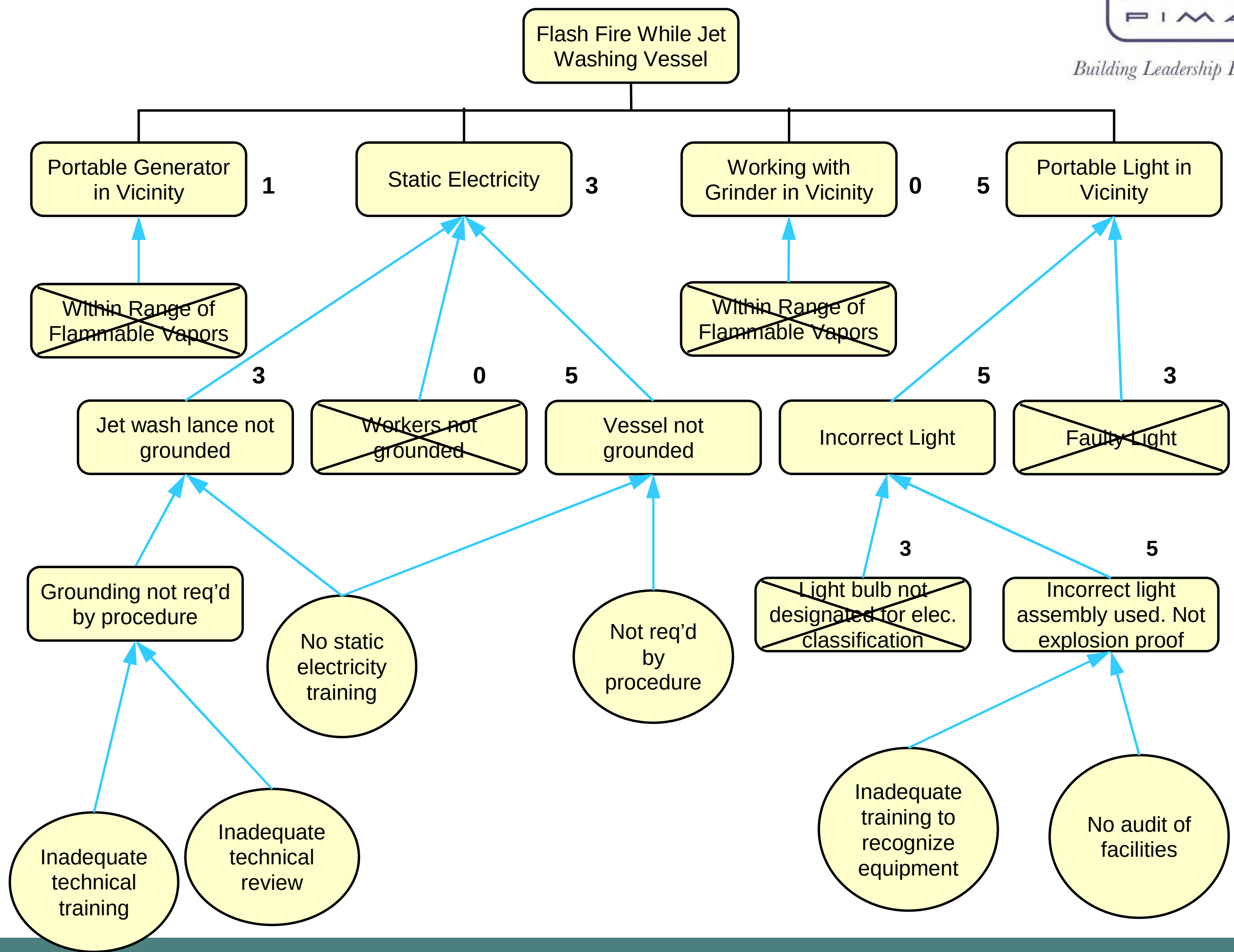
- After determining root causes for one observation, go back and repeat the process for the other observations. Continue until you have explained all the observations to ensure you haven't overlooked some root causes.
- In the Fuse case, finding the root cause of one observation explained the other three.
- The fuse which failed and caused the 'Pop' was in the motor control center that was being started.
- When it failed, it took out several other fuses, interrupting power to the four drives.
- When the drives lost power, the motors they were controlling stopped, which caused the faceplate rolls that the motors were turning to also stop.

Failure Summary

DATE:	6/9/93
FAILURE CATEGORY:	Drive Failure
WASTE:	1800 lbs.
DOWNTIME:	2 hours
MACHINE:	SM 310
INITIATING EVENT:	Motor Drive Failure
PHYSICAL FACTOR:	**Too small a fuse** was installed in an application, which resulted in the fuse blowing apart catastrophically. The explosion took out many other fuses in a domino effect, which left many functions inoperable.
HUMAN FACTOR:	**Did not know proper fuse rating.** Fuse rating label not read.
SYSTEM FACTOR:	**Inadequate training**, supervision and accountability.

What is the **Probability** of that Observation or Cause being responsible for the Effect above it?

Example of Weighting for Sporadic Failures



When Building a WHY Tree
Avoid These Common Practices

People will tend to:

Infer: "This is a lot like that so they should react the same way."

Perceive: "I can't prove it but I just know it must be."

Assume: "We've seen this problem before. The same thing must be causing it.

Don't use someone else's subjective BELIEFS as objective FACTS

Conventional Wisdom can Mislead You

Tips For Building Good WHY Trees

ARE THE CAUSE and EFFECT STATEMENTS CLEAR?

- The cause/effect statement should contain a subject and a verb as a minimum.

Pump Impeller Wears **Is better than** Pump Impeller Failure

- There should be only one cause/effect

Bearing Fails and Seal Leaks **Is really** Bearing Fails **plus** Seal Leaks

- Statement should contain no if- then statements

If the bearing fails then the seal leaks **Is really** Bearing Fails → Seal Leaks

Tips For Building Good WHY Trees

IS THE CAUSE and EFFECT TRUE?

- Does this cause really have this effect?

Bearing Fails

Valid

Oil drains from pump

There may be a correlation between weather conditions and pump failure but that is not the same as cause and effect.

Pump Fails

Invalid

Weather Humid

Tips For Building Good WHY Trees

- Is the arrow too long?

Training Inadequate → Pump Fails

Use short steps of logic

- Is the cause/effect tangible?

To be tangible it must be measurable or observable

Stop Watering Plant → Plant dies

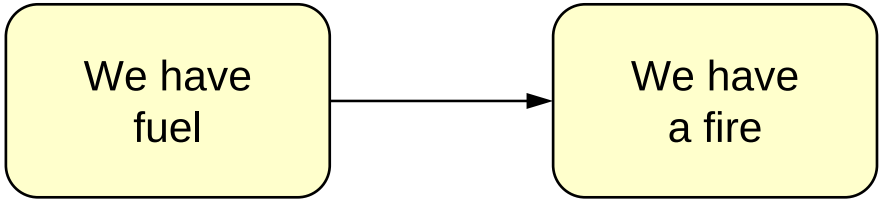
Tangible cause
Tangible Effect

My boss is unhappy with me → My performance appraisal is poor

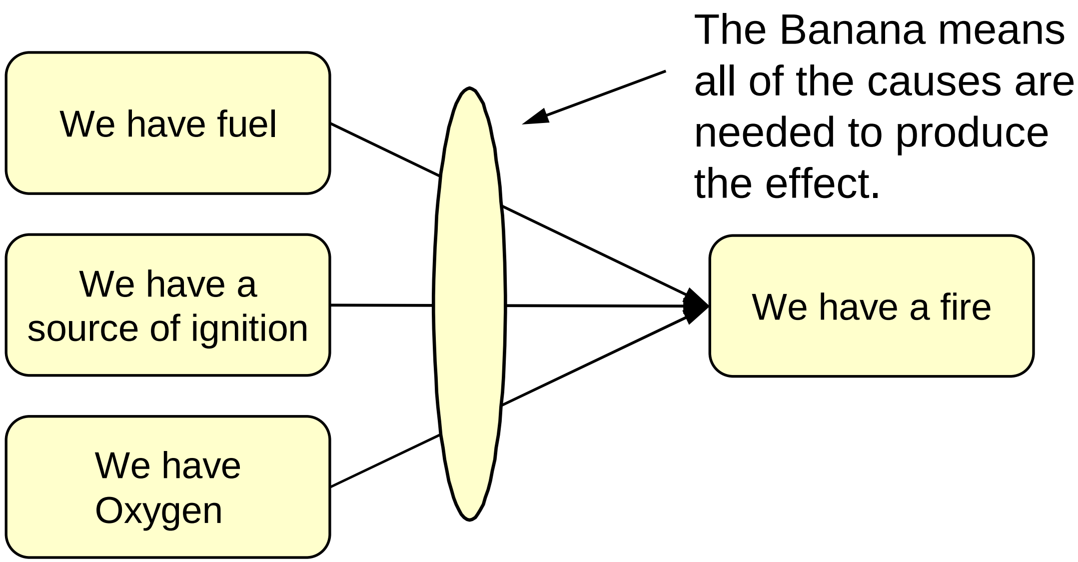
Intangible Cause
Tangible Effect

Tips For Building Good WHY Trees

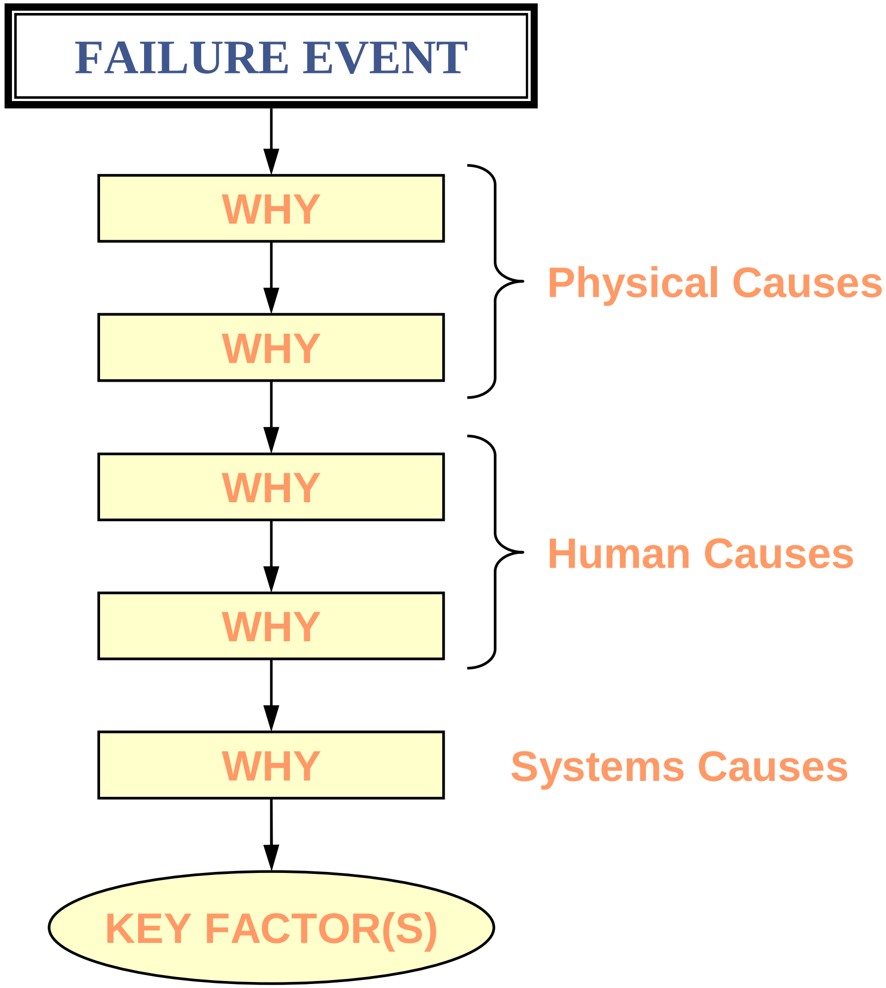
- Is this cause enough?
  Does this cause <u>on its own</u> always have this effect?



“*If* we have fuel *and if* we have a source of ignition *and if* we have oxygen *then* we have a fire”



How Many Times Do You Ask WHY?



Experience shows you should drive down at least five (5) levels (5 times) to get to Operating System Key Factor(s)

When Do You Stop Asking WHY?

When you find the Root Key Factor(s) at the Operating System,

or

At the point where you no longer have control or influence over the solution.

There are certain things connected with your job that you have direct control over. There are other things you have influence on without direct control.

Area outside your sphere of INFLUENCE or CONTROL

Then there are things you have neither control or influence over. Forget about them, or get the appropriate person(s) to deal with them.

An example is the 35A and 50A fuses in the WHY Tree example, which are manufactured nearly alike.

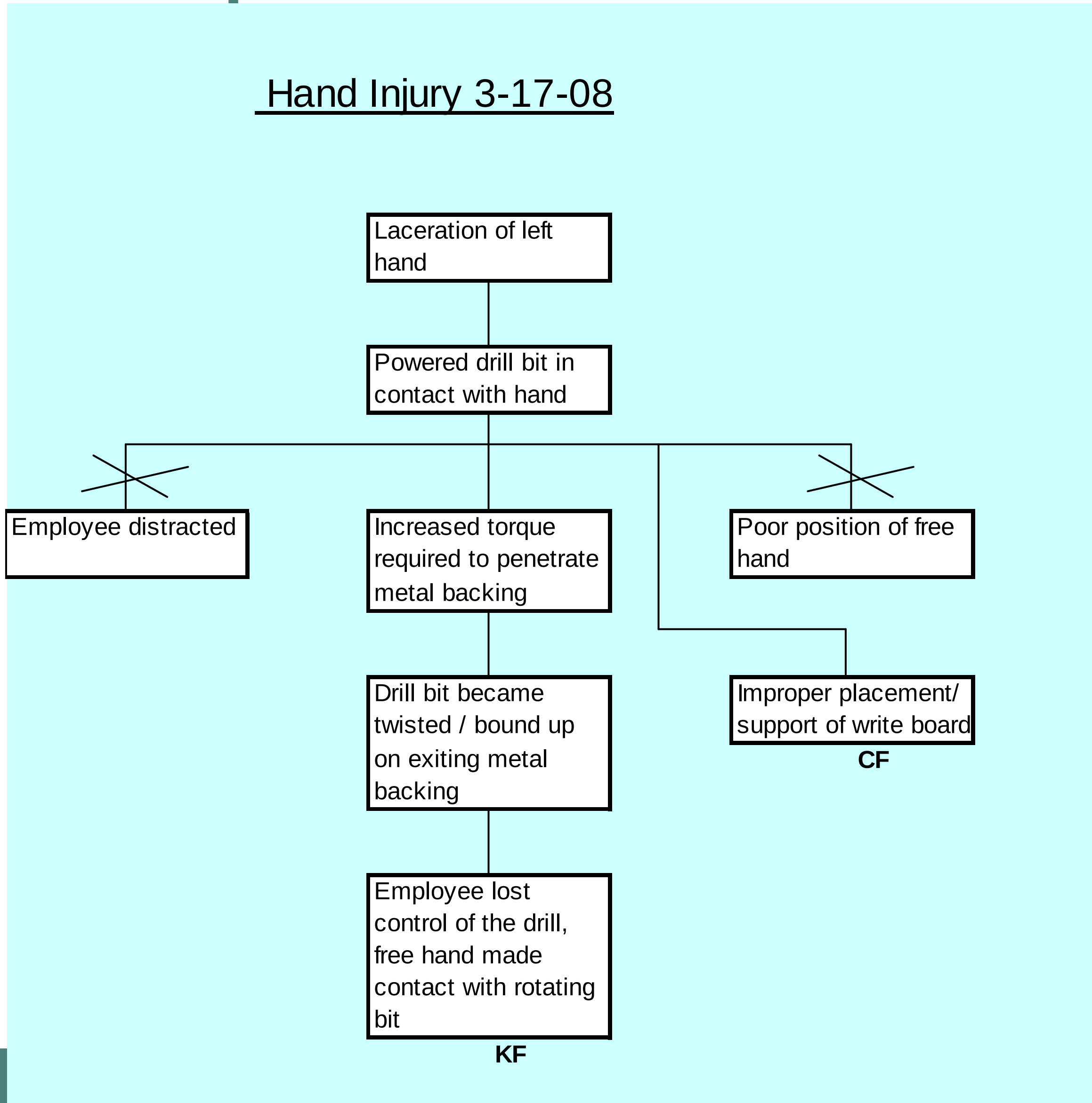
How long does it take to complete a "WHY Tree"?

- Depends on the complexity of incident and number of observations or "branches" to be processed
- Consider breaking "WHY Tree" sessions down into segments to maintain group focus and energy
- Verification activities should occur between sessions with report back
- Don't rush the process - sacrifice quality of investigation and ultimately the findings / improvements

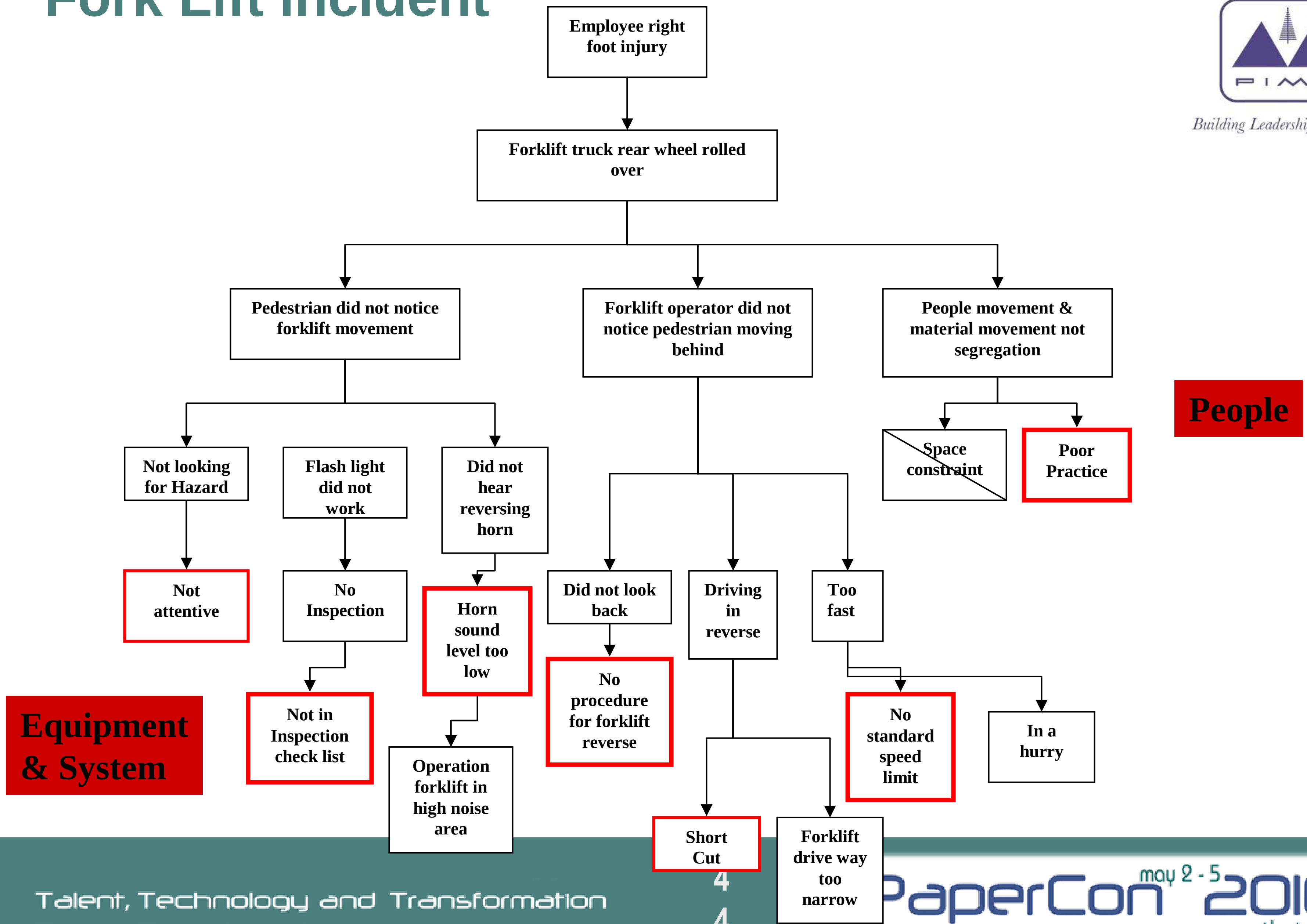
What Hinders the WHY Tree Process?

- Not verifying Hypotheses thoroughly enough
- Mis-identify symptom for root causes - focus on mgmt systems that are correctable by the organization
- Not brainstorming enough at each Intermediate cause and jumping too far down the Tree towards a Key Factor (leaps of logic
- Stopping too soon before all Key Factors are found
- “Failure to Follow Procedures” or “Operator Error” Traps (not a key factor - why ?)
- People on the WHY Tree team

Why Tree Example



Fork Lift incident



The WHY Tree Logistics - Best Practices

- Use Large Post It® Notes to identify and post observations and hypothesis at various levels.
- Draw in lines only after finishing each branch of tree (in case you need to move notes around).
- Keep draft in secure location until completed.
- If complex WHY Tree, word process in draft form between WHY Tree brainstorming sessions.
- Once finalized with Post It® Notes, word process for inclusion in incident report.

Documentation of WHY Trees (Preservation of information)

- Use electronic documentation.
- Include the list of “facts” or “evidence” that was collected, especially for serious incident or injury WHY Trees.
- Include any verification of hypotheses documents.
- Include names of participants.
- Include recommendations from the Root Causes.
- Save engineering calculations and analyses, pictures, sketches, bucket lists, verification lists, etc.
- WHY Tree leader is expected to create a hard copy of the WHY Tree and communicate it to the business.

Corrective and Preventive Actions

Eliminate hazards.

Control hazards.

Add rules, procedures, and training
to protect people from hazards.

Good Corrective Actions

- Consider the effects of hazards and risk:
  - **Probability (prevent recurrence)**
  - **Severity (smaller consequences)**
  - **Cost (and level of approval required)**
  - **Reliability over time (dependability and ISP)**
  - **Impact on the organization**
  - **Time frame for implementation (achievability)**
  - **Systems affected (scope of solution)**
  - **Criteria and ability to safely resume operations**

Typical Final Reports include :

- **Title –** a one-line descriptive phrase
- **General parameters –** unit/location, date/time, number, issue date, etc
- **Classifications –** PSM, fire , injuries, near miss, contractor, etc
- **General Description –** what happened at higher level
- **Detailed Description –** more details on events and findings
- **Detailed Chronology –** line by line approach if applicable
- **Key Factors/Contributing Factors –** results of root cause failure analysis
- **Conclusions/Summary –** summarize the overall results
- **PSM/OD elements for strengthening –** which elements involved
- **Detailed recommendations –** list of actions based on key factors
- **Team/Committee –** names and titles of team members
- **Cost –** Estimate costs related to incident
- **Why Tree** - body of work for root cause failure analysis
- **Attachments** – appendices (diagrams, calculations, lab reports, etc), references

Management Responsibilities

- Ensure that all incidents are reported.
- Create an atmosphere of trust and respect that leads to openness in reporting and investigation of incidents.
- Establish systems and procedures to assure an effective and efficient incident investigation process.
- Provide the resources and priority attention necessary for timely, thorough, and comprehensive investigations.
- Implement systems to ensure learnings and recommend-ations of an investigation are acted on to prevent recurrence.

Putting It All Together

Resources

- **Reliability Center Incorporated 501 Westover Avenue Hopewell, Virginia 23860**
- **Failsafe Network, Inc. PO Box 119, Montebello, Virginia 24464**
- **TapRooT® - 2007 System Improvements, Inc. • 238 South Peters Road • Suite 301 • Knoxville, Tennessee 37923**
- **Cause Mapping (Google this)**

THE PHOTOCATALYTIC PAPER WITH COATING FORMULATIONS OF TITANIUM DIOXIDE AND NATURAL ZEOLITE

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Paper Engineering, Chemical Engineering and Imaging
College of Engineering and Applied School
Western Michigan University

PaperCon may 2 - 5 2010 atlanta ga

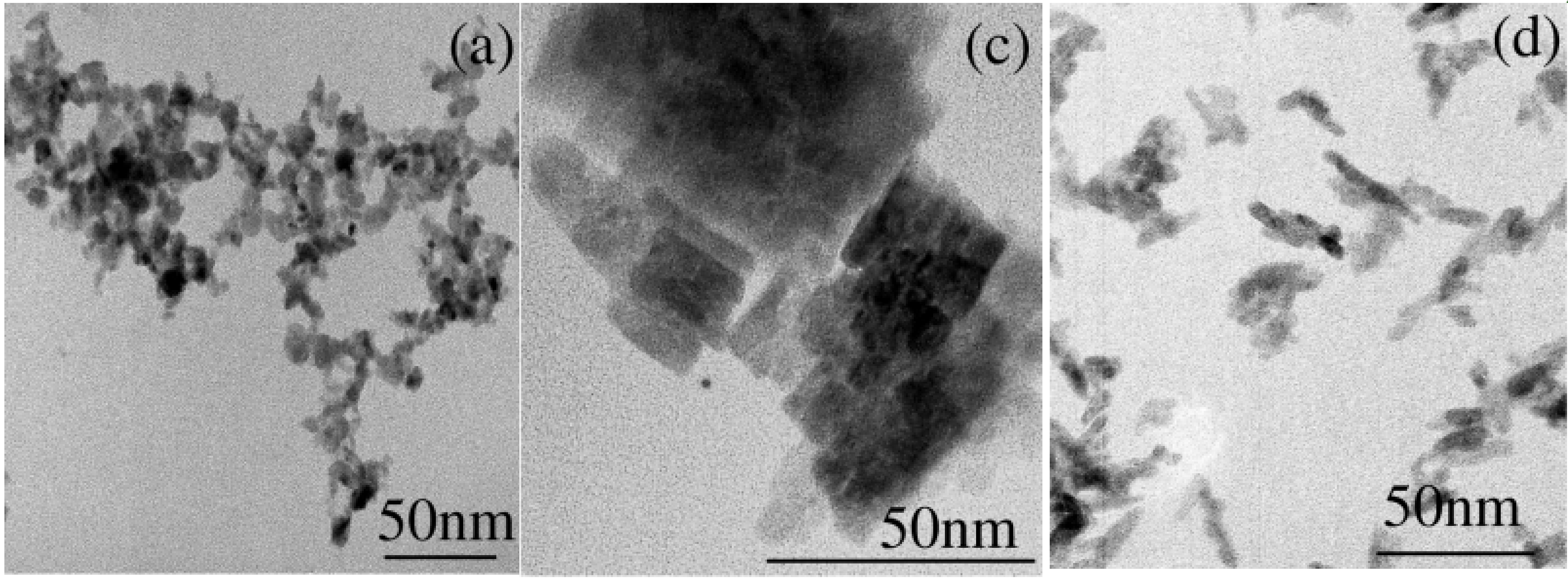
Talent, Technology and Transformation

Overview

- Introduction
- The purpose of this research
- Methodology
- Results and discussion
- Summary and Conclusions
- Questions

Introduction

- **Titanium Dioxide**
- White Pigments
  - It provides whiteness and opacity due to a very high refractive index and bright white color.
  - It has been used in the applications that require high opacity and brightness as coating.
- Photocatalysis
  - It can be used as a photocatalyst, as it is chemically activated when exposed to light and can decompose organic gases.
  - There are 3 crystal structures, anatase, brookite and rutile.

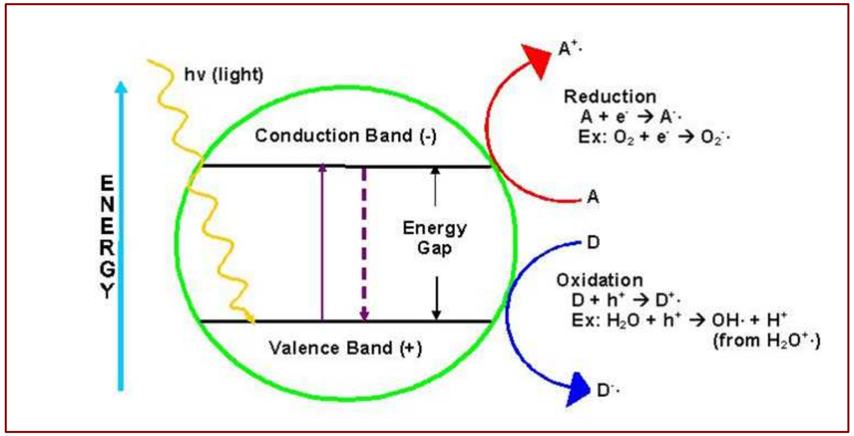


- Anatase, brookite and rutile
- Anatase has a higher surface area.
- It can be transformed to rutile by increasing the temperature.

Mechanism for Photocatalytic Activity

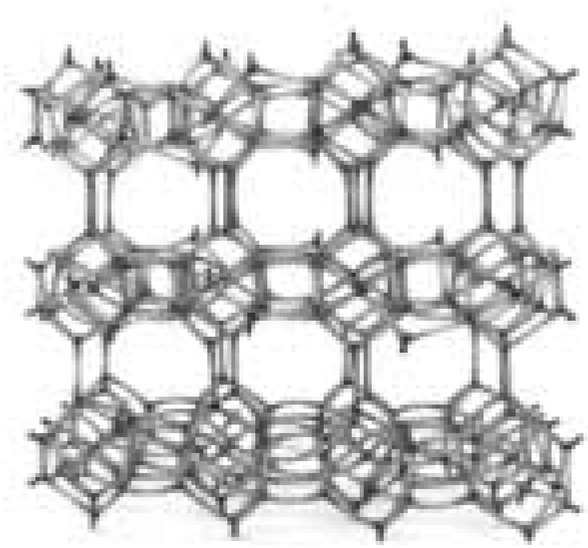
- Photocatalytic activity (PCA) results from the ability of a material to create an electron hole pair as a result of exposure to ultraviolet or visible radiation.

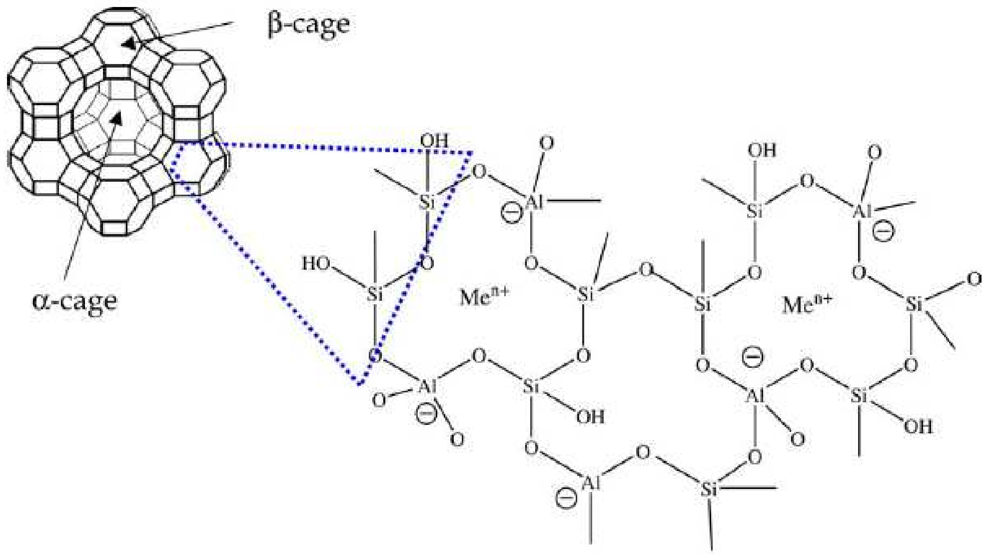
- The reactions that occur during photocatalytic activity are shown below.



Natural Zeolite

- Zeolites are highly crystalline, hydrated aluminosilicates, having a uniform pore structures.





Purpose of this study

- The purpose of this study is to determine the optical properties as a function of the ratio of TiO_2 (Anatase/Rutile), Zeolite and coat weight.

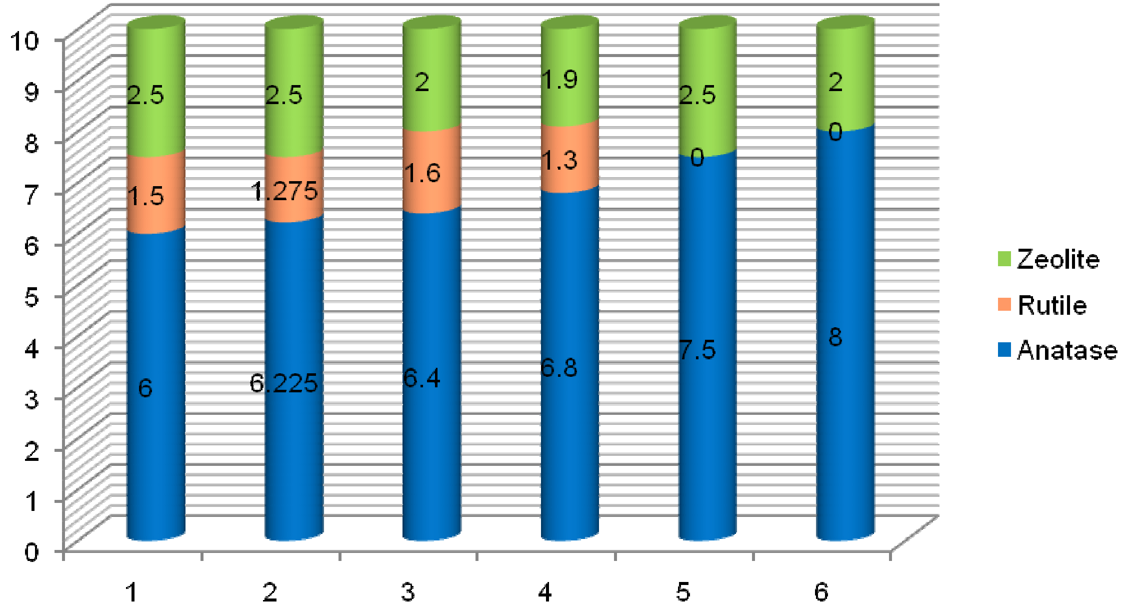
- To compare the efficiency of decomposition of toluene for the different coatings.

METHODOLOGY:
Experimental Design:

Sample	Anatase %	Total TiO_2 %	Binder	Coat weight gsm	Base
1	80	75	S/B latex	6	Wood Free
2	80	75	S/B latex	8	Wood Free
3	83.3	75	S/B latex	6	Wood Free
4	83.3	75	S/B latex	8	Wood Free
5	80	80	S/B latex	6	Wood Free
6	80	80	S/B latex	8	Wood Free
7	83.3	80	S/B latex	6	Wood Free
8	83.3	80	S/B latex	8	Wood Free
9	100%	75	S/B latex	6	Wood Free
10	100%	75	S/B latex	8	Wood Free
11	100%	80	S/B latex	6	Wood Free
12	100%	80	S/B latex	8	Wood Free
13	69.7	83.3	Polyco	6	Nippon
14	69.7	83.3	Polyco	8	Nippon
15	69.7	83.3	Acronal	6	Nippon
16	69.7	83.3	Acronal	8	Nippon

Coating formulation: Example

	Dry Parts
Anatase	60
Rutile	15
Zeolite	25
Latex (s/b)	10

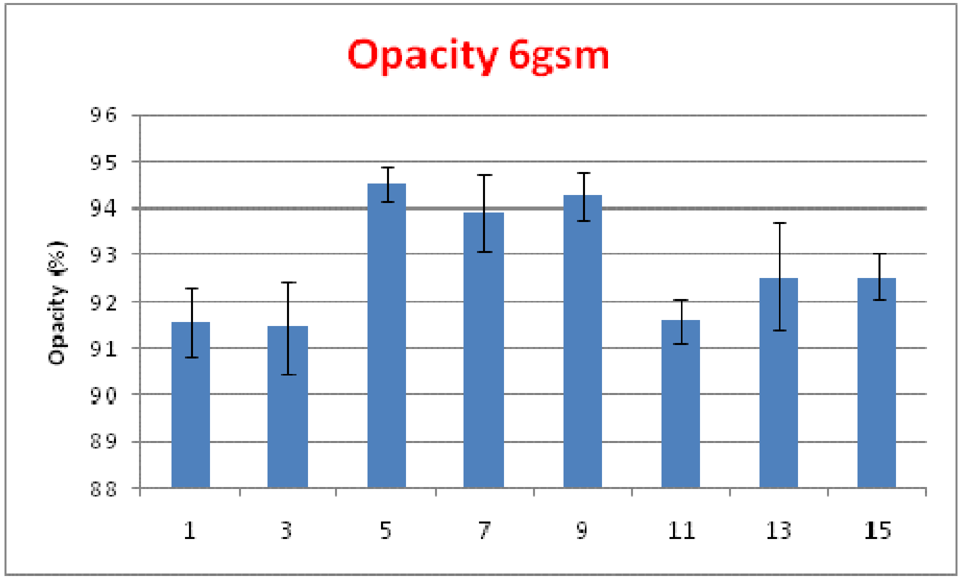


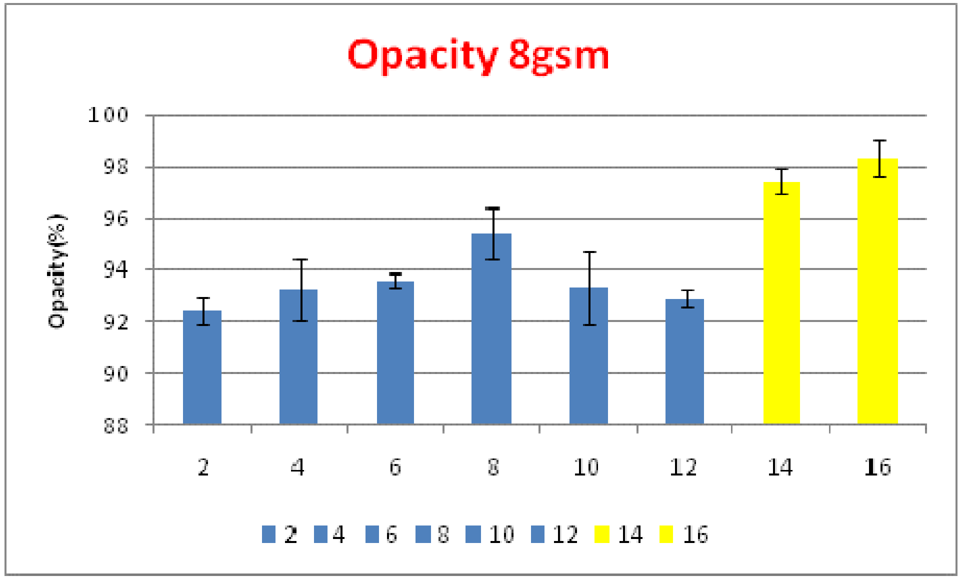
1. 80% A 75% Ti (6gsm,8gsm)
2. 83.3% A 75% Ti (6gsm,8gsm)
3. 80% A 80% Ti (6gsm,8gsm)
4. 83.3% 80% Ti (6gsm,8gsm)
5. 100% A 75% Ti (6gsm,8gsm)
6. 100% A 80% Ti (6gsm,8gsm)

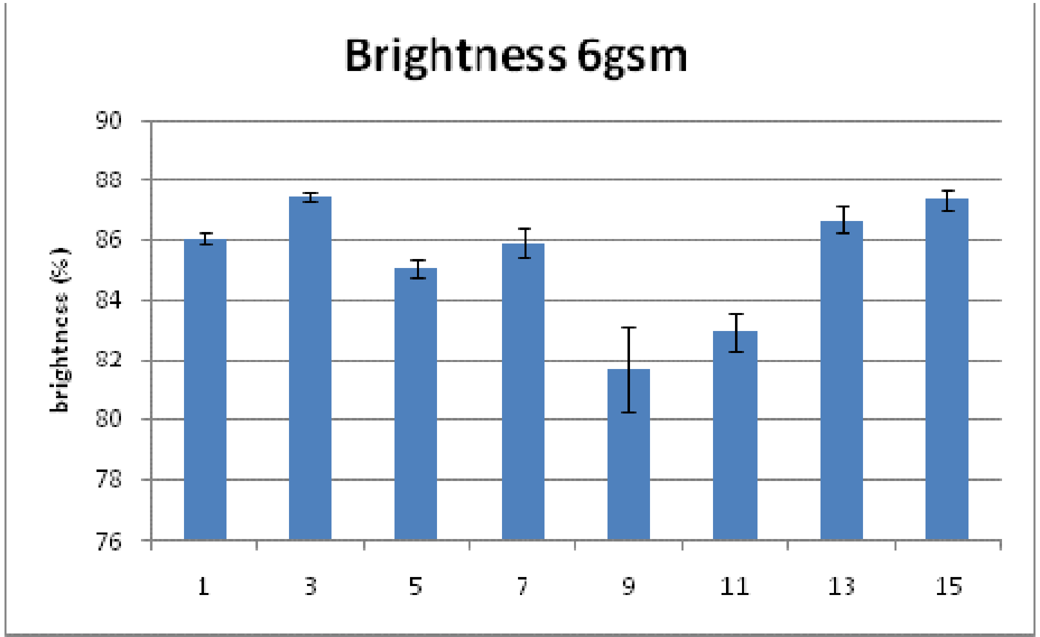
- All the samples were coated using hand draw-downs.
- Optical properties were measured (Brightness, Gloss and opacity).
- All the data was analyzed using ANOVA, using MiniTab 15.
- The efficiency of UV light decomposition of toluene was measured.

RESULTS AND DISSCUSIONS

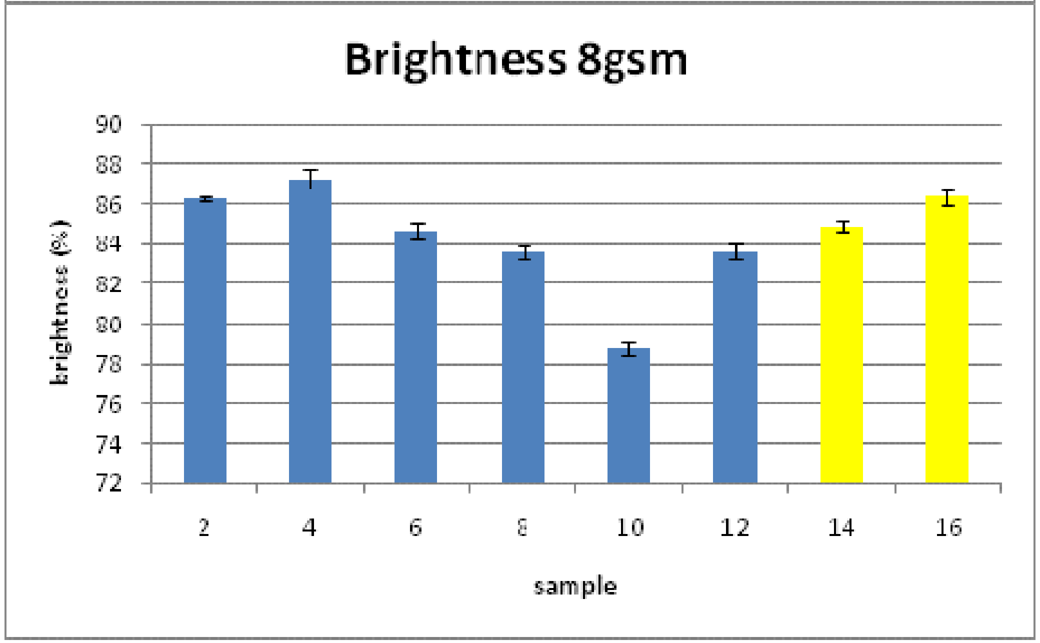
- Optical properties of the samples



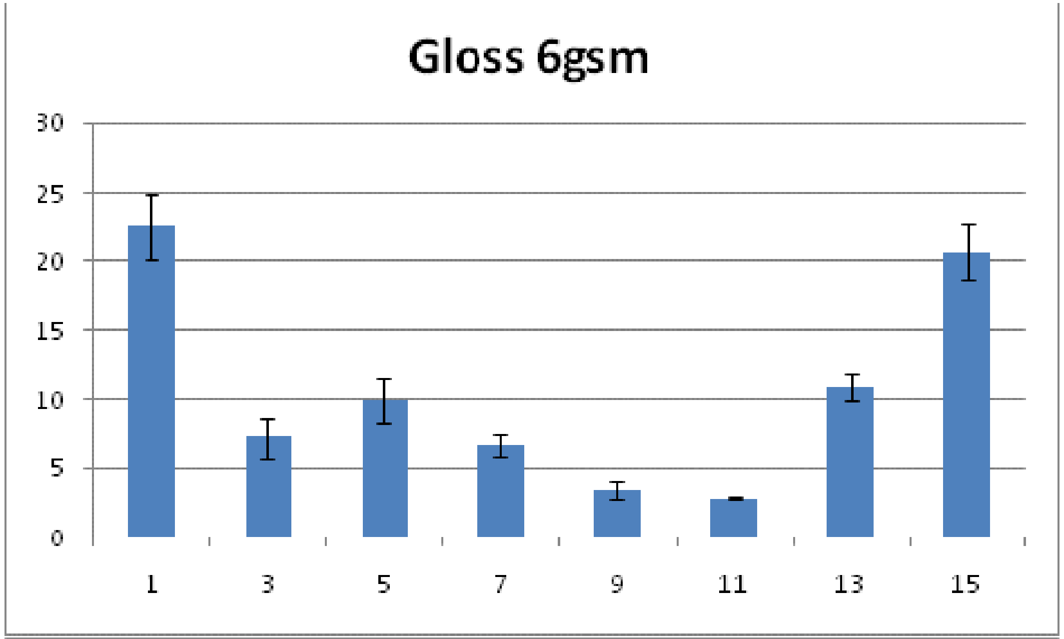


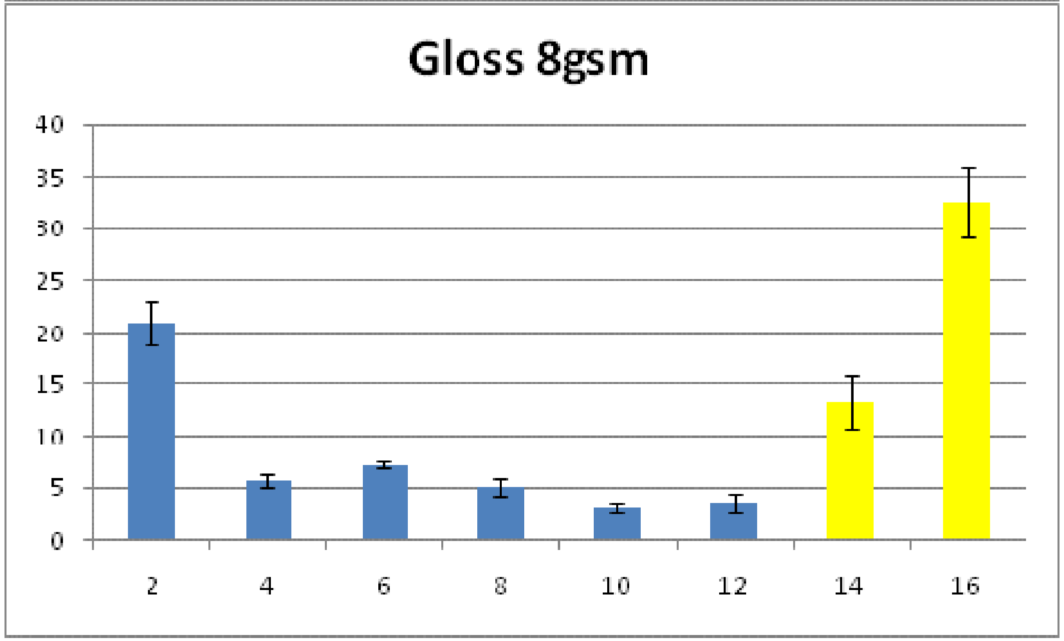


Brightness 6gsm
brightness (%)
90
88
86
84
82
80
78
76
1
3
5
7
9
11
13
15



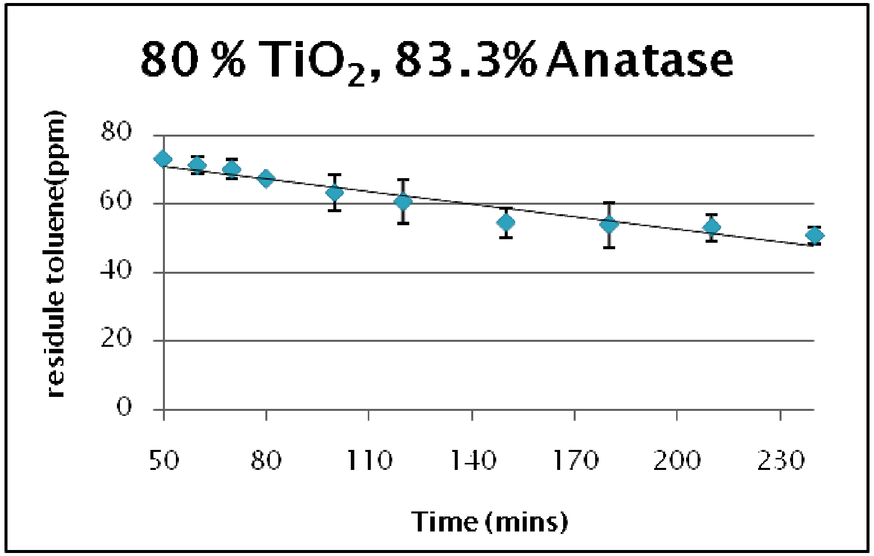
Brightness 8gsm
brightness (%)
90
88
86
84
82
80
78
76
74
72
2
4
6
8
10
12
14
16
sample

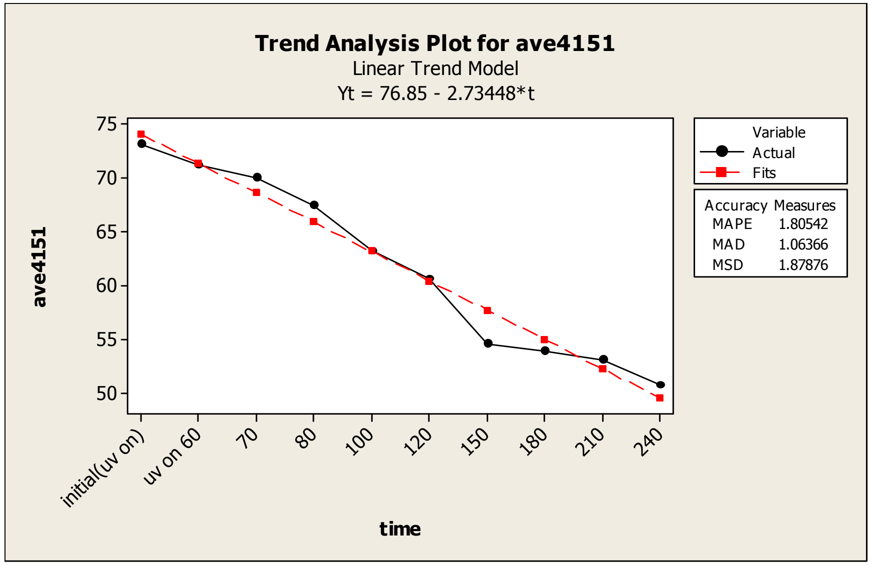

Gloss 6gsm
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15


Gloss 8gsm
40
35
30
25
20
15
10
5
0
2
4
6
8
10
12
14
16

Gas Chromatography:

Time (min)	initial	UV on 60	70	80	100	120	150	180	210	240
Residual (ppm)	73.1	71.3	70.1	67.40	63.3	60.7	54.5	53.9	53.1	50.7
SD deviation	0	2.3	2.8	0.37	5.1	6.2	4.3	6.5	4.0	2.4

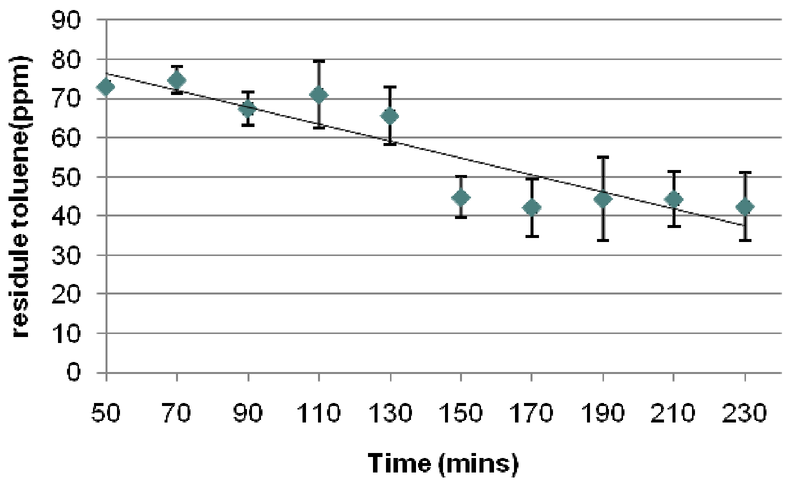


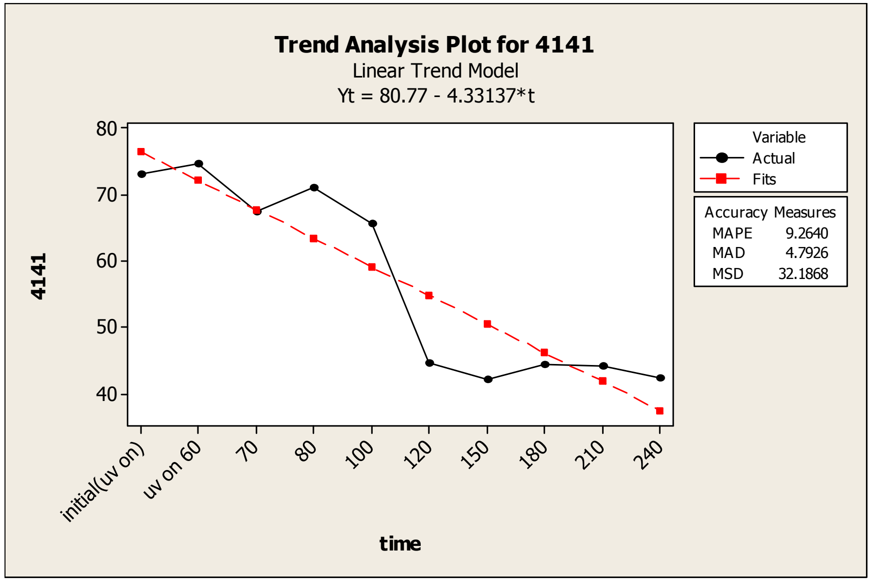


The percentage of the removal toluene is:

100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%- 69.4%=30.6%

Time	initial	UV on 60	70	80	100	120	150	180	210	240
residual (ppm)	73.096	74.8	67.4	71.0	65.6	44.7	42.1	44.3	44.2	42.3
SD deviation	0.006	3.4	4.3	8.6	7.3	5.2	7.3	10.7	7.1	8.7

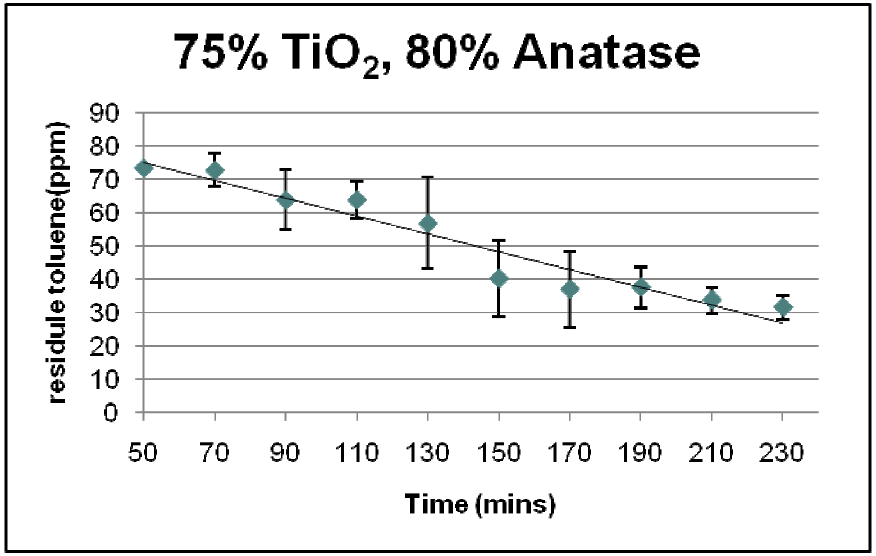


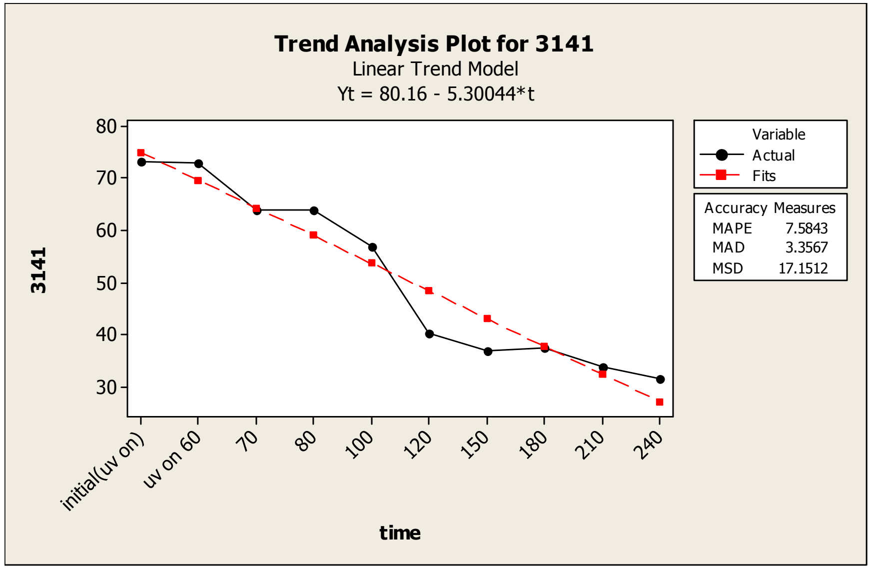


The percentage of the removal toluene is:

100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%-57.84%=42.16%

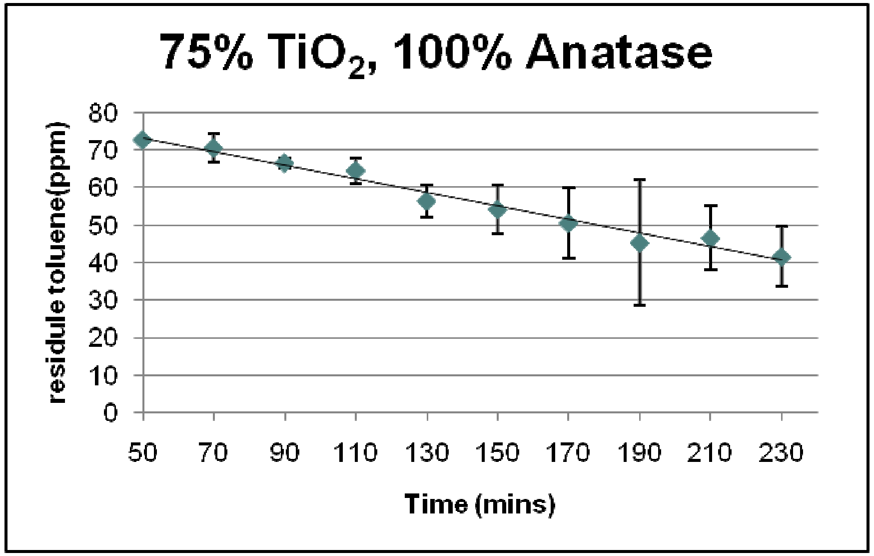
Time	initial	UV on 60	70	80	100	120	150	180	210	240
residual (ppm)	73.1	72.7	63.7	63.8	56.8	40.2	37.0	37.5	33.8	31.5
SD deviation	0.4	5.0	9.0	5.7	13.7	11.5	11.3	6.1	3.9	3.7

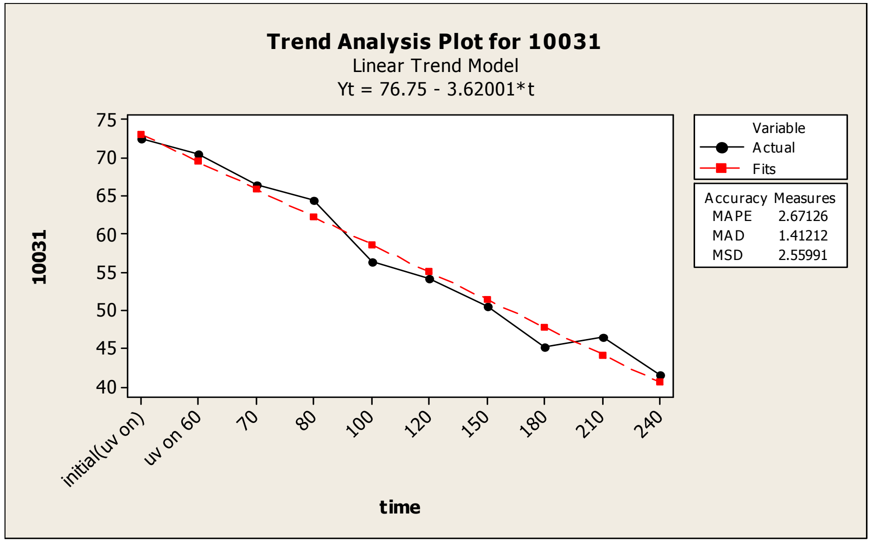




The percentage of the removal toluene is:
100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%-43.14%=56.86%

Time	initial	UV on 60	70	80	100	120	150	180	210	240
residual (ppm)	72.6	70.5	66.5	64.4	56.4	54.1	50.5	45.4	46.5	41.6
SD deviation	0.7	3.7	1.4	3.4	4.3	6.5	9.3	16.7	8.5	8.0

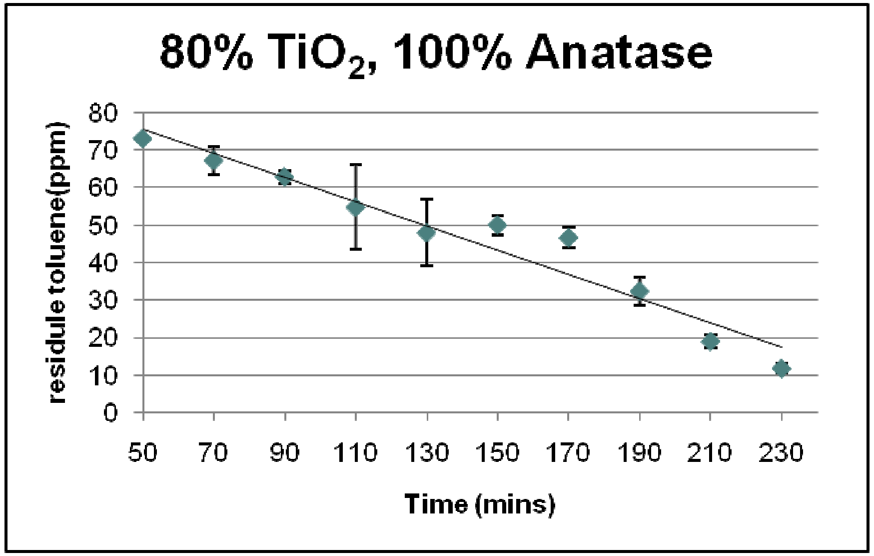


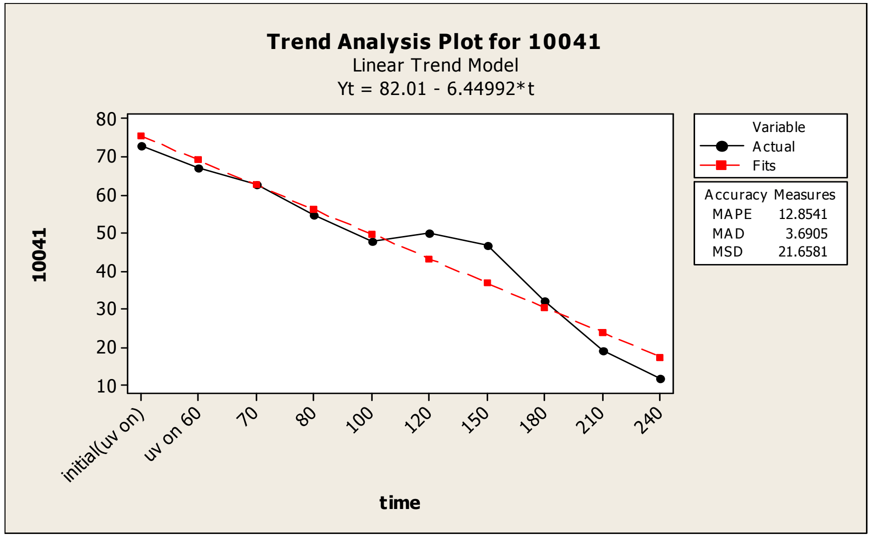


The percentage of the removal toluene is:

100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%-57.25%=42.75%

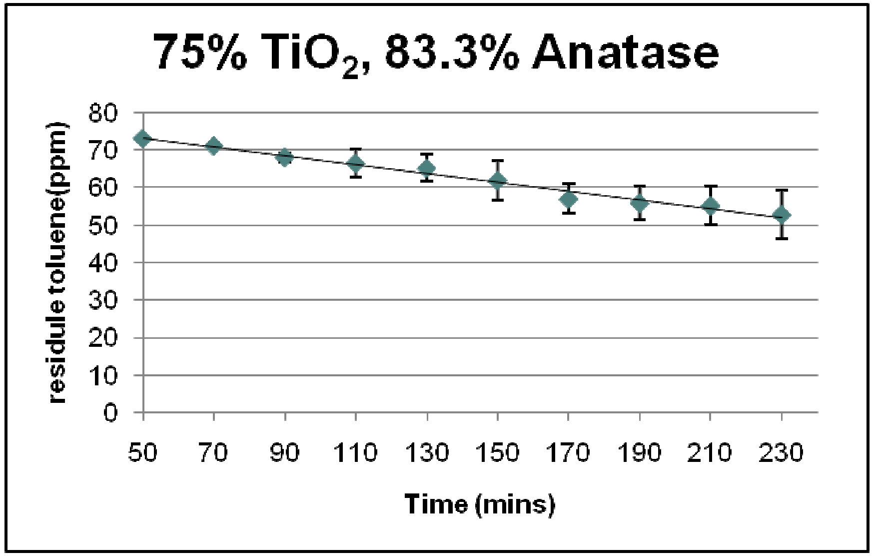
Time	initial	UV on 60	70	80	100	120	150	180	210	240
Residual (ppm)	73.0	67.2	62.8	54.7	47.9	50.0	46.6	32.3	19.0	11.7
SD deviation	0.1	3.7	1.6	11.3	8.9	2.6	2.8	3.9	1.7	1.3

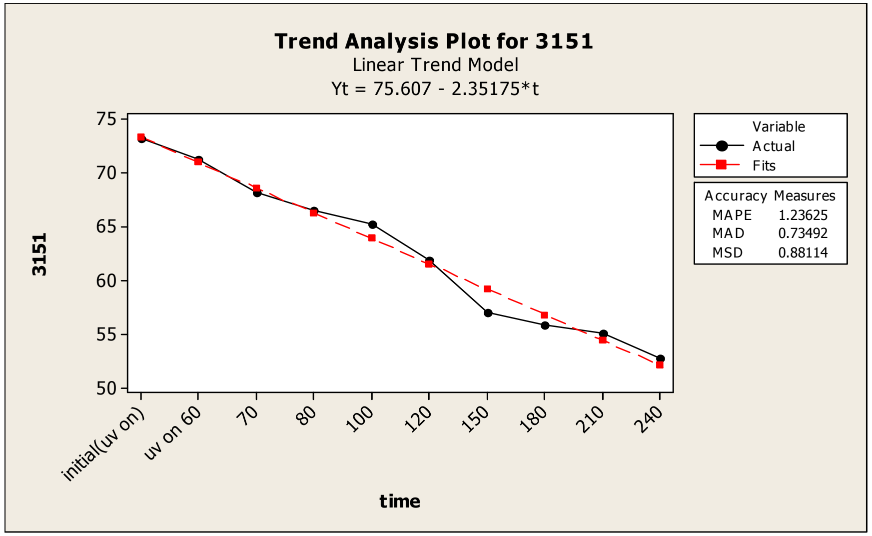




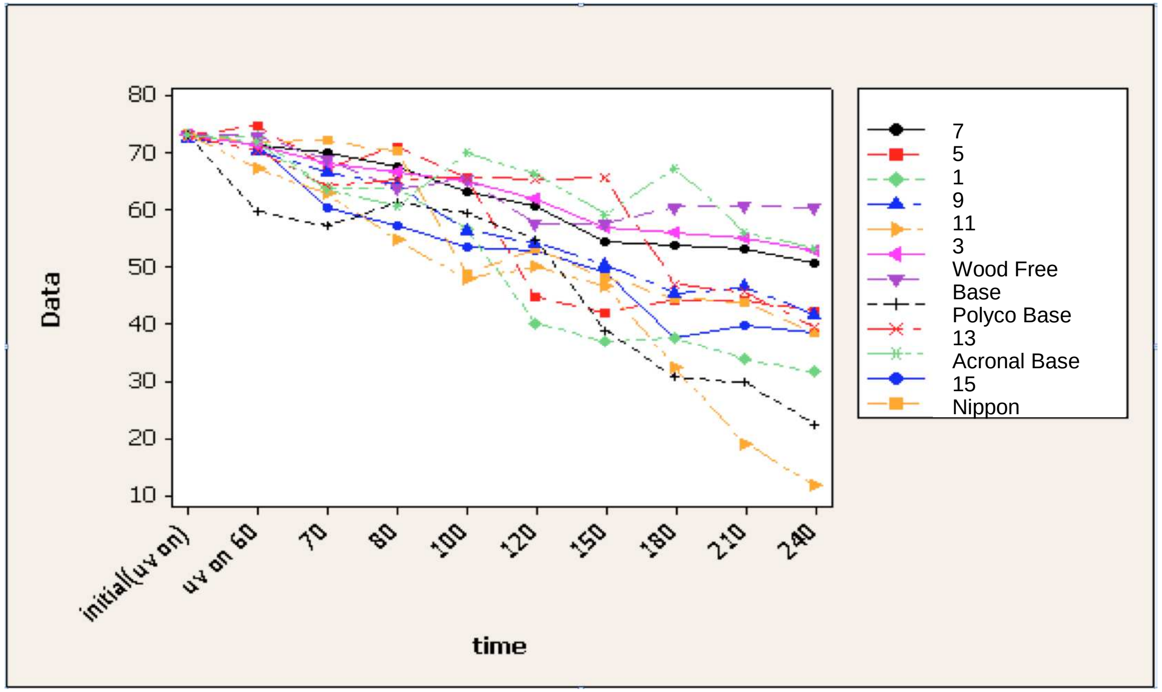
The percentage of the removal toluene is:
100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%-16.07%=83.93%

Time	initial	UV on 60	70	80	100	120	150	180	210	240
Residual (ppm)	73.1	71.18	68.1	66.5	65.2	61.9	57.0	55.9	55.1	52.8
SD deviation	0	0.79	1.2	3.8	3.6	5.2	3.9	4.3	5.0	6.5





The percentage of the removal toluene is:
100 %-{[Initial toluene-Ave residual toluene (240 mins)]/Initial toluene}%= 100%-73.36%=26.64%



- Sample 11 was the most efficient in decomposing toluene.
- Samples 7 and 11 decomposed toluene faster.
- The three samples of Nippon paper tended to give similar values.

Conclusions

- For the optical properties, opacity was tested and samples 11 & 12 (100% Anatase, 80% TiO_2) has higher opacity than that achieved by the others.
- Brightness was tested and samples 7 & 8 (83.3 % Anatase, 80% TiO_2) was significantly better than that achieved by the others.
- Samples 5 & 6 (80% Anatase, 80% TiO_2) had significantly higher gloss than the other samples.
- Sample 11 (100% Anatase with 80% TiO_2) had the highest efficiency.

QUESTIONS?

TyKote® Specialty Paper Products

Rob Beyersdorf & Steve Ottone

May 3, 2010

yKote® High Performance Polymers

oducts For Highly Specialized Paper Coating Applications

Kote® and some Rovene® products have been designed for Specialty Paper ating applications where barrier (MVTR, O_2), water resistance, and/or grease sistance are required. Current and new products can be formulated to meet the de array of specifications for existing and emerging wax replacement application

- Products Are Designed With Excellent Pigment Compatibility
- Formulation Design Assistance Available: We Offer Water-Based Polymers!
- MVTR Performance Well Understood
- Water Resistance (Cobb, etc.) Can Be Controlled
- New Grease Resistant Products In Development
- TyKote Products Provide Excellent Option for Wax Replacement

Company Overview

ease Visit www.mcpolymers.com

Privately Held Company Focused on Emulsion Polymers

Participate in Broad Array of Industries and Markets

- ❖ Papermaking and Saturation Included
- ❖ Barrier Company: MVTR Paints, Mastics, Membranes

Diverse Chemistry Portfolio

- ❖ Carboxylated and Non-Carboxylated Styrene-Butadiene Products
- ❖ Acrylic and Styrene-Acrylic Emulsion Polymers
- ❖ Thickeners and Plastic Pigments Being Investigated

Investing in R&D and Growth

- ❖ R&D Laboratories in Charlotte and NC Research Campus
- ❖ Dow-Reichhold Specialty Latex Acquisition our First

yKote® High Performance Polymers

roducts For Highly Specialized Paper Coating Applications

TyKote 1004

- ❖ Premium Performance, Balanced MVTR/OGR

TyKote 1005

- ❖ Improved MVTR/Water Resistance

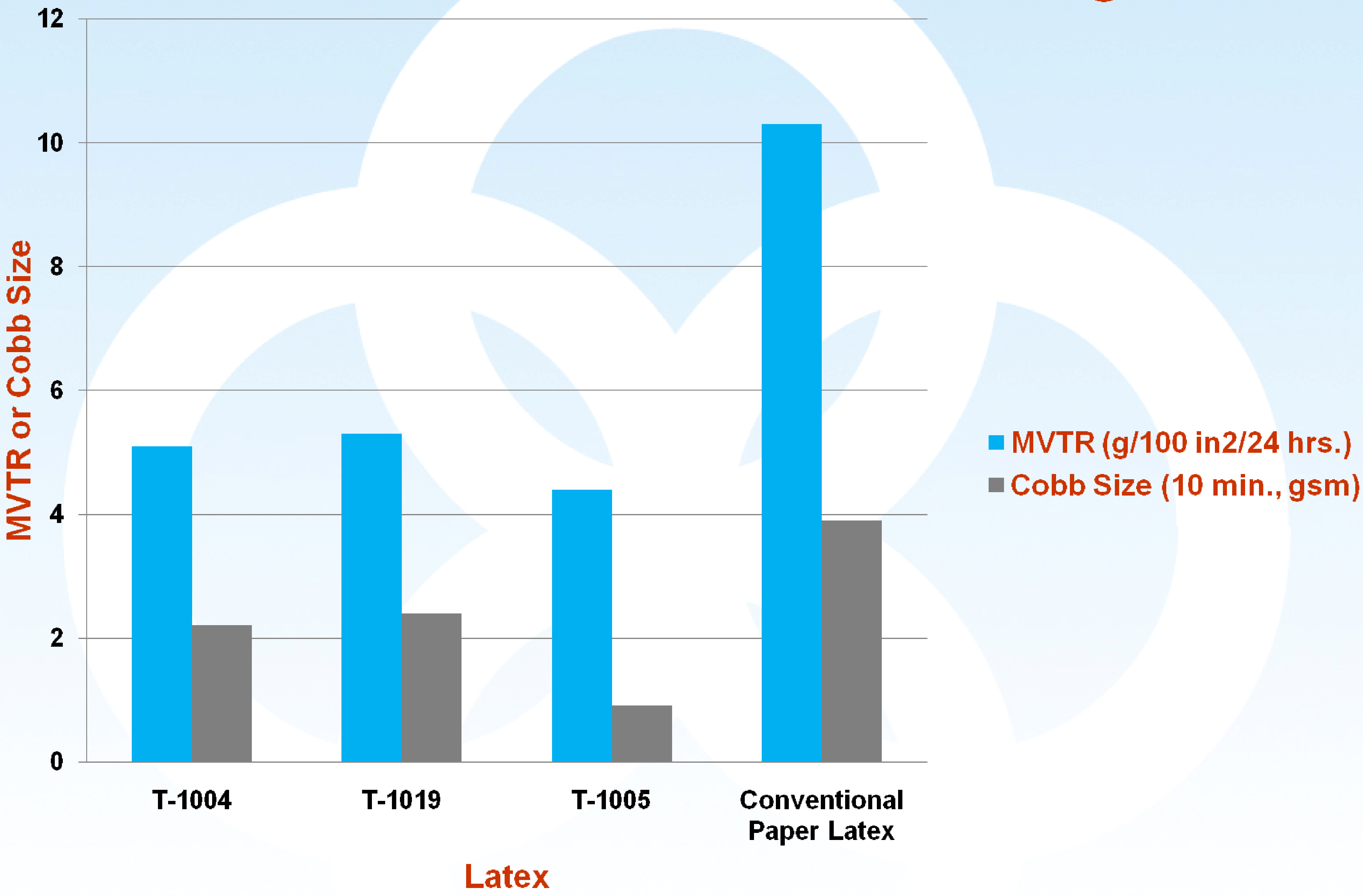
TyKote 1019

- ❖ Balanced Performance and Cost

Rovene 18106

- ❖ Styrene-Acrylic for Oil and Grease Resistance

Water Resistance of Barrier Coatings



yKote® Polymers

hat's New

Improved Water Resistance at Any Glass Transition Temperature

- ❖ TyKote 1005, etc.

High Strength Binders

- ❖ Research Work Across Markets

Enhanced Pigment Compatibility for Formulation Latitu

S-B's With Improved Balance of MVTR and Oil/Grease

Styrene-Acrylics With Outstanding Grease Resistance Wi

Maintaining Water Resistance Needed

- ❖ We Are Ready to Discuss Your Requirements

n Summary...

ntact Us to Discuss Any of Your
per Coating or Papermaking Needs

Steve Ottone, R&D Coating Expert
- ❖ Technical Program Committee

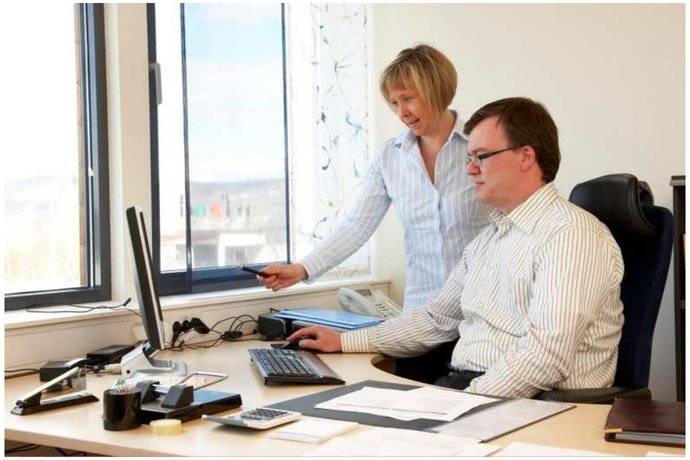
Bob Klein, Sales Manager
Rob Beyersdorf, R&D/Mktg/Sales
See Us or Call
- ❖ 1-877-413-0949

THANK YOU!

MultiJet on-line cleaning system

Business Overview

- 350 installations worldwide
- Global industry leader for high-pressure water cleaning equipment
- Strong references with systems supplied to Europe, Asia and increasingly to North America
- Headquarters and production facility located in Huskvarna, Sweden
- Exclusive partnership with Andritz in NA



Network and References

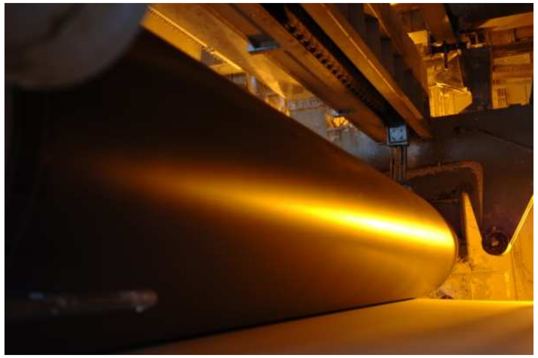
Current Network

- Offices
- Agents / Distributors
- References

IMPROVING PAPERMACHINE EFFICIENCY

Introduction to the m-clean systems

m·clean PAPERTECH

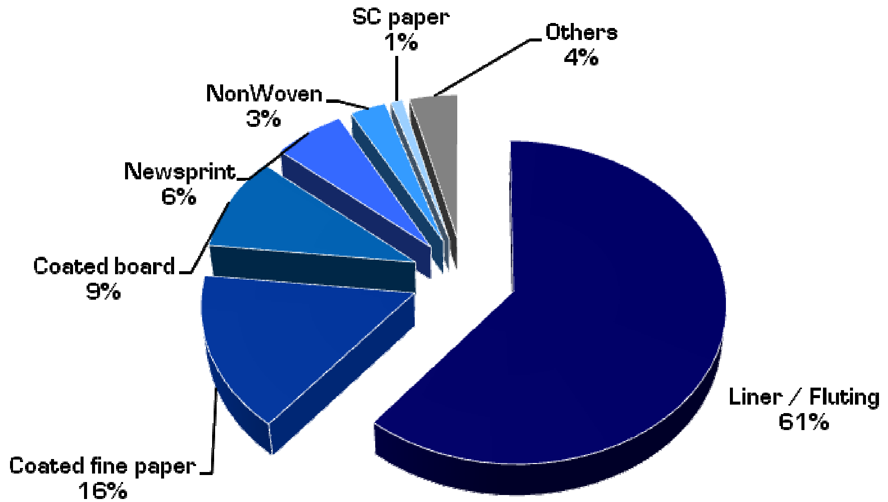
Dryer Fabric cleaning	Backing Roll cleaning	Transfer belts & Press Roll cleaning
		

MULTIJET ► ***For cleaning paper machine clothing, transfer belts and press rolls***

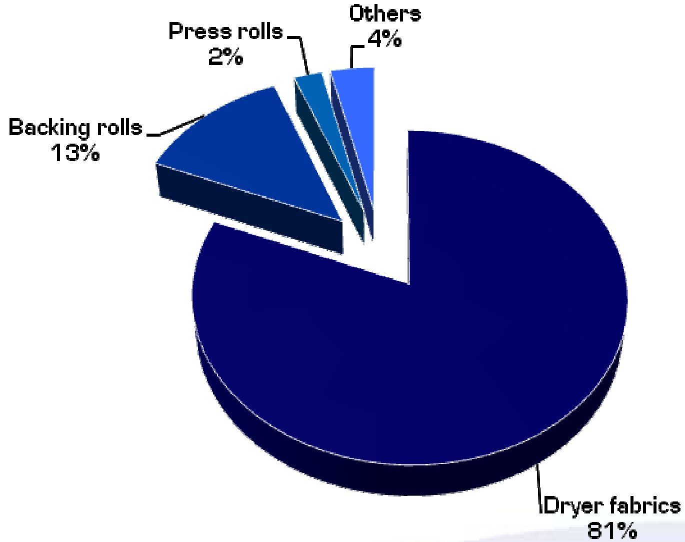
MULTI JET & BRUSH ► ***For online and offline backing rolls***

Total units: 350

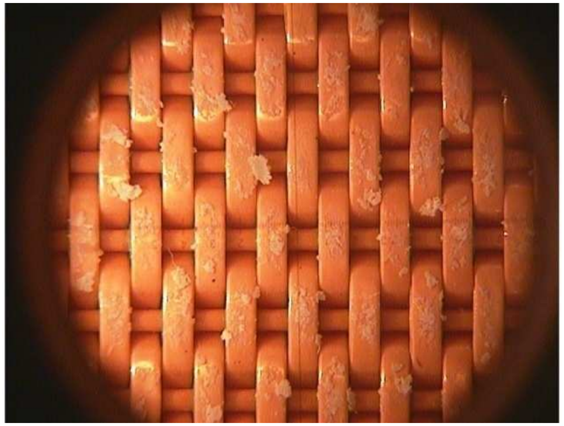
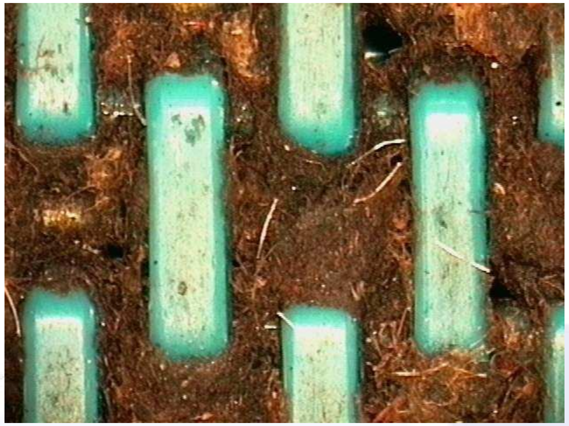
Installed base by Paper Grade



Installed base by Application



MultiJet will clean

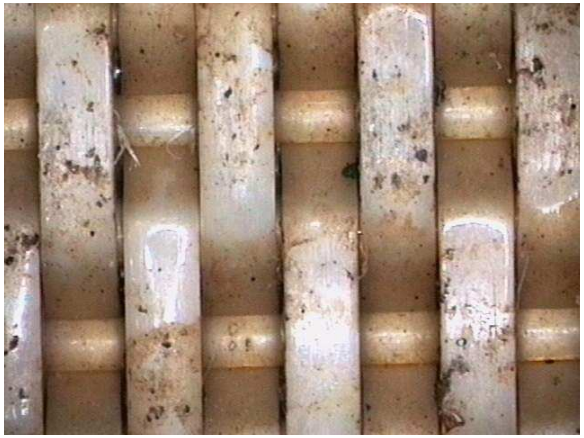
Surface contamination	White pitch contamination	In weave contamination
		
Fabric A	Fabric B	Fabric C

MultiJet will eliminate or minimize

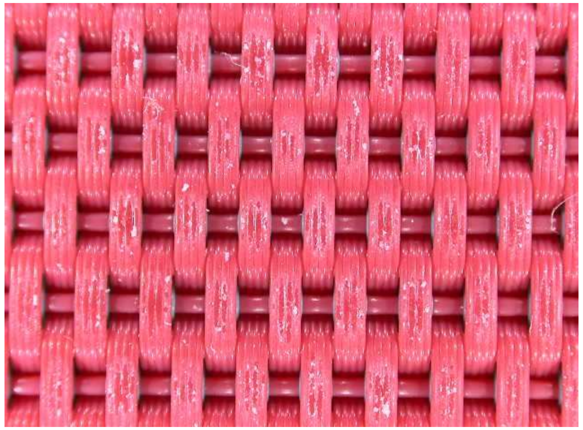
- Web breaks
- Low permeability in fabric
- Dirt spots in paper
- Negative influence on paper moisture profile
- Bad ventilation / evaporation
- Reduced effect of stabilizers
- Reduced effect of heat transfer
- Fibres sticking on cylinders and fabrics
- Contamination on guiding rolls

MultiJet cleaning system

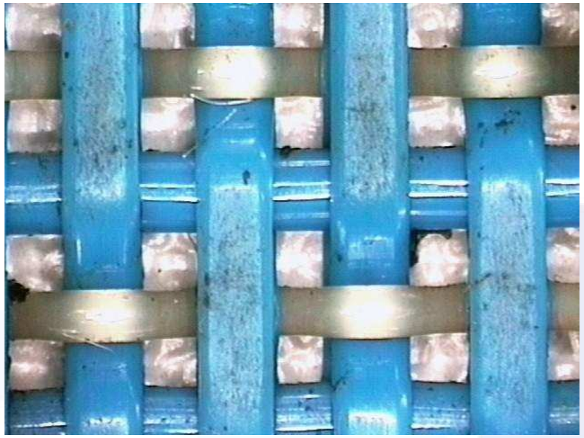
Fabric A after cleaning



Fabric B after cleaning



Fabric C after cleaning



The MultiJet cleaning head reaches cleaning results that cannot be achieved by other competing systems in demanding conditions

Benefits MultiJet concept

- Efficient cleaning with up to 600 bars water pressure together with efficient vacuum evacuation
  - No paper breaks during cleaning
  - No water marks in paper during cleaning
  - All contaminations collected outside the paper machine

m·clean PAPERTECH

Benefits MultiJet concept

- Fast payback time of investment by:
  - Improved paper machine runnability
  - High permeability value during fabric lifetime
  - Guaranteed uptime
  - No paper machine shutdown for manual fabric cleaning
  - Improved paper quality
  - Increased drying efficiency
  - Increased machine output
  - Increased dryer fabric lifetime
  - Low maintenance cost

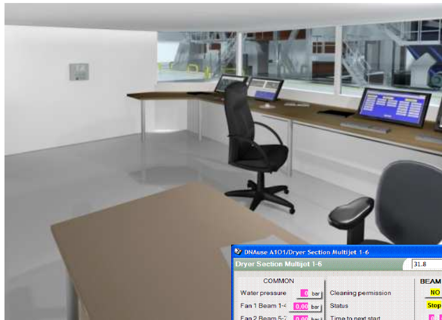
MultiJet cleaning unit

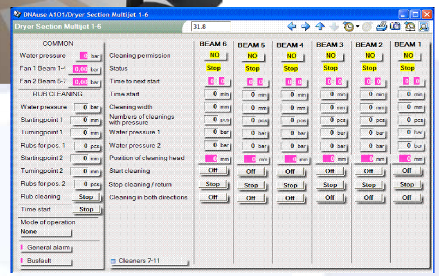
Siemens S7 or Allen Bradley

Vacuum and air

High pressure water

Control by Siemens S7 or Allen Bradley





One central unit can support several cleaning units

Return on Investment

• Paper break reduction:	up to 100%
• Higher paper machine up time:	up to 5%
• Steam reduction:	up to 5%
• Longer fabric life time:	up to 100%
• No need for manual cleaning	Saving/Safety
• Elimination of chemical cleaning	Saving
• No downgraded paper due to markings on the sheet	Saving
• No downgrades paper due to stickies on rolls or fabrics	Saving
• Elimination of rejected paper (printing house etc.)	Saving
• Elimination of paper breaks in rewinder	Saving
• Improved CD profile	

MULTIJET

IMPROVING PAPERMACHINE EFFICIENCY

Pro-Cote® Soy Polymers

New Developments

Pro-Cote® Soy Polymer Introduction

Innovative Water-Soluble Soy Polymers produced from soybean protein

- Key Product Characteristics - Proven performance
  - Pigment-interactive, because of amphoteric product charge.
  - Water Holding, through hydrated nature of dissolved polymer.
  - Viscosity modification through hydrodynamic effects and interaction with pigments.
  - Excellent high shear stability through polymer's protective colloid action.
  - Good Binding Power, equivalent to or better than commodity SB latex .

- Multi Functional additive, replacing several other components in your coating

Pro-Cote® Soy Polymer Introduction

- Opportunity to significantly reduce total cost:
  - Functional Co-Binder (Pigments and Latex)
    - Allowing lower total binder
  - Process Runnability Agent (Rheology/Water Holding/Immobilization)
    - Allowing higher productivity

- Stable or improved quality:
  - Finishing and Converting Enhancer
    - (Glueability/Anti-Blocking/Anti-Hazing/Reduced Dusting)
  - Final Print Quality Improvements
    - (Smoothness/Missing Dot/Ink Gloss)\

- Biodegradable, Renewable Resource

Pro-Cote® Soy Polymer New Developments

- Pro-Cote® Soy Polymers is a family of products, adapted to several needs
- Latest developments:
  - Improved performance
  - Designed to be REACH compliant
  - Reduced Carbon footprint
- Example: Pro-Cote® E115702-6

Pro-Cote® Soy Polymer New Developments

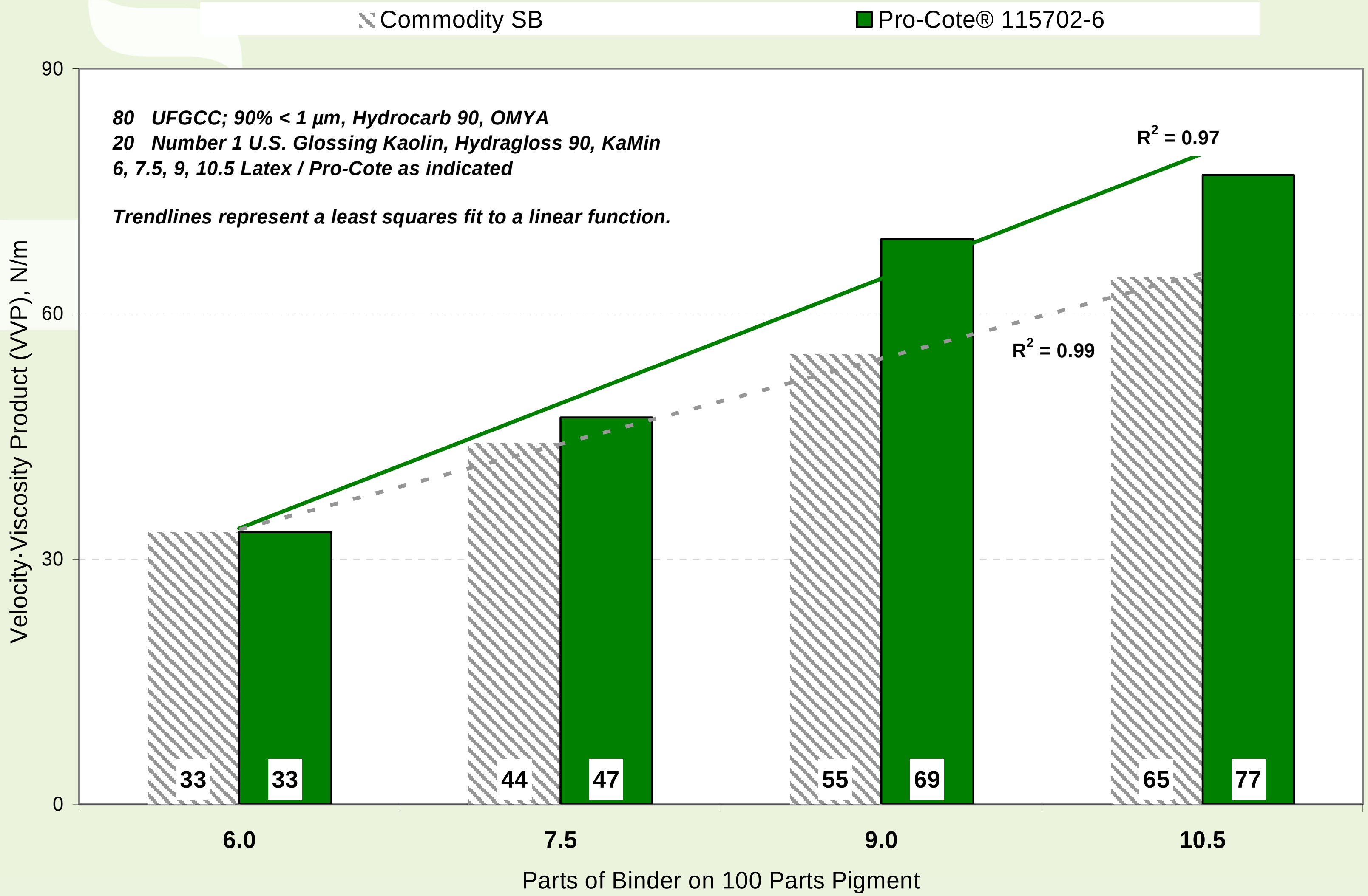
- Performance
  - – Functionality as adhesives
    - In high GCC coatings stronger than SB Latex
  - – Resist depletion
    - Strongly associated with other coating components
      - – Amphoteric (cationic / anionic)
      - – Colloidal material
  - – Renewable / Sustainable

Pro-Cote® Soy Polymer Strong Binder

- Pro-Cote® E115702-6 soy polymer
  - Exceptional performance in Ground Calcium Carbonate coatings
    - Strength
      - Can be used alone or in combination with latexes to significantly reduce total binder (latex, starch etc.)
    - Rheology
      - Allows higher coating solids than other natural binders
      - Strong water holding minimizes variation of coating solids in process

⇨ **Total cost reduction + stable (or improved) quality**

Pro-Cote® Soy Polymer Strong Binder



DuPont Soy Polymers

DuPont™ Pro-Cote®
renewably sourced™ soy polymer

Pro-Cote® Soy Polymer
New developments

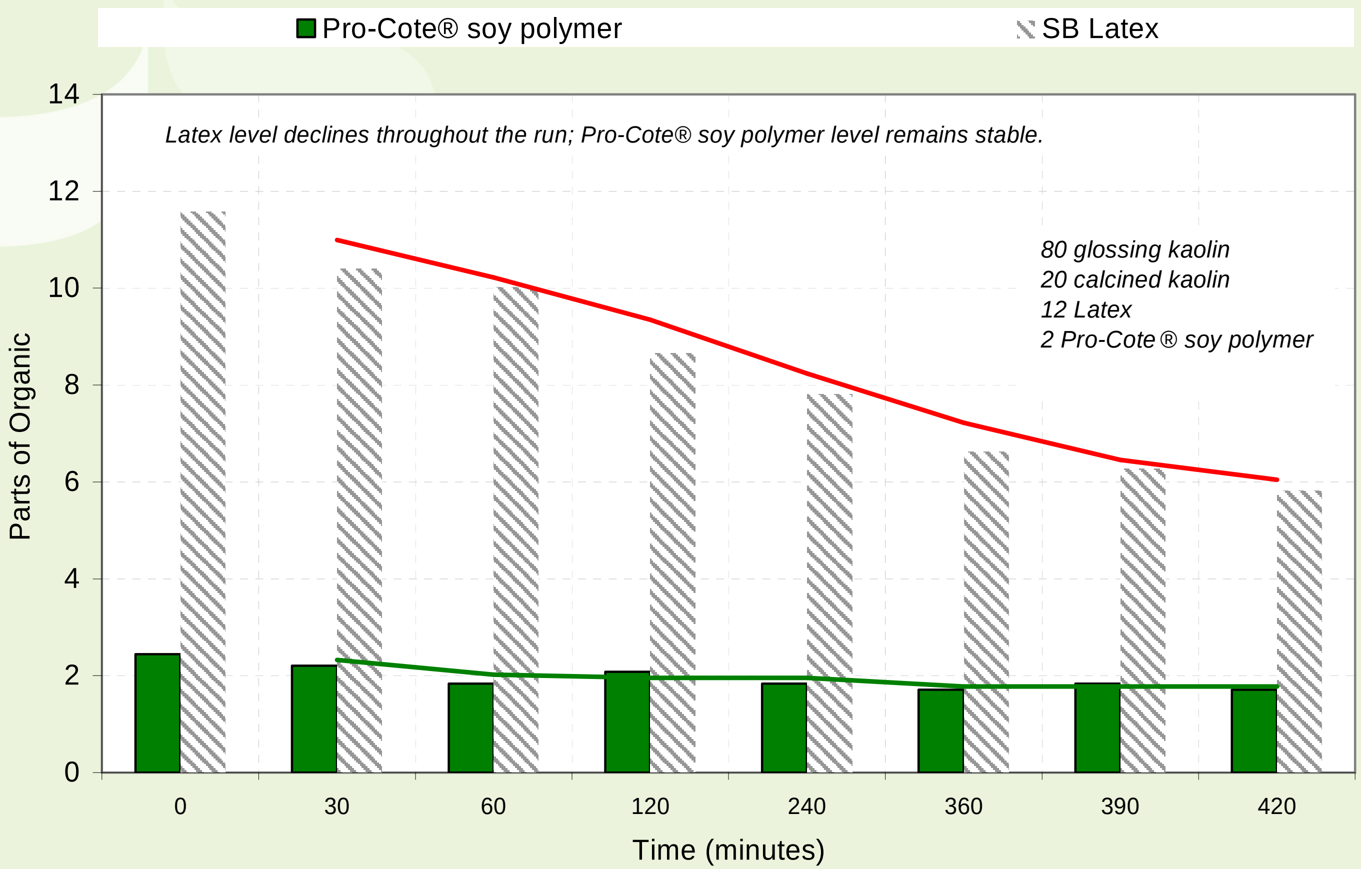
Performance

- **Functionality as adhesives**
  - **In 100% CaCO3 coatings stronger than SB Latex**

- Resist depletion
  - Strongly associated with other coating components
    - Amphoteric (cationic / anionic)
    - Colloidal material

- **Renewable / Sustainable**

Pro-Cote® Soy Polymer Resists Depletion



Pro-Cote® Soy Polymer New Developments

- Pro-Cote® soy polymers are
  - Strong
    - In 100% CaCO3 coatings stronger than SB Latex
  - Resist depletion
    - Strongly associated with other coating components
      - Amphoteric (cationic / anionic)
      - Colloidal material
  - **Renewable / Sustainable – REACH compliant**

Pro-Cote® Soy Polymer renewability & product stewardship

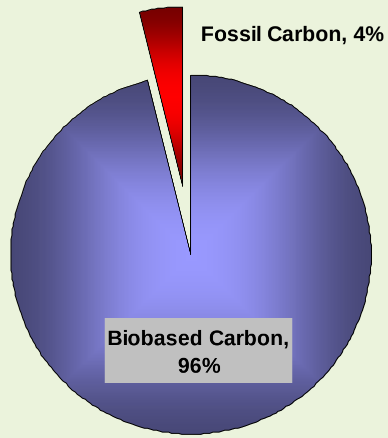
- Pro-Cote® E115702-6 soy polymer
  - Designed to be REACH compliant

    = 100% REACH COMPLIANT

  - soy protein:
    - Biodegradable
    - Renewable
    - Lower CO_2 & energy impact then synthetic alternatives or casein

Pro-Cote® Sustainable Solution

- Renewable, testing according ISO



- Life Cycle Analysis according ISO standards 14040 series:

Per 1000 lbs of Binder (dry basis)				
Impacts	**Units**	**Pro-Cote**	**SBR Latex**	**Pro-Cote Vs. SBR**
Global Warming	g CO2 equivalents	1,033,571	1,397,781	**- 36%**
Fossil Fuel Depletion	MJ surplus energy	2,769	5,786	**- 52%**

Summary
Pro-Cote® soy polymer

⇨ Multi Functional additive,

- Replacing several other components in your coating
- Improved productivity
- Stable/increased quality

⇨ Sustainable solution

- Biodegradable
- Renewable
- Lower CO_2 & energy impact

DuPont™ ProCote®

Renewably Sourced™ Polymer

⇨ REACH Compliant grades

GREATER EFFICIENCY
IN PAPER MANUFACTURING

PaperCon 2010, Atlanta GA

CONTENT

01 FACTS ABOUT XPERION

01 FACTS ABOUT XPERION

- 6 production plants
- 210 empoyees
- Markets: Industry, Aerospace, Energy, Environment, Automotive
- Sales network throughout the world
- xperion built 3500 carbon fiber rolls for paper industry since 1990
  - ➔ e.g. 90 breast rolls for shaken applications, 300 dryer felt rolls, 200 guide rolls for calanders, etc.
  - ➔ in Europe, North America and Asia
  - ➔ for end-users and OEM's

02 TECHNICAL ASPECTS OF XPERION CARBON COMPOSITE PRODUCTS

02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS

SUMMARY OF FEATURES

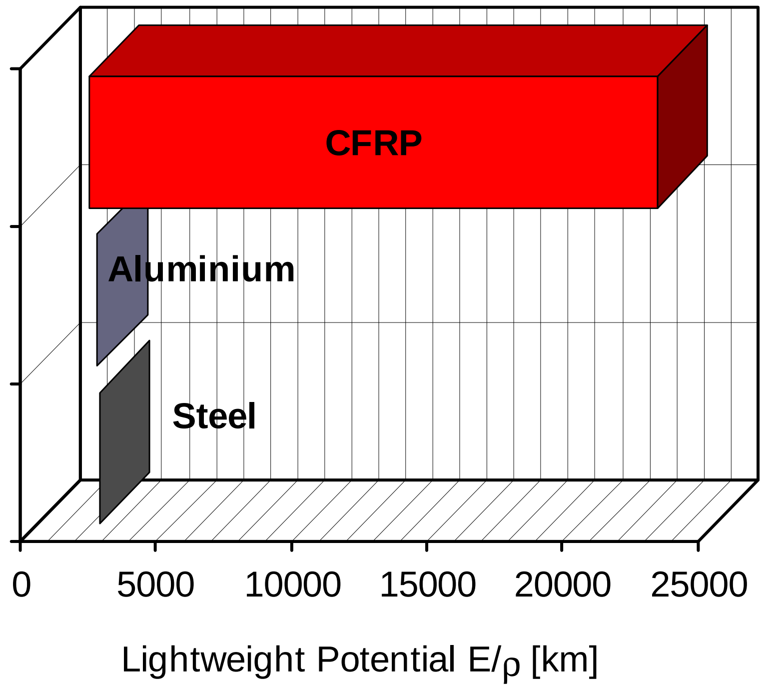
- Twice the speed of a steel roll of same dimensions
- Smooth, more quiet operation and greatly reduced vibration velocities and –paths
- Thermal (dimensional) stable
- Extremely low moment of inertia
- Extremely light
- No corrosion and great chemical resistance

02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS
MAXIMUM LIGHTWEIGHT POTENTIAL

- Ratio of elastic modulus to density (specific rigidity) up to ten times higher with composite roll tubes
- Elastic modulus from 60 to 320 GPa

This means:

- Smaller diameters
- Lower inherent deflection
- Higher speeds

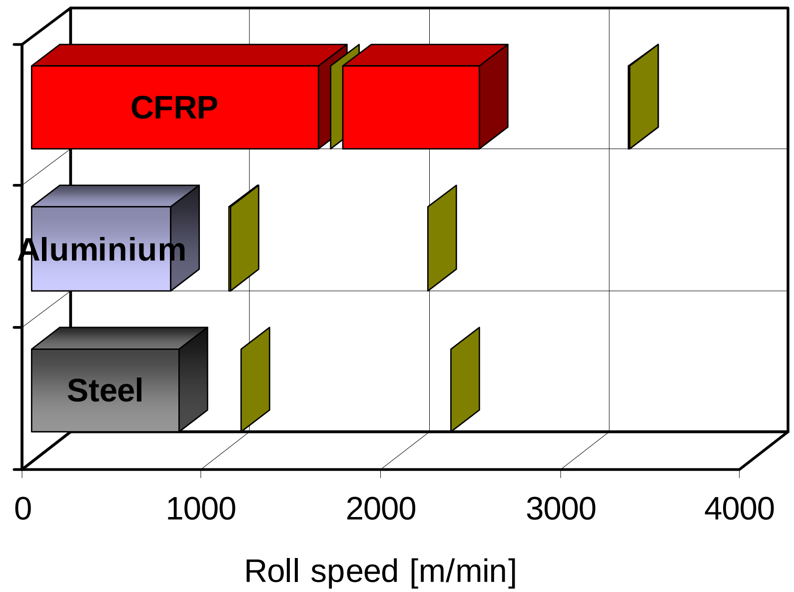


02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS
HIGHER WEB SPEEDS

- steel rolls limited by semi-critical speed
- CFRP rolls can be operated above semi-critical
- operation at semi-critical level with CFRP rolls possible

This means:

- A faster machine with the same roll geometry



Felt guide rolls
Ø545x7400
3000 N/m over 180°
Deflection 0.35 mm/m

xperion

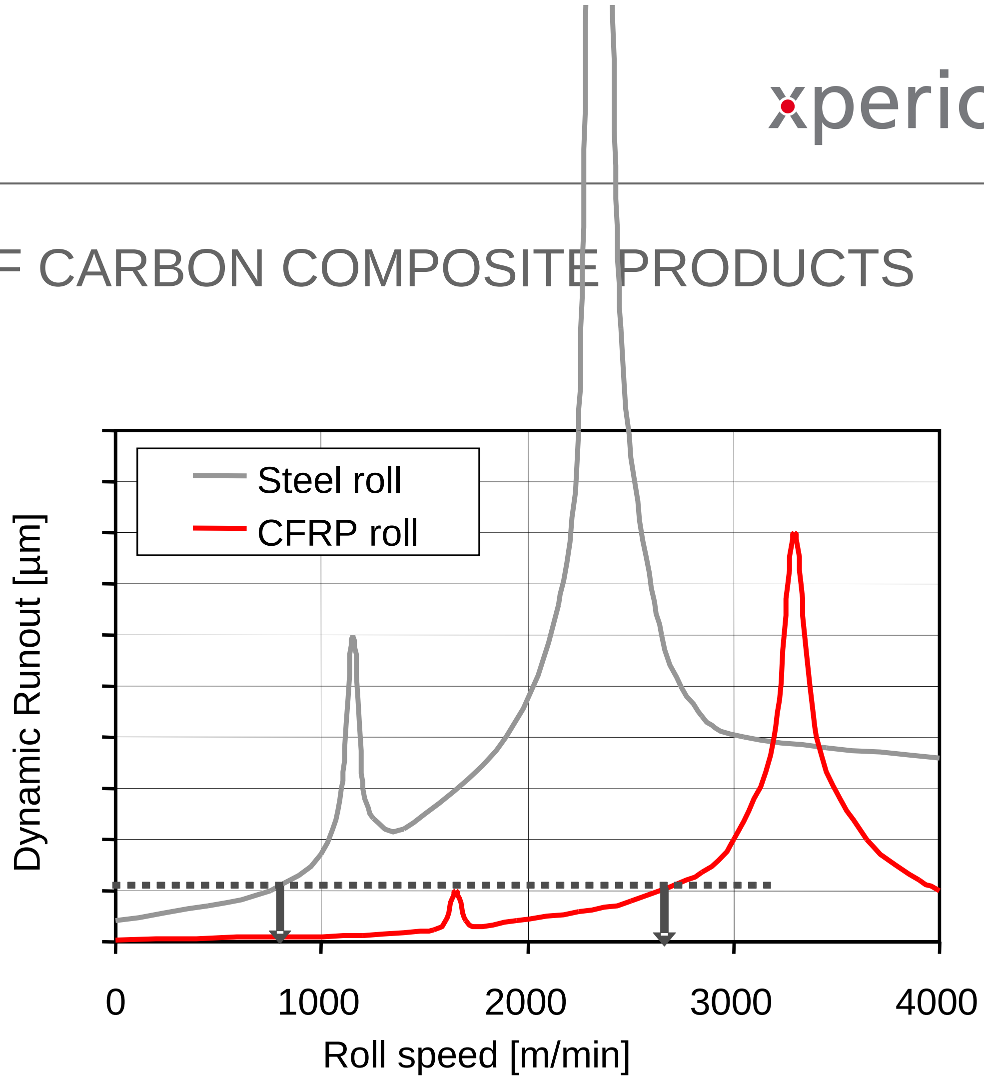
02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS

VERY QUIET RUNNING

- Imbalances much smaller
- Rotor asymmetry much smaller
- Therefore vibrations significantly less pronounced

This means:

- More precise measurements with measuring rolls
- Much higher speed with same uneven running

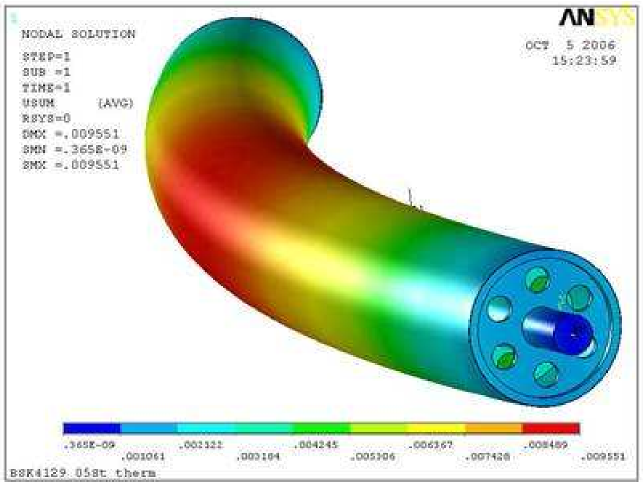


Felt guide roll
Ø545x7400
3000 N/m over 180°
Deflection 0.35 mm/m

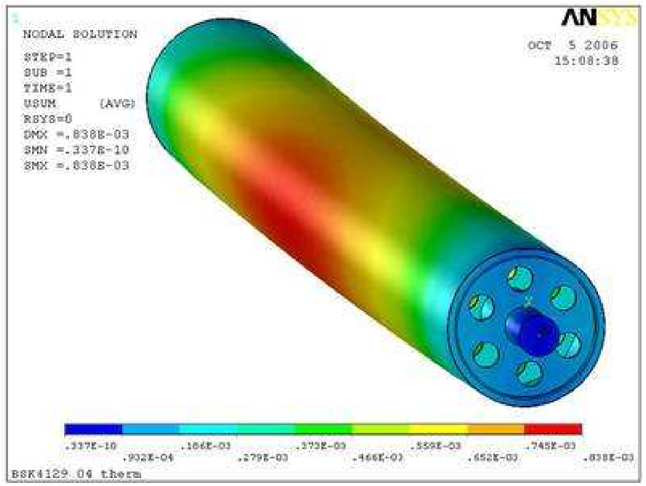
xperion

02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS

THERMAL DIMENSIONAL STABILITY



Steel roll: Deformation 2.39 mm



xperion CFRP roll: Deformation 0.21 mm

- Standard roll laminates have values in the range of 5 to 10 % of steel rolls
- Zero or negative values for thermal expansion of CFRP possible (with laminate optimization)

This means:

- Insensitivity to non-homogeneous temperatures

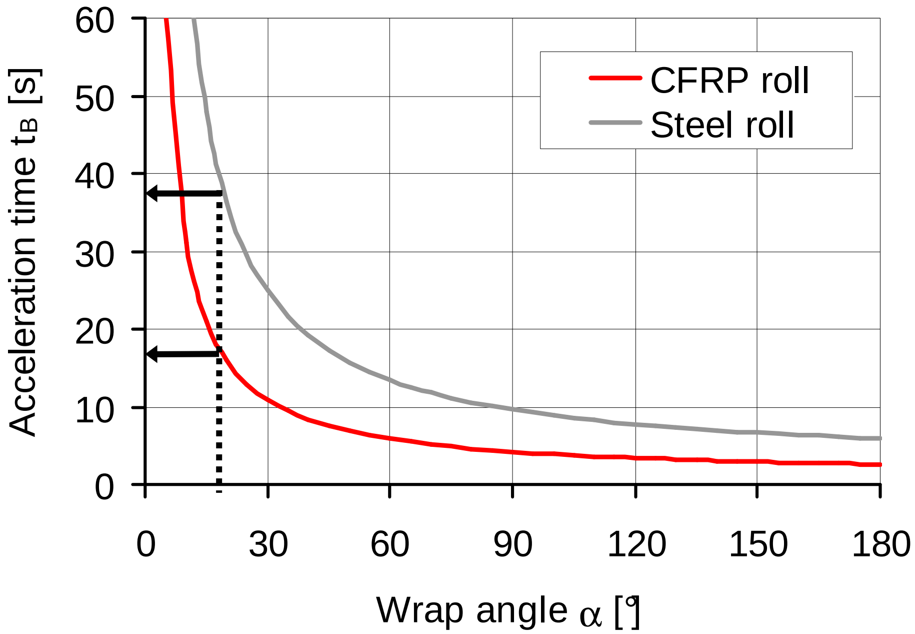
(Deformation exaggerated by a factor of 50)

02 TECHNICAL ASPECTS OF CARBON COMPOSITE PRODUCTS
EASIER START UP

- Low moment of inertia (approx. 10-50% of steel roll)
- Lower friction moments of the roll material are sufficient

This means:

- Lower wrap angles possible
- Faster acceleration with the same wrap angle
- Same acceleration time even with small wrap angle



Coefficient of friction 0.3
Web tension 1000 N/m
Diameter 545 mm
Rolls with the same flexural strength

03 XPERION´s CFRP PRODUCTS FOR PAPER MACHINES

03 XPERION´s CFRP PRODUCTS FOR PAPER MACHINES

RANGE OF PAPER PRODUCTS

X-GUIDE

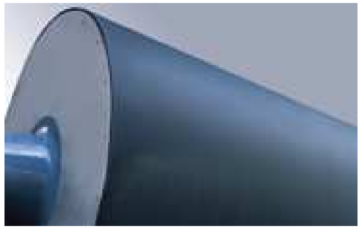
X-GUIDE PLUS

X-TREME

X-SHAKE

X-DOC

X-BOW



X-COAT

X-REEL

Plus e.g. applicator beams, roll segments for winders, composite shells (for textile calanders) etc.

xperion

THANK YOUR FOR YOUR ATTENTION!

Building Leadership Excellence

people resources solutions

Papermakers Presentations

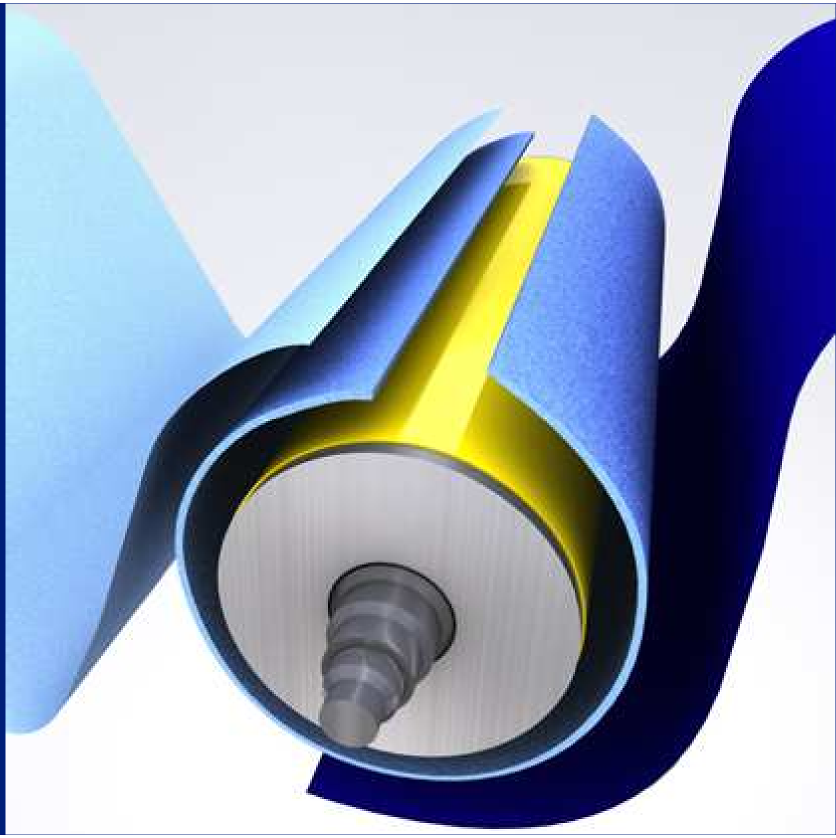
PaperCon 2010 may 2 - 5 atlanta ga

Talent,
Technology and
Transformation

VOITH

TAPPI

PaperCon may 2-5 2010 atlanta ga



New Fabric Technology

Tom E. Coulter
VP Product Management
Voith Paper Fabric & Roll Systems

Agenda

- New Technology Development
- Next Generation Triple Layer Forming Fabric
- Next Generation Hybrid Technology Press Fabric

Papermaking Challenges Drive R&D Efforts

Health & Safety

Energy

Sheet Quality

Production

Environment

Global Product Development and Applied Research

Product Development Groups

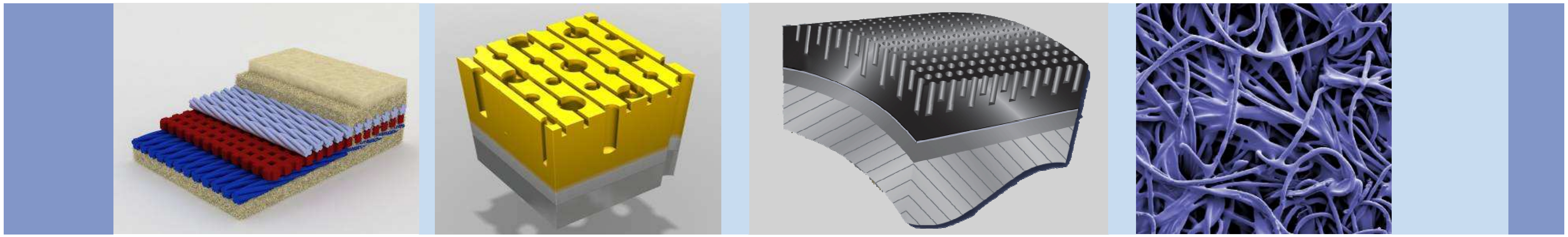
Forming	Press	Drying	FIN

Fabrics & Rolls

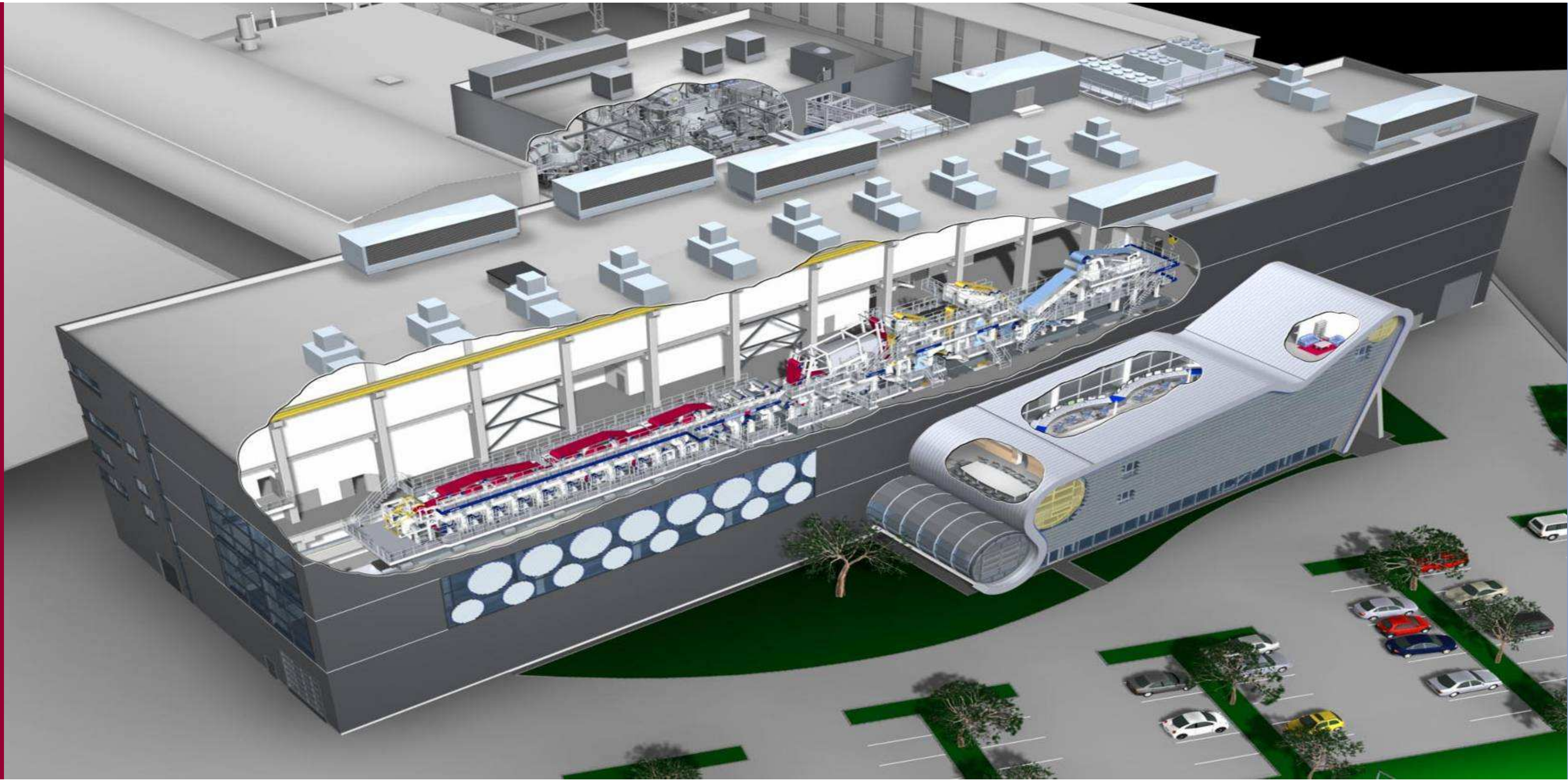
Technology Scale up and Transfer

Research Technology Platforms

- Material
- Surface
- Simulation
- Textile/NW
- Analytic

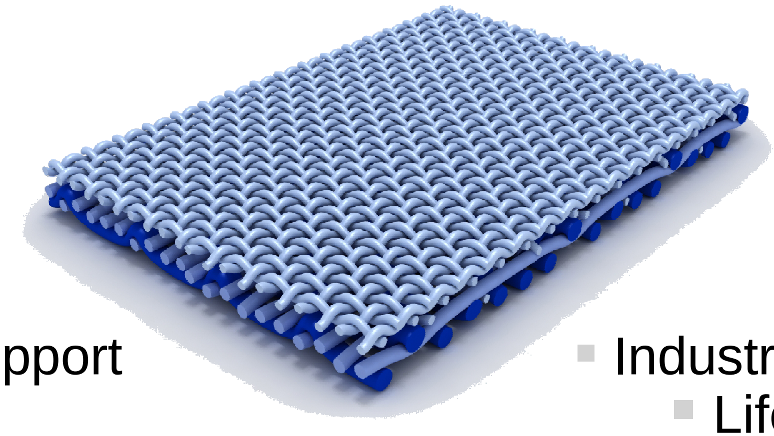


New technology tested at our Paper Technology Center



Next Generation Triple Layer
Designed to meet the full range of customer demands

A unique balance



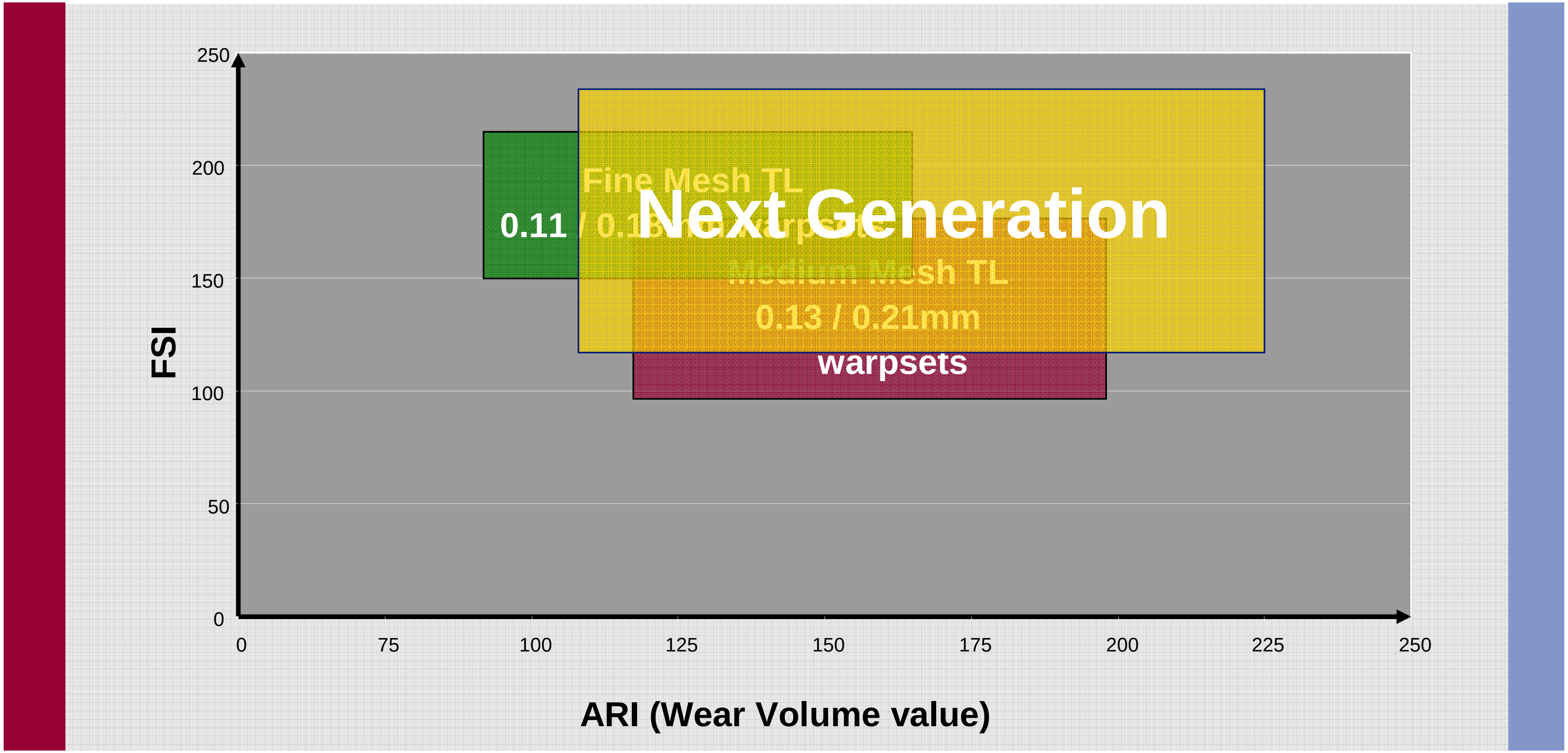
Sheet Quality

- Industry high Fiber Support
  - Fines Retention
  - Formation
  - Cleaner runnability
- Industry high Open Area
  - headbox flows / formation

Performance

- Industry high Wear Volume
  - Life Potential
- Thin Caliper (down to 0.026”)
  - Couch Solids
  - Cleaner runnability

Comparison of Features – Next Generation vs Conventional Triple Layer



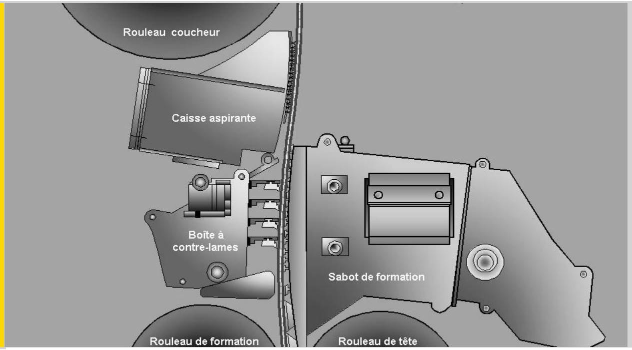
Next Generation - Results

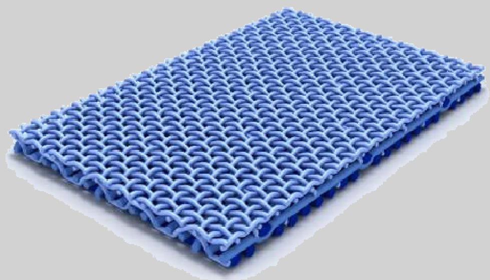
Machine Data

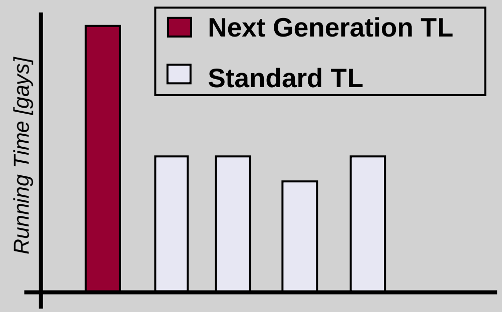
Grade	Woodfree-Coated
Furnish	Pulp
Former	BelBaie
Speed	4100 fpm (1250 m/min)
Width	330” (8.50 m)

Results / Benefits

- **Exceptional fabric stability**
  - “most stable design we have ever run on Backing Position”
- **Increased Drainage**
  - Sheet Formation improved with higher headbox flows
- **Industry high Wear Volume**
  - Competition triple layer averaged 42 days
  - Next Generation has run 87 days
- **Ran cleaner than other designs**

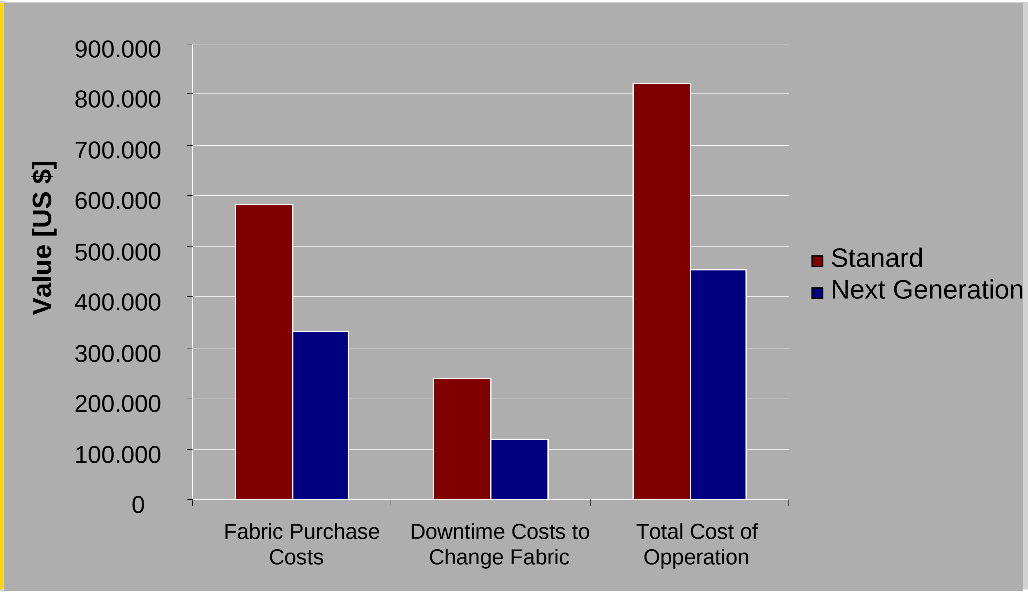






Next Generation - Results

Mill Cost Benefits by Increased Backing Position Fabric Life



Annual Costs of Operating

Backing Fabrics on PM7 Backing

- Fabric cost savings = $ 250,000
- Down time savings = $ 120,000
- Total Annual Savings = $ 370,000

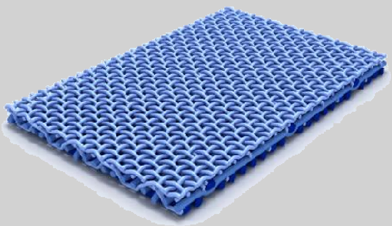
BelBaie – WoodFree Coated

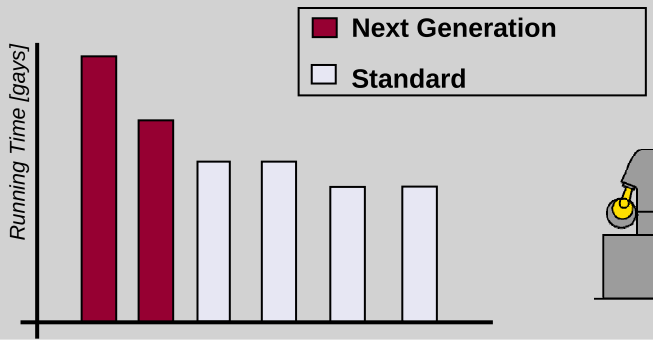
Next Generation - Results

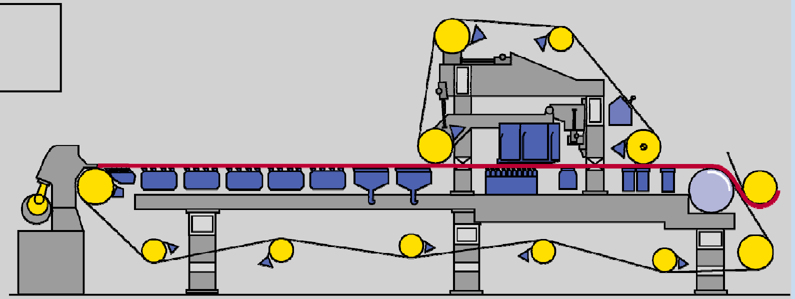
Machine Data	
Grade	Newsprint
Former	DuoFormer D
Speed	3805 fpm (1160 m/min)
Width	290” (7.30m)

Results / Benefits

- **Significant increase in fabric wear potential**
  - TL competition averaging under 50 days
  - Next Generation has run over 100 days
- **Increased mechanical retention**
  - reduced Retention Aide usage / improved Formation
  - Reduced drive loads
- **Improved MD stablity – limited Stretch Roll capacity**







Next Generation - Results

Mill Cost Benefits by Increased Base Position Fabric Life

Cost comparison	Competitor	Voith
Fabric cost ($)		
Life time (days)	40	80
Fabric changes / year	9	5
Cost savings		**300 000**
Fabric costs ($/year)	**$720 000**	**$420 000**
Additional benefits		**Lower power consumption**
Additional benefits		**Reduced retention aid usage**

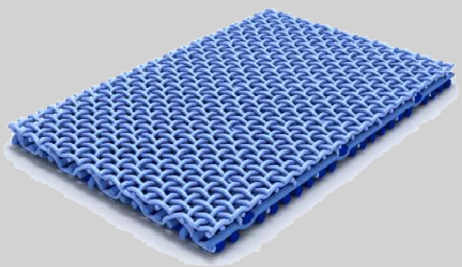
Next Generation - Results

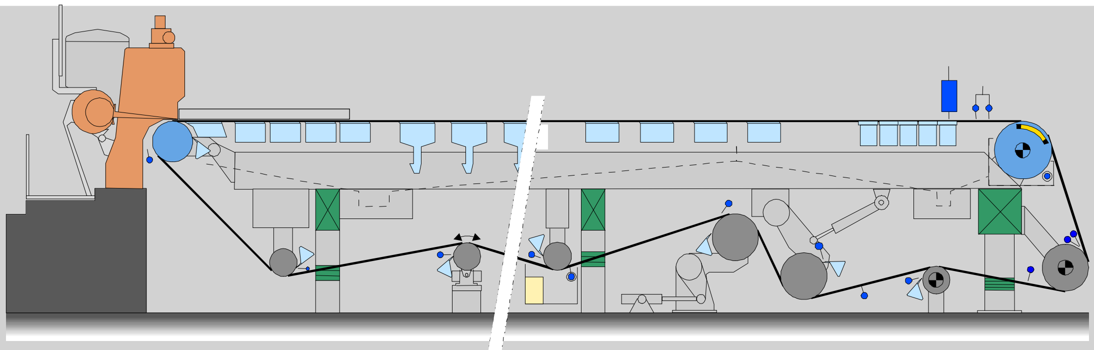
Machine Data

Grade	LWC
Former	Fourdrinier
Speed	4100 fpm (1250 m/min)
Width	330” (8.40 m)

Results / Benefits

- **Increased headbox flows compared to competition products**
  - cleaner HB operation / reduced wet end breaks
  - Improved Formation
- **Eliminated Stock-On Stock-Off guiding issues**
- **Improved Trim quality**
- **Improved sheet 2-sigma profile**
- **Excellent wear potential / excellent stability**
- **Improved Couch Solids by 0.5 – 1.0%**

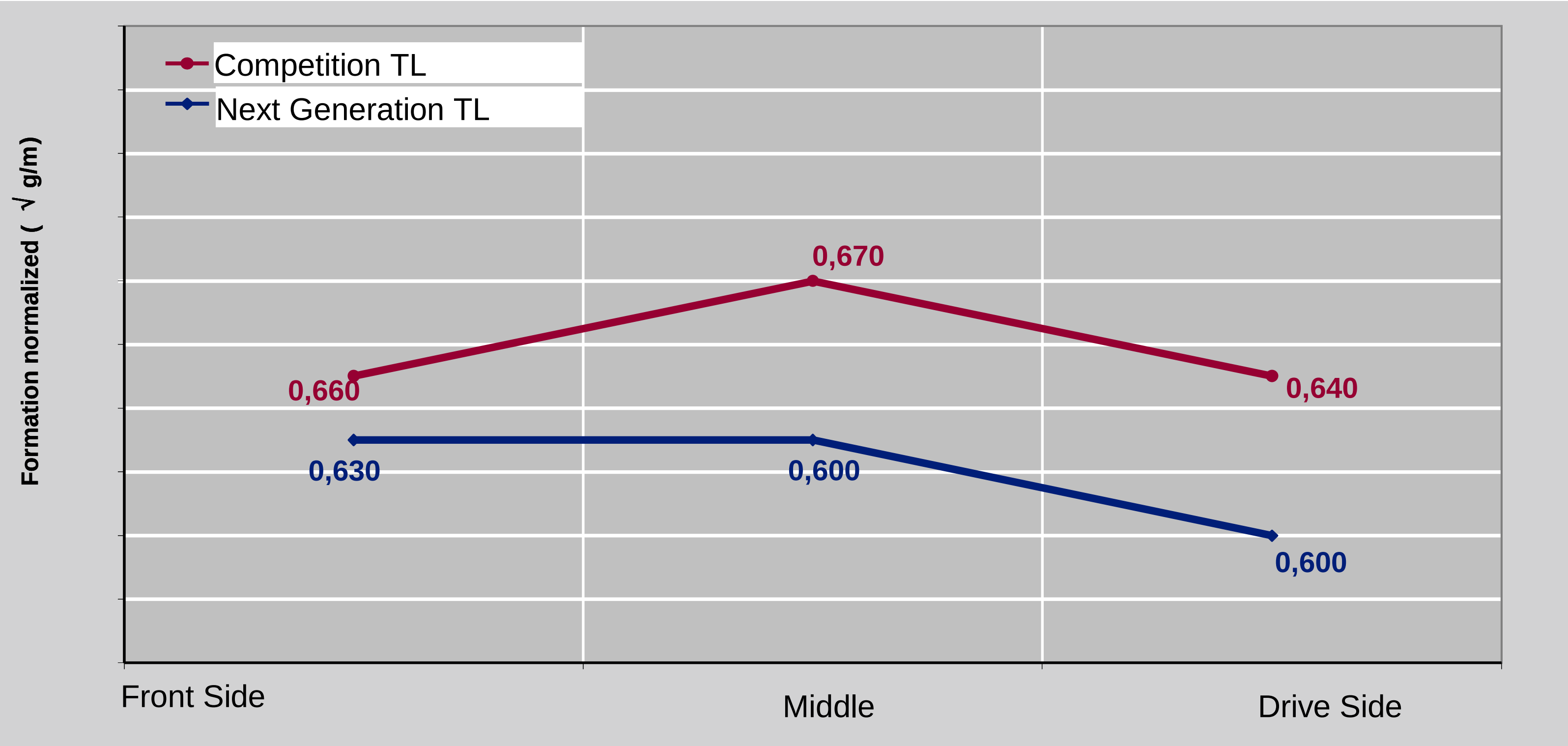




Next Generation - Results

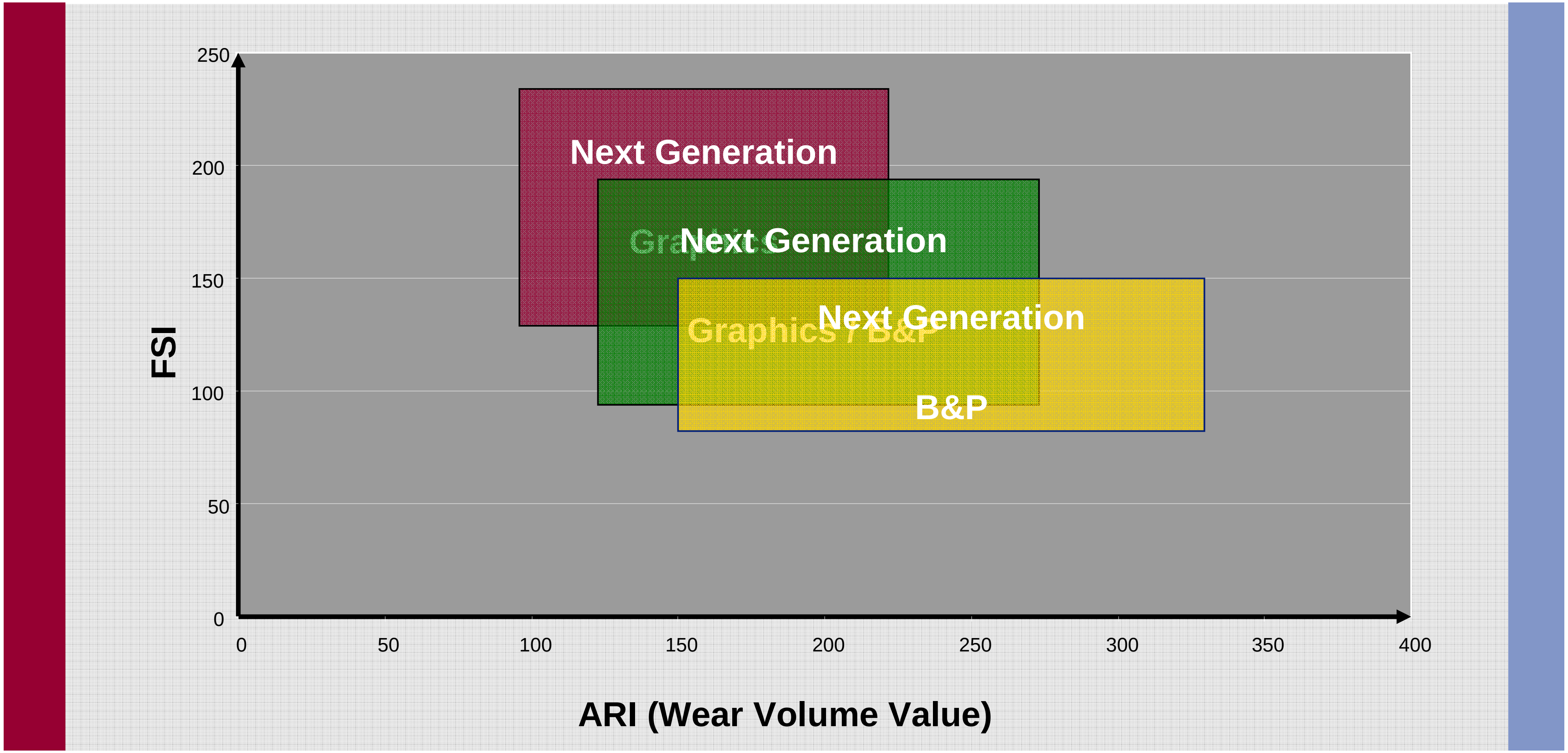
Formation Improvement

Ambertec Formation (Standard Deviation – lower values = better formation)

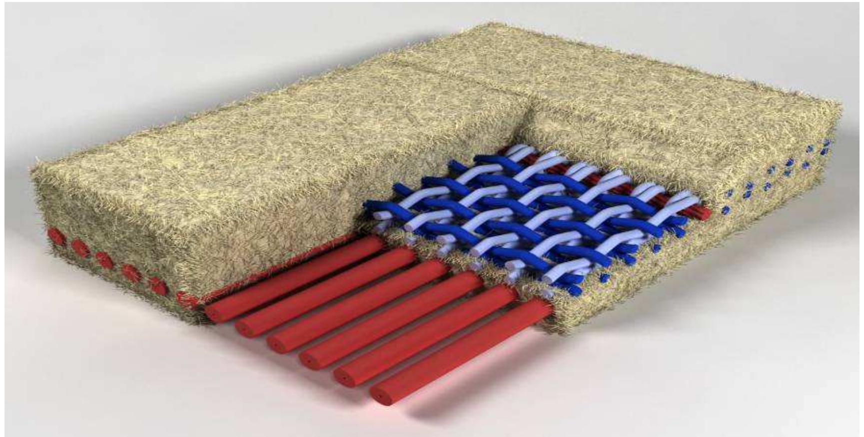


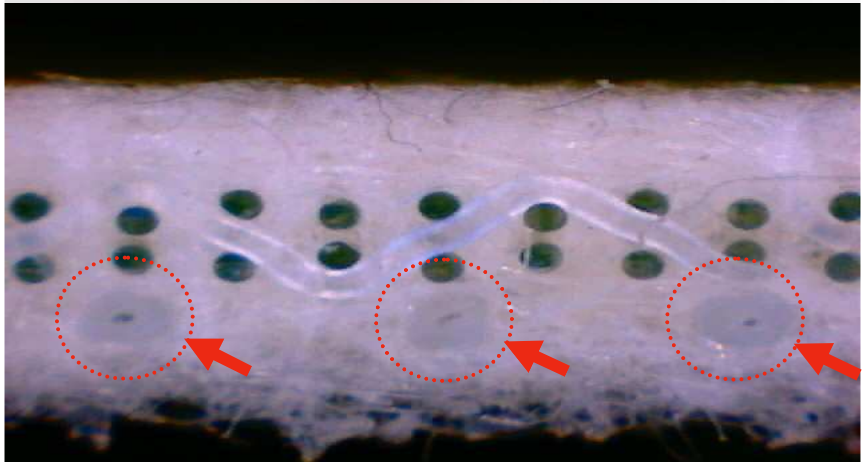
Fourdrinier – LWC

Next Generation Series of Products



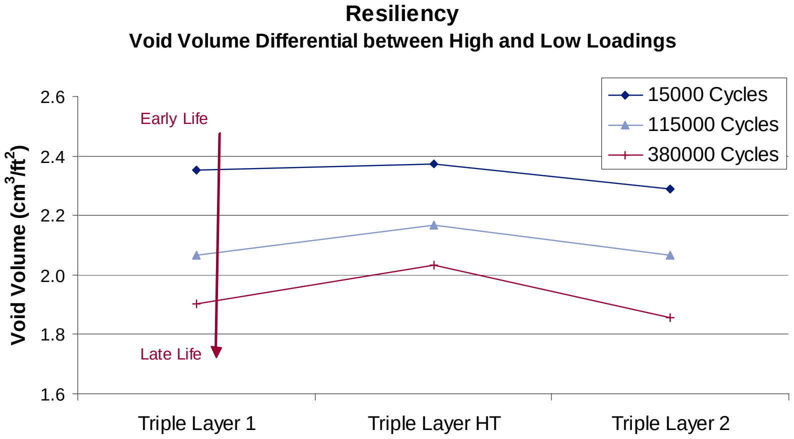
Press Fabric Innovation – Hybrid Technology

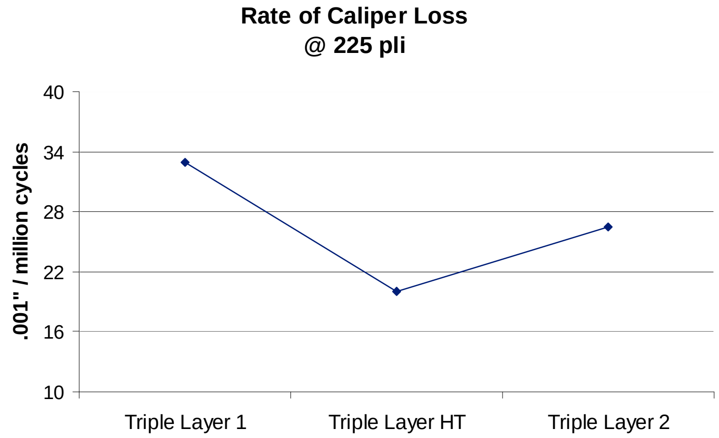


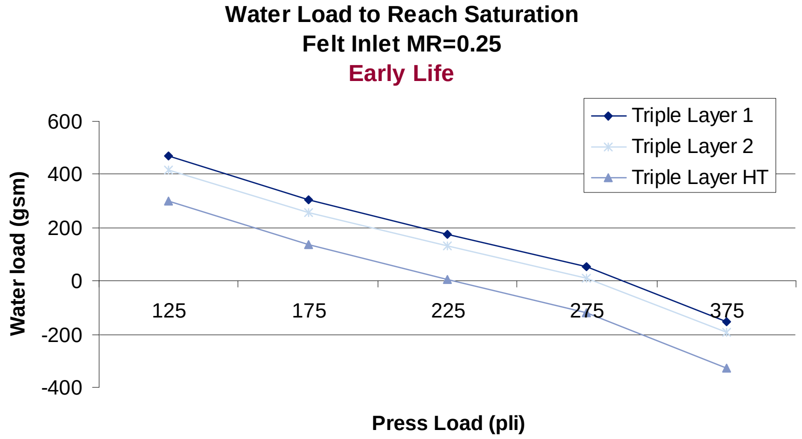


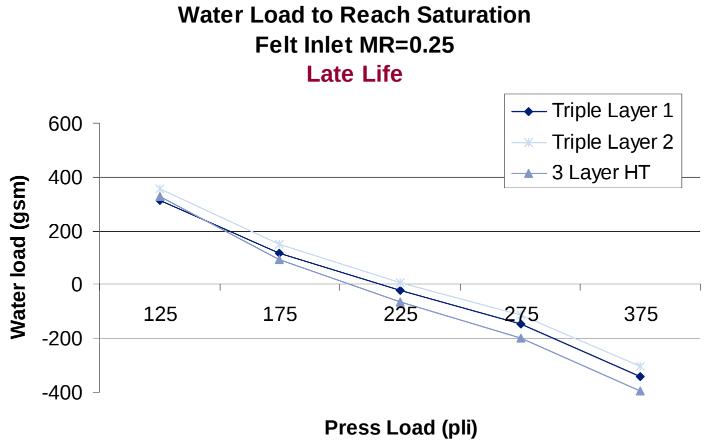
- **Non-woven, elastomeric roll side structure.**
  - Elastomeric Yarn provides resiliency for vibration dampening and steady state pressing throughout felt life.
  - Compressibility provides a quick startup and increased nip dewatering if applicable.
  - MD rollside Flow Channels provide low MD flow resistance and increased dewatering rates.

Press Fabric Innovation – Hybrid Technology







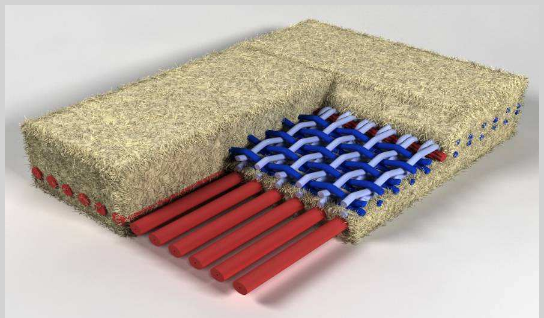


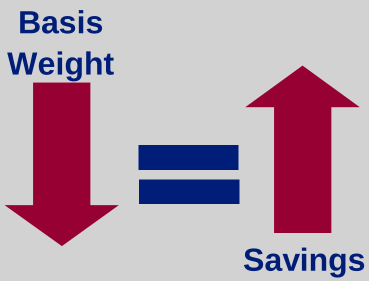
Hybrid Technology Seamed Press Fabric Results

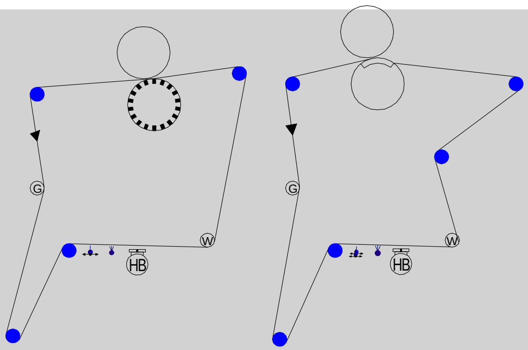
Machine Data	
Grade	Coated Bleached Board
Press	Open Draw 2nd
Speed	1000 fpm (300 m/min)
Width	220” (5.6m)

Results / Benefits

- **Basis weight reduction on 8-12 pt. grades**
- **1.35% weight reduction, equates to 154 tons/month**
- **Customer verified $526,300 savings per year**







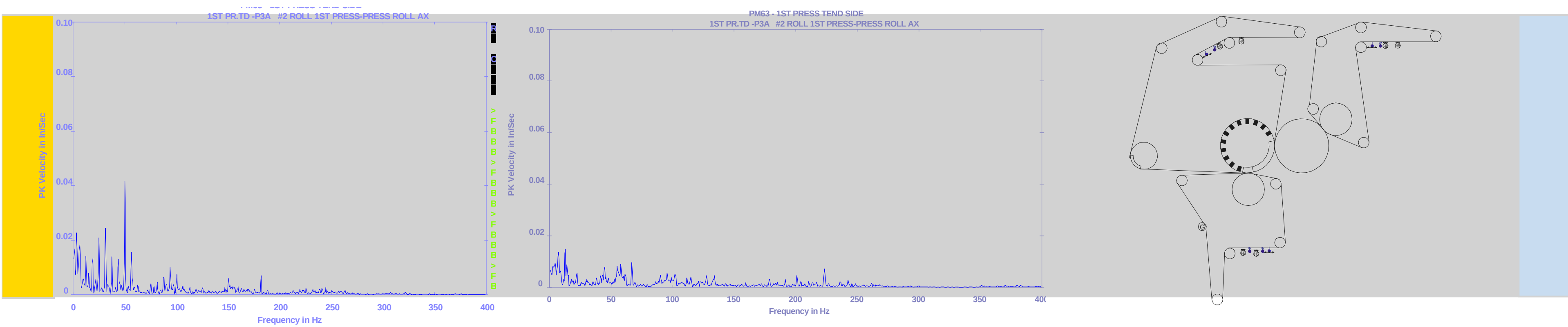
Hybrid Technology Seamed Press Fabric Results

Machine Data	
Grade	Uncoated Free
Press	Tri-Np Btm
Speed	3000 fpm (909 m/min)
Width	278” (7m)

Results / Benefits

- **Fabrics run smooth early in life. Vibration increases after two weeks as the fabric compacts and fills.**

- **HT fabric ran 32 days – scheduled off with no increase in vibration noted through run**



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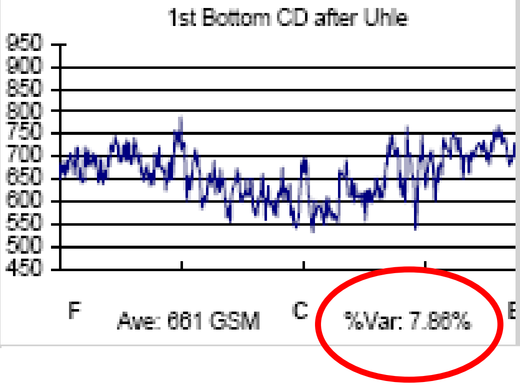
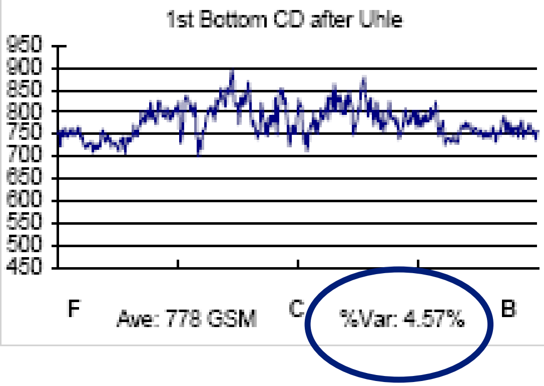
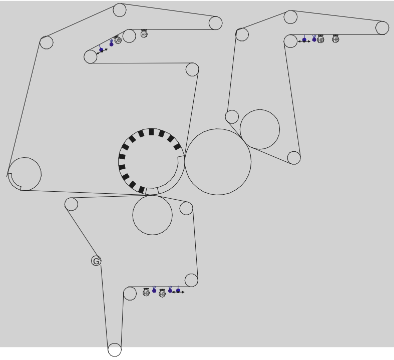
- **Improved CD moisture profile variation by 40%**







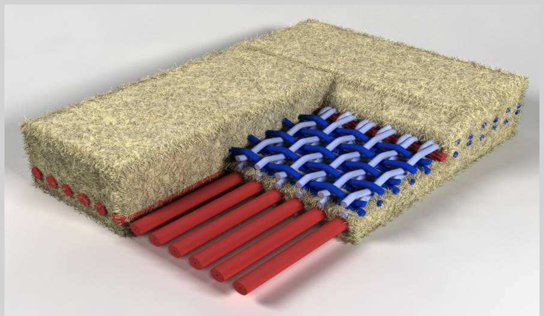
Hybrid Technology Seamed Press Fabric Results

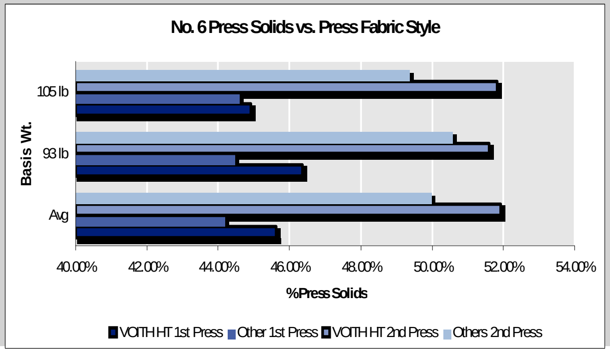
Machine Data

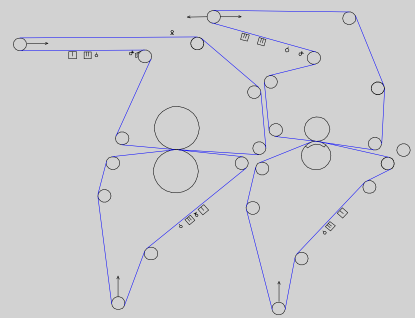
Grade	Coated Liner
Press	DBL Felted 1st & 2nd
Speed	1300 fpm (394 m/min)
Width	234" (5.9m)

Results / Benefits

- **Increased press exit solids 1.5- 2%**
- **5.2% TPH increase on average**
- **Improved speeds all grades**
- **Lower uhle box vacuums over life**
- **3% reduction in basis weight on average**

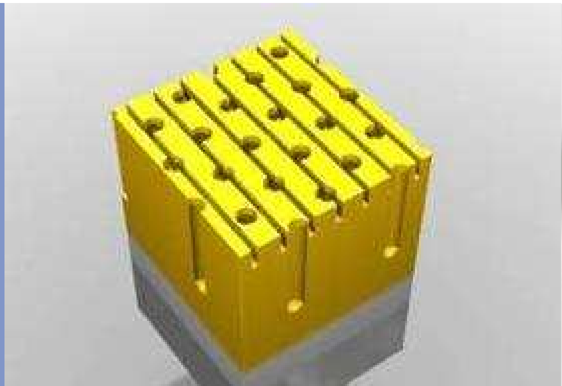


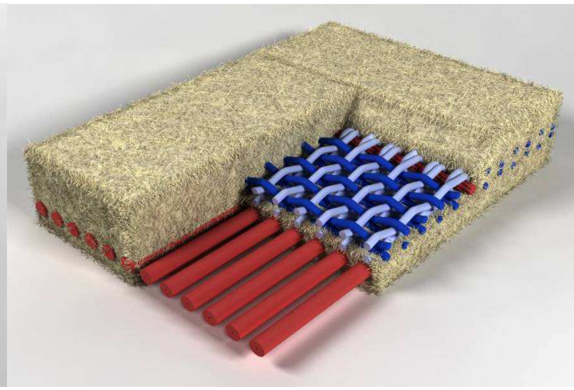


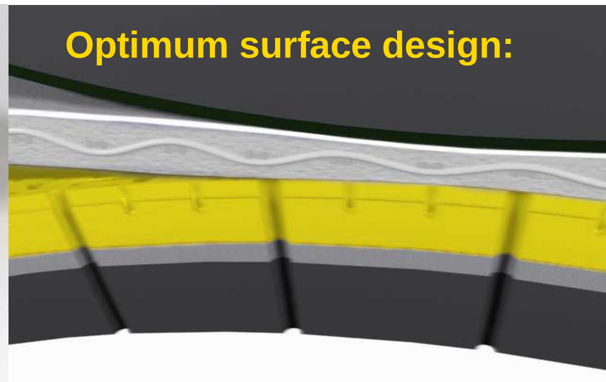


Combination of Poly Roll with maximum surface design with HT Fabrics will optimize press performance

- Optimum “bridging effect“
- Lower flow resistance in Z-direction
- No groove closure
- Elimination of fabric wear (roll side)
- High uhle or nip dewatering depending upon application
- Optimum utilization of the void capacity under pressure







Improving Dry-end Operation OEE (Overall Equipment Efficiency)

PaperCon 2010
may 2 - 5
atlanta ga

Talent,
Technology and
Transformation

Introduction

- 27 Years of experience in the P&P industry.
- 70+ JumboMaster® systems installed.
- 1.2% average slab-off reduction.
- Different grades (Newsprint, CFS, LWC, MFC, SCA, Fine, Directory).

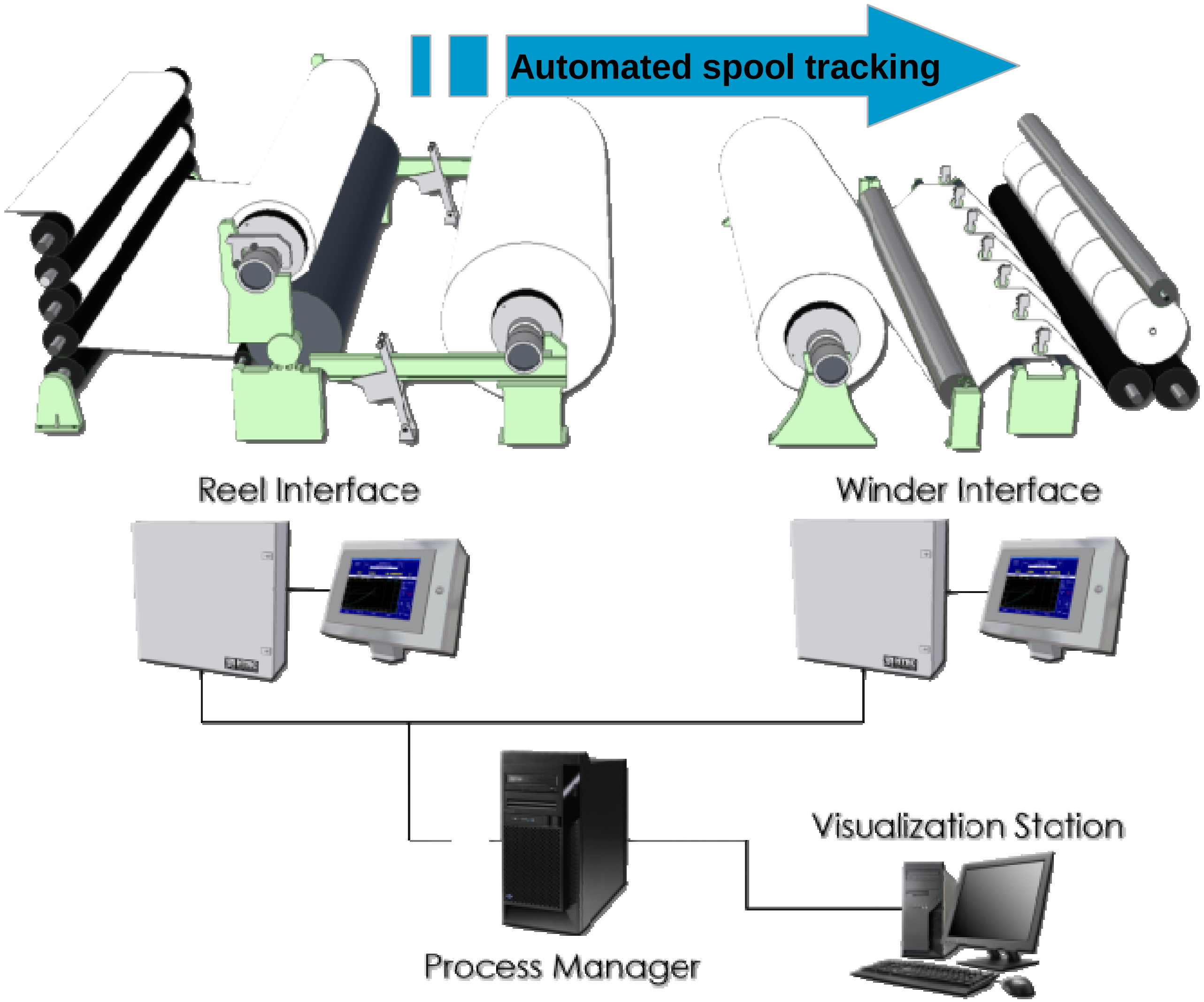
Introduction

- Installed on most machine builders equipment and vintages.
- In-depth analysis of data obtained from our systems demonstrated possible improvements:
  - **0.35% losses on average.**
  - **10% productivity.**
  - **$100,000 transportation costs.**

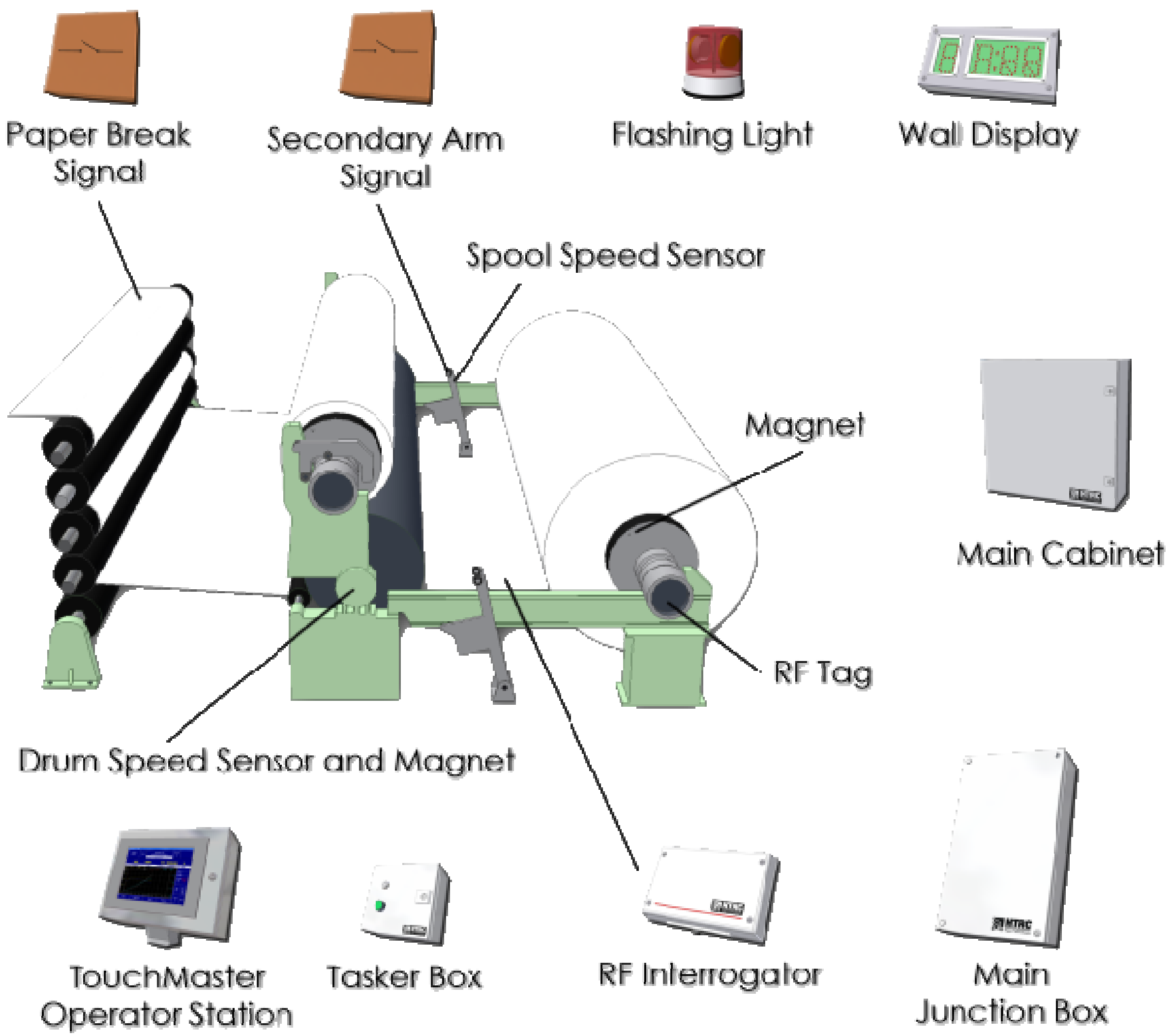
Introduction

Met to Imp	1	2	3	4	5
101.6	23.4	40.6	54.9	67.3	78.2
106.7	25.4	43.7	58.7	71.9	83.6
114.5	28.4	48.5	64.8	79.0	91.7
127.0	33.5	56.4	74.9	90.9	105.2

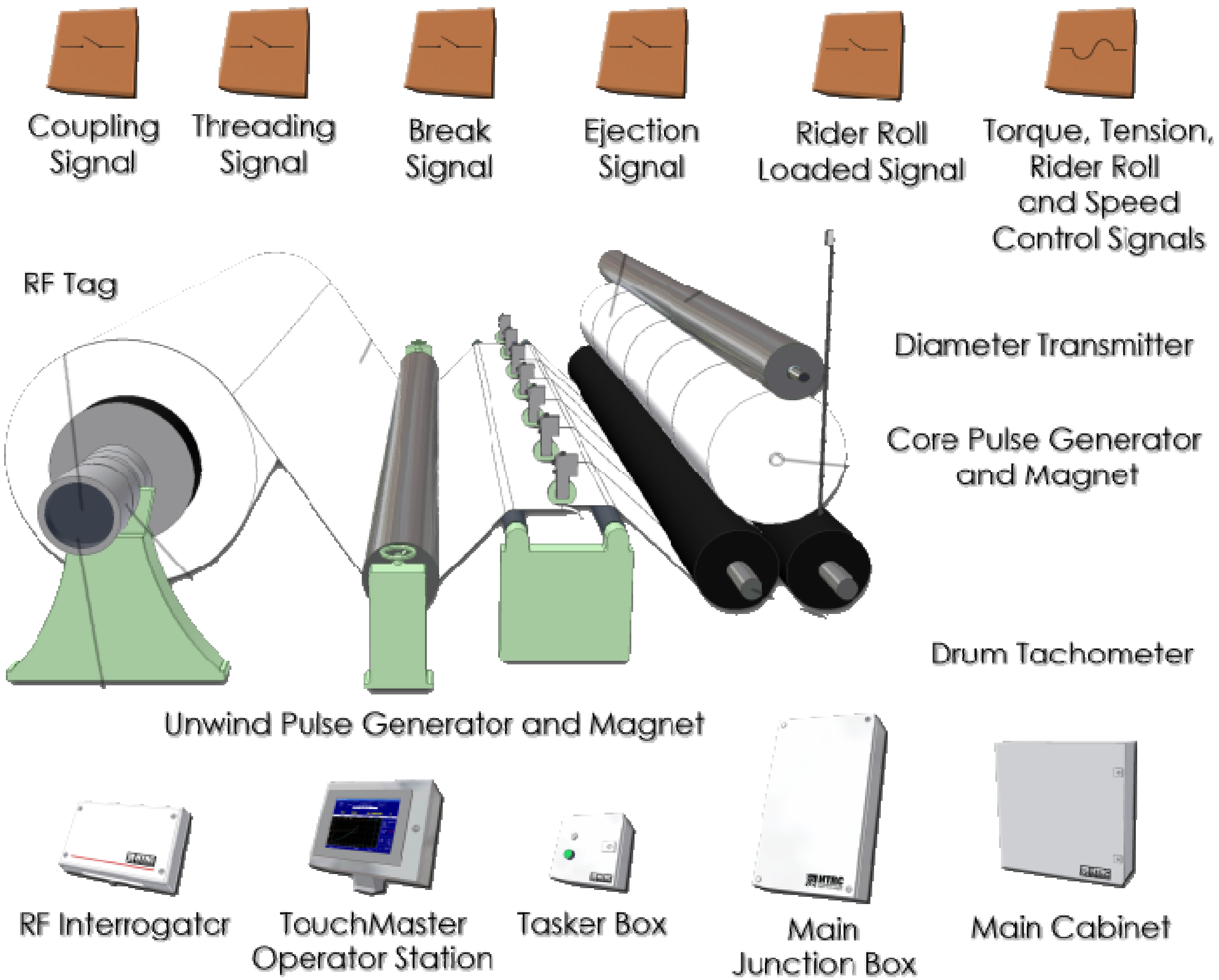
System Overview



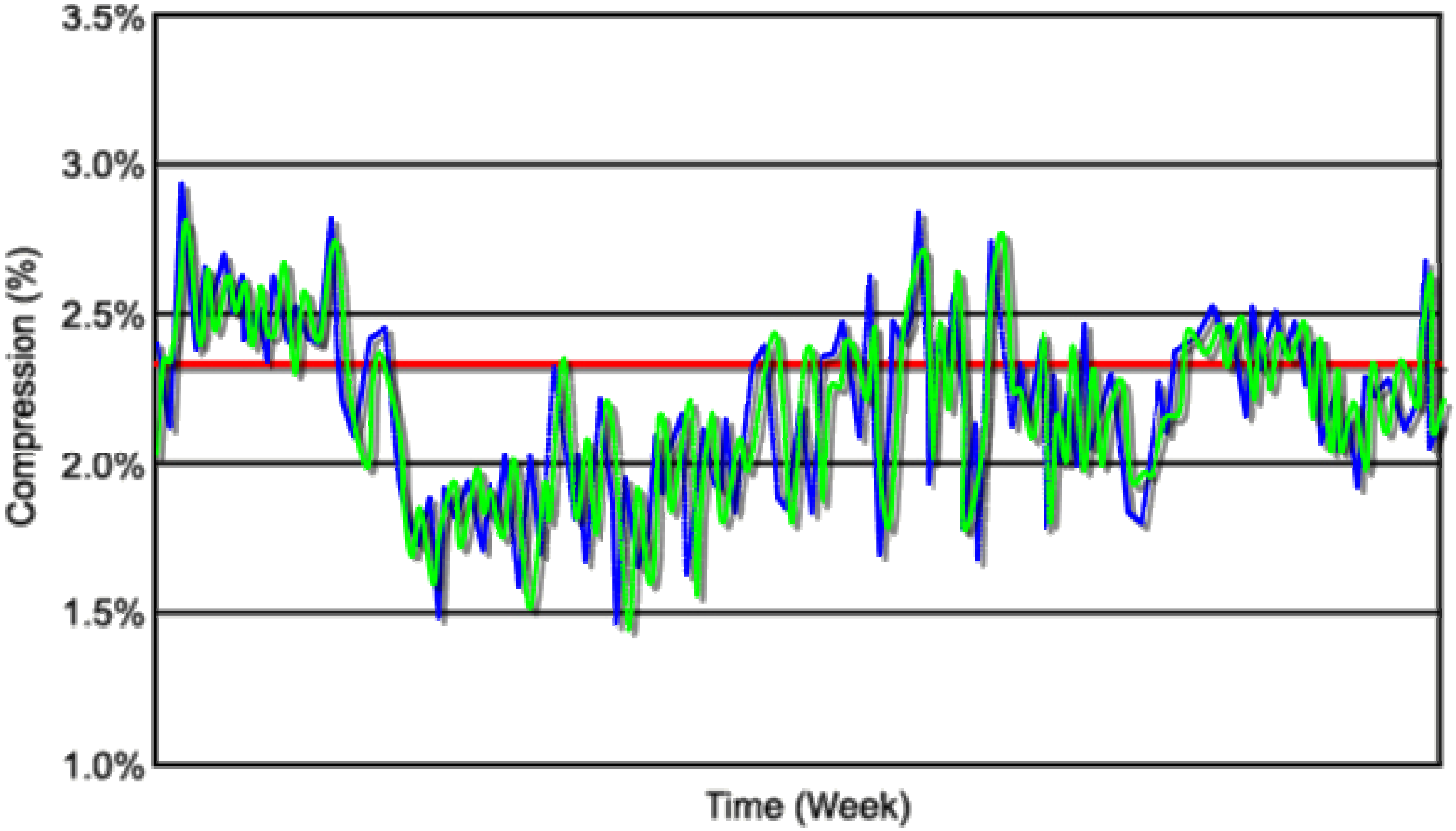
Reel technical interface



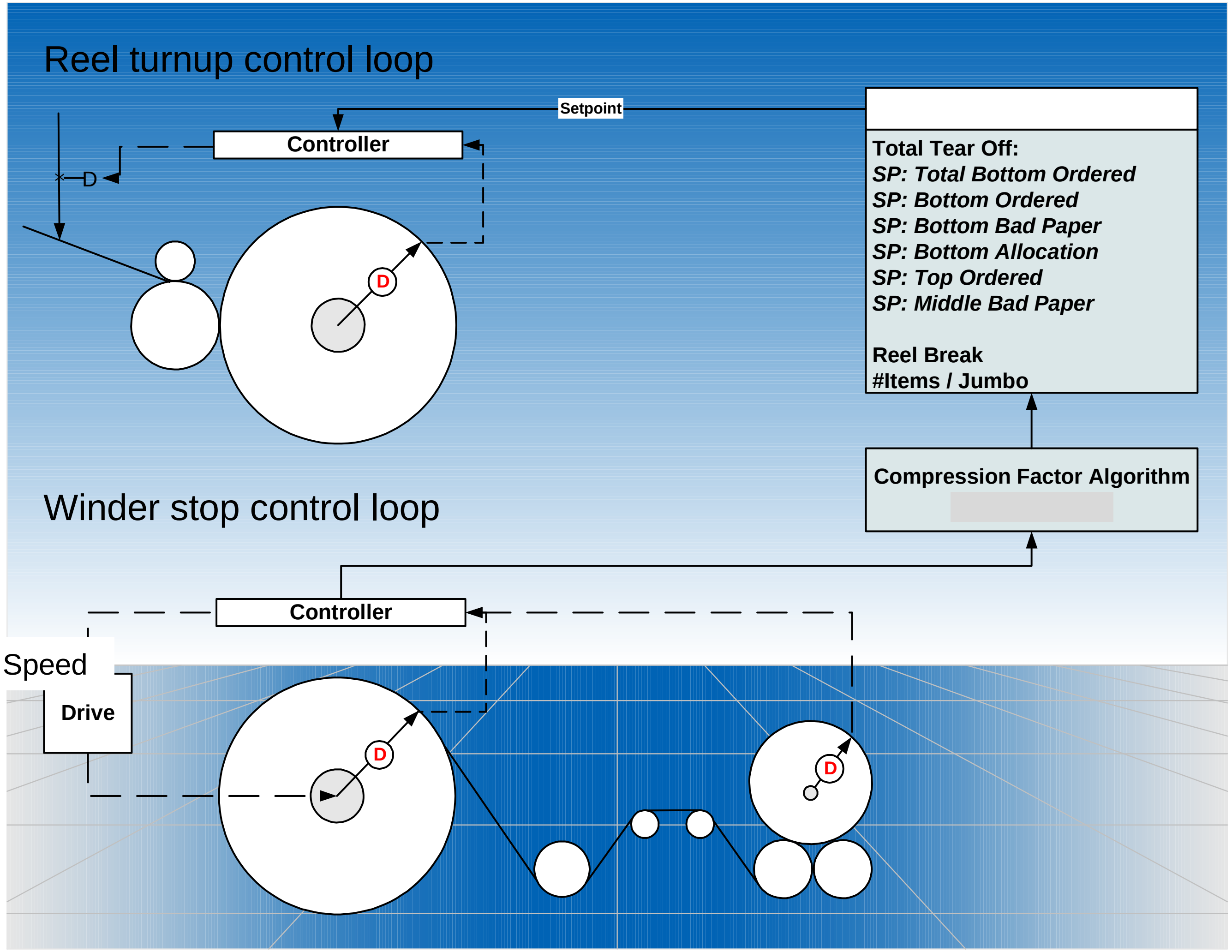
Winder technical interface



Varying Compression at the Winder



Closed Loop



Reel turnup control loop
Setpoint
Controller
D
D
Total Tear Off:
SP: Total Bottom Ordered
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SP: Bottom Bad Paper
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SP: Top Ordered
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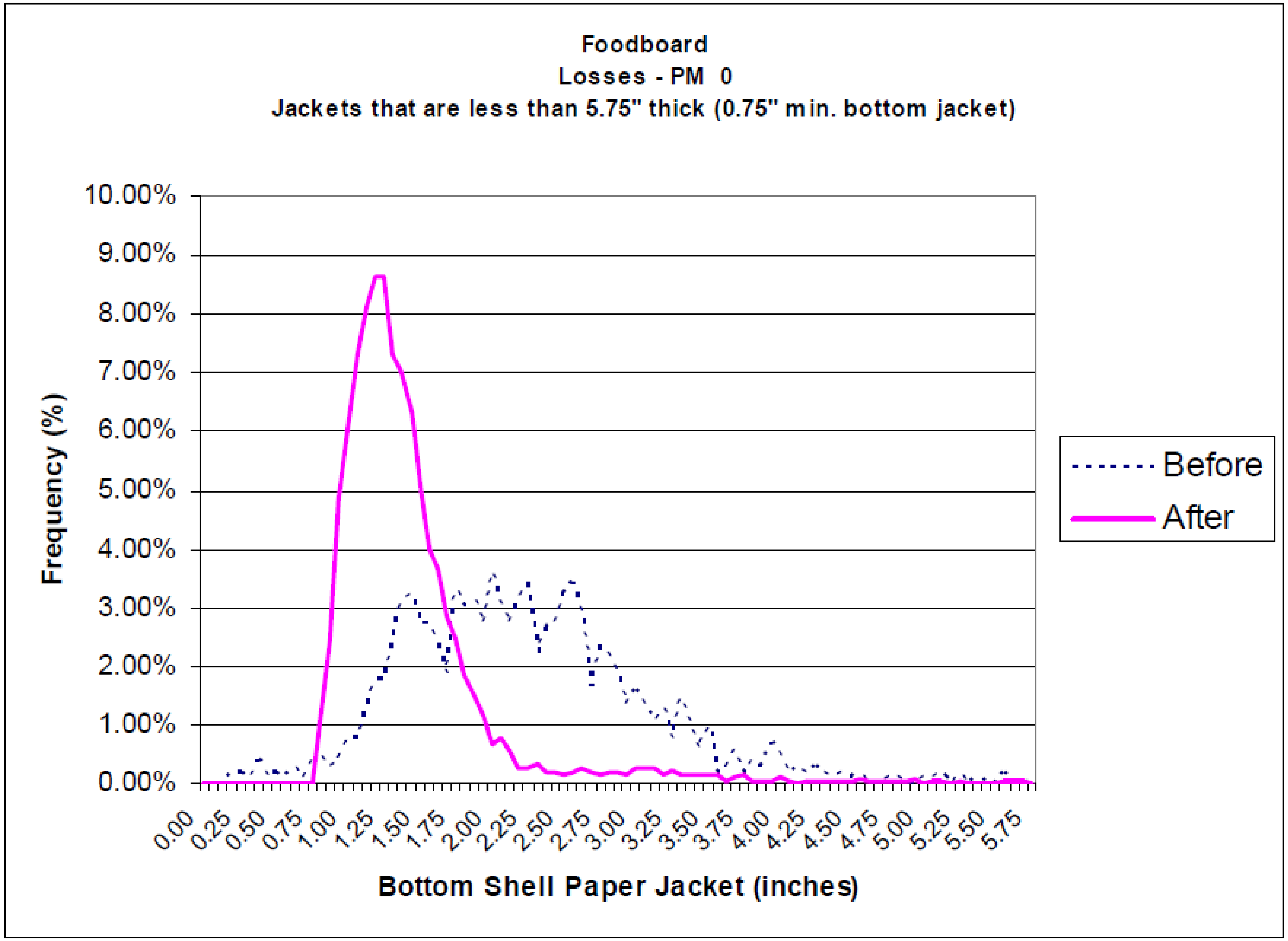
D

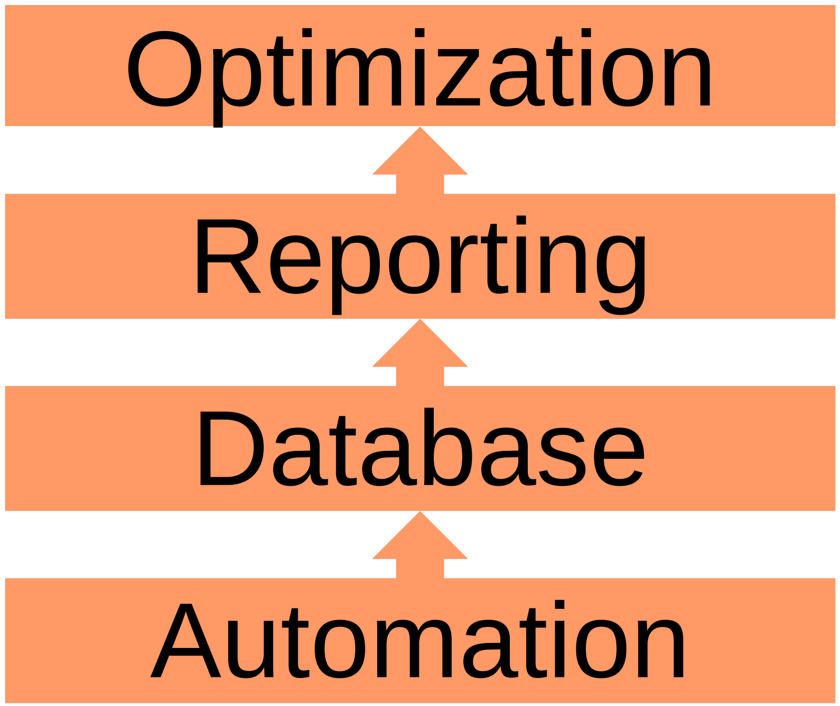
Reduced Variability - Foodboard sample



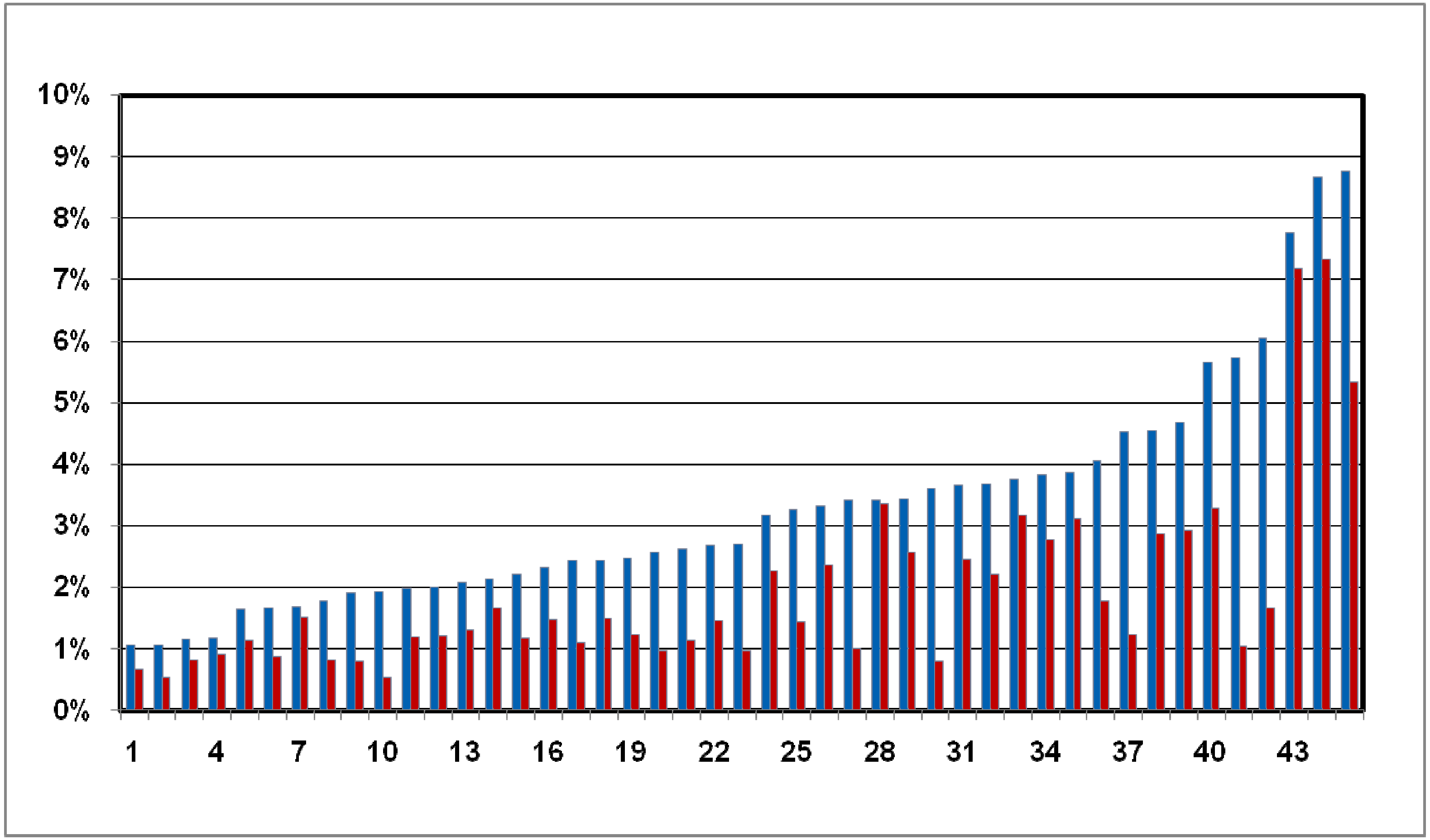
Optimization

TAPPI people resources solutions

PIMA Building Leadership Excellence



Benchmarking



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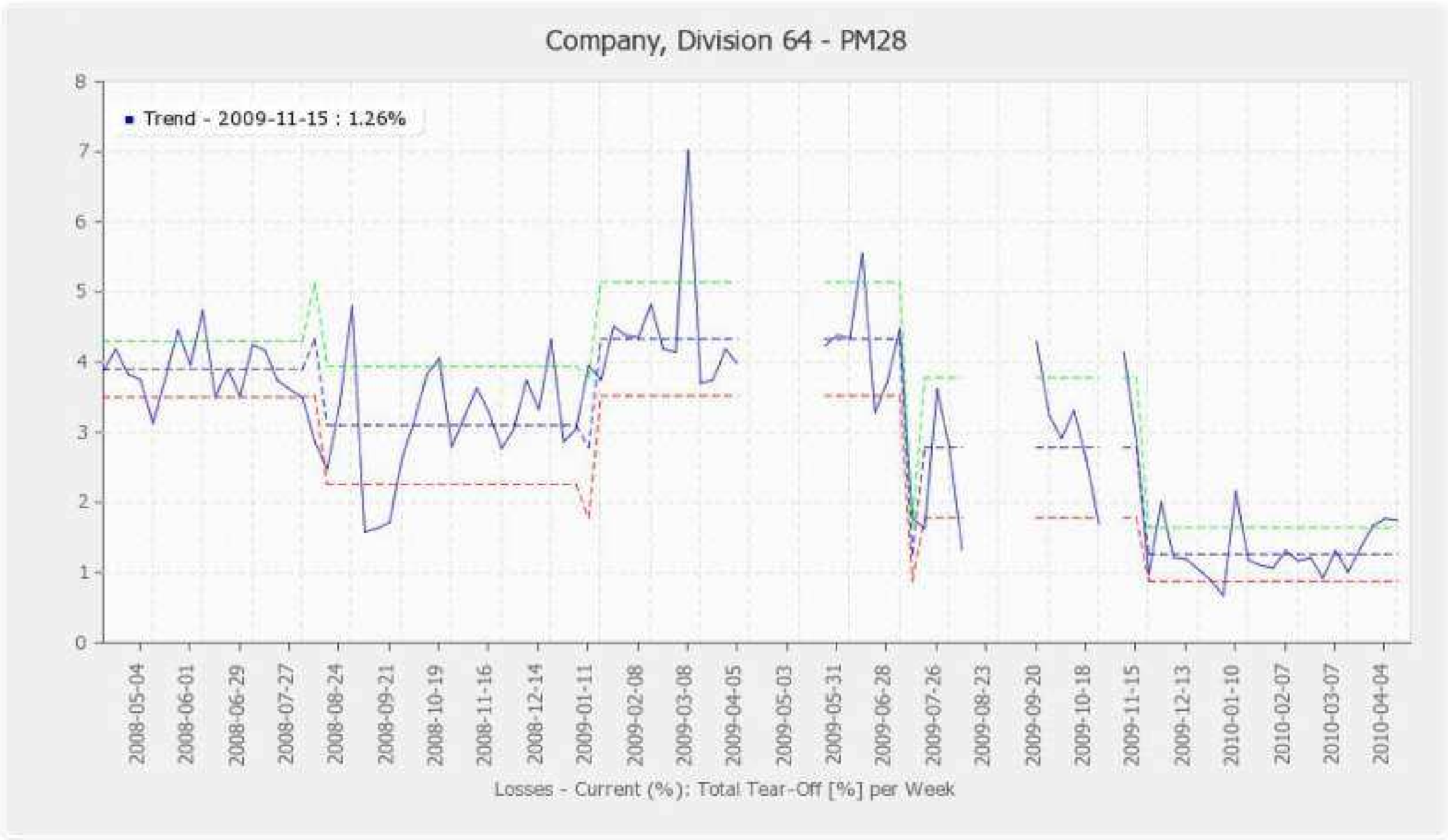

Company, Division 64 - PM28
Trend - 2009-11-15 : 1.26%
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2008-06-01
2008-06-29
2008-07-27
2008-08-24
2008-09-21
2008-10-19
2008-11-16
2008-12-14
2009-01-11
2009-02-08
2009-03-08
2009-04-05
2009-05-03
2009-05-31
2009-06-28
2009-07-26
2009-08-23
2009-09-20
2009-10-18
2009-11-15
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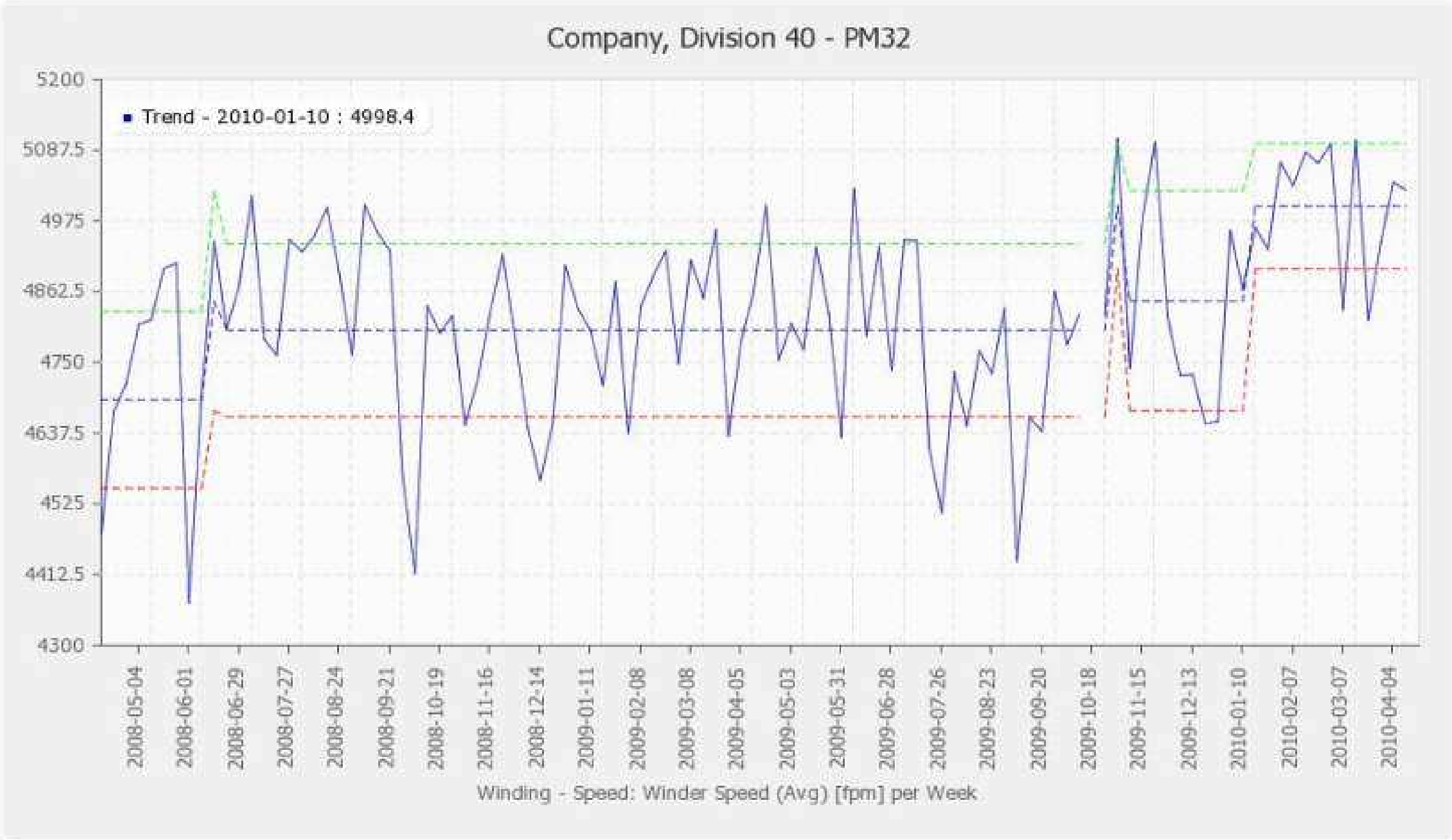
Losses - Current (%): Total Tear-Off [%] per Week

Winder Productivity



Conclusion

Product type:	Coated board.
Production capacity:	300,000 tons/year.
Expected efficiency increase:	1.0%

Total savings slab losses
300,000 tons/year x 1.0%
3,000 tons/year of additional good paper.

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Weight increase per roll: 1.0%.

Transportation costs
1% per year in costs reduction.

Core and wrapping cost
1% per year in costs reduction.

PIMA

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people resources solutions

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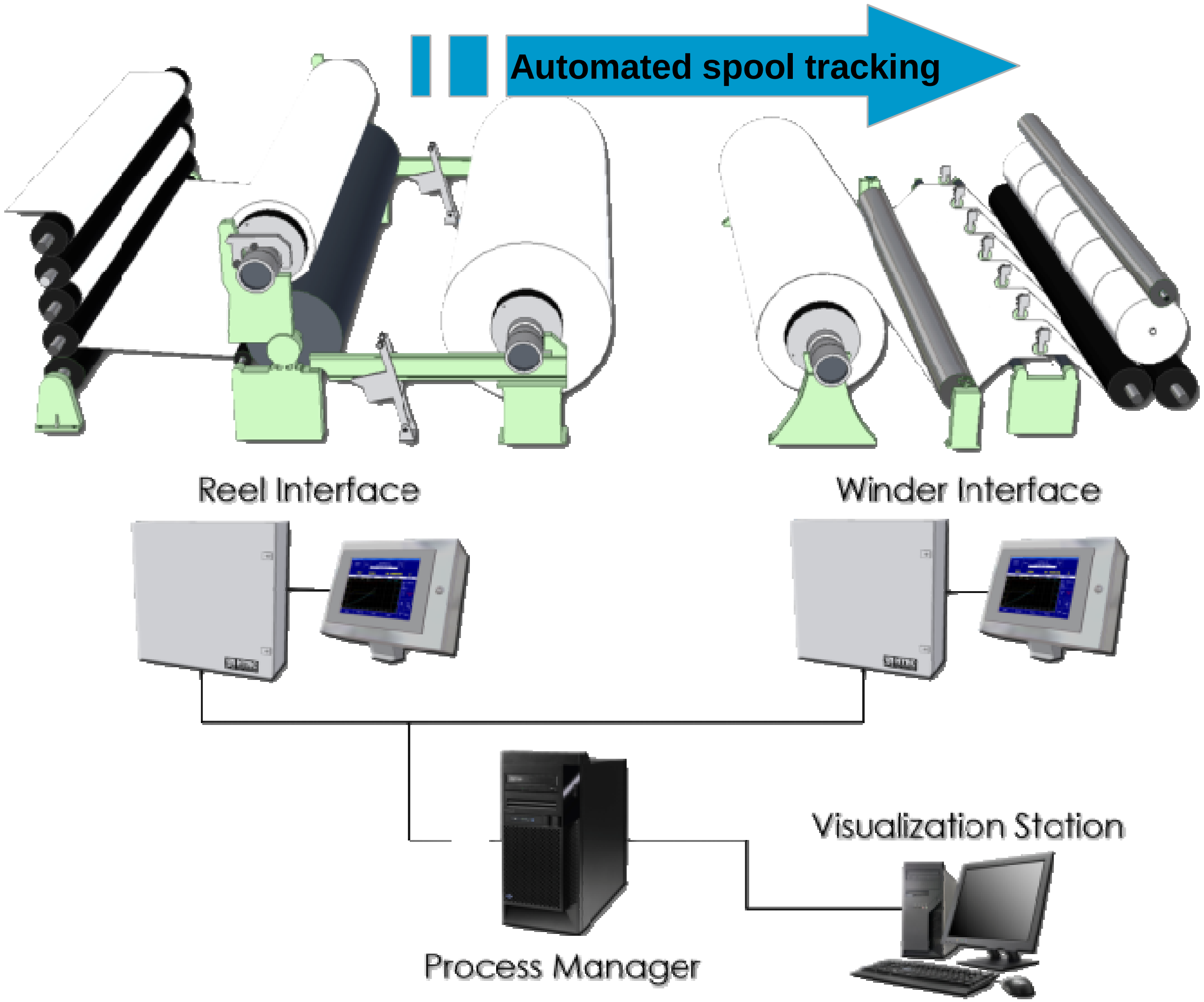

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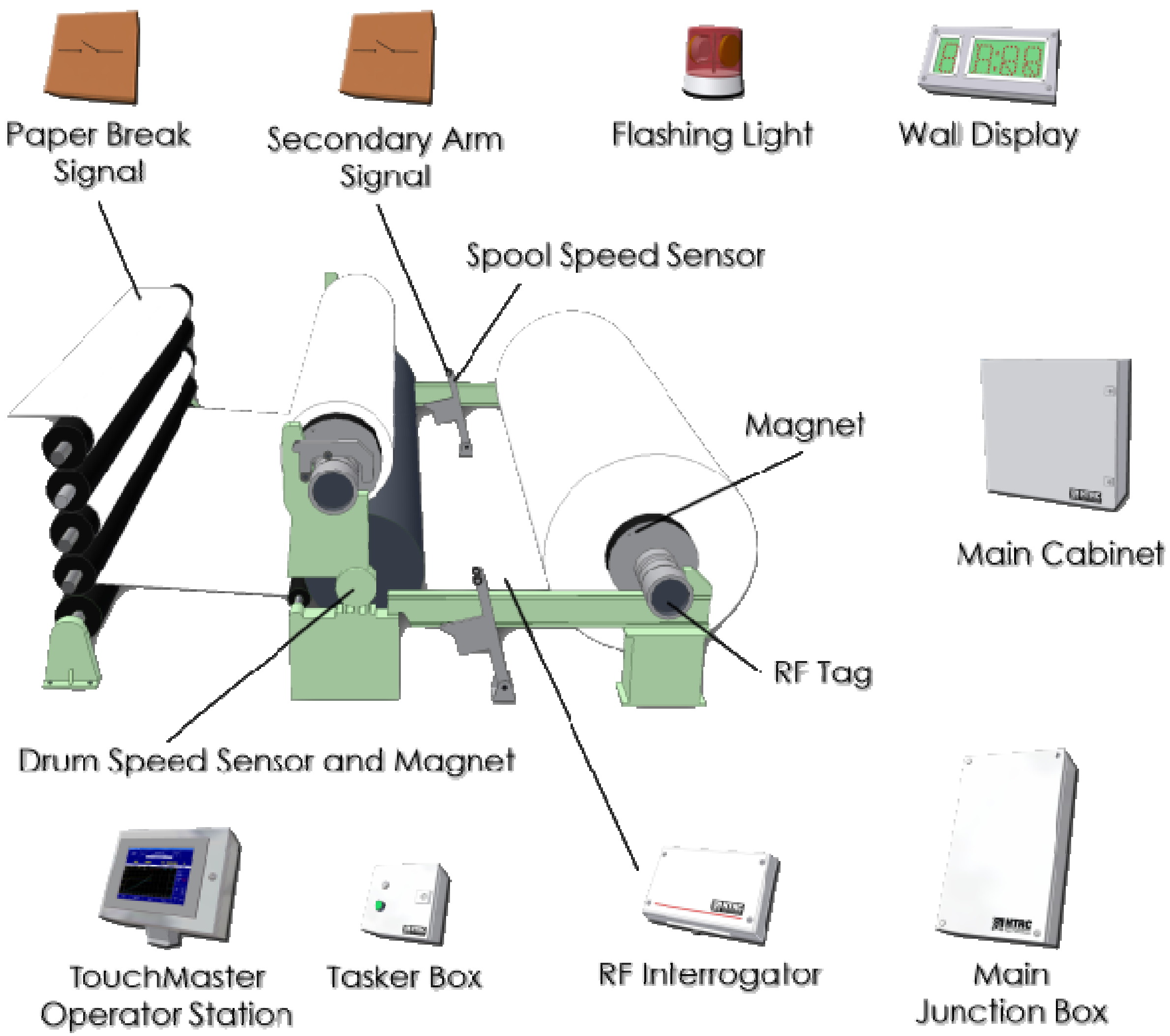

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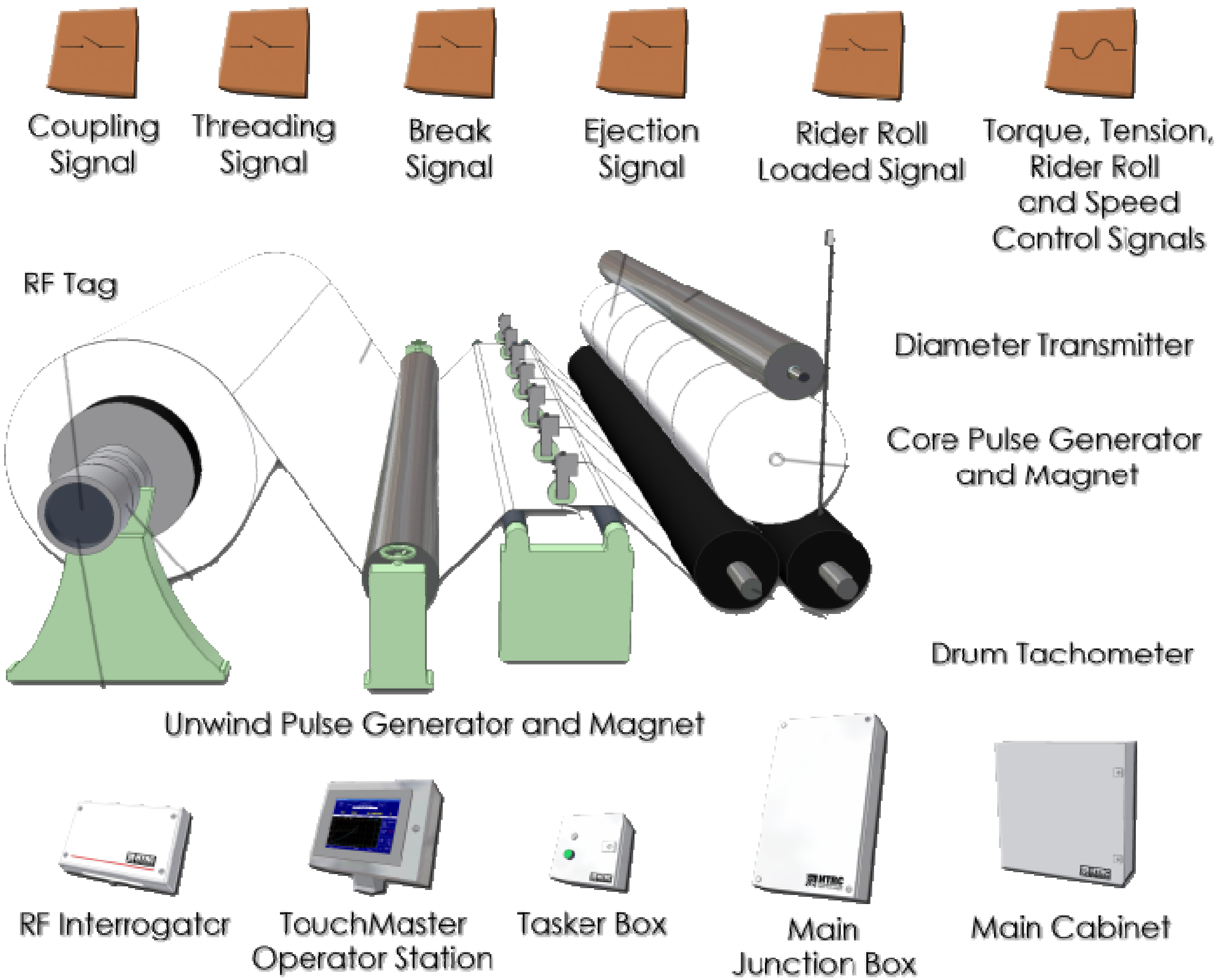

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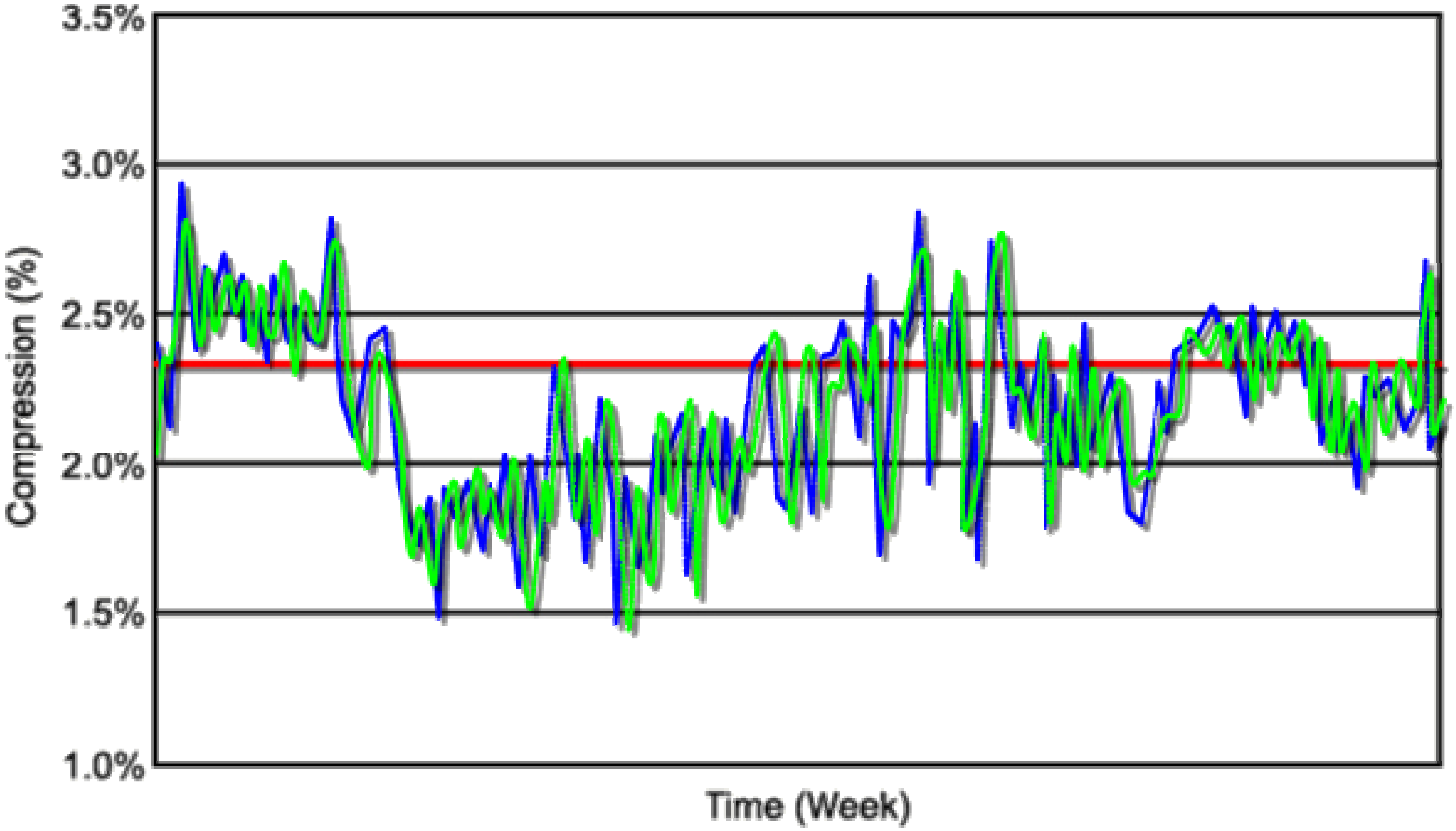

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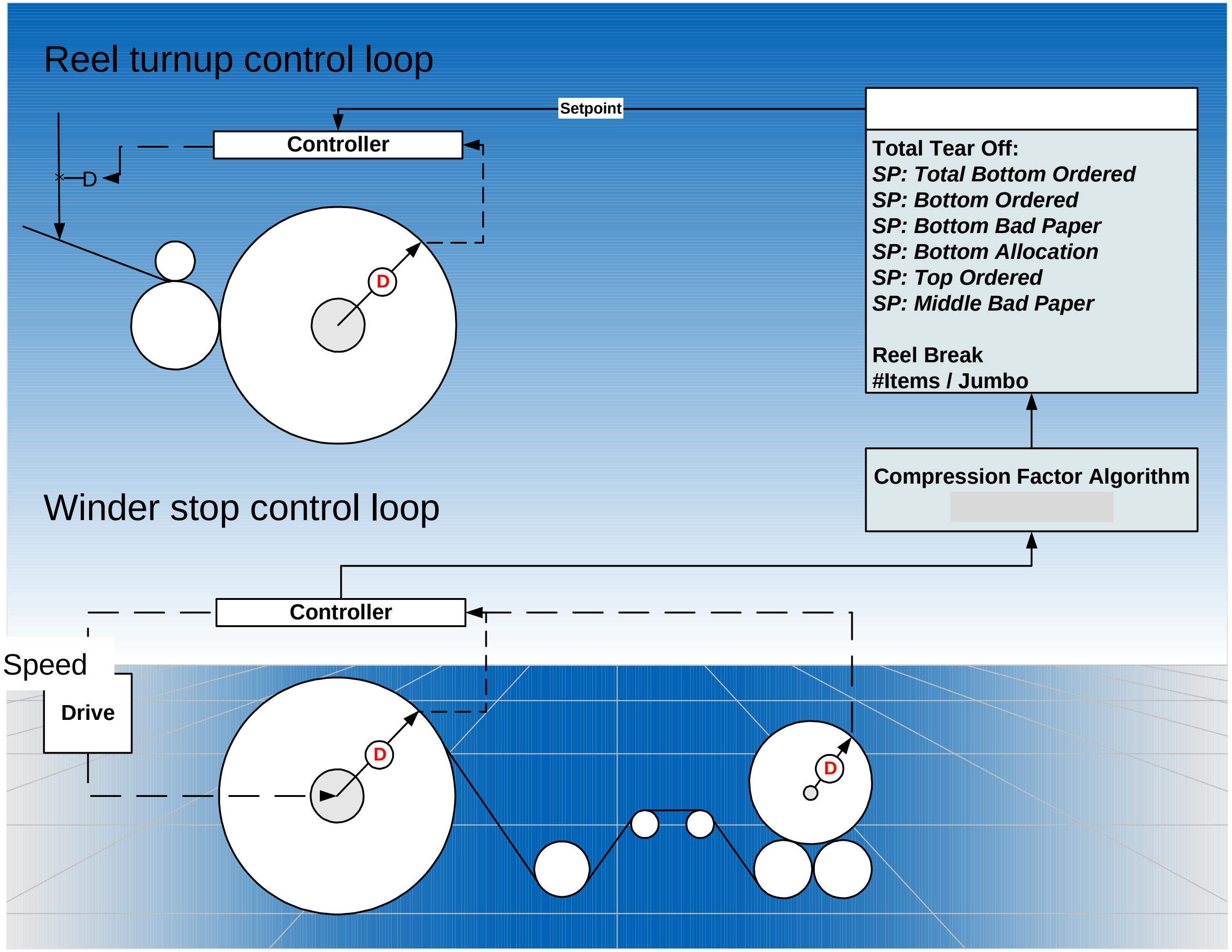
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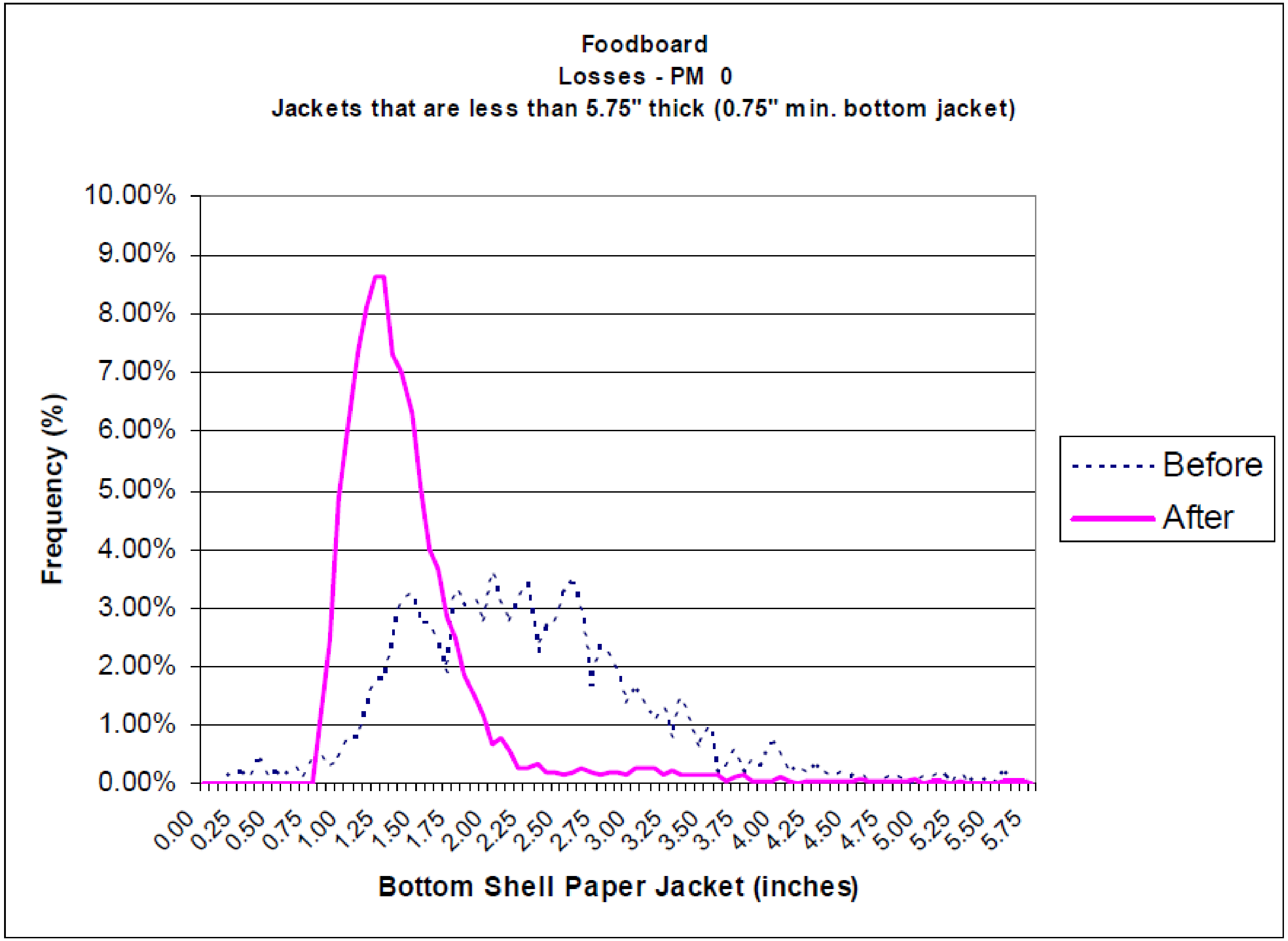

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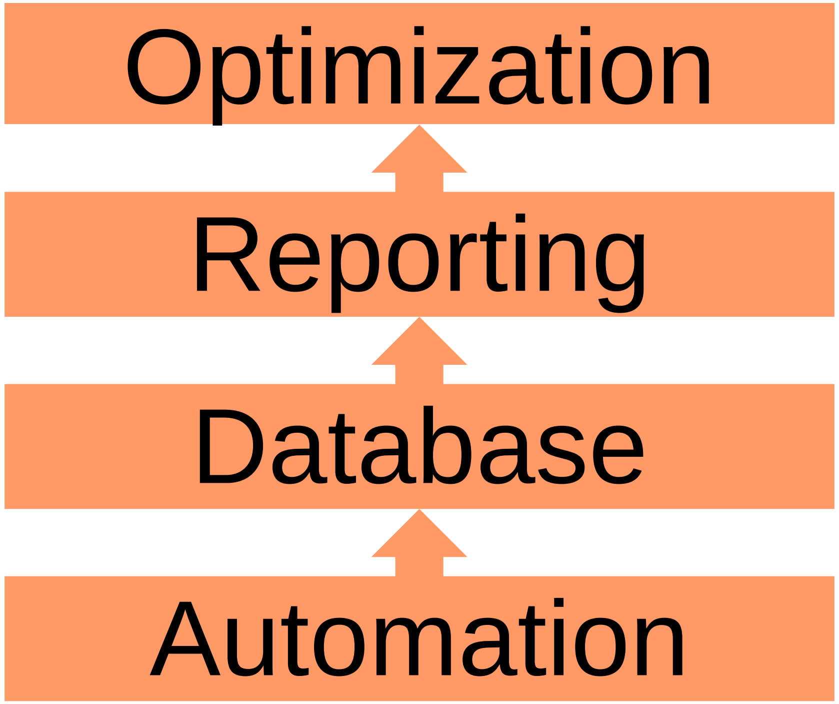

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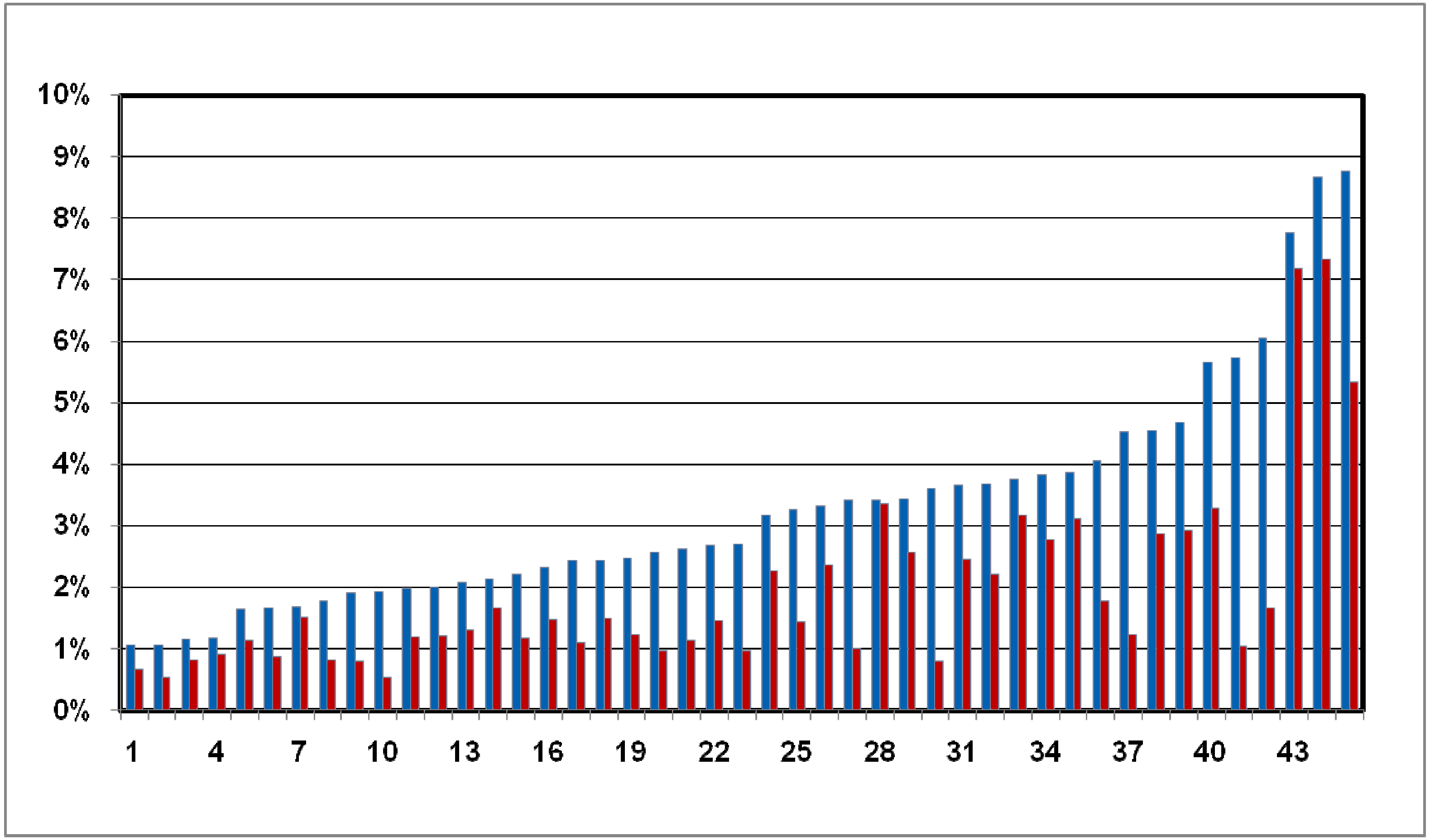
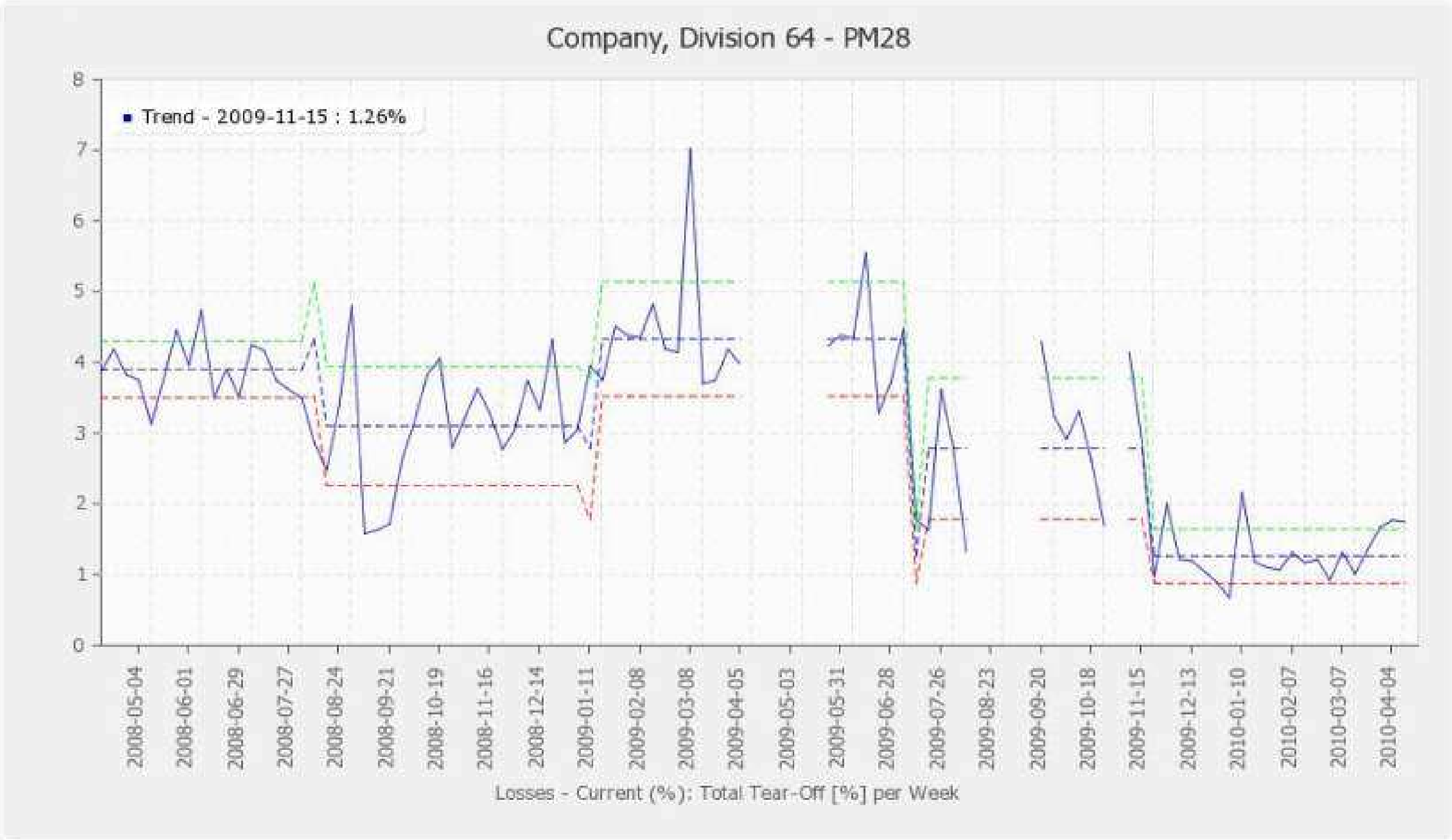


Losses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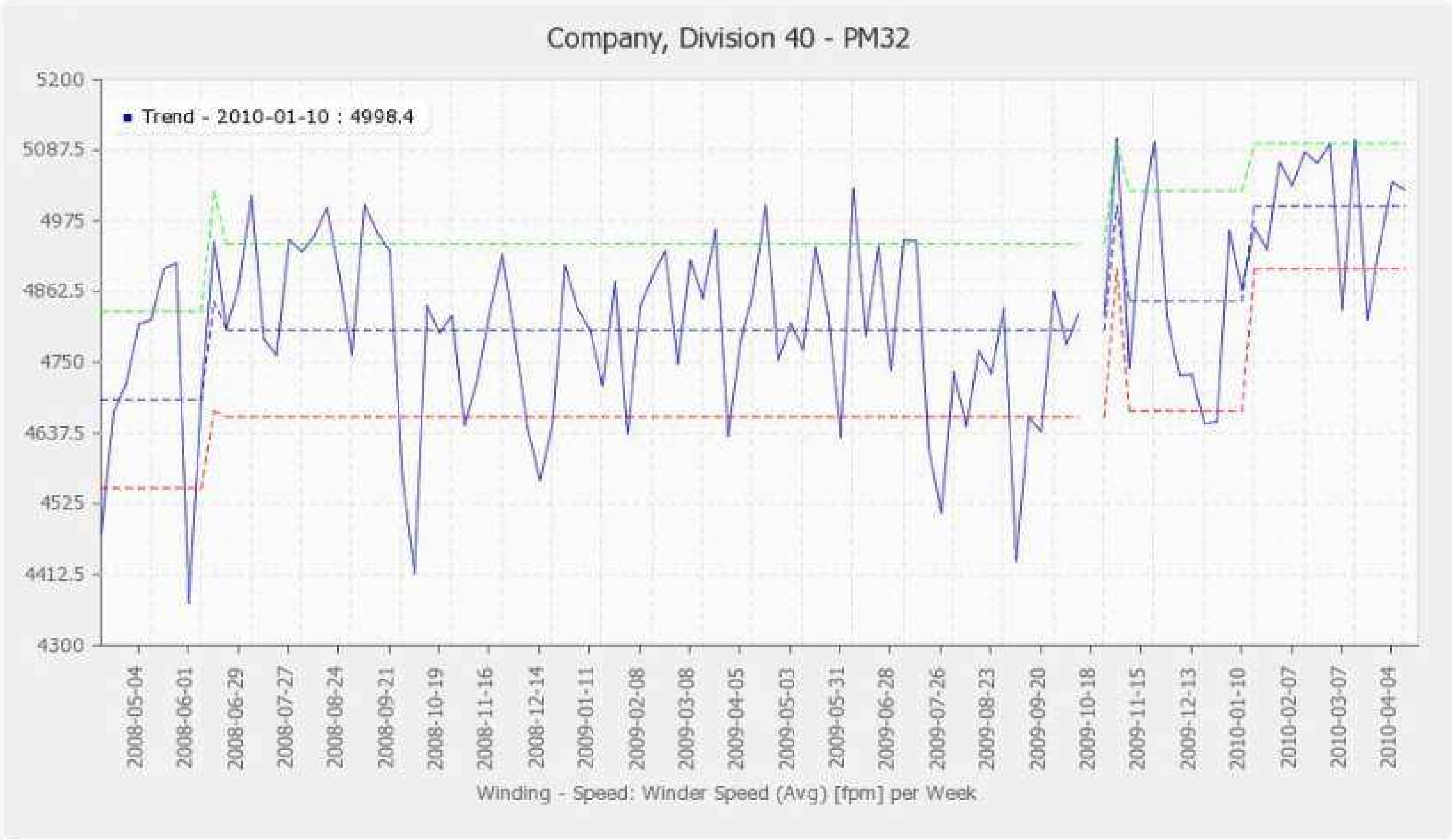

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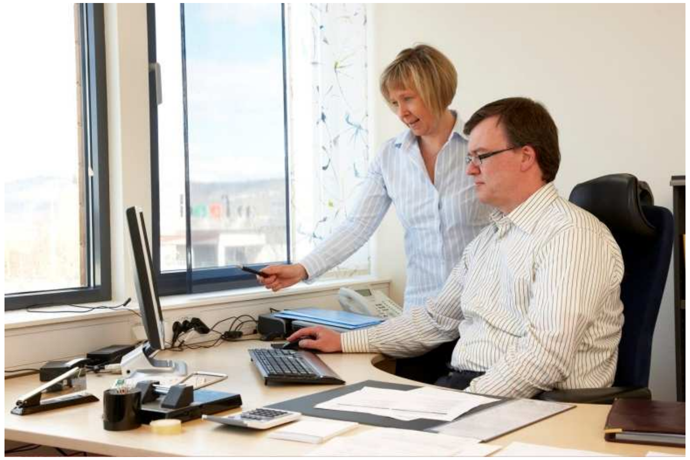
MultiJet&Brush on-line cleaning system

IMPROVING PAPERMACHINE EFFICIENCY

Business Overview

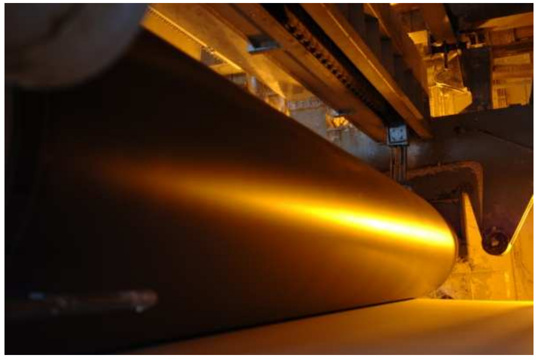
m·clean PAPERTECH

- 350 installations worldwide
- Global industry leader for high-pressure water cleaning equipment
- Strong references with systems supplied to Europe, Asia and increasingly to North America
- Headquarters and production facility located in Huskvarna, Sweden
- Exclusive partnership with Andritz in NA



Network and References

Introduction to the m-clean systems

Dryer Fabric cleaning	Backing Roll cleaning	Transfer belts & Press Roll cleaning
		

MULTIJET — ***For cleaning paper machine clothing, transfer belts and press rolls***

MULTI JET & BRUSH — ***For online and offline backing rolls***

IMPROVING PAPERMACHINE EFFICIENCY

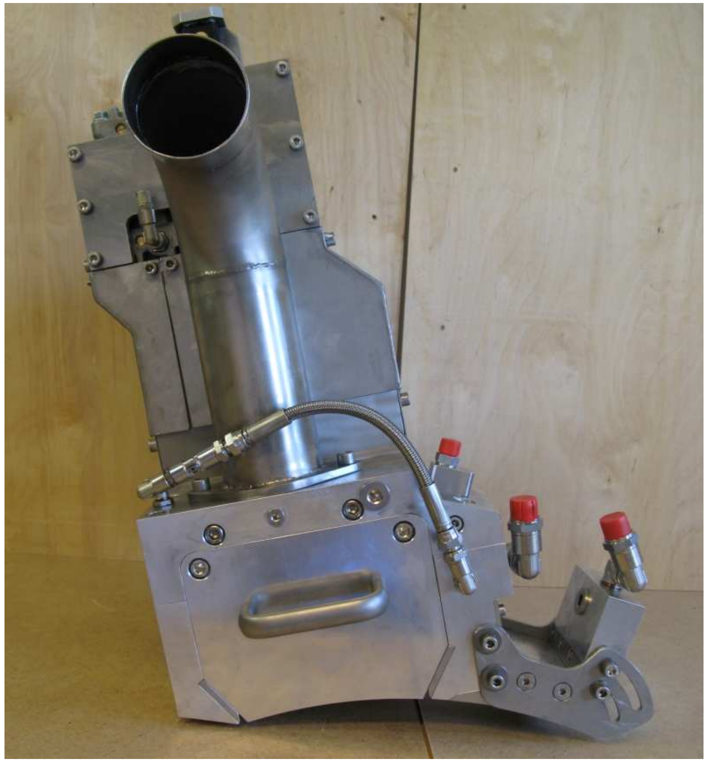
m·clean
PAPERTECH

MultiJet&Brush will eliminate or minimize backing roll waste caused by:

- Coating streaks
- Coating colour residue
- Bleed through
- Shadow marks
- Butterflies
- Glue & Adhesive tape
- Fibres & Chemicals

MultiJet&Brush online cleaning system

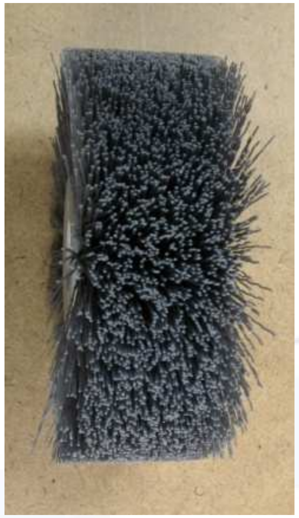
MultiJet&Brush cleaning head



MultiJet&Brush installed on backing roll

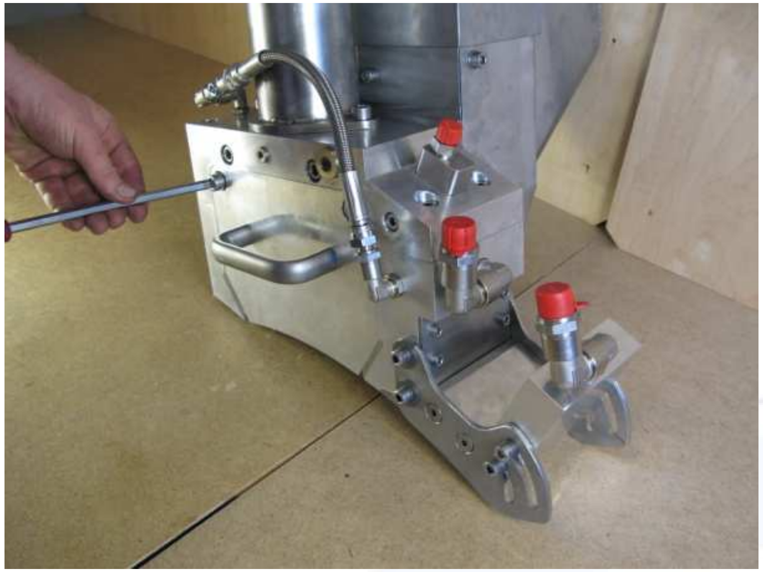
MultiJet&Brush - Brush specifications

- Ø150mm brush for long service life
- Three different types of brushes
- Cleans all type of contamination without damaging the backing rolls
- Suitable for all type of roll covers



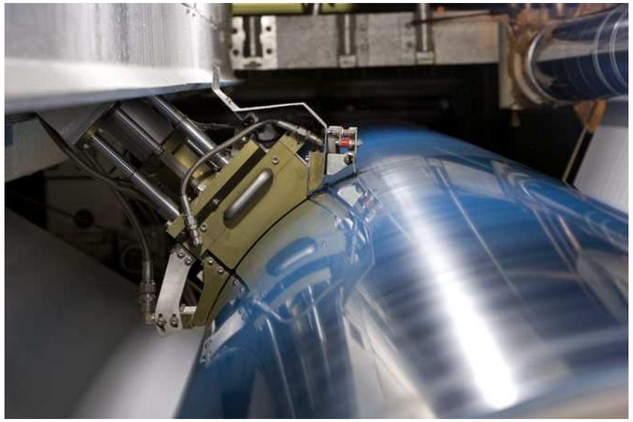
MultiJet&Brush – Easy brush maintenance

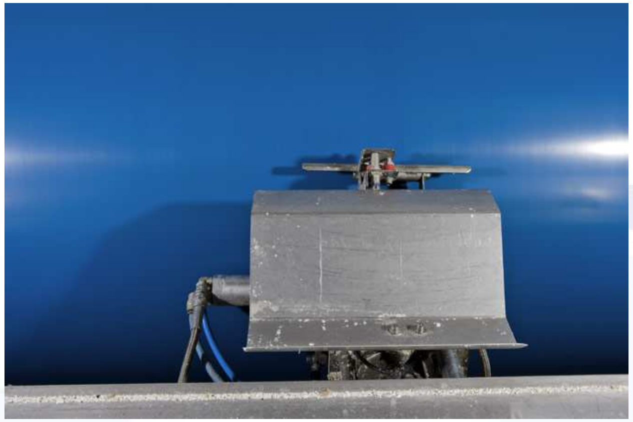
- Change the brush in less than two minutes
- Brush can be changed during paper production
- Brush fitted with only one screw
- Cover easily removed and equipped with handle



Benefits MultiJet&Brush concept

- Efficient cleaning with high pressure water in combination with rotating brush and vacuum
    - No negative effect in paper nor paper breaks during cleaning
    - No moisture left on the backing roll
    - Efficient cleaning of all types of surface contaminations





Benefits MultiJet&Brush concept

- Fast payback time of investment by:
  - Minimizing backing roll related waste
  - Minimizing still stand for backing roll cleaning at web break
  - Decreased paper machine shut down time for manual cleaning
  - Improved paper machine runnability
  - Improved paper quality
  - Guaranteed uptime
  - Minimizing amount of web breaks
  - Low maintenance cost

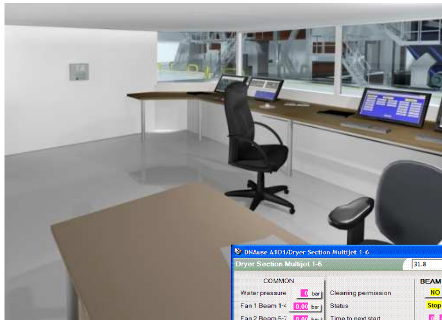
MultiJet&Brush cleaning unit

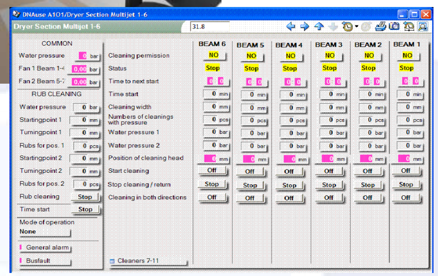
Siemens S7 or Allen Bradley

Vacuum and air

High pressure water

Control by Siemens S7 or Allen Bradley





One central unit can support several cleaning units m·clean PAPERTECH

Return on Investment

• Reduction of backing roll related paper breaks:	up to 100%
• Improved machine up time:	up to 5%
• No need for manual cleaning	Saving/Safety
• No downgraded paper due to markings on the sheet	Saving
• Elimination of rejected paper (printing house etc.)	Saving
• Improved CD profile	

m·clean
PAPERTECH

MULTI JET & BRUSH

ANDRITZ

IMPROVING PAPERMACHINE EFFICIENCY

Increased Filler Content in Graphic Papers

K. M. Broadus, M. A. Ancona, W. Cheng, R. T. Gray,
D. Castro

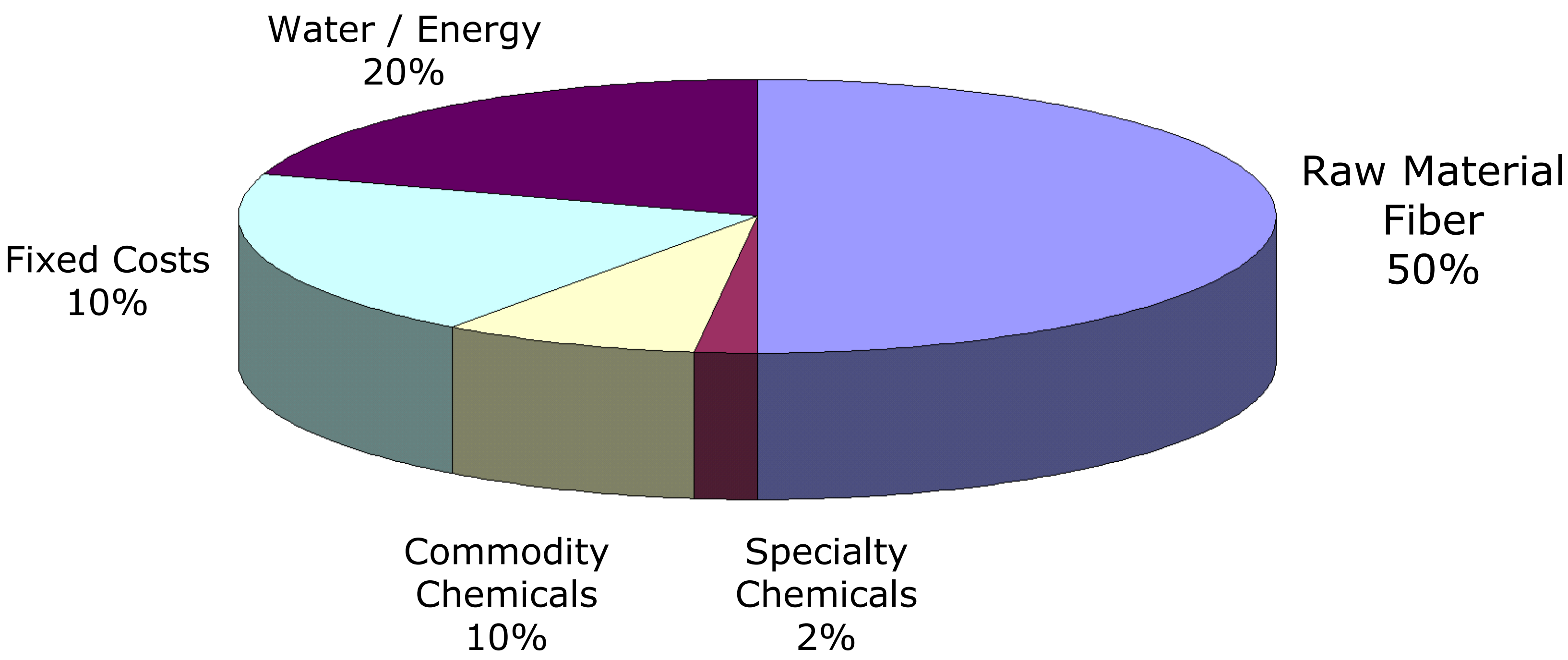
Abstract

- Purchased virgin fiber can cost 5 times more than filler.
- Nalco’s technology delivers increased ash content while preserving the sheet’s strength and optical properties.
- Pilot and commercial machine data will be presented.

Conclusions

- Successfully used to increase sheet ash content up to 5 units while maintaining sheet attributes in pilot and commercial machines.
- UCFS mill has utilized this technology consistently for over 1 year across all paper grades.
- Improved internal bond strength is a key deliverable.
- Resulted in equal or less dust in printing and converting trials, even at higher sheet ash levels.

Raw material cost reduction is a key business driver for every papermaker in today's market.

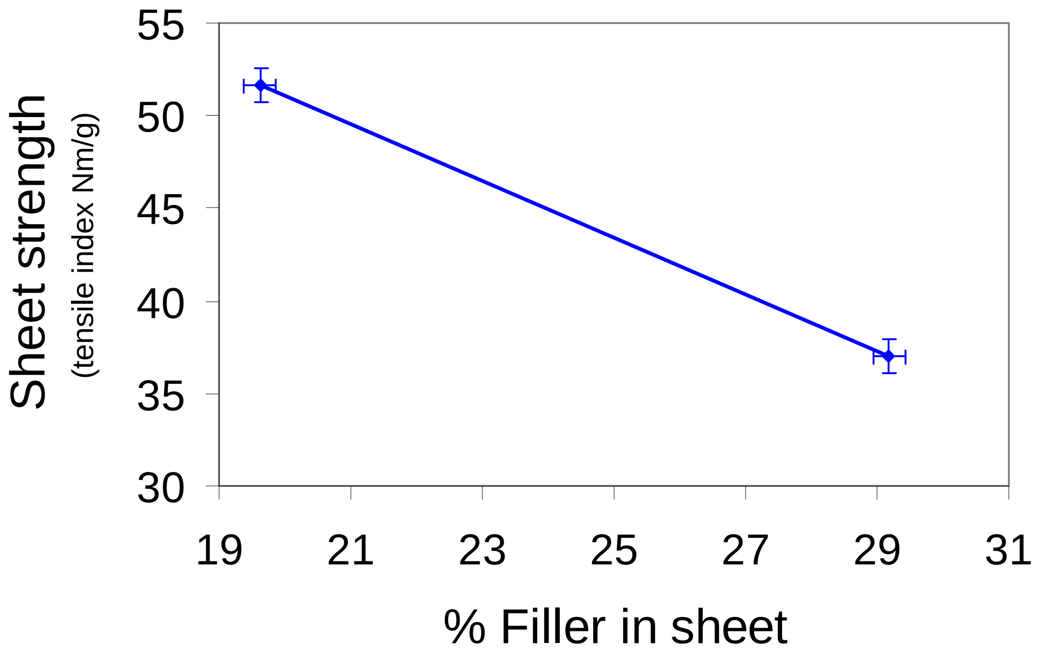


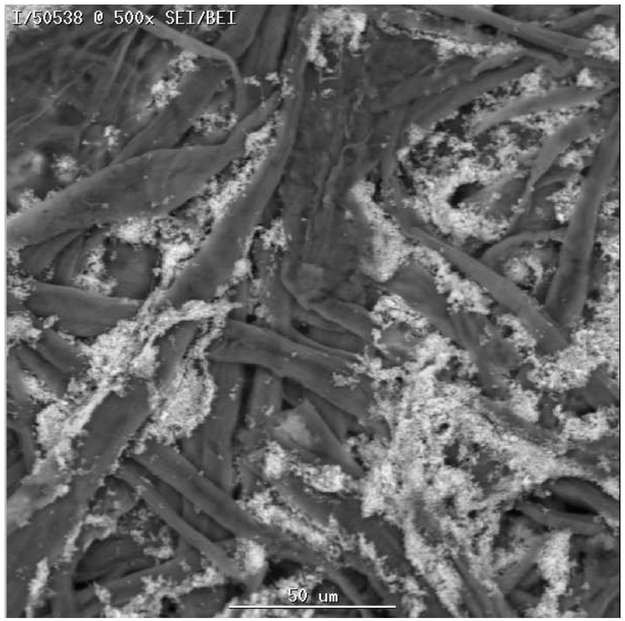
The cost of filler (PCC and GCC) is approximately 20% of the cost of purchased virgin fiber.

Challenges in higher filler usage

Loss in sheet strength as filler level increases

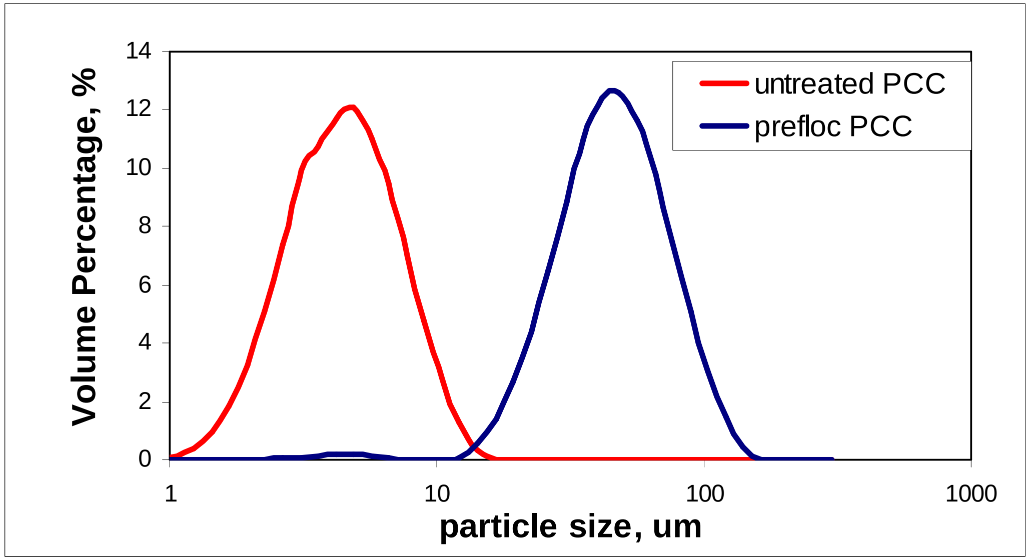
Dusting and picking in converting and printing operations

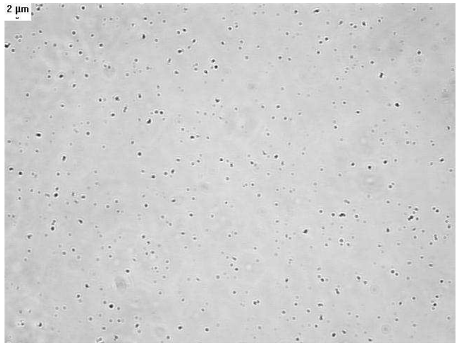


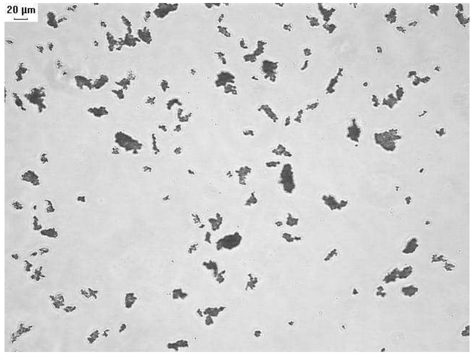


Technology

- *Basis of Nalco's approach: Increase particle size of filler in order to minimize the interference with the fiber-fiber bonding strength network*
- *Controlled size distribution of filler flocs provides strength without compromising the formation and optical properties of the sheet*







- Designed for ash increases of 3-5 points
- Applicable for PCC, GCC or a blend of PCC/GCC
- Intended for UFS and CFS grades; demonstrated with a variety of furnish types
- Treated on-site; no holding time required before use
- Introduced with minimal adjustments to paper machine operations

Differentiation

Controllable Method

Well-defined particle size distribution of filler flocs

Improved Stability

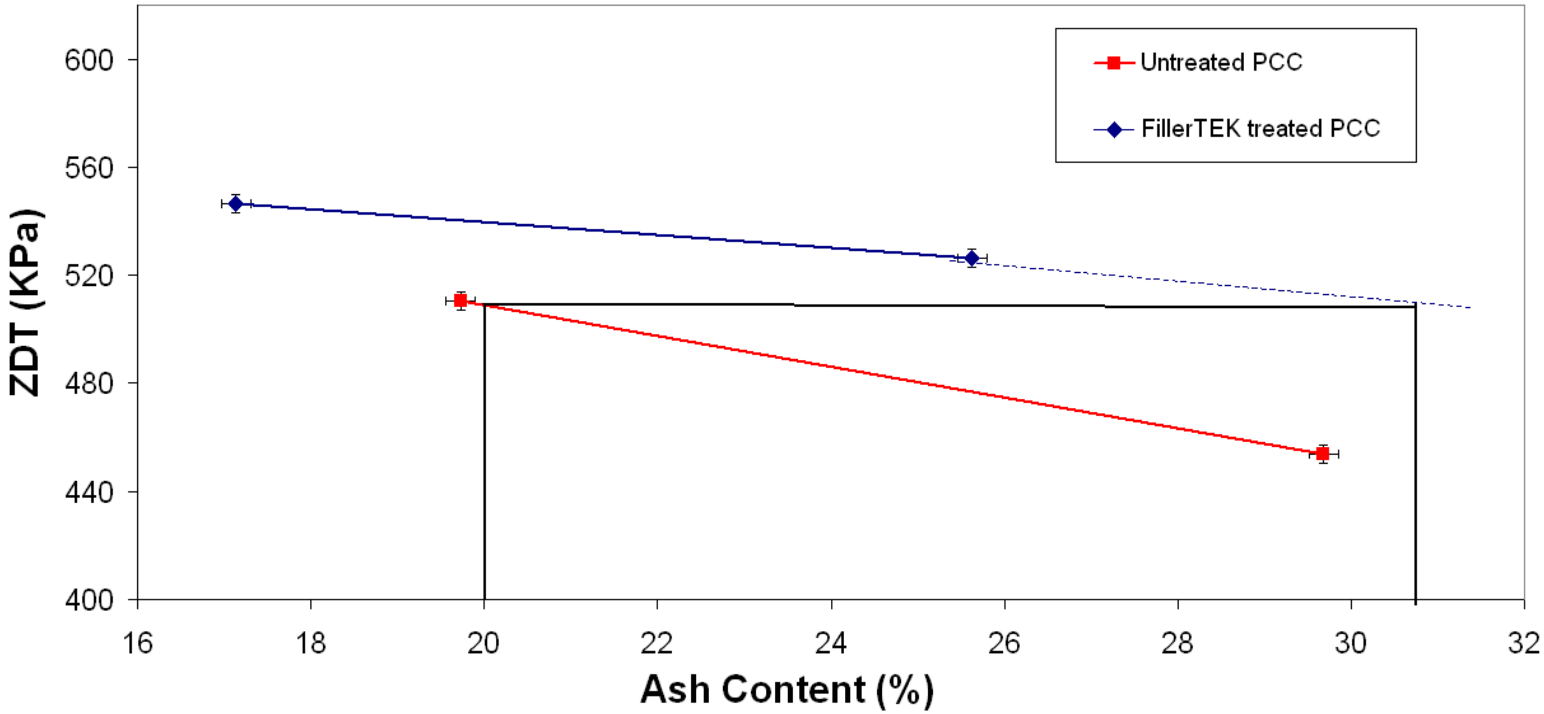
Filler flocs exhibit improved shear stability

ROI

Maximize your profits by raising the limits

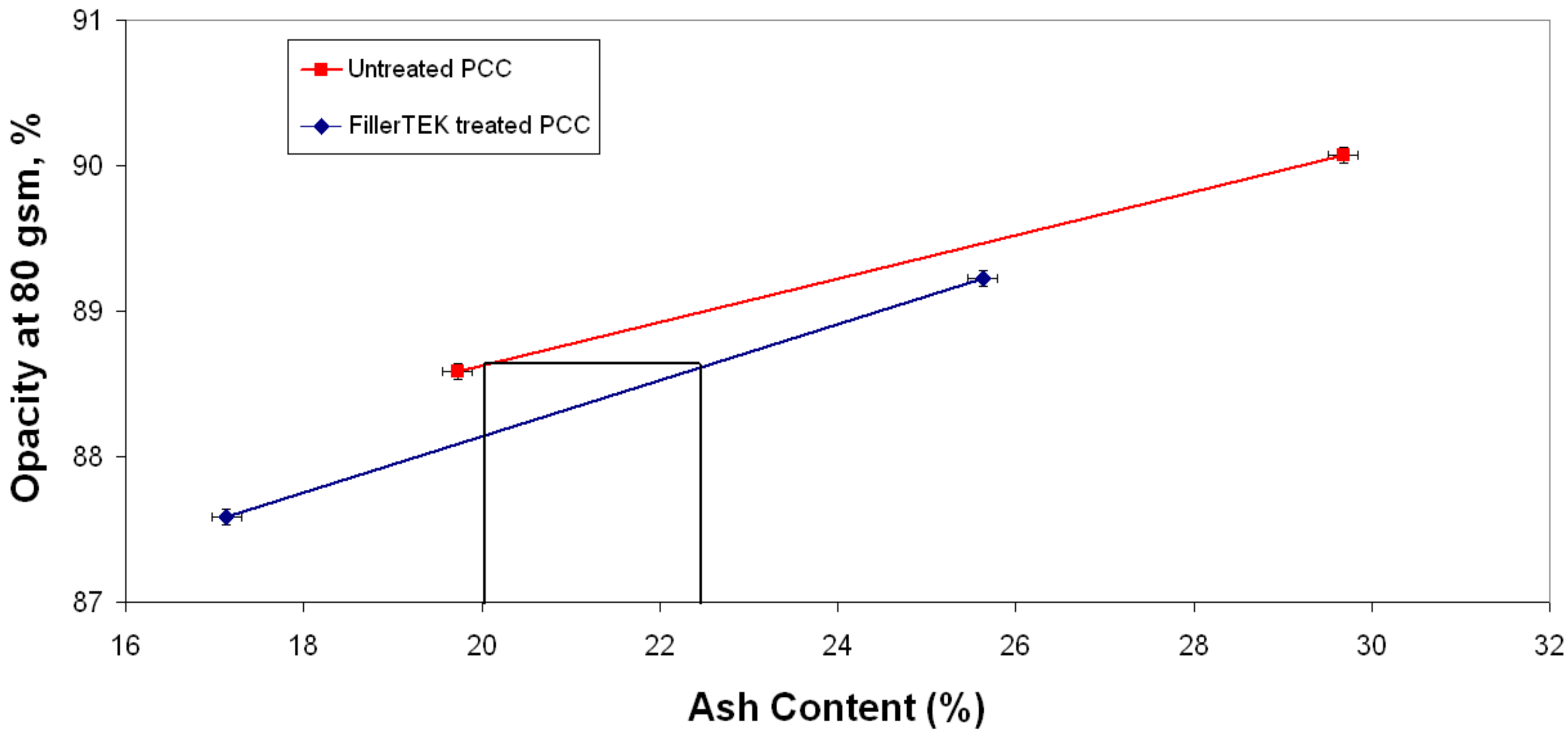
- Differentiation is achieved through a combined chemical and mechanical approach.
- Offering is strengthen by Nalco’s expertise in wet-end operations and papermaking.

Impact of Bond Strength
Pilot machine trial on EuroFEX gap former, 1000 m/min



- The ash level can be increased by 10 points without a loss in internal bond strength as measured by z-directional tensile.
- Eucalyptus /pine furnish, 80 gsm sheet produced in pilot trial at Innventia AB

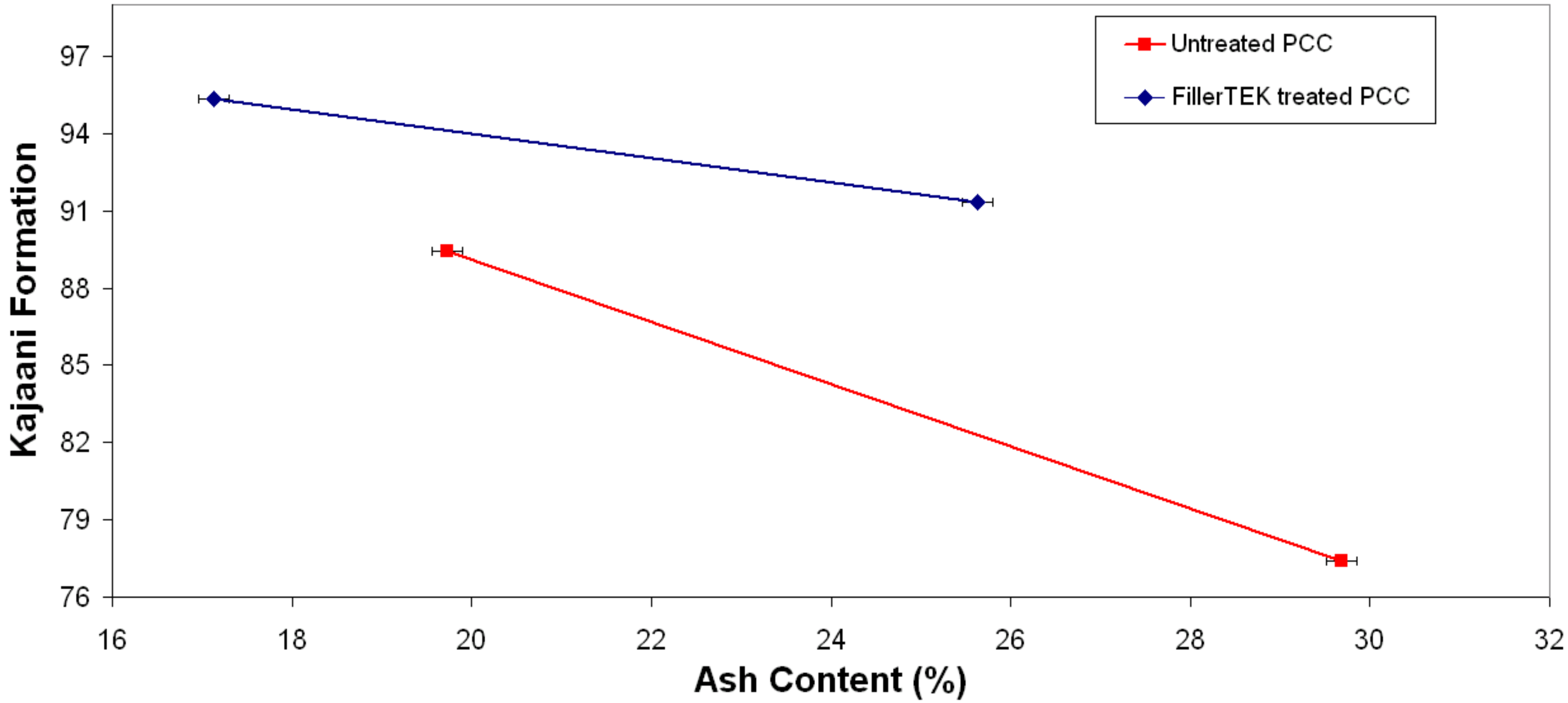
Impact of on Opacity
Pilot machine trial on EuroFEX gap former, 1000 m/min



- Opacity loss due to filler treatment can be recovered with a 2.5 point increase in ash content.
- Eucalyptus /pine furnish, 80 gsm sheet produced in pilot trial Innventia AB

Impact of on Formation

Pilot machine trial on EuroFEX gap former, 1000 m/min



- Sheets showed a slight improvement in Kajaani formation relative to untreated PCC, at comparable FPR and FPAR values.
- Eucalyptus /pine furnish, 80 gsm sheet produced in pilot trial Innventia AB

Commercial Application

- Uncoated free sheet mill in Latin America:
  - Produces 75 gsm copy paper and offset grades
  - Top-former machine operating at 800 m/min; 400 TPD
  - Using a blend of PCC/GCC

- Sheet ash:
  - Historical ash level was 18%; currently at 23%

- ***Utilized continuously across all grades for over one year.***
  - Paper machine runnability is good:
    - Production rate stable
    - Sizing (ASA) usage steady, despite filler increase

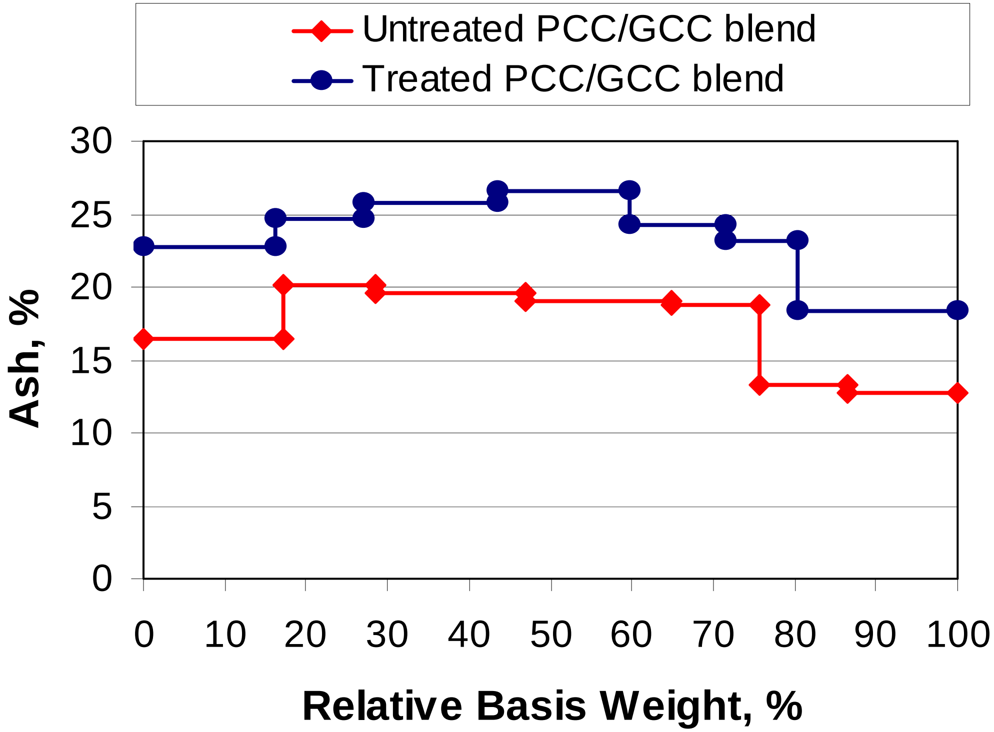
Impact of Sheet Properties
Commercial Account

	Untreated Filler		FillerTEK Treatment		Impact of FillerTEK Technology
Sheet Property	Value	Std. Dev.	Value	Std. Dev.	
Sheet ash, %	17.7	0.50	22.2	0.50	+4.5 pt ash increase
Basis Weight gsm	76.33	1.17	74.87	0.92	Lower
Bulk (cm^3/g)	1.38	0.02	1.38	0.01	Equal
Internal bond (ZDT)	571.7	18.0	574.0	10.6	Equal
Tensile index (Nm/g)	54.32	2.97	52.73	2.73	Equal, within std dev
Bending resistance (mN)	103.5	9.3	91.1	8.6	Reduced
Porosity (ml/min)	1157	87	1198	66	Equal, within std dev
PPS Roughness (um)	6.43	0.32	6.01	0.11	Smoother sheet
Sizing, HST (sec)	69.15	25.3	61.43	25.4	Equal, within std dev
Opacity at 75 gsm	94.43	0.76	94.63	0.52	Equal
Brightness, %	91.20	0.08	91.09	0.20	Equal

Results represent an average of 10 samples randomly selected from 10,000 sheets.

Mill incorporated BCTMP in furnish for cost savings and bulk advantage.

Distribution of Filler in Z-Direction
Commercial Sheets

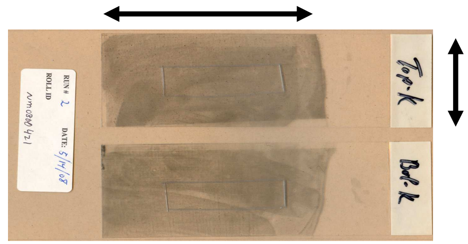


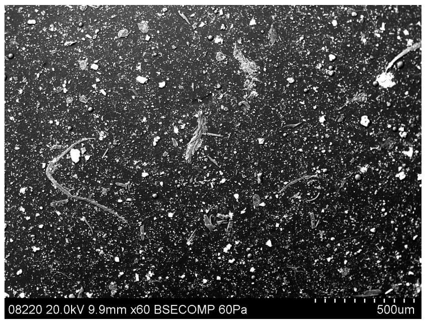
- z-Direction ash profile remains similar at the higher level.

Sheets were found to generate *47% less dust* in a converting study of 10,000 sheets.

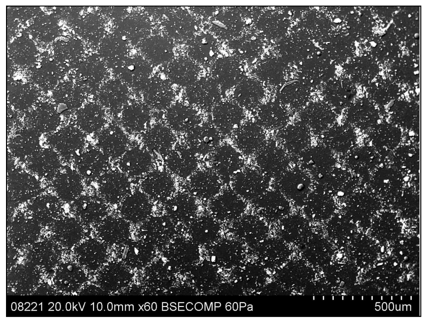
Print Trial at RIT

- Goss Sunday heat set offset press; 4 head (KCMY), 28,000 impressions
- Commercially produced 75 gsm text grade sheets:
  - Untreated PCC at 25% ash
  - Treated PCC at 25% and 29% sheet ash
- No runnability problems observed at higher sheet ash.
- Linting was monitored by tape pulls of printing blanket.





Top side



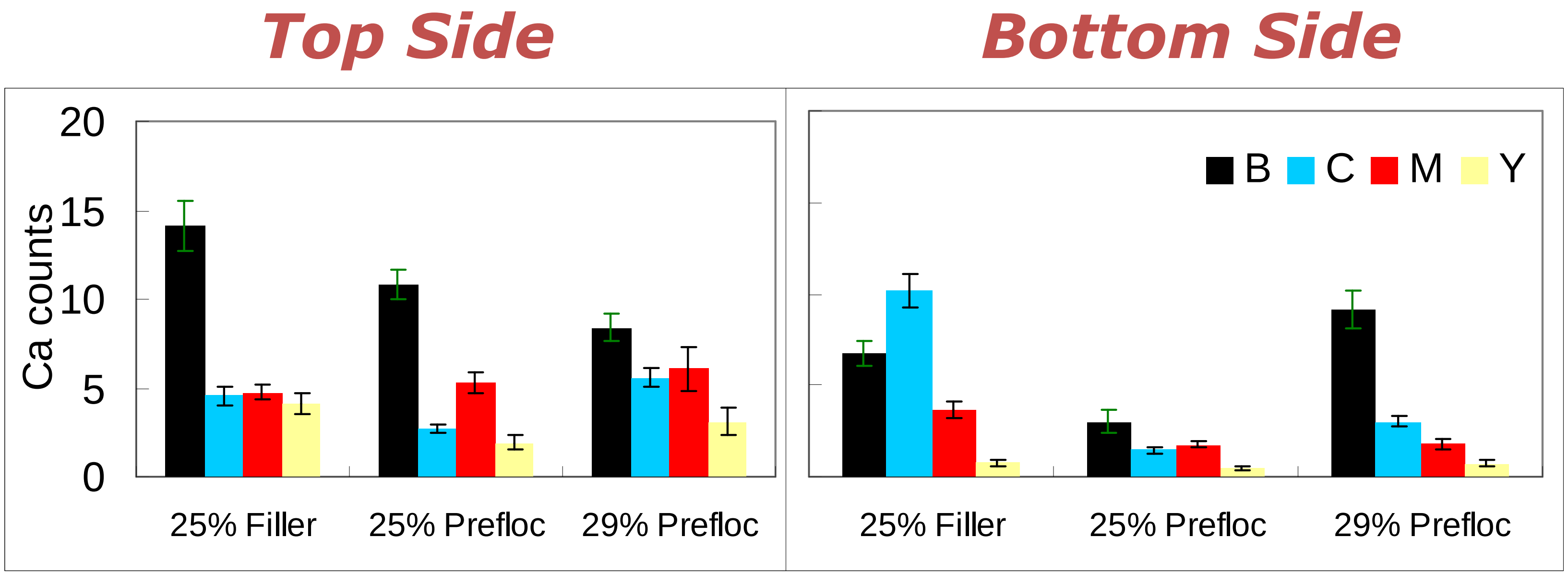
Bottom side

SEM images of tape pulls

Reduced Linting in Print Trial

- Tape pulls of printing blanket were analyzed for calcium (Ca) levels by EDS (energy dispersive x-ray spectroscopy).

- Conclusion: Linting decreases with Chemical technology.



75 gsm text grade

Dissolution of Detrimental Material from SC and LWC Sheets by Heatset Offset Fountain Solutions

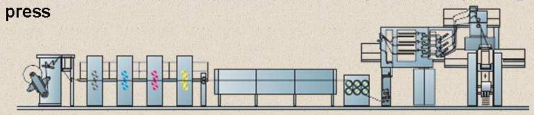
Ali Chami[1,2], François Brouillette[1,2] and Patrice Mangin[2]

1) Ciba Industrial Chair on Paper Chemicals
2)Centre intégré en pâtes et papiers, Université du Québec à Trois-Rivières, Trois-Rivières, Québec, Canada

Introduction

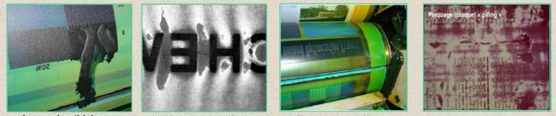
The heatset offset lithography process is the most used for commercial printing

- More than 50% of world's print
- Surface properties of paper is a critical parameter
- Defective paper surface can lead to paper destructuration and release of detrimental material
- This material can form deposits on different parts of the printing press



Piling is a harmful type of deposits in offset lithography

- Undermines the quality of printing
- Leads to accumulation of waste ink, chemicals materials or paper on blankets



Increasing thickness ink-lifting on blanket — Precipitated Calcium Carbonate (PCC) on blanket — Downstream piling on blanket — Piling on plate

Causes of piling are varied and complex, but three major potential causes identified in the literature

- Dissolution of detrimental material from the sheet in particular calcium ions and fatty acids
- Excessive evaporation or absorption of the ink vehicle in the sheet
- Excessive absorption of the fountain solution in the sheet

Objectives of this study

Investigate the *dissolution of detrimental material* from the sheet caused by paper - fountain solution interactions in order to

1. Determine the deposit formation potential of the dissolved material
2. Determine changes of physical properties of the sheet after the contact with fountain solution

Experimental

Experimental

- Paper samples (SCA, SCA+, LWC) collected at a local commercial printer
- Custom-made fountain solution (8% total solids)
  - Solvent (80% DI water)
  - Cosolvent (8% ethylene glycol butyl ether)
  - Wetting agent (8% diethylene glycol butyl ether)
  - Plate protector (4% gum arabic powder)
- pH adjusted with citrate buffer (pH 4,5 and 7,0)

Cobb wetting device

Method

- Fountain solution added to a Cobb device containing the tested sheet for specific contact times (0-10s)
- Dissolved material and treated sheets are collected for analysis

Characterization

- Dissolved material: EDTA titration, viscosity, density
- Treated sheet: SEM
- Deposits: FTIR, ICP-OES

Results and Discussion

SEM characterization of sheet surfaces

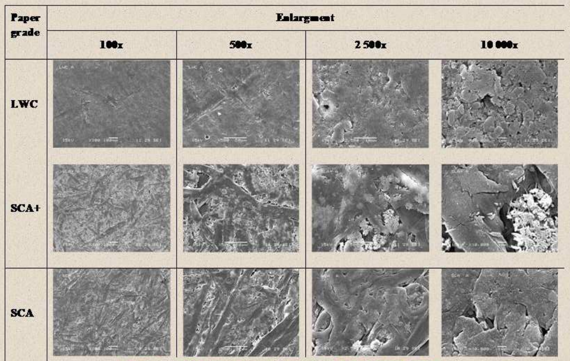


Fig. 1. SEM images of sample sheet surfaces

Interaction between paper and buffered fountain solutions within 10s contact time (Fig. 1)

- Total washing of PCC from SCA+ sheet from the top side at pH 4,5, but bottom side and neutral fountain solution treated sheets are less affected
- Larger holes appeared on LWC surface with acidic and neutral FS (due to FS surfactants detached amounts of kaolin particles)
- Detachment of GCC/Clay blend from sheet surface under acidic attack, FS surfactants and capillary network

Characterization of FS precipitates found after FS-paper interaction

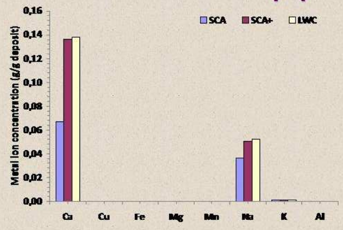


Fig. 6. Metal ion profile of FS precipitates

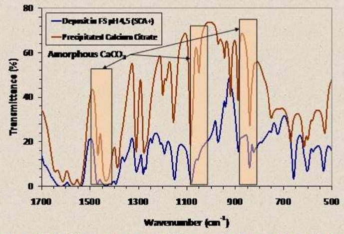


Fig. 7. FTIR analysis of FS precipitates for SCA+

Characterization of dissolved material in FS after FS-paper interaction

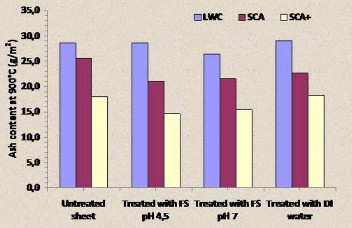


Fig. 2. Ash content of untreated and treated paper samples

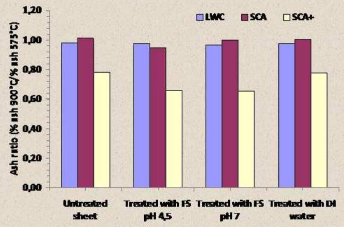


Fig. 3. Ash ratio

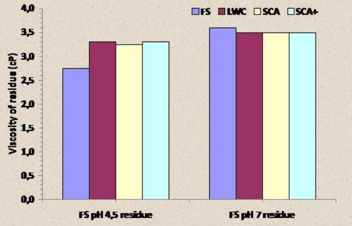


Fig. 4. Viscosity of FS residues

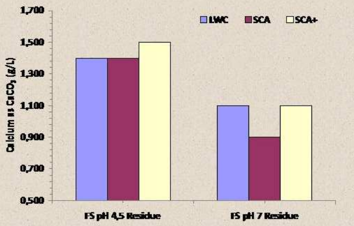


Fig. 5. Calcium content in FS residues

Interactions between paper and buffered fountain solutions within 10s contact time

- SC papers undergo a decrease in its capacity to retain calcium as a result of contact with both acid and neutral fountain solutions (Fig. 2 and Fig. 3)
- Acidic fountain solution increases the viscosity of the residues by dissolving PCC (Fig. 4)
- On contrary, neutral fountain solution decreases the viscosity of residues due to adsorption of surfactants on the sheet surfaces (Fig. 4)
- EDTA titration showed calcium in all residues. Calcium concentration was limited by the solubility of precipitates in acidic and neutral conditions (Fig. 5)

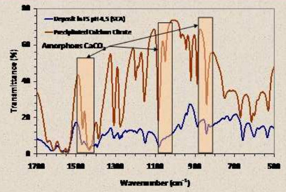


Fig. 8. FTIR analysis of FS precipitates for SCA

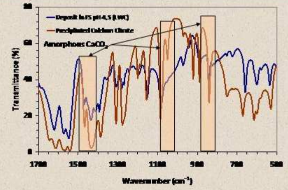


Fig. 9. FTIR analysis of FS precipitates for LWC

Interactions between paper and acidic fountain solution within 10s: after a while, deposits appeared into fountain solution residues

- Significant amounts of calcium was detected in SCA, SCA+ and LWC deposits by ICP-OES analysis (Fig. 6)
- FTIR analysis shows that peaks of deposits spectra coincide with those of calcium citrate spectra, indicate that SCA, SCA+, and LWC deposits contain calcium citrate (Fig. 7,8,9)

Conclusions

Fountain solution is a main parameter in piling

- Acid pH (4-5) dissolved completely PCC/GCC from the top side and less from the bottom side of the sheet
- Fountain solution with pH above 6,5 still removed a considerable amount of PCC from the sheets
- An increase of PPS porosity because pore size increased in paper structure following the disappearance of PCC/GCC

Surfactants based fountain solution have an impact on surface properties

- Surfactants present in the fountain solution facilitated the detachment of kaolin particles from paper surfaces
- An increase of PPS roughness by accumulation of surfactants present in fountain solutions on surface

High offset ink tack could easily detach harmful substances from the surfaces of paper

- Therefore, an environment favorable to piling is created

Acknowledgements

- Josée Doucet and Michel Paquin, UQTR for technical assistance
- Natural Sciences and Engineering Research Council of Canada and Ciba Corporation for their financial support

<u>Coating Structure Measurement Relation to End Product Attribute</u>

Authors: A Das, Abhijit Bhattacharya

Abstract:

The topography of a coated paperboard surface has been found to have substantial impact on the print quality parameter particularly Dot Gain, due to uniform absorption and splitting of ink. The nature of three-dimensional surface undulations in coating layer structure is known as surface topography. Its impact has been observed by macroscopic evaluation of a relevant print quality parameter - dot gain. This paper explores *firstly*, the impact of various Coating recipes and Infra Red Drying of Coated Folding Box board on the topography of coated board surface. And *secondly*, the impact of topography or the microscopic undulations of coated paperboard surface on print quality. In particular, it has been found that a coated board structure which demonstrated very narrow distribution of surface peak and voids / valleys (low Spk Values & Svk values) has yielded lower variation in Dot Gain.

Keywords: Surface Topography, Infra Red Drying, Spk, Svk, Dot Gain

---

Introduction:

Quantification and characterization of the coating Layer structure details are important for predicting the printing ink behavior on the paper surface during printing.

Characterization of Coating Layer Structure has been done by Hommelwerke Topography measuring device. By using the Design of Experiments methodology, and with different configurations of coating and drying patterns, the impact of coating & IR Drying on surface topography has been evaluated as briefed above. In order to further evaluate the impact of the surface topography upon print quality; print trials were conducted on a specially designed S*ix Color Offset Test.* Subsequently Dot Gain was measured using Gretag Macbeth Spectrophotometer.

Fair degree of correlation has been established between nanoscale nature of three dimensional surface undulations in coating layer and Dot Gain. Typically more uniform surface topography with narrow distribution of surface peaks and void structure have resulted in more uniform print appeal with minimum variability in Dot Gain. This is attributed to more uniform absorption of oils present in the ink and subsequently uniform splitting of ink under the blanket in offset printing process.

Methodology:

A. Six trials were conducted as per Design of Experiments, on 3 Ply Board Machine No 4 at ITC LIMITED. All these trials were conducted on online Blade Coated Folding Box Board 300 g/m^2, with different Top Coat Recipe and IR dryer combination.

B. Surface structure of the Coating Layer has been analyzed using Hommel T 8000 topography tester. Three dimensional topographic images and certain surface texture parameters like Spk – Surface Peaks, Sk and Svk – Surface Valleys have been analyzed.

C. The different trial combinations were printed at the same time on a specially designed 6 – Color Offset Test Form in a commercial sheet-fed offset printing press.

D. Assessment of Print Quality have been done in two ways:

Subjective Evaluation: Visually assessing print quality and assign objective scoring by panel. The panel is selected using a technique called "Attribute Agreement Analysis" so as to bring objectivity in what is essentially a subjective visual assessment.
Objective Evaluation: Measurement of Dot Gain was done using Gretag Macbeth Spectroeye Spectrophotometer. Subsequently Dot Gain Data have been statistically evaluated and further correlated with Topography parameters, Spk, Sk, & Svk.

The above methodology has been found particularly useful in establishing the correlation between *firstly*, different coating recipe with coating surface topography and *secondly,* coating topography with Dot Gain in the final print.

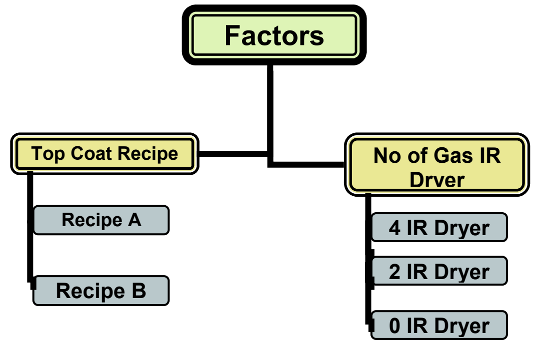


Figure 1: Depicts two factors and respective levels in each factor. Two different types of Coating Recipe with different pigment combination have been used. At the same time Number of Gas IR Dryers has been regulated at 3 Levels, i.e. Level1 - 4 IR Dryers have been switched on after the Top Coat Application. Similarly at Level2 – 2 IR Dryers and at Level3 – 0 No IR Dryer has been switched on after Top Coat application.

Experiments:

1. Board Machine

Six trials were conducted on 3 Ply Board Machine No 4 at ITC LIMITED. All the trials were conducted on Coated Folding Box Board 300 g/m^2, with different Top Coat Recipe and IR dryer combination at the same speed (400 m/min) using the same furnish on the same day. The top coat weight was maintained at 12 g/m^2 for all the trials and was applied through Blade Coater with 9^o bent blade ceramic tip blade. Gas IR dryer as well as Hot Air Dryers were used post coating for drying of Top Coat in all the trials. Three Hot Air Dryers were used for all the trials; however the number of Gas IR Dryers were regulated at different levels as part of the trial. For all these trials precoat recipe was same and Coat Weight of 10 g/m^2 was applied through Blade Coater at 4^o bent blade ceramic tip blade. Other Board Machine process parameters like press load, draw and machine calendar loads were maintained at the same level for all the six trials.

Only two factors have been varied as per Design of Experiments for these trials. The factors are:

- **Top Coat Recipe – Two different coating recipes (A & B) with different pigment combination have been used.**
- **No of Gas IR Dryer – Three different levels of Gas IR Dryer (4, 2 and 0) have been used in combination with two different top coat.**

Trial Combinations are as follows:

Trial 1 – Recipe A + 0 IR Dryer Switched on
Trial 2 – Recipe A + 2 IR Dryer Switched on
Trial 3 – Recipe A + 4 IR Dryer Switched on
Trial 4 – Recipe B + 0 IR Dryer Switched on
Trial 5 – Recipe B + 2 IR Dryer Switched on
Trial 6 – Recipe B + 4 IR Dryer Switched on

Under each trial combination 60 Metric Tons of material has been manufactured on Board Machine.
Subsequently surface topography analysis on these trial samples have been carried out on Hommelwerke Topography tester. At the same time print trials have been conducted by printing specially designed Test Form on commercial 6 Color Heidelberg SM 74 Sheet-fed offset Printing Machine.

2. Topography Analysis

Three dimensional surface analysis of the coating structure of these trial samples have been evaluated on Hommelwerke Topography Tester. This device measures micro level undulations or roughness of the coating surface structure using a diamond probe tip, which moves with constant speed over the paper surface. Deflection of the probe tip according to the micro roughness structure of the surface produces a carrier frequency signal which is processed by an integrated computer and interpreted as surface roughness. Subsequently three-dimensional micro-roughness structure of coated paper surface is generated which is termed as surface topography.

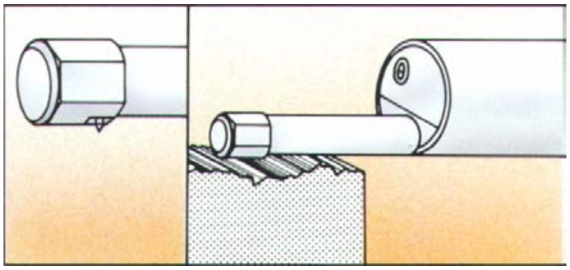


Figure 2: Above figure shows the diamond probe tip measuring the micro roughness of coated surface by virtue of deflection of the probe tip according to the micro roughness structure of the surface.

Characterization of the surface topography also includes measurement of surface texture parameters like Spk – Peak Region, Sk – Core Region and Svk – Void Region of the surface, These parameters are functional parameters for characterizing the surface texture, i.e.

a. Whether the surface is having more of peaks / hills

b. Whether it is plateau shaped with the peaks are uniformly distributed

c. Or otherwise whether the surface is having more of valleys indicating more of voids with higher fluid retention properties.

All these parameters (Spk, Sk and Svk) are defined from the surface bearing area ratio curve which is also called the Abbott curve, and is calculated by accumulation of the height distribution histogram of the surface peaks and valleys structure.

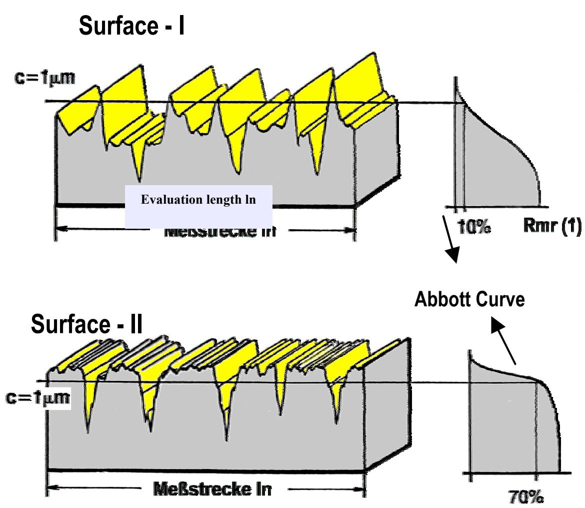


Figure 3: This figure demonstrates two different natures of surfaces. Surface – I consists typically more of peaks / hills and is more susceptible to wear when subjected to calendaring, rewinding or while printing. Thus non –uniform structure is more prone to non – uniform ink absorption while printing.

Whereas, Surface – II is typically plateau shaped having large number of void structure. This kind of a surface structure will have more fluid retention, which is more porous in nature.

Abbott curve for the above two surfaces as shown above will be totally different, since the peaks & valleys distribution is different for the two surface. For Surface – I, the slope of Abbott Curve is steaper whereas for Surface – II it is flat.

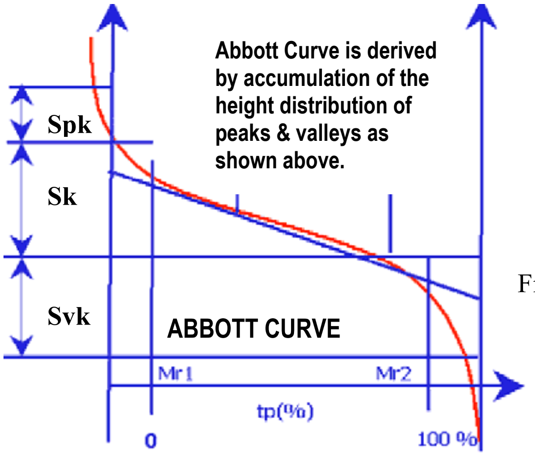


Figure 4

Various components of Abbott Curve is explained elaborately in the following section.

Spk: It is defined as the Reduced Peak Height and is a measurement of the peaks on the surface above a reference line. These peaks will be the areas of most rapid wear when the subjected to friction, while calendaring, rewinding or while printing. Higher the Spk value, higher is the non –uniformity on the surface and hence higher is the probability of non – uniform ink absorption while printing, thus leading to undesired print results.

Sk: It is defined as the core region and is the height difference between the intersection points of the found least mean square line. If the surface is more of a plateau shaped, Sk value will be lower, indicated flat surface with less of of peaks and valleys.

Svk: It is the valley depth on the surface and is a measurement of the void structure. Higher the value of Svk, higher is the depth of the valley or void indicating more prous structure.

These parameters are derived from the Abbott curve as follows. First, the least mean squares line fitted to the 40% segment of the curve that results in the lowest decline, see figure below. Extend this line so that it cuts the vertical axes for 0% and 100% and draw horizontal lines at the intersection points. Then draw a straight line that starts at the intersection point between the bearing area ratio curve and the upper horizontal line, and end on the 0% axis, so that the area of this triangle is the same as the area between the horizontal line and the bearing area ratio curve. Using the same principle, draw a line between the lower horizontal line and the 100% axis.

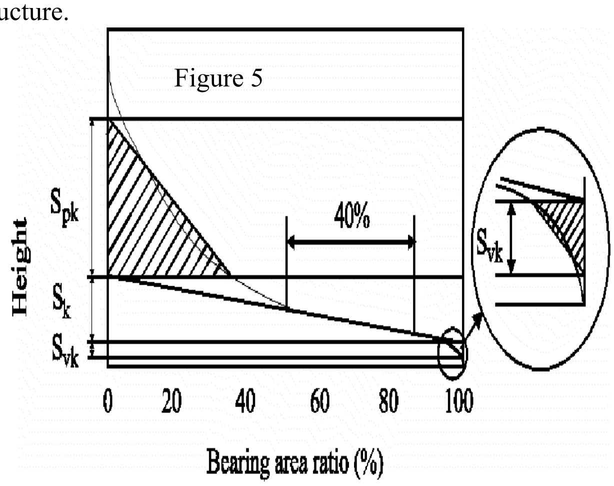


Figure 5

Hence, the functional parameters Spk – Peak Region, Sk – Core Region and Svk – Valley Region is arrived at and interpreted for characterizing surface topography.
Results from above mentioned topography analysis are consolidated for predicting print performance of various trial combinations, which is discussed in the section "Results & Discussion".

3. Printing Trials

Print trials were conducted on commercial sheet - fed offset 6 Color Heidelberg SM 74 Printing Machine.

All these trials were conducted on specially designed 6 – Color Test print form, which has been designed to evaluate both back trap mottle as well as water interference mottle within one single sheet. The was possible by printing Cyan in 1st, 3rd and 6th Unit simultaneously, thus enabling evaluation of Effect of Multiple Ink Splitting as well as Ink Repellence without any change in ink sequence.

Color Sequence of Test Print Form

1	2	3	4	5	6
Cyan	Black	Cyan	Magenta	Yellow	Cyan

Table 1: Cyan is printed in 1st Station to study the phenomenon of Back Trap (Both Dry & Wet Splitting). Multiple splitting of this ink under five subsequent printing nips, makes it highly susceptible to Back Trap Mottle.
Cyan is again printed in 6th Station to study the phenomenon of Water Interference Mottle. Printing this ink, after the substrate receives fountain solution from 5 preceding printing units makes it highly susceptible to Water Interference Mottle.
However, since in most of the commercial jobs, color sequence is K C M Y (where cyan is printed after black & before Magenta) in this test print form Cyan is again printed in the 3rd station.

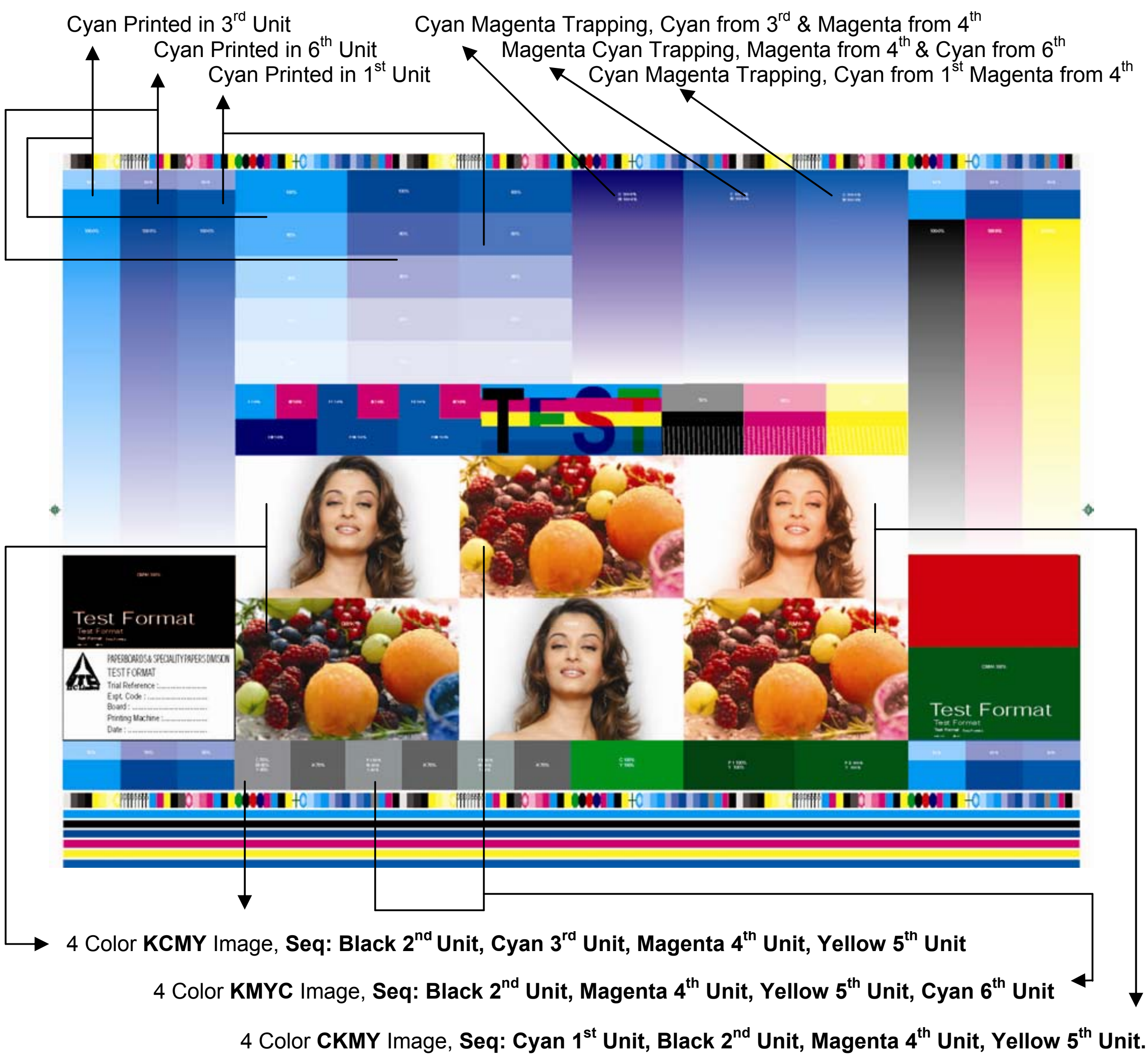
The color separation on the offset plates was done in such a manner that, same four color image & other test elements could be printed three times simultaneously, using three different 4 Color Sequences, which are:

- C K M Y – Cyan Printed in 1st station
- K C M Y – Cyan Printed in 3rd station
- K M Y C – Cyan Printed in 6th station

2000 sheets were printed under each trial combination in identical press settings on the same day using the same plate, blanket, packing material and ink & fountain solution. Before starting up the trial, Optical Density Profiling was done across the width of printing machine for all the colors individually. The test form is elaborately depicted in the next section highlighting all the salient features.

Figure 6: The test print form is shown below, where the various components are categorically depicted. As mentioned above, the printing plate design facilitates reproduction of Cyan from three different stations of printing machine. Therefore as shown below, the same four color image or other test elements can be reproduced using three different color sequences. This is achieved by printing cyan from different printing stations without changing printing station for other process colors, viz. Magenta, Yellow and Black.

Since the following image is digital copy (JPEG Format), the cyan printed from three different printing stations are visually demonstrating different hue; however the sheet printed on offset machine does not exhibit such difference.



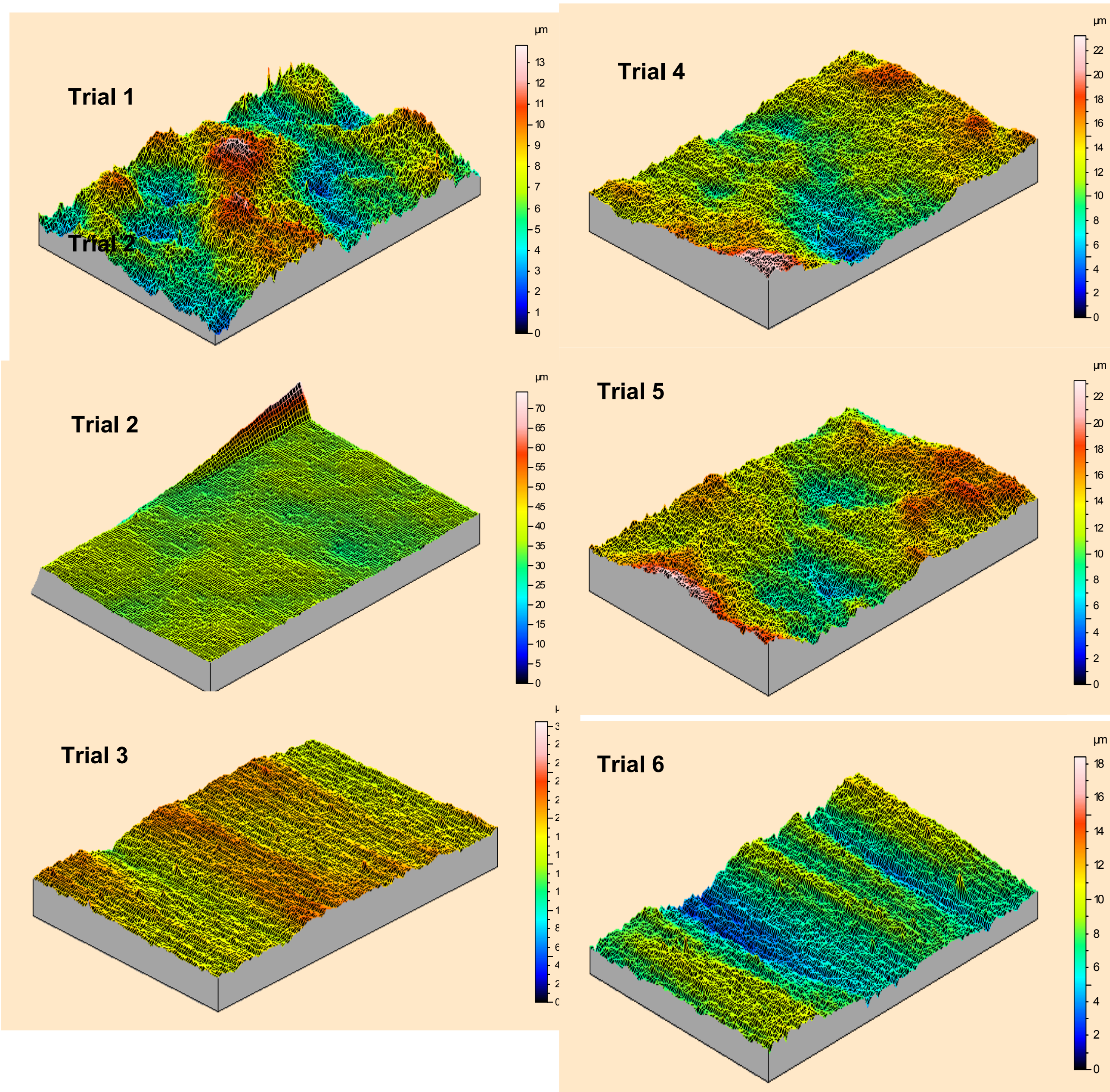
Results & Discussion:

1. Hommel Topography Analysis Results

Samples pertaining to all the six trial combinations were subjected for Topography measurements on the Hommel Topography T8000 measurement devise.

Square samples of size of 5 mm X 5 mm have been used for topography evaluation.

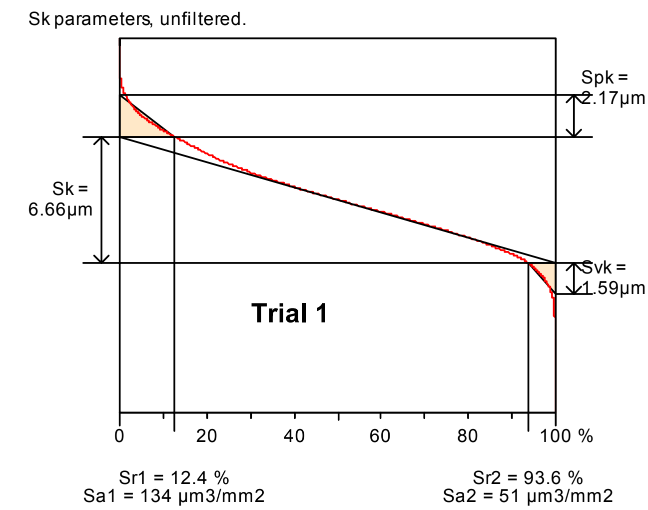
Figure 7: Following are the three dimensional topographic image generated by the equipments for each of the six trial combinations.

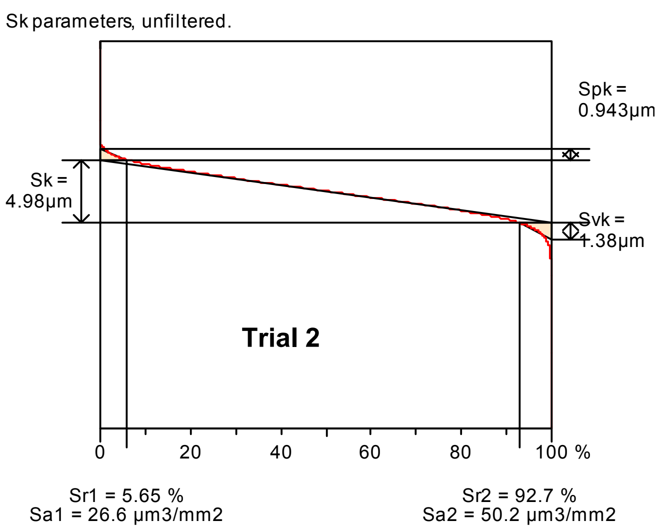


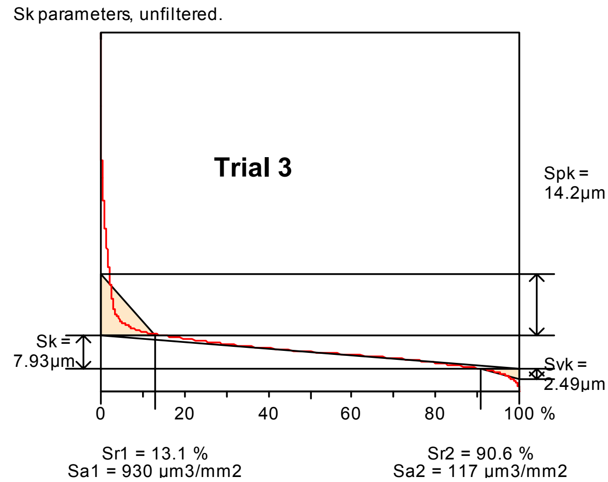
As seen above, Trial Combination 2 (i.e made with Coating Recipe A with 2 IR Gas Dryer Combination) is demonstrating very uniform three dimensional surface structure.

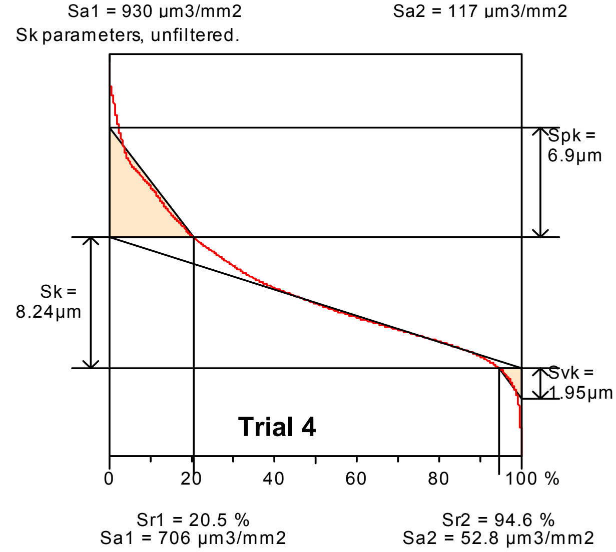
Similiary Abbott Curve and all other functionsl parameters (Spk, Sp, and Svk explained in the earlier section) have ben analyzed.

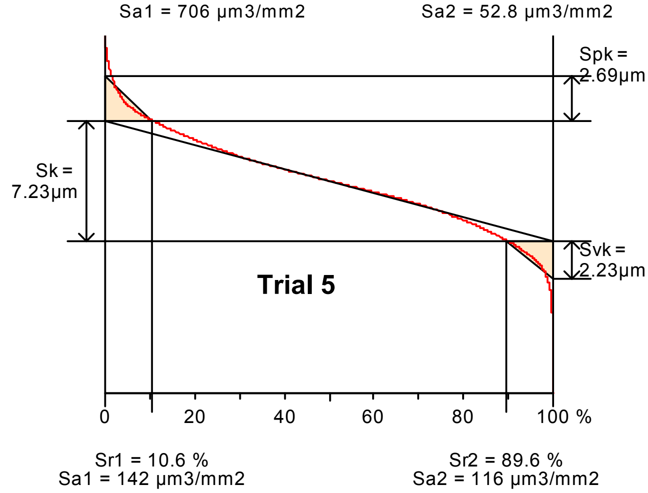
Graph 1: Following are the ABBOTT Curve for all the trial combination.



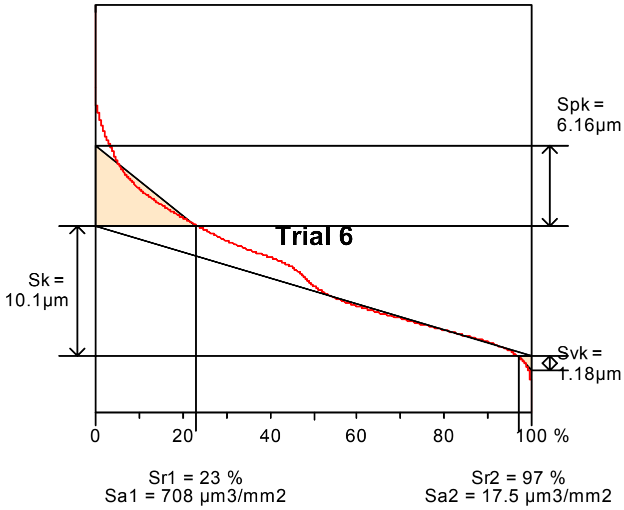








Sk parameters, unfiltered.



Summary of Topography Analysis

Trial Combination	Spk - µm (Peak)	Sk - µm (Core)	Svk - µm (Void / Valley)	Remark
1	2.17	6.66	1.59	High Core
2	**0.943**	**4.98**	**1.38**	**Low Peak and Valley**
3	14.2	7.93	2.49	Very High Peak and Core
4	6.9	8.24	1.95	High Peak and Core
5	2.69	7.23	2.23	High Core, Peak, Valley
6	6.16	10.1	1.18	Very High Core, Peak

Table 2: From the table above, it can be seen that Coating Recipe A with 2 IR Dryers (i.e Trial 2) has resulted in very uniform structure with low peaks and valleys structure among all the trial combinations.
Therefore it is expected that due to more uniform ink absorption and splitting in the offset print trials, trial combination 2 will yield superior print quality.

2. Print Quality Assessment

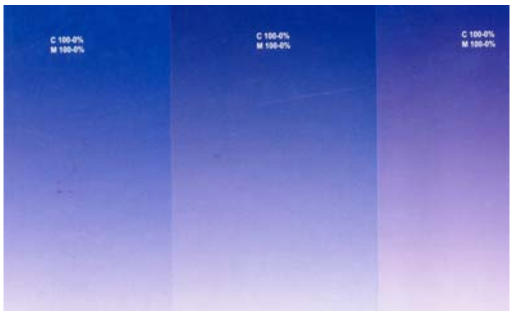
The Print quality assessment has been done in two ways:

2.1 Subjective Evaluation - Visual assessment of Print Quality
After conducting the print trials, visual rating was given on a scale of 1-5 by panel of appraisers comprising three Appraisers, viz. A–A, A–J and A–S. The panel members have been selected based upon their expertise and experience.
Visual rating has been assigned to each of the printed samples by three appraisers on a scale of 1 – 5, where;

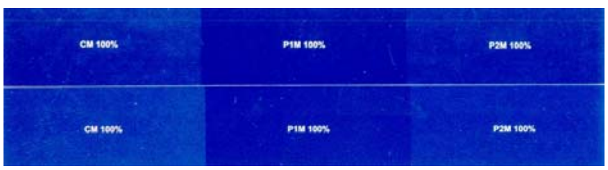
1: Very Good Print Quality
2: Good
3: Moderate
4: Bad
5: Vary Bad Print Quality

However, instead of assigning one score to the entire printed sheet, it was has been divided in four region of Interest for more comprehensive evaluation. The Region of Interests is detailed below in Figure 8:

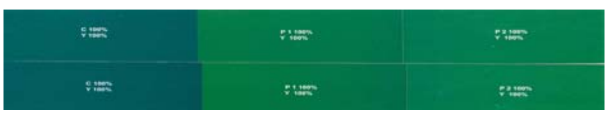
1. Blue Tint - Cyan Magenta Vignette Trapping



2. Blue Solid – Cyan Magenta Solid Trapping



3. Green Solid – Cyan Yellow Solid Trapping



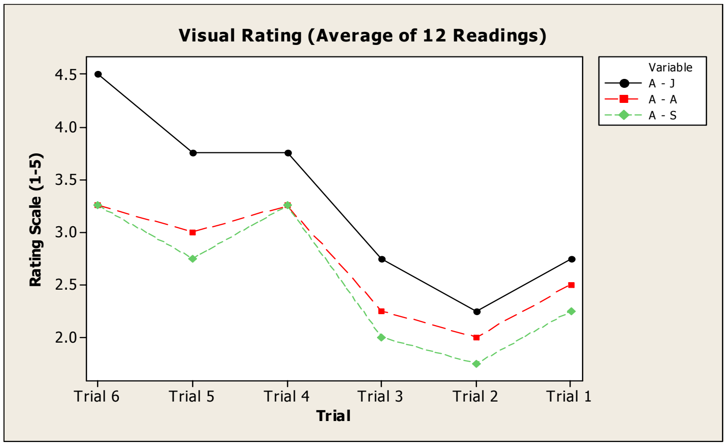
4. Gray Balance Patches

Each appraiser has visually rated above mentioned 4 Region of Interests for each printed sheets. And under each trial combinations 3 sheets has been rated. Therefore total 12 Readings have been assigned each appraiser against each trial combination. However average of these 12 readings against each of the trial combinations by each of the appraisers has been shown below.

Summary of Subjective Evaluation – Visual Score

It has been typically observed that all the appraisers have assigned least score to Trial 2. Lowest score indicates superior print quality. (Score summarized in Graph 2)

We have seen earlier in the Topography analysis that Trial 2 has demonstrated lowest Spk and Svk values, indicating a superior surface with uniform distribution of peaks & valleys.



Graph 2

2.2 Objective Evaluation

For objective evaluation of print quality, Dot Gain for Cyan was measured using Gretag Macbeth Spectroeye Spectrophotomer.

10 consecutive printed sheets from each of the six trial combinations were measured for Dot Gain for all the three cyan colors both for 80% and 40% tint

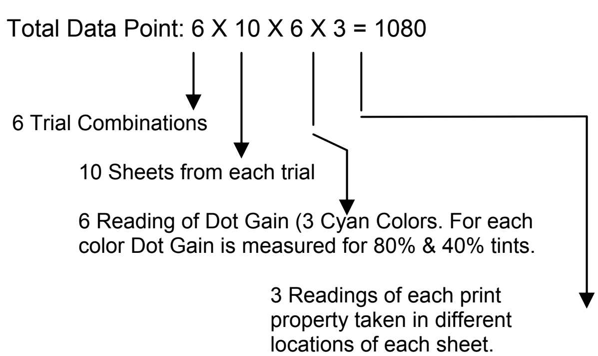


Figure 9: The total number of Data Points is shown above. The methodology has been statically derived considering Repeatability and Reproducibility.

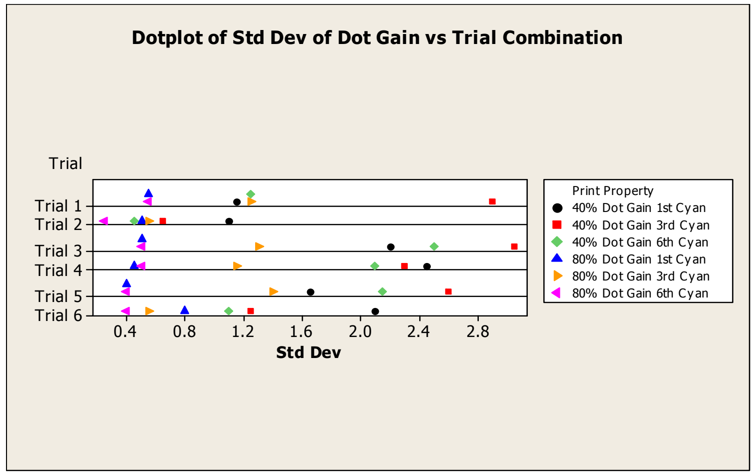
Mean Dot Gain and Standard Deviation have been analyzed for the following:

1. 80% Tint of Cyan printed in the 6th Printing Unit (referred as 80% 6C)
2. 40% Tint of Cyan printed in the 6th Printing Unit. (referred as 40% 6C)
3. 80% Tint of Cyan printed in the 1st Printing Unit. (referred as 80% 1C)
4. 40% Tint of Cyan printed in the 1st Printing Unit. (referred as 40% 1C)
5. 80% Tint of Cyan printed in the 3rd Printing Unit. (referred as 80% 3C)
6. 40% Tint of Cyan printed in the 3rd Printing Unit. (referred as 40% 3C)

The mean and standard deviation of Dot Gain for all the above mentioned combinations against each of the six trial combinations is tabulated below under Table 3:

DOT GAIN Data

Trial	Print Property	Mean Dot Gain	Std Dev
Trial 1	80% Dot Gain 6th Cyan	17.6	0.527
Trial 2	80% Dot Gain 6th Cyan	17.0	0.236
Trial 3	80% Dot Gain 6th Cyan	17.5	0.520
Trial 4	80% Dot Gain 6th Cyan	17.7	0.500
Trial 5	80% Dot Gain 6th Cyan	16.8	0.408
Trial 6	80% Dot Gain 6th Cyan	17.2	0.401
Trial 1	40% Dot Gain 6th Cyan	28.1	1.269
Trial 2	40% Dot Gain 6th Cyan	26.2	0.441
Trial 3	40% Dot Gain 6th Cyan	29.7	2.500
Trial 4	40% Dot Gain 6th Cyan	29.3	2.121
Trial 5	40% Dot Gain 6th Cyan	25.2	2.137
Trial 6	40% Dot Gain 6th Cyan	29.0	1.118
Trial 1	80% Dot Gain 1st Cyan	15.6	0.527
Trial 2	80% Dot Gain 1st Cyan	14.7	0.500
Trial 3	80% Dot Gain 1st Cyan	15.8	0.524
Trial 4	80% Dot Gain 1st Cyan	15.8	0.441
Trial 5	80% Dot Gain 1st Cyan	16.8	0.408
Trial 6	80% Dot Gain 1st Cyan	15.8	0.803
Trial 1	40% Dot Gain 1st Cyan	25.1	1.167
Trial 2	40% Dot Gain 1st Cyan	20.7	1.118
Trial 3	40% Dot Gain 1st Cyan	22.7	2.180
Trial 4	40% Dot Gain 1st Cyan	23.7	2.449
Trial 5	40% Dot Gain 1st Cyan	22.7	1.633
Trial 6	40% Dot Gain 1st Cyan	25.1	2.088
Trial 1	80% Dot Gain 3rd Cyan	13.6	1.236
Trial 2	80% Dot Gain 3rd Cyan	12.4	0.527
Trial 3	80% Dot Gain 3rd Cyan	13.0	1.323
Trial 4	80% Dot Gain 3rd Cyan	14.6	1.130
Trial 5	80% Dot Gain 3rd Cyan	14.0	1.414
Trial 6	80% Dot Gain 3rd Cyan	13.0	0.527
Trial 1	40% Dot Gain 3rd Cyan	20.1	2.892
Trial 2	40% Dot Gain 3rd Cyan	16.3	0.667
Trial 3	40% Dot Gain 3rd Cyan	18.6	3.050
Trial 4	40% Dot Gain 3rd Cyan	21.9	2.315
Trial 5	40% Dot Gain 3rd Cyan	20.0	2.610
Trial 6	40% Dot Gain 3rd Cyan	18.7	1.225



Graph 3

Table 3:

The Standard Deviation of Dot Gain is also graphically depicted above in Graph 3 for better understanding of the variability of Dot Gain

It is observed that the Standard Deviation of Dot Gain (for all three Cyan Colors) is lowest for Trial Combination 2. The Dot Gain analysis correlates with our Topography analysis and visual evaluation of print quality

Table 4: The topography parameters (Spk, Sk and Svk) have been cross tabulated with Std Dev of Dot Gain for all the colors against each of the trial combinations.

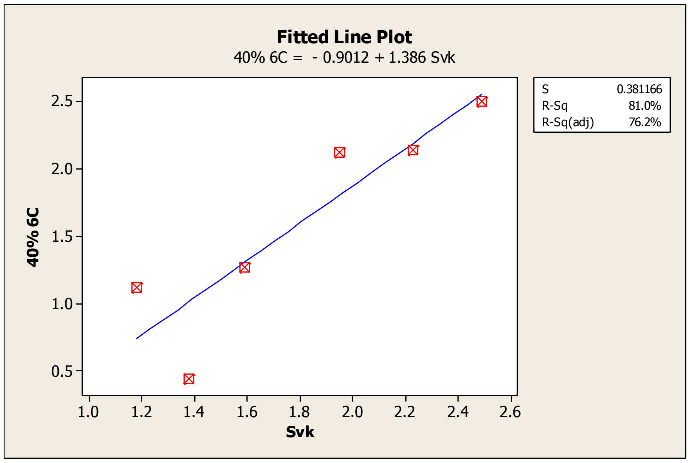
Table 4

Trial Combination	Spk	Sk	Svk	80% 6C	40% 6C	80% 1C	40% 1C	80% 3C	40% 3C
1	2.170	6.660	1.590	0.527	1.269	0.527	1.167	1.236	2.892
2	0.943	4.980	1.380	0.236	0.441	0.500	1.118	0.527	0.667
3	14.200	7.930	2.490	0.520	2.500	0.803	2.180	1.323	3.050
4	6.900	8.240	1.950	0.500	2.121	0.441	2.449	1.130	2.315
5	2.690	7.230	2.230	0.408	2.137	0.408	1.633	1.414	2.610
6	6.160	10.100	1.180	0.401	1.118	0.524	2.088	0.527	1.225

The Std Deviation of Dot Gain is lowest for Trial 2 and highest for Trial3 across all the three cyan colors (in both 40% & 80% tints).
At the same time the Spk and Svk values are least with Trial 2 and highest with Trial 3. Therefore it can be concluded that there exists a strong correlation between Topography parameters and Variability in Dot Gain.

In order to further establish the correlation regression analysis have been done. The predictor or the independent variable (X) has been chosen as Svk and response or dependent variable (Y) has been chosen as Std Deviation for Dot Gain for 40% tint of Cyan printed in the 6th Printing Unit.

Regression Analysis: 40% 6C versus Svk



Graph 4

The regression equation is
40% 6C = - 0.901 + 1.39 Svk
S = 0.381166 R-Sq = 81.0% R-Sq(adj) = 76.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	2.4738	2.4738	17.03	0.015
Residual Error	4	0.5812	0.1453		
Total	5	3.0549			

The R-Square Value of 81% and P-Value of 0.015 indicates there is a strong relationship between the Topography Parameter (Svk) and Std Deviation of Dot Gain.

Conclusion

This paper has helped in understanding the impact of Coating recipe (made with different Pigments types) & controlled Infra Red Drying, firstly upon Surface Topography. And secondly the impact of surface topography upon Dot Gain has been established. It has been been proved that Trial Combination 2 (i.e Coating Recipe A + 2 IR Dryer) has more uniform coating structure and therefore the variability in Dot Gain is the least. This behavior of dot gain is attributed to more uniform absorption and splitting of ink during offset printing.

Thus it can be concluded that for achieving improved print appeal and lower variability in Dot Gain, the coating layer structure needs to be engineering for narrow distribution of peaks and valleys. This is possible by selecting the right grade of pigment and regulating the Infra Red Drying of coating layer.

Acknowledgements

I convey my sincere thanks to the entire Technical and Paper Machine team of ITC LIMITED, Paperboards & Specialty Papers Division, Unit: Bhadrachalam.

Reference

Douglas C. Montgomery – Introduction To Statistical Quality Control 4th Edition

Richard Gagnon – Reducing Back Trap Mottle in Multi Layer Coating Systems, TAPPI 2006 Coating & Graphic Arts Conference

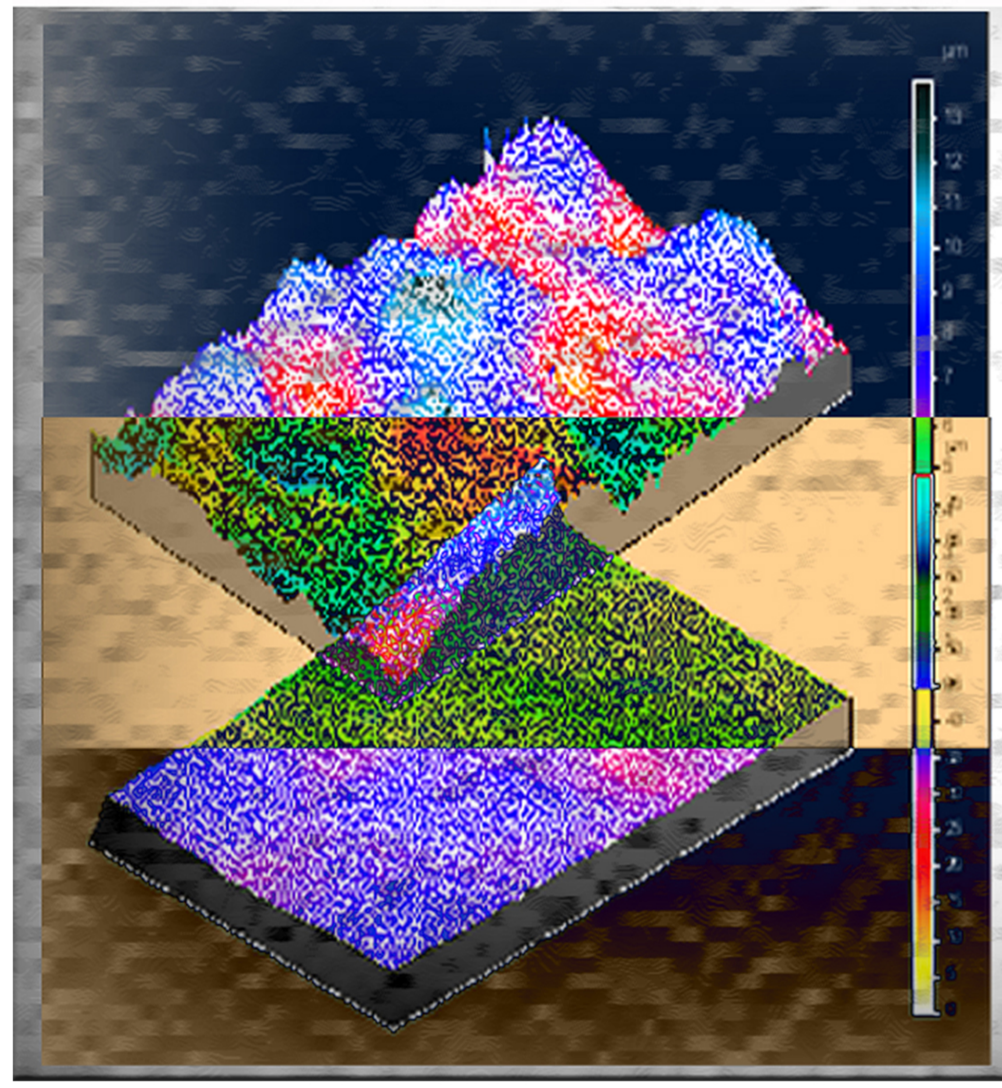
Maximizing Precoat Contribution to Final Sheet Quality – Taiwan Technical Association of the Pulp and Paper Industry, Don Hiscock & Tai Kang Chu
April 12 2005

Helmut Kipphan – Handbook of Print Media, Heidelberg 2nd Edition

X-Rite, A Guide to Understanding Graphic Arts Densitometry www.xrite.com

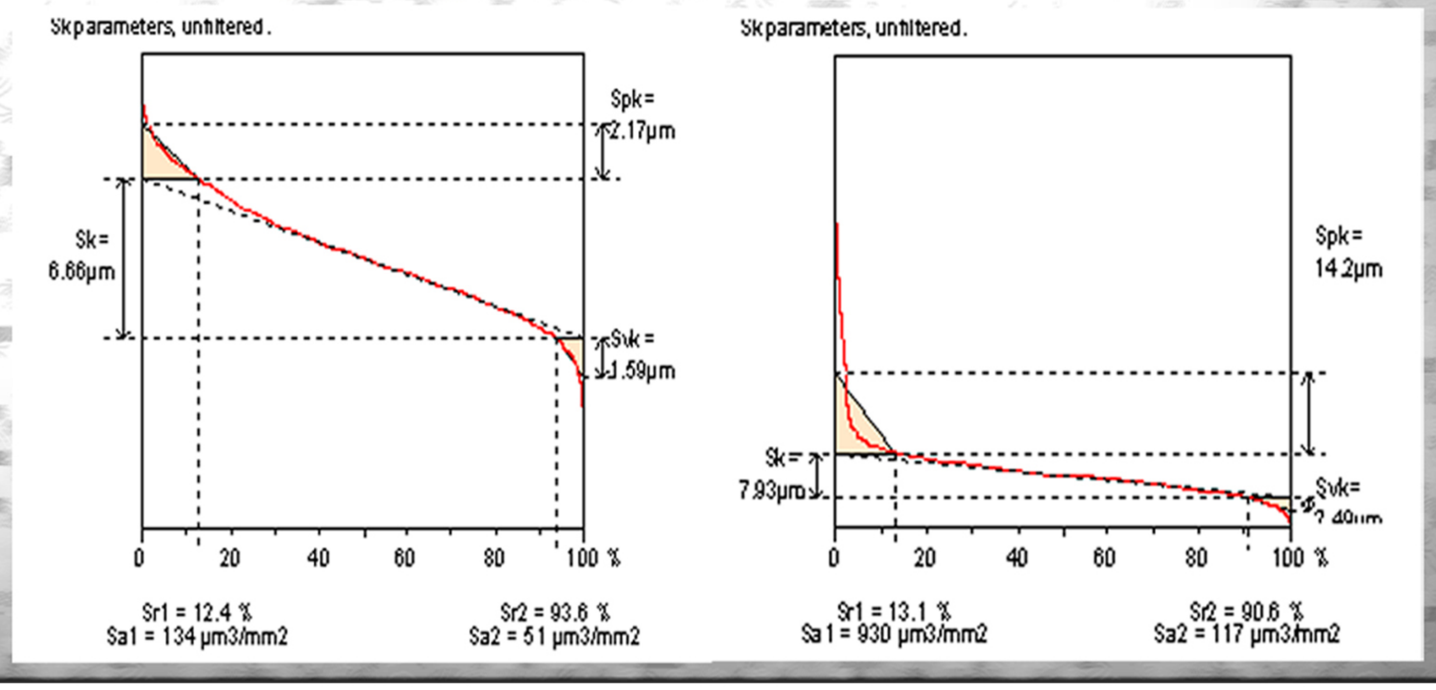
SAPPI Knowledge Bank – Mottling Mottled Impression www.sappi.com

Surface Topography relation to Dot Gain



INTRODUCTION

It has been found that certain coated board structure which demonstrated very narrow distribution of surface peak and voids / valleys (low Spk Values & Svk values) have yielded lower variation in Dot Gain.



Experiments

- Trial 1 – Recipe A + 0 IR
- Trial 2 – Recipe A + 2 IR
- Trial 3 – Recipe A + 4 IR
- Trial 4 – Recipe B + 0 IR
- Trial 5 – Recipe B + 2 IR
- Trial 6 – Recipe B + 4 IR

1. Six trials were conducted on 3 Ply Board Machine No 4 at ITC LIMITED. All the trials were conducted on Coated Folding Box Board 300 g/m2, with different Top Coat Recipe and IR dryer combination at the same speed (400 m/min) using the same furnish on the same day.

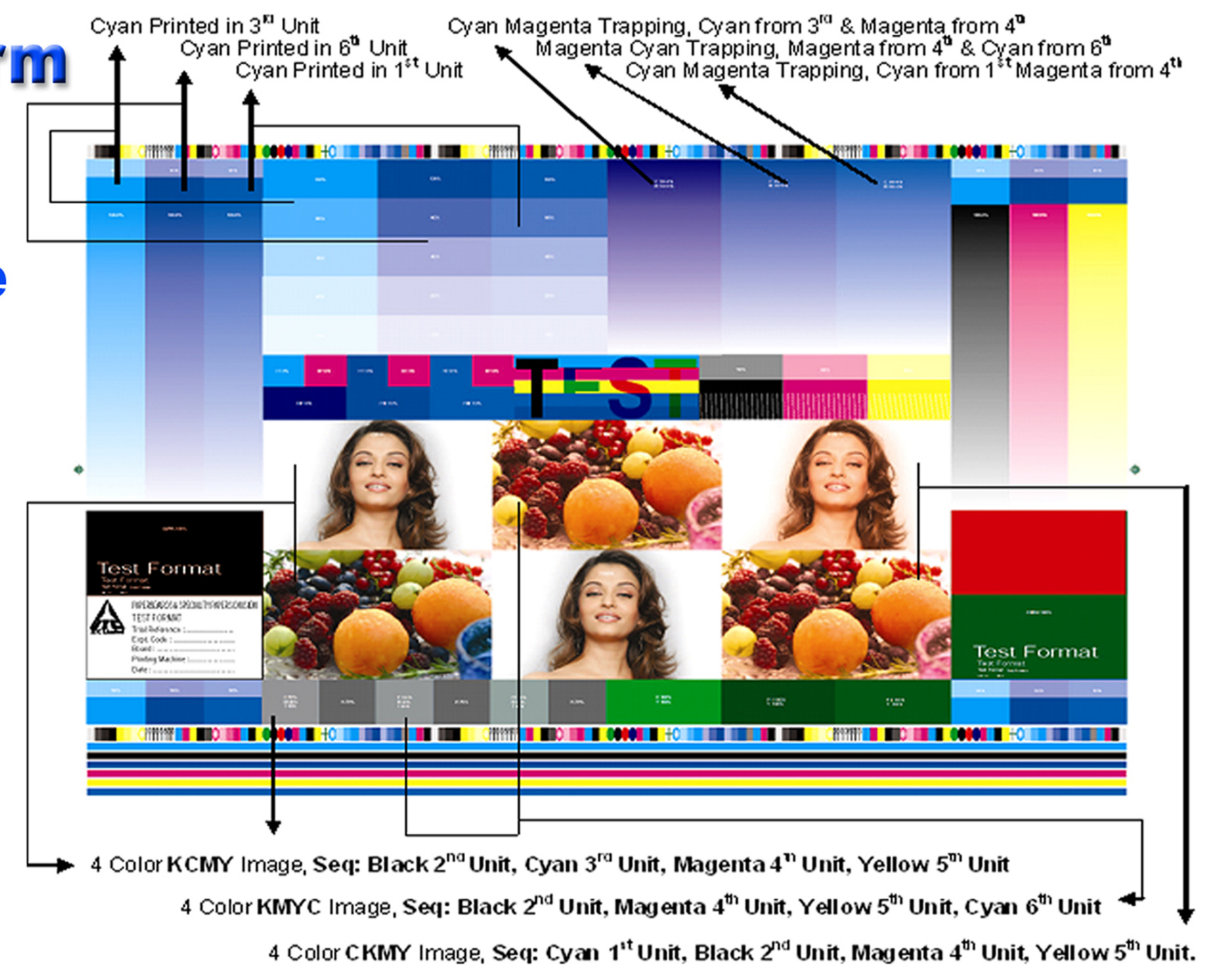
2. Surface structure of the Coating Layer has been analyzed using Hommel T 8000 topography tester. Three dimensional topographic images and certain surface texture parameters like Spk – Surface Peaks, Sk and Svk – Surface Valleys have been analyzed.

3. The different trial combinations were printed at the same time on a specially designed 6 – Color Offset Test Form in a commercial sheet-fed offset printing press.

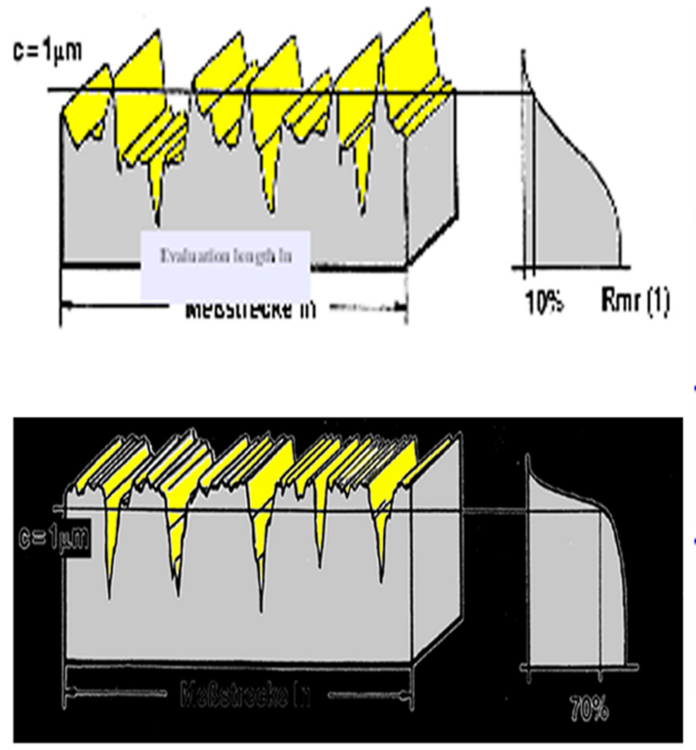
4. Assessment of Print Quality have been done in two ways:
Subjective Evaluation: Visually assessing print quality and assign objective scoring by panel.
Objective Evaluation: Measurement of Dot Gain was done using Gretag Mcb Spectroeye Spectrophotometer.

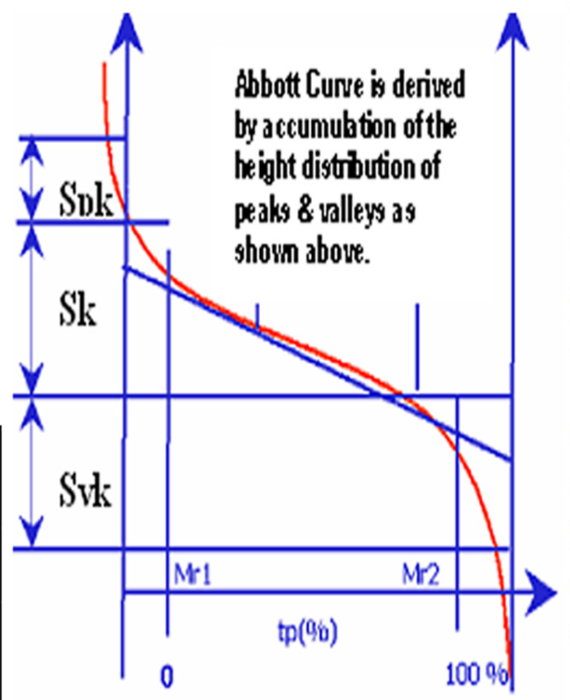
Print Test Form

Color Sequence
- 1st Cyan
- 2nd Black
- 3rd Cyan
- 4th Magenta
- 5th Yellow
- 6th Cyan



Topography Analysis

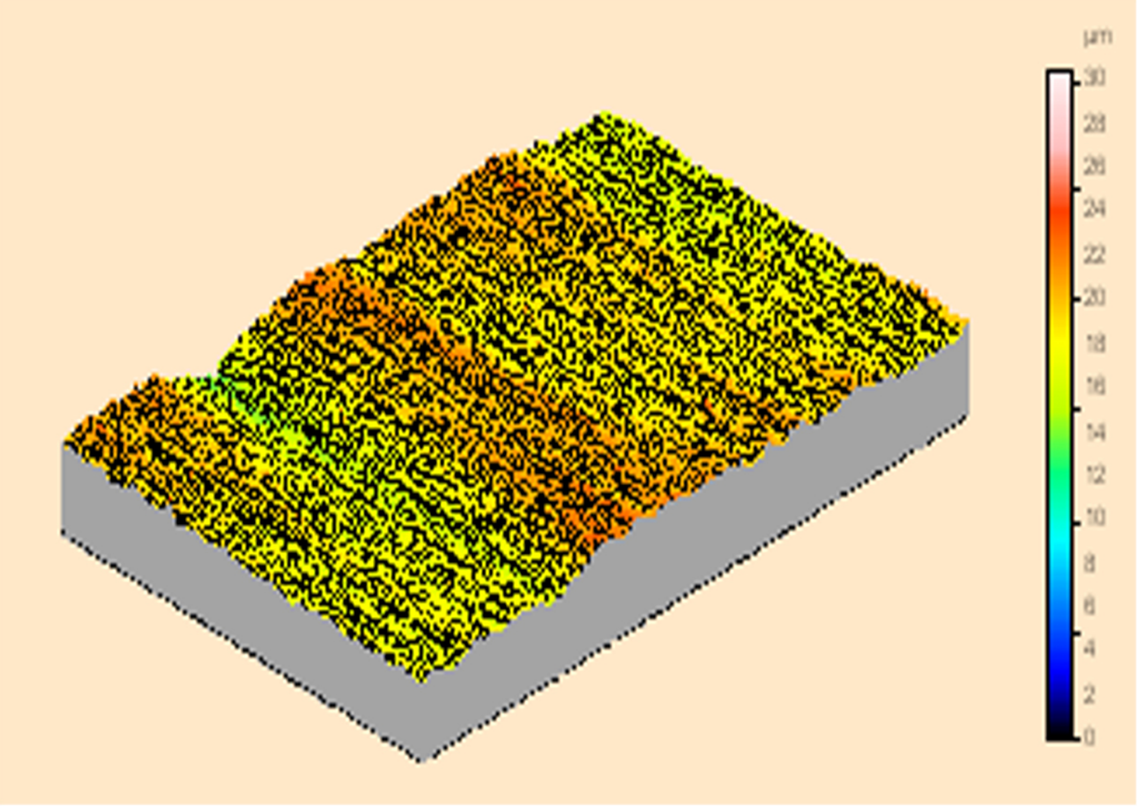


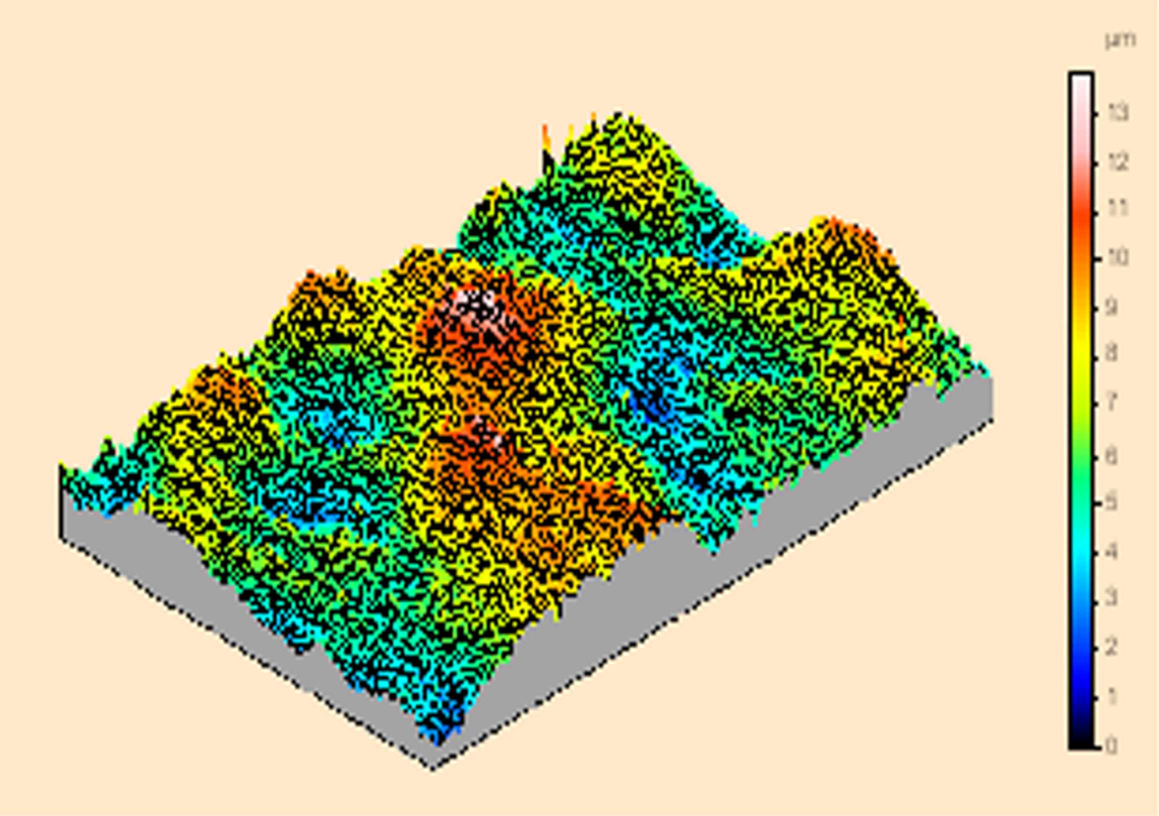


Spk: It is defined as the Reduced Peak Height and is a measurement of the peaks on the surface above a reference line. These peaks will be the areas of most rapid wear when the subjected to friction, while calendaring, rewinding or while printing. Higher the Spk value, higher is the non –uniformity on the surface and hence higher is the probability of non – uniform ink absorption while printing, thus leading to undesired print results.

Sk: It is defined as the core region and is the height difference between the intersection points of the found least mean square line. If the surface is more of a plateau shaped, Sk value will be higher, indicated flat surface with less of of peaks and valleys.

Svk: It is the valley depth on the surface and is a measurement of the void structure. Higher the value of Svk, higher is the depth of the valley or void indicating more prous structure.



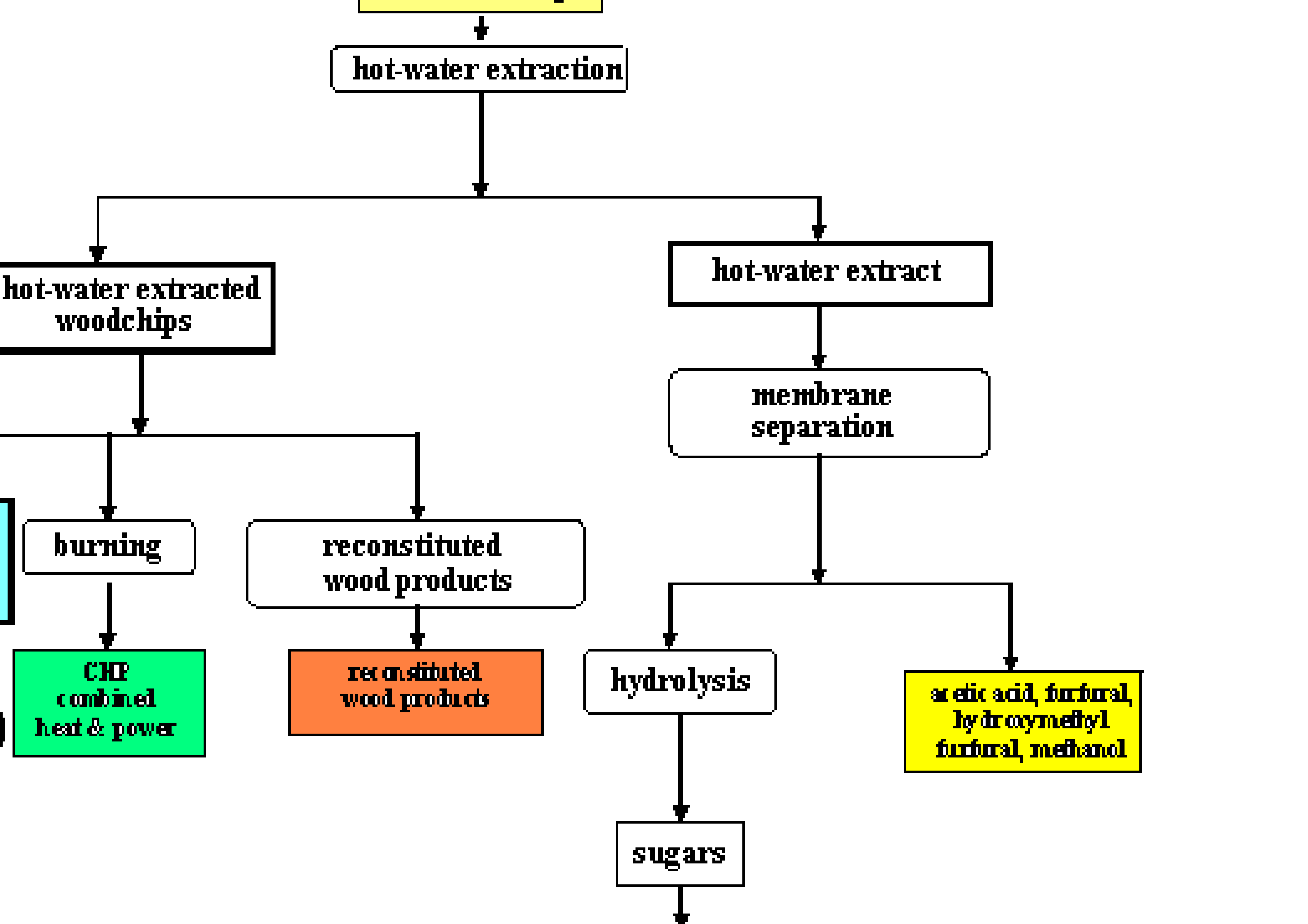


Results & Discussion

Trial Combination	Topography			Dot Gain Standard Deviation					
	Spk	Sk	Svk	80% 6C	40% 6C	80% 1C	40% 1C	80% 3C	40% 3C
1	2.170	6.660	1.590	0.527	1.269	0.527	1.167	1.236	2.892
2	0.943	4.980	1.380	0.236	0.441	0.500	1.118	0.527	0.667
3	14.200	7.930	2.490	0.520	2.500	0.803	2.180	1.323	3.050
4	6.900	8.240	1.950	0.500	2.121	0.441	2.449	1.130	2.315
5	2.690	7.230	2.230	0.408	2.137	0.408	1.633	1.414	2.610
6	6.160	10.100	1.180	0.401	1.118	0.524	2.088	0.527	1.225

The Std Deviation of Dot Gain is lowest for Trial 2 and highest for Trial3 across all the three cyan colors (in both 40% & 80% tints).

At the same time the Spk and Svk values are least with Trial 2 and highest with Trial 3. Therefore it can be concluded that there exists a strong correlation between Topography parameters and Variability in Dot Gain.


hot-water extraction
hot-water extracted woodchips
hot-water extract
membrane separation
burning
reconstituted wood products
CHP combined heat & power
reconstituted wood products
hydrolysis
acetic acid, furfural, hydroxymethyl furfural, methanol
sugars

Quality Control System Performance Assessment

Practical Procedures and Indexes

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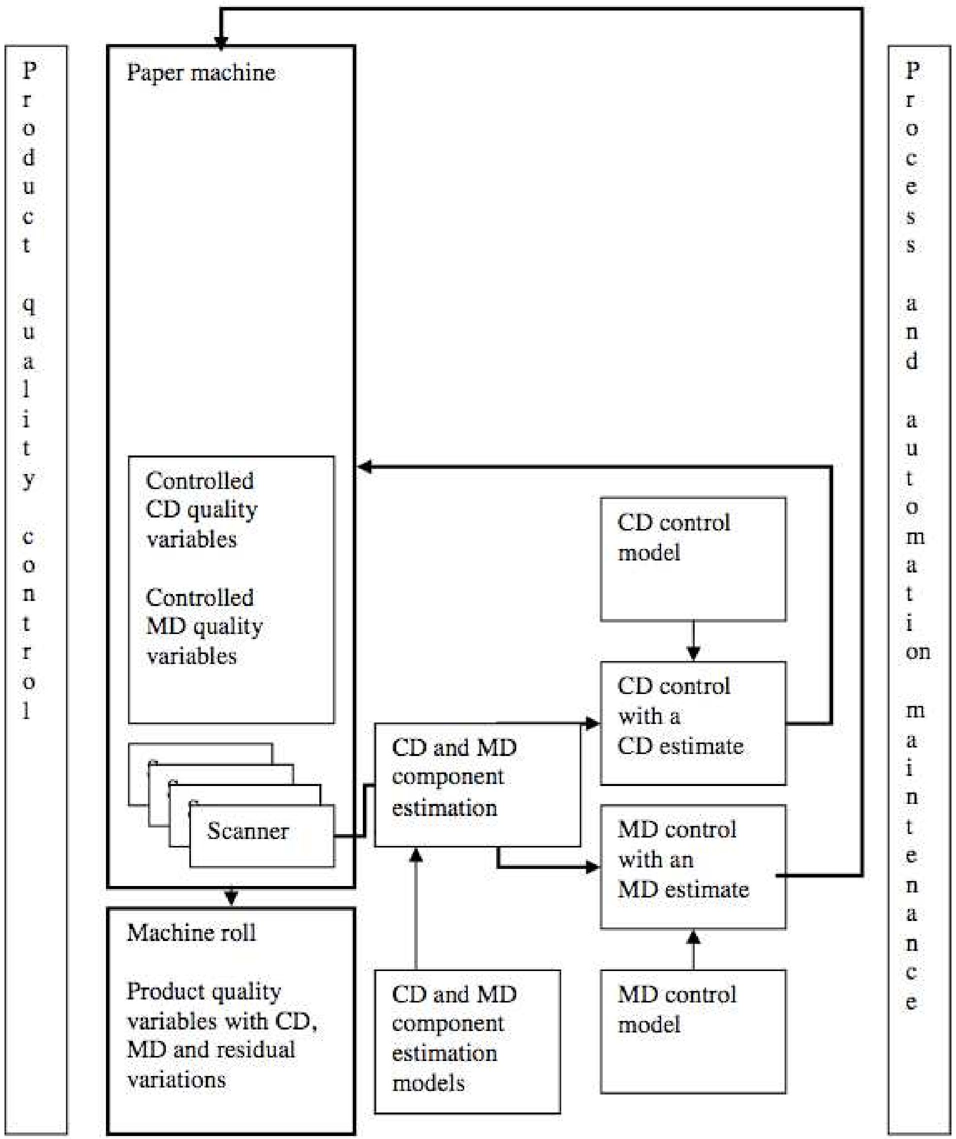
Kymenlaakso University of Applies Sciences, FI-48400 Kotka, Finland

Abstract

- Performance as a quality control system property describes to what extent measurement, monitoring, machine direction (MD) and cross direction (CD) control can be executed. The performance is defined with some measurable indexes.
- On paper and board machines, quality variables are widely measured with traversing scanners.
- The performance of quality control systems is limited due to insufficient measurement and control technology.
- Real CD profiles cannot be measured, and fast MD variations cannot be detected.
- The performance of CD and MD profile estimation is imperfect and aliasing effects may occur.

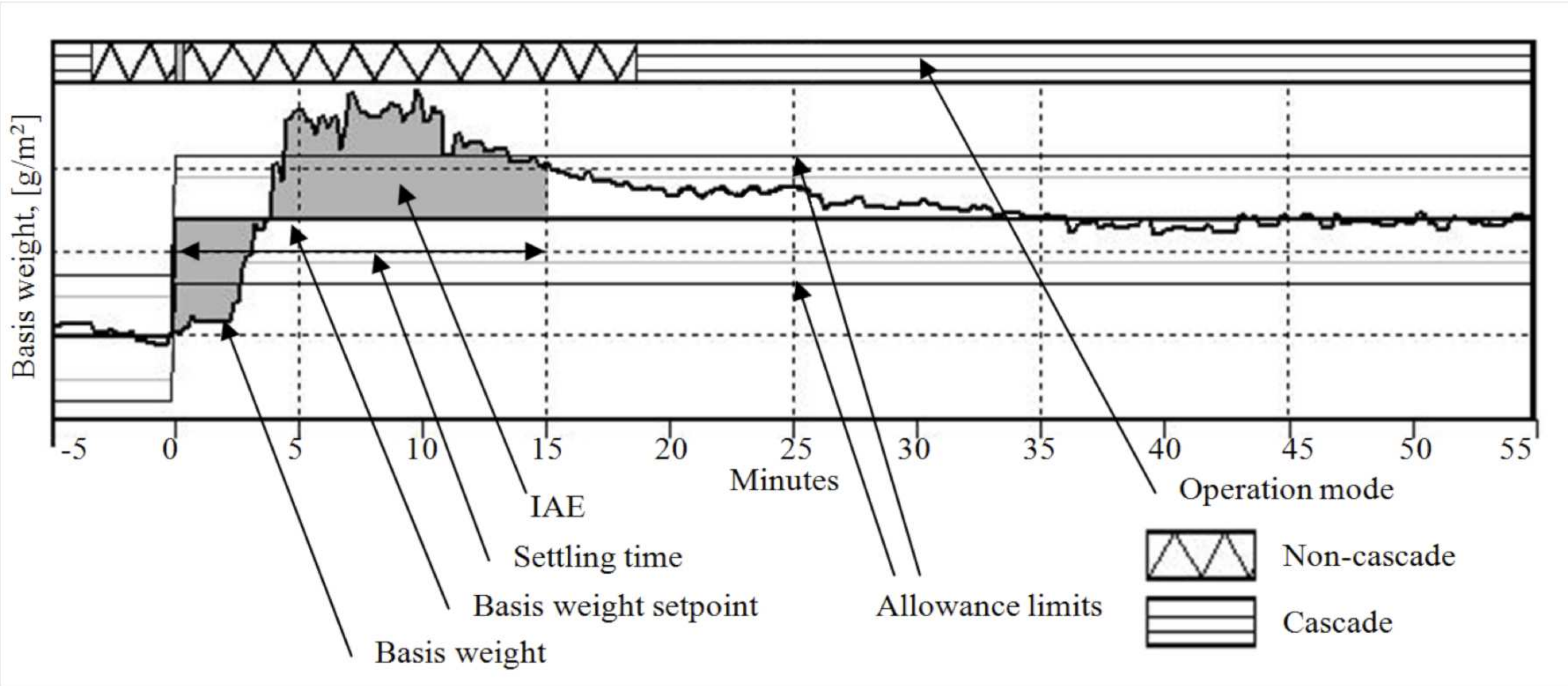
Quality Variable Measurement and Control



- Quality measurement signals of traversing scanners have to be preprocessed and separated into CD and MD components.
- Quality variables have to be controlled separately in CD and MD.
- Operation and maintenance activities affect quality variables.

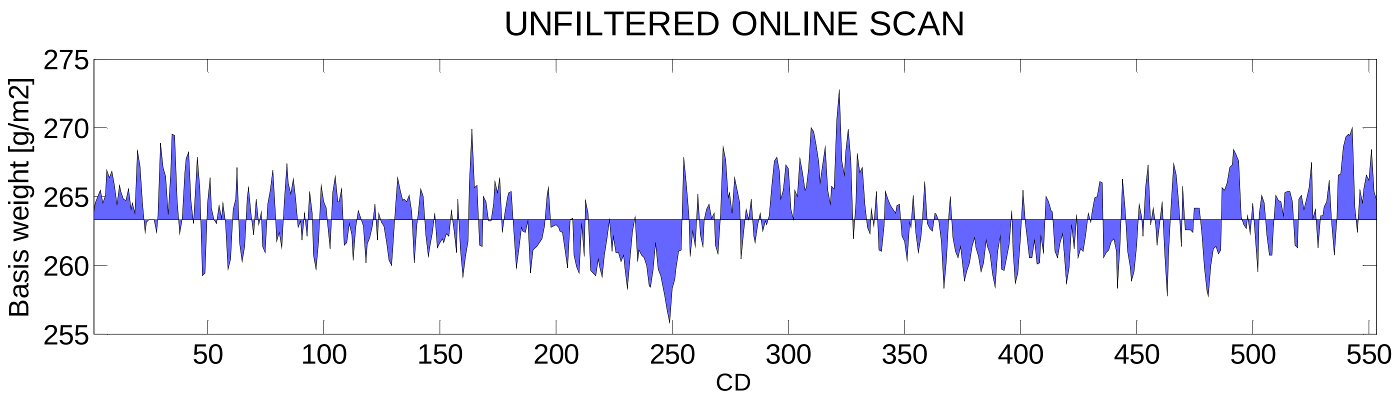
Performance Indexes in MD Quality Control
Everyday Operation and Maintenance Aspect

- Operation modes of control loops, cascade and non-cascade
- Settling times, remaining inside allowance limits
- Error integrals, differences between controllable variables and set points

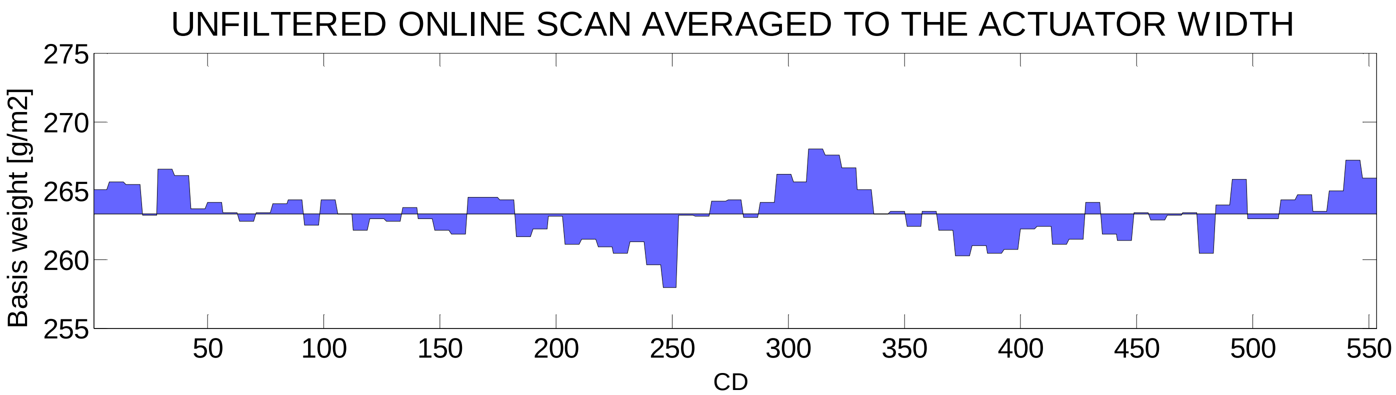


Performance Indexes in CD Control
Everyday Operation and Maintenance Aspect

- Operation modes of control loops, cascade and non-cascade
- Mean value profiles, differences from set point profiles
- Error integrals IAE, differences between controllable variables and set points
- 2-sigma values, variability

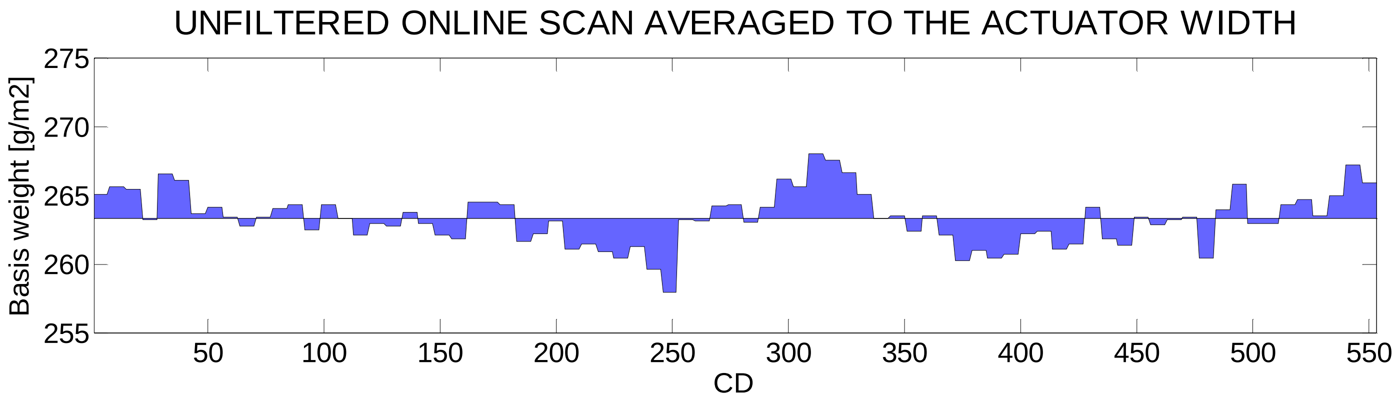


mean value 263,3 g/m2
minimum value 255,8 g/m2
maximum value 272,7 g/m2
2-sigma value 5,2 g/m2

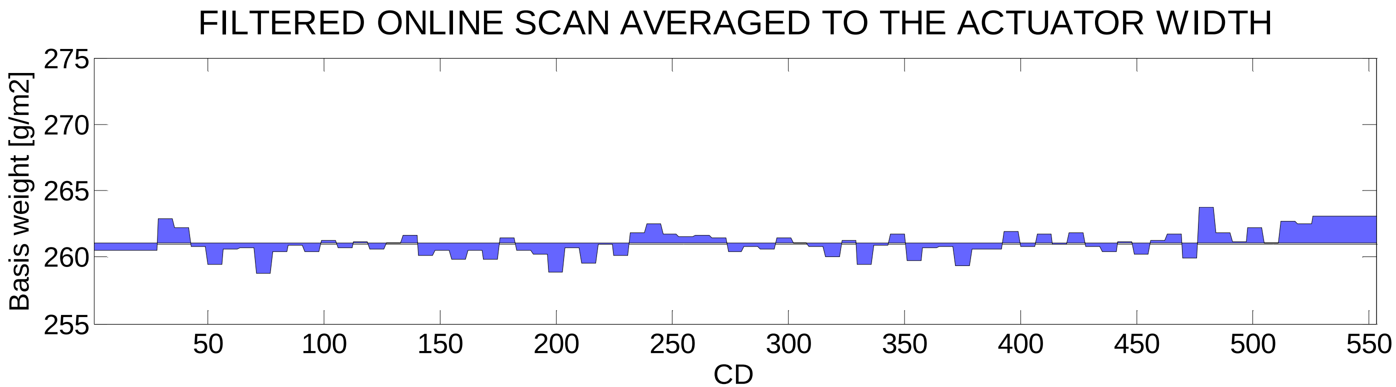


mean value 263,3 g/m2
minimum value 257,9 g/m2
maximum value 268,0 g/m2
2-sigma value 3,8 g/m2

Performance Indexes in CD Control
Filtering Effects



mean value 263,3 g/m2
minimum value 257,9 g/m2
maximum value 268,0 g/m2
2-sigma value 3,8 g/m2

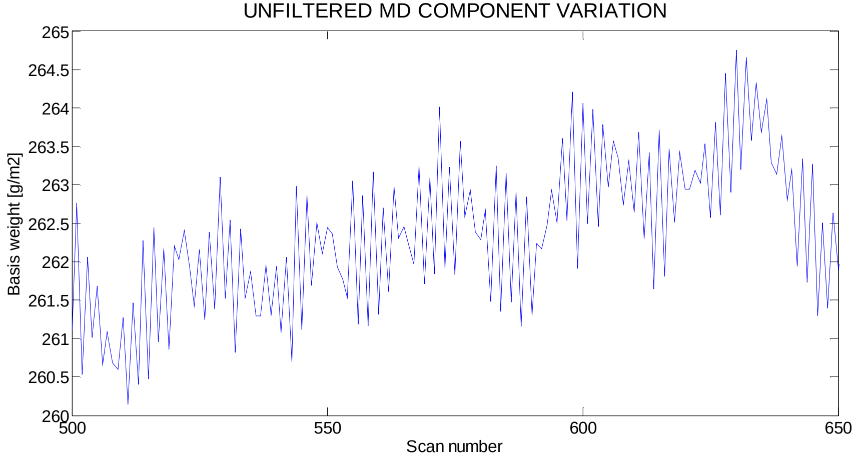


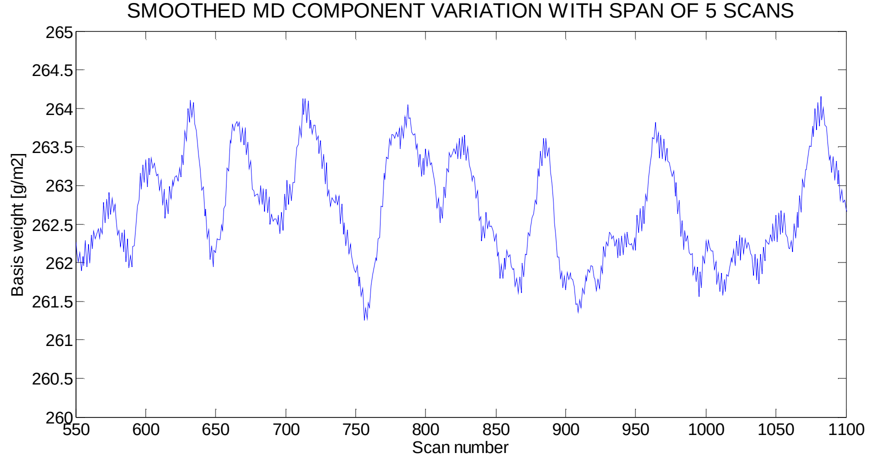
mean value 261,1 g/m2
minimum value 258,8 g/m2
maximum value 263,8 g/m2
2-sigma value 2,0 g/m2)

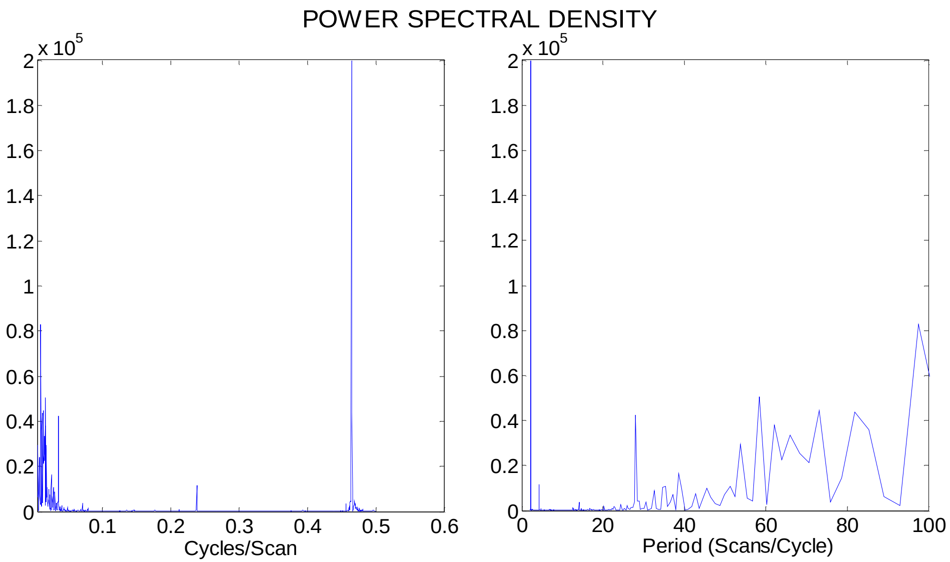
$$x^{n}_{filtered} = a * x^{n-1}_{filtered} + (1-a) * x^{n}_{unfiltered}$$

Filtering a measured profile reduces signal variations significantly and may even change the mean value level and the shape of the profile.

Performance Indexes in MD Quality Control
Process and Automation Development Aspect







- This presented MD variation data comes from a web analyzer (real CD profiles).
- **Power spectrums** can be calculated in several different ways, like by using fast Fourier transforms (FFT).
- Imperfections and insufficiencies in process machinery or in instrumentation can be revealed by using power spectrum analyses.

Performance Indexes
Quality Management Aspect

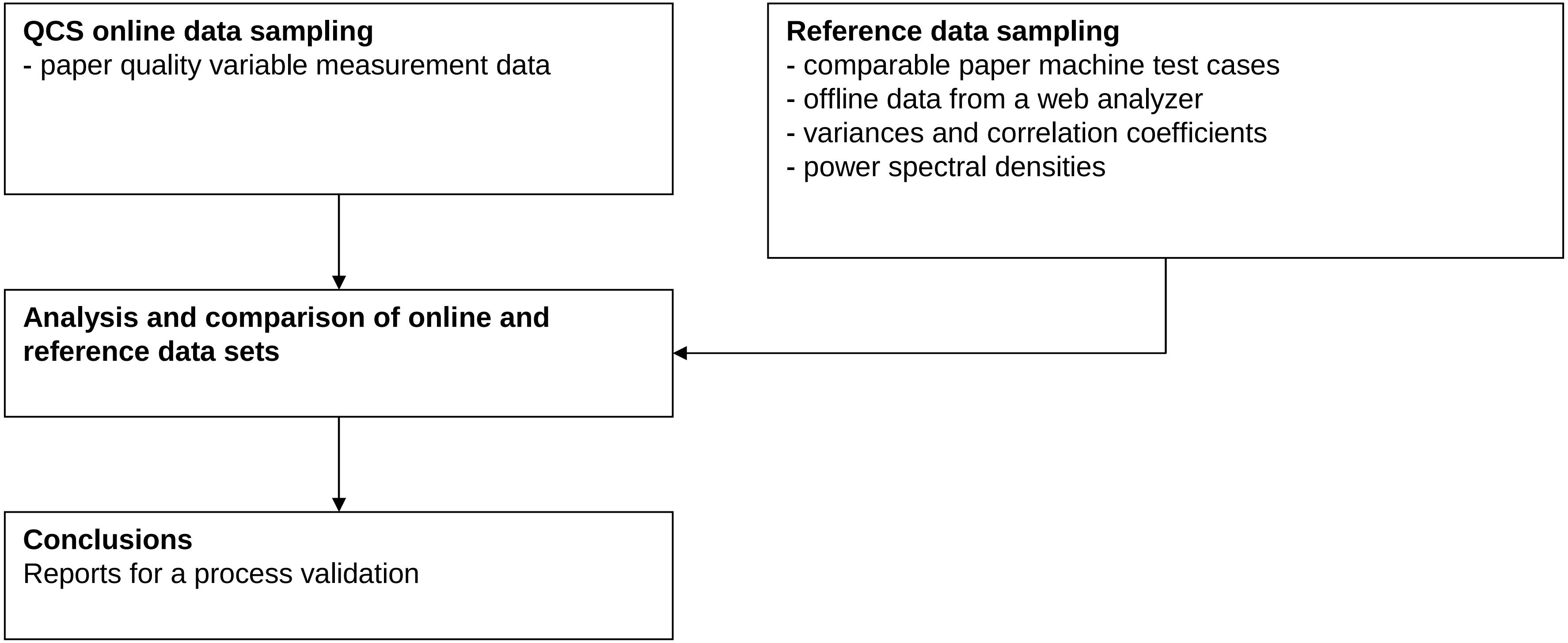
Measurement sensor performance may be described by using the concepts **repeatability** (short-term) and **reproducibility** (long-term) with indexes

- mean values
- variances
- standard deviations
- 2-sigma values.

Sensors' performance can be improved by regular calibrating procedures:

- hourly **internal calibration**, comparison to internal samples
- weekly **dynamic calibration**, comparison to lab measurements
- yearly **accredited field calibration**, comparison to traceable foil samples.

Process Validation Procedure
Process and Automation Development Aspect



A **process validation** aims to show that the specified paper products can be manufactured with the available process machinery and control systems in production circumstances.

Conclusions

- On paper and board machines, real CD profiles cannot be measured by traversing scanners, but nevertheless the process has to be run.
- Raw online profiles often contain fast machine direction variations which reduce the quality of CD and MD profile estimation needed for CD and MD control.
- By following rather straightforward methods and indexes such as statistical indexes, error integrals, control loop operation modes and settling times, we are able to come along with our quality control systems.
- The greatest challenges come with the understanding of rather complicated signal processing methods and hundreds of adjustable parameters in commissioning and maintenance.

References

1. Sell, N. editor, Process control fundamentals for pulp and paper industry, Tappi Press, USA, 1995, pp. 275 - 325, ISBN 0-89852-294-3.
2. IEC 61069-1, Industrial-process measurement and control, Evaluation of system properties for the purpose of system management, Part 1: General considerations and methodology, International Electrotechnical Commission, Switzerland, 1991, 41 p.
3. Kangasrääsiö, J., Hemming, B., Calibration of a flatbed scanner for traceable paper area measurement, in Measurement science & technology, Vol. 20, number 10, Institute of Physics, Bristol, ROYAUME-UNI, 2009, ISSN 0957-0233.
4. Mäkelä, M., Vehviläinen H., Quality control system performance – a review to evaluation practices, in Proceedings of PaperCon'09, May 31 - June 3, 2009, in St. Louis, USA, TAPPI, 2009, 11 p.

HIGH STIFFNESS SURFACE COATING OPTIMIZATION THROUGH STARCH ENCAPSULATION OF PLATY KAOLIN

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Background

- Objective is to apply a coating that will provide a high stiffness per unit basis weight: platy clay or starch enclosure of kaolin particles may provide and increase
- Starch encapsulated kaolin applied as a surface coating – the swollen starch jackets take up air void volume provide greater stress transfer between clay particles in t he coating
- Considering the coated paper as a sandwich structure, coating thickness T_c and base paper thickness T_b:

$$S_b = \frac{E_b T_b^3}{12} + \frac{E_c \bullet (T_b + T_c)^2 \bullet T_c}{2} + \frac{E_c T_c^3}{6} \approx \frac{E_c T_b^2 T_c}{2}$$

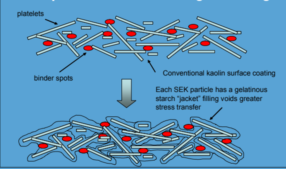
- Coating effective modulus E_{eff} is the volume fraction weighted sum of its components:

$$E_{eff} = \sum_i E_i \alpha_i$$

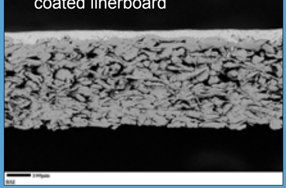
- For no air void volume, binder modulus E_s, pigment modulus E_p and CPVC = pigment volume fraction α_p:

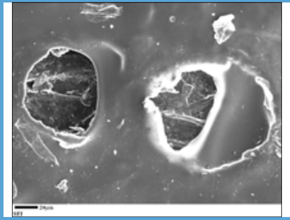
$$E_c \cong E_p \alpha_p + E_s (1 - \alpha_p)$$

Concept behind SEK coating advantage



SEM cross section of clay coated linerboard

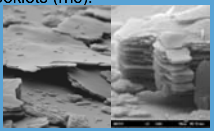




SEM of multilayer coated linerboard – platy clay coating is visible through the polymer top coat pin-holes

Experimental

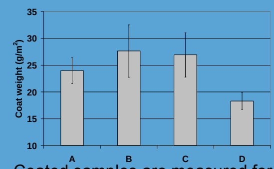
- **Coating formulations were made from 100:16 pigment:binder 55% solids from…**
  - **A:** fine clay (KCS™),
  - **B:** delaminated platy (Astraplate™)
  - **C:** super platy barrier (HX™)
  - **D:** starch treated filler (SEK)
- All coatings were applied with #15 wire rod drawdown onto:
  1. 205 gsm linerboard single side
  2. 50 gsm newsprint both sides
- Super platy clay was also encapsulated to make formulation **E1** and **E2**:
  1. 100:2.5 Penford 280 starch added to HX slurry, heated 90 deg C 90 minutes
  2. Dried and ground
  3. Powder passed through #325 filter
  4. Filtered powder blended with SB latex 100:16
- Comparison of starch treatment of super platy clay was compared with straight starch addition in formulation **C+**:
  1. Starch added separately 100:2.5 to pigment binder blend
  2. Mixture heated to 90° C prior to drawdown application
- Ideally, the clay should be dispersed into platelets (lhs) not aggregates of booklets (rhs):



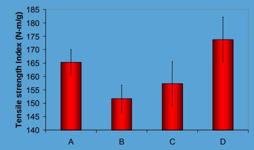
- IPST trials were conducted with clay coated linerboard: reduces WVTR and increases top coat hold-out

Results

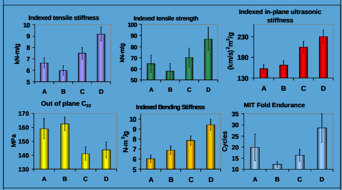
- Coat weights are lowest for starch treated filler kaolin



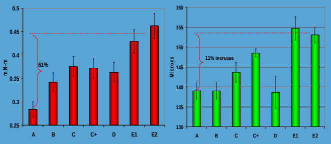
- Coated samples are measured for several physical properties, differences in properties from the different coatings are more evident when normalized to the basis weight of the coating:



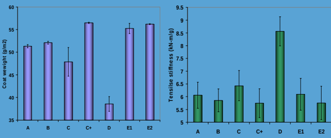
- Coatings applied to both sides of 50 gsm newsprint highlight differenced between the coatings more clearly:



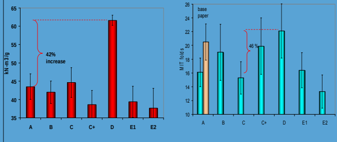
Increases in bending stiffness for starch treated clays exceed what can be accounted by caliper increases from the coatings:



Coat-weights are consistently lowest for starch coated filler kaolin, normalized strength properties show the highest gains for this coating



Left graph below shoes the indexed in-plane modulus being the highest for starch treated filler clay. Another concern is fold resistance with application of clay coating shown in the right graph:



Conclusions

Starch treated clays were explored for use as surface coatings in attempt to get higher strength properties, the findings were:

- Starch treated filler kaolin produces the lowest coat-weights but the highest gains in strength properties per unit coat weight
- The highest bending stiffnesses were attained using encapsulated platy clay
- Starch encapsulation is more effective for strength gains than starch addition
- Starch treated filler kaolin demonstrated the highest fold endurance compared to other coatings.
- Results are presented here as indicative towards proof of concept and require repeats, verification
- Runnability and printability, optical properties of starch treated coatings remain for future work
- Continuing work is targeting use of platy clays for strength and barrier coating advantages.

A potential drawback of high-modulus coatings is that they are more brittle than low-modulus coatings, and their tendency to crack during folding is increased. This may to some extent be mitigated by increased tensile strength. A number of

REFERENCES:

Husband, J.C., Preston, J.S., Gate, L.F., Storer, A., Creation, P., The influence of pigment particle shape on the in-plane tensile strength properties of kaolin based coating layers, *Tappi Journal,* vol. 5, no. 12, 3 – 8 (2006).

Husband, J.C., Gate, L.F., Norouzi, N., Blair, D., The influence of kaolin shape factor on the stiffness of coated papers, *Tappi Journal* June 2009 12-17.

Popil, R., Joyce, M., Strategies of economical alternatives for wax replacement in packaging, *Tappi Journal* April 2008, 11-18.

Popil, R.E. Optimizing Water Resistance of Linerboard Coatings Using Pigments, *Tappi Journal* 5(9):18-26. (2006).

Yan, Z., Liu, Q., Deng, Y., Ragauskas, A., Improvement of Paper Strength with Starch Modified Clay, *Journal of Polymer Science* vol. 97 44 – 50, (2005).

Yoon, S-Y., Deng,Y., Clay-starch Composites and their Application in Papermaking, *Journal of Applied Polymer Science* vol. 100, 1032 – 1038 (2006).

Zhao, Y.,Hu, Z., Ragauskas A., Deng, Y., Improvement of paper properties using starch-modified precipitated calcium carbonate filler, *Tappi Journal* vol. 4, no. 2 (2005).

Habeger, C.C., Wink, W.A., Ultrasonic Velocity Measurements in the Thickness Direction of Paper, *Journal of Applied Polymer Science,* vol. 32, no. 4, 4503-4540 (1986).

Waterhouse, J.F., Ultrasonic Testing of Paper and Paperboard: Principles and Applications, *Tappi Journal* vol. 77, no. 1, 120-126 (1994).

Haj-Ali,R.,Choi,J.,Wei,B-S,Popil,R.,Schaepe,M.,(2008). Refined nonlinear finite element models for corrugated fiberboards, *Composite Structures,* 84(4);321-333.

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