Optimum Steam Plant Efficiency Through Advanced Controls and Energy Dashboards

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Goal of Presentation

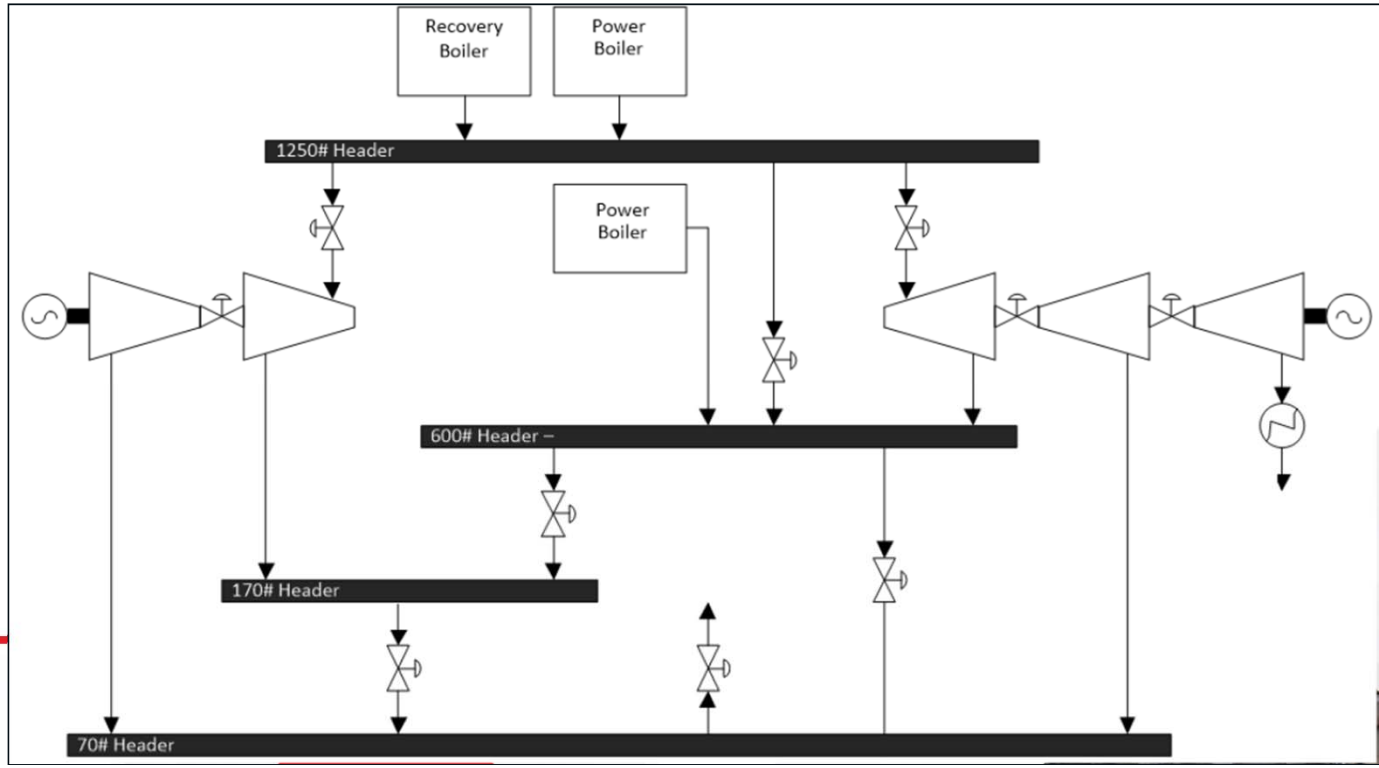
Explore energy challenges and review cost reduction projects through advanced automation technologies.

Presentation Overview:

- Cogeneration
- Internal cost of generating power
- Understanding the duck curve
- Benefits of Advanced Controls (APC) for utility systems
- Energy Dashboards

Cogeneration: the importance of on-site power generation

Cogeneration utilizes steam turbines to transform thermal energy into electrical energy.



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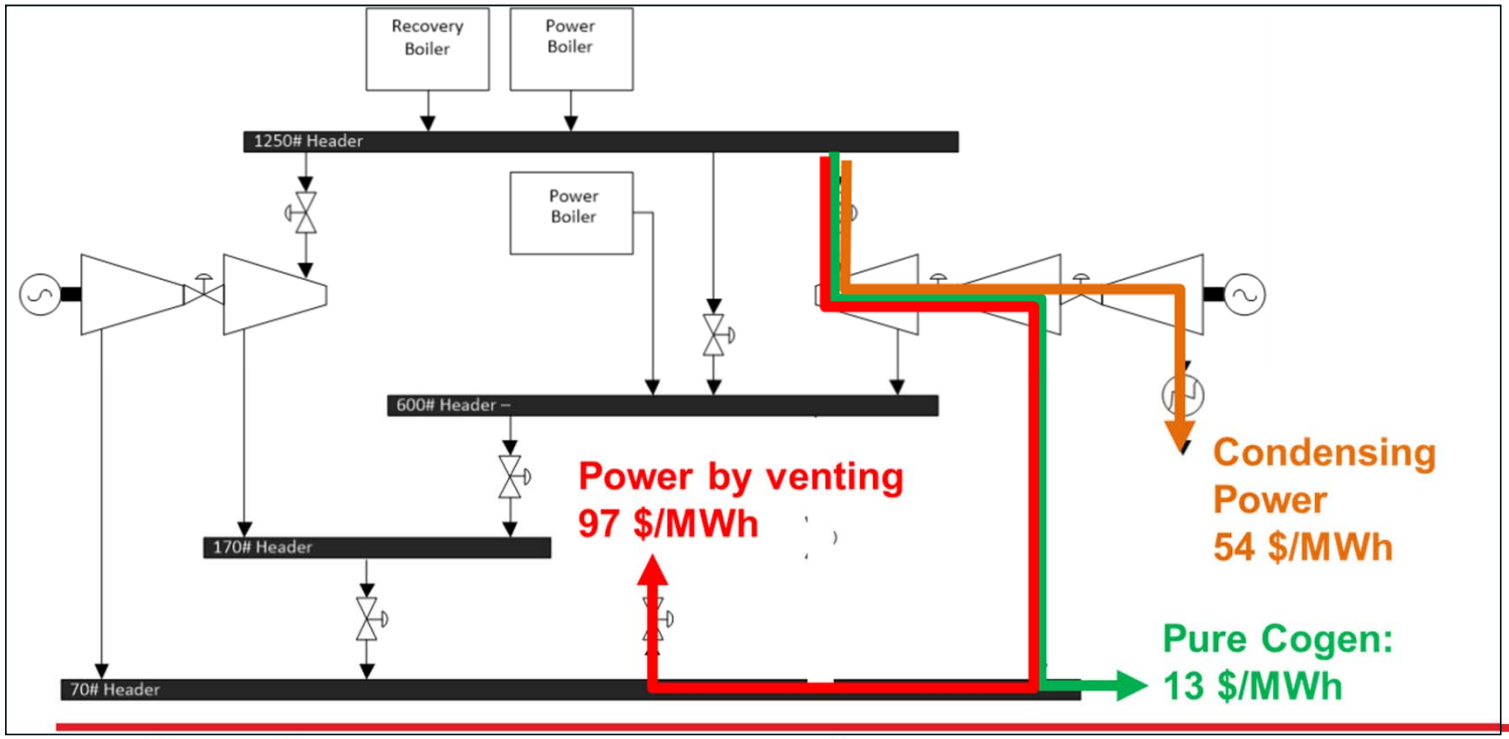
Key Input Variables to profitable cogeneration

1. **Fuel cost and boiler efficiency** determines the cost of steam.
2. **Turbine thermal-to-power efficiency** (heat rate) determines the capability of steam turbines to convert thermal energy into electrical power.
3. **Power contracts** will determine the cost of electricity to the mill.

Other variables: carbon footprint, reliability, electrical constraints, etc.

Steam Paths:
Visual representation of cost of power … and when do make a profit?



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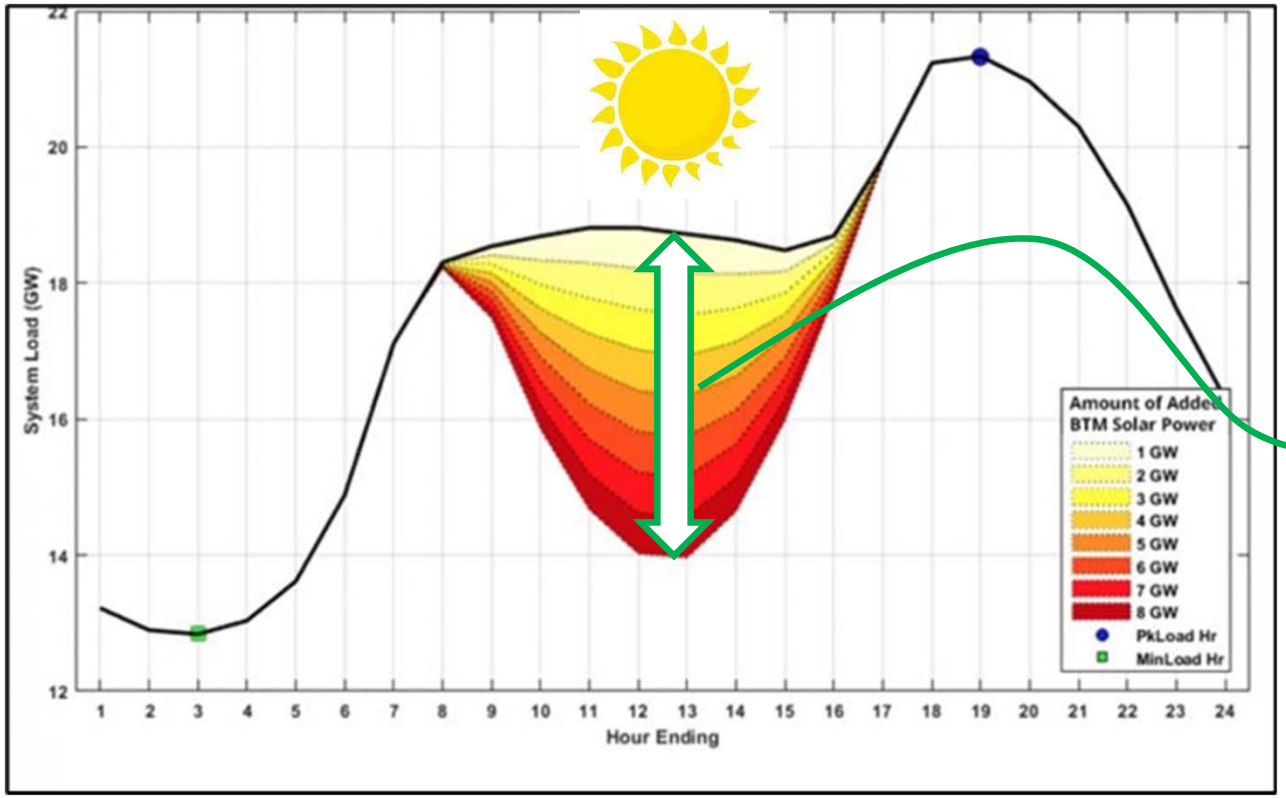
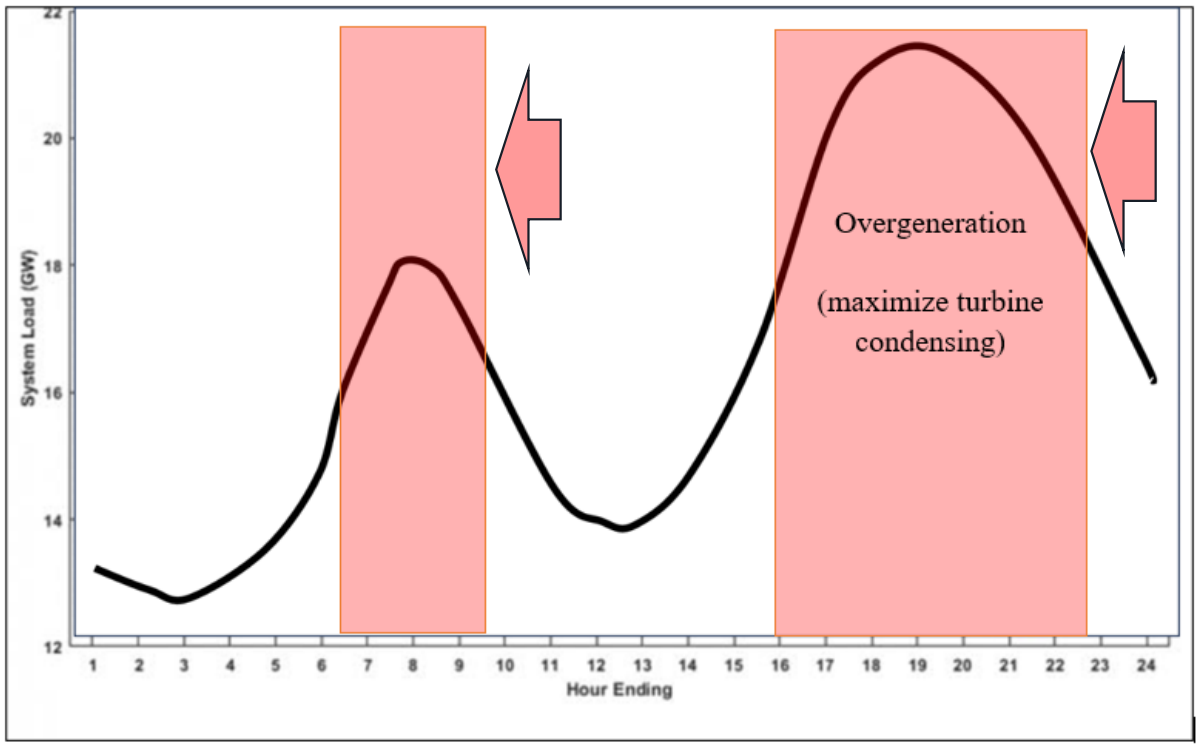
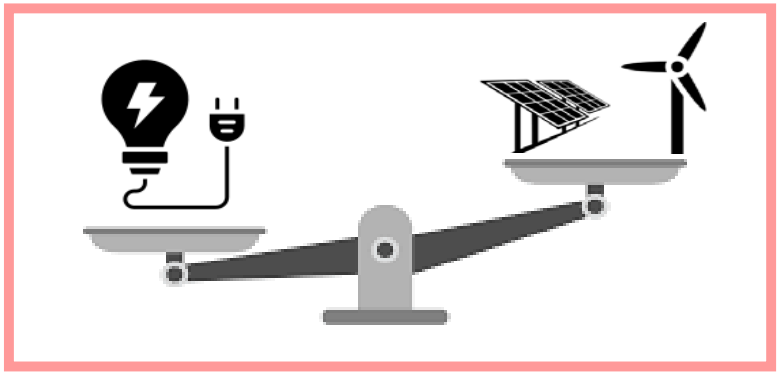
The Duck Curve: system load vs. time



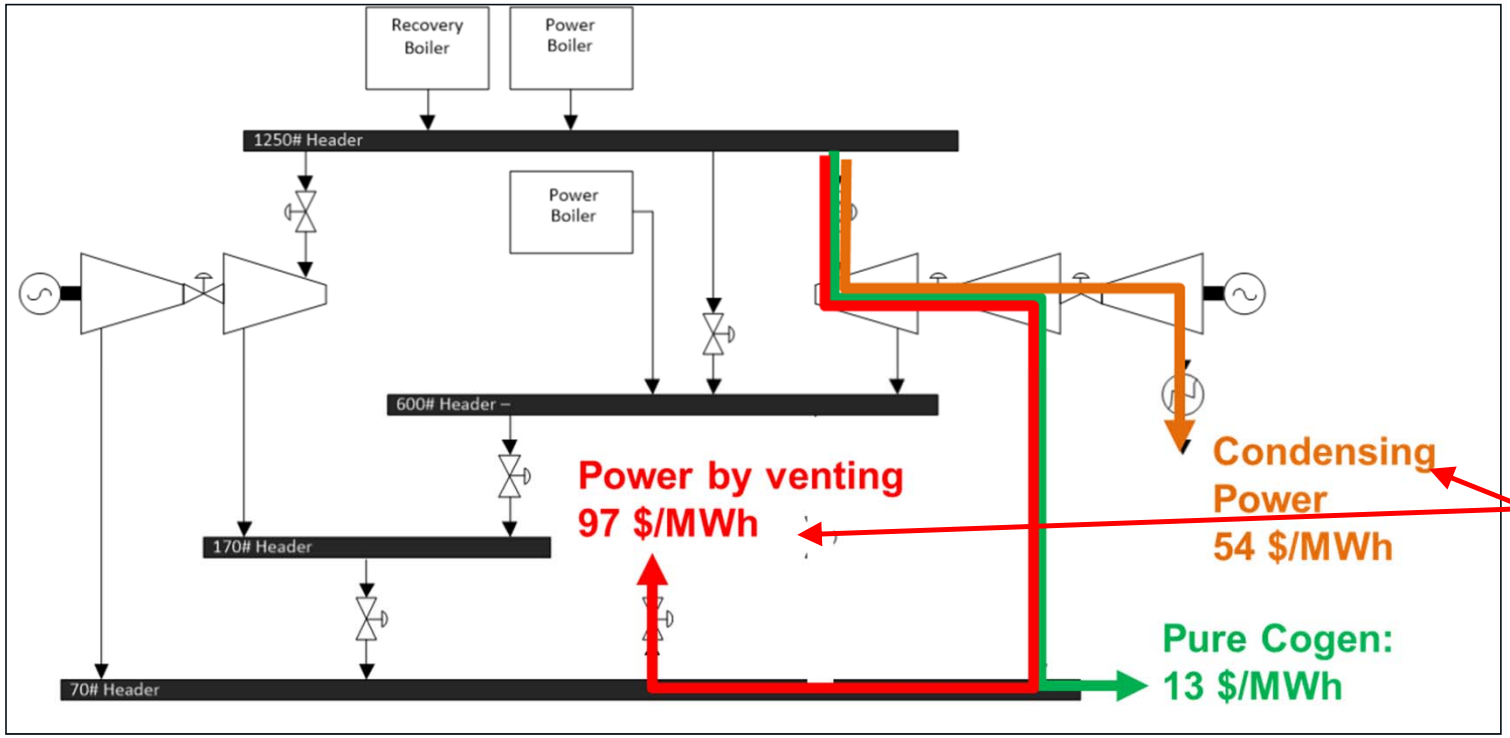
Impact of renewable energy

The Duck Curve … and two periods of overgeneration





Overgeneration for cogeneration



Overgeneration: burn more fuel to generate more power

Advanced Controls Steam & Firing Rate

- **Primary Goal: keep the lights on!**

- **Secondary goal – reduce cost and carbon footprint:**
  1. Determine the specific flow demand for each steam header,
  2. Calculate the most profitable path
  3. Determine the constraints for the different paths (valves in manual, turbine tripped or constrained, etc.).
  4. Feed the different steam headers

Maintaining Advanced Controls Performance

- Is the APC turned off?
- Are there reliability issues still existing when the APC running? Why?
- Are there instrumentation or mechanical issues that need to be fixed?
- Profit Gap: How far from the optimum profitability point is the APC running at?

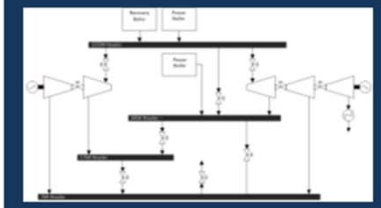
Energy Dashboards for performance tracking

Input Variables:

- Steam demand
- Power contract
- Equipment availability
- Boiler capacity and efficiency
- Turbine type and efficiency
- Biomass and fossil fuel cost
- ....

Digital Twin

process model



Optimum Operation

- Firing Rate Demand
- Turbine generation
- PRV opening
- Venting
- ....

ALARM ON DEVIATION

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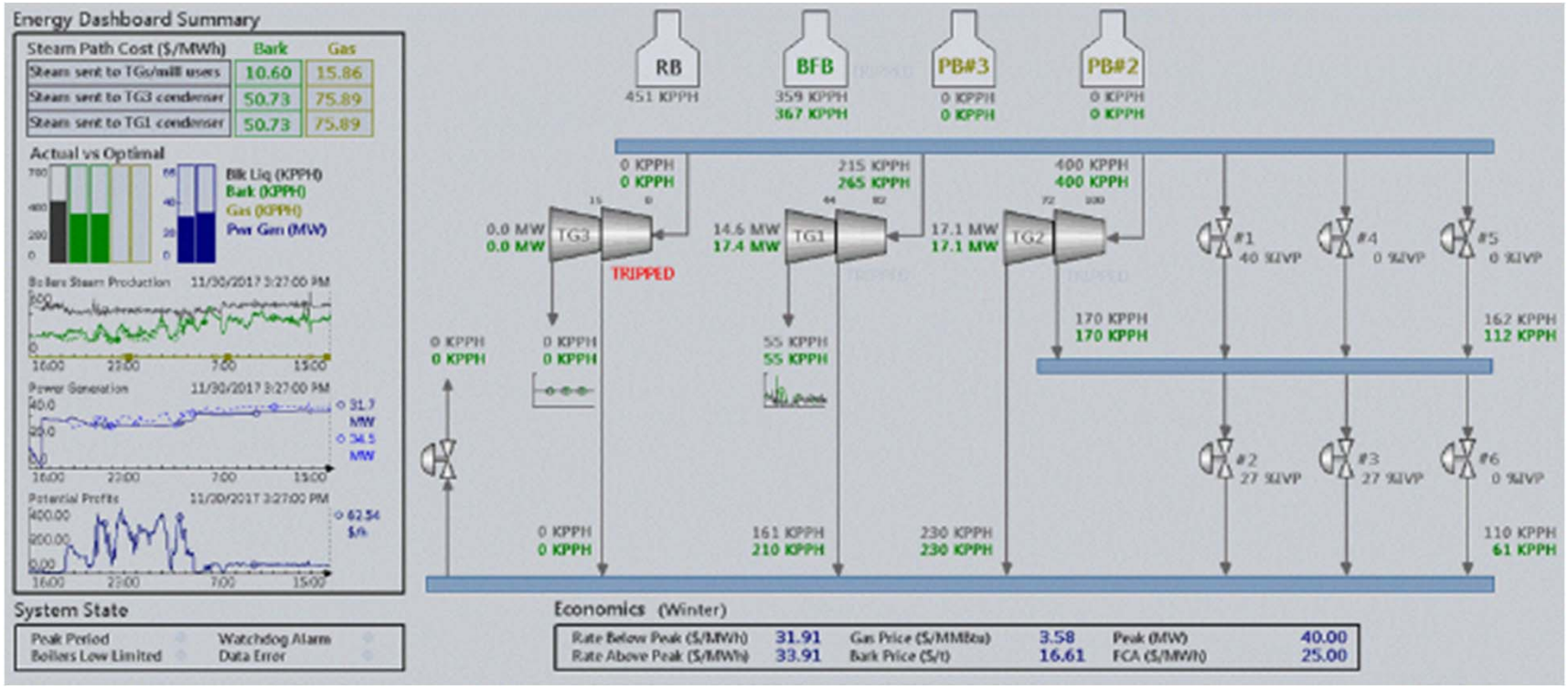
Example of Steam Dashboard Interface



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Conclusion

Cogeneration plants are highly complex

- **Challenges:** Fluctuations in steam demand, boiler availability, fluctuations in fuel cost and power rates, steam plant reliability, operator training, carbon footprint, etc.
- **Solution:**
  - Advanced controls with online profit optimization.
  - Performance monitoring using Dashboards
  - Operator Training
- **Benefits:** Increased uptime and lower operating cost

Questions & Discussion