DECARBONIZATION BY ELECTRIFICATION OF INDUSTRIAL FACILITIES

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MEET OUR SPEAKER

James Turner

Executive Director, Process Technology

James Turner is an Executive Process Director with over 30 years at Fluor. He manages Process Designs for many refinery and petrochemical projects and has published and presented more than 25 technical articles about process design and project execution.

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POTENTIAL DECARBONIZATION STRATEGIES FOR INDUSTRIAL FACILITIES

- Energy Efficiency
- Carbon Capture
- “Green” Fuels
- Materials Recycling
- Electrification

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WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Is your facility operating at its peak energy efficiency?

Many operators see a noticeable improvement in their Energy Intensity Index from Electrification

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WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Are there looming maintenance or equipment replacement?

Investments on maintenance / equipment replacement can be spent on Electrification

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WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Looking for ways to reduce NOx or other emissions?

Benefit from the NOx, SOx, and PM10 credits that are generated by an electrification project.

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WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Are your utility systems maxed out, or out of balance?

Improve your fuel (or other utility) balance(s)

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WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Do you need to re-balance steam and electricity usage?

Electrification allows synergies with fuel gas recovery projects

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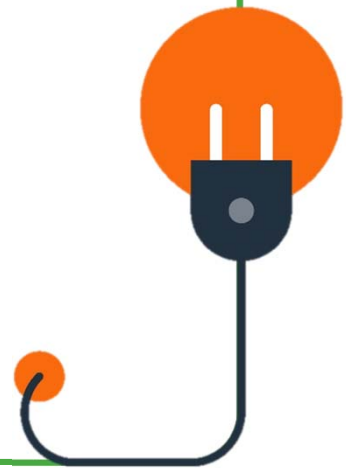
WHY ELECTRIFICATION?

Is your facility facing any of the following problems?

Facility-wide energy optimization sound intriguing, but also intimidating?

Opportunity for Strategic reconfiguration



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CARBON REDUCTION AND LCFS CREDITS

- Dating back to 2007
- LCFS Credits can help project economics

LCFS – Low Carbon Fuel Standard
CI – Carbon Intensity

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CHALLENGES TO ELECTRIFICATION

CHALLENGES TO ELECTRIFICATION

- Utility Balances
  - Power
  - Steam
  - Fuel Gas
  - Water
- Unit and Product Balances
- Safe Operating and Relief Scenarios

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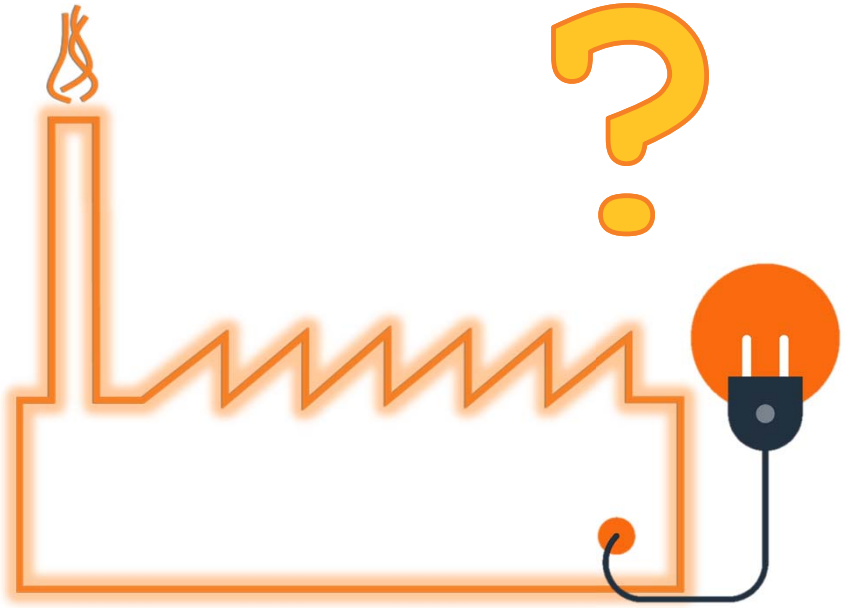
HOW TO ELECTRIFY?



- Heat Pumps instead of reboilers/condensers
- Electric heating instead of steam or fuel fired heaters
- Electric motors instead of steam turbines

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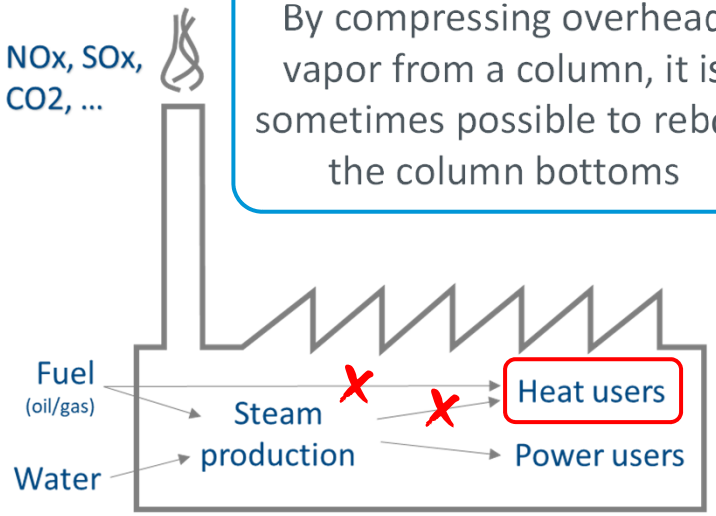
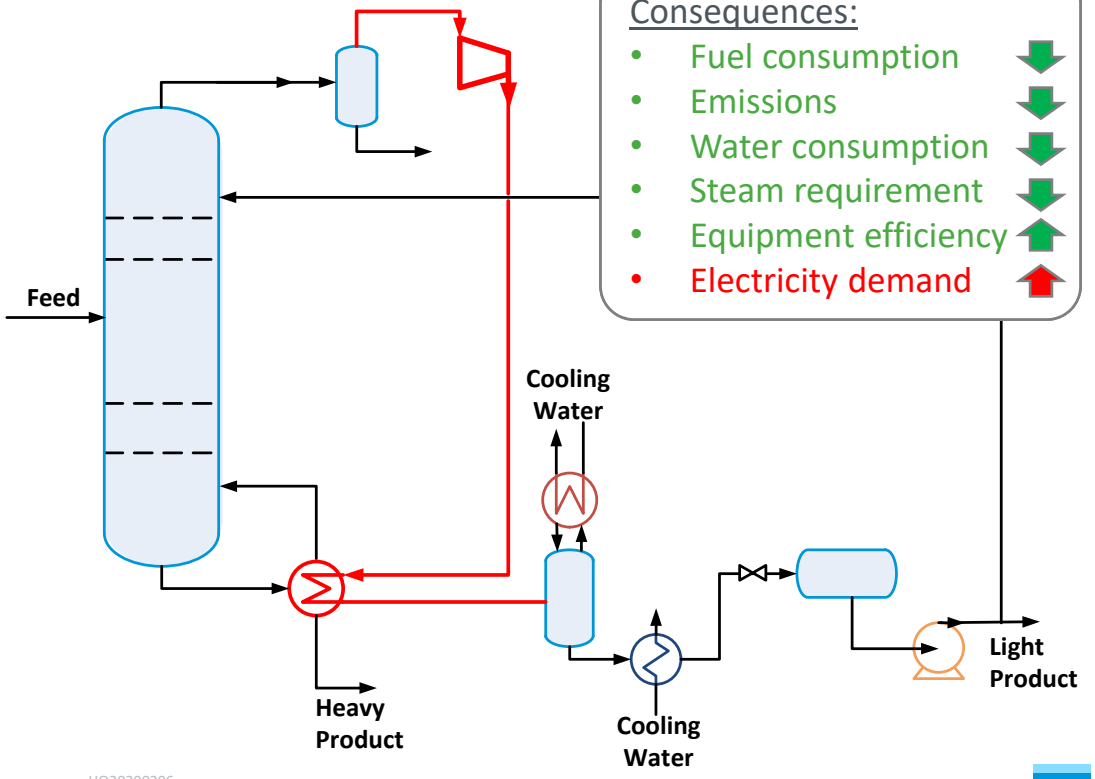
HEAT PUMP INSTEAD OF REBOILERS / CONDENSERS

A.K.A. MECHANICAL VAPOR RECOMPRESSION

By compressing overhead vapor from a column, it is sometimes possible to reboil the column bottoms





Consequences:

- Fuel consumption ↓
- Emissions ↓
- Water consumption ↓
- Steam requirement ↓
- Equipment efficiency ↑
- Electricity demand ↑

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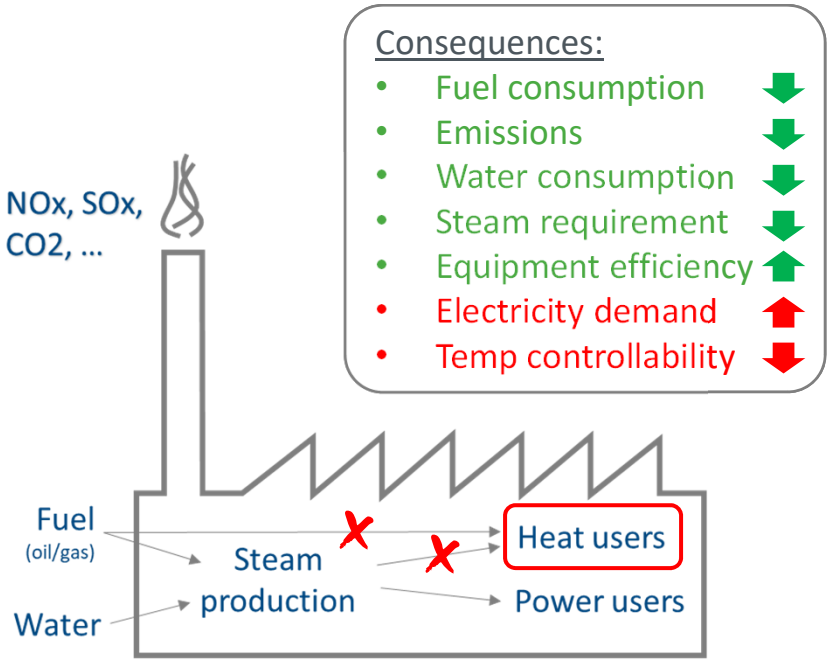
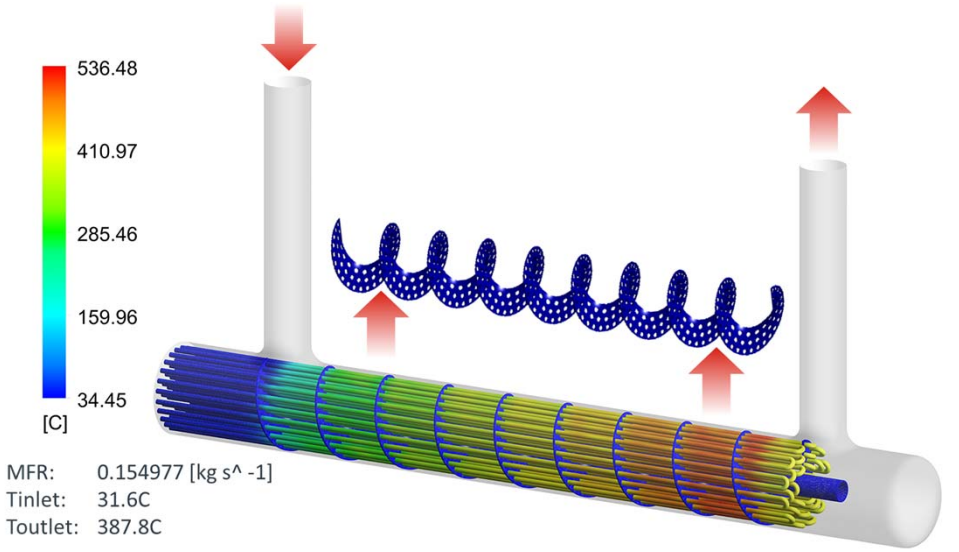
ELECTRIC HEATING OF STEAM / FUEL-FIRED HEATERS

E.G. WATLOW HELICAL FLOW ELECTRICALLY HEATED EXCHANGER





WATLOW Helical Flow Electrically Heated Exchanger

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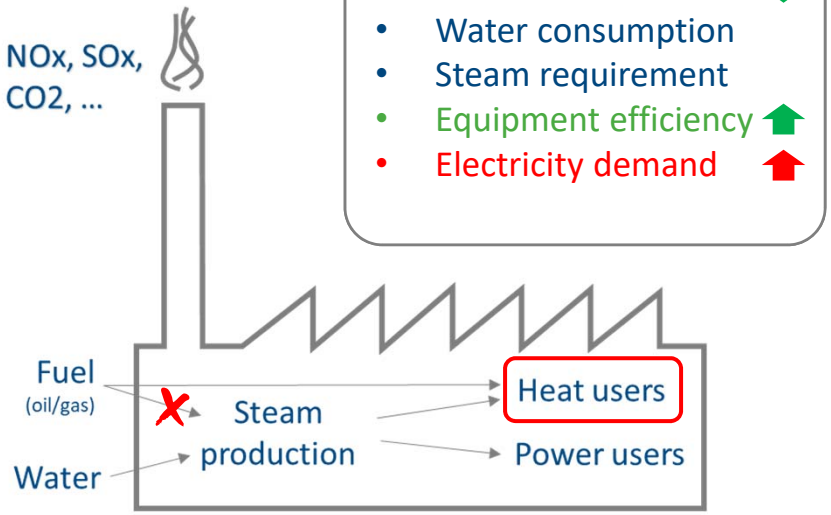
ELECTRICAL BOILER

E.G. STORK E-BOILER

Consequences:

- Fuel consumption ↓
- Emissions ↓
- Water consumption
- Steam requirement
- Equipment efficiency ↑
- Electricity demand ↑



Stork Electric Steam Boiler

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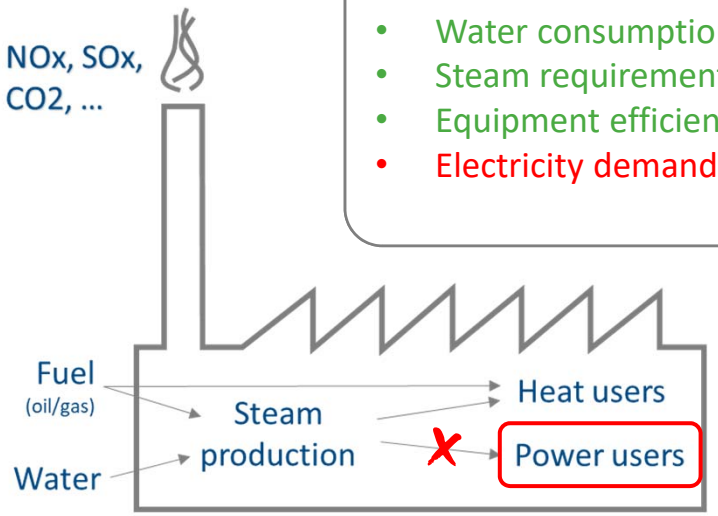
ELECTRIC MOTORS INSTEAD OF STEAM TURBINES

Consequences:

- Fuel consumption ↓
- Emissions ↓
- Water consumption ↓
- Steam requirement ↓
- Equipment efficiency ↑
- Electricity demand ↑



Sample photo of an Electric Motor

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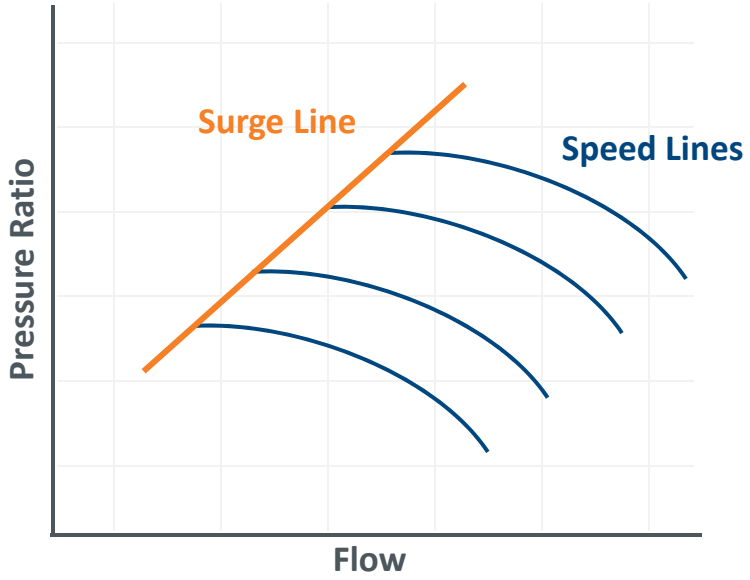
PROCESS IMPACT FROM OPERATING SPEED

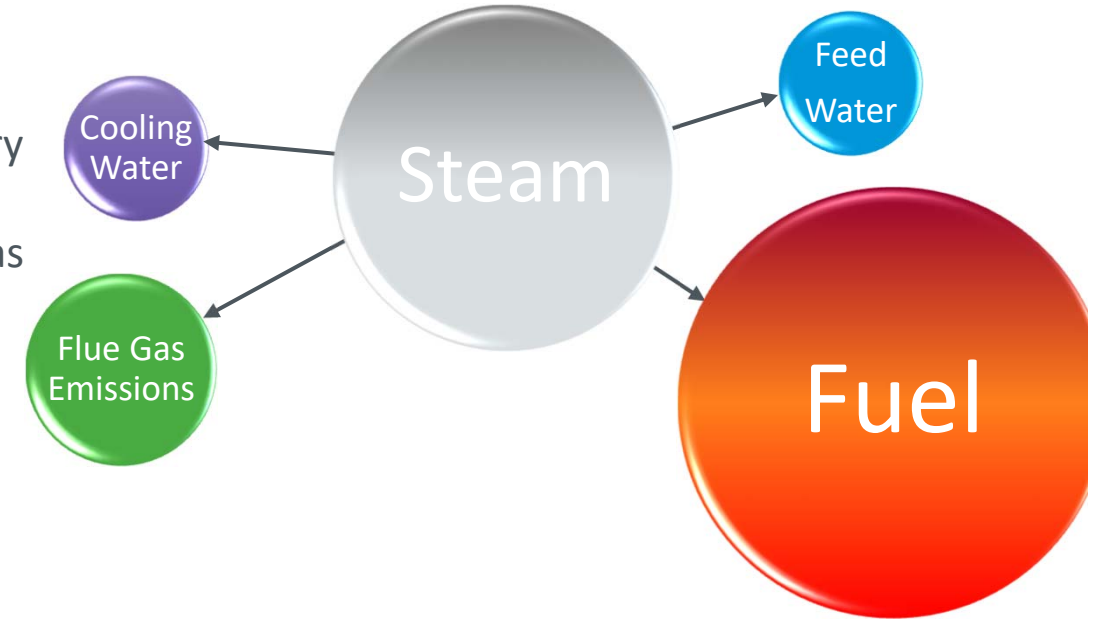
Centrifugal compressor Driver

- Existing Steam Turbine
  - 3300 rpm with discharge at 140 psia
- Fixed speed motor available
  - 3600 rpm with discharge at 160 psia
  - 3200 rpm with discharge at 120 psia
  - Process alterations may be required
- Variable speed motor available



UTILITY BALANCE IMPACT

- Impact to fuel balance
  - May become “long” on fuel
    - Consider increased LPG recovery from the fuel gas pool
    - Consider ways to reduce fuel gas production
- Impact to cooling water
- Impact to water consumption



EXAMPLE OF REDUCING STEAM DEMAND

Compressor - 12,000 hp

Condensing Steam Turbine

- 600 psig steam source
- 135,000 lb/h steam
- 125 MMBtu/h fired duty
- 7,500 gpm Cooling Water

Motor

- 382 amps at 13,800 volts (3 Ph)
- 98% efficiency, PF=1.0
- 9.1 MW consumed

Back-pressure Steam Turbine

- 600 psig steam source
- 150 psig steam back-pressure
- 318,000 lb/h steam

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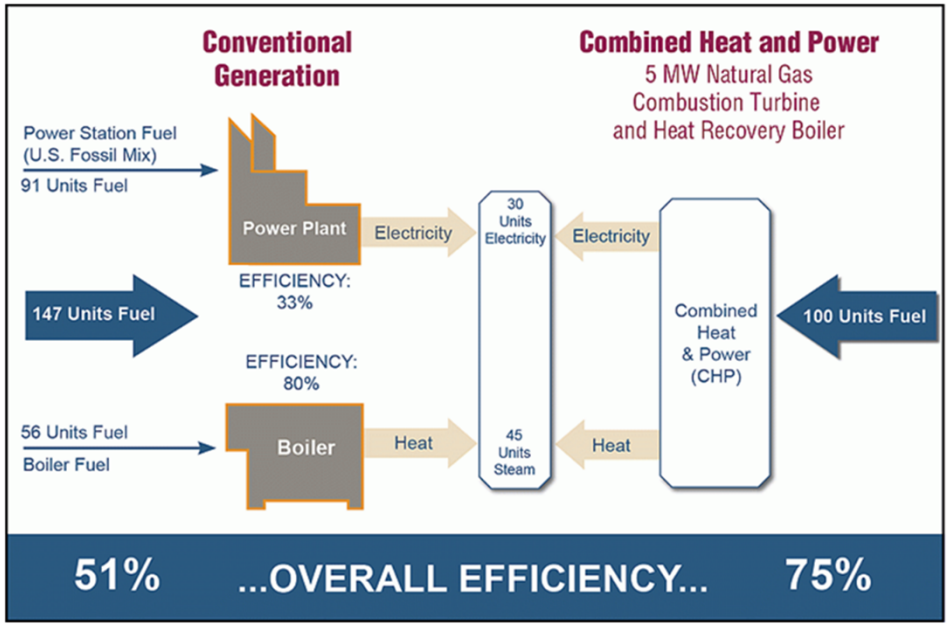
COGENERATION OR COMBINED HEAT POWER (CHP)

- Simultaneous electric and steam production from fuel gas
- Offsets “outside fence” electric usage from motors replacing turbines
- Further decreases steam demand from existing boiler
- Can be combined with carbon capture to produce electricity and steam with low carbon emissions



from https://www.epa.gov/chp/chp-benefits

NEW FACILITIES DESIGN

Traditional Hydrogen Fuel

Carbon Capture System

CO_2 Product

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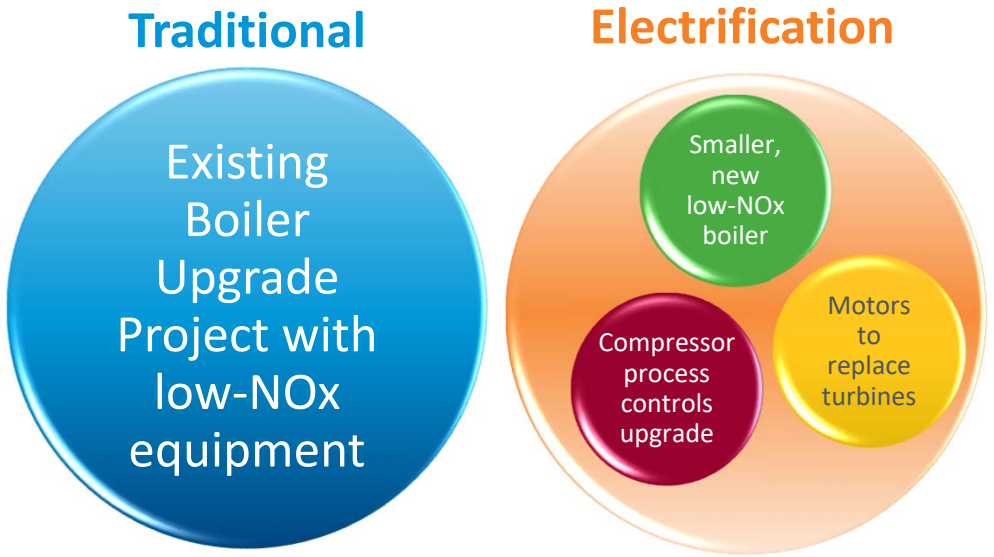
CONSIDERATIONS FOR ELECTRIFICATION

- Develop an accurate power, steam and fuel gas balance for the facility.
- Consider upset and other operating cases, such as when individual units are shut down for maintenance.
- Understand the reliability of the existing systems
- Understand the reliability of "over the fence" suppliers of power and/or fuel
- Opportunities for capital projects associated with changes in emissions requirements



Capital project approach using Electrification

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CONCLUSION

- Understand the benefits
  - Reduction in carbon footprint
  - Reduction in operating cost
  - Improvement in energy efficiency
  - Reduction in other emissions and water consumption
- Understand the cost
  - Capital cost to implement changes
  - System upgrades required (both within facility and by outside suppliers)
  - Process ISBL and OSBL impacts

QUESTIONS?

COMMENTS?

Please type your questions in the Q&A section*

**Make sure to address it to "All Panelists"*