PJVA/GPAC 18TH JOINT CONFERENCE

DALE HILDEBRAND
SR. VICE PRESIDENT
GENALTA POWER

WASTE ENERGY TO POWER PROJECTS IN ALBERTA

AGENDA

- Waste Energy to Power
- Cost Considerations
- Behind the Fence Options & Benefits
- Economics
- Deal Structures
- Operations

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WASTE ENERGY TO POWER?

- Energy efficiency projects that convert a un-used or under-utilized energy source and convert to electricity
- Electricity generators are energy conversion machines:
  - Electricity = $75/MWh = $21/GJ
  - Natural gas = $5/GJ
  - Coal = $0.50/GJ
  - Wind = $0/GJ
- Takes capital to convert energy

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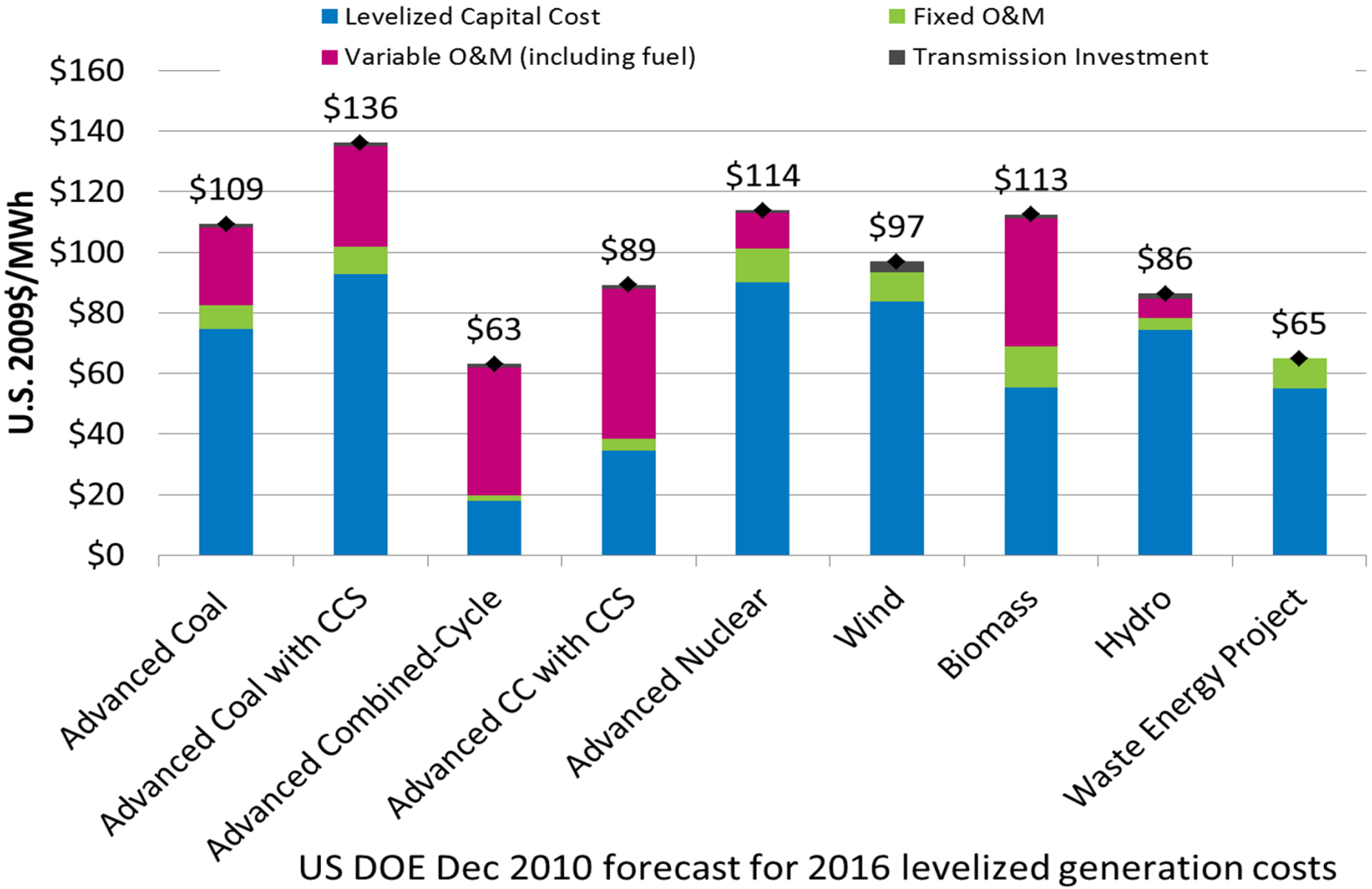
COST OF GENERATION?



US DOE Dec 2010 forecast for 2016 levelized generation costs

PRODUCER'S DRIVERS FOR CHANGE

- Environmental Compliance
- Electricity Costs
- Green

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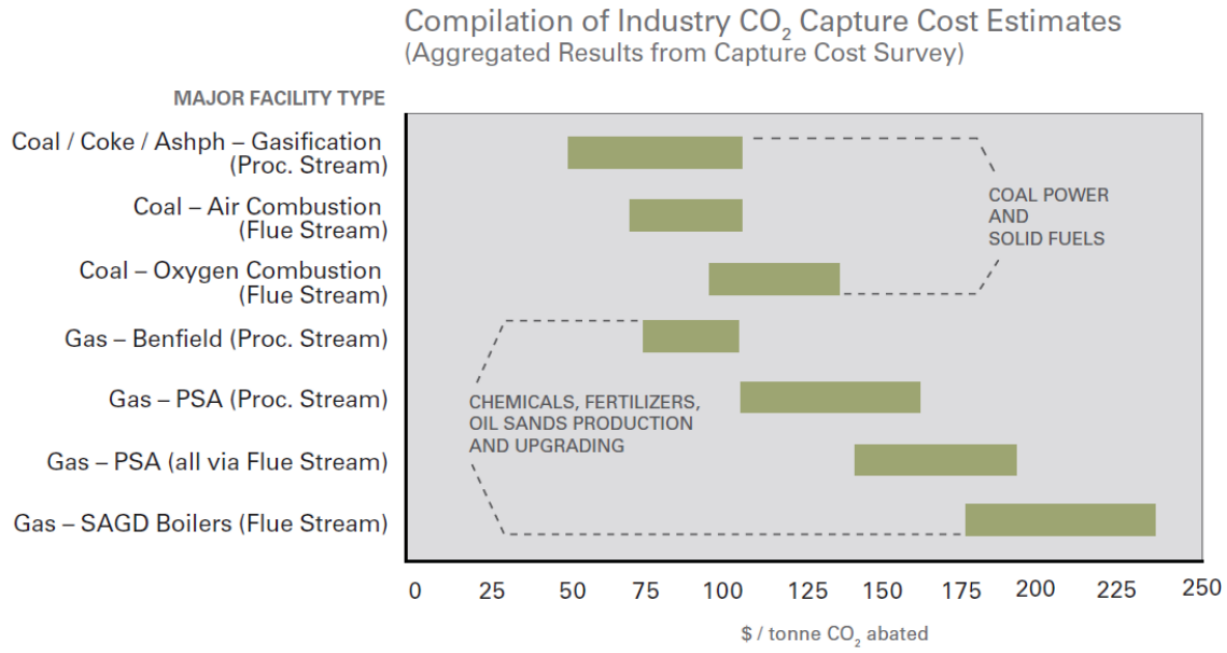
GREENHOUSE GAS COMPLIANCE

- Alberta – Large Emitters Regulation
  - $15/tonne
- Future cost to generate or purchase :

Cost of Capture



ICON CO_2

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ELECTRICITY COSTS

- Electricity Costs – upward pressure in most Canadian jurisdictions
  - Replace aging generation – coal legislation?
  - Transmission upgrades – Bill 50
  - Demand growth – 2 to 4% per year

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SUPPLY RESPONSE

- "Behind the Fence" generation can be equivalent to a demand reduction
- More predictable power prices
- GHG credits
- Reduced tariff costs

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BEHIND THE FENCE POTENTIAL

- **US estimates 65,000 megawatts coming from waste energy recovery, which is 100% clean, fossil-fuel free energy**
  - ***Sources: based on data from US Environmental Protection Agency and US Department of Energy***
- **In Alberta 2,000 MW of Recovered Industrial Energy is available for Power Production**
  - ***Source: Pembina Institute, Greening the Grid***
- **In Alberta 37,000 MMcf in 2010 of Waste Gas was flared or vented to the atmosphere equating to 300 MW (4.6% not conserved)**
  - ***Source: ERCB, 2011 Upstream Petroleum Industry Flaring and Venting Report***

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BEHIND THE FENCE OPTIONS

- Waste Solid Fuel
  - Biomass - boilers / steam turbine
- Cogeneration
  - Heat for process?
- Combined cycle
  - Economies of scale?
- Waste Energy
  - Heat
  - Pressure – gas and liquid
  - Gas

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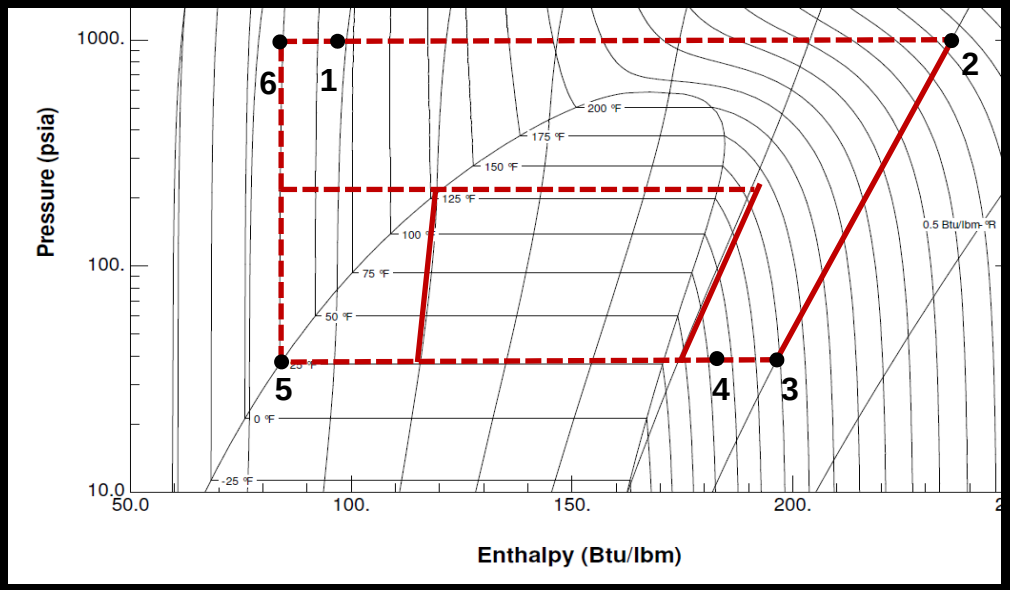

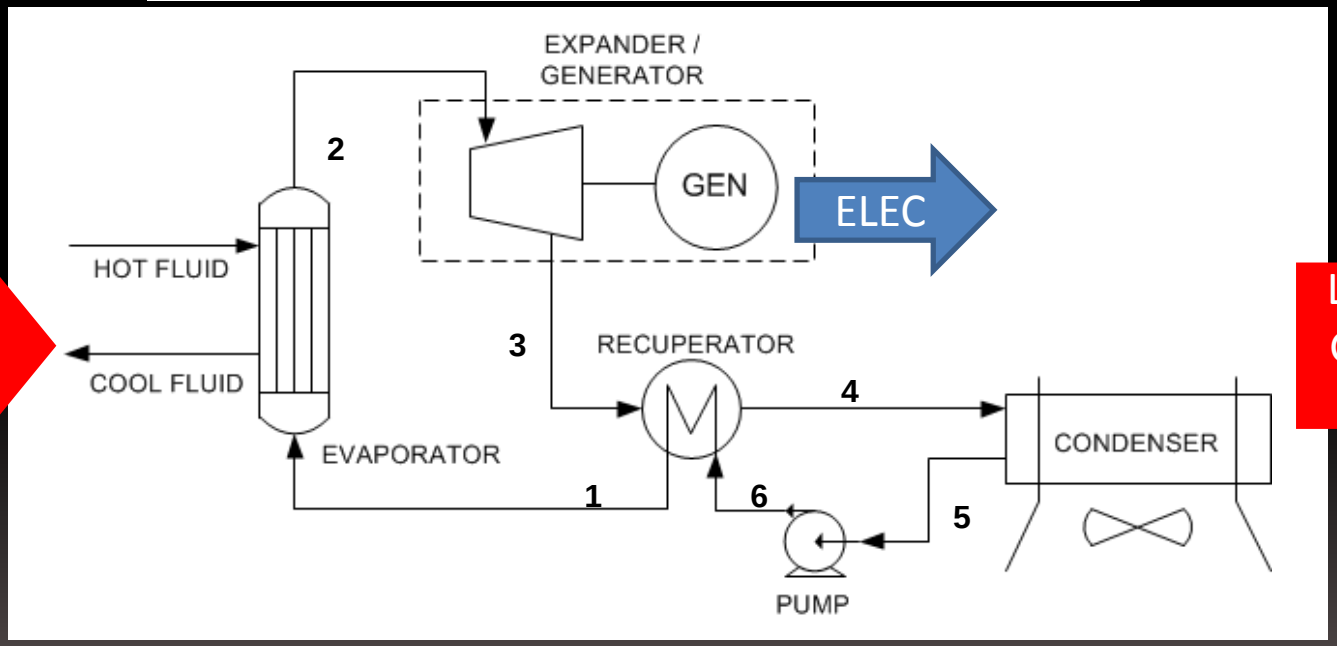

HIGH GRADE HEAT

LOWER GRADE HEAT

WASTE HEAT TO POWER

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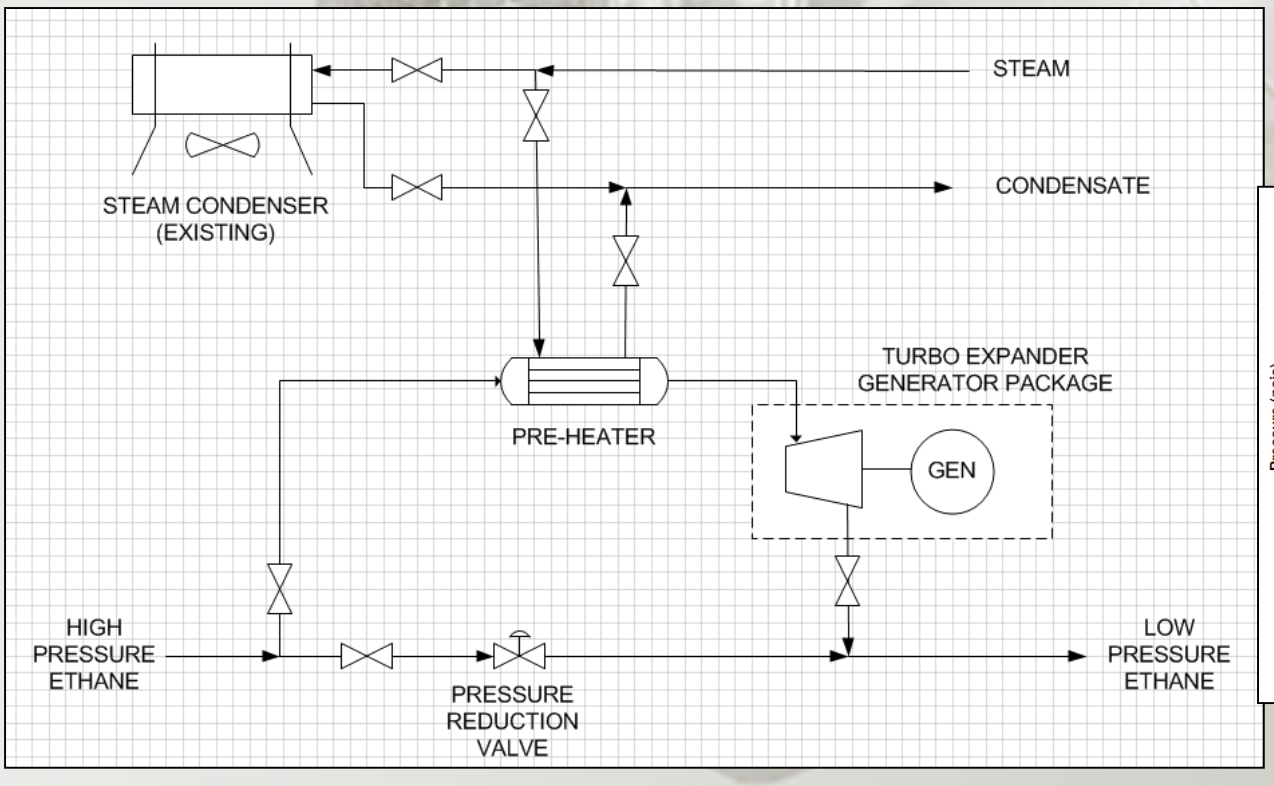
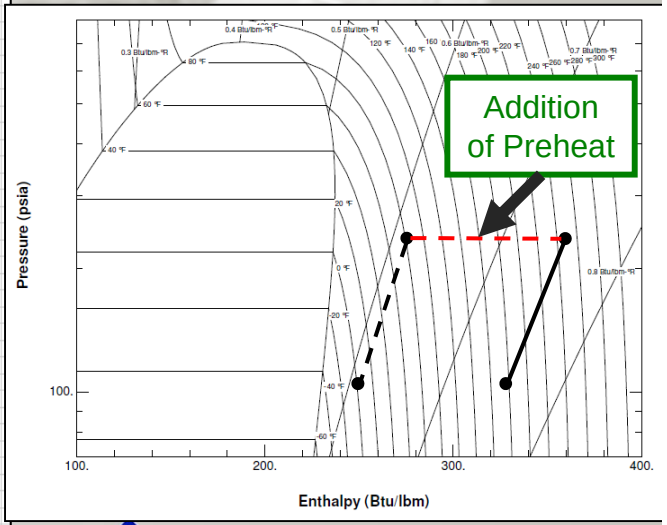
WASTE PRESSURE TO POWER

Ethane Pressure Letdown





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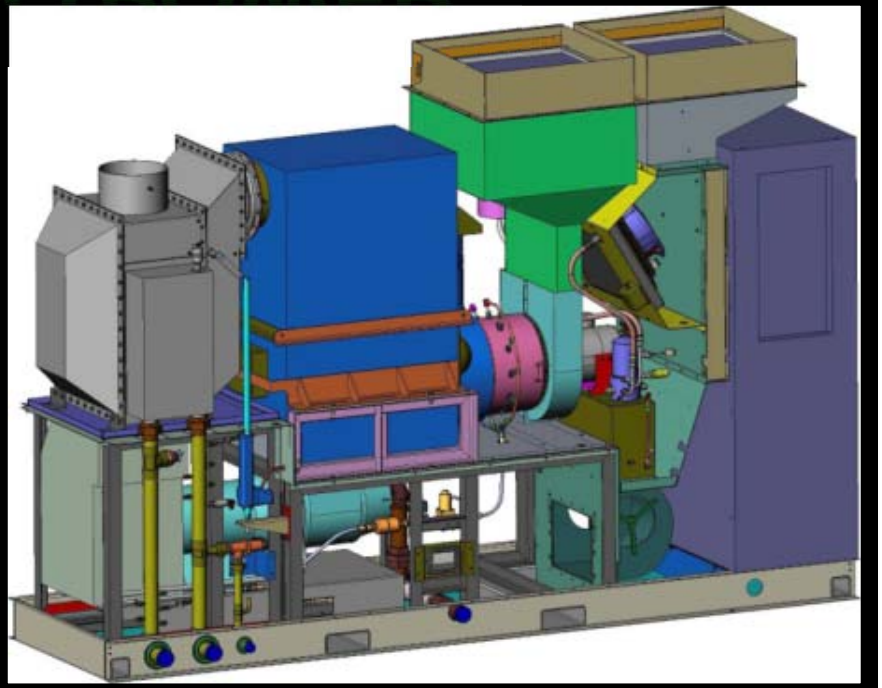
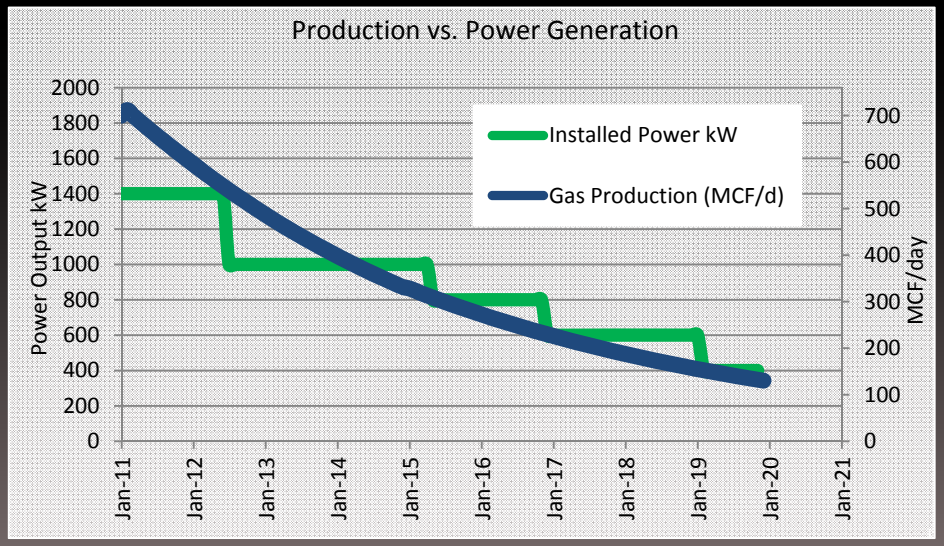
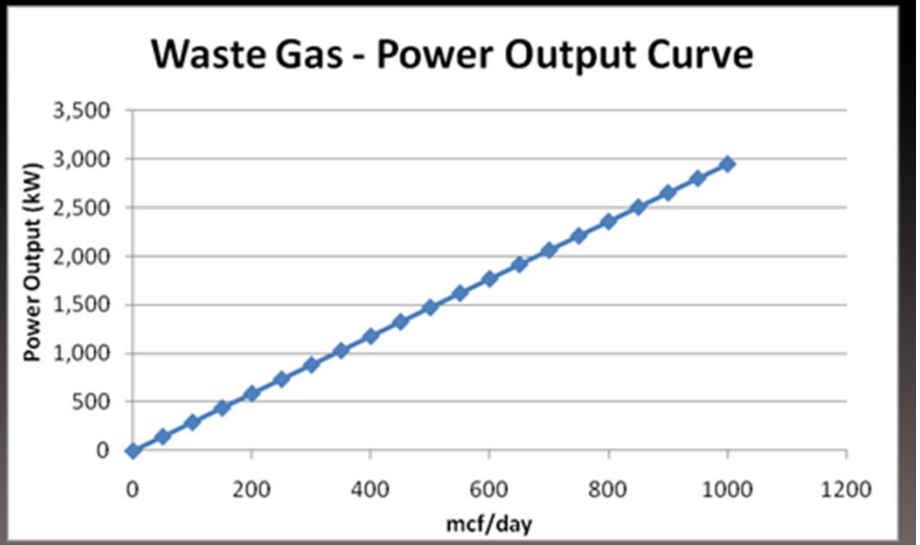
WASTE GAS TO POWER

Considerations

- 3 Phase Power in area
- Gas analysis
- Technology options
- Permits / approvals
- Heat recovery

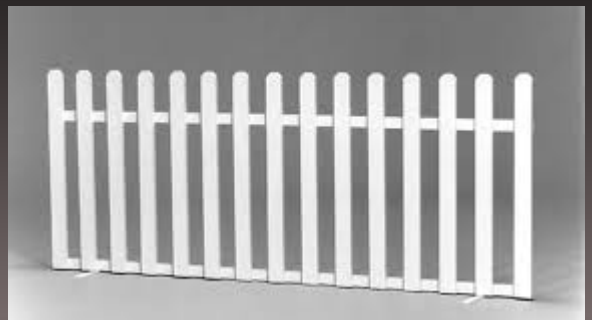






BEHIND THE FENCE BENEFITS

- Predictable Electricity Price
  - Can fix price of electricity for 10 to 20 years
- Access to Greenhouse Gas Credits or Emissions Reductions
  - At $15/tonne = $80k/year per MW of generation capacity
- Onsite Power – Reliability
- Utility Tariff Savings



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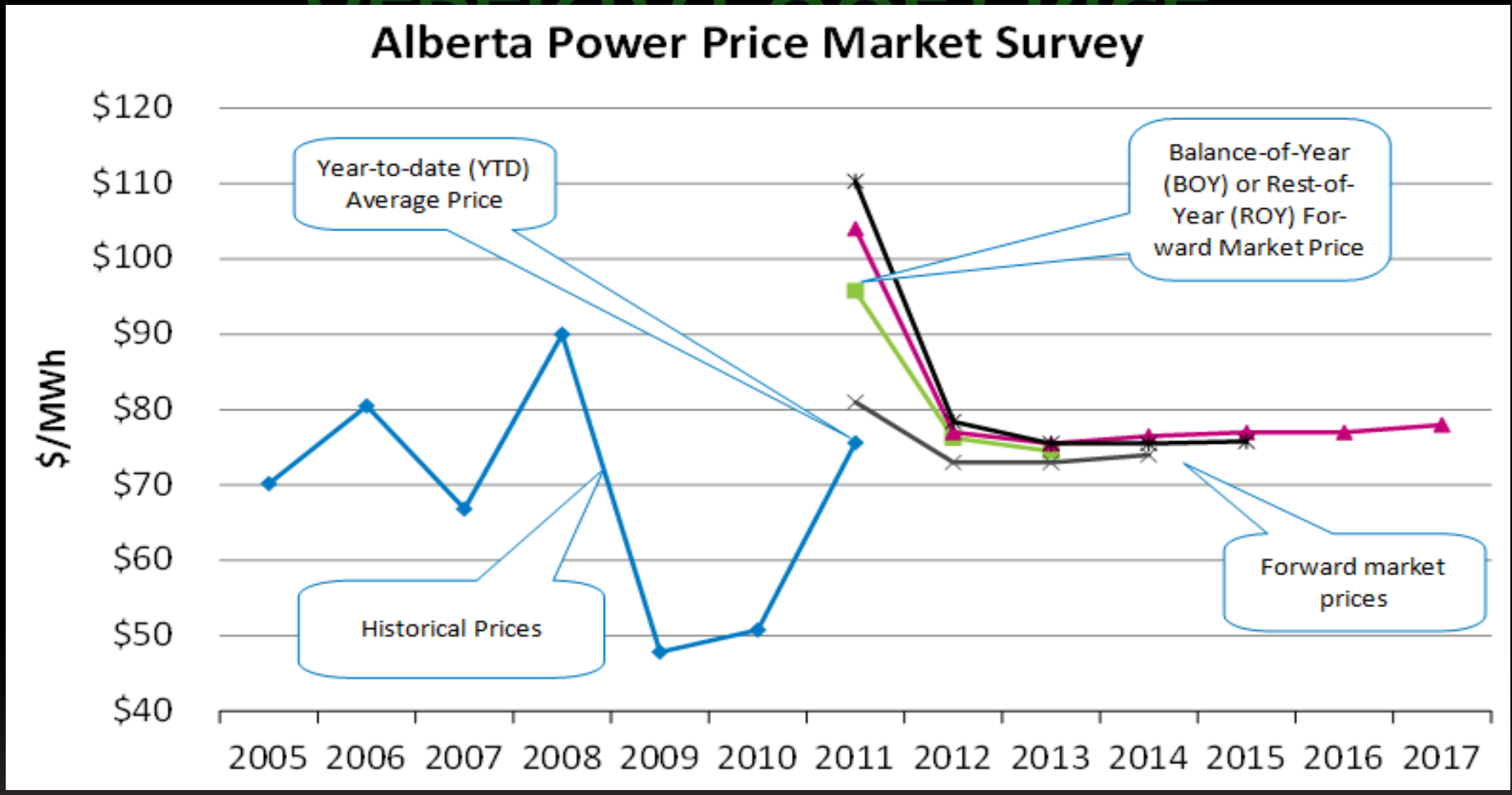
ALBERTA POOL PRICE



- Historical volatility – expected to increase
- Pool price expected to be higher than forword market

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ALBERTA UTILITY TARIFF SAVINGS

- Bill 50 Impact: transmission charges from $15/MWh today to $40 + /MWh by 2018
- Distribution charges for industrial facilities add
  - $15 to $40/MWh
  - Function of size and load factor
- Tariff Cost Savings with BTF generation
  - Currently $6 to $12/MWh
  - Or $50k to $100k/year per MW of generation capacity
  - Could increase by 2 to 3 times

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ECONOMICS - 2011

	Grid Supply	Behind the Fence
Electricity	$75/MWh (forward price)	$70 - $90/MWh
GHG Credits		**$15/tonne = $8 to $10/MWh**
Tariff Cost	$15 to $40/MWh	$15 to $40/MWh
Tariff Cost Savings		**$6 to $12/MWh**
Total Cost	**$90 to $115/MWh**	**$63 to $116/MWh**

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ECONOMICS – 2020 (?)

	Grid Supply	Behind the Fence
Electricity	$90/MWh (estimate ???)	$70 - $90/MWh
GHG Credits		**$30/tonne = $16 to $20/MWh**
Tariff Cost	$40 to $90/MWh	$40 to $90/MWh
Tariff Cost Savings		**$15 to $30/MWh**
Total Cost	**$130 to $180/MWh**	**$60 to $149/MWh**

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WHAT'S THE PROBLEM?

- Energy efficiency optimization projects typically do not meet producer's return targets
- Competition for capital with revenue producing projects
- Typically small in comparison to development projects
- Non-core

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OPTIONS

- Producer does design, build, own and operate
  - Business drivers?
  - Competency?
  - Regulatory approvals
- Third party does design, build, own and operate (or some combination)
  - Site access?
  - Liability?
  - Deal structure?

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STRUCTURES WITH 3RD PARTIES

- Joint Venture
  - Open book
  - Risk sharing
- Carried interest
  - Profit sharing
- Payout
  - Profit to developer until capital payout, then shared
- Power Purchase Arrangement
  - Fixed price (typically with escalators)
  - Tied to pool price (typically a discount)

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OPERATIONS ARRANGEMENTS

- Industry standard :
  - Remote operation
  - Producer provides daily checks
  - Generation owner provides maintenance

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REGULATORY REQUIREMENTS

- Power Plant Approval
  - Public consultation
  - Noise study
  - Air dispersion modeling
- Municipal Development Approval
- Utility Connection

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SUMMARY

- Waste energy to power projects can assist with environmental compliance
- Behind the fence generation can reduce costs
  - GHG credits
  - Power prices
  - Tariff savings

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