Introduction to SMU Geothermal Energy & Waste Heat to Power Conference
Successful Heat to Power Development
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Agenda

• Introduction to:
  ▪ NRGreen Power, and
  ▪ Alliance Pipeline Canada

• Technology
  ▪ Waste Heat to Power—advantages & process
  ▪ Organic Rankine Cycle

• Development Opportunities and Challenges
  ▪ Waste Heat to Power Opportunities
  ▪ Advancing Waste Heat to Power in the U.S.

• Closing remarks & Questions
Overview – NRGreen Power

• NRGreen Power is an Alliance Canada related party first established in 2002

• Commercial development of waste heat electrical generation opportunities at Alliance Pipeline compressor stations

Strong and Stable Ownership
50% Enbridge
50% Veresen
Waste Heat to Power Generation

Advantages:

- Electric generation that produces no new greenhouse gas emissions
  - Avoidance of @ 55,000 tonnes of GHG’s per year (as compared to traditional fossil fuel generation)
- Technology can be applied to existing industrial facilities and transmission pipelines
- Reliable source of power from pipeline compressors (98+%) = baseload power
- Can be interconnected at distribution or transmission voltages
Waste Heat to Power Generation Process:

Innovative technology consists of two processes:

- The 1st process loop captures waste heat from hot turbine exhaust using a heat exchanger that contains circulating thermal oil and a waste heat recovery unit.
- The 2nd process loop is the energy converter system that transfers the heat from the thermal oil to a circulating organic working fluid through a series of heat exchangers using the Organic Rankine Cycle process.
ORegen™ – General Electric

Diagram showing a flow of fluids through various components such as air-cooled condenser, expander generator set, recuperator, vaporizer, nitrogen blanket, expansion vessel, hot oil storage, gas turbine exhaust, and hot oil pump.
Successful Development in Canada

• Four Waste Heat to Power Generating facilities in Saskatchewan:
  ▪ Kerrobert, SK – in service 2006
  ▪ Alameda, Estlin & Loreburn, SK – in service 2008

• Safe (no incident) operations at all sites since start-up

• Semi attended operation – ORMAT ORC technology

• Long-term Power Purchase Agreement with SaskPower

• Max generating capacity @ 5.4 MWhr per site
New Facilities: Alberta Initiatives

- **Whitecourt Recovered Energy Generation Project:**
  - 1st global application of G.E.’s innovative ORegen™ system
  - Designed to reliably generate **14 Megawatts** of electricity per hour with no new emissions, water or incremental fuel
  - Project is funded in part from Alberta’s Climate Change Emissions Management (CCEMC) Corporation
  - Projected in-service date: **Q2 2013**

- Deregulated market risk offset
  - “Pool Pricing” Agreement & CCEMC funding

- Subject to Alberta regulatory regimes
Whitecourt Recovered Energy Project

Project Construction Underway

Utilizing heat generated from Alliance Pipeline’s Windfall Compressor Station operations near Whitecourt, Alberta
Waste Heat to Power
U.S. Opportunities:

Proposed Projects at Alliance Compressor Stations:

Seven sites capable of 6 MW

These projects will provide the following benefits:

• Can generate 700,000 MWh per year
  • Enough to power ~182,000 homes

• No new GHG emissions and does not use water
  • Offset @385,000 tonnes of GHG Emissions per year

• Estimated ~ $300 million of capital investment
U.S. Development Challenges

• Waste Heat to Power is **NOT** on a level playing field with other “emission-free power”
  ▪ Generation result ‘equivalent’ to other Renewables
  ▪ WHP not defined in PURPA or Energy Independence and Security Act of 2007

• Perceived U.S. Regulatory uncertainties (FERC):
  ▪ Allow for pipeline-related entities to develop projects outside of the current rate-base & rate of return
  ▪ Consider developing a Waste Heat to Power Policy Statement

• Lack of demand for Heat to Power by Utilities
  ▪ Potential Grid Interconnection challenges
Advancing Waste Heat to Power:

• Create utility demand for waste heat to power generation by including in State renewable energy portfolio requirements

• Minimize “Transmission Interconnection” barriers, including:
  - Interconnect study queue’s
  - Costs related to interconnection

• Add Waste Heat to Power as a qualified technology in
  - Tax Codes – Section 45 (PTC’s) & 48 (ITC’s)
  - Future Master Limited Partnership eligibility
Closing remarks:

• NRGreen Power has a solid, safe and efficient history operating WHP facilities

• Advantages of NRGreen Power’s Projects include:
  ▪ Electricity generation that produces no new greenhouse gas emissions
    • Reliable source of base-load power from existing pipeline compressors
  ▪ Technology can be applied to other industrial heat sources

• Project Economics require Public Policy Support on a State / Federal level to facilitate future development of Waste Heat to Power Projects in the U.S.
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