Acid Gas Re-Injection

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Increasing Revenue through Fuel Gas Savings & Methane Emissions Reduction
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This presentation includes forward-looking statements. The forward-looking statements reflect management’s current beliefs and assumptions with respect to such things as the outlook for general economic trends, industry trends, commodity prices, capital markets, and the governmental, legal and regulatory environment.

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Topics

- Spectra Energy At A Glance
- Spectra Energy’s Acid Gas Re-Injection Experience
- Kwoen – Acid Gas Re-Injection
- Kwoen – More Methane to Market & Reduced Emissions
- Closing Thoughts
Spectra Energy Transmission System
Largest Pure-Play Midstream System in North America

- **Storage Capacity**: 250 Bcf
- **Transmission Pipe**: 17,500 mi
- **System Compression**: 3,000,000 HP
- **Natural Gas Throughput**: 3.2 Tcf
- **Canadian Processing Capacity**: 5.3 Bcf/day
- **Distribution Main Lines**: 22,000 mi
- **Distribution Service Lines**: 13,000 mi
- **Retail Customers**: 1.3 MM

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**Corporate Headquarters**
- **Major Office Location**
- **Natural Gas Storage**
- **Natural Gas Processing Plant**
- **Natural Gas Pipeline**
- **Natural Gas Liquids (NGL) Pipeline**
- **Union Gas Distribution Service Area**
Our western Canadian operations are comprised of four distinct and separate businesses:

- **BC Pipeline**: Our NEB-regulated cost of service transportation business
- **BC Field Services**: Our NEB-regulated integrated gathering, and processing business
- **Midstream**: Provincially regulated gathering and processing business
- **Natural Gas Liquids**: Our Empress, Alberta based NGL extraction, fractionation, transportation, storage, and marketing business.
BC Field Services
Significant Processing Potential

Fort Nelson Area

Fort Liard

Fort Nelson

Buckinghorse Plant

Sikanni Plant

B.C.

Yukon

Fort Nelson Gas Plant

McMahon Gas Plant

Pine River Gas Plant

Ft Nelson = 1.0 Bcf/d (raw)

McMahon = 620 Mmcf/d (raw)

Pine River = 560 Mmcf/d (raw)

Fort St. John Area

Fort St. John

Boundary Lake Plant

McMahon Plant

Alliance

Gordondale

Dawson Creek

Chetwynd

Pine River Plant

Kwoen Plant

Grizzly Valley Area

B.C.

N.W.T.

U.S.A.

ALBERTA

YUKON

Legend

Spectra Energy Transmission:

- BC Pipeline Mainline
- Mainline Looping
- Gathering Lines
- DEGT Process Plant
- Midstream Process Plant
- Compressor Stn.
- Booster Stn.
- Alaska Highway
Western Canadian Sedimentary Basin
The most Acid Gas Re-injection projects in the world

**WCSB – confluence of opportunity & experience for world class Acid Gas Re-injection (AGR) & Carbon Capture Storage (CCS) Projects**

44 CO2-rich acid gas injection projects are currently operating in Western Canada since the early 1990s:

- Mostly small scale
- A total of 2.5 Mt CO2 and 2.0 Mt H2S had been injected in Western Canada by the end of 2003
- Provide important examples of effectively managing injection of CO2 & H2S
- No detectable leakage

BC Field Services operates the largest of these at Kwoen, BC Facility (30 Mmcf/d H2S/CO2)
BC Field Services AGR Ranking—“leaders in the field”

**Acid gas injection** (total Acid gas H2S + CO2)

**Storage projects**

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**BC Field Services AGR/CCS projects**

- **Jedney 1** ~39 Kt CO2/yr
- **Jedney 2** ~ 30 Kt CO2/yr
- **Sikanni** ~ 5 Kt CO2/yr
- **Kwoen** ~ 100 Kt CO2/yr
  (largest AGR in North America)

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Adapted from Page 233. Carbon Dioxide Capture and Storage. IPCC (2005)

Kwoen Facility
Acid Gas Capture, Pipeline & Storage

- Injection Well
  Current 30 Mmcf/d acid gas (85% H2S & 15% CO2)

- AGR Pipeline

- Acid Gas Dehydration

- Acid Gas Compressors

- H2S/CO2 Acid Gas stream compressed to supercritical & dehydrated for piping to Sequestration Zone

- Kwoen Gas Plant

- Sequestration Zone

- Impervious Cap Rock

- Permanent Disposal in supercritical state

- Impervious Base Rock

Kwoen Upgrader Facility:
- Receives raw gas from producer wells via Grizzly Valley RGT
- Separates acid gas from inlet stream using Morphysorb® process
- Serves as pre-treatment facility for Pine River gas plant
- Stripped acid gas re-injected for permanent sequestration
- Expansion underway to 40 MMcf/d

Pine River Gas Plant
Raw gas from Producer wells
## Kwoen Facility
More Methane to Market + Reduced Emissions

### Conventional Processing & Sulphur Recovery:
- Stripped acid gas sent through sulphur recovery to remove most of hydrogen sulphide & converted to elemental sulphur
- Remaining hydrogen sulphide + entrained CO2 is incinerated
- Significant Customer fuel gas used:
  - gas drive compression
  - incineration to heat SO2 & CO2 for stack and dispersion into atmosphere
- GHG emissions significant:
  - combustion CO2
  - formation CO2
  - SO2 and NOx emissions dispersed into atmosphere

### Kwoen – Capture, pipeline & storage
- Significantly lower fuel gas used
  - electric drive compression
  - no incineration
- Lower GHG emissions:
  - less combustion CO2 w/ electric drive compression & no incineration required
  - Formation CO2 not emitted but re-injected
- Lower SO2 emissions:
  - H2S re-injected & stored
- More methane to market

### Other Consideration:
Kwoen built in 2002 is a mixture of best cost alternative for our customers + maximum use of locational advantage
- Best capital & operating cost alternative
- Relatively inexpensive electrical supply available vs burning customer gas for fuel
- Appropriate disposal reservoir availability (Containment, depth, injectivity and size)
- Experienced staff to build, operate & manage large scale sour gas plants & AGR projects
Closing Thoughts

• Climate Change, Clean Air Act, Kyoto => some form of GHG /Clean Air emission control is coming
  • need clear policy & regulation framework for CO₂ emission credits & Clean Air from federal government
  • Federal framework should recognise & accept provincial regulations and agencies governing application, approval & monitoring of acid gas injection schemes (ie. AEUB, OGC, etc)

• Western Canada Sedimentary Basin AGR projects demonstrate proven technology, stable geological setting and provincial regulatory framework exists to manage and permanently store CO₂ and H₂S

• Similar AGR to Spectra Energy Transmission’s Kwoen can effectively deliver:
  • more methane to market => value to customers
  • reduce CO₂ and SO₂ emissions => value to the environment & the plant’s neighbours
Closing Thoughts

- Turning a waste into an additive value proposition => translating Kwoen from AGR to CCS
- Supplying CO2 emission credits:
  - CO2 permanently stored + total plant has considerably less CO2 emitted than injected
  - In applying internationally recognized standards & in-house measurement program combined => CO2 emission credits in the “warehouse”
  - Commercial contracts in place with the shippers who own the CO2 in the “warehouse”
  - Working on product definition, pricing & transaction => added new potential value

Spectra Energy Competencies in AGR/CCS:

Source & Commercial Management
- CO2 & H2S
- Measurement
- Design, build & operate
- Financial strength & credit

Capture
- Sour gas plants
- Different processes
- Kwoen, Pine River, Fort Nelson, McMahon

Pipeline
- Raw gas transmission
- Compression & pumps
- Dehydration

Storage
- Gas storage (Union Gas)
- AGR/CCS Kwoen
- Commercial storage / warehouse experience
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