“VX™ Cycle”

Ultra-Small-Scale and Mid-Scale LNG Production Technology
Overview of Expansion Energy LLC

• Created & patented the “VX™ Cycle” technology
• Energy technology development firm
• Core technological expertise:
  – Cryogenics
  – Processing of gases
• Business model: Technology licensing; strategic alliances
• Headquarters: Metro New York City, USA
• Technology portfolio (partial)
  – Liquefied natural gas (LNG) production
  – Waterless fracturing & EOR technology (avoids use of water & chemicals)
  – Utility-scale & commercial-scale power storage
  – Carbon capture & sequestration
  – Coal ash (CCR) processing / clean-up

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VX™ Cycle – “Mobile LNG™” Production Technology
Patented “VX™ Cycle” LNG Technology Overview

• **Mobile** LNG production plants
  – Trailer-mounted or skid-mounted
  – Factory-built / turnkey
  – Fully functional within days/weeks of arrival at deployment site

• Ultra-small-scale LNG production
  – As low as 1,500 gallons/day (GPD)
  – Far smaller than competing technologies

• A methane expansion cycle – methane is both the product and the refrigerant

• Gas-to-LNG conversion efficiency of 70-75% for < 10,000 GPD plants
  – Efficiency is higher ( > 80%) at larger scales or with higher-pressure feed gas

• Produces its own power ➞ No connection to the electrical grid is required

• Can be fully automated ➞ No continuous labor required

• Ambient temperature rating: -40° F to 110° F

• Additional option: Separation of NGLs (propane, butane, etc.) from the feed gas
## “VXTM Cycle” Applications

### Upstream
- Monetize associated gas at oil wells
  - Eliminate gas flaring
- Separate NGLs from feed gas (optional feature)
- Stranded gas fields w/o pipelines
- LNG fuel to replace diesel for:
  - Drilling rigs
  - Hydraulic fracturing pumps
  - Field trucks
  - Construction equipment
  - Distribution to nearby retail LNG fueling stations
- Offshore oil & gas platforms

### Midstream
- LNG for shipping to remote communities & gas “microgrids”
- LNG for shipping to remote industrial & mining/quarry sites
- Peak-shaving gas storage facilities

### Downstream
- “Distributed” production of vehicle-grade LNG at fueling stations (replaces diesel fuel)
- Eliminates the need to truck LNG from large, centralized plants to distant fueling depots
- Upgrade existing CNG stations
- Clean, inexpensive LNG fuel for:
  - Long-haul/heavy-duty trucks
  - Delivery fleets
  - Railroad locomotives
  - Marine (ships/barges/ferries)
  - Construction & mining equipment
“VX™ Cycle” Advantages

• Mobility – trailer-mounted or skid-mounted plants

• VX methane expansion cycle provides:
  – High efficiency – uses an optimal balance of refrigeration & compression + uses waste heat/cold
  – Low capital cost
  – Low operating costs

• Simplifies LNG production vs. other LNG technologies such as: Mixed Refrigerant Cycles / Nitrogen Cycles / Cascade Cycles
  – Less complex equipment
  – Fewer process inputs (e.g., no separate refrigerants to ship in; no “make-up” refrigerants)
  – Less sensitive to ambient temperatures

• Can utilize virtually any high- or low-pressure feed gas
  – Pipeline gas from local gas distribution systems or interstate pipelines
  – Well gas

• Small, modular VX plants allow for incremental expansion with low capital risk
  – Use of multiple modules ensures a higher % of uptime
Contact Information

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