LNG: A Proven Carbon Reduction Solution for Kazakhstan’s Transportation Network

UNECE Decarbonization Workshop
November 24th – 25th 2021
Almaty, Kazakhstan

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LNG Overview

- Liquefied Natural Gas ("LNG") is a cryogenic fuel derived from natural gas
  - A -162 °C liquid stored at low pressure
  - 600 times less volume than natural gas
  - 2.4 times more energy output than CNG
    - LNG is superior to CNG for high horsepower applications and extends operating ranges

- Easy and safe to transport and store
  - LNG is non-explosive, non-corrosive, non-toxic
  - If released, evaporates quickly and disperses, leaving no residual residue

- Conventional LNG plants are complex and expensive
  - Generally implemented for marine export sales
  - Multi-year construction times and +US$10 Billion

- Modular LNG ("mLNG") plants are more efficient and cost-effective
  - Localizes LNG production and distribution
  - Ideal for regions with limited pipeline networks
  - Smaller footprint
Multiple Benefits of LNG Implementation

- More environmentally friendly than diesel
  - 30% lower greenhouse gas emissions, 95% lower particulate emissions, 100% lower sulphur emissions
  - Supports Kazakhstan’s energy transition plans and emission reduction commitments
  - No soil or water contamination

- Enhanced engine performance and less wear
  - LNG has +20% more BTU energy output than diesel (by weight)

- Kazakhstan’s transition to LNG will reduce diesel fuel demand
  - Reduces need to expand local refining capacity
  - Reduces dependence on foreign fuel imports

- Standardizes fuel used by international road transport fleets to that of Western Europe and China

- Numerous LNG industrial applications are already proven worldwide
  - Long-distance road haul trucks, mining haul trucks, rail locomotives, agriculture machinery, remote power generation, marine vessels
Kazakhstan’s Energy Transition is Underway

- **Government Resolution No. 797**
  - Expands the use of Kazakhstan’s natural gas resources to replace diesel as a motor fuel
    - Decreases GHG emissions and lessens climate change
    - Contributes to energy self-sufficiency by reducing diesel imports
  - Allocates 500 million cubic meters of natural gas per year to gasify the transportation sector

- **Government Action Plan includes**
  - Establishing LNG and CNG fueling stations and distribution networks
    - Over 200 fueling stations to be constructed in Kazakhstan
    - Services the Western China to Western Europe, and Khorgos to Tashkent freight corridors

- **Planned gasification of the transportation sector**
  - 30,000 vehicles identified as candidates for LNG and CNG conversions
  - Locomotive pilot study is underway with early 2023 LNG trials
  - Ongoing discussions with mining companies on LNG conversions and infrastructure
LNG for Mine Haul Trucks and Locomotives

- Condor has identified large open-pit mining operations as priority beneficiaries of LNG
  - Significant volumes of fuel are used in mining operations
  - Fuel consumption increases as the open pits get deeper, requiring more haul trucks
- Haul trucks use a blend of 70% to 80% LNG and the remainder diesel
  - Caterpillar, Komatsu, Belaz and Hitachi are easily converted to dual-fuel usage while maintaining the flexibility to operate on diesel-only if required
- Multiple operator studies of dual-fuel usage confirm that truck performance, payload, and reliability remain the same as diesel-only fueled trucks
- LNG locomotives have a longer operating range compared to diesel locomotives
  - Fuel tender with ~45,000 liters LNG capacity is hauled directly behind locomotive
    - Less frequent re-fuelling requirements
    - Supports one or two locomotives, thereby reducing overall capital investment requirements
- Kazakhstan Temir Zholy ("KTZh") is evaluating proven LNG conversion technology
  - Pilot program is designed to improve efficiency, increase locomotive speeds, reduce fuel and operating cost, and reduce environmental impacts
  - Convert two existing diesel locomotives to LNG by early 2023
  - Once the pilot project is completed, KTZh to convert 280 additional locomotives
    - New locomotives to operate 100% on LNG
Industry Leading LNG Technology

- The Condor group has proven expertise in modular LNG production and distribution
  - Built the first greenfield LNG facility in the U.S. for the supply of marine fuel
  - Technology was developed by the U.S. Department of Energy
    - Group has +40 U.S. patents
- Technology provides best-in-class efficiency
  - Natural gas used as the refrigerant source
  - No need to store and recycle large quantities of nitrogen, ammonia, ethane or propane for the refrigeration process
  - No need for refrigeration compressors, associated piping, utilities
  - Shorter plant construction times
- Easier to operate
  - Multiple feed-gas operating pressures
  - Multiple control points to manage production rates based on fluctuating feed gas rates and pressures
- Modular design easily expands to meet increased demand
Concluding Remarks

- LNG is more environmentally friendly than diesel
  - Promotes a structured energy transition
  - 30% lower greenhouse gas emissions, 95% lower particulate emissions, 100% lower sulphur emissions
- Kazakhstan’s LNG transition is underway
  - Action plan includes pilot programs, distribution networks
- Recent technological advancements enables widespread LNG use in the transportation sector
  - Long-distance road haul trucks, mining haul trucks, rail locomotives, agriculture machinery, remote power generation, marine vessels
  - Conversion to LNG has been successfully implemented worldwide
- Condor has industry-leading LNG technology
  - U.S. Department of Energy patented technology
- Condor will install Central Asia’s first modular LNG facility in Kazakhstan
  - Fully operational in 2023