



# AN INVALUABLE CHP PLANT FOR GREECE

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The Liquid Natural Gas (LNG) Terminal on Revithoussa Island, 45 km west of Athens, Greece, is one of the three supply sources for the Greek Natural Gas Transmission System. Since 2009, the Terminal's energy needs are fully covered by a gas engine-based Combined Heat and Power plant built by Burmeister & Wain Scandinavian Contractor A/S (BWSC) to lower emissions and ensure a constant high level of reliability, efficiency and flexibility.

The BWSC Combined Heat and Power (CHP) plant on the island Revithoussa, also known as The Power Integration Station, plays a crucial role for Greece in the safeguard of uninterrupted supply of natural gas.

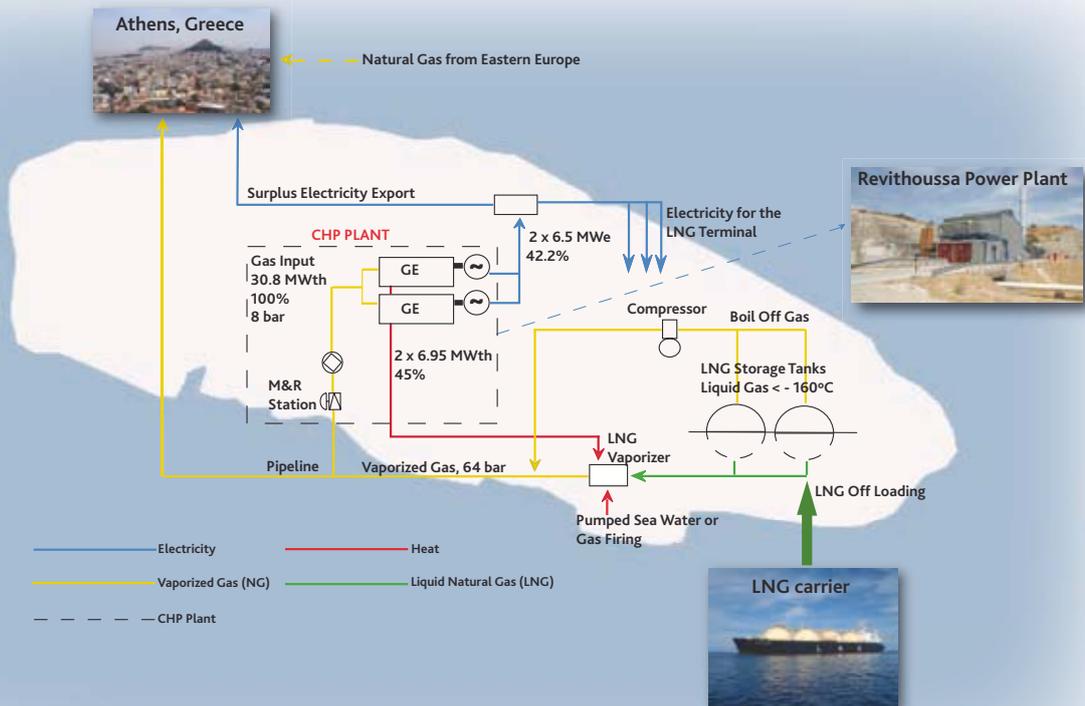
Thanks to the CHP plant, the LNG Terminal can operate in autonomous mode without being electrically fed by the main grid; i.e. in cases of mainland electricity grid failures.

Natural gas in the form of Liquefied Natural Gas (LNG) is received at the Terminal, stored and vaporised in the Terminal's special facilities before being distributed to the mainland. The heat produced by the CHP plant is used for the LNG vaporisation at the terminal, ensuring the best possible overall utilization of the fuel gas with an efficiency of the CHP plant up to 87.2% (electrical  $\eta = 42.2\%$  and thermal  $\eta = 45.0\%$ ).

## LOW EMISSIONS AND HIGH RELIABILITY THROUGH STATE-OF-THE-ART DESIGN

The CHP plant comprises a powerhouse with pressurized ventilation system and a separate gas metering and regulation station. It is powered by two Caterpillar G16CM34 medium speed gas engines of 6.5 MWe each, creating an output of 13 MWe and 13.9 MWth. The selected engines offer low emissions, high reliability and high flexibility.

### Schematic Process Diagram for Revithoussa LNG Terminal



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In periods without heat demand, the CHP plant can still produce electricity using the back-up radiator cooling facility and hence, providing high operational flexibility to the LNG Terminal. The generated power is supplied to the existing 6 kV grid. The control system contains both local control panels for the plant and integration with the existing LNG Terminal control center situated approximately 200 meters from the CHP plant. The LNG Terminal control center is the master control center. In practice this means that the operators monitor the gas production as well as the various power outputs from the entire Terminal at the same time.



NATURALLY DELIVERED WITHIN TIME AND BUDGET

Severe safety measures surrounded the construction phase of the project due to the considerable amounts of gas stored on the island being located in a seismic zone. Since, it was required to maintain gas production and distribution throughout the entire construction phase, strict rules applied for security and safety, e.g. the handling of electrical, welding and cutting equipment on the island.

Nevertheless, BWSC implemented this complex project in record time of 18 months and ahead of schedule in April 2009 - for which the company received much accolade and a commemorative plaque from the client. Afterwards, a successful 3-month plant operation period followed with effective take-over in July 2009.

PART OF STRONG POLITICAL ENERGY INCENTIVES

The CHP plant represents two pillars of the Greek energy policy – the promotion of gas as an integral part of the diversification of energy sources towards lower emissions and the promotion of energy-efficient CHP plants.

Besides the societal benefits of saved primary energy, avoided network losses and reduced greenhouse gases, the BWSC plant is part of the Greek implementation of the European Directive on Cogeneration 2004/08/EC.



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The plant is partly financed as part of the National Strategic Reference Framework, which programmes European Union funds for environmental purposes for specifically Greece.

#### FACING SUBSTANTIAL CHALLENGES

Greece only produces a small amount of natural gas. At present, it relies mainly on imported oil to satisfy its energy needs. Greece thereby faces substantial challenges in this field along with most other European countries.

Currently, the Greek natural gas market is growing. One third of the natural gas consumed in Greece is imported as LNG. The remaining part is imported from Russia by pipeline.

Natural gas is becoming more attractive as a fuel for electricity production especially due to lower environmental pollution. Gas fired power plants produce twice the electricity per ton of emitted CO<sub>2</sub> compared to coal fired plants. The CO<sub>2</sub>-quota scheme imposes substantial costs on generating electricity from coal instead of gas. Moreover, gas fired plants are more flexible with regard to adjusting production to electricity prices and can thus charge a higher average price than inflexible production like nuclear and coal. Increasingly, gas is used for direct household consumption.

European indigenous gas production is declining. Few new discoveries are made, with a consequent decline in reserves, and EU25 now holds only a fraction of approximately 1.4% of total known gas resources. With the current production level, EU25 will have consumed its reserves in approximately 15 years, without new discoveries. The large gas reservoirs are to be found in the Middle East, Russia and Africa. These facts all make a strong case for increased import dependency in Europe over the coming years, an import dependency which is already high.

The high, and growing, import dependence is a great concern for several European countries. Today, Western Europe's three largest import sources, Russia, Norway and Algeria, account for 89% of total imports. This is a concern for two reasons. Firstly, security of supply will be more difficult to ensure when there are few alternative sources. Secondly, the exporters may gain substantial market power.

This supply gap can be covered by gas transported by either pipeline or in the form of LNG, Liquefied Natural Gas. Given the anticipated substantial increase in gas demand, LNG will be of crucial importance in order to balance the market. The demand for LNG in EU is estimated to increase by 350 % from 2005 to 2020!



Burmeister & Wain Scandinavian Contractor A/S (BWSC) is a leading turnkey contractor and operator for large and medium scale power plants. Furthermore, BWSC is involved with selected CHP and renewable energy plants. Within three decades, BWSC has supplied more than 160 power plants to 50 countries, with a total generating capacity in excess of 2,900 MW.



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