

Opinion

Israel : Gassing up for NGVs

For the first 50 years of its relatively young history Israel has been dependent on imported energy; natural gas from Egypt, oil from Russia and Azerbaijan, and coal from various places as far away as South Africa and Australia. But in 2000 with the discovery of 1 trillion cubic feet (Tcf) (28.3 billion cubic meters- Bcm) of the Mediterranean-based Mari-B natural gas field off the coast of Gaza, Israeli policy makers began strategizing about a revolutionary shift in the country's energy balance.

Initially most of the gas was used in large industries and to replace coal-and-oil-fired electricity. Between 2004 and 2010, 20.6 Bcm of natural gas replaced 12.6 million tons of fuel oil and 6 million tons of diesel oil for a financial savings of 4.25 billion NIS (€963 million). By the first quarter of 2015 natural gas represented just over 42% of the state-owned Israel Electric Corporation's generating capacity. While coal remains dominant at about 57% it is down from 62% one year earlier and is planned to shrink further.

But since 2004 when Mari-B's first gas was brought on-shore the field's capacity diminished steadily and could not be relied upon as a sustainable gas source on its own. New Mediterranean gas discoveries were announced in 2009 in the off-shore Tamar field and in 2010 in the Leviathan field about 130 km west of the port city of Haifa. In 2011 natural gas imports from Egypt stopped due to their political turmoil and Israel began importing LNG as a stopgap measure. This further motivated Israel to develop its newly discovered off-shore gas resources as fast as possible. Gas from Tamar began flowing in 2013 and gas from the Leviathan field is expected on-shore by 2017. Today there is about 640 km of gas pipe in the network. About 80 km is the land-based distribution gas pipe

network. It is anticipated that nearly 30 Tcf (849 Bcm) from Tamar and Leviathan will be able to provide gas for the next 50 years, with likely more off-shore production possible from other adjacent areas in the Mediterranean.

What to do with the new-found (government-owned) gas resources?

The new gas resources represent a dramatic strategic and economic opportunity for Israel both domestically and internationally. But, there are also enormous challenges in creating, regulating, operating and expanding a sustainable natural gas industry from production to the so-called 'burner tip.'

In October 2011 an inter-ministerial group was created to examine the government's policy regarding natural gas in Israel. Named after its Chairman, the 'Tzemach Committee' priority was to "ensure that the limited (natural gas) resources would be utilized in order to maximize their value for the Israeli public and contribute to the country's foreign relations." Among other things the committee surveyed 12 of the 30 largest gas producing countries with characteristics similar to Israel and its new natural gas opportunity. They evaluated and drew conclusions from various government experiences setting policies – incentives, mandates, regulations – in order to better understand what balance of conditions needs to be achieved in creating a secure, economical, profitable and sustainable gas supply and distribution network for both domestic consumption and export. The outcome of the report also was based upon much public debate and input from many sectors of the Israel society.

Developing a market for NGVs was amongst the committee's recommendations. The Tzemach Committee determined in its August 2012 report that one third of private vehicles (about 820,000 cars) and

two thirds of public vehicles (including about 12,000 buses) could be converted to natural gas by 2040, with gas consumption in the transport sector reaching 40 Bcm (1.6 Tcf). The report stated: "The Committee seeks to encourage the development of alternative fuels based on natural gas for local consumption in the Israeli economy by including demand for natural gas for transport in its policy recommendations."

In June 2013 the Fuel Choices Initiative (FCI) was created within the Office of the Prime Minister, comprised of participants from 10 government ministries with a 10 year mandate and an annual budget of NIS150 million (€34.5 million). The FCI's analysis of the NGV market potential includes an ambitious vision of NGV penetration that, if NGVs can be introduced by 2014-2015, they could achieve 50% substitution by 2025 and reduce the share of oil by 60%.

Exhibit 1 shows the Fuel Choices Initiative targeted fuel consumption replacement for the vehicle population as converted to natural gas propulsion.

Israel NGV policy making: Thoughtful and pro-active

Policy makers have moved quickly to advance the NGV market build-up and ensure that actions taken are in accordance with strict safety requirements and expectations of the government. The range of policy options being considered include financial incentives, mandates, demonstration programs, developing standards, and funding of R&D.

- The Compressed Natural Gas Directive (CNGD) of the Ministry of National Infrastructure, Energy, and Water Resources prescribes very specific requirements for the development of local fueling stations, as it says, "To create conditions for the safe and efficient development

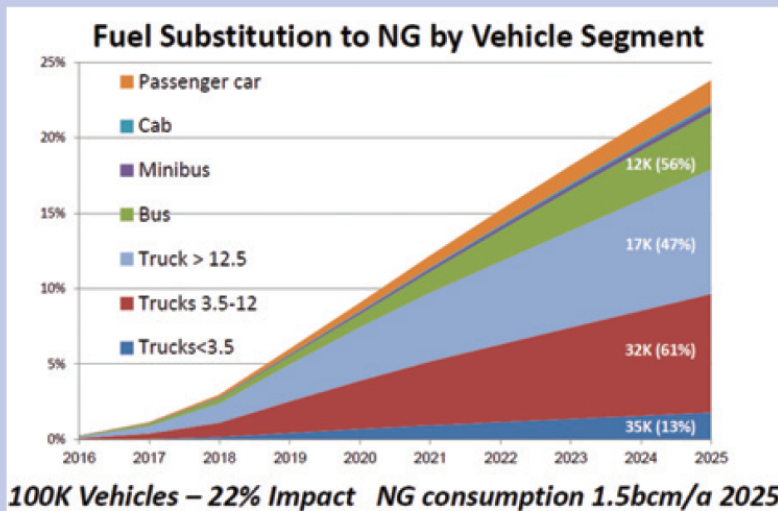


Exhibit 1

Source: Fuel Choices Initiative Israel NGV, Saar Shafir, Deputy Managing Director, Fuel Choices Initiative, NGV Workshop, Tel Aviv, 9-10 September 2015.

and use of CNG systems in accordance with Israeli governmental law and policy.” The Directive also pertains to distribution network compression stations, CNG trailers, decompression stations as well as other auxiliary network systems.

- Some standards already have been developed (NGV Filling Stations: SI-6236 and Automotive Natural Gas: SI-6119) and other requirements also recognize and reference UNECE Regulation 110, the Pressure Equipment Directive 97/23/EC (PED) as well as various ASME (American Society of Mechanical Engineers) standards. Israel also follows mandatory requirements for motor vehicles to be compatible with the European rules on Whole Vehicle Type Approval.
- Other policies by the Fuel Choices Initiative being considered or implemented include: a Green Tax; ‘Safety net’ for filling stations; support program for fleets (buses/garbage trucks); pilot and demonstration projects (Ministry of Energy/Transportation); research & development support at a level of NIS 100million co-investment fund (€23million); requirements for fleet conversions; and international collaborations/information sharing.

Israel is plotting an ambitious and strategic course to be amongst world leaders in NGV technology much like they have done in the fields of agriculture and medical technology.

NGV policymaker workshop focuses on safety and lessons learned

One of the efforts to foster ‘international collaborations’ was an NGV workshop for Israel policy makers in Tel Aviv on 9-10th September 2015 that was initiated and organized between Israel’s Ministry of National Infrastructure, Energy and Water Resources and the U.S. Department of Energy (DOE) and Argonne National Laboratory, under the auspices of the U.S.-Israel Energy Dialogue agreement. U.S. DOE’s Argonne National Laboratory Clean Cities Team Leader, Marcy Rood, and Israel Chief Scientist (Acting) and Senior Manager for Oil Replacements, Dr. Bracha Halaf brought together an international team of NGV experts, Israeli policy makers and stakeholders who participated in a one-and-a-half day event, Clean Cities Transportation: A Workshop for Israeli Policymakers on the Proper Use of Compressed

Natural Gas (CNG) in the Transportation Sector. The workshop presentations had a ‘global view’ but emphasized many aspects about safety, standards, and regulations. More than 40 Israeli policy makers participated from nine different government agencies including infrastructure, transport, the environment, standards, fire safety and security as well as holders of licenses to distribute natural gas and representatives of fuel companies.

- In the opening session the Israeli NGV program of the Fuel Choices Initiative was described by Saar Shafir, Deputy Managing Director of the FCI. Dr. Jeffrey Seisler, CEO of Clean Fuels Consulting, who has been working under contract to Argonne and the U.S. DOE on fostering international NGV cooperation, presented NGVs in their global context, identifying a wide range of opportunities, challenges and strategies being employed in ‘NGV countries’ globally.
- Creating the foundation for NGV standards, regulations, safety and training are of critical importance to the Israel government. Eng. Yasha Jurborsky, Chief Engineer and Safety Commissioner of the Natural Gas Authority described the Israeli CNG Directive while Dr. Seisler provided a global view of UNECE and European regulations and ISO standards. Livio Gambone, Technical Manager, Transportation Fuels from the Canadian Standards Association (CSA Group) focused on the development of performance-based standards for CNG cylinders and fuel systems. He also provided a history and analysis of CNG vehicle in-service failures.
- Practical safety requirements and a risk-assessment for LNG/CNG maintenance facilities was presented by Dr. Chris LaFleur from the Sandia National Laboratory, part of the U.S. Department of Energy. Mr. Jurborsky from the Natural Gas Authority talked about safety of the ‘CNG fueling chain’ from the Israeli perspective and Mr. Gambone went more deeply into issues and practices associated with CNG cylinder and fuel system inspection and requalification.

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- State-of-the-art and best practices for stationary and mobile CNG fueling and delivery systems were presented by Diego Goldin, Executive Director of NGV Global. The Israeli Ministry of Transport testing and demonstration of CNG bus explosions also was highlighted since there are special physical security concerns about the possible effects of suicide bombers attacking buses in Israel.
- Finally, successful implementation strategies and lessons learned by government policy makers world-wide were presented by Dr. Seisler. Marcy Rood discussed the U.S. Clean Cities model and how to build a successful market for alternative fuel vehicles based on many experiences in the United

States.

The workshop included some wide-ranging and energetic discussions between the participants. Israel has moved quickly and decisively to create an NGV program suited to their unique set of circumstances and the dialogue between the U.S. and Israeli government officials on energy and NGVs will continue into the future both in Washington and Israel.

Many challenges and unique circumstances are being addressed

Every country has its own unique set of circumstances – geopolitical, economic, environmental and security –

that must be understood in order to craft a successful NGV development program. Israel is no exception and they have their share of challenges unique to their situation.

- **Earthquake zone:** Israel sits on the geological crossroads of two major and some minor tectonic plates and the history of the region has been partly shaped by seismic activity occurring over the centuries. As such, all buildings and infrastructure facilities must be built taking into consideration special durability and physical sustainability requirements, which increases the cost.
- **Security issues:** Concerns about incoming rocket bombs and suicide bombers have lead Israel to bury their largest fuel repositories, design 'bunker' structures for CNG fuel stations. The Israelis must take extra technical precautions to mitigate the impacts of terrorist attacks, such as testing CNG cylinders compared to diesel fuel tanks durability in the face of bombings, as periodically have occurred on public buses. This type of consideration has not been a concern in any other global NGV markets.
- **Regulatory liability.** Though specifically prohibited in the CNG Directive, regulators enforcing compliance have been held liable for equipment and systems that they approved as safe but failed. This practice could lead to additional time-consuming layers of bureaucratic approvals at the national and local level that would slow the construction of CNG stations and likely, conversions of vehicles as well.
- **Security of domestic gas supply vs exportation:** Though not specific to the Israeli NGV program, maintaining the balance between securing the domestic gas supply in the long term versus exporting gas, which helps sustain and expand the exploration and production infrastructure, is an on-going debate. Customers must be convinced that CNG will be available to fuel cars nationwide and for the long term otherwise the program won't meet the current expectations for growth.

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Israel has a reputation for making the desert bloom. The vision and plan is that they also will create a flowering market for NGVs, yet much remains to be done in order to nurture this growth and achieve the vision.

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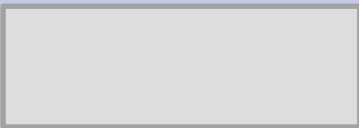


Table 1 shows the total vehicle population by type in 2014; also indicating kilometers per vehicle travelled annually. The numbers and usage suggest that there are many a variety of high-priority vehicle classifications that could have economic benefit by running on natural gas.

Table 1
Israeli Vehicles 2014

TOTAL	2,965,727	Km/yr/vehicle
Private vehicles(1)	2,457,236	15,961
Trucks(1)(2)	327,792	27,081
Minibuses	14,120	49,504
Buses	17,795	56,195
Taxis	20,106	81,000
Special service Vehicles(3)	4,597	n/a
Motorcycles	124,081	n/a

Data based on: Israel Central Bureau of Statistics

1. Including dual purpose vehicles (most having a load capacity up to 0.9 tons.

2. Including road tractors.

3. Ambulances, sanitation vehicles, etc.

http://www.cbs.gov.il/reader/cw_usr_view_SHTML?ID=616

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