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LPG
WEEK

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NEW OPPORTUNITIES FOR LPG SOLAR HYBRID SYSTEMS IN TELECOM AND OTHER MARKETS (REPLACING DIESEL AND COAL)



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Telecommunication, Automotive, HVAC, Farming are applications that consume enormous amounts of diesel and produce very significant amounts of pollution.

Telecommunications is the largest and most accessible market to penetrate for LPG sales followed by backup generators and off grid power generation.

Water pumping and power generation for farms, are also profitable markets to pursue.



HELP CLEAN THE ENVIRONMENT WHILE EXPANDING YOUR LPG AND NATURAL GAS SALES

Polar's new line of gas engines and hybrid power systems provide significant advantage over diesel in the following markets:



Wireless Telecommunication Towers



Electric Vehicle Charging



Water pumping



ECO Tourism



Charging EVs should exceed the market previously experienced by propane vehicles.

Side Note: The most profitable position for an LPG distributor is to serve either as an ESCO or leasing to Telecom and other markets. This is a value-added opportunity.

Telecommunications consumes diesel in tens of billions of liters of every year. Globally, the top 100 cellular towers companies own and operate over 1.5 million cell sites.

According to articles posted, the Telecom industry currently produces 4% of the world's carbon emissions and this is expected to grow to 20% with 5G, IoT, and Edge computing. The high energy consumption presently goes unnoticed by most "Green Organizations" and government Agencies.

LPG with or without solar can annually save individual telecom companies tens of millions of dollars in energy costs annually.

To accelerate the acceptance of LPG over diesel in all markets requires a greater effort in education of both the LPG seller and applications user.



Overcoming the customers' negative experiences with using lawn and garden type engines in generators for solar and prime power applications. Through product awareness aimed both end users and the LPG distribution executives.

Offset any disadvantages of LPG through innovative application and system design. Using more efficient engines, combining solar, using DC, making use of engine's waste heat.

Increasing the effort of LPG producers to pursue newer markets and passing down these new marketing efforts through their distribution channels. Including the new rLPG, and rDME fuels.

Having the LPG trade associations lobby with Governments and Energy Departments to reduce the tariffs on clean fuel generators and the LPG fuel itself. For many the gain is helping solve the issues with bad grid, rural development, improved hard currency reserves, enhancing tourism, lower cost energy and reduction in pollution.

Most homes will not be able to fast charge EVs due to limited electric service; an LPG or natural gas DC generator provides fast charging and if the engine's waste heat utilized, this system can offer a lower carbon footprint than most electric utilities.

As the climate gets warmer the need for air-conditioning increases the demand on the electric utility grid. Japan faced a utility problem due to a rapid rise in air-conditioning demand, to solve for this problem, engine driven heat pumps were developed to use their NG grid. Other Pacific Nations pursued same solutions using LPG.



LPG / PROPANE / NATURAL GAS HYBRID SOLAR POWER SYSTEM

High-Efficiency gas DC genset with heat recovery (low capital cost) + Zero-emission Solar PV energy (low operating costs) = LOW-COST SUSTAINABLE POWER

- Provides a lower carbon footprint than traditional on-site generators or grid-supplied power.
- Low maintenance and lower cost of ownership.
- Various applications include: on-grid, off-grid prime power, backup power, micro-grid, EV charging, heating, and air-conditioning.



Applications making the use of solar, LPG or NG, and the engine's waste heat will typically have both a lower carbon footprint and a lower energy cost than the electric utility.

Many utilities continue to burn diesel, fuel oil, and coal to produce electricity.

Having a very long life and fuel-efficient LPG engine is the first step in the competition against diesel. Having a brand name backed by a good reputation does not mean that this LPG engine has the performance requirement to compete with a diesel. This assumption has led to many failed projects thereby reinforcing the end users concept that diesel is more reliable and less maintenance.



POLAR POWER'S DC GAS GENERATOR HELPS SOLAR ENERGY BECOME MORE AFFORDABLE AND DECREASES THE USE OF DIESEL

- Operates on Natural Gas, LPG, and Propane with high fuel efficiency
- Less maintenance and lower operational cost than Diesel with three times longer engine life
- Designed to operate 24/7 requiring very little maintenance
- Lower cost and less maintenance than most Fuel Cells
- Low carbon footprint with approximately 85% fuel to useful energy efficiency when making use of the engine's waste heat option
- Max Power is 15 kW, 8 kW for 90,000+ hour run time life
- At 15 kW of electrical power the useable heat energy is approximately 37,000 kcal/hr with a temperature range of 50° C to 72° C
- Very quiet operation, less than 63 dba at 7 meters. Less noise than most air-conditioners.

ENGINE:

- 3 Cylinder, .95 liter displacement Toyota engine
- ECU control by Bosch
- 15 liter oil capacity
- Oil change intervals of 4,500 hours
- 10,000 hour long life Iridium spark plugs
- Diesel engine block converted to gas. Heavy duty crankshaft, bearings, flywheel, pistons
- Stellite exhaust valves
- No belts or pulleys, no belt driven water pump, cooling fan, or SLI Alternator
- Electric brushless coolant pump
- No timing belts or chains driving overhead cam, overhead CAM is driven by gear
- Efficient combustion has greatly simplified emissions equipment attached to the engine.



ALTERNATOR:

- Permanent magnet 32 pole alternator manufactured by Polar Power
- No brushes, bearings, exciters, or AVR



- LPG is frequently lower in cost than Diesel.
- LPG emits 14% - 18% less CO2 than Diesel.
- Diesel emissions are carcinogenic causing new restrictions in installation.
- The Polar LPG DC generator can reduce fuel consumption up to 40% over a diesel.
- Polar LPG DC Generator configured in a solar hybrid system can reduce fuel consumption up to 90%
- The Toyota LPG engine has lower maintenance and 3X longer service life than the best diesel engines.



Two Polar 27 kW DC generators mounted on the back of a pickup truck charging 2 EVs during their field trails



Not being able to fast charge at home or office, long lines at charging stations, power outages, or miscalculation of EV range is leaving many drivers stranded without a charge. Emergency roadside service can either move the EV to a charging station or charge the EV on the spot. The most efficient solution is a mobile LPG fueled DC Generator for fast charging the EV on the spot.

Limited grid power and Having access to fast charging is the second most important factor in the decision to purchase an EV

Solar Hybrid Applications

There are many applications that run the AC generator 24 hours a day without using solar. And in other applications the AC generator is run for a limited time each day powering the load while charging a battery, eventually shutting down and allowing the battery to power the load. When the battery charge is low the cycle repeats. First example consumes large volumes of diesel fuel, and second example can lower the fuel consumption.

The lowest CAPEX and OPEX costs, most reliable operation, and environmentally friendly technology is combining solar with LPG.

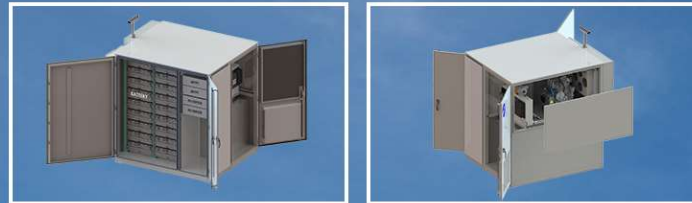
Its not a cost-effective solution for most applications using 100% solar (PV). 100% solar typically requires the solar array to double in size and the battery bank to triple in size. A generator is typically included to backup the batteries and solar controls and provide additional energy when needed.



THE SIMPLEST AND MOST EFFICIENT WAY TO INSTALL A HYBRID SOLAR SYSTEM

ALL-IN-ONE INTEGRATED SYSTEM INCLUDES:

- **DC Generator** is the most efficient means of combining Solar Energy with Clean Fuel
- **Capacitor** is used in place of a Battery for more reliable starting of the DC Generator
- **Batteries** store the excess energy produced by the Solar Array
- **MPPT Solar Control** optimizing the energy from the Solar Array
- **Inverter** converts energy from the Solar, Battery, and DC Generator to AC
- **Heat Exchangers** capture the waste heat from the DC Generator for heating water and space
- **Digital Controls** automate the process and provide remote monitoring and control
- **Optional Air-Conditioning** for homes and offices



DC GENERATOR WITH WASTE HEAT RECOVERY

- DC Generator operates on Natural Gas, LPG, and Propane
- Powder Coated Aluminium Cabinet with stainless steel hardware
- Units can be combined to increase capacity
- Remote Monitoring and Control
- 15 kW Electrical Output
- Up to 37,000 kcal/hr of Heat
- Up to 30 KVA in AC Electrical Output
- Up to 6 Tons of Refrigeration / Air-Conditioning



At sites where the fuel demand is high the concerns over fuel delivery is high, this favors diesel.

The solar hybrid sites are typically designed for 80% to 90% solar energy with fuel providing 20% to 10% of the site's energy requirements. With lower fuel consumption, LPG is now favored.

Prewired / prepackaged equipment reduces installation costs and improves serviceably.

What are the factors impeding the sale of LPG into telecom markets?

LPG marketing and supply chain. Telecom companies do not know who to contact for fuel delivery contracts. It is impractical for large fuel contracts to be negotiated with the small local LPG outlets.

Many of the cell sites have remote locations and are not currently serviced with LPG fuel; however, they are serviced with diesel. There should be no reason why diesel can be delivered and not LPG.

If there are off grid cell sites, then there are off grid communities. The marketing opportunity is to use the telecom company as the area's "anchor" customer purchasing a large volume of fuel, then with the new routes expand service the local community. Note:

Selling LPG into rural communities will have a positive effect against deforestation and increase resource for community development.



Comparison

	Diesel	LPG
ENVIRONMENTAL	<ul style="list-style-type: none"> • Rapidly changing emission standards reduce engine availability to OEM's and increases engine cost. • Strict emission controls is increasing Diesel engine complexity thereby reducing reliability and making maintenance more difficult. • Diesel is carcinogenic and causes respiratory issues 	<ul style="list-style-type: none"> ✓ Environmentally Clean Fuel, rarely effected by change in environmental regulations. ✓ Clean exhaust ideal for use near population centers. ✓ LPG has 14% to 18% less carbon emissions
STORAGE, SHELF LIFE TRANSPORTATON	<ul style="list-style-type: none"> • Diesel fuel has limited storage life and sometimes requires additives. Transportation of Diesel to the site exposes the fuel to water contamination which can damage the engine. • Diesel engines require clean and moisture free fuel to operate reliably. 	<ul style="list-style-type: none"> ✓ LPG has virtually unlimited shelf life which leads to greater engine reliability. ✓ During emergencies LPG may be more Obtainable. ✓ Using Vapor feed contaminants remain in the tank.
ENGINE NOISE	<ul style="list-style-type: none"> • Due to compression ignition, Diesel engines produce much higher noise (knock) thereby requiring a noise attenuation system. Noise is a concern when systems are installed close to population centers or in the backyards. 	<ul style="list-style-type: none"> ✓ Low operating noise of LPG engine allows for deployment of engines in close proximity to population centers and indoor facilities.
FUEL THEFT	<ul style="list-style-type: none"> • Diesel theft is a key factor increasing operating costs by 10% to 25%. In addition, the practice of diluting diesel fuel as a means of pilferage leads to premature engine failure. 	<ul style="list-style-type: none"> ✓ LPG is more difficult to steal; making it the ideal fuel for telecom applications.
LIFE CYCLE COSTING	<ul style="list-style-type: none"> • Diesel engines are subject to damage (wet stacking) if run with light loads. • Quality Diesel engines will have a service life of 14,000 to 30,000 hours. 	<ul style="list-style-type: none"> ✓ The service life of a "quality" LPG engine is 60,000 to 90,000 hours. ✓ Due to environmental benefits most nations provide subsidies to use of LPG thereby reducing operating costs.



Where is the market resistance?

Failure of LPG distribution to apply resource to market to new customers and demonstrate supply capability. If the customer thinks fuel delivery will be a problem his interest stops there.

Only after the customer is convinced of a reliable fuel supply will shop for a generator or other LPG appliances.



To accelerate the acceptance of LPG over diesel in all markets:

Overcoming the customers' negative experiences with using lawn and garden type engines and generators in prime power applications through education and product awareness. Aimed both end users and the LPG distribution executives.

- Increasing interest and effort on the part of the LPG producers to pursue newer markets, especially with the new rLPG, and rDME fuels
- Having the LPG trade associations lobby with Governments and Energy Departments to reduce the tariffs on clean fuel generators. For many the gain is improved hard currency reserves, enhancing tourism, lower cost energy and reduction in pollution.

Most applications for power generation will require an engine and alternator. Increasing the efficiency of the both the engine and alternator (generator) is required to compete with a diesel generator. This message is missed by many LPG trade organizations as they tend to promote the backup type LPG generators from the top brand name companies who provide the least efficient but lowest cost LPG generators. These low-cost generators adversely affect the market by demonstrating that diesel is the better fuel.

A diesel engine has a higher compression ratio than spark plug ignition engine, and this gives the diesel engine higher fuel efficiencies. The popular “lawn and garden” engines, used by the most popular generator companies, have low compression to reduce engines’ production cost, size, and weight. To compensate the fuel efficiency difference between the 2 technologies (compression ignition/ diesel and spark ignition / LPG) the following steps were taken:

- The Toyota 1KS engines have a higher compression ratio compared to most LPG engines, approximately 12:1 verses 9:1
- The coolant pump, fans, SLI alternator were removed from the engine reducing the parasitic losses in the engine and improving fuel efficiency.
- Coolant pump and fans are electrically driven at optimum speeds improving reliability and efficiency.
- Polar had made efficiency improvements in the overall generator design by using permanent magnet alternators optimized for production of DC current as opposed to AC. This increased efficiency in generating electricity reduces fuel consumption.
- Polar made optimizations in the overall application to further reduce fuel consumption. For example, being able to charge batteries directly from the DC generator as opposed to using battery chargers with AC generators reduces fuel consumption and system cost.

The result is that the customer now sees lower maintenance, higher reliability, and lower fuel costs. In a generator application the Toyota 1KS engine has a serviceable life span of 60,000 to 90,000 hours compared to a Diesel engine with life span of 12,000 to 30,000 hours.



As the emission requirements increase for Diesel engines:

- Many engine models have been discontinued.
- Common rail diesel engines require more maintenance and very susceptible to failure using a poor-quality diesel fuel.
- Elaborate catalysts and filters have been added to the diesel to reduce particle pollution, but these filters can double the cost of a small diesel and greatly add to the maintenance.
- Diesel engine prices have skyrocketed, and deliveries are now typically 6 to 12 months.
- Diesel fuel has increased in cost along with a rise in theft.

It have been said for a long time now that due to emissions requirements the LPG/NG engines will replace the diesel, especially the small engines. Now is the time the LPG producers, distributors, generator companies, and trade organization come together and make the push for LPG.

