

# Qnergy Remote Propane Power Generation

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# Qnergy

*Sales/Operation Discussion*



# Our Mission

A photograph of a metal platform with a generator and control panel on a body of water. The platform is elevated on metal legs and has a set of stairs leading up to it. The generator is a large, light-colored unit with a control panel on top. The background shows a body of water, a fence, and a cloudy sky.

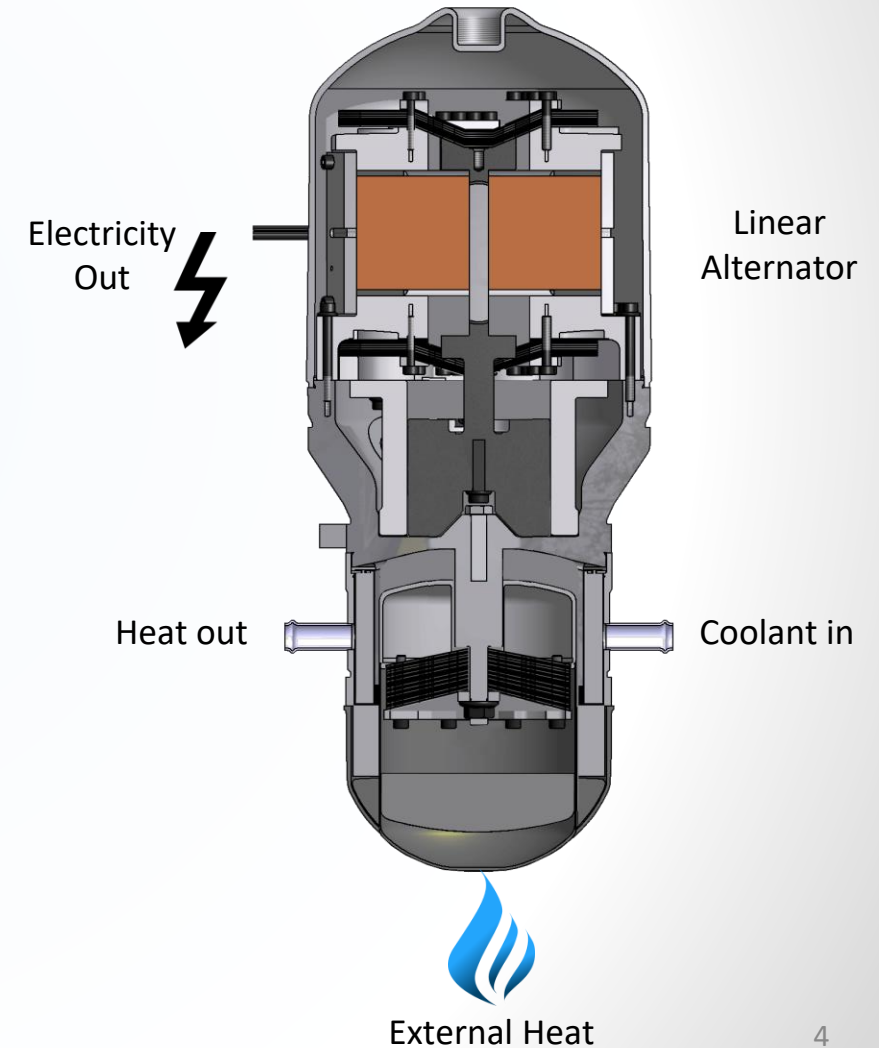
Provide reliable remote power to improve efficiency,  
decrease cost and reduce emissions

# Leaders in Free-Piston Stirling Technology

Simple design and decades of expertise led to unparalleled reliability

- Welded, hermetically sealed enclosure - no helium refilling required
- Simple design - only 66 parts in the entire engine
- Flexure bearings technology enables frictionless linear movement with no contact or lubrication
- Designed for 80,000 maintenance-free operating hours
- Material fatigue life well beyond the required engine operating life
- Multiple levels of IP protection: patents, know-how, trade secrets, manufacturing tools

*“Wear mechanisms have been eliminated by non-contacting bearings and non-contacting seals.” [NASA](#)*

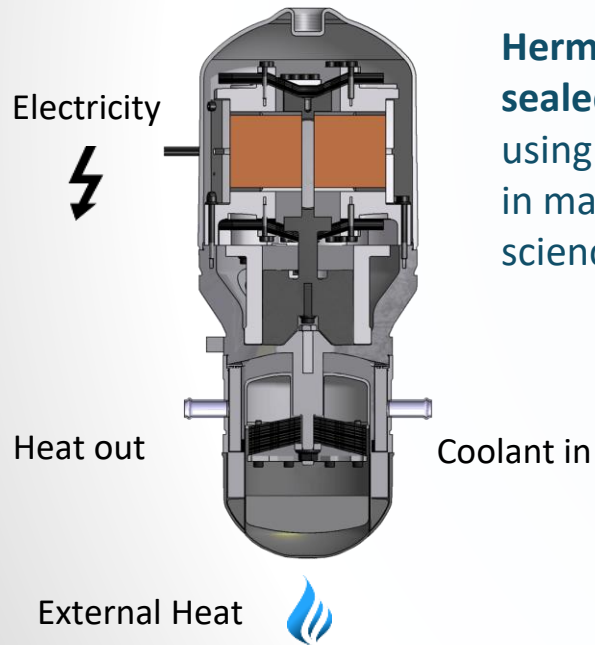




# Differentiated Technology

Leveraging \$350M and decades of development combined with advancements in material science and power electronics to build a commercial Stirling generator

## Superior Linear Stirling Engine



**Hermetically sealed** engine using advances in materials science

+

## Electronics Control



**Proprietary** Hardware and Firmware

Electronic **Load Following**

**Smart** monitoring and control

Real-time Analytics

=

## Maintenance-free generator

**80,000** maintenance-free hours

**Clean** Near zero CO & NO<sub>x</sub> emissions

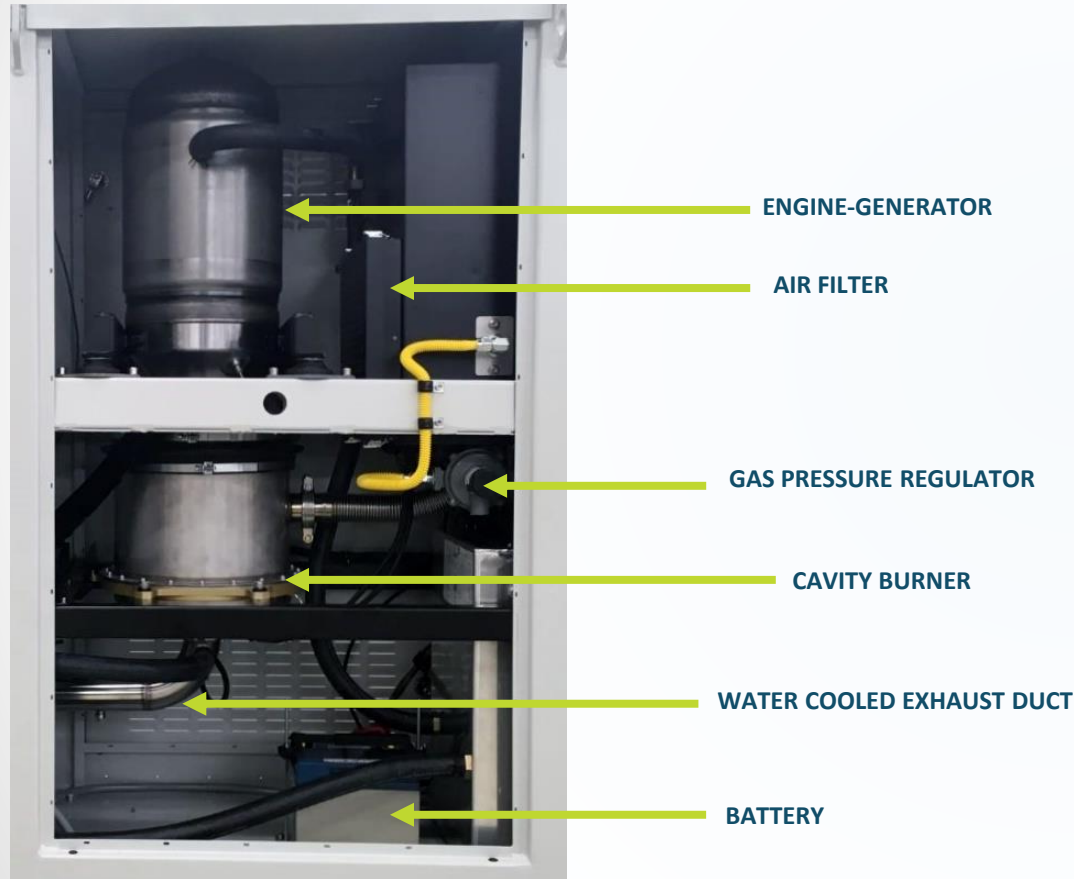
**Compatible** with conventional and renewable fuels

Multiple levels of **IP protection**

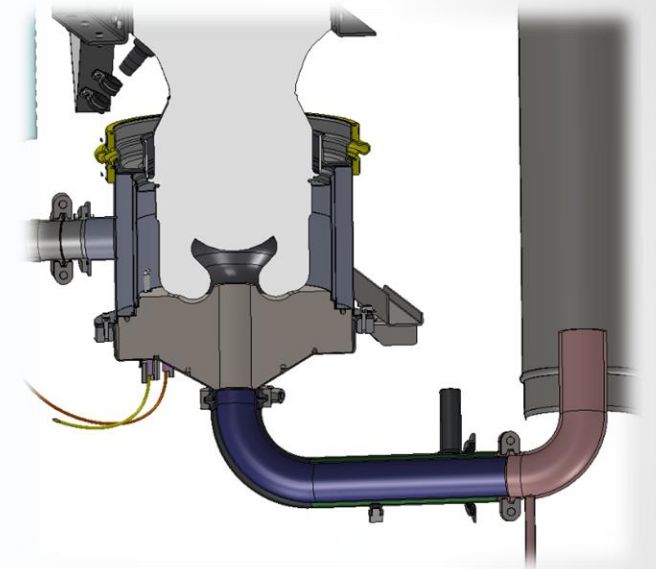


# PowerGen Cross Section

Simple design and low emissions



- Fully enclosed combustion chamber
- Exhaust is diluted and exits at below  $< 200^{\circ}\text{F}$
- All surfaces are cooled



Emissions	Value (English Units)	Values (SI Units)
NOx @ 5% O2	30.0 ppm	66.0 mg/kWh
CO @ 5% O2	9.0 ppm	12.0 mg/kWh
VoC	Negligible	Negligible
CO2	0.1 Lb/kWh	0.24 kgCO2/kWh

PowerGen Specification	5650 Series	1800 Series	1200 Series	600 Series
Power Output*	5,650 Watts	1,800 Watts	1,200 Watts	600 Watts
Fuel Type	Gaseous Fuels: NG, LPG, Propane, Wellhead Gas			
Fuel Consumption (max)	3,964 ft <sup>3</sup> /day (NG) 44.4 gal/day (Propane)	1,300 ft <sup>3</sup> /day (NG) 10 gal/day (Propane)	935 ft <sup>3</sup> /day (NG) 7.2 gal/day (Propane)	550 ft <sup>3</sup> /day(NG) 4.3 gal/day (Propane)
Fuel Pressure Range	3-50 PSI (Natural Gas) 2-10 PSI (Propane)			
Caloric Value (min / max)	751/3,382 BTU/ft <sup>3</sup>			
Ambient Temperature Operation** Ambient Temperature Rated (Startup)	-13°F to 122°F 5°F to 122°F			
Cabinet Electrical Rating	IP54			
Electrical Configuration***	120/240 VAC Split Phase			
Certification	cETLus (UL2200) (CSA C22.2#100/C22.2#14)e3w			
Dry Weight	866 lbs (392 kg)			

\* For detailed performance data, please request the engineering specification document

\*\* Ask about a low temperature operation package (down to -40°F)

\*\*\* Additional electrical output configurations available

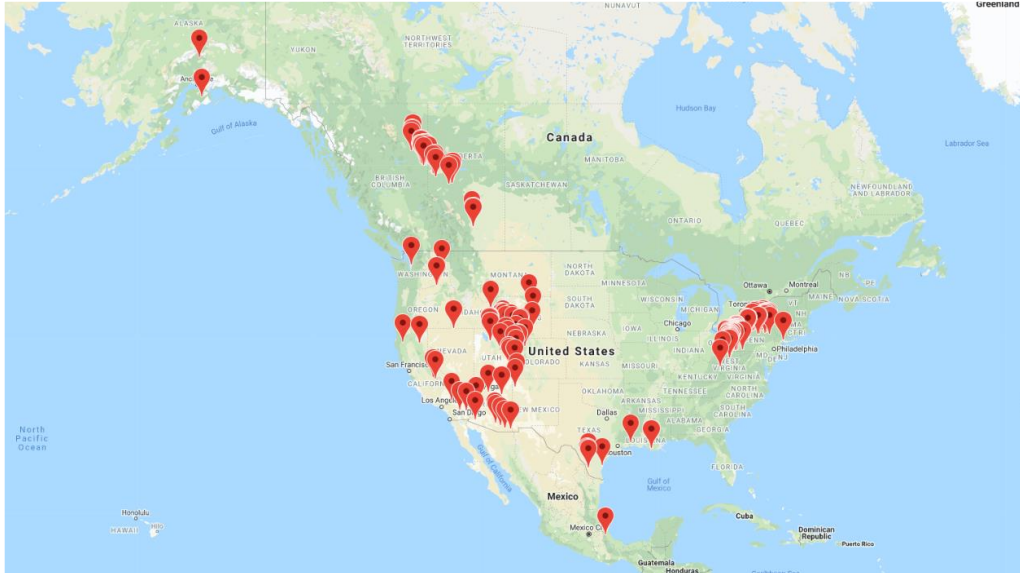
## Additional Feature Options:

- Glycol Heat Trace
- Extreme Low Temperature Module
- Remote Monitoring
- Extended Standby
- Impressed Current Cathodic Protection
- Three Stage Battery Charging
- Configurable Voltage Outputs
- Gas Pressure Reduction System
- Custom Enclosure Color
- Fuel Conditioning
- Hybrid Compatible
- Sour Gas Service
- Heat Recovery
- Enhanced Security



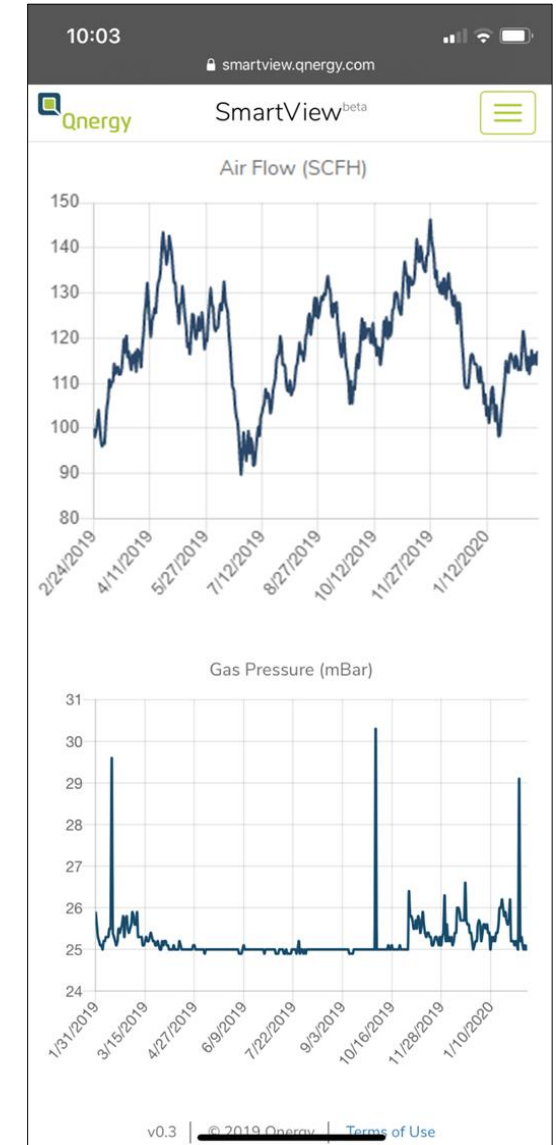
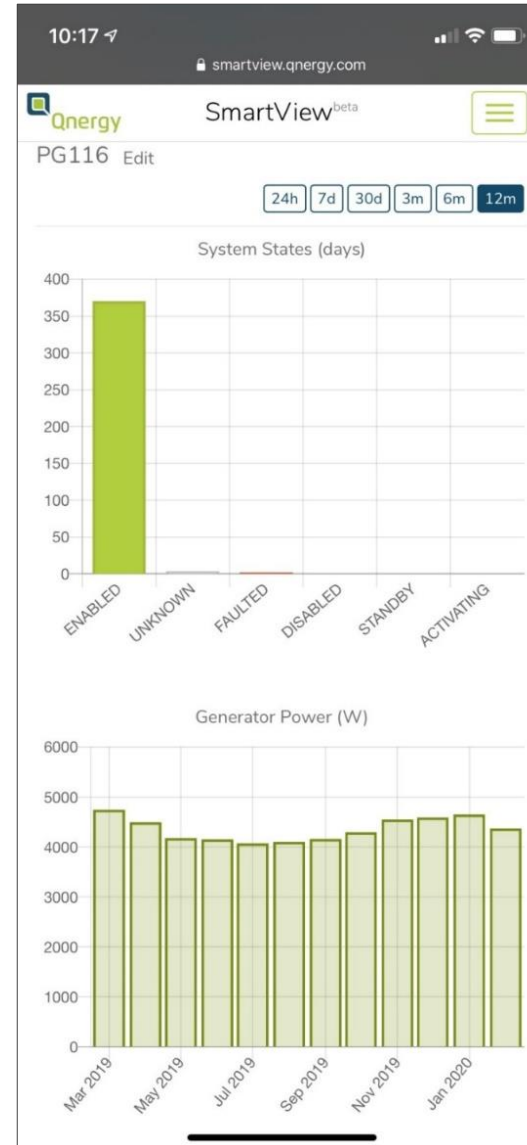
# Remote Monitoring

Monitor and control anytime, anywhere



“The ability to troubleshoot a device in an hour, remotely is absolutely critical. Kudos to your team!”

*Operations Manager in a leading Oil & Gas company*



# Resiliency: Always On – Any Environment



**Trusted:** Customers trust Qnergy to work reliably for tens of thousand of hours outdoors



**Proven:** Hundreds of systems work seamlessly in the harshest ambient conditions



**Available:** Fuel agnostic: well-head gas, piped natural gas, propane, biogas and hydrogen

## Unparalleled Reliability



A system in **Wyoming** with 30,000 hrs maintenance-free operation

## Arctic Temperatures



Remote cell tower in **Alaska** working at  $-40^{\circ}$   
Picture through a helicopter window

## Heat Waves



Cathodic Protection unit in **Arizona** working at shade temps of  $125^{\circ}$  F

## Hurricanes



A system in **Louisiana** working through Hurricanes Laura and Delta

## Off-shore



Off-shore installation in the **Gulf of Mexico**

## Glycol Heat Trace Module for PowerGen



### Glycol Heat Trace

The Glycol Heat Trace (GHT) feature allows for the waste heat from the Stirling engine to be used by the customer. A plate heat exchanger is used to separate the engine coolant and the GHT media. The GHT media is circulated using a rotary vane pump on a variable speed motor. The PowerGen monitors the supply and return temperatures of the GHT media and adjusts the units operation to match the heat load and meet the return temperature set point.



### Features

- Up to 73,000 BTU/HR of heat available\*
- No external power supply required
- User selectable return temperature
- User setable maximum supply temperature
- Supports up to 2,100ft of heat trace length\*
- Integrated glycol reservoir and strainer
- Externally visible glycol level indicator
- Ideally suited for remote locations
- Remote monitoring of supply/return temperatures and system health with email notifications available
- Externally accesable ON/OFF toggle switch with indication of pump operating
- Adjustable pump speed
- Support Modbus TCP/IP monitoring and control

[www.qnergy.com](http://www.qnergy.com)

## Gas Conditioning Unit



### Qnergy's Gas Conditioning Unit (GCU)

Designed for use with the entire PowerGen Remote Power products line. It is designed to protect this highly reliable remote power system from entrained liquids in the gas stream. The GCU allows for liquid and solid contaminants to be removed from the inlet fuel line before entering the PowerGen's fuel delivery system. The GCU features 2 liquid level sensors that will indicate when liquids are present and ultimately, shut in the PowerGen fuel system if liquid levels exceed the GCU capacity. The GCU also employs the use of electric heat trace, powered by the PowerGen, to install at any pressure drop locations upstream of the PowerGen. This will reduce the chance of liquids freezing and condensing within the fuel delivery line.



### Benefits

- Recommended for any gaseous fuel feed line
- Max pressure of 100PSI, 1/2" NPT inlet port
- ASME/CRN certified steel knockout drum
- Over 3 gallons capacity
- Over 40ft of heat trace supplied
- Remote monitoring of GCU capacity sensors
- Manual 1/2" drain valve
- Supports Modbus TCP/IP monitoring
- Operable at -40°F/C\*
- Available as factory-installed option or field retrofit

\* Insulation blanket available.



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## PowerGen N+ Solutions

Qnergy's Power Interface Package allows the paralleling of multiple power sources with flexible AC and DC output options.



### BENEFITS

- Scalable for 5, 10 and 15kW power levels
- Seamless backup battery integration
- Increased system reliability
- Fuel consumption optimization (Propane or Natural Gas)
- Can readily be hybridized with renewable energy sources (i.e. PV and wind)
- Reduced maintenance and cost of ownership
- Dispatchable generation
- IOT connectivity

### POWERGEN 5.65KW STIRLING ADVANTAGE VS TRADITIONAL ENGINES

- Maintenance free 80,000h engine life (no oil changes, no field rebuilds)
- Efficient, low-emission combustion (100x lower than EPA CO and NOx limits)
- Wide operating temperature range (-40°C to 40°C)
- Load-following engine (no load banks or wet-stacking issues)
- SmartView web-based monitoring system

## PowerGen Solar Hybrid

Qnergy's solar hybrid system leverages the PowerGen Stirling engine to supplement photovoltaic power creating the most reliable off-grid power system.



### BENEFITS

- Hybrid design blends the advantages of solar energy with those of Stirling power
- 24/7, year-round off-grid power
- Smaller PV panel footprint
- Smaller battery bank with longer life (no deep cycling)
- Reduced engine fuel consumption
- Decreased operating costs (less maintenance and downtime)

### POWERGEN STIRLING ADVANTAGE

- Maintenance free 80,000h engine life (no oil changes, no field rebuilds)
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# PowerGen – Select Applications



- Instrument Air for methane abatement
- Cathodic Protection
- Mainline Valve Control
- Instrumentation and metering for pipeline and well-pad
- Artificial-lift equipment
- Communication and SCADA systems
- Monitoring and site control
- Lighting, security and safety equipment
- Renewable power backup and buffer

# Tier 1 Clients (selection)

## Energy



## Utilities



## Transportation



## Government



**700+** systems

**80+** customers

# Telecom/Controls



# Remote Monitoring





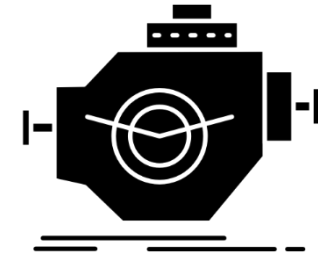
# Liquids Pipeline Cathodic Protection



# Railroad Controls



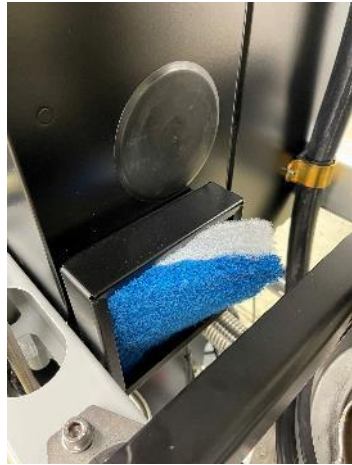
# PowerGen vs Genset



	PowerGen	Genset
<b>Power Range</b>	600W – 5.65kW	6kW – MWs
<b>Engine</b>	External Combustion	Internal Combustion
<b>Fuel</b>	Unprocessed gas, Propane	Commercial grade
<b>Emissions</b>	0.066 g/kWh NOx .012 g/kWh CO	6 g/kWh NOx [1] 2.5 g/kWh CO
<b>Life</b>	10-15 years (>100,000 hours)	1.5 - 2 years (15,000 hours)
<b>Maintenance</b>	Annual (preventative)	1000 hours (oil change)
<b>Cold Start</b>	-40 °C (-40 °F)	0°C (32 °F)
<b>Low Load</b>	Load following	Reduced efficiency, wet stacking



# PowerGen Annual Maintenance – 1 Hour!



- Reusable, easy-to-clean filter

Air Filter

- Clean with fluid or brush

Radiator

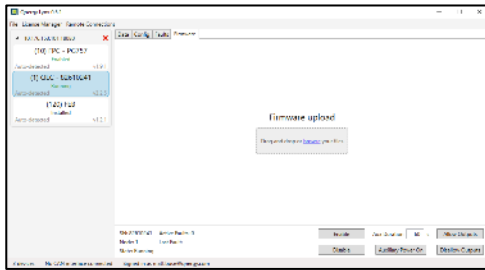


Firmware

- Update to latest firmware remotely

Gas Tuning

- Tuned through lambda sensor and Qnergy Software



# PowerGen/CAP3 Key Features and Benefits

## Best performance at the lowest cost

- **Price:** Lower TCO (\$/watt) than any comparable technology in this power range
- **Installation:** Small footprint, easy installation, no landowner issues related to running power network, and avoid cutting trees to run power lines
- **Maintenance:** Zero cost for lubricants, logistics and waste recycling
- **Flexible Fuel:** Operate on multiple gaseous fuels including well-site wet gas which reduces venting and flaring
- **Flexible Operation:** Multiple start-stops or continuous operation, at same reliability
- **Control Functionality:** Dry contacts, relays and MODBUS for easy interfacing
- **Flexibility:** Modular and responsive power algorithms with multiple optional Vac and Vdc power
- **Remote Monitoring:** Web based connectivity and cloud-based monitoring
- **Efficiency and Emissions:** Excellent efficiency while meeting stringent emission requirements.

# Questions

## Dan Midea

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**Thank You!**

