



CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

Magic Toyota

Edmonds, Washington

100-kW Reciprocating Engine System



Photo Credit: Dean Wallace Photo

Quick Facts

- LOCATION:** Edmonds, WA
- MARKET SECTOR:** Automotive Sales
- FACILITY SIZE:** 47,000 sq. ft. Automotive Dealership Expansion
- FACILITY Total Electrical Energy Use:** Use of net metering makes the dealership a “net zero” electrical consumption building
- EQUIPMENT:** 1-100 kW packaged reciprocating engine CHP system
- FUEL:** Natural gas-fired
- USE OF THERMAL ENERGY:** Hydronic space heating and ramp de-icing
- CHP TOTAL EFFICIENCY:** 83.5% with water jacket and exhaust heat recovery
- PAYBACK:** Estimated at 4-5 years
- CHP IN OPERATION SINCE:** September, 2018

Site Description

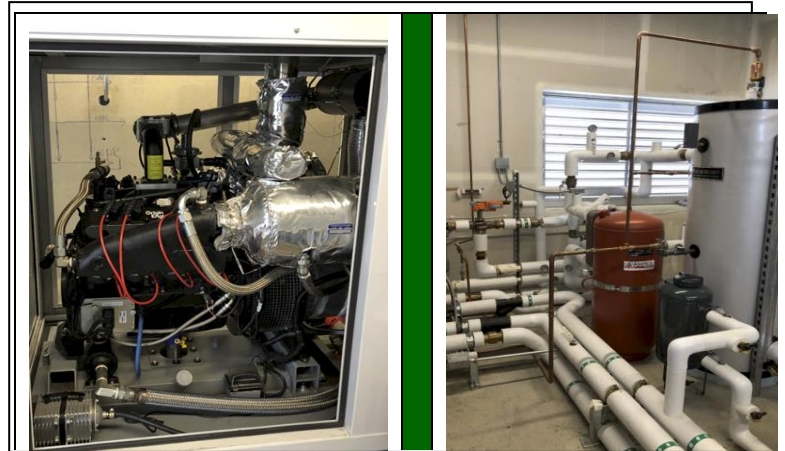
Seventeen miles North of Seattle, Magic Toyota of Edmonds operates a 47,500 sq. ft. automotive dealership complete with a showroom, customer lounge, a new car delivery area, 17 service stalls, 2 alignment racks, a detail department, and a 66 space elevated parking deck above the service area. The building space heat is provided by hydronic circulating water loops that recover water jacket and exhaust heat from a 100 kW Tecogen reciprocating engine Combined Heat and Power (CHP) unit.

Reasons for CHP

An inspection of the U.S. Department of Energy’s Combined Heat and Power Installation database indicates that Magic Toyota is the first commercial sector application of a CHP unit in the state of Washington. Magic Toyota is a private, family run business that values sustainability, resilience, and energy independence. The dealership is in the Edmonds area, within a convergence zone that is susceptible to storm-induced utility power outages. The family wanted to be able to continue operations without the availability of utility power. Strout-Kamp, the architect for expanding and transforming the original dealership from 29,000 sq.ft. to 47,500 sq. ft., recommended CHP and suggested that a 100 kW reciprocating engine would serve to meet their anticipated electrical and thermal loads. Foushee & Associates of Bellevue, WA was retained for design and construction management and incorporated the CHP unit directly into the facility’s HVAC system design. Instead of specifying a conventional HVAC system or using natural gas-fired radiant heating units for the service bays, the availability of “free” hot water prompted them to adopt a hydronic slab heating loop to provide space heating. Hot jacket cooling water and energy recovered from exhaust heat is circulated to a holding tank or “heat reservoir” with a secondary hot water loop serving the radiant slab heating needs. This design prevents overheating the polyethylene (PEX) piping in the concrete slab and eliminates the possibility of thermal concrete cracking.

CHP Equipment & Configuration

A natural gas-fired 100 kW Tecogen CHP project provides 85% of the dealership's peak electrical demand. The remaining 15% of the power requirement is supplied by Snohomish County Public Utility District (SnoPUD). When electricity usage drops at night, the CHP project sends surplus energy to SnoPUD under a net billing arrangement, making the dealership a net zero electrical energy consumer.



The Tecogen 100 kW reciprocating engine is enclosed in a boxed and soundproof indoor enclosure (left). Hydronic loops for radiant slab heating (right).

CHP Design, Installation, and Operation

Titan Electric served as electrical contractor and systems integrator. They worked with the PUD regarding interconnection requirements and interconnection relays for the inverter-controlled generation. They also designed the switching system that allows the CHP unit to serve critical loads during a utility power outage. The automotive dealership has trained mechanics on hand that allows them to conduct their own reciprocating engine maintenance.

Energy Efficiency Benefits

Tecogen developed the nation's first packaged cogeneration module in 1982 and has over 2,800 units shipped to date. The 100 kW unit has an electrical efficiency of about 29% (HHV) and, given complete utilization of the 640,000 Btu/hour of recoverable heat, can achieve a total efficiency of 83.5%. Low reciprocating engine exhaust emissions are obtained with a three-way catalytic converter. Variable speed operation allows for generation down to 10 kW. A "smart" inverter senses the loss of utility power and facilitates utility interconnection requirements while allowing for grid-independent operation. Recovered heat is pumped through pipes in the service bay slab for space heating while keeping the floor dry from rainwater brought in by cars and trucks. Hot water is diverted to rooftop radiators when there is no call for heat.

Utility Interconnection Requirements

SnoPUD has adopted guidelines that allow generation up to 15% of a circuit's minimum load to interconnect under a streamlined net metering process. In addition, for inverter-based sources of generation, SnoPUD accepts UL 1741 certification as assurance that the CHP project will cease to energize the grid during a power outage. For this project, Magic Toyota used an approved installer and SnoPUD simply verified circuit loads and the UL 1741 listing of the inverter. The utility did not charge for the interconnection study as the CHP project fell under their net metering process. A four-quadrant meter is used with net-metered applications to monitor reactive and real power in forward and reverse flows.

Service bay doors are constantly opening and closing and would lose energy with a conventional HVAC design. The jacket cooling water from the CHP project provides a free source of heat for the radiant slab in our service bays. Heat is also supplied to the ramp to the upstairs parking lot to evaporate rain water and prevent ice formation.

*--- Peter Chung, General Manager,
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For More Information

U.S. DOE Northwest CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)

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More CHP Project Profiles:

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