

Ultra-Low Emissions Enhances Advanced Technology CHP Module

Tecogen is proud to introduce the **InVerdē[®] Ultra¹⁰⁰** CHP module, the first and only natural gas engine-driven CHP system able to operate within the extremely low levels of regulated pollutants allowed by the distributed generation regulations for 2007 set by the California Air Resources Board (CARB). The **InVerdē Ultra¹⁰⁰** emissions not only meet, but exceed the stringent CARB 2007 regulations by utilizing Tecogen technology developed under a California Energy Commission (CEC) sponsored research program (co-sponsored by Sempra Utilities' Southern California Gas division).



Figure 1. Tecogen InVerdē[®] Ultra¹⁰⁰ Module Model

All of our Combined Heat and Power (CHP) systems use cutting edge technology to generate electrical power, along with thermal power recovered from the natural gas engine. Though a valuable source of energy, thermal power is usually lost in electrical production in the form of waste heat. However, captured and recycled thermal power can be used for very energy demanding heating processes, such as heating spaces and water. The benefit to customers is a dramatic reduction in their energy costs. The societal benefit is likewise impressive, with CHP efficiency typically twice that of conventional utility power, reduction in carbon emissions are inversely proportional, reducing greenhouse gas emissions by 50% or more. CHP is recommended as a preferred resource option for the future by many notable environmental groups such as the Sierra Club, Greenpeace, and the America Council for Energy Efficient Economy.

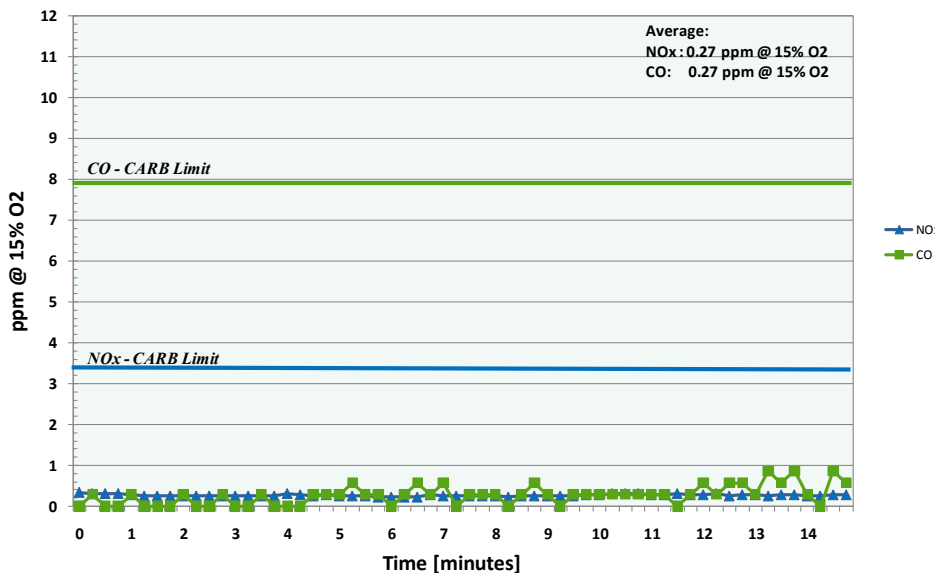


Figure 2. Results of Emissions Test for the Ultra Low Emissions Adaptation at Full Load Output (proper maintenance required for continuous compliance).

With the development of the **InVerdē Ultra¹⁰⁰**, Tecogen improves upon CHP technology leaving an even smaller ecological footprint. Each newly designed unit is tested by an industry-standard fifteen minute emissions test measuring the levels of both NOx and CO vs. time. Figure 2 shows the typical performance results of this test on the **InVerdē Ultra¹⁰⁰** module with the ultra-low emissions technology, illustrating the robust compliance of the module with CARB 2007. The measurements are well below the CARB compliance limits, averaging less than 1ppm.

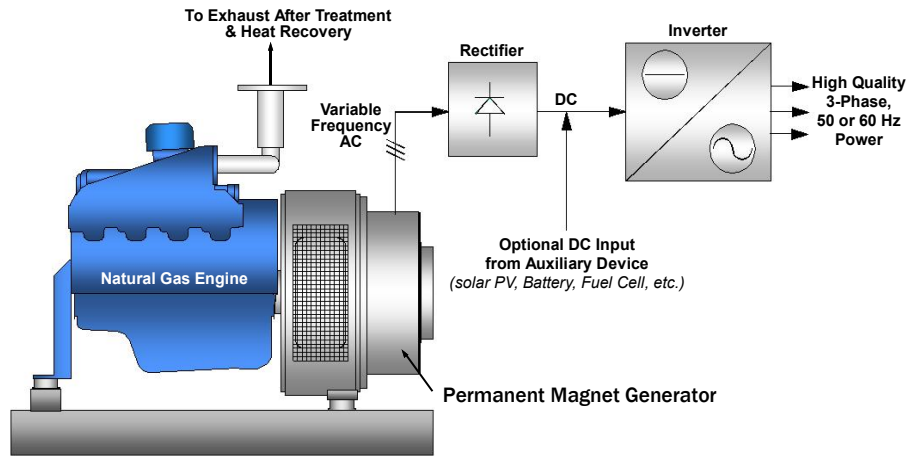


Figure 3. The InVerdē Ultra¹⁰⁰ Advanced Power Generation Technology

Cutting Edge CHP Technology

The **InVerdē Ultra¹⁰⁰** utilizes a totally unique power generation technology made possible from recent advances and cost breakthroughs in power electronics (variable speed drives) and magnetic motor/generator materials (hybrid vehicle drive systems). The product was developed under a major grant from the California Energy Commission's Public Interest Energy Research (PIER) program and Sempra Utilities (Southern California Gas/ San Diego Gas & Electric).

The **InVerdē Ultra¹⁰⁰**, shown in Figure 1, is a natural gas fueled CHP module rated at 100 kW continuous electrical output while simultaneously producing 6.7 therms per hour of hot water (230°F). When all the recoverable heat is used¹, the overall efficiency reaches an impressive 90%.

The **InVerdē Ultra¹⁰⁰** module features a low-emissions natural gas engine, which drives a water-cooled permanent magnetic generator (PMG). This module is conceptually depicted in Figure 3. The engine is operated over a wide speed range, depending on the load requirement, while the power electronics convert the variable frequency output from the PMG to high quality 60-Hertz power. Variable speed operation in grid-tie mode maximizes fuel efficiency under part load conditions, while also allowing operation in a "peaking" mode of 125 kW for several hundred hours per year to offset especially high "on-peak" utility demand tariffs and energy charges or to obtain extra savings from utility demand reduction programs.

This is the first engine-driven product to carry full UL 1741 Certification for "utility-safe" interconnection, while also providing seamless power transfer to stand-alone operation in the event of a power outage. The product features the proprietary control software, incorporated under exclusive license from the

¹ Based on the lower heating value (LHV) of natural gas (905 BTU/ft³)

Wisconsin Alumni Research Foundation² and demonstrated at the AEP Dolan Laboratory³, enabling multiple machines to load-share on an isolated bus, without any interconnecting or supervisory controls.

This highly innovative control method solves the difficult problem of applying clusters of small-scale prepackaged CHP modules that can operate both in grid-tie mode and during power outages, without complex and expensive controls. The single **InVerdē Ultra¹⁰⁰** Module, equipped with this control architecture, can be applied in a building block fashion to many types and sizes of facilities, and provide power outage security, in addition to their CHP benefits.

Typical Applications

The most common applications for the product are facilities that have concurrent and consistent electric and heating loads and ownership that values the standby power feature. Typical applications are schools, hospitals, recreation facilities, and multi-unit housing of almost any category (e.g., elder housing, condominiums, nursing care homes, dormitories, etc.).

² The Wisconsin Alumni Research Foundation is the University of Wisconsin's technology licensing affiliate.

³ AEP is American Electric Power, the 11-state Midwest Electric Utility.



Obtaining More Information

For more information about the **InVerdē Ultra¹⁰⁰** Premium Power Module contact Mr. William Martini, Tecogen West Coast Sales Manager at 503.641.1768, or Mr. Jeffery Glick, the Tecogen East Coast Sales Manager at 781.466.6481. Detailed specifications are available at www.tecogen.com.