PROJECT PROFILE

Ford Motor Company Research and Engineering Center

34 MW CHP System with Thermal Storage

Background

In 2016, the Ford Motor Co. initiated an Energy Master Planning process for its Dearborn, Michigan facilities. The process identified a range of energy and environmental sustainability objectives (see inset). One of the first projects identified in the planning process was the modernization of the Research and Engineering Center (REC), a 6.5 million square foot campus which includes office buildings, laboratory facilities, a large dynamometer building and several wind tunnels. The project included the construction of a new central energy plant and utility distribution system.

Sustainability Objectives

50% reduction in CO_2e emissions
50% reduction in water use
60% increase in chilled water production efficiency
100% of space heating load satisfied from waste heat recovery
Source: IDEA District Energy Magazine (Autumn 2019) Article "Renewal through transformation in Dearborn"

Historically, the REC's electrical requirements were provided by DTE Electric (local regulated electric utility) through its electric grid. The REC's thermal requirements were provided through a Ford owned and operated central steam generating plant (Elm Street Boiler Plant) and a mix of both individual building chillers and centrally generated chilled water.

Quick Facts

Location: Dearborn, Michigan
Market Sector: Automotive Manufacturing
CHP Generation Capacity: Total 34 MW
Prime Movers:
- Two 14.5 MW Solar Turbine Titan natural gas turbine/generator sets
- One Siemens 5 MW steam turbine/generator set

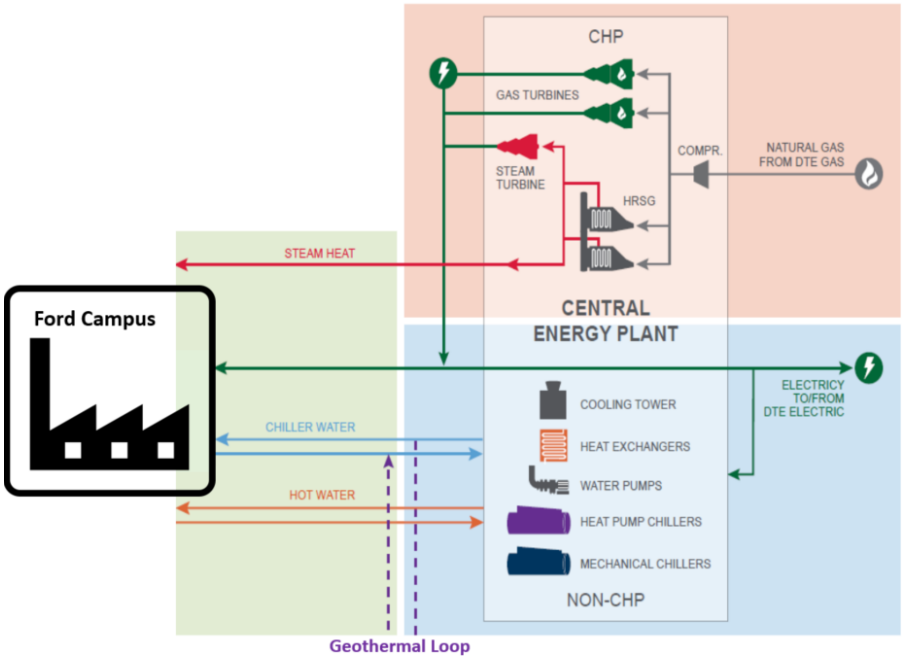
CHP Fuel Source: Natural gas
CHP Heat Recovery:
Two Rentech Heat Recovery Steam Generators (HRSG), each capable of producing 185,000 lb/hr steam to drive the steam turbine and provide hot water for space heating.
Total CHP System Cost: $62M
Financial Arrangement: DTE Electric owns the CHP system and DTE Energy Services operates and maintains the CHP system.
Began Operation: 12/31/2019

Project Description

As a result of a competitive procurement process, Ford Motor Co. entered into a three-way partnership with DTE Energy Services (a leading developer of energy related businesses in North America) and DTE Electric. Construction of the REC's new energy plant and distribution system started in April 2018. One of the central features of the project is the combined heat and power (CHP) system. It consists of two 14.5 MW Solar Turbine Titan 130 natural gas fueled turbine/generator sets, each coupled to a Rentech heat recovery steam generator (HRSG). The HRSGs are equipped with duct burners and are capable of operating as natural gas boilers should the turbines be inoperative. Fully fired, each HRSG can produce 185,000 lb/hr of 200 psi steam. Part of the steam is stepped down in pressure to serve the REC campus steam and hot water loads with the balance of the 200 psi steam used to drive a Siemens 5 MW steam turbine/generator set (STG).

Ford REC's New Energy Plant: Source DTE Energy Services

The CHP system and associated infrastructure is owned by DTE Electric as one of its rate-base generation assets. This provides DTE Electric's customers with a competitive, resilient alternative to the new gas Combined Cycle Gas Turbine (CCGT) plants required in their Integrated Resource Plan (IRP). This approach also allows DTE Electric to retain Ford as a fully-bundled customer, benefiting all utility customers.



In addition to the CHP system, the project includes several additional advanced technologies. DTE Energy Services owns, operates and maintains the following equipment, providing hot and chilled water to the Ford REC.

- Two Trane Centrifugal Heat Pumps (1,200 tons and 1,800 tons)
- Four Trane Centrifugal Chillers, each rated at 3,200 tons with series evaporators and series condensers
- A 5 million gallon, 40,000 ton-hr Thermal Energy Storage (TES) system (5,000 tons for 8 hr period)
- A distribution system supplying 42°F chilled water and 120°F low temperature space heating hot water (HRSG steam-to-water heat exchangers, centrifugal heat pumps, and heat rejected from the STG condenser).
- Geothermal ready infrastructure/piping capable of installing a future 3,000 ton geothermal system.

The total cost of the project was approximately $275 million (including the cost of the new energy plant that houses the CHP system), with the CHP system totaling approximately $62M. The project construction was completed and systems fully operational by December 2019.

Results and Lessons Learned

- **Financing Model:** The project utilized a design-build-own-operate-maintain (DBOOM) model which minimized capital outlay by Ford Motor Co while providing them N+1 reliability for utility supply, improved campus energy efficiency and carbon footprint (70,000 MT of CO_2e annual emission reduction), a state-of-the-art energy plant (CHP generation, advanced thermal technologies, integrated controls), and the ability to focus on its core automotive business (outsourcing utility plant operations and maintenance to a single purpose financially engaged partner).

> "The ability to identify clear technical and financial roles for each partner (Ford, DTE Energy Services and DTE Electric) provided the incentives needed to complete the successful construction with full operation of the new energy plant in just over 2 years (26 months)."
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> *Michael P Larson, Director, Business Development; DTE Energy Services*

- **CHP Performance:** In 2020 the CHP system (34 MW) operated at over 95% availability providing approximately 289,000,000 kWh to Ford and other DTE Electric Customers.
- **Smooth Transfer:** DTE Energy Services selected the person to be assigned as Plant Manager for the new energy plant during the final engineering phase of the project and integrated him into the team as Construction Manager. This action ensured a smooth transition from construction through commissioning through full operation of the plant.
- **Advanced Controls and Control Sequencing:** The new energy plant contains a mix of advanced technology equipment. Attention to control strategies and proper sequencing of assets is key to efficient operation.

For More Information

The Midwest CHP TAP is a U.S. DOE sponsored program managed by the Energy Resources Center located at the Univ. of Illinois at Chicago 4/15/21

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