

(I believe)

DTE Energy



DTE Energy Hydrogen Technology Park



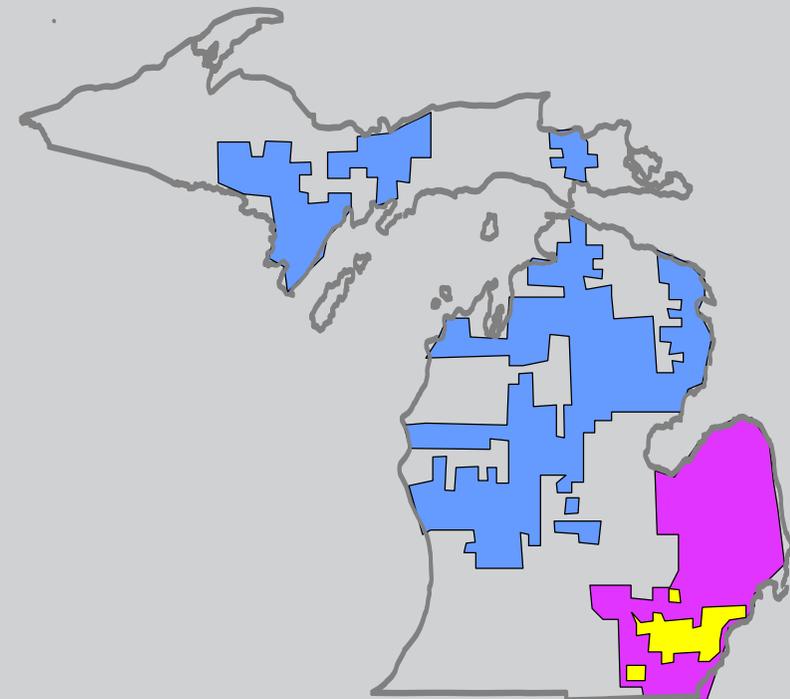
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DTE Energy - Company Overview

- **Full-spectrum regional energy provider**
 - An electric and natural gas utility
 - Non-regulated energy related businesses
- **Assets of \$19 billion**
- **Annual revenues over \$7 billion**
- **2.6 million customers**
- **11,000 MW of generation**
- **600 BCF natural gas delivery**
- **11,000 employees**



Utility Service Territory

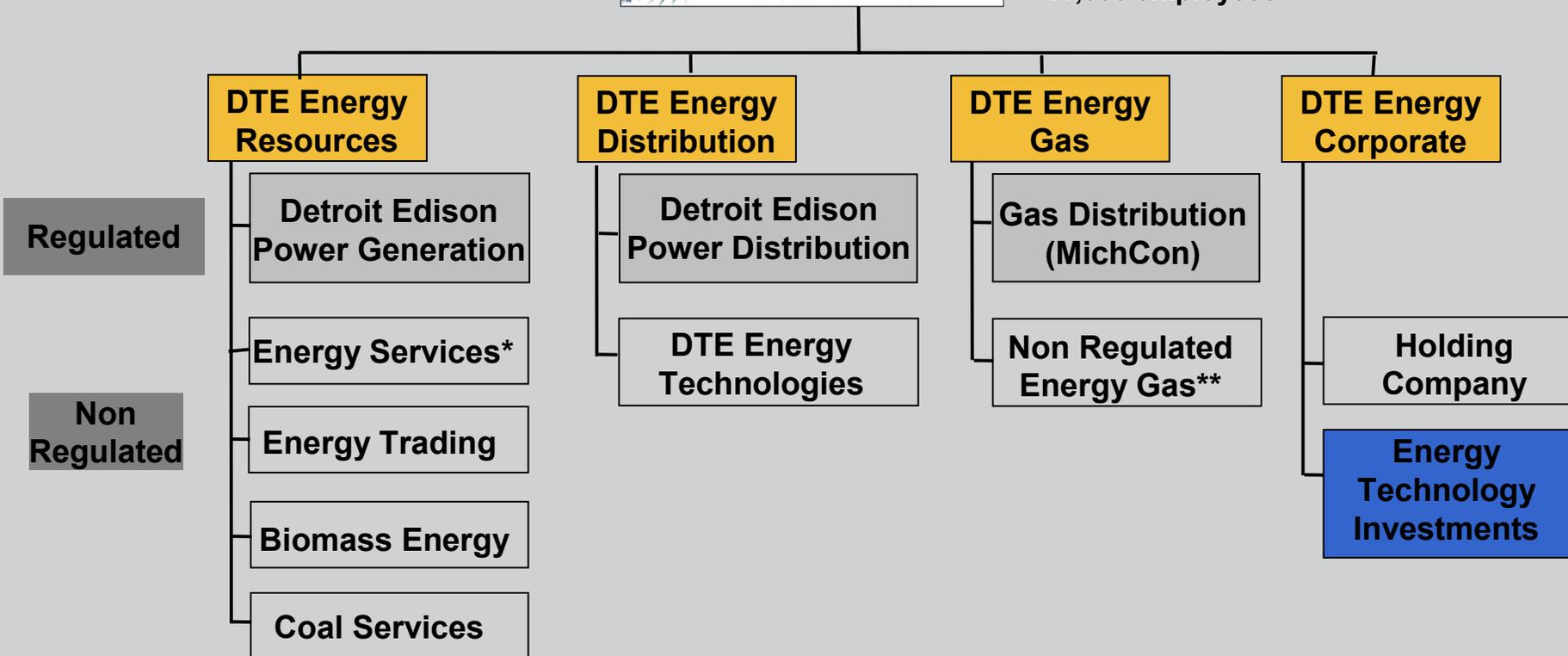




Diversified Energy and Energy Technology Company



- \$ 7 billion in revenues
- \$19 billion in assets
- 11,000 employees



* Energy Services: Coal Based Fuels, Merchant Generation and On-Site Energy Projects

**Non Regulated Energy Gas: Pipelines, Storage & Michigan Gas Production



Detroit Edison & Service Area



Service Area: 7,600 Sq. Miles

Customers: 2.1 million

System Peak Load: 12,132 MW

Annual Sales: 56,000 GWH

37% Commercial

29% Residential

29% Industrial

5% Wholesale & Interconnection

Distribution Substations 662

Distribution Circuits 2,808

1,876 @ 4.8kV

932 @ 13.2kV

Distribution Circuit Miles 38,939

20,184 @ 4.8kV

18,755 @ 13.2kV

Subtransmission 2,664 @ 24 kV

797 @ 41.6kV

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Project Rationale

Given the potential for the commercialization of hydrogen as a replacement energy carrier for fossil fuels, DTE Energy will develop and test a working prototype of a hydrogen-based energy system.

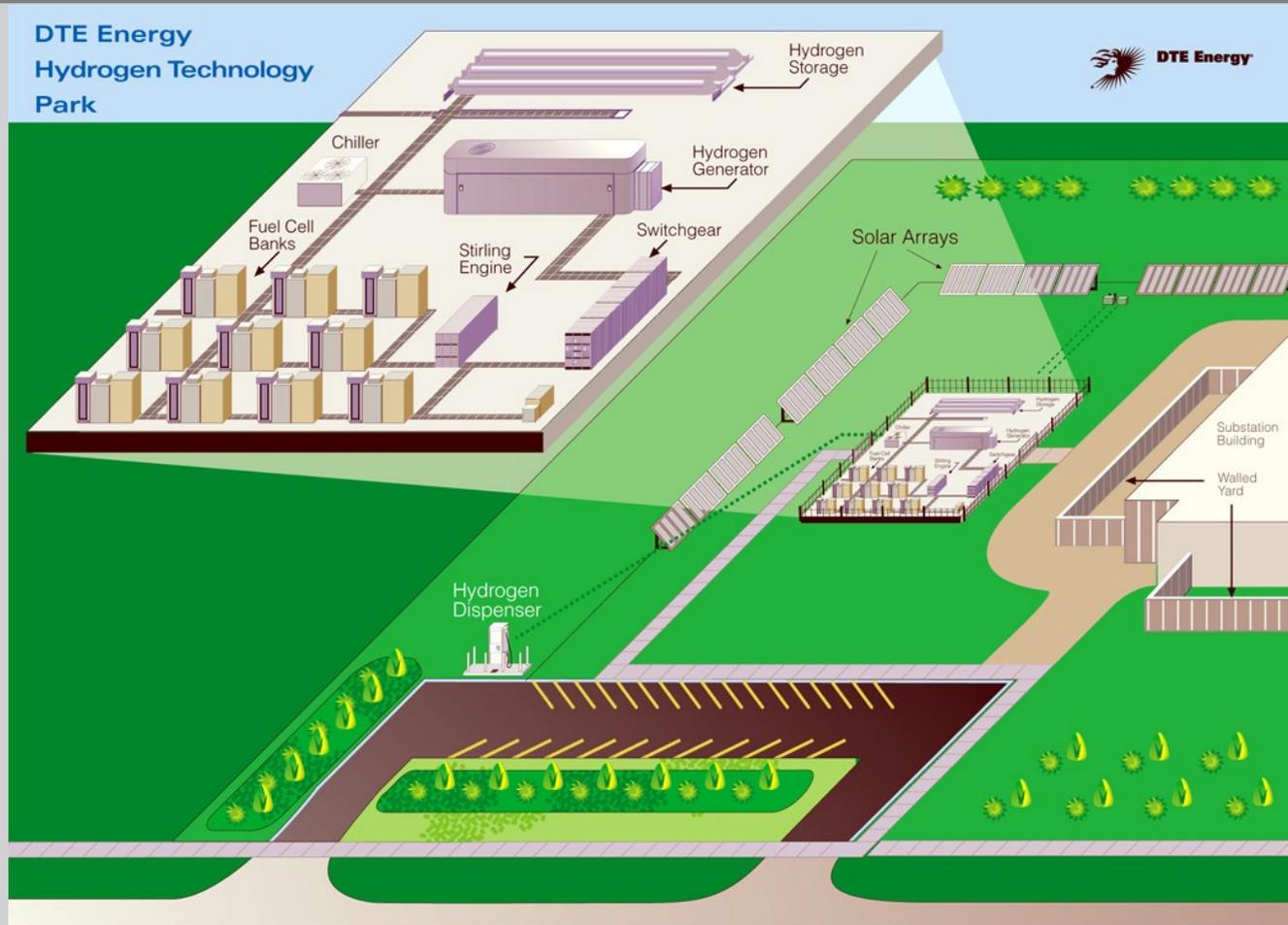
The company believes this demonstration project, which models a complete renewable hydrogen system, from hydrogen generation using biomass/solar power to storage to electrical generation and vehicle fueling, will provide meaningful information into the technical and economic challenges of realizing a hydrogen-based economy.



Project Overview

System Attributes:

- End-to-end hydrogen energy system
- Electrolysis-based hydrogen production
- On-site renewable energy source
- Fuel cell-based power generation
- Vehicle re-fueling
- Remotely operated & controlled



Southfield, MI



Objectives

- **Demonstrate an end-to-end, multi-use hydrogen energy station in order to:**
 - **Test on-site, co-production of hydrogen for stationary fuel cell power and vehicle fueling applications**
 - **Identify the technical and economic drivers of system performance**
 - **Validate component and system technologies**
 - **Develop applications experience in hydrogen energy systems**



Objectives

- **Contribute to development of relevant safety standards and protocols for hydrogen-based power systems.**
- **Evaluate the market opportunities for hydrogen energy systems.**
- **Educate the public on hydrogen-based energy systems.**



Why Electrolysis?

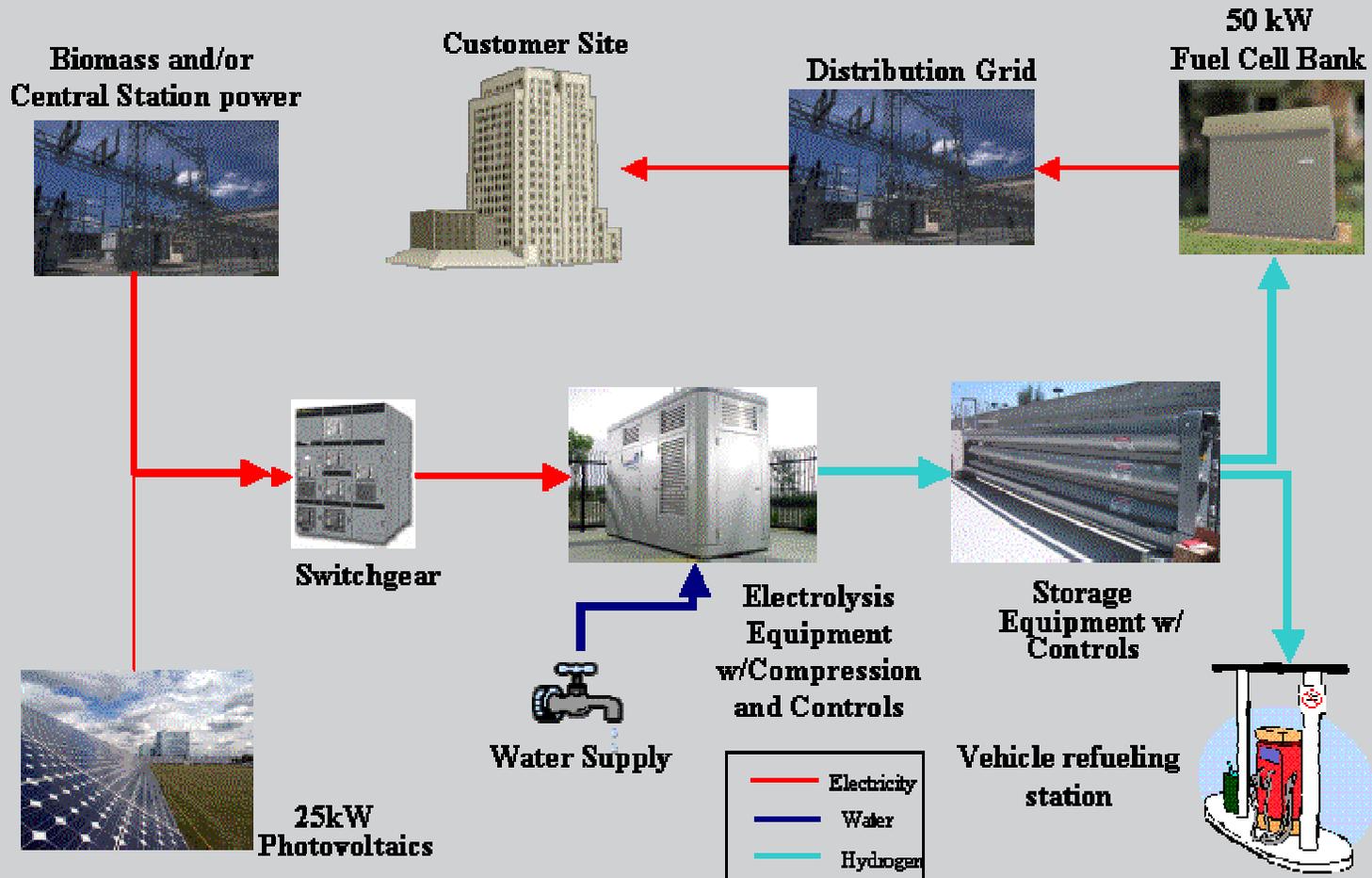
- **Established, time-tested technology**
- **Allows modeling of renewable energy system**
- **Allows analysis of multiple power sources (i.e. solar, wind, gas, coal, nuclear)**
- **Tests peak-shaving application**
- **Leverages available infrastructure (substation)**
- **Minimizes/eliminates fuel purity concerns**



Process Flow Diagram

System Operations Center (SOC) (not shown):

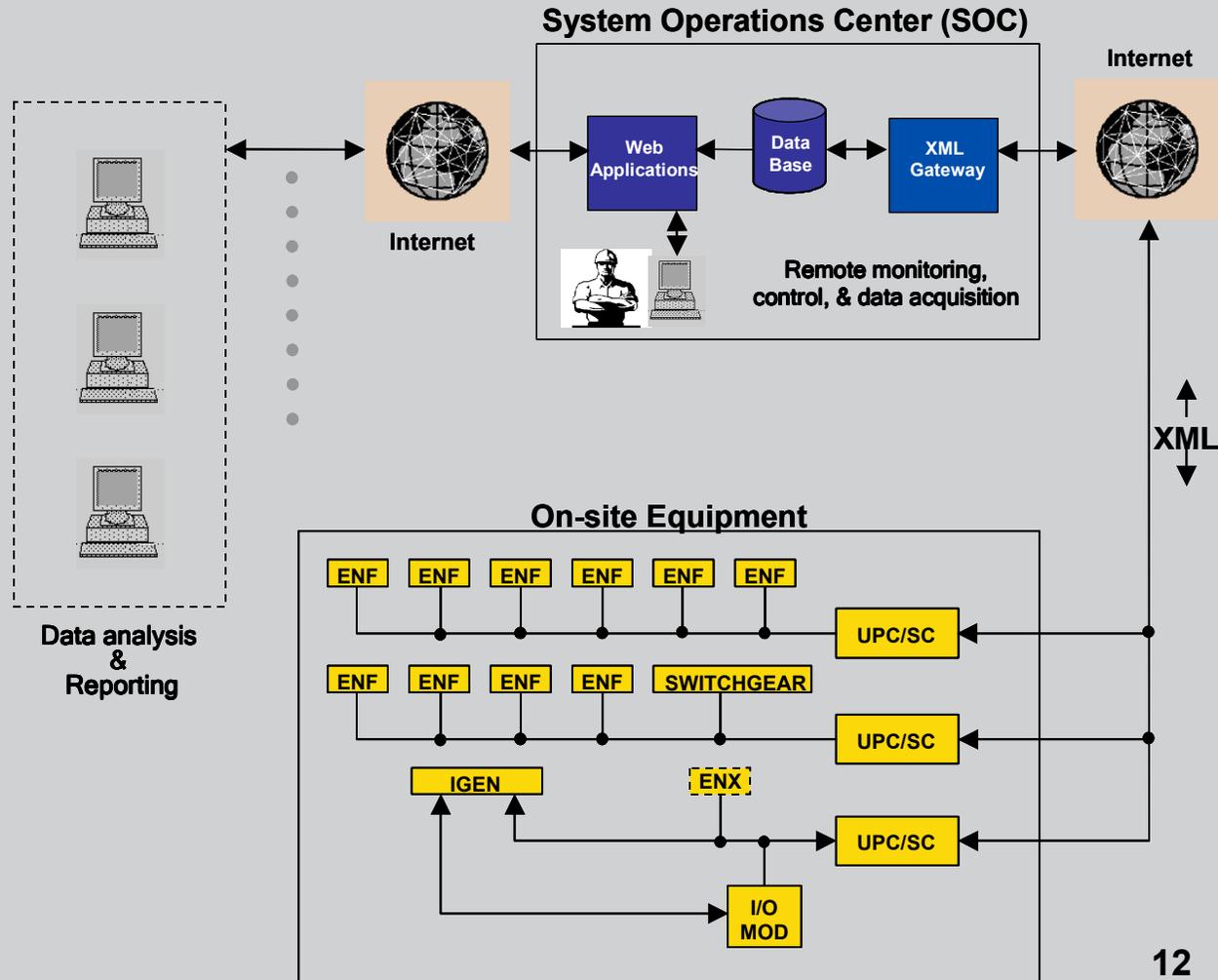
- Provides remote monitoring & control
- Allows for system optimization
- Fully integrated with site instrumentation for automated data collection & storage





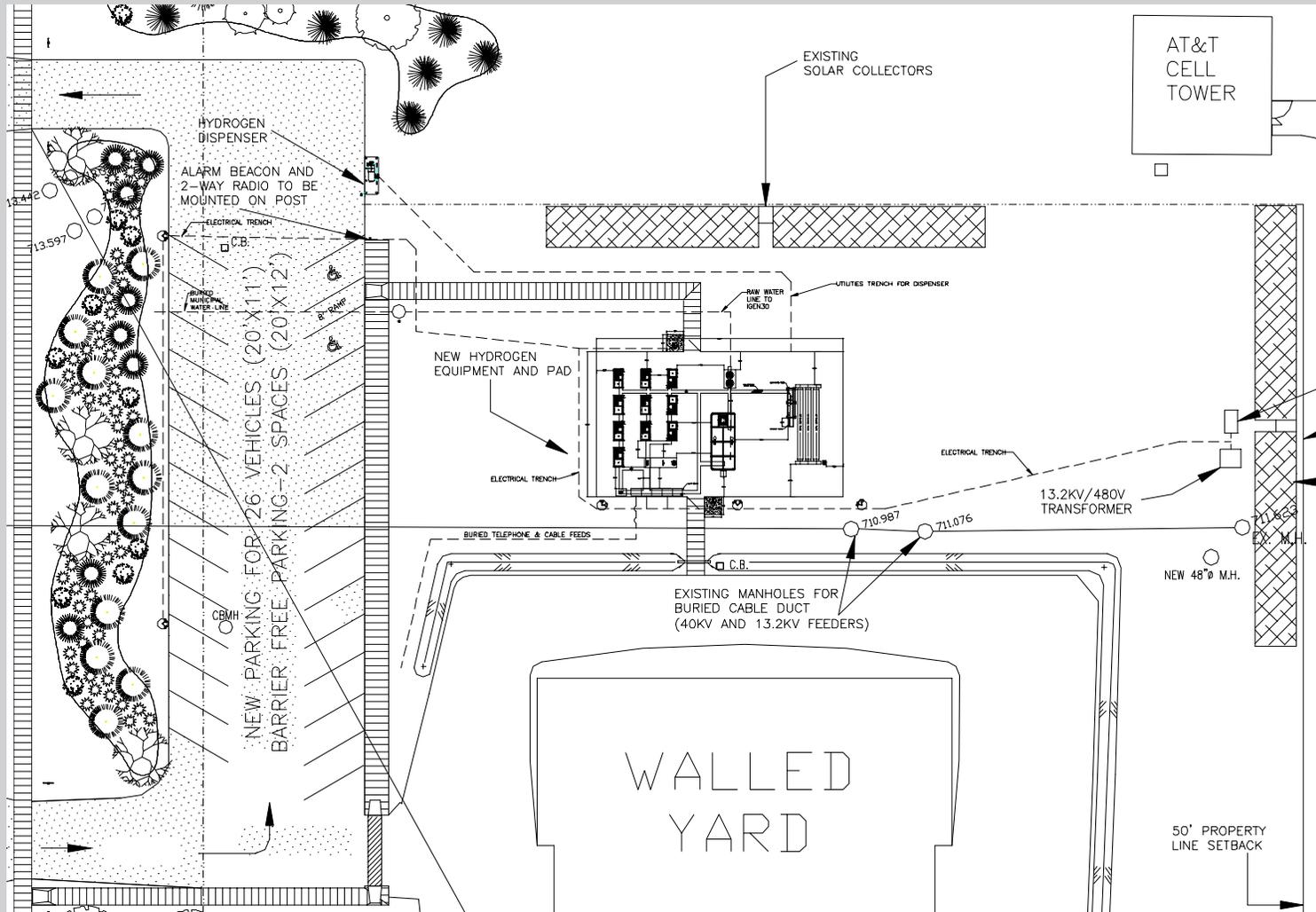
Remote Monitoring & Control System

- System capable of remotely monitoring and recording all relevant system parameters including:
 - Runtimes
 - Power consumed
 - Hydrogen mass produced/consumed
 - Alarms & warnings





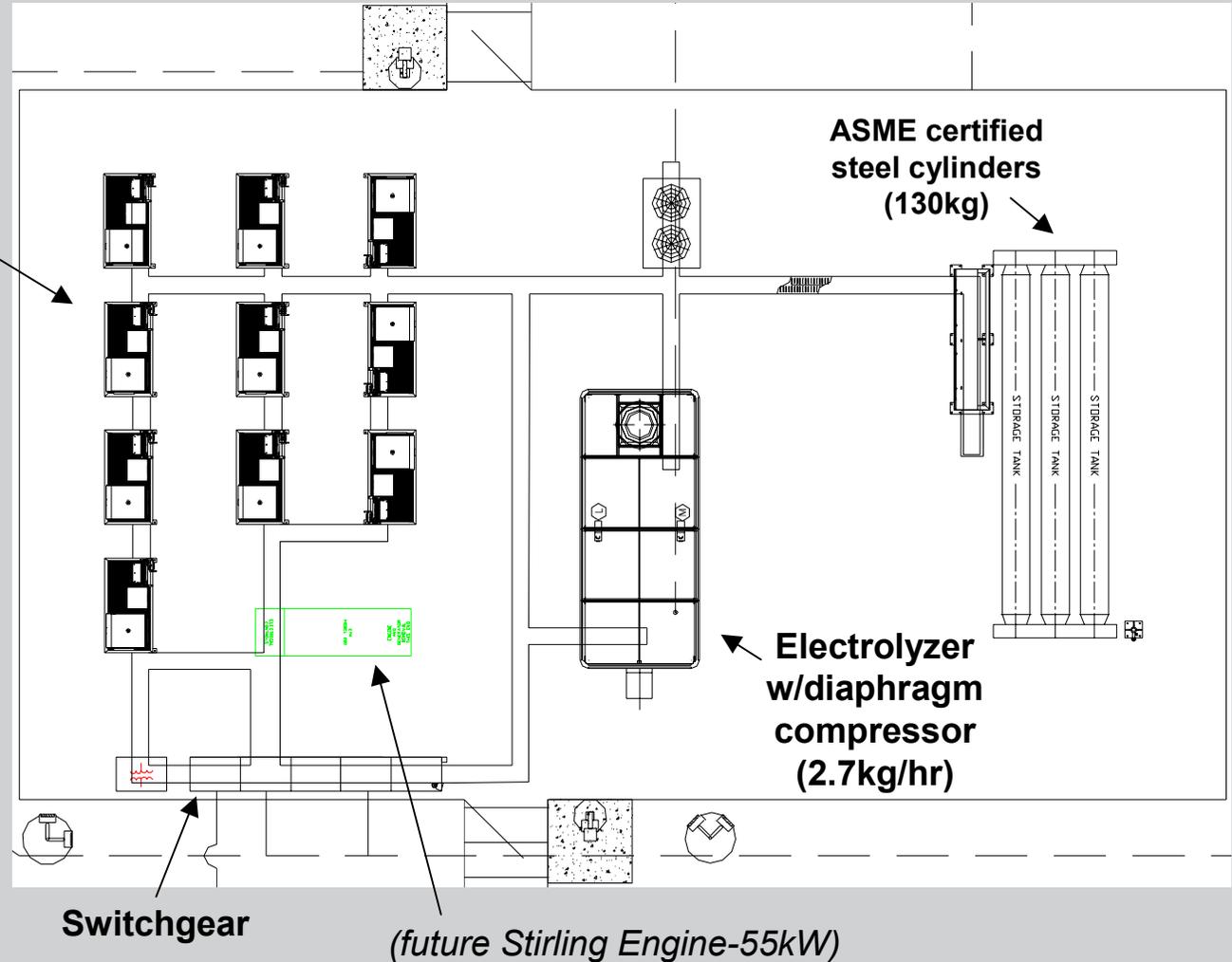
Site Layout





Equipment Pad

- 10 stationary fuel cell subsystems
- Operate in tandem for AC power generation (40-50kW)





Project Site





Southfield Substation





Start of Construction





Fuel Cell System



10 subsystems



Fuel Cell Subsystem



Front



Back



Electrolyzer





Storage





Dispenser



example

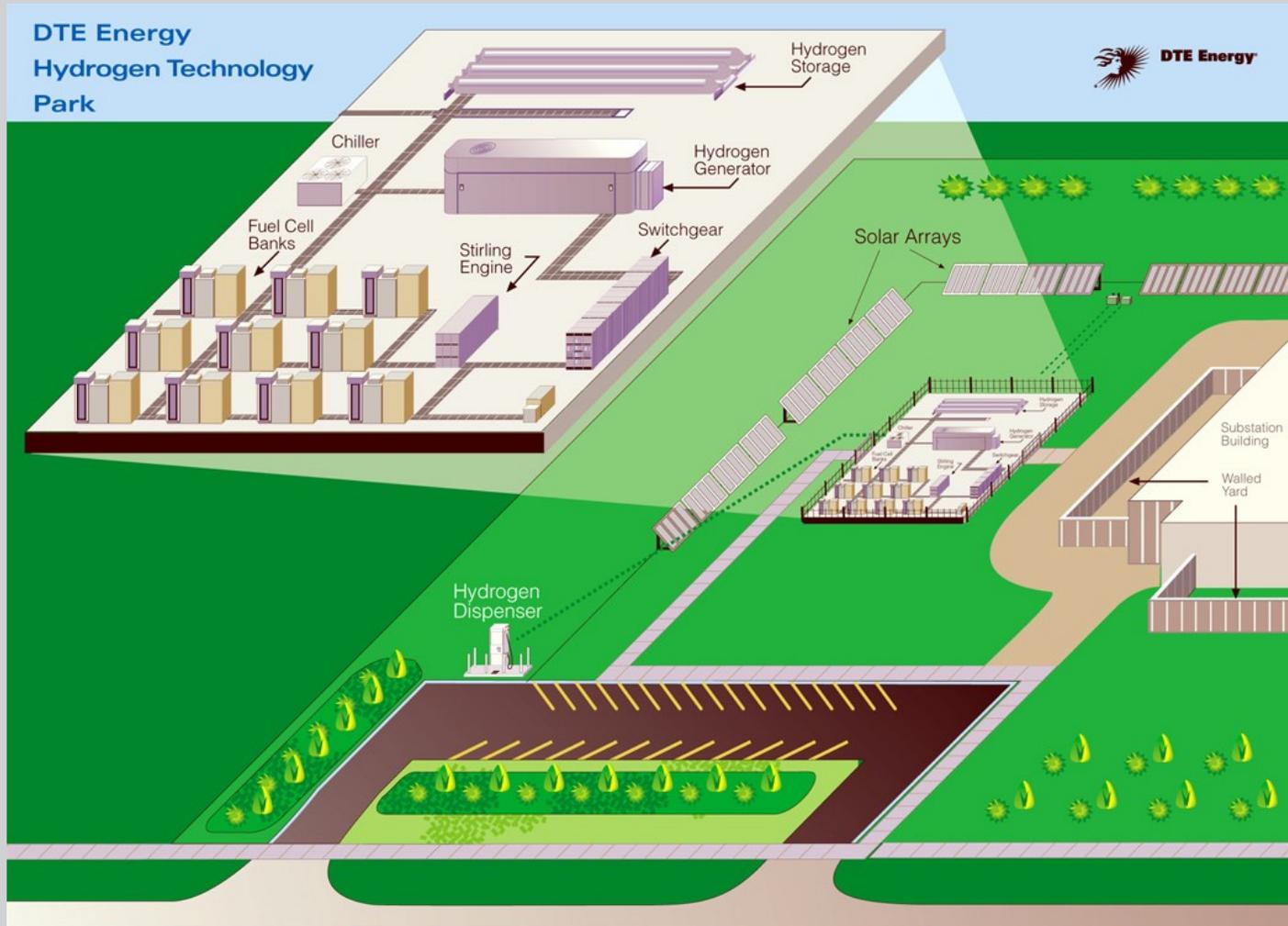


Installed System





Project Review





Approach

Enterprise wide initiative:

- **DTE Energy Ventures –Technology Investments (project sponsor)**
- **DTE Energy Technologies – integrated DG solutions**
- **Detroit Edison – electric utility**
- **MichCon – gas utility**
- **DTE Biomass Energy – non-regulated renewable energy provider**



Interactions & Collaborations

Lawrence Technological University

- Data collection & analysis lead
- Project to serve as ‘working laboratory’ in new alternative energy curriculum

BP

- Infrastructure partner for DOE Hydrogen Fleet Demonstration project
- Providing best practices/lessons learned from EU and other hydrogen refueling installation experiences

DaimlerChrysler

- Vehicle partner for DOE Hydrogen Fleet Demonstration project

BOC

- Collaborator on gas handling, system optimization, & commercial off-take opportunities



DAIMLERCHRYSLER



LAWRENCE
TECHNOLOGICAL
UNIVERSITY




BOC
Delivering solutions globally



Project Timeline

