DTE Hydrogen Power Park

DOE Merit Review

May 19-22, 2003

DTE Energy

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 biomass/solar power to hydrogen generation and storage to electrical generation and vehicle fueling, will provide meaningful information into the technical and economic challenges of realizing a hydrogen-based economy.

Approach

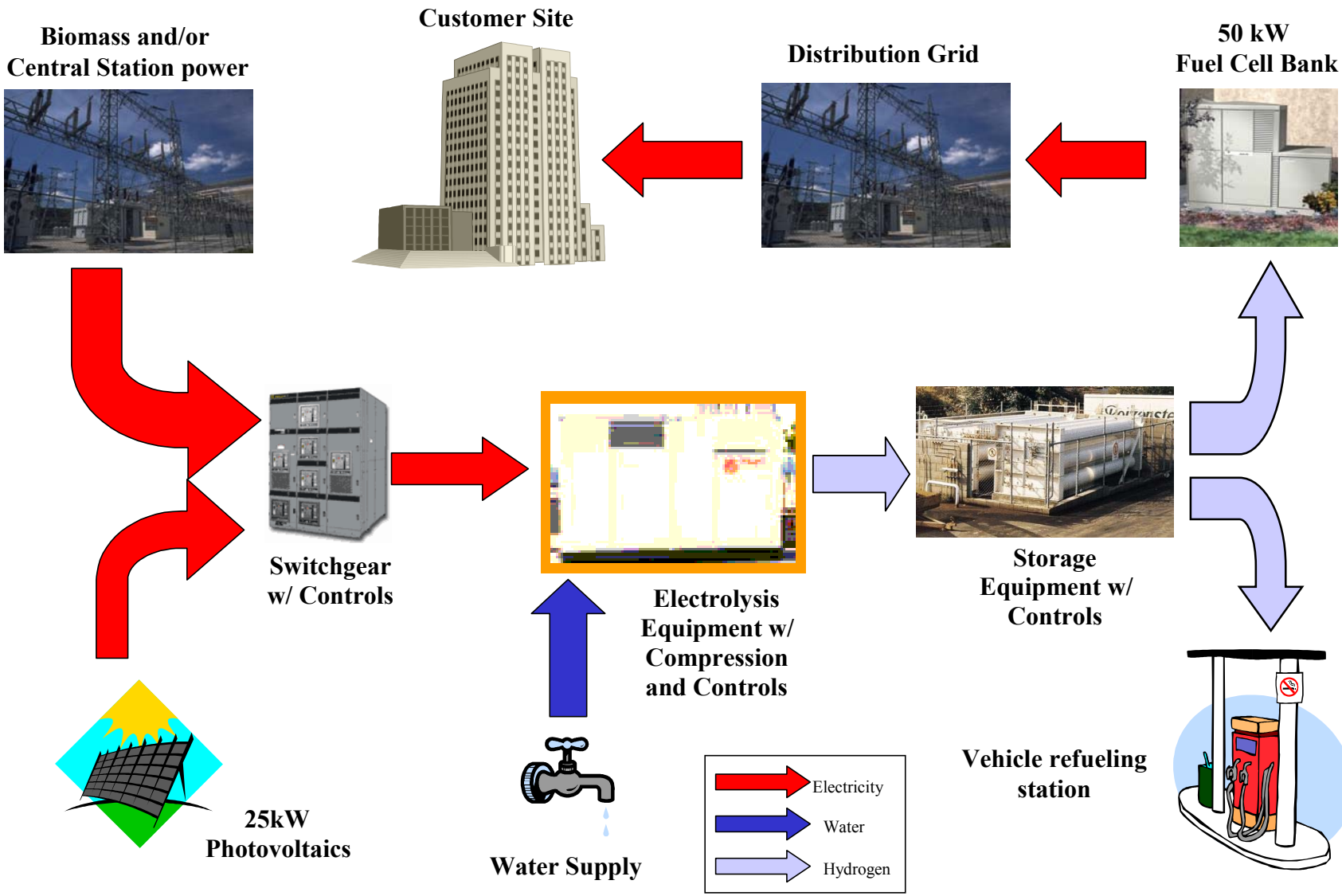
Approach

DTE Energy continues its commitment to integrating clean and renewable technologies into its portfolio.

This project will be the first of its kind to integrate renewable energy into an end-to-end hydrogen energy station concept that utilizes solar & biomass power combined with electrolysis and stationary PEM fuel cell technology to take advantage of low-cost power during off-peak hours to generate hydrogen for on-peak power generation and vehicle fuelling.

Using state-of-the-art hydrogen generation, storage, regeneration and control technologies, the project will evaluate opportunities to reduce overall system cost and maximize performance through optimization of system design & operation, practical approaches to permitting, and integration of power and transportation applications using a common hydrogen infrastructure.

Approach


Biomass and/or
Central Station power
Customer Site
Distribution Grid
50 kW
Fuel Cell Bank
Switchgear
w/ Controls
Electrolysis
Equipment w/
Compression
and Controls
Storage
Equipment w/
Controls
25kW
Photovoltaics
Water Supply
Vehicle refueling
station
Electricity
Water
Hydrogen

Approach

Enterprise wide initiative for DTE Energy, employing a diverse group of business units with relevant and complementary capabilities:

- Edison Development Corporation –Technology Investments
- DTE Energy Technologies – Integrated DG solutions
- Detroit Edison – Electric utility
- Michigan Consolidated Gas – Gas utility
- DTE Biomass Energy – Non-regulated renewable energy provider

Develops, installs, and operates a multi-use compressed gas hydrogen system capable of delivering approximately 500 kWh/day of on-site electricity and vehicle fuel using:

- On-site renewable energy source (demonstrating zero emission pathway)
- ~170 kW electrolyzer (effective for low volume on-site hydrogen requirements)
- Compressed gas storage at +5,000 psi (proven, safe, relatively cost effective)
- 25 – 75 kW fuel cell bank (quiet, clean, efficient)
- Hydrogen vehicle fueling at up to 5,000 psi (state of the art)

Approach

Integrates and installs system on-site

- Simplifies design and construction
- Minimizes footprint
- Reduces cost
- Mitigates execution risk

Uses installed infrastructure base

- Solar panels (from existing Detroit Edison renewable energy program)
- Electrical substation (power supply to / from system)
- Multiple generation sources – solar / grid
- Water supply (potable – purification part of electrolysis system)

Relevance

Technology Validation Aspect

Demonstrates a complete, integrated hydrogen system using representative commercial units in a real-world application under realistic operating scenarios

Can provide data necessary to validate component technical targets

Can provide feedback for efficient Department of Energy R&D program management

Barriers Addressed

Hydrogen Refueling Infrastructure: provide information on early penetration barriers, including high cost of hydrogen production, low availability of hydrogen production systems, and safety issues

Project Objectives	DOE Technical Barrier
Build knowledge and experience in hydrogen infrastructure design and implementation, including safety requirements and applicable codes	Hydrogen Refueling Infrastructure
Determine conditions for system optimization and cost reduction, including design footprint and multi-use energy stations	
Evaluate peak shaving potential, scaling potential, and competitiveness of electrolysis-based hydrogen systems with other on-site production technologies	

Barriers Addressed

Market assessment and economic analysis: based on project learnings and system performance data, assess market potential and develop business plan for commercialization of hydrogen energy systems

Project Objectives	DOE Barrier
Identify the key drivers of economic performance for integrated hydrogen-based power systems, including fuel sources, capital costs, O&M expenses, safety codes & standards, and emissions	Market and economic assessments
Benchmark use of central station power for hydrogen production against DG technologies, including renewable	

Barriers Addressed

Hydrogen from Renewable Resources: provide operational, durability, and efficiency information on renewable/electrolyzer systems in distributed applications, including integration of biomass and solar

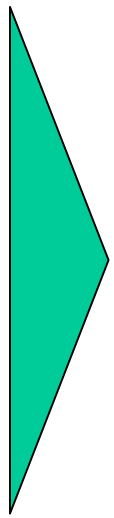
Project Objectives

Develop, install, and operate a compressed gas hydrogen system capable of delivering approximately 500 kWh/day of on-site electricity and fuel for vehicle refueling

Integrate system with on-site renewable (solar) power and carbon-neutral biomass power via the grid

Evaluate operational, durability, and efficiency information of a renewable/electrolyzer system

DOE Technical Barrier

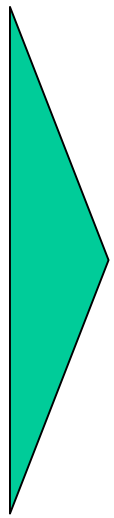


Hydrogen from Renewable Resources

Barriers Addressed

Codes & Standards: contribute real-world information needed to develop codes and standards that will permit deployment of integrated distributed generation and refueling applications in a cost-effective, timely manner

Project Objectives	DOE Technical Barrier
Permit and install electrolytic hydrogen production and storage facility in the State of Michigan	Codes & Standards
Permit and install hydrogen refueling facility in the State of Michigan	
Permit and install hydrogen DG application in the State of Michigan	



Barriers Addressed

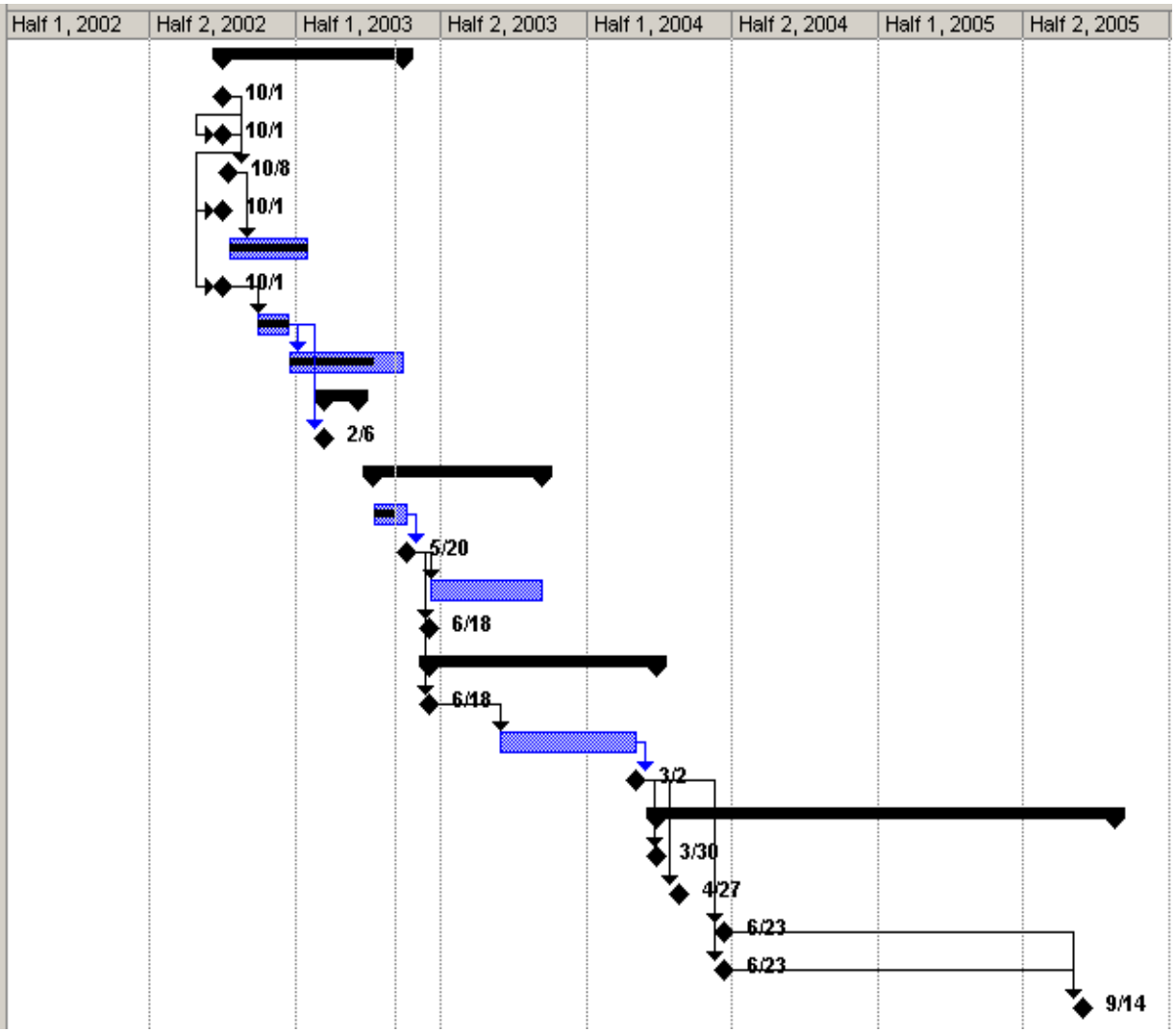
Co-production of hydrogen & electricity: contribute to understanding the economic viability of clean technology systems that co-produce hydrogen fuel and electricity

Project Objectives	DOE Technical Barrier
Identify the characteristics of an economically viable hydrogen-based energy system for peak shaving applications and its potential for use in fuelling applications	Co-production of hydrogen and electricity
Evaluate impact of multi-use energy station design on the economics of hydrogen-based infrastructures	

Timeline

Project Timeline

Task Name
Gate 0
Define project value & goals
Outline conceptual design & schedule
Select key personnel
Perform technology review
Determine need for strategic partnerships
Develop proposed workplan & budget
Identify potential risks [e.g. technical, operational]
Evaluate current safety codes and identify gaps
Gate 1
Select site
Gate 2
Project Kickoff & Startup
Develop design (specs and drawings)
Procure equipment
Finalize budget
Gate 3
Obtain site permits
Construct site
Start up/Commission system
Gate 4
Operate, monitor, maintain the system
Develop educational materials
Develop Technical Report
Assess economics and develop business plan
Issue Final Report (including final educational materials)



Project Timeline

Phase I (First 6 months)

- Select Team
- Establish optimal technologies and sources
- Develop workplan & budget
- Establish codes & standards framework
- Site system

Phase II (months 7-18)

- Design system & obtain permits
- Procure equipment
- Install, commission and operate system
- Develop educational program

Phase III (months 19-36)

- Operate, monitor, and maintain system
- Develop technical report
- Assess economics and develop business plan
- Document and publish project results

Accomplishments

Accomplishments

Phase I (First 6 months)

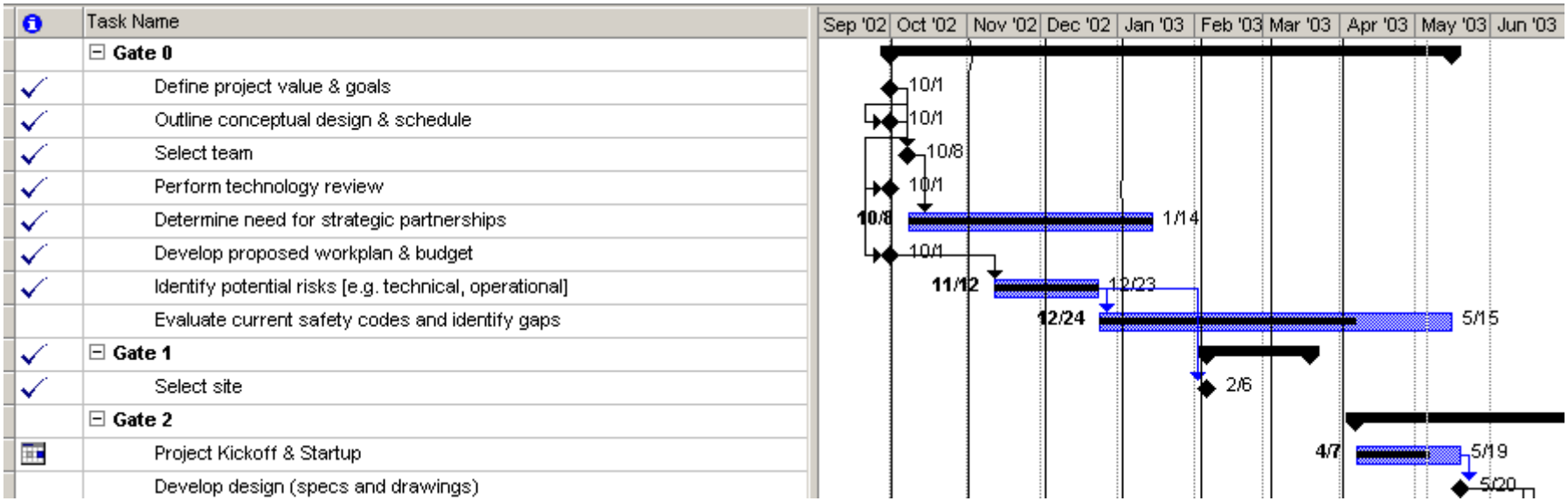
Select Team - **complete**

Establish optimal technologies and sources - **complete**

Develop workplan & budget - **complete**

Establish codes & standards framework - **in progress**

Site system - **complete**



Collaborations

Significant Interactions

Internal

- Edison Development Corp (EDC) – Project Sponsor
- DTE Energy Technologies (DTech) – Project Manager
- Detroit Edison (DeCo) – Site owner & operator
- Michigan Consolidated Gas (MichCon) – NGV expertise
- DTE Biomass Energy – renewable energy supplier

External

- Private Sector
  - Working with third party firms and equipment suppliers to source optimal system designs and technologies
- Government Sector
  - Coordinating efforts with State alternative energy technology development programs to leverage resources and information exchange
- Academic
  - Collaborating with cross-disciplinary university programs to match project opportunities with educational needs

Current Plan

Plan with milestones

Phase II (months 7-18)

[in progress]

Design system & obtain permits

Procure equipment

Install, commission and operate system

Develop educational program

Phase III (months 19-36)

Operate, monitor, and maintain system

Develop technical report

Assess economics and develop business plan

Document and publish project results