DE-FE0031615 Hydrogen to Power (H2P) Kickoff Briefing

Official Title, "A Modular Heat engine for the Direct Conversion of Natural Gas to Hydrogen and Power Using Hydrogen Turbines"

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Agenda

- Background
- Technical Approach
- Project Objectives
- Project Structure
- Project Schedule
- Project Budget
- PMP & Risk Management

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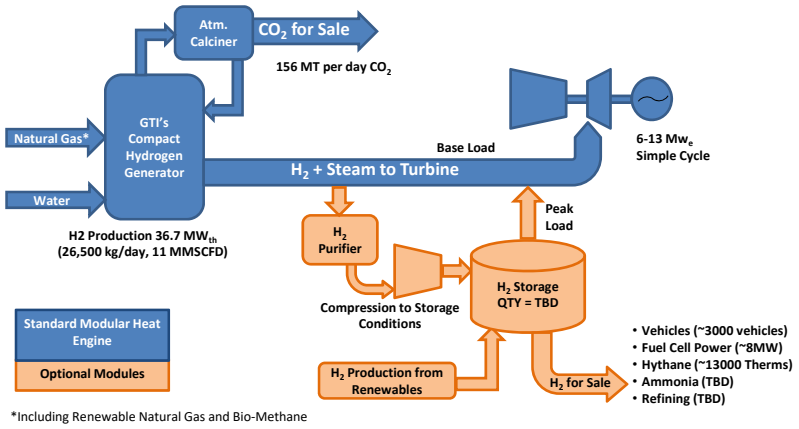
H2P System – Demonstration System Concept



*Including Renewable Natural Gas and Bio-Methane

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CHG Technology Overview

Sorption Enhanced Steam Methane Reforming

$CH_4 + 2H_2O + Heat(a) \rightarrow 4H_2 + CO_2$

$CaO + CO_2 \rightarrow CaCO_3 + Heat(b)$

$CH_4 + 2H_2O + CaO \rightarrow 4H_2 + CaCO_3$

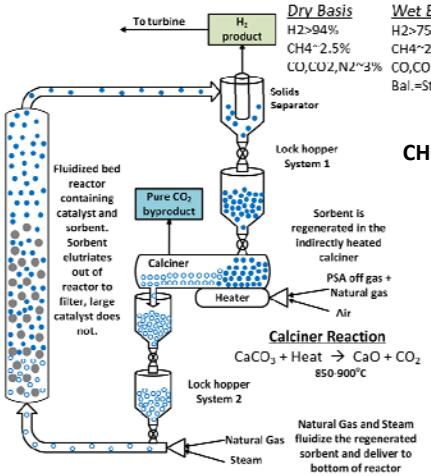
Heat(b) ~ 95% Heat(a)

700°C, 20-35 psig

Catalyst:
Commercially Available
Ni on Alumina
2mm diameter

Sorbent:
Natural Solid Sorbent:
Limestone or Dolomite
<0.2mm diameter

- Catalyst
- Sorbent
- Sorbent with CO_2



H2 Product Composition

	Dry Basis	*Wet Basis*
	H2>94%	H2>75%
	CH4~2.5%	CH4~2%
	CO,CO2,N2~3%	CO,CO2,N2~2.8%
		Bal.=Steam for NOx Control

CHG Operating at 275 Psig

	%Vol-Dry	%Vol-Wet
H2	91.1	63.2
CH4	7.7	5.4
CO	0.7	0.5
CO2	0.4	0.3
N2	0.2	0.1

Calciner Reaction

$CaCO_3 + Heat \rightarrow CaO + CO_2$

850-900°C

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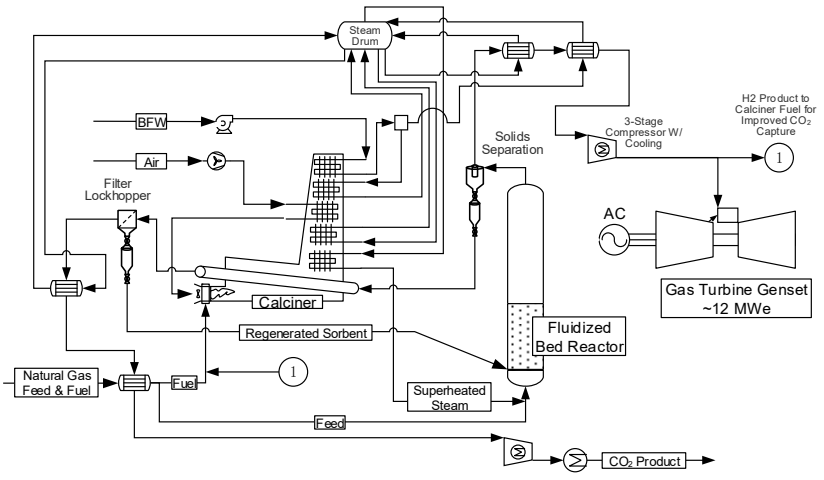
Demonstration Scale Schematic



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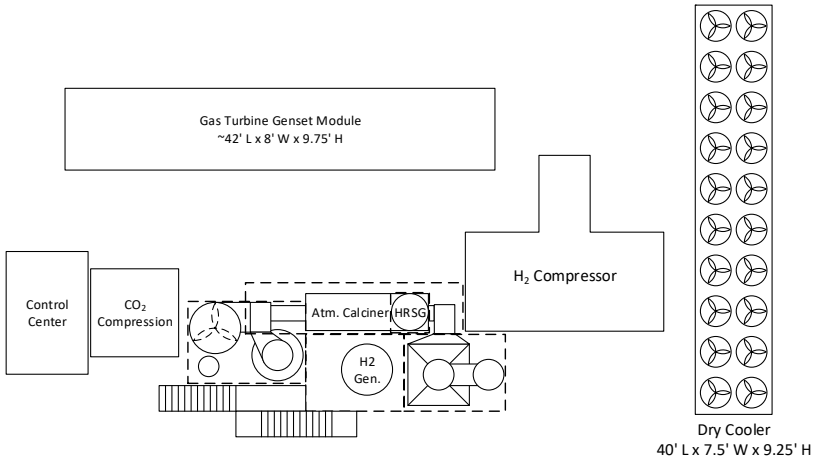
Modular System Concept



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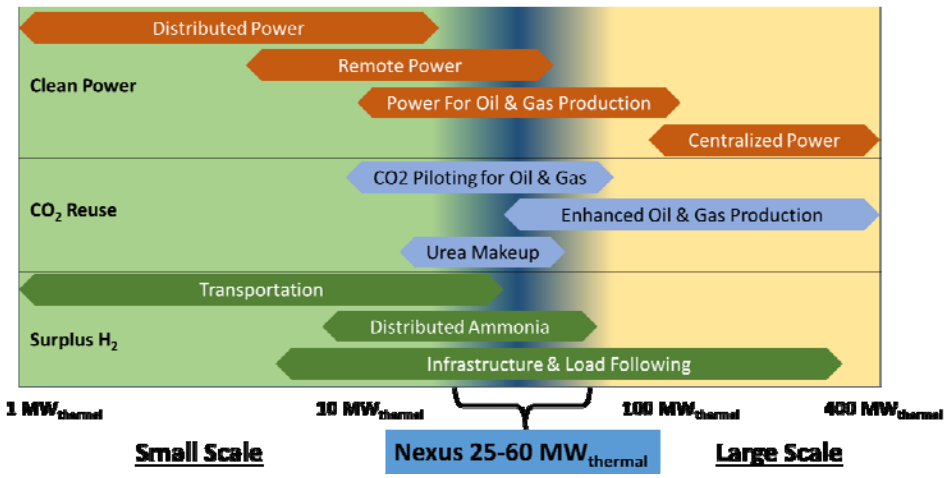
Markets



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Technical Approach

Vision: Design, build and operate a modular heat engine system for efficient co-production of clean power, CO_2 and H_2

Phase I – System Definition

Create Team: End-Users
OEM's
NG Distributors
Industrial Gas Co's

Define System: Requirements
Architecture
Modularity

Assess: Technology Readiness
Technology Gaps
Techno-Economics (Lvl 5)
Phase II Test Planning

18 Months

Phase II – Preliminary Design

Perform:
Tech. Gap Reduction Testing
- Components & System

Assess:
Updated Techno-Economics
Technical Maturation Plan

Design:
System Design
Front-End Engr. Design
Plant Cost Estimate (Level 4)

Up to 48 Months

System Concept Demonstrator

Planning:
Site planning
End-user agreements
Funding Sources

Engineering & Construction:
Detailed Design
Site Engineering
Plant Installation

Operations:
Start-up & Commissioning
1 year+ operations

36+ Months

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Phase I - Objectives

1. Define the system and component parameters via interactions with technology development and end-user organizations, thus creating a viable system and team
2. Perform detailed thermodynamic cycle and performance analysis of the system
3. Optimize the size(s) and overall specifications for the key subsystems and components
4. Identify technology gaps and recommend a test plan to close the gaps
5. Establish performance baseline for an integrated system along with levelized costs
6. Design a modular system concept to take advantage of factory-built modules

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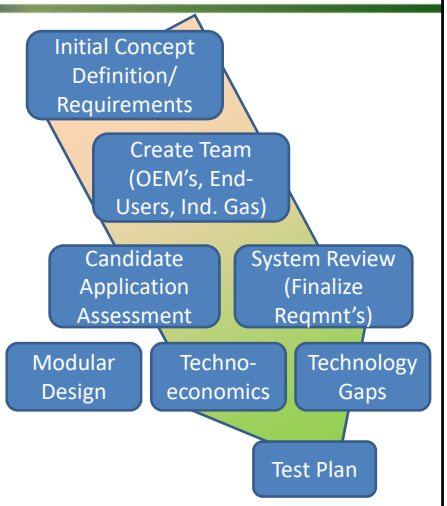
Project Tasks

1. Project Management and Planning
2. Concept Development
   - 2.1 Process Simulation
   - 2.2 Define Basic Requirement
   - 2.3 Team Survey for System Architecture
   - 2.4 System Optimization
   - 2.5 Finalize Baseline requirements
   - 2.6 Modular Design
3. Technology Maturation
   - 3.1 Technology Maturation Plan
   - 3.2 Phase II Test Planning
4. Establishing a performance baseline for an integrated system along with levelized costs
   - 4.1 Identify Candidate Applications
   - 4.2 Evaluate Applications
   - 4.3 Application Selection



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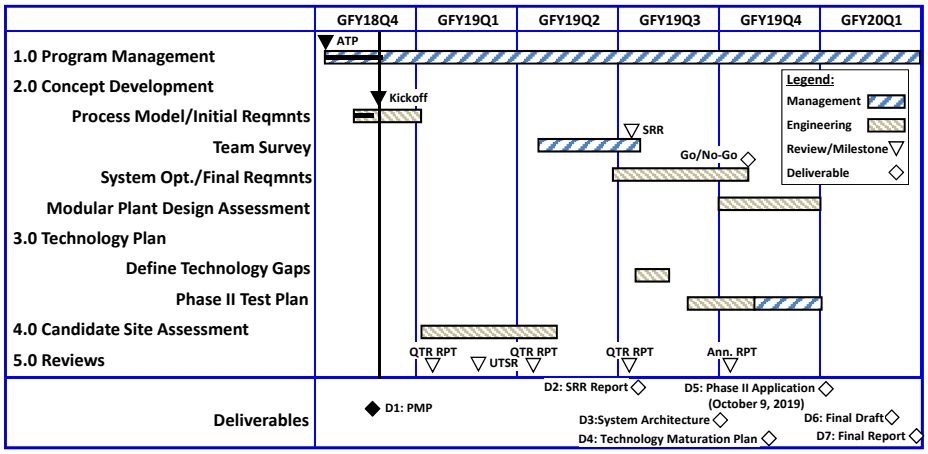
Project Schedule



Project Budget

Project Funding Profile	Budget Period 1 07/01/2018-10/31/2019		Total Project	
	Government Share	Cost Share	Government Share	Cost Share
GTI (Applicant)	$ 500,000	$ 65,000	**$ 500,000**	$ 65,000
Pacific Gas & Electric (3rd Party Cash C/S)	$ 0	$ 60,000	**$ 0**	$ 60,000
Total	$ 500,000	$ 125,000	**$ 500,000**	$ 125,000
Cost Share	80%	20%	80%	**20%**

Project Costing Profile (By Month)	**Budget Period 1 - 07/01/2018 - 12/31/2019**								
	Jul-18	**Aug-18**	**Sep-18**	**Oct-18**	**Nov-18**	**Dec-18**	**Jan-19**	**Feb-19**	**Mar-19**
Federal Share	$49,654	$12,064	$48,901	$50,942	$38,794	$8,009	$11,327	$3,054	$30,905
Non-Federal Share	$0	$0	$0	$0	$0	$0	$21,667	$21,666	$21,667
Total Planned	$49,654	$12,064	$48,901	$50,942	$38,794	$8,009	$32,994	$24,720	$52,572
	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
Federal Share	$21,915	$28,426	$32,988	$38,120	$30,180	$41,782	$3,177	$25,170	$24,592
Non-Federal Share	$0	$0	$0	$20,000	$20,000	$20,000	$0	$0	$0
Total Planned	$21,915	$28,426	$32,988	$58,120	$50,180	$61,782	$3,177	$25,170	$24,592

Management Plan

- Developed an Earned Value system to monitor cost and schedule performance of the project
- Performed a risk assessment for Technical, Resource, and Management
  - 5 Technical risks were identified, all risks were assessed as low, except:
    - Inability to identify a candidate application for the vision demonstration
  - 2 Resource risks were identified, both were low
  - 4 Management risks were identified, all risks were assessed as low, except:
    - Schedule delays in gathering the team together (mainly end-user/site owners)

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Thank You!

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