Hawaii Hydrogen Power Park

"A Real World Laboratory"

Mitch Ewan

Hydrogen Systems Program Manager

Hawaii Natural Energy Institute

Hydrogen “Power Parks”

- U.S. DOE Vision – Transition to Hydrogen economy will begin with small-scale Distributed Generation systems fuelled by Hydrogen
- These systems will also have the capability to dispense H2 for H2-fueled vehicles
- DOE has named these H2 DG and transportation fuelling systems “Hydrogen Power Parks”

Hawaii H2 Power Park

- October 2002 State of Hawaii (DBEDT) awarded US DOE contract to develop a Hawaii Hydrogen Power Park.
- One of 3 Hydrogen Power Parks
  - Hawaii
  - Michigan (DTI of Detroit)
  - Arizona (APS)
- DBEDT contracted HNEI to implement the project.

Hawaii Natural Energy Institute

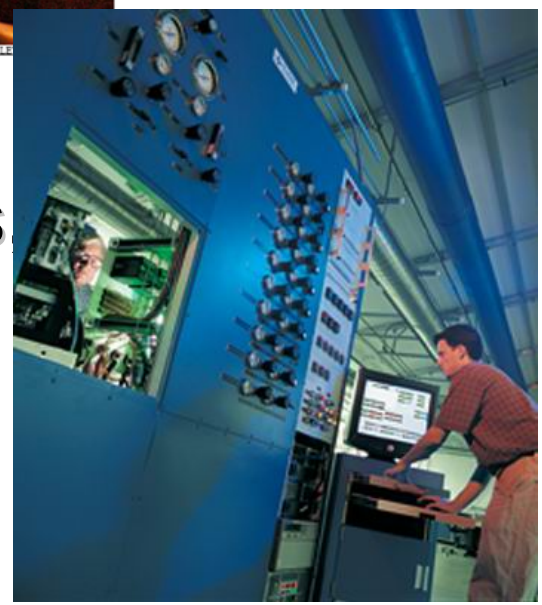
Mandate: Assist state in developing Hawaii's renewable energy resources.

- Established by the Hawaii Legislature in 1974.
- Research unit of the University of Hawaii
- Named U.S. DOE Center of Excellence for Hydrogen Research and Education in 1996
- Twenty (20) Years of Building a "World-Class" Hydrogen Program

Hawaii Natural Energy Institute

Current research

- Hydrogen and fuel cells,
- Sea-bed methane hydrates,
- High value products from biomass,
- Photovoltaics
- Biotechnology



Hawaii Power Park Objectives

- Stimulate hydrogen technology development in Hawaii
- Educate government officials and public about hydrogen technologies
- Provide infrastructure to attract additional R&D to Hawaii
- Identify barriers and solutions to codes and standards requirements

Hydrogen Power Park Partners

DBEDT
STATE OF HAWAII
Principal Investigator

HNEI
Hawai'i Natural Energy Institute
University of Hawai'i at Mānoa
Implementing Partner

City and County of Honolulu

US DOE

POWER PARK

SENTECH, INC.

Hawaiian Electric Company, Inc.

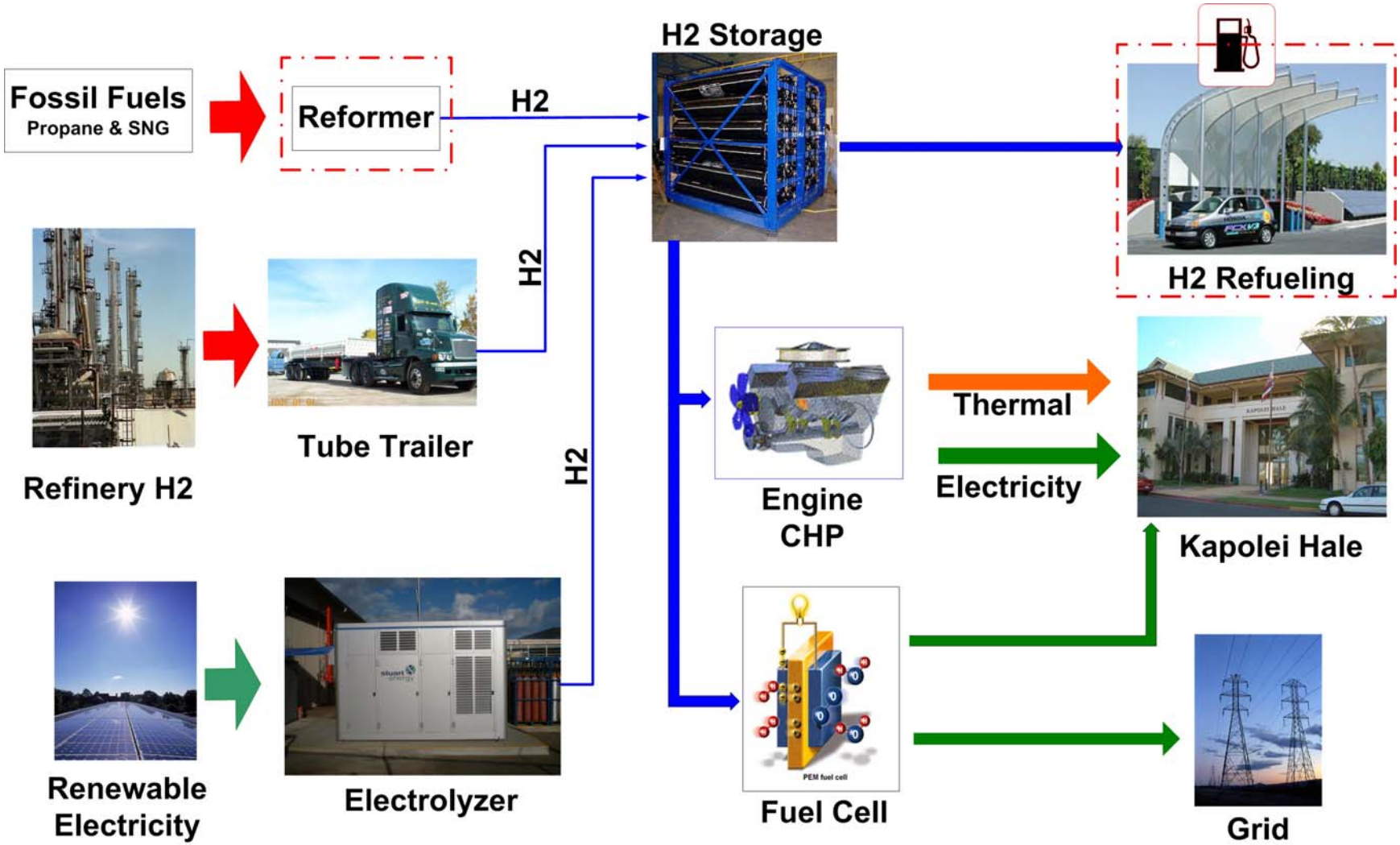
THE GAS COMPANY

stuartenergy

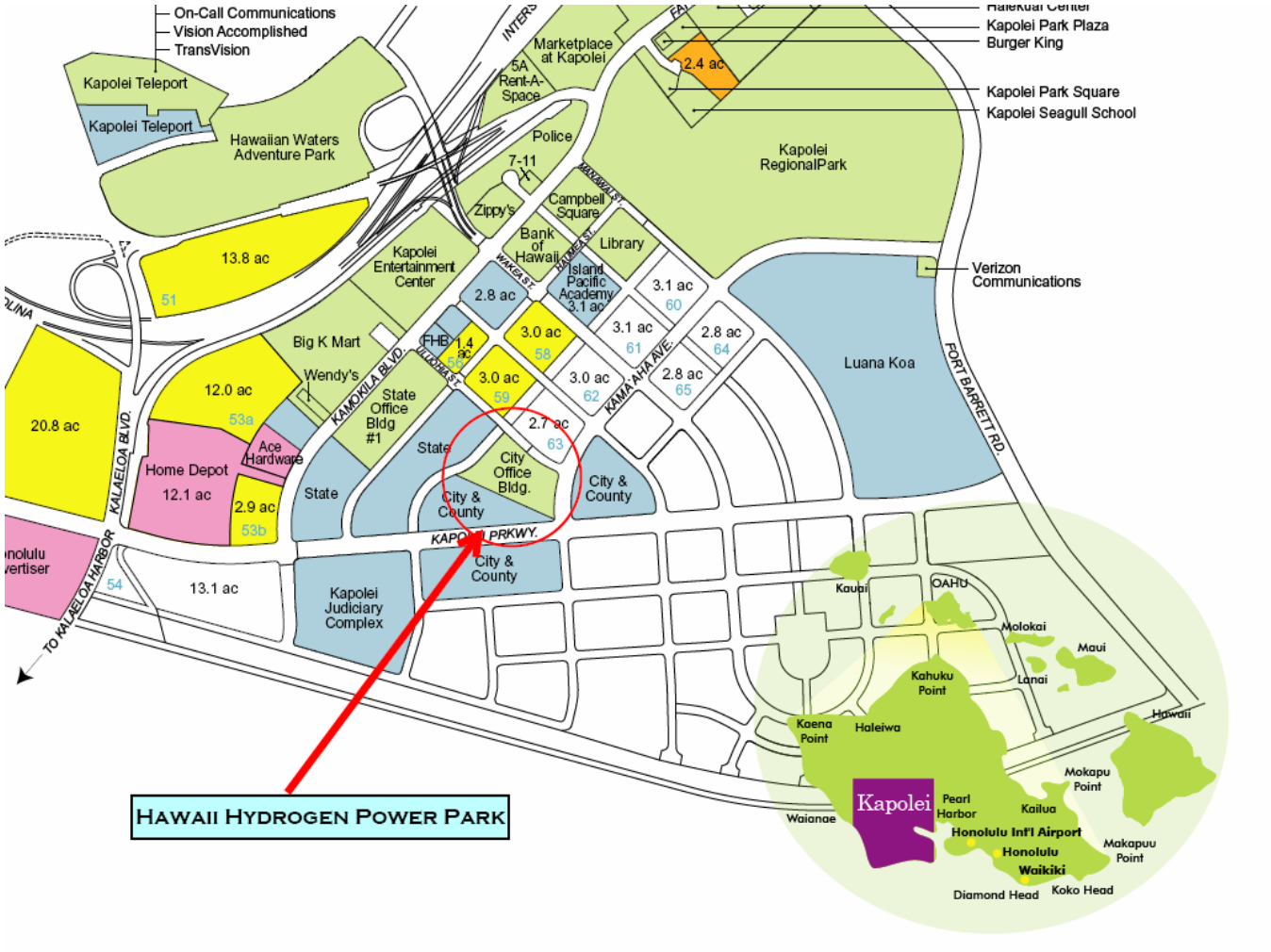
Features of Hawaii Hydrogen Power Park

- Internal combustion engine providing heat & power to building (CHP)
- Low & high-pressure hydrogen storage systems
- Building-connected PEM fuel cells
- Renewable energy from parking lot PV solar array
- Electrolysis for hydrogen production
- Hydrogen vehicle refueling kiosk

Conceptual Design



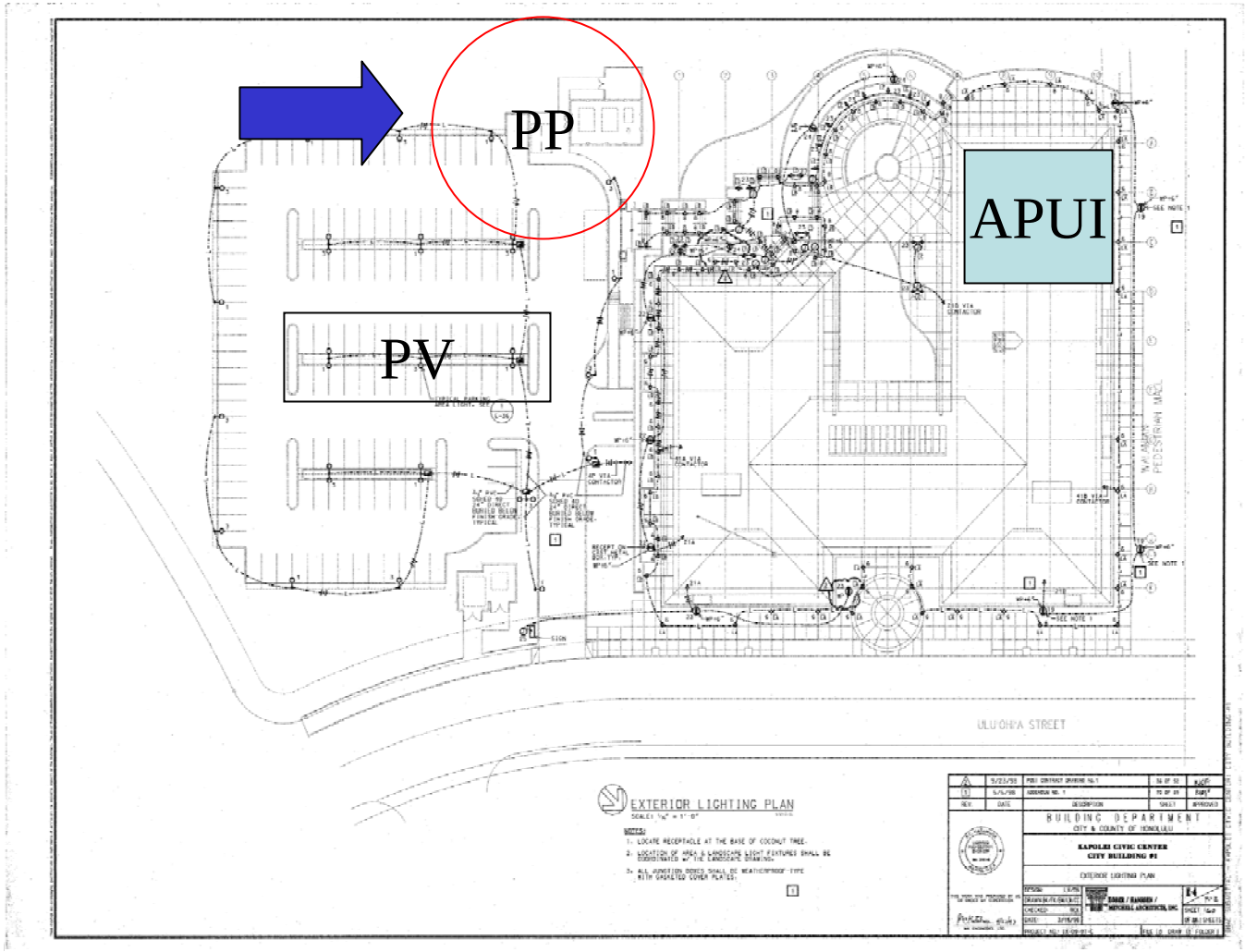
Location – Kapolei



Kapolei Hale

Kapolei Hale

Site Plan


PP
PV
APUI
ULUOHIA STREET
EXTERIOR LIGHTING PLAN
BUILDING DEPARTMENT
CITY & COUNTY OF HONOLULU
KAPOLEI CIVIC CENTER
CITY BUILDING #1
EXTERIOR LIGHTING PLAN

Kapolei Hale

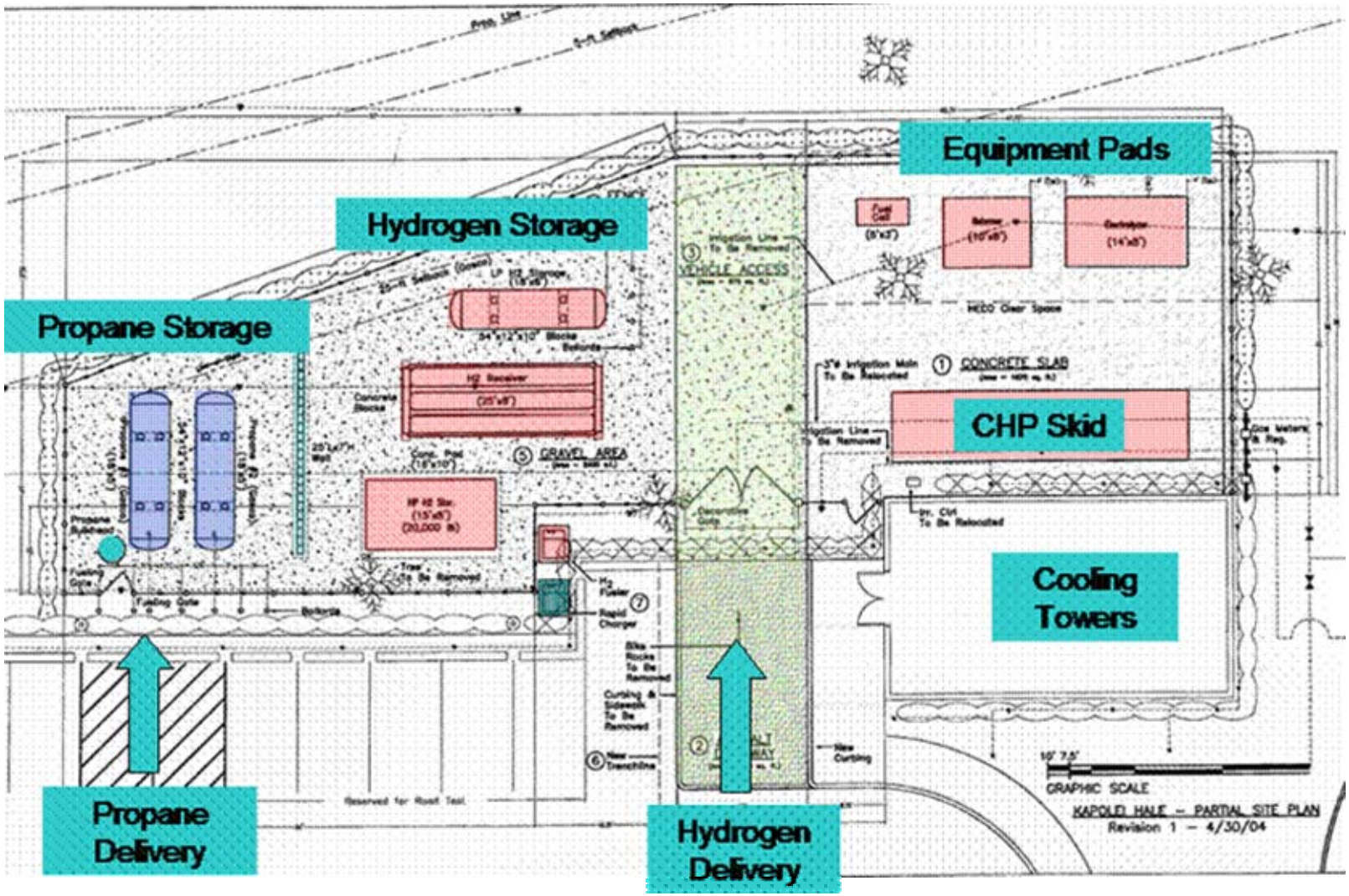
Kapolei Hale

PV Covered Parking Lot

Solar Power

H_2

Design


Equipment Pads
Hydrogen Storage
Propane Storage
CHP Skid
Cooling Towers
Propane Delivery
Hydrogen Delivery
KAPOLEI HALE – PARTIAL SITE PLAN
Revision 1 – 4/30/04

Electrolyzer

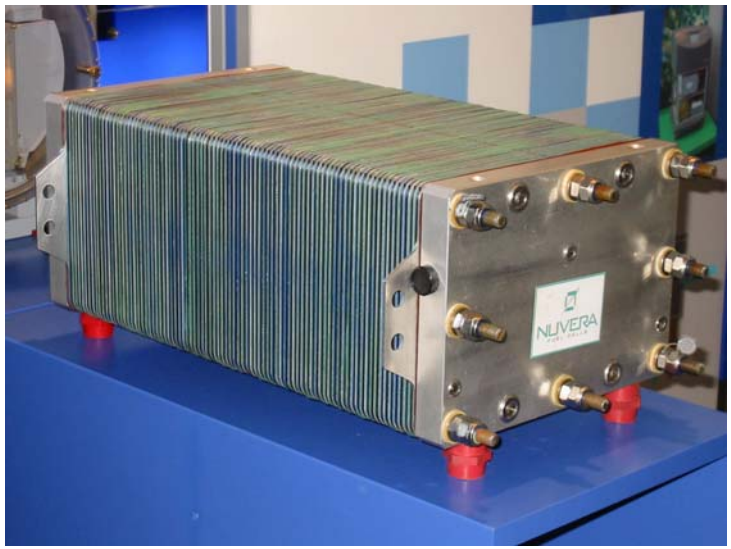
High Pressure Hydrogen Storage

Low Pressure Hydrogen Storage

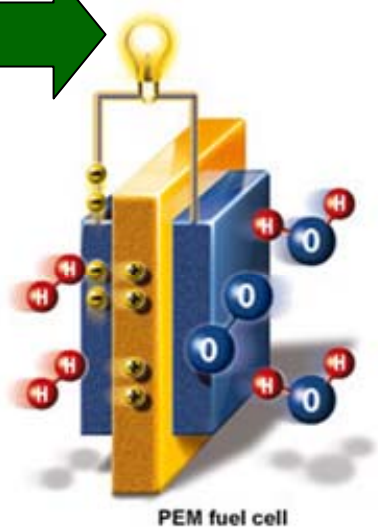
Fuel Cell Energy Conversion

H_2

O_2



Power

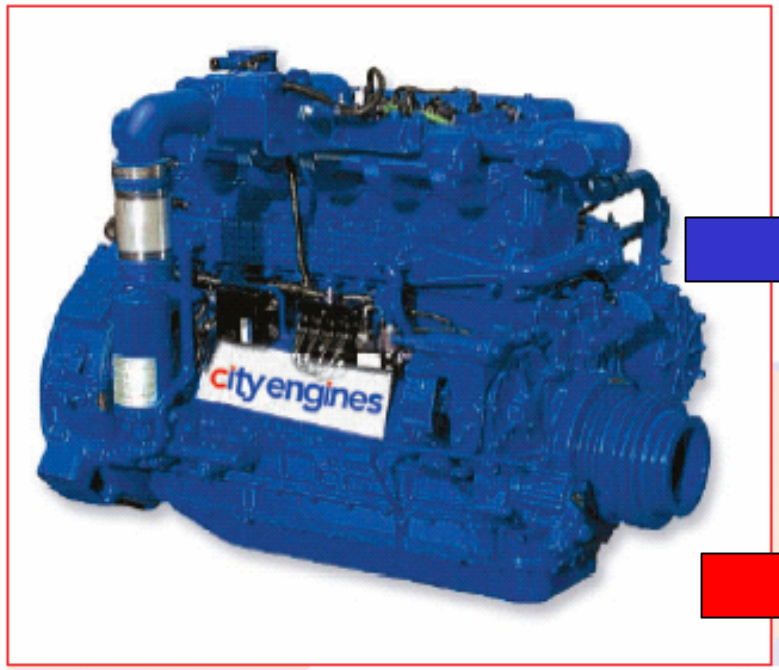


Hot Water

Engine Energy Conversion

H_2

Propane



Power

Heat

Combined Heat & Power

Combined Heat & Power (CHP)

- Extract up to 90% of energy content of fuel
  - 45% heat
  - 45% electrical
    - Hot Water
    - Air Conditioning
      - Absorption Chillers

Energy Conversion Selection

- Fuel Cells have remained expensive
  - ~$3,000 -$5,000 per kW
  - 150 kW system ~ $500,000 - $750,000 (if you can purchase one)
- Engines much cheaper.
  - $50 - $100 per kW
  - H2 fueled engine a logical pathway to building H2 infrastructure
  - Transition to pure H2 engines and fuel cells

CHP System Supply

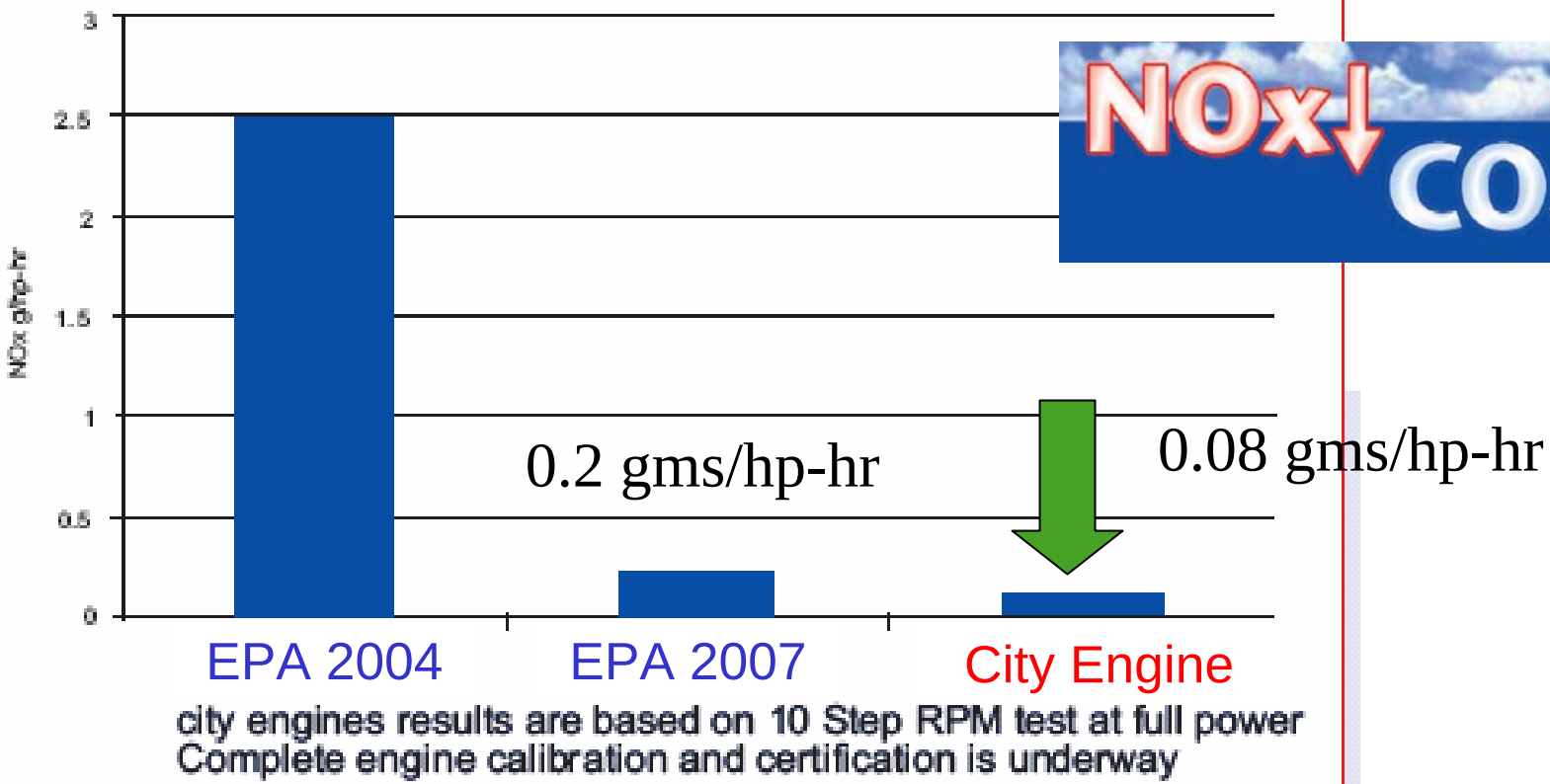
- Hess Microgen to supply complete CHP system.
- Skid Mounted
- Daewoo 11 liter, spark ignition engine
- Marathon 480V, 3-phase, 250kW generator
- 50-ton absorption chiller

Engine Modifications

- Modified for 30% hydrogen-propane blend by Collier Technologies
- "City Engine"
- Similar engine to be used for metropolitan buses

Engine Emissions with H2 Blend

EPA Standards vs City Engine Results



city engines results are based on 10 Step RPM test at full power
Complete engine calibration and certification is underway

Data Analysis

- Effect of H2/Propane Mixture on CHP performance
  - Engineering Analysis
  - Economic Analysis

Speed Bumps

- Legal Agreements
  - Risk management & Indemnification issues
  - Educational Opportunities
  - Some self-inflicted
- Regulatory
  - CHP a docket item for the PUC
- Funding
  - The usual challenges

Economic Development

First Class Facility for Ongoing Program Development

Project Sustainability

- A “Real World” project site
- Excellent supporting infrastructure
- Supportive leadership & policies
- Attracts new Technologies and Projects

A True Team Effort

- Many organizations and people have contributed:
  - US DOE
  - State of Hawaii - DBEDT
  - City & County of Honolulu
  - Our industrial Partners
    - HECO
    - GasCo
    - Stuart Energy

When Oil Runs Out