Achieving Climate Neutrality through Energy Conservation and Renewable Energy

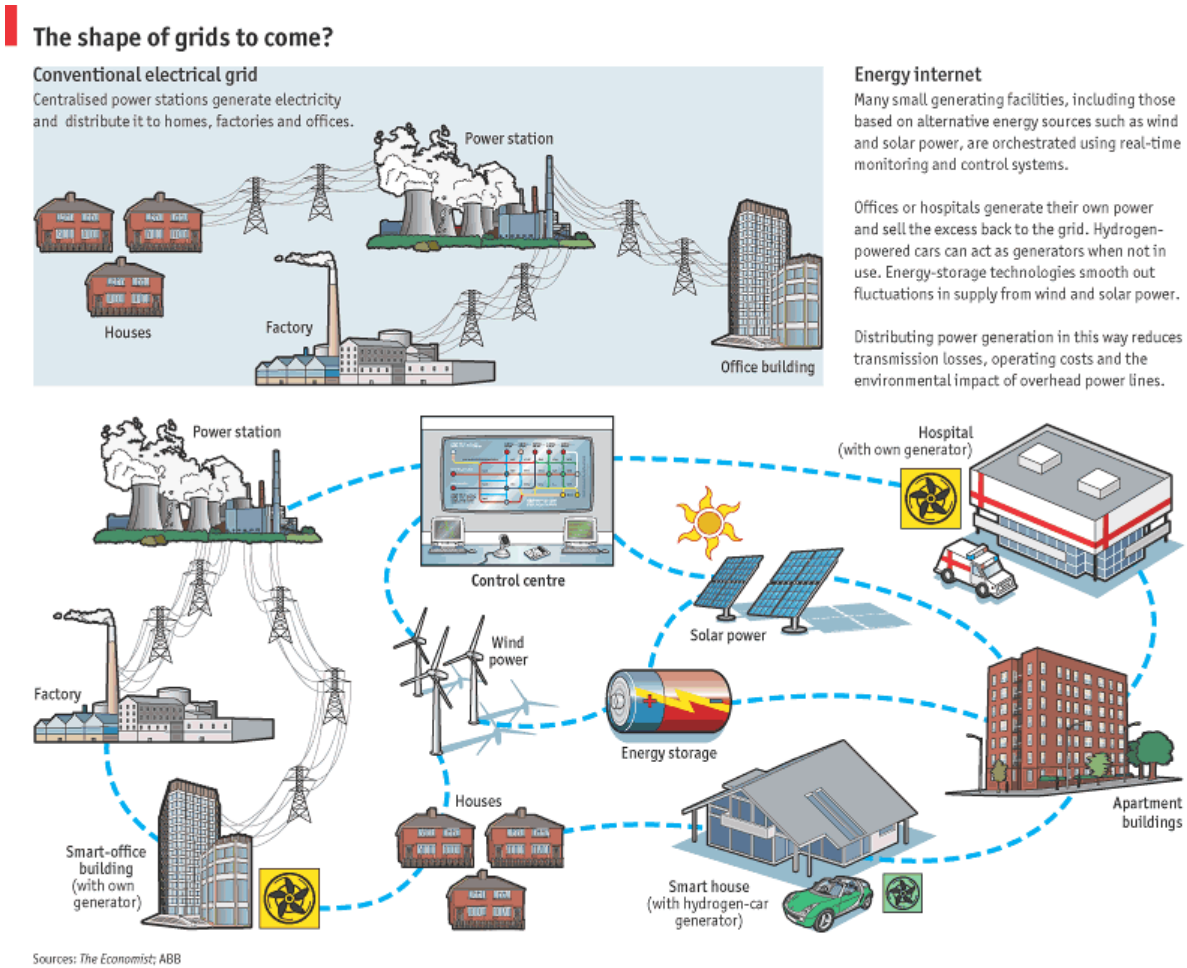
Community College Conference on Sustainability

Larry Eisenberg

Executive Director, Facilities Planning and Development

April 2008

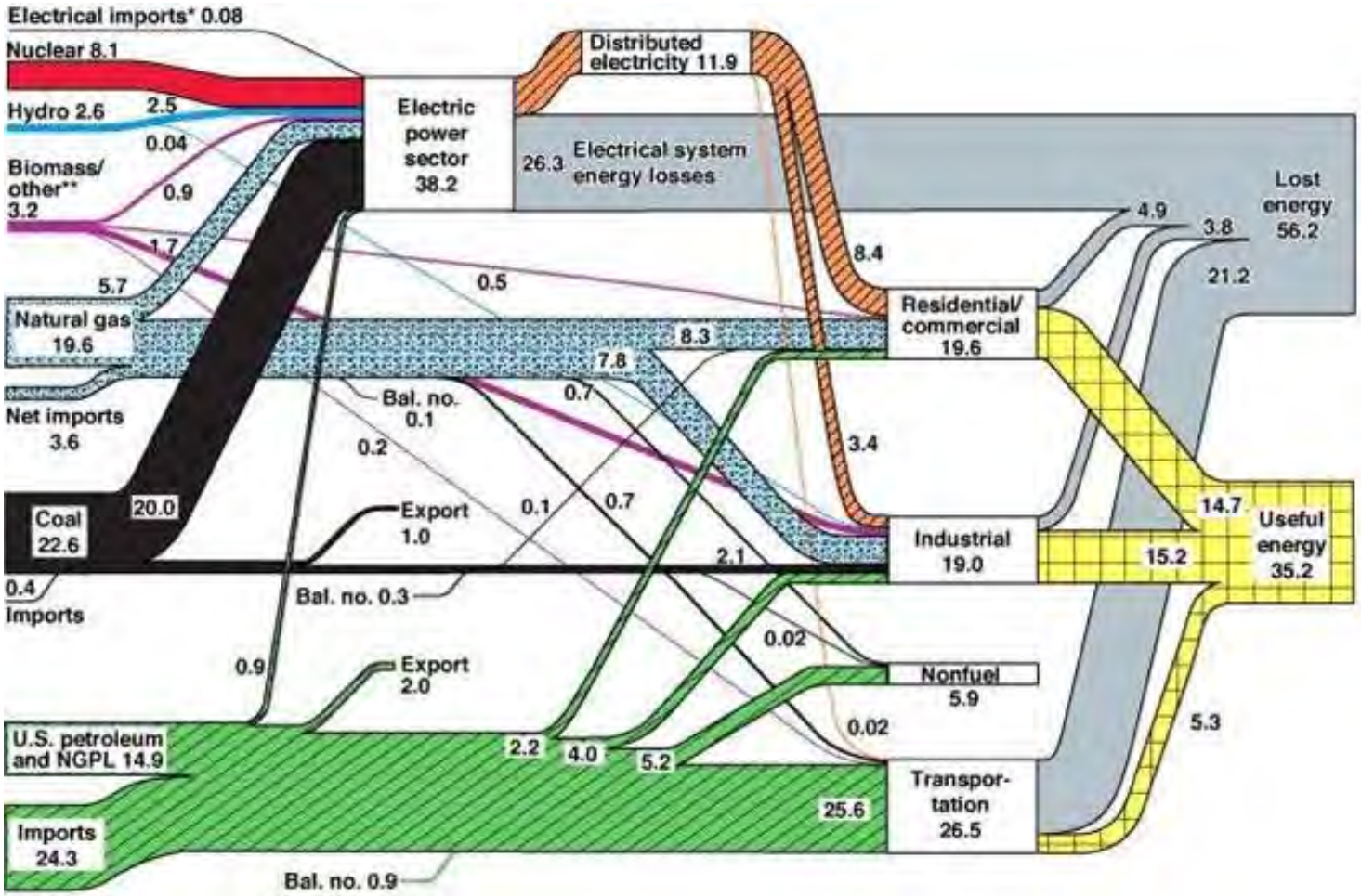
Energy Infrastructures:
central grid and on-site generation



Trends in US Energy/Power Sectors

Net Primary Resource Consumption ~97 Quads

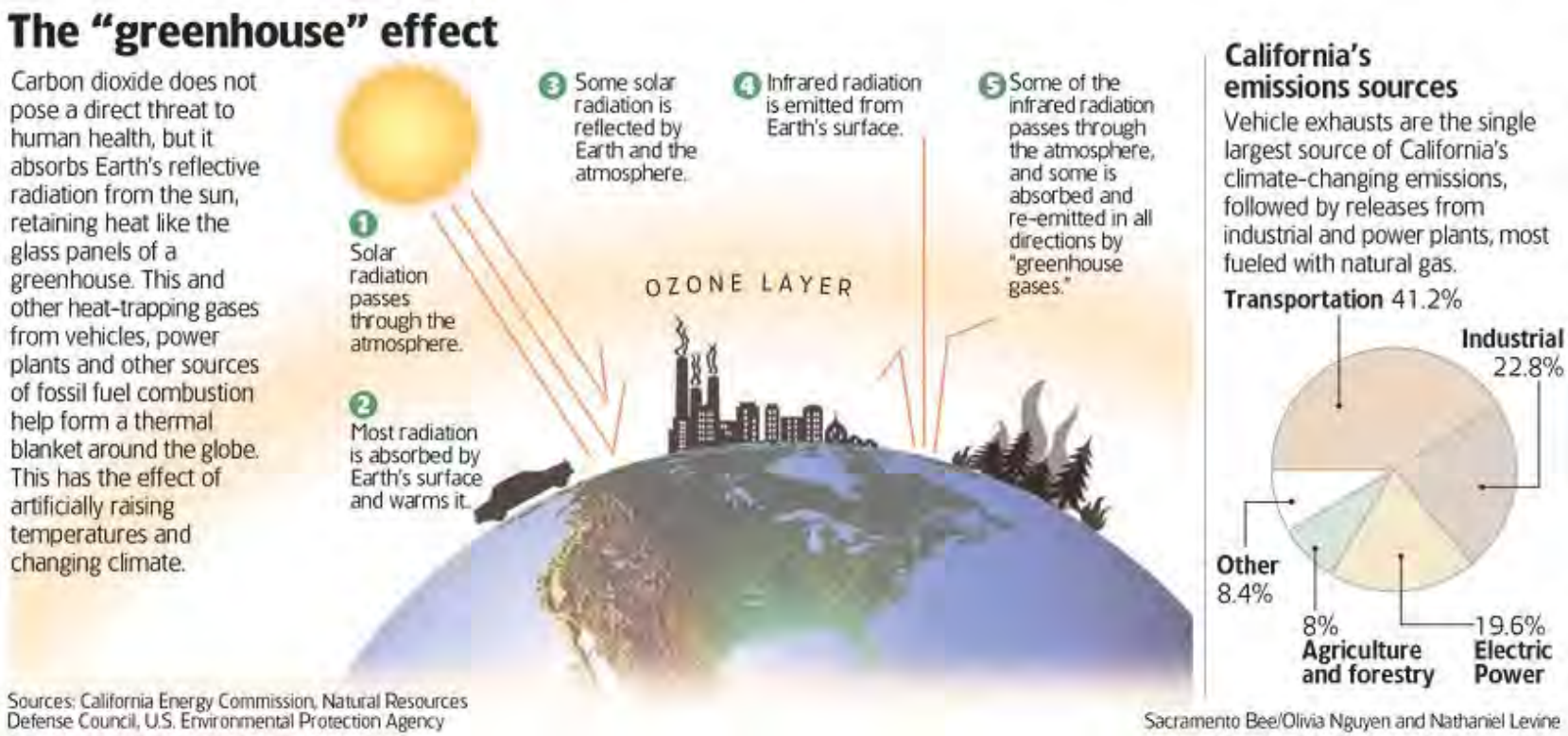
Source: US Dept of Energy and Lawrence Livermore National Laboratory



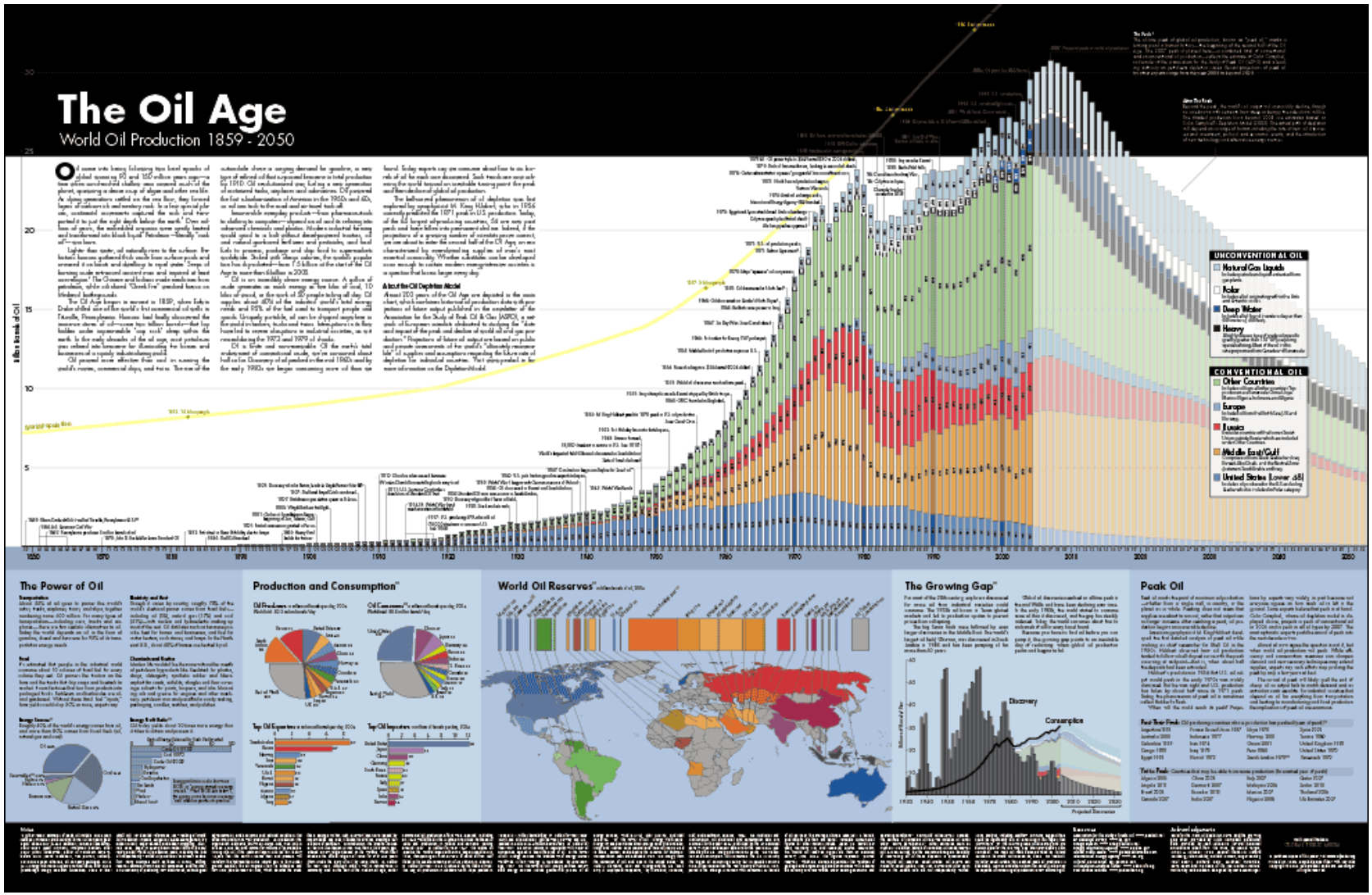
Climate Change and Global Warming

Civic-Markets and Public-Private Partnerships

Setting Goals for conservation and renewable energy generation



Peak Oil and Gas: by 2020



Is “Nuclear Power” Decisively Effective for Clean & Sustainable Energy?

[B] Life of “Power Station

Life: 30 ~ 40 years

Renewal

Necessary to Construct Too Many Power Stations

Life Extension

* Criteria on Degradation Judgment?
* Rehabilitation is OK?

Need to Shift Energy-Resources from Fossil or Uranium to “New Energy” before “Catastrophe” Occurs!

Several Tens Years’ Use

Only One Generation

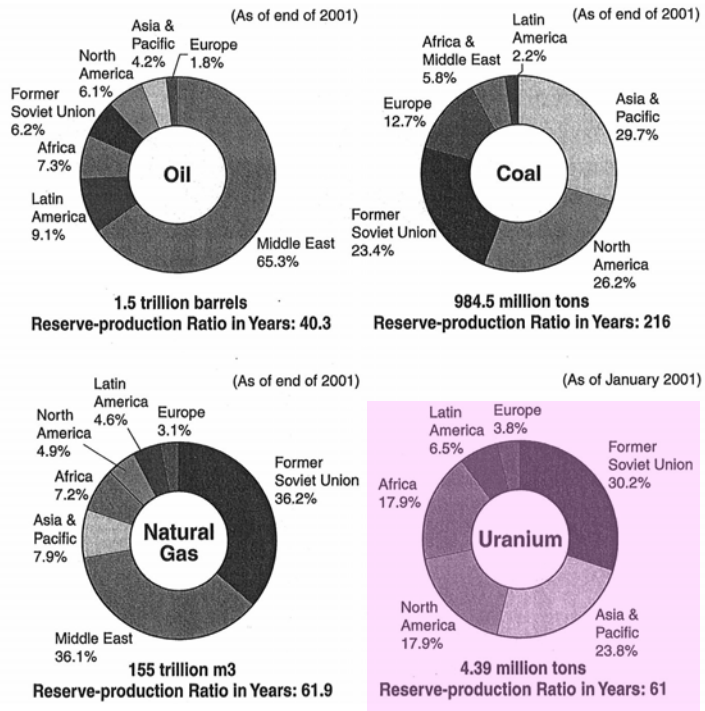
Back-End

Watch Wastes for 100 Years

&

10 Thousand-year-Stock in Underground Tunnel

[A] Life of Resources



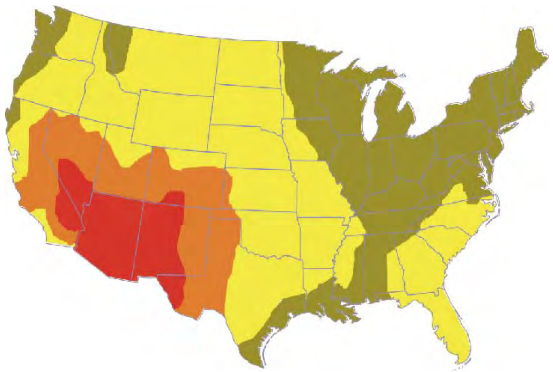
Uranium: Around 60 Years

(below one century)

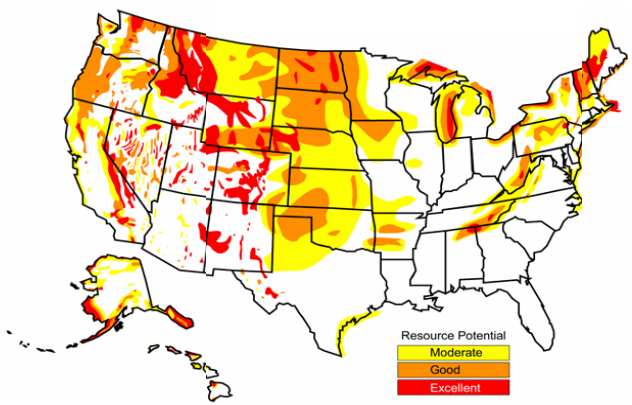
Transient Resource

Renewable Energy Resources in USA

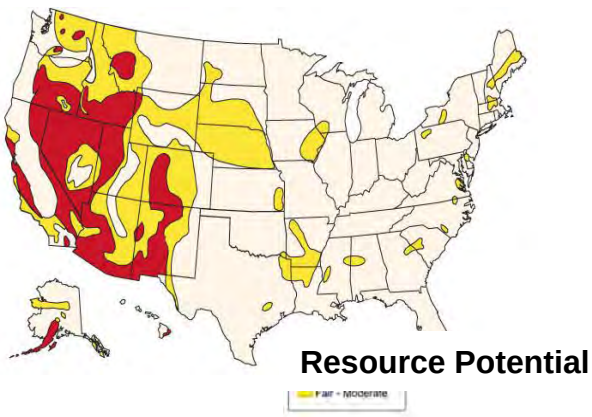
SOLAR ENERGY



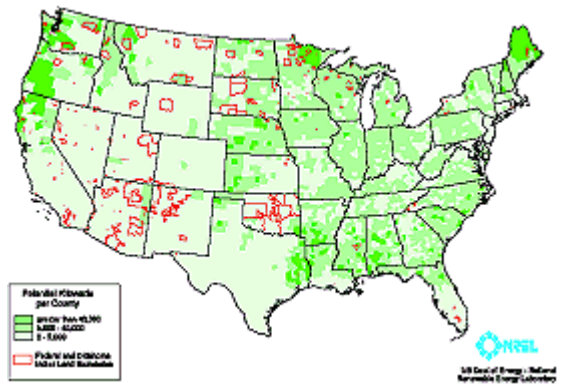
WIND POWER



GEOTHERMAL



BIOMASS

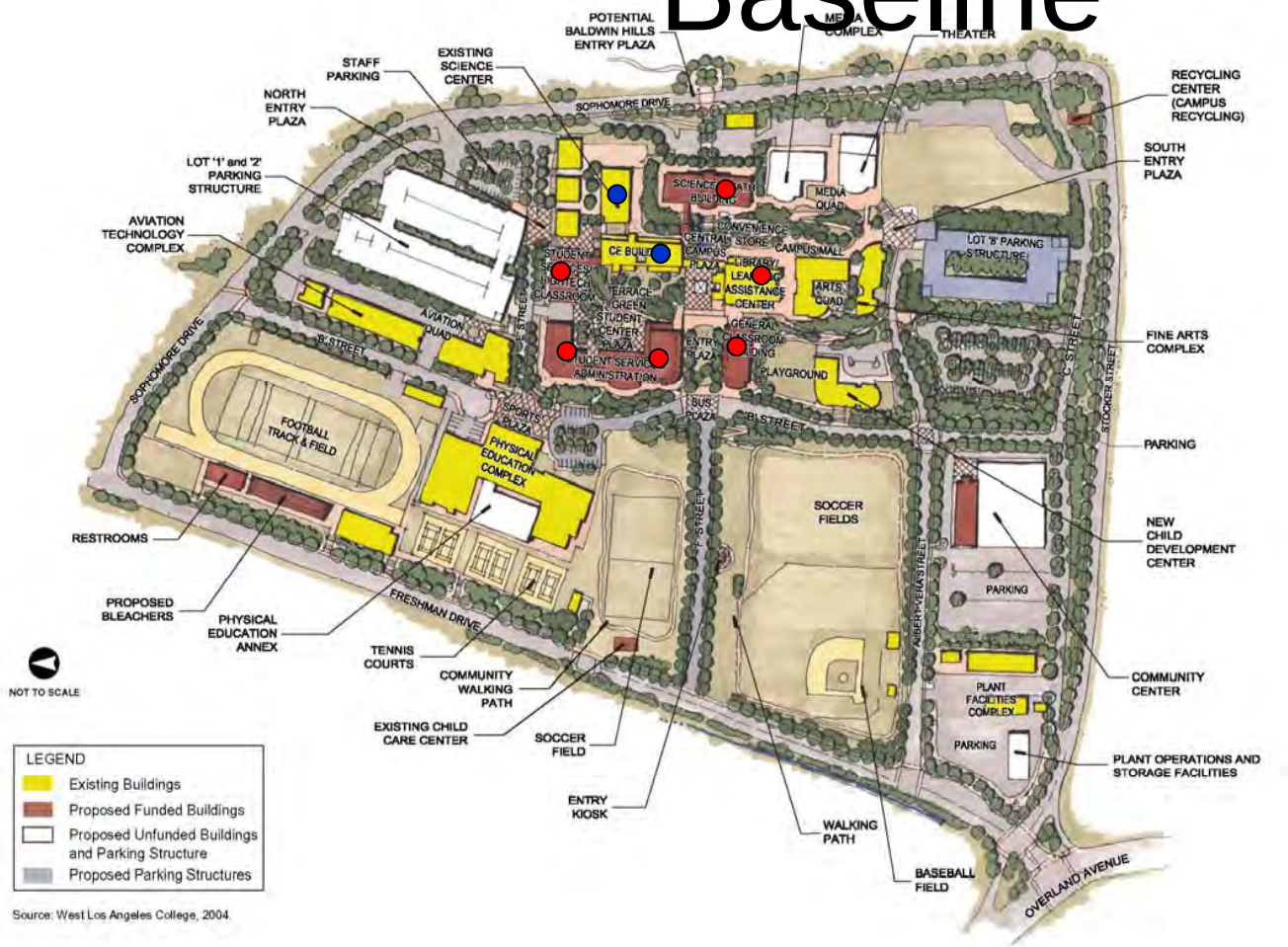


Solar / Photovoltaic Project

Sample Portfolio
Carport/Shade structure Projects

- Dual Benefit: Shade + Electricity
- Interest high with public agency customers who have concerns with rooftop systems
- Highly visible public statement
- Innovative designs possible
- Costlier than rooftop systems due to additional cost of steel support structures

West Los Angeles College - Baseline



Source: West Los Angeles College, 2004.

Total Elec. Consumption

7,216,762 kW

Total Gas Consumption

5,961 MMBtus

Total Water/Sewer
34,625 kgals

LACCD Comprehensive Energy Strategic Plan

A Paradigm Change:

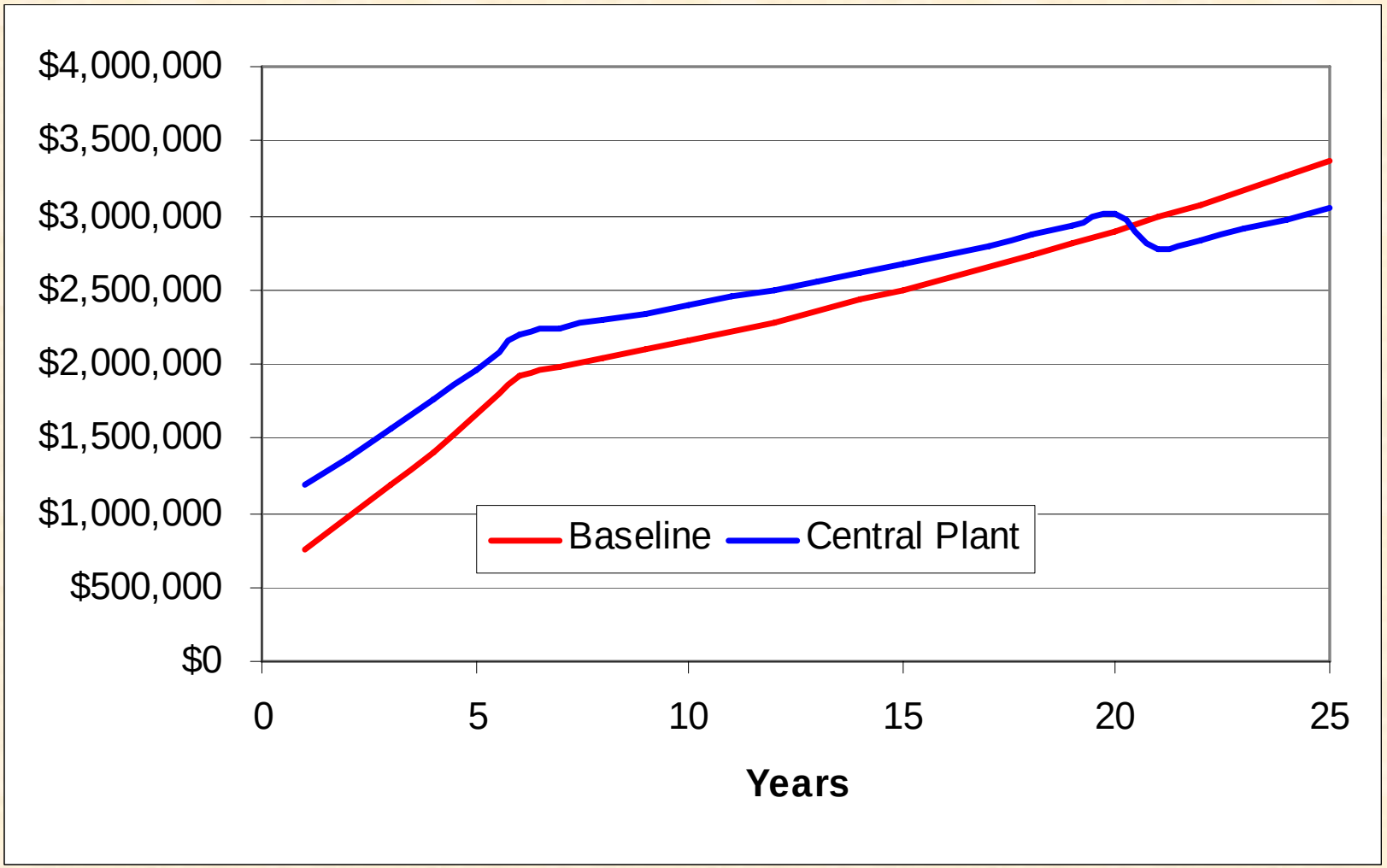
1. Efficient Renewable Energy Central Plants
2. Demand Management Through Performance Contracts
3. One MW Solar/PV per campus
4. Sustainable Curriculum Program

1. Renewable Central Plant

Objectives

- One Central High Efficiency Sustainable Source for Hot Water and Chilled Water
  - Heating and Cooling
- Meet current demand with expansion capbility for future facilities and needs
- Provide power for clusters of buildings
- Digital Control System

BASELINE vs CENTRAL PLANT LIFE CYCLE COST COMPARISON



Central Plant Features

- Solar Heat Tube
  - Hot Water – near steam
- Absorption Chillers (Multiple Units)
  - Chilled Water for Air Conditioning
- Thermal Storage – Ice
- Co-Generation – Electricity and Heat
- Hot Water Boiler / Heater

Vacuum Tube Heat-pipe Collectors and Architectural Design Possibilities

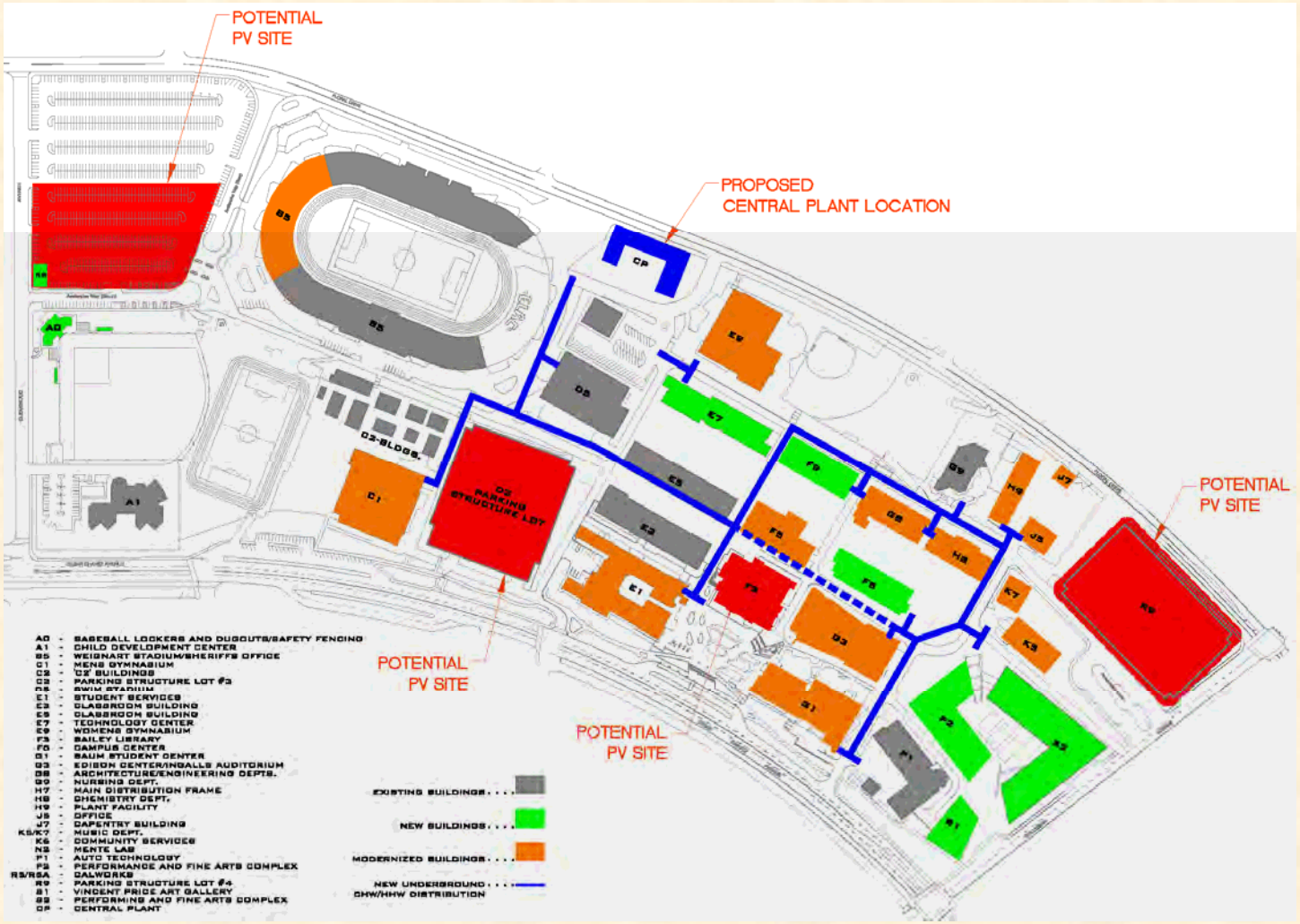
Audubon Center at Debs Park

A solar televillage learning campus

East LA College Campus

Central Plant/PV Farm

Location/Utility Routing



Central Plant Costs

- Proposition 39 bond resources
- SS. 5956 Private sector financing
- AB 1492 – State of California Financing through the Foundation for California Community Colleges
  - Lowest Cost Borrowing
  - Requires Intercept Mechanism

2. Performance Contracts

- Retrofit all energy consuming elements for maximum efficiency
- Install conservation features in all buildings
  - Insulation
  - Low-E Glass
  - White Roof
  - Green Roof
- State of the art and new technologies
- Metering and Monitoring Systems

Performance Contract Financing

- Design – Installation – Financing By Private Sector
- SS. 4217 Contract – 25 year payback maximum
- Uses Private Sector Funding
- Guaranteed Payback within existing utility charges
- Incentive Funds Available from California Public Utility Commission and municipal programs administered by the utilities

Performance Contract Arithmetic

- Electric / Gas Bill Before Energy Measures- Annual
- Electric / Gas Bill After Energy Measures - Annual
- Difference (Amount Available for Payback) - Annual

- $1,000,000
- $ 800,000

$ 200,000

3. Alternative Energy Concept

- Private Sector third party to install
- Parking Lots and Roofs
- Hybrid systems with storage
- Future technology innovations

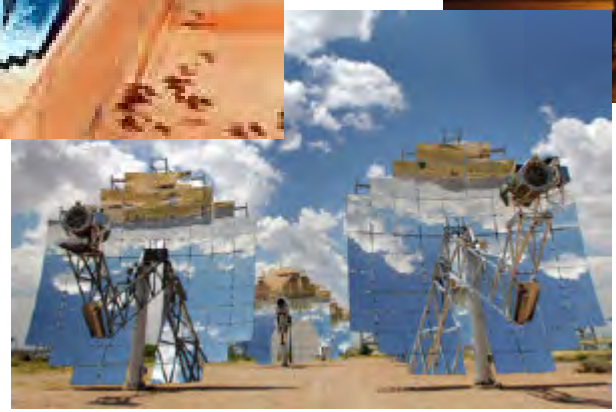
Solar Roof Photovoltaic

Moscone Center:

Jobs and training for solar installation (2004)

Stirling Engine Solar Farm

Barstow, California



Wind Power

Coachella Valley

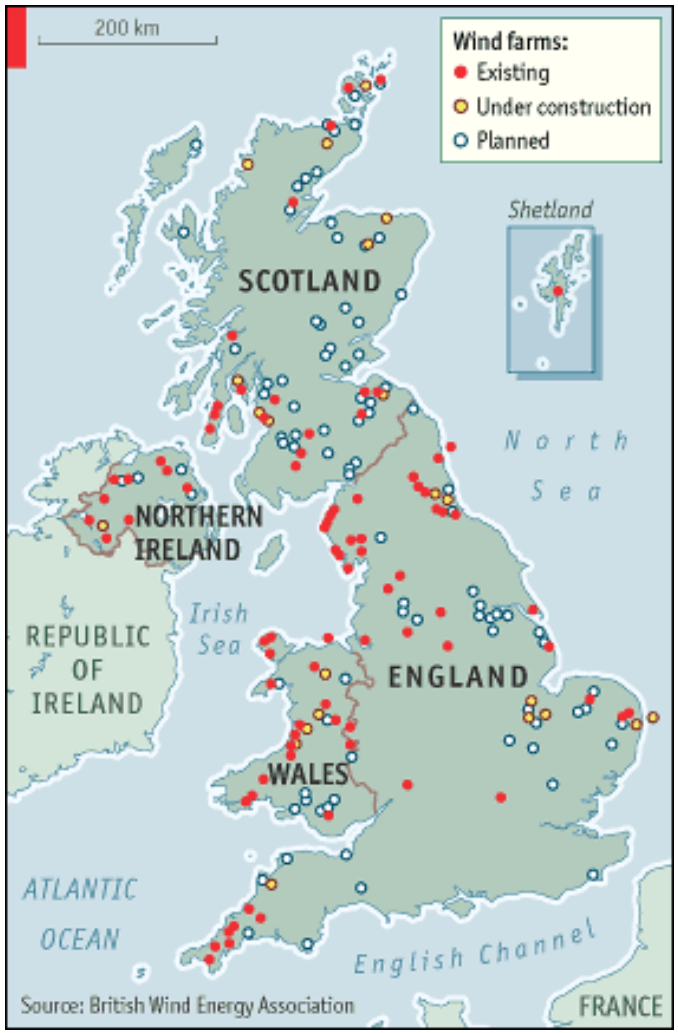
Wind Mill Power

Costs are competitive with natural gas

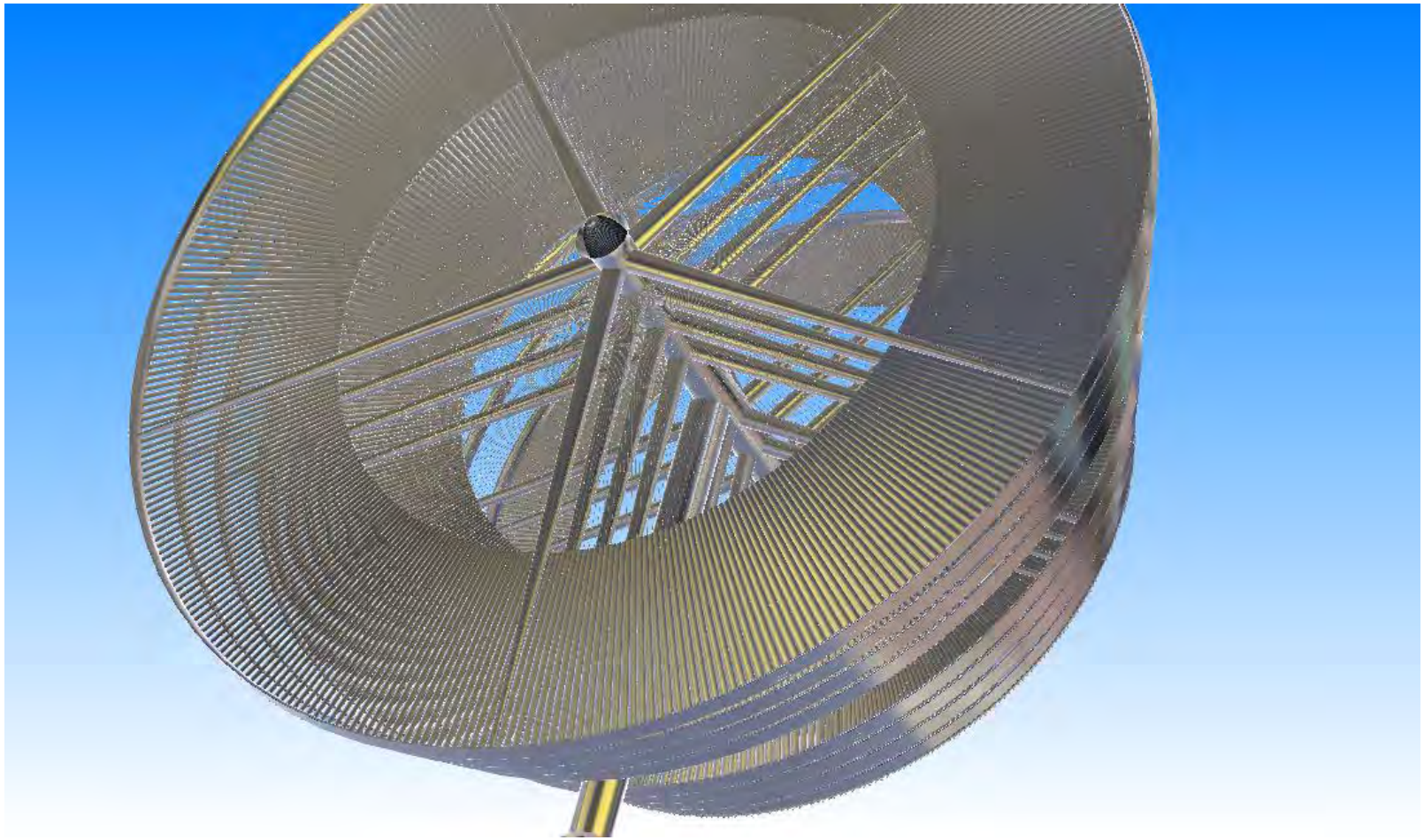
- Wind Power uses wind to create electricity
- Accounts for around 1% of California's electricity supply
- On-site wind power
- Case in point: farms and town in N. Europe
- The turbine technology and costs have changed.
- Hybrid Systems and Integrated
- On-site Generation
- *Courtesy of California Energy Commission and Distributed Energy Systems 2006*

UK Wind and Ocean Turbines:

The Case of Scotland (April 05)

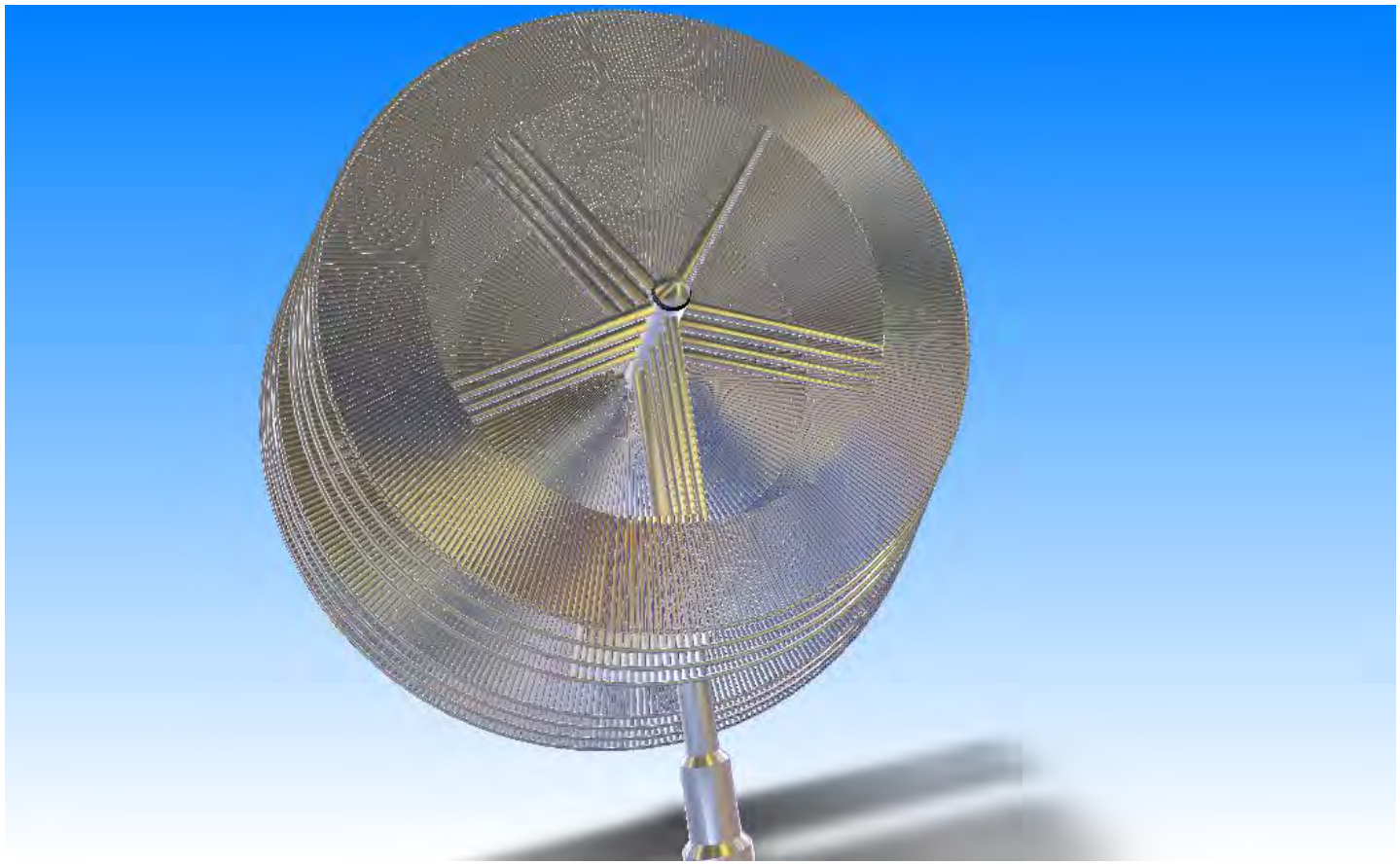


Windfall Clean Energy



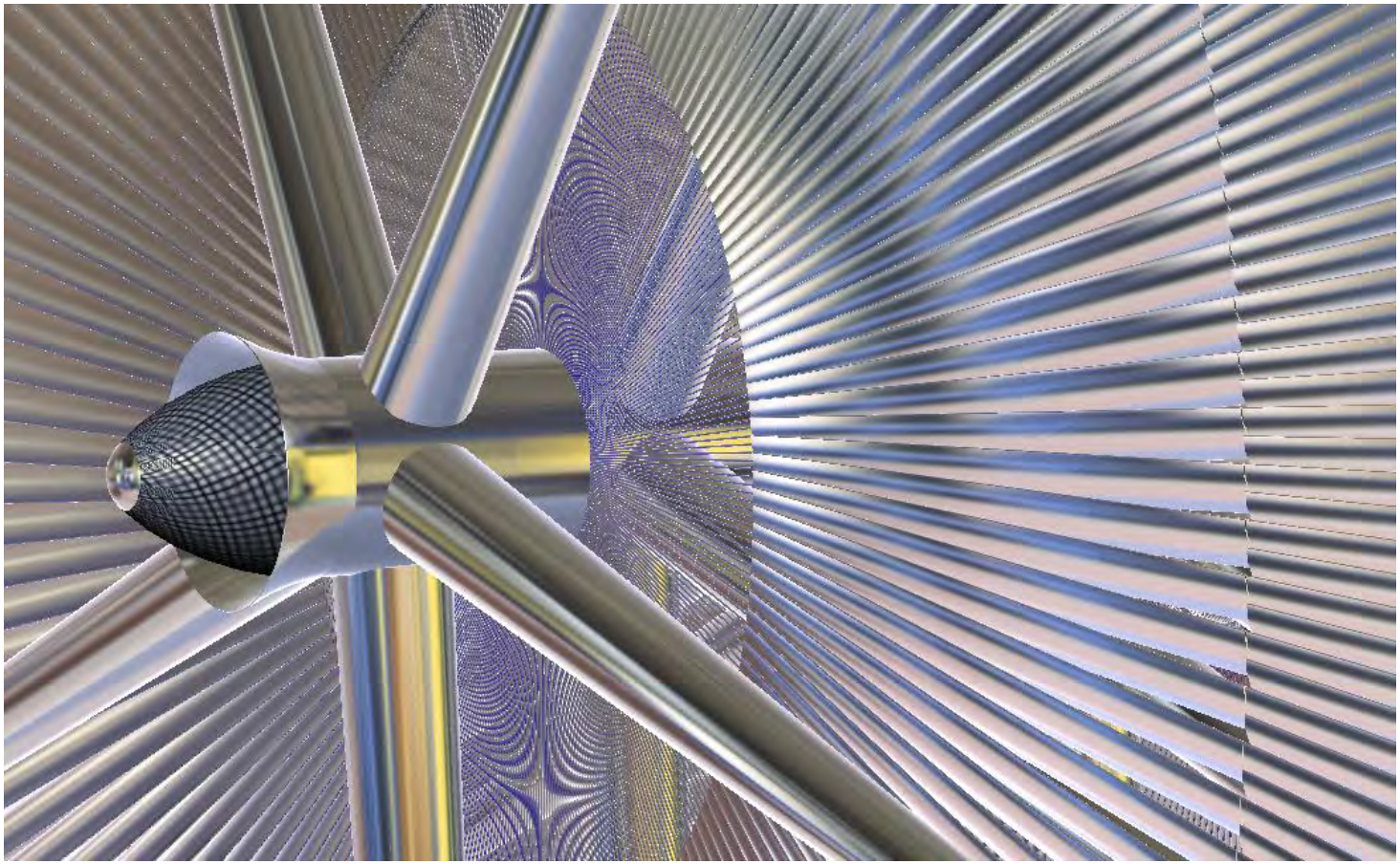
- Satisfying the world's need for electric energy without pollution

Windfall Clean Energy



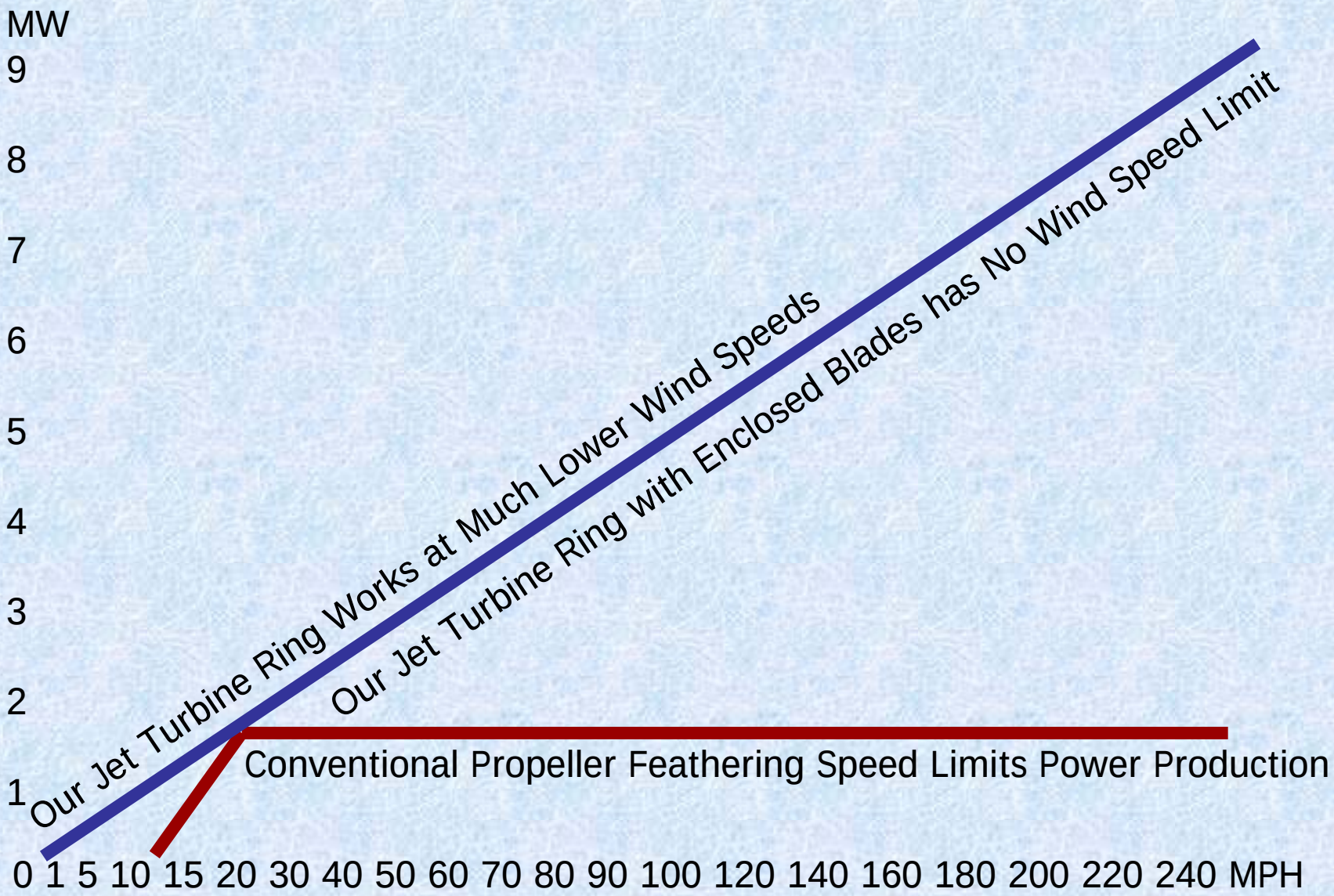
Each layer of thousands of wings successively become larger in diameter which aims the system directly at the wind, and enhances the performance of each ring by providing laminar wind at the edges.

Windfall Clean Energy

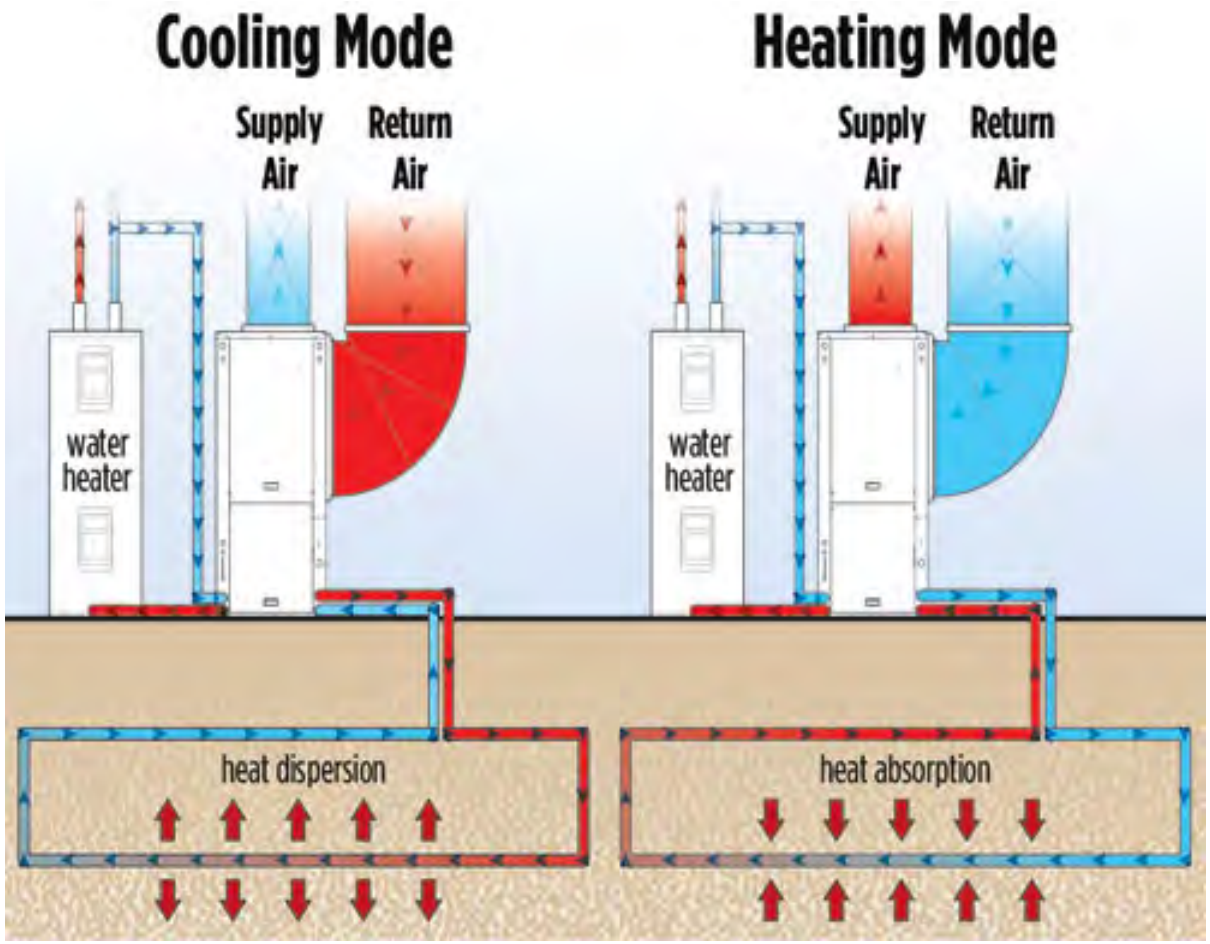


Thousands of light weight and extremely strong steel cables efficiently support thousands of wings while securing the outer ring at extreme wind speeds while the spokes transfer huge torque.

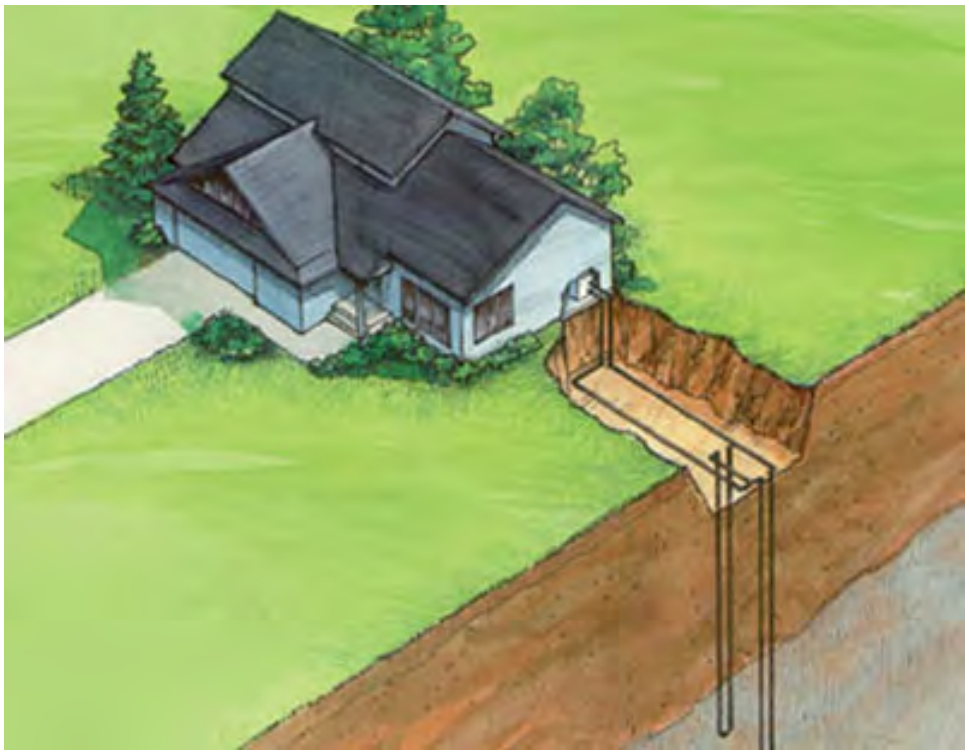
Windfall Clean Energy



Ground Source Geo-Thermal



Ground Source Geo-Thermal



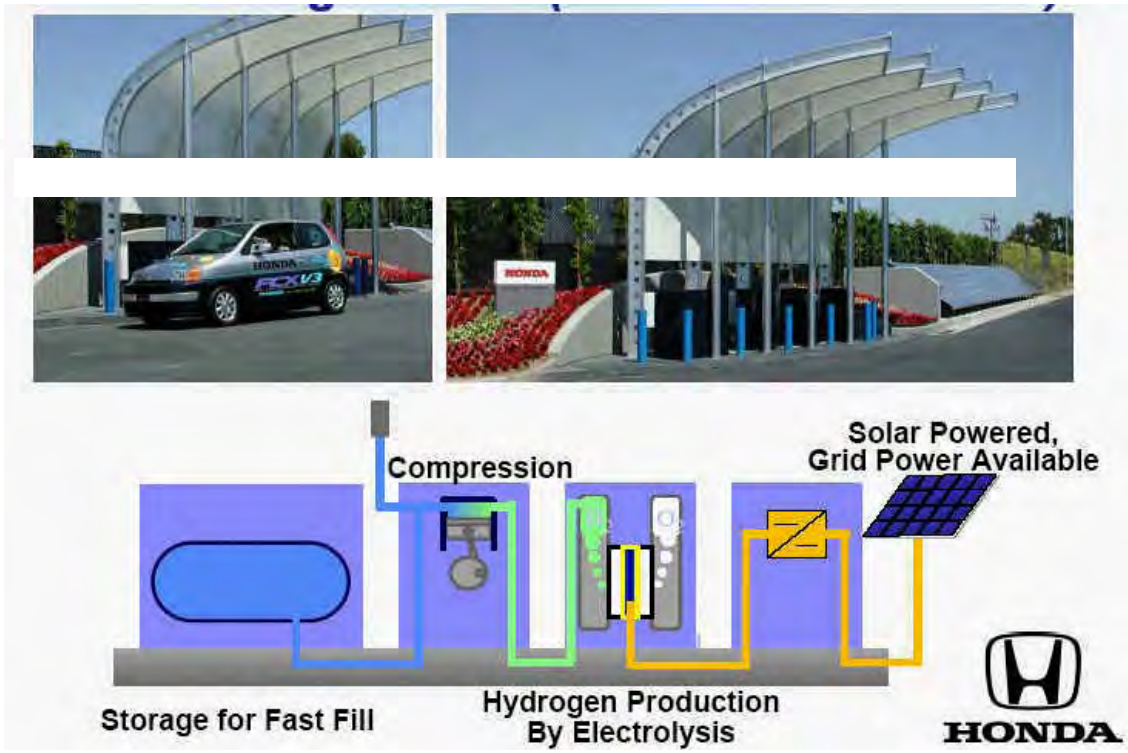
A Water Planet

- ¾ of the Earth is covered by water
- Water is made up of hydrogen and oxygen

Alternate Energy 3rd Party Arithmetic

- Federal Energy Credit – 30%
- Rapid Depreciation – 25 %
- Utility Incentives – 20 %
- Green Tag Sale – 5% (?)
- Bulk Procurement – 10 % (?)
- 10 Cents on the Dollar !!!

Green Hydrogen Fueling Station:Torrance, CA



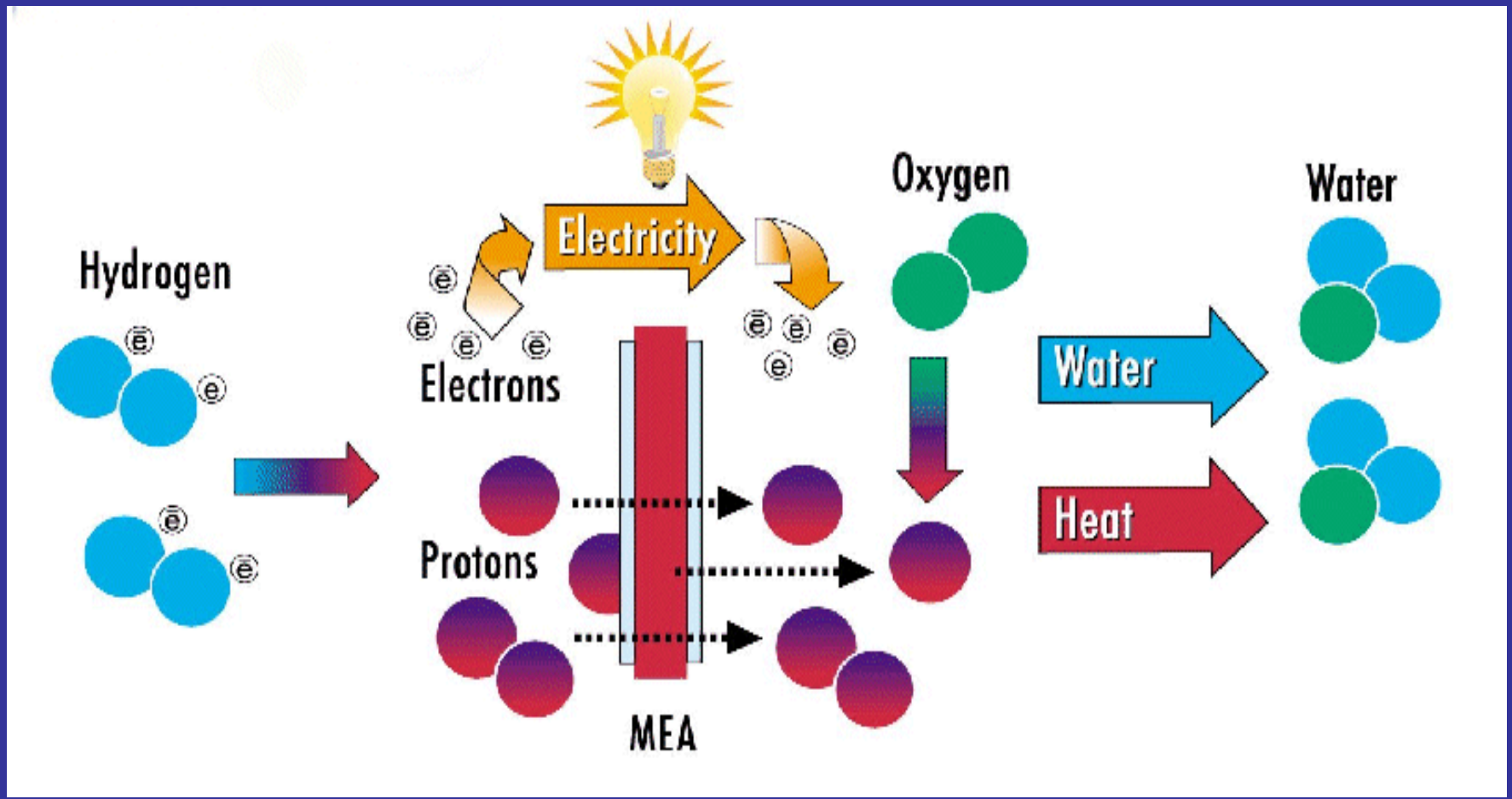
Renewable Hydrogen Pathway

Distributed Energy Solutions

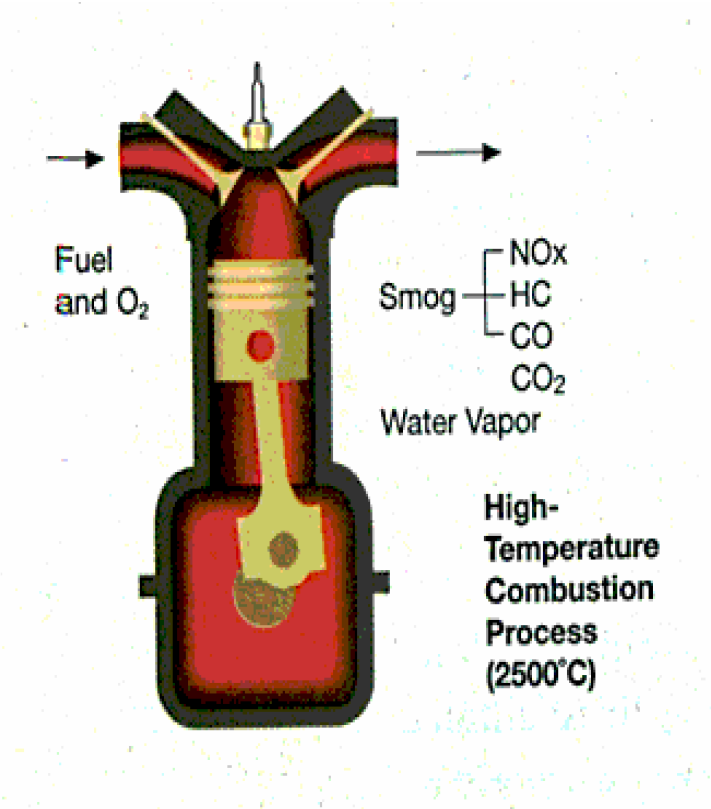
- Renewable H_2 is based on water electrolysis is the only pathway to deliver a zero-emission energy cycle
- H_2 is the ideal medium for storing electricity for on-demand distributed power generation and fueling
- Scale-up of renewable power and HES solutions will address “clean and secure” energy requirements
- Wind power is becoming “low-cost” energy solution
- Advanced solar technology and volumes driving lower costs
  - Significant potential for home energy applications

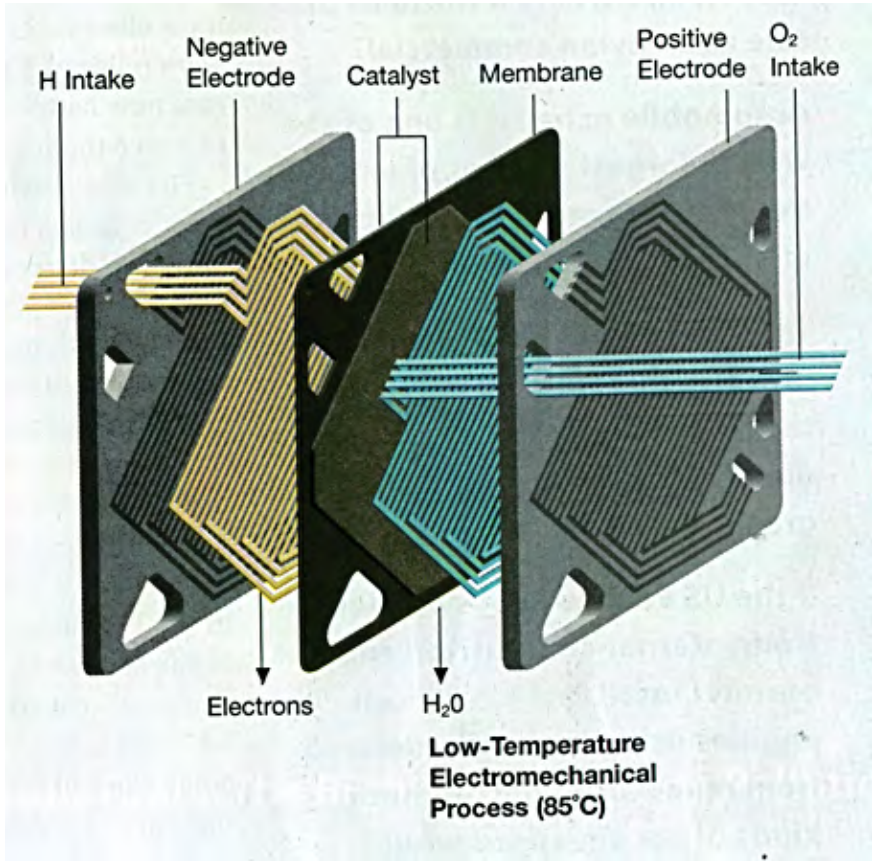
Fuel Cell Basics

A fuel cell is a device that generates electricity by a chemical reaction



Internal Combustion VS Fuel Cell





Fuel Cell System - 3 major modules

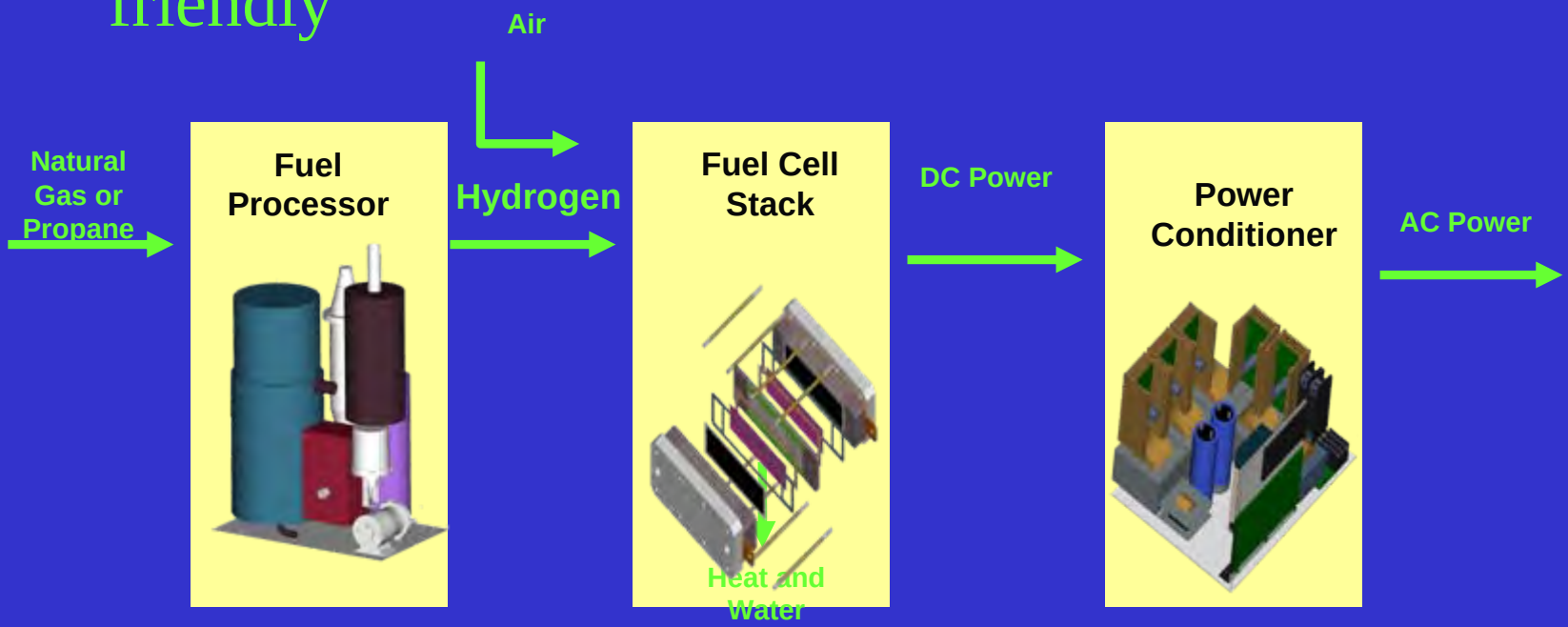
Fuel Processor Module (Reformer) - **reforms natural gas (CH4) into hydrogen rich gas (**reformate**) for use by fuel cell.**

Power Generation Module (Fuel Cell) - **uses hydrogen in** reformate **to produce electricity (DC voltage)**

Power Conditioning Module (Inverter) - **converts DC Voltage produced by the Fuel Cell into AC Voltage (240VAC) for use by the grid.**

Integrated Fuel Cell System

- Direct energy conversion
- Low maintenance and capital costs
- More environmentally friendly
- Quiet operation
- Scalable
- No transmission and distribution losses



Power Generation

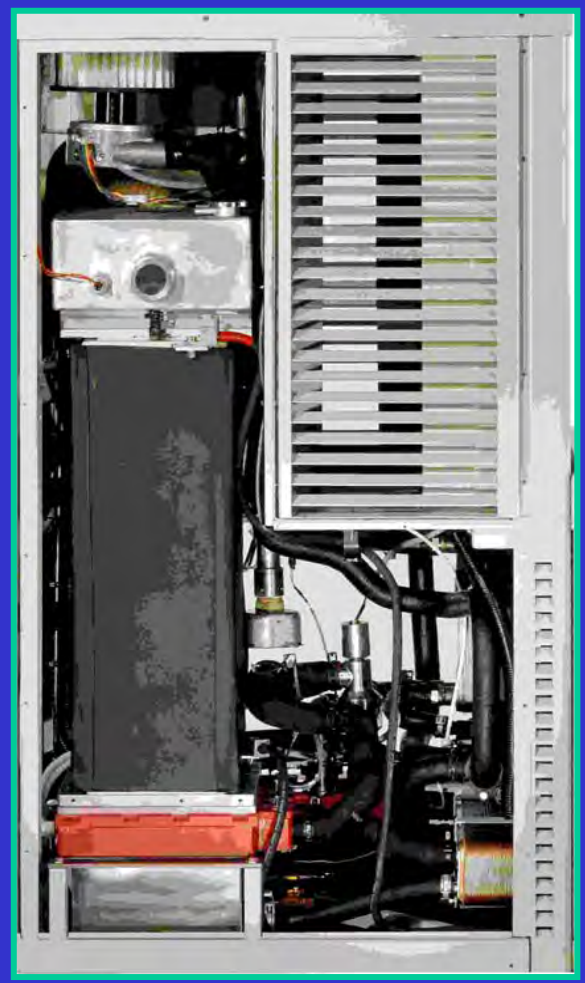
Fuel & Air Delivery

Cooling

Waste Heat Capture

Integrated Controls

- Fuel Processor
- Stack/Balance of Plant
- Inverter/Grid



iCeL is a unique, proven, scalable, intelligent, high density energy storage system. With many applications, most anything requiring energy can be powered by an iCeL.

ICEL

HIGH DENSITY STORAGE

We make iCeL energy packs in a variety of sizes. For example, the 714 model specifications are:

- 12" x 3" x 6" (L x W x H)
- weighs 12 pounds
- stores 1 kilowatt hour of readily dispatchagle energy.

That is a lot of power in a very compact, lightweight package. As a reference point, ten model 714 iCeL's will power an average home for 24 hours.

Designed and Built in America

Designed and Built in America

iCeL Systems, Inc • 7122 Sophia Ave • Van Nuys, Ca. 91406 • (818)909-3440

INTELLIGENT

iCeL technology incorporates software and advanced controller circuitry that enables devices to be programmed to operate based on:

- time frame
- energy consumption factors
- integration with conventional power
- integration with renewable power

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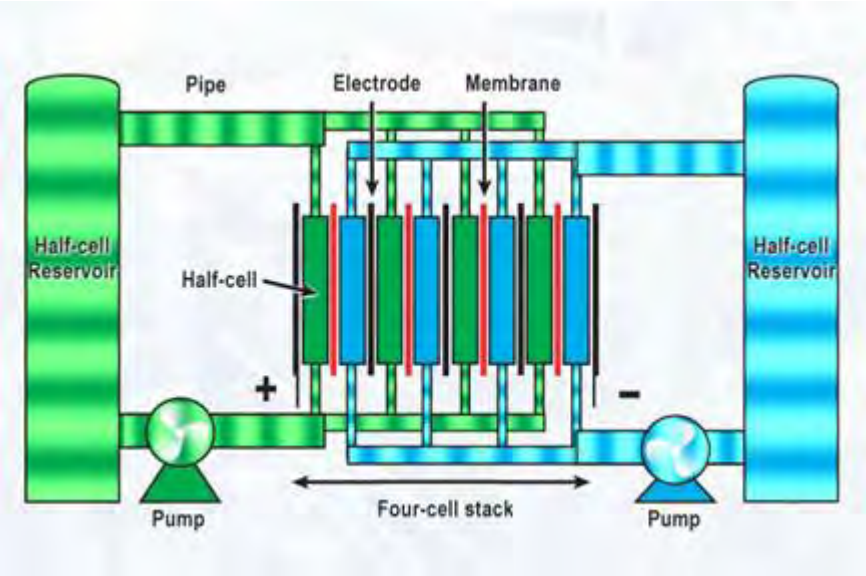
VRB Flow Battery Technology

A liquid electrolyte that is separate from the electrode.



Oxidation process

$V^{4+} \Rightarrow V^{5+} + e^-$

$V^{5+} + e^- \Rightarrow V^{4+}$

Charge

Discharge

Reduction process

$V^{3+} + e^- \Rightarrow V^{2+}$

$V^{2+} \Rightarrow V^{3+} + e^-$

Description

- Electrochemical energy storage system
- Reversible fuel cell – reduction and oxidation of single element: Vanadium
- Instantaneous (<1ms) energy recovery
- Standard 5kW and 50kW building blocks
- Remote control and monitoring, including real-time State of Charge (SOC) feedback

VRB Power Systems Inc.

Energy Storage & Power Quality Solutions

VRB-ESS on King Island
Islanded Wind Integration

- Situation: Islanded wind/diesel system
  - Four existing 1,500-kW diesel engine generators (6MW)
  - Three existing 250-kW wind turbines (750kW)
- Problem: Added two 850-kW wind turbines (1.7MW)
  - Excellent wind regime, but did not coincide with island's electrical load
  - Ratio of wind: diesel capacity increased from 12.5% to 40%
  - System imbalance – cleaner, most cost effective resource was needed to stabilize the grid, reduce spinning reserve, capture spilled wind
- Solution: Installed 200 kW 4 hour (or 400kW for 10 sec; or 300kW for 5 min) VRB-ESS. VRB ESS captures spilled wind and discharges during the day in load-following mode.

King Island Project Benefits*

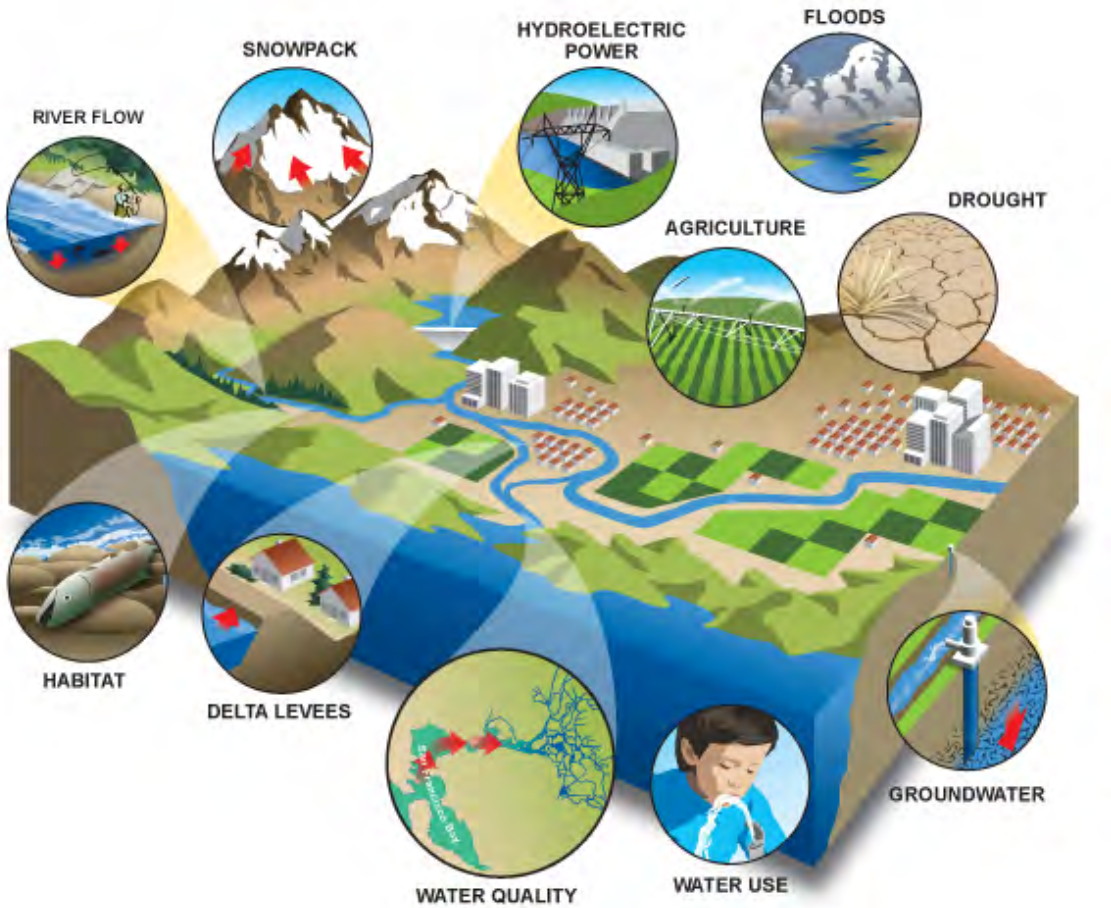
- Reduces emissions
  - 4,000,000 kg/year CO_2
  - 99,000 kg/year NO_x
  - 75,000 kg/year unburned hydrocarbons
- Capture “spilled” wind - $51,200/y
- Reduce spinning reserve - $91,500/y
- Improve operating efficiency - $83,200/y
- Reduce maintenance - $23,000/y
- Net annual savings: $248,900/y, 3.5 year payback

*(projected, pending verification)

Inside the Flow Battery Installation at King Island

6 MW VRB-ESS Tomamae Wind Farm, Japan
Grid-Connected Wind Farm Output Smoothing

Water - Pumped Storage



4. Sustainable Development Curriculum

- Green Buildings – Learn technology from actual projects
- Offer certificates, licenses and advanced degrees
- Career opportunities and training for jobs, new companies and advanced degrees
- Sustainable Development Curriculum:
  - –solar, wind, geothermal,hybrid technologies
  - – economics, business, life cycle accounting, investment
  - – operations and maintenance
- Impact on Climate Change -- the solutions for global warming are available today for immediate implementation

Off The Grid !!

- Using current and future Proposition 39 bond resources
- Buy Out
  - Central Plant Loans
  - Performance Contracts
  - Photovoltaic / Fuel Cell Installation
- No Future Energy Cost !

Thank You

Contact Information

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