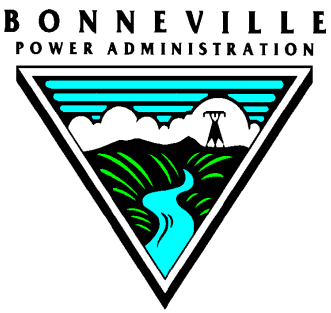
June 2001

EnergyWeb@2010

Mike Hoffman, Technology/Innovation Lead,
Bonneville Power Administration



What we are going to cover:

Where did the Energy Web concept come from:

The past versus the future - centralized versus web resources

Examples of the Energy Web - associated issues & benefits

Generation, renewables, enabling technologies

What BPA has done in the last year

What BPA is planning to do in the next year

Where did the Energy Web concept come from?

Early in 1999 BPA commissioned a team to come up with new ideas for Renewables and Conservation programs (ReCon) for strategic planning purposes.

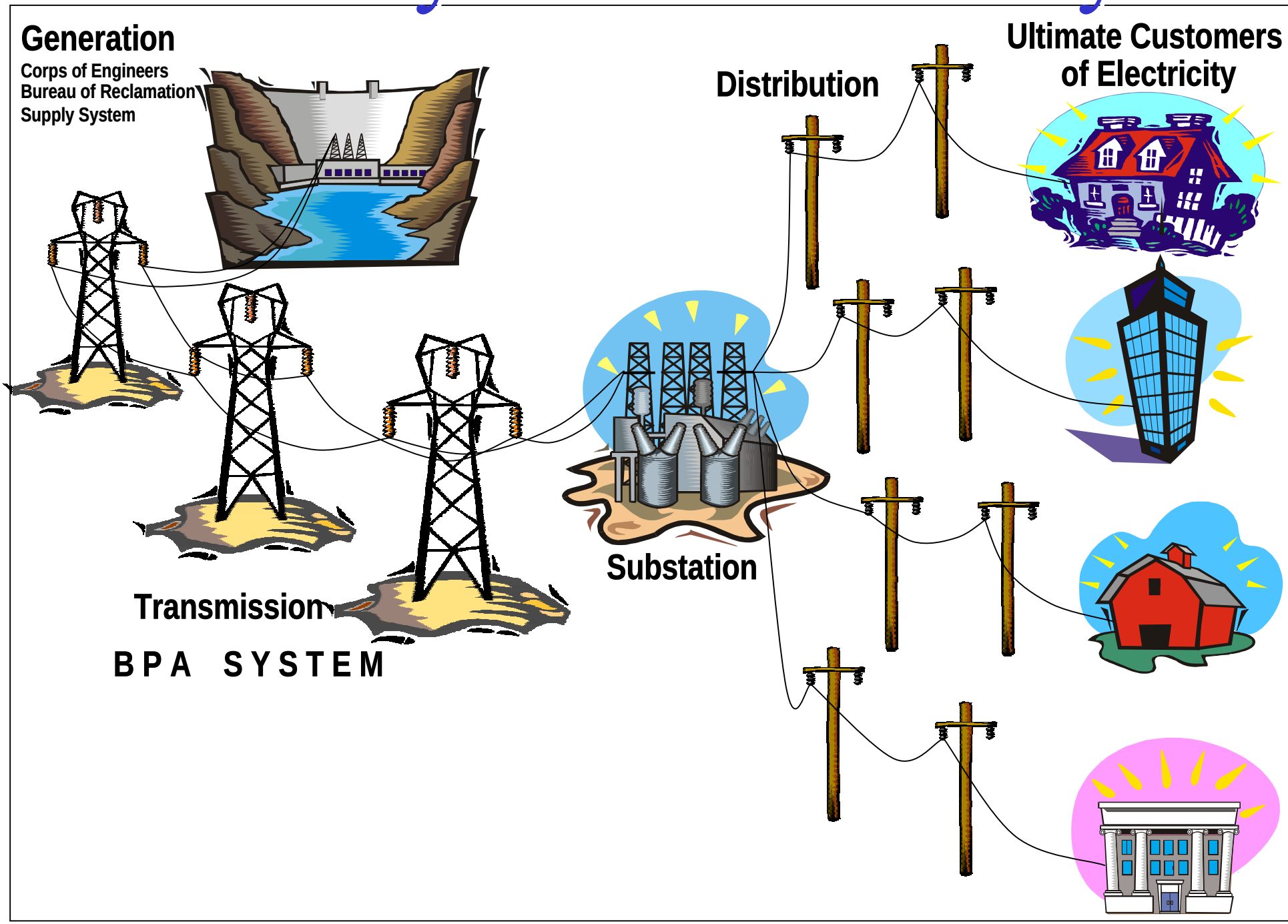
The team chose to look at the future of the energy industry, to think about how it could change, and how those changes might affect energy users and (consequently) BPA.

The team quickly shifted focus from renewables and conservation to technologies and market principles that already are, and will continue to alter, the energy marketplace at all level - wholesale, industrial, commercial, and residential.

To keep from bogging down in day- to-day details, the team picked 2010--a point 10 years in the future--as the focus for its vision.

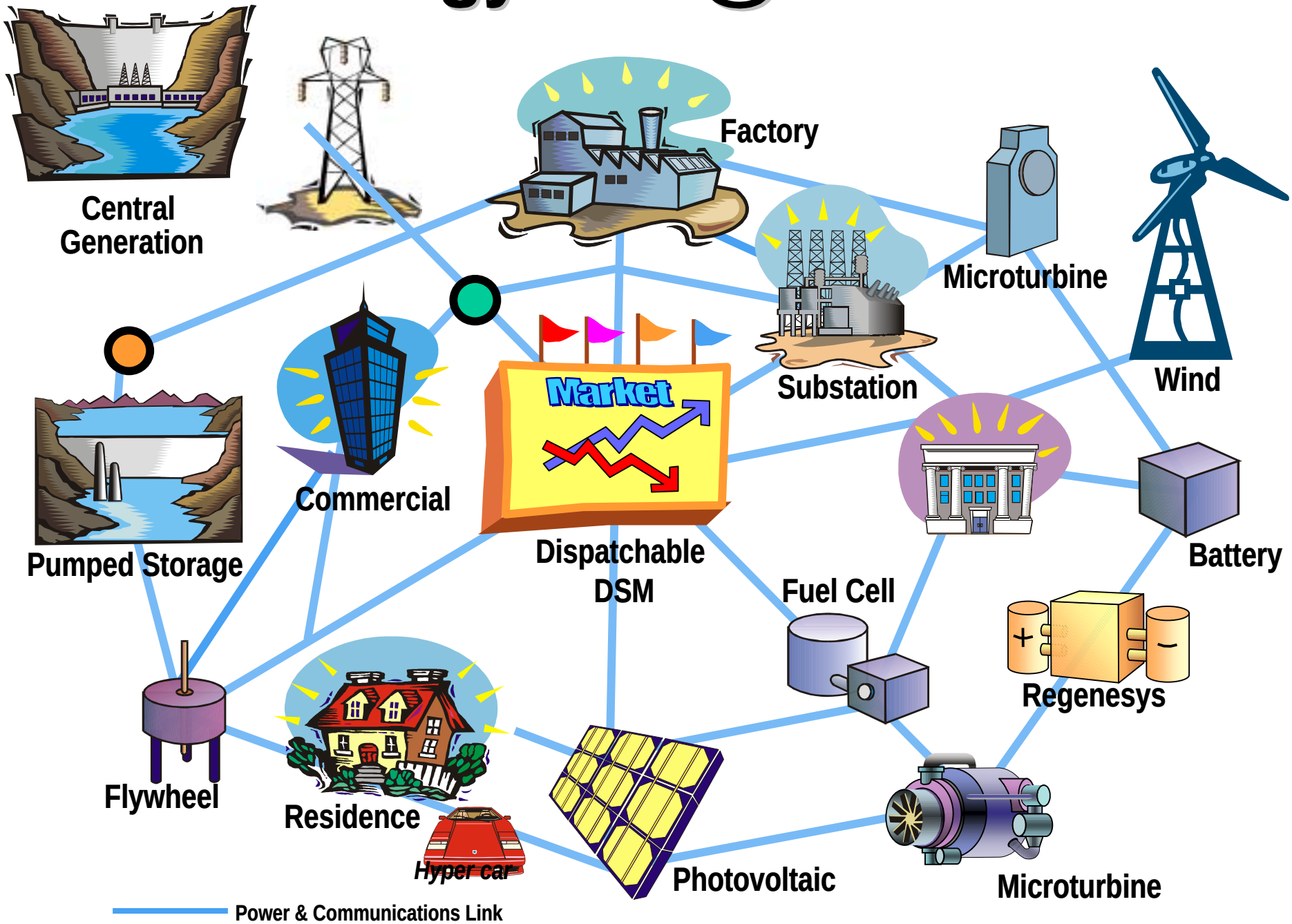
Here is the past:

Today's Central Utility



This is what BPA thinks the future is:

Energy Web@2010



Energy Web definition:

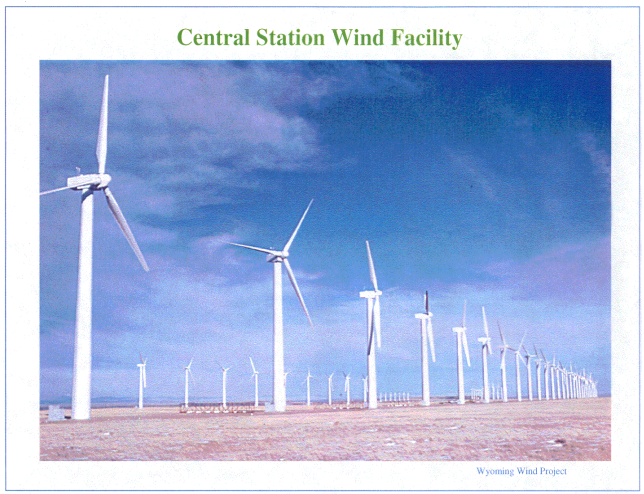
The integration of the utility electrical system, telecommunications system, and the energy market to optimize loads on the electrical network, reduce costs to consumers and utilities, facilitate the integration of renewable resources, increase electrical system reliability and reduce environmental impacts of load growth.

What is Energy Web@2010?

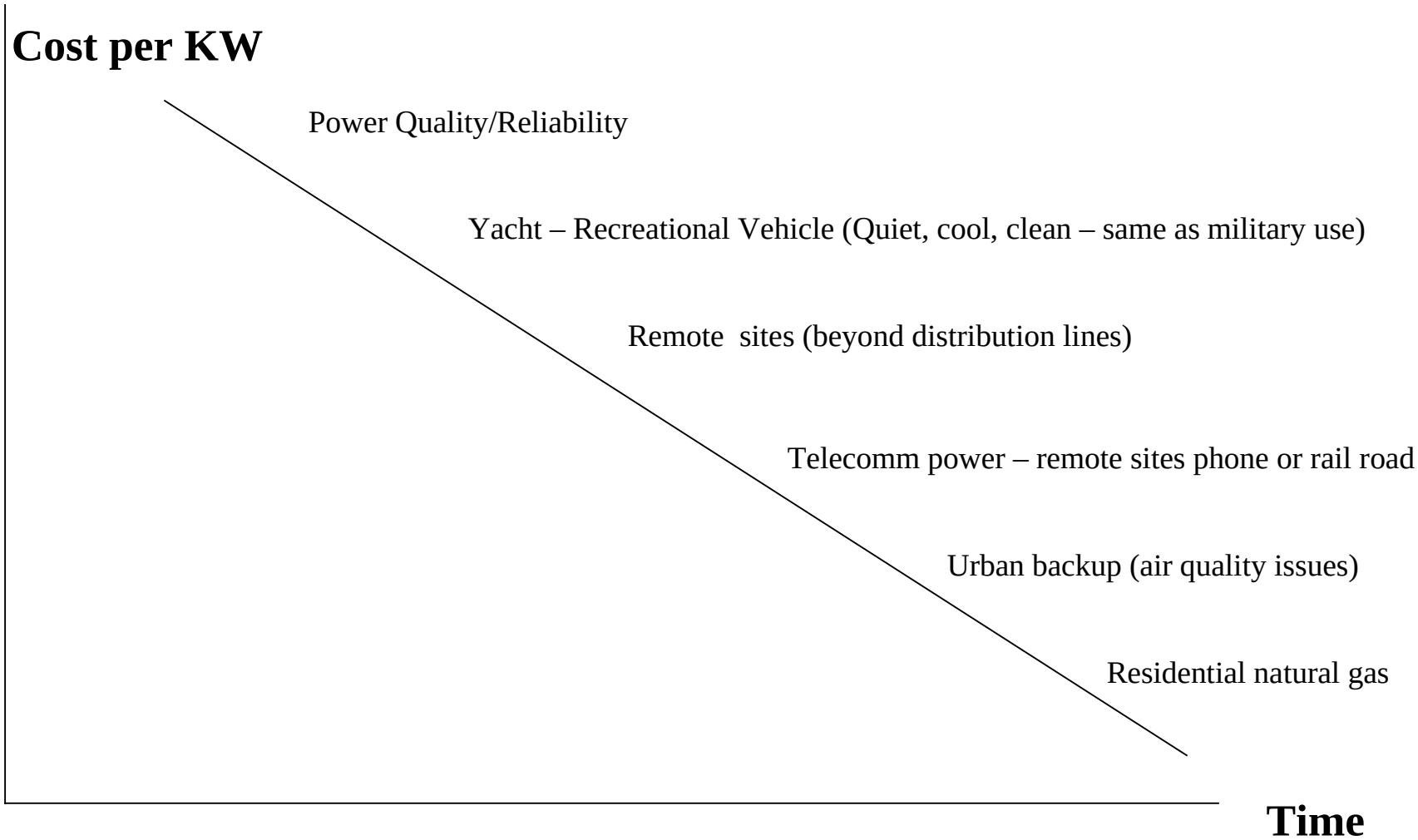
technological innovation,
market principles,
and a lighter environmental footprint.

BPA Fuel Cell

Demand Exchange (PLM)



Renewables



Distributed Power implementation slope

- high value comes first

ENERGY WEB 2010 - CHARACTERIZED

A High Level of Information Flow (price discovery, market information, lots of products/services)

Consumer Choice

Highly Integrated Delivery System for Consumer Service

Distributed Generation

Driven by Market Principles and Competition

Energy Efficiency

Technologically Complex

Environmentally Friendly

Why you should participate:

Energy Web@2010 is happening as we speak.

Technological Innovation is both a threat to, and an opportunity for any utility.

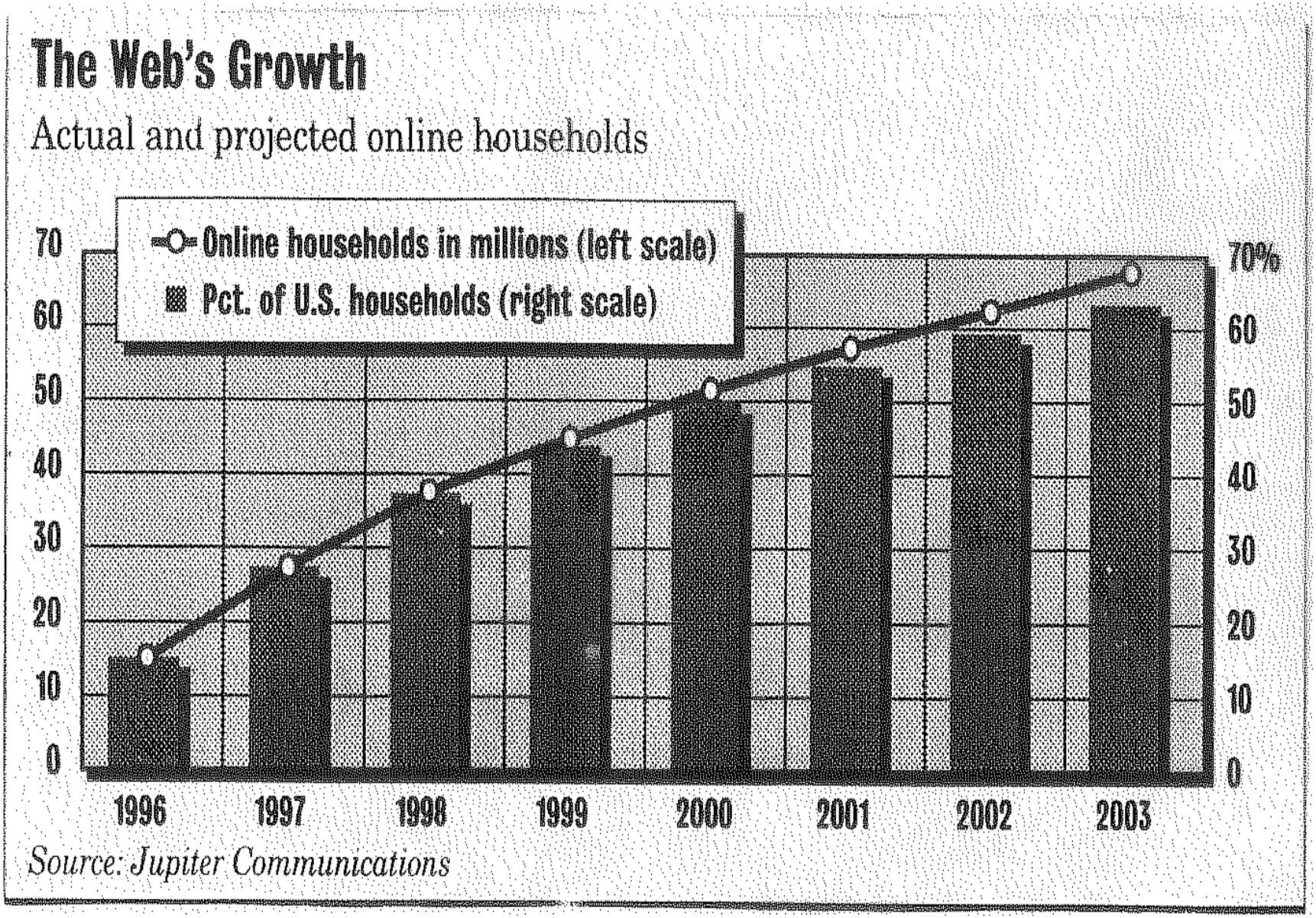
The world is becoming even more globally connected.

Utilities have a duty to improve their energy supply.

Utilities own a huge infrastructure we can use to promote change for the public good and make money with efficiency.

Want to bet against the Energy Web?

That would be like betting against PC's or the Internet



Energy Web Issues for utilities

How should a utility or energy service company position its products as the market changes?

How should a utility fulfill its public duties in a decentralized, consumer-driven industry?

What vision should reflect the EnergyWeb idea in your utility?

How should a utility structure its capital investment criteria,

particularly for long-term investments in the Energy Web?

VISUALIZE THE YEAR 2010

The Power System at the Turn of the Millenium has Changed

Centralized Generation was Tweaked to Optimize Output Value

The Centralized System has been Supplemented by:

- Lots of Dispatchable Generation
  - Fuel Cells
  - Micro Turbines and Generators
  - Reciprocating Engines
  - PV, Wind, Geothermal and Other Renewables
  - Energy Storage systems (Regenesys)
  - Dispatchable Demand Side Management

VISUALIZE THIS IN YEAR 2010

Generation is Highly Differentiated (various shades of green)

Energy Efficiency Commonplace (smart appliances, houses)

Energy Management Control Systems

Monitors on systems – to Sense Problems, Opportunities for Efficiencies

These Things are Linked by Communications and Logic: Chips Talking To Chips

COMMUNICATIONS REVOLUTION

Smart-Meters/Appliances/Equipment (IP6)

Online billing and payment systems

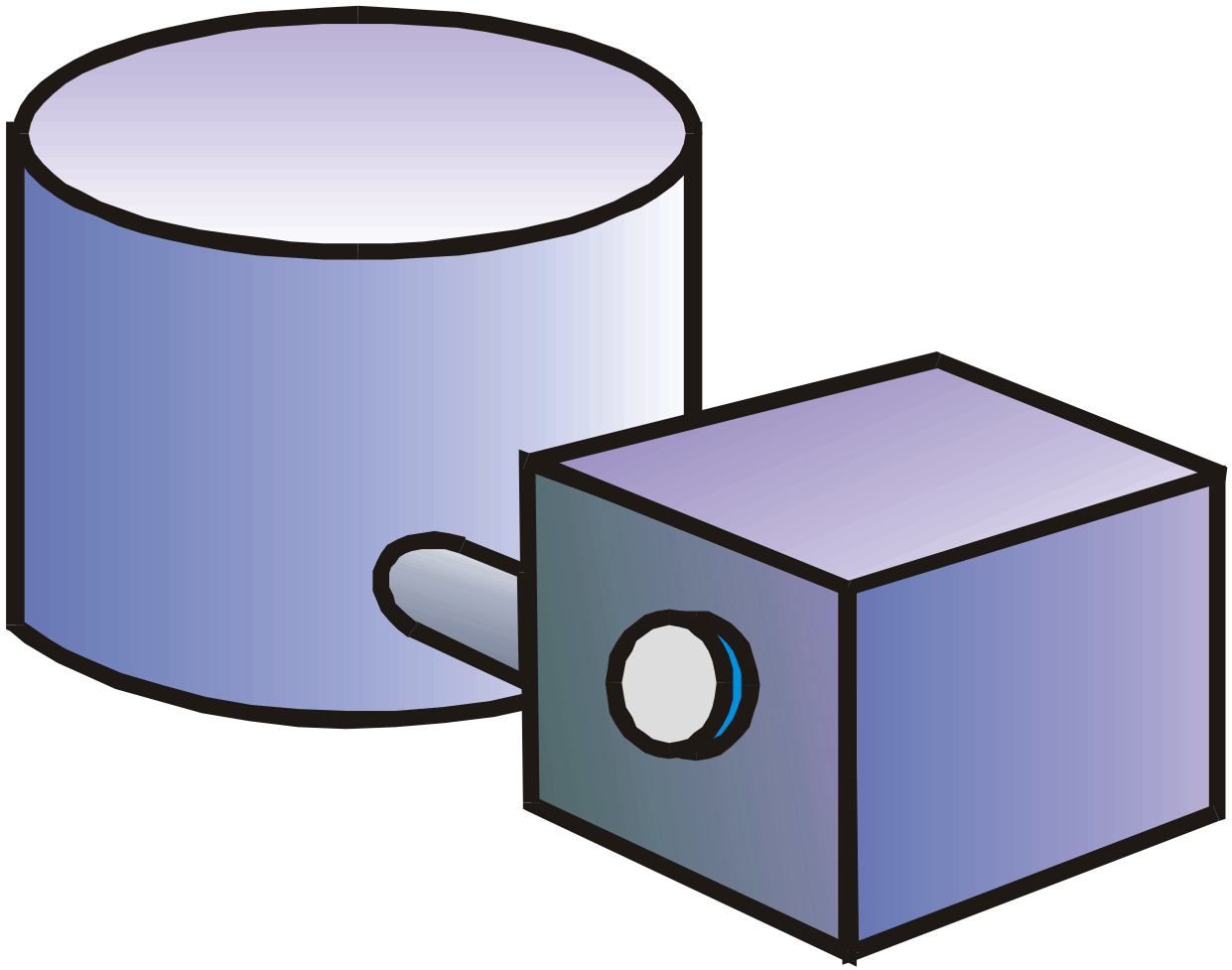
Fiber Optics/Satellites/XDSL/MMDS/LMDS

Remote Monitoring/Control Capability

Integrated Control Systems

Technology Leap Frogging(Cellular to PCS)

Fuel Cell Examples



IdaTech Alpha fuel cell - BPA customer site

IdaTech 1kw prototype design

Sulzer Hexis

Solid Oxide Fuel Cell (SOFC)
1KW Electrical Output
Furnace unit for hydronic heating system for European use

Plug Power - PEM Fuel Cell

ONSI PC25 (200kw) Edwards AFB - California

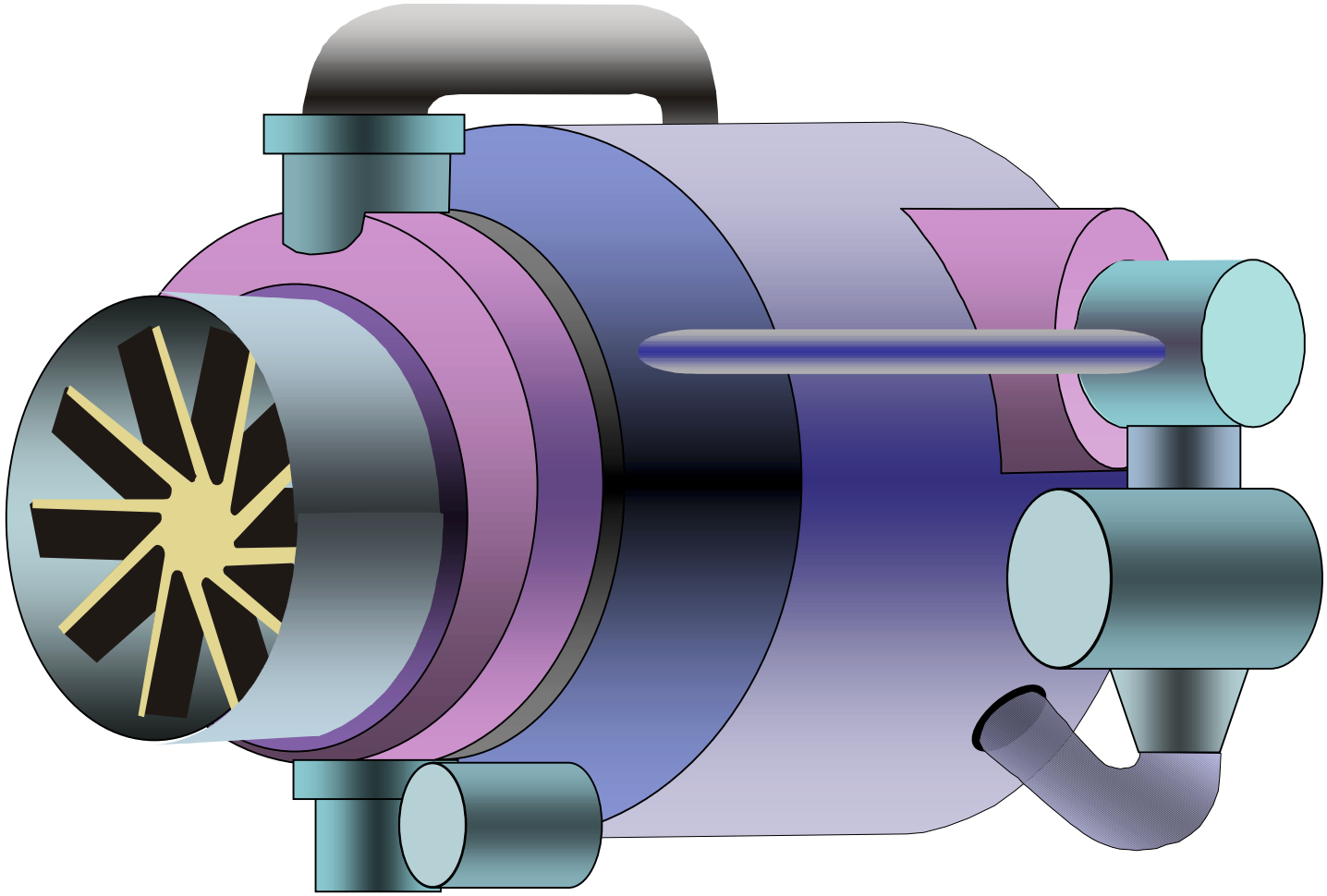
Business Issues to Consider - Fuel cells

Porter's Five Forces Analysis for PEM fuel cells

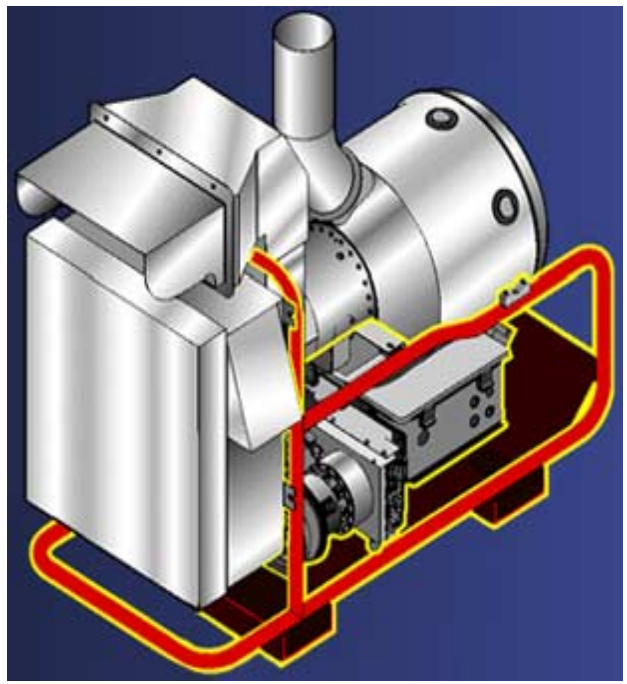
Questions to Answer for Yourself:

- **Internal Rivalry**: Competition for Market Share by Firms Within a Market.
- **Entry/Exit Barriers**:
  - Profits Attract Competition,
  - New Entrants Steal Business and Divide Market Demand,
  - High Cost to Exit,
  - Inability to Shift Resources to Other Business Activity If Industry/firm Fails
- **Substitute Products**:
  - New Entrants Erode Profits by Stealing Business and Intensifying Internal Rivalry,
  - Substitutes Based on New Technologies Lower Costs
- **Supplier Power**:
  - Ability of Suppliers to Extract Profits From the Industry/firm,
  - Monopoly Power Raises
- **Buyer Power**:
  - Ability of Customers to Negotiate Lower Purchase Prices,
  - Willingness of Consumer to Shop Around

Microturbines Gensets

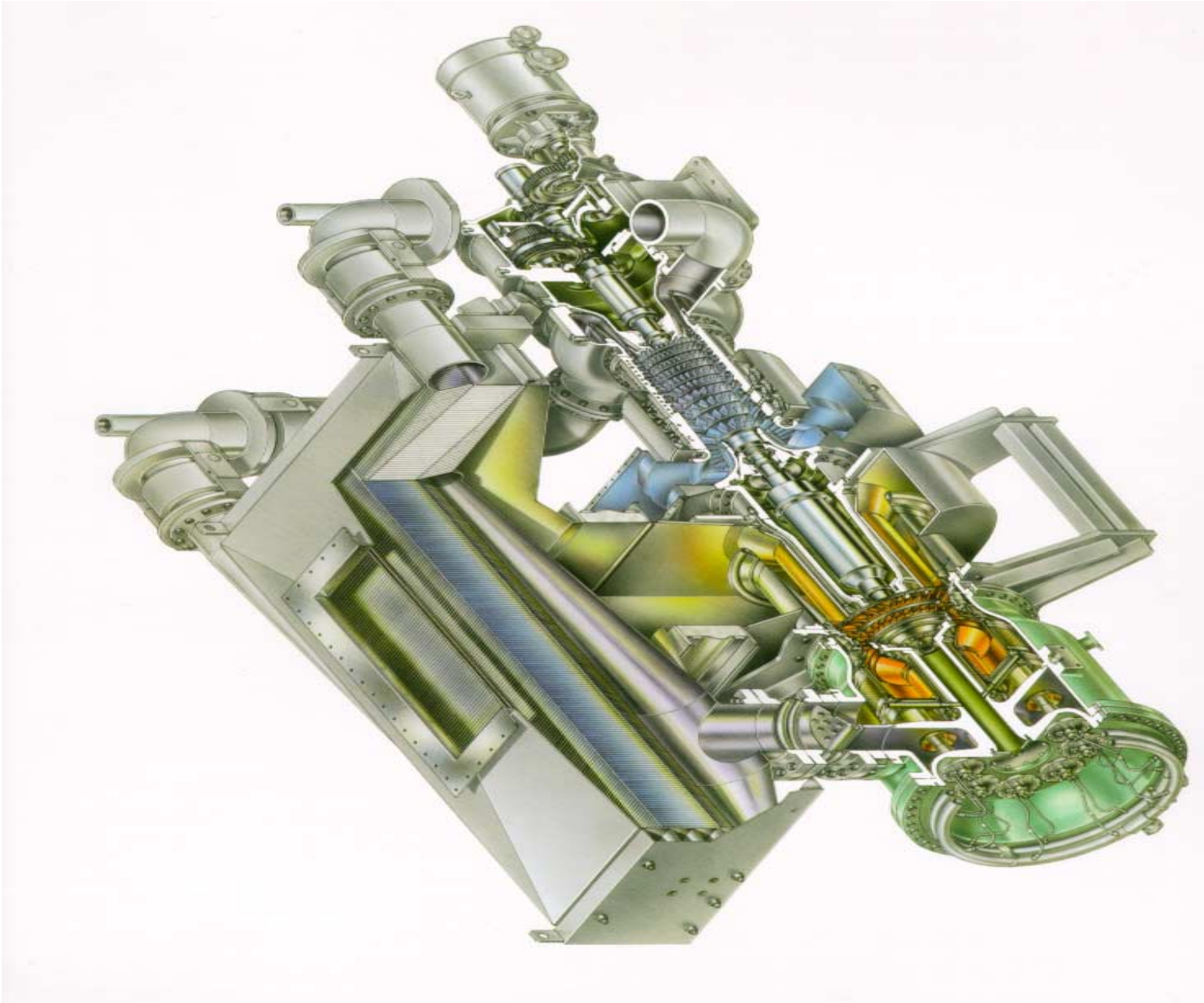


Capstone Microturbine

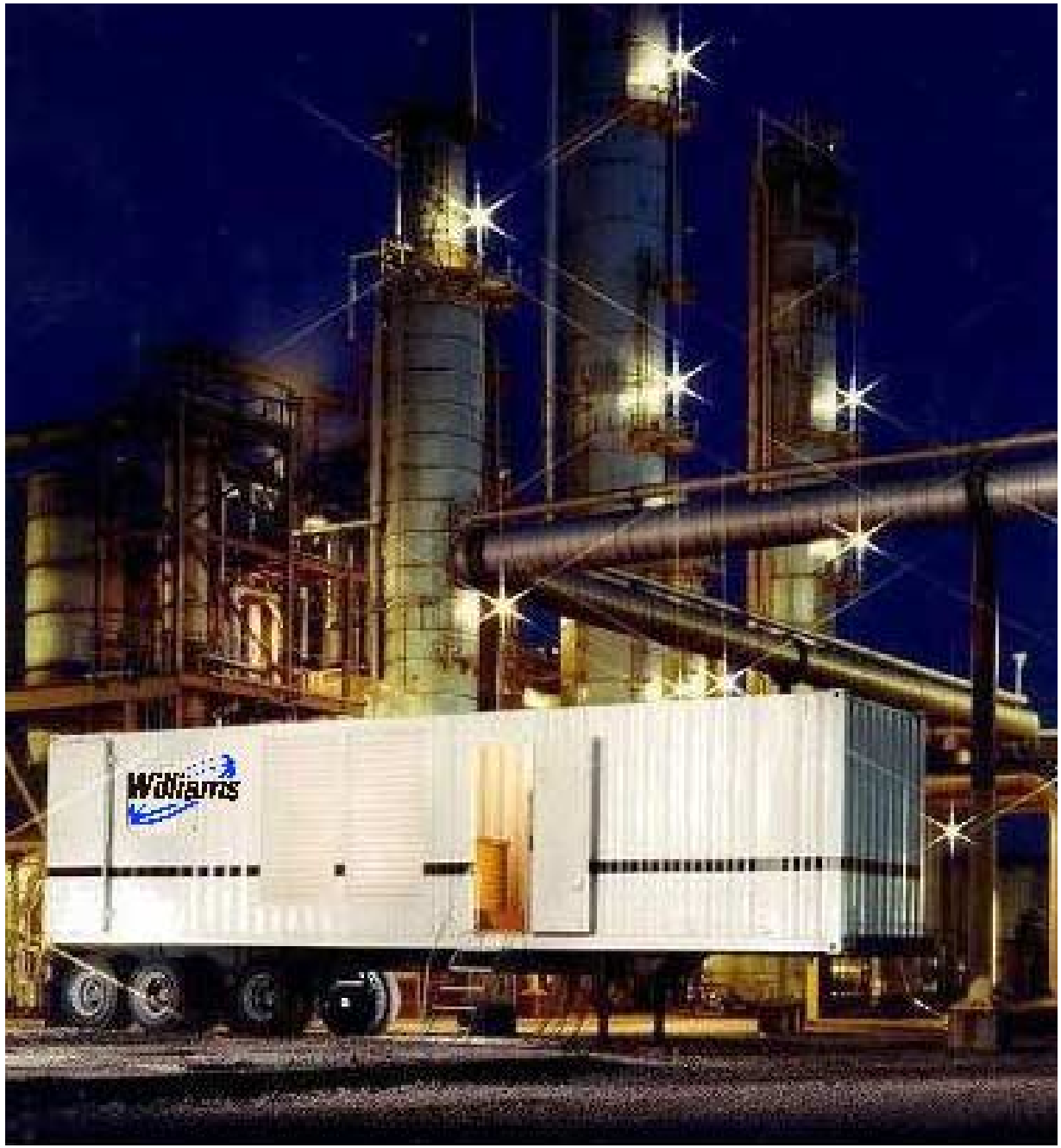


AlliedSignal - Parallon 75

Solar Turbines Mercury 50



Mobile Genset



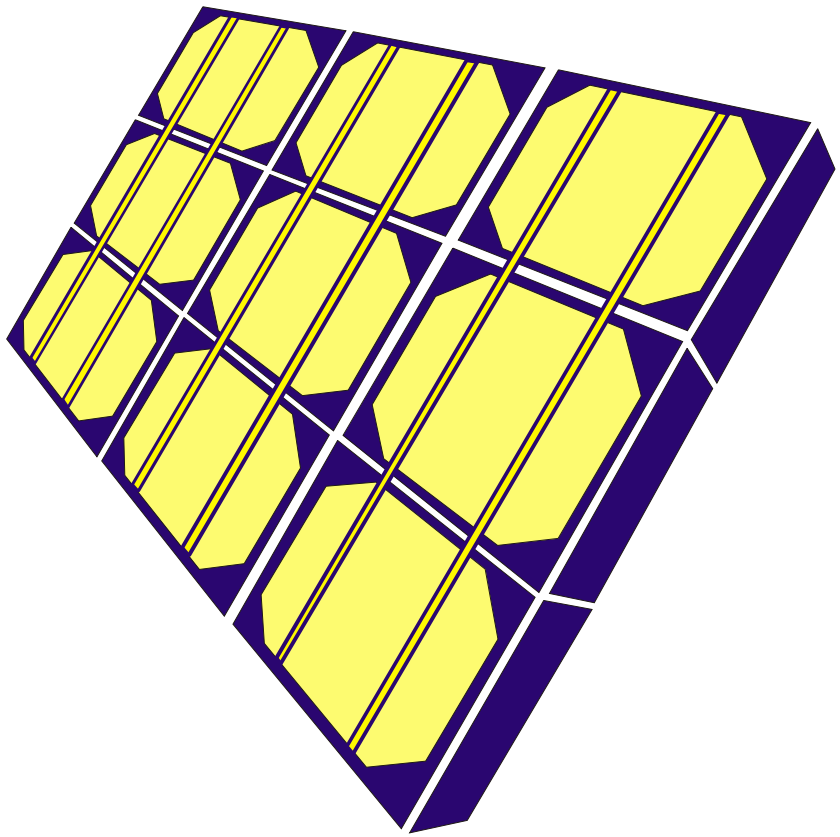
GEOTHERMAL ENERGY PLANT

West Ford Flat Facility, California

Whisper Gentech Stirling Engine

Stirling Genset

Renewables - PV, Wind



On December 27, 2000, the National Renewable Energy Laboratory updated its tally of new renewable energy capacity built to serve green power customers. BPA is still number one.

Capacity Added from Green Marketing Activities (kW)

Last Updated on December 27, 2000

Program by State	Wind	Solar	Biomass	Geothermal	Planned
California					
Commonweath	0	0	0	5,000	0
Enron	16,500	0	0	0	0
Green Mountain	2,100	232	0	0	0
PG&E Corporation	0	0	0	0	44,400
Tenderland	0	0	0	0	10,000
New England					
Allenergy	0	0	1,600	0	0
Sun Power Electric	0	93	0	0	0
Northwest					
Bonneville Power	33,920	0	0	0	0
New York					
Atlantic Renewable Energy	0	0	0	0	12,000
PG&E Generating	11,550	0	0	0	0
Vestas American	6,600	0	0	0	0
Pennsylvania					
Atlantic Renewable Energy	0	0	0	0	15,600
Community Energy	130	0	0	0	130
Green Mountain	10,400	43	0	0	87
Totals:	**81,200**	**368**	**1,600**	**5,000**	**82,217**
Percentage of Totals:	**92.1%**	**0.4%**	**1.8%**	**5.7%**	
Total Added:	**88,168**				

The above table was found at: http://www.eren.doe.gov/greenpower/new_gp_t2.html

Other categories can be found at: http://www.eren.doe.gov/greenpower/new_gp_cap.shtml

Renewables at BPA

Resources - Solar, Wind, Small approved Hydro, possibly Geothermal
As of April 2000 BPA has sold 36.7MW average - mostly wind, some hydro and a tiny amount of solar.

Goals:

Year	Power	
2002	150MW	
2004	300MW	
2010	1000MW	(RFP May 2001 - 1000MW)

Who's buying "green" power?

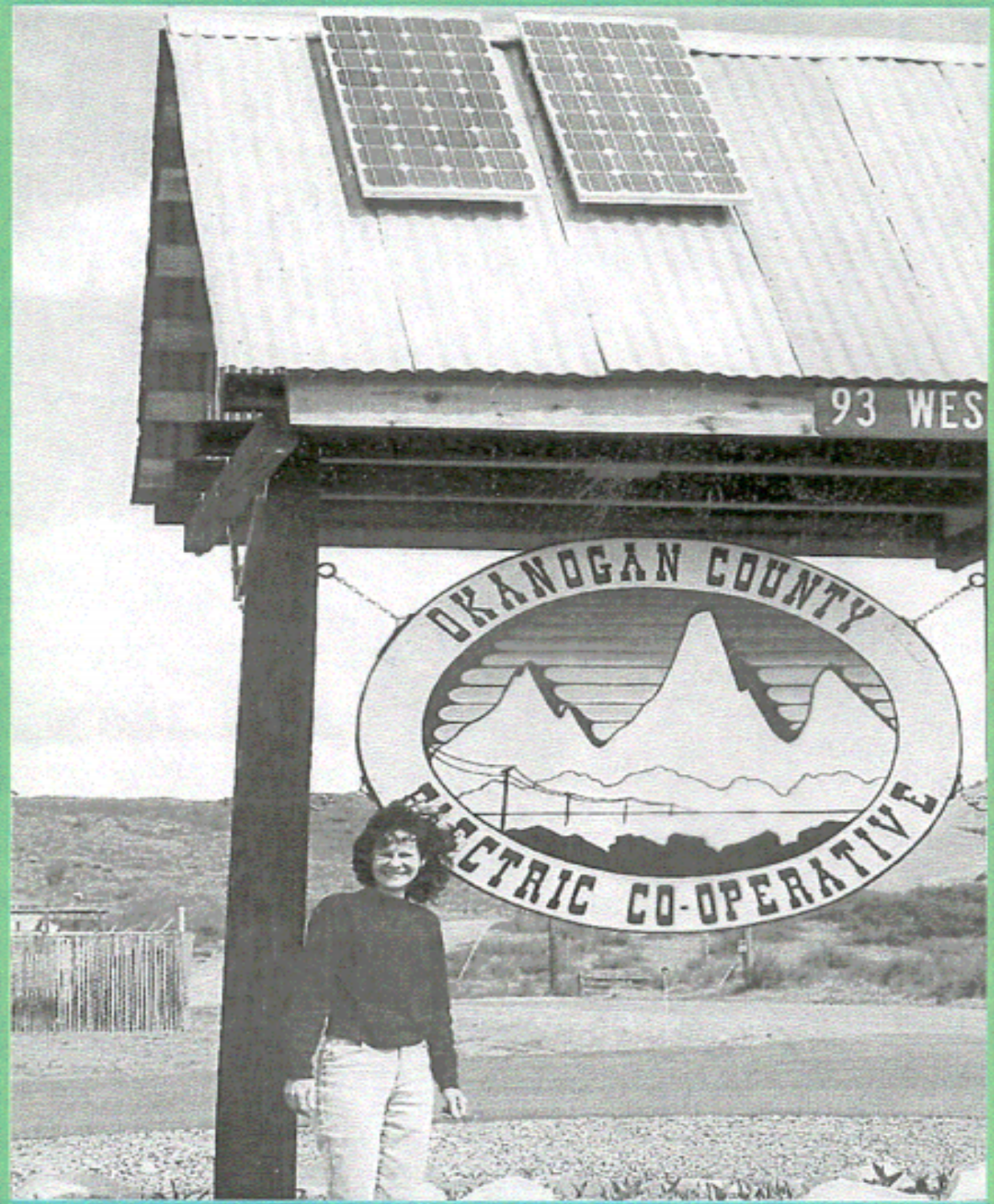
Emerald PUD	3.0 aMW
Flathead Electric Co-op (Mont.)	1.0 aMW
Idaho Falls, City of (Idaho)	0.5 aMW
Lakeview Light & Power (Wash.)	1.0 aMW
Midstate Electric Co-op (Ore.)	0.2 aMW
Monmouth, City of (Ore.)	0.5 aMW
Orcas Power & Light (Wash.)	0.5 aMW
Portland General Electric (Ore.)	up to 14.0 MW
Salem Electric (Ore.)	6.5 aMW
Snohomish Co. PUD (Wash.)	10.0 aMW
Tacoma City Light (Wash.)	1.0 aMW

More info - http://www.bpa.gov/Power/PGC/wind/wind.shtml

Solar Voltaic

in

Remote Areas



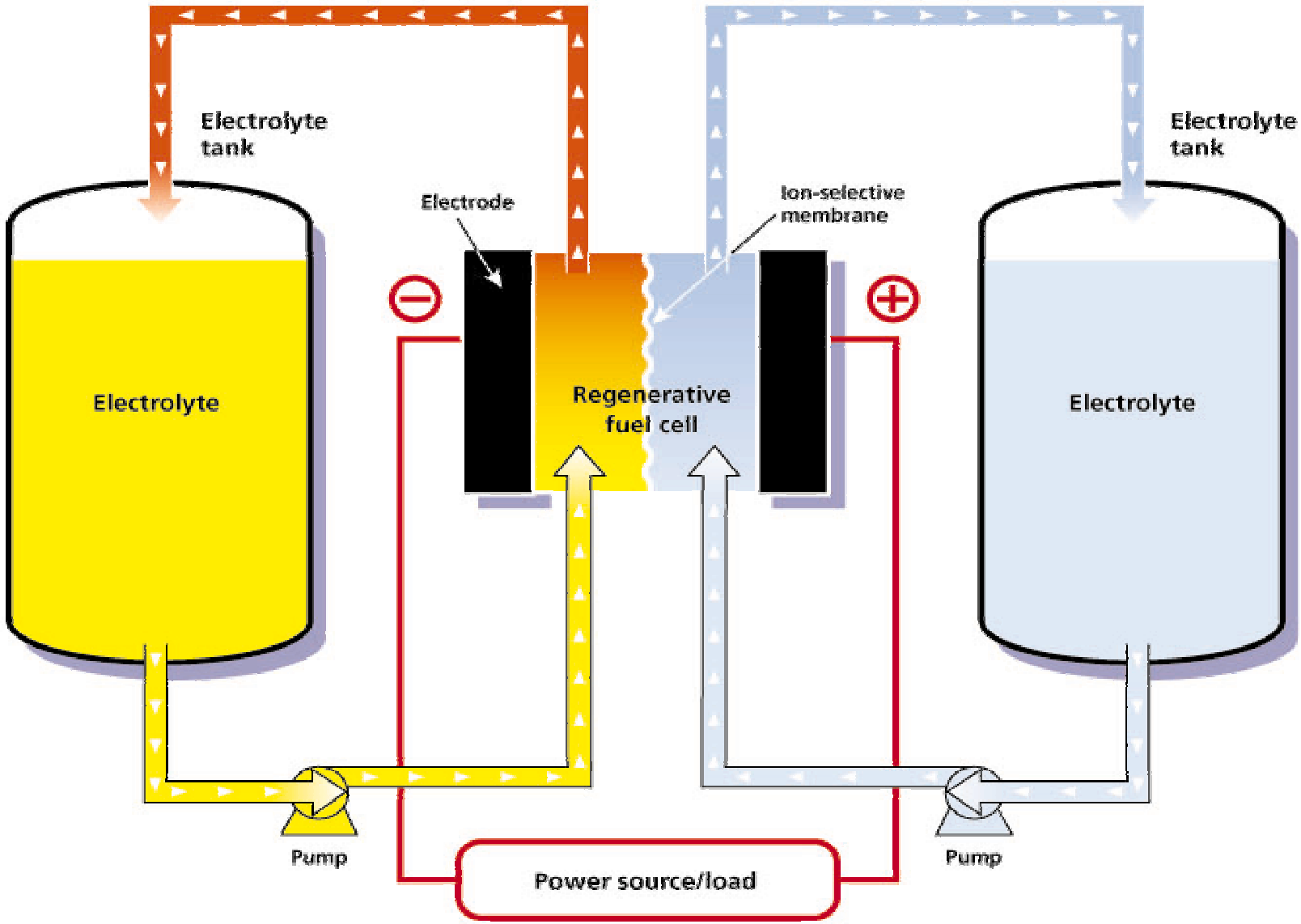
Ashland Solar Roof

Dish Sterling

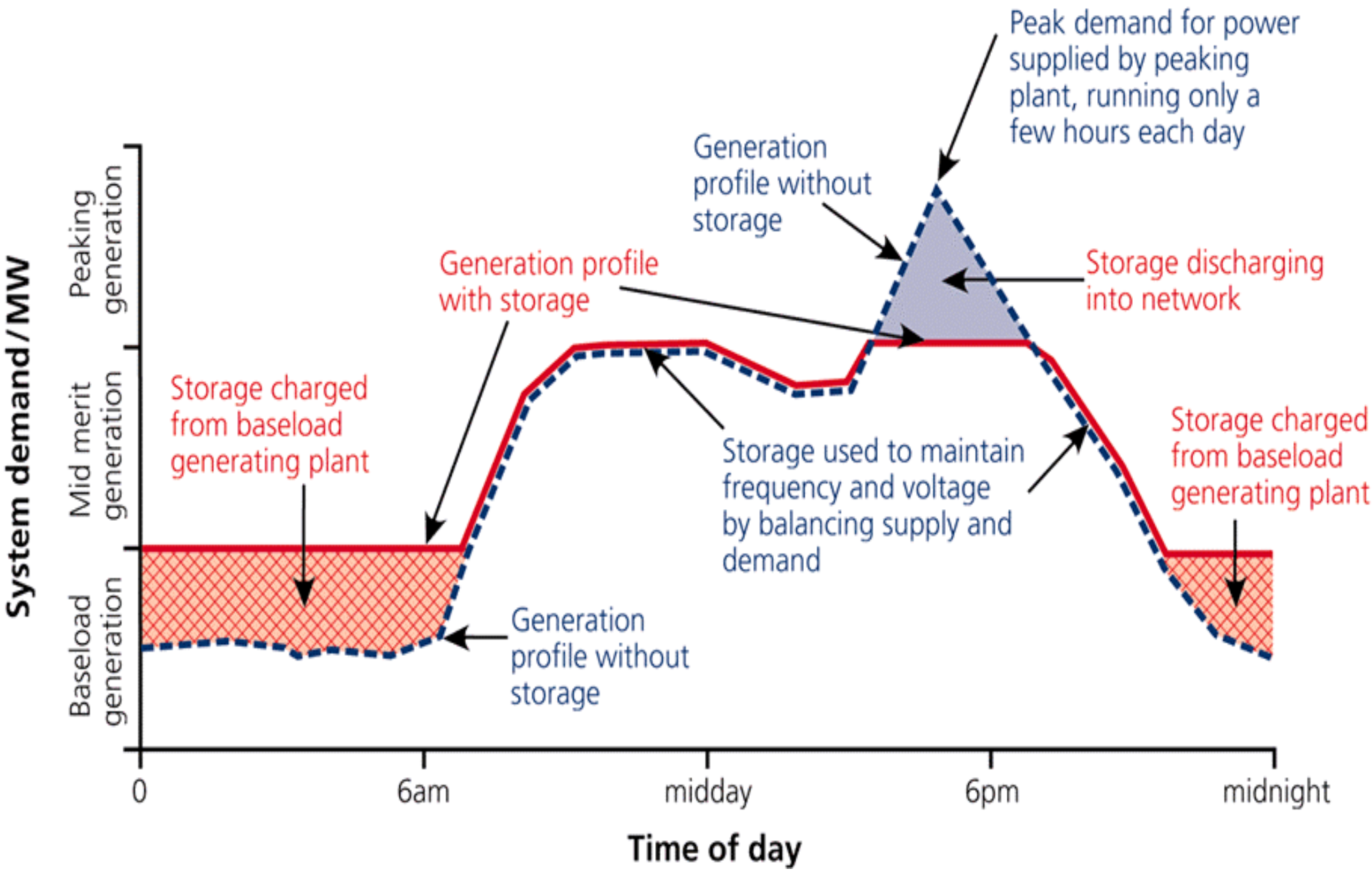
CENTRAL STATION WIND FACILITY

Wyoming Wind Project

The Regenesys™ system

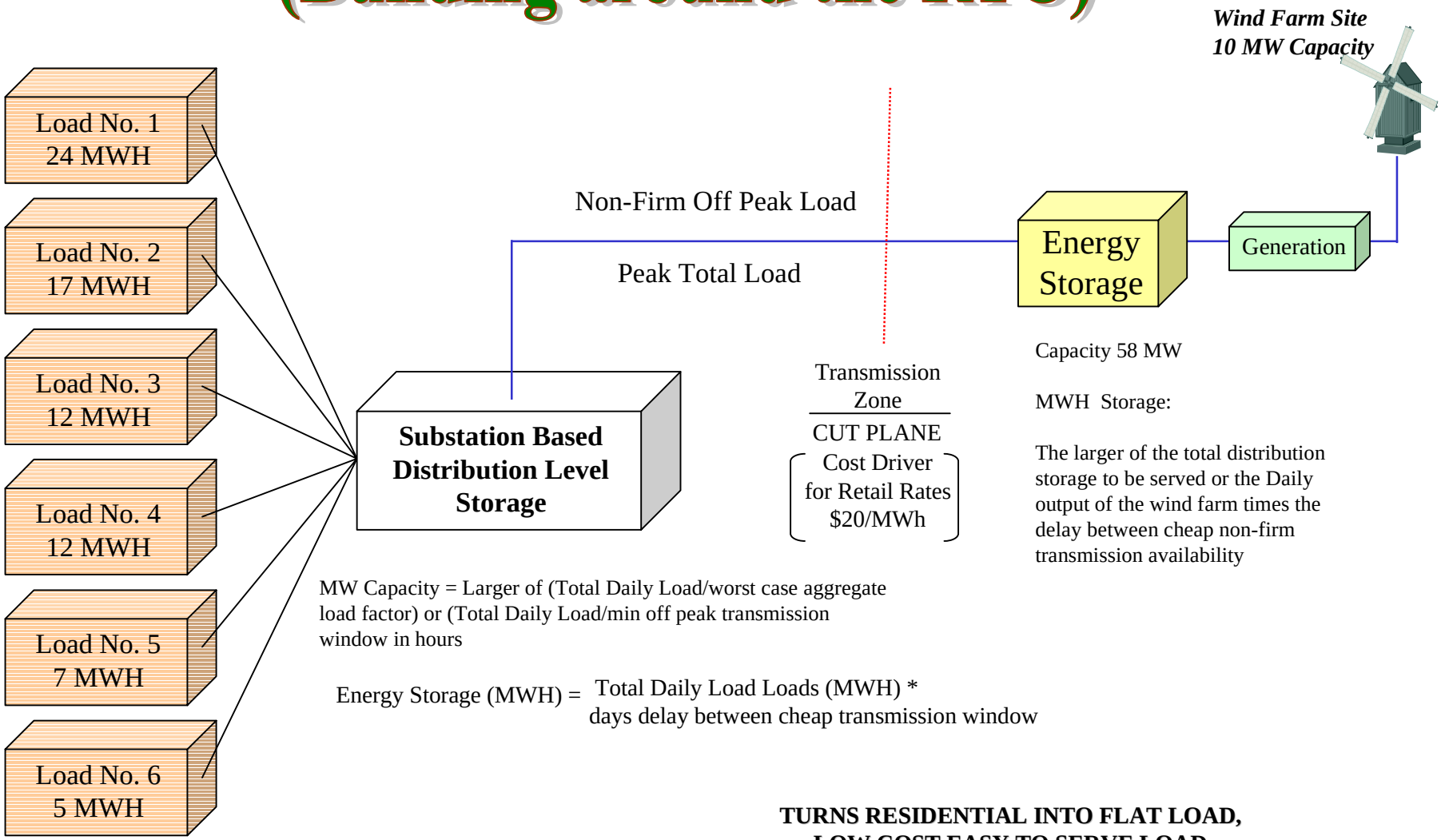


Regenesys Uses



Regenesys Plant Design - Little Barford, UK

Virtual Green Extension Cord
(Building around the RTO)



MW Capacity = Larger of (Total Daily Load/worst case aggregate load factor) or (Total Daily Load/min off peak transmission window in hours

Energy Storage (MWH) = Total Daily Load Loads (MWH) * days delay between cheap transmission window

TURNS RESIDENTIAL INTO FLAT LOAD, LOW COST EASY TO SERVE LOAD

RETAIL ACCESS OR TIME OF DAY RATES ARE NECESSARY TO SELL THE EXTENSION CORD TO END USERS

Prepared by: Allan E. Ingram, Mechanical Engineer, Bonneville Power Administration

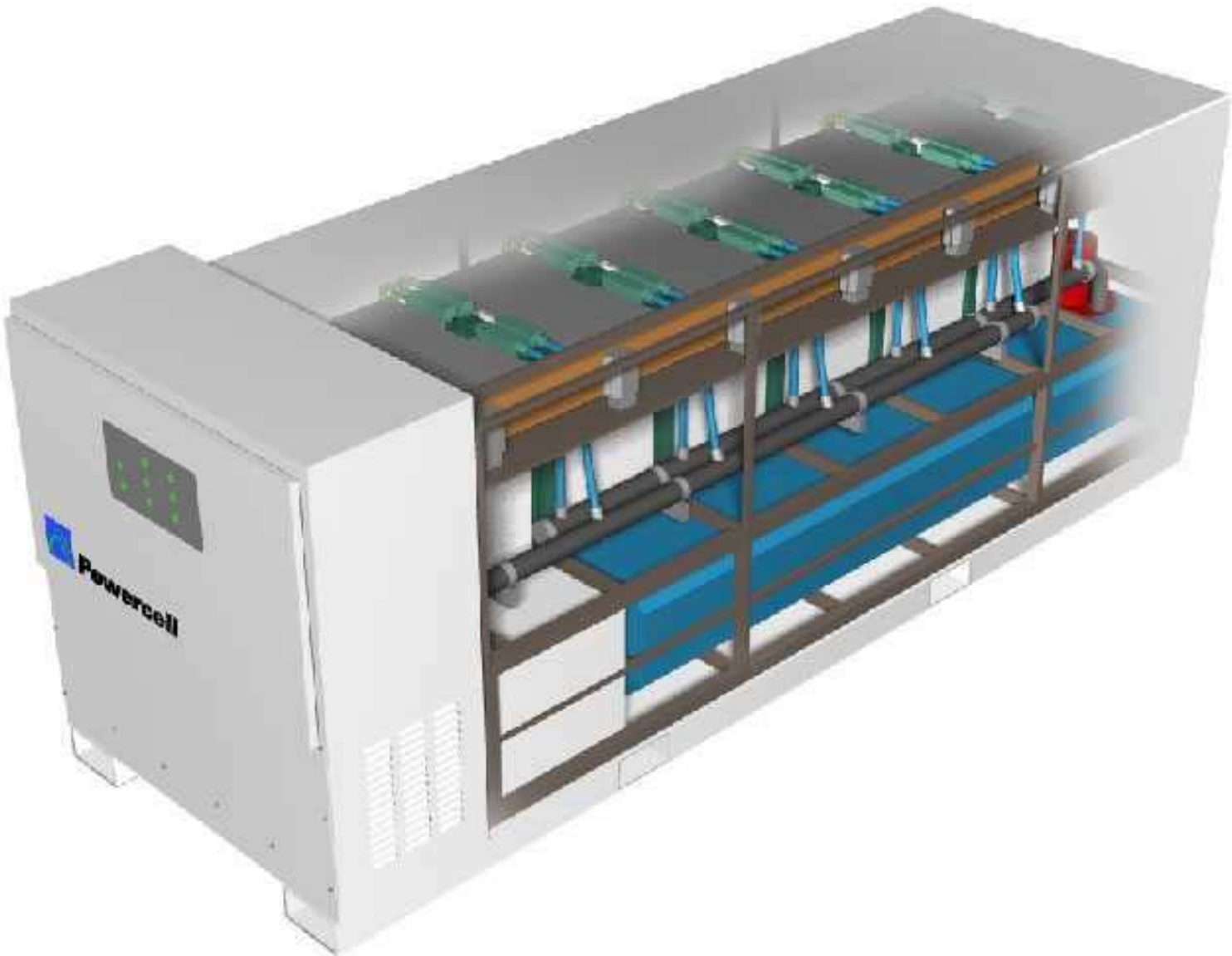
Advantages of using Energy Storage with Renewables

- Flat power blocks of renewables (wind, solar, etc.) could displace dirtier or higher CO2 content sources of power like coal or natural gas.

- If energy storage systems were of large enough and cheaper enough they could help with night time operational issues on a hydro system, where minimum flows must be maintained for fish, navigation and other reasons – i.e. store energy at night, maintaining flows and sell during the day at HLH prices.

- This could help minimize the use of pumped storage facilities which have gained recreational and fishing uses that once put in place are politically hard to return to hydro operations use

PowerCell Battery



Smart metering - a major component of the EnergyWeb - will be key to “chips talking to chips” for accounting

What are the options for utilities in the market?

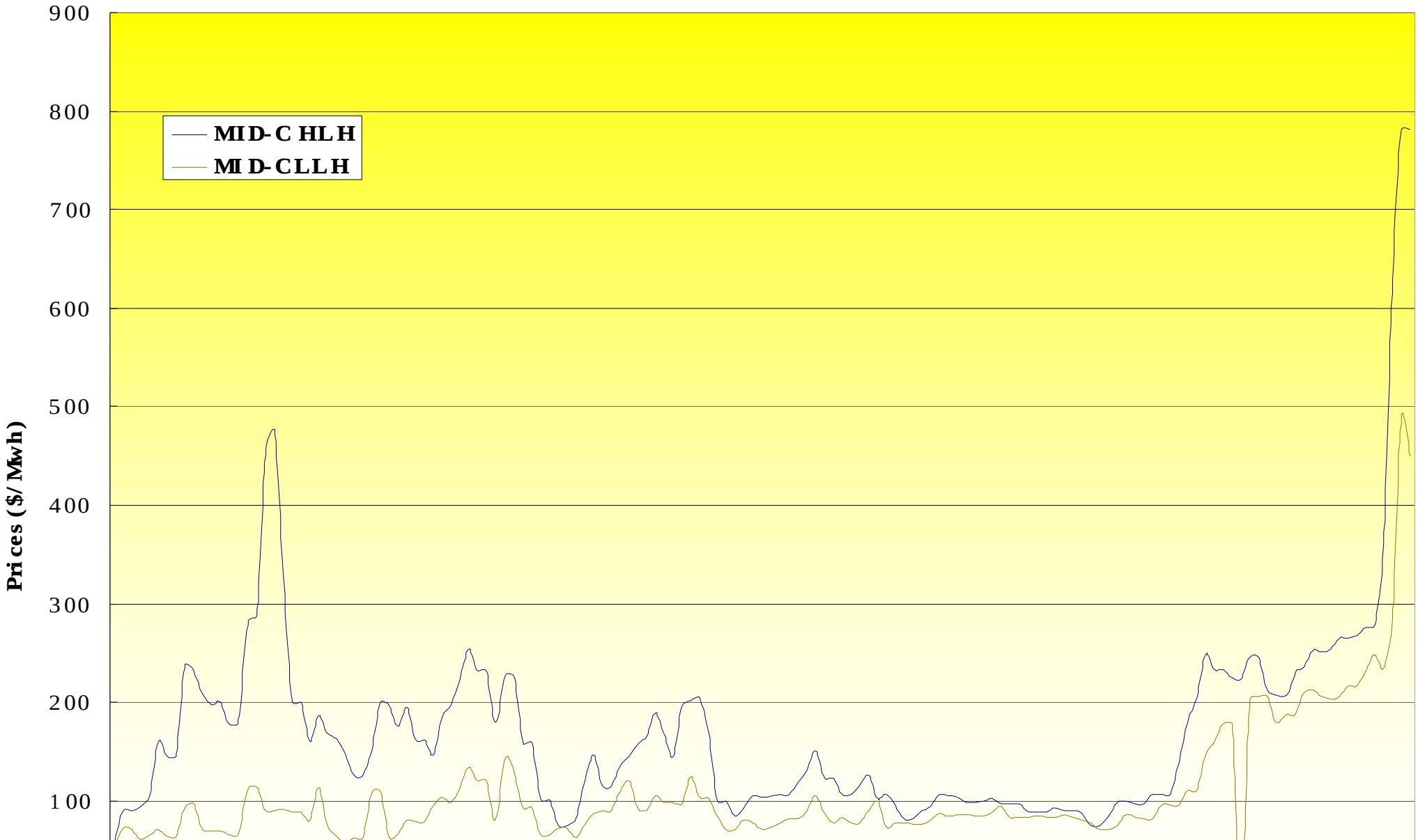
Distributed Generation (DG)

Energy Storage (ES)

Dispatchable Demand Side Management (DDSM)

Conservation - Energy Efficiency (EE)

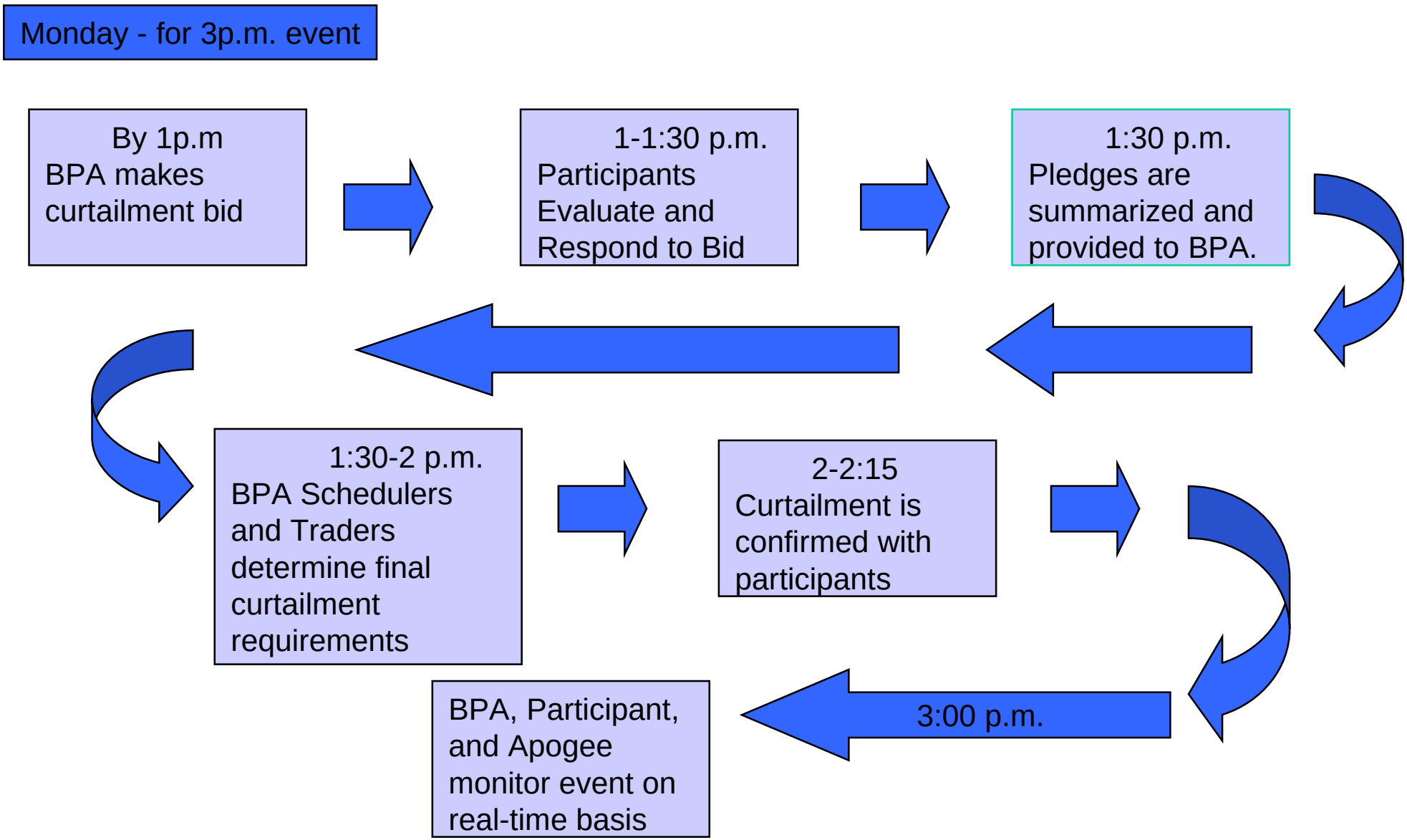
The reason for Peak Load Management or Energy Storage - Daily Price Spreads (or Value and Time Scale for ES in PNW)



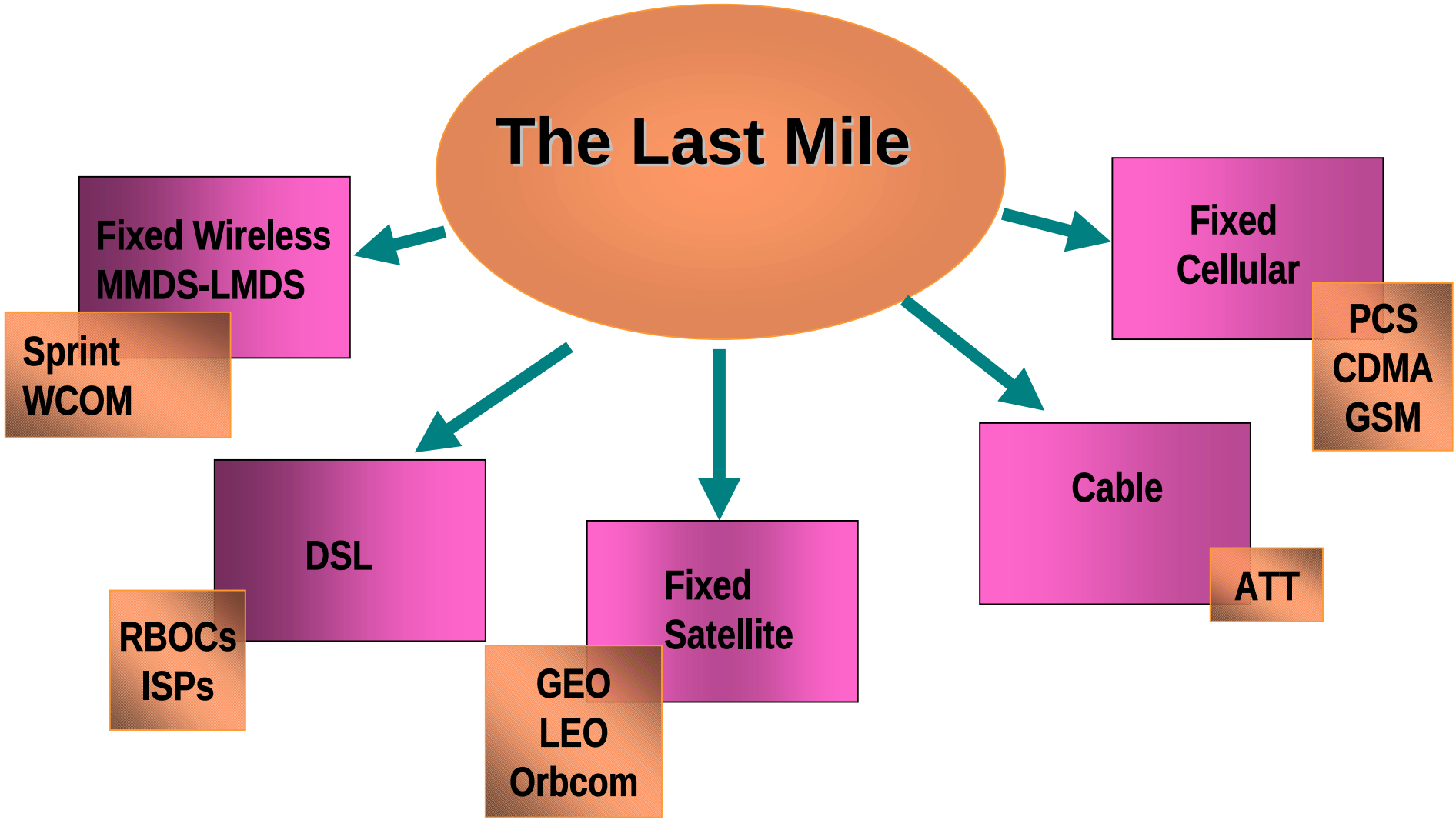
http://www.demx.com/

The
DEMAND EXCHANGE
The Power of Customer Choice℠

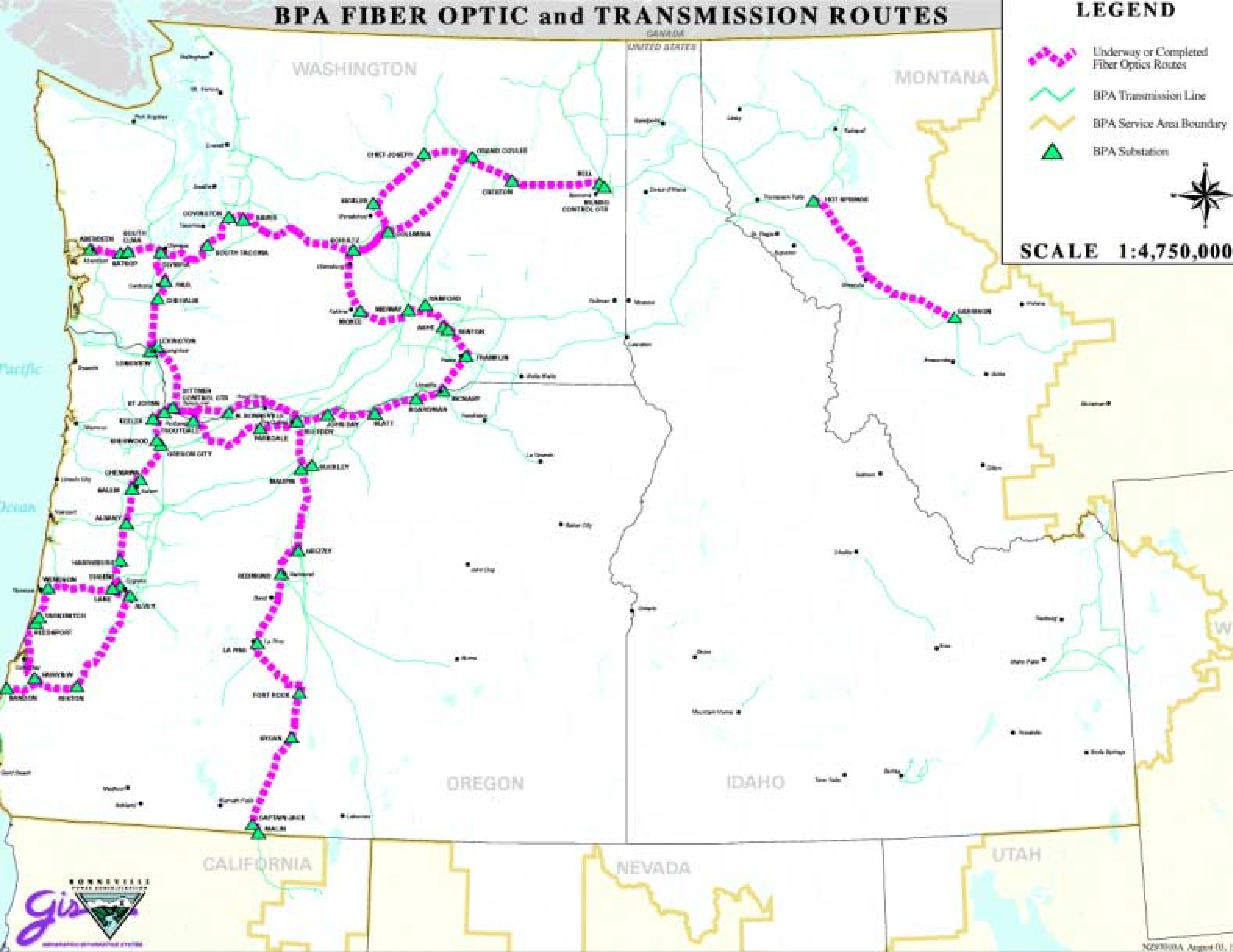
So how does the DEMX work?
Real-Time Demand Exchange Mechanics



Communications in the EnergyWeb



BPA FIBER OPTIC and TRANSMISSION ROUTES



What BPA is working toward in FY 2001

Continue Fuel Cell project

Expand PLM project - add virtual generation hot water heater control expansion

Demo data sharing for the Energy Web

Work toward Energy Storage Demo

MicroTurbines demo

Smart buildings seminar - (DEMX applications)

ROLES YOU CAN PLAY

Innovator

Enabler

Advocate

Leader

Investor

Partner

WHY YOU SHOULD PARTICIPATE:

Energy Web 2010 is happening as we speak

Technological innovation is both a threat and an opportunity

The world is becoming even more globally connected

We have a duty to improve - Energy Supply & Quality of Life

Utilities have been social and technological innovators

Utilities and Government agencies manage a huge infrastructure that can be used to promote change for the public good

How could you implement the Energy Web?

PowerCo

Marketing to the Web
Technological Innovation
Distributed Generation
Environmental Focus
Develop Renewables
Green Power Certification
Promote Consumer Choice
Promote Market Development
Develop New Products
Sound Financial Practices
Outreach
Advocacy

TransCo

Building the Infrastructure
Technological Innovation
Environmental Focus
Develop System Control
Improve Reliability
Be as “frictionless” as possible
Sound Financial Practices
Outreach
Advocacy

Others who have concepts similar to the Energy Web

US - Kal Kobayashi, energy program manager County of Maui in Hawaii, next slide

Germany - EWE, Oldenburg, one of ten largest German utilities - Andreas Ballhausen & CEO Dr. Werner Brinker (prototyping currently) following slide

Germany - EUS consulting, SWK, & city of Bocholt - in operation integrating wind and energy storage to shave peaks - IIR Energy Storage Conference, London, 30, 31 Jan. 2001

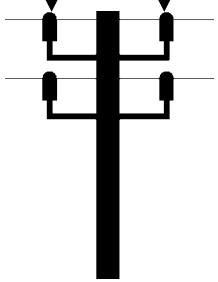
UK - Dr. Alan Collinson, EA Technology - IIR Energy Storage Conference, London, 30, 31 Jan. 2001

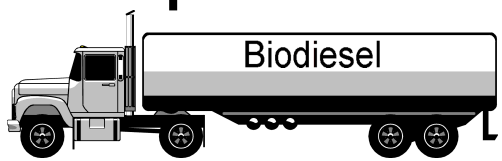
Maui - The Intergrid

Home Powersites

Commercial Powersites

Industrial Powersites





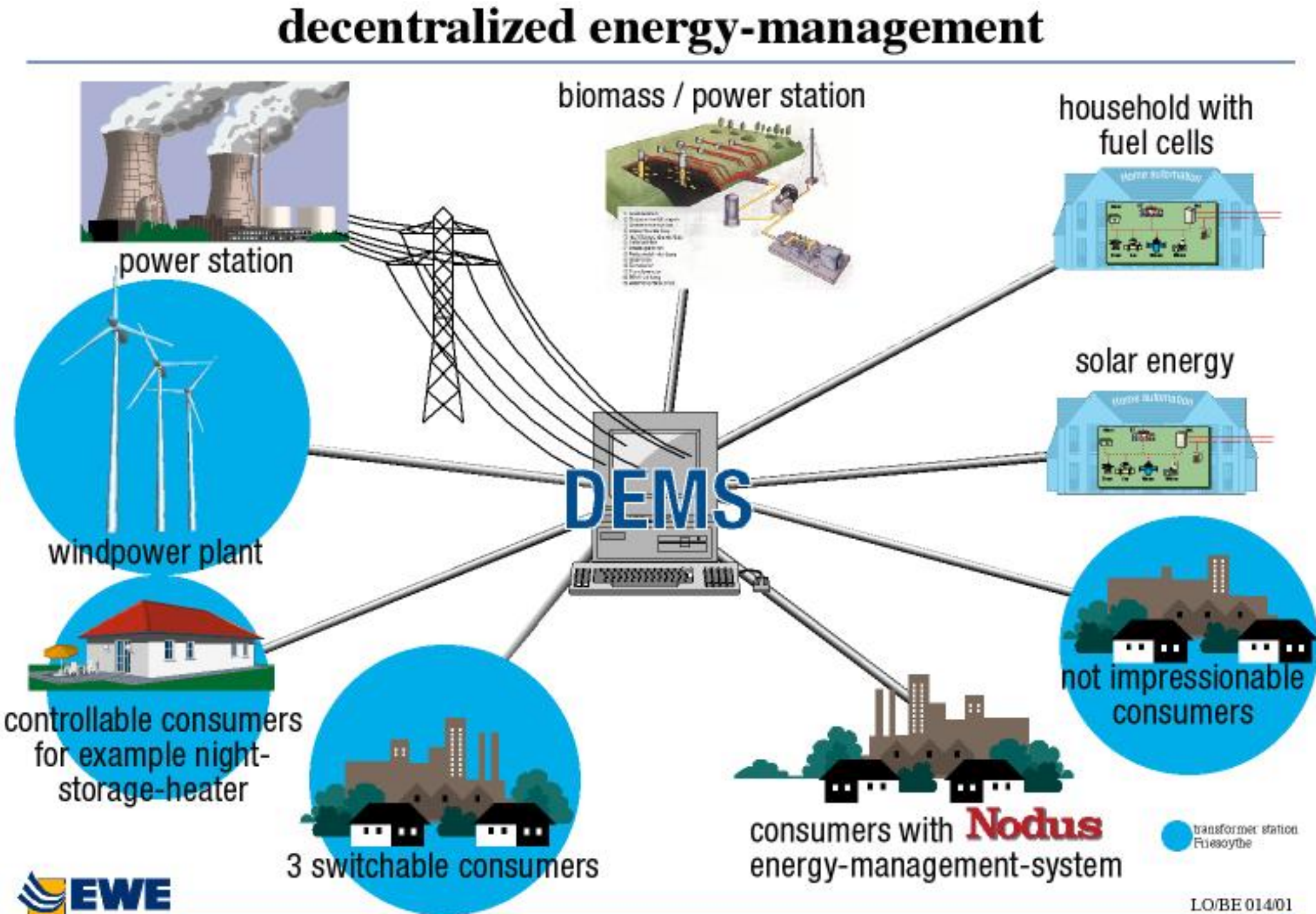
Gaseous Fuels
- Propane Delivery
- Gas Pipelines

Electric Grid
- Power Plants
- Power Lines

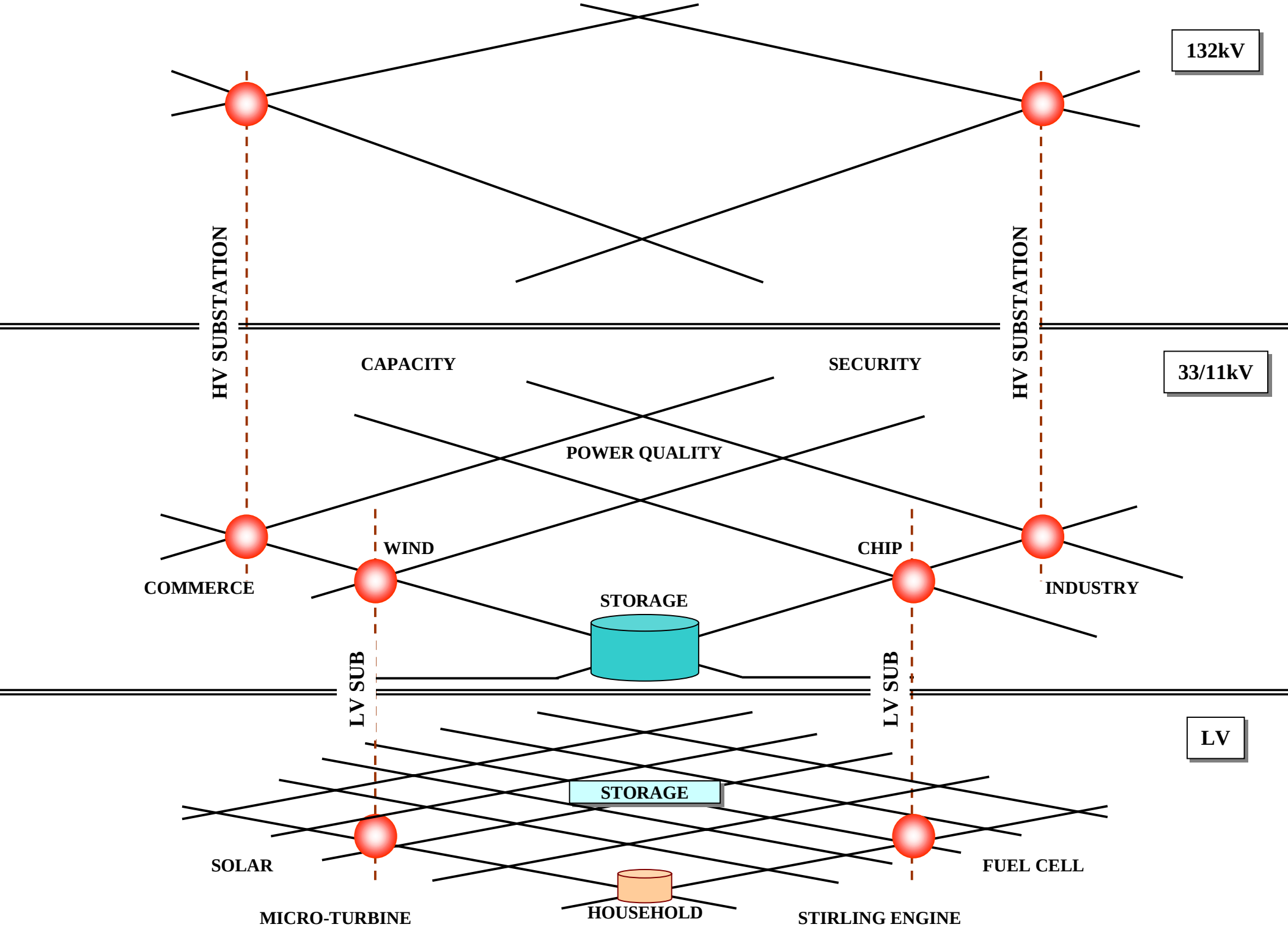
Solid Fuels
- Bagasse
- Coal
- Refuse

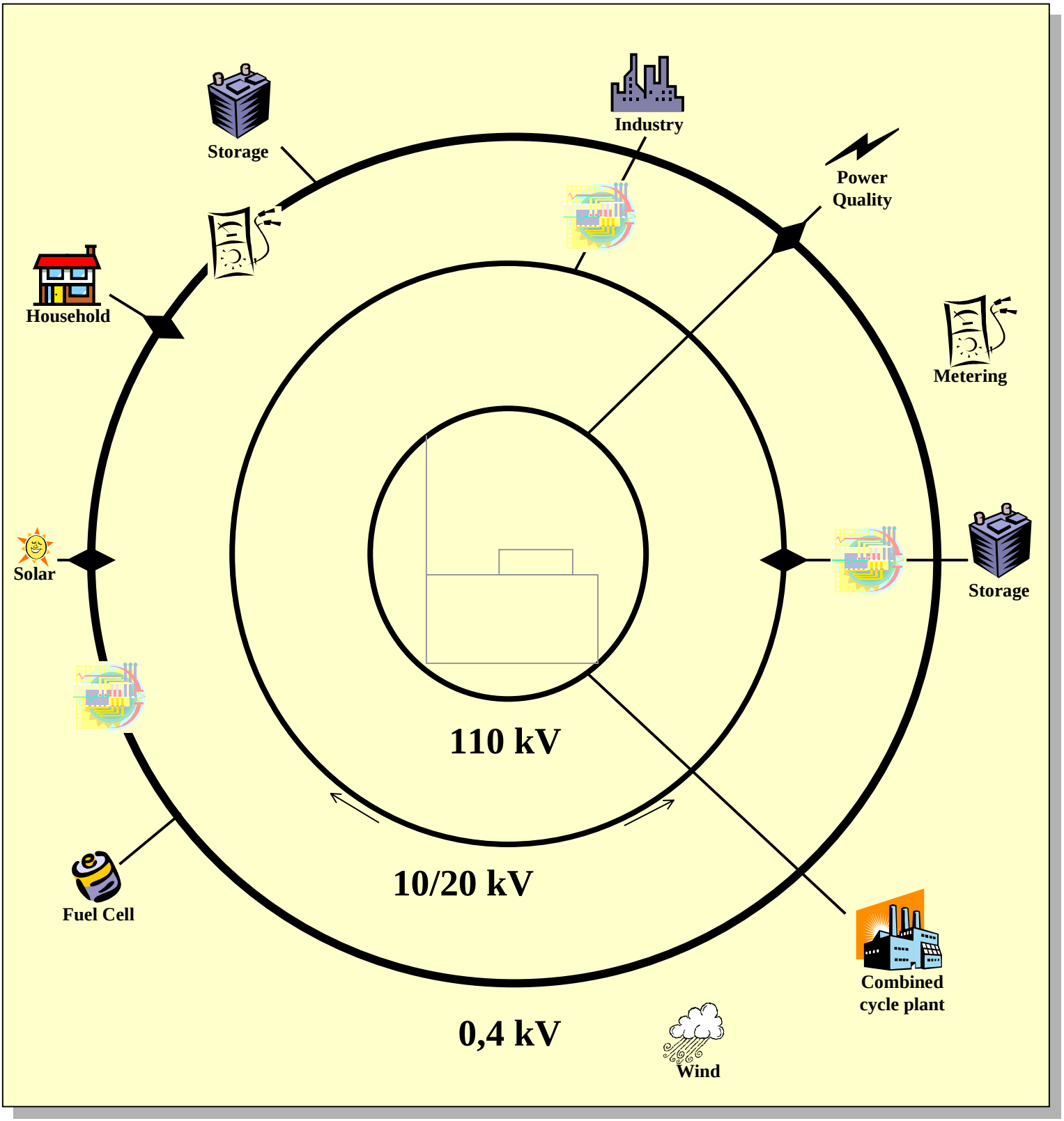
Liquid Fuels
- Diesel
- Biodiesel
- Ethanol

EWE - DEMS concept



INTERCONNECTED NETWORK - Allan Collinson EA Technology - UK





Intelligent Electric Power Networks

Advantages:

Fuel cell system

Energy storage

Power Quality

+

Decentralized energy management systems

+

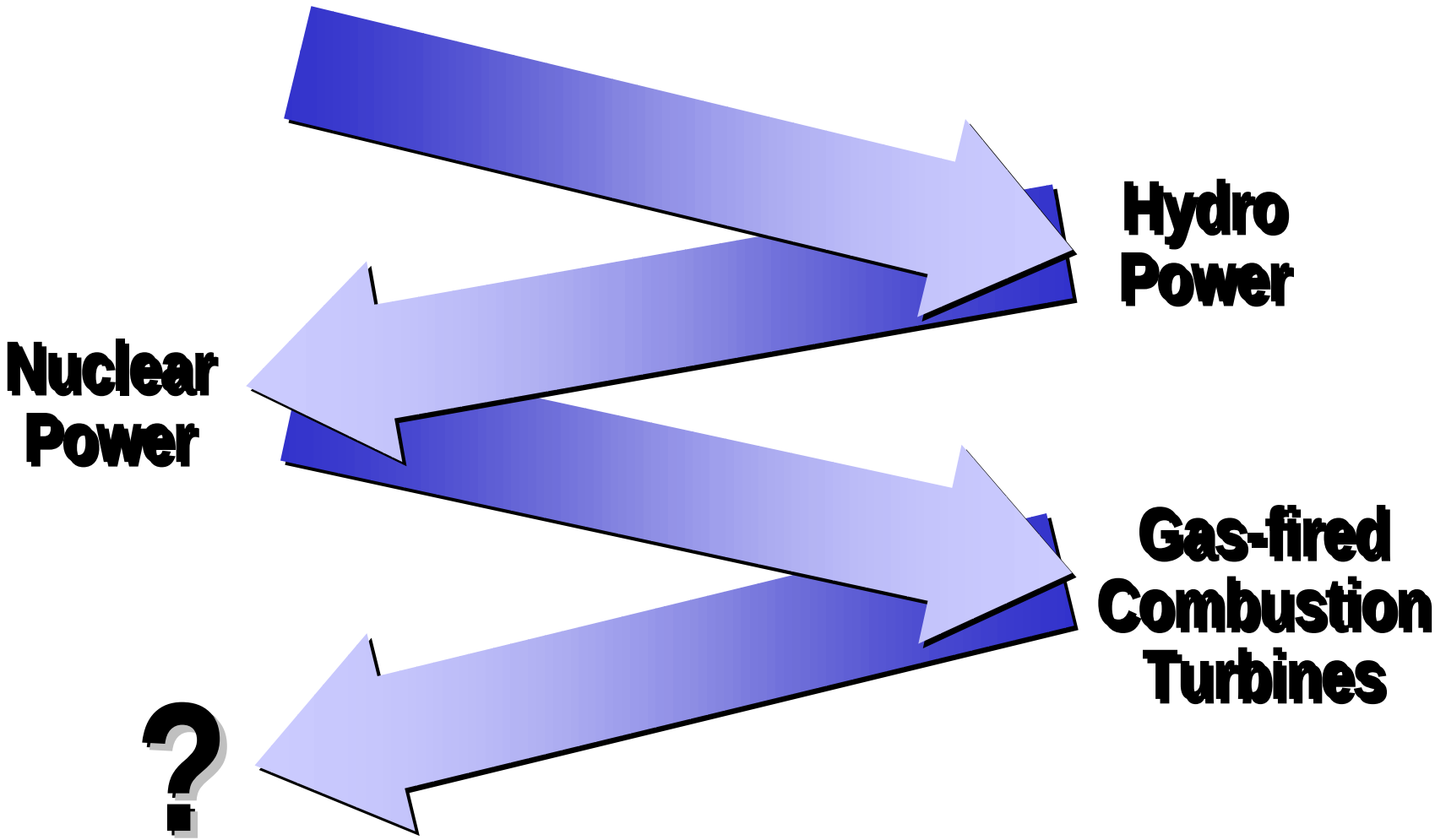
Intelligent communication systems

=

The Electric Power Network of the Future

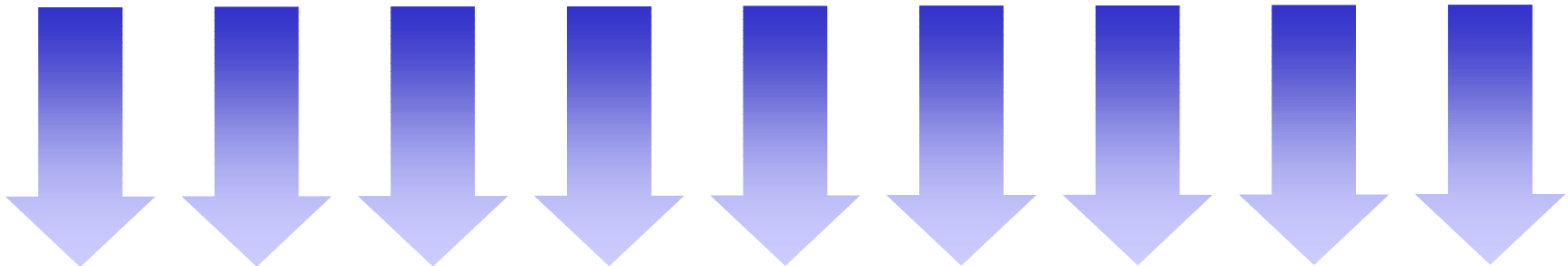
Thomas Pierschke - EUS, Germany

The "Lurch Theory" in Action



High Risk: Large Investment; Centralized Control; Little Diversity

EnergyWeb @ 2010 Approach: Kaizen



Lots of small steps working toward a vision that will change over time.

"Kaizen" - Continuous Improvement


"I've got a great idea"
"It won't work here."
"We've tried it before."
"This isn't the right time."
"It can't be done."
"It's not the way we do things."
"We've done all right without it."
"It will cost too much."
"Let's discuss it at our next meeting."