



Salem, Oregon

December 1, 2009

Renewable Energy Technologies & Distributed Generation

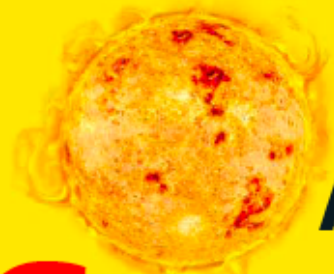
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The Long-Lost
Siblings of
OUR SUN

page 40



A Plan for a

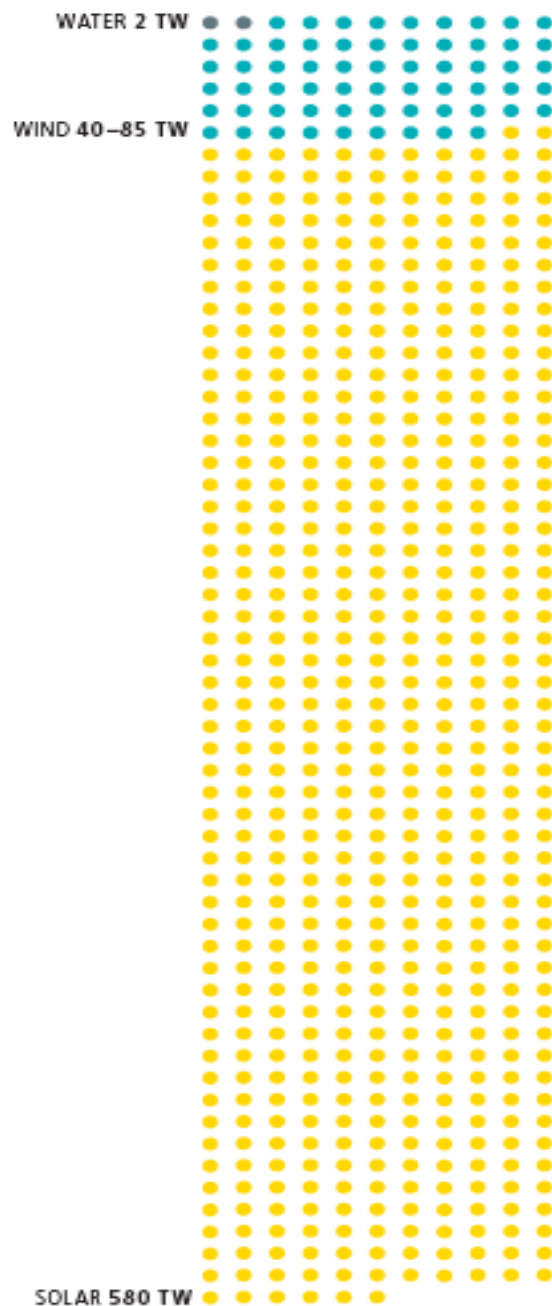
Sustainable Future

How to get all energy from
wind, water and solar power
by 2030



What is
possible?

**RENEWABLE POWER AVAILABLE
IN READILY ACCESSIBLE LOCATIONS**



**POWER NEEDED
WORLDWIDE IN 2030**



IF CONVENTIONAL
SUPPLY 16.9 TW

OR



IF RENEWABLE
SUPPLY (MORE
EFFICIENT)
11.5 TW

**RENEWABLE INSTALLATIONS
REQUIRED WORLDWIDE**

WATER 1.1 TW
(9% OF SUPPLY)

490,000

TIDAL TURBINES - 1 MW* - <1% IN PLACE
*size of unit

5,350

GEOHERMAL PLANTS - 100 MW - 2% IN PLACE

900

HYDROELECTRIC PLANTS - 1,300 MW - 70% IN PLACE

3,800,000

WIND TURBINES - 5 MW - 1% IN PLACE

720,000

WAVE CONVERTERS* - 0.75 MW - <1% IN PLACE
*wind drives waves

1,700,000,000

ROOFTOP PHOTOVOLTAIC SYSTEMS* - 0.003 MW - <1% IN PLACE
*sized for a modest house; a commercial roof might have dozens of systems

49,000

CONCENTRATED SOLAR POWER PLANTS - 300 MW - <1% IN PLACE

40,000

PHOTOVOLTAIC POWER PLANTS - 300 MW - <1% IN PLACE

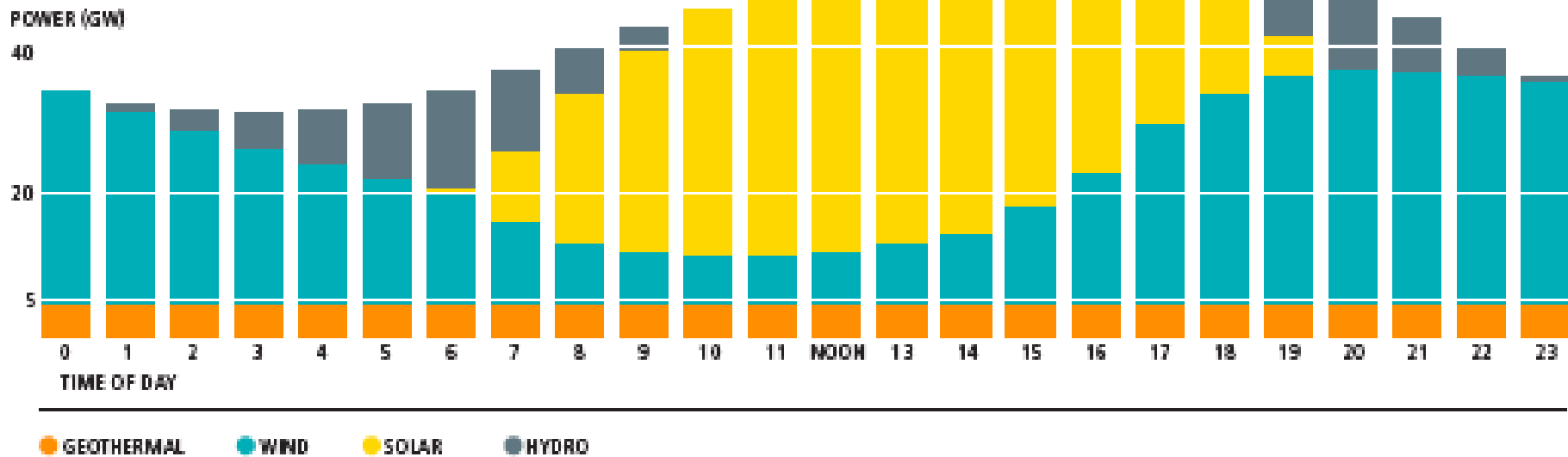
WIND 5.8 TW
(51% OF SUPPLY)

SOLAR 4.6 TW
(40% OF SUPPLY)

What's Possible?

CLEAN ELECTRICITY 24/7

typical July day. The hydroelectric capacity needed is already in place.



Array of Technologies

Small-scale

- Solar photovoltaics (PV)
- Small-scale wind
- Solar thermal
- Biogas
- Biomass
- Small hydro
- Wave & tidal

Large-scale

- Wind

Distributed Generation

- Fuel cells



Federal Incentives

- Investment tax credit (30% of up-front costs)
- Accelerated depreciation (over 5 years)
- Production tax credit (2.1 cents/kWh)
- Clean Renewable Energy Bonds (Feds pay holder a tax credit in lieu of interest from issuer)
- USDA incentives (REAP, EQIP)

Federal Incentive Implications for Projects

- Federal tax incentives allow for multiple equity investors in projects
- Dramatically lowers cost of energy to the project host (e.g., landowner)
 - Host may just pay for the power output – at a predictable rate into the future!
- Today, more common for commercial building projects

Oregon State Policies

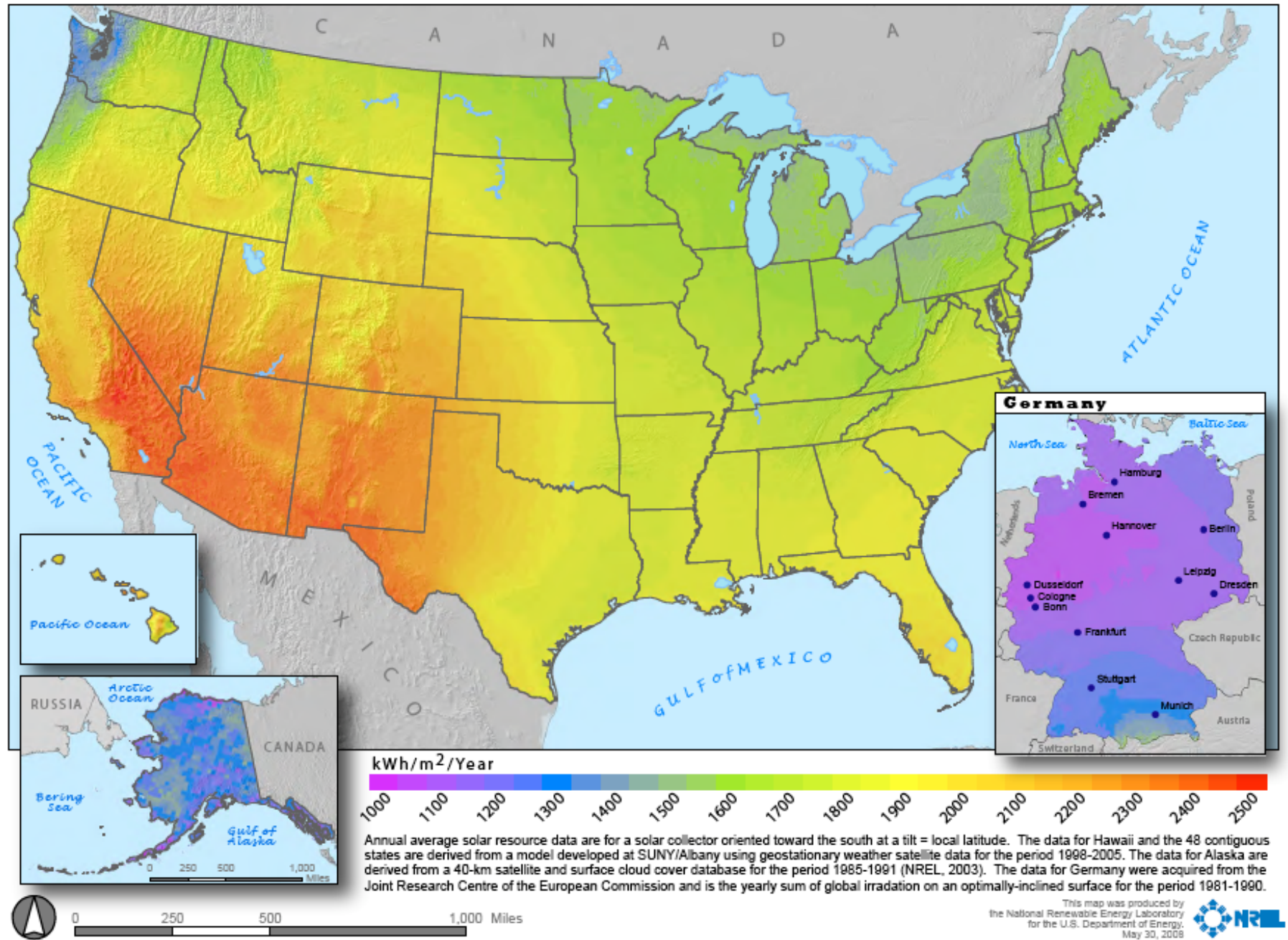
- **Renewable Energy Portfolio Standard**
 - A new value stream for projects (renewable energy credits)
 - Small projects get a bonus credit (and more value)
- **Business Energy Tax Credit**
 - Program currently under refinement by ODOE
 - Questions over changes to pass through mostly affect public entities
- **State Energy Loan Program**
 - SELP Loans exist for larger scale projects
 - EEAST residential and commercial loans still in pilot phase

Solar Photovoltaics

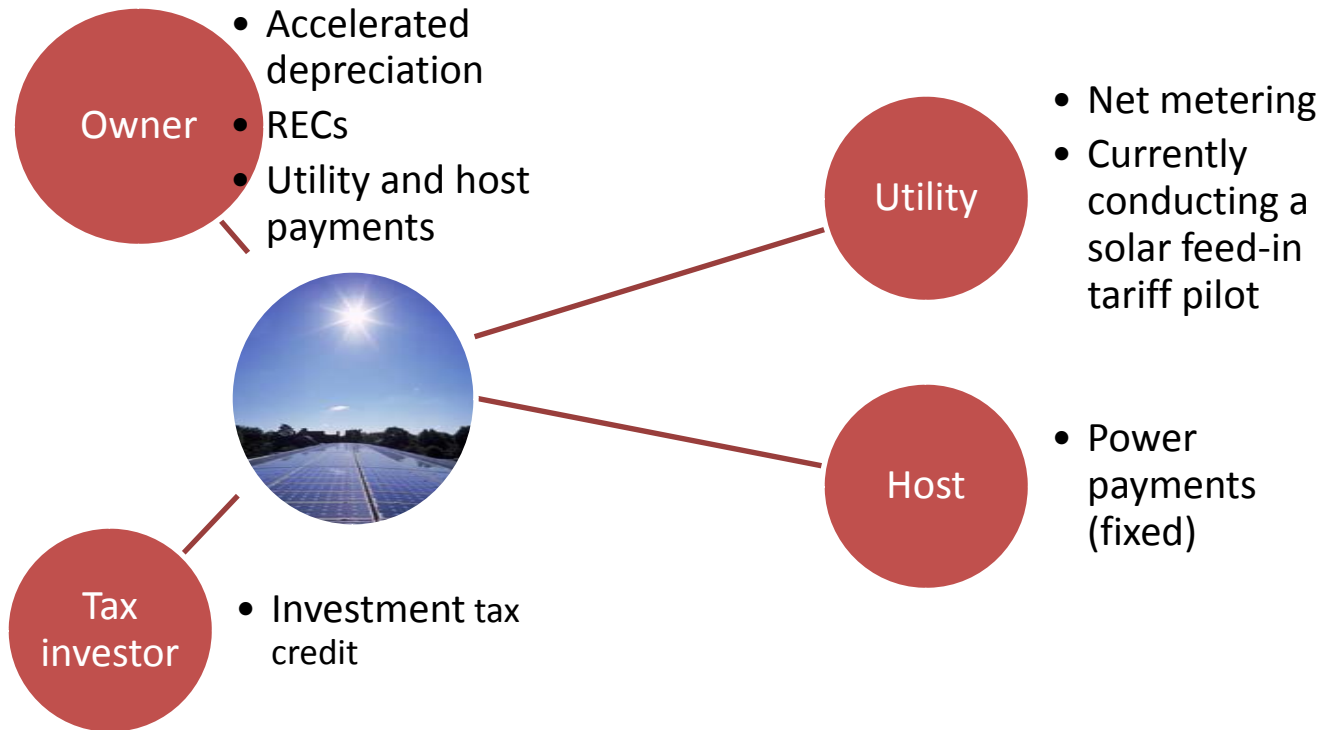
- Rising in growth due to technology cost cuts and strong state policy mandates
- Willamette Valley has good solar resource
- Relative ease in permitting and installation compared to large-scale renewables
- Third-party financing model very successful – minimizes cost to host and can fix host's energy prices



Photovoltaic Solar Resource : United States and Germany



Third-Party Financing for PV



Small-Scale Wind

Has lagged behind PV in market growth, due to lower policy support

Cost competitive with PV

A bit more work: wind measurement, permitting for tall structures

Most feasible in semi-rural and rural settings: siting, wind availability



Solar Thermal

- Established technology for water heating, especially in residential & multifamily applications
- Qualifies for federal investment tax credit and accelerated depreciation, but not production tax credit, state cash incentives, or net metering
- Less than 10-year payback versus electric, longer versus gas
 - Federal tax incentives are key



Biogas

- Many sources: animal waste, wastewater treatment, landfills
- Strong, measurable, and clearly defined environmental benefits
- Internal combustion the most popular conversion choice
- Future climate change regulation + energy incentives = opportunity?



Biomass

- Many sources: wood (waste or other), agricultural residues or commodity crop
 - Fuel availability is dependent on dynamics in other industries - e.g., timber, ag
- Strong environmental benefits with proper management
- The wood products industry has produced power from process waste for decades—many are refurbishing old systems for higher efficiency
- Depending on legislature, some biomass facilities may be eligible for the RPS



Small Hydropower

- Very cost competitive versus other power sources
 - Qualifies for net metering (<100 kW), federal production tax incentive,
- Loose definition: is it generation size, or project design to limit impoundments?
 - Definitions vary
- Increasingly popular as “run-of-river” in existing irrigation canals
- Be aware of extra permitting hurdles (Federal Energy Regulatory Commission) and associated lead times

Wave/Tidal

- Emerging area of development
- Oregon coast is one of the areas getting attention
- Current efforts facing some opposition, largely related to fisheries

Large-Scale Wind

- Most mature renewable energy technology today with dramatic growth
- Oregon has moderate wind resources compared to some mountain and Midwestern states
- Unclear what uncertainty over the BETC will do for investment – debate mostly over wind
- Some concerns over its variability, but many regional utilities have invested based on least cost



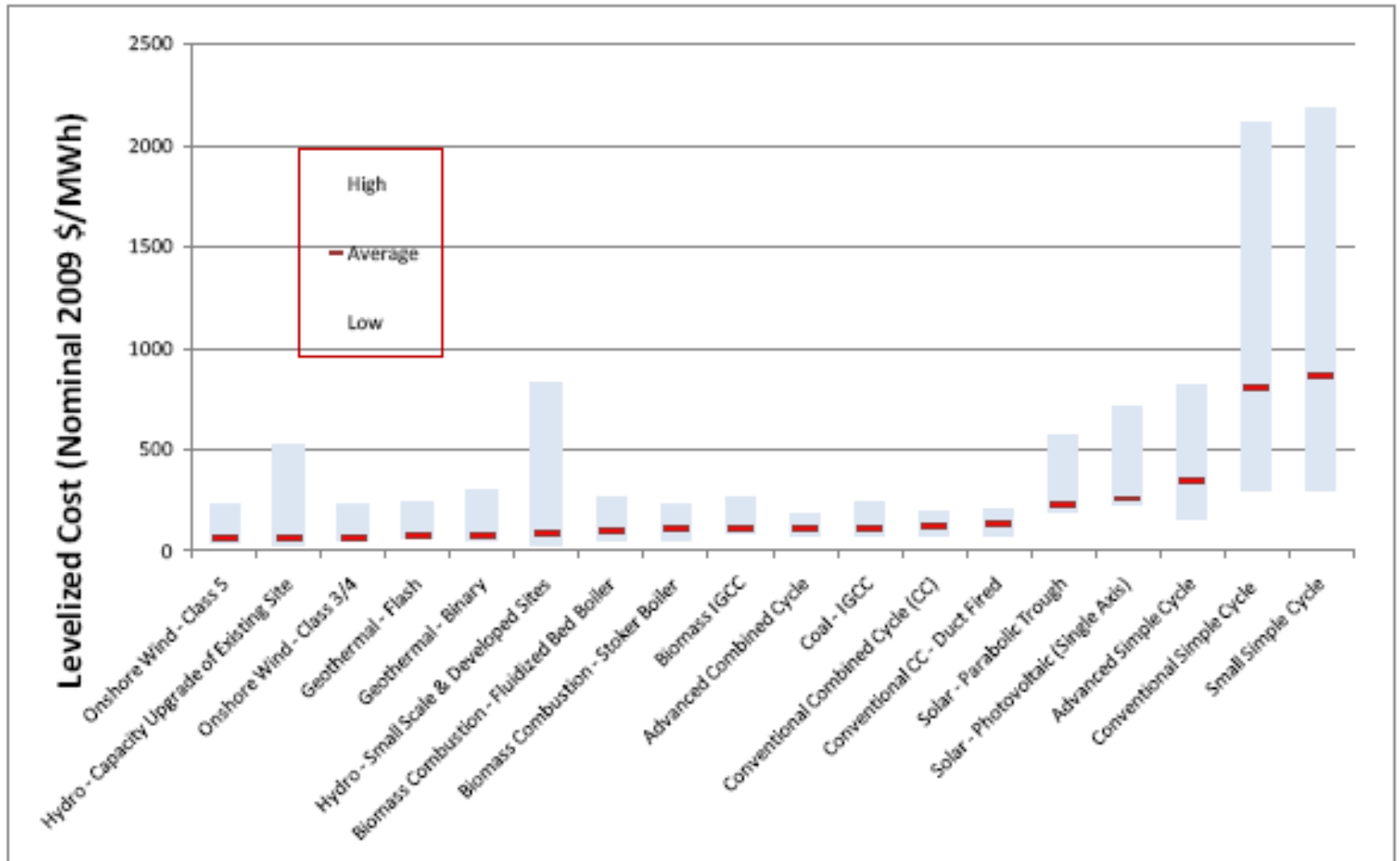
Fuel Cells

- Possible for mobile (cars) and stationary (buildings) applications
- Fuel formulation costs and fuel quality problems have raised performance risks
- Most common with natural gas, rather than biogas
- Still awaiting its promise touted by developers a decade ago

Market Status

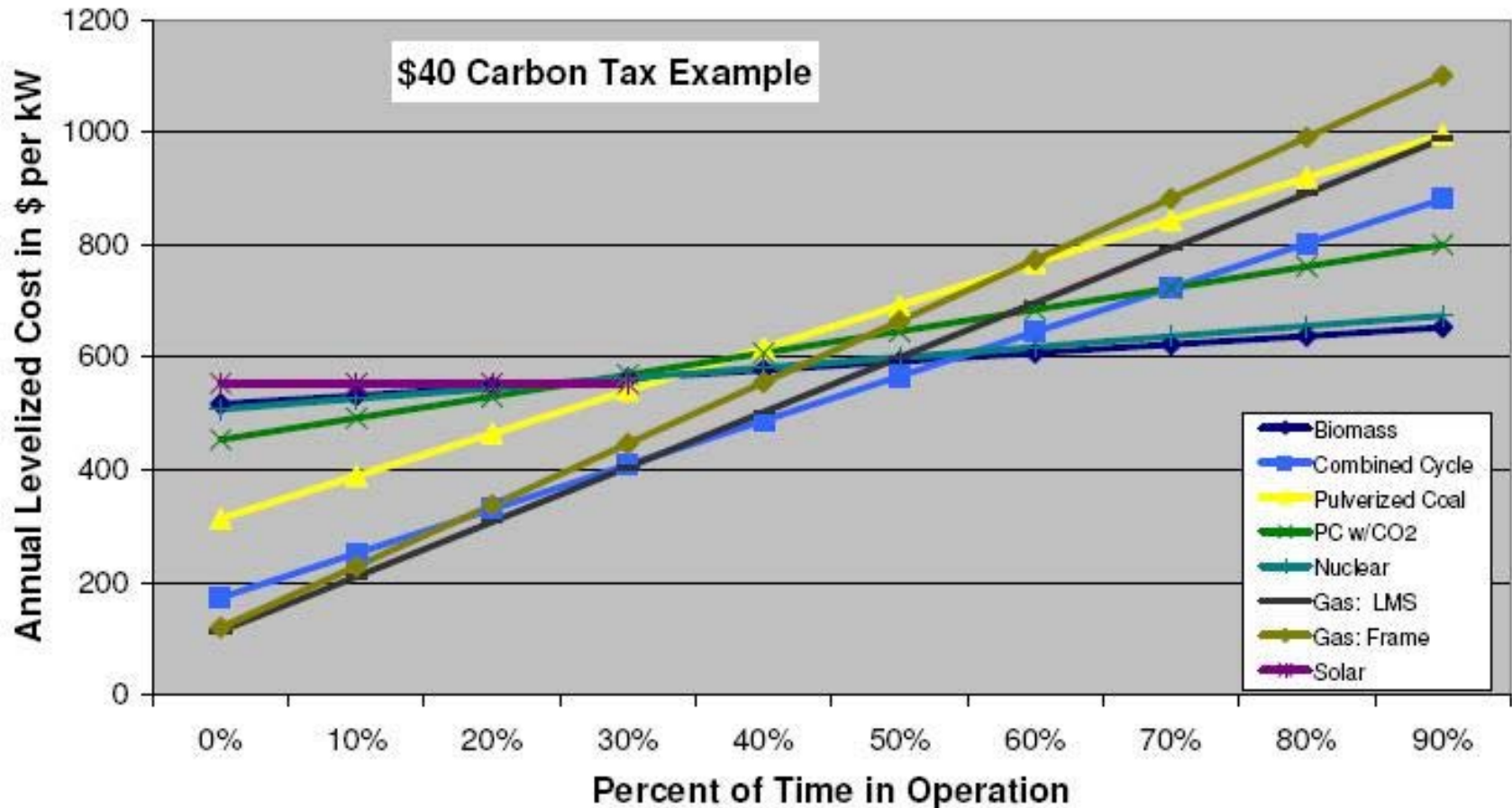
Large wind	8,500 MW installed in U.S. in 2008. Over 25,000 MW installed at end of 2008.
Small wind	2,500 systems in operation in U.S. in 2006, totaling 18 MW
Small hydro	1,402 projects in operation in U.S., generating 5,400 MW
Fuel cells	Approx. 3,000 stationary fuel cell projects globally, at approx 800 MW
Biogas - water	106 wastewater treatment plants in U.S. use biogas for energy
Biogas - dairy	111 projects in operation at approx 34 MW
PV	292 MW of grid-tied installed in U.S. in 2008, with 791 MW total.

Relative Costs



Source: Energy Commission

Greenhouse Gas Regulation May Play a Role...



Source: Public Service of New Mexico

Typical Barriers

- Up-Front Cost (other than large wind)
- Transmission (currently large-scale only)
- Permitting (large wind, small wind, small hydro)
 - Zoning and building requirements
- Credit markets for new technologies (teaching the financiers—less of an issue for large wind and PV)
 - Credit availability overall is a challenge for everybody—someone needs to have a tax appetite for federal tax incentives

Salem Renewable Options

PGE Residential and Business Customers:

- Greensource: customers can offset 100 percent energy use with renewable energy (mostly biomass and new wind)
- Clean Wind: allows customers to buy small amounts of wind power at a fixed price

Salem Electric:

- The cooperative purchases 4.5% of its portfolio from BPA's environmentally preferred program.

NW Natural:

- "Smart Energy" program allows customers to invest in projects that prevent release of GHG emissions (such as capturing biogas)