



Good Work Under the Sun

The Basics of Solar

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The Opportunity

Solar energy development brings 12+ jobs per MW (35 million +) and increase in gross regional income (*1 GW = ≈\$4- \$6 billion*).

Solar energy development lowers risk and cost of power and increases energy security, reliability, and surety.

Arizona is a key nexus for solar energy deployment and solar energy innovation and manufacturing.

Benefits of Solar Energy

Solar is a zero-emission energy source

Solar is scalable and growing

- Growing globally at 41% per annum, 60% in U.S.
- When combined with other smart grid technologies it can meet 100% peak load growth

Solar is competitive

- Nuclear, coal, natural gas power plant costs have increased significantly
- Transmission infrastructure has increased in costs and takes significantly longer

Solar is predictable

- Distributed technologies can be built quickly, averting power crises more effectively
- Combined with demand response, solar is as predictable as a fossil fuel peaking plant
- Solar is well correlated to air conditioning and lighting loads

Solar space is available

- Each year over 2 billion square feet of new roofs are installed – supporting far more than 40 GW solar needed to meet 100% of incremental load growth in the US

A Framework

Technology Type

Solar Thermal

Solar Photovoltaic (“PV”)

Development Format

Central Station

Distributed Generation (“DG”)



Solar Thermal and Solar Electric

Solar Thermal

- Residential
 - Space and domestic water heaters
 - Pool heaters
- Nonresidential
 - Service water and space heating
 - Industrial Scale Solar Thermal
 - Utility Concentrated Solar Power (CSP)



Solar Electric Photovoltaic (PV)

- Residential and Nonresidential built in modular units of collector panels and inverters



Solar Water Heating

- Produces Heat for domestic hot water and/or space heating
- Various kinds of system
- Ground or Roof mounted
- Current cost per lifetime kwhr (after incentives)
\$.07 - \$.12
- Reasonable initial cost



CSP Options for Large-Scale Power



Solar Electric (PV)



Photovoltaics (PV) Solar Electric: Kinds of Technology

Crystalline

- More energy produced / sq. ft.
- More \$\$\$ per kW
- More prevalent
- Time-tested

Types:

- Mono-crystalline silicon
- Poly-crystalline silicon

Thin film

- Less energy produced / sq ft.
- Less \$\$\$ per kW
- Better performance in shading & heat
- Flexible and laminate forms

Types:

- Amorphous silicon (a-Si)
- Cadmium telluride (CdTe)
- Copper indium gallium diselenide (CIGS)



Modules & Mounting Methods



Electric Power Generation Development Format

Central Station

- Large scale (20MW+), remote locations, connected to transmission infrastructure
(higher voltage, longer distance)

Distributed

- Large (up to 20MW) to small scale connected to distribution network near customer load
(lower voltage, shorter distances)

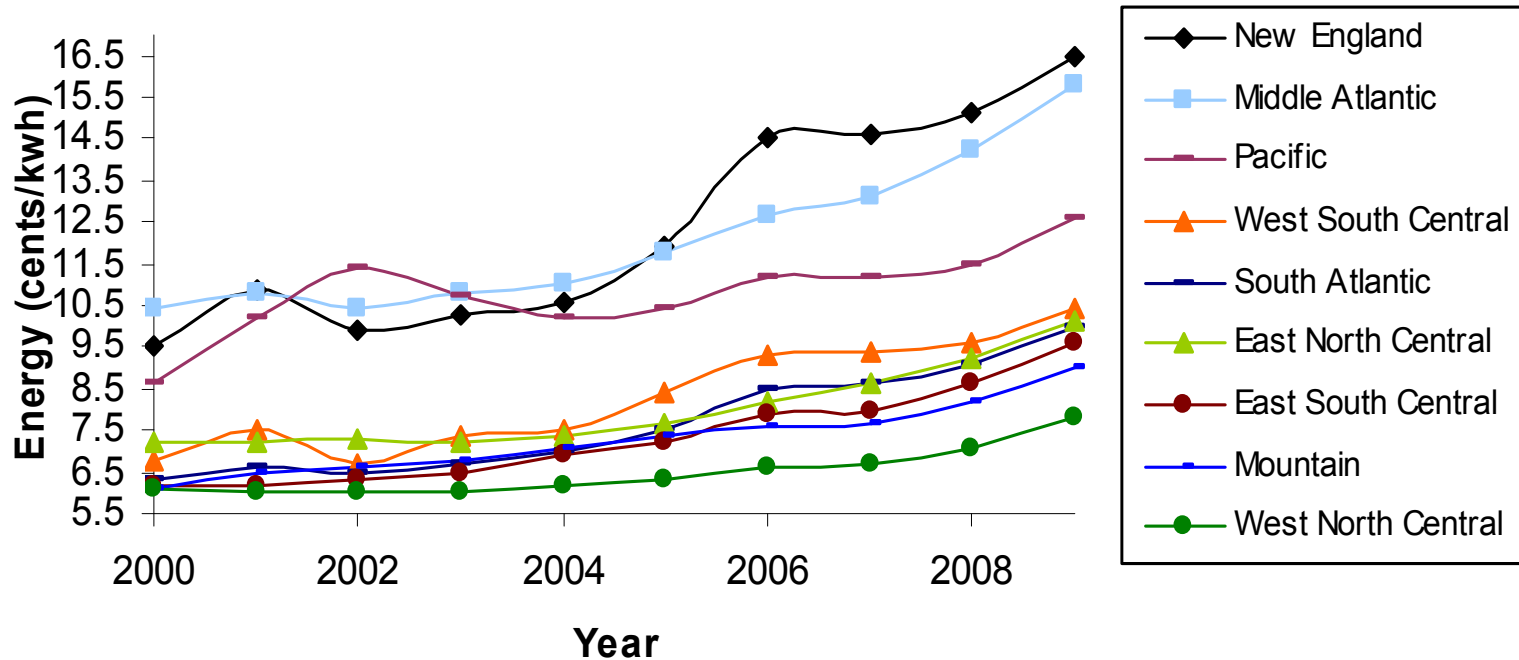
Reducing Risk & Exposure to Fossil Fuels

- Electricity Price Drivers
- Solar Benefits



U.S. Commercial Electricity Prices: By Region

On average, prices have increased 4.76% each year
for the last 8 years



Energy Demand Drives Costs

Demand drives energy production

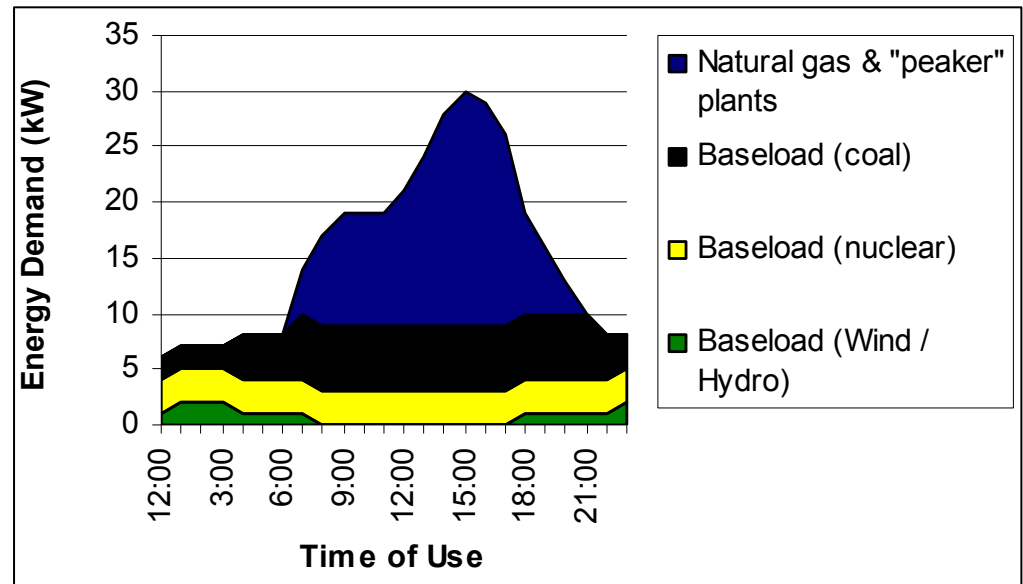
- Energy plants are dispatched by (lowest) variable costs

Utility rate breakdown

- Baseload rate
 - driven by volatile variable costs
- Peak rates
 - determined by facility's highest energy use

To save energy \$\$\$

- Reduce peak demand from utility



Peak Energy Prices: Volatile & Increasing

Cause

Lower natural gas (NG) production

→

Less new NG drilling

→

Oil prices increase

→

Higher NG prices

→

Effect

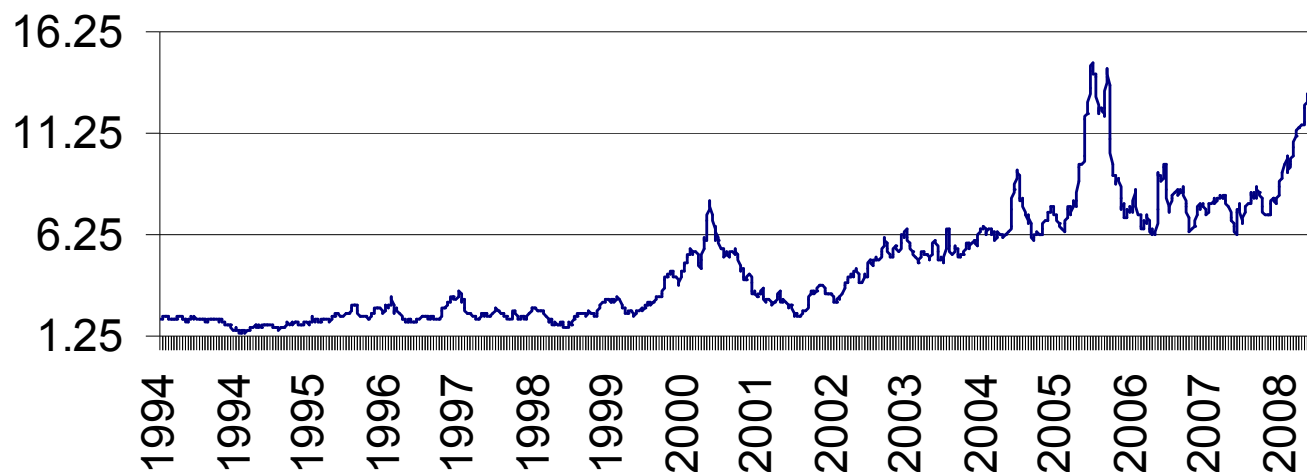
Higher NG prices

Higher NG prices

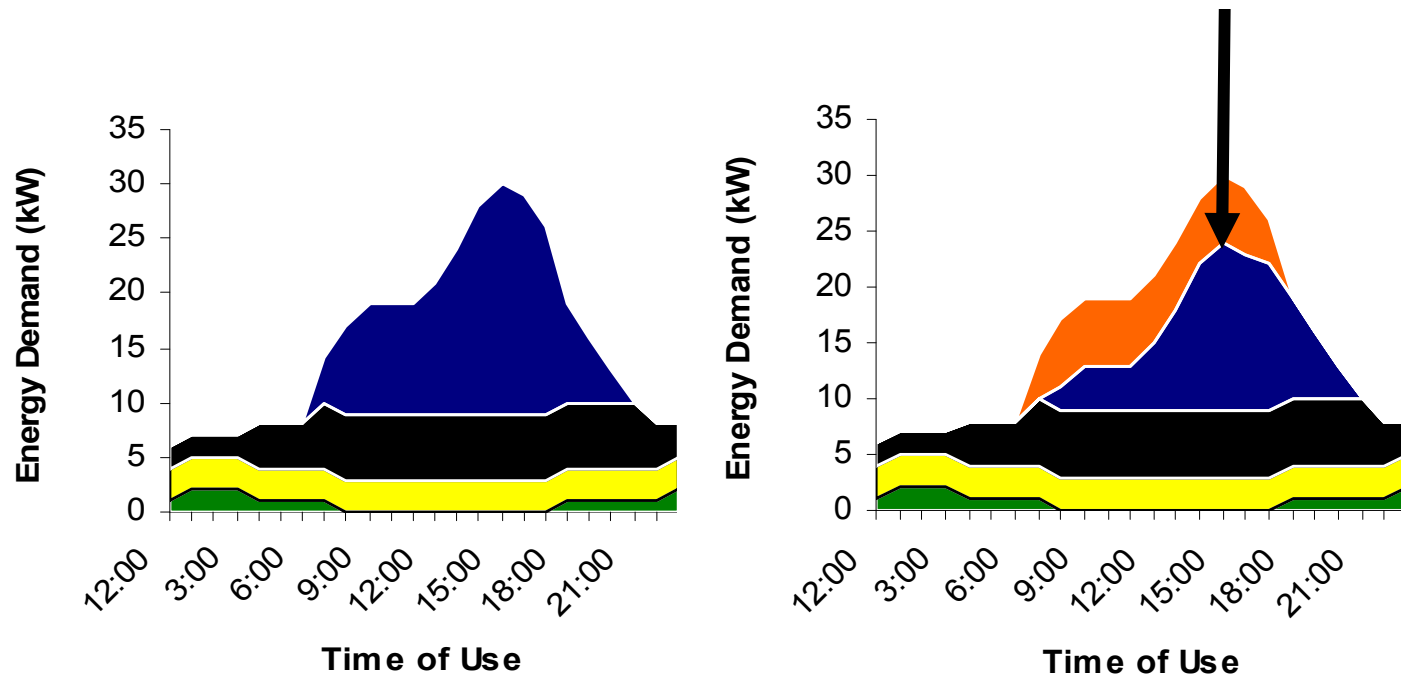
Higher NG prices

Utilities raise rates

Natural Gas Futures Prices



Solar reduces your peak demand



- Solar
- Natural gas & "peaker" plants
- Baseload (coal)
- Baseload (nuclear)
- Baseload (Wind / Hydro)



Thank you for coming!

