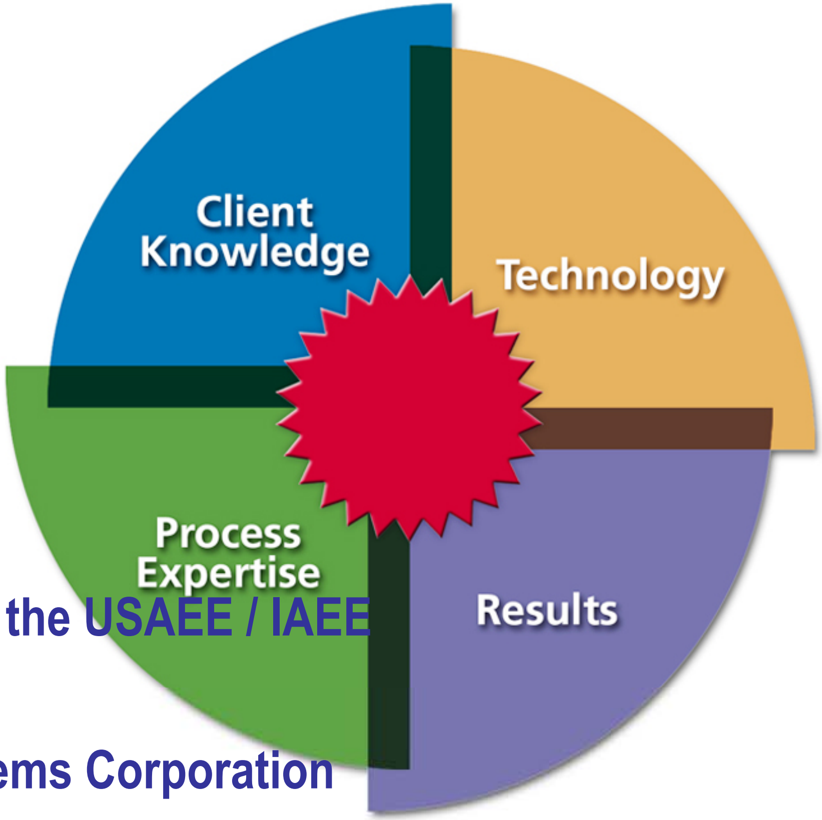
Will High-Priced Oil Revolutionize the Energy Industry?



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Is customer-sited distributed generation likely to be a disruptive technology?

- Disruptive technologies initially appear as unfamiliar, inferior, and often unprofitable alternatives to standard products, and initially appeal to only a small segment of “fringe” users
- Manufacturers of “established technologies” ignore them
- They improve, offer desired features, and prices fall; Adoption increases rapidly
- “Established-technology” companies resist adopting the disruptive technologies until it’s too late
- Classic examples: PCs replaced mainframe computers; MCI’s microwave towers replaced AT&T’s copper wires; diesel-electric replaced steam locomotives; digital cameras replaced film

(see books and articles by Clayton Christensen)

Is customer-sited distributed generation likely to be a disruptive technology?

- We believe the answer is, “YES!”

  Reasons:

  - High oil prices (>$55/bbl) are permanent
  - Result in high natural gas and coal prices; which means high electricity prices
  - Many end-users want higher reliability than grid provides
  - Many technologies; growing proof of reliability; many manufacturers; decreasing installed costs
  - Need to reduce GHG and polluting emissions
  - Favorable government policies and growing international financial support

Favorable government policies:

- Funding for R,D&D
- Government purchases
- Broke the monopoly of electric utilities:
  - PURPA (1978) requires utilities to accept DG:
    Buy power generated by QFs (CHP & RE/IPP)
    Continue to serve customers who install DG
    w/"fair tariffs"
  - Actions to deregulate the wholesale market
  - State-level actions to establish RPS, deregulate the retail market, establish standardized interconnection requirements, allow net metering, require IRPs and "all-source bidding" for new resources

Distributed Generation Technologies

- Fuel-burning reciprocating engines and gas turbines; most producing both electricity and thermal energy (hot or cold)
  5 kW to 100 MW units
- Solar PV and Wind (electricity-only)
  1 kW to 3.6 MW units
- Solar-thermal (producing both electricity and thermal energy — hot or cold)
  25 kW to 100 kW units
- Fuel cells (producing both electricity and thermal energy — hot or cold)
  1 kW to 250 kW units

Distributed Generation Technologies (continued)

- Cogeneration (combined heat and power, or CHP) has been used for about 100 years in universities, hospitals, and industrial plants. Much of it is fueled by biomass and not fossil fuels. Its major virtue is high overall efficiency (70 to 90 %).
- The thermal output usually serves the space-, water-, and process-heat end-uses, but by incorporating an absorption-cycle chiller, the space-cooling end-use can also be served.
- Fuel cells are <u>potentially</u> a major player:
  - Produce both electricity and thermal energy
  - Wide range of technologies and capacities
  - Zero pollution (once hydrogen is available)
  - Used in transportation sector as well as buildings/factories
  - Large, well-known companies are actively involved (GE, GM, Honda, Toyota, BMW, etc.)

Distributed Generation Technologies: One example in detail

Solar PV systems:

- Global PV industry compound annual growth rate is about 30%; will go from $7 Billion to $30 billion in annual revenues by 2010 – 2011
- PV prices declining along 80% learning curve; cost per installed Watt depends on transaction costs – $12 down to $4/W
- Industry growth in the U.S. so far is largely policy-driven (e.g., RPS standards) and consumer-driven; leading solar states are those with the largest incentives (CA, NJ, AZ, and soon NV)
- Utility leaders such as SMUD and Austin Energy are driven by various interests—peak-demand reduction, fuel-cost stability, positioning as a "Green-industry" leader, etc.
- Utility benefits of PV can increase site- and time-specific value

What can distributed PV do?

- **Improve transmission system reliability**

  Example: CEC-funded "Strategic Location of Renewable Technology Based on Grid Reliability" to "Investigate the extent to which renewable distributed electricity generation can help address energy and transmission constraints in California's electric system…" Davis Power Consultants, August 2004

- **Reduce peak demand costs**

  Example: "Peak Power Requirements," presentation to Solar Power 2004 by Guy Sliker (NYPA) indicates high peak value in New York City, if PV is complemented with low-cost DR to insure load-carrying capacity

- **Provide multiple local network benefits**

  Example: "Optimal Portfolio Methodology for Assessing Distributed Energy Resource Benefits for the Energynet™"by Peter Evans (New Power Technologies) 2005, for CEC, field date shows a small amount of carefully sited DER can benefit the power delivery network through reduced losses and improved voltage profile.

What else can PV do?

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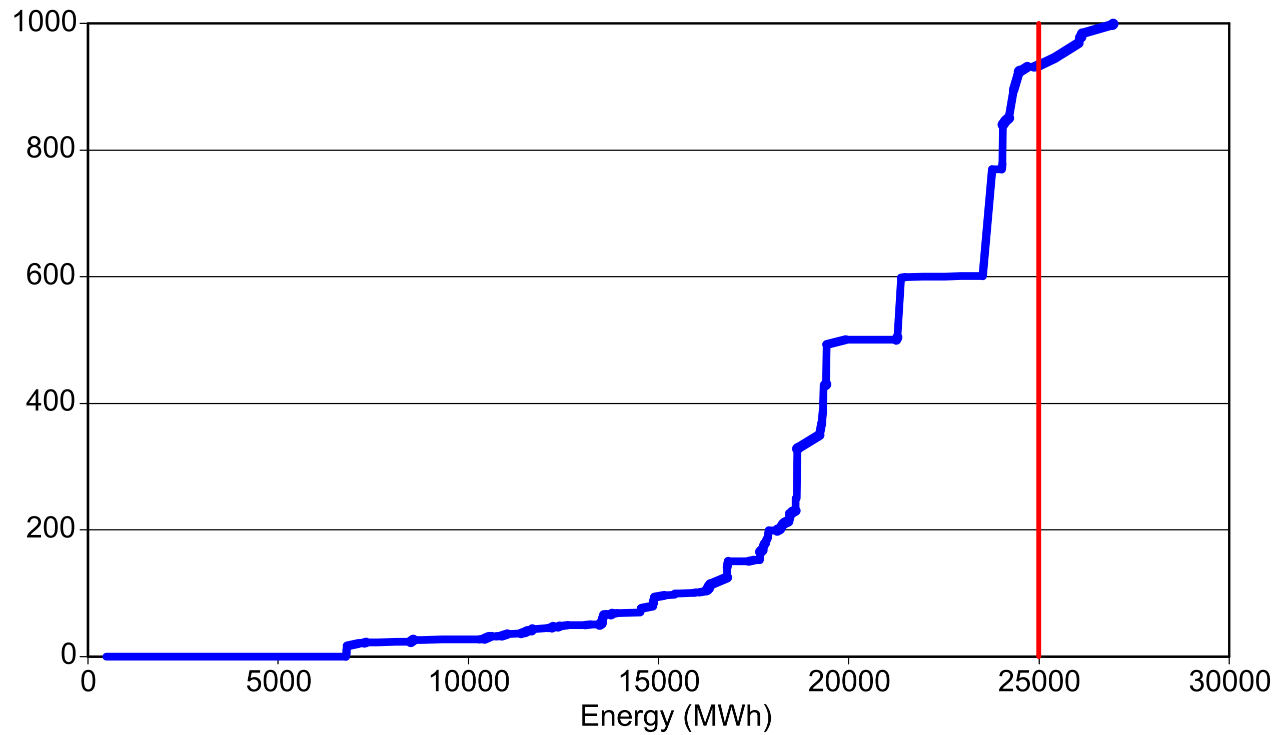
- **Provide a hedge against rising fuel costs**
  Example: "Portfolio-Based Electricity Generation Planning: Policy Implications for Renewables and Energy Security" by Shimon Awerbuch, Ph.D., SPRU–University of Sussex Brighton December 2004. "Adding fixed-cost (even higher priced) resources lowers portfolio risk and cost." (What would be the price and performance risk of a 30-year fixed cost contract for natural gas?!)
- **Diversify renewable energy portfolios**
  Example: Global Energy Associates, 2005 estimates the demand for new wind generation, based on current RPS regulatory requirements, is >50 GW. While both wind and solar are intermittent, solar is much more likely to be a peak resource, and does not incur costs of new transmission facilities.
- **More benefits, too**
  …but most are location- and time-specific, suggesting a need for careful integration or direction from the utilities that serve a major part of the customer load. Will utilities embrace this challenge?

The PV resource is available 15%-25% of load hours They include the most expensive to serve hours for utilities whose loads peak on hot summer days

ISO New England supply curve (dispatch curve) for peak demand hour
$/MWh vs MWh of demand
Source: Michael Rogol, MIT; ISO-NE Historical Bid Data; Kate Martin (MIT LFEE)



The role of utility leadership in advancing all kinds of DG

- Gradually re-emerging interest in portfolio diversification and integrated resource planning
- Risk analysis (fuel cost, infrastructure, climate-risk) evidenced in some utilities
- Regional leadership in capturing high-tech integration efficiencies (e.g, Bonneville Power Administration's "Non-Wires Solutions" project)
- Some utilities are evaluating DG and other DER solutions as alternative to distribution grid upgrades
- Decoupling sales and revenue in some states allows utilities to avoid being penalized by lower MWh sales; other regulatory strategies are emerging.

The role of new competitors and innovators is key, too

- New approaches to DER are highly integrative, tying distributed generation to high-tech controls, demand response, etc.
- Problems (e.g., intermittency) are also opportunities for innovation
- DER to-date driven by customer's demand for clean, reliable alternatives to conventional utility service
- Emergence of alternative companies (e.g., Sun Edison) provides options for "virtual utility services" such as financing
- Electric SUN contends these forces alone (without win-win utility partnerships) are not strong big enough or fast enough, given rising energy needs/costs and climate risks
- But a diverse, competitive marketplace can surprise you.

Conclusions

If we hope to avoid a massive construction effort in costly new coal technology, nuclear, and T&D facilities nationwide, then a collaboration among all stakeholders—policy makers, NGOs, consumers, DER industries, and utilities—must begin today.

In any event, DG will play a larger role in 2025 than present forecasts show.

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Aspen Systems Corporation in a large information-services and consulting firm that does work for more than a dozen different federal and state agencies, and utilities in North America and Europe. Our activities span all forms of distributed resources, including energy efficiency and demand response in addition to distributed generation and renewable energy.

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ElectricSUN
The Electric Solar Utility Network

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Electric SUN is a learning organization aimed at advancing collaborative strategies among utilities, the solar industry, and energy stakeholders, to increase the effective and profitable use of distributed solar PV.