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Stichting Laka: Documentatie- en onderzoekscentrum kernenergie

De Laka-bibliotheek

Dit is een pdf van één van de publicaties in de bibliotheek van Stichting Laka, het in Amsterdam gevestigde documentatie- en onderzoekscentrum kernenergie.

Laka heeft een bibliotheek met ongeveer 8000 boeken (waarvan een gedeelte dus ook als pdf), duizenden kranten- en tijdschriften-artikelen, honderden tijdschriftentitels, posters, video's en ander beeldmateriaal. Laka digitaliseert (oude) tijdschriften en boeken uit de internationale antikernenergie-beweging.

De catalogus van de Laka-bibliotheek staat op onze site. De collectie bevat een grote verzameling gedigitaliseerde tijdschriften uit de Nederlandse antikernenergie-beweging en een verzameling video's.

Laka speelt met oa. haar informatie-voorziening een belangrijke rol in de Nederlandse anti-kernenergiebeweging.

The Laka-library

This is a PDF from one of the publications from the library of the Laka Foundation; the Amsterdam-based documentation and research centre on nuclear energy.

The Laka library consists of about 8,000 books (of which a part is available as PDF), thousands of newspaper clippings, hundreds of magazines, posters, video's and other material.
Laka digitizes books and magazines from the international movement against nuclear power.

The catalogue of the Laka-library can be found at our website. The collection also contains a large number of digitized magazines from the Dutch anti-nuclear power movement and a video-section.

Laka plays with, amongst others things, its information services, an important role in the Dutch anti-nuclear movement.

Appreciate our work? Feel free to make a small donation. Thank you.

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Due Diligence on The Economics and Business Risks of New Nuclear Power

Craig A. Severance CPA
Author, *Business Risks to Utilities as New Nuclear Power Costs Escalate* (Electricity Journal, May 2009)
Co-Author, *The Economics of Nuclear and Coal Power* (Praeger, 1976)
Website Resources: *www.EnergyEconomyOnline.com*

March 4, 2010
Brookings Institution/Global Public Policy Institute Conference
"Towards a Nuclear Power Renaissance?
Challenges for Global Energy Governance"
Potsdam, Germany

Evaluating New Nuclear Power Economics and Business Risks

- Multiple studies & projections
- Levelized Cost of Energy primary focus
- Costs unproved, rely on *nuclear vendors*
- Promoter business plans always look competitive – yet most have serious weaknesses
- Due Diligence process asks questions that highlight strengths and weaknesses
- Trillions of dollars of energy investment now at stake
- Serious weaknesses exposed? Go slow.

“Who Stopped New Nuclear Power?”

- Not environmentalists – government policies always *favored* nuclear power

- Not Three Mile Island 1979 accident – cancellations already underway *before* accident

- Utility boards & Wall Street stopped nuclear expansion after true costs, business risks evident

Core Due Diligence Tests

1. Does proposal match customer needs?
2. Financial Ability/Financial Stress
3. Reliability of Cost Projections
4. Assessment of Competition
5. Reliability of Revenue Projections

Business Test #1:
Does Proposal Match Customer Needs?
– Current Utility Environment –

- Demand forecasts highly uncertain
- Energy efficiency efforts increasing
- Smart Grid to be implemented
- Distributed generation (PV, Central Heat & Power) growing
- Renewable energy increasingly large % of total MWhs
- Need to quickly reduce GHG emissions

Does Proposal Match Customer Needs? – Ideal New Power Plant Now –

- Short lead time – can wait till demand better known
- Modular size – With only ~1%/yr growth, track demand curve with smaller additions
- Preserve capital needed now for Smart Grid, energy efficiency
- Load-following plant to work well with intermittent wind, solar
- Achieve lower carbon emissions

Does Proposal Match Customer Needs? – New Nuclear Power Plant –

- Very long lead time -- major spending based on shaky 10 year forecast
- Added in huge chunks (1,100-1,600 MW) -- unable to track closely to growth curve
- Massive capital required– drains capital needed for efficiency, Smart Grid projects
- Unable to operate as load-following plant – incompatible with renewables
- Very slow to achieve low carbon emissions

Load-following plants meet utility needs best

- Cheaper: $1,100 - $4,000/KW
- Smaller units – track load curve closer
- Quicker to build – match load curve when needed, cut CO_2 emissions quicker
- Dispatchable plants that also run 24/7 when needed (i.e. can fill baseload needs)

Load-Following Plants Available Now

- Wind +/or PV with Compressed Air Energy Storage

- Solar Thermal/Natural Gas Hybrid Steam Generators

- Geothermal (high or low-temperature)

- Hydro/Micro Hydro

- Combined Cycle Gas Turbines

Matching Customer Needs: Load-Following vs. Baseload Plants

"I think baseload capacity is going to become an anachronism....You don't need fossil fuel or nuclear [plants] that run all the time....We may not need any [more], ever."
—Jon Wellinghoff, Chairman
Federal Energy Regulatory Commission
22 April 2009

Business Test #2: Financial Stress

- Can utility *afford* project & maintain financial ratios?
- Six Wall Street Investment Banks (2007): No loans for new nuclear – too risky
- Government loan guarantees protect lender but *no protection for shareholders, ratepayers*
- Projects so large – cost overruns alone can exceed utility's entire Net Worth
- How will cost overruns be funded once government loan guarantee exceeded?

Financial Stress: Conclusions

- Downgrade of Bond Ratings (*Moody's* June 2009 Special Comment)
- Everything being gambled on one project – "Nuclear's Bet The Farm Risk" (*Moody's* June 2009 Special Comment)
- Nuclear projects easily "Corporate Killers" (*Citi's* November 2009 analysis "New Nuclear – The Economics Say No")

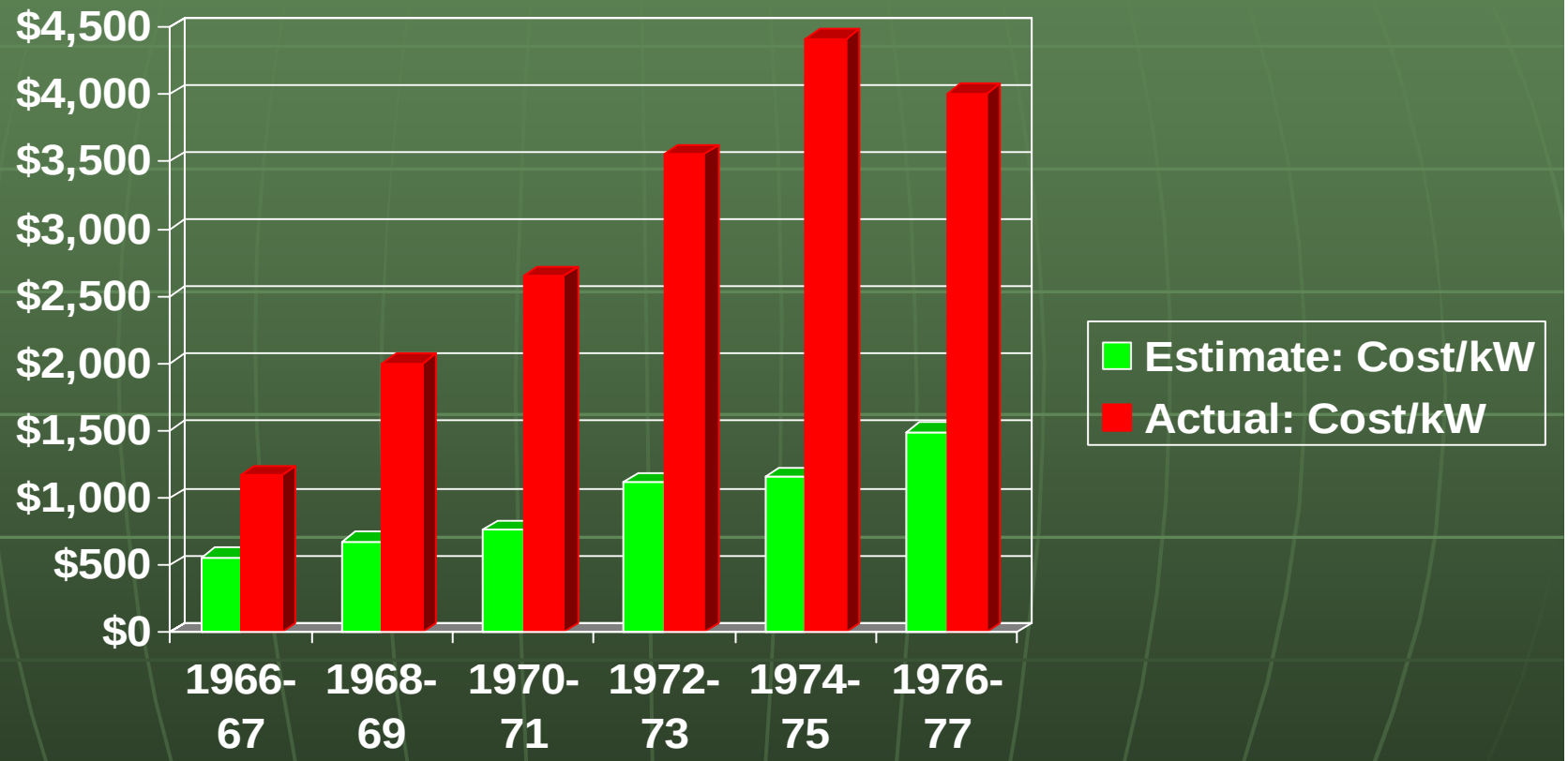
Test #3: Reliability of Cost Projections

- Nuclear industry historical record: **2-4 X** original estimates (EIA)
- Cost escalations exposure over long period
- Vendors cannot/will not commit to price
- Nuclear cost estimates keep changing drastically. South Texas Project began at $6 Billion estimate – now over $13 Billion. Olkiluoto 75% > budget
- Delays are wild card – expose project to more years of ungovernable cost inflation

Nuclear Optimism Vs. Reality

Estimate v. Actual Cost/kW in 2002$ - w/o Financing Costs

By Year When Construction Started



Source: U.S. Energy Information Administration, converted to 2002$ by MIT Paul Joskow

Has Nuclear Industry Shown Cost Credibility?

Have Real$ Cost Escalations Stopped?

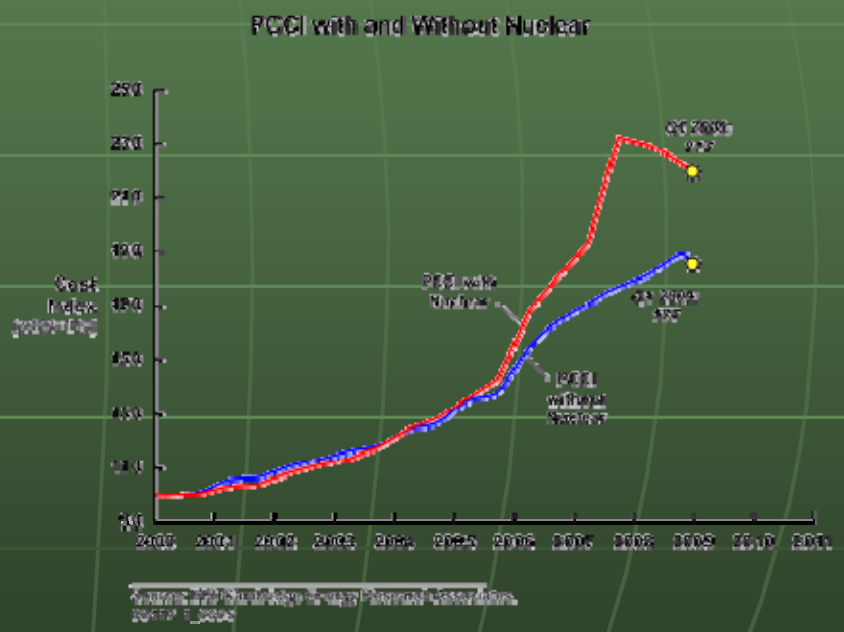
- Cost studies typically pick “Overnight Cost” and stick with it
- No *further* Real$ cost escalations assumed during construction
- Examples: MIT 2009 Update; Florida Power & Light
- Reality: severe cost escalations have hit power plant construction, only recession broke trend
- Power plant construction costs escalated 12.75%/yr 2000-2007 (CERA) – avg. Real$ cost escalation 10%/yr
- Is real$ cost escalation *over*? Have China, others stopped their aggressive building programs?

Nuclear Needed *Lower* Construction Costs BUT

Power Plant Construction Costs More than Doubled

- Driven by rapidly expanding economies e.g. China, India, Brazil
- MIT New Nuclear 2002$= $2,000/kW "Overnight" Cost
- New Nuclear 2007$ >$4,000/kW "Overnight" cost (MIT, Florida Power & Light estimates)

Power Capital Costs Index 00-09 Q1



Source: Cambridge Energy Research Assoc. Press Release Jun 23, 2009

Example of "Counting The Costs" – To COMPLETE a Nuclear Mega-Project

- "Overnight" Cost: $ 3,671/kW
- Escalations in Costs: $ 2,505/KW
- Cost of Capital: $ 2,256/kW

"All-In" Costs $ 8,432/kW*

Total Cost for 2,700 MW 2-Unit New Nuclear Facility

$22.8 Billion

*Based on CPS STP "Overnight" Cost Estimate, CPS Avg. Weighted Cost of Capital, and nuclear cost escalations only ONE HALF 2002-2007 Average

Reliability of Nuclear Cost Projections : Conclusions

- "What is clear is that it is completely impossible to produce definitive estimates for new nuclear costs at this time..." Steve Kidd, Director of Strategy & Research, World Nuclear Association, *Nuclear Engineering International*, 22 August 2008
- "We see very little prospect of these costs falling and every likelihood of them rising further." *Citi* analysis "New Nuclear – The Economics Say No", 9 November 2009
- "We think the probability that things will go wrong with these large projects is greater than the probability that things will go right." *Moody's* Senior V.P. Jim Hempstead, *WSJ*, 18 February 2010

Mega Project Sunk Costs vs. Modular Project Flexibility

Reactor Mega Project

- Long planning & construction period
- Costs can increase drastically while project still underway
- One project – ZERO kWh produced till complete
- Changing your mind results in abandoning enormous sunk costs (often billions)
- Specter of "Completely Wasted Money" if project abandoned

- "Boiling the Frog" – if facts had been known at beginning would have "jumped out" but "slow boil" keeps utility in
- Only nine U.S. nuclear projects in first wave abandoned once construction began, even though avg. 2-4 times original estimate

Mega Project Sunk Costs vs. Modular Project Flexibility




<u>Modular Projects</u>

- Smaller projects, shorter lead times
- Able to expand or shrink projects
- Flexible – can quickly change technologies
- If 1,000 MW planned but conditions change after 200 MW built – 200 MW *still generates electricity*
- No specter of massive sunk costs abandoned

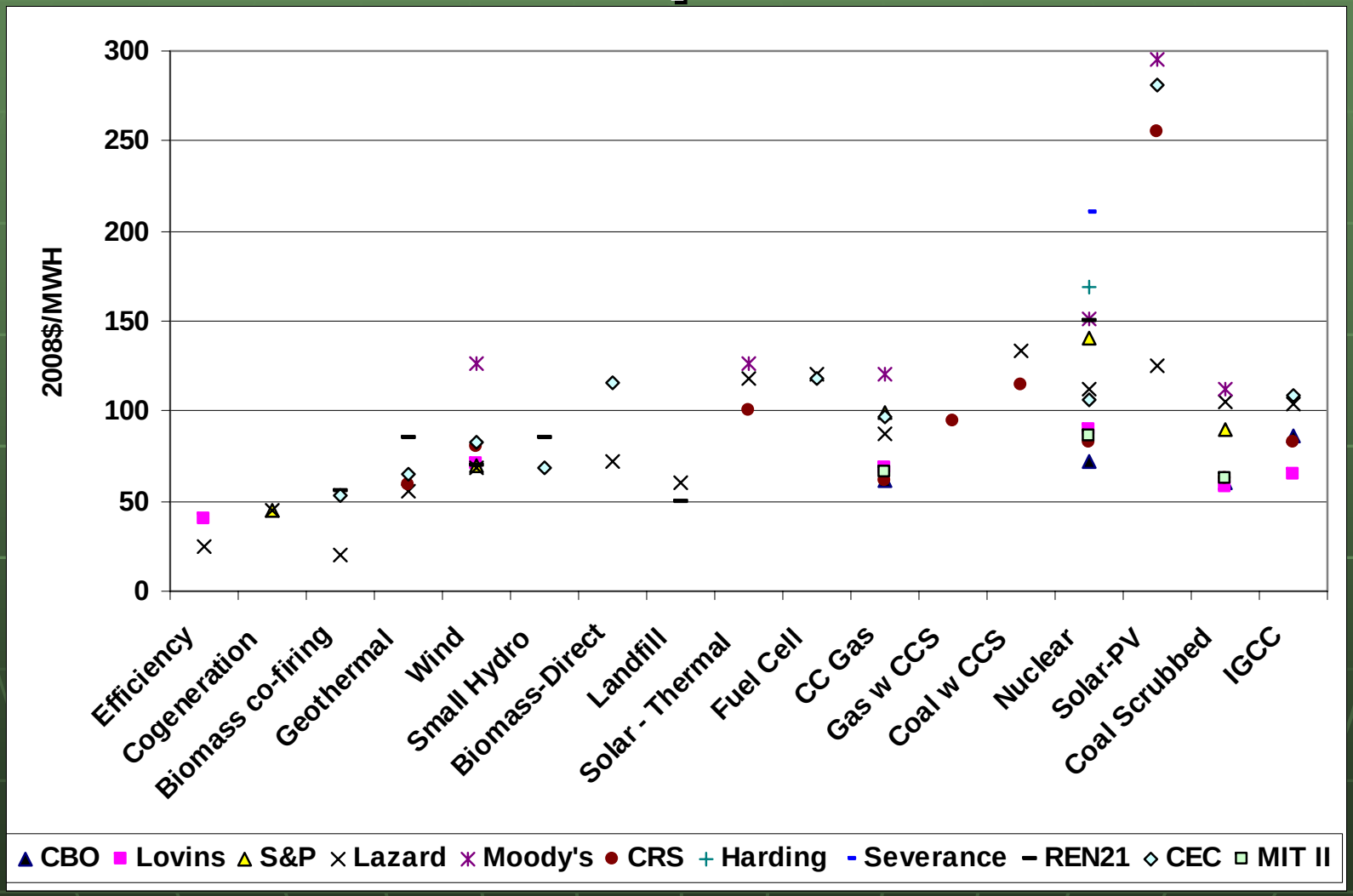
Business Test #4: Competition
Three Types of Competition

- KWh's *not purchased*: Efficiency and Distributed Generation (e.g. PV, Combined Heat & Power, Bloombox)
- Other Types of Central Power Generation
- Society's other needs: should electricity drain so much capital?

Competition: Efficiency & Distributed Generation

- *McKinsey* 2009: efficiency can profitably save half of current U.S. coal-electric production by 2020
- Distributed Power: in 2006 delivered 1/6 of global electricity, 1/3 of new electricity, 1/6 to >1/2 of all electricity in a dozen industrial nations (Rocky Mountain Institute)
- Governance Issue: Efficiency & distributed most direct benefit to ordinary citizens, "democratization of power"

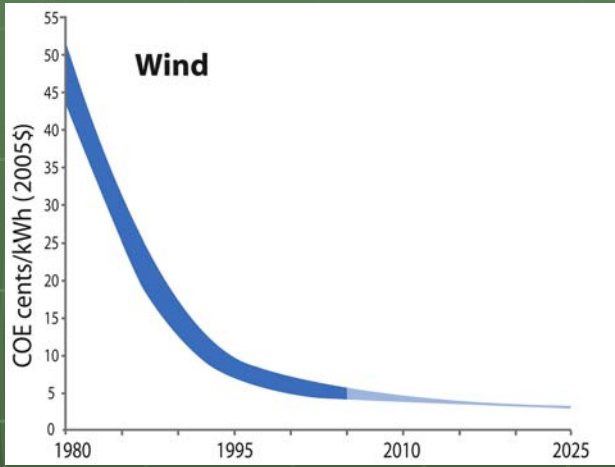
Competition: Other Types of Power – Comparative Costs

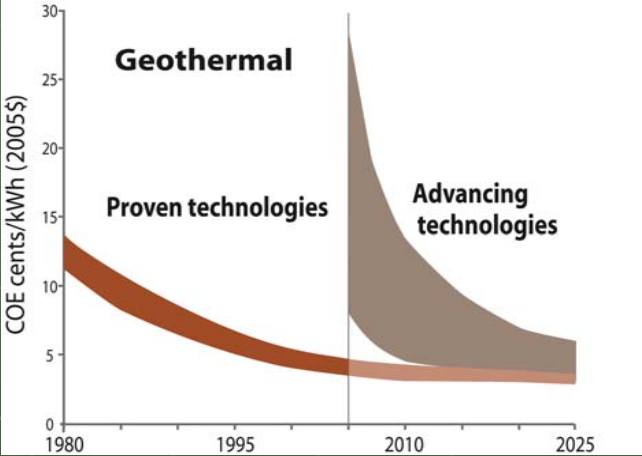


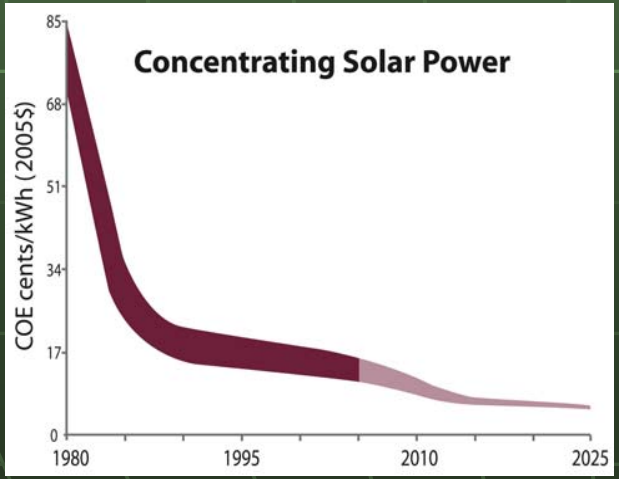
Source: Mark Cooper, Sr. Fellow for Economic Analysis, Institute for Energy and the Environment, Vermont Law School, July 2009

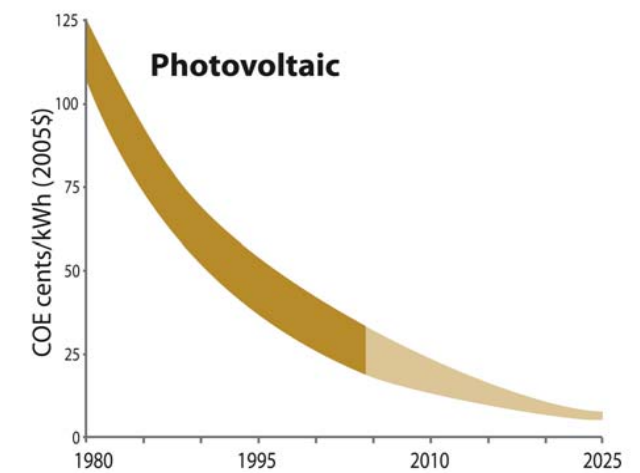
Renewable Energy Cost Trends

Advantage of FACTORY MADE Mass Production Cost Curves
– Renewable Portfolio Standards Achieve Desired Goal –





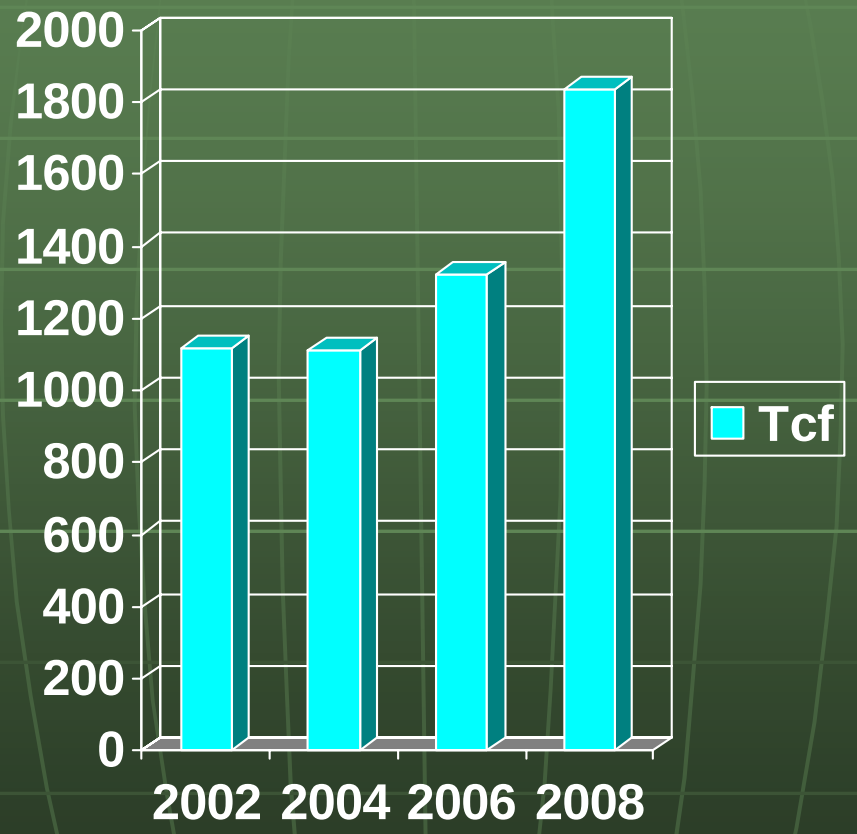




Source: NREL Energy Analysis Office (www.nrel.gov/analysis/docs/cost_curves_2005.ppt)

Levelized cost of energy in constant 2005$

“Game Changer” - U.S. Natural Gas Supply Greater than Expected

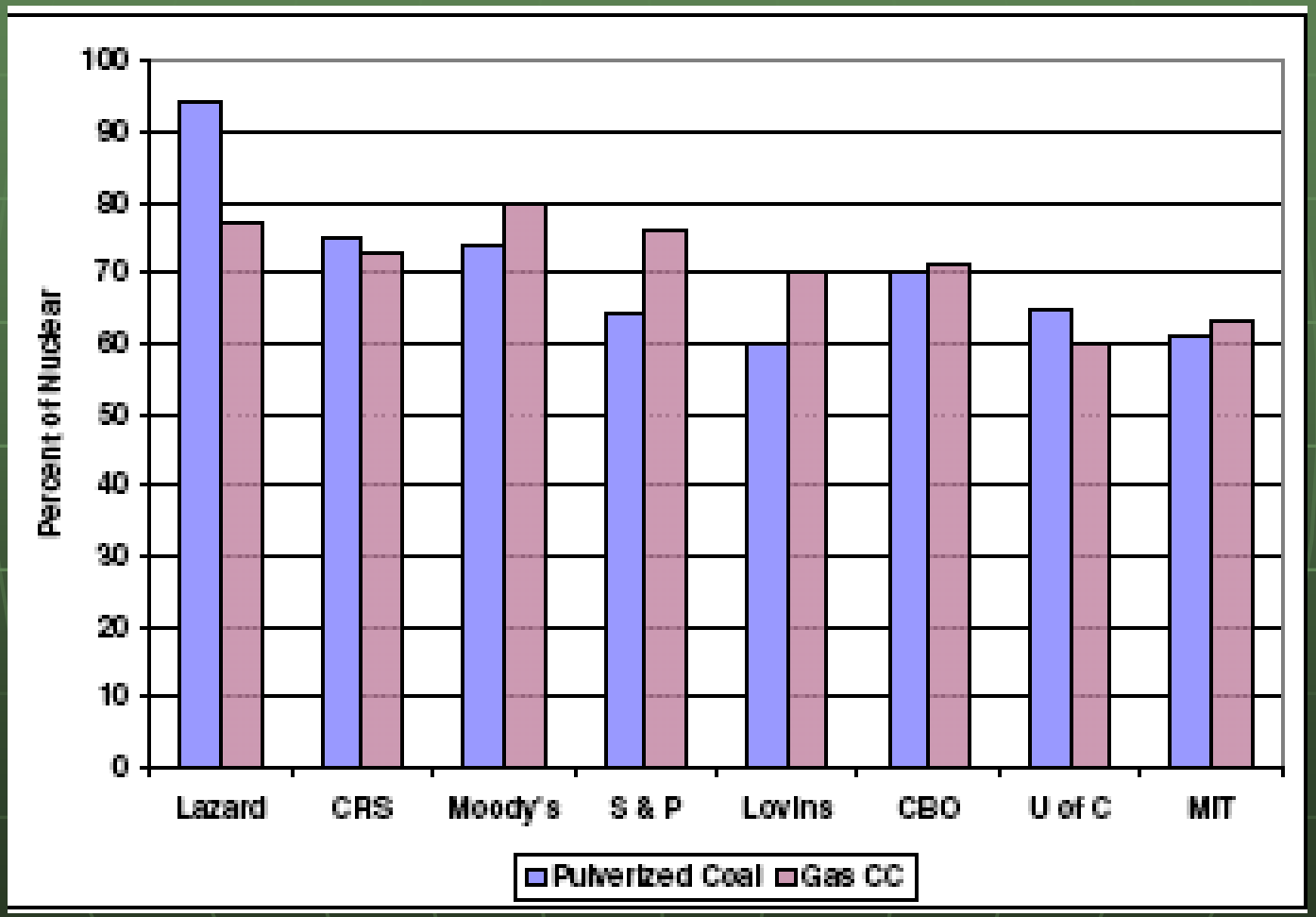


Source: Potential Gas Committee/CO School of Mines

(Shale Gas Exploration Now Also Underway in Europe, China)

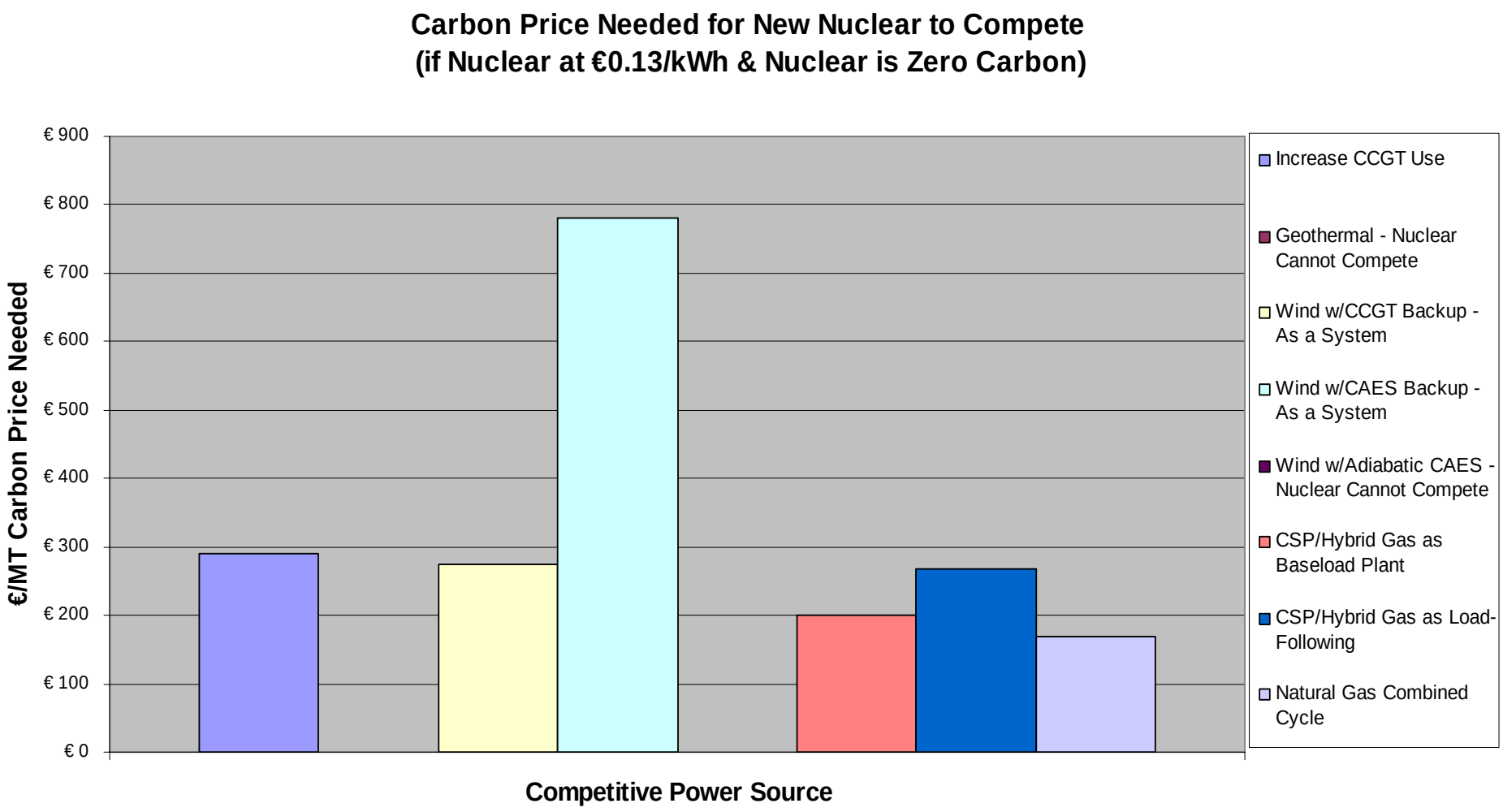
New Nuclear Still Loses Against Coal and Natural Gas

Coal & Natural Gas Costs as % of Nuclear Cost



Source: Cooper, Mark "The Economics of Nuclear Reactors: Renaissance or Relapse", June 2009

Could Carbon Price Help New Nuclear Close the Gap?



Competition for Capital: Society's Other Needs

- Annual World Development Assistance and Aid – All Purposes **$106 Billion** (2005 Data, World Resources Institute, *World Resources 2008*)
- Annual Cost to Curtail Species Extinctions Worldwide **$46 Billion** ("The Price of Survival", Spiegel Online Intl, 23 May 2008)
- Cost to Save Rainforests **$22-$36 Billion** U.N. Negotiations on REDD: Reducing Emissions from Deforestation and Forest Degradation proposal (NY Times 24 Sep 2009)
- Annual Cost to End World Hunger **$30 Billion** U.N. Food and Agricultural Organization, 2008
- Cost to Build just 100 new Nuclear Reactors **$1,100 Billion**

Business Test #5: Sufficient Revenues?
Three Threats to Revenue Adequacy

- Rate increases, efficiency may destroy customer demand for kWh's
- Inadequate Prices Received for kWh's Sold
- Lower than Projected Generation Output (# of kWh's)

Could Demand Go Flat?

What Happens to Revenue if Customers Save?

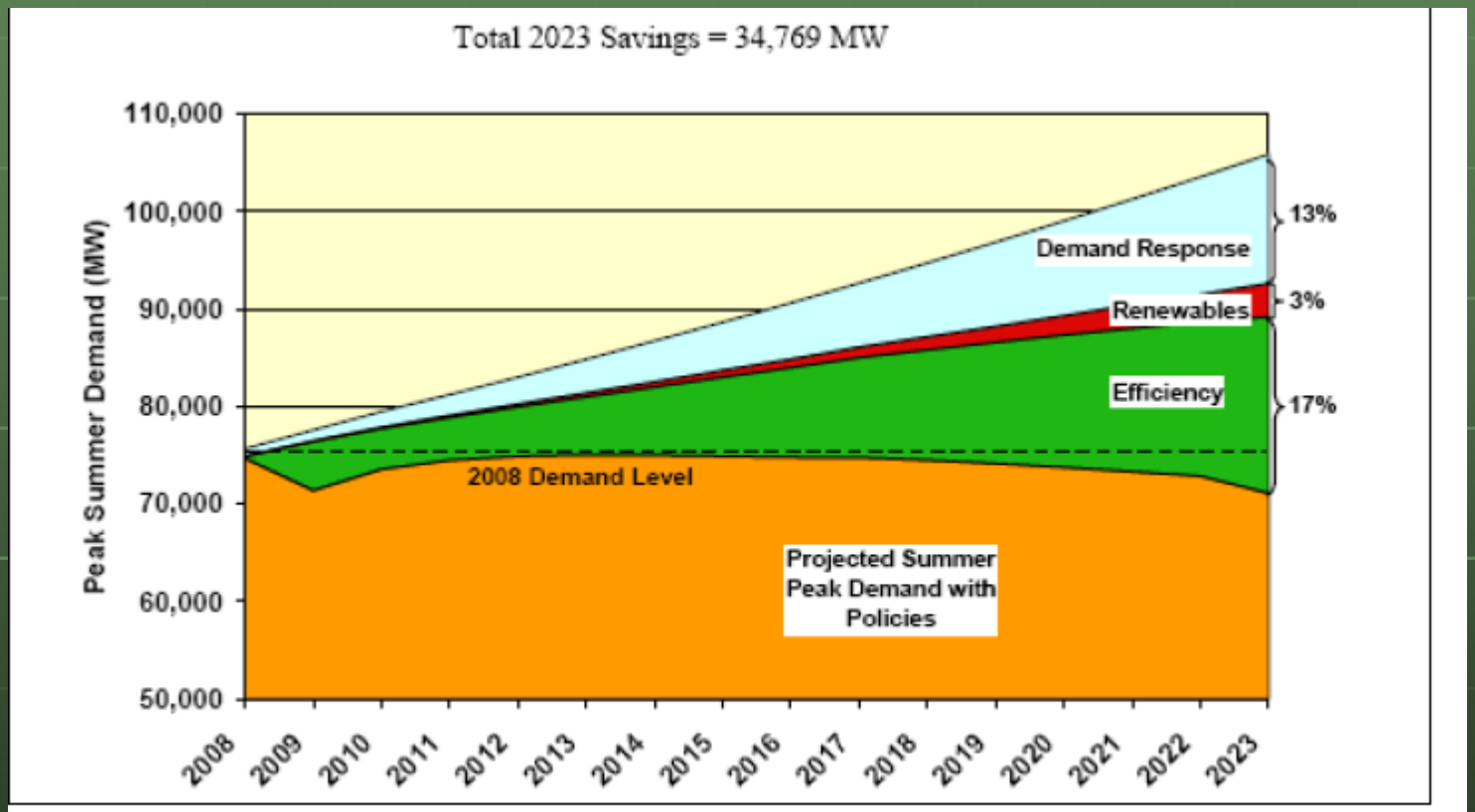


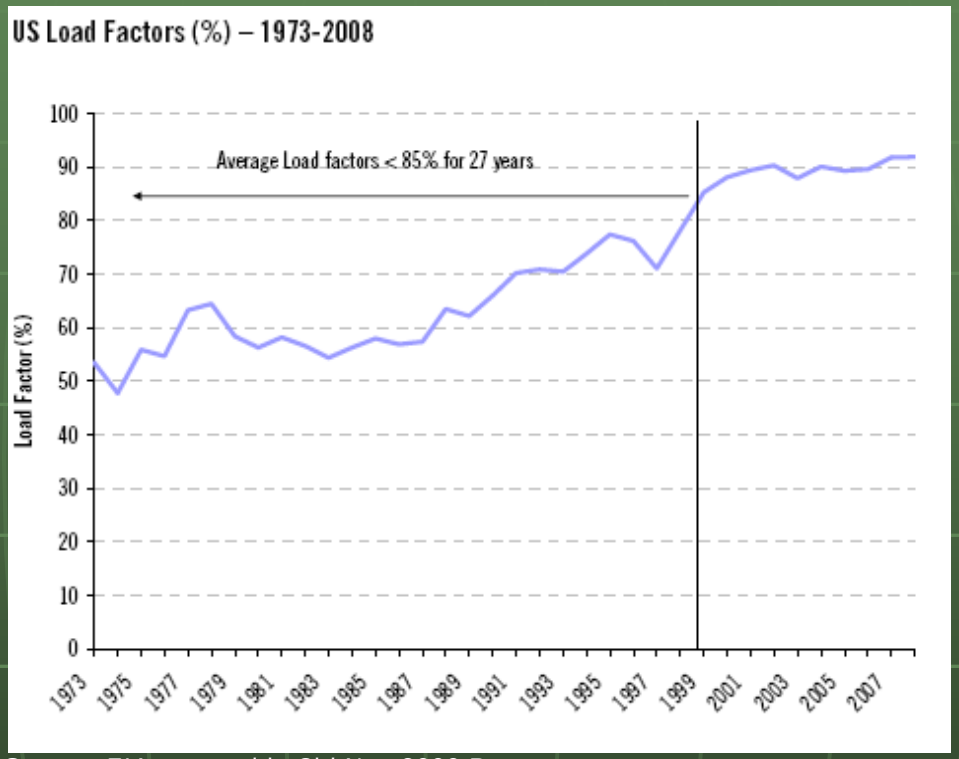
Figure 11: Overall Impact of Efficiency, Demand Response, and Renewable Measures Recommended by ACEEE for Texas

Source: American Council for Energy Efficient Economy 2007 Report

Threat to Revenue: Prices Received

- *Citi*: UK electric market would have paid *too little revenue > 80% of time* - *Citi* Nov 2009
- *U.S. Congressional Budget Office*: loan default well over 50% likely as prices received unlikely to cover new nuclear costs - CBO 2003 Report
- *Simmons & Company*: "The economics of nuclear power in a low priced gas environment are not very compelling." Also, "wind power may not compliment nuclear... given that wind power can be produced in the off-peak periods thereby threatening nuclear power at the baseload." "Simmons Energy Briefing: Nuclear Energy Update" 25 February 2010

Threat to Revenue: Lower than Projected Output



Source: EIA as used in Citi Nov 2009 Report

- Radically New Nuclear Plant Designs
- Lifetime Capacity Factor of US, other nuclear fleets low on average
- Early years most important for ROE
- Existing workforce retiring, shortages of trained nuclear personnel expected

Summary of Tests of New Nuclear as Business Proposal

1. Customer Needs: *Poor Fit*
2. Financial Stress: *Extreme*
3. Costs: *Ungovernable*
4. Competition: *Cannot Beat*
5. Revenue: *Inadequate*

Conclusion: *Severe Weaknesses*

Prudent Path for Utilities Now

- Adopt “least cost” strategies - $500 rebate could save $10,000 new plant construction
- With economy and demand uncertain, use shorter-lead-time plants – track demand curve closer, wait longer to commit.
- Use load-following and peak plants to guarantee *capacity* so lights stay on (kW)
- Use intermittent (e.g. wind, solar PV) to generate carbon free *energy* (kWh) and cut fossil fuel use