

# Across the “Second Valley of Death”: Designing Successful Energy Demonstration Projects

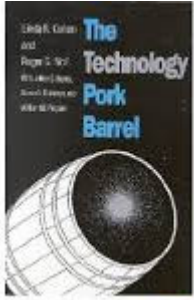
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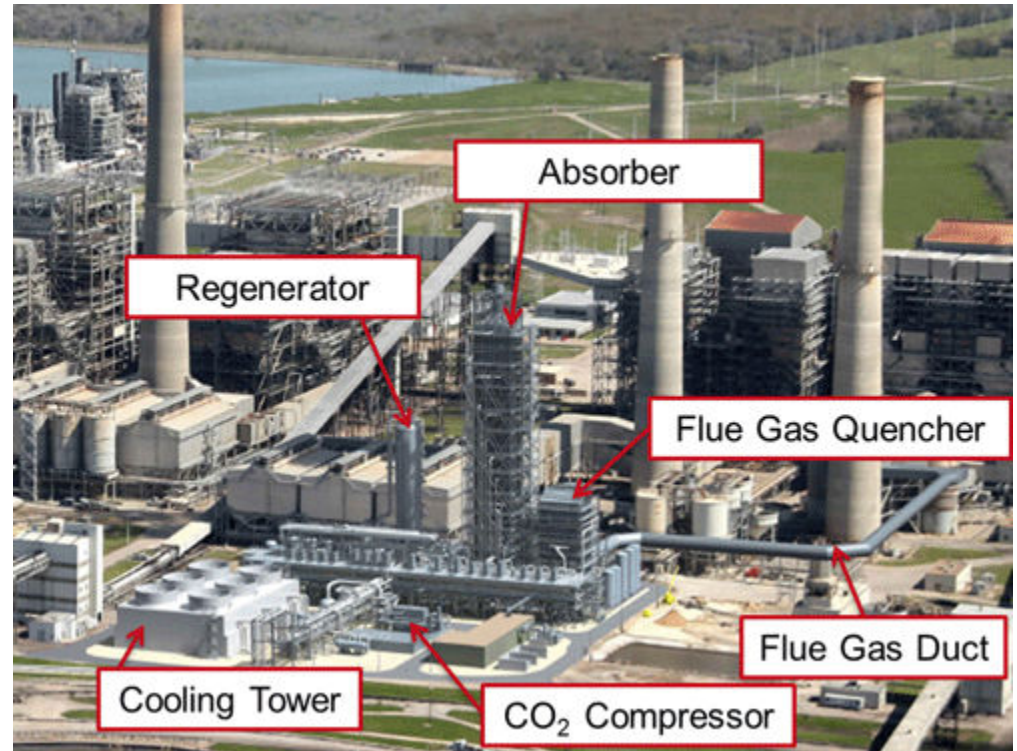


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# Clinch River v. Petra Nova: Which Is Paradigmatic?



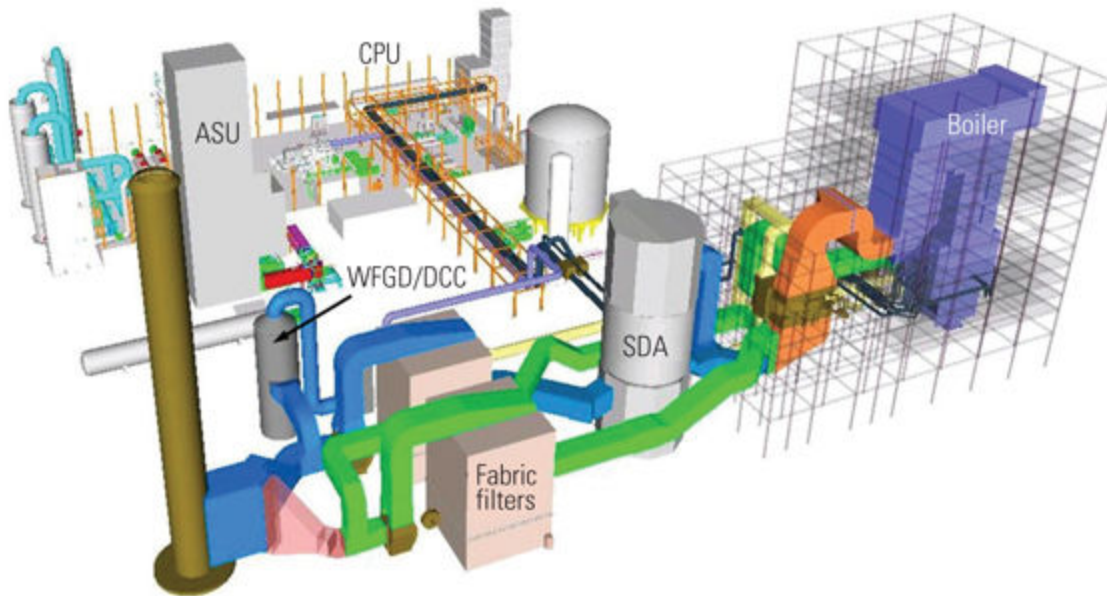
Clinch River Breeder Reactor  
(Source: [ANS](#))



Petra Nova Carbon Capture Facility  
(Source: [Mitsubishi](#))

# Why Demonstrate?

- Integration
- Tight coupling
- Risk reduction
  - Techno-economic
  - Institutional



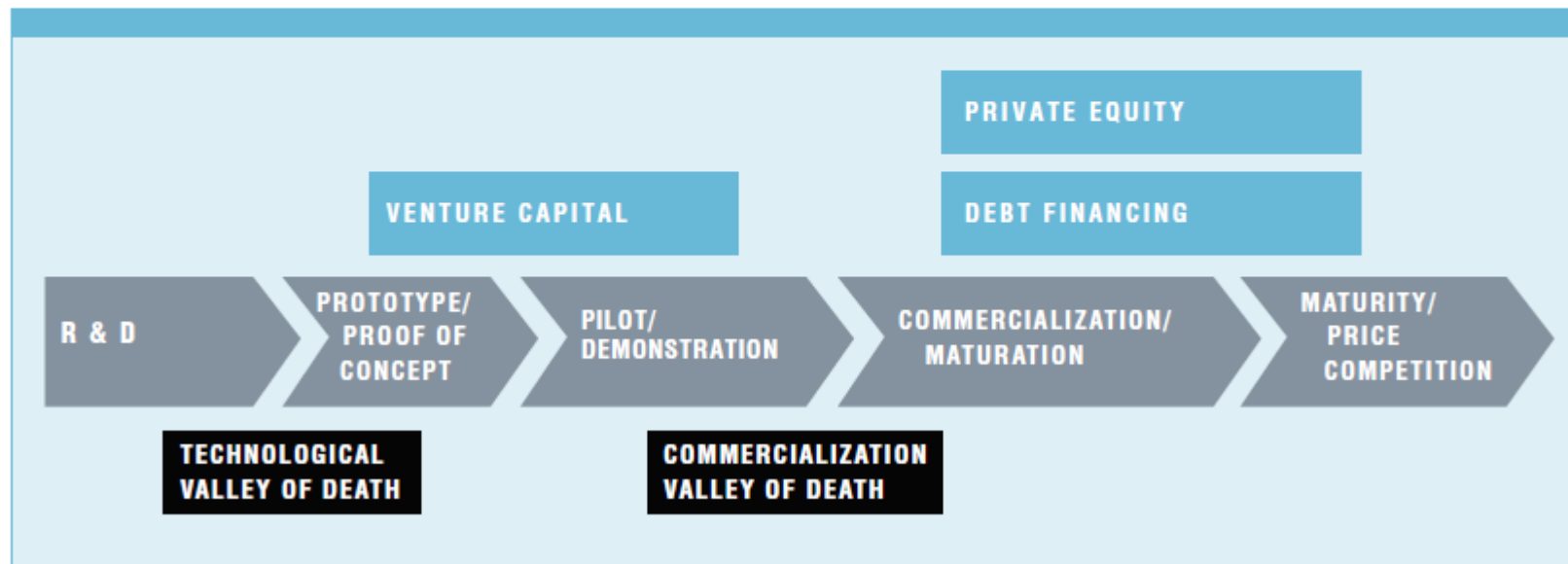
Source: [Power](#),  
January 1, 2011

Notes: ASU = air separation unit, DCC = direct contact cooler, SDA = spray dryer absorber, WFGD = wet flue gas desulfurization

# Demonstration: The Second Valley of Death

Figure 1

## THE ENERGY INNOVATION CYCLE AND THE CLEAN ENERGY VALLEYS OF DEATH



Source: Jesse Jenkins and Sara Mansur, “Bridging the Clean Energy Valleys of Death,” Breakthrough Institute, November 2011

# Nemet et al.: 511 Demo Projects. Median Share Public Finance: 64%

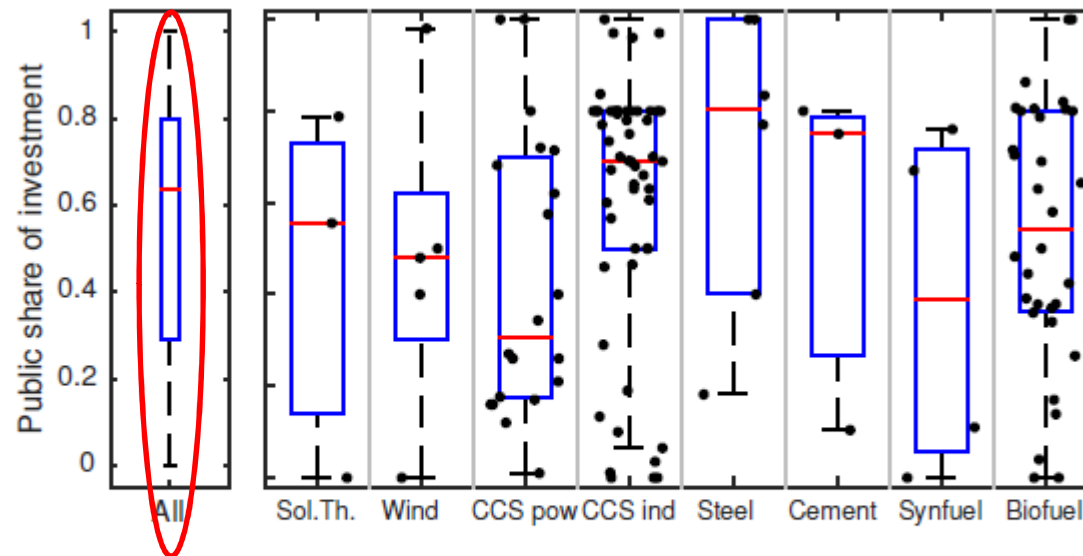


Figure 3: Contributions of public sector to demonstration projects included in analysis. Boxes represent 25–75th percentile ranges, red line is median, and dashed lines indicate full range.

Source: Gregory F. Nemet, Martina Kraus, and Vera Zipperer, “The Valley of Death, the Technology Pork Barrel, and Public Support for Large Demonstration Projects” (discussion paper 1601, DIW Berlin, 2016),

# Obama Administration Projects

Technology Field	No. of Projects	Average Project Total Budget (Millions)	Average Federal Project Share	Median Federal Project Share	Total DOE Funding Allocated (Millions)
<b>Advanced Clean Coal</b>	6	\$1,412.5	28.8%	26.0%	\$1,753.8
<b>Bioenergy</b>	2	\$93.6	45.4%	N/A	\$85.4
<b>Enhanced Geothermal</b>	2	\$28.5	43.4%	N/A	\$26.5
<b>Energy Storage</b>	16	\$40.5	43.6%	47.9%	\$156.6
<b>FutureGen 2.0</b>	1	\$1,774.8	59.1%	59.1%	\$1,048.3
<b>Industrial CCS</b>	3	\$358.1	64.7%	65.9%	\$686.8
<b>Offshore Wind</b>	7	\$14.5	64.4%	58.2%	\$61.2
<b>Smart Grid</b>	16	\$53.4	49.1%	49.9%	\$422.9
<b><i>Total</i></b>	<b><i>53</i></b>	<b><i>\$248.5</i></b>	<b><i>47.9%</i></b>	<b><i>49.9%</i></b>	<b><i>\$4,241.50</i></b>

# Design Principles for Demo Projects

1. Insulate project decisions from politics
2. Share costs in rough proportion to benefits
3. Engage all segments of value chain
4. Foster open information exchange
5. Undertake only if reasonable expectation of follow-on investment

# Principle 1: Political Insulation

## U.S. Offshore Wind: Advanced Technology Demonstration Projects

Funding Opportunity Announcement Number: DE-FOA-0000410

Announcement Type: Amendment 000005

CFDA Number: 81.087

### TA 2, Criterion I: Technical Concept and Impact (Weight: 30%)

- The overall relevance and applicability of the technical concept and approach in addressing the specific innovation objectives of the FOA;
- The rationale and evidence provided supporting the conclusion that the proposed wind energy facility will be ready for integrated pilot system demonstration at the end of Budget Period V;
- Degree of innovation for the proposed approach and the extent to which the proposed concept offers advantages over other solutions or approaches from a cost of energy perspective;
- The potential of the proposed concept to advance the state of the art and the knowledge base of the industry;
- Likelihood that proposed project will lead to commercial development, including commercialization in the U.S. of the turbine and other technical solutions proposed for the project; and
- Proposed testing, data collection and performance validation plan to achieve IEC-like type certification; and quantify turbine and system technical and economic performance for 5 years after commissioning.

### TA 2, Criterion II: Reduction in Cost of Energy (Weight 30%)

- Extent to which a detailed cost of energy (LCOE) analysis, including all assumptions, calculations, and sources used to calculate the impact of the proposed design on COE, is presented for the proposed project with rigor, clarity, transparency and completeness. See Appendix H for example and calculation template to be submitted; and
- Extent to which the LCOE analysis for proposed project can be projected to show a clear path from the demonstration-scale to cost-effective commercial-scale deployment at 10 ¢/kWh or the local "hurdle" price at which offshore wind can compete with other regional generation sources without subsidies.



**Business Impact**  
**FutureGen Rises from the Dead**  
The DOE's backing revives a pioneering clean-coal project.  
by Tyler Hamilton June 24, 2009

**MIT  
Technology  
Review**



# Principle 2: Cost-Sharing

Technology Field	Average Federal Project Share	Median Federal Project Share
Advanced Clean Coal	28.8%	26.0%
Bioenergy	45.4%	N/A
Enhanced Geothermal	43.4%	N/A
Energy Storage	43.6%	47.9%
FutureGen 2.0	59.1%	59.1%
Industrial CCS	64.7%	65.9%
Offshore Wind	64.4%	58.2%
Smart Grid	49.1%	49.9%
<b>Total</b>	<b>47.9%</b>	<b>49.9%</b>

- Mainly set by statutory guidelines
  - 50% for most
  - 70% for industrial CCS
  - Petra Nova exception that proves rule
- DOE discretionary authority rarely used.

# Principle 3: Value Chain

Battelle led the project, collaborating with the Bonneville Power Administration (BPA), technology infrastructure providers and field demonstration partners (including rural electric cooperatives, public utility districts, municipalities, independent utilities, and a university campus).

In addition to Battelle and BPA, the project participants were:

Technology Infrastructure	Field Demonstration
Alstom Grid	Avista Utilities (Washington)
IBM	Benton PUD (Washington)
Netezza (now part of IBM)	City of Ellensburg (Washington)
QualityLogic	Flathead Electric Cooperative (Montana)
Spirae	Idaho Falls Power (Idaho)
Vaisala (previously 3TIER)	Lower Valley Energy (Wyoming)
	Milton-Freewater City Light & Power (Oregon)
	NorthWestern Energy (Montana)
	Peninsula Light Company (Washington)
	Portland General Electric (Oregon)
	University of Washington (Washington)

Partner/Recipient	Recipient Type
End User	27
Project Developer	7
Technology Vendor	13
Other	1
Non-Profit	5

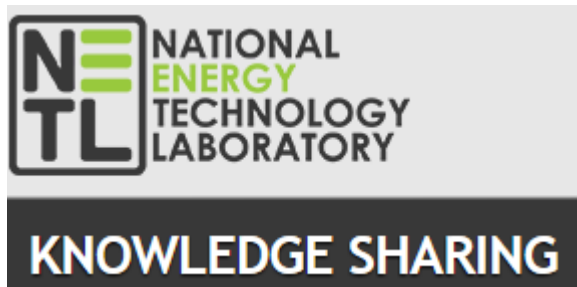
## OWNERSHIP & VALUE CHAIN PARTNERS

<b>Ownership Model</b>	Utility-Owned
<b>Equity Owner 1</b>	Duke Energy
<b>Equity Owner 1 Percentage</b>	100%
<b>Energy Storage Technology Provider</b>	Xtreme Power
<b>Power Electronics Provider</b>	Yunicos
<b>Integrator Company</b>	Yunicos
<b>O&amp;M Contractor</b>	Yunicos
<b>Developer</b>	Duke Energy

## Notrees Battery Storage Project - Duke Energy

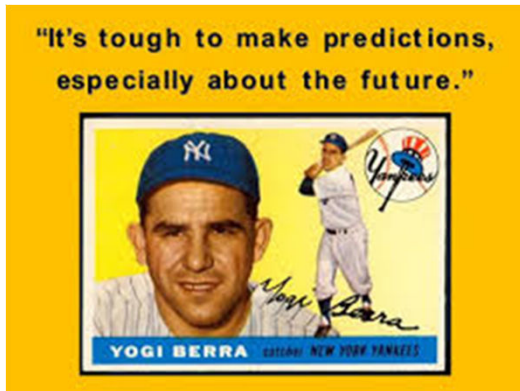
# Principle 4: Information-Sharing

- Tradeoff between incentive for private investment in the demonstration project and competition during commercialization phase.
- Varied approach across programs

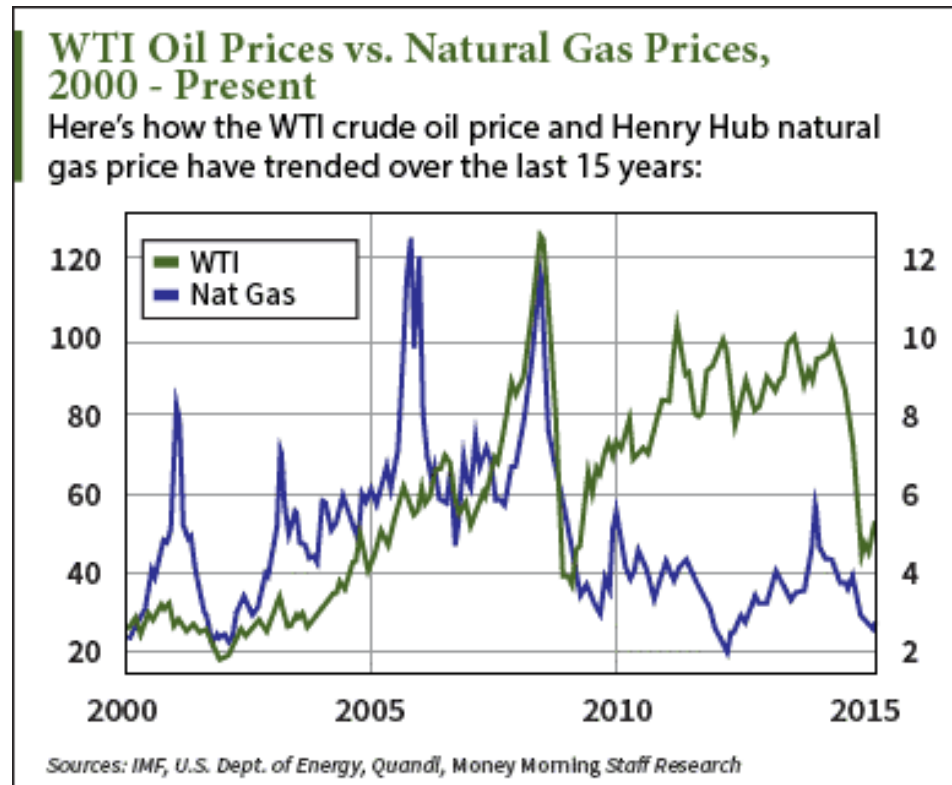


**Advanced Wind FOA:** This program is covered by a special protected data statute. The provisions of the statute provide for the **protection from public disclosure, for a period of up to five (5) years** from the date of its development, of first-produced data that would be trade secret, or commercial or financial information that is privileged or confidential, if the information had been obtained from a non-Federal party.

# Principle 5: Follow-On Opportunities



The future of some of technologies demonstrated in the Obama era is almost entirely dependent on continuing policy support over the intermediate term, such as tax incentives or carbon pricing, which is uncertain, while others may be able to attract follow-on investment from commercial interests without such policies.



# Options To Consider (Not Mutually Exclusive)

RICHARD K. LESTER  
DAVID M. HART



## Closing the Energy- Demonstration Gap

An Energy Technology Corporation  
Will Improve the Federal Government's  
Efforts to Accelerate Energy Innovation

John M. Deutch  
*Massachusetts Institute of Technology*

*A regional approach to demonstrating  
the commercial potential of major  
new energy technologies would open up  
new opportunities for accelerating  
innovation.*

# Conclusions

- Build & sustain robust portfolio
- Co-invest with private sector
- Ensure that private partners lead
- Make information-sharing a higher priority
- Avoid excessively rapid scale-up
- Be prepared to terminate projects
- Consider alternatives to DOE
- Encourage other agencies, regions, and states