Lessons Learned from Major Demonstrations/Integrated Projects

NATIONAL ENERGY TECHNOLOGY LABORATORY

Solutions for Today | Options for Tomorrow

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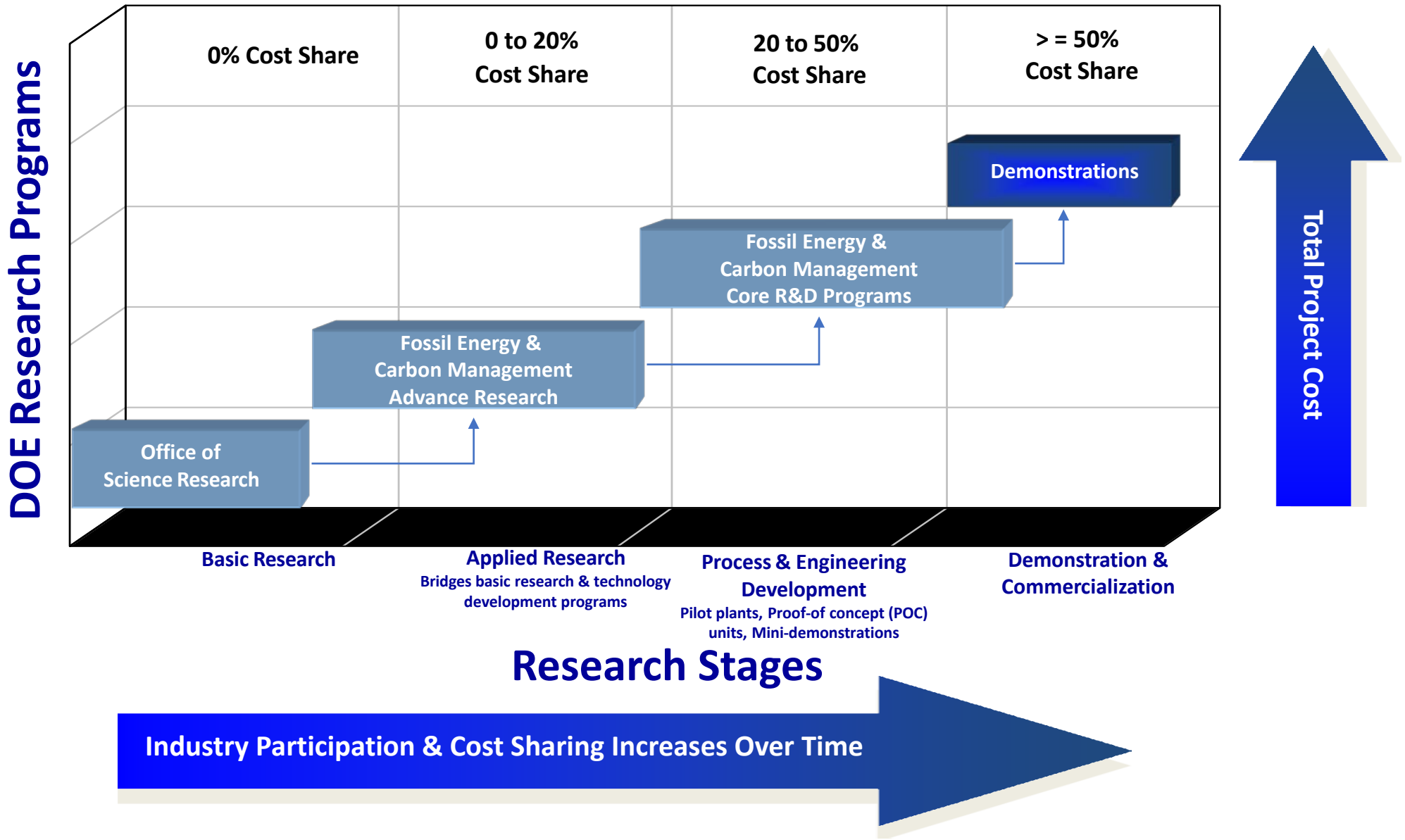
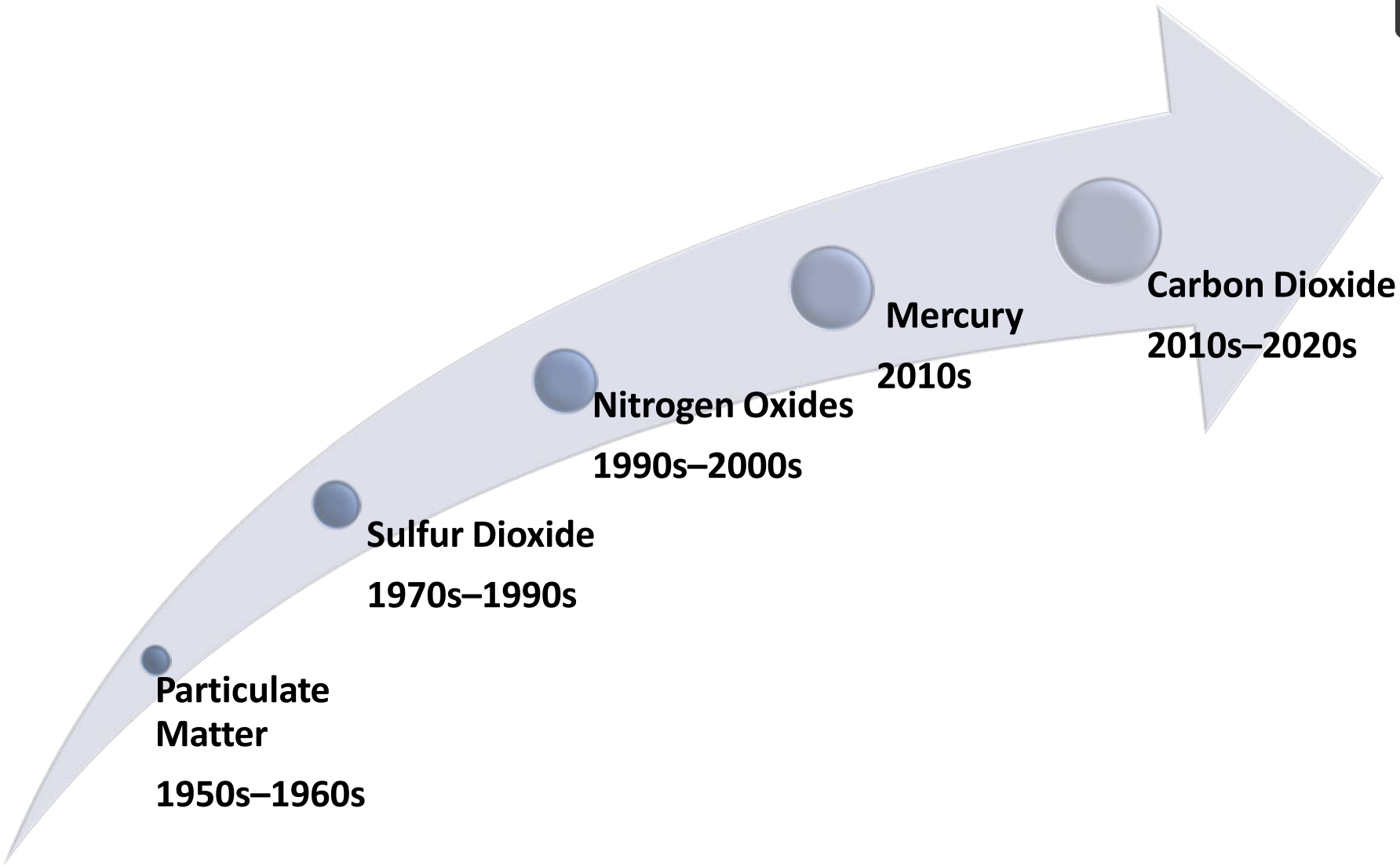
U.S. DEPARTMENT OF ENERGY

Cost Share Ensures Commercial Relevance



Evolution of Air Pollution Controls



Major Air Pollution Control Demonstration Projects

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Advanced SO_2 Scrubbers (or Flue Gas Desulfurization)

Pure Air (Bailly), CT-121 (Yates) & S-H-U (Milliken/Cayuga)

NO_x Emissions Control Technologies

Selective Catalytic Reduction, Selective Non-Catalytic Reduction, Low-NO_x Burners & Fuel Reburning

Hazardous Air Pollutants (HAPs)

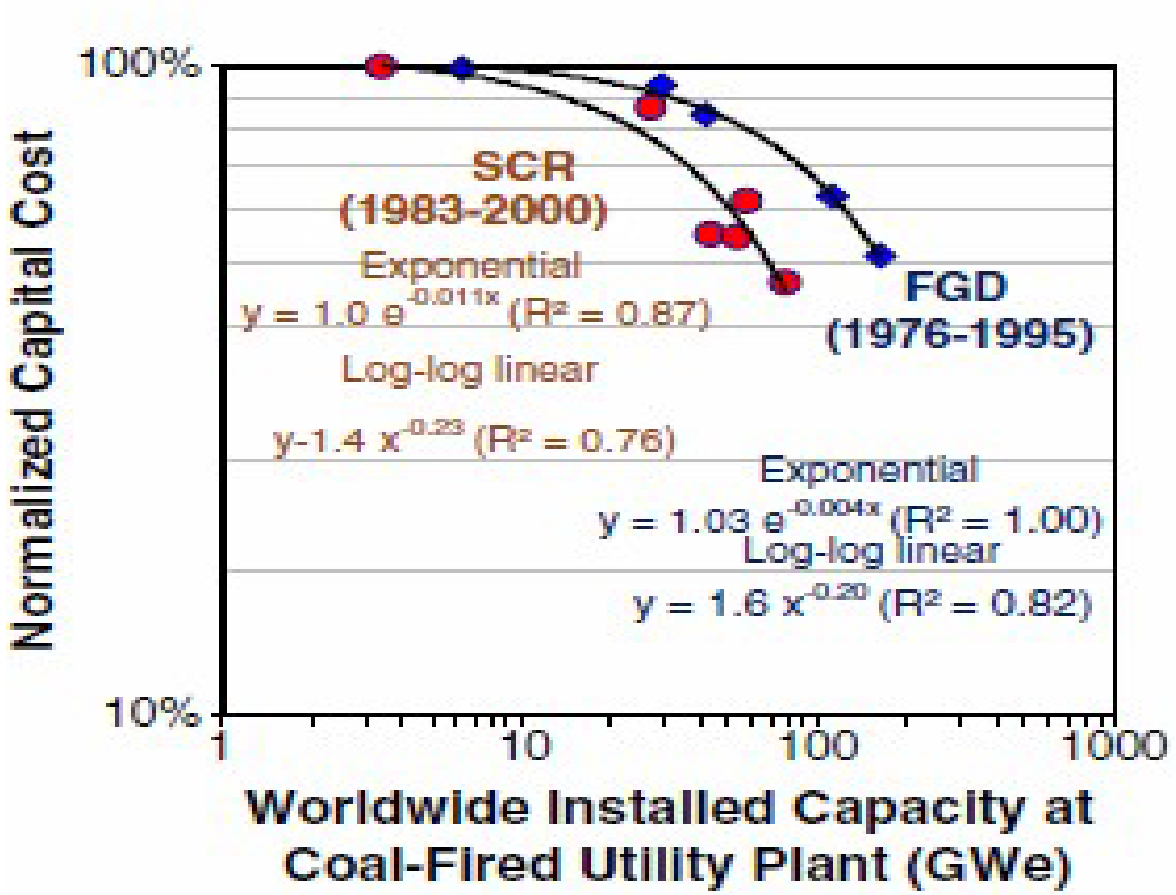
HAPs testing on 10 projects of differing configurations; led to R&D focus on mercury emissions

CO_2 Emissions Capture Technologies

Archer Daniels Midland, Air Products & Petra Nova

SO_2 & NOx Control Learning Curves

Non-linear learning curves are prevalent in power plant emission control technologies



Yeh, S., Rubin, E.S., Hounshell, D.A., and Taylor, M.R. (2009) Uncertainties in Technology Experience Curves, for Integrated Assessment Models, Environmental Sci. and Technol. **43** (18), 6907-14.

Key Challenges to Carbon Capture and Storage

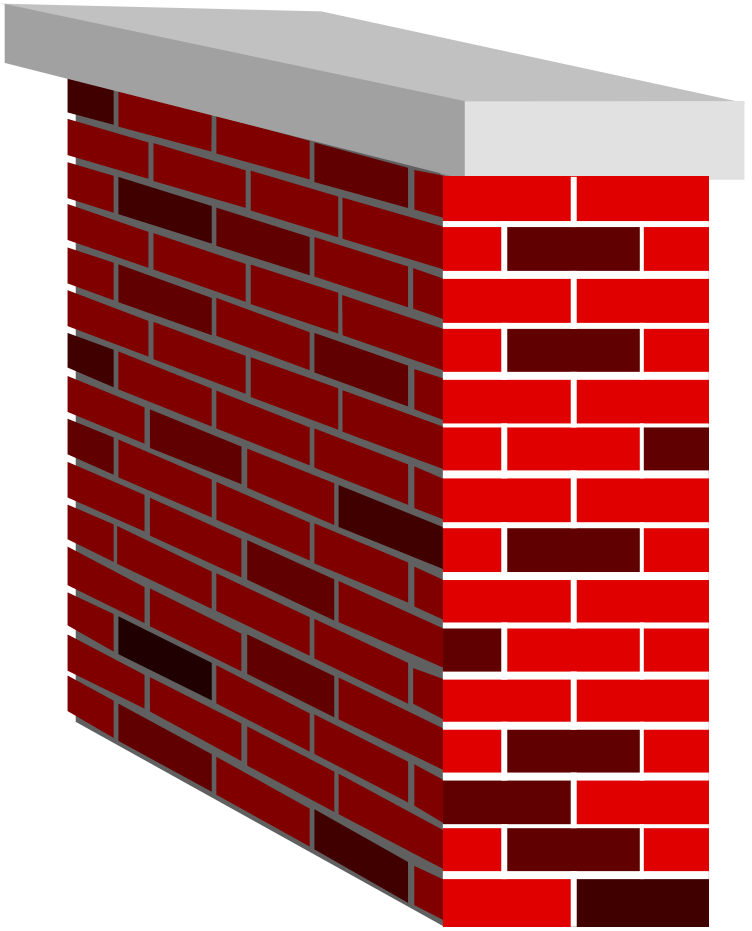
Projects helping to address both Technical and Legal/Social Issues

Technical Issues:

- **Capture Technology**
  - Existing Power Plants
  - New Power Plants
  - Industrial Processes
- **Cost of CCS**
- **Sufficient Storage Capacity**
- **Permanence**
- **Best Practices**
  - Storage Site Characterization
  - Monitoring/Verification
  - Site Closure
  - Etc.

Legal/Social Issues:

- **Regulatory Framework**
  - Permitting
  - Treatment of CO_2
- **Infrastructure**
- **Human Capital**
- **Legal Framework**
  - Liability
  - Ownership
    - Pore space
    - CO_2
- **Public Acceptance (NIMBY → NUMBY)**



Some Lessons Learned

- Technology performance often degrades with scale-up.
- Baseline technologies often improve over time and are not necessarily stagnant.
- Project finance, schedule, cost ≈ Technical considerations
- DOE generally favors technology-forcing projects, but the technology must also be 'ready-to-scale' (i.e., technical merit and technical maturity/readiness).
- Read the entire Funding Opportunity Announcement, including evaluation criteria, proposal preparation instructions, & model cooperative agreement.
- Read the enabling appropriations legislation, to understand the objectives (and to be able to recognize at least some of the areas where DOE has no wiggle room in negotiations).
- For highly specialized negotiation topics (e.g., intellectual property provisions), make certain subject-matter experts are present at relevant discussions.
- Keep the lines of communication open with DOE, and with the local community (-ies).
- Engage local communities proactively & respectfully.

Some Lessons Learned (continued)

- Successful projects often boil down to managing risk, so perform a thorough risk analysis, hazard & operability analysis, etc.
- Build ample time into your project schedule.
- DOE approvals are not necessarily slow, even though DOE does exercise a relatively high degree of due diligence.
- National Environmental Policy Act compliance isn't the same as permitting. Environmental Impact Statements can require more engineering information than is initially available.
- Financial modeling should indicate a viable project, before financial engineering techniques are deployed.
- Financial closing prior to construction is a watershed event for projects that are dependent upon project financing.
- Recognize trade-offs between a single large component (lower cost) & several smaller ones (higher operational reliability).
- Be careful when overlapping design & construction activities.

Some Additional Lessons Learned

Including the "soft side" of project management

Be passionate about job & career, but also be kind to the people you work with.

Be patient and polite, yet persistent.

Be frank and open.

Are there really two sides to every issue?

- Complex issues can have more than two 'sides' to consider.

Dig deep!

- Scratch well beneath the surface, to see/understand better

Do the math!

Look beyond the % signs

- Seek to understand absolute number stats, as well as percentages.

Develop good people skills…

- …Especially, good listening skills.

Read…

- …And strive to become a better writer in the process.

Imagine. Dream. Explore. Discover. Create.

Make today a good one!

For More Information

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