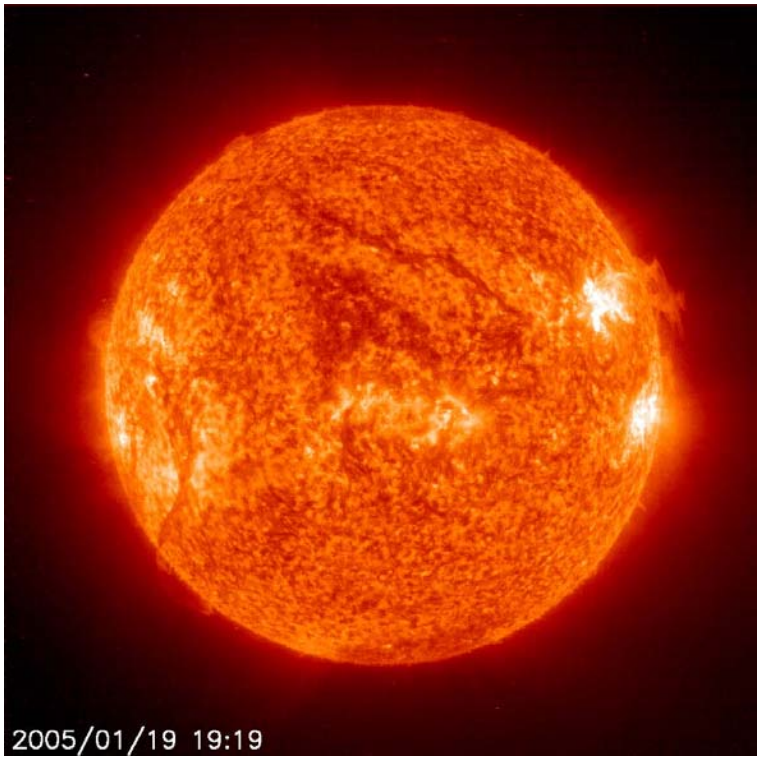
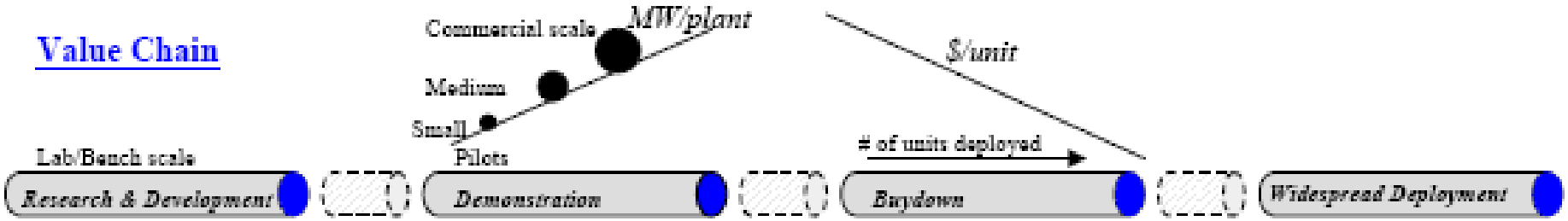
Energy Technology Innovation

The Role of Government RD3



Anthony Eggert
Hydrogen Technical Advisory Committee
July 15, 2009

Stages of Energy Technology Innovation (ETI)



Barriers

- Difficulty of capturing benefits of R & D
- Long time horizons
- High risks

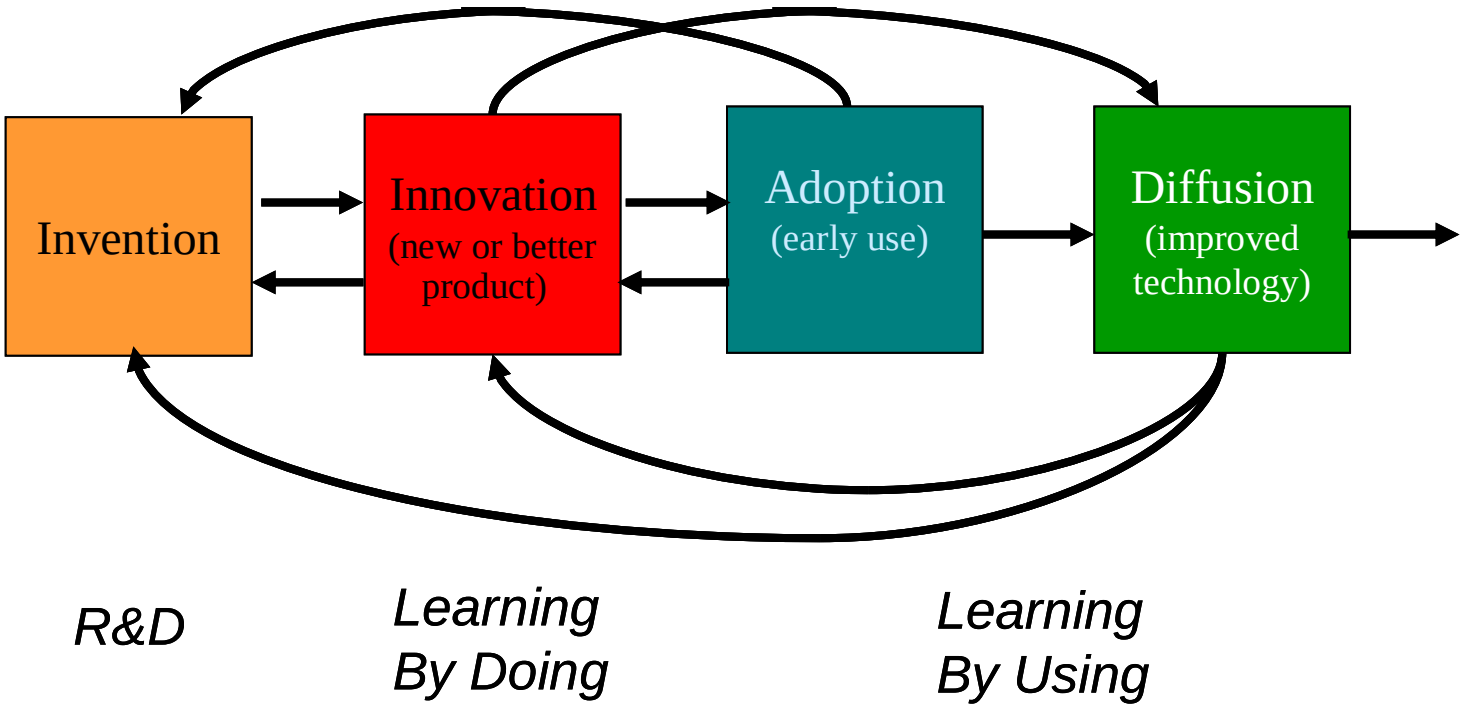
- Difficulty of capturing benefits of demonstration
- Long time horizons
- Risks
- Large capital costs

- Financing of incremental cost
- Cost uncertainty
- Technological and other risk

- High transaction costs
- Price for competing technologies doesn't include externalities;
- Lack of retail finance
- Lack of information

Source: PCAST 1999

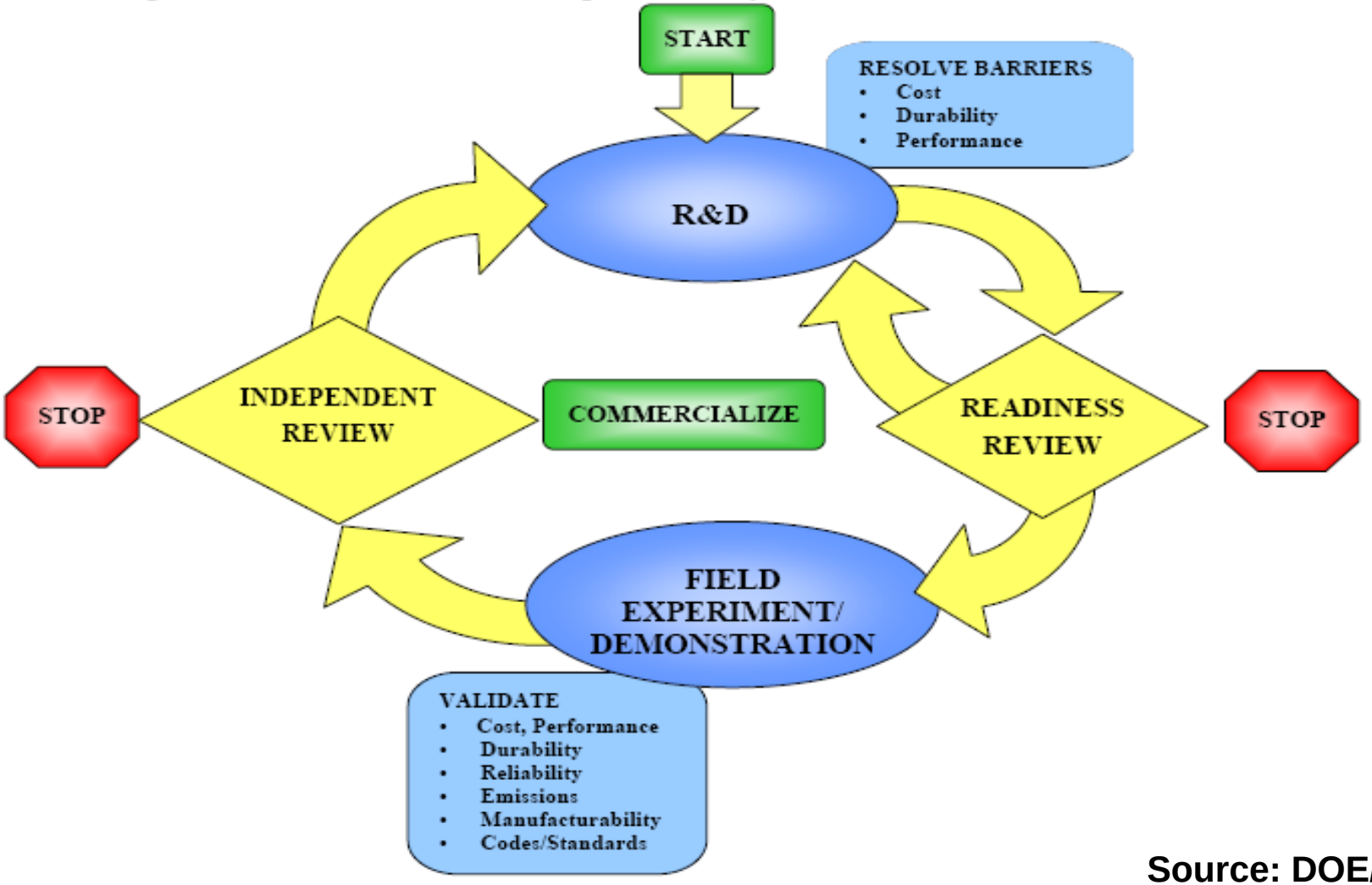
Stages of ETI



Source: Rubin (2005)

Stages of ETI

Figure 10. The R&D – Field Experiment Cycle



Source: DOE/EERE

Role of Government Support

Direct Government Funding of Research and Development (R&D)

- R&D contracts with private firms
- R&D grants and contracts with universities
- Intramural R&D conducted at gov't laboratories
- R&D contracts with consortia (2 or more of the actors above)

Direct or Indirect Support for Commercialization and Production; Indirect Support for Development

- Patent protection
- R&D tax credits
- Production subsidies or tax credits to firms bringing new technologies to market
- Tax credits or rebates for new technology buyers
- Government procurement
- Demonstration projects

Support for Learning and Diffusion of Knowledge and Technology

- Education and training
- Codification and transfer of knowledge
- Technical standard-setting (non-regulatory)
- Technology and/or industrial extension services
- Publicity and consumer information

Source: Alic, Mowery and Rubin, 2003

CCTP Goal Area	Technology Strategies	Education, labeling and information dissemination	Tax policy and other financial incentives	Coalitions & partnerships	International cooperation	Market conditioning including government procurement	Technology demonstration	Codes and standards	Legislative act of regulation	Risk mitigation
Energy End-Use and Infrastructure	Transportation	54	29	24	15	16	12	10	7	1
	Buildings	58	21	22	15	20	5	14	5	3
	Industry	45	14	28	13	4	6	2	1	2
	Electric Grid and Infrastructure	19	7	11	12	4	6	1	3	1
Energy Supply	Low-Emission, Fossil-Based Fuels and Power	23	15	8	14	5	6	2	1	1
	Hydrogen	11	6	2	5	3	4	3	0	1
	Renewable Energy & Fuels	48	30	19	19	18	11	7	7	2
	Nuclear Fission	7	4	3	7	2	2	0	0	2
Carbon Sequestration	Carbon Capture	5	5	4	6	2	4	0	0	1
	Geologic Storage	4	4	4	7	2	3	1	1	1
	Terrestrial Sequestration	18	12	7	8	5	2	0	0	1
Non-CO_2 Greenhouse Gases	Methane Emissions from Energy and Waste	14	3	7	9	1	1	0	2	1
	Methane and Nitrous Oxide Emissions from Agriculture	8	7	1	6	1	0	0	0	2
	Emissions of High Global-Warming Potential Gases	17	3	15	6	1	0	2	0	1
	Nitrous Oxide Emissions from Combustion and Industrial Sources	14	9	10	7	2	3	6	5	1
Totals		345	169	165	149	86	65	48	32	21

* Column totals represent the number of deployment activities impacting the 15 technology strategies. Totals are indicative measures of relative frequency of application. Double counting occurs because a single deployment activity may impact multiple technology strategies. The count does not include activities that are authorized but not implemented. See Annex B for details.

Source: USCCTP/CCCSTI

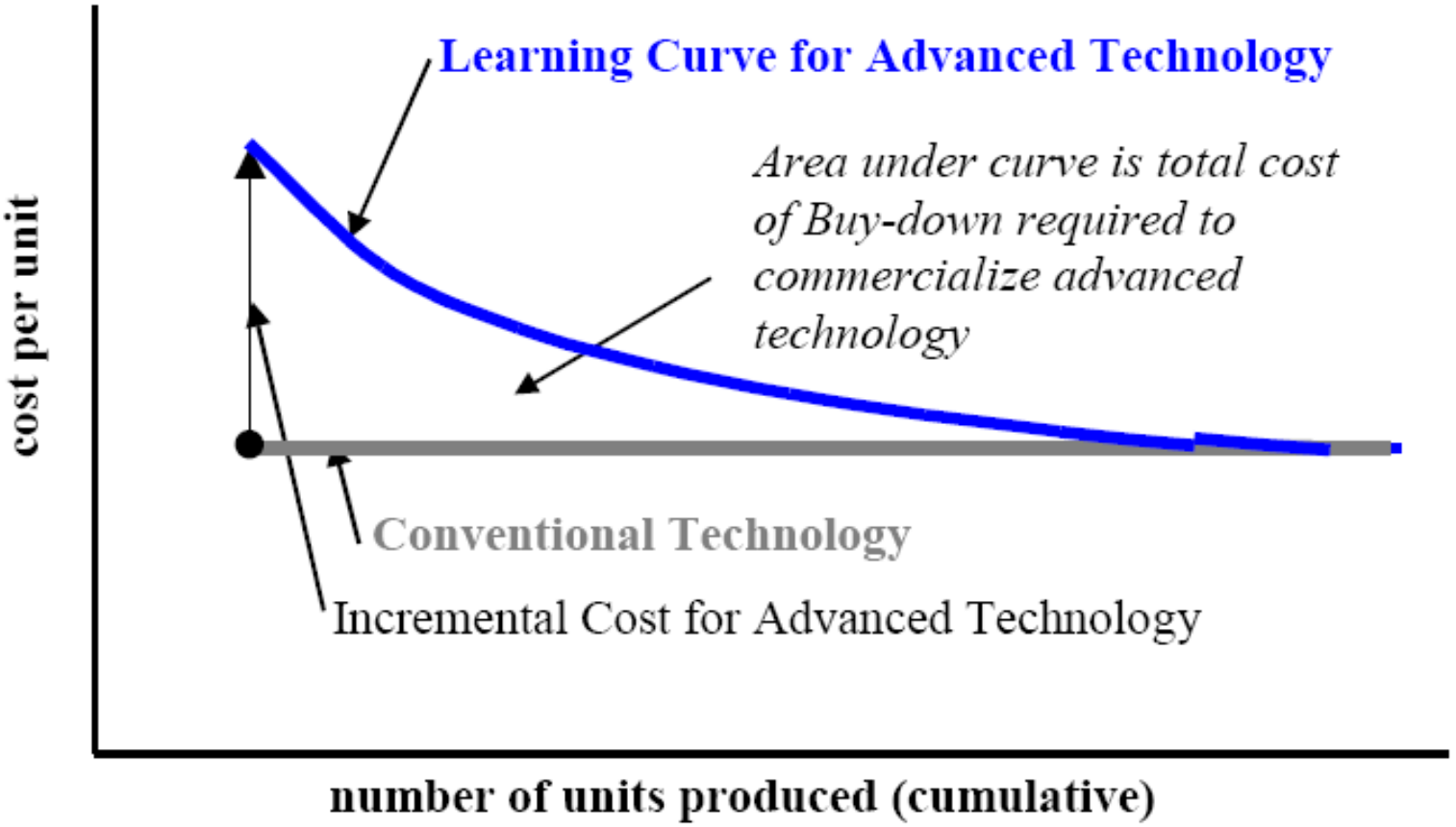
EERE Hydrogen and Fuel Cells Budget *(in thousands)*				
Key Activity	**FY 2007** *appropriation*	**FY 2008** *appropriation*	**FY 2009** *appropriation*	**FY 2010** ***request***
Fuel Cell Systems R&D	0	0	0	63,213
Hydrogen Production & Delivery R&D	33,702	38,607	10,000	0
Hydrogen Storage R&D	33,728	42,371	59,200	0
Fuel Cell Stack Component R&D	37,100	42,344	62,700	0
Technology Validation	39,413	29,612	14,789*	0
Transportation Fuel Cell Systems	7,324	7,718	6,600	0
Distributed Energy Fuel Cell Systems	7,257	7,461	10,000	0
Fuel Processor R&D	3,952	2,896	3,000	0
Safety, Codes & Standards	13,492	15,442	12,500*	0
Education	1,978	3,865	4,200*	0
Systems Analysis	9,637	11,099	7,713	5,000
Manufacturing R&D	1,928	4,826	5,000	0
Market Transformation	0	0	4,747	0
Total	$189,511	$206,241	$200,449	$68,213

Source: DOE Report to Congress, 2009

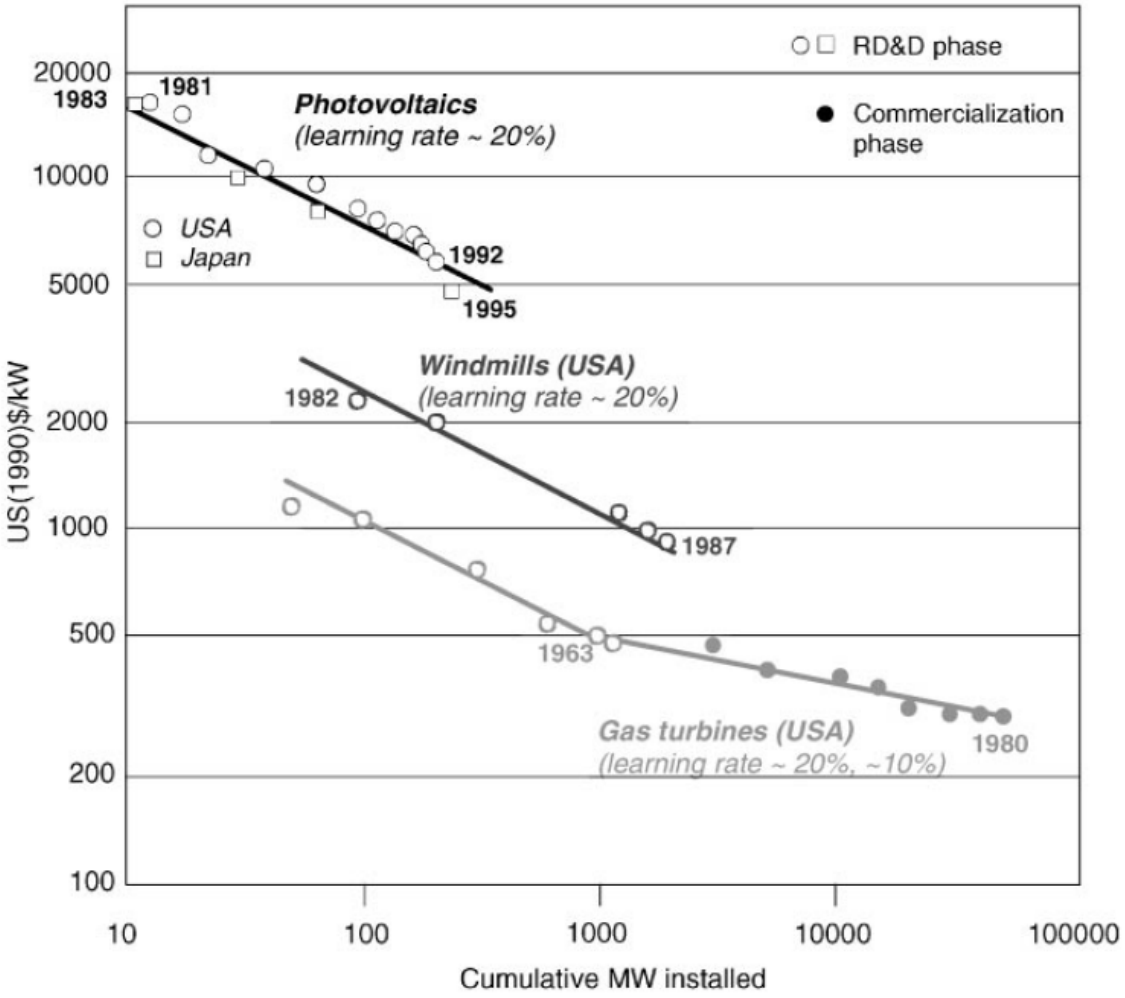
Discussion Questions

1. What is (or should be) the evolving role of USDOE spending on RD3?
2. Does the current plan reflect the appropriate priorities (across categories? across time?)
3. How can this spending best leverage existing and future private sector spending?
4. How do we create durable RD3 policy and avoid the typical boom/bust cycles of Government RD3 spending?
5. What is the role of Government RD3 in relation to other proposed policies/regulations?

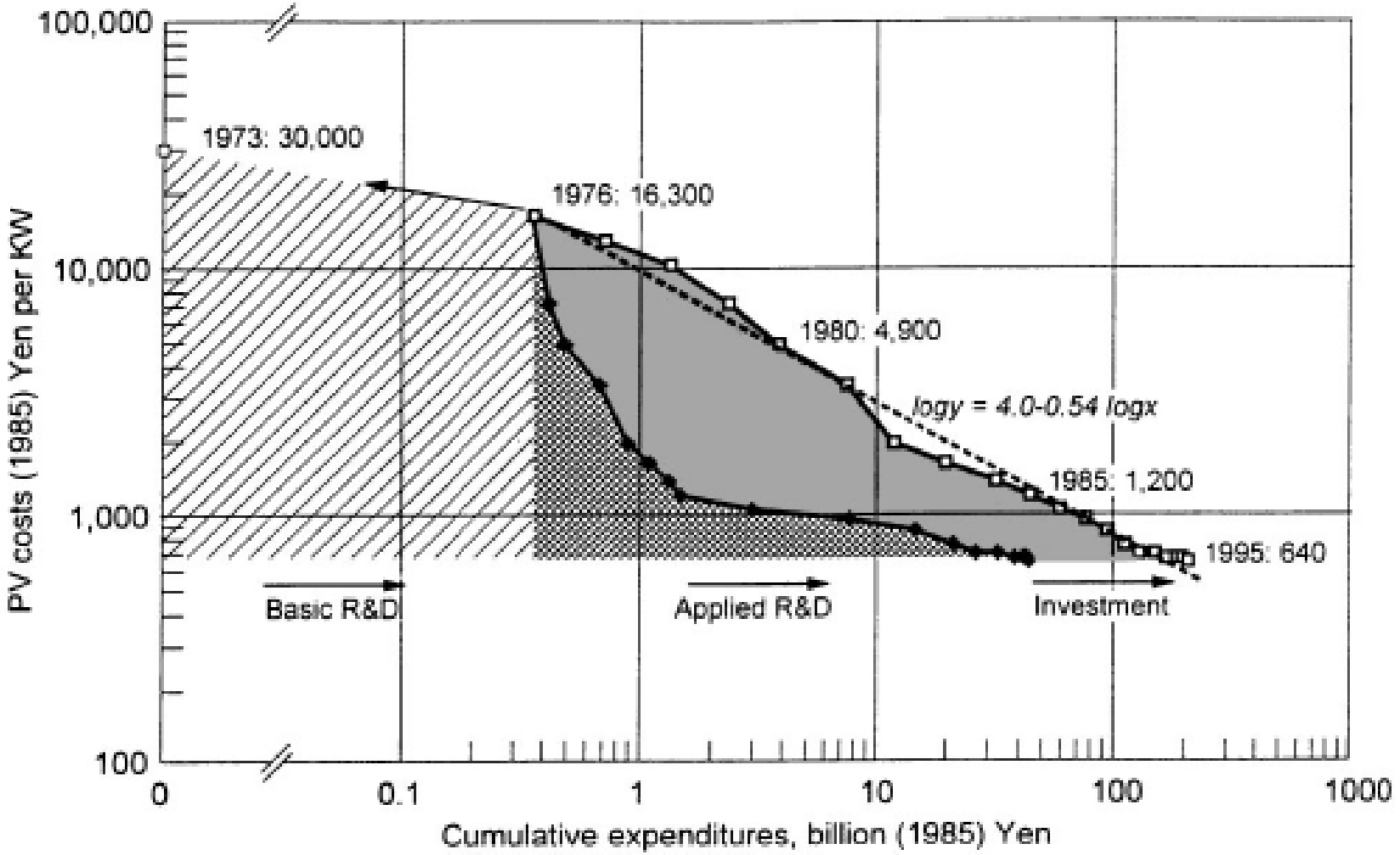
Learning curves for ETI



Learning curves for ETI

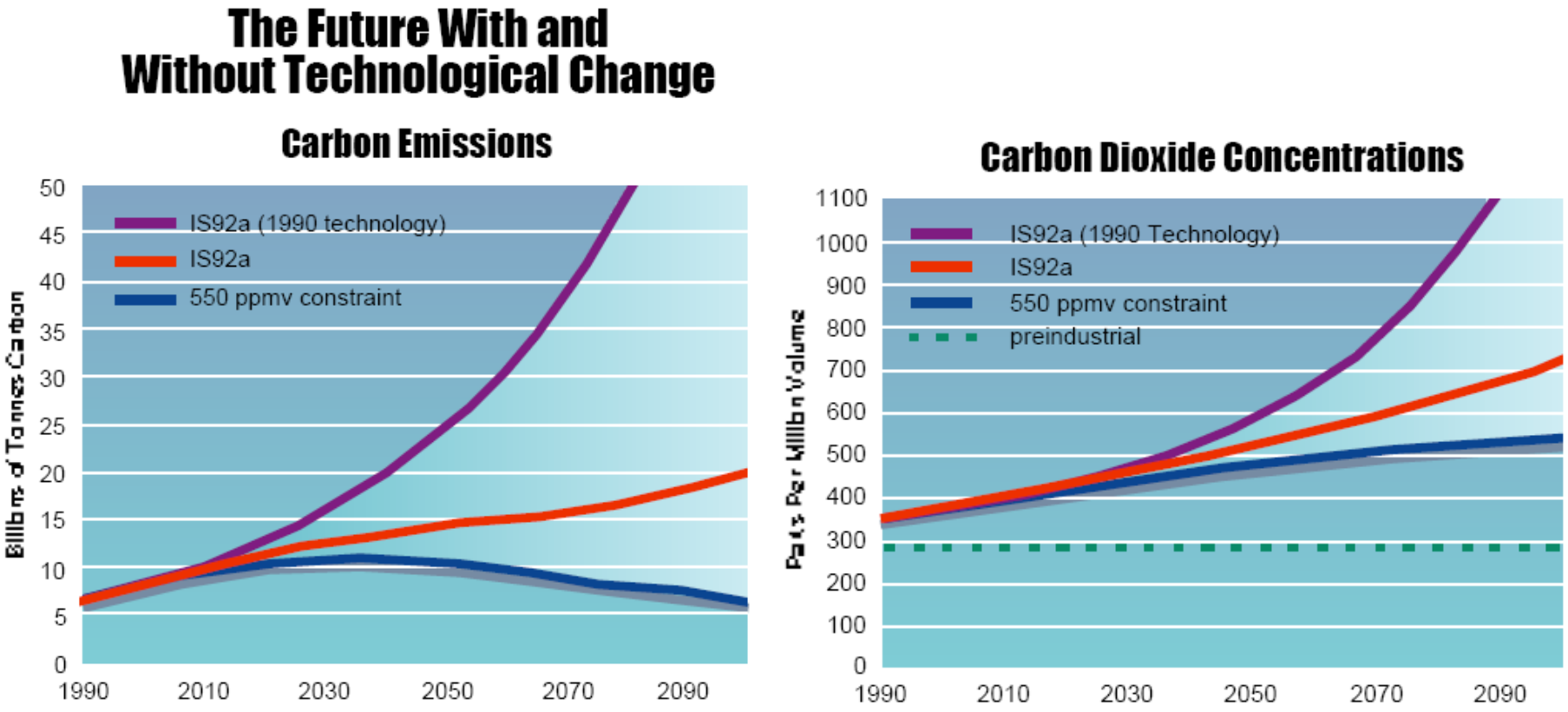


Learning curves for ETI



Grubler, et. al. , Energy Policy, 1999. **27**(5): p. 247-280.

Why we need Energy Technology Innovation (ETI)



Source: Edmonds, GTES 2004