Economic and Policy Frameworks for Energy Technology Deployment

EPRG Research seminar

Cambridge, May 2006

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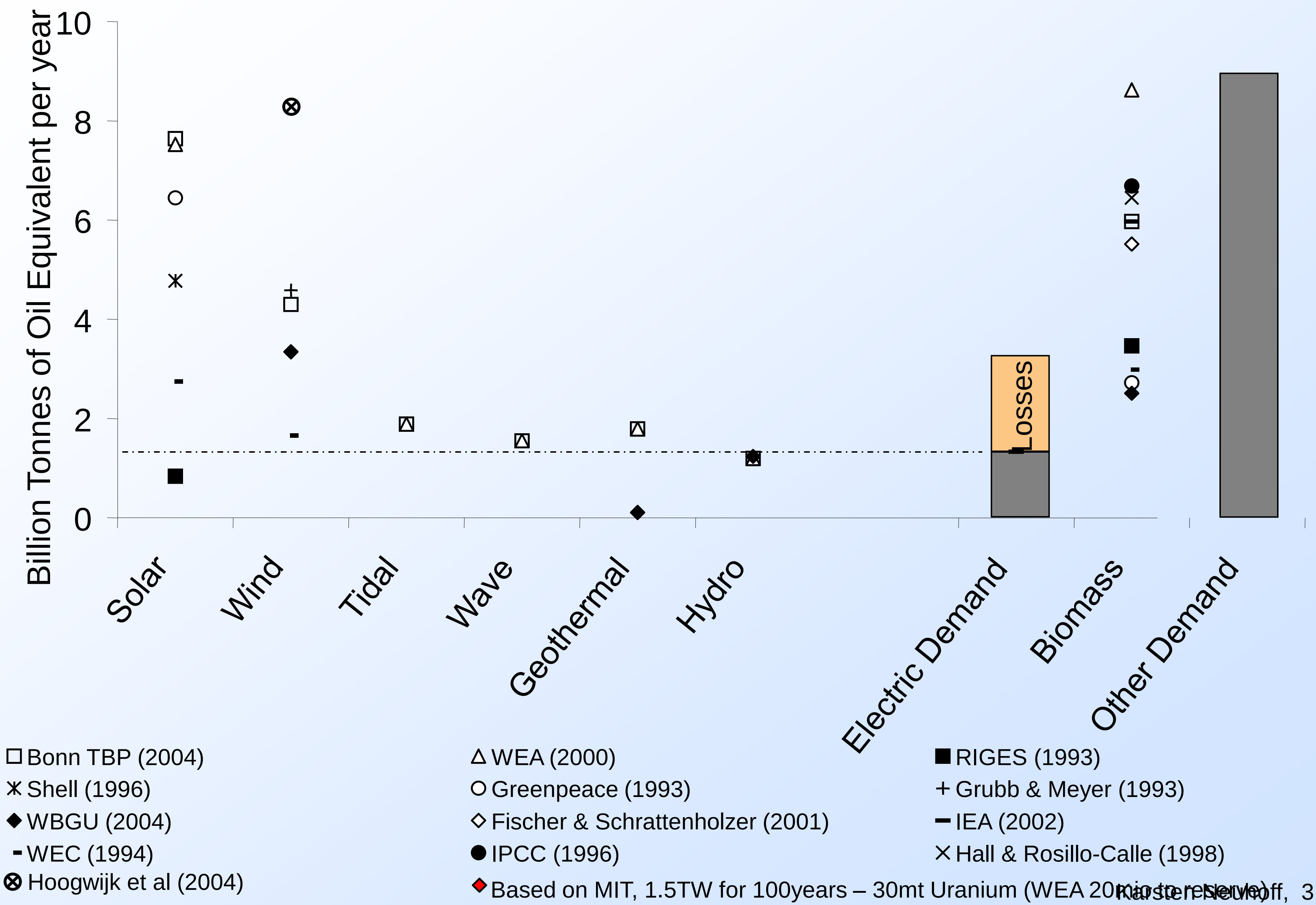
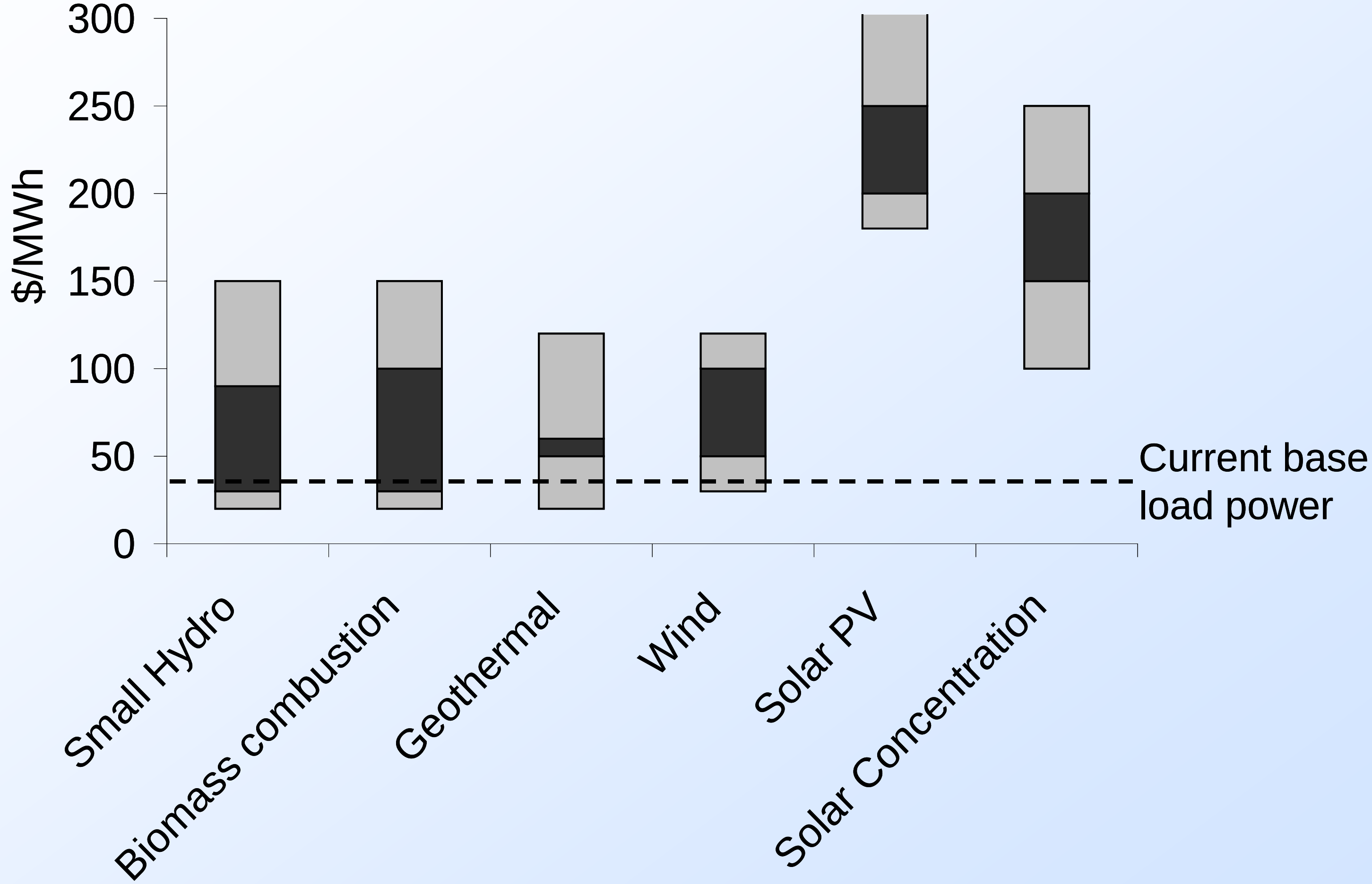
Energy Technology Deployment

1. Resource and technology availability
2. Learning by doing principles
3. R&D expenditure – complement or substitute?
4. Growth to the limit
5. Strategic deployment
6. International cooperation
7. Conclusion

Resource base is available

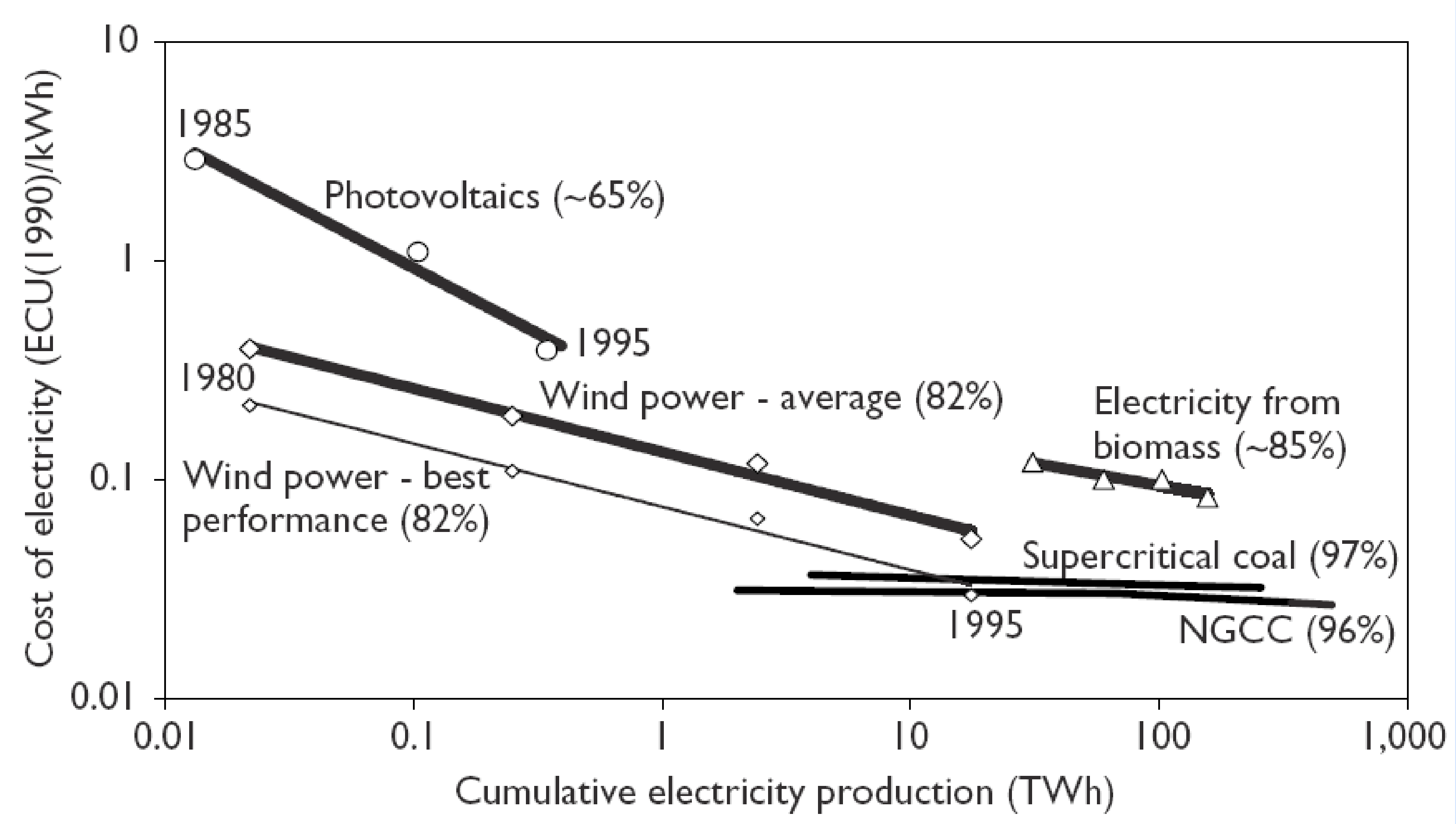


But costs for most technologies still higher



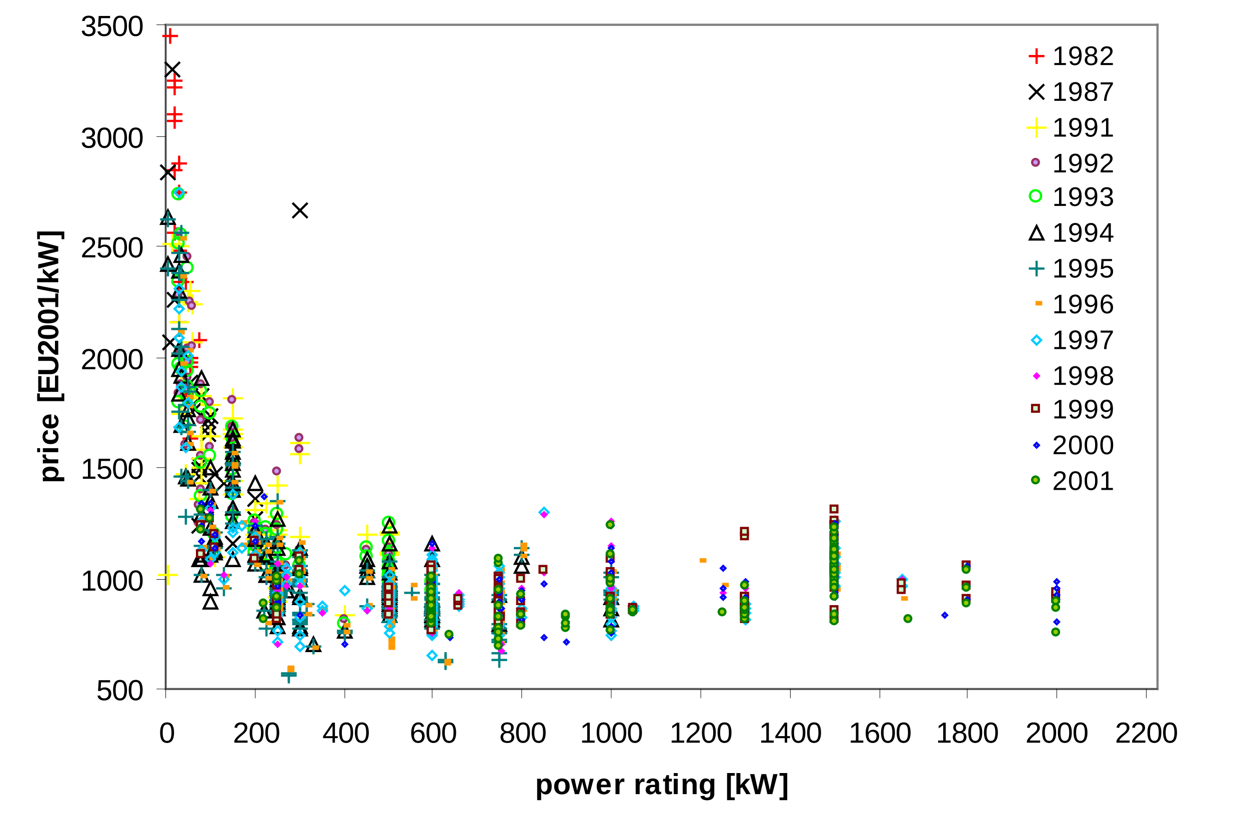
Source: International Energy Agency 2003.

Improvements through market experience
- one perspective on cost evolution



International Energy Agency (2000) Experience Curves for Technology Policy. Paris.

Application to wind data

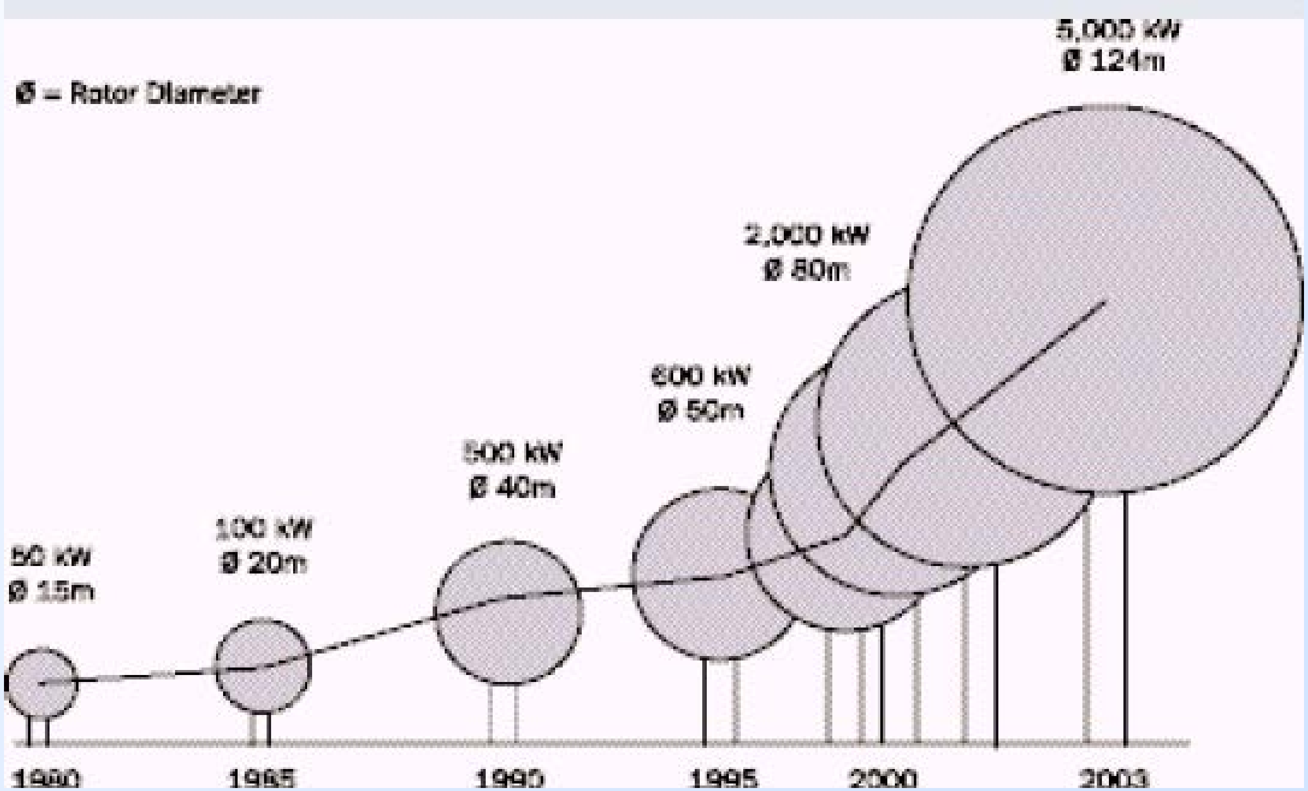


*B*ased on data compiled by M. Junginger from BWE editions 1991-2001, and Danish list prices for 1982, 1987. Adjusted using German and Danish GDP deflator (IMF, 2005), and exchange rates 1EU(2001) =1.956DM and 7.46DKK

Source: EPRG Working paper – Coloumb/Neuhoff 2005

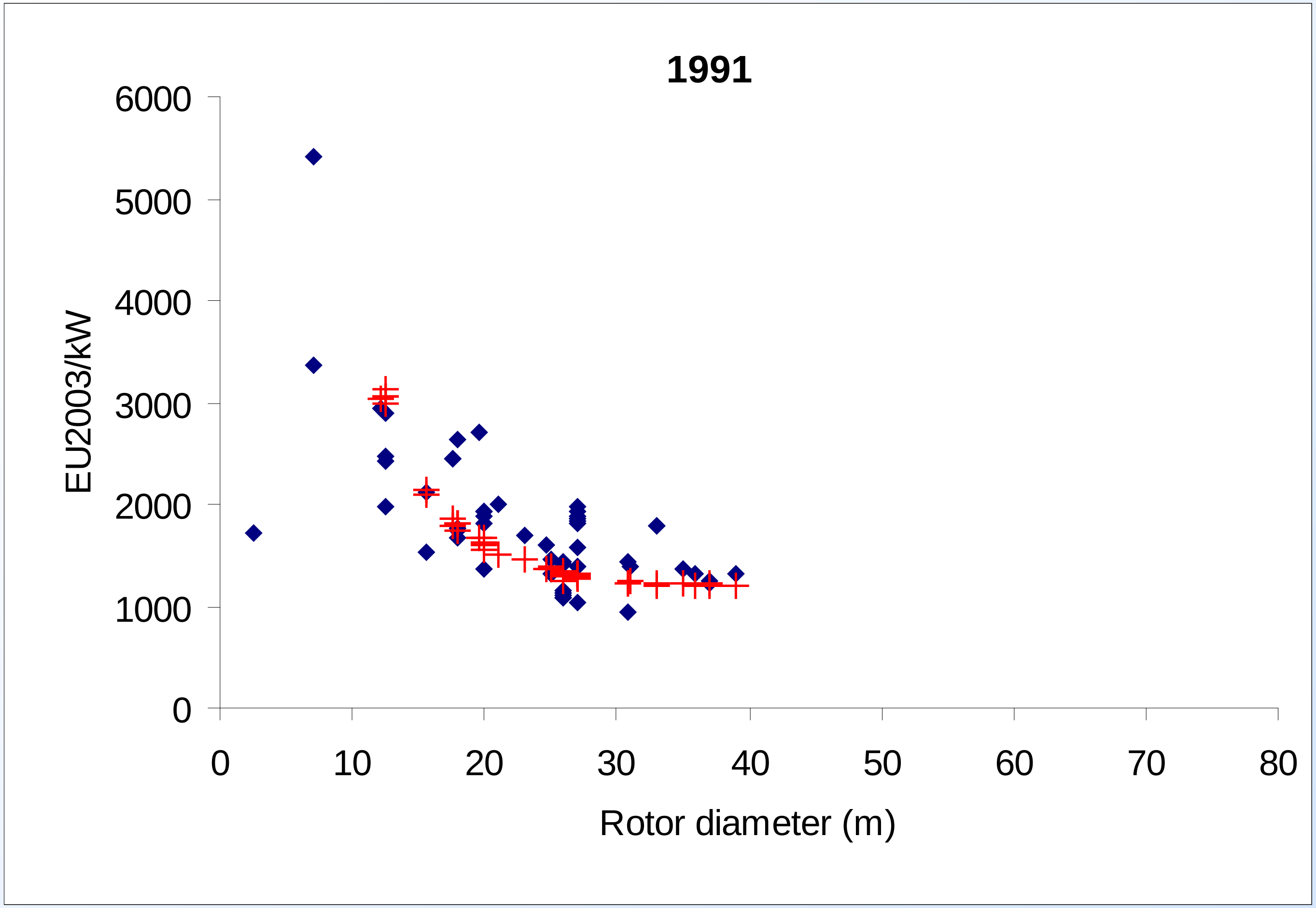
Wind energy costs – driven by multiple effects

- Production scale
- Experience effect
- Turbine scale



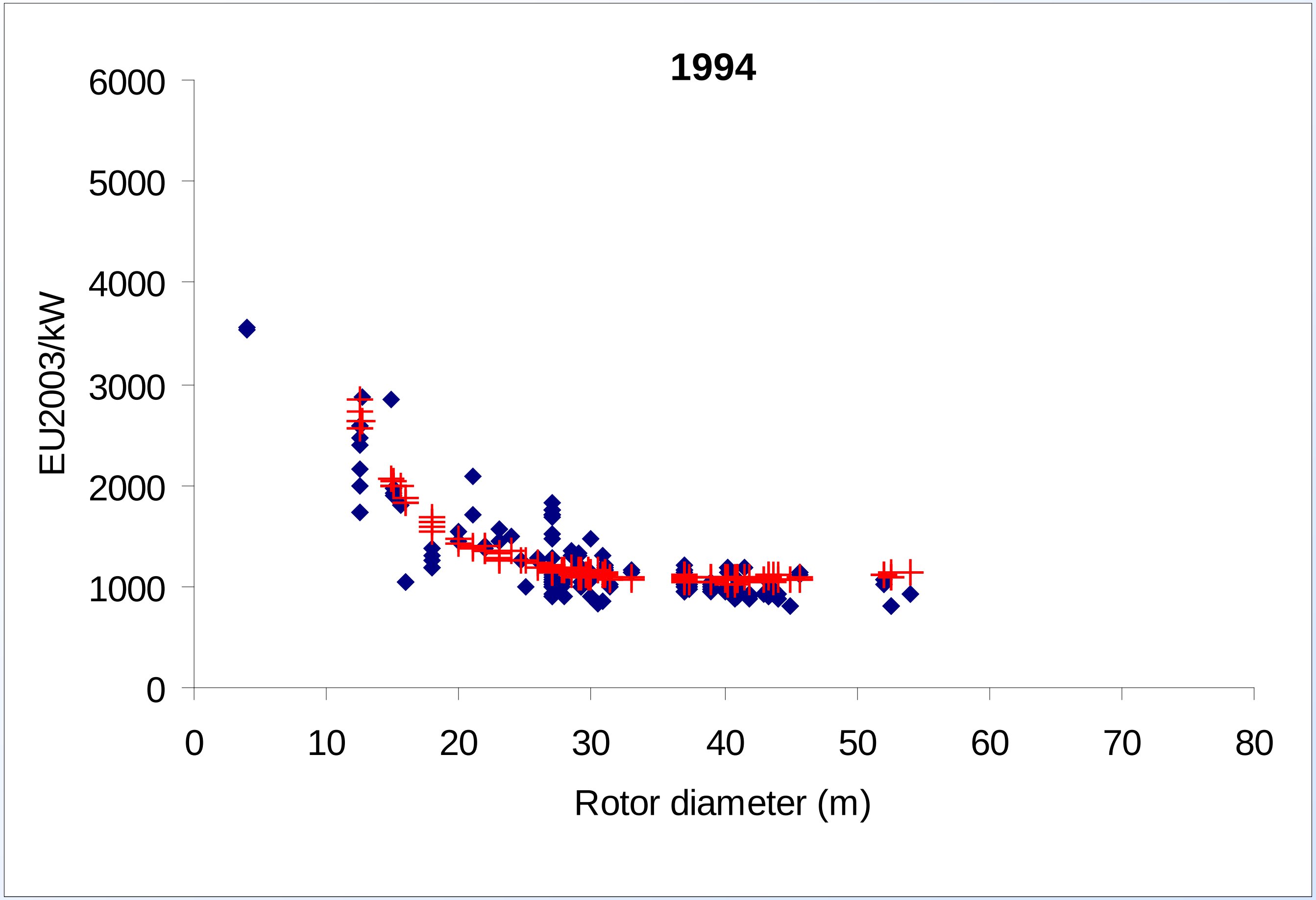
Source: EWEA (2004)

Price evolution

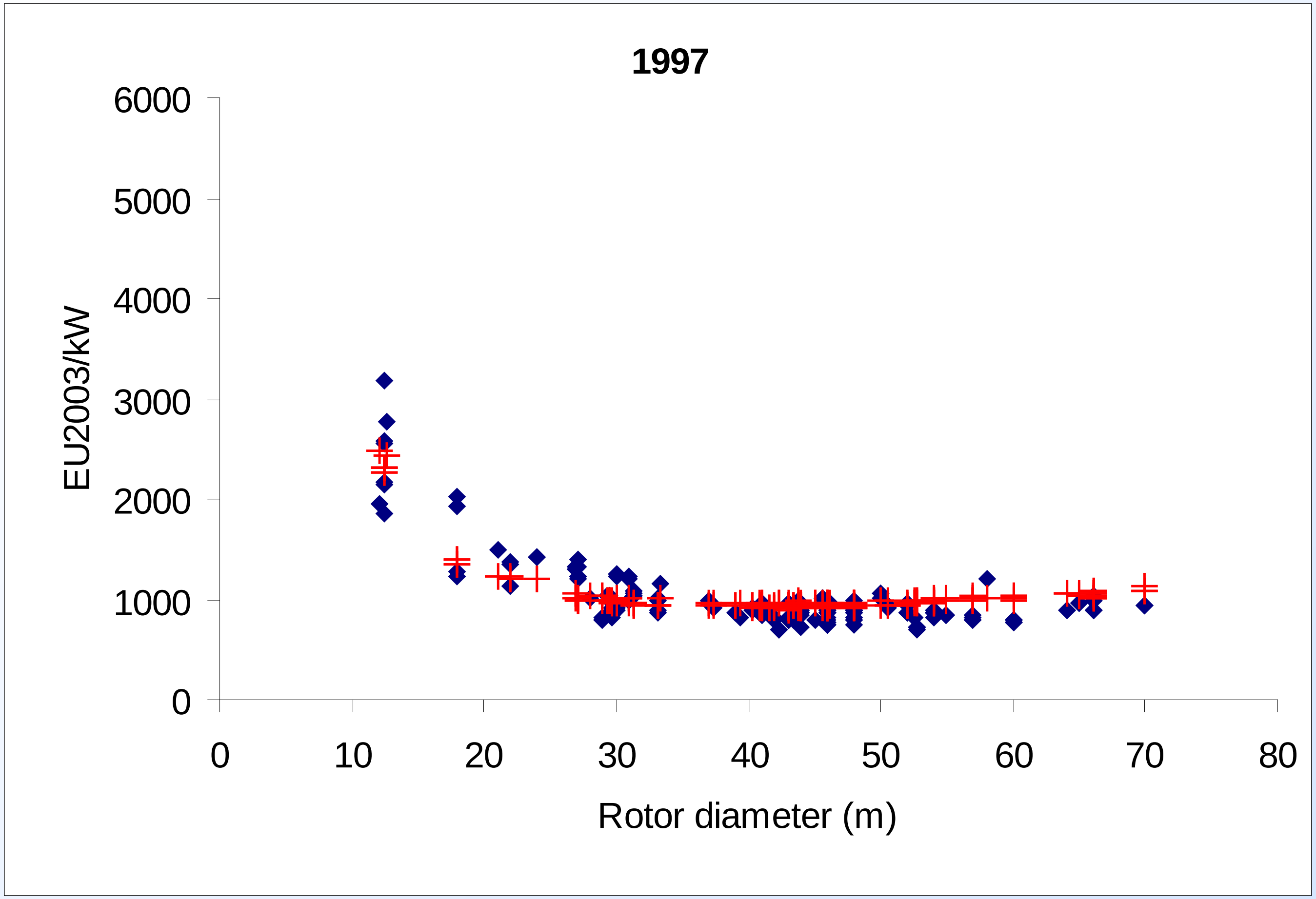


Source: EPRG Working paper – Coloumb/Neuhoff 2005

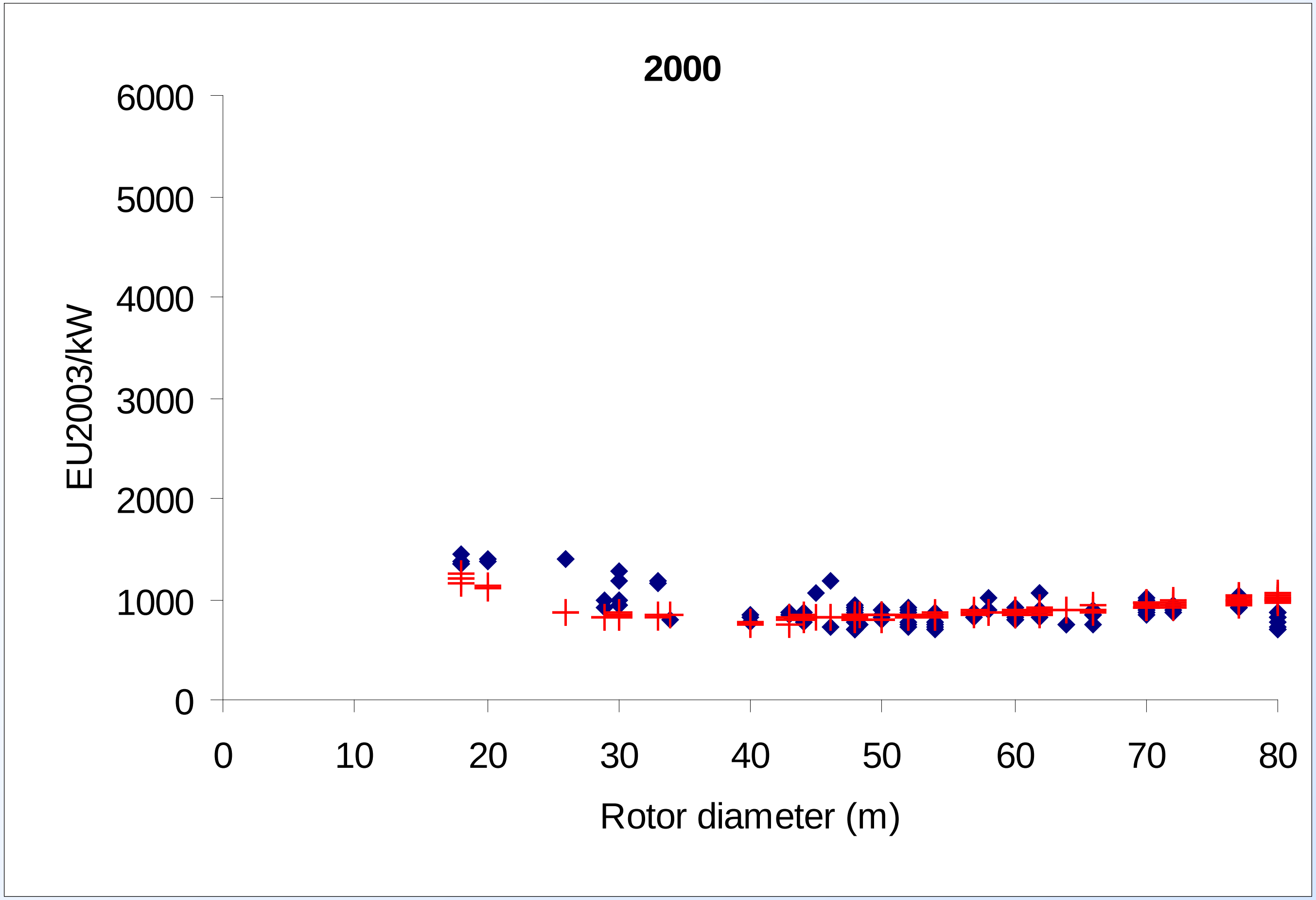
Price evolution



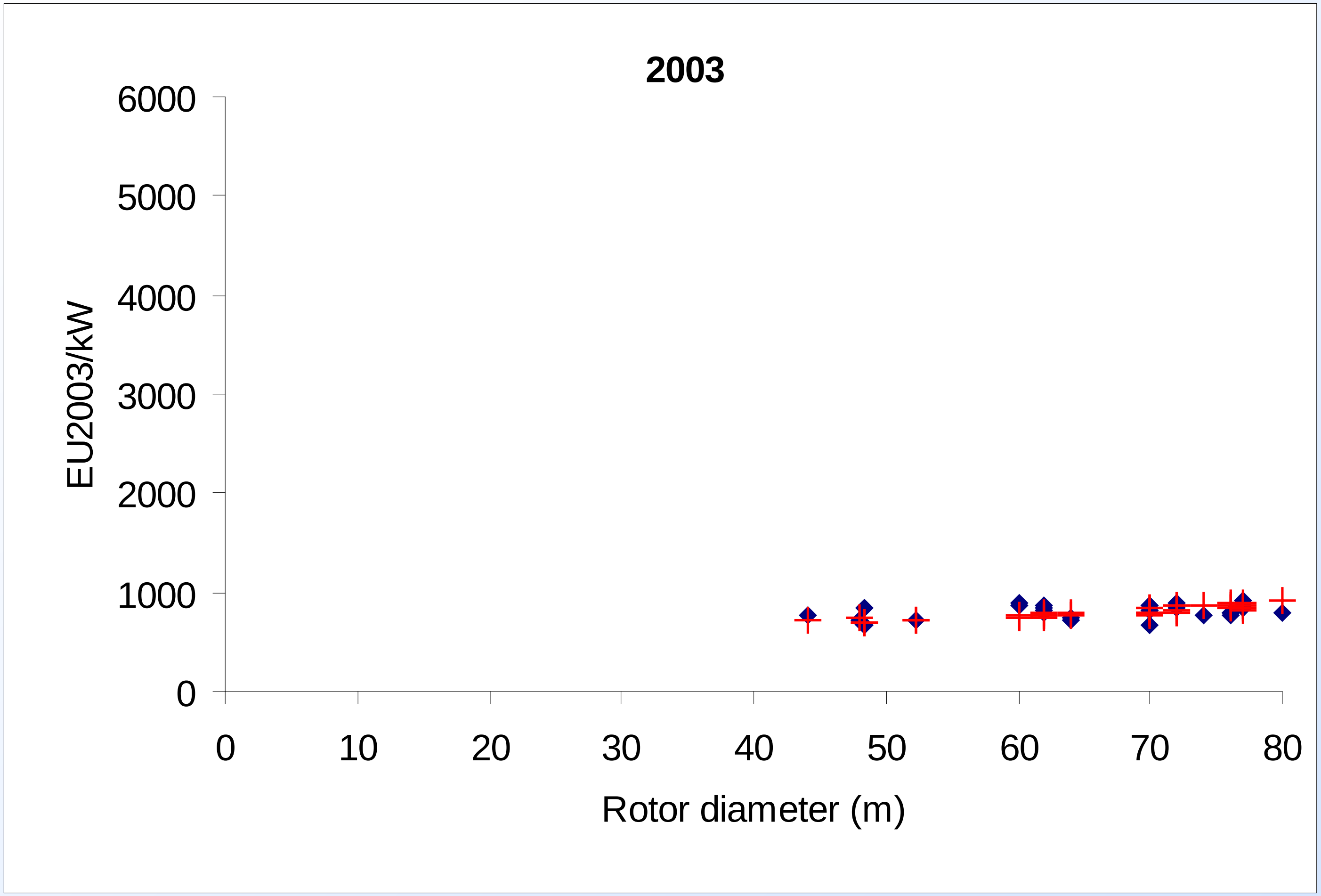
Price evolution



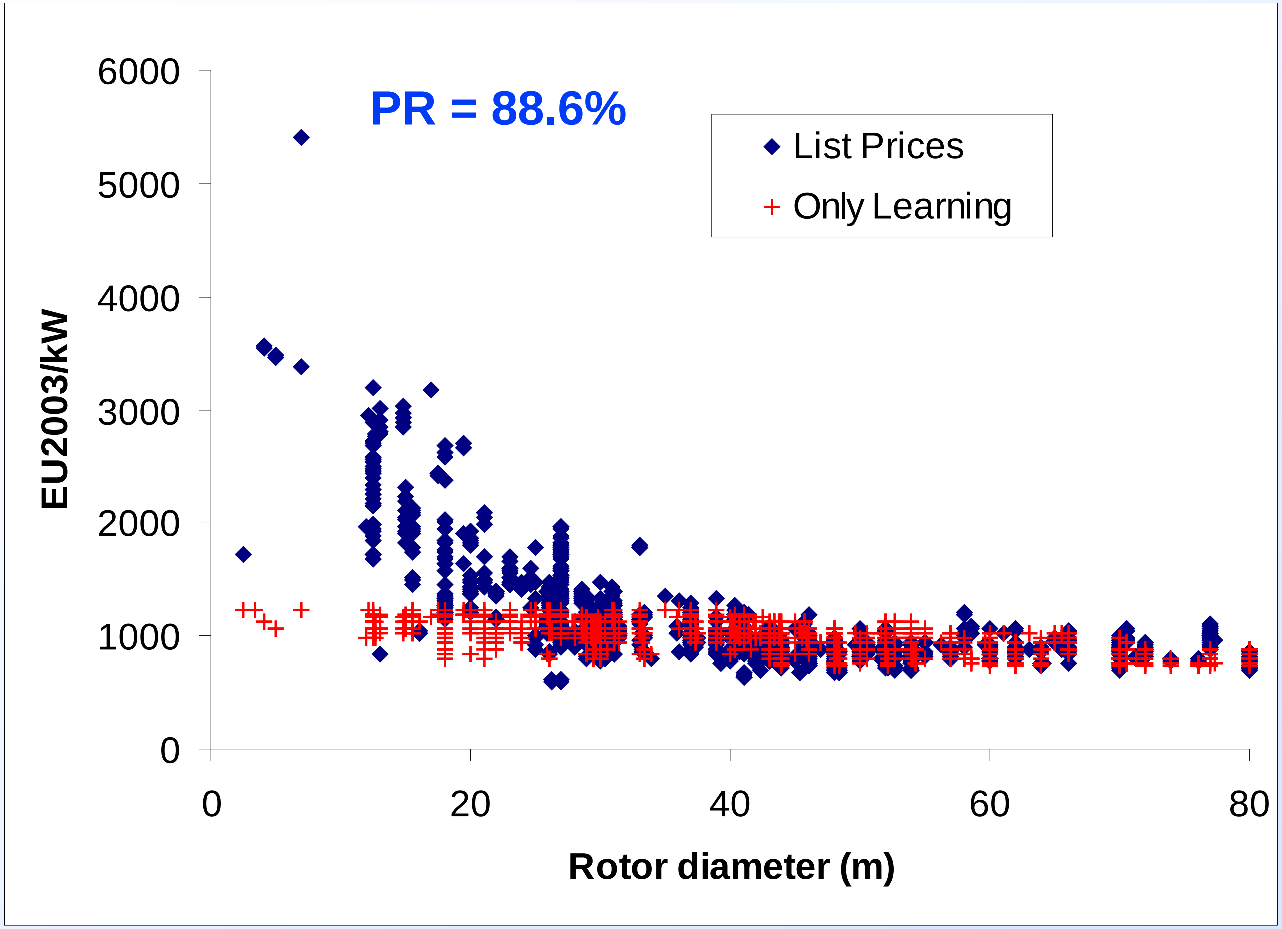
Price evolution



Price evolution



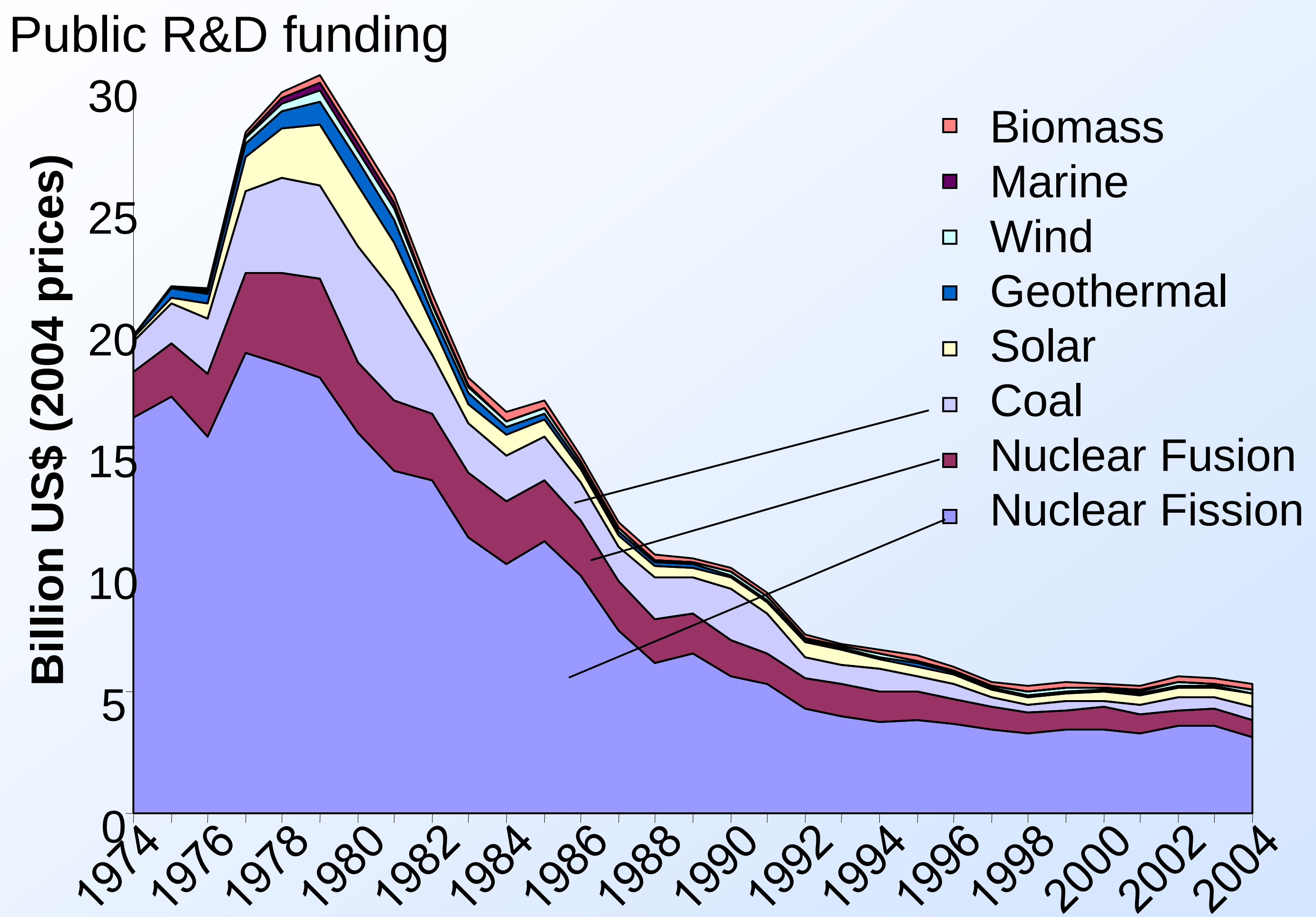
Learning only…



Based on:

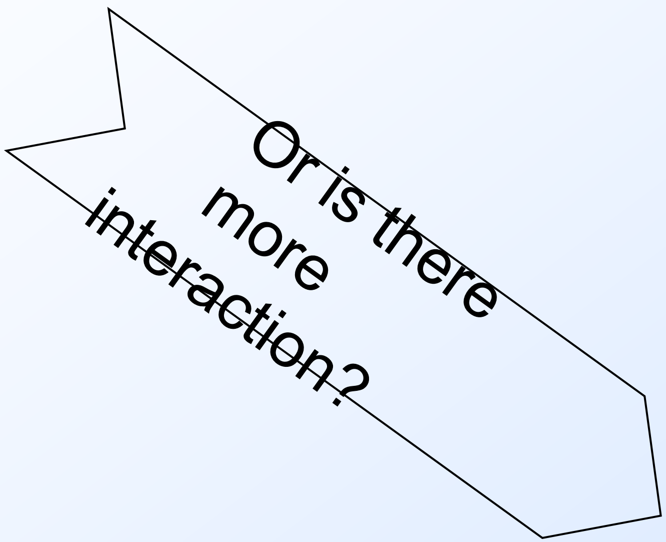
- Global cumulative capacity
- 90% mass dependence, i.e $C\%_0 = 10\%$

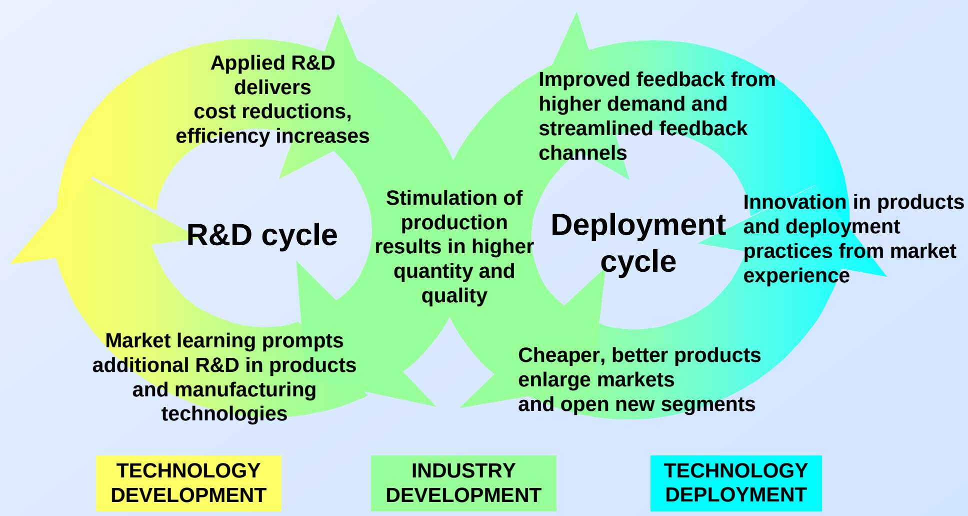
R&D – substitute or complement for strategic deployment?



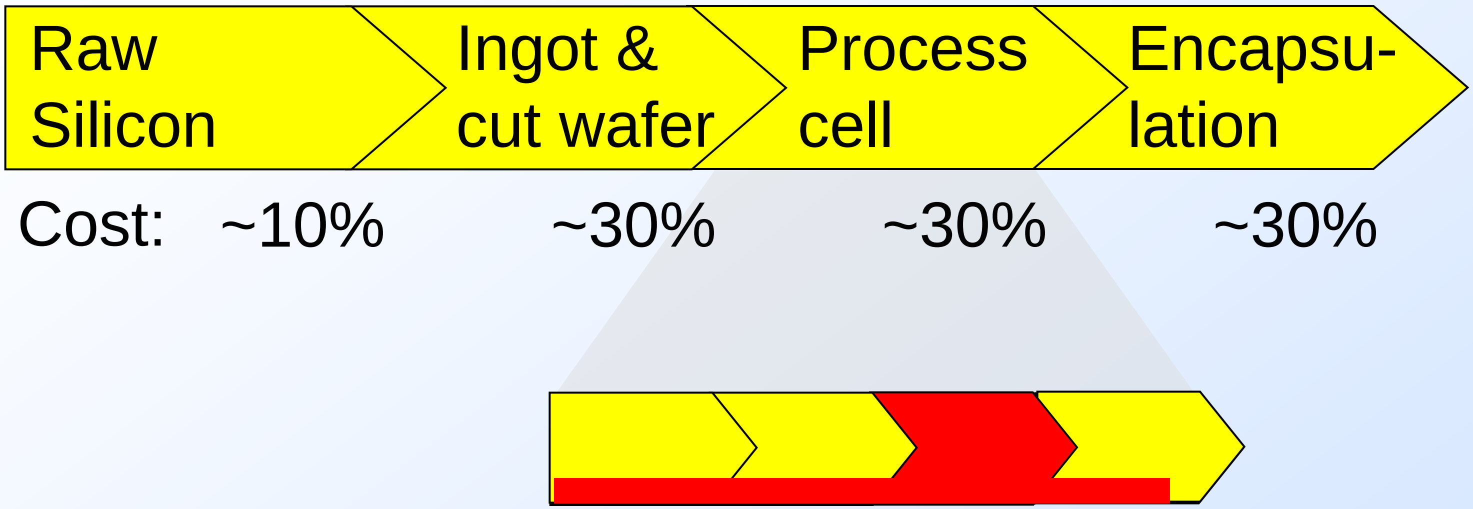
Source: IEA

R&D – substitute or complement?





Example: Solar PV production

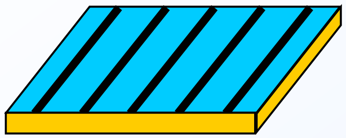


Product innovation: Coating: TiO_2 -> SiN_x

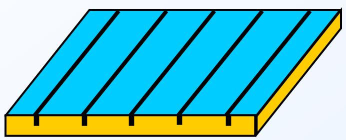
Process innovation: Wafer: 400um -> 200um

Interaction between growth and learning rate

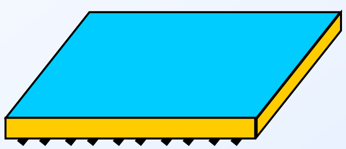
Illustrative



Too much shadowing



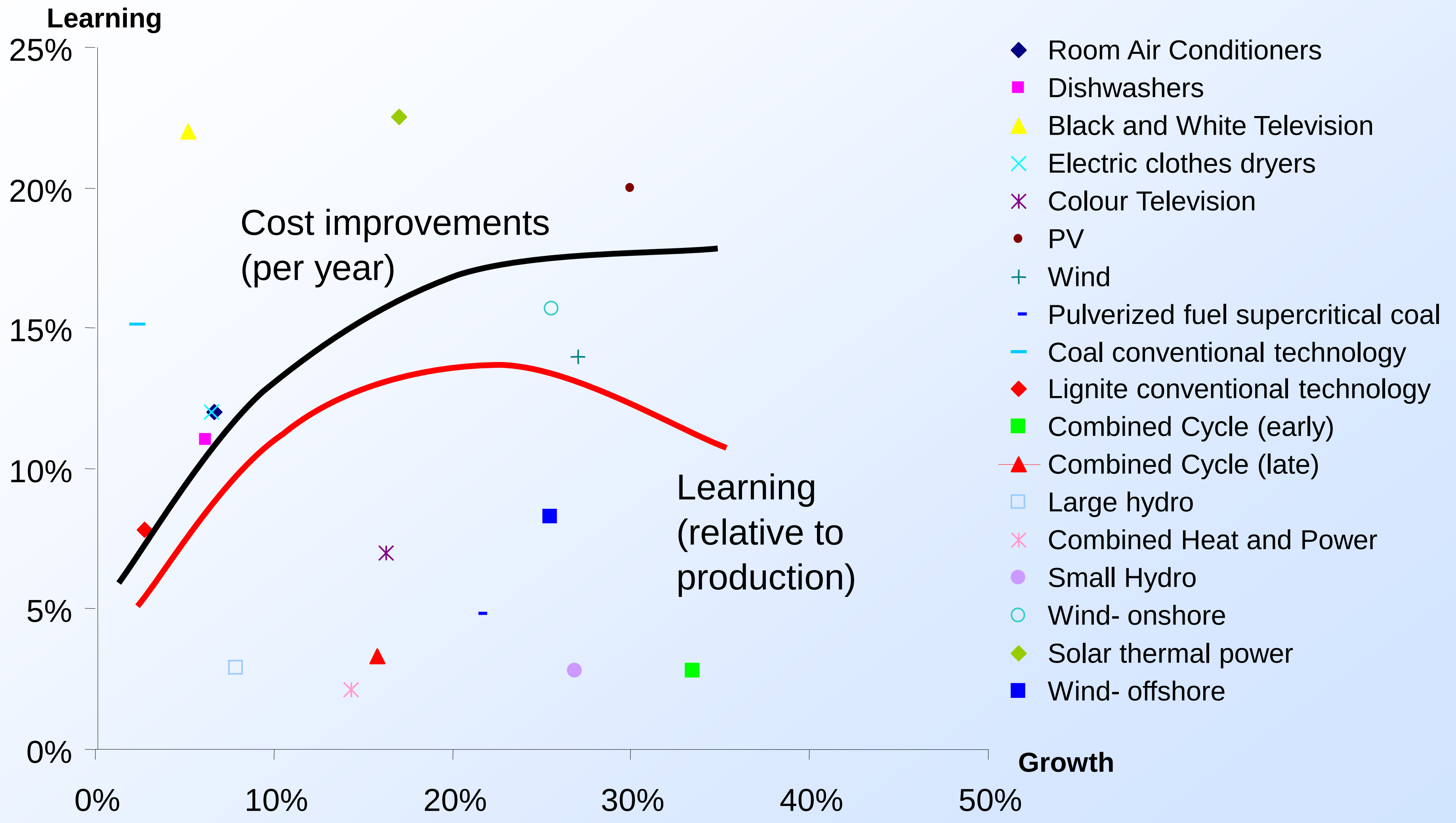
Saturn (BP)



Backjunction (Sunpower)

	Market growth			
	0%	X %	2X %	3X %
Year of first utilisation				
Saturn (BP)	5	1	1	1
Backjunction (Sunpower)	7	2	1	1
Learning over time	slow	medium	fast	fast

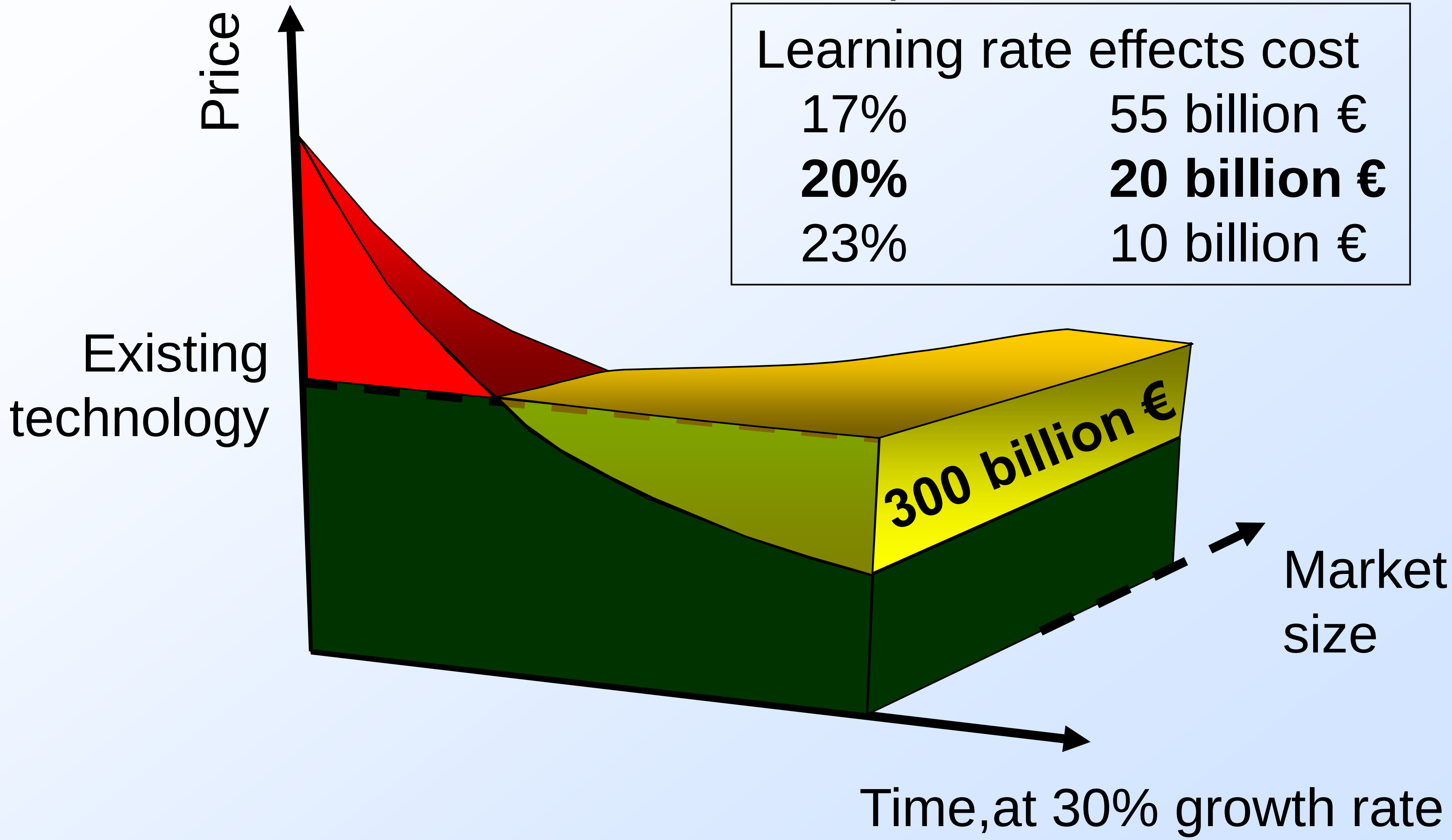
Implications for learning rate



How to make tech

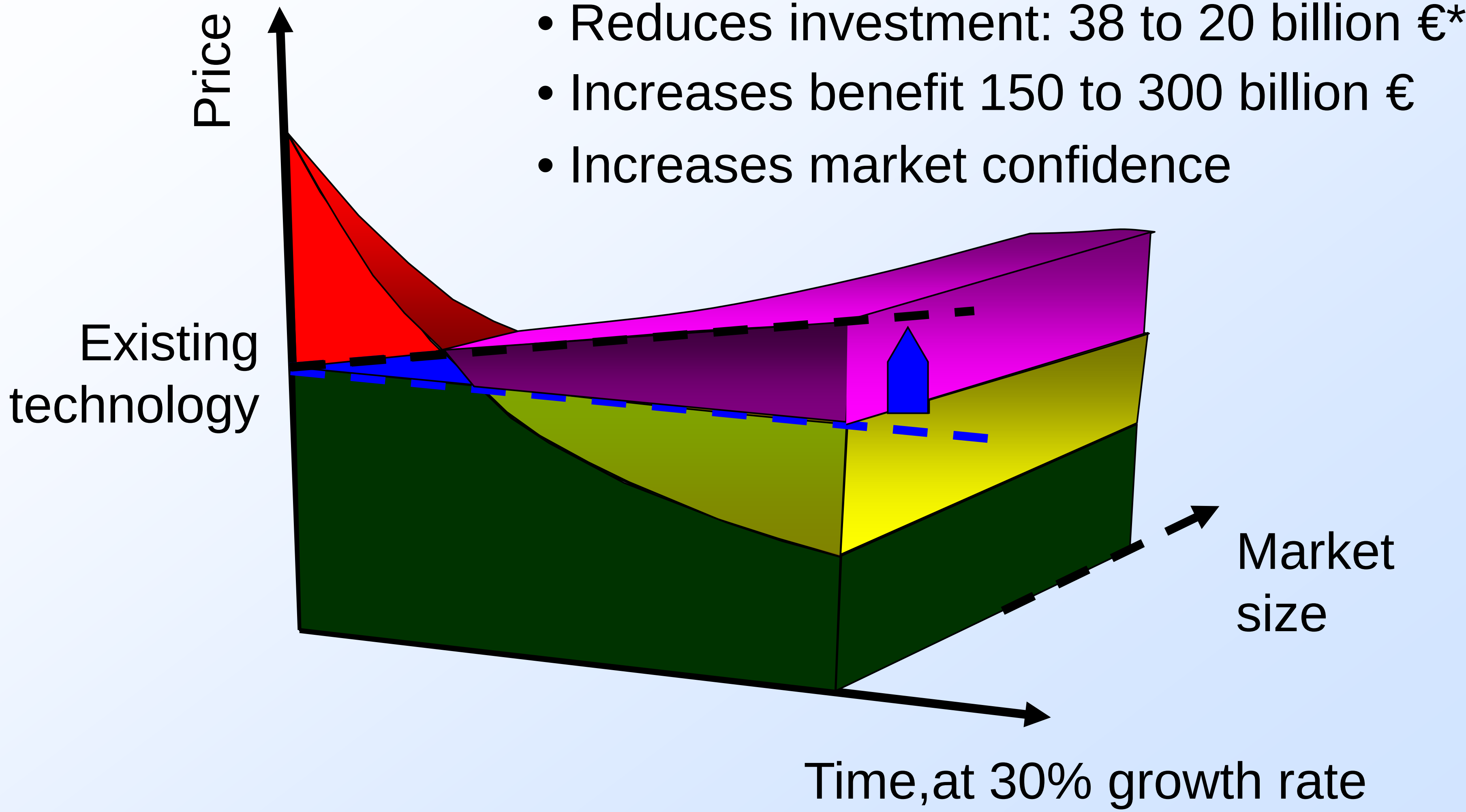
Example Solar PV:

Learning rate	effects cost
17%	55 billion €
20%	**20 billion €**
23%	10 billion €



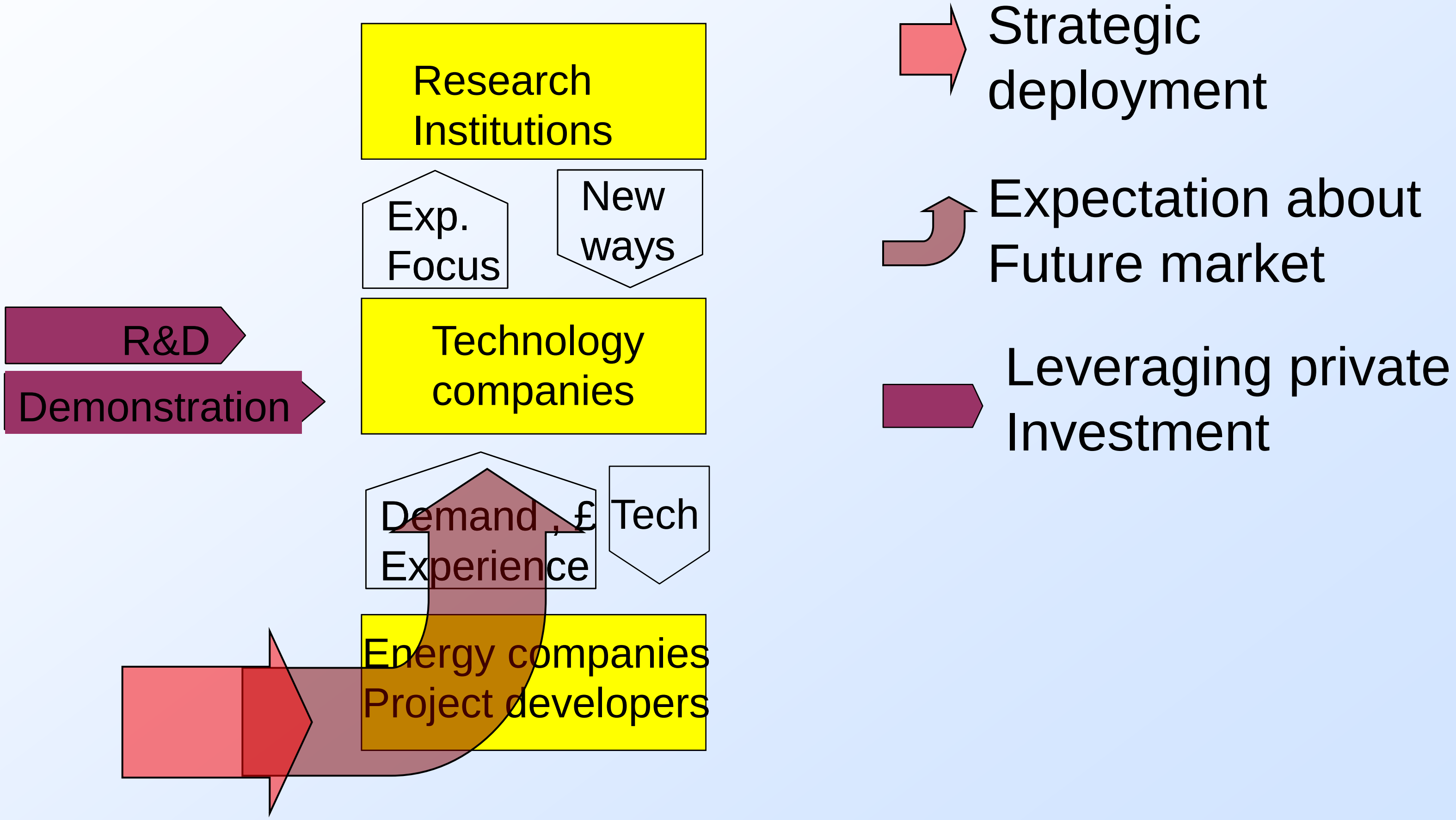
5% discount rate

Internalisation of CO2 benefits new technologies



* Break even price moves €40/MWh to €50/MWh, 5% discount, 2005-2040

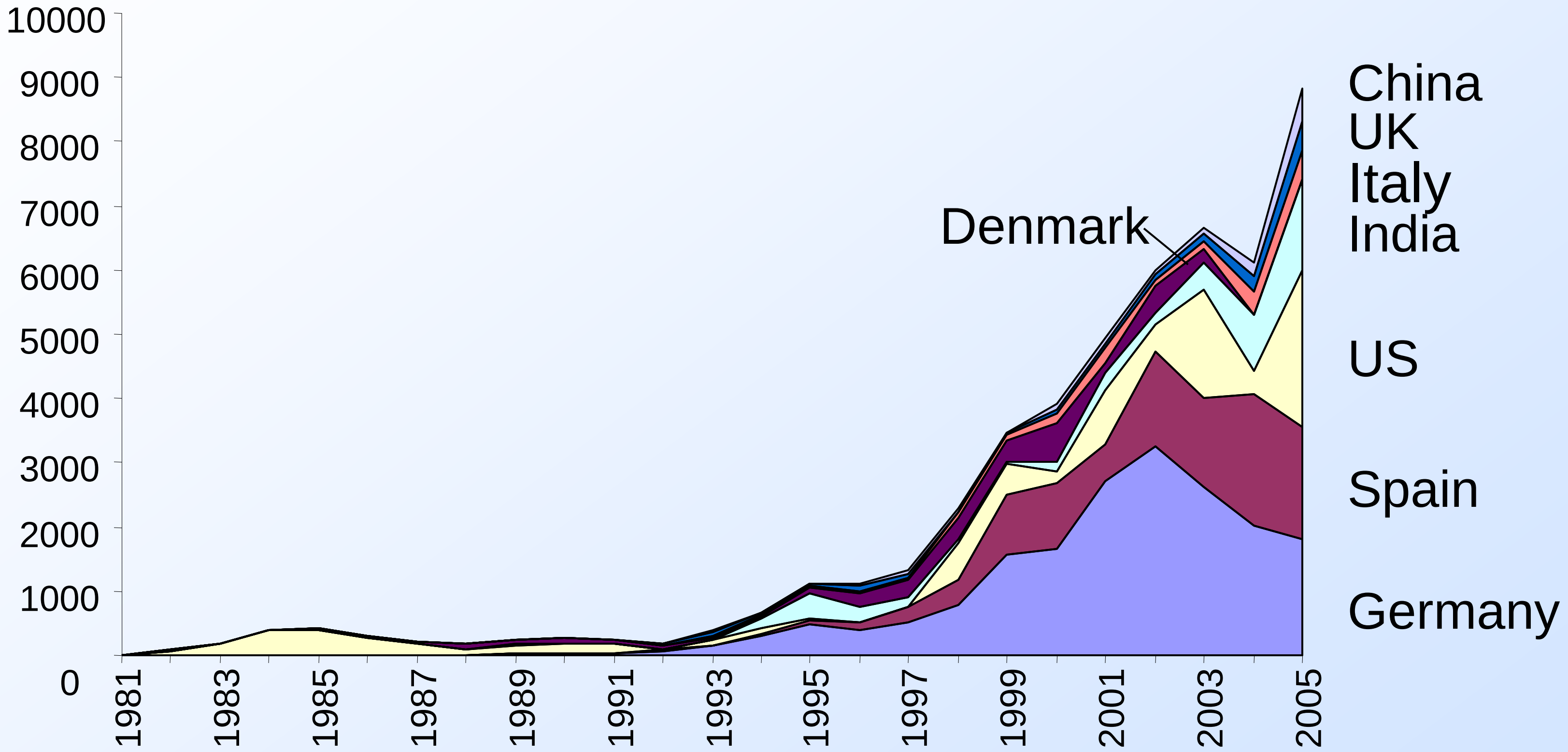
How does strategic deployment work?



Source: Neuhoff/Sellers EPRG 2006

Future demand difficult to predict

Installed wind power per year (MW)

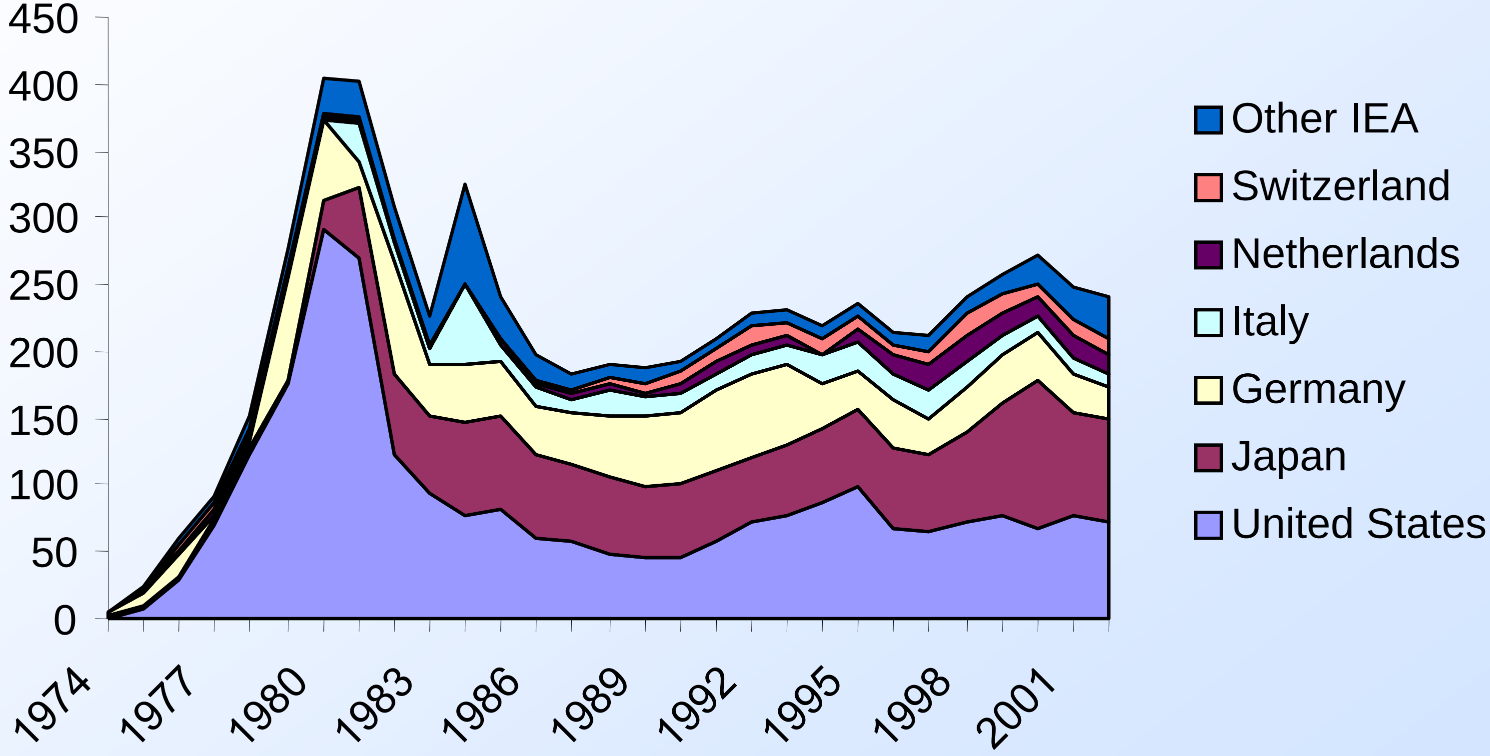


… international markets average over some of national volatility

Source BTM consult, GWEC

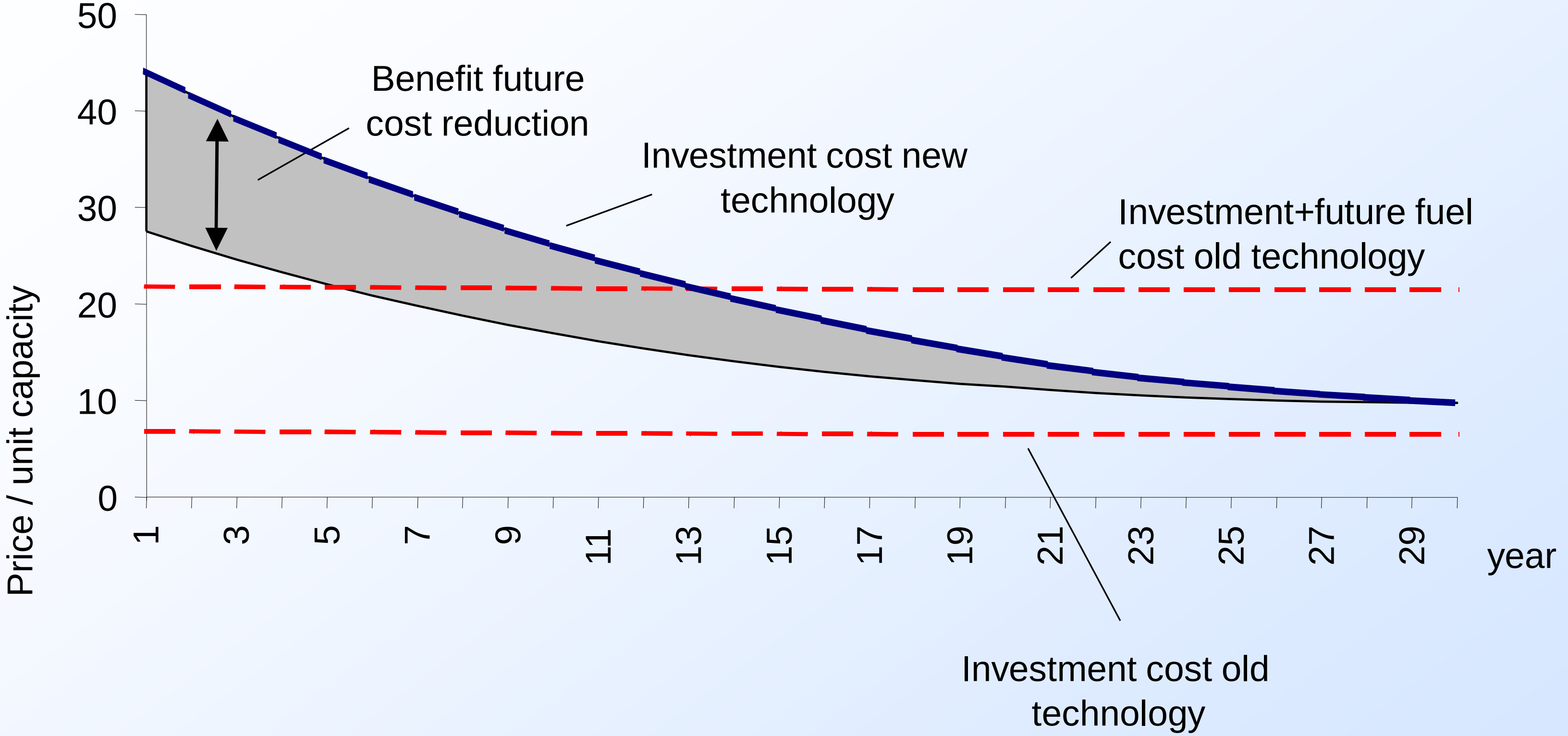
Global aggregation reduces volatility

RD&D expenditure on Photo Voltaic (Mio. $ 2002)



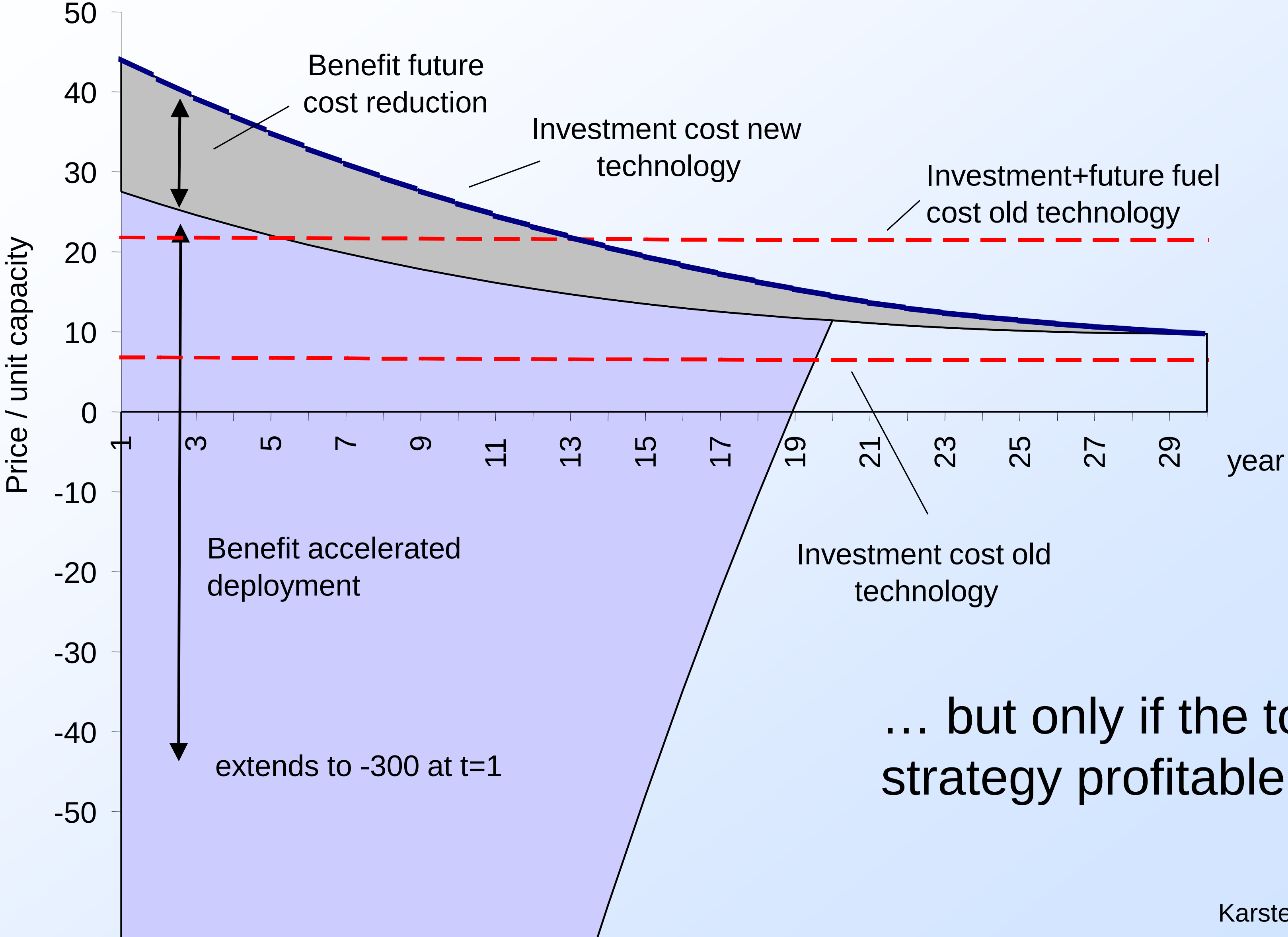
Source IEA

Marginal Learning Externalities



Additional investment brings additional experience
-> this reduces future investment costs
-> but not sufficient to justify technology in early years

… adding the benefit from accelerated future deployment adds value to early deployment



… but only if the total strategy profitable.

Conclusion

- Resources available
- Learning by doing could drive down costs
- RD&D complement not substitute for market experience
- Use time effectively that is required for new technologies
- Strategic deployment
  - Creates market experience
  - Provides well defined interface with government
- Parallel implementation of strategic deployment
  - Increases scale and reduces volatility
  - Increases political support