

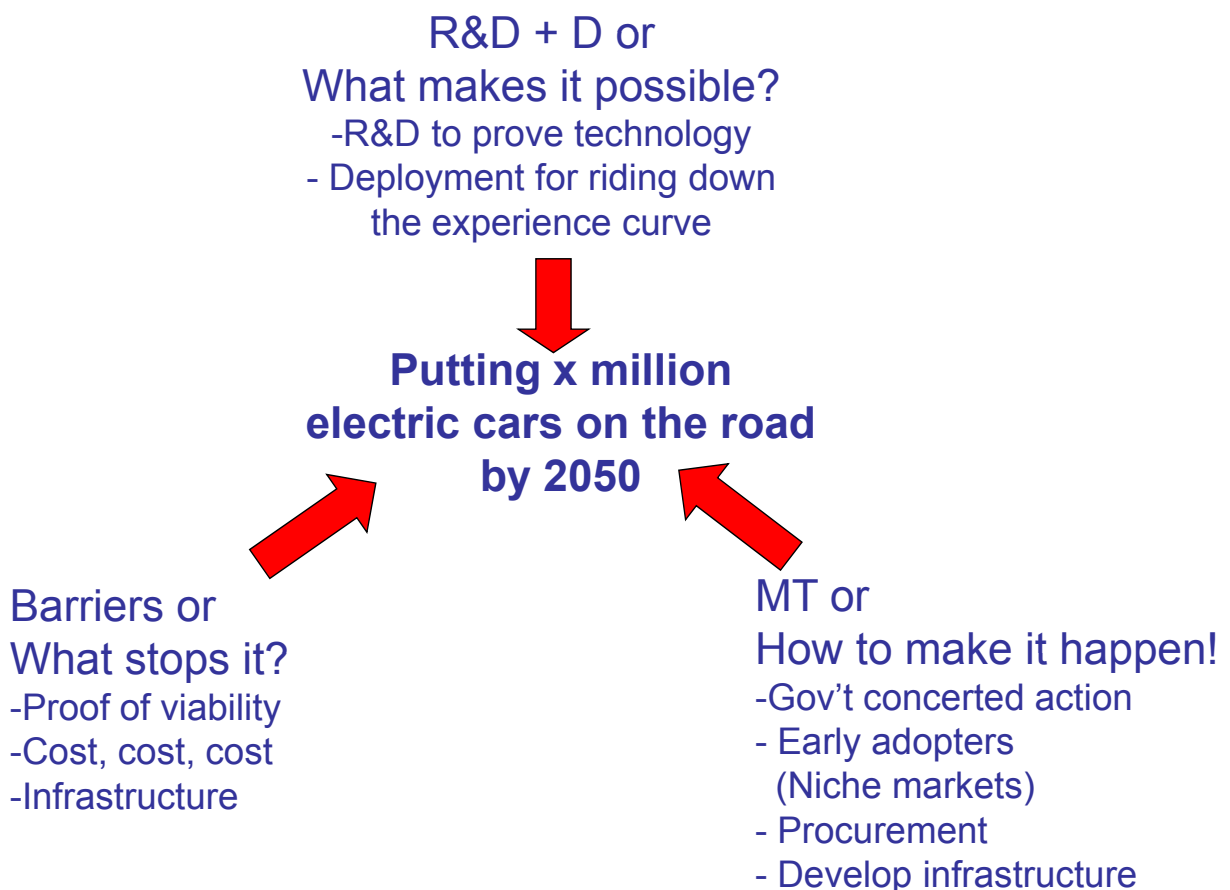
**IEA EUWP Workshop on
Electricity in the future Transport System
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Stockholm**

Making it possible

The double action of deployment programmes

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Triangulating to empower deployment programmes

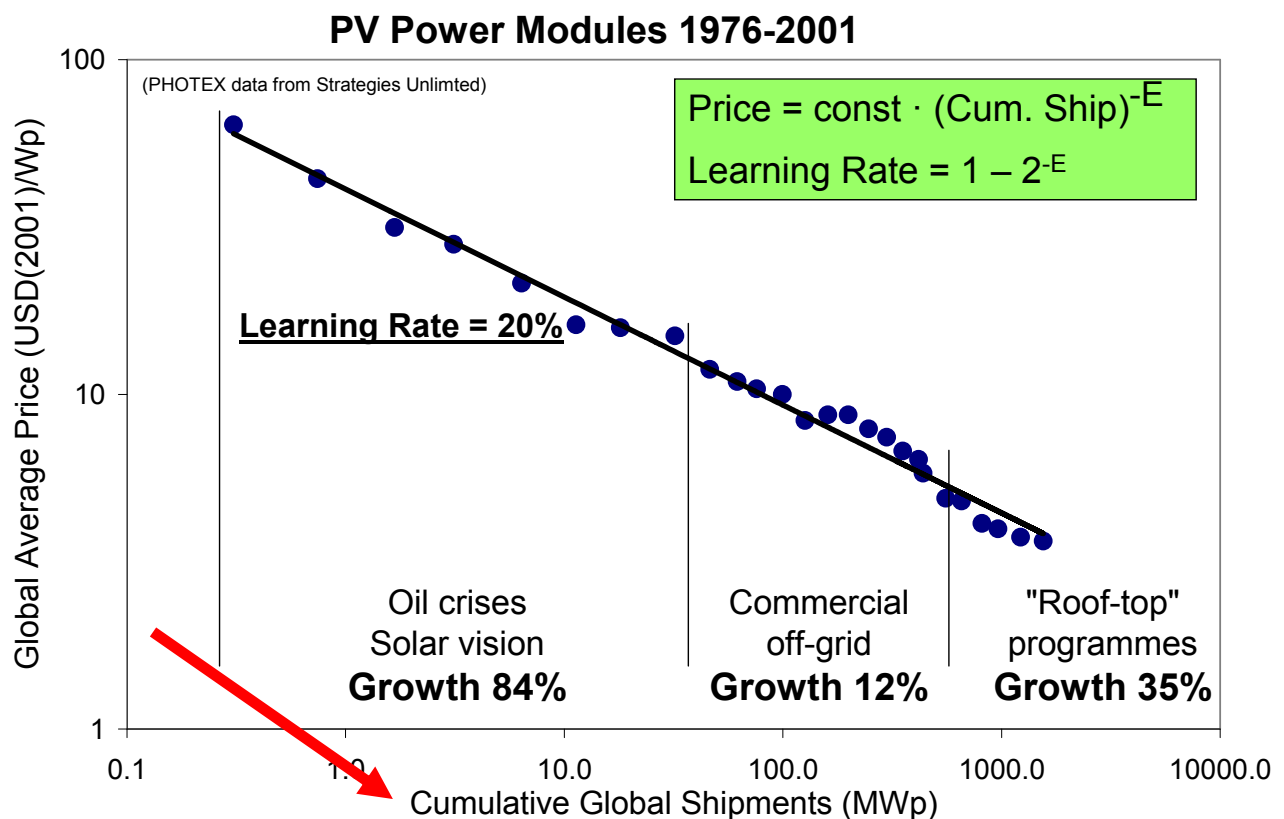


Making it possible

The double action of deployment programmes

- Increasing market take up today
- Successively reducing future cost and improving future efficiency (initiating a virtuous circle leading to steadily increasing market take up)

Experience Curve shows stable Technology Learning over three decades and four orders of magnitude in spite of a deployment roller-coaster



Technology Learning and its Measurement

- **Technology Learning:** enhances the capacity of market actors to reduce cost and increase the technical performance of technologies deployed in the market

actors: technology manufacturers, operators, users

technology: airplanes, cars, power plants → turbines, PV-modules

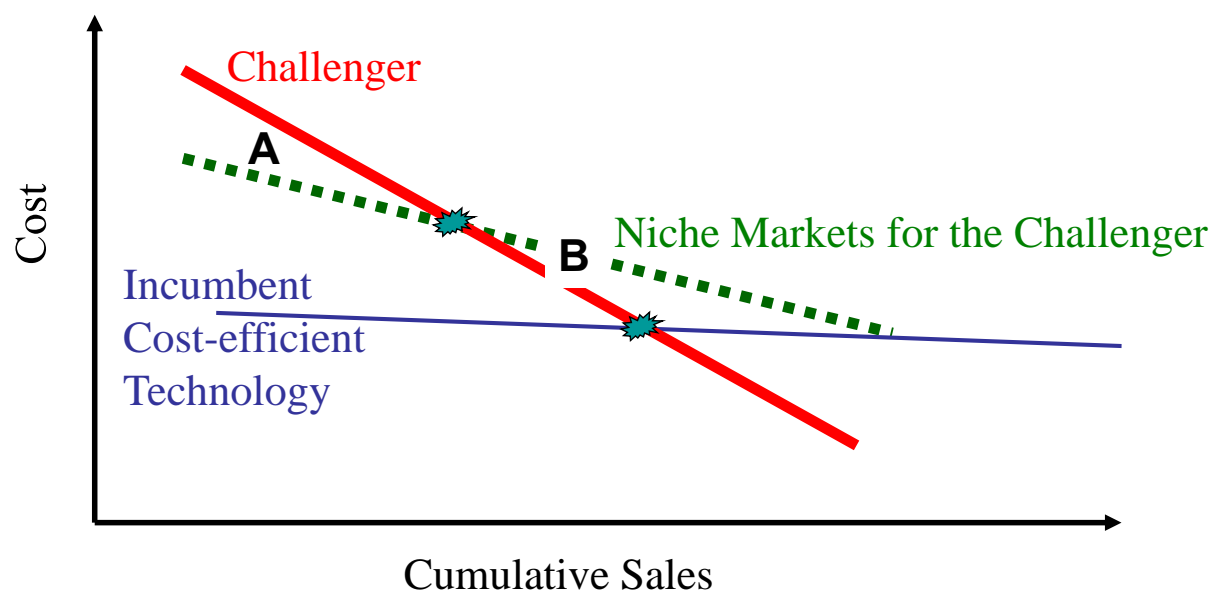


- **Experience/learning curves:** measures technology learning in the special case where technical properties remains same



- Technology Learning requires **market action**
- Technology Learning relies on **internal processes** within the market actors, e.g., industry R&D, LBD in manufacturing
- Role of **government R&D** in technology learning?

How to design Deployment Programmes stimulating industry internal processes at low cost to tax payers?

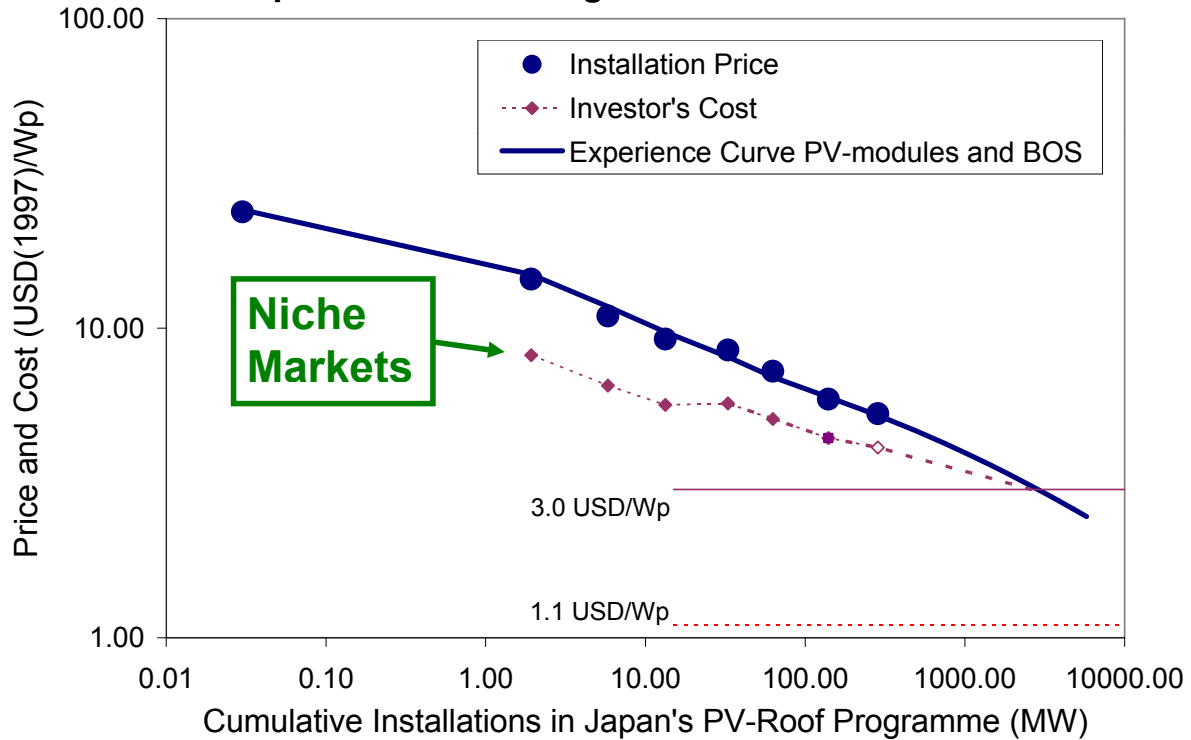


- Special efforts to create niche markets (labelling, feed-in tariffs)?
- Is the niche market curve flat enough?
- Contributions from industry in “A” to have the benefits in “B”?

It Works: Niche Markets to stimulate Learning Investments from private sources

(Example Japan Residential PV Systems, IEA 2000)

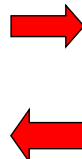
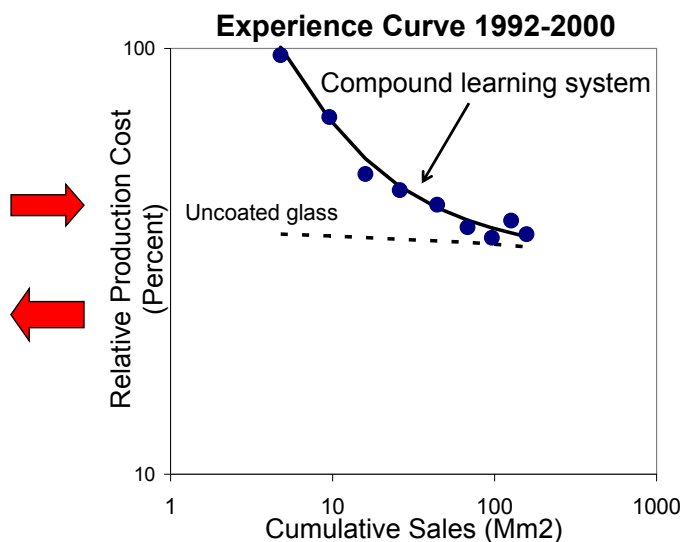
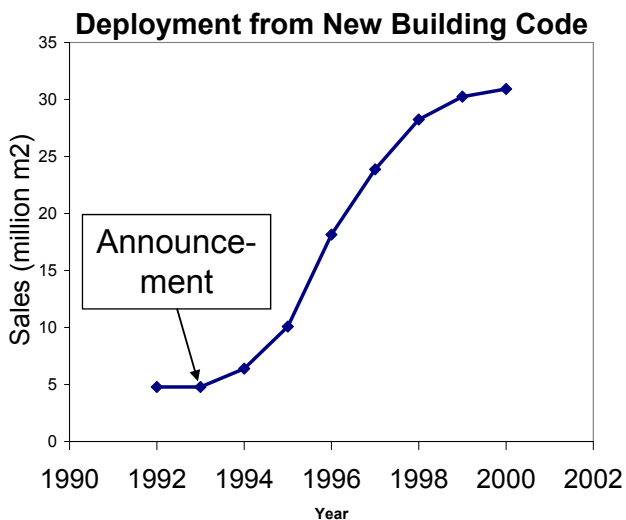
Japan's PV-Roof Programme: Use of Niche Markets



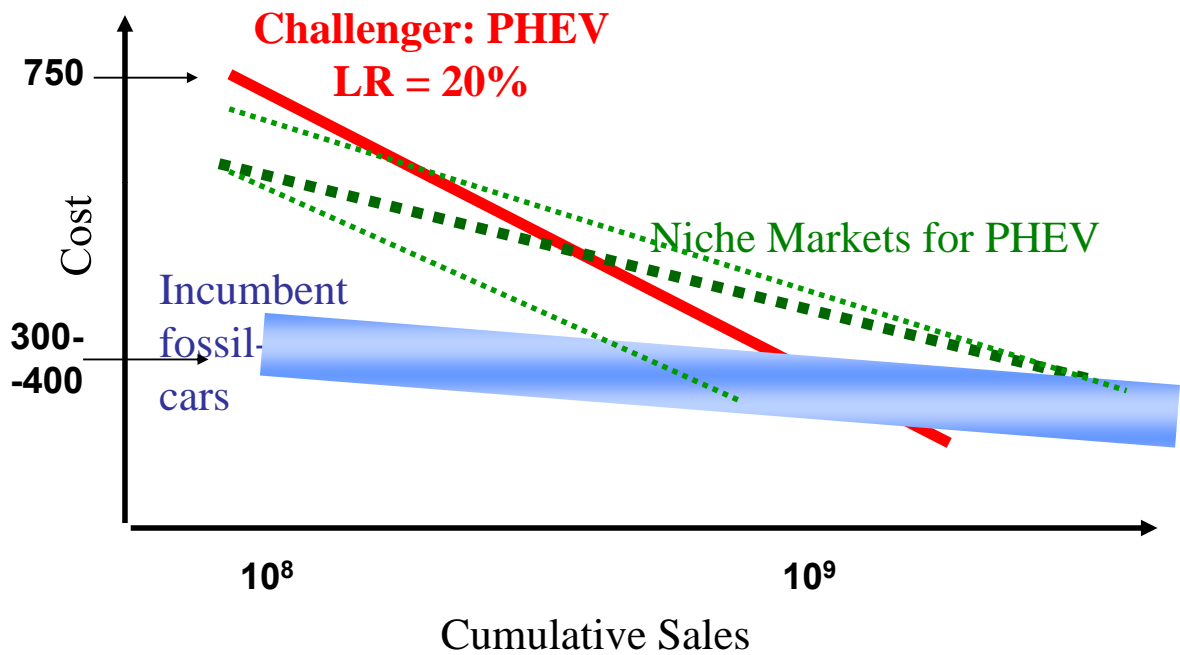
It Works: Building Code stimulating Technology Learning

(Wene 2008a)

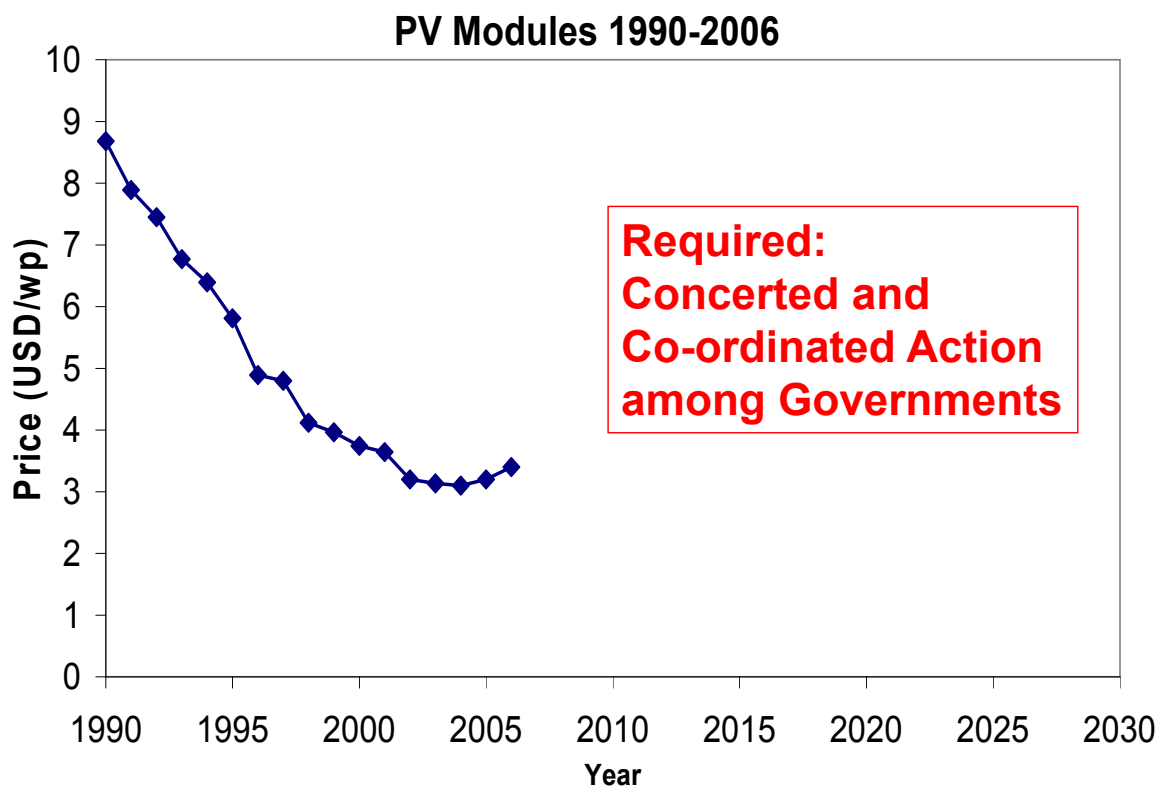
Germany 1992-2000: Coated Glass for Selective Windows
(Data from Blessing 2002)



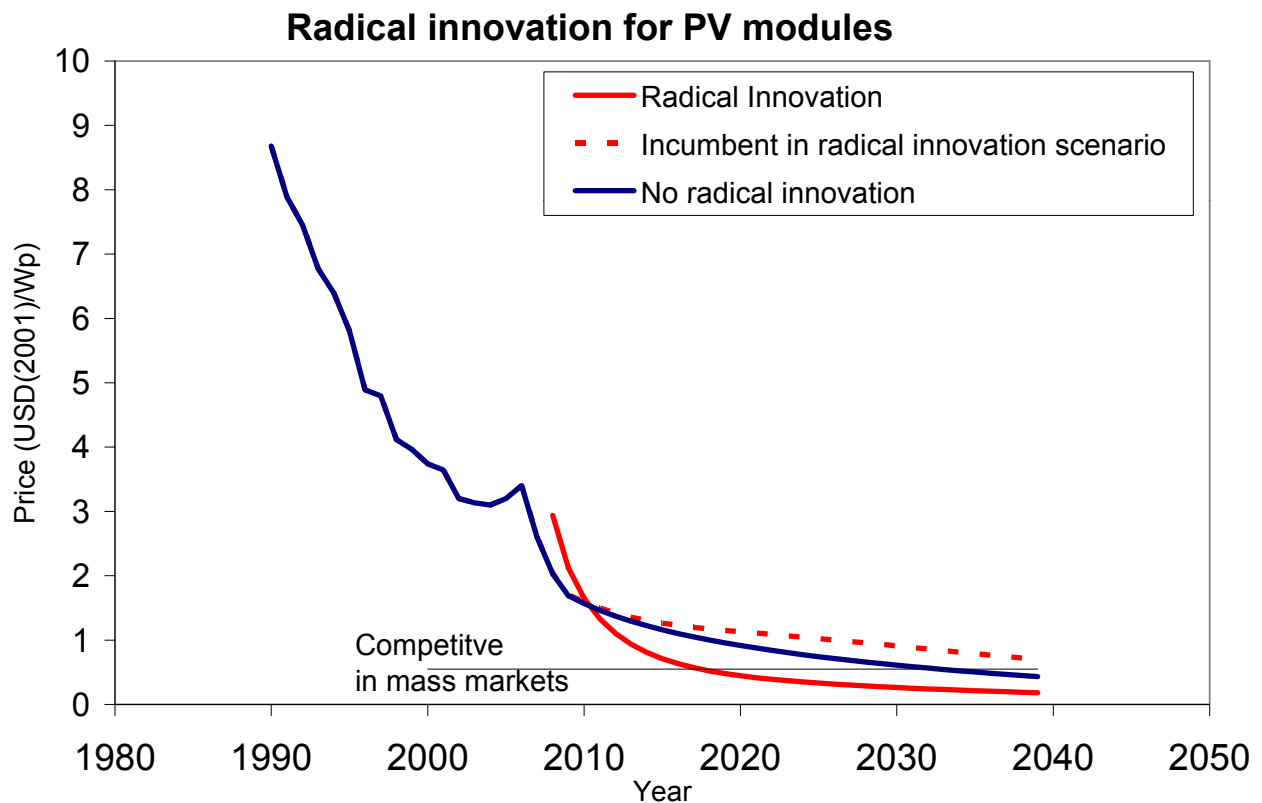
How does this apply to EV and PHEV? The key component – batteries?



Lack of co-ordination between deployment programmes have led to high scarcity costs for silicon



Radical Innovation may open new opportunities (... and this is what Gov't R&D should focus on)



Summary

Use of Experience/Learning Curves

- **Characteristics of Technology Learning**
 - Requires market action = technology deployment
 - Relies on internal processes within market actors for Incremental Innovations
 - Gov't R&D should focus on Radical Innovations
- **Design of efficient Deployment Programmes**
 - Concerted and Co-ordinated Gov'ts' Actions
 - Means to stimulate the internal processes within market actors
 - Need to stimulate learning investments from private sources
 - Creation and interaction with niche markets
- **Reliable tool for Energy Policy**
 - Continue investigations of learning rates and FEPs
 - But theoretical basis important for effective tool

Thank you!

References:

IEA/OECD (2000), *Experience Curves for Energy Technology Policy*, International Energy Agency/Organisation for Economic Co-operation and Development, Paris.

IEA/OECD (2003), *Creating Markets for Energy Technologies*, International Energy Agency/Organisation for Economic Co-operation and Development, Paris

Wene, C.-O. (2007), "Technology Learning Systems as Non-Trivial Machines", *Kybernetes, Special Issue on Management Science, Vol. 36, No ¾, pp. 348-363 (chosen as a Highly Commended Award Winner at the Literati Networks Award for Excellence 2008)*

Wene, C.-O. (2008a), "A Cybernetic Perspective on Technology Learning", in: T. Foxon et al. (eds,) *Innovations for a Low Carbon Economy: Economic, Institutional and Management Approaches*, Edward Elgar, London

Wene, C.-O. (2008b), "Energy Technology Learning through Deployment in Competitive Markets", *The Engineering Economist*, Vol 53, pp 340-364.

High-level Reports positive to experience/learning curve to inform energy policy. But there are important caveats

● IEA Energy Technology Perspectives

“Technology learning is the key phenomenon that will determine the future cost of renewable power generation technologies. Unfortunately, the present state-of-the-art does not allow reliable extrapolations.”

● UK Stern Report

“There is a question of causation since cost reductions may lead to greater deployment; so attempts to force the reverse may lead to disappointing learning rates. The data shows technologies starting from different points and achieving very different learning rates. The increasing returns to scale can be used to justify deployment support, but the potential of the technologies must be evaluated and compared with costs of development.”

Critical assessment of Experience/Learning Curves: High-level Reports positive but important caveats

➤ IEA Energy Technology Perspectives

- Key phenomenon for determining future cost of renewable
- State-of-the-art does not permit reliable extrapolations

➤ UK Stern Report

- Can be used to justify deployment support
- Very different learning rates from causes uncertain



● Empirical studies:

- Analyse and verify learning rates
- Features, Events, Processes (FEPs) causing technology learning

● Theoretical basis:

- Systems Approach needed - FEP do not explain learning rates
- Modelling the technology production system