

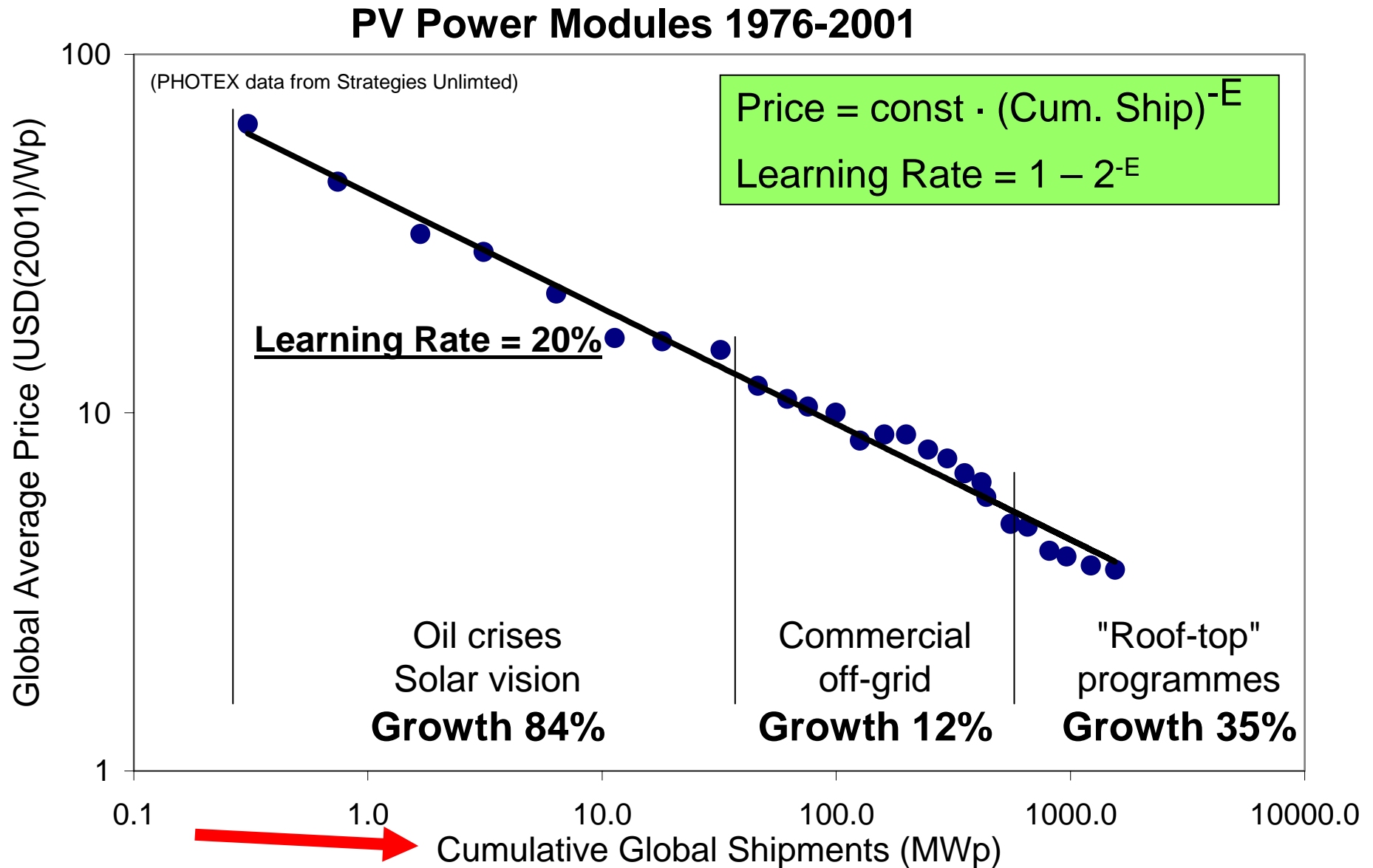
**International Workshop on
Technology Learning and Deployment**

**IEA Headquarters, Paris
11-12 June 2007**

**Why and how to use Experience Curves
to design and evaluate Deployment Programmes**

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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

- **Learning:** a process enhancing capacity for effective action



- **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

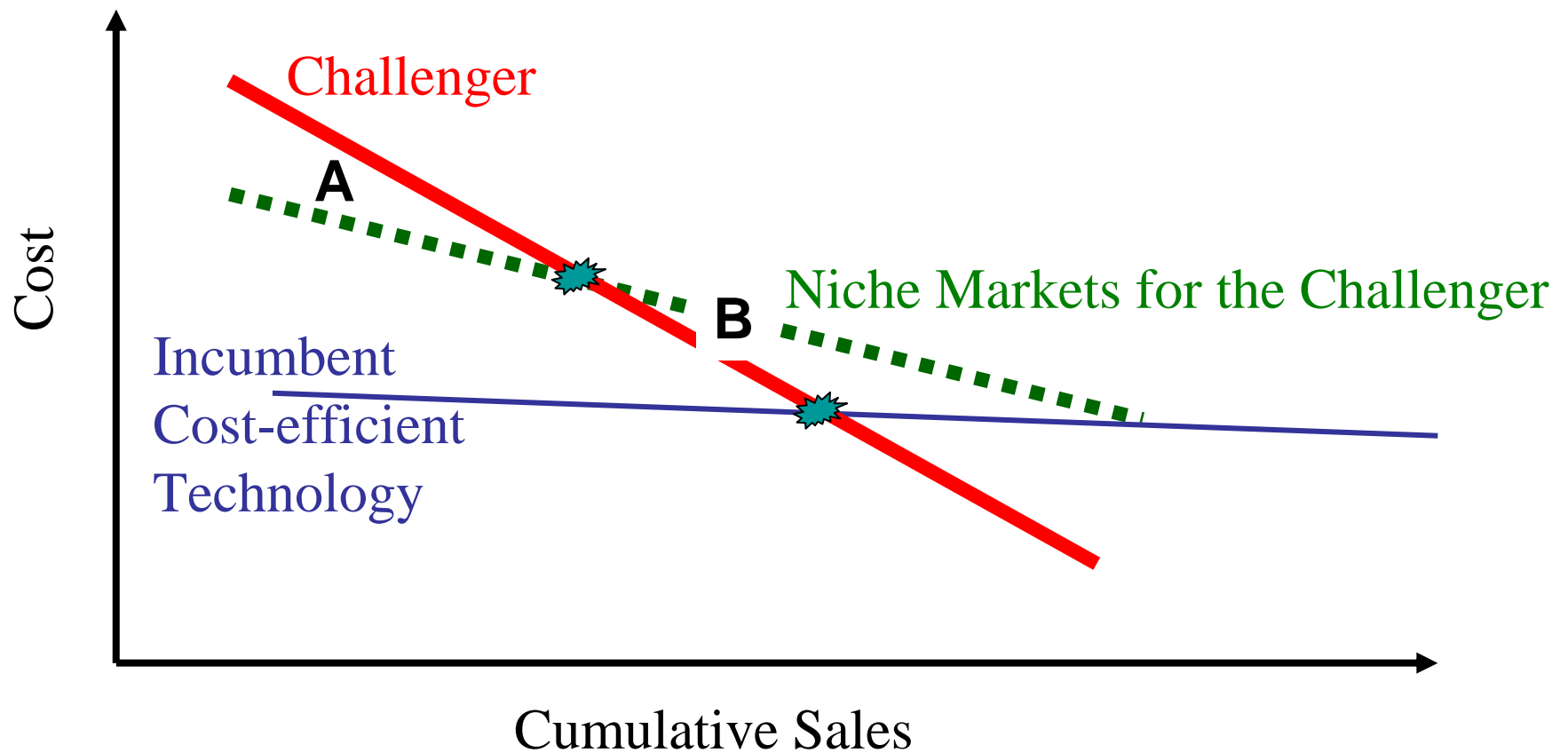


- **Experience/learning curves:** measures technology learning in the special case where technical properties remains same



- 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?



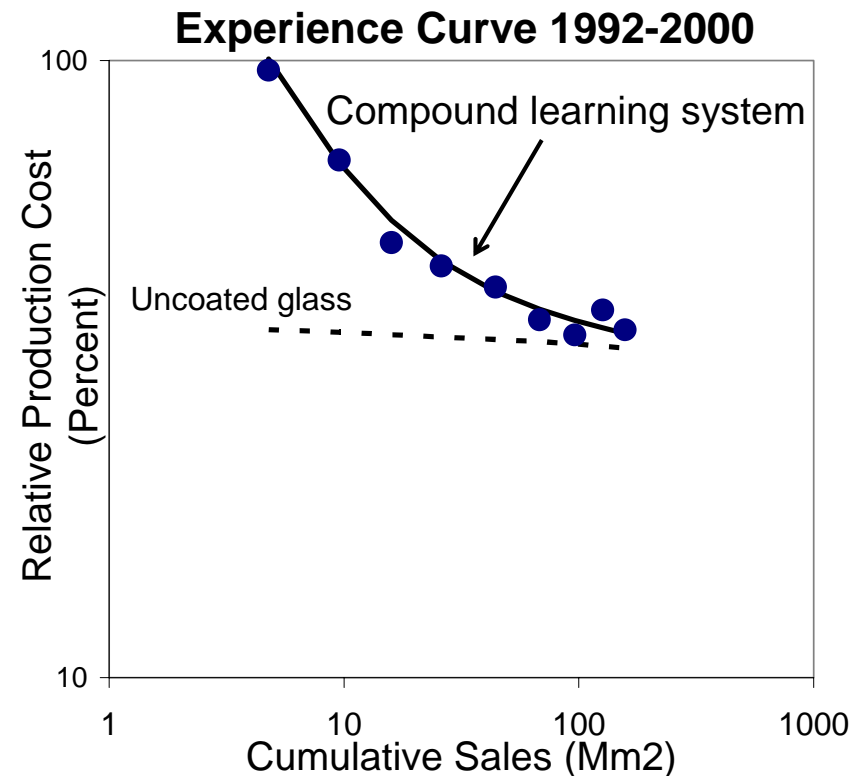
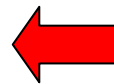
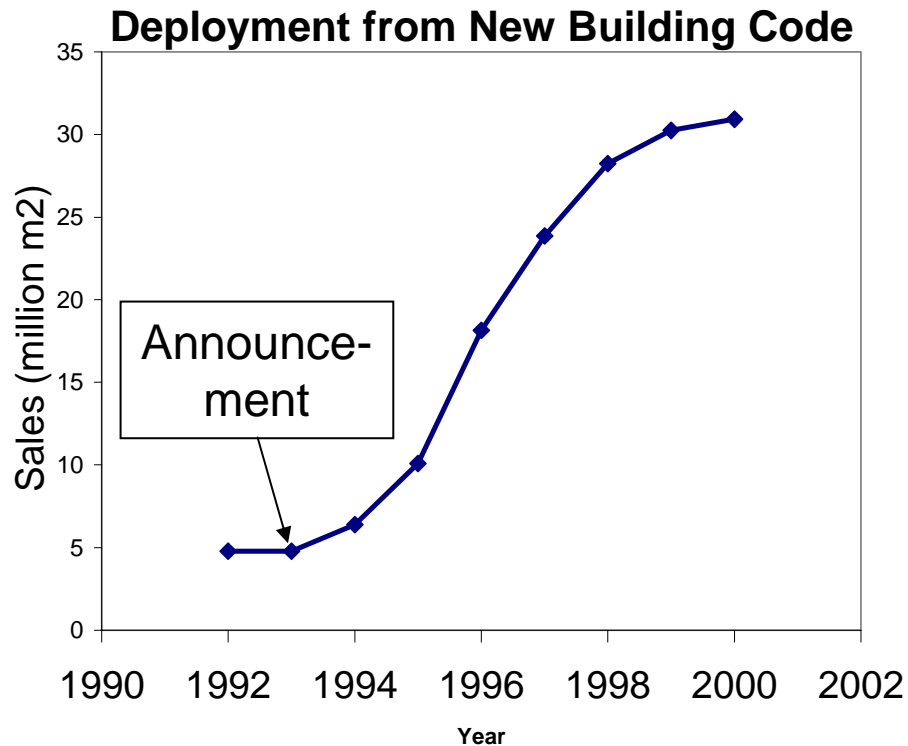
- Special efforts to create niche markets (labelling, feed-in tariffs)?
- Is the niche market curve flat enough?
- Contributions from industry in “A” to have the benefits in “B”?

Examples of DP stimulating Technology Learning and measured by Experience Curves

(IEA(2000), Experience Curves for Energy Technology Policy)

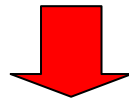
Germany 1992-2000: Coated Glass for Selective Windows

(Data from Blessing 2002)



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

Summary

Use of Experience/Learning Curves

➤ **Characteristics of Technology Learning**

- Requires market action = technology deployment
- Relies on internal processes within market actors
- Leaves open the role of Gov't R&D (“Janus-face”?)

➤ **Design of efficient Deployment Programmes**

- 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", to be published in *Kybernetes, Special Issue on Management Science*.

Wene, C.-O. (2008), "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 (to be published)

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.”