ETP 2008
Deploying Demand Side Technologies

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Initial Findings

- Unique analysis estimating deployment costs for a range of demand side technologies
- Learning curves are currently the best tool available to estimate future deployment needs
- Engineering models often over estimate costs
- Deployment costs for building, transport and industry technologies under ACT Map are estimated at $ 1.5 trillion
- Learning investments are estimated at $ 1.0 trillion
- Deployment costs for power generation under ACT Map are estimated at $3.95 trillion

Technology Life Cycle

R&D	Technologies in need for R&D to overcome technical barriers and to reduce costs. The outcome is still uncertain, especially in the early stages of development.
Demonstration	Demonstration of the technology. Often government funding is needed to finance part or all of the costs of the demonstration.
Deployment	**Successful technical operation, but in need of support to overcome cost barriers. With increasing deployment learning-by-doing effects will result in gradually decreasing costs.**
Competitive (Diffusion)	Technology is cost competitive in some or all markets, but some technologies may require sustained incentives to value CO_2 emission reduction or other benefits.

Deployment vs Diffusion

- Deployment support is warranted only for non-competitive technologies
- Where higher capital cost are not justified by lower operating costs
- Cost effective technologies do not require deployment, but diffusion support
- The majority of energy efficient measures in ETP are already cost effective
- Life cycle cost analysis applied to determine cost effectiveness of technology

Life Cycle Cost Analysis

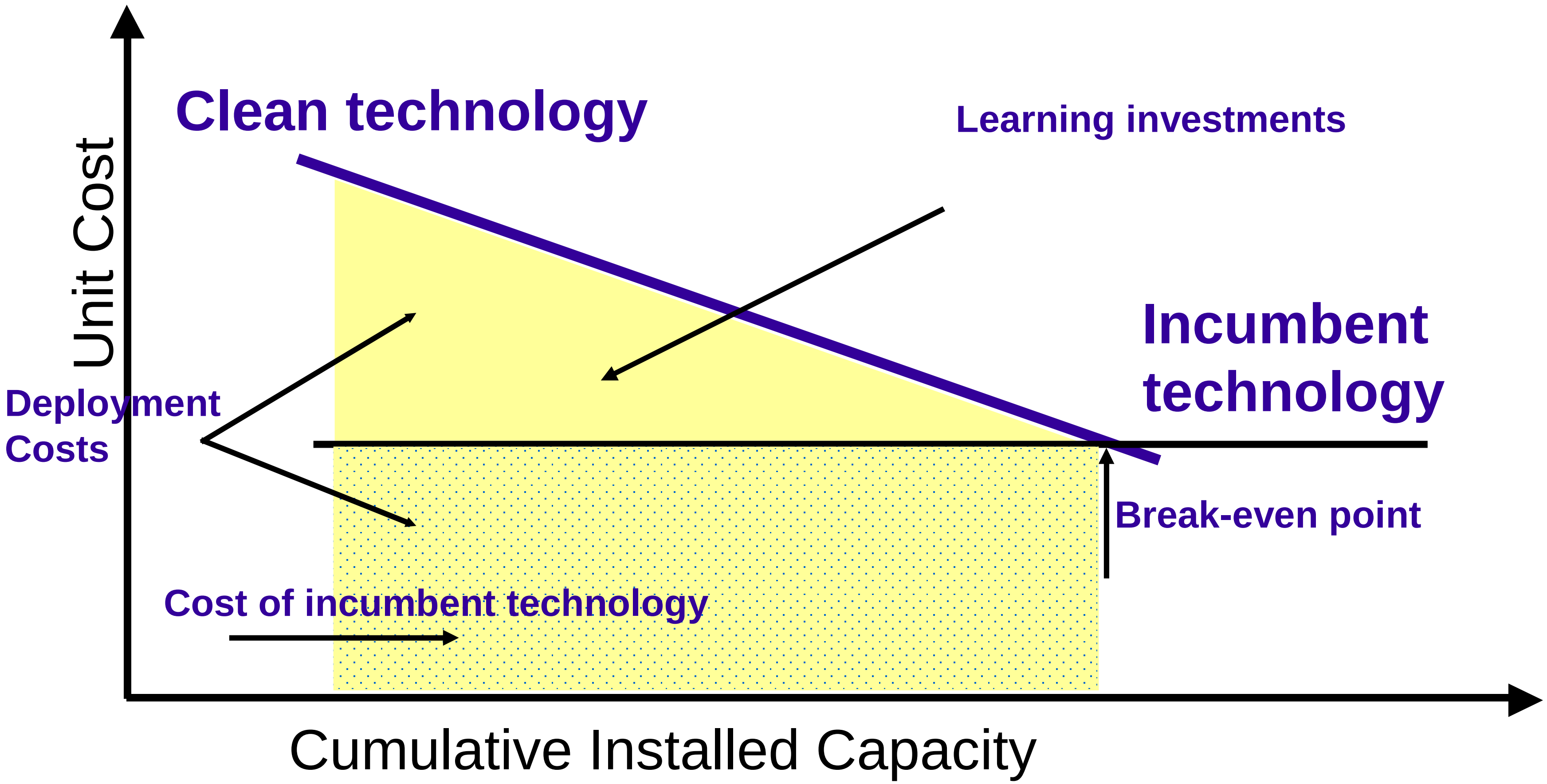
Typical characteristics and costs of CFLs

	Incandescent lamp	CFL
Initial cost of bulb (USD)	0.50	10.00
Light output (lm)	900	900
Lamp power (W)	75	15
Efficacy (lm/W)	12	60
Lifespan of bulb (h)	1 000	10 000
Calculations over a 10 000 h operating period, assuming an electricity tariff of USD 0.1/kWh		
Electricity consumption (kWh)	750	150
Cost of electricity (USD)	75.00	15.00
Cost of lamps (USD)	5.00	10.00
Total cost of lamps and electricity (USD)	80.00	25.00
Total savings for CFL (USD)	–	55.00
Implied cost of conserved energy (USD/kWh)	–	0.008

Source: Lights Labour's Lost, IEA (2006)

- **Government intervention is needed to over come market barriers to diffusion**

Learning Curves



Learning Curve - Uncertainty

- Cost vs price
  - Price data leads to distortions, but cost data is not often available
- Which system boundary?
  - Are learning rates constant or decreasing
  - Correcting for price data distortions
- Global vs national learning curves

Learning for Demand Side Technologies

- The bulk of learning curve analysis has focused on supply technologies
- Learning can also be applied for demand technologies
- The definition of an energy technology is not clear for demand technologies
- System boundary chosen can significantly impact the outcome

Observed Learning Rates for Demand Technologies

Technology	Country / Region	Period	Learning Rate (%)
Ford Model T	USA	1909 -1923	13
Refrigerators	USA	1980 -1998	12
Freezers	USA	1980-1998	22
Clothes Washers	USA	1980-1998	13
Electric Clothes Dryer	USA	1980-1998	12
Dish Washer	USA	1980-1998	16
Room Air conditiner	USA	1980-1998	15
Selective Window Coatings	USA	1992-2000	17
Heat Pumps	Germany	1980-2002	30
Heat Pumps	Switzerland	1980-2004	24
Facades with insulation	Switzerland	1975-2001	17-21
Double glazed coated windows	Switzerland	1985-2001	12-17
CFL	Global	1990-2004	10
Air conditioners	Japan		10-17

Source: McDonald and Schrattenholzer 2001 & 2003, Laitner 2004, ECN 2005, Jakob 2003, and Ellis 2007

Key Findings from Supply workshop

- **June 11-12 Deployment workshop focused on supply technologies**
- **Learning curves, when backed by bottom-up engineering models can be useful tools**

- **Global learning rates should be used**
- **More analysis is needed to better understand how learning is achieved and why cost reductions occur**

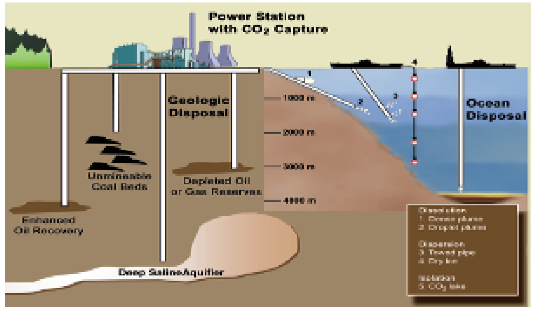
Key Findings from Supply workshop

- Flexible policy framework is needed
- Too much government support is a problem
- Industry should be encouraged to establish itself
- Governments should avoid picking technology winners
- More efficient international cooperation for technology deployment is needed

Key Technologies

- **Buildings**
  - Ground source heat pumps
  - Solar heating and cooling
- **Industry**
  - CCS for blast furnace
  - CCS for cement
  - CCS for black liquor gasifiers
  - Feedstock substitution
- **Transport**
  - Lignocellulosic ethanol
  - FT biodiesel
  - Hybrid vehicles
  - Plug in hybrid electric vehicles
  - H2-FCVs

Solar Heating & Cooling, Heat Pumps, Zero Net Emission Bldgs.



Carbon Capture and Storage

Vehicles: Efficiency, Biofuels, H_2 Fuel Cells

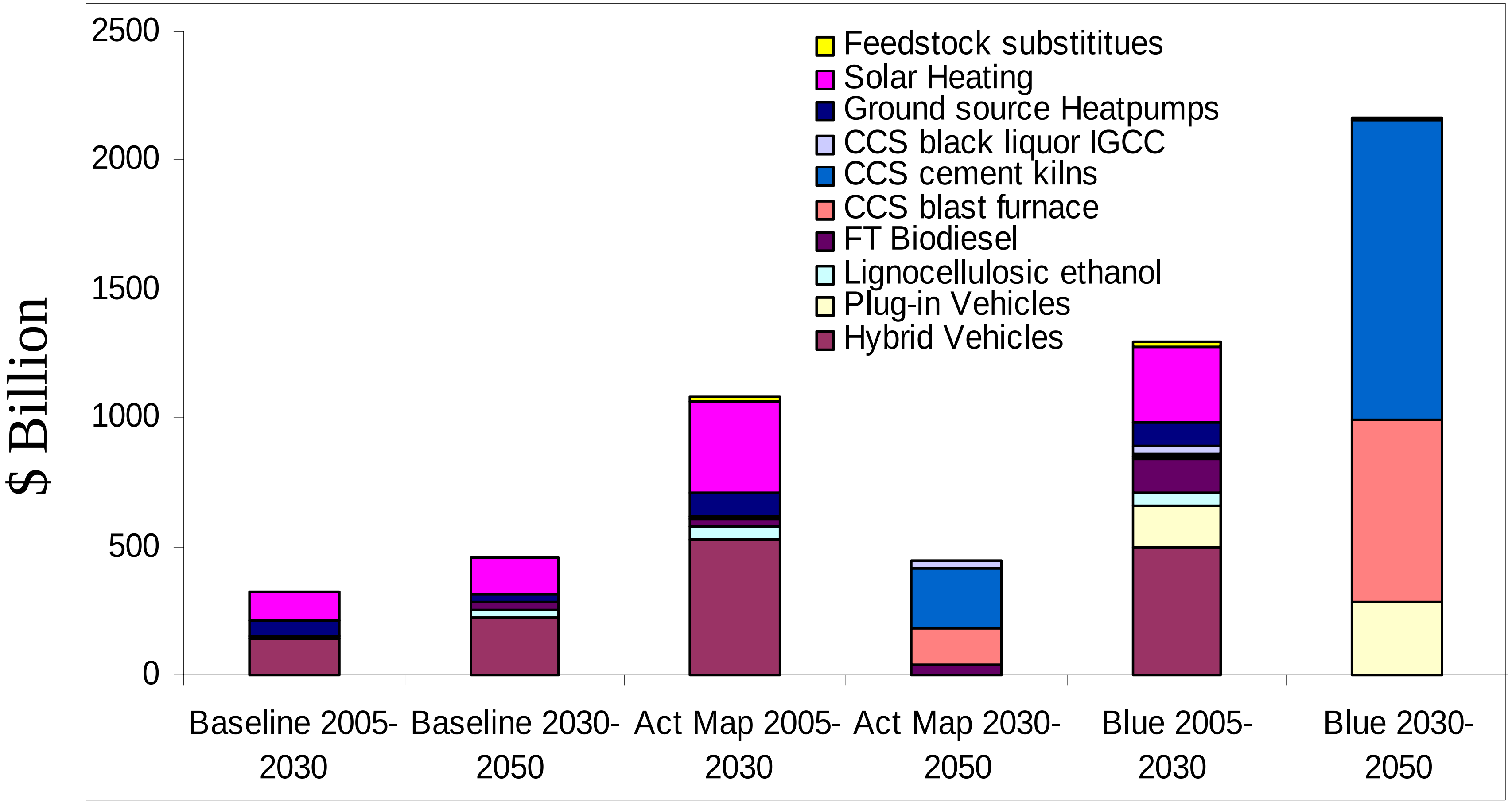
Assumed Learning Rates

	Unit	Boundary	Learning rate (%)
Fuel Cell Vehicles (m of cars)	$/kW	FCV drive system cost	22%
Hybrid Vehicles (m of cars)	Car	ICE+electric+battery	20%
Lignocellulosic ethanol (Mtoe)	$/litre	fuel cost	2%
FT-biodiesel (Mtoe)	$/litre	fuel cost	5%
Plug-in Vehicles (m of cars)	Car	Batteries for plug-ins	20%
Ground Source Heat Pumps (m)	$/system	heat pump + installation	15%
Solar Heating and Cooling (m m2)	$/m2	panel	10%
Feedstock substitution, Mt	t ethylene	0	10%
CCS blast furnace (Mt CO2)	$/t CO2	CCS cost	5%
CCS cement kilns (Mt CO2)	$/t CO2	CCS cost	5%
CCS black liquor IGCC (GW)	$/kW	Production cost	5%

Deployment Costs

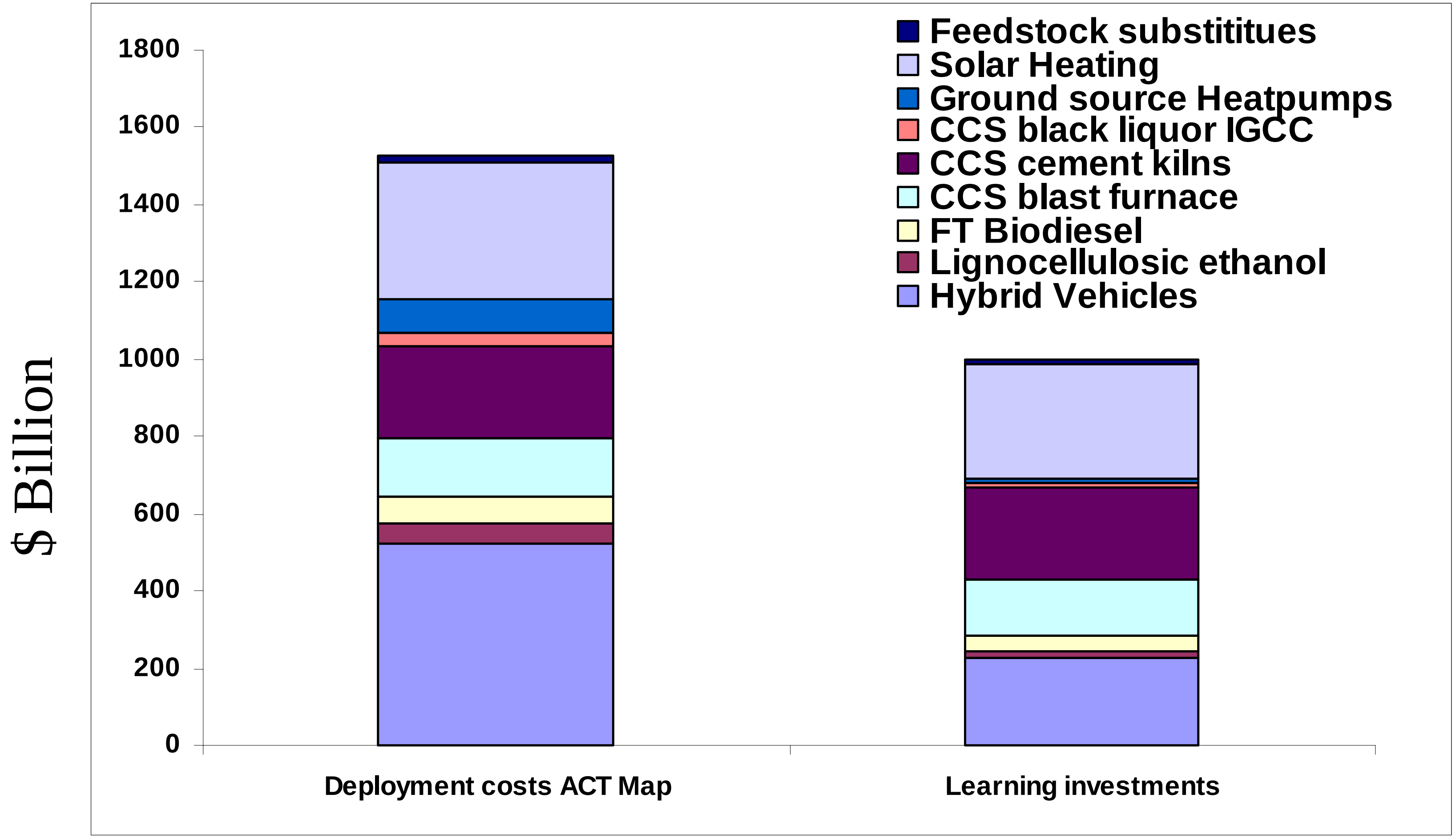
- Estimates calculated through the use of learning curves
- Deployment costs are very sensitive to both learning rate and market growth rate (time needed for each doubling)
- Total investment cost to reach cumulative production necessary for technology to reach commercialisation stage
- Deployment costs – cost of incumbent technology = learning investments

Deployment costs



Figures are not discounted

Learning investments



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Workshop objectives

- Input on the use of learning curves to estimate deployment costs
- Feed back on our initial results
- Discuss deployment policies aimed at promoting clean energy technologies
- This workshop will feed into the technology learning and deployment chapter of ETP 2008

Time Path

- Final report May 2008
- Final chapter February 2008
- Committee review December 2007
- Expert review November 2007
- Draft chapter October 2007

Thank You

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