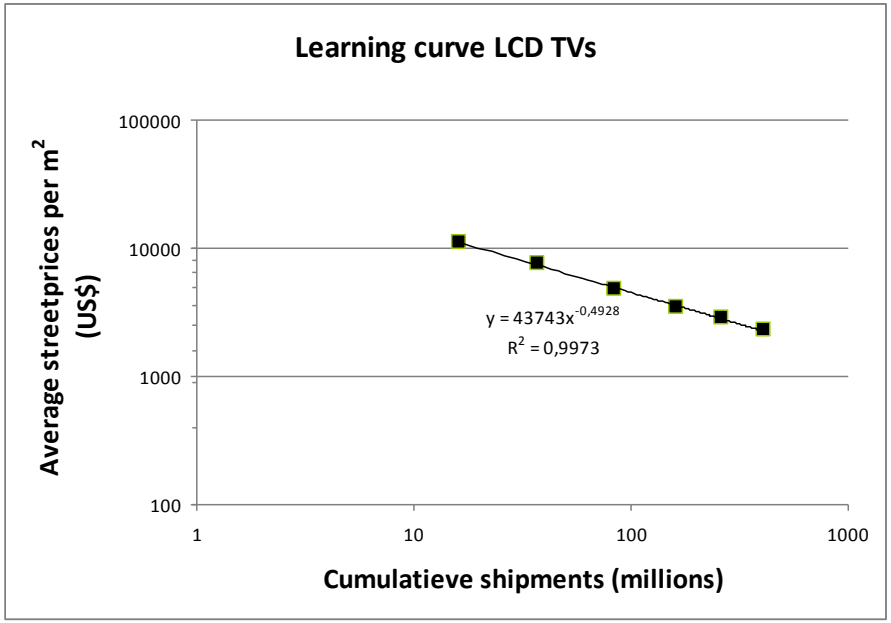


NL Agency
Ministry of Economic Affairs

Applying learning curves in ecodesign measures

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22 January 2013

>> Focus on energy and climate change

Why apply learning curves?

To set more ambitious efficiency standards within the **legal framework** of the ecodesign directive (2009/125/EC).

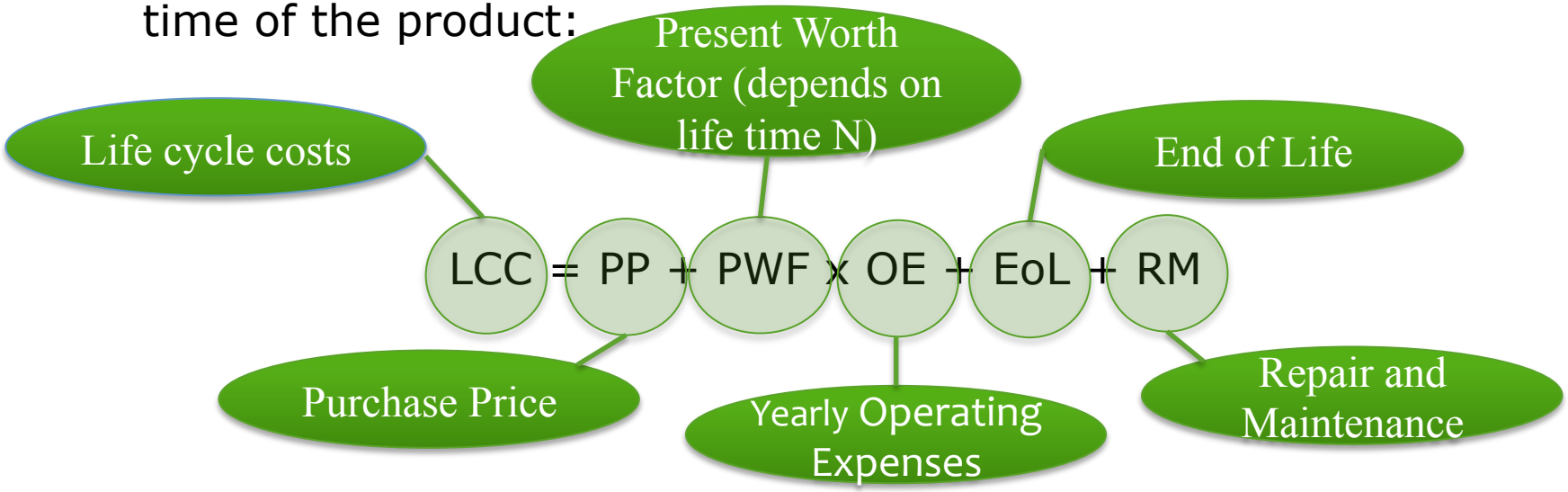
Legal framework: standard to be set at minimum lifecycle cost level.

So, this presentation will cover:

- Minimum lifecycle costs (LCC), and the assumption behind using LCC
- Learning curves and the integration in lifecycle costing
- Some estimates of extra savings
- What if the assumption behind using LCC is not true?

What are life cycle costs?

Life cycle costs are the costs for the end-user during the life-time of the product:



Formula can be simplified to:

$$LCC = PP + N \times OE$$

Life cycle costs to set standards I

Assumption: relation between purchase price (PP) and total operating expenses (NxOE) through efficiency

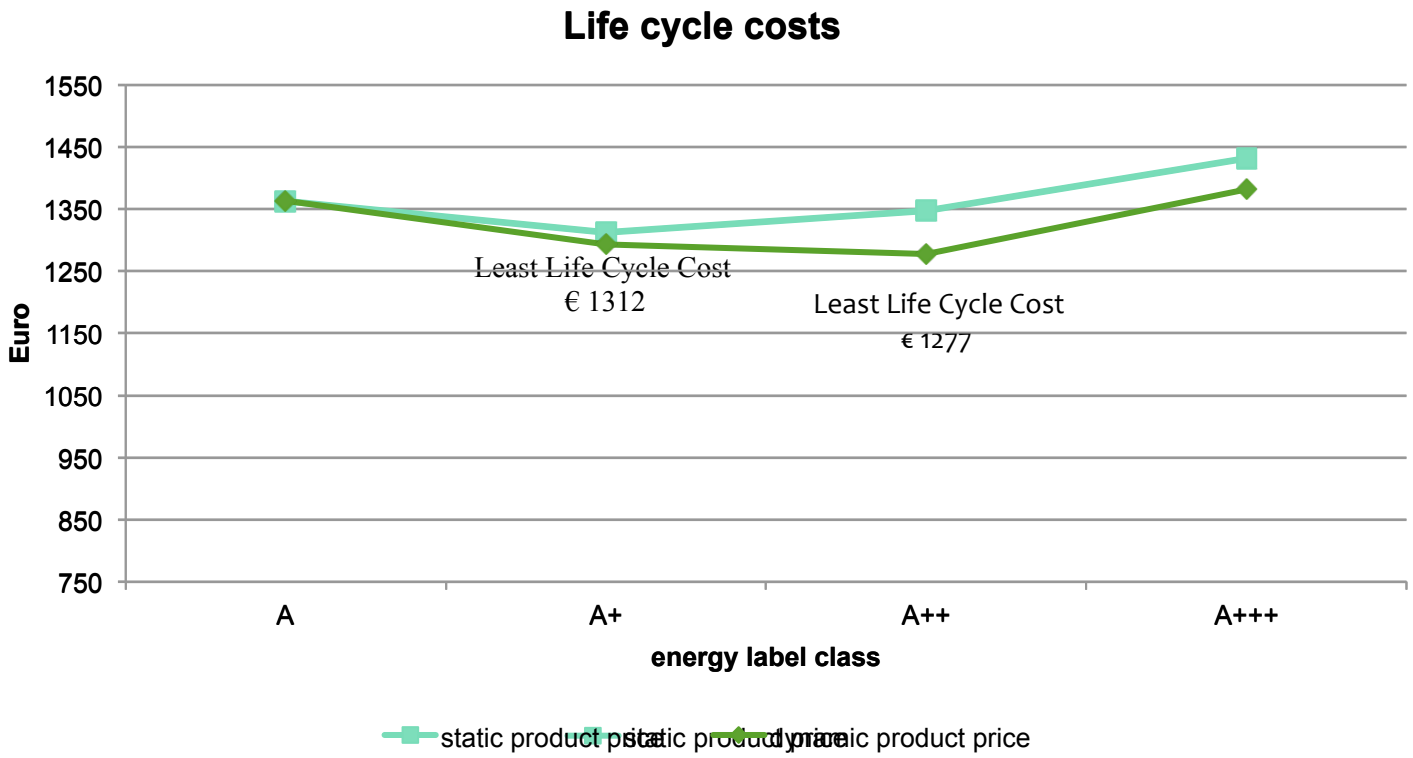
Efficiency ↑ Purchase Price ↑ Operating Expenses ↓

Different options for achieving efficiency improvements;
example refrigerator-freezer:

- Increase insulation
- Improve compressor efficiency
- Use compressor with variable speed

Efficiency improvements classified by energy class: A/A+/A++/A+++

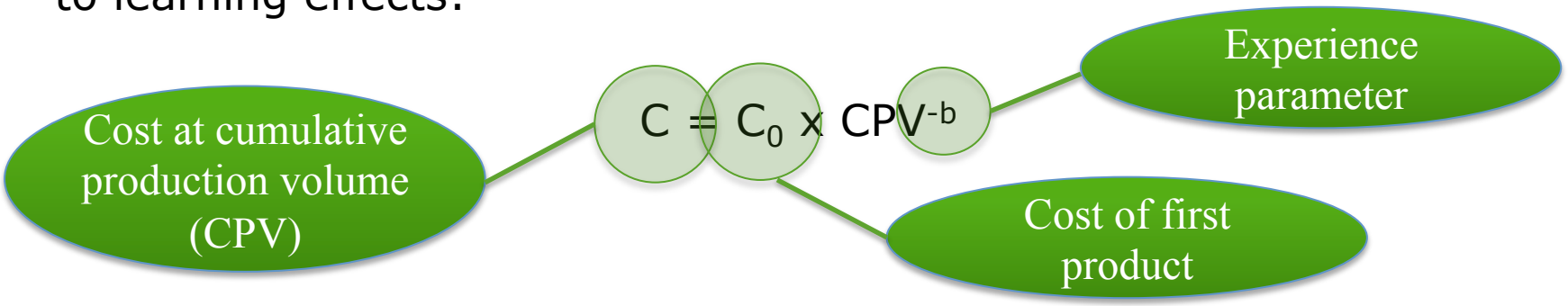
Life cycle costs to set standards II



Using learning curves for dynamic pricing

Life cycle costing uses fixed product prices.

However: product cost is decreasing with increasing production due to learning effects:



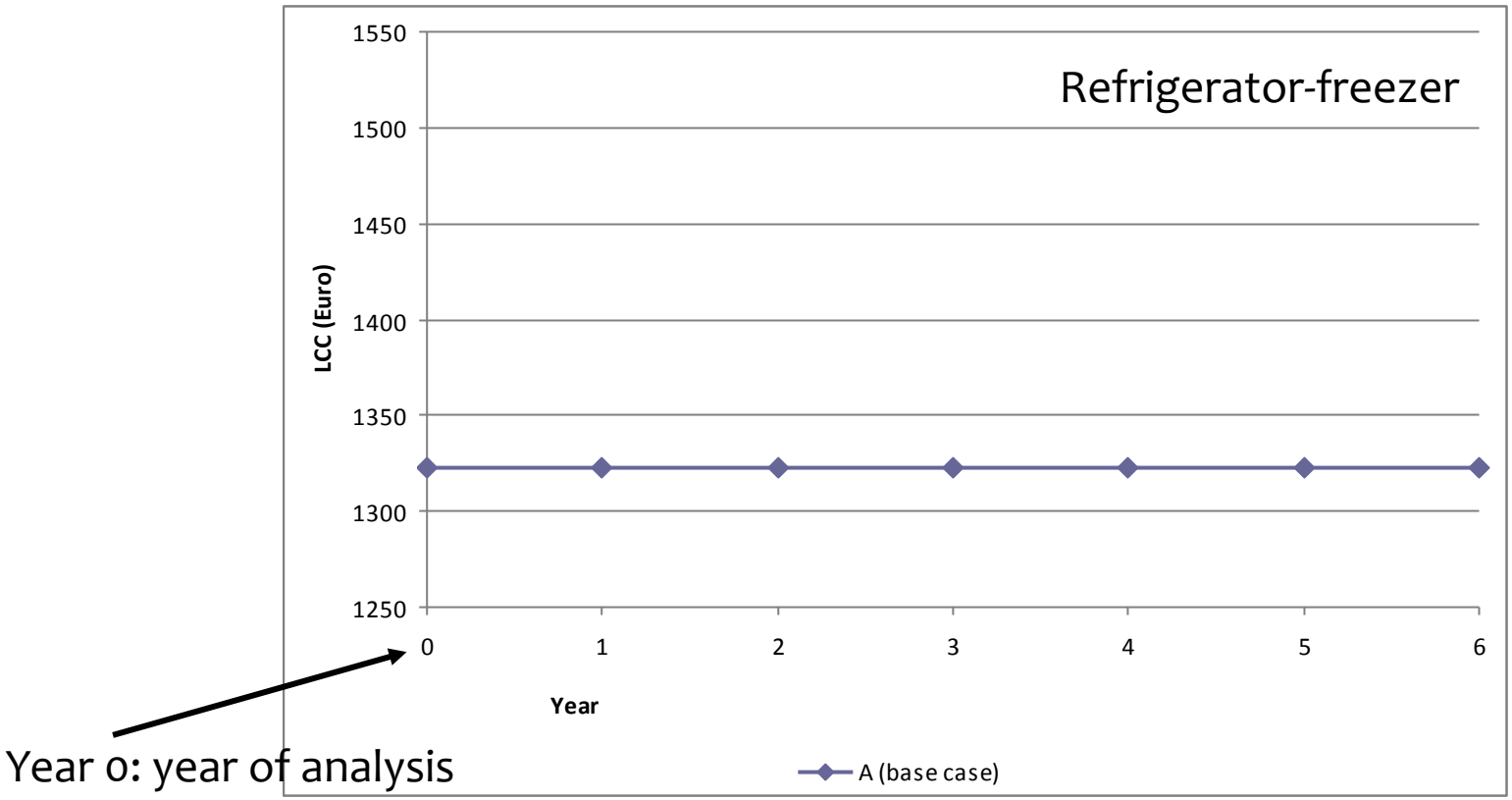
$LR = 1 - 2^{-b}$

Learning ratio: reduction in costs when production volume is doubled.

Learning ratios from literature

Product	**Average learning rate**
Laundry drier	14 %
Refrigerator	9 %
Freezer	13 %
Television (CRT)	12 %
Television (LCD)	29 %

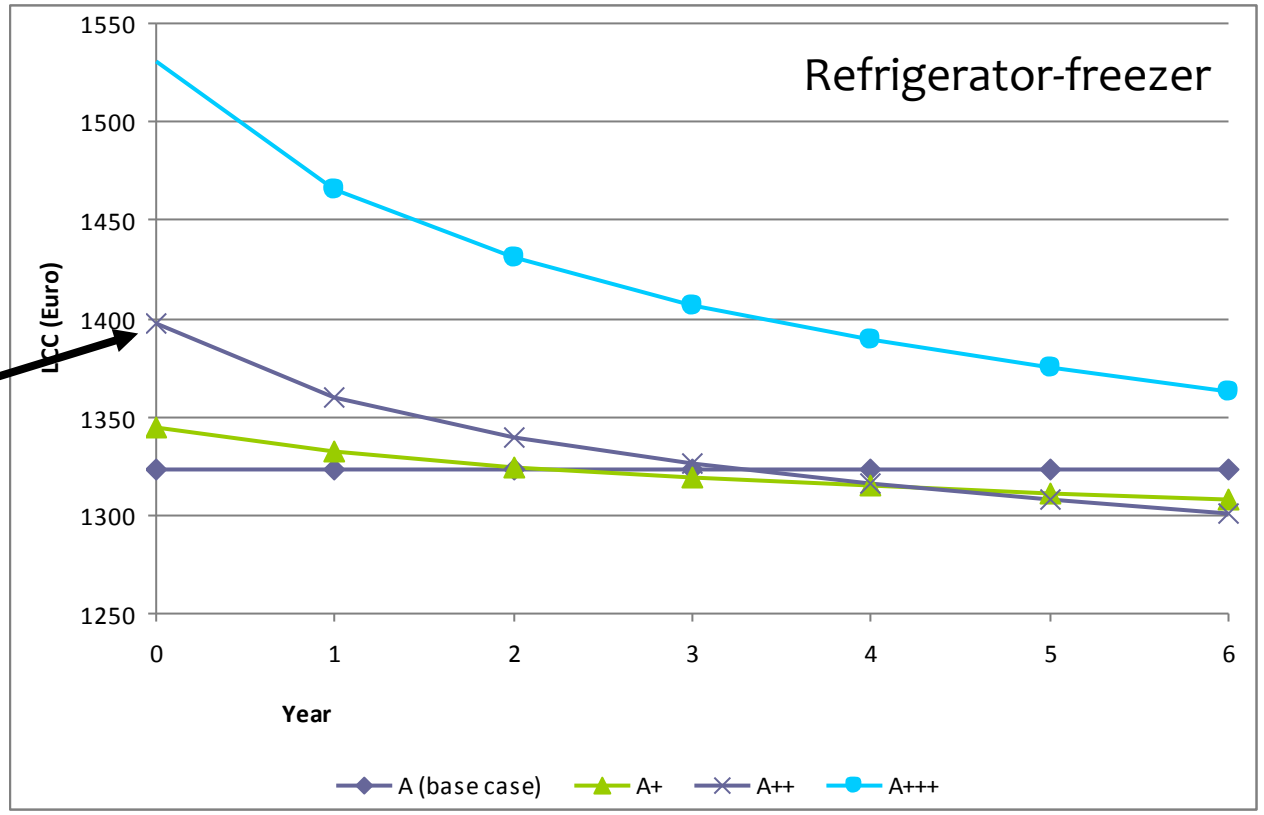
Integrating learning curves in lifecycle costing I



Year 0: year of analysis

Integrating learning curves in lifecycle costing II

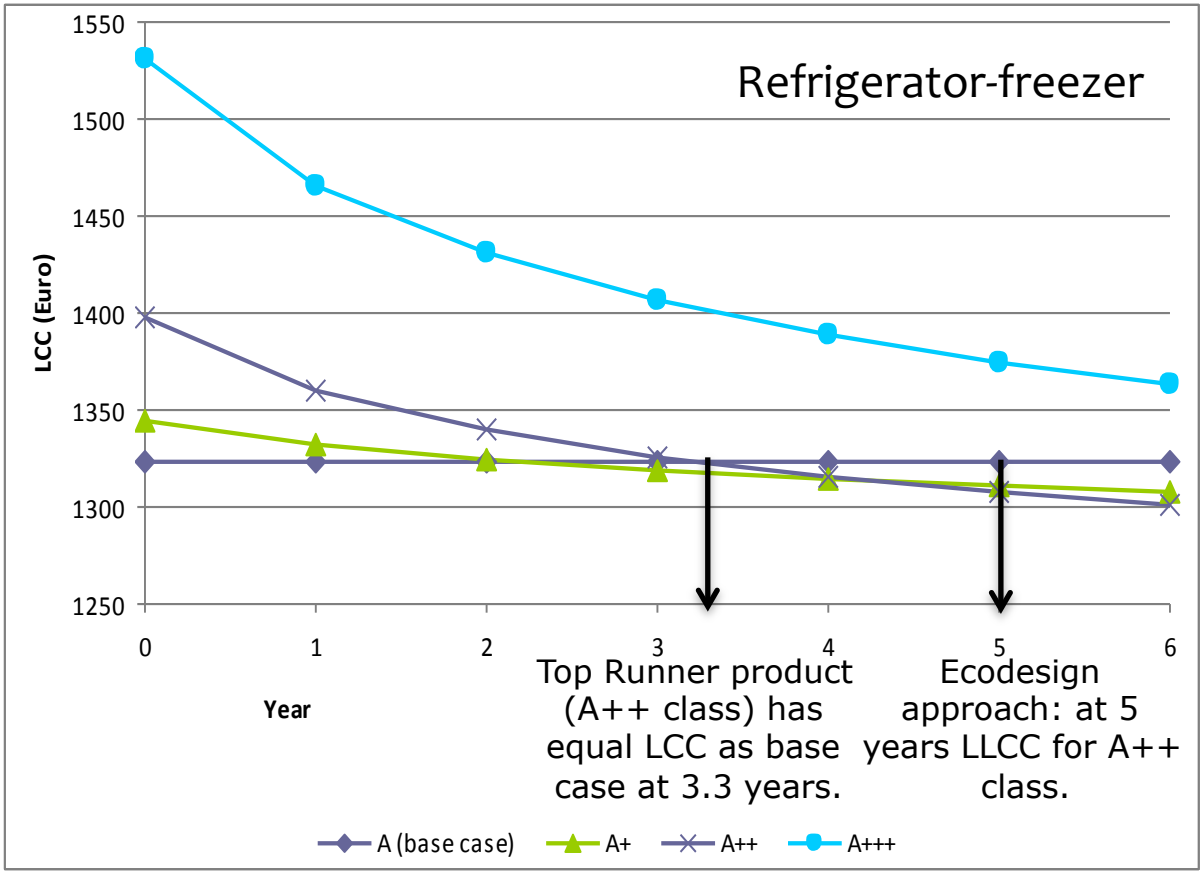
A++ is most efficient product on the market in Year 0.



Two ways to integrate learning curves in life cycle costing

Ecodesign: time period fixed, calculate new life cycle curve (with dynamic pricing) at end of that period.

Top Runner: most efficient product at time of analysis is Top Runner product, calculate time period when LCC is equal to base case.

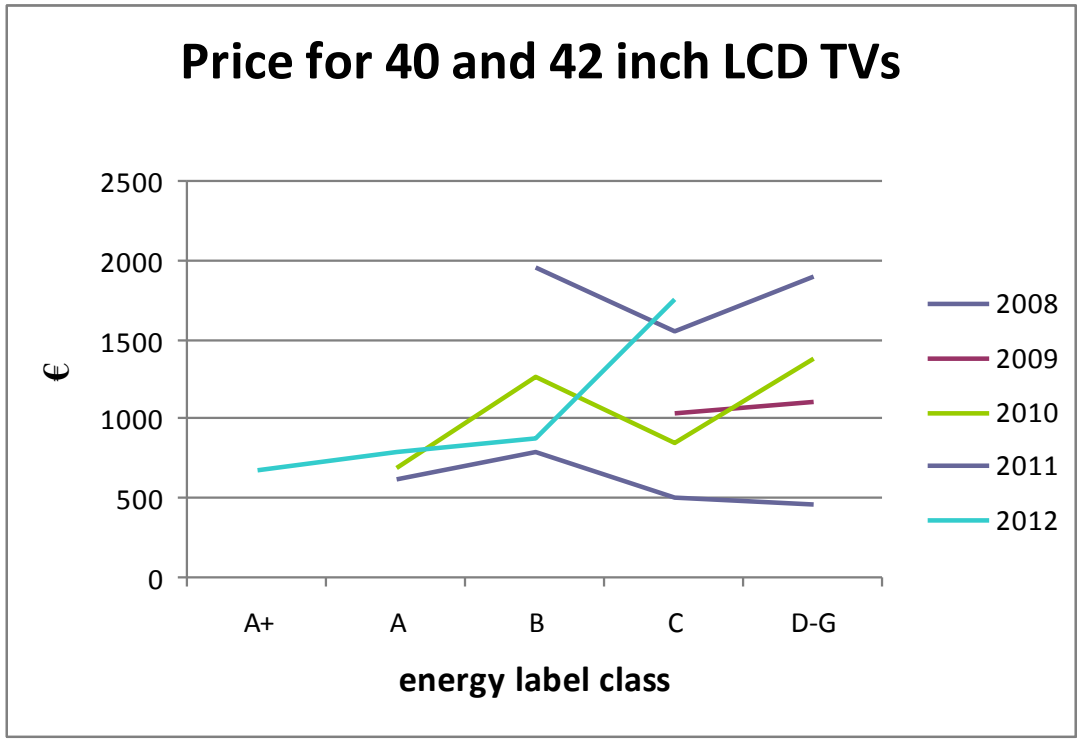


Extra savings - estimate

Product	Current approach	Ecodesign approach	Additional savings EU in 2025
	LLCC point [energy class]		[TWh/year] (% of savings with current approach)
Condensing drier	B	A++	**5 (143%)**
Refrigerator-freezer (no non-frost)	A+	A++	**6 (100%)**

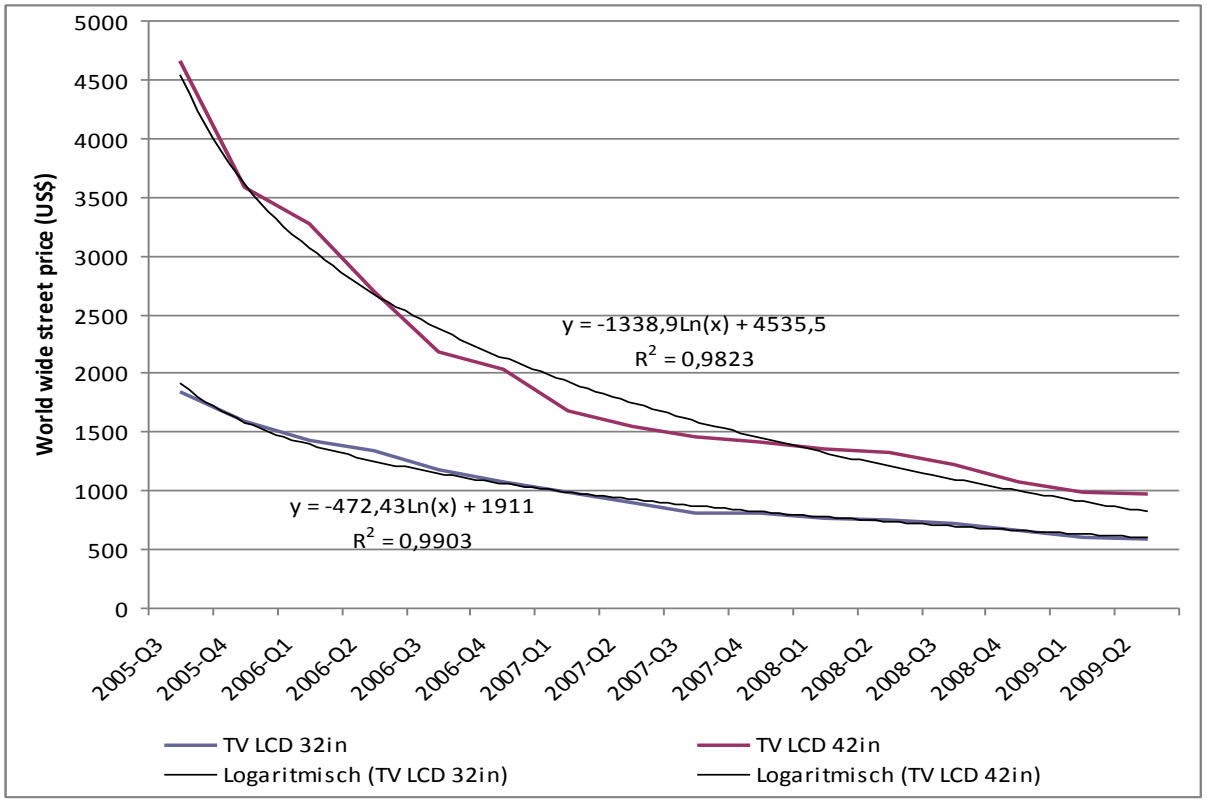
Does this work for TVs?

NO, because price is not related to energy efficiency (energy label class)



Does this work for TVs?

YES, because price decreases in time.



Concluding

- Learning curves, i.e. learning rates, can be used to set more ambitious ecodesign efficiency standards within the current legal framework.
- Learning rates are available for a large number of products.
- Learning rates can be integrated in lifecycle costing when energy efficiency is related to product price.
- For products, e.g. LCD TVs, where energy efficiency is not related to price, learning rates are important for the timing of measures.

Thank you for your attention!

Questions?

Difference between cost and price structure of a product

