RES policy design implications:
The impact of volatile energy and raw material prices

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This presentation reflects research conducted within the European project:
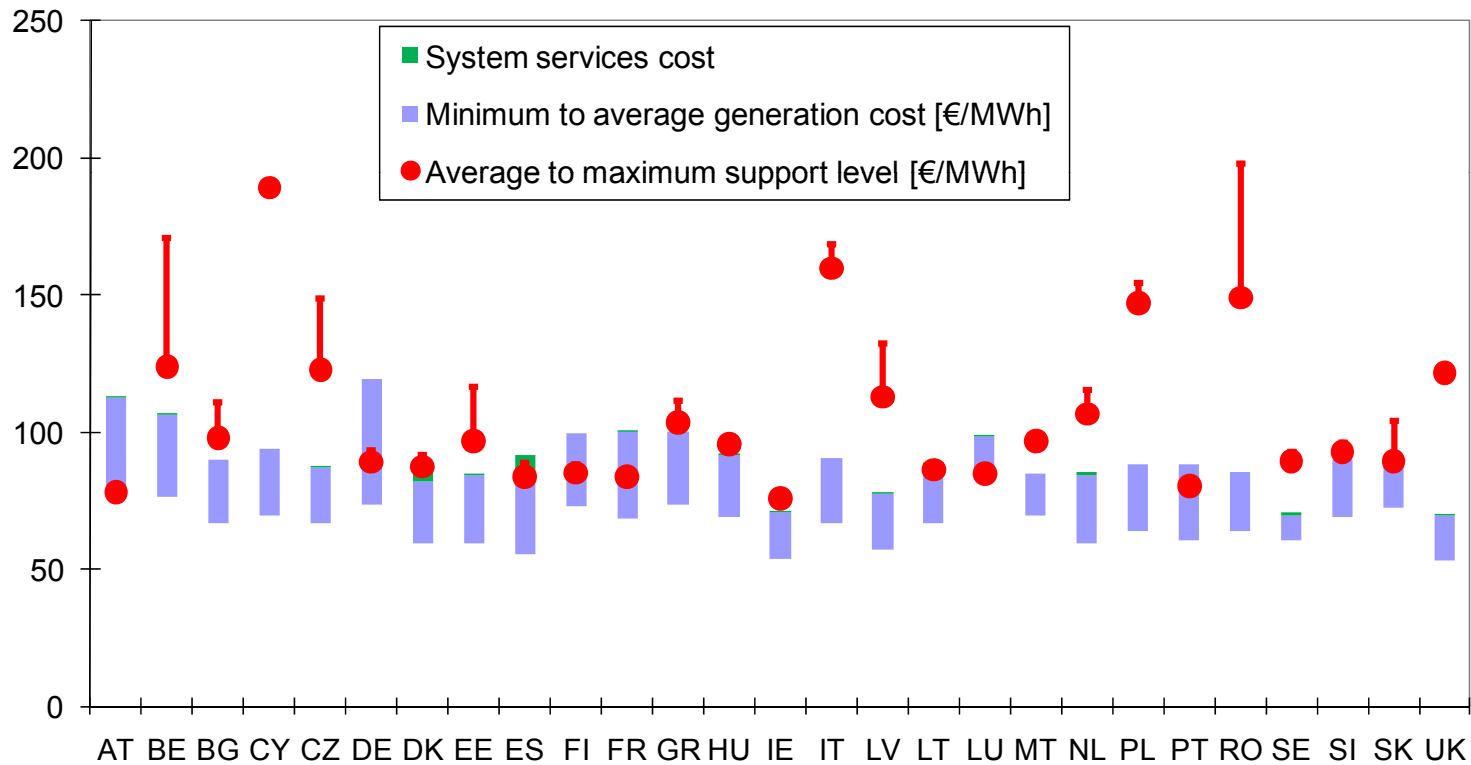◄Shaping an effective and efficient European renewable energy market ... www.reshaping-res-policy.eu

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Content

- Motivation

- Background information and data

- Methodology: Theoretical approach

- Analyses and results

- Conclusions and next steps

Support levels for wind onshore (EU27)

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Efficiency: To assure that wind onshore can deploy as required
($\rightarrow$ a key technology for meeting the 2020 RES target)
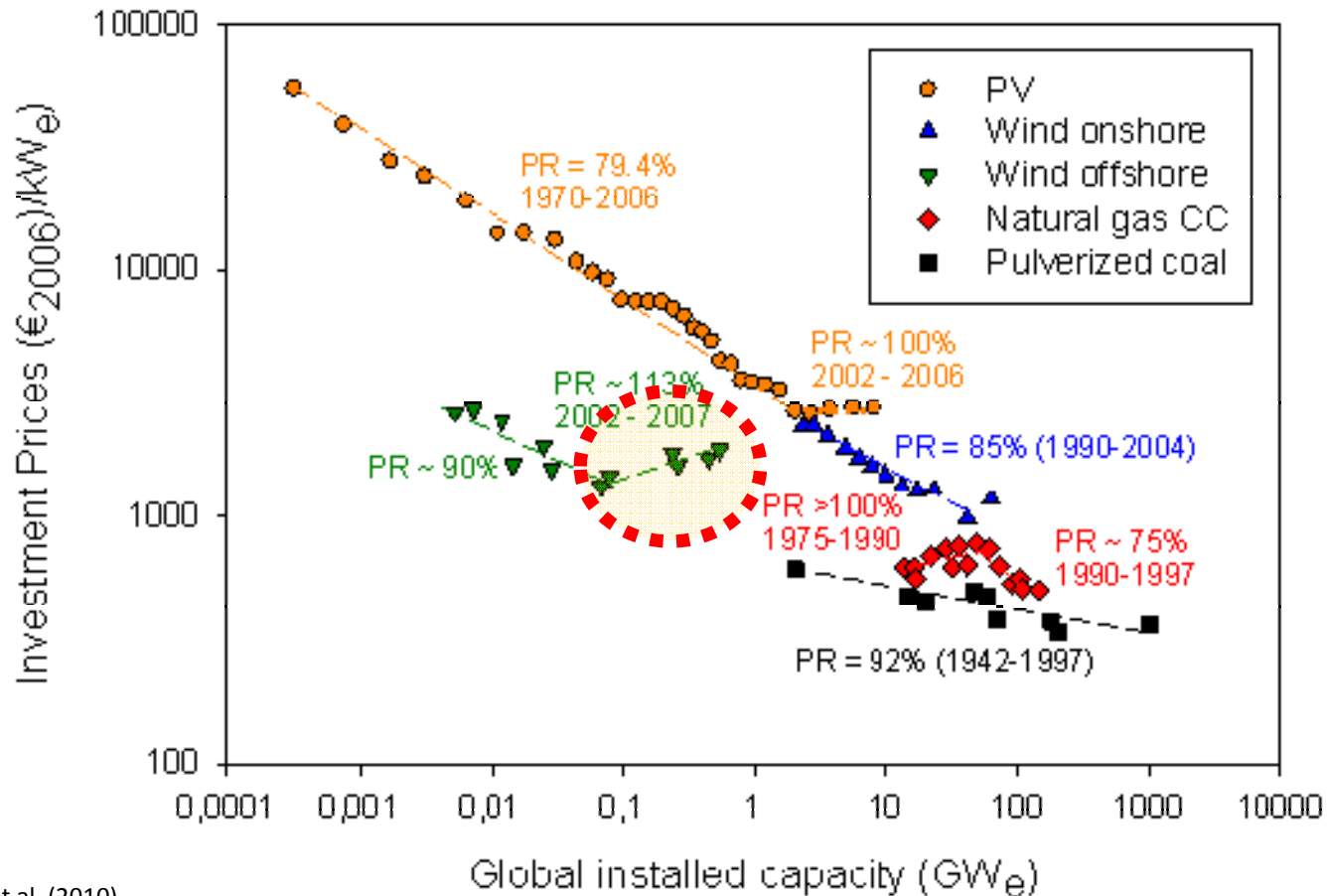**but** at comparatively low cost for the consumer / society

*… and all that in a **dynamic context** …*

Quelle: Held et al, 2010

Technological learning
... the old "fairy tale"?

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- *Observed historic cost development for various energy technologies and identified progress ratios*

  → *"Negative learning" in 2002-2007 ?!?*

Source: Junginger et al. (2010)

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RE-Shaping
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- *Correlation between steel prices and capital cost for wind onshore: 0.66*

- *Correlation between steel- and coal prices: 0.74*
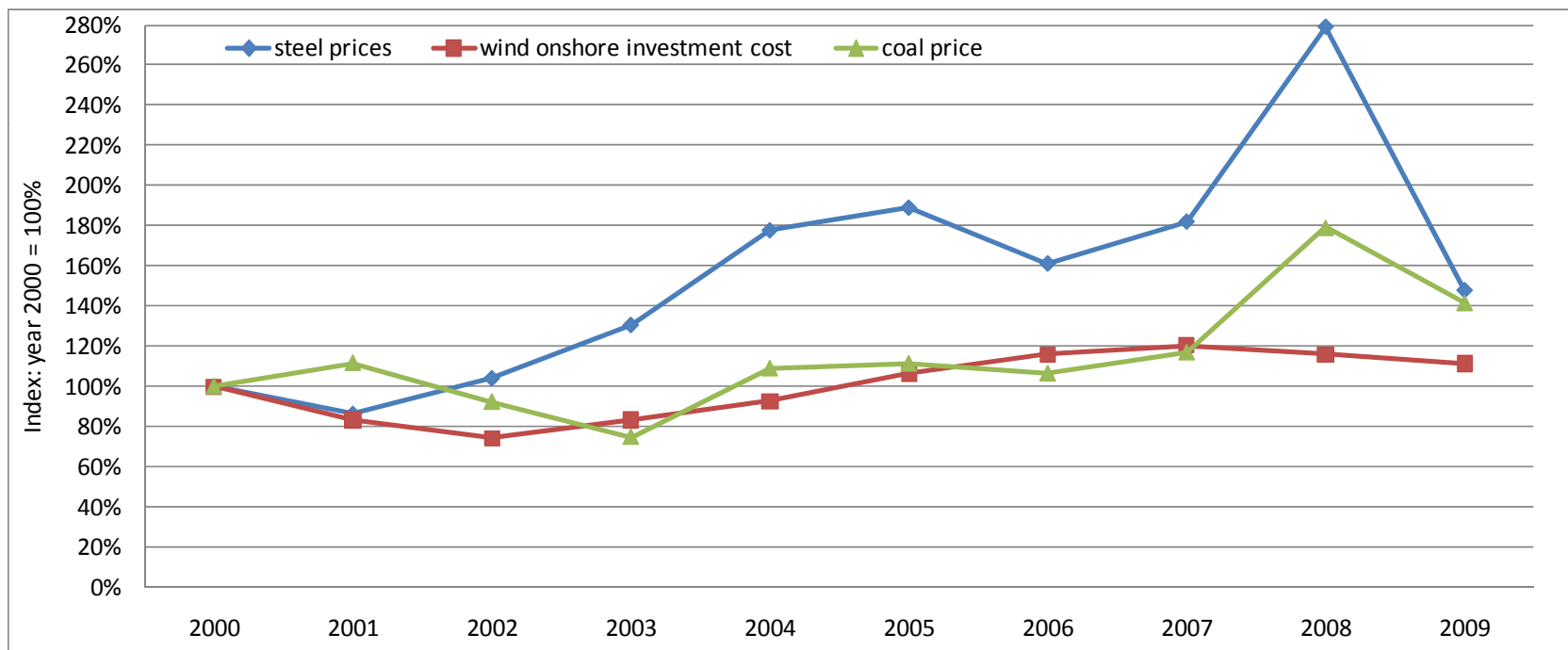
Source: Wind onshore capital cost … (EWEA, 2010), steel price … (Steel Business Briefing), and coal price … (European Commission)

Method of approach

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$$c(x_t) = c(x_0) \cdot \left(\frac{x_t}{x_0} \right)^{-b} \cdot \prod \left(\frac{CP_0}{CP_t} \right)^{LCP}$$

$$LR = 1 - 2^{-b} \qquad PR = 1 - LR$$

Practical Implementation:

- Identification of the impact of **energy prices on raw material prices**

- Calculation of raw material prices → in the past, and in the future …

- Data adjustment for conducting a **regression analysis of capital cost** for RE technologies

- **Quantitative** assessment of the **future development of capital cost** (for RE technologies)

Impact of energy prices on raw material prices

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- Distortion of coke prices due to production shortages in the near past

- Increasing coal prices cause a shift to new technologies in steel production (requiring a lower input of coal)
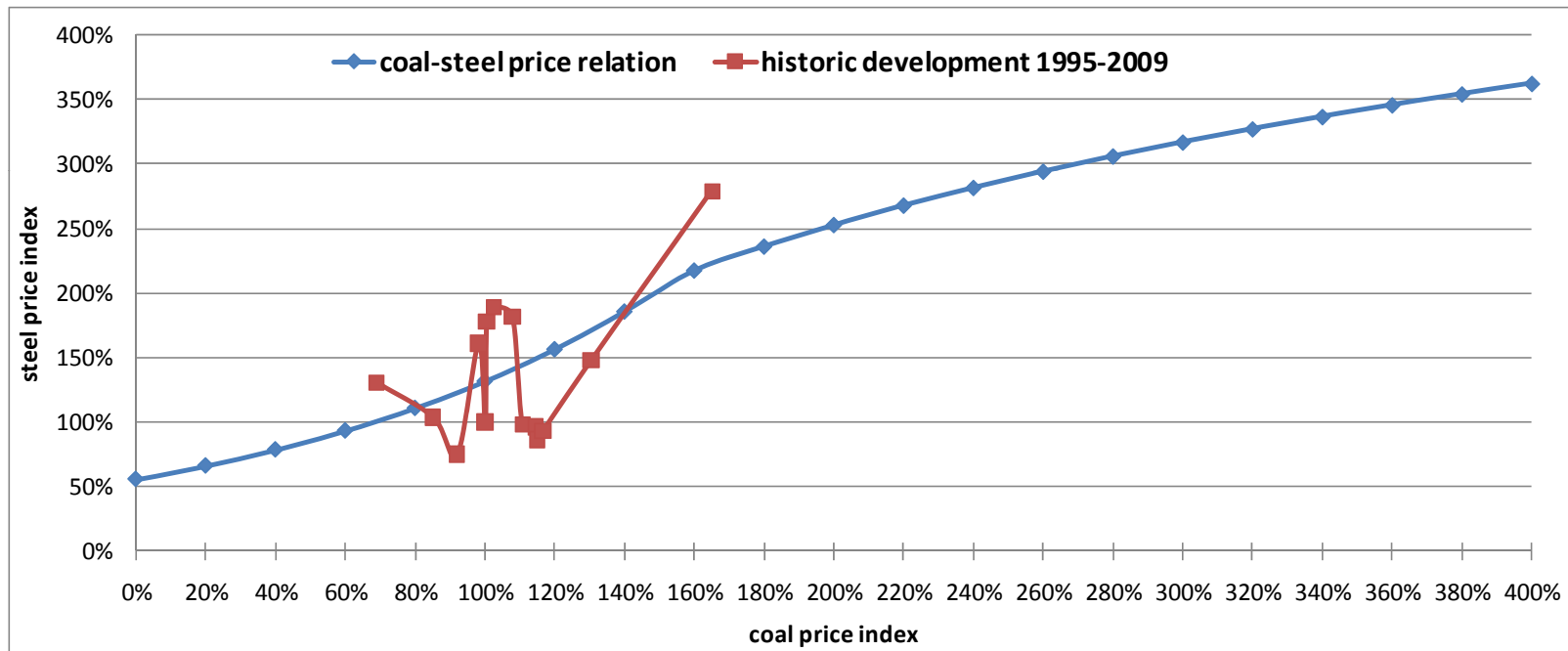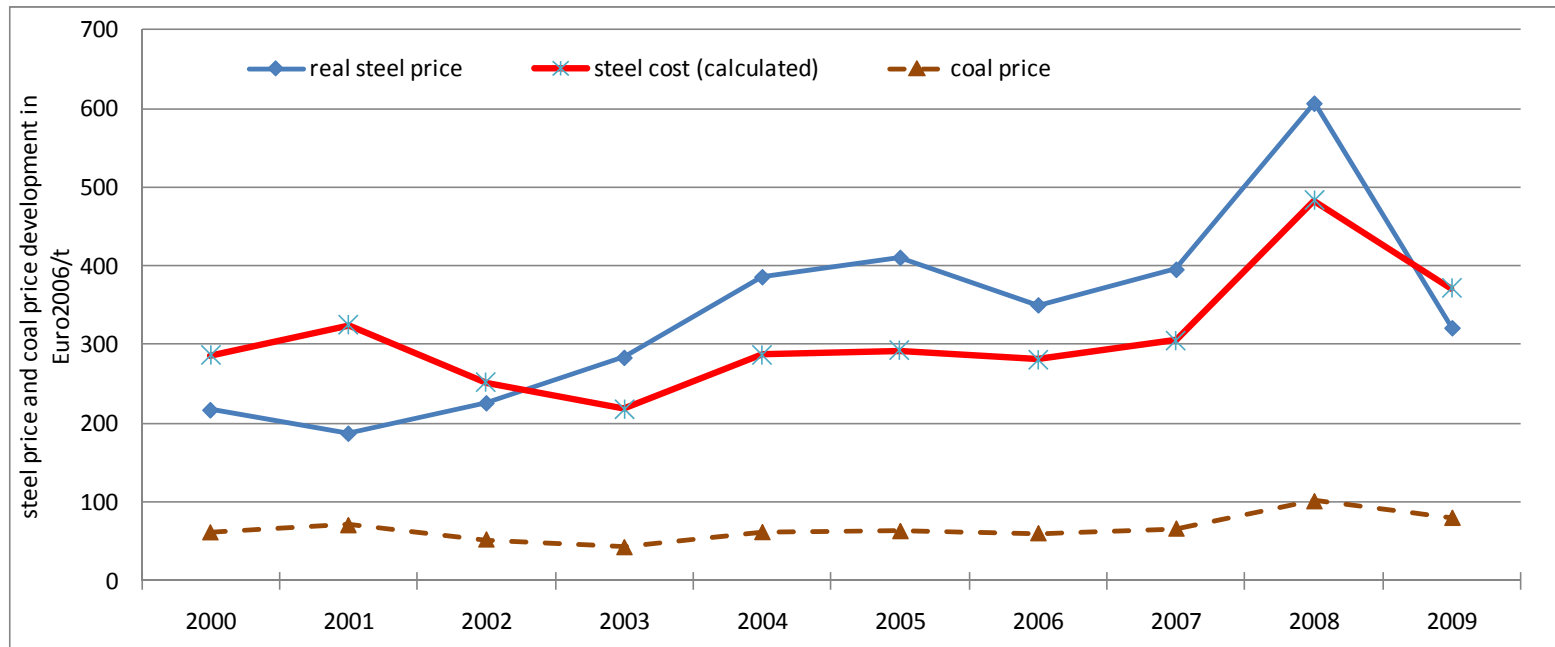

Source: Own calculations

$$\forall p_{coal} \leq 1.575 \Rightarrow c_{steel} = 0.5567 * e^{0.86 * p_{coal}}$$
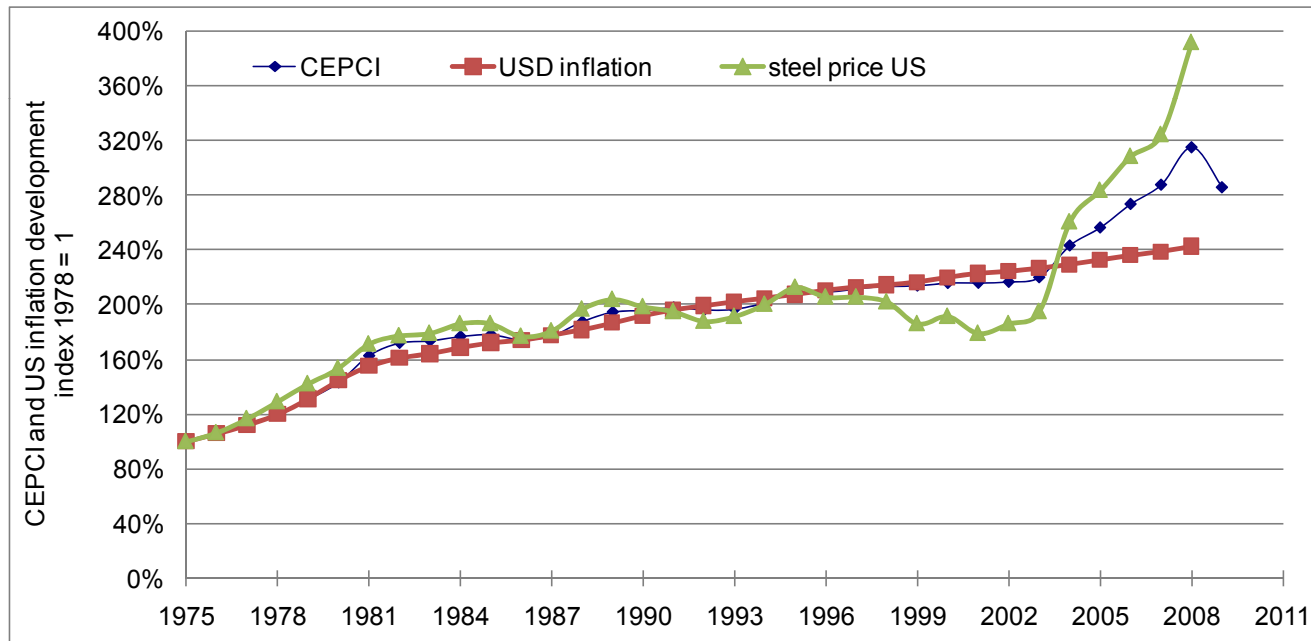
$$\forall p_{coal} > 1.575 \Rightarrow c_{steel} = 1.5811 * \ln(p_{coal}) + 1.4308$$

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Calculation of raw material costs

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- Pure consideration of **energy prices** for the definition of commodity prices (costs) → **estimation of the "minimal impact" that commodity price have on capital cost for RE technologies**

- Significant **difference in 2001**, where the **impact of market peculiarities is larger than the impact of energy prices**
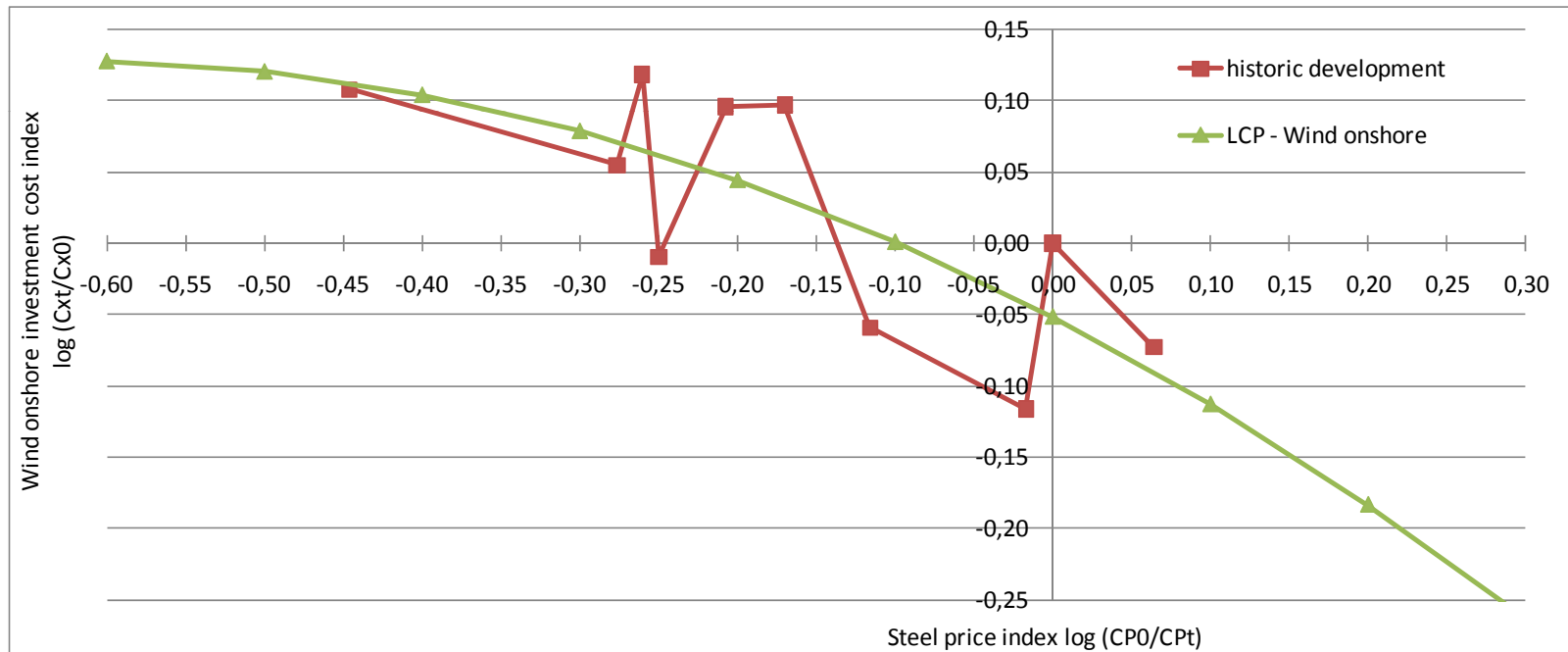

Source: own calculations

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- **Technological learning** cannot be considered in **regression analysis** – due to data gaps for the near past ...

- → **Learning rate was identified for a certain period** ... capital cost "cleaned up" (i.e. for the impact of learning) for the whole assessment period
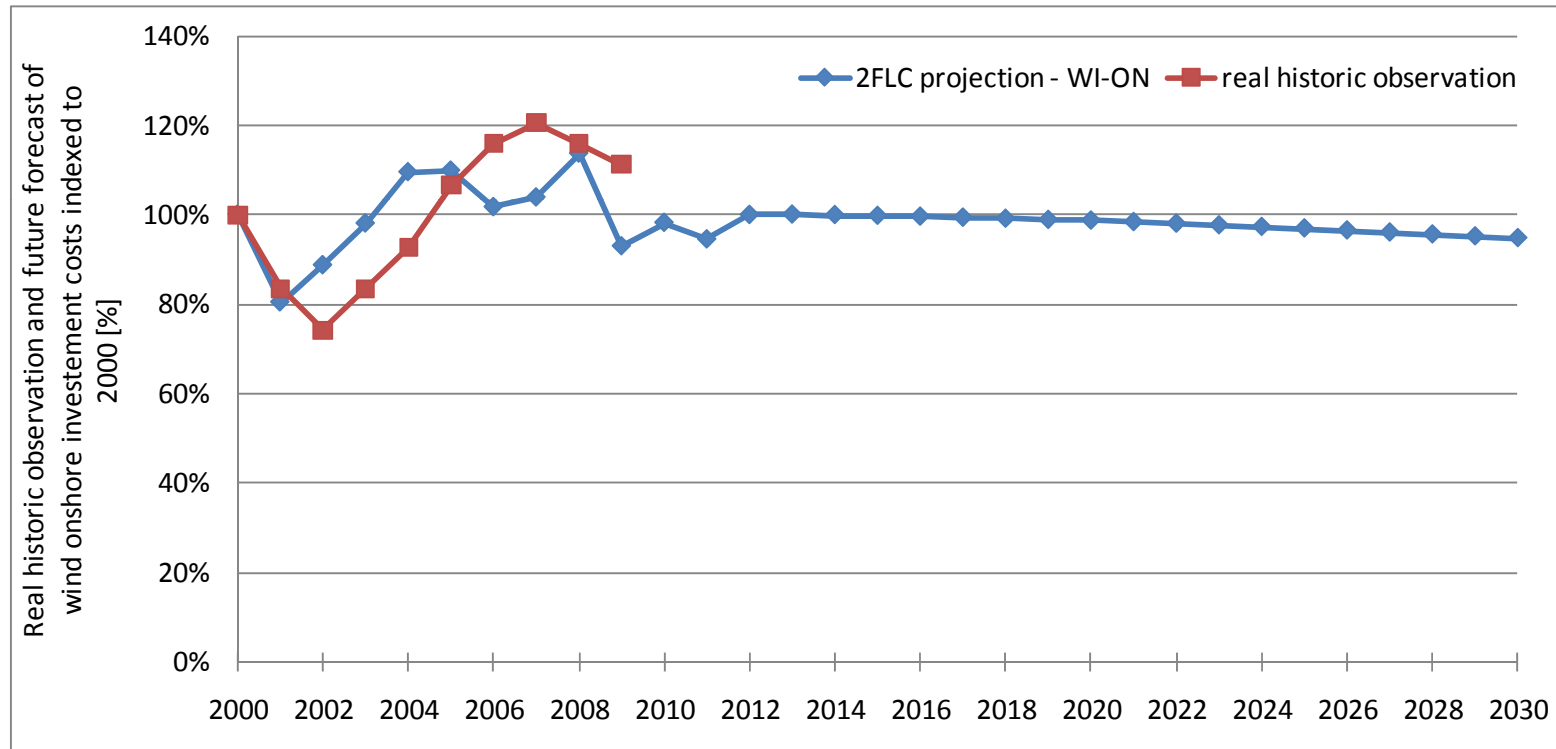

Source: Chemical engineering plattform; www.che.com

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Data adjustment for conducting a regression analysis

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- Regression analysis based on data for the period **1999 to 2009**

- **Increasing steel prices** (over a longer period) **may lead to substitution effects** (i.e. use of alternative raw materials…), and consequently a **reduction of their impact on capital cost for wind onshore** can be observed
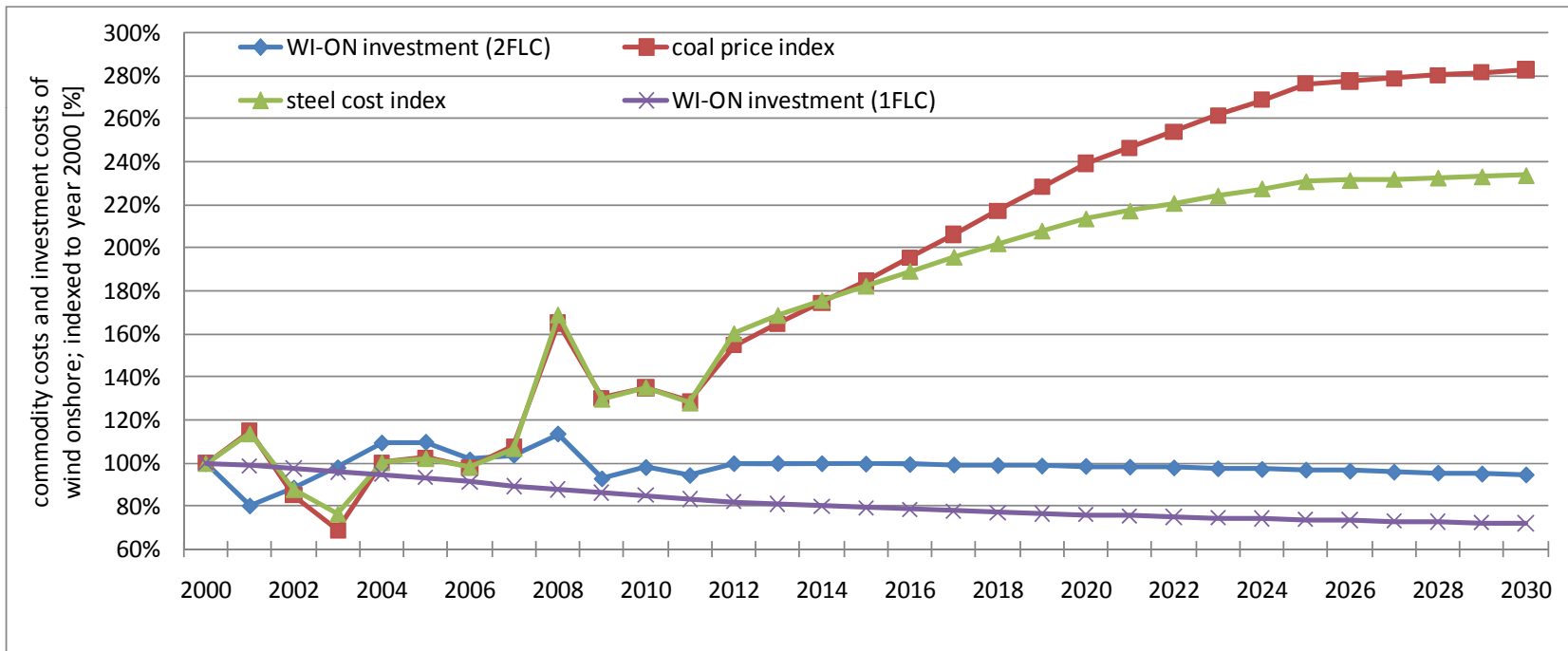

Source: Own calculations

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- **Comparison of calculated to "actual" capital cost** for wind onshore

- **Minimal impact of raw material prices** indicates a similar trend but does not allow to follow in (full) detail the actual observations…

Source: own calculations

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Results - expected future cost reduction w/o consideration of energy/raw material prices

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- Correlation between energy prices and capital cost for wind onshore

- Comparison of default modelling approach (1-factor-learning-curve (1FLC)) and improved approach (considering the impact of raw material prices) (2FLC)
  → „effective" learning rate reduced from 7 to 1.2%

Source: own calculations

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Results
- impact of the new approach

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- **Volatile character** of capital cost for energy technologies in the near past can be explained

- **Novel technologies show a stronger impact of (real) learning** compared to raw material (or energy) prices, while **for mature technologies it appears to be the other way round.**
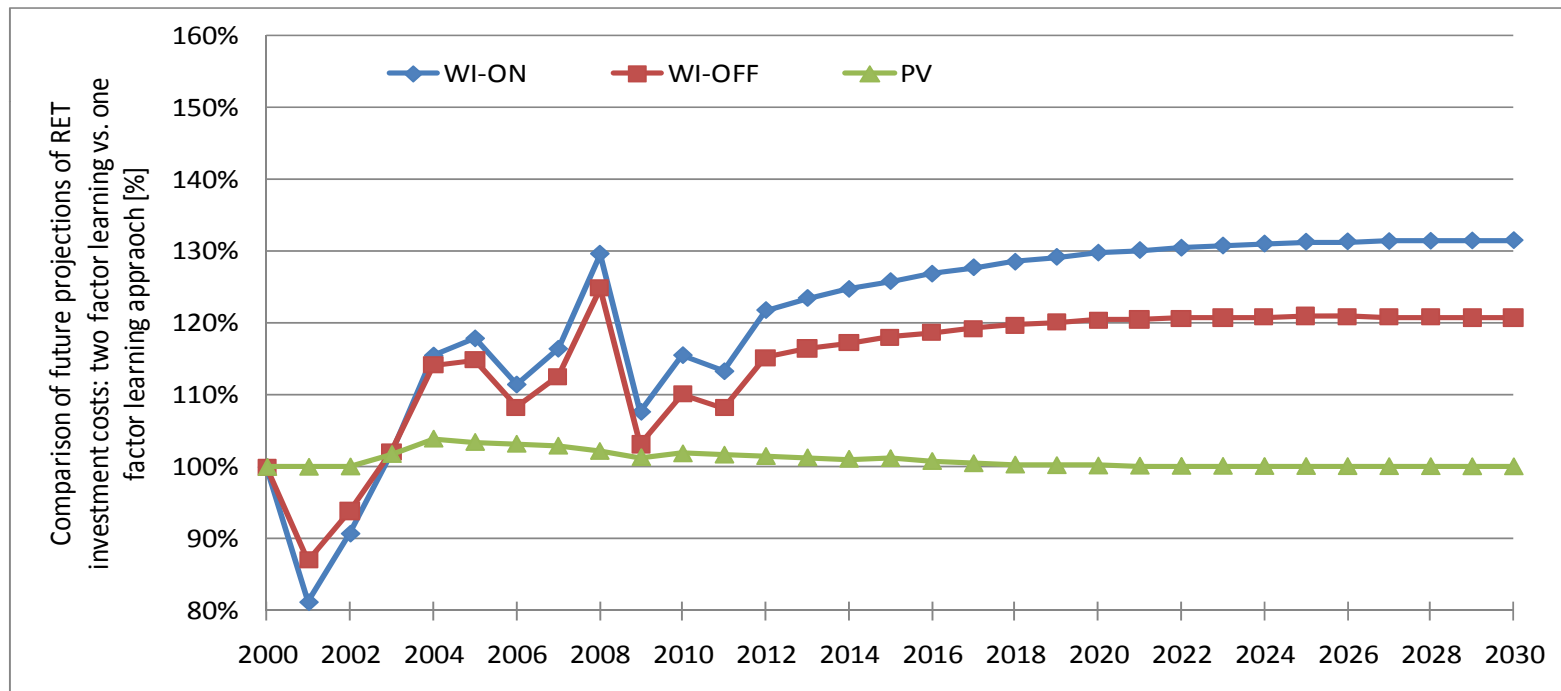

Figure: New versus traditional approach
[% - share of default (old) approximation]

Source: own calculations

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Conclusion & outlook

Conclusions

- **Raw material prices** have a **significant impact** on the cost for energy technologies, specifically for **(mature) RE technologies**

- **Raw material / commodity prices depend** on **various parameter** → **consideration** of solely the impact of **energy prices** indicates the "**minimal impact**" **on the cost for RE technologies**

- **The "multi-factor" learning approach appears a suitable complementary** (to traditional modelling techniques for technological change) for energy models **to allow an improved estimation of future cost changes.**

Next steps

- Research related to other key commodities for RE technologies (e.g. concrete)

- Focus on biomass conversion and concentrated solar thermal power

- Implementation of the novel approach in *Green-*X and identification of consequences for an improved design of support instruments for RE technologies

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Thanks for your attention!

Wissen ist nicht genug – wir müssen handeln!
Wollen ist nicht genug – wir müssen es tun!

(Johann Wolfgang von Goethe)

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