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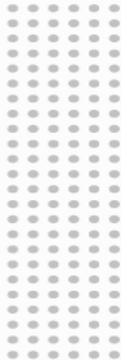
Energiewirtschaftliches Institut
an der Universität zu Köln



The Potential of Natural Gas As a CO₂-Mitigation Option

June 24, 2014

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1. The Basic Concept of CO₂-Mitigation Costs

- Concept for identifying the economically efficient way of mitigating CO₂
- Is a mitigation option less costly in avoiding emissions than the corresponding reference technology?
- Costs for reducing a specific amount of CO₂ by using a mitigation option M compared to a reference technology Ref

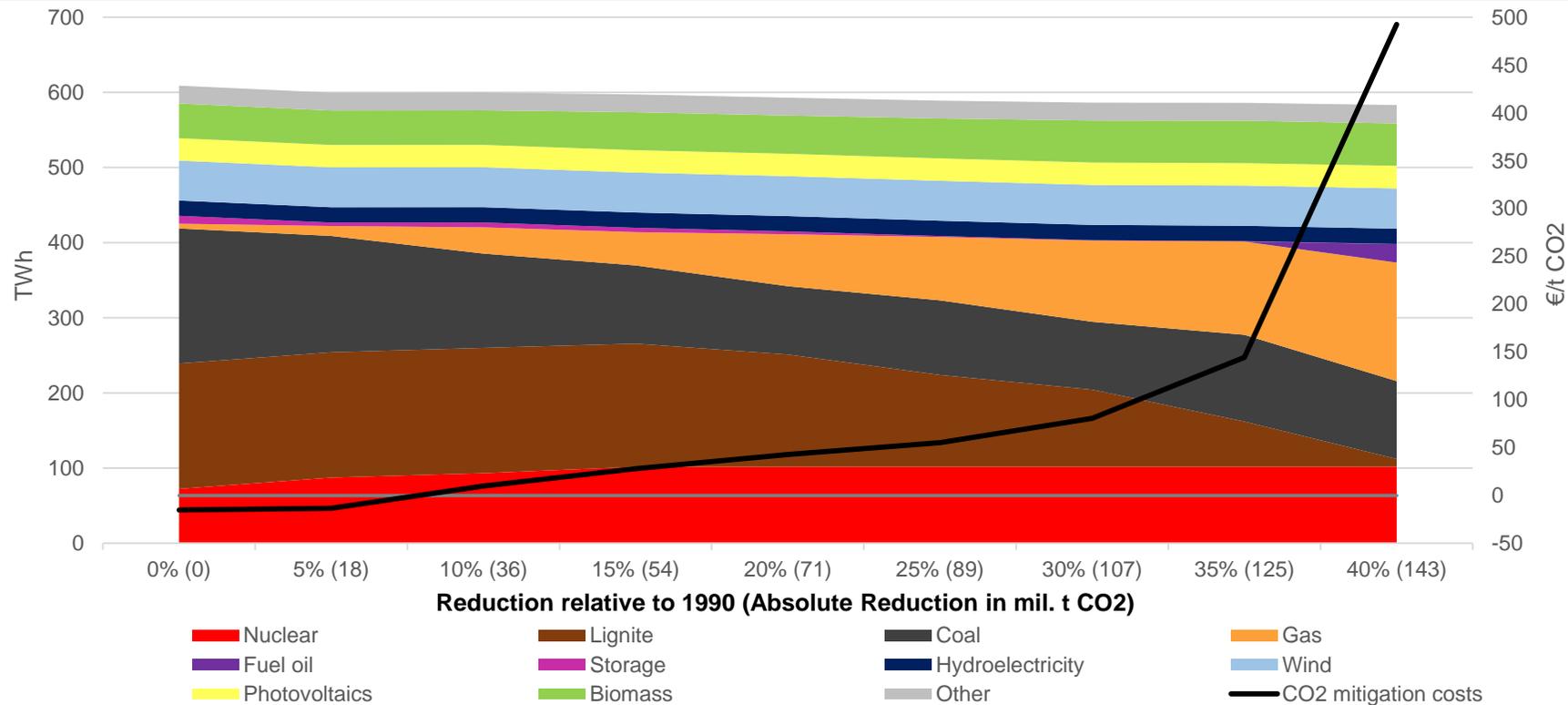
$$\text{Mitigation Costs} = \frac{k_M - k_{Ref}}{e_{Ref} - e_M} = \frac{\Delta k}{\Delta e}$$

Example: Car M is less costly than car Ref and emits less CO₂ emissions.



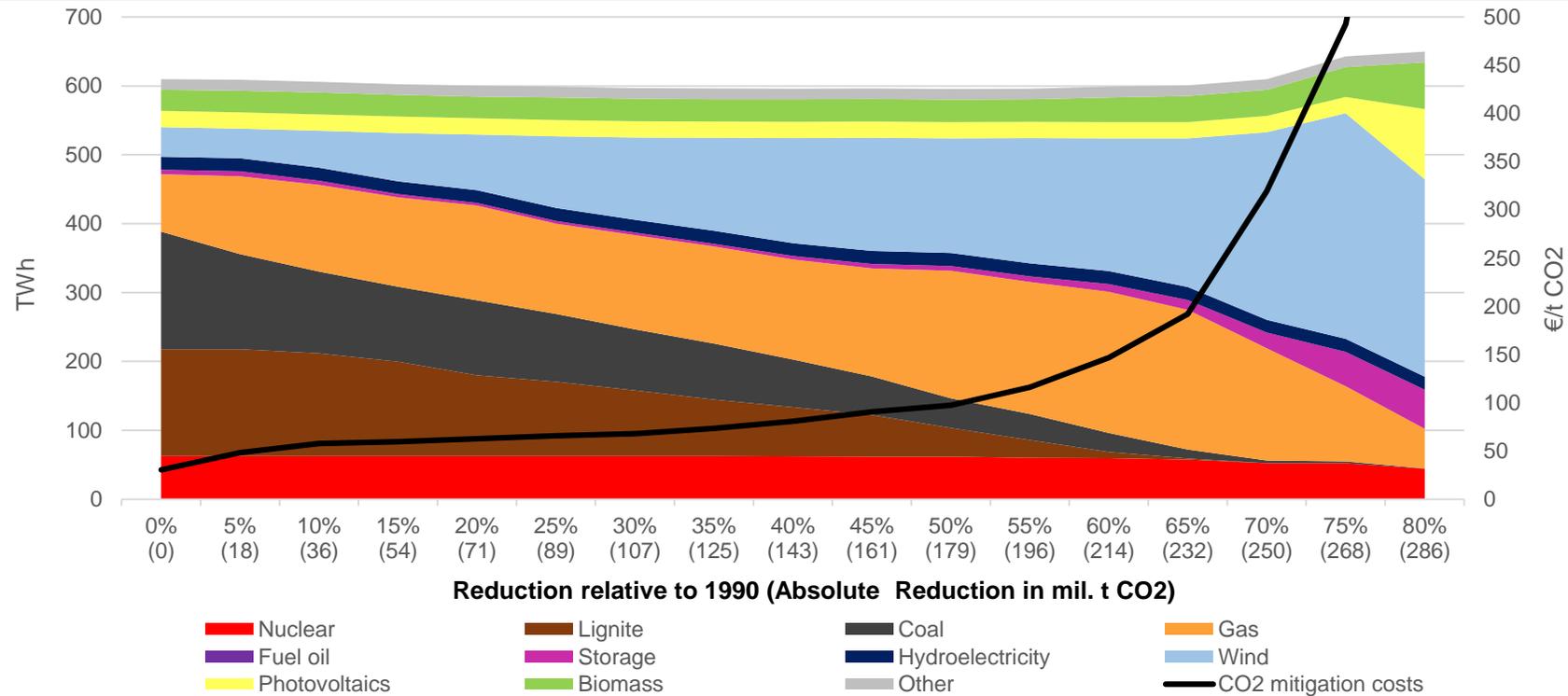
Negative CO₂-mitigation costs, i.e. the accordance of economic and ecological rational

Power: Results for the Current Plant Fleet



- In case of optimal climate policy, power generation from gas-fired plants increases with more ambitious reduction goals and crowds out generation from coal-fired plants
- The existing power plant fleet allows a reduction by 40% compared to 1990
- Beyond a reduction of 25%, the marginal mitigation costs amount to about 50 €/t CO₂. They increase up to levels of 400 €/t CO₂.

Power: Results for 2020



- If investments in new power plants are possible, an achievement of more ambitious goals is possible in the medium-term (up to 80% compared to 1990)
- First, reduction goals up to 65 % are achieved by a higher utilization of gas and wind plants. Only after that, capacity additions of PV takes place
- Beyond a reduction of 50%, the marginal mitigation costs amount to about 100 €/t CO₂. They increase up to a level of 400 €/t CO₂.

Power: Options for Action

National over-achievement of EU CO₂- Reduction Goals

In sectors like the power sector, national instrument (e.g. EEG) lead to an over-achievement of the EU CO₂-reduction goals. No mitigation is realized through the EEG.

Revision of EU Reduction Goals without national instruments

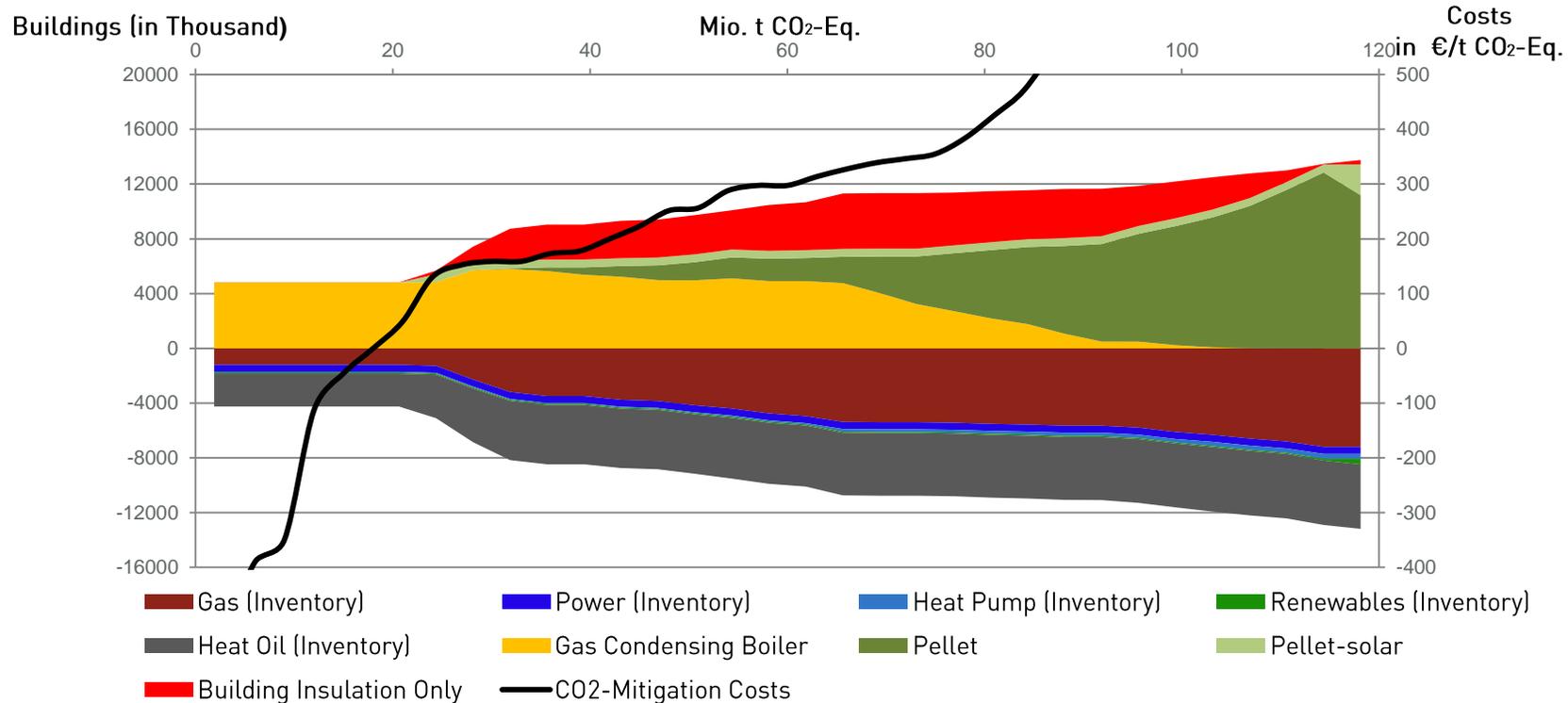
Low flexibility in specifying CO₂- reduction volumes

Very high and very low prices for CO₂-certificates can occur if a reduction quantity is fixed and if there is uncertainty on economic developments in the future.

Price Floors and Price Caps for EU CO₂- reduction goals

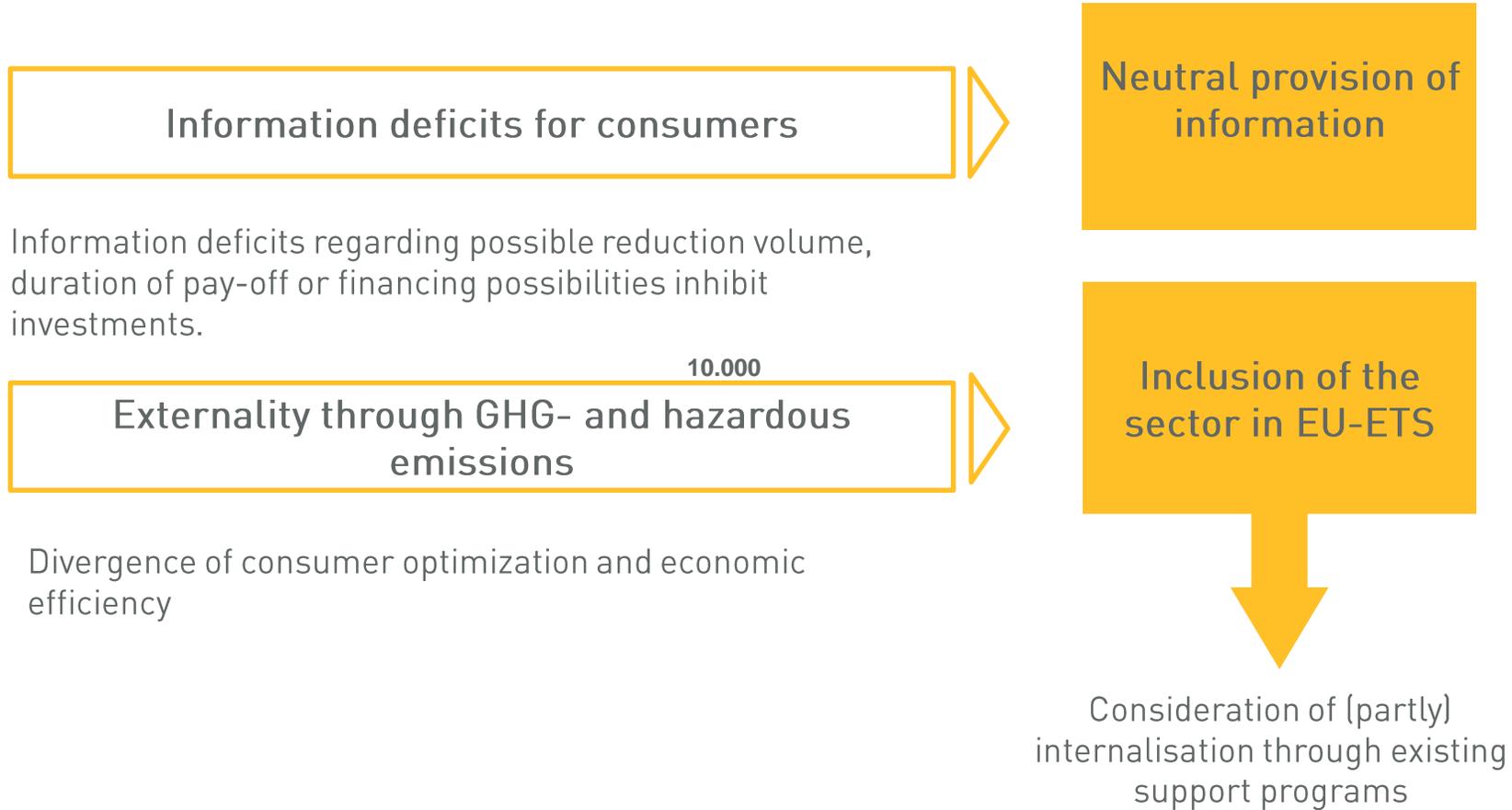
Reform of EU-ETS

Heating: Results



- The gas condensing boiler technology is the least costly replacement alternative for reduction goals below 65 Mio. t CO₂-Eq.
- A 13 % emission reduction (18 Mio. t CO₂) compared to 2010 is possible at „negative costs“ and saves about 1.42 billion EUR per year.

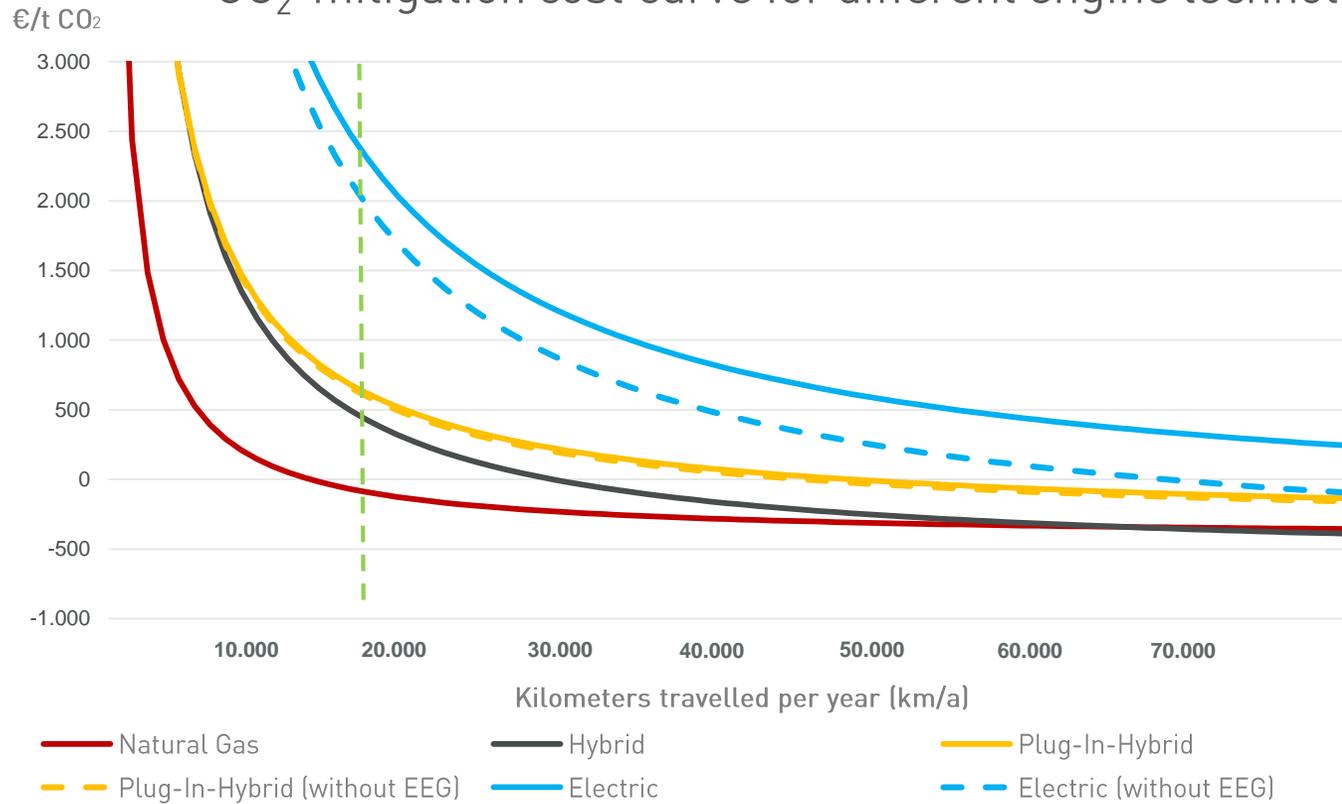
Heating: Options for Action



Passenger Cars

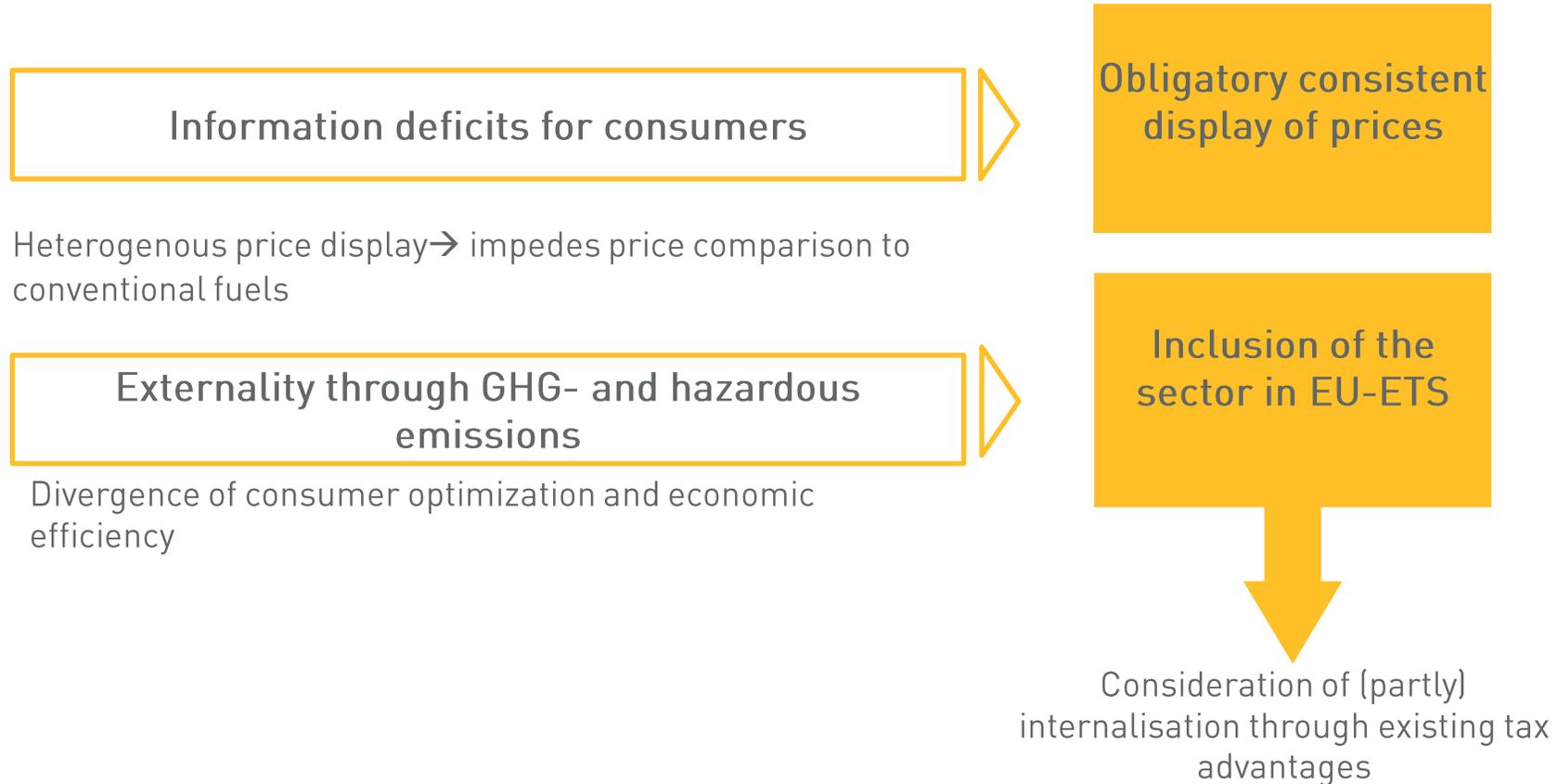


CO₂-mitigation cost curve for different engine technologies



| | Natural Gas | Hybrid | Plug-In-Hybrid | Electric |
|------------------------------|-------------|--------|----------------|----------|
| Break-Even-Kilometers (km/a) | 13.000 | 28.000 | 47.000 | >100.000 |

Passenger Cars: Options for Action



In all analyzed sectors, natural gas is currently the most cost-efficient option for mitigating CO₂.

- For CO₂-reductions up to 50% compared to 1990, the substitution from coal-plant power through power from gas plants is the most cost-efficient mitigation option in the current power plant fleet.
- Substituting old gas and oil heating systems with gas condensing boilers reduces emissions by 13 % compared to 2010 and saves about 1.42 billion EUR per year.
- Natural gas-fuelled passenger cars are the most cost-efficient CO₂-mitigation option in that sector.

Thank you very much for your attention!

Questions of Remarks?

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