

Association Webinar Rewinds

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Webinar Rewinds

Topic: Carbon Pricing Shaping Carbon-Neutral Energy & Transport Systems: Technology Exchange, Business Cases

Moderator/Speaker: Hans Auer

Speakers: Karlo Hainsch and Sebastian Zwickl-Bernhard

Date/Time: September 27, 2021 10:00 - 11:00 AM Eastern Time

Host: International Association for Energy Economics

More details: [\(Click here\)](#)





Two possible future business cases depending on the CO₂ price development



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 835896

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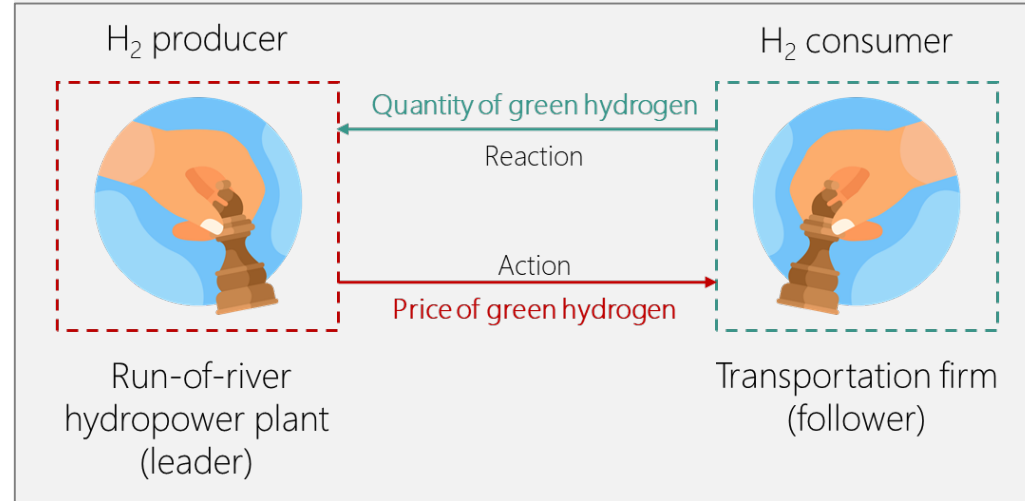


Hydropower-based green hydrogen production

- Non-cooperative game between hydropower plant owner (H_2 producer, leader) and transportation firm (H_2 consumer, follower)
- Trade-offs between electricity trading (future electricity contracts & day-ahead) and hydrogen production
- The transportation firm aims for an optimal and cost-minimized coverage of its energy demand and chooses between conventional fuels and green hydrogen



Presented at the Applied Energy Symposium MIT A+B; 11.08.2021 - 13.08.2021
Video available under <https://www.youtube.com/watch?v=yixhlv0-p8s&t=17s>



Bi-level optimization problem

$$\max_{y,x,\lambda,\mu} -\lambda_t^{load} \cdot q_t^{load} + q_t^{con} \cdot p_t^{con} + q_t^{CO2} \cdot p_t^{CO2}$$

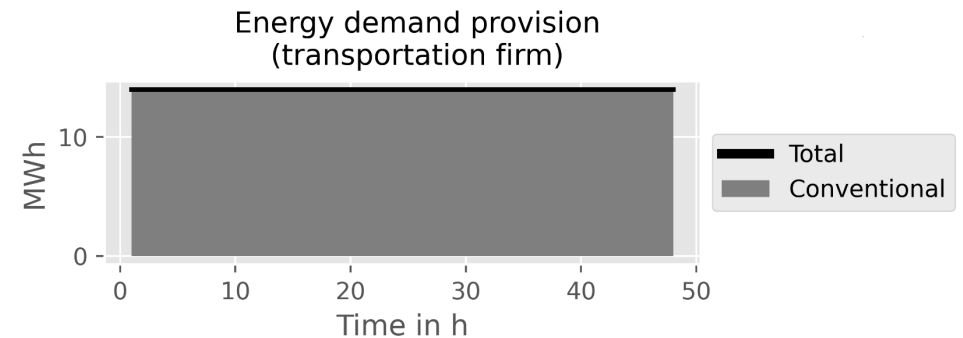
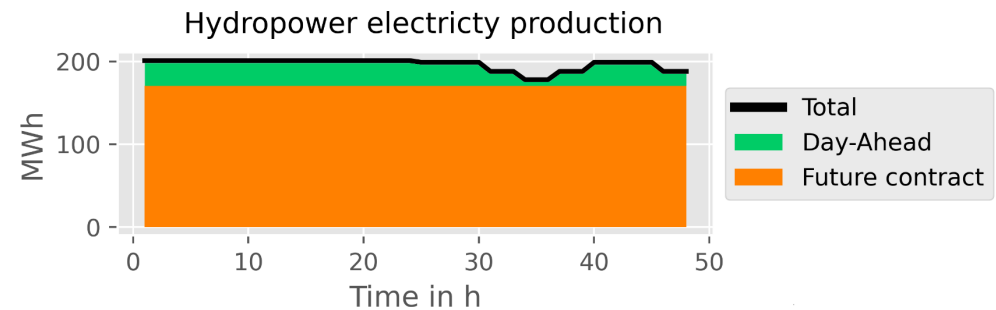
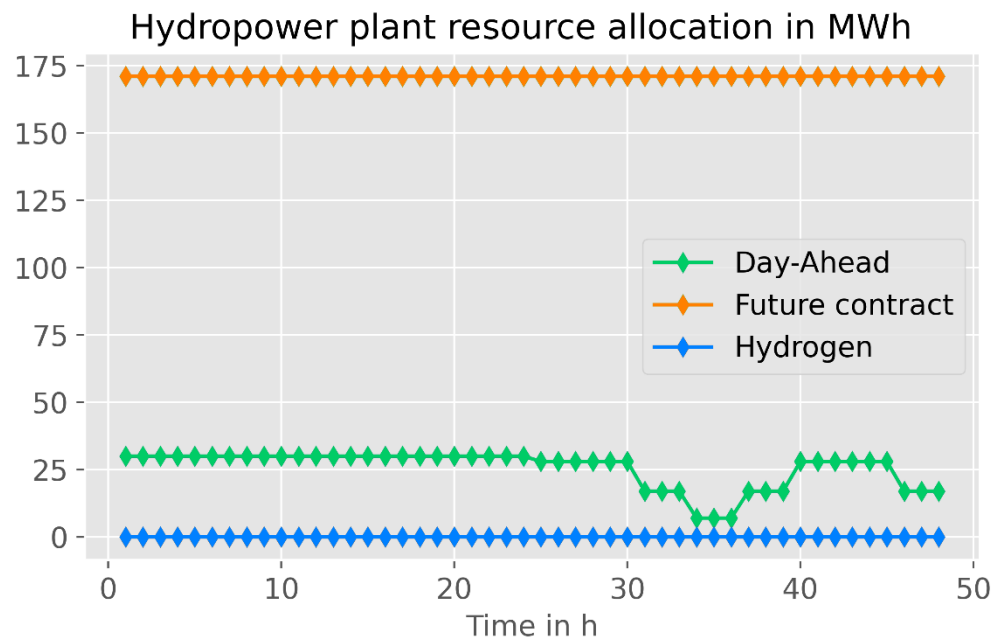
$$q_t^{spot} \cdot p_t^{spot} + q_t^{future} \cdot p_t^{future}$$

Numerical example (2020)

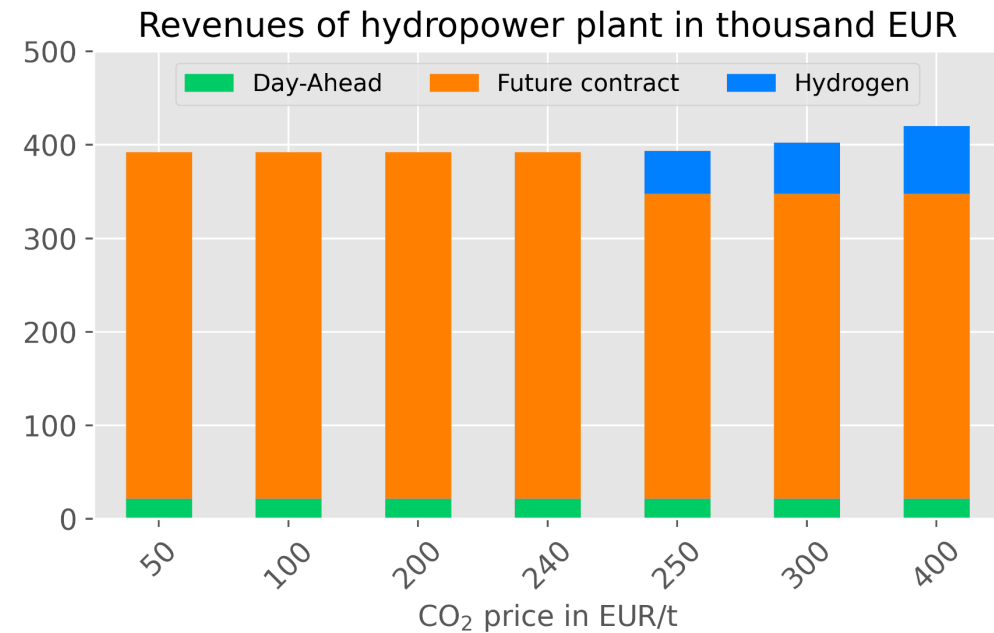
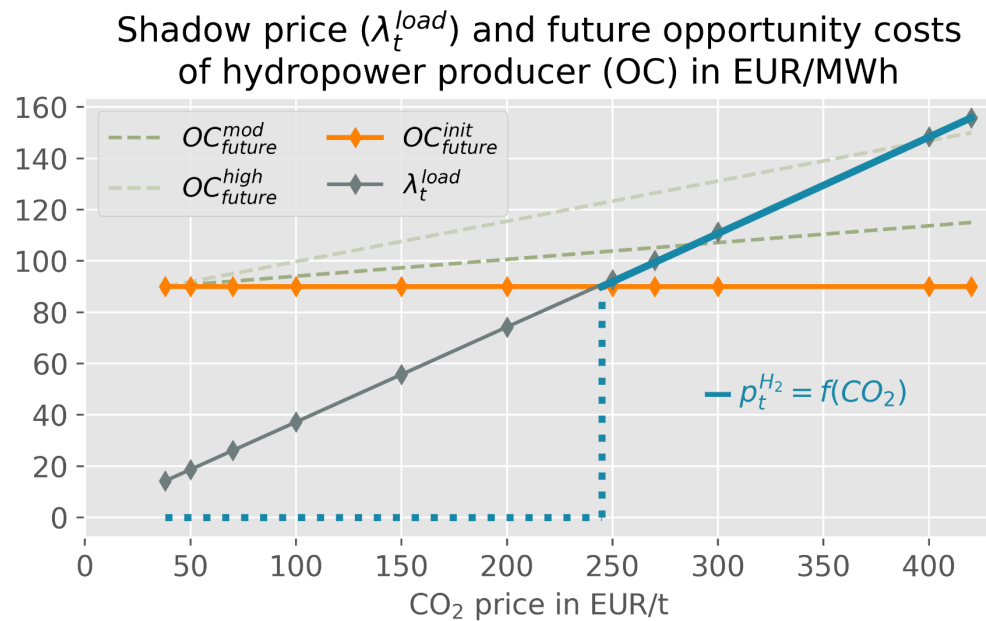
- Central Western European wholesale electricity market place (EPEX)
- Austrian wholesale electricity market place (EEX)

27.09.2021

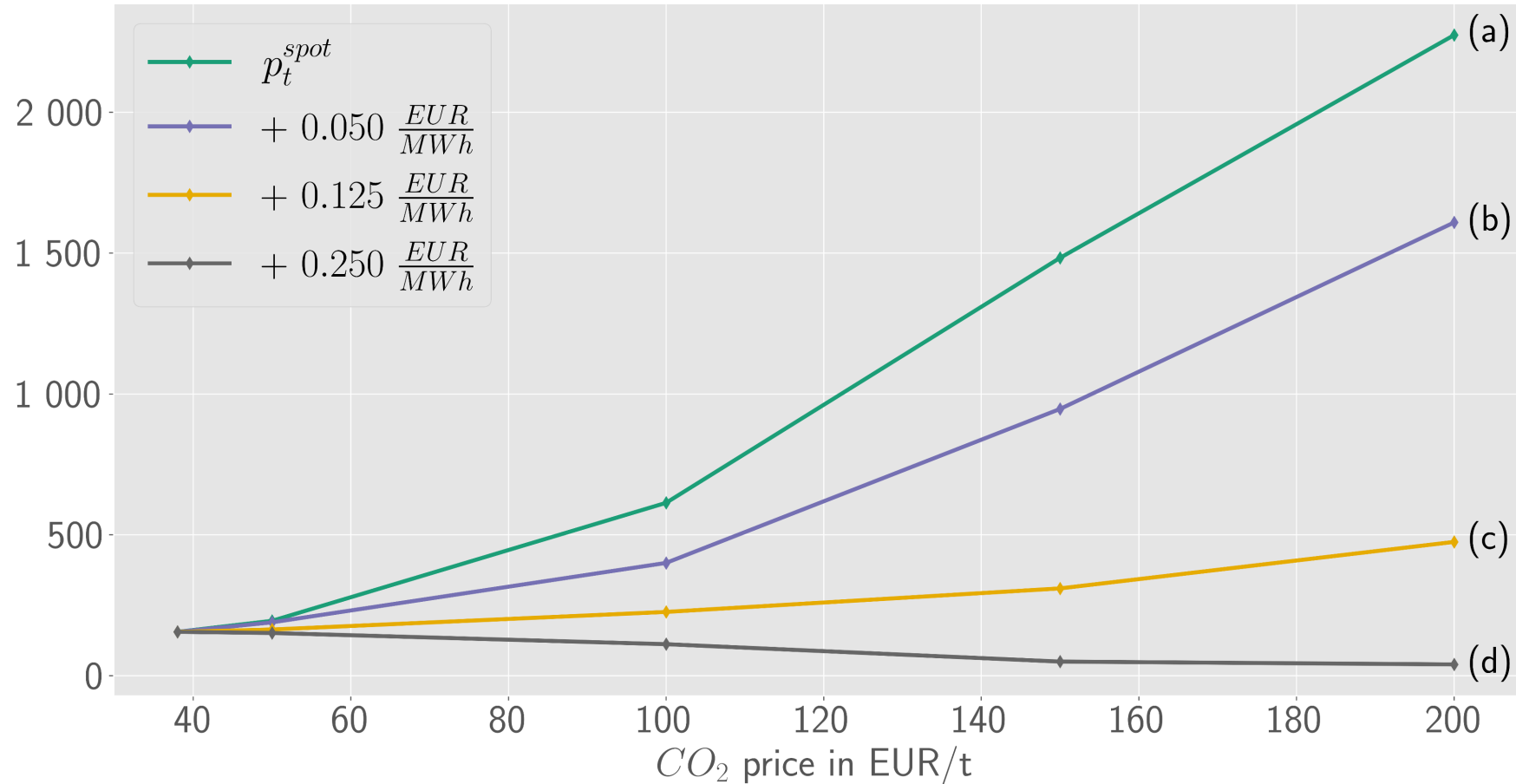
Hydropower plant resource allocation, electricity production, and energy demand provision of the transportation firm



Up to a CO₂ price of almost 245EUR/t, no hydrogen price is set as the leader's decision (opportunity costs \leq revenues).



H₂ annual full-load production hours for different day-ahead spot market price increases



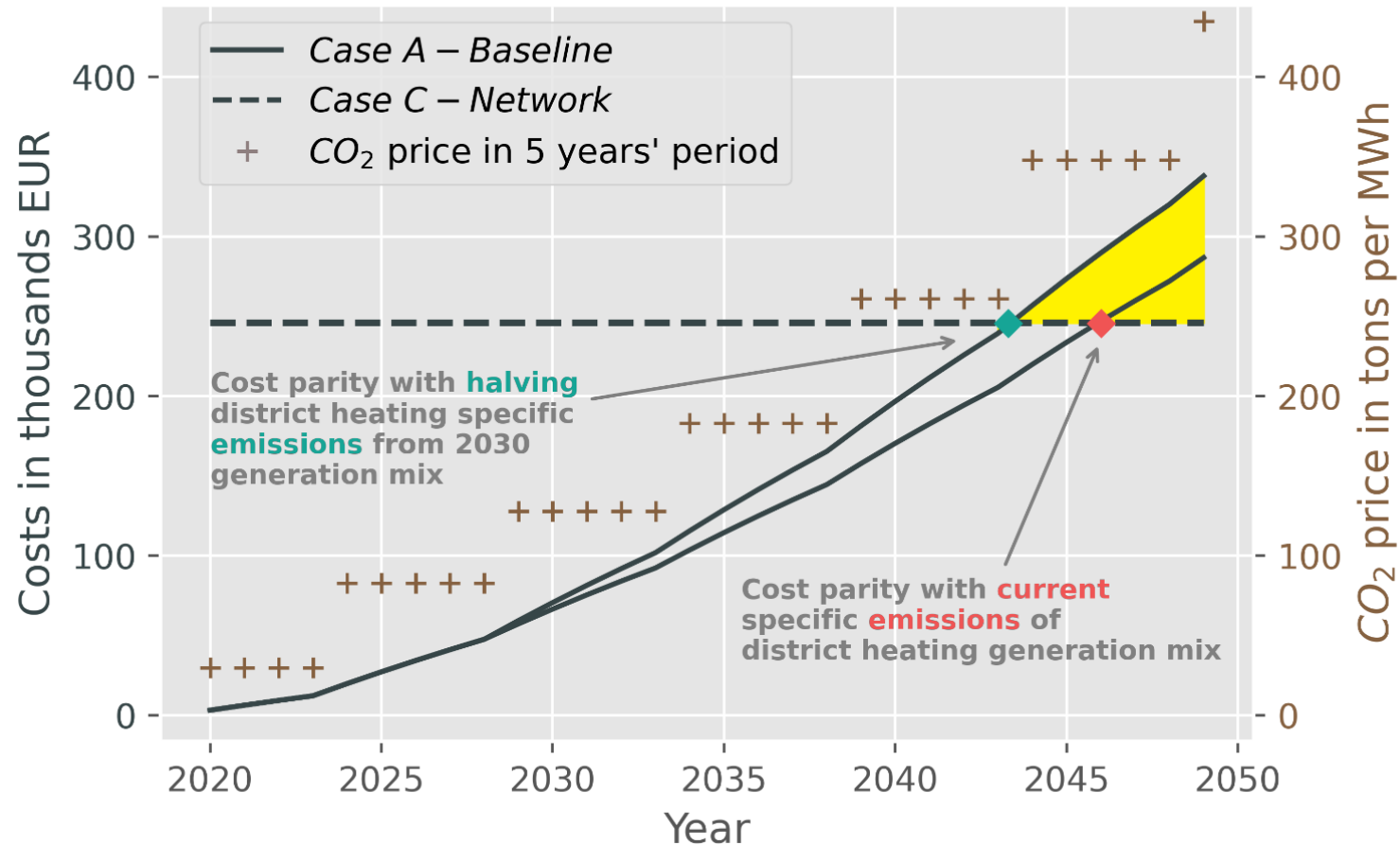
Distribution grid decommissioning at the local level

- Decommissioning of the natural gas distribution grid of an urban neighborhood (low temperature heat supply)
- Viability of “green” gas is uncertain at the end-user device level
- Two alternative decarbonization scenarios (electrification and network expansion)
- Costs of inaction (e.g., penalties for failing to meet climate targets)

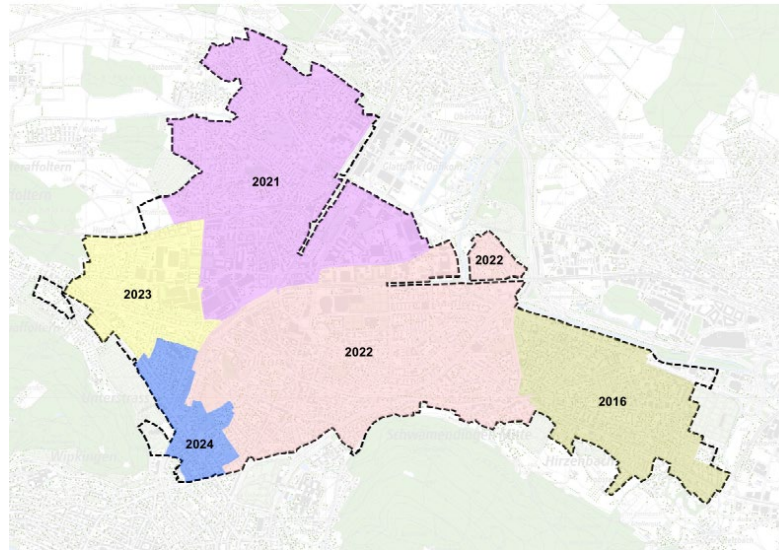


End-user cost parity between 2043 and 2046 in the network expansion scenario

Average end-user costs per building until 2050

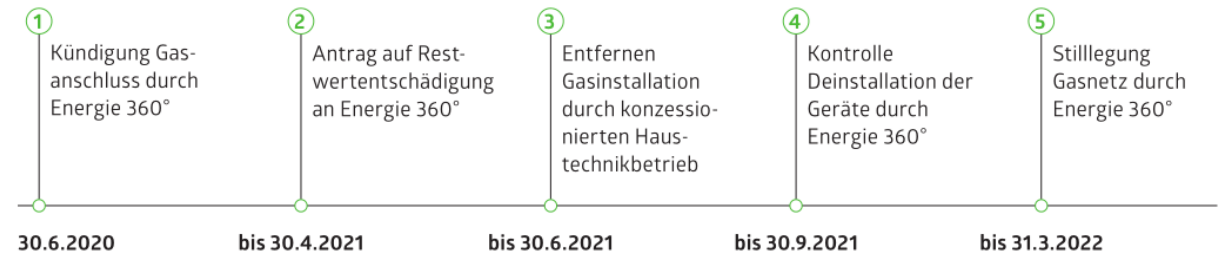


Practical example of decommissioning the gas distribution grid in Zürich (Switzerland)



Practical realization timeline

Zeitplan



Remove the end-user's device

Submit application for remaining value compensation

Remaining value compensation payments according to date of device installation

Zeitpunkt der Geräteinstallation	2002*	2003	2004	2005	2006	2007	2008	2009	2010	2011*
Entschädigung bei Netzstilllegung 2021	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%

Concluding remarks

An increasing CO₂ price as the key determining parameter leads to improved competitiveness and expected profitability of the business case studied.

- A CO₂ price above 245EUR/t triggers profitability of **green hydrogen** production from hydropower (Central Western European wholesale electricity market)
- Possible stranded assets resulting from **decommissioning the gas distribution grid** must not play a decisive role, especially since the trade-off analyses in this work show that alternative scenarios of lower/zero-emission energy service provision are even more economical in the longer term since the CO₂ price is expected to increase in the next decades



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Thank you for your attention 😊



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