



WRAP-UP AND POLICY RECOMMENDATIONS REGARDING THE TRANSITION TO A LOW-CARBON EUROPEAN ENERGY SYSTEM

TU Dresden

Project Coordinator

Prof. Dr. Dominik Möst

Final REFLEX Stakeholder Workshop

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Both a more decentral and a central low carbon European energy system have the potential to achieve significant emission reductions of – 80 % compared to 1990

① Industry, Residential and Tertiary Sector ② Transport Sector ③ Electricity and Heating Sector ④ Environmental and Societal Impacts

- **Normative scenarios** (*Mod-RES and High-RES decentral and central scenario*) describe possible futures, but other decarbonisation pathways are also possible
- Besides techno-economical challenges, **the societal and ecological dimension needs to be included** to ensure acceptance and sustainability for the transformation of the energy system
- **Combination of different measures** within different energy sectors needed

	Industry	Residential & Tertiary	Transport	Electricity & Heat Supply
<p>General measures</p> <ul style="list-style-type: none"> • Strengthen Emissions Trading Scheme or CO₂ tax • Increase in energy efficiency • Electricity as main energy carrier • Further research needed 	<ul style="list-style-type: none"> • Process improvements • Use of electricity and hydrogen • Pilot and demonstration plants required 	<ul style="list-style-type: none"> • Incentives for buildings refurbishment • EU-wide regulations for building standards • Exploit new sector coupling technologies for RES integration 	<ul style="list-style-type: none"> • Fuel efficiency standards for all road vehicles • Modal shifts to efficient modes • Tax and pricing strategies • Sufficient and timely infrastructure deployment • Alternative fuels 	<ul style="list-style-type: none"> • Fast RES expansion preferable • Long-term clarity and certainty for power and heat plant investments • Mix of flexibility options for RES integration necessary

To achieve the ambitious decarbonisation targets, the role of the energy demand side becomes crucial

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AVAILABLE TECHNOLOGIES NOT SUFFICIENT FOR DECARBONISATION OF EU INDUSTRY

- > 80% decarbonisation is possible – even without CCS in industry processes,
- But process innovations are required as CO₂-free secondary energy carriers, innovations in material efficiency and circular economy

RETROFITTING THE BUILDING STOCK TO REDUCE OVERALL HEATING DEMAND AS WELL AS SWITCHING ENERGY CARRIER

- More savings needed to achieve targets by either more in-depth refurbishment or by refurbishing more buildings

ALLOWING FOR SECTOR COUPLING (POWER TO HEAT)

- Including local area networks using heat pumps, regeneration of heat sources

IN THE BUILDING SECTOR, UNTAPPED DEMAND SIDE MANAGEMENT POTENTIALS ARE AVAILABLE BUT THEY NEED FAVORABLE CONDITIONS FOR BID AGGREGATION

- In the tertiary sector for e.g. space cooling or ventilation,
- In the residential sector for heat pumps

FOSTER TECHNO-ECONOMIC PROGRESS (LEARNING INVESTMENTS)

- For heat pumps to reduce cost for equipment as well as drilling, planning and installation
- For building insulation materials to reduce material cost

To face the continuous growth of passenger and freight transport demand, strong and timely responses are required

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MEASURES TO BOOST THE ENERGY EFFICIENCY OF THE TRANSPORT SYSTEM

- Fuel efficiency and CO₂ standards for all new road vehicles, forcing the automotive industry to innovative vehicles with zero / low-emission powertrains
- Supporting modal shifts to more efficient modes, e.g. rail and public transport systems but also active modes and sharing mobility in urban areas
- Complementary measures aiming at increasing car occupancy rates (sharing mobility) and optimizing the city logistic chain in urban areas

MEASURES TO SUPPORT THE ELECTRIFICATION OF ROAD TRANSPORT

- Subsidies, tax and pricing strategies to support the transition to new drive technologies by increasing their financial attractiveness (especially in the first years)
- Charging infrastructures deployed sufficiently and timely to reduce range anxieties as well as extra efforts for charging and refueling actions
- Preferable market driven phase-out of pure internal combustion engine cars and vans

ALTERNATIVE FUELS TO COPE WITH LACK OF MATURE LOW-EMISSION TECHNOLOGIES

- Alternative fuels in form of biofuels or synthetic fuels based on electrolysis and additional treatments (Power-to-Gas (PtG) and Power-to-Liquid (PtL)) for modes for which mature low-emission drive technologies will not be developed in the near future (i.e. aviation and ships)



The electrification of demand side sectors and market designs as a coordinated EU CRM are important measures for the EU energy system transition

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PATHS TOWARDS A LOW-CARBON ELECTRICITY AND HEAT SUPPLY

- To substitute fossil fuels, the **electrification of the demand sectors** is of high **importance**
- For the remaining fossil fuel based energy supply, a **switch to less carbon intensive fuels** has to be enforced (e.g. biofuels, natural gas, hydrogen etc.)
- Back-up capacities still relevant, at **high CO₂ prices (> 70 EUR/t_{CO2})** **CCS is an important** decarbonisation option
- **Higher RES shares** can significantly **reduce fossil fuel** based electricity generation
- **Storages compete with DSM and sector coupling measures**, but their value should not be underestimated
 - Besides their relevance in the residential sector (PV-battery-systems), storages relevant for RES integration and system services
- **Heat Storage increases operation flexibility** of district heat generation units
- **Biomass can play an important role** in substituting fossil fuels in district heat generation

EU COORDINATED CRM INCREASES GENERATION ADEQUACY AND REDUCES WHOLESALE ELECTRICITY PRICES

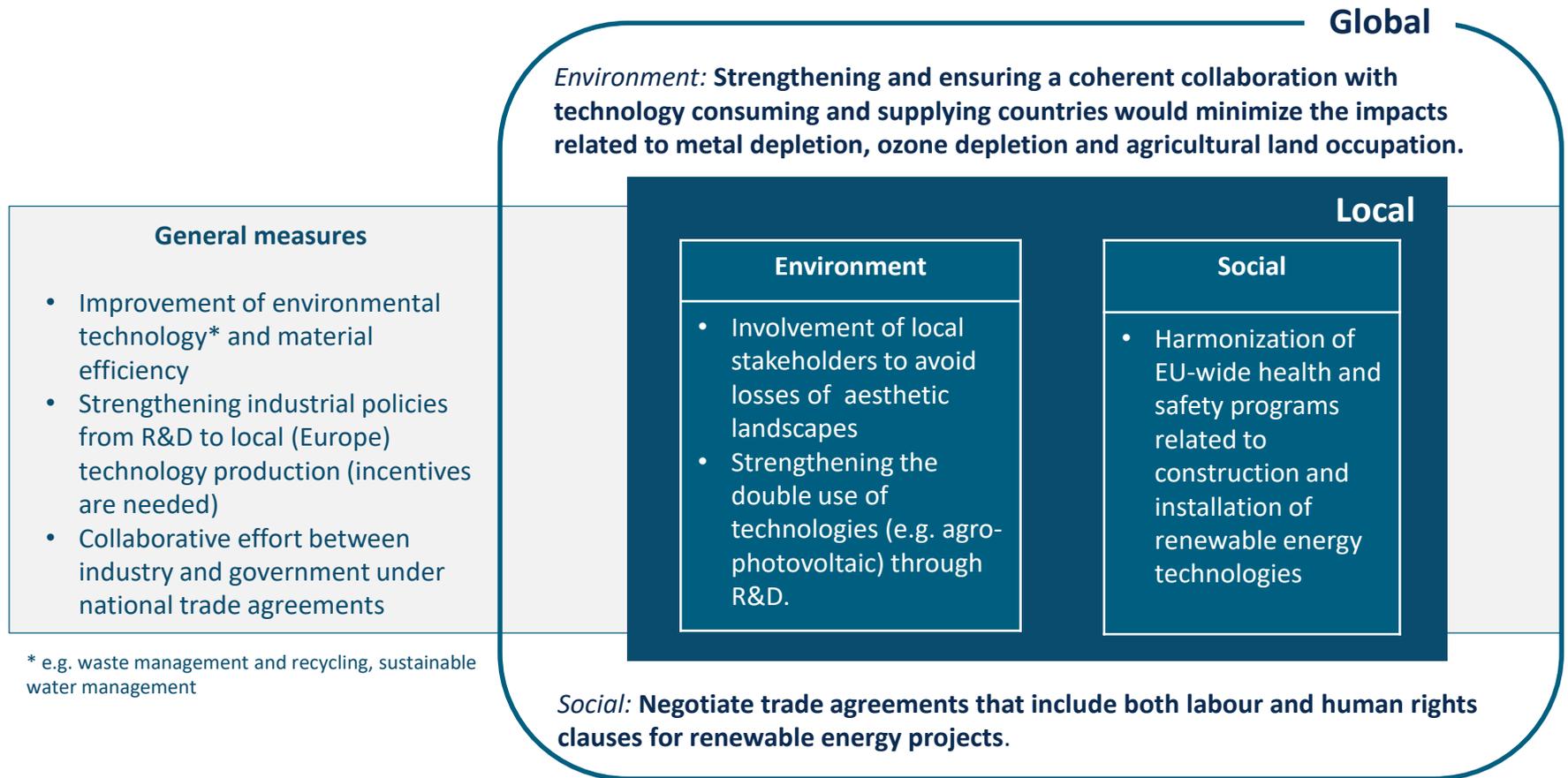
- Unilateral and **uncoordinated introduction of capacity remuneration mechanisms** (CRMs) may result in **substantial cross-border effects** (including free-riding and threats to generation adequacy)
- To **mitigate** these **market distortions**, cross-border coordination is advisable: Either **interconnectors** should be allowed to **participate in any CRM of neighbouring countries** or alternatively, a **coordinated European CRM** may be considered.



Detecting environmental and social impacts in an early stage of development – from local to global issues

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- A transition towards High-RES energy systems will potentially affect the environment and society according to the supply and monitoring market segment of technologies and consumables.



Dissemination of the Reflex results and next steps

SELECTED DELIVERABLES

- D2.2 Empirical study on DSM potentials and survey of mobility patterns in European countries
- D4.3 Report on cost optimal energy technology portfolios for system flexibility in the sectors heat, electricity and mobility
- D5.2 Report on investments in flexibility options considering different market designs

SELECTED POLICY BRIEFS

- Technological Learning in Energy Modelling: Experience Curves
- How to balance intermittent feed-in from renewable energies?
– A techno-economic comparison of flexibility options
- Capacity remuneration mechanisms in Europe

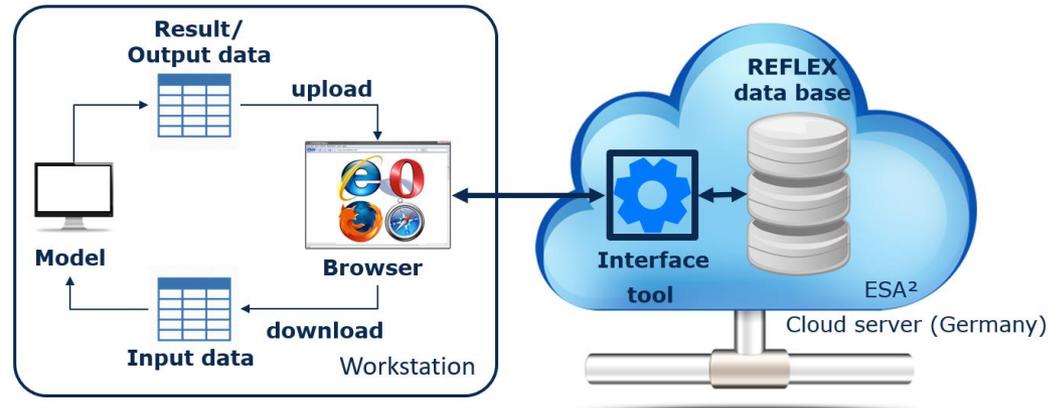
<http://reflex-project.eu/public/paper-publications/>



Dissemination of the results and next steps

DATA CATALOGUE AND DOWNLOAD PORTAL

<https://data.esa2.eu/tree/REFLEX>



TWO BOOK PUBLICATIONS RESULTING FROM THE REFLEX PROJECT

- Book on *“Technological learning in the transition to a low-carbon energy system”*
- Focus on experience curves and implementation in energy system models
- Contributed volume published with Elsevier (end of 2019)

- Book on *“The Future European Energy System - Flexibility Options and Technological Progress”*
- Sectoral-based Reflex analyses and results considering technological learning and social as well as environmental life cycle assessment
- Contributed volume published with Springer (end of 2019)



Thank you! Questions?

Prof. Dr. Dominik Möst

TU Dresden, Chair of Energy Economics

dominik.moest@tu-dresden.de

www.reflex-project.eu

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