



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

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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><b>General measures</b></p> <ul style="list-style-type: none"> <li>• Strengthen Emissions Trading Scheme or CO<sub>2</sub> tax</li> <li>• Increase in energy efficiency</li> <li>• Electricity as main energy carrier</li> <li>• Further research needed</li> </ul>	<ul style="list-style-type: none"> <li>• Process improvements</li> <li>• Use of electricity and hydrogen</li> <li>• Pilot and demonstration plants required</li> </ul>	<ul style="list-style-type: none"> <li>• Incentives for buildings refurbishment</li> <li>• EU-wide regulations for building standards</li> <li>• Exploit new sector coupling technologies for RES integration</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel efficiency standards for all road vehicles</li> <li>• Modal shifts to efficient modes</li> <li>• Tax and pricing strategies</li> <li>• Sufficient and timely infrastructure deployment</li> <li>• Alternative fuels</li> </ul>	<ul style="list-style-type: none"> <li>• Fast RES expansion preferable</li> <li>• Long-term clarity and certainty for power and heat plant investments</li> <li>• Mix of flexibility options for RES integration necessary</li> </ul>

# 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 CO<sub>2</sub>-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 CO<sub>2</sub> 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 CO<sub>2</sub> prices (> 70 EUR/t<sub>CO2</sub>)** **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

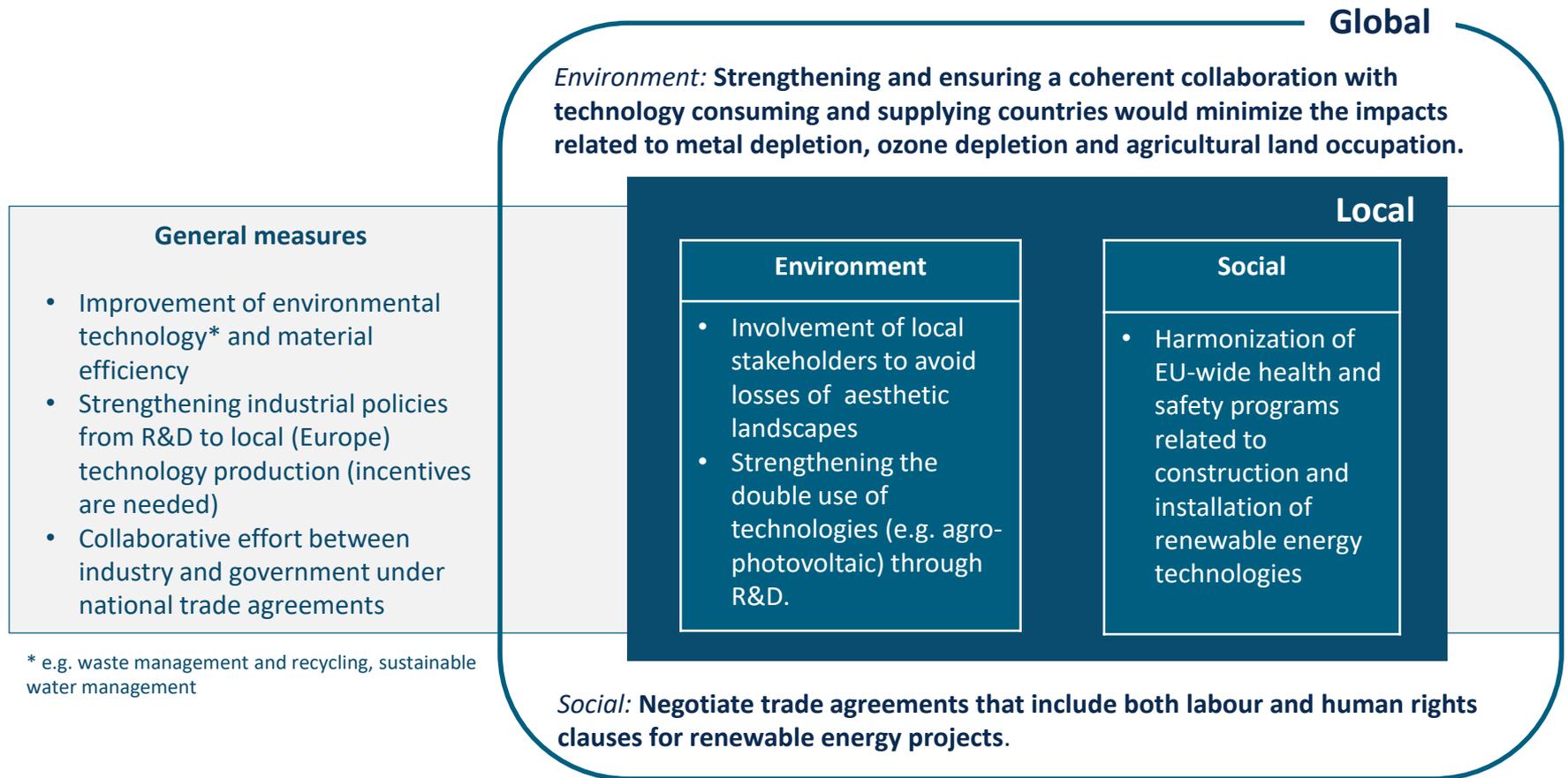
- Unilateral and **uncoordinated introduction of capacity remuneration mechanisms** (CRMs) may result in **substantial cross-border effects** (including free-riding and threats to generation adequacy)
- To **mitigate** these **market distortions**, cross-border coordination is advisable: Either **interconnectors** 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

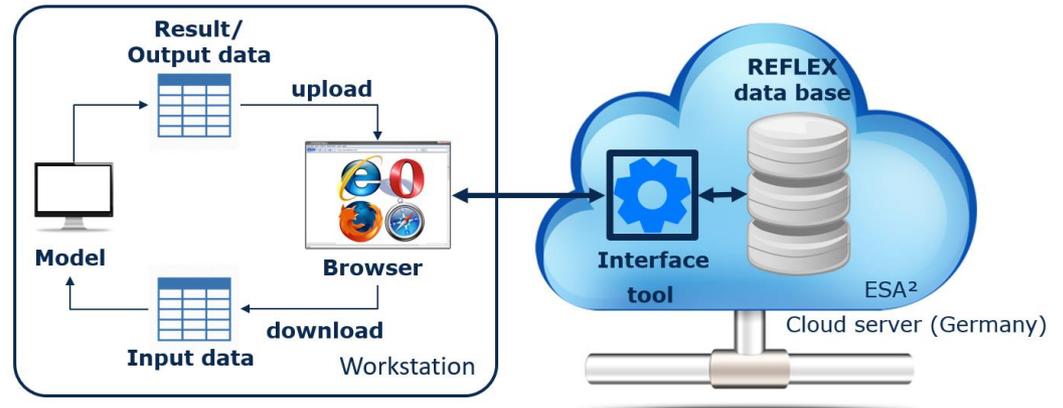
<http://reflex-project.eu/public/paper-publications/>



# 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?

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