Evaluation of the role of energy storages in Europe with TIMES PanEU

ETSAP Workshop Madrid
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Outline

1. Introduction
2. ESTMAP storage database – potentials
3. Scenario analysis
4. Conclusions and outlook
Introduction

Motivation:

• Political induced increase of share of renewables in the EU-28
• Increasingly feed in of electricity from variable renewables (wind and pv)
• Flexible options and especially Storages are needed

ESTMAP:

• Including ESTMAP storage database in TIMES models
• Scenario analysis
Energy system model TIMES PanEU

- Technology oriented bottom-up partial equilibrium model
- 30 region model (EU 28, No, CH, IS)
- Energy system model
  - SUPPLY: reserves, resources, exploration and conversion
  - Country specific renewable potential and availability
  - Electricity: public electricity plants, CHP plants and heating plants
  - Residential and Commercial: End use technologies (space and water heating, space cooling and others)
  - Industry: Energy intensive industry (Iron and steel, aluminum copper ammonia and chlorine, cement, glass, lime, pulp and paper), food, other industries, autoproducer and boilers
  - Transport: Different transport modes (cars, buses, motorcycles, trucks, passenger trains, freight trains), aviation and navigation
- Country specific differences for characterization of new conversion and end-use technologies
- Time horizon 2010 - 2050
- GHG: CO2, CH4, N2O, SF6 /Others pollutants: SO2, NOx, CO, NMVOC, PM2.5, PM10
## Storage potential for Europe

**ESTMAP database**

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### One existing reservoir

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### Scenario analysis from the ESTMAP project

#### Scenario definition

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<td>Base</td>
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<td>GHG reduction in the EU-28 (vs. 1990)</td>
<td>40 %</td>
<td>90 %</td>
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<td>Share of renewables at electricity consumption in the EU-28</td>
<td>30 %</td>
<td>80 %</td>
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<td>Share of renewables at gross final energy consumption in the EU-28</td>
<td>27 %</td>
<td>75 %</td>
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<td>PV Capacity in Europe</td>
<td>120 GW</td>
<td>180 GW</td>
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Scenario analysis from the ESTMAP project

Electricity production by energy carrier in Europe

- Increased electricity demand in the EU-28 until the year 2050
- Electrification of the energy system until the year 2050 (achieve GHG emission targets)
- Electrification enables integration of fluctuating renewable energies
- Decrease in fossil fuel based power production and an increase in renewable energy generation
Scenario analysis from the ESTMAP project
Capacities in Europe

- Increase of capacities corresponding to the generation in all 3 scenarios
Scenario analysis from the ESTMAP project
Electricity storages in Europe

- Investment in additional electricity storage capacities from the year 2030 onwards
Scenario analysis from the ESTMAP project

Electricity storages in Europe

Storage content

GWh

- Battery stationary
- Redox Flow
- Battery stationary Lead Acid
- Battery stationary Lithium Ion
- CAES adiabatic cavern
- CAES adiabatic tank
- CAES diabatic cavern
- Pump Storage
Scenario analysis from the ESTMAP project

Electricity trade in Europe

Electricity net imports [TWh]

-500 -400 -300 -200 -100 0 100 200 300 400 500

Base Base MorePV BatteryCost Base MorePV BatteryCost Base MorePV BatteryCost Base MorePV BatteryCost

2010 2020 2030 2040 2050
Conclusions and outlook

• For all three scenarios an increased electricity demand in the EU-28 until the year 2050 can be observed
• This electrification of the overall energy system contributes to achieving the GHG emission targets as set in the EU roadmaps and reflects the increasing share of fluctuating renewable energy sources (wind and PV) in the energy system
• Investment in additional electricity storage capacities from the year 2030 onwards are needed beside of the use of other flexibility options in the energy system.
• First investments in the European model are in diabatic CAES and battery storages and in the subsequent periods in pump storage und adiabatic CAES
• The cost reduction of adiabatic CAES until the year 2050 leads to an economic advantage of this storage technology towards the end of the model horizon
• The adiabatic CAES contributes to the reduction of the GHG emissions in Europe compared to the diabetic storage, which requires natural gas as an input to store electricity
• But the additional flexibility options might change the picture.
Thank you for your attention!

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