Assessing the role of storage in EU27 using the JRC-EU-TIMES model

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Overview

- **Context**
- Methods
- Results
- Conclusions

Context

1. **Increased share of variable RES may require the deployment of energy storage** solutions, which could store power generated in times of discrepancy between supply & demand and shift the stored energy to periods of high demand and/or to ease bottlenecks on grids

2. What could be the **role of energy storage** from an energy system perspective?

3. What **factors affect the deployment** of energy storage across EU?

4. To what extent can a **large energy system model with limited time resolution provide useful insights** to model energy storage?

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Methods

Electricity Storage
CAES, pumped hydro, large batteries
H2 (seasonal), small batteries

Thermal Storage
large water tanks, underground storage

JRC Technology Map

ETSAP technology datasheet

JRC-EU-TIMES model
2005-2050 | 12 time-slices

Assess factors affecting deployment of storage:
- CO2 cap
- Costs
- RES electricity deployment

Electricity *versus* heat storage?
Impact on power mix?

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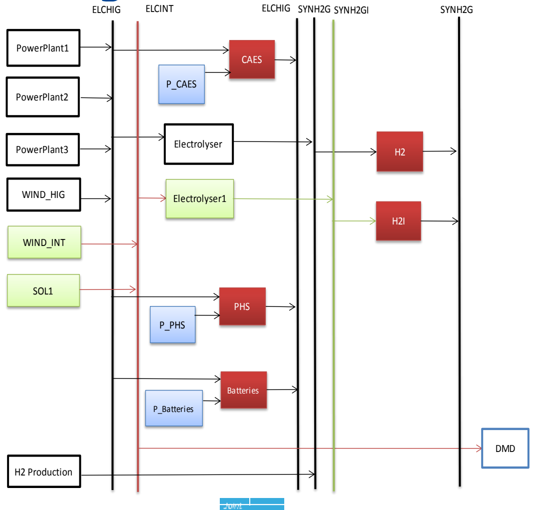
Bulk ELC storage in JRC-EU-TIMES



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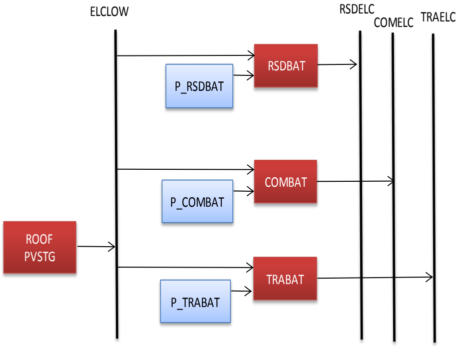
RSD, COM, TRA ELC storage



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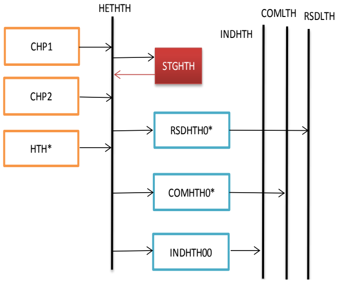
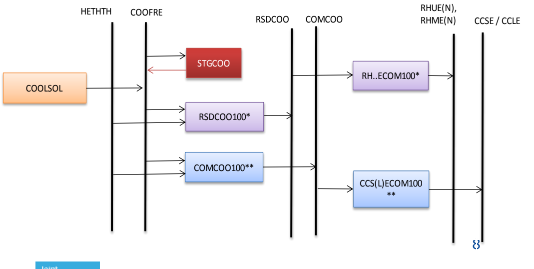
Thermal storage (heat and cooling)





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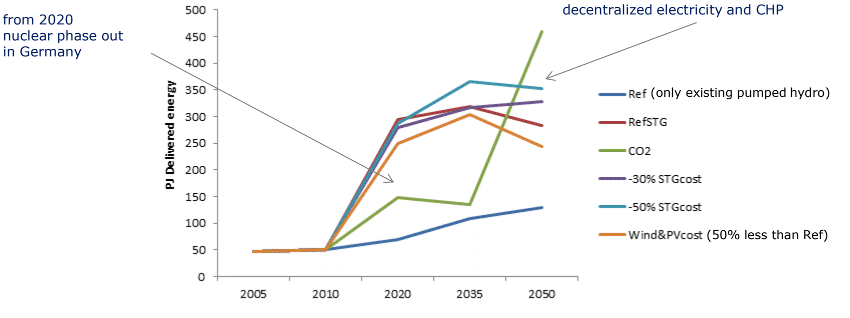
New storage only from 2020

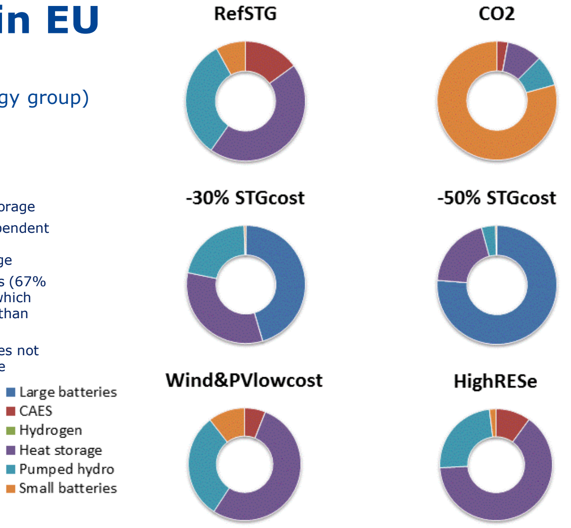


- Maximum deployment of storage due to CO2 cap (in 2050 85% less from 1990 levels; 20% less in 2020)
- electricity stored represents 1-8% of total generated electricity
- heat stored only up to 7-11% of generated heat

Stored energy in EU in 2050

(% energy delivered per technology group)

- interplay between heat and electricity storage
- role of existing pumped hydro highly dependent on costs of other storage technologies, especially large batteries and heat storage
- CO2 cap drives electrification of buildings (67% of FEC and 37-46% in other scenarios) which have higher variation across time-slices than other end-use sectors
- higher variable RES electricity shares does not lead to higher storage but affects storage portfolio



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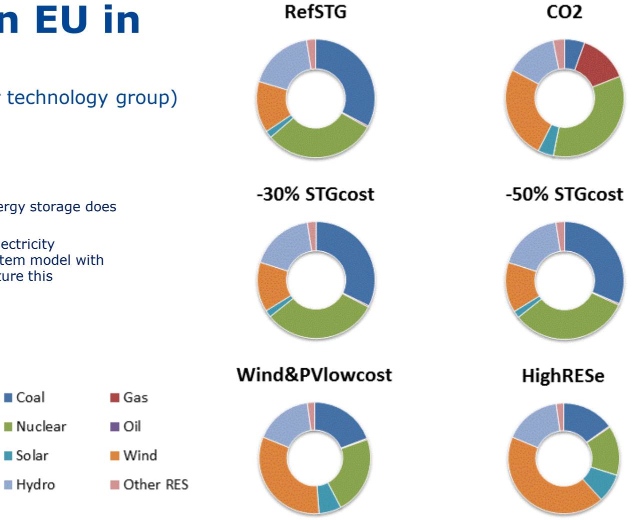
Power mix in EU in 2050

(% electricity delivered per technology group)

- as expected it is the limited energy storage does not affect the power mix
- improve modeling of variable electricity commodity to see if a large system model with limited time resolution can capture this



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Factors affecting storage in EU in 2050

	Ref	STG	CO2	-30%	-50%	REScost	HighRESe
% RES electricity	37%	36%	47%	36%	36%	58%	70%
% RES heat	20%	19%	48%	18%	18%	16%	19%
% electricity wind+PV	16%	16%	30%	16%	16%	39%	51%
Stored energy (PJ)							
Heat	0	127	44	107	69	129	93
Electricity	129	156	416	220	283	114	53
Total	129	283	460	327	352	243	145

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Energy storage where in 2050?

where higher differences in ELC and HEAT prices across time slices

ELC price difference 2.5 higher

Heat price difference 1.5 higher

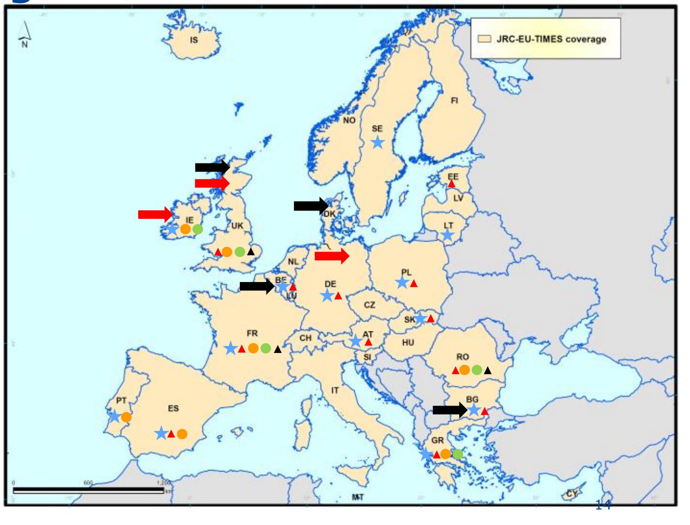
Thermal storage

CAES

Large batteries

Small batteries

Pumped hydro



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Conclusions

1. Not only storage technology costs or RES deployment determine the deployment; **electrification** in end-use sectors seems to be relevant;
2. There is an interesting **competition** between electricity and thermal storage;
3. A model as JRC-EU-TIMES seems to be able to **provide interesting first insights** on the role of energy storage technologies;
4. It is necessary to further assess **technical possibilities and limitations for bulk storage** deployment, especially CAES.

Next steps

(on-going work)

1. Fully assess the contribution of storage technologies in the peaking equation as sometimes the storage capacity is directly used;
2. Introduce a maximum potential for CAES deployment;
3. Further analyse the storing of cooling, not competitive at this moment;
4. Include in the model heat storage associated to solar thermal heat, also available for industry;
5. Further assess the effect in deployment of variations in efficiency of storage technologies as well as for the other techno-economic parameters already tested;
6. Improved modelling on variable electricity via ELCINT commodity and taking into account the load curves of PV and wind;
7. Soft-link with detailed (dispatching) storage models with high time resolution to assess energy system effects.

Thank You!

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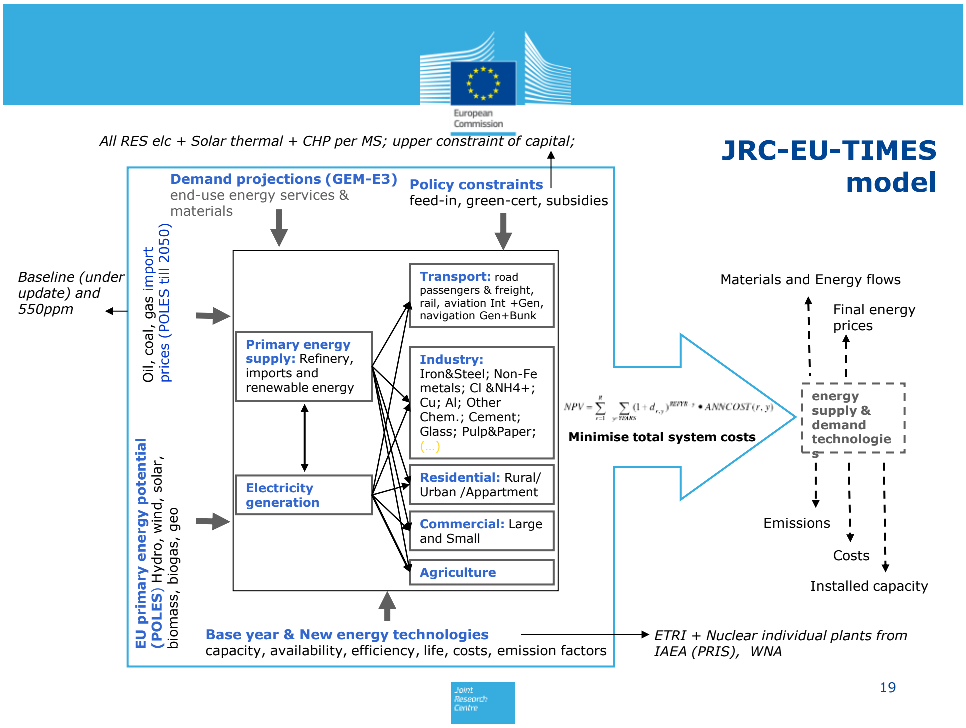
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JRC-EU-TIMES model
All RES elc + Solar thermal + CHP per MS; upper constraint of capital;
Demand projections (GEM-E3)
end-use energy services & materials
Policy constraints
feed-in, green-cert, subsidies
Baseline (under update) and 550ppm
Oil, coal, gas import prices (POLES till 2050)
EU primary energy potential (POLES) Hydro, wind, solar, biomass, biogas, geo
Transport: road passengers & freight, rail, aviation Int +Gen, navigation Gen+Bunk
Primary energy supply: Refinery, imports and renewable energy
Industry: Iron&Steel; Non-Fe metals; Cl &NH4+; Cu; Al; Other Chem.; Cement; Glass; Pulp&Paper; (...)
Electricity generation
Residential: Rural/ Urban /Appartment
Commercial: Large and Small
Agriculture
Minimise total system costs
Materials and Energy flows
Final energy prices
energy supply & demand technologies
Emissions
Costs
Installed capacity
Base year & New energy technologies
capacity, availability, efficiency, life, costs, emission factors
ETRI + Nuclear individual plants from IAEA (PRIS), WNA
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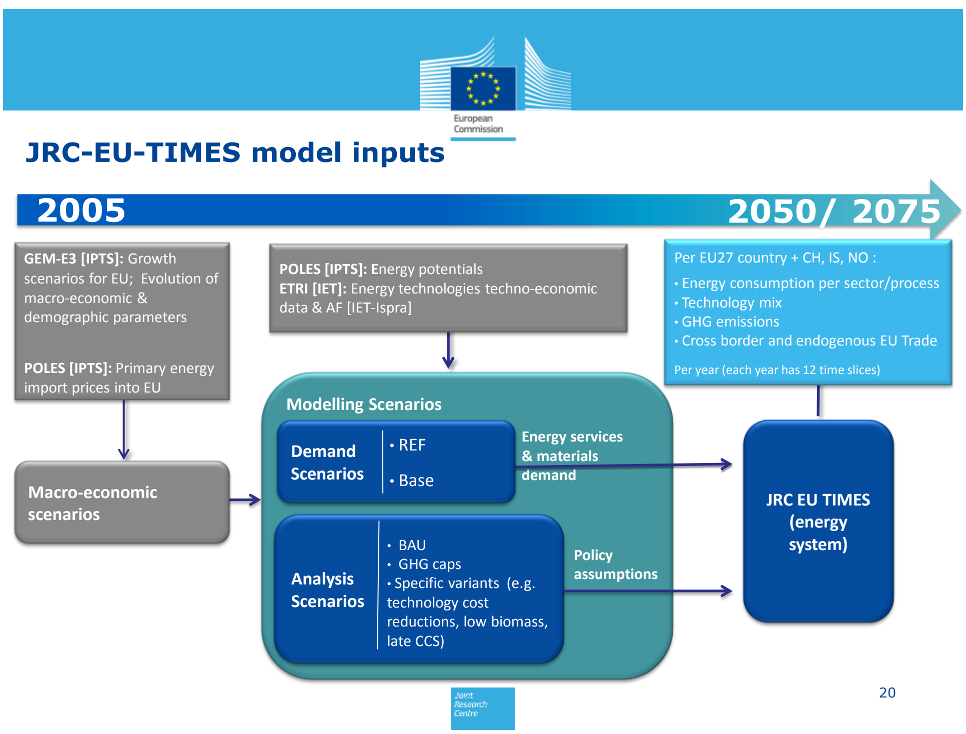
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JRC-EU-TIMES model inputs
2005
2050/ 2075
GEM-E3 [IPTS]: Growth scenarios for EU; Evolution of macro-economic & demographic parameters
POLES [IPTS]: Primary energy import prices into EU
POLES [IPTS]: Energy potentials
ETRI [IET]: Energy technologies techno-economic data & AF [IET-Ispra]
Per EU27 country + CH, IS, NO :
• Energy consumption per sector/process
• Technology mix
• GHG emissions
• Cross border and endogenous EU Trade
Per year (each year has 12 time slices)
Macro-economic scenarios
Modelling Scenarios
Demand Scenarios
• REF
• Base
Energy services & materials demand
Analysis Scenarios
• BAU
• GHG caps
• Specific variants (e.g. technology cost reductions, low biomass, late CCS)
Policy assumptions
JRC EU TIMES (energy system)
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