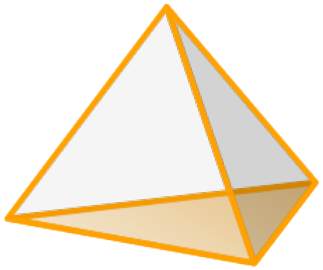
4th International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 13-14 November 2018

Sector coupling and distributed energy storages for the integration of renewable energy sources

ECES Annex 28
DESIRE



4th Generation District Heating Technologies and Systems

PlanEnergi

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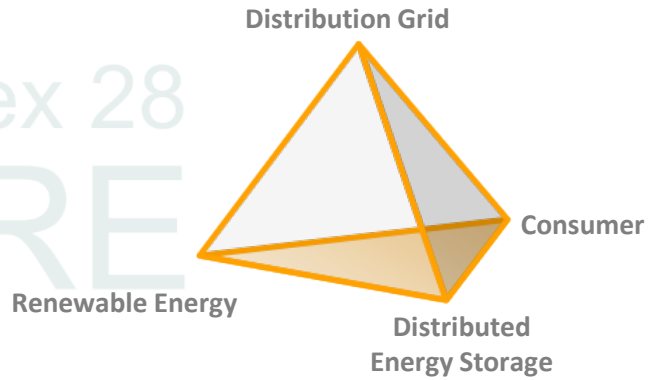
Aim of the study

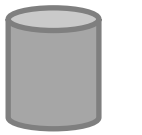
*To estimate the **technical** and **economic potential** for using **distributed energy storages** for **integrating fluctuating renewable energy sources**, thereby lowering the greenhouse gas emissions of the energy system.*



Energy storage

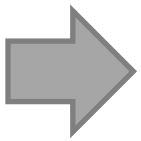
"So you need to store your renewable energy…? That's easy – the answer is batteries!"

Categorisation of methods for balancing energy supply and demand



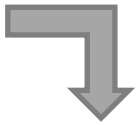
(Distributed) energy storage

- Electrical energy storage
- Thermal energy storage



(Distributed) energy conversion

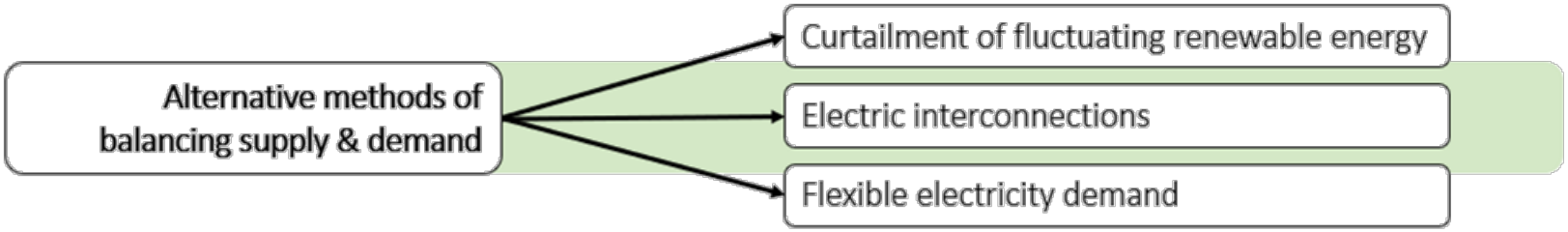
- Power-to-heat
- Power-to-gas



Alternative methods of balancing supply & demand

- Curtail-ment of wind &PV
- Electrical inter-connections
- Flexible demand

Scenario approach and technologies included in the model



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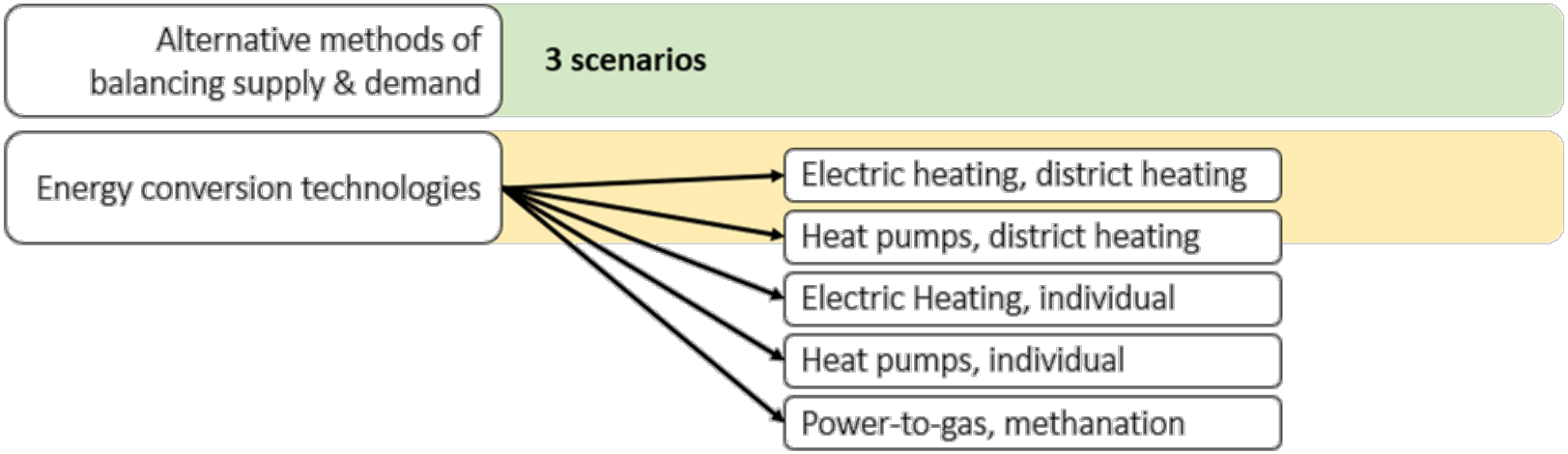

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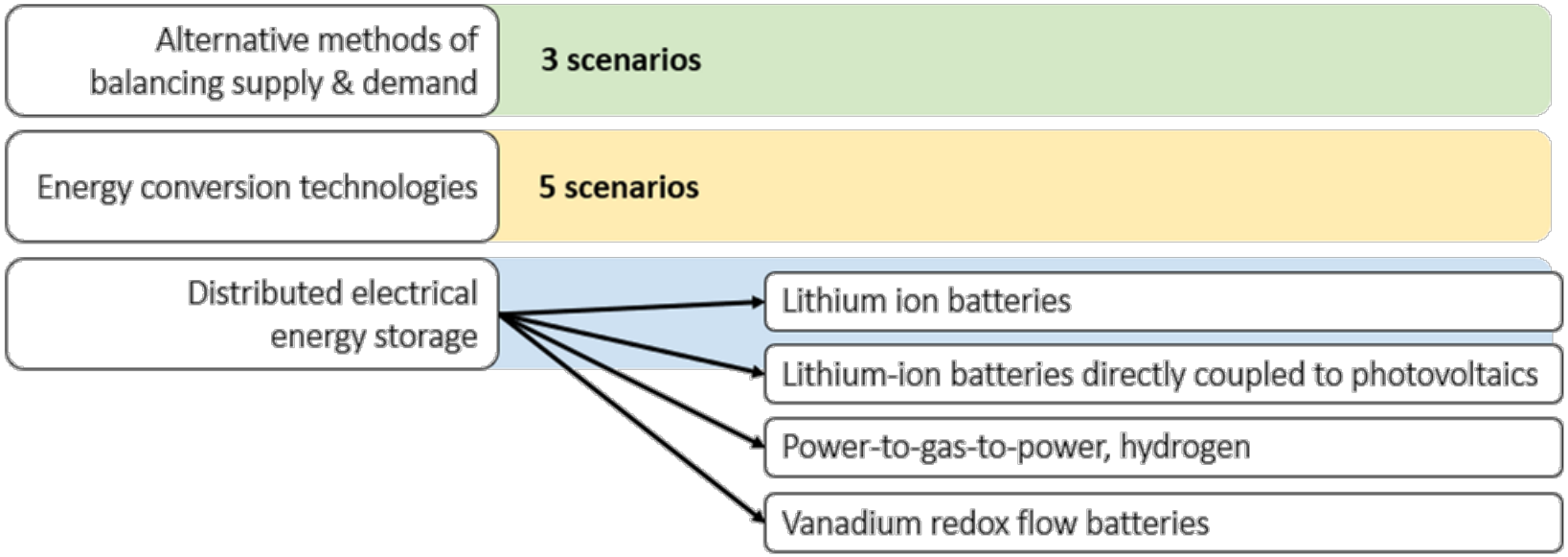

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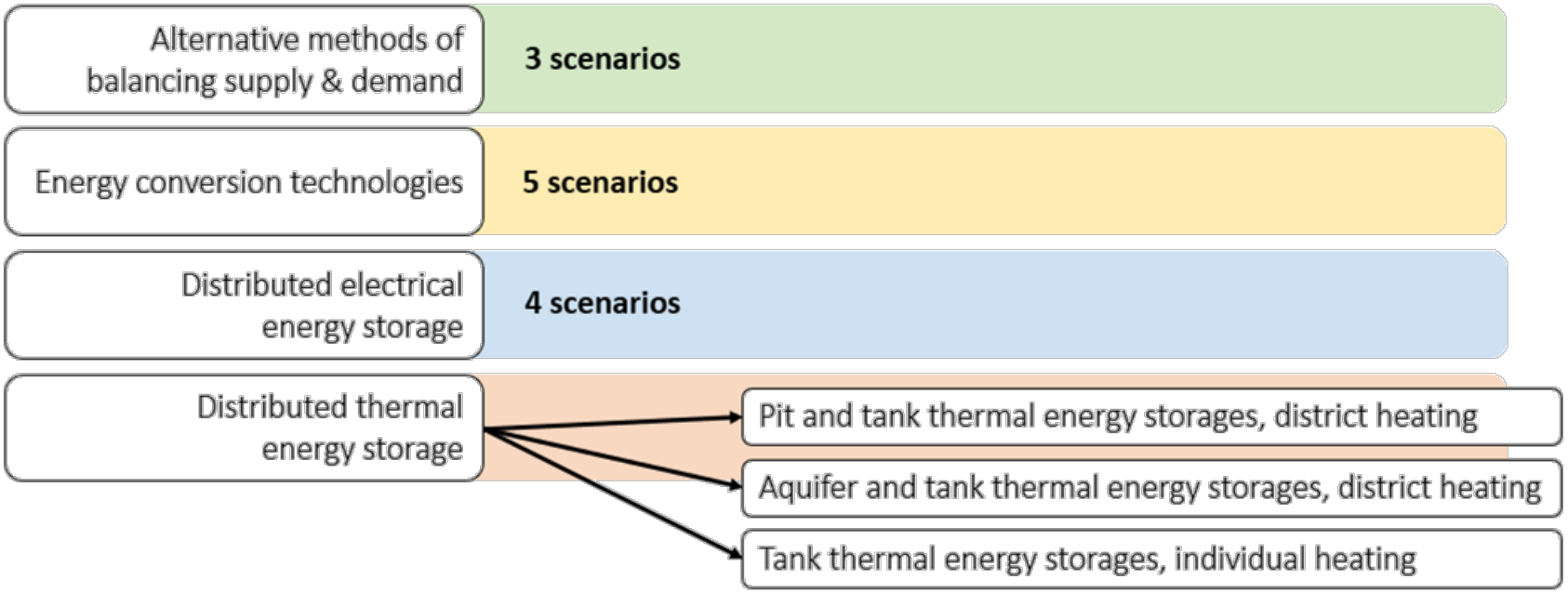

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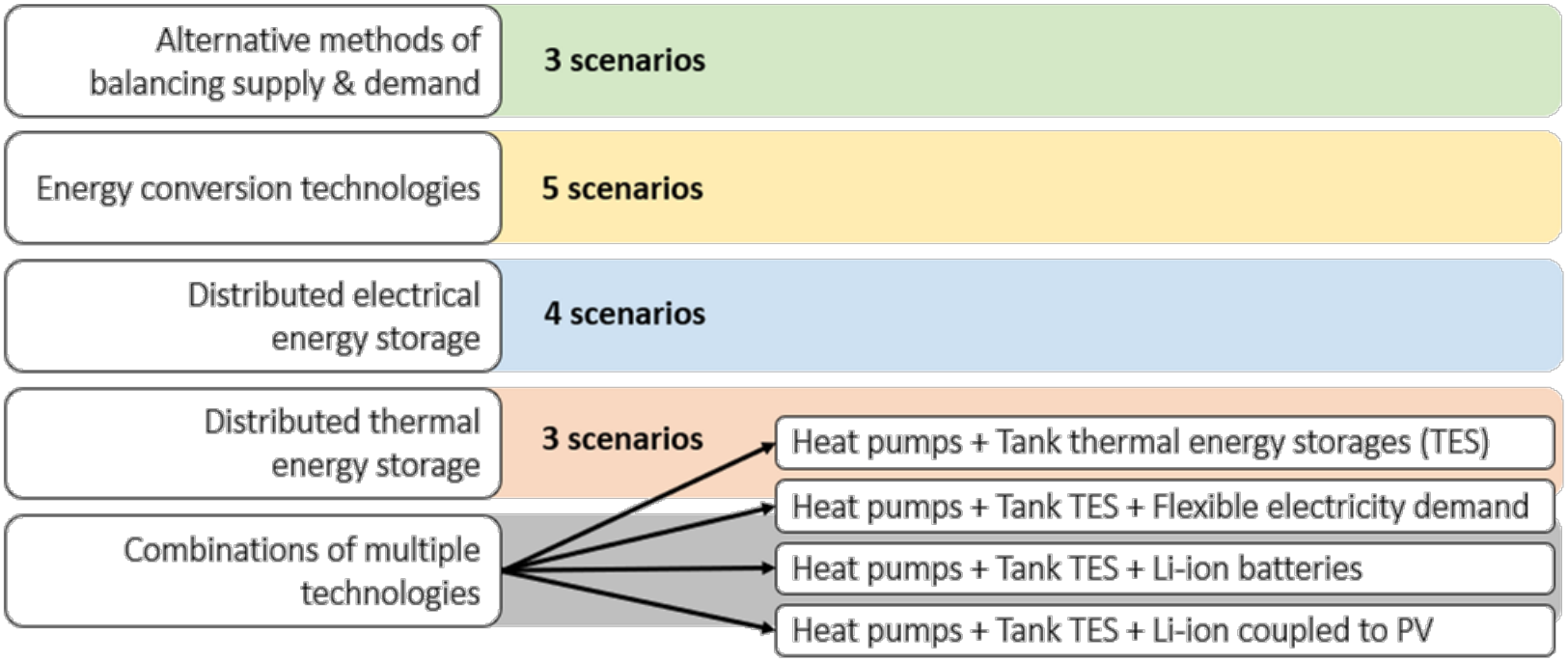
Scenario approach and technologies included in the model

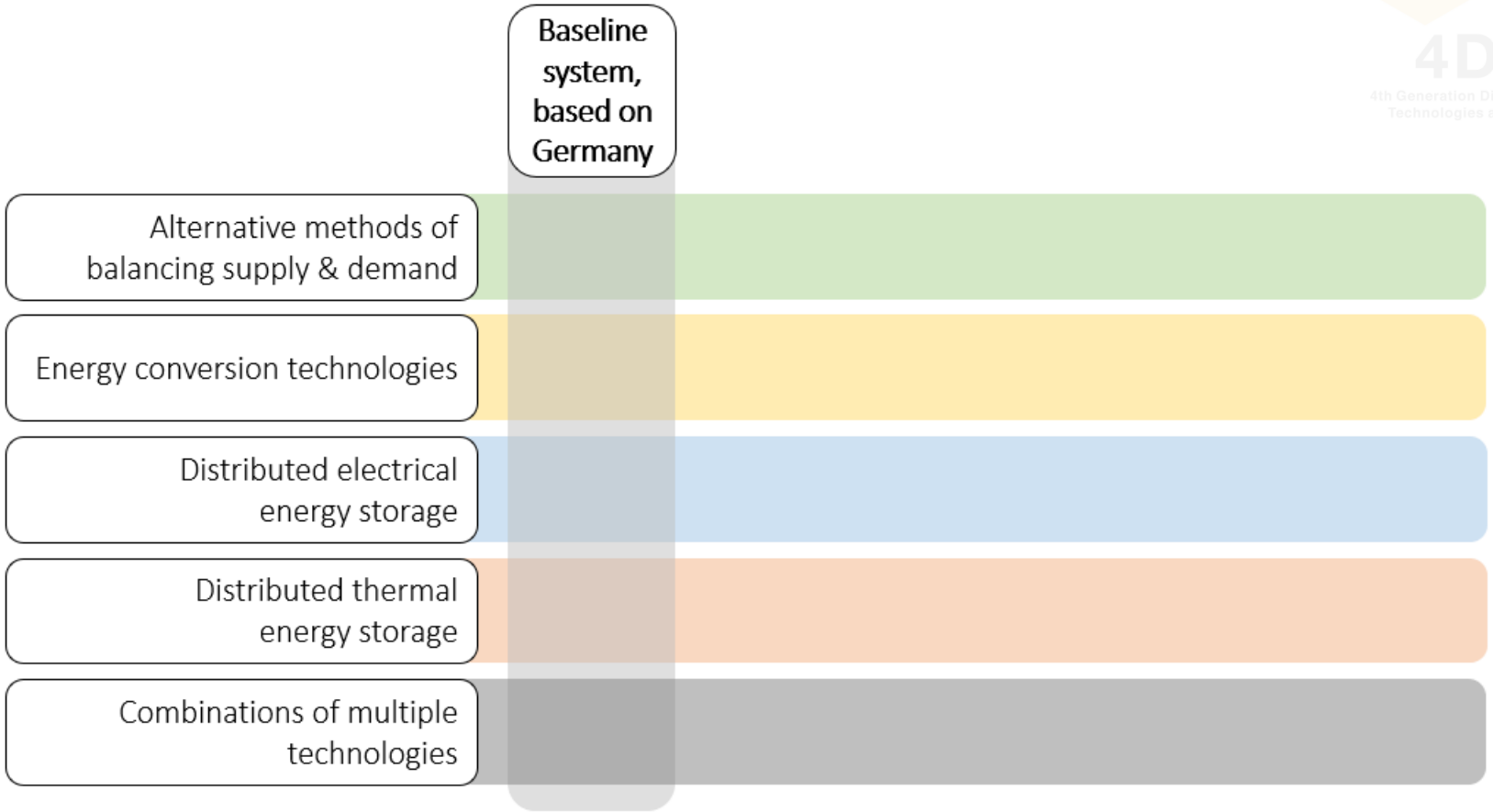


Scenario approach

15 technology specific scenarios.
4 technology-combination scenarios.

Alternative methods of balancing supply & demand	**3 scenarios**
Energy conversion technologies	**5 scenarios**
Distributed electrical energy storage	**4 scenarios**
Distributed thermal energy storage	**3 scenarios**
Combinations of multiple technologies	**4 different scenario combinations**

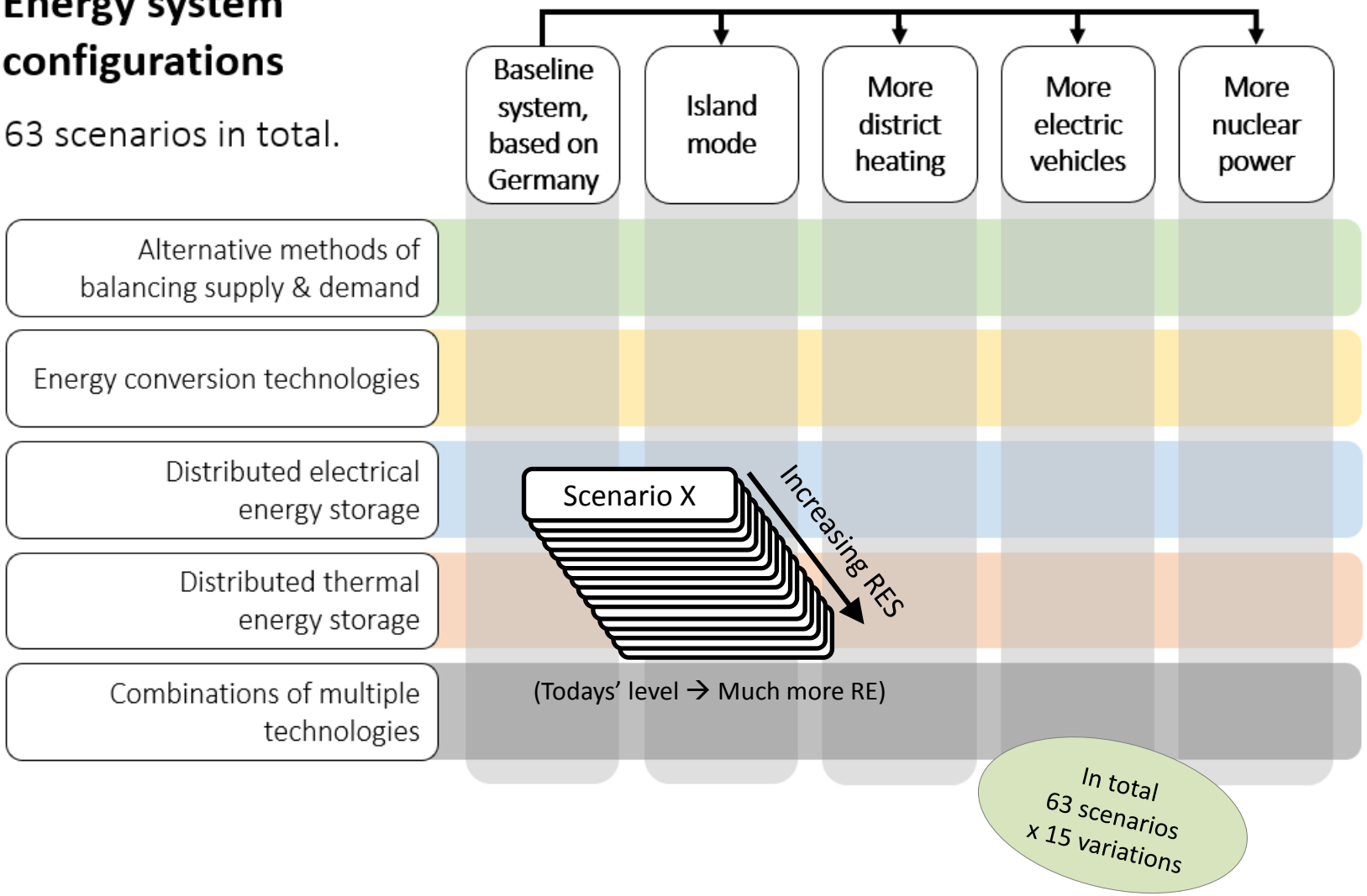
Scenario approach



Scenario approach

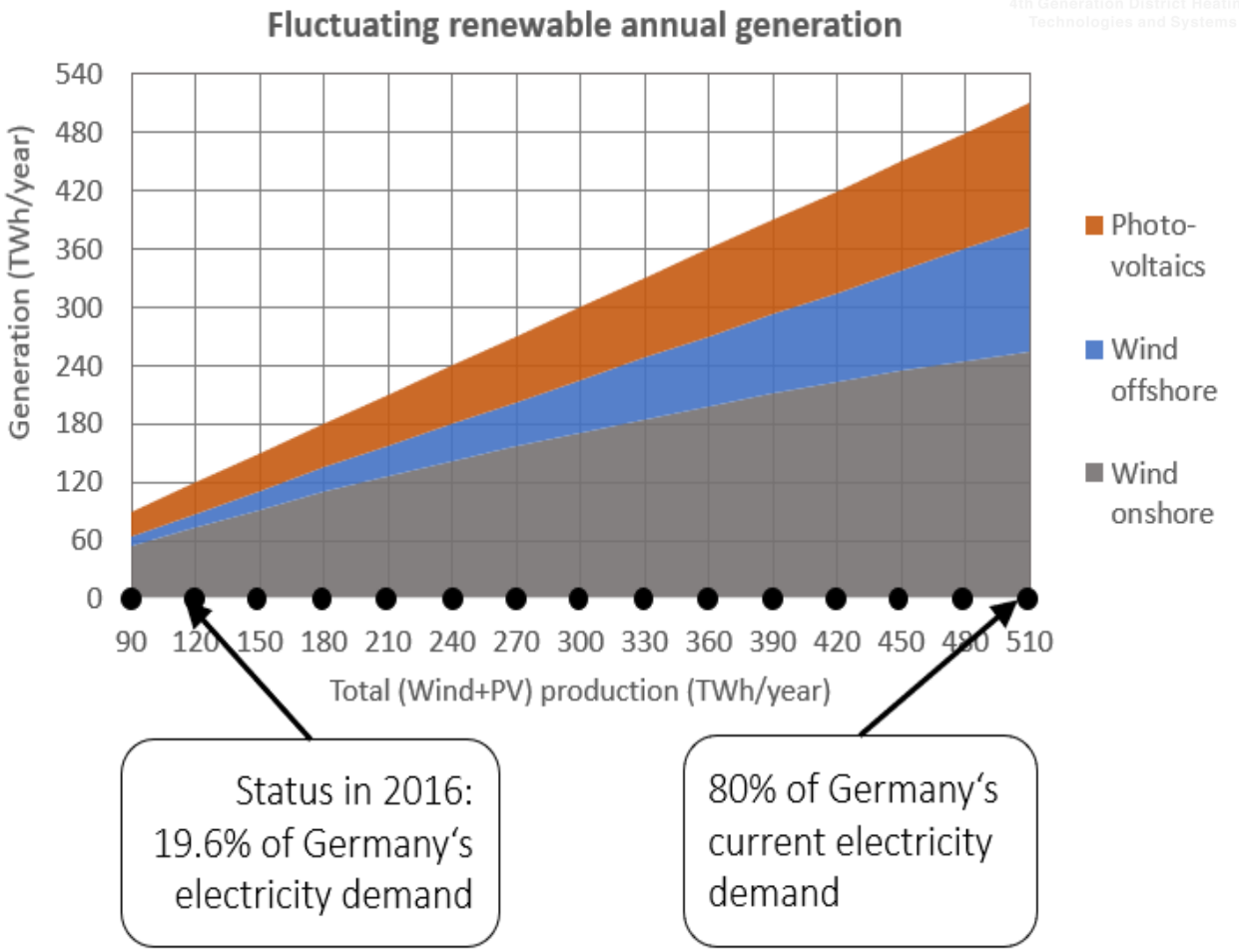
Energy system configurations

63 scenarios in total.

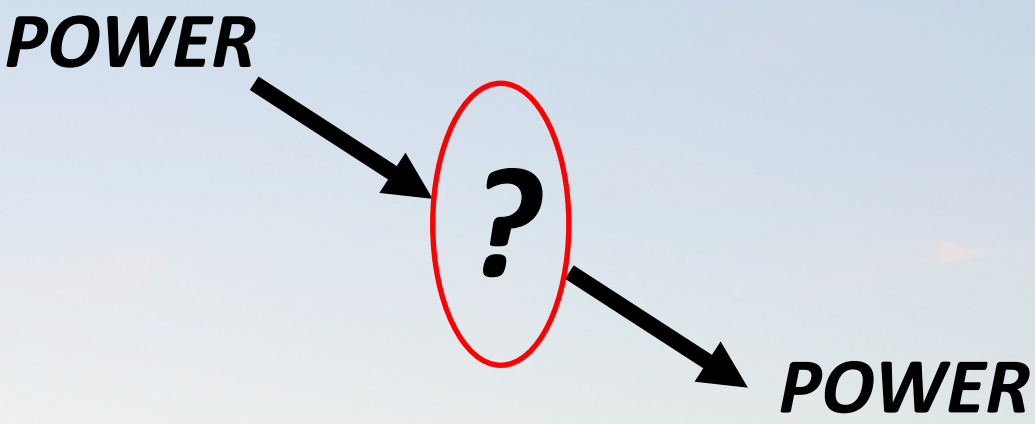


Scenario approach – Increasing share of VRE

- Each scenario:
  15 variations with varying electricity generation
  (wind and PV)
- A ratio of 25% PV & 75% wind turbine generation was found optimal (baseline)



Where should it go?



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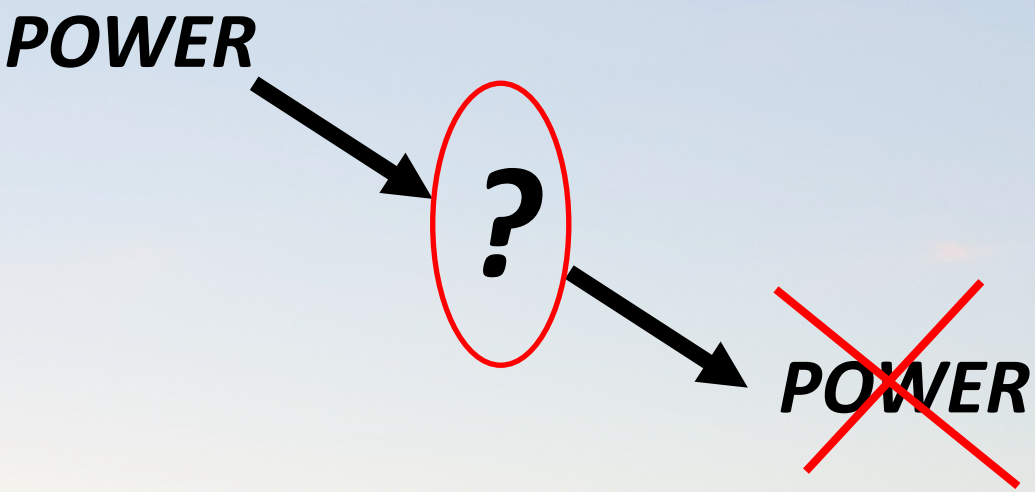
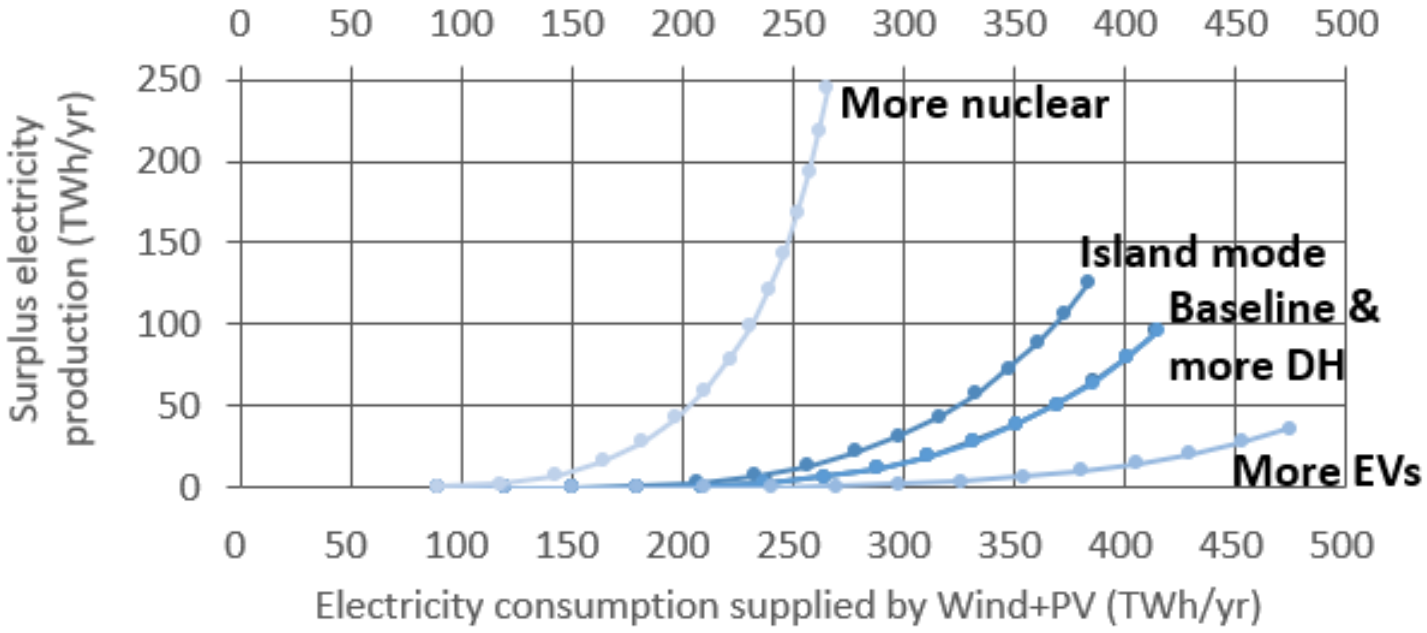


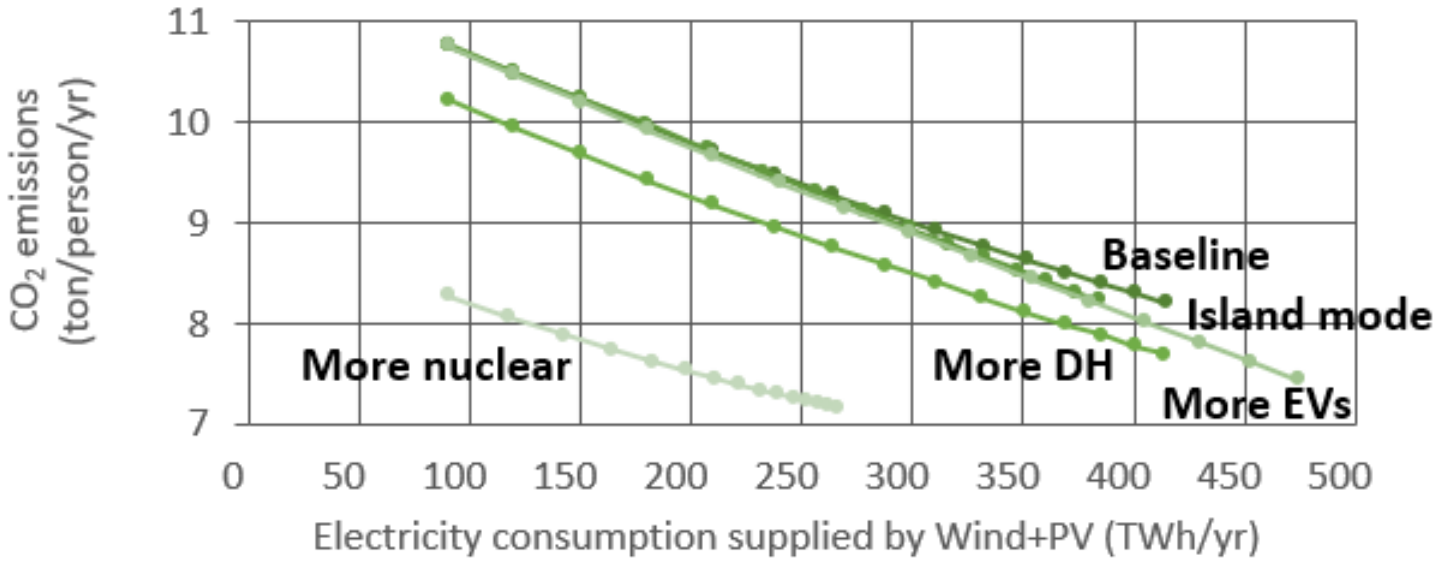
Indicators for assessing the model results

Economy	**The total socio-economic energy** system costs per person, per year. (€/person/year)
Environment	**The total CO_2 emissions** arising from the energy system operation per person, per year. (ton CO_2/person/year)
Energy system	**The "discharged energy"** per year (i.e. how much energy the storage or conversion solution "discharges" to the energy system) (TWh/year)

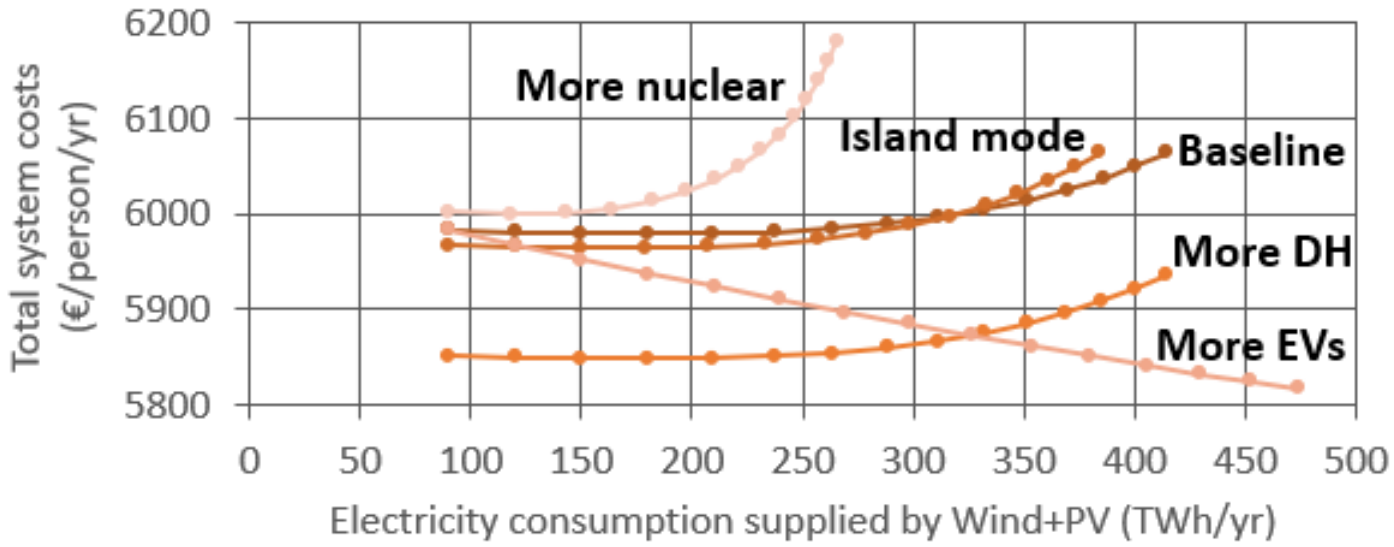
Baseline scenario results

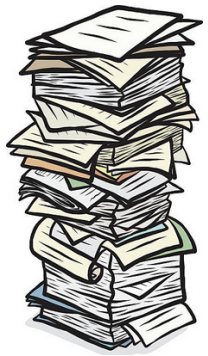


Baseline scenario results



Baseline scenario results





Result summary & policy recommendations

4DH
4th Generation District Heating Technologies and Systems

Energy system redesign measures

- **District heating, with low-CO_2 emitting heat generation** (enables inexpensive thermal storages).
- **Electric vehicles with smart charging** (introduces cost-effective distributed electrical energy storage).
- **Electrical interconnections to island systems**
- **Less inflexible nuclear power**.

Distributed energy storage and conversion

- **Flexible sector coupling** (e.g. power-to-heat via heat pumps and thermal storage).
- **Heat pumps**
- **Flexible electricity demand**
- **Thermal energy storage**
- **Reduction of electrical energy storage investment costs** (currently not socio-economically feasible)

Recommendations

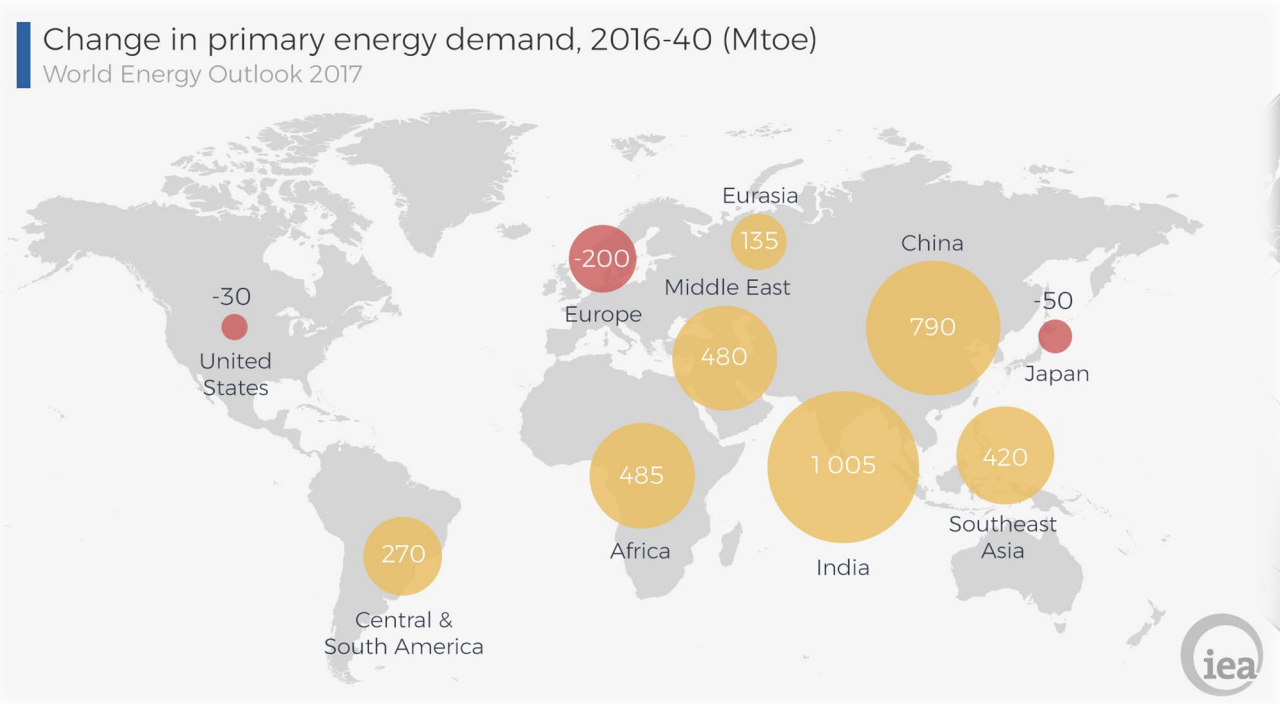
- Much more RE is needed to displace fossil fuels for the current *and* the future energy demand (transport, chemical industry, data centres etc.)
  → We need to speed up!
- This increasing amount of fluctuating RE requires flexibility
  - DH + thermal storages can provide a lot of that flexibility
  - Flexible demand for HPs, EVs etc. can ”make room in the system” for more RE
- Ambitious long-term goals together with a favourable and stable investment environment for RE (and RE-supporting technologies) should be ensured e.g.
  - increased CO_2 emission costs (compared to current levels)
  - stopping fossil fuel subsidies
  - implementing the right incentive schemes for RE technologies
  - create incentives to supply flexibility services also on local level
- ICT hardware + software + incentives can engage smaller consumers

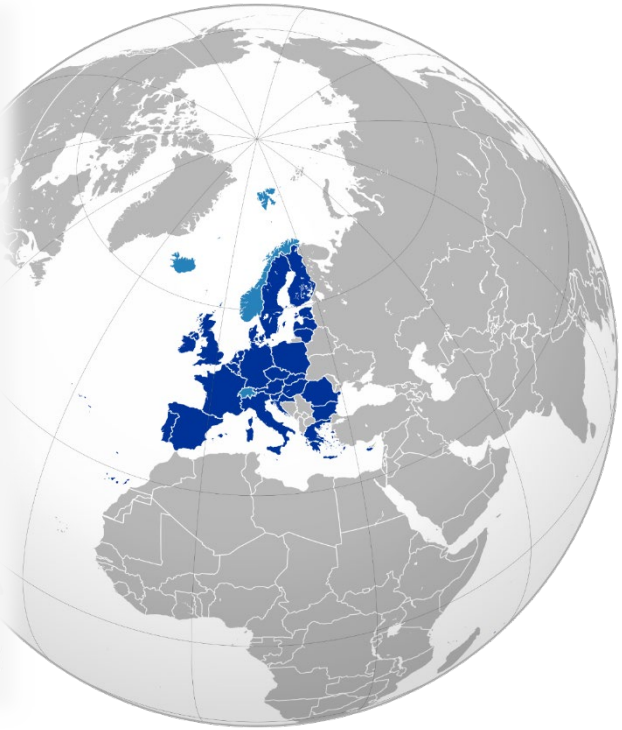
Outlook…

Best practices and good ideas of EU projects and conferences should not be limited to Europe…

↓ IEA WEO 2017 New Policies Scenario

We have work to do…!





Thank you for your attention

More info at planenergi.eu/DESIRE

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