Overview of the scenarios, methodology and key results

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Agenda

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The need for model-based assessments in the scope of the EE1st principle

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Models, assumptions and conceptual aspects

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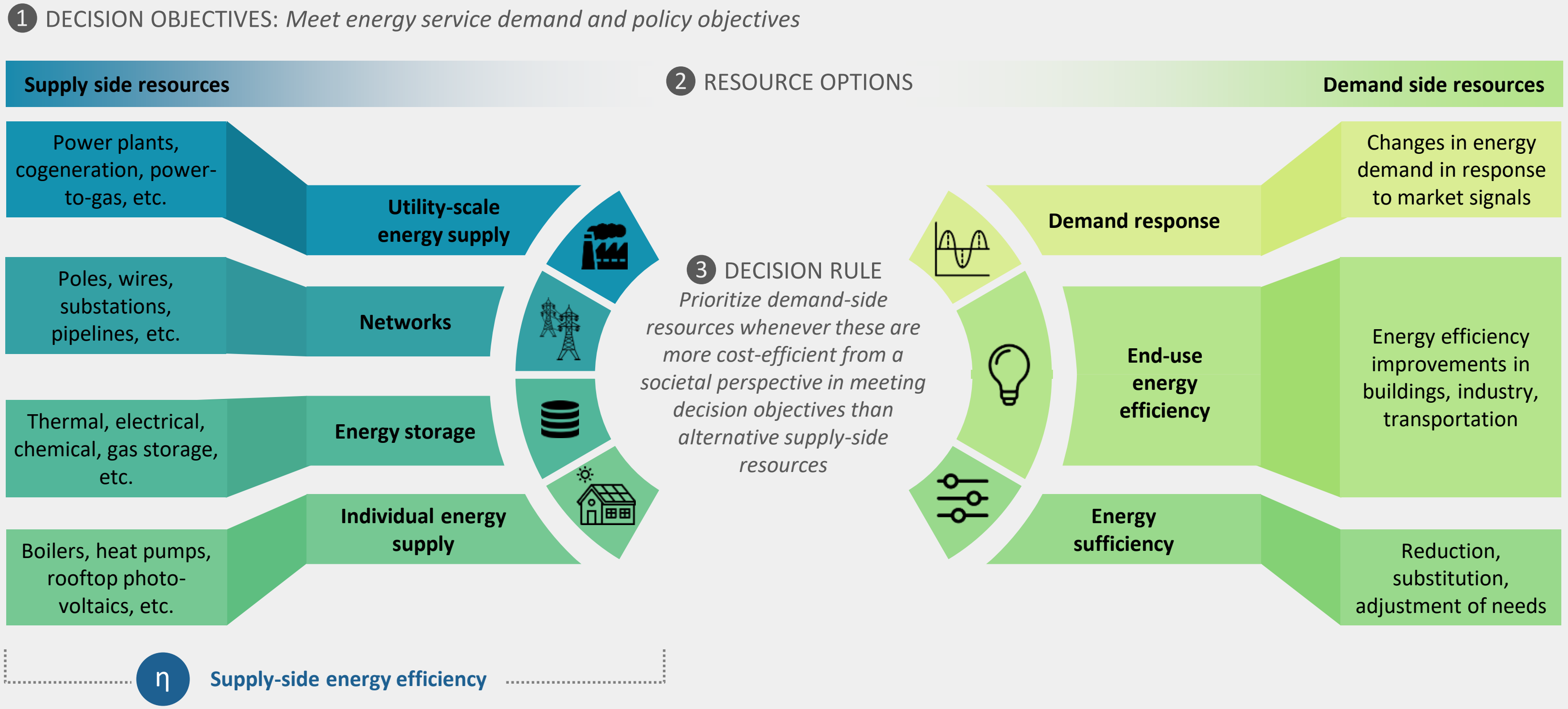
Building sector efficiency pays off, but there are limitations

04 | Discussion
Why the model-based results should be interpreted with caution

Background

The Energy efficiency first (EE1st) principle can be conceptualized as follows



The need for dedicated model-based assessments on the EE1st principle

EU energy & climate policy

- Net-zero emissions by 2050
- Interim targets by 2030
- EE1st prominently featured in existing (e.g. Governance Regulation) and planned legislation (e.g. EED recast)

Existing studies [1,2,3]

- Building sector decarbonisation by 2050 requires 20% to 55% reduction in energy demand
- Heat pumps and district heating cover bulk of building heating demand

Research gap

- Assessing the societal trade-off between saving and supplying energy in the building sector [4]
- Methodological limitations (e.g. spatio-temporal detail of models) [5]

[1] JRC (2020): Towards net-zero emissions in the EU energy system by 2050.
[2] McKinsey (2020): Net-Zero Europe. Decarbonization pathways and socioeconomic implications.
[3] IEA (2021): Net Zero by 2050. A Roadmap for the Global Energy Sector.
[4] Agora Energiewende (2018): Building sector Efficiency.A crucial Component of the Energy Transition.
[5] ENEFIRST (2020): Review and guidance for quantitative assessments of demand and supply side resources in the context of the Efficiency First principle.

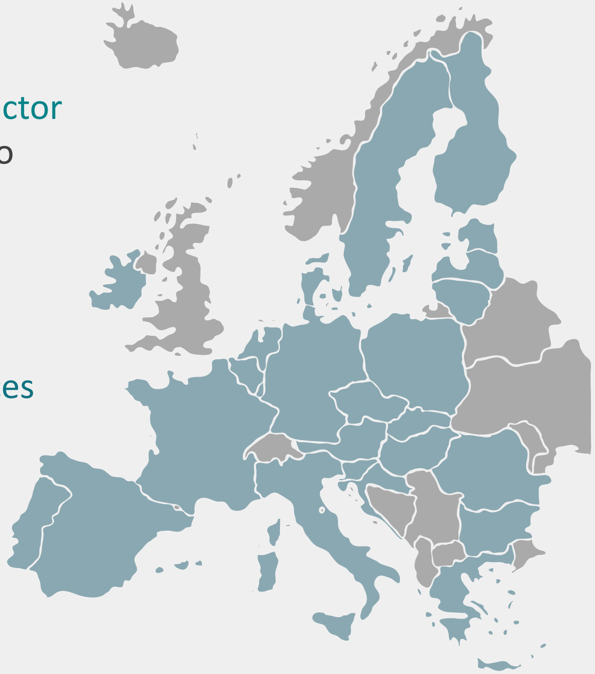
Investigating Energy Efficiency First in the EU building sector

Question

What level of end-use energy efficiency in the EU building sector would provide the greatest societal benefit in transitioning to net-zero GHG emissions?

Key properties of our analysis

- Integrated appraisal of demand- and supply-side resources
- Common objective: Net-zero GHG emissions by 2050
- Systematic accounting of costs and benefits
- Societal perspective (ambition)



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Methodology

We investigate three scenarios for the EU building sector and energy supply

SCENARIOS

	Low efficiency in buildings (LowEff)	Medium efficiency in buildings (MediumEff)	High efficiency in buildings (HighEff)
Decision objectives	**2020 to 2050** Meet energy service demand **2030**	▪ ≥55% reduction GHG emissions (1990) ▪ ≥32% share for renewable energy ▪ ≥32.5% improvement in energy efficiency	**2050** Net-zero GHG emissions according to European Climate Law
BUILDINGS: **Thermal efficiency**	Moderate component requirements and renovation rates	Enhanced component requirements and renovation rates	Ambitious component requirements and renovation rates
BUILDINGS: **Appliance efficiency**	Moderate minimum energy performance standards	Enhanced minimum energy performance standards	Ambitious minimum energy performance standards
BUILDINGS: **Individual heat supply**	Optimized capacity expansion & operation | Balanced deployment of solar thermal, heat pumps, etc.		
BUILDINGS: **Energy sufficiency**	Equal indoor temperatures, floor space, technology ownership, appliance use intensity, etc.		
ENERGY SUPPLY: **Fuel prices**	Fuel prices for crude oil, natural gas, hard coal according to *Sustainable Development* scenario (IEA World Energy Outlook 2019)		
ENERGY SUPPLY: **Other energy demand**	Energy demand in industry & transportation according to *1.5TECH* scenario (Clean Planet for All study)		
ENERGY SUPPLY: **Electricity supply**	Optimized capacity expansion & operation | No CCS, coal phase-outs, declining biomass, power transmission based on TYNDP-2018		
ENERGY SUPPLY: **District heating supply**	Optimized capacity expansion & operation | Limited potential for solar thermal, geothermal, biomass		
ENERGY SUPPLY: **Hydrogen supply**	Optimized capacity expansion & operation | 20% share of hydrogen & synthetic methane in building gas demand in 2050; high import prices		

See also: ENEFIRST (2021): Concept development for a model-based assessment of the E1st Principle. Deliverable D3.2 of the ENEFIRST project.

Energy system cost is the central performance indicator in the analysis

Σ ENERGY SYSTEM COST (EUR_{2018})

	Capital costs [1]	Fuel costs [2]	O&M costs	Other costs
Buildings	▪ Building renovation ▪ Heating equipment ▪ Electrical appliances & lighting equipment	▪ Wholesale costs for natural gas, fuel oil, coal, biomass	▪ Maintenance costs for heating systems	-
Electricity supply	▪ Generation plants ▪ Electricity storage facilities ▪ Electricity networks	▪ All relevant fuel costs (wholesale)	▪ Import/export cost ▪ Fixed & variable O&M costs of supply assets (incl. ancillary services)	▪ EU emissions allowance costs (ETS)
District heating supply	▪ Boilers & cogeneration plants ▪ Heat storage facilities ▪ Heat networks	▪ All relevant fuel costs (wholesale)	▪ Fixed & variable O&M costs of supply assets	▪ EU emissions allowance costs (ETS)
Hydrogen supply	▪ Hydrogen electrolysers ▪ Methanation facilities	-	▪ Import/export cost ▪ Fixed & variable O&M costs of supply assets	-

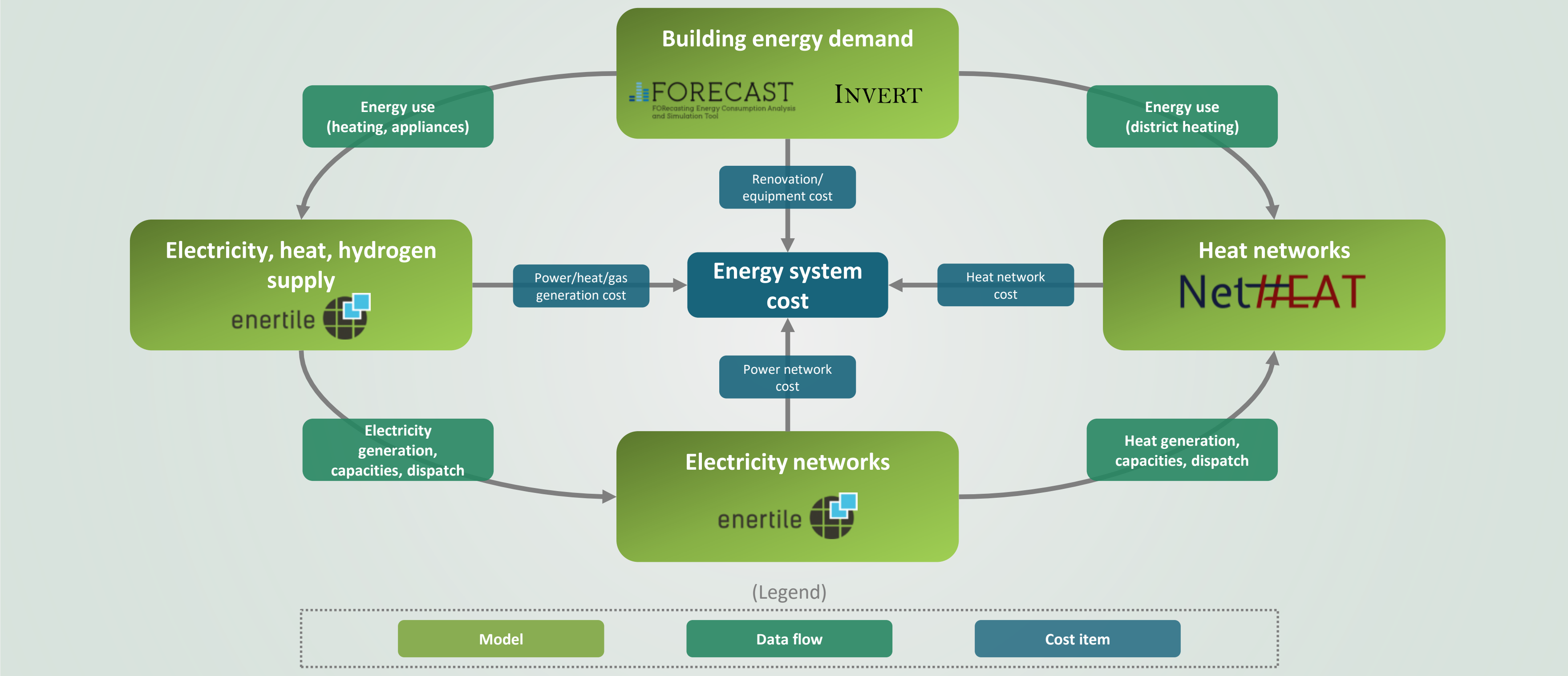
[1] 2% discount rate for transforming capital expenditures into annual capital costs (“annuities”)

[2] Excl. taxes (valued added tax, environmental taxes, renewable taxes, nuclear taxes, etc.)

Coming up in eηefirst: Report on multiple impacts in the scope of the EE1st principle

- Conceptual background | Why taking the EE1st principle seriously means acknowledging multiple impacts
- Decision-support with Multiple Impacts | How different impacts can be aggregated to inform decisions in different venues
- Multiple impacts in practice | How the inclusion of impacts alters the outcome of cost-benefit analysis

Four models are coupled to assess energy system cost and other variables



Do you think the **approach** used is relevant to assess the system- and society-wide value of implementing EE1st in the building sector?

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What do you think is the most important to investigate when considering the EE1st principle?

- ❑ The impacts of different depths and rates of building renovations
- ❑ The impacts that different levels of final energy demand can have on the needs in energy infrastructures (generation capacities, networks, …)
- ❑ The impacts on cumulated GHG emissions over 2020-2050
- ❑ Other impacts (e.g., health, employment)
- ❑ A total system cost (combining the main impacts that can be monetized, and primarily the whole costs of supply-side and demand-side investments and operation)

Results


Morris Charts
Line Chart
Area Chart
Bar Chart
Donut Chart
Sparkline Charts
Line Chart
Bar Chart
Pie Chart
Easy Pie Charts
25%
50%
75%
100%

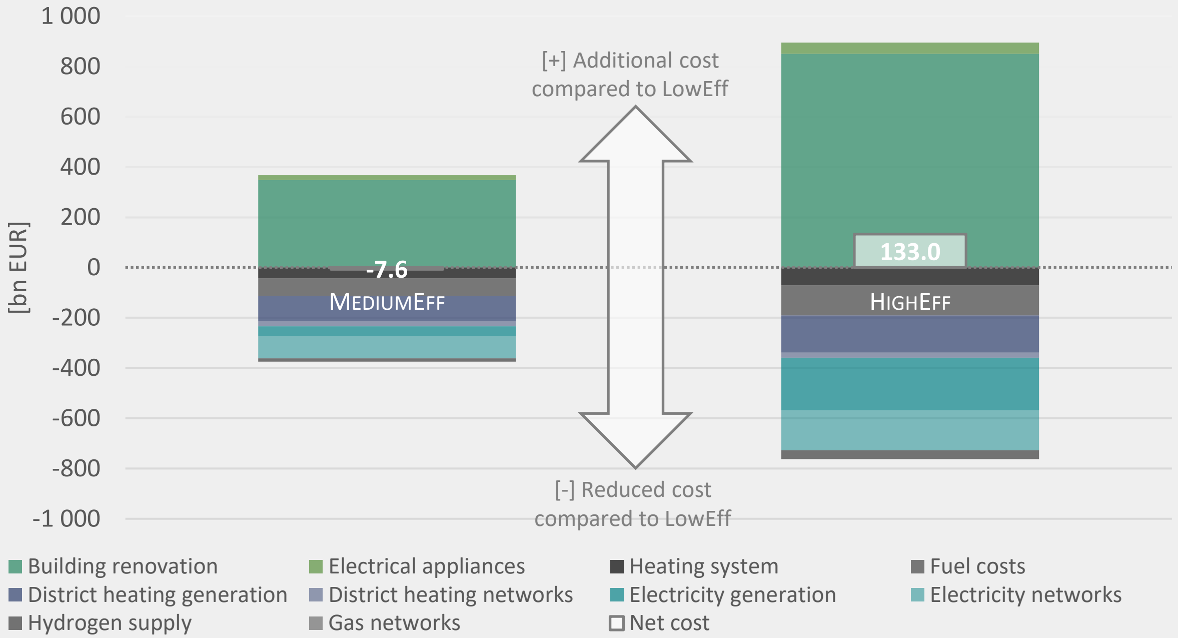
Check out the eɳefirst SCENARIO EXPLORER

Interactive dashboard and disaggregated outputs by Member State

Easy access and handling in MS Excel

To be released along with report in March 2022

Energy system cost



Cumulative differential cost compared to LOWEFF scenario for EU-27 by cost item (2020–2050) [bn EUR]

Results

- MEDIUMEFF is the most cost-efficient way to reach net-zero
- HIGHEFF scenario leads to additional cost until 2050
- Substantial cost savings for power generation & networks

Key message

Enhanced energy efficiency in buildings (MEDIUMEFF) slightly reduces energy system cost by lowering the need for energy supply.