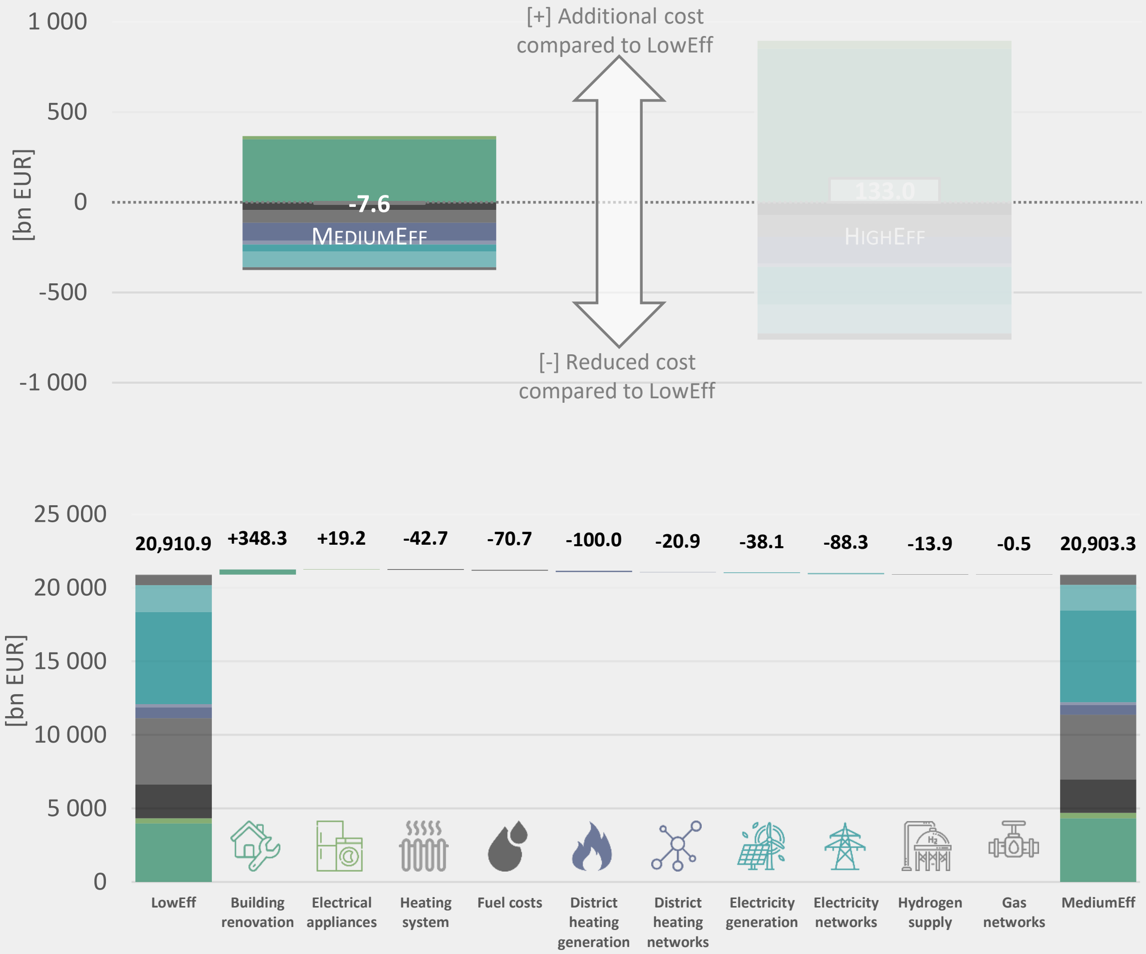
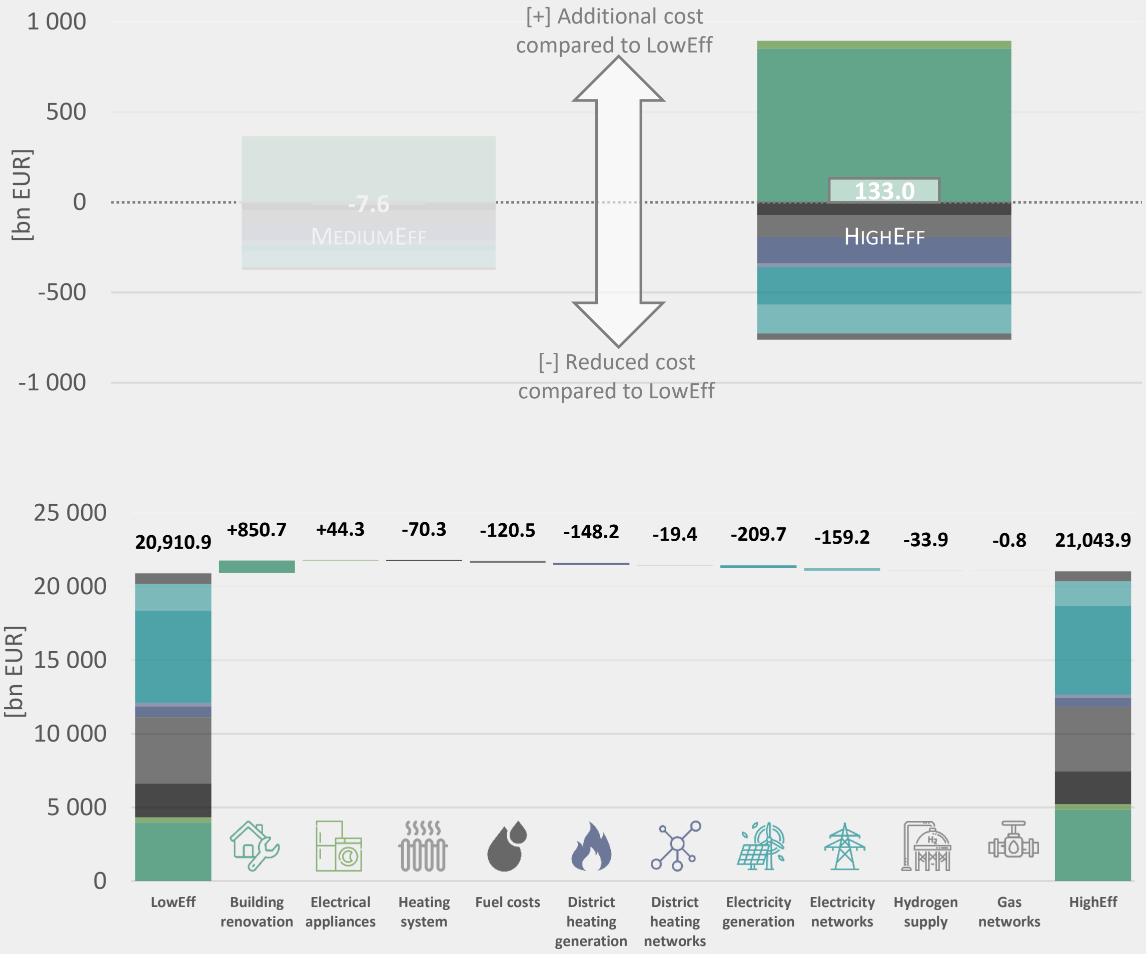
Key findings



Cumulative differential costs compared to LowEff for EU-27 (2020–2050) [bn EUR]

Key findings



Cumulative differential costs compared to LOWEFF for EU-27 (2020–2050) [bn EUR]

Key findings

- **End-use energy efficiency is a crucial component of a cost-efficient transition to net-zero emission levels.** Reducing final energy demand for heating and electrical appliances by 30% compared to 2020 may minimize the cost for transitioning to net-zero until 2050.
- **However, end-use energy efficiency has clear limitations from an energy system cost perspective.** There is little rationale for prioritizing end-use energy efficiency over supply-side alternatives beyond the ambition levels of the MediumEff scenario. The HighEff scenario would create additional cost of +140 bn EUR relative to MediumEff while reaching the same outcomes.
- **Supply-side efficiency is significant across all scenarios and should stand alongside end-use energy efficiency in the narrative of the EE1st principle.** Heat pumps and district heating cover 62% to 67% of building heating demand across the three scenarios. Alternatives are either limited (e.g. biomass) or cost-intensive (e.g. hydrogen boilers).
- **As with every model-based analysis, these results should be taken with caution.** The problem is not only uncertainties, but also the capabilities of the model setup as well as conceptual issues in counting costs and benefits.

Discussion of the model-based results

Three reasons why the results should be interpreted with caution

Parameter uncertainties

- ❑ Learning rates & technology cost
- ❑ Fuel prices
- ❑ Climate conditions
- ❑ …

Model capabilities & scope

- ❑ Power & gas network modelling
- ❑ Economy-wide rebound effects
- ❑ Role demand response & energy sufficiency
- ❑ What if *Energy Efficiency last*?

Conceptual issues

What defines costs and benefits from a societal/economic perspective?

What multiple impacts have to be taken into account?

What defines costs and benefits from a societal viewpoint

	[-] Costs to society	[+] Benefits to society
Buildings	• CAPEX/OPEX for building renovation, heating systems, electrical appliances • Search and information cost • External costs from upstream production chain	• Health & well being • Workforce productivity • Poverty alleviation …
Electricity supply District heating supply Hydrogen supply	• CAPEX/OPEX for generation and storage assets • CAPEX/OPEX for networks • OPEX for retail (trading, metering, etc.) • CAPEX/OPEX for power-to-gas facilities • CAPEX/OPEX for hydrogen/gas networks • External costs from fuel combustion (GHG emissions, air pollution) • External costs from renewables (land use, water use, aesthetics, noise, etc.) • External costs from power networks (exposure to electrostatic fields) • External costs from upstream production chain	• Macroeconomic impacts / employment • Energy security …

(Legend)

- included in analysis
- partly included in analysis
- not included in analysis