Energy Efficiency First and Multiple Impacts: integrating two concepts for decision-making in the EU energy system

Tim Mandel (Fraunhofer ISI)
Ivana Rogulj (IEECP)
Benigna Boza-Kiss (CEU)
Lukas Kranzl (TUW)
et al.

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Agenda

01 | Theory

Why are multiple impacts so important in the scope of the Energy Efficiency First (EE1st) principle?

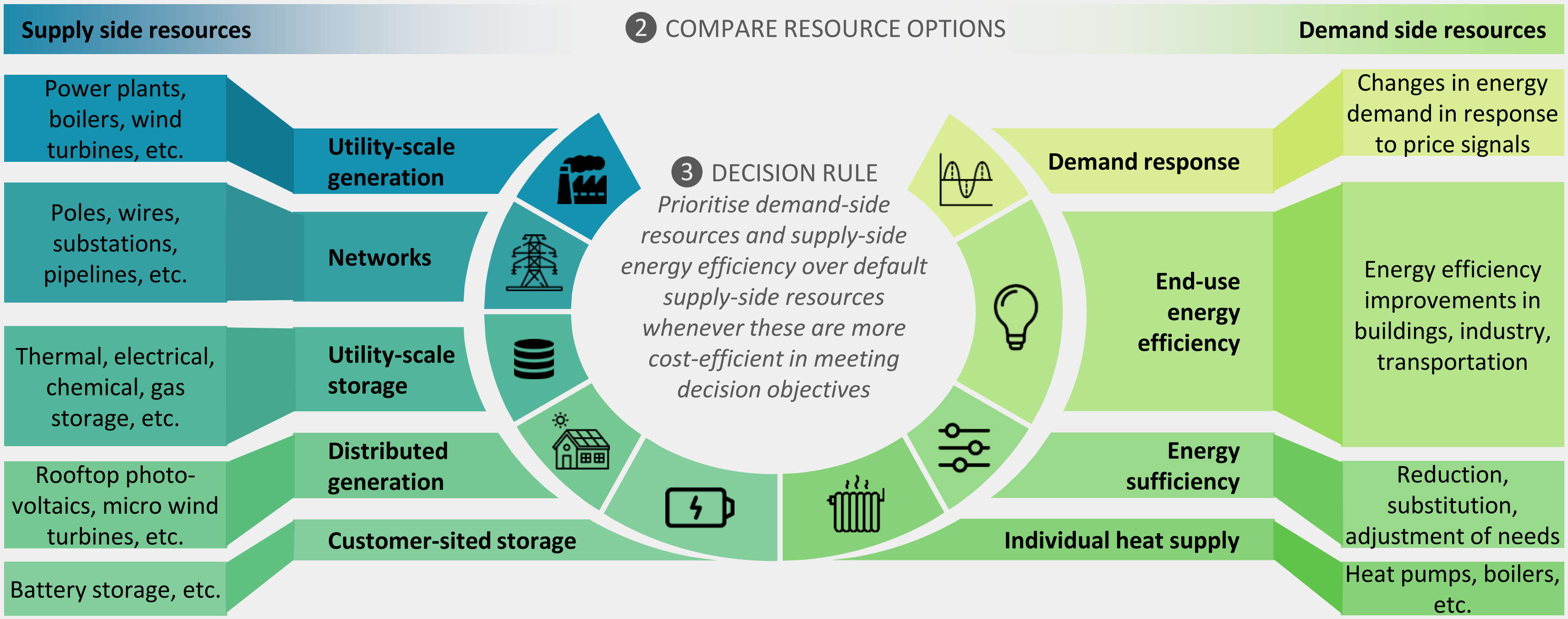
02 | Practice

Some quantitative evidence on multiple impacts in a model-based analysis for the EU

01 | Theory: Multiple impacts in the context of Energy Efficiency First

What does « Energy Efficiency First » mean?

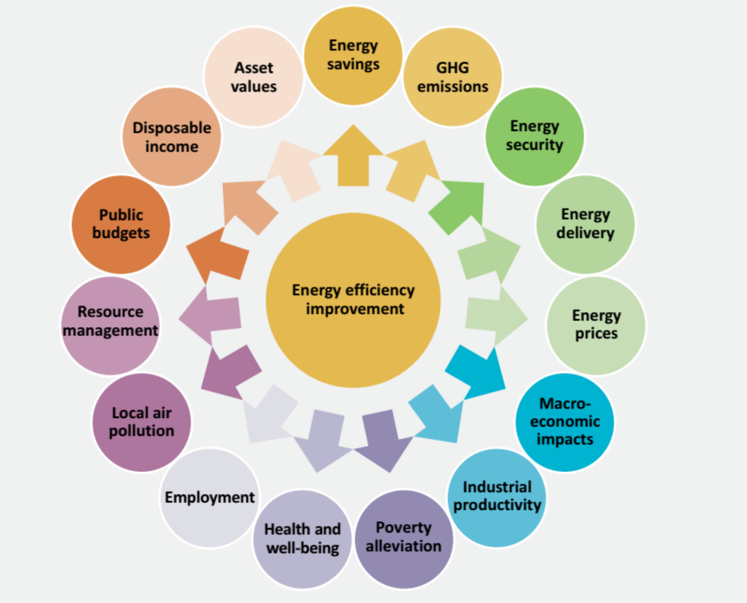
1 DEFINE DECISION OBJECTIVES: *Meet energy service demand and policy objectives*



η **Supply-side energy efficiency**

Multiple impacts (MIs) can be understood as follows

Some prominent MIs of energy efficiency



Source: IEA (2015): Capturing the Multiple Benefits of Energy Efficiency. Paris: International Energy Agency (IEA).

> **Multiple Impacts (MI) denote all benefits and costs related to the implementation of low-carbon energy measures which are not direct private benefits or costs involving a financial transaction and accruing to those participating in this transaction**

Source: Ürge-Vorsatz, Diana; Kelemen, Agnes; Tirado-Herrero, Sergio; Thomas, Stefan; Thema, Johannes; Mzavanadze, Nora et al. (2016): Measuring multiple impacts of low-carbon energy options in a green economy context. In Applied Energy 179, pp. 1409–1426.

There is a gap between ambition and reality in applying the Multiple Impact concept

Ambition

- **EED proposal (Art. 3)** | *"In applying the energy efficiency first principle, Member States shall: (a) promote and, where cost-benefit assessments are required, ensure the application of **cost-benefit methodologies** that allow proper assessment of **wider benefits** of energy efficiency solutions from the societal perspective"*
- **EC recommendation on EE1st** | *"Assess cost-effectiveness and wider benefits of energy efficiency measures from a societal perspective when making **strategic decisions**, designing **regulatory frameworks** and planning future **investment schemes**"*

Practical challenges

- **How to quantify MIs?**
- **How to monetize MIs?**
- **How to aggregate MIs?**

The use of cost-benefit methodologies has great relevance in various instances, e.g.

EC Impact Assessments | Revise consideration and aggregation of MIs in Better Regulation Guidelines

Municipal heat planning | Provide guidelines for use of CBA/MCA in selection of actions

Power & gas transmission network planning | Include demand-side options and their MIs in CBA methodologies by ENTSO-E/ENTSOG

Comprehensive assessment of heating and cooling *(Art. 14 EED)* | Include demand-side options among the options to be considered, including comprehensive set of MIs

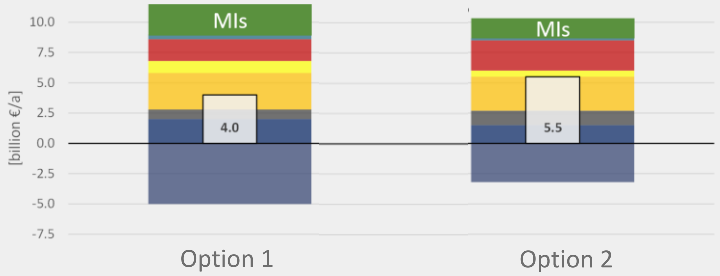
Public procurement | CBA methodologies for large public sector investments

Building codes | Include MIs in cost-optimality calculations for EPBD

…

CBA and MCA are two possible decision-support frameworks for making informed decisions in the scope of E1st and MIs

Cost-benefit analysis (CBA)



Multi-criteria analysis (MCA)

Criterion	Weight	Option 1	Option 2	...
Human health	2x	*1*	*2*	*3*
Employment	1x	*1*	*3*	*2*
Air pollution	2.5x	*1*	*2*	*3*
Resources	0.5	*2*	*1*	*3*
...	...	...	...	...

Comparison of CBA and MCA

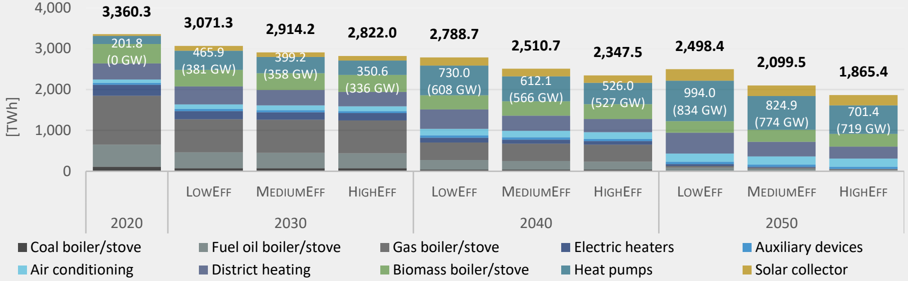
		Cost-benefit analysis (CBA)	Multi-criteria analysis (MCA)
Outline	Approach	Quantification of impacts as costs and benefits expressed in monetary units	Merging of quantitative and qualitative impacts through scoring and weighting
	Theoretical foundations	Welfare economics	Operational research
	Aggregation of impacts	Monetization	Scoring, weighting
	Performance indicator	Net benefits	Decision ranking
Selected issues	Monetization	► Need for monetization to express costs and benefits in single metric	► No need for monetary valuation
	Overlapping impacts	► Expression in single monetary unit requires thorough check for overlaps and double-counting	► Overlaps can be a problem if multiple similar metrics are used on criteria
	Stakeholder involvement	► Possible but not required	► Formal part of decision-making process
	Distributional effects	► Not a standard feature of CBA, but suitable methods exist	► Can be clearly accommodated
	Discounting	► Controversial selection of discount rates in assessing costs and benefits	► No dealing with issues of time and discounting
Practical use	Possible coverage of impacts	► Advanced methods for nearly all relevant MI; broader problem is overlaps	► Wide applicability to different impacts, also integrating non-quantifiable ones
	Ease of use	► Dedicated methods and expertise needed per impact	► Lengthy consensus necessary to value impacts and impute weightings
	Ease of communication	► Simple: ability to express all impacts in single unit	► Intransparent and subjective if scoring and weighting is primarily based on experts' preferences

► problematic | ► occasionally problematic | ► unproblematic

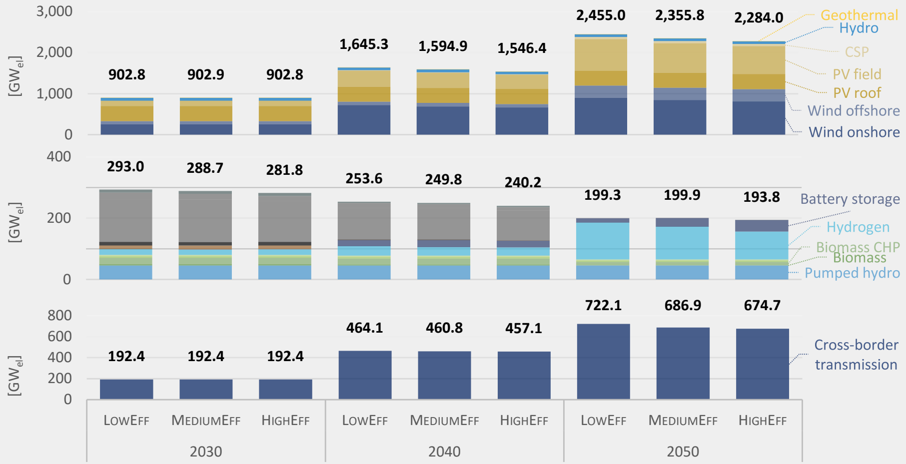
02 | Practice: Multiple impacts in model-based assessment for EU-27

Introducing the ENEFIRST scenarios

Final energy demand for heating and cooling by technology in EU-27 [TWh]



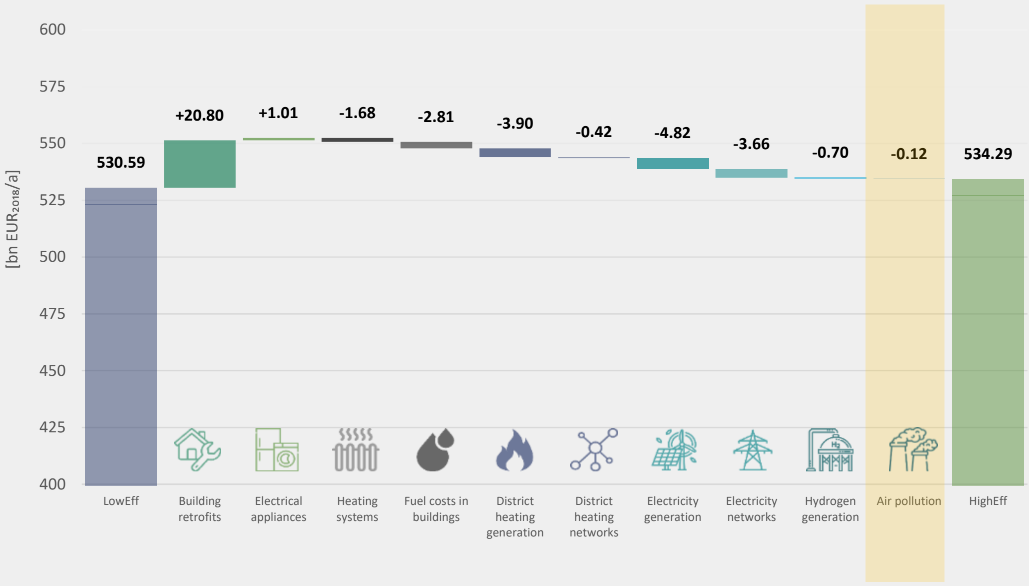
Installed capacities for electricity



ENEFIRST (2022): Quantifying Efficiency First in EU scenarios: implications for buildings and energy supply. Deliverable D3.3 of the ENEFIRST project. Brussels: ENEFIRST Project. Available online at http://enefirst.eu, checked on 3/31/2022.

Air pollution impacts

Decomposition of average energy system cost in EU-27 (2020–2050)



Cumulative emissions and damage cost from air pollution in EU-27

Scenario	Emission source	Cumulative emissions (2020–2050) ($t_{emission}$)			
		NMVOC	*NO_X*	*PM*	*SO_2*
LowEff	Buildings	573,046	6,897,457	932,037	2,702,254
	Energy supply	132,274	4,839,720	68,849	1,163,315
MediumEff	Buildings	571,072	6,855,804	941,435	2,701,009
	Energy supply	127,892	4,697,482	67,727	1,161,958
HighEff	Buildings	570,133	6,859,144	957,270	2,701,942
	Energy supply	121,624	4,494,603	66,048	1,156,071

Scenario	Emission source	Cumulative damage cost (2020–2050) ($bn\ EUR_{2018}/a$)				
		Biodiversity losses	*Crop damage*	*Health damage*	*Material damage*	***Total***
LowEff	Buildings	0.570	0.153	4.206	0.049	**7.317**
	Energy supply	0.422	0.115	1.772	0.030	
MediumEff	Buildings	0.567	0.152	4.201	0.049	**7.259**
	Energy supply	0.412	0.112	1.736	0.030	
HighEff	Buildings	0.568	0.152	4.216	0.049	**7.199**
	Energy supply	0.398	0.107	1.681	0.029	

SO2 = sulfur dioxide, NOX = nitrogen oxide, PM = particulate matter, NMVOC = volatile organic compounds without methane

Conclusions

- Solving the trade-off between system resources implies a fair comparison that is not limited to financial costs, but also includes intangible socio-environmental effects in the form of MIs.
- Assessing the relative merits of resource options in impact assessments, infrastructure investment and other decision-making contexts requires some form of aggregation of MIs.
- Relevant decision-support frameworks for this purpose include cost-benefit analysis, multi-criteria analysis and a range of miscellaneous indicator-based approaches. In itself, each of these frameworks has critical limitations and none of them can replace human judgement.
- Inclusion of air pollution impacts slightly improves the cost-effectiveness of building retrofits and other end-use energy efficiency measures from a societal viewpoint in achieving net-zero GHG emissions by 2050

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Merci !

Tim Mandel
tim.mandel@isi.fraunhofer.de

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