

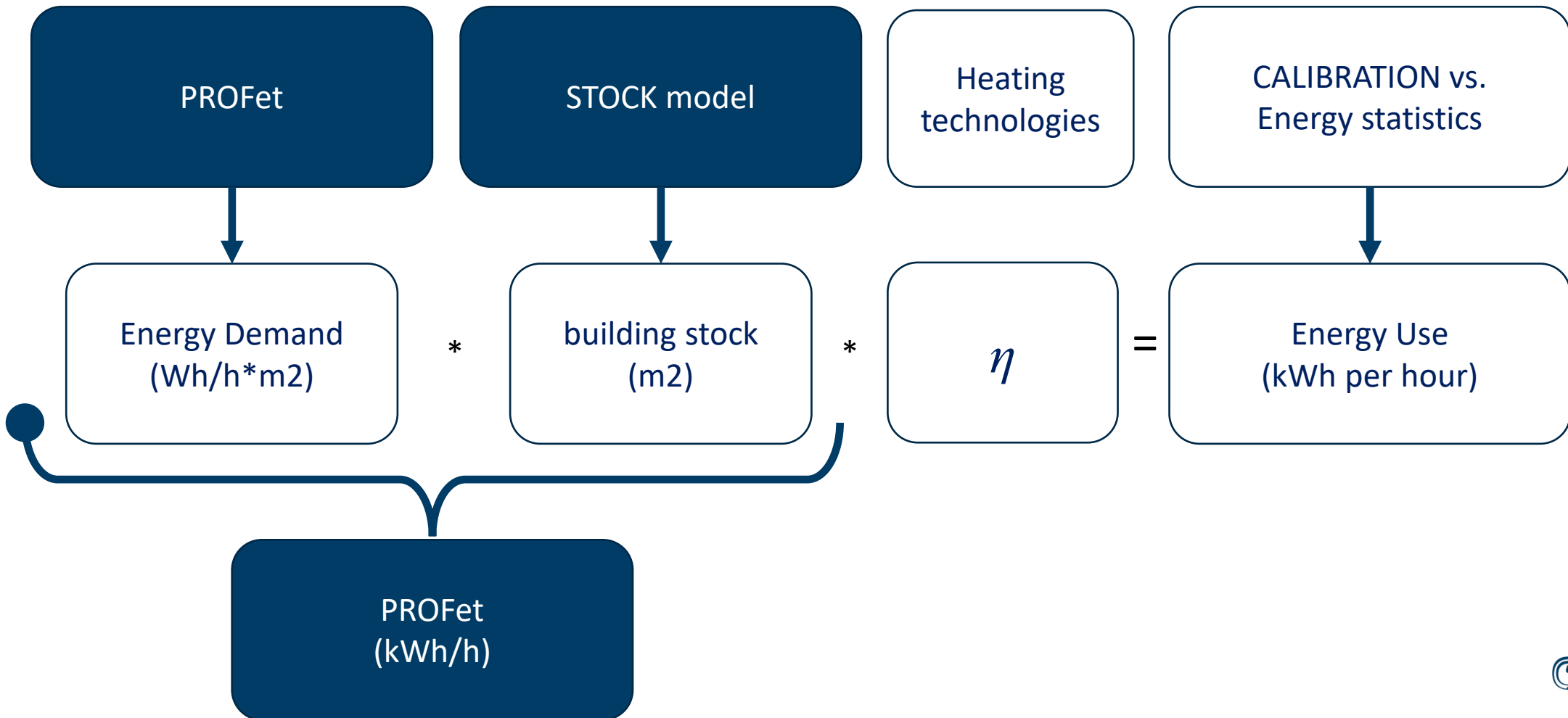


— 70 years —
1950-2020

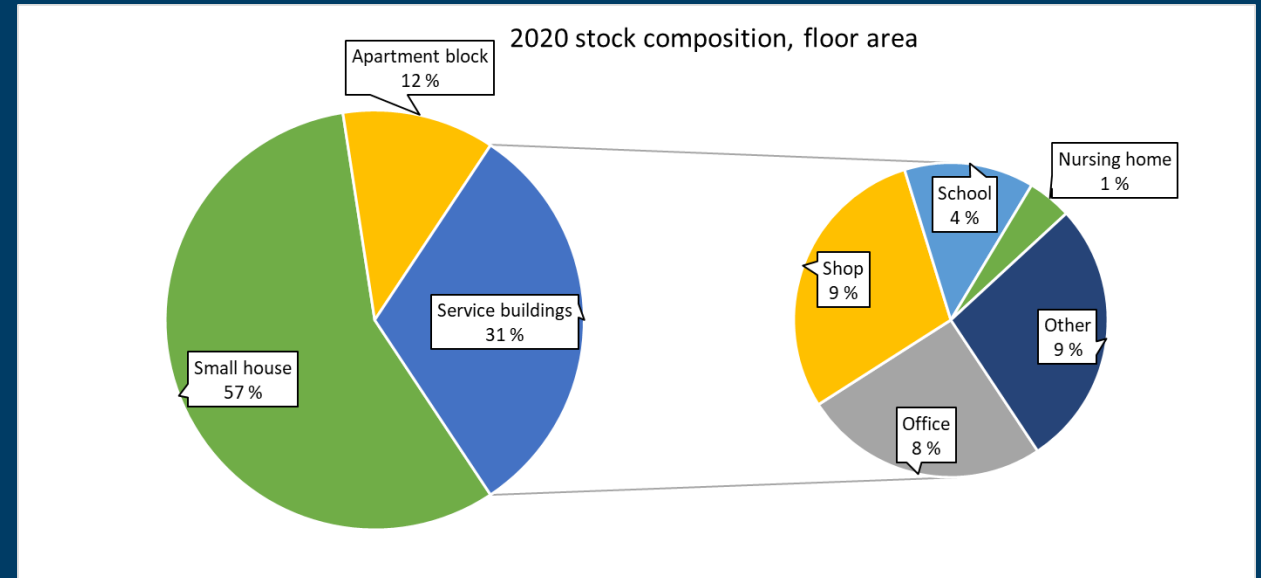
BUILDING STOCK EVOLUTION AND CALIBRATION

Flexbuild Workshop 9 March 2021

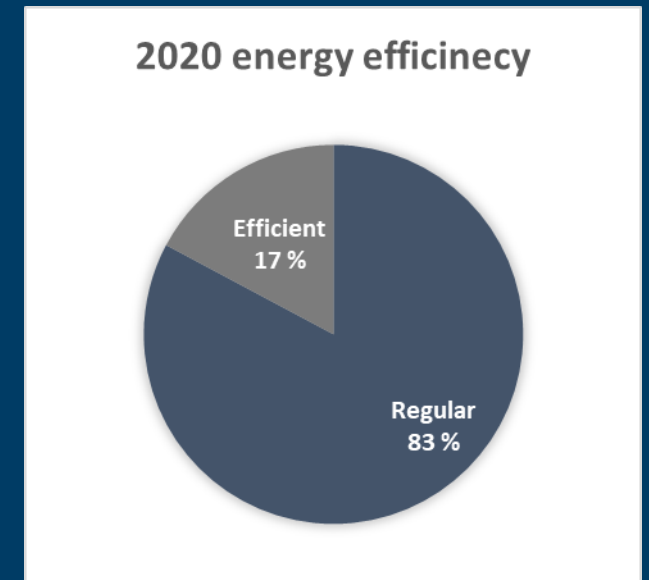
Methodology



Building stock



- 2020: 386 million m²
- Small house, apartment block, service buildings
- 2020-2050
 - New: efficient or very efficient
 - Renovated: regular or efficient
 - Unchanged: regular



Building stock model: RE-BUILDS

Nina Holck Sandberg

Dynamic modelling of national dwelling stocks
 Understanding phenomena of historical observed energy demand and future estimated energy savings in the Norwegian dwelling stock

Doctoral thesis
 Trondheim, March 2017

Norwegian University of Science and Technology
 Faculty of Engineering Science and Technology
 Department of Energy and Process Engineering
 Industrial Ecology Program

Oslo University of Applied Sciences
Energy Policy
 Journal homepage: <http://www.osloia.hogskulen.no/energi>

Large potentials for energy saving and greenhouse gas emission reductions from large-scale deployment of zero emission building technologies in a national building stock

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ABSTRACT

Keywords: Potential energy savings, Zero emission building technologies, Domestic energy, Energy saving potential, GHG emissions energy potential, GHG emissions

1. Introduction

The building sector accounts for almost one third of the total global final energy use and more than half of the final electricity demand. About one fourth of global direct and indirect greenhouse gas (GHG) emissions originate from the building sector (International Energy Agency 2011). The UN Agenda 2030 policy, with Sustainable Development Goal 13, sets global targets to reduce climate change (United Nations, 2015), and the Paris Agreement sets targets to limit global warming to well below 2 °C by 2100 compared to pre-industrial levels, which requires a rapid decline in global GHG emissions (Pongracz et al., 2015).

The building sector can contribute significantly to reduce climate change mitigation targets through large-scale energy efficiency measures and decarbonizing its final energy use (Gustavsen et al., 2016). Mitigation pathways consistent with a 2 °C future in integrated assessment models are reliant on a large-scale decarbonization of the global building sector and an energy efficiency (improvement of building envelopes and appliances (Kemp et al., 2011), especially, the need for pushing zero and near-zero building standards becomes particularly more important to low energy demand countries (building sector climate targets without using negative emissions technologies (Gustavsen et al., 2017)).

Aggregated GHG emissions from the building sector towards 2100 will likely depend on predicted scenarios and large-scale decarbonization of providing climate change mitigation measures in the remaining years. The long lifetime and renovation cycle of buildings can create specific risk factors related to the conventional Energy Agency (2007) assumptions for used for a rapid large-scale construction of high performance buildings to build a better building for the future. A ten-year study of action will result in an aggregated global energy use towards 2060 that corresponds to three times of additional energy occupancies in the building sector. Transitioning to new ways to

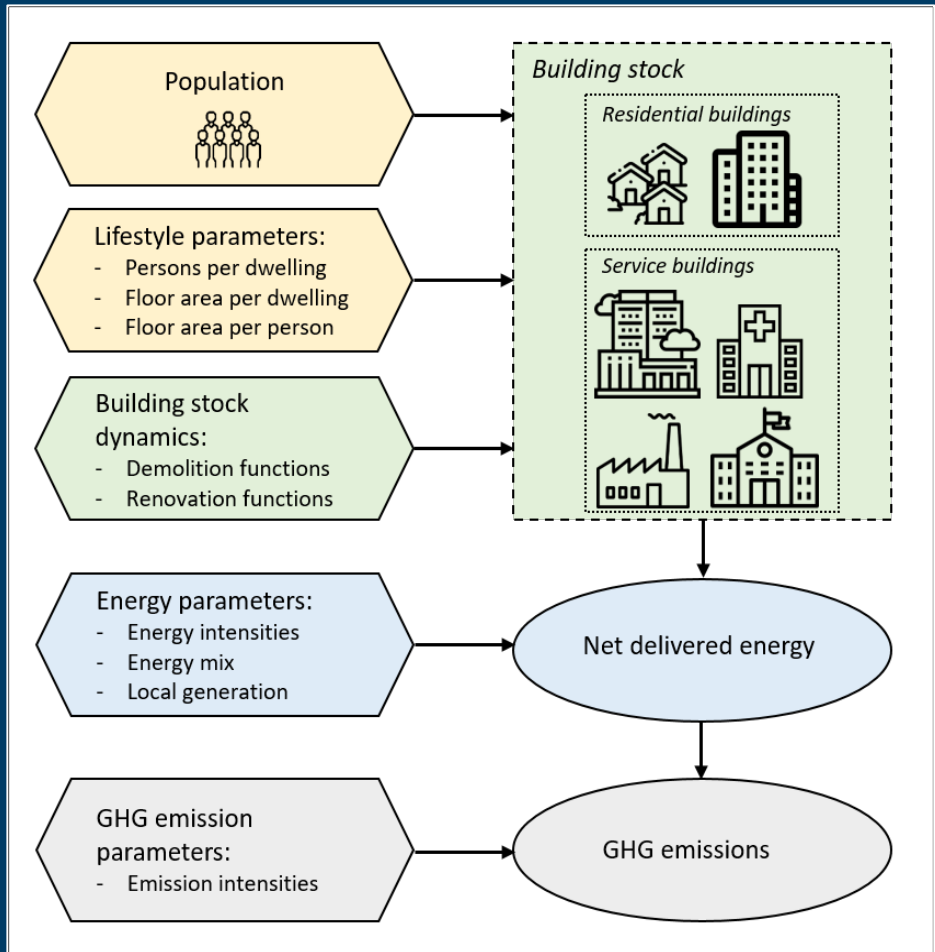
SINTEF

Potensial- og barrierestudie
 Energitjenester i næringsbygg

Forfatter
 Kristin Fjellheim, Synne Craxing Lars, Harald Væst Walnum,
 Nina Holck Sandberg, Caroline Chang, Gystein Fjellheim

Oppdragsgjver
ENOVA SINTEF Community
 2019-11-30

TEKNOLOGI FOR ET BETDRE SAMFUNN

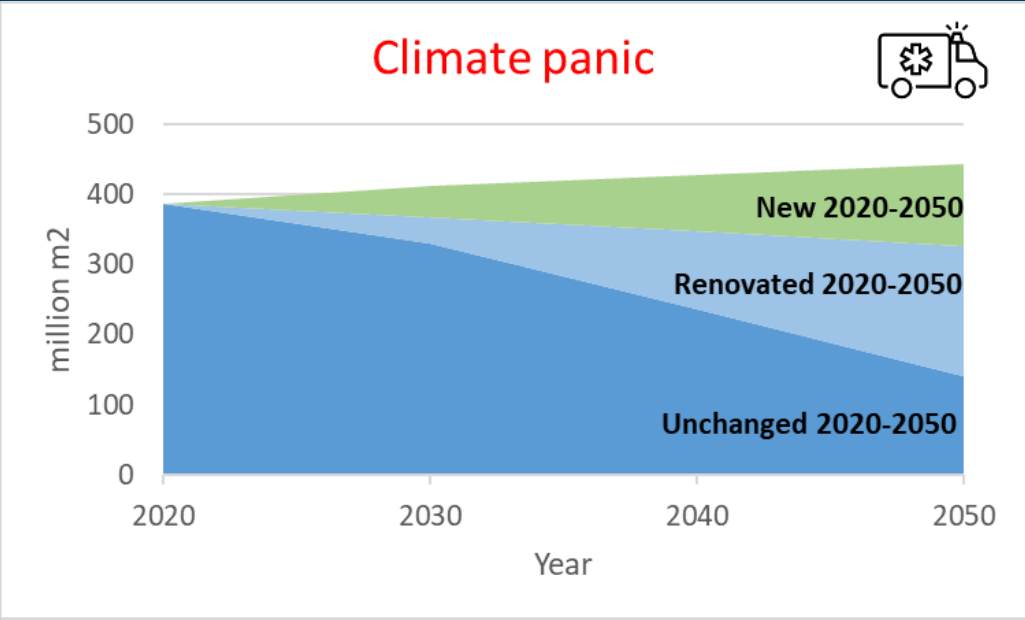
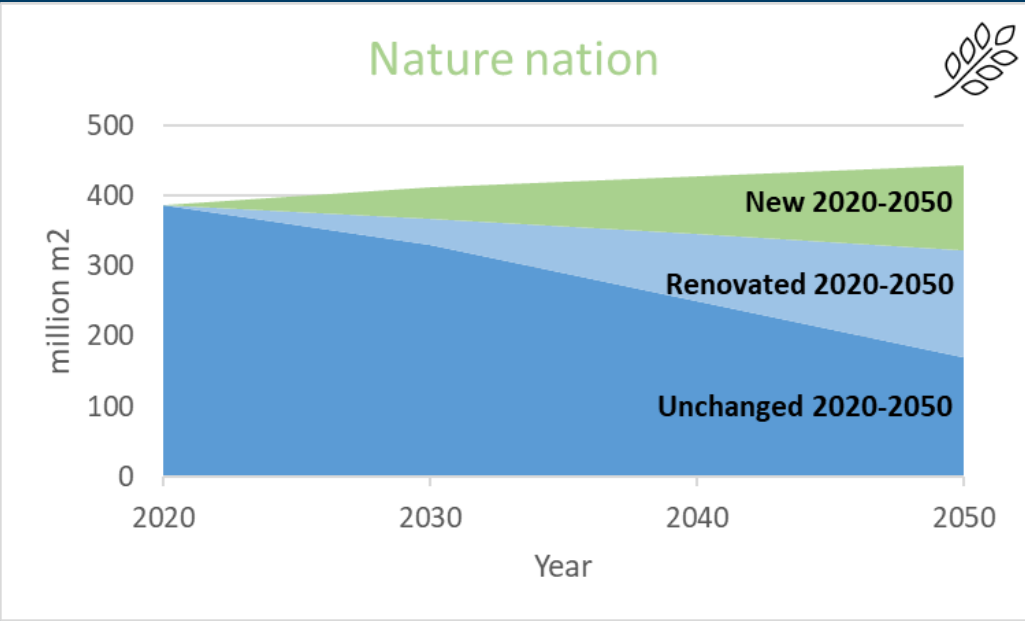
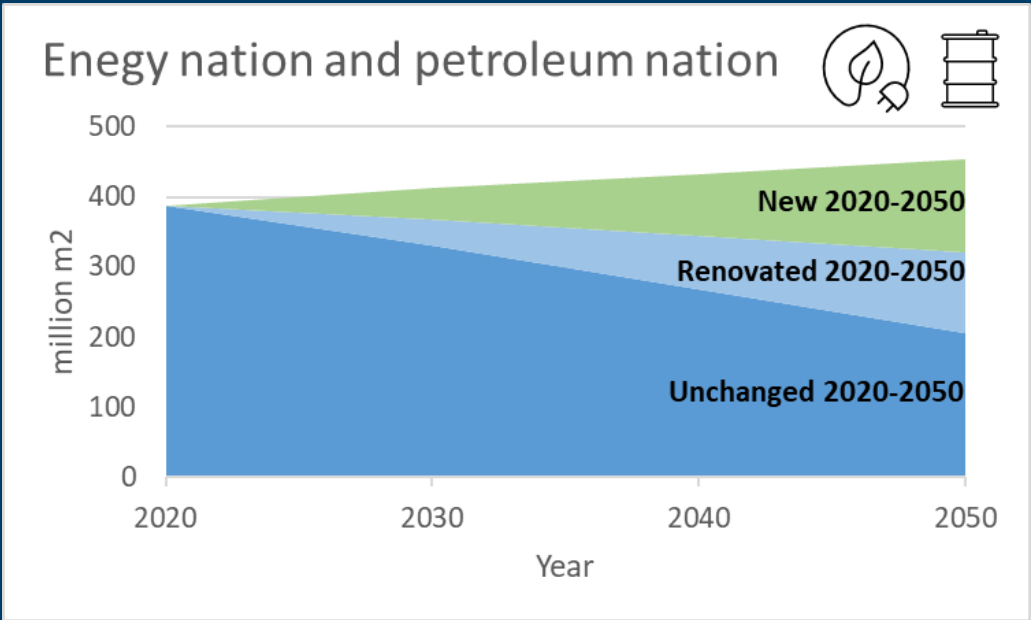


Building stock

Storyline assumptions 2020-2050

Storyline assumptions	Energy nation		Petroleum nation		Nature nation		Climate panic	
	2020-2029	2030-2050	2020-2029	2030-2050	2020-2029	2030-2050	2020-2029	2030-2050
Share of new being Efficient	100.0 %	0.0 %	100.0 %	100.0 %	50.0 %	0.0 %	100.0 %	0.0 %
Share of new being Very efficient	0.0 %	100.0 %	0.0 %	0.0 %	50.0 %	100.0 %	0.0 %	100.0 %
Share of renovated being Regular after renovation	80.0 %	67.0 %	80.0 %	80.0 %	50.0 %	50.0 %	80.0 %	0.0 %
Share of renovated being Efficient after renovation	20.0 %	33.0 %	20.0 %	20.0 %	50.0 %	50.0 %	20.0 %	100.0 %
Renovation rate, service buildings	1.3 %	1.5 %	1.3 %	1.5 %	1.3 %	2.1 %	1.3 %	2.6 %
Renovation rate with energy-efficiency rate, service buildings	0.3 %	0.5 %	0.3 %	0.3 %	0.7 %	1.0 %	0.3 %	2.6 %
Demolition rate, service buildings	0.5 %	0.5 %	0.5 %	0.5 %	0.5 %	0.5 %	0.5 %	0.4 %
Construction rate, service buildings	1.1 %	0.9 %	1.1 %	0.9 %	1.1 %	0.9 %	1.1 %	0.8 %
Renovation rate, dwelling stock	0.9 %	0.9 %	0.9 %	0.9 %	0.9 %	1.5 %	0.9 %	2.0 %
Renovation with energy efficiency rate, dwelling stock	0.2 %	0.3 %	0.2 %	0.2 %	0.5 %	0.8 %	0.2 %	2.0 %
Demolition rate, dwelling stock	0.6 %	0.7 %	0.6 %	0.7 %	0.6 %	0.7 %	0.6 %	0.7 %
Construction rate, dwelling stock	1.4 %	1.4 %	1.4 %	1.4 %	1.4 %	1.4 %	1.4 %	1.4 %
Average floor area per person, dwelling stock (m2)	50.7	52.1	50.7	52.1	50.6	51.2	50.7	51.4

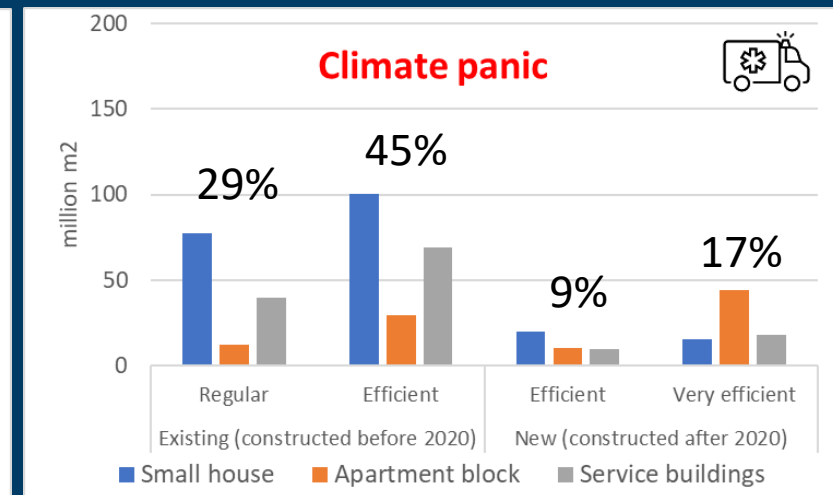
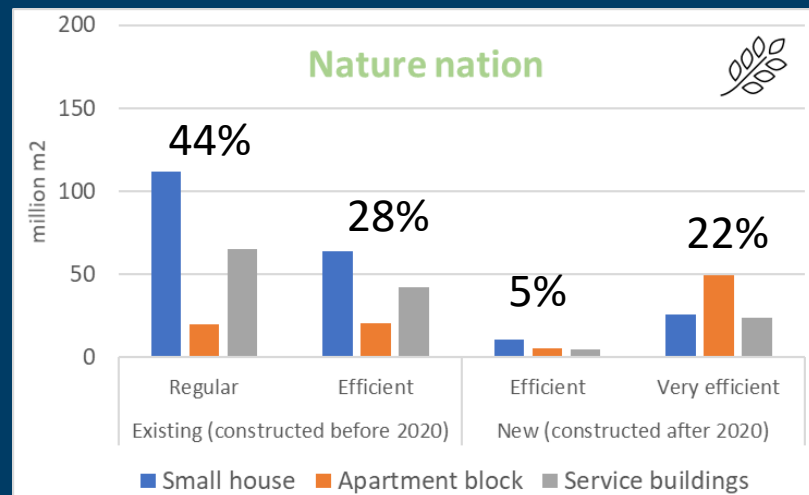
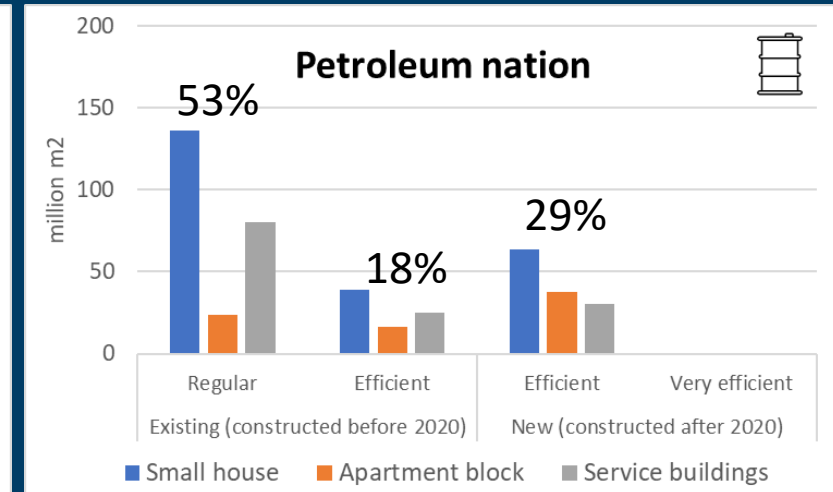
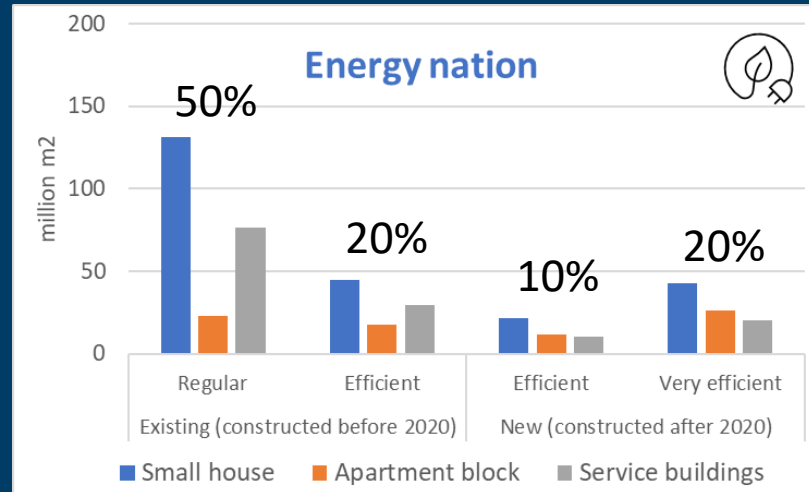
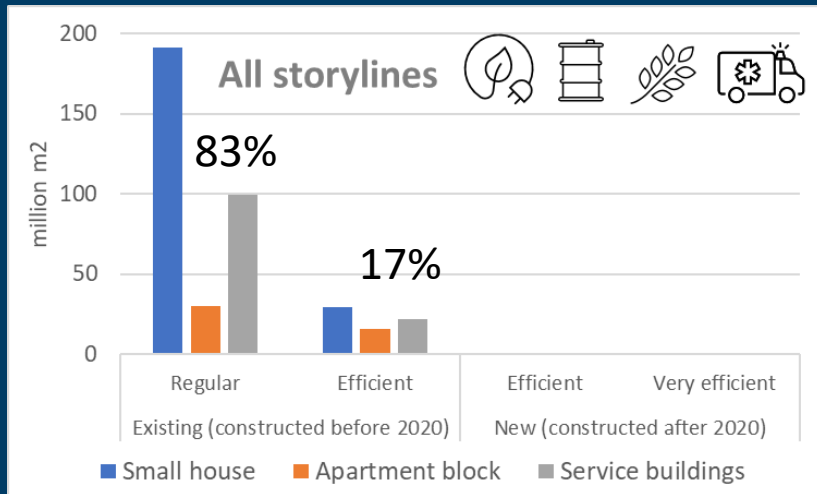
Building stock development 2020-2050



Energy efficiency (m²)

2050

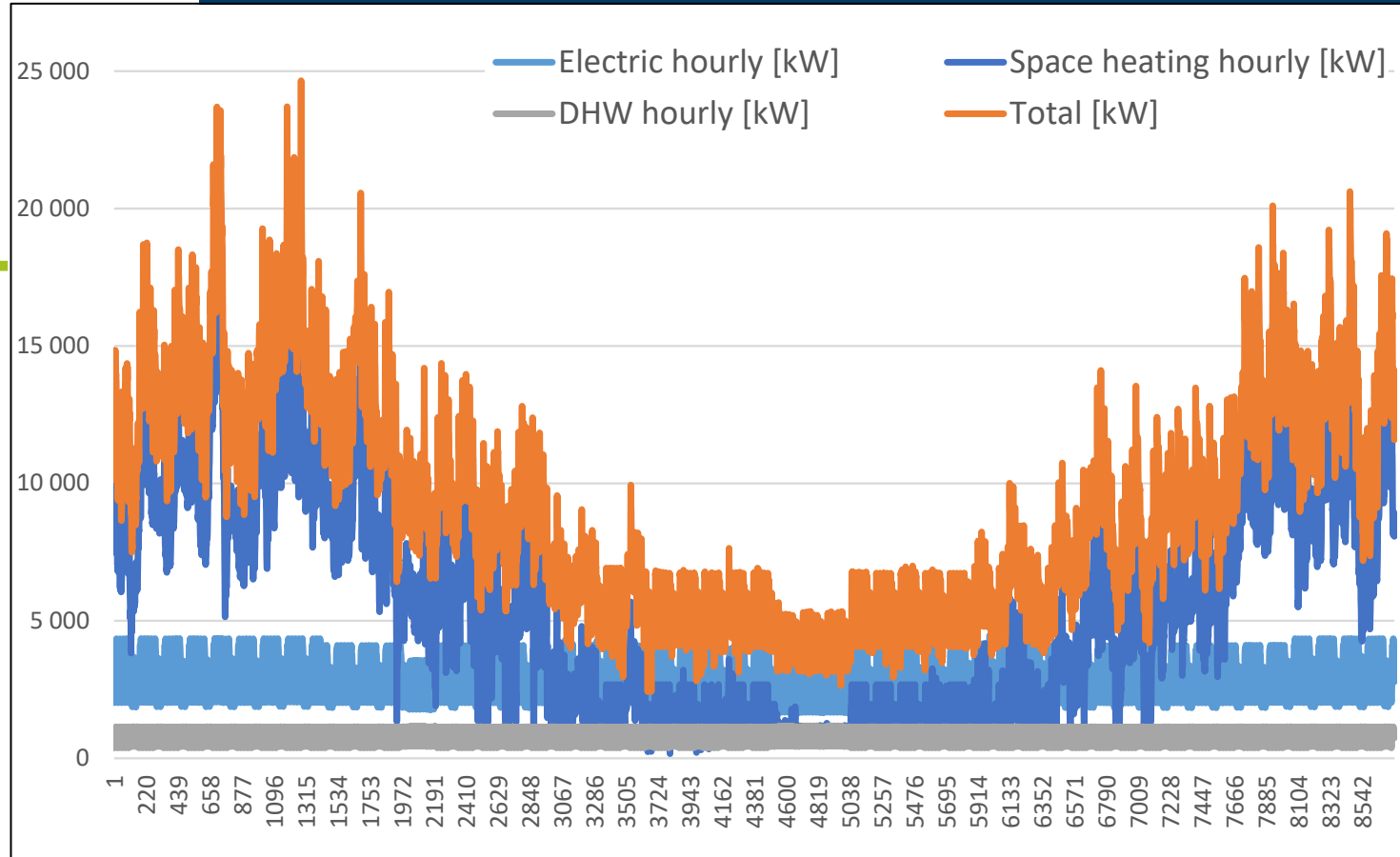
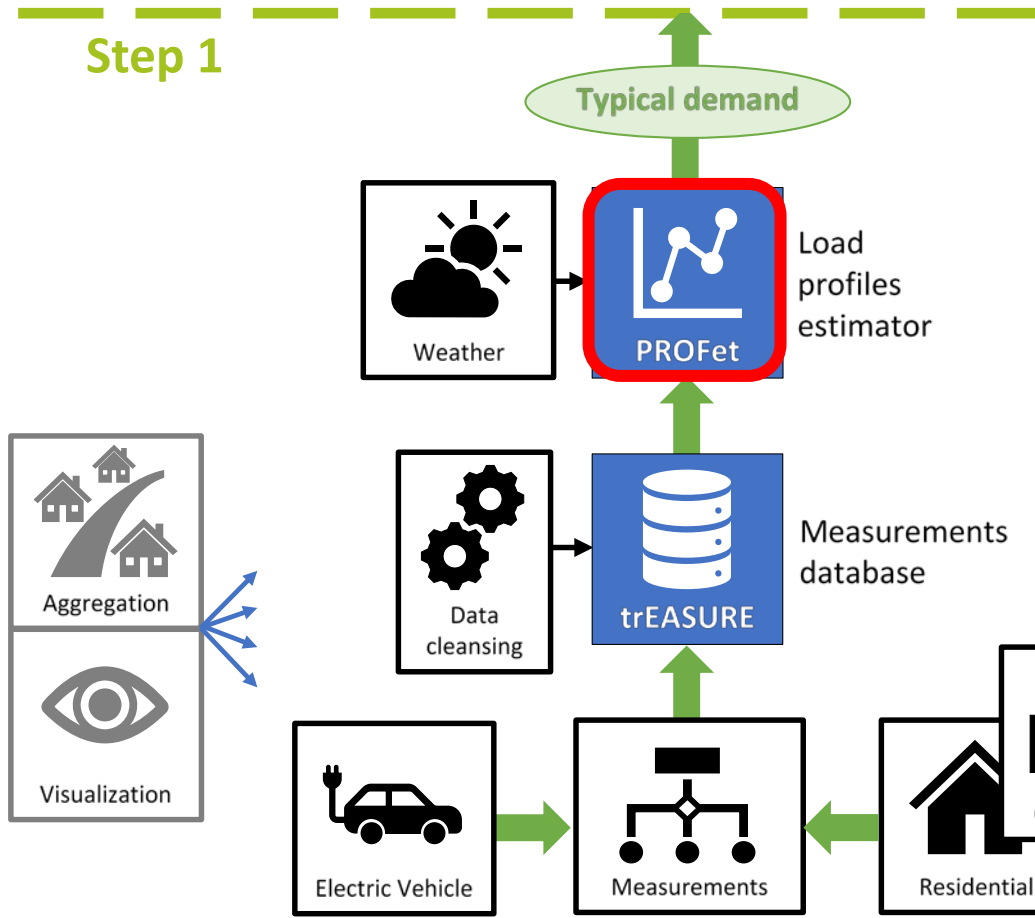
2020



PROFet

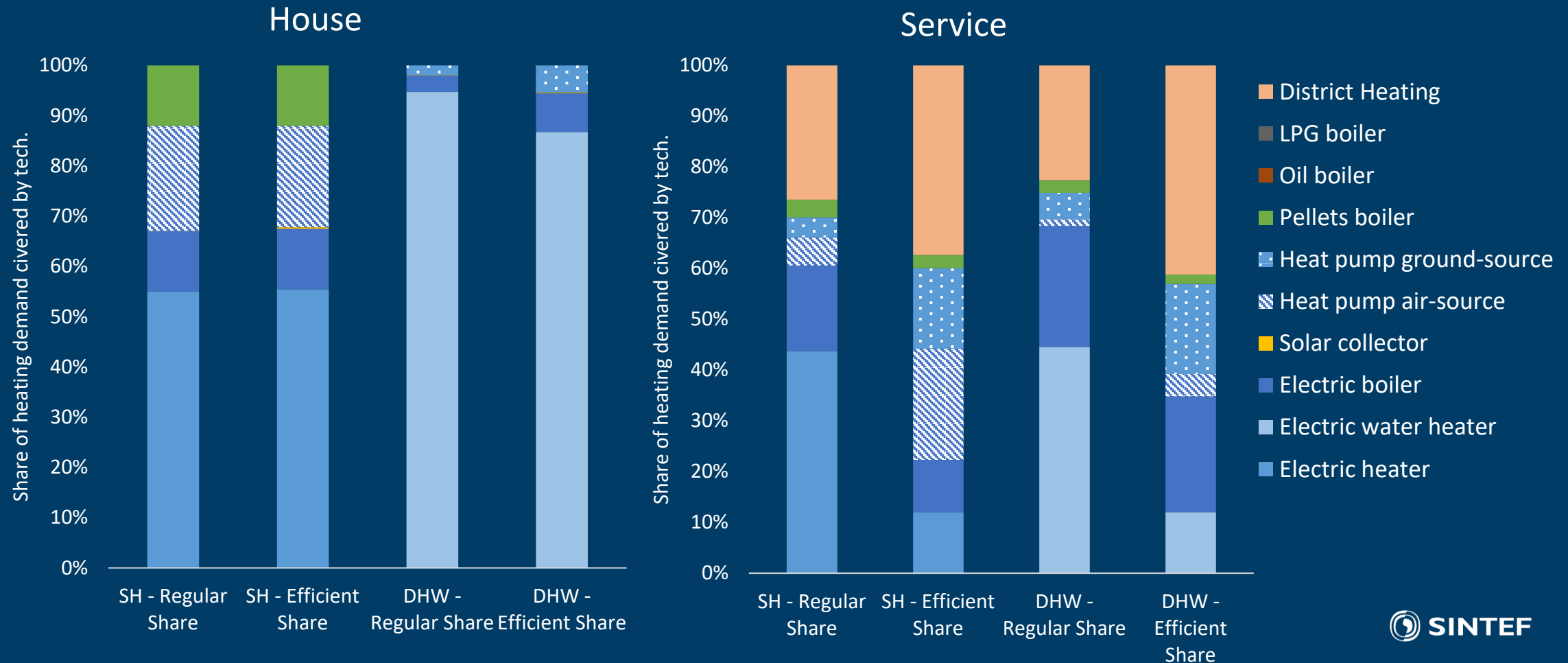
energy demand load profiles estimator

Step 1

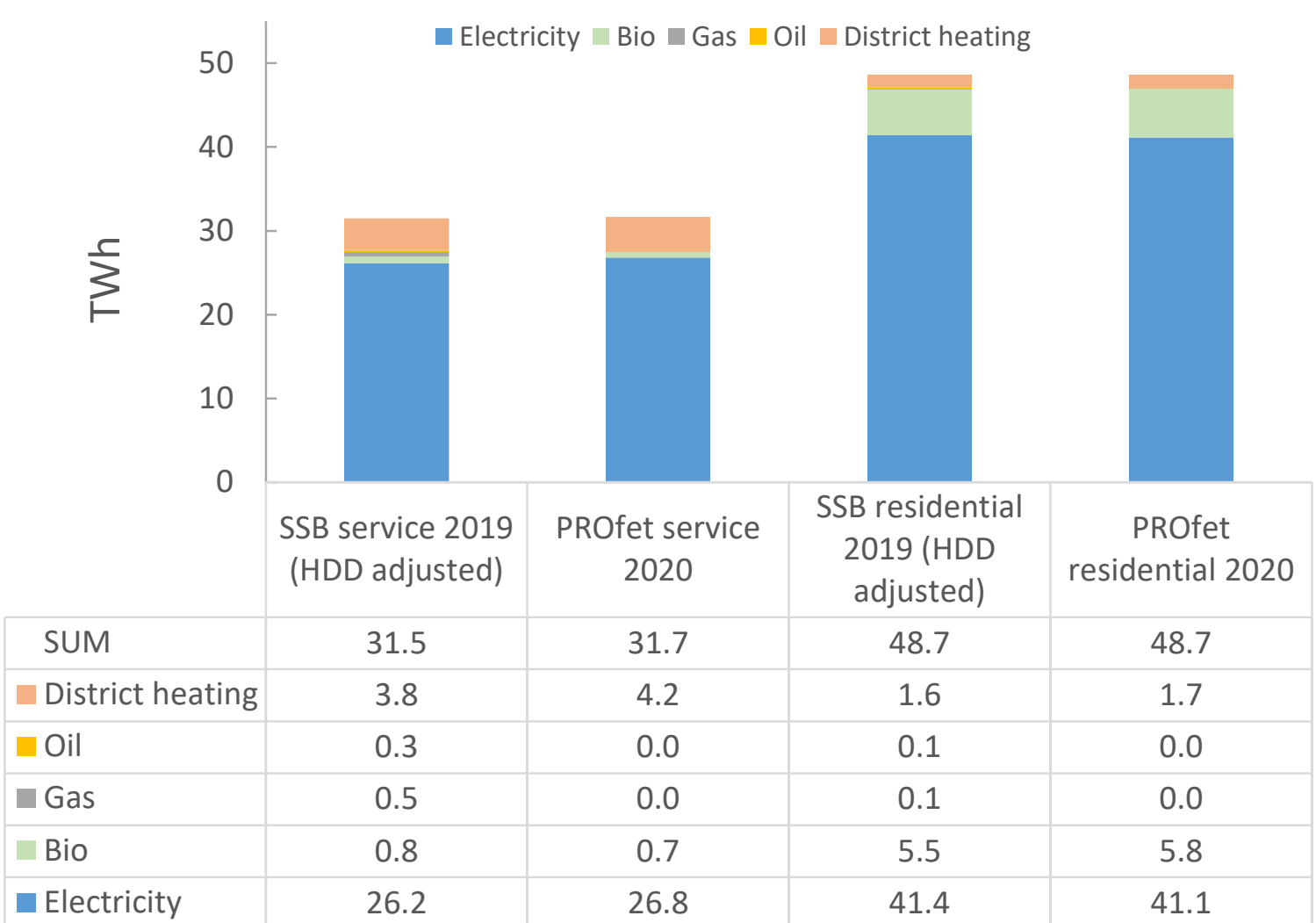


Heating technologies 2020

- Sources: Based on "Potensial og Barrierestudien 2021" (SINTEF, ENOVA)

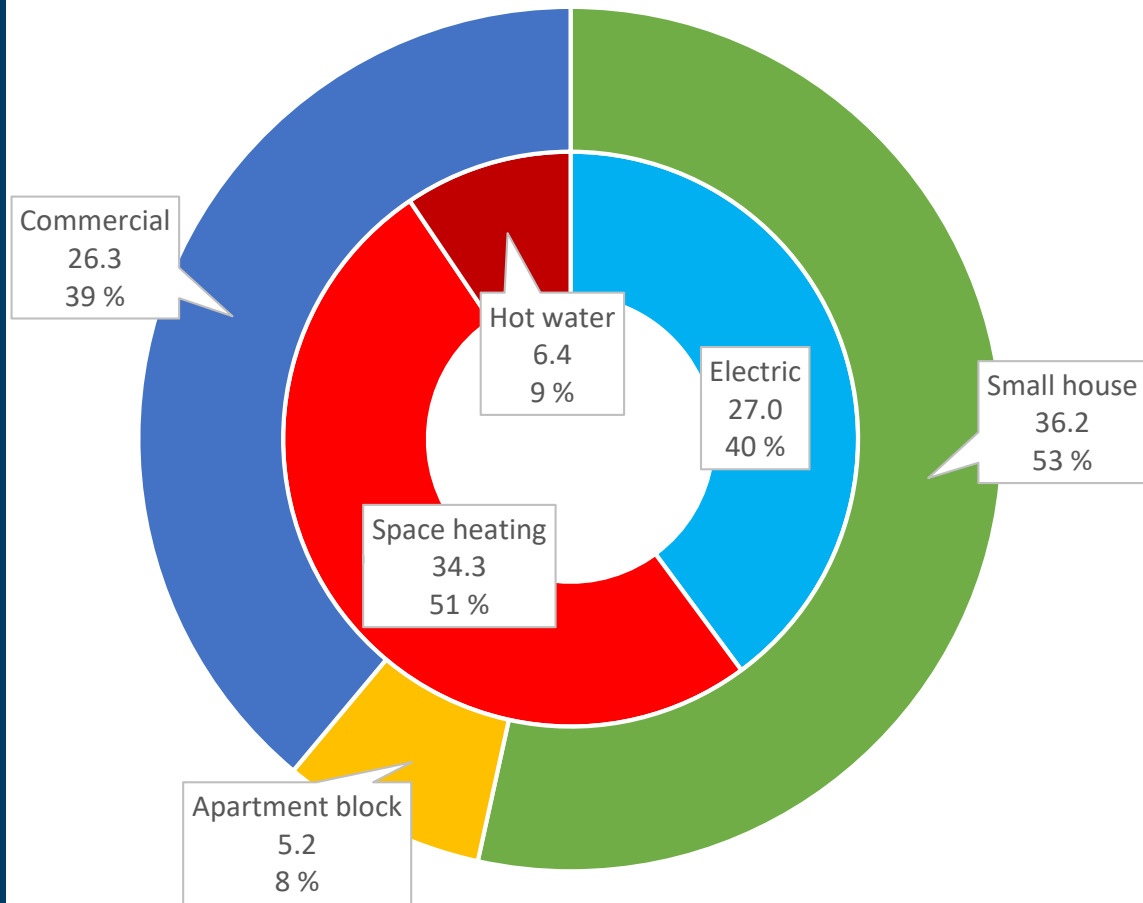


Calibration Results in year 2020

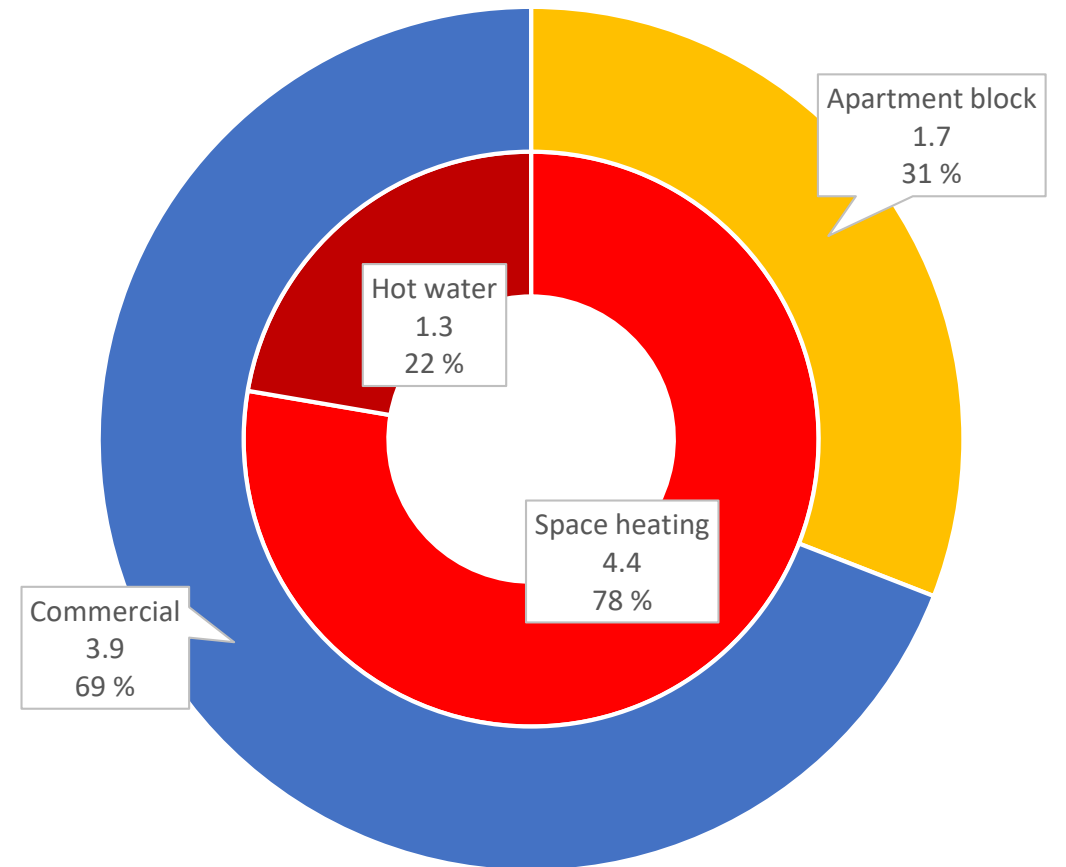


Energy use in 2020

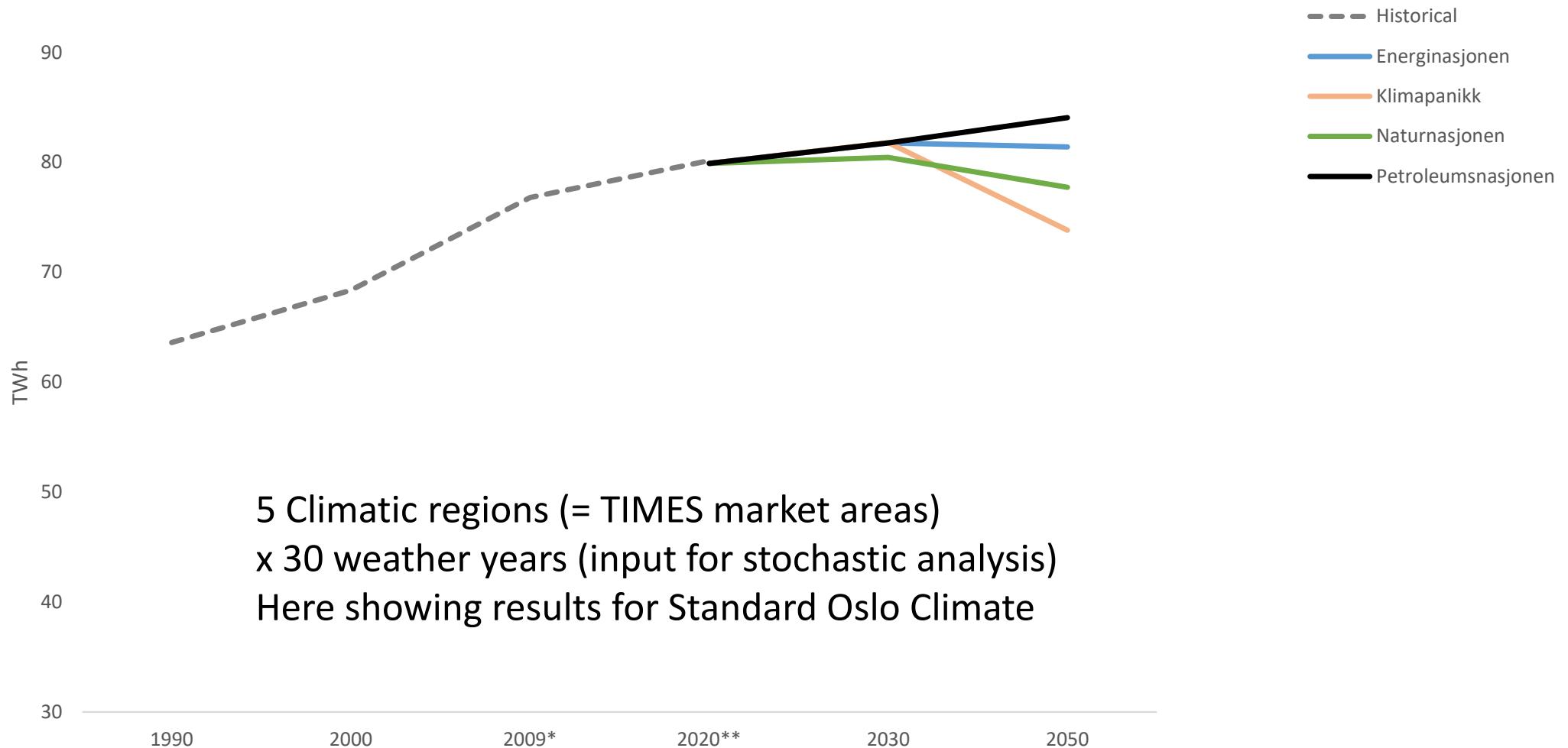
Electricity use, per Building type & Energy service [TWh, %]



District Heating use, per Building type & Energy service [TWh, %]

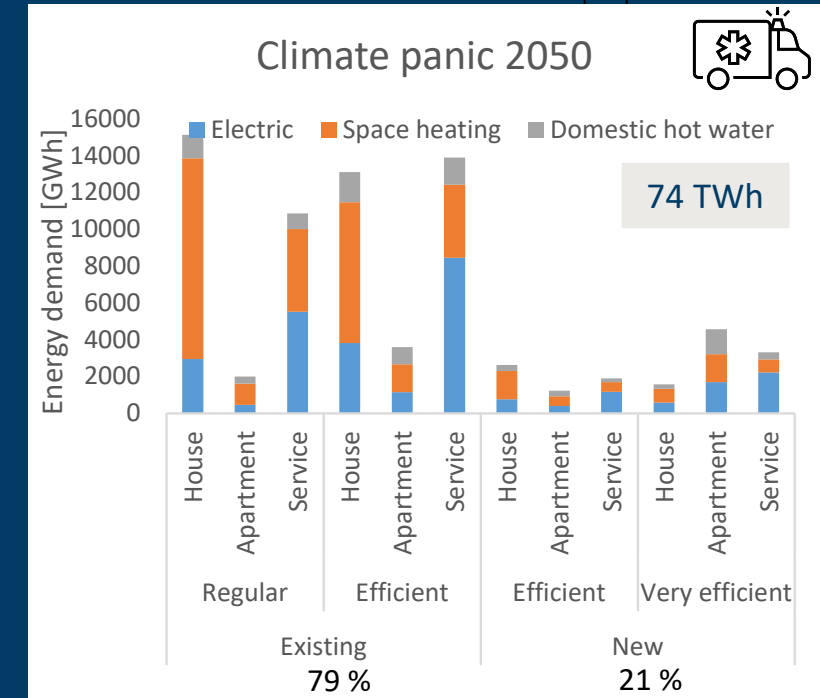
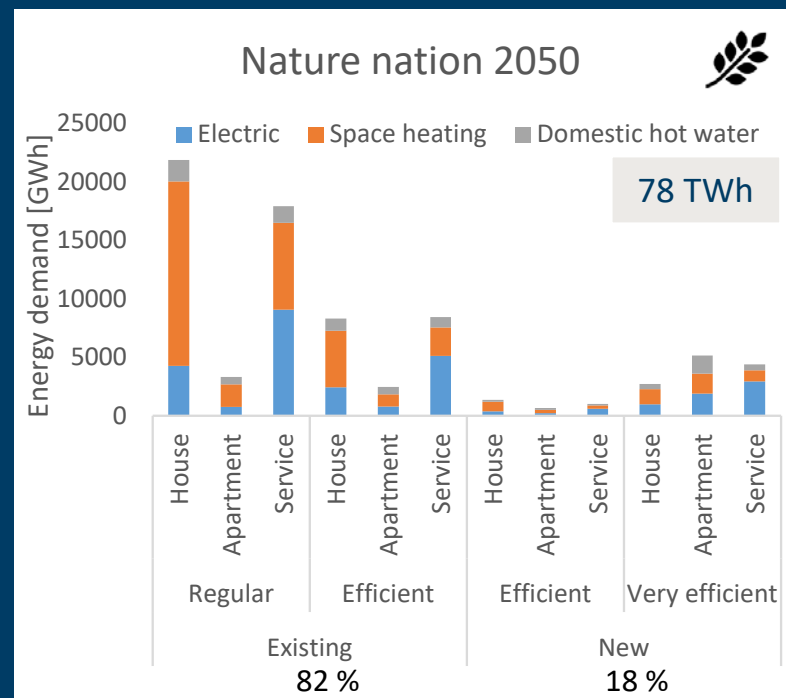
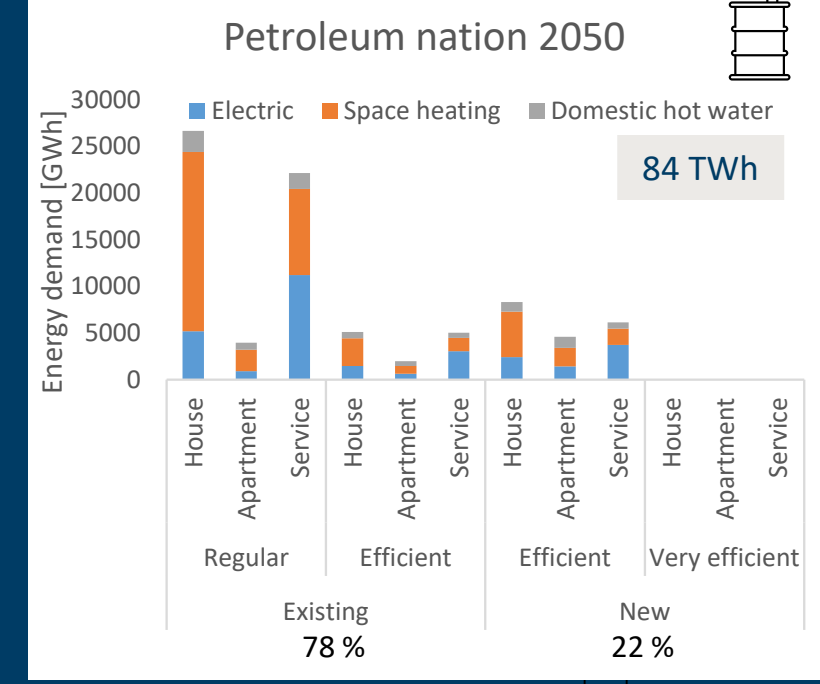
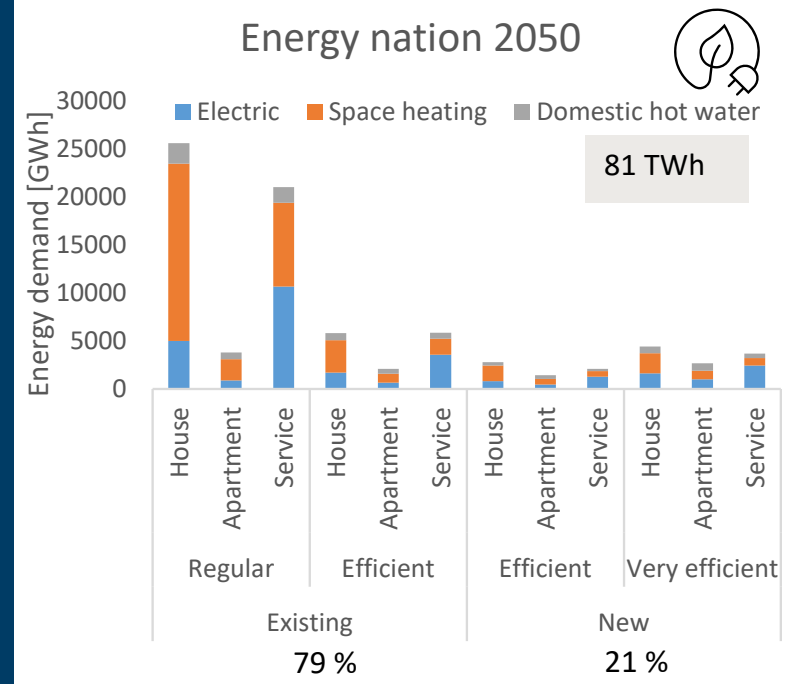
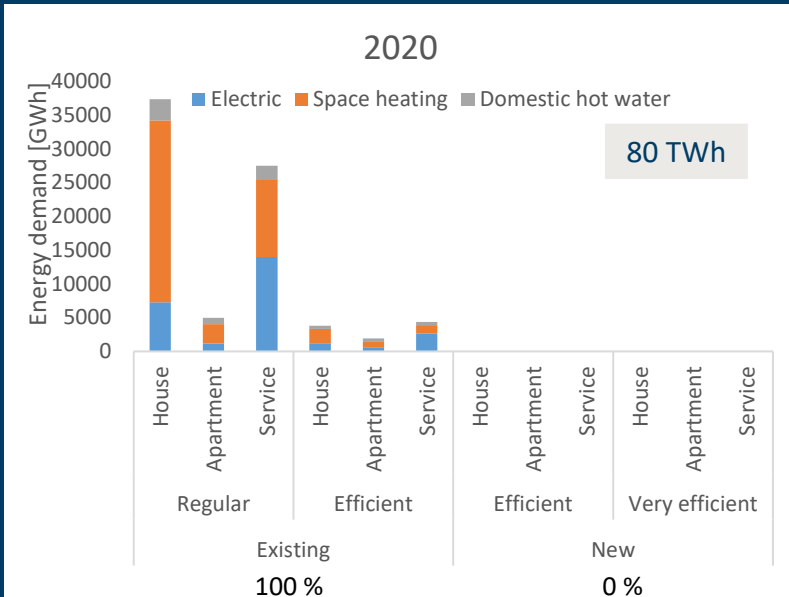


Building stock Energy demand development in Storylines



5 Climatic regions (= TIMES market areas)
x 30 weather years (input for stochastic analysis)
Here showing results for Standard Oslo Climate

Total energy demand





— 70 år —
1950-2020

Teknologi for et bedre samfunn