SO YOU THINK YOU'RE GREEN?

FOCUS ON HOUSING

JANUARY 26 2021 | WEBINAR

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LIVE POLL !

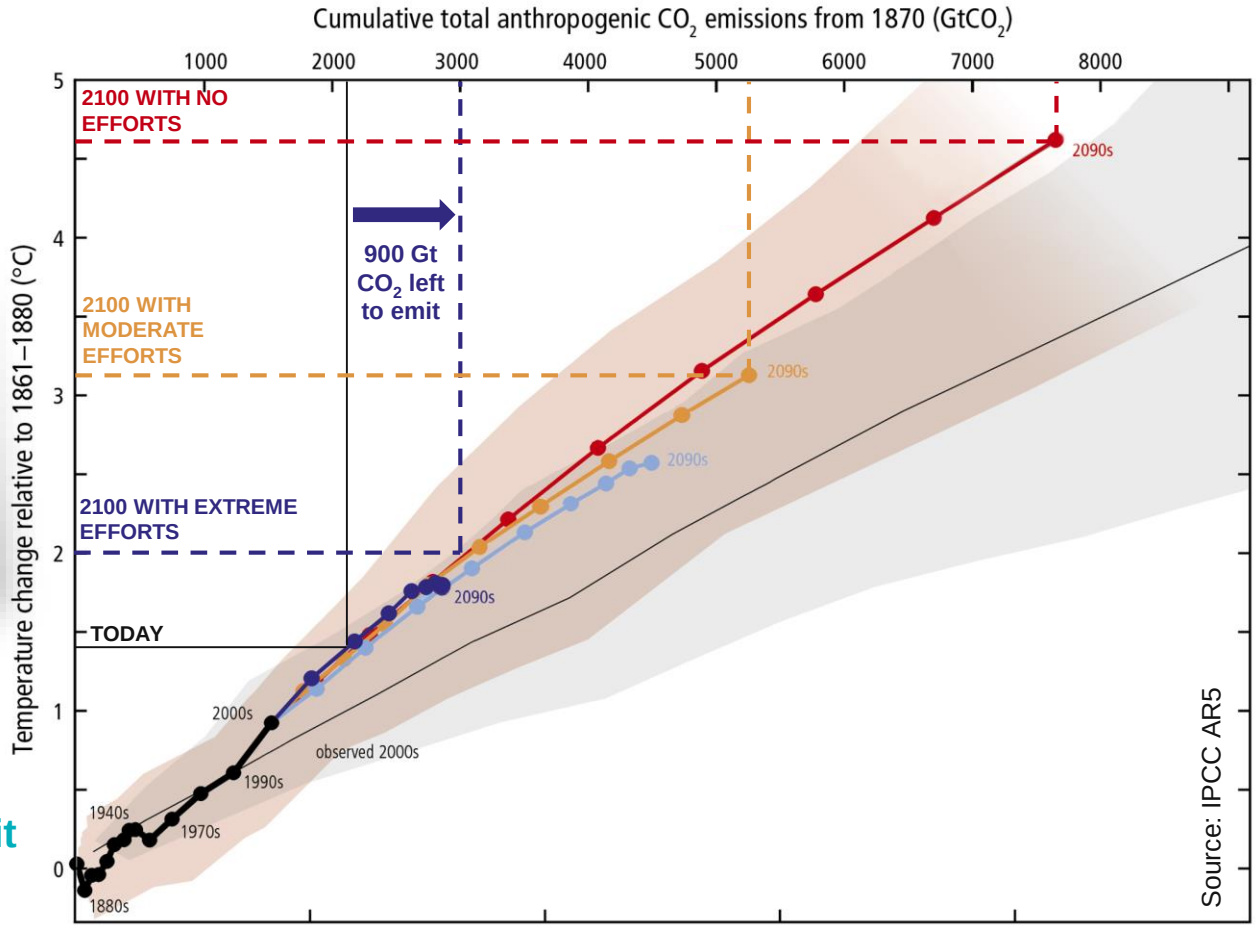
1. CARBON FOOTPRINT

Temperature and CO_2 emissions?

Carbon footprint

The **Paris agreement** is a pledge to remain under **2°C of warming**

This translates roughly into an additional **800-1000 Gt CO_2 left to emit**



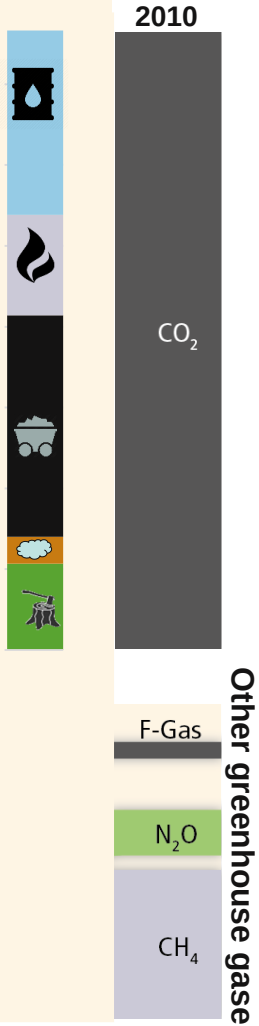
Carbon footprint

Carbon dioxide (1 kg = **1** kg CO_2 eq.)

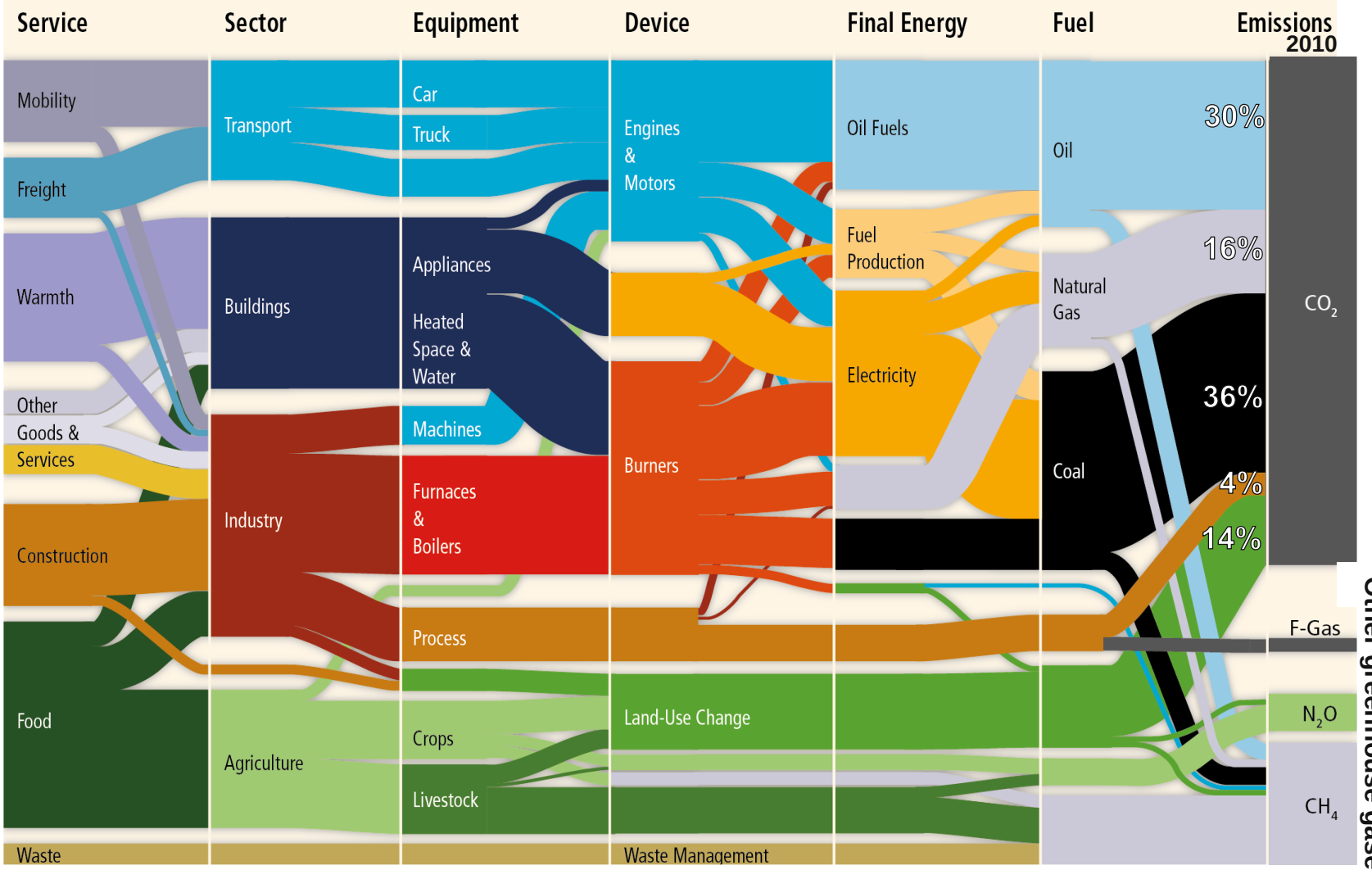
Fluorinated gases (1 kg = **8000-23000** kg CO_2 eq.)

Dinitrogen monoxide (1 kg = **300** kg CO_2 eq.)

Methane (1 kg = **25** kg CO_2 eq.)



Carbon footprint



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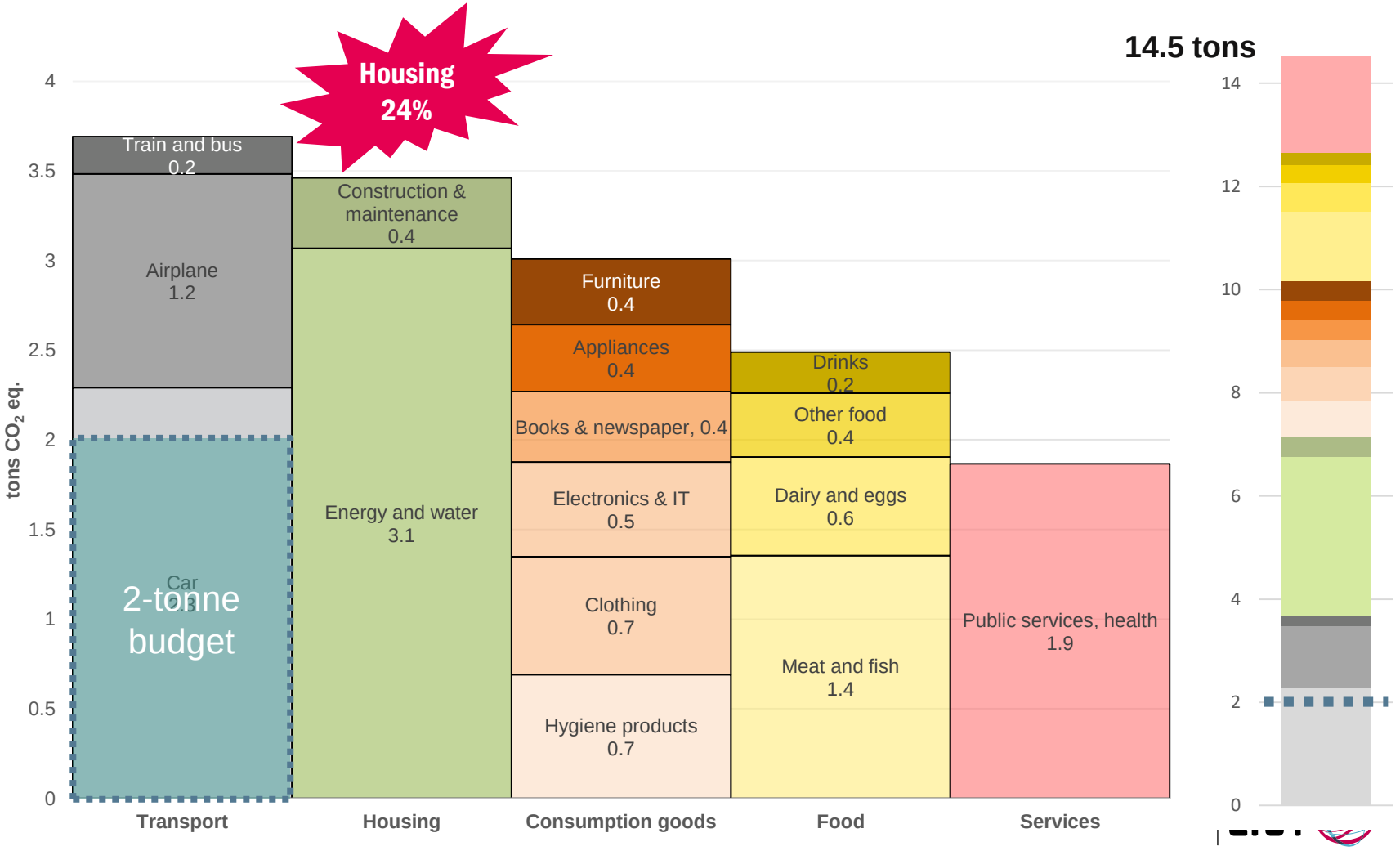
Carbon footprint



Outline

1. CARBON FOOTPRINT
2. HOUSE CARBON PROFILE
3. HEATING
4. ELECTRICITY
5. HOUSE DESIGN

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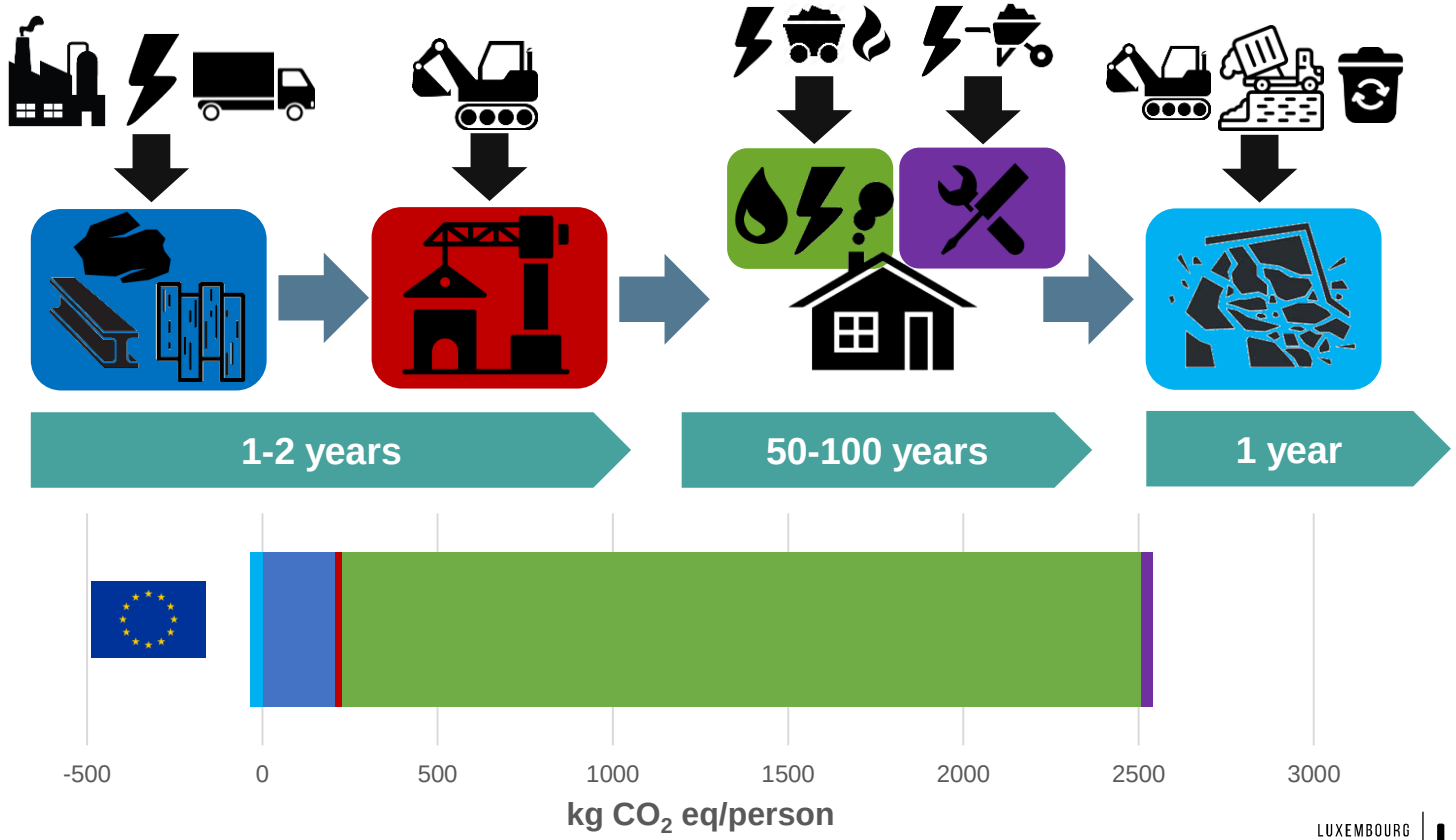
1. CARBON FOOTPRINT

2. HOUSE CARBON PROFILE

Where do greenhouse gases (GHG) come from?

Housing carbon profile



Source: Lavagna et al. (2018)

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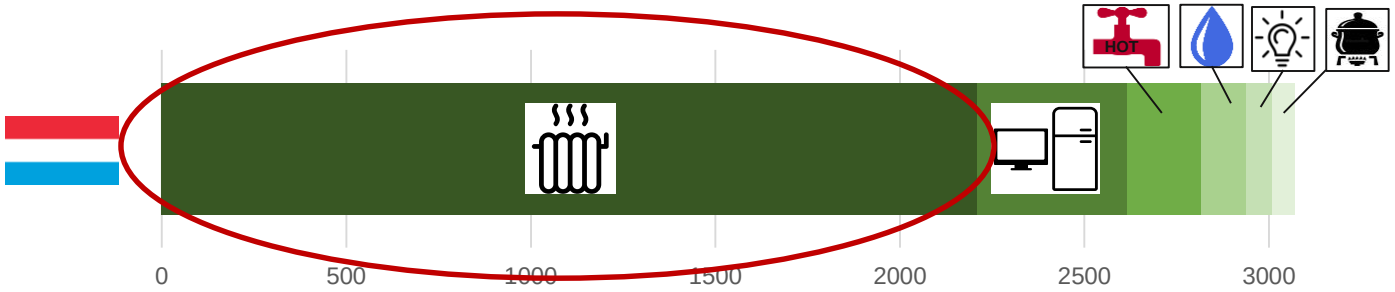
Housing carbon profile

1. Heating
2. Electric appliances
3. Hot water

Households energy use
9915 kWh/p./year
6428 kWh/p./year

Households water use
150 m^3/p./year



64%
Priority for reduction

3.1 tons CO2 eq.
2.3 tons CO2 eq.

Source: Lavagna et al. (2018); Eurostat

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1. CARBON FOOTPRINT

2. HOUSE CARBON PROFILE

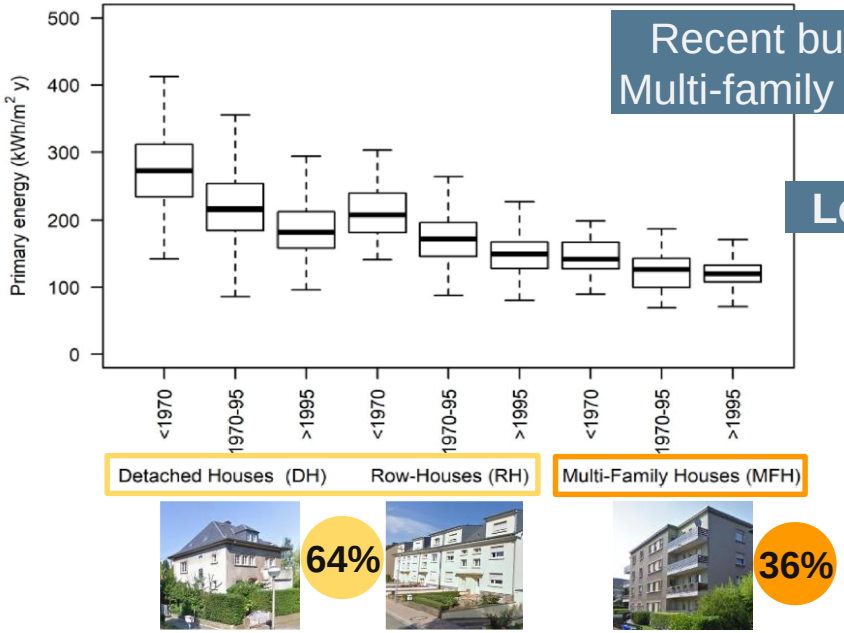
3. HEATING

What influences heating impacts

$$\frac{\textbf{Energy intensity}\ \text{kWh/m}^2\text{/year} \times \textbf{Dwelling size}\ \text{m}^2 \times \textbf{Energy impact}\ \text{kg CO}_2\ \text{eq/kWh}}{\textbf{Occupation rate}\ \text{person/dwelling}}$$

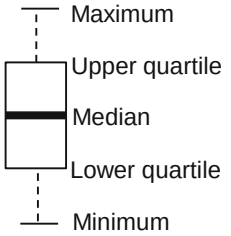
Heating

- Temperature
- House performances



Recent buildings → better insulation
Multi-family house → less exterior walls

Lower energy use



Source: Lavagna et al. (2018); Mastrucci et al. (2020)

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What influences heating impacts

Energy intensity kWh/m²/year **X** **Dwelling size** m² **X** **Energy impact** kg CO_2 eq/kWh

Occupation rate person/dwelling



Tableau 1 : Surface par type de logement, 2012

	Maison isolée	Maison mitoyenne	Appartement
UE-28	127.3	114.6	79.2
Zone €	132.7	115.0	83.0
BE	149.8	129.6	83.4
DE	142.0	126.0	81.5
FR	123.7	104.5	71.4
LU	186.2	157.1	85.9

Source : STATEC, EUROSTAT

2.8 persons

2.4 persons

67 m²/person

57 m²/person

35 m²/person

Source: Lavagna et al. (2018); STATEC (2014)

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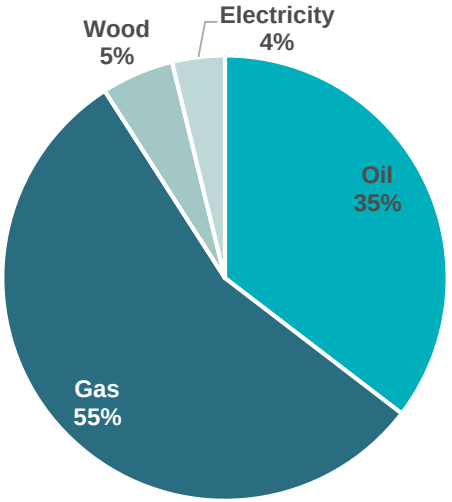
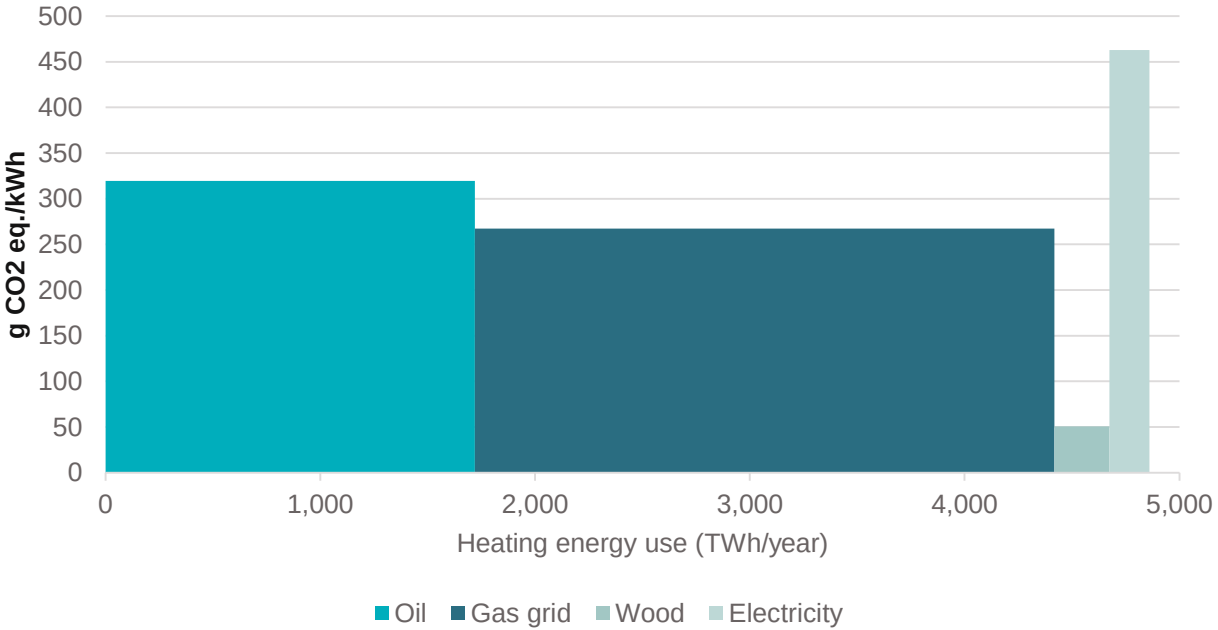
What influences heating impacts

$$\frac{\textbf{Energy intensity}\ \text{kWh/m}^2\text{/year} \times \textbf{Dwelling size}\ \text{m}^2 \times \textbf{Energy impact}\ \text{kg CO}_2\text{ eq/kWh}}{\textbf{Occupation rate}\ \text{person/dwelling}}$$

Heating



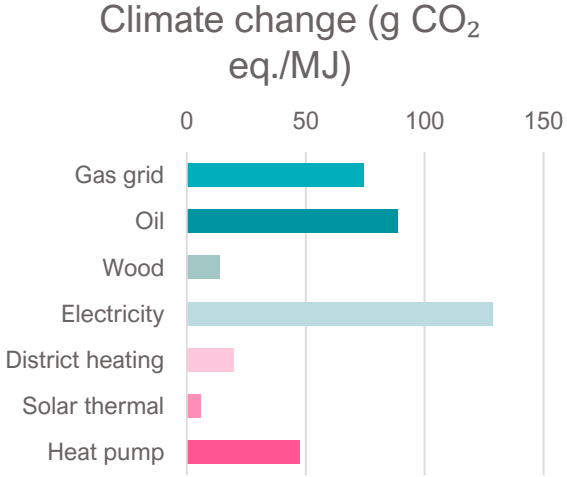


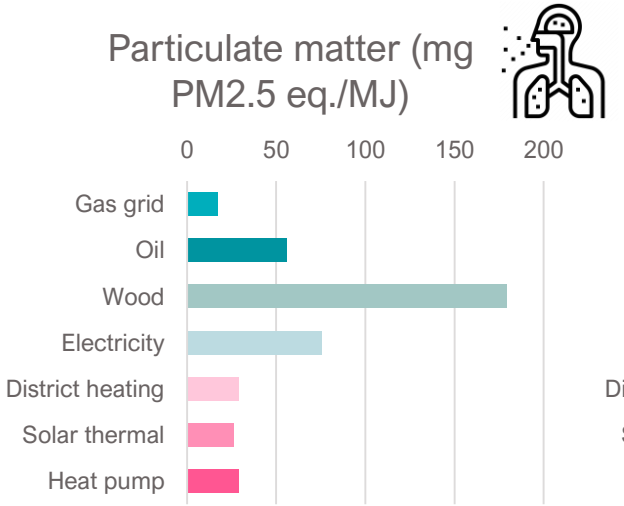
Source: ecoinvent, ODYSSEE-MURE

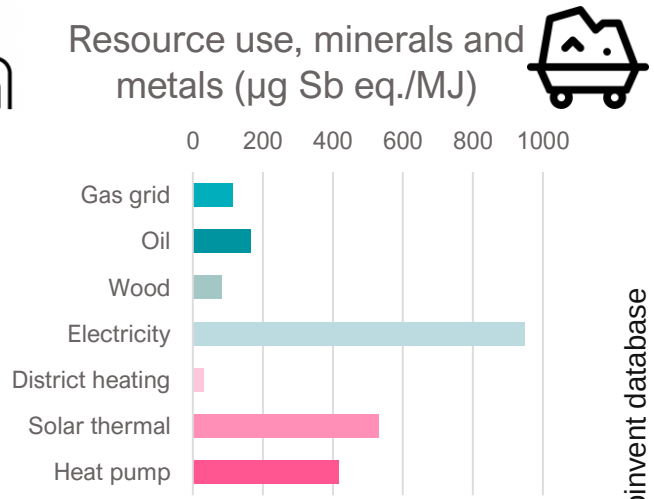
What influences heating impacts

$$\frac{\textbf{Energy intensity}\ \text{kWh/m}^2\text{/year} \times \textbf{Dwelling size}\ \text{m}^2 \times \textbf{Energy impact}\ \text{kg CO}_2\ \text{eq/kWh}}{\textbf{Occupation rate}\ \text{person/dwelling}}$$

Heating







Source: ecoinvent database

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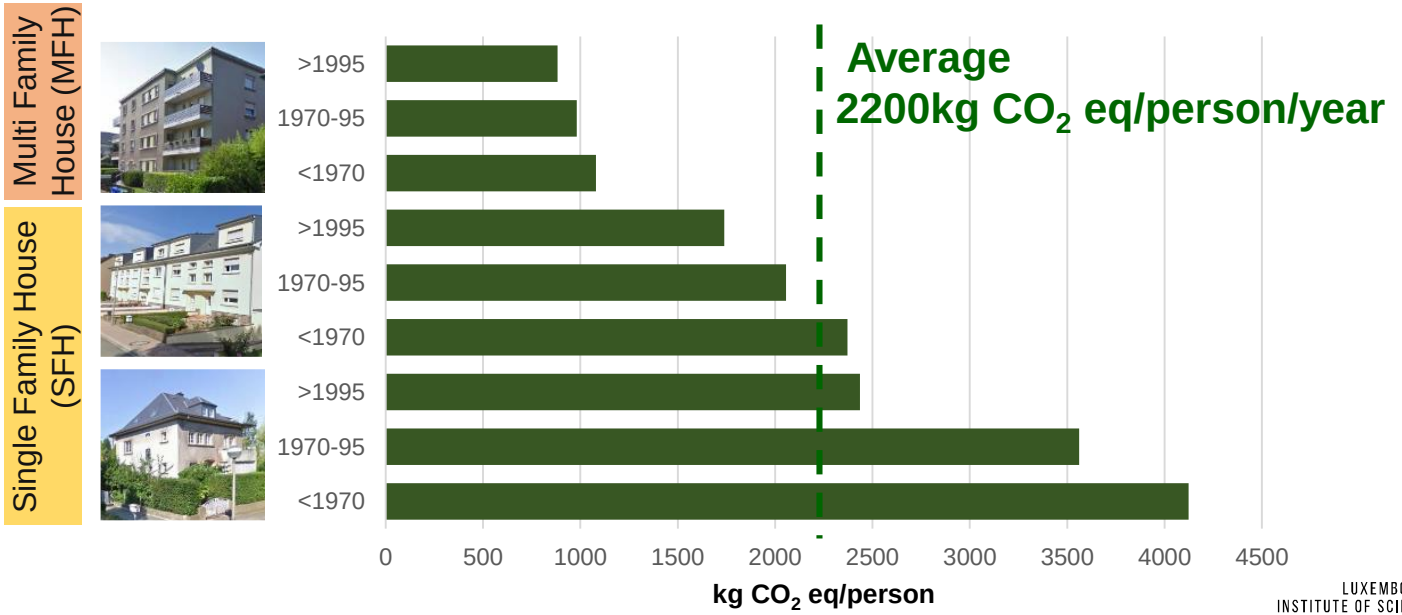
What influences heating impacts

Energy intensity kWh/m²/year **X** **Dwelling size** m² **X** **Energy impact** kg CO_2 eq/kWh

Occupation rate person/dwelling

Heating



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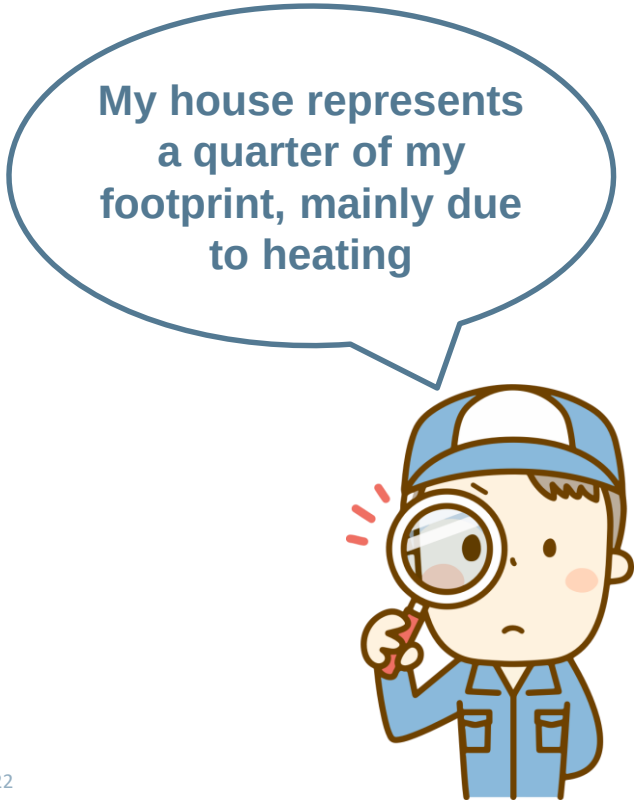
Take-away messages

Heating



- ✓ **~60%** of housing emissions come from heating
- ✓ Reduction of heating bills
  - ✓ Adapt and reduce **temperatures**
  - ✓ Choose **smaller and more efficient houses**
- ✓ **Low-carbon alternatives** to fossil fuels but inducing other environmental trade-offs

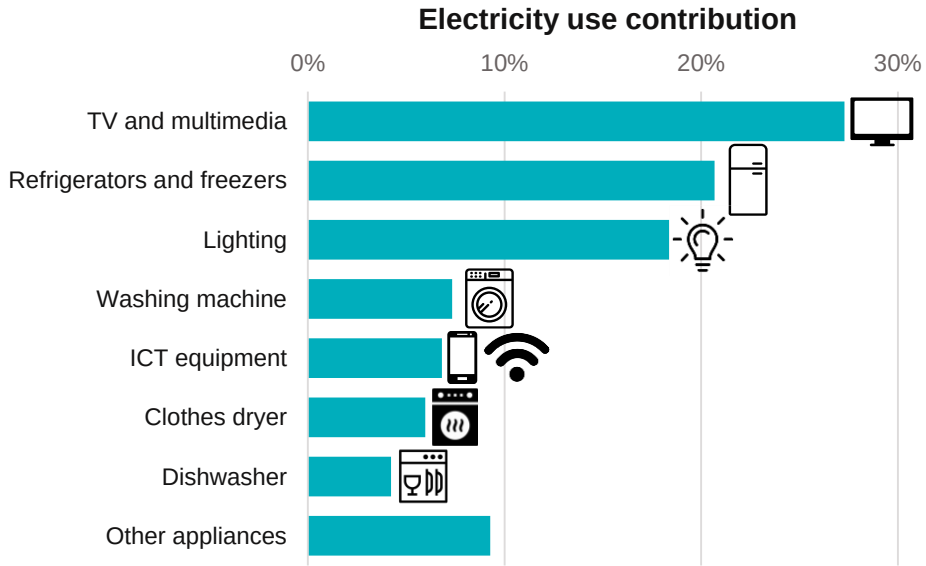
1. CARBON FOOTPRINT
2. HOUSE CARBON PROFILE
3. HEATING

4. ELECTRICITY

Electricity consumption at home…

Influencing factors

- Number of devices → adapt purchase to real needs
- Time of use → turn off if unused
- Eco-friendly behaviours → temperature settings, appliance maintenance, etc.



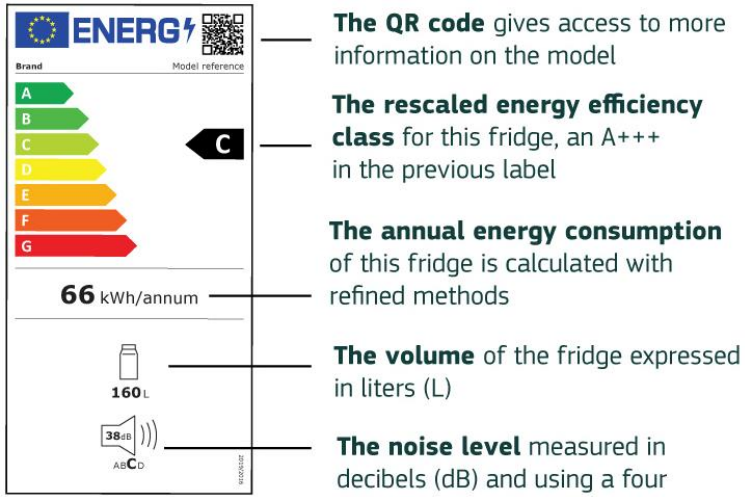
10% to 40% savings with eco-behaviours

Source: Gulotta et al. (2020)

Electricity consumption at home…

Influencing factors

- Number of devices → adapt purchase to real needs
- Time of use → turn off if unused
- Eco-friendly behaviours → temperature settings, appliance maintenance, etc.
- Device power → energy labels mandatory for 14 product types



The QR code gives access to more information on the model

The rescaled energy efficiency class for this fridge, an A+++ in the previous label

The annual energy consumption of this fridge is calculated with refined methods

The volume of the fridge expressed in liters (L)

The noise level measured in decibels (dB) and using a four classes scale

20% to 70% savings with best class devices

Source: ADEME (2019); oekotopten

Electricity

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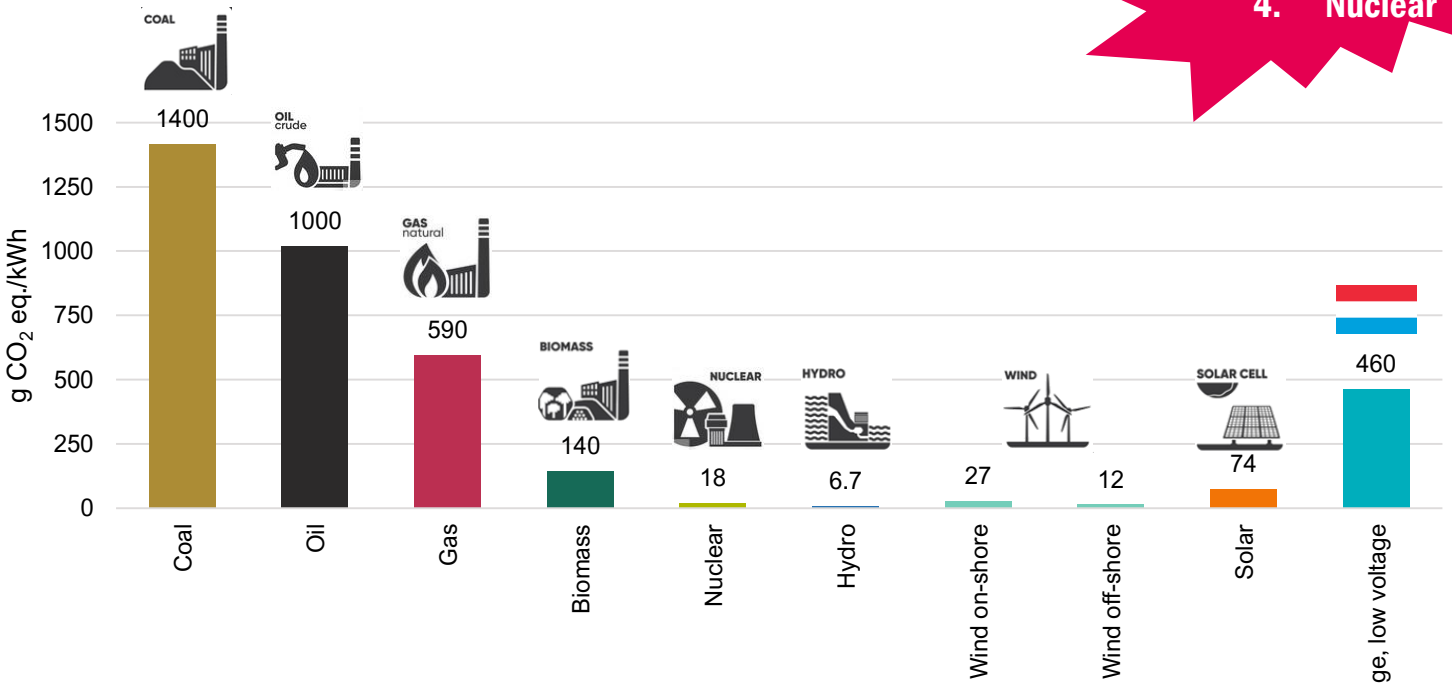
LIVE POLL !

Electricity and greenhouse gases

GHG intensity of 1 kWh produced with various modes

1. Coal
2. Gas
3. Solar
4. Nuclear

Electricity



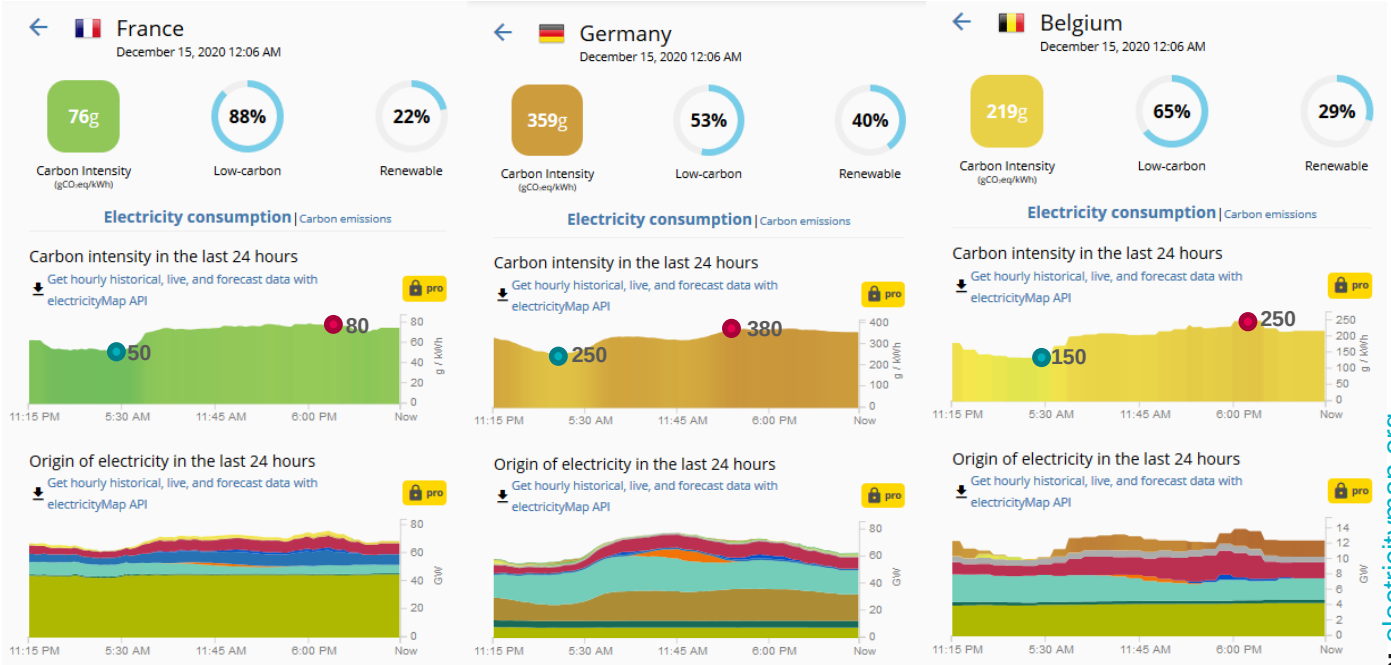
Lifecycle greenhouse gas emissions from electricity production through various sources, global warming potential over 100 years, excluding biogenic carbon, including fugitive methane emissions at extraction, "coal" = hard coal and lignite average, **Source:** ecoinvent 3.6 and IFEU (for fossil-fuelled plants), as shown in European Commission (2020)

The right time at the right place

Electricity needs to be produced when it's consumed

Electricity

Depending on load, climate, trade, and maintenance of power plants, electricity production varies permanently



Source: electricitymap.org

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Green electricity?

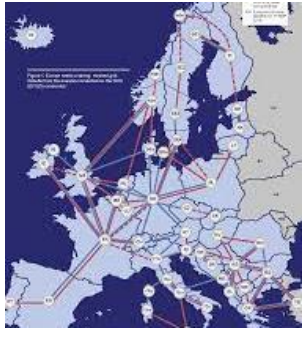
AIB
association of issuing bodies

AIB
Guaranteeing the origin of European energy

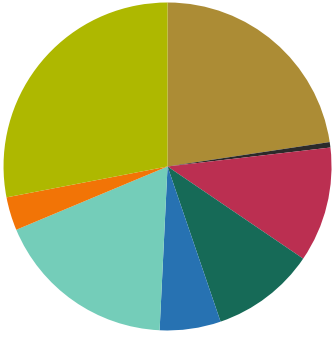
enovos

100% Renewable Energy Regular Surveillance
TÜVRheinland CERTIFIÉ
www.tuv.com ID 0000053913

Calculix.lu



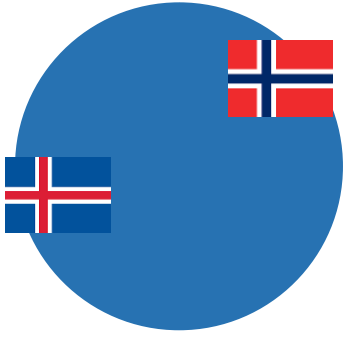
Consumption mix

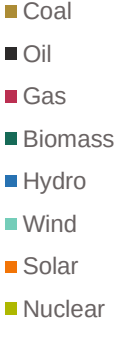


Luxembourg consumption mix

What everyone gets due to production, plus imports, minus exports

enovos Naturstroum



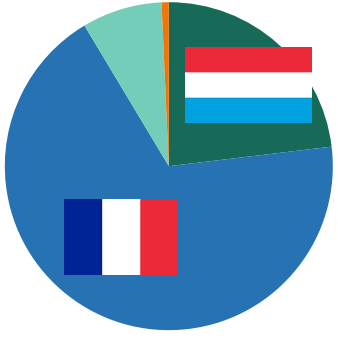


Based on the “guarantees of origin” scheme (called EECS in Europe)

Exclusively from Norwegian and Icelandic hydropower electricity

Unlikely influence on the electricity mix

enovos Nova Naturstroum



National and regional renewable energy sources and newer power plants (< 3 year-old)

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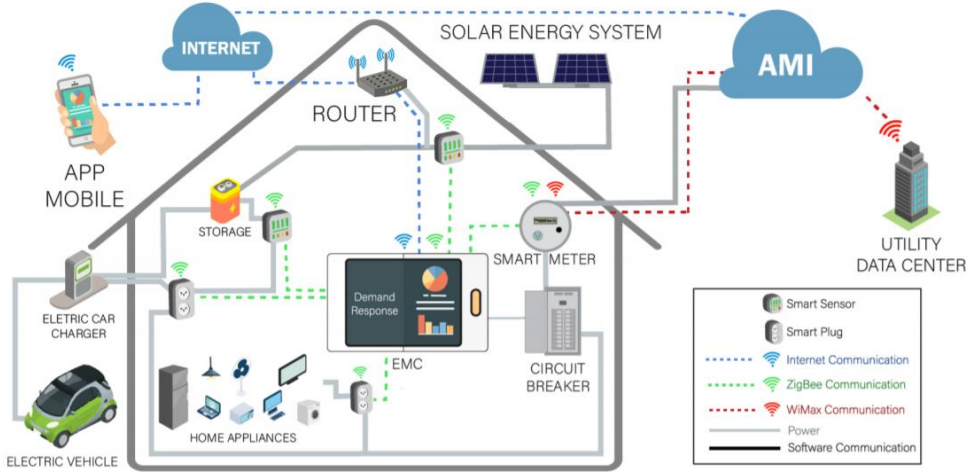
Source: enovos.lu, aib.net

Smart houses: the solution?



Impacts of connected objects and their use **<** Benefits from energy savings?

- ✓ Energy use (production and use of connected objects, data transmission)
- ✓ Critical materials content of devices
- ✓ Low recycling rate of electronic waste

- ✓ Intended application
- ✓ Routine effects
- ✓ Smart features not fully used

Electricity

Source: Veras et al. (2018); Yang et al. (2014)

Take-away messages

Electricity

- ✓ The use of **electricity or water** (25% of housing footprint) can be significantly reduced (up to 70%) with **eco-behaviours** for the purchase and use of equipment
- ✓ Electricity **green contracts** covering recent low-carbon power plants could facilitate the energy transition

1. CARBON FOOTPRINT
2. HOUSE CARBON PROFILE
3. THERMAL ENERGY
4. ELECTRICITY

5. HOUSE DESIGN

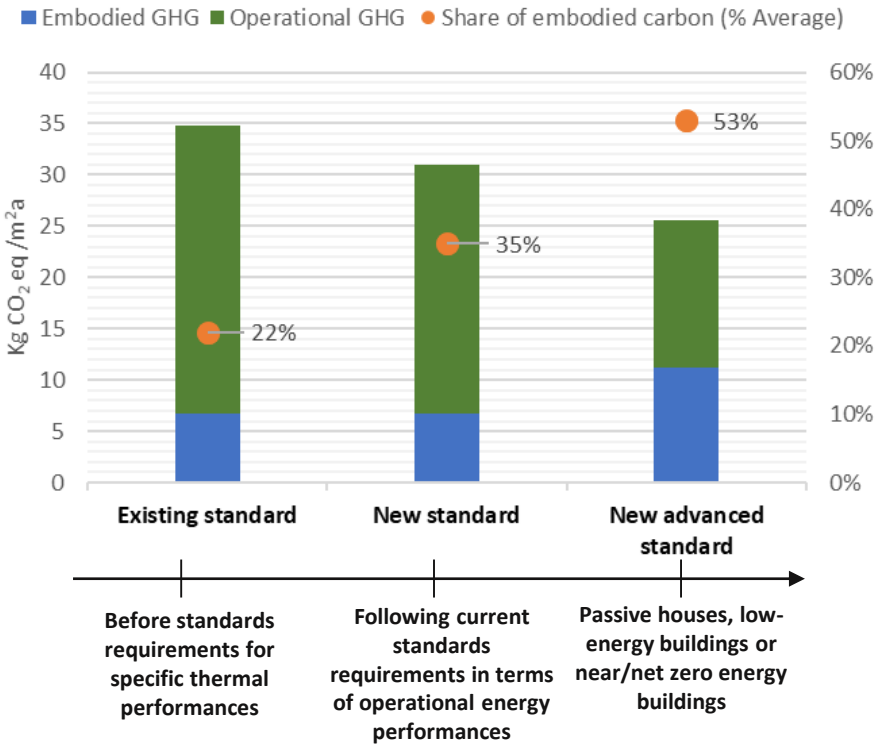
BUILDING OPERATIONAL VS EMBODIED IMPACTS

House design

Materials production represents 10 to 20% of average carbon footprint of Single Family House.

Operational GHG emissions:
Arising from energy consumption during the building use phase.

Embodied GHG emissions:
Arising from manufacturing and processing of construction materials.



Share of embodied GHG becomes more significant due to efforts made to improve operational energy performance.

Source: Röck et al. (2020)

LIVE POLL !

SINGLE FAMILY HOUSE – NEW CONSTRUCTION

COMPARISON OF EMBODIED GHG FROM BUILDING FRAME

House design

Wood
- ✓ Local and Renewable
- ✓ Biogenic CO2 storage
- ✓ Light weight
- X Land use
- X Wood treatment
- X Limited valorisation after use

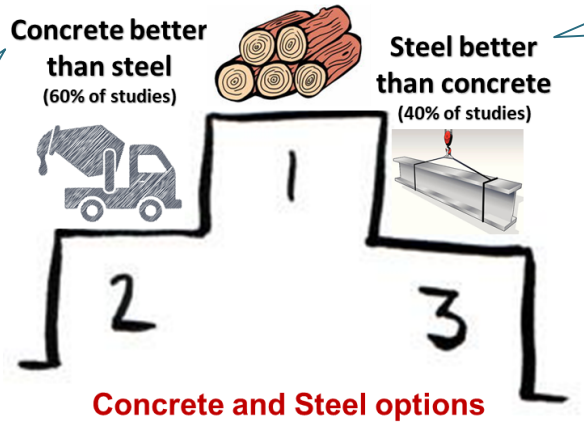
! Wooden fra… …ficial for GHG emissio… …on resources …ter !

2. Steel > Concrete > Wood

Steel
- ✓ High recycled content
- ✓ Recyclable
- X Energy-consuming process

Concrete
- ✓ Local
- X GHG and energy-consuming
- X Heavy material
- X Low valorisation potential at End of Life

Wood is better
(90% of studies)



Concrete and Steel options remain comparable

Source: Saade et al. (2020)

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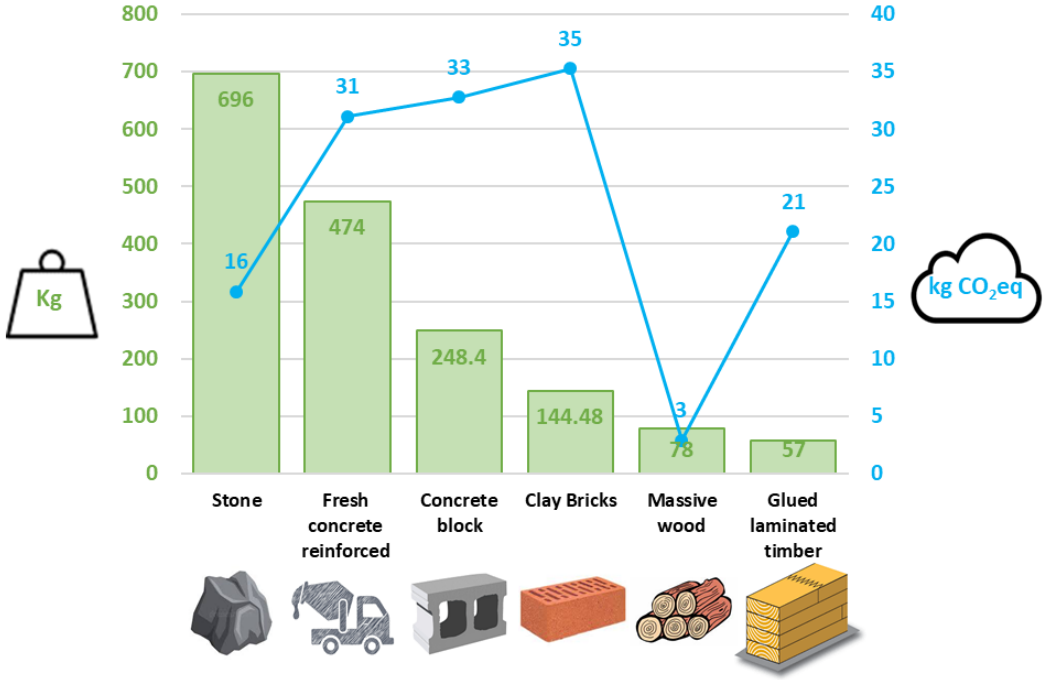
SINGLE FAMILY HOUSE – NEW CONSTRUCTION

House design

Comparison of structural materials options for external wall

Reference: 1 m² wall



- **Materials requiring intermediary transformation processing generate more impacts.**

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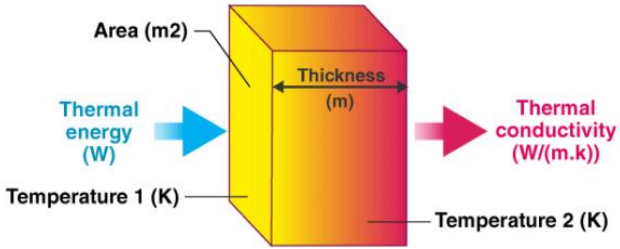
SINGLE FAMILY HOUSE

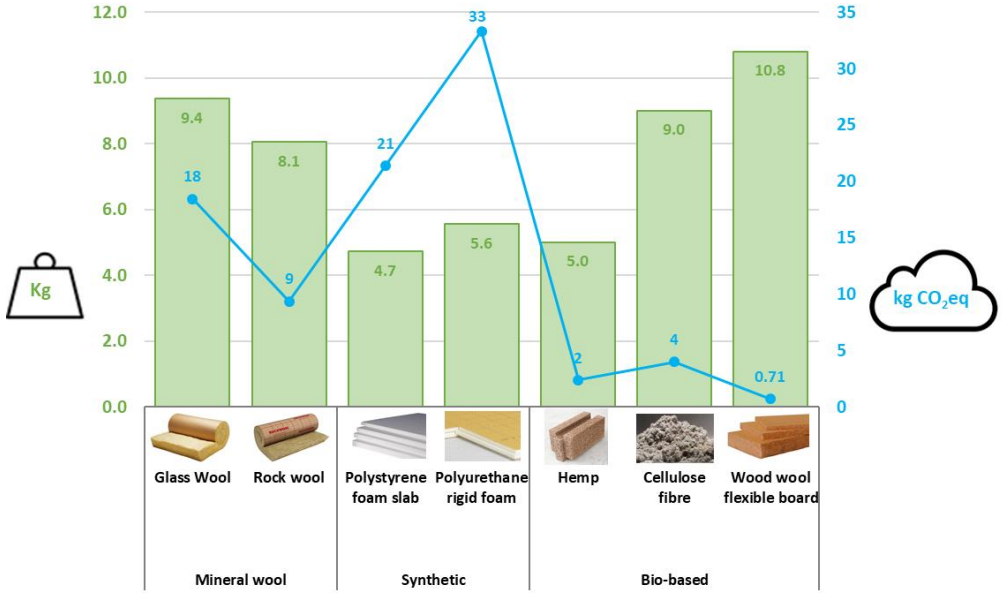
House design

Comparison of insulation materials options for external wall
Reference: 1 m² wall with the same thermal performance



Thermal conductivity = Ability to conduct heat

The lowest it is the thinner can be the insulation material



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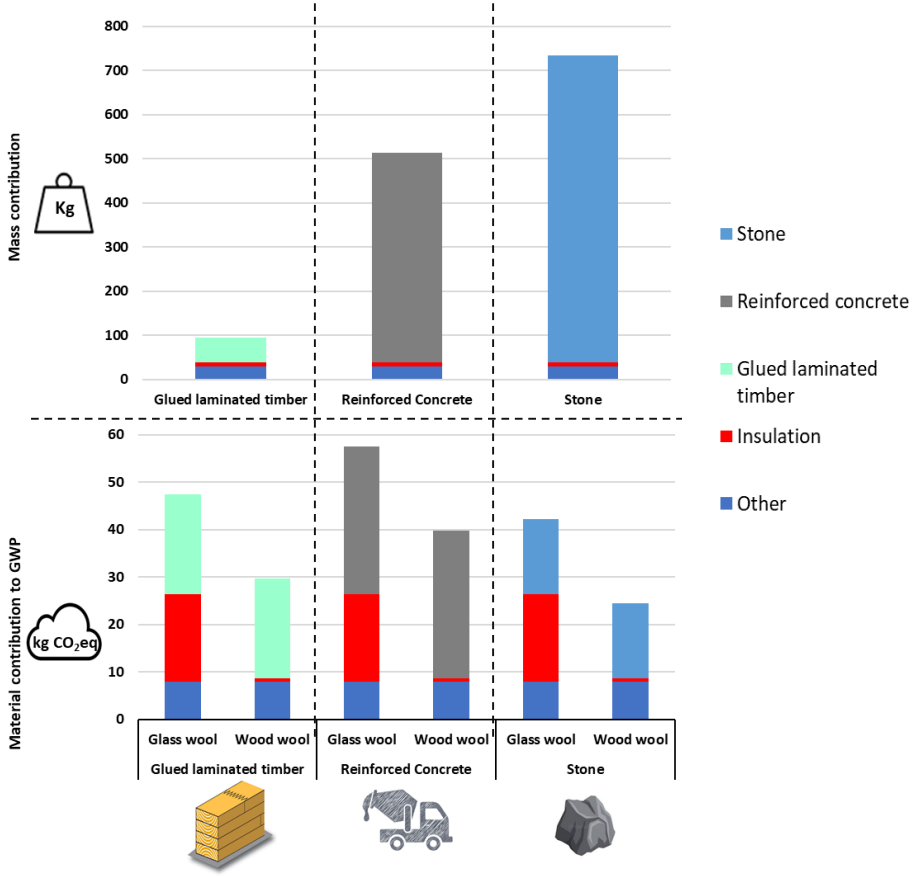
SINGLE FAMILY HOUSE – NEW CONSTRUCTION

House design

Comparison of GWP from 1m2 of external wall



Structural material contribute to

- 60 to 95% of mass
- 38 to 78% of impact on GWP

Insulation: Wood wool vs Glass wool

- Induce variation of mass by +0.2 to +1.4%
- Induce variation of GWP by -30 to -43%

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SINGLE FAMILY HOUSE

NEW CONSTRUCTION VS REFURBISHMENT

“Material and energy savings due to refurbishing and repurposing building surfaces has been estimated between 20-30%” (Vita et al. 2019)

Environmental advantages depend on various parameters and behaviours:

House design

- ✓ Repair and Renovation for thermal performances will decrease energy use for heating
- ✓ Refurbishment induces limited intensive use of materials

- ✓ Similar thermal performances can be achieved with passive house
- ✓ New construction induces high intensity of materials consumption & land use

Choice of materials can counterbalance the benefits of refurbishment and induce additional impacts

Source: Vita et al. (2019)

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Take-away message

House design

The construction or refurbishment of houses can also follow good practices

- ✓ The **building materials** represent 10%-20% of housing impacts but this could **increase with new standards**
- ✓ **Environmental trade-offs** observed between **bio-based** and **mineral or fossil** based materials
- ✓ **Refurbishing** non-efficient buildings can lead to 20 to 30% of materials and energy savings

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6. TAKE-AWAY MESSAGES

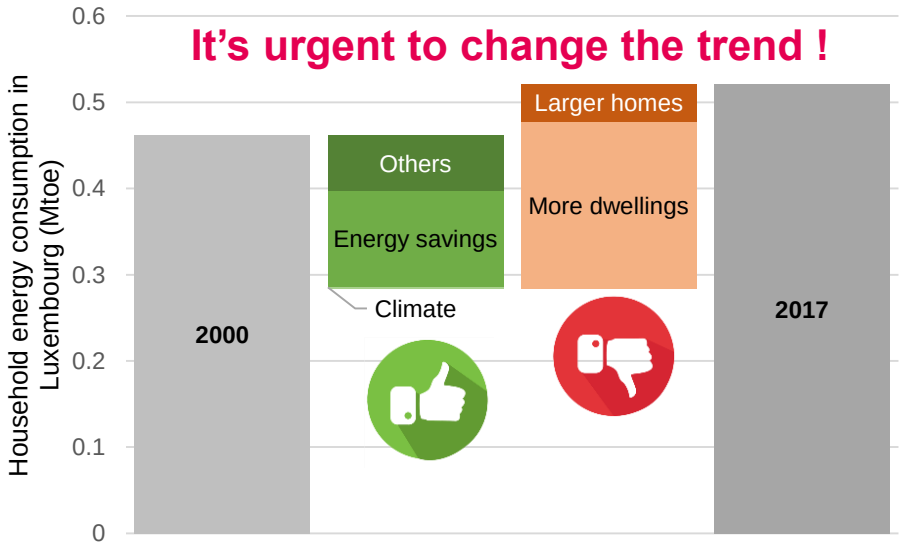
Take-away messages

A-label equipment
Small size equipment
LED lighting
Install low-carbon heating

Refurbish your house
Move to a smaller and passive house

Quick wins → **Replace old equipment** → **House changes**

Low temperature settings
Short showers
Turn-off and unplug
Use eco-programmes
Maintain equipment
Use off-peak hours
Switch to green contract



Source: ODYSSEE-MURE