

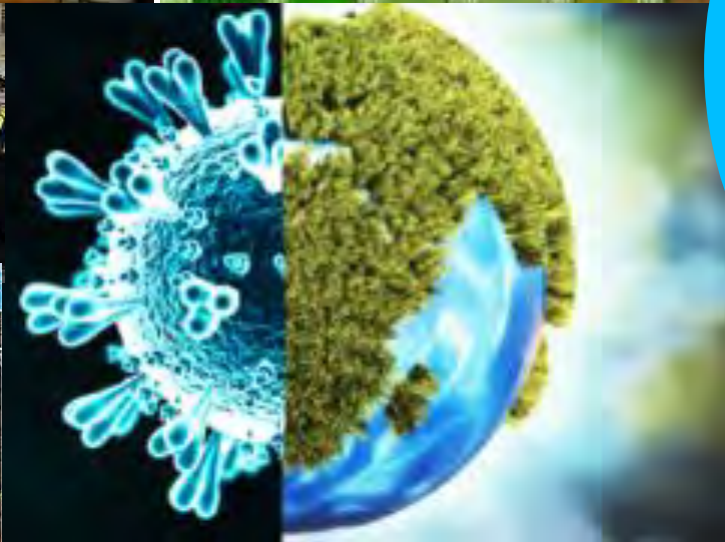


University of Stuttgart
IER Institute of Energy Economics
and Rational Energy Use



**Energy poverty or
vulnerable consumers?
An energy-economic
comparison of the policy
approaches to
addressing
vulnerabilities in the
energy system in
Germany**

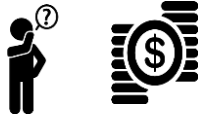
**Audrey
Dobbins**



Picture sources: <https://bbpcork.org/2015/02/22/the-economy-grows-but-so-does-poverty/>; <https://www.netzerowatch.com/britain-faces-fuel-poverty-crisis-as-7-million-households-are-plunged-into-energy-debt/>; <http://www.energieverbund-thueringen.de/leistungen.shtml>; <https://www.kallesoe.dk/om-os/miljoeprofil.aspx>; <https://inhabitat.com/wp-content/blogs.dir/1/files/2018/02/solar-panel-wall-carousel-889x309.jpg>; https://georgianjournal.ge/media/_thumb/images/GJ/2015/7/wind-turbines17.jpg; https://en.wikipedia.org/wiki/Yellow_vests_protests#Other_countries_or_regions; [sportpoint74/Bigstockphoto.com](https://sportpoint74.Bigstockphoto.com) via: [bit.ly](https://www.bbc.com/news/science-environment-59049770); <https://www.bbc.com/news/science-environment-59049770>; <https://newpol.org/a-green-recovery-and-the-fight-ahead-to-avoid-a-return-to-business-as-usual/>;

1. Introduction and challenges

Framework and challenges in Germany



Energy Poverty

Energy poverty on the rise:

- 3-20% of the population **vulnerable** to or in **energy poverty**
- energy poverty is not recognised by the national government
- Current policies aim at poverty alleviation

➤ Access, affordability

Sources: Pye et al 2015, EPOV 2020



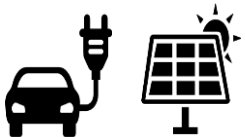
Households

Significant consumers of energy:

- Households consumed ~**28% of the final energy consumption** in 2018
- Space and water heating (84%), 60% with **fossil fuels**
- 55% tenants

➤ Decision-making power

BMWK 2020, Destatis 2018



Energy Transition

Households key to successful energy transition and expected to contribute to decarbonisation targets:

- Energy transition targets to **decarbonise by 2045**
 - Heating with renewables and efficiency in electricity and heating demand
- Average household modelling assessments
- Average households are not representative!

➤ Mobilisation of private sector capital, averaged household modelling assessments

BMWK 2021

2. Household energy vulnerability

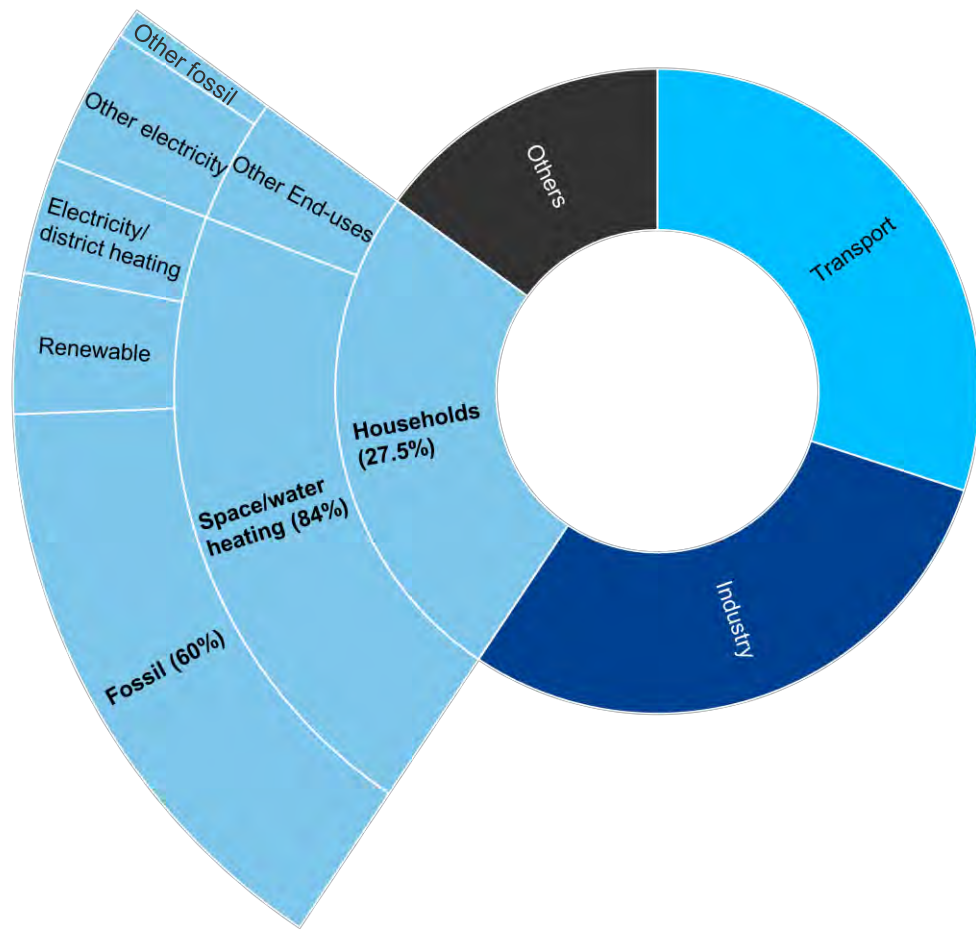
Linked but distinct concepts

	Energy Poverty	Vulnerable Consumers
Concept/Who?	Those affected by one or more of low income, high energy bills and poor energy efficiency	Those disadvantaged within the electricity and gas markets and identified as in need of protection, typically those drawing social welfare benefits
Which fuels?	All fuels (+ mobility)	Electricity and gas
Which measures?	longer-term, preventative measures – energy efficiency, renewable energy	Short-term, curative measures – bill support, disconnection protection
Policy domain?	National Energy and Climate Plans / Energy policy	Electricity Directive/ Social policy

- The legislated concept for household energy vulnerability shapes the policy response
- Germany -> social welfare beneficiaries -> general support
- **Access, affordability**

2. Household energy

Household energy transition challenges



+ Renewables

- Direct: Biofuels, solar thermal, PV
- Indirect: Electricity, district heating

+ Energy efficiency

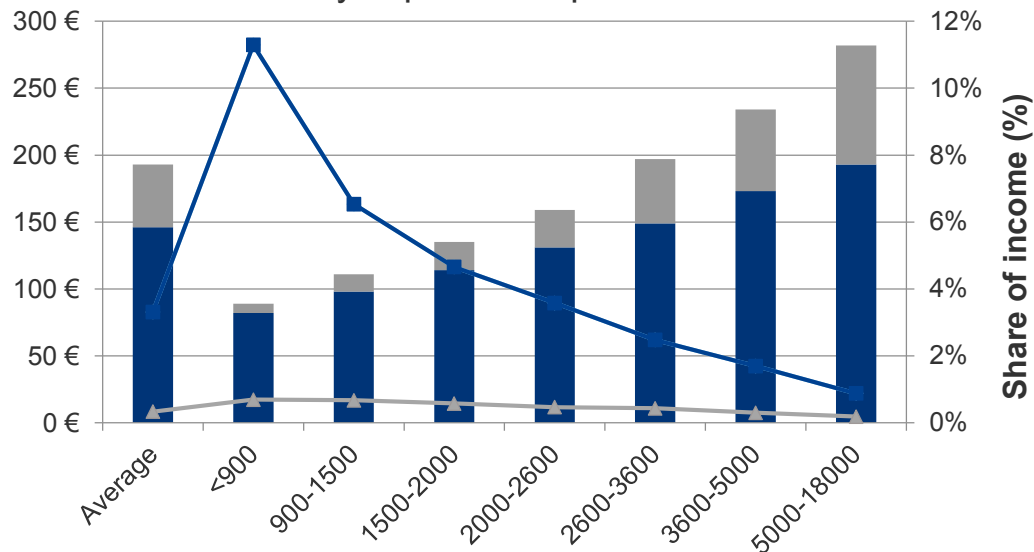
- Building renovation
- Heater exchange
- Appliance upgrade
- ...

- Mobilisation of private capital!
- Investment and consumption behaviour of households

2. Household energy

Investment and consumption

Monthly expenditure per household

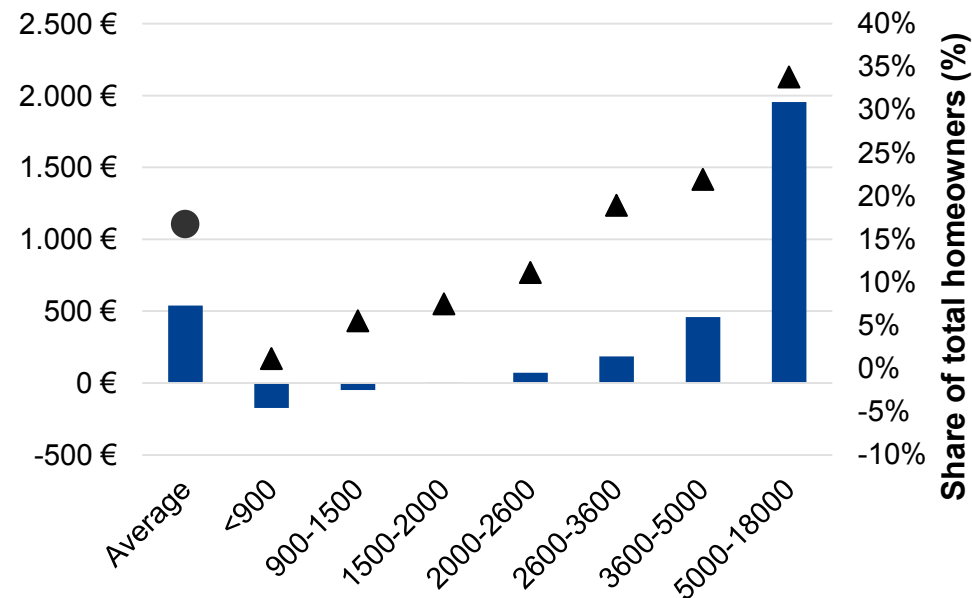


Income groups (€ per household and month)

- Household appliances, maintenance and renovations (investment)
- Household energy (consumption)
- Share of income on energy expenses (consumption)
- ▲— Share of income on energy expenses (investment)

Potential to afford investments

Monthly savings per household



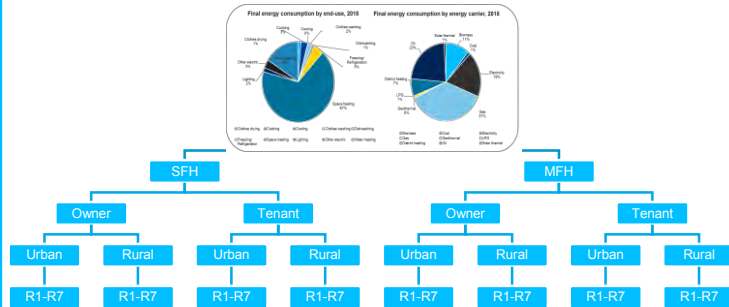
Income groups (€ per household and month)

- Average monthly household savings
- ▲ Share of total homeowners
- Share of households (financial + decision-making power)

- 17% of households have sufficient capital and are homeowners
- Financial capacity and decision-making power
- Average households not representative

3. Methodology – 3 steps

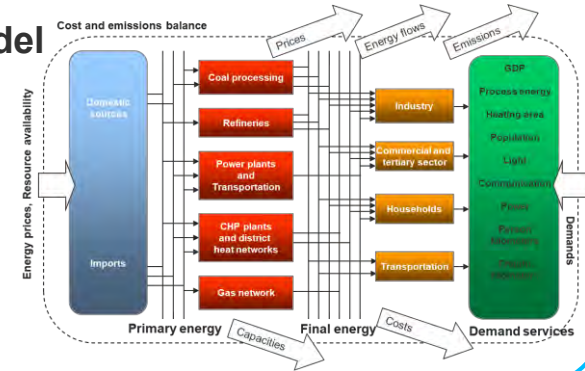
1 Characterise the household sector



- Investment and consumption patterns
- Access to resources
- Affordability
- Financial capacity
- Decision-making power

2 Energy system model

- Investments
- Energy transition
- Trade-offs



3 Policy evaluation

Subsidies

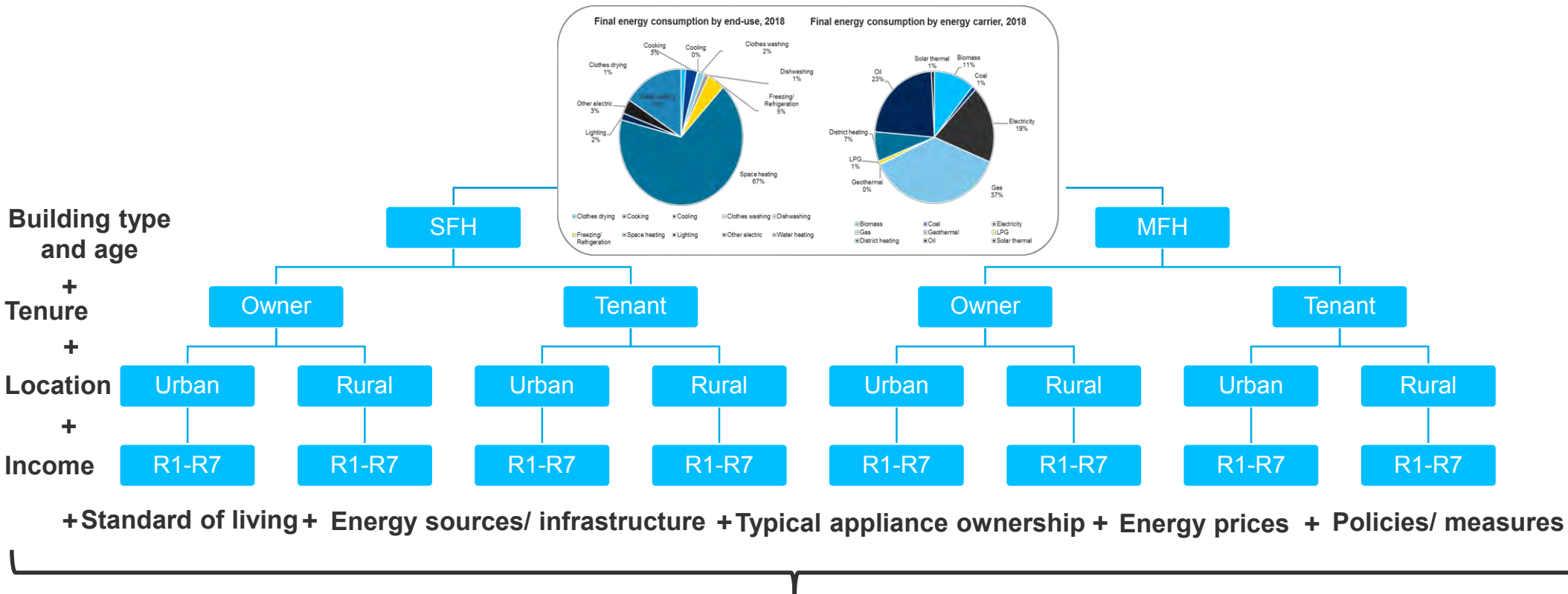
Investments

Consumption

3. Methodology

Step 1: Characterise the household sector

Disaggregation of final energy consumption by end-use and energy carrier

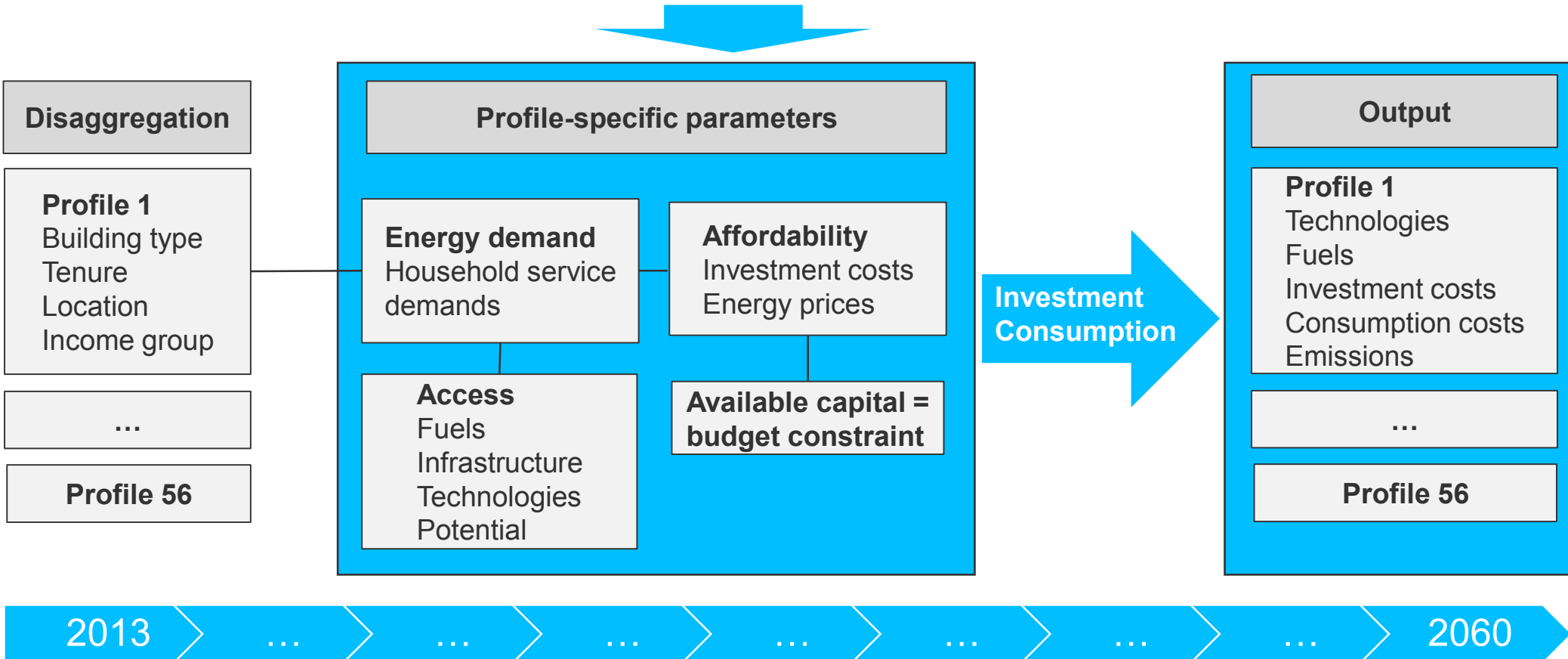


Typical patterns for fuels + end-use for each profile based on income group, location, tenure, building type

3. Methodology

Step 2: Energy system optimisation model - **TIMES Actors Model (TAM)-Households**

Model objective: Achieve decarbonisation targets, minimise costs, maximise benefits



3. Methodology

Step 3: Policy evaluation

Scenario	Description
Reference (REF)	Disaggregation and budget constraints; implemented policies; no subsidy ; Carbon tax on fossil fuels
Energy poverty (EP)	REF + subsidisation of investment in renewables and energy efficiency; Carbon tax on fossil fuels
Vulnerable consumers (VC)	REF + subsidisation of consumption of electricity; Carbon tax on fossil fuels (subsidised)

4. Assessment

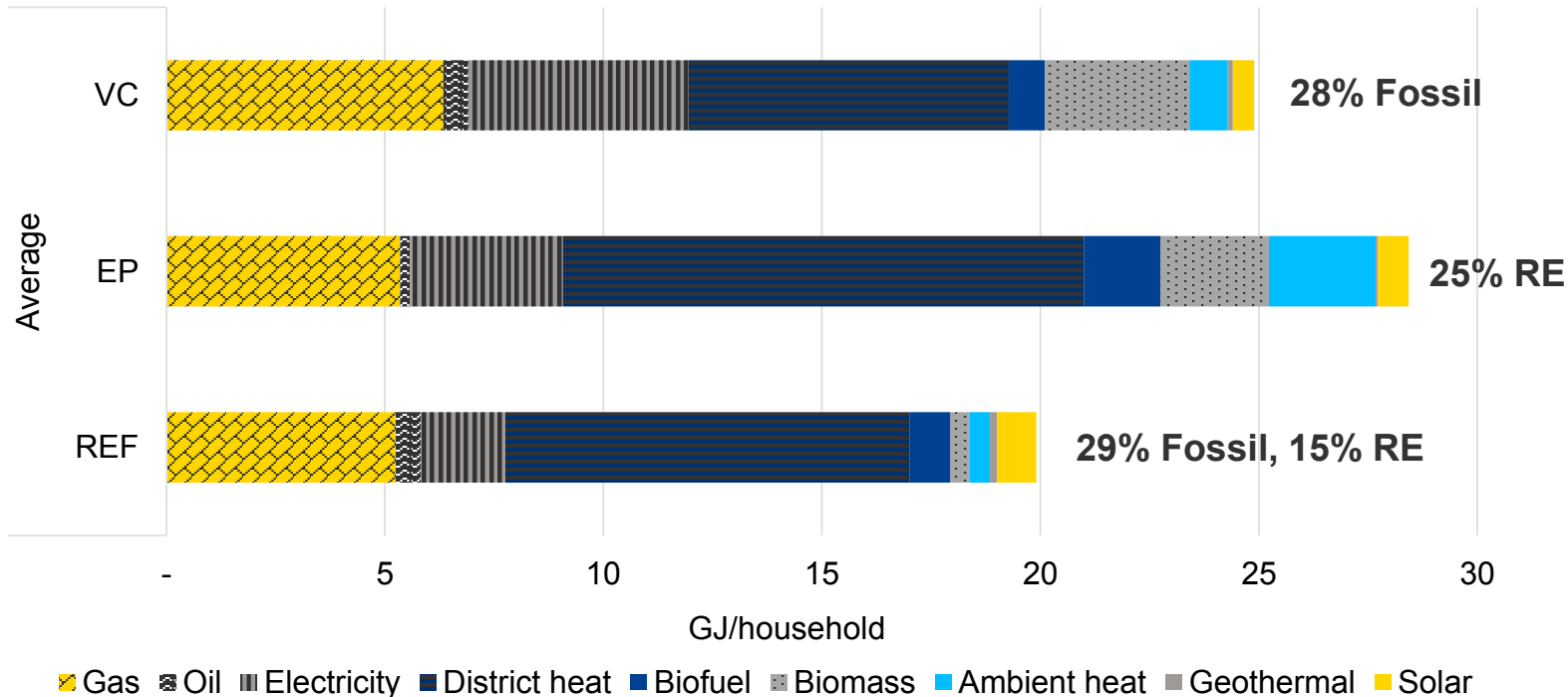
Average consumption per household, 2035
(of 3 lowest income groups)

Scenarios:

REF: TAM-HHs with disaggregation and budget constraints; implemented policies, no subsidy

EP: Energy poverty – subsidisation of investment

VC: Vulnerable consumer - subsidisation of consumption

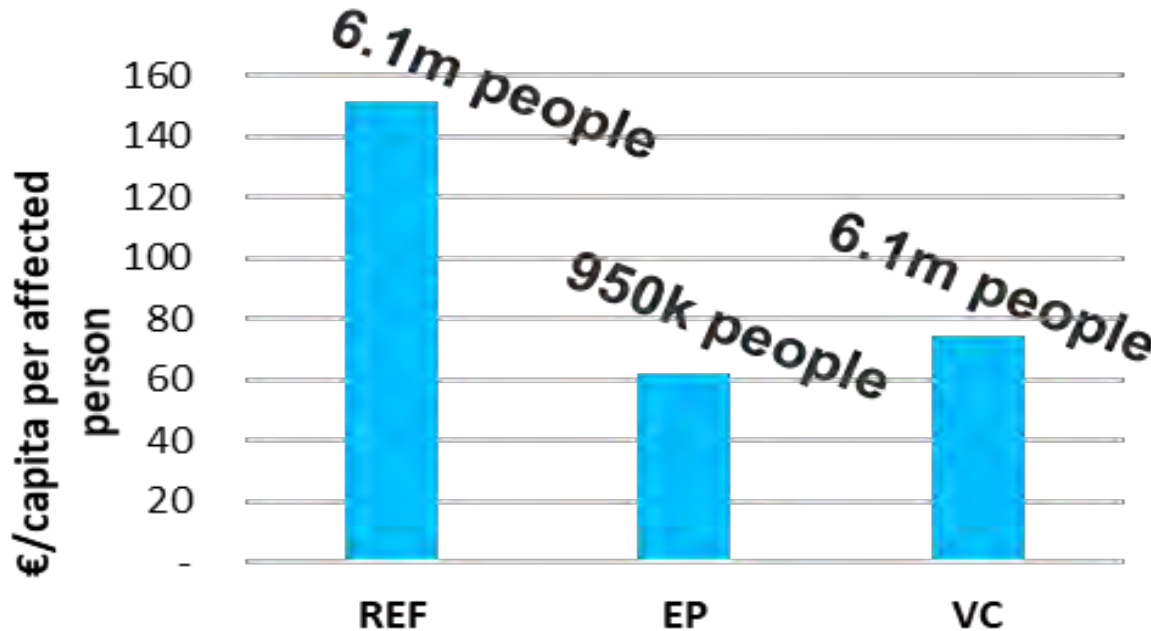


- Subsidising investment supports energy transition targets and households energy welfare
- Subsidising consumption maintains the Status Quo (fossil fuels)

4. Assessment

Suppressed demand by scenario, 2035

€/ capita applies to affected population only
(of 3 lowest income groups)



Scenarios:

REF: TAM-HHs with disaggregation and budget constraints; implemented policies, no subsidy

EP: Energy poverty – subsidisation of investment

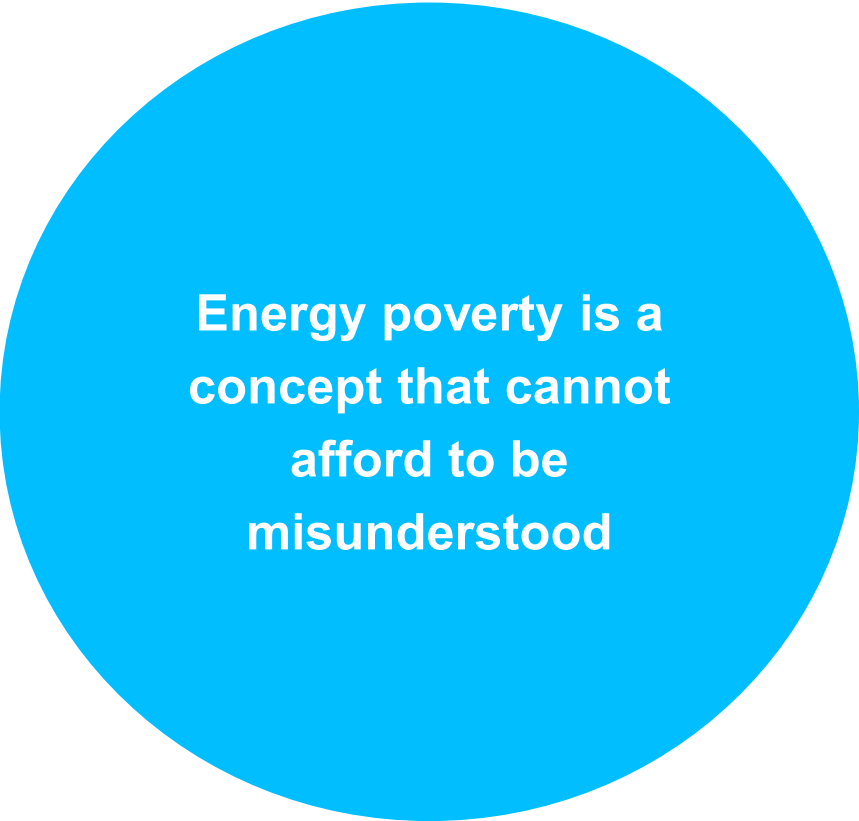
VC: Vulnerable consumer - subsidisation of consumption

Suppressed demand = unfulfilled household energy services = budget deficit

- Evaluating energy consumption patterns alone is not enough
- Affordability

5. Conclusions

- **Assess energy welfare AND the energy transition:**
Identifying and unifying the objectives to address overarching and household challenges and assess more than just energy
- **Policy response** defined by how household energy vulnerability is understood -> **overarching coordination**
- **Targeting policies** to be cost-effective and improving the energy welfare of households is possible



**Energy poverty is a
concept that cannot
afford to be
misunderstood**

Thank you!

Questions?

Comments?

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Selected references

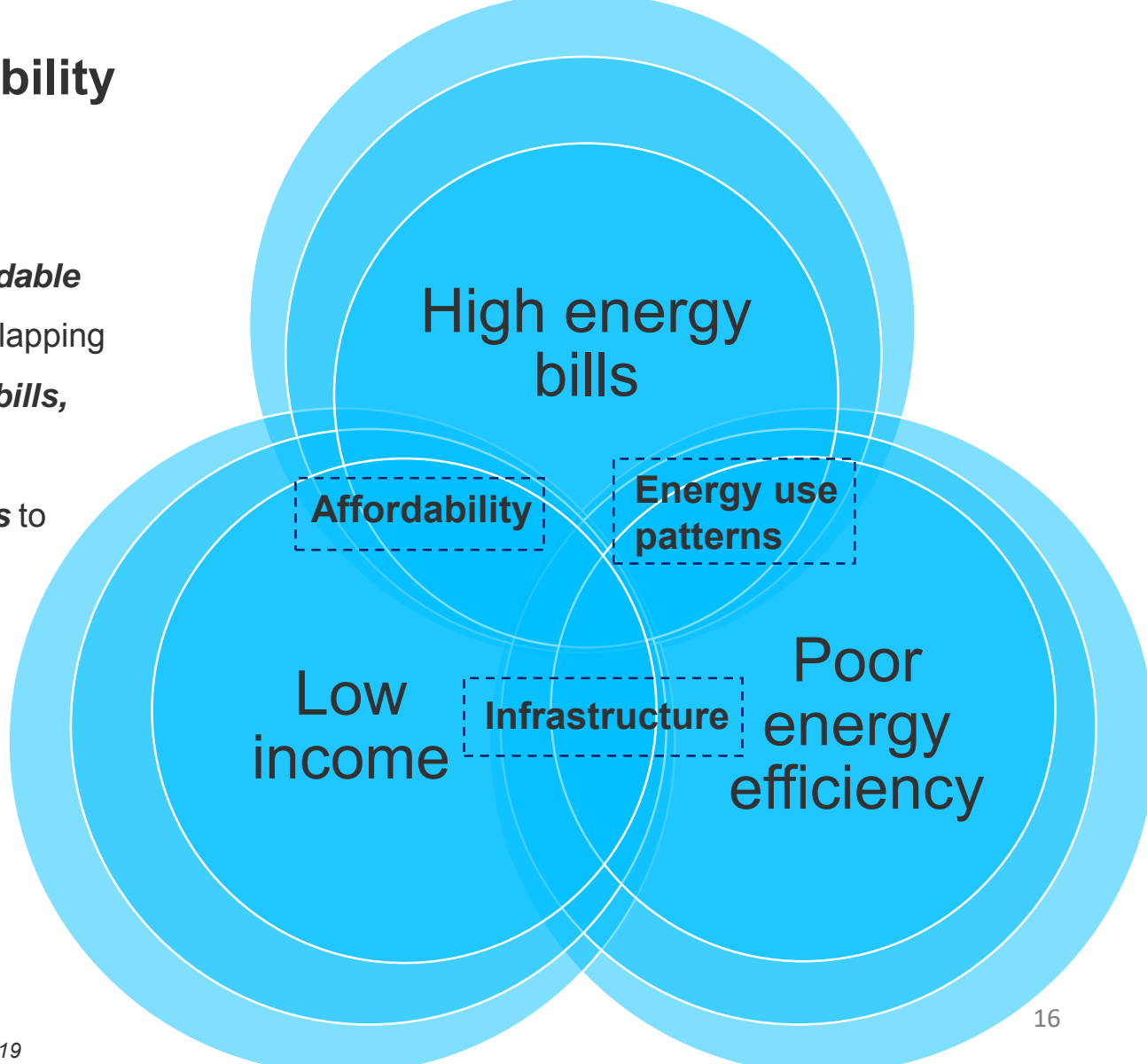
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2. Household energy vulnerability

What is energy poverty?

A situation where households are not able to adequately meet their energy needs at **affordable** cost, and is caused by a combination of overlapping factors including **low income, high energy bills, poorly insulated buildings and inefficient technologies** and sometimes limited **access** to clean and affordable energy sources

- Complex and dynamic issue
- Difficult to identify households
- **National Energy and Climate Plans**
 - Recognition for energy poverty in 17 countries
 - Officially defined in 5 countries



3. Methodology

Budget constraints

Budget constraints to account for *affordability*:

- Defined as the total available capital for investments, fuel costs, taxes, maintenance and operation for each of the profile/actor groups defined (e.g., total available capital for all households with income less than 900€ per month, living in urban, SFH)
- Limited financial capital for different profiles to make investments against other expenses

$$\sum_{r=1}^R \sum_{t \in TECHS_A} new_cap_{r,y,t_A} \times inv_cost_{r,y,t_A} \leq Budget_{A,y}$$

Where:

new_cap_{r,y,t_A}	is new capacity of a technology t of actor A built in year y in region r ;
inv_cost_{r,y,t_A}	is the specific investment cost of the above (equal across regions/actors);
$Budget_{A,y}$	is the maximum budget available to actor A in year y (e.g. citizens);

Sources:

- Report on TIMES-Actors-Model development: https://www.ier.uni-stuttgart.de/forschung/projekte/abgeschlossen/dezentral/downloads/BMWi-03ET4026_Schlussbericht_Dezentral.pdf
- Loulou, Richard; Remme, Uwe; Kanudia, Amit; Lehtila, Antti; Goldstein, Gary (2016): Documentation for the times model part ii. Available online at https://iea-etsap.org/docs/Documentation_for_the_TIMES_Model-Part-I_July-2016.pdf.

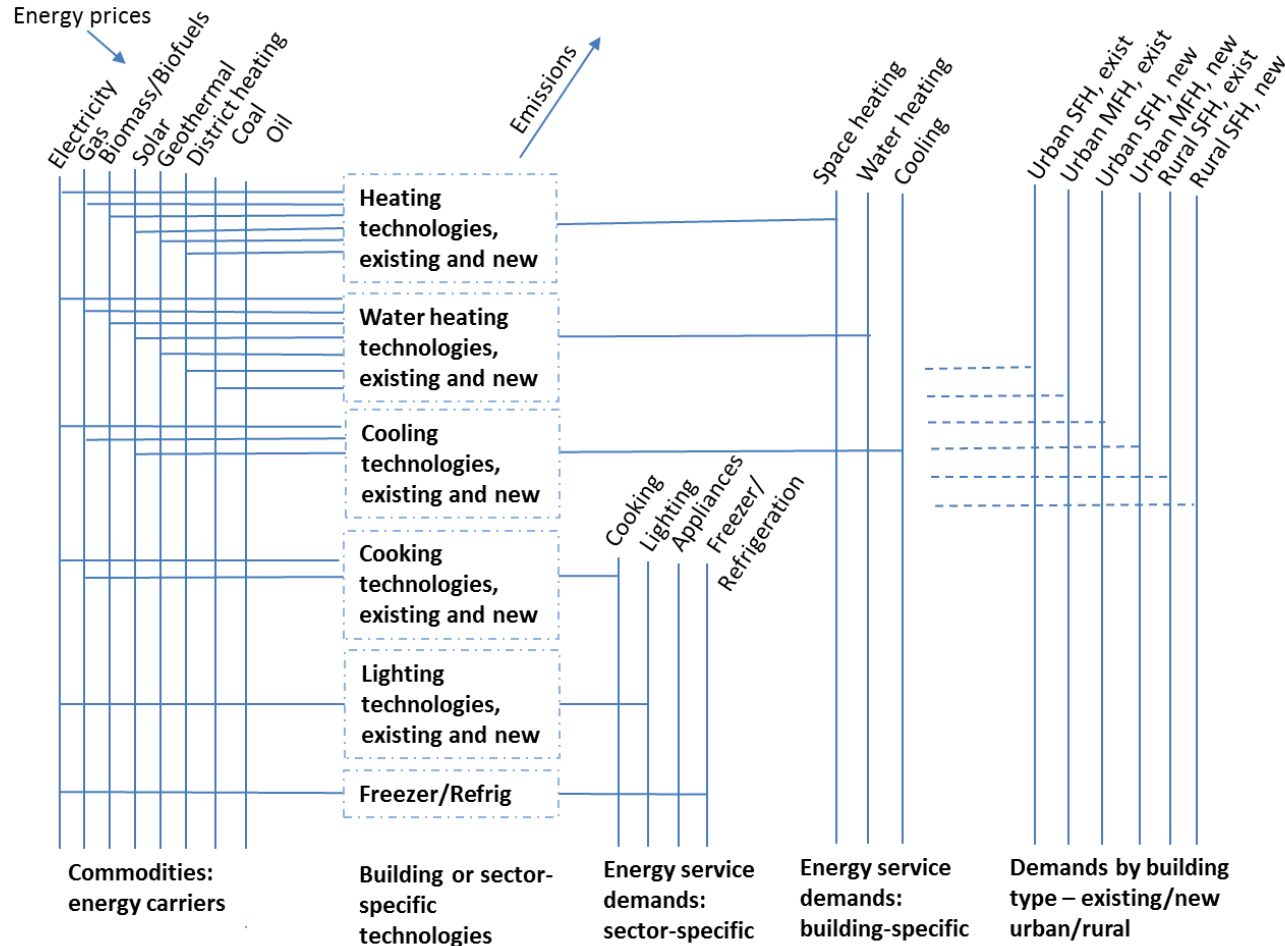
3. Methodology

3. Scenario overview

Scenario	Scenario description
Reference (REF)	Disaggregation, budget constraints, implemented policies
Energy poverty (EP) vs. Vulnerable consumers (VC)	Subsidisation of investment in renewables and energy efficiency vs. consumption
Carbon Tax	Consumer pays
	Carbon tax split 50:50 tenants/landlords (CO2TO)
Compensation schemes	Carbon tax & Renewable energy levy collected -> "Climate Bonus" -> 100€ per capita (CB)
	Carbon tax & Renewable energy levy collected -> "Climate Bonus Low Income" -> 200€ per capita but only to lower income half of the population (CBLI)
Coping mechanisms	Case study: lack of upfront investment capital -> use of second-hand appliances for freezing/refrigeration services (2HM) or extending their lifetime beyond the economic lifetime (EXT)

4. Energy System Analysis

How can an energy system modelling assessment be improved to consider energy poverty?



Aggregated Reference Energy System for the residential sector

- Aggregated demands and building-specific technologies for space heating, water heating and cooling
- Aggregated demands and sector-specific technologies
- MFH restricted to urban areas

4. Integrated energy system assessment

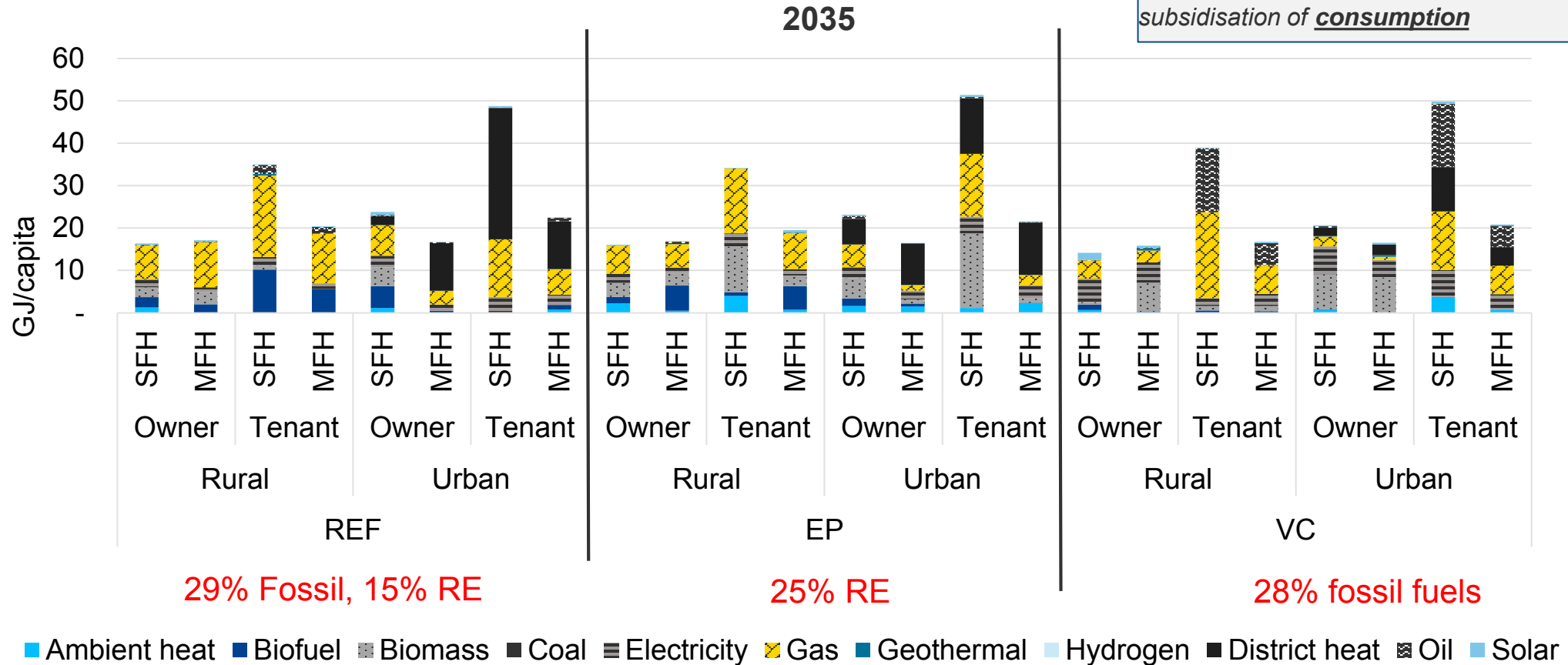
Impact of access and affordability in TAM-Households model

Scenarios:

REF: TAM-HHs with disaggregation and budget constraints; implemented policies

EP: Energy poverty – subsidisation of **investment**

VC: Vulnerable consumer - subsidisation of **consumption**



4. Integrated energy system assessment

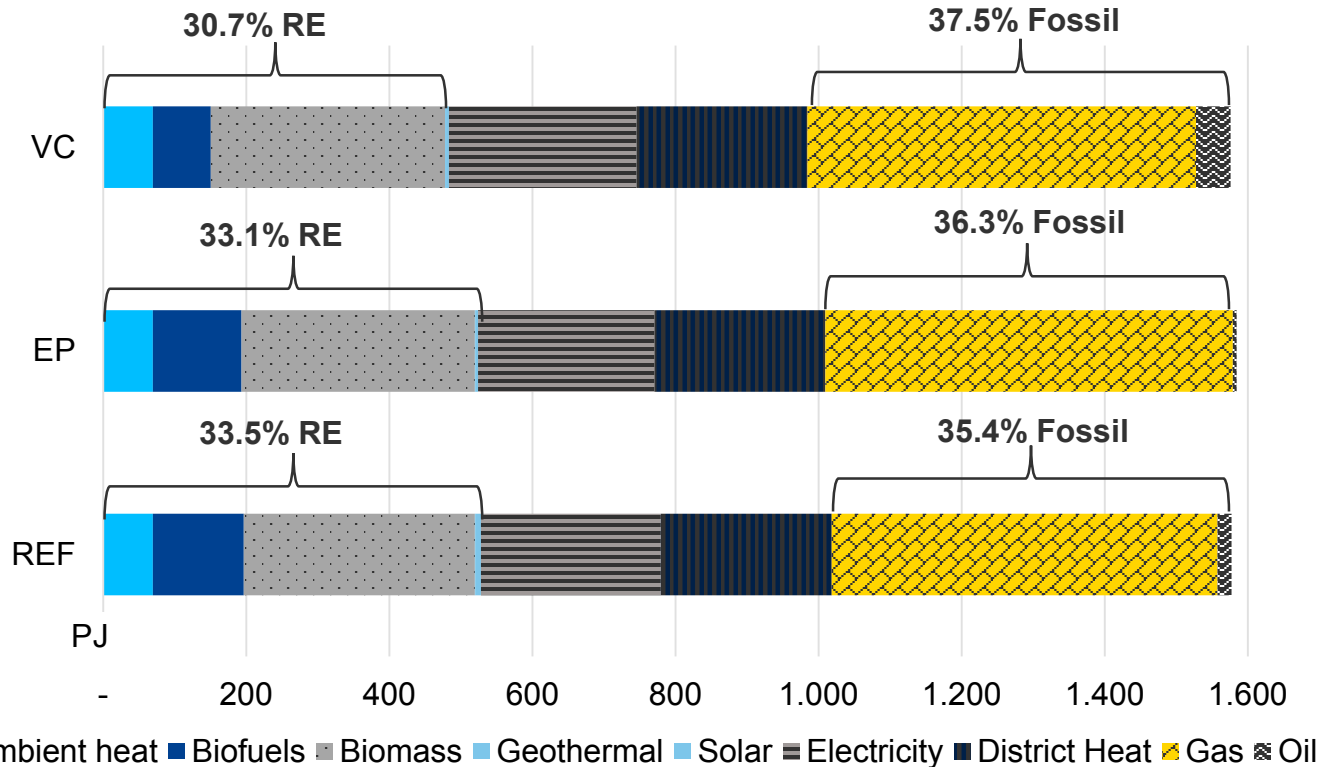
Total consumption all households, 2035

Scenarios:

REF: TAM-HHs with disaggregation and budget constraints; implemented policies, no subsidy

EP: Energy poverty – subsidisation of investment

VC: Vulnerable consumer - subsidisation of consumption



- Overall trend similar
- Lowest 3 income groups = 27.5% of all households but ~10% of total household energy consumption
- Top-down approach insufficient