



How to deal with the users? Consumer roles and everyday practices in Zero Carbon built environments

Kirsten Gram-Hanssen

1st Nordic ZEB+ Trondhjem 6-7 november 2019

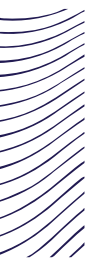


AALBORG UNIVERSITY
DENMARK

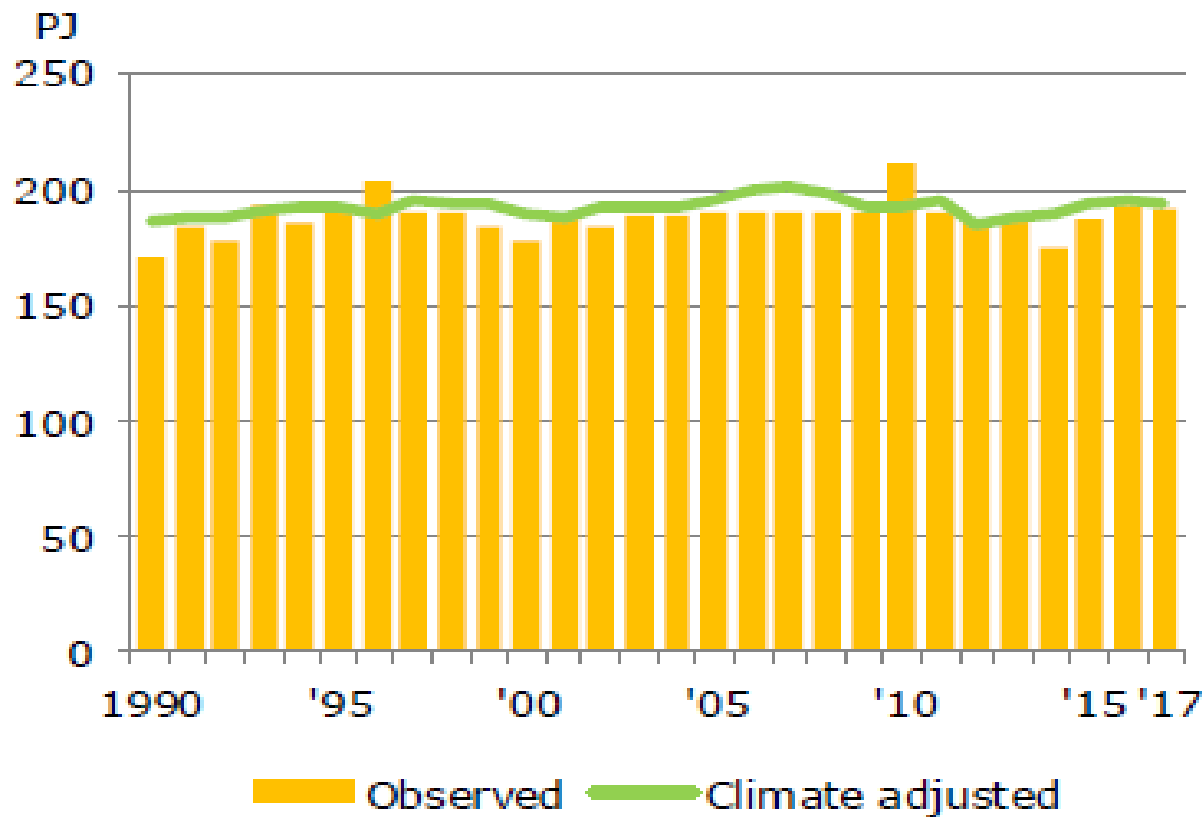
What I will talk about...

- ▶ Questioning the idea that efficient buildings alone will deliver sustainability
- ▶ Describe the problems of rebound, performance gap and changed practices
- ▶ Introduce ways of understanding users and new role for consumers
- ▶ What to do with buildings to reach a sustainable future?

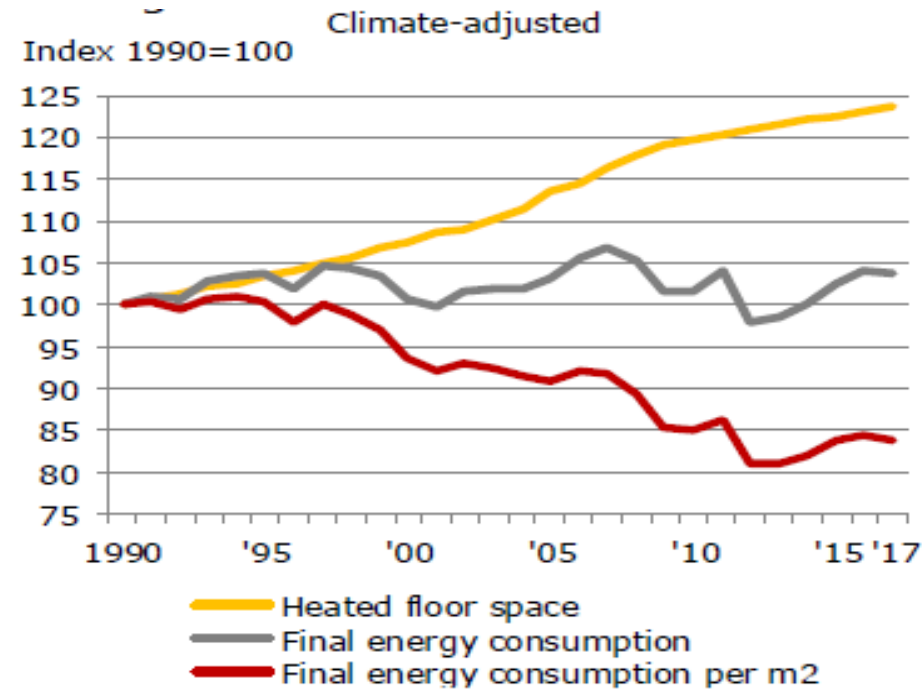




Energy consumption in households in Denmark.....not much is happening

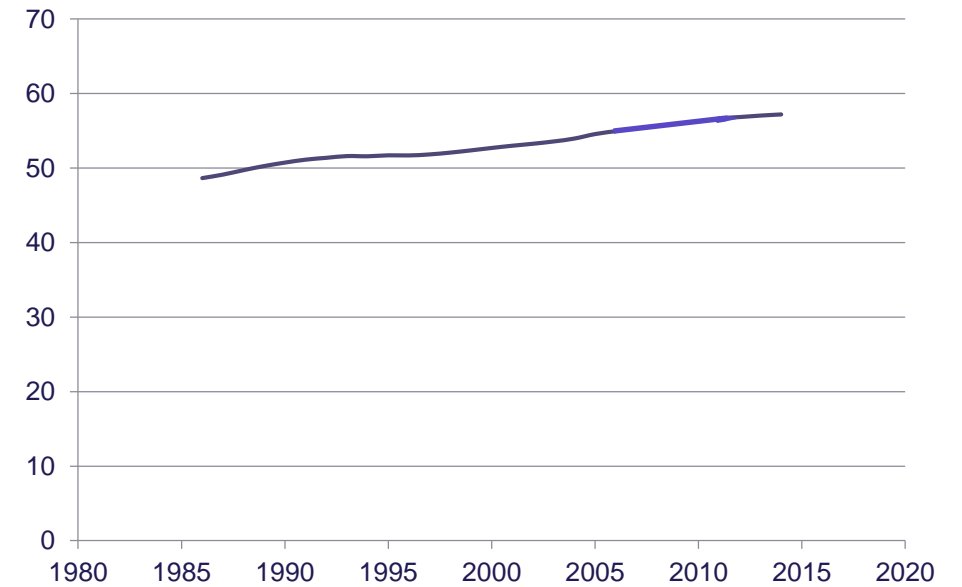


Energy efficiency and number of heated square meters



Energy statistics, Danish Energy Agency, 2017

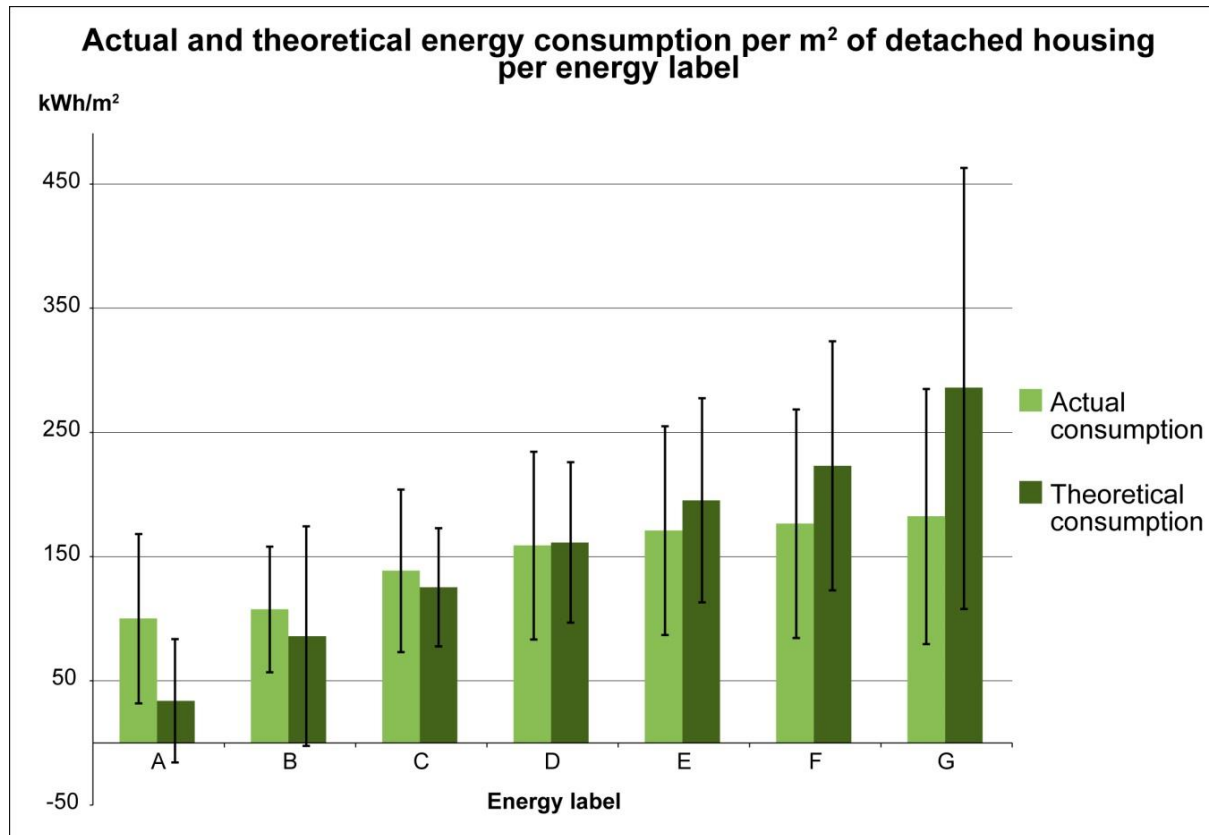
Squaremeter per person



Statistics Denmark, 2013



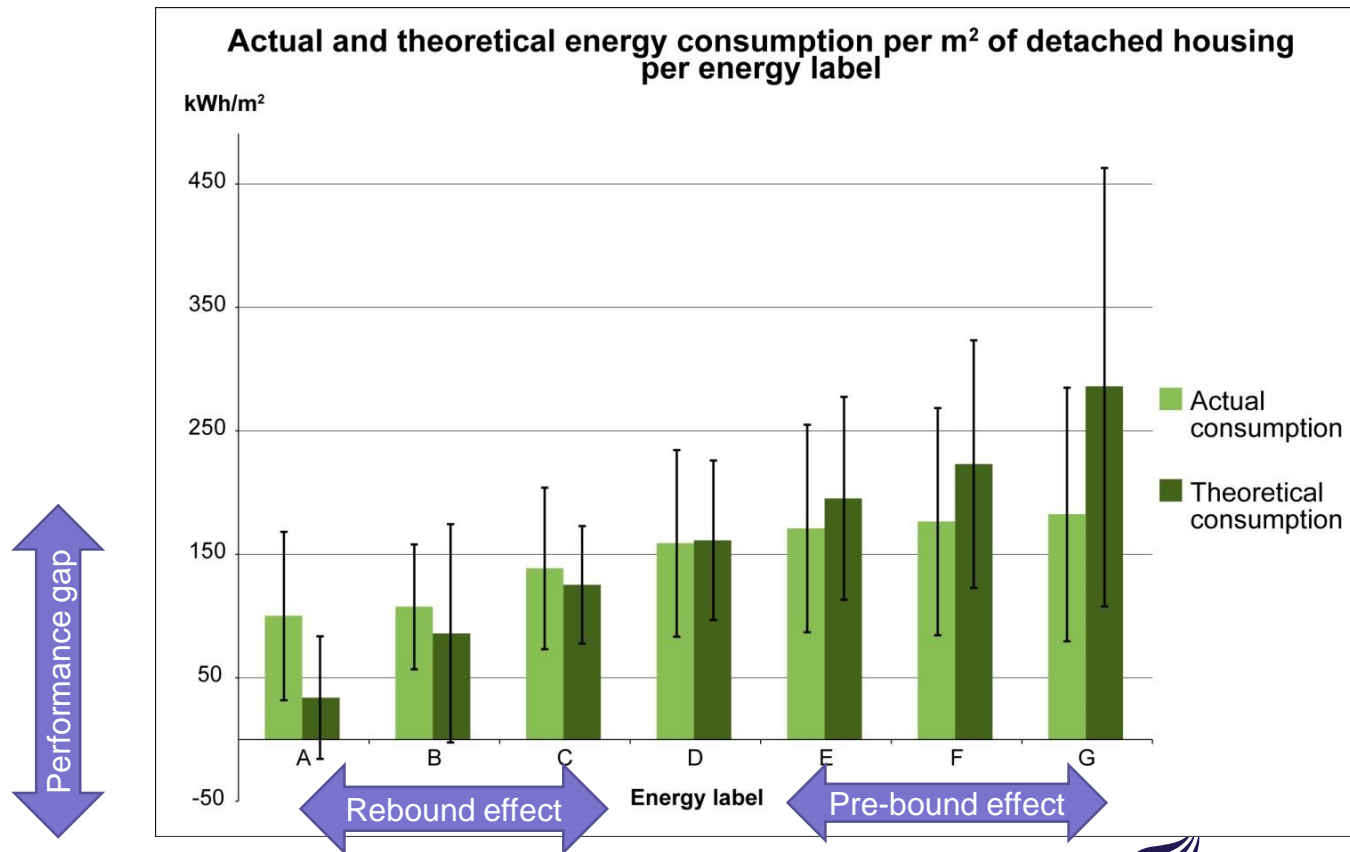
Efficient homes versus efficient practices....



Based on 230.200 detached Danish houses with an energy label. (Gram-Hansen and Hansen, 2016)

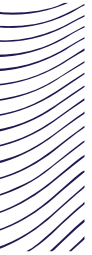


Efficient homes versus efficient practices....



Based on 230.200 detached Danish houses with an energy label. (Gram-Hansen and Hansen, 2016)





14 Qualitative interviews: Different building - different comfort

Underfloor heating: Another type of comfort:

- changing practice of heating
- difficult/slow to regulate
- regulating less
- equal heating in all rooms
- heats more rooms
- nice for the feet if warm – get used to that, but low-energy homes do not need it



(Madsen, 2018)



A survey among detached home owners

Data:

- N=1.216 persons, response rate = 69.5 %
- Detached owner occupied with district heating
- Combined with register data on people and buildings

Questions on:

- Airing
- Temperature
- Clothing



(Hansen et al, 2018)





Results summarized

Building characteristics influence practices

- ▶ People regulate thermostats less if they have underfloor heating
- ▶ People dress warmer in older buildings
- ▶ People (reports) keep higher temperatures in newer buildings
- ▶ Surprisingly, airing habits do not depend on building type/age

But doings also relate to household characteristics, for example...

- ▶ Higher educated dress warmer and heat less
- ▶ Older as well as families with children air more

(Hansen et al, 2018)



Building regulations and energy efficiency?

- ▶ Theoretical calculations (pre-build)
- ▶ Still tighter requirements announced a head
- ▶ Market mechanisms to develop more efficient products
- ▶ For new-build and retrofitting of existing buildings
- ▶ **Assumptions of a theoretical efficiency independent of the use**



Continued development towards Near Zero Energy Buildings

Traditional technologies:

- Envelope insulation
- Building airtightness

Newer technologies:

- Ventilation with heat recovery
- Demand controlled ventilation
- Solar shading to control overheating and daylight
- Control of window opening



More user robust technologies



Less user robust technologies

If user interaction were included - other technologies might be developed



Development and innovation in building technologies

What products are developed and what happens in use:

- Sun shading - but if used during winter?
- Mechanical ventilation with heat recovery – but if still opening windows?
- Low-temperature underfloor heating, but if heating to have warm feet?



Use and management: what should be on the agenda?

- Avoid technologies which indirectly guide users towards more consumption
- Can buildings and technologies “guide” the users to consume less?
- The usability of technologies and interfaces
- The interaction between different building technologies (e.g. thermostats and sun shading)



Discussion of building regulations

Regulations has so far delivered

- ..energy efficient innovation in buildings and technologies
- ..buildings which consume less
- ..buildings with higher more uniform indoor temperatures

Continuous tightening along the same line:
expensive and not delivering further
reductions



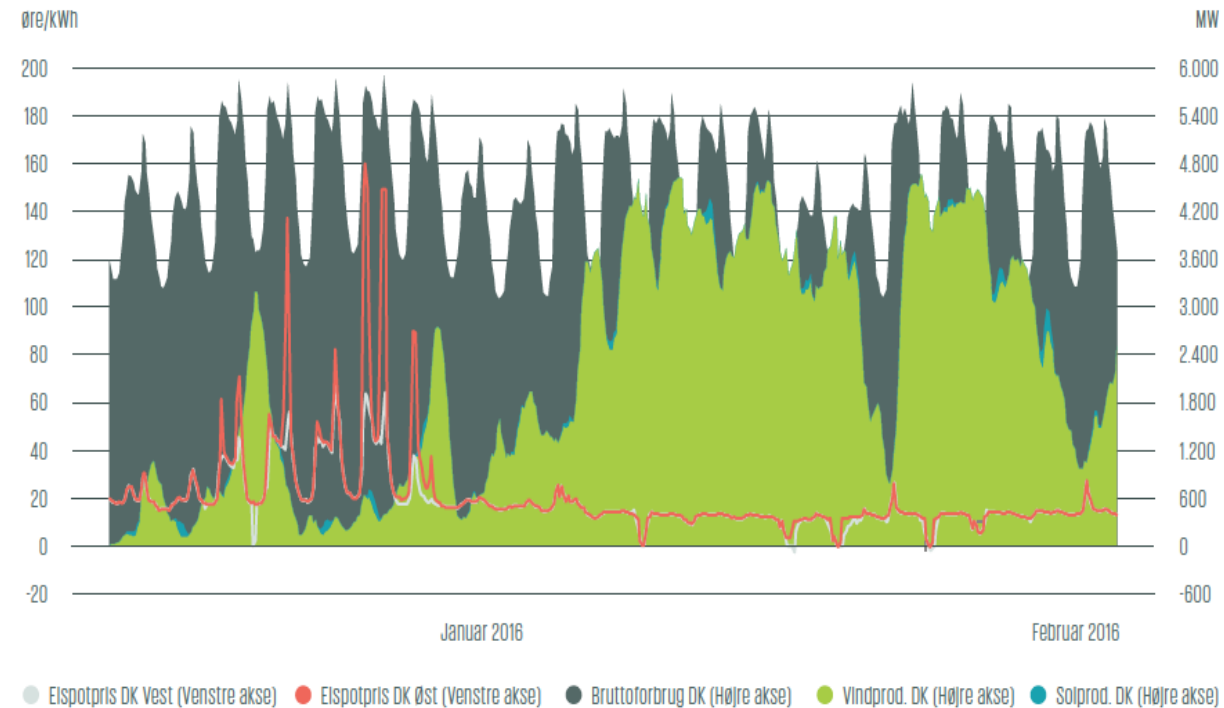
Suggestions for future building regulations

- Energy modeling which include user behavior (e.g. rebound estimates)
- Supplement pre-construction theoretical calculations by post-occupancy measurements and commissioning



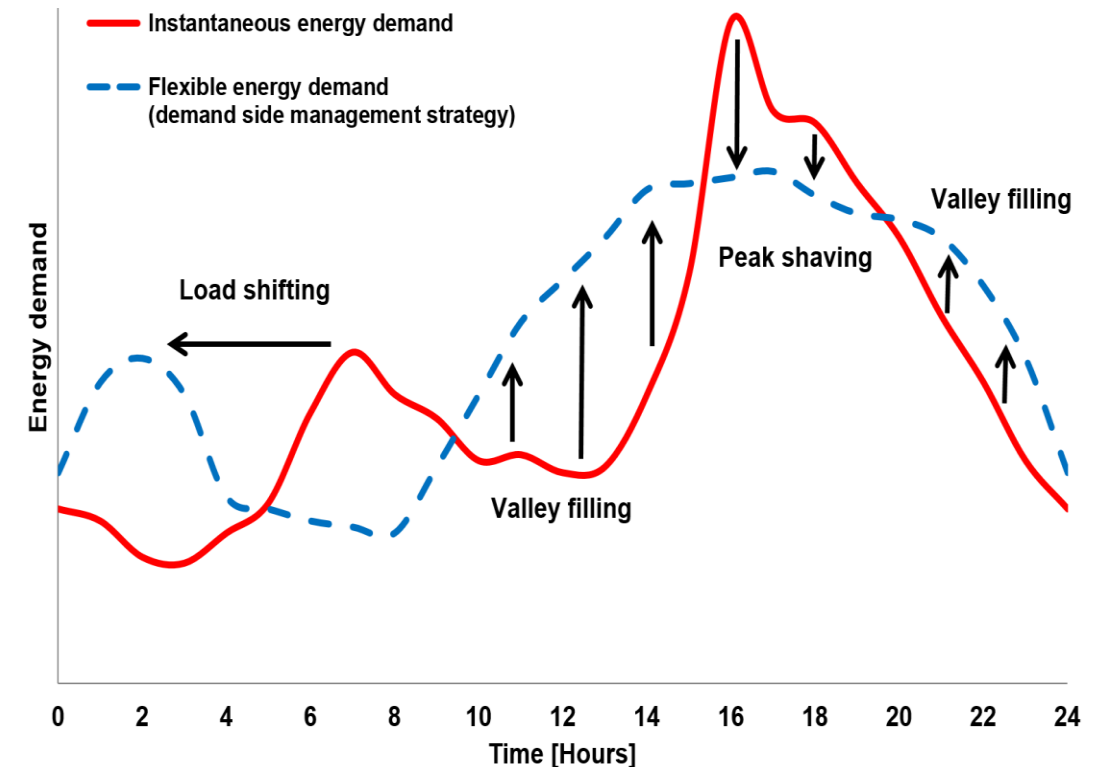
Energy in the future is about flexibility

- ▶ Production follows wind and sun, resulting in peaks and valleys
- ▶ Demand follows societal rhythms resulting in other peaks and valleys
- ▶ Delivering in peaks are environmental and economically costly
- ▶ Sometimes we produce energy that cannot be used



New roles for consumers in a reconfigured energy system

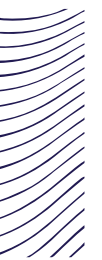
- ▶ We still need to reduce consumption – **“Redusers”**
- ▶ Deliver flexibility to heating and electricity network by postponing and reducing peak consumption – **“Flexumers”**
- ▶ Produce energy for the grid or for self consumption – **“Prosumers”**



New consumer roles and new technology

- ▶ If consumers should *reduce* their consumption, *move* it or *produce* (parts of) it themselves – smart home technology is often envisioned as part of the solution from policy and industry
- ▶ Are awareness of energy realistic?
- ▶ Could smart technology also create higher consumption?



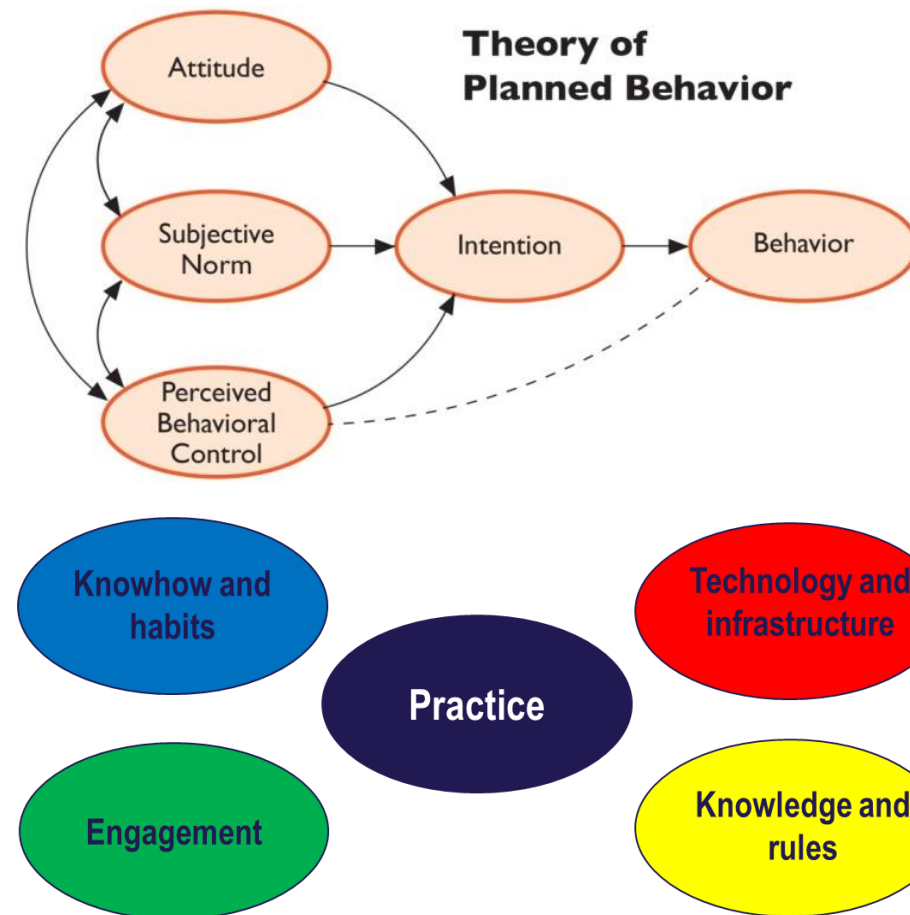


Consumers are important - how to understand them?



Behavioural *versus* Practice Theoretical approaches

- Individual *versus* collective
- Rational *versus* habitual
- Focus on the individual *versus* on the practices
- Technology and infrastructure not included *versus* included



Norms of comfort develops over time together with introduction of new technology

- ▶ Infrastructures, buildings and technology have changed the last 100 years – norms of comfort and indoor climate have changed together with this
- ▶ Underfloor heating, smart home control and Zero+ houses will also lead to new norms of comfort
- ▶ Comfort norms will continue to change – what technologies will influence them in less consuming directions?



Concluding

- ▶ New technology always also mean new practices
- ▶ Technology alone will not save the climate
- Consumers needs to be included to lower consumption
- ▶ Focus on new collective norms and routines rather than individual awareness
- ▶ Develop buildings which support lower consuming norms and routines



Thank you for your attention

kg@sbu.aau.dk