Case descriptions for student workshop

Case description: Heating Dutch houses more sustainably

About households in the Dutch heating transition:
New heating and other indoor climate control technologies are recognised as necessary for transitions towards a low-carbon and climate-resilient society (IEA, 2013). In the Netherlands, the heating of spaces and domestic hot water accounts for 81% of the total energy demand of residential buildings (IEA, 2020) and is, therefore, an attractive target for reduction. The large-scale introduction of heat pumps for residential buildings should reduce CO2 emissions and save energy while providing a comfortable indoor climate in homes (van Leeuwen et al., 2017). They replace the commonly used gas boiler systems (van der Bent et al., 2022). This transformation of indoor climate systems should help achieve the goal of an energy-neutral Dutch residential building stock by 2050 (Tigchelaar et al., 2019).

Heat pumps end up in households, and how people heat and cool their homes is critical to actually realising sustainable outcomes. In relation to heat pumps, for example, the motivations and social and informational needs in the decision to acquire sustainable technologies are extensively studied (Ebrahimigharehbaghi et al., 2019). Households (as users of technologies) are also increasingly seen as sources of innovation, modification and redesign of technologies and other solutions (Ornetzeder & Rohracher, 2006). Meanwhile, mundane household interactions (or 'occupant behaviours') are also considered a threat to the energy efficiency of buildings with sustainable technology (Caird et al., 2012; Roy & Caird, 2013). Unexpected behaviours of residents (such as opening windows) might contribute to a gap between predicted and actual energy consumption, and thus reduce the success of heat pump transitions (Guerra-Santin, 2013; Pettersen et al., 2017).

Technically, a heat pump boosts low-temperature heat in the ground, air, or water to temperatures suitable for heating a building and/or domestic hot water (Roy & Caird, 2013). The energy (in the form of heat) that is transferred to the house can be up to four times higher than the energy (in the form of electricity) required to run the pump (a metric known as Coefficient of Performance (COP)). The current Dutch building stock is largely fitted with gas-fired condensing boiler systems which heat both domestic hot water and the water flowing through radiators emitting heat in every room (Kieft et al., 2021). While these gas-fired condensing boilers heat water to a temperature between 55°C and 85°C, heat pumps offer a different approach to domestic heating, as they normally produce heat at much lower temperatures (below 45°C). Heat pumps operate most effectively in well-insulated buildings with larger low-temperature heat emitters, preferably under-floor heating or convector radiators, which heat indoor air slowly and evenly, rather than quickly. Finally, a relevant feature of most heat pumps is their limited capacity to produce domestic hot water. Systems deal with this by heating the hot water slowly (often during the night) to 55°C and storing it in a storage tank until needed. Typical storage tanks have a capacity of 100-200L, whereas a 2008 study in the UK found that the mean domestic hot water consumption per household is 122 litres a day (Measurement of Domestic Hot Water Consumption in Dwellings, 2008).

Vision:

- *To move to a completely energy neutral housing stock by 2050*. This means electric heating of spaces and hot water, and (ideally local) clean production of consumed energy. This also means careful adaptation of residents who make mindful use of the weather conditions, and live and heat their homes according to when energy is available.

Possible Pathway(s):

- *From households as passive end-users of heat pumps, to household as experimenting participants in the transition*
    - Here, households experiment and creatively innovate their own solutions to living with new heating technologies. Residents invent their own solutions that work for them, and could also be shared with others (e.g., heating your body with a warm jug when coming home in a cold house, or collaborating with technical stakeholders to improve technology functioning). This also creates flexibility for residents towards situations when there is not enough energy or the heat pump cannot cope with high heating demands. Residents are not seen as barriers who misuse technologies, but as local co-inventors and innovators who participate and collaborate in transitioning to a more equitable and sustainable future.

Some actors to consider:

- Households / residents / technology buyers and energy consumers

- Technology installers – e.g, Unica, Kropman, and many smaller local installation companies
- Technology developers – e.g, Panasonic
- Building companies renovating and building new houses – 'aannemers'
- Building owners – e.g., social housing organizations
- Energy companies- e.g., Essent, Vattenfall
- Municipalities (cities and towns)- the expected coordinators of energy transitions
- National governments- e.g., the ministry of Binnenlandse Zaken en Koninkrijksrelaties (en 'Wonen')
- Energy cooperations – collectives of citizens producing their own energy together with e.g., shared solar farms
- Energy coaches - helping residents live save money and live more sustainably

Some barriers for change and things to consider:

- 'There is no time for dealing with citizens', the energy transition needs to go very fast, and currently citizens are often seen as barriers.
- Technology companies are very focussed on making the right technical choices, and in this way unburdening end-users 'ideally, people shouldn't notice anything', but in practice this is not the case.
- Energy price determines energy savings, people consume less when it is costly. This contributes to sustainable living, but it also leads to unjust situations for the poor, who cannot afford to invest in more clean technologies, and also have no option of turning the thermostat even lower.

Case description: Transitioning the Dutch food system to cater for enough

About food waste:
Today, there exists a significant disparity in food distribution across the globe. This imbalance has resulted in poverty and famine in some countries, while others experience abundance, leading to extensive food waste (FAO,2013). This wastage has severe negative social, economic, and environmental impacts, affecting the well-being of individuals and society (FAO,2013; Salhofer et al., 2008). Moreover, food waste contributes 8-10% of global greenhouse gas emissions and exacerbates the three planetary crises of climate change, nature and biodiversity loss, and pollution and waste (FAO, 2013; UNEP, 2021). To fulfil the United Nations' objective of reducing food waste by 50% before 2030 and to cope with the increasing global demand for food, a holistic strategy addressing various aspects such as consumer behaviour, retail practices, and macro-environmental factors is required, ultimately transitioning the food system (Aschemann-Witzel et al., 2015; Schanes et al., 2018).

In the Netherlands, the amount of food wasted in the supply chain ranges from 1.77 to 2.55 billion kilos annually, with consumers being responsible for the largest share of this waste, representing 33% (van Dooren & Mensink, 2018). Despite increasing awareness and concern for the implications of food production and consumption, consumers find it challenging to adopt food waste-free behaviour. Some reasons for this include insufficient culinary-related skills, over-preparation and over-buying, and concerns for food safety (Stangherlin & de Barcellos, 2018). As a leader in the agri-food domain, the Netherlands hopes to become one of the first countries to reduce 50% of its food waste (STV, 2023)

Vision:

- *To move to a food system that has enough for all with hardly any waste.* This helps increase food security and reduces the food systems' contribution to GHG emissions.

Possible Pathway(s):

- *Pathway 1: Embrace flexibility*
    - This pathway embraces flexibility and highlights the benefits that come with this. It envisions even more flexible food purchasing with on-the-spot delivery to consumers' homes, offices, or somewhere in between. Consumers can purchase ingredients, meal boxes, or ready- to-go meals. Framing meals as 'categories' like pasta or curry allows for flexibility in ingredients, helping consumers adapt to unpredictable produce. This flexibility means that consumers see more variable food offerings on retailer shelves as well as more diversity in produce.

- *Pathway 2: Put vitality first*
    - This pathway puts vitality first and governs the prevention of illness properly. It achieves this by implementing holistic health programs and repositions food purchases in a larger set of

lifestyle offerings around vitality and well-being. These lifestyle services are offered by sports facilities and retailers as part of their commitment to the vitality consortium. This empowers consumers during their health journey by offering personalised meals, food tasting to explore one's identity, and capturing consumption patterns by apps that can be reviewed with personal vitality coaches. This helps consumers work towards a lifestyle that makes them feel balanced and strong while repositioning retailers from food companies to care companies.

- *Pathway 3: Celebrate the food journey*
    - This pathway celebrates the food journey. It enables people to experience and contribute to local food production. Small-scale experience farms throughout the city offer consumers a place to grow their own produce, engage with others who have gardens or enjoy the various events and courses on offer. These farms, along with a central market, provide a place for people to share food knowledge, gain a better sense of how the seasons impact food cycles, and nudge people to view global food as complementary to local products. Retailers stimulate a shared responsibility for optimising local production by providing a platform for farmers, civil servants, entrepreneurs, and citizens to create, develop and test novel ideas.

- *Pathway 4: Optimize through learning*
    - This pathway uses smart technology to learn about ourselves as individuals and as a society. Online platforms, apps and smart devices support insight into consumption patterns and support learning around food purchase, preparation and storage. This is done while optimizing in terms of personal wellbeing and sustainability. The data allows retailers and producers to have a more synergistic relationship. Regional consumption data allows producers to grow what we eat, implement more preserving techniques, and use imperfect foods. While local consumption data helps retailers manage their stock efficiently based on local buying practices.

Some actors to consider:

- Consumers/Households
- Retailers—e.g., Jumbo, Albert Heijn, Picnic, Crisp, LIDL
- Farmers—e.g., small-scale farms, large intensive farms
- Wholesalers and Manufacturers—e.g., Unilever, HAK, Iglo,
- Government—e.g., Ministry of Food Quality, Nature, and Agriculture
- The Foundation Against Food Waste (Samen Tegen Voedselverspilling)
- National Nutrition Centre (Voedingscentrum)
- Restaurants
- Food/meal delivery services—e.g., HelloFresh, Too Good To Go

Some barriers for change and other things to consider:

- Business models do not often support the sale of food. Why would a retailer sell less, and what is in it for them?
- Fingers are often pointed to others—the producers and retailers grow and sell what people want, yet people want things because the system provides them—take 'ugly' food as an example.
- Food waste is a consequence of consumption; people don't want to waste, but other values conflict with food waste-free behaviours. How can these other values be aligned with food waste-free behaviours by people and the system?