From gas to green

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Chapter 9
From Gas to Green: Designing a Social Contagion Strategy for the Energy Transition in Rotterdam, the Netherlands

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Key words: theories of change, societal transitions, behaviour change, bottom-up, scaling, systemic design

Abstract
To reach the 2050 climate goals, massive socio-technical transitions are required. For requisite impact, not only industry and government need to transform, but a critical mass of society must adopt greener alternatives. A common yet pervasive trend observed is that people prefer to maintain the status quo, resisting change. Leveraging the strength of design in shaping behaviour (change), we propose and illustrate how social influence or 'social contagion' can be used to activate communities of citizens, not just individuals, to adopt greener alternatives. Our case study lies within the Dutch energy transition context. Lying at the intersection of design,

psychology, and sociology, this study contributes toward theories of *scaling behaviour* change and proposes practical tools to *implement* change within transition design. The case study shows how designers can play a critical role in shaping sustainable systemic transitions and argues for pluralistic applications of design thinking.

Introduction

Owing to global warming and frequent earthquakes in the gas-producing north Groningen region, the Dutch government aims to discontinue the consumption of natural gas by 2050. Currently, about 90% of the homes in the Netherlands use natural gas for heating purposes (Beckman & van den Beukel, 2019). In 30 years, these 7 million residential homes and 1 million other buildings must transition to using greener energy alternatives such as solar power, wind power, residual heat from industries and geothermal energy. Technological innovation in the past two decades has ensured that these alternative technologies are now mature, viable and widely available. Yet, active adoption by citizens and associated changes in practices and beliefs in households are proving difficult to achieve. Adoption by society and institutionalisation of these technologies is essential to achieve the requisite impact (Geels, 2004). Given this background, the government and local councils in the Netherlands are faced with the question, 'How to practically activate a critical mass of citizens to transition from gas to green energy sources?'.

This challenge falls within the purview of designers since design shapes people's perceptions and behaviours, whether intentionally or unintentionally (Lockton, 2013). Additionally, as Ceschin & Gaziulusoy (2016) and Buchanan (2015) outline, methodological maturity in the field of design has led to an evolution in the nature of challenges designers now concern themselves with –from symbols, physical objects, services and processes to broader environments, systems and organisations. The application of design towards these broader environments is more commonly referred to as Design Thinking. There are some interesting design movements that deal with these new challenges, such as 'Systemic Design', 'Transition Design' and 'Design for Sustainability'. They bring forward a design approach to intervene in complex systems while striving for long-term sustainable change. The tools and methods available from these design movements combined with the general capability of a design thinking process to embrace ambiguity and complexity offer a different approach to tackling societal problems. In this study, we approach the socio-technical challenge in the Dutch energy transition context using design thinking. We utilize a design approach towards conceiving strategic ways of activating citizens to adopt sustainable energy alternatives.

We explore how social influence or social contagion can activate residents to adopt greener energy alternatives and support the energy transition using the Reyerood neighbourhood in Rotterdam as a case study. We follow a 'research through design' approach (Stappers & Giaccardi, 2017) wherein our process is inspired by the double-diamond approach of design thinking. This approach entails that the results from our case study are multi-layered. The first layer includes what we learn by embarking on a design process, in co-creation with the municipality, for social contagion and the energy transition. In this we have identified individual residents' motivations and apprehensions towards the energy transition in Reyeroord and the relations between residents within the social networks. Second, the outcomes of the design process, culminate in the development of the 'Design for Social Contagion framework and toolkit' which codify a design (thinking) approach for the municipality to create interventions and shape contagion processes to activate residents. This was preliminarily tested with the municipality of Rotterdam. Last, by applying design thinking in the context of the energy transition we learn about the value of such an approach, which we will reflect upon.

Resistance to Change

There is increasing awareness amongst citizens about the need for and value of sustainable lifestyles, yet it does not reflect in their behaviours and consumption patterns (Frederiks et al., 2015). The transition from gas to green requires citizens to invest time, money and effort to make changes and overcome the short-term inconveniences of a technology change. The return on this investment is not visible in the immediate future nor are long-term financial savings. There is ambiguity too, as to who will make the decision (together) and initiate action to change: the tenants, house-owners, housing associations, housing corporations, the municipality or the national government. Even if citizens have a positive attitude towards gas discontinuation, achieving the 'socio' component of a socio-technical-system change is highly challenging given this perception of inconvenience and uncertainty.

The challenges described above can be theorised as ‘lock-ins’ that reinforce accepted ways of thinking, doing and being (Klitkou et al., 2015) and hold citizens (and energy providers) in the current socio-technical gas system. To overcome lock-ins, governments often turn to top-down policy mechanisms to stimulate preferred behaviours. These policies are often met with public resistance. For example, when the city of Barcelona first introduced ‘superblocks’ where car traffic was permitted only on perimeter roads to curb pollution and car collisions in 2017, car owners and residents from surrounding neighbourhoods took to the streets to resist the change (O'Sullivan, 2017).

Providing financial incentives is the other commonly opted route. However, a provision of financial incentives does not imply that citizens will actively opt for the gas to green transition (Frederiks et al., 2015). For instance, people in Boulder, Colorado did not actively purchase energy-efficient appliances even though the government provided free home energy audits, rebates, and other incentives (Simon, 2010). This highlights the need for novel strategies to overcome societal lock-ins and stimulate changes in citizens’ behaviours.

Looking to transition theories and literature from the domains of technology and innovation diffusion, it is observed that there is limited practical guidance on how to activate a critical mass of citizens to adopt innovation at the micro-scale. Theories like the Multi-Level-Perspective (Geels, 2002), Technology Innovation System theory (Hekkert, et al., 2007) and Strategic Niche Management (Caniëls & Romijn, 2008) are analytic in nature and provide zoomed-out, meta-level understanding of the dynamics of transitions. These advocate the co-evolution of user practices, norms and technology, but do not offer concrete strategies to activate individuals and communities. From the domain of policy development and governance, Transition Management (Loorbach & van de Lindt, 2007) emphasizes the involvement of stakeholders through transition arenas. These arenas are focused on strategic activities, limited to select stakeholders and early adopters. The experimentation phase of transition management, where activation of citizens must happen, provides less tools for practically activating a critical mass.

The diffusion of innovation theory by Rogers (1983) highlights how innovation can spread within communities through active influencers and front-runners. While this has merit when it comes to the diffusion of certain products and services, it does not always prove useful for complex behaviours that need to overcome entrenched routines and beliefs and require a considerable investment in terms of time, money and effort (Centola, 2018). Moving away from well-functioning technologies (systems) requires intrinsic and extrinsic motivation as well as changes in cultures and norms– which cannot be guaranteed simply by diffusion of *knowledge* of innovation.

Here, design thinking and its abductive problem-solving capability can help in unveiling and deconstructing societal lock-ins and devising persuasive strategies for change.

Design thinking for systems transitions

Today’s societal problems are characterised by the interaction of several socio-technical systems with high levels of complexity and unpredictability which cannot be controlled by a single definitive solution. Tackling such problems or transitioning away from such systems requires an explorative way of working and the creation of a variety of interventions at different levels in a system (van der Bijl-Brouwer & Malcolm, 2020). Design thinking provides one such explorative approach towards complex challenges.

As Drew et al. (2021) highlight, the core capacities of design thinking include integrative thinking, perspective-taking, abductive reasoning, propositionality, reflexivity and synthesis-through-making. These are valuable not only to understand the existing paradigms and navigate/ visualise system complexity, but also to reimagine futures. These can help in building the big-picture, a collective/ shared understanding of desirable futures and states of our systems.

At the granular level, given that the ethos of design thinking lies in creativity and abductive thinking/ reasoning where at the start of the process both the ‘WHAT and ‘HOW’ of tackling a problem are unknown (Dorst, 2011), it is apt that design thinking be applied to shape interventions towards system change. As Norman (2020) highlights, this includes diving deeper into local cultures and communities and co-designing solutions with community members. Apart from their own design expertise, honing diffuse design capabilities (as Manzini (2015) terms it) and co-designing interventions enable designers to engage in and transverse across different levels of a system.

Apart from designing these standalone interventions, as Nelson & Stolterman (2012. p.57) argue, designers are "able to create essential relationships and critical connections in their designs and between their designs and the larger systems in which they are embedded". This is the very ethos of systemic design with its focus on 'how independent parts become an inter-dependent whole'. Thus, design thinking is inherently systemic in nature and can prove valuable in shaping both, the big-picture (interdependent whole) and the interventions (independent parts) towards the big-picture for systems change.

This application of design thinking in shaping the future states and interventions towards the future states is captured in the emerging domains of 'Transition design' (Irwin et al., 2015) and 'Systemic design' (Drew et al., 2021) with a focus on deep transformation. These emphasise that deep transformation necessities a shift in mindset – a certain 'way of thinking' before 'doing' - which is inherent to design thinking. These domains advocate identifying 'new ways of designing' or 'leverage points' for intervention to steer change. One such leverage point for intervention we identify is 'Designing for behaviour change'; which we explore in the next part of the chapter and our case study.

Design interventions for Behaviour Change

Design inherently includes a process of change (towards preferable situations) which shapes practices. Designers fulfil peoples' needs while enabling them or prompting them to do or not to do something through the design of tangible and intangible aspects of a product-service-system or socio-technical system. The affordances provided by this design activity or the interactions and emotions evoked through design intervention influence peoples' associations, attitudes, decisions and actions (Lockton, 2013). In turn shaping long-term routines, habits and cultural paradigms.

There is increasing consciousness amongst designers about this (desirable or undesirable; and intentional or unintentional) impact of design on (consumer) behaviours; and thus, an increased sensibility of intentionally and explicitly influencing behaviours. This is captured within the field of 'Design for behaviour change' (Michie et al., 2011; Lilley, 2007; Niedderer et al., 2014) which draws upon behavioural sciences like psychology, sociology and neuroscience to inform design interventions and strategies to trigger certain behaviours. The interventions either aim at triggering a direct cognitive change in an individual or shaping contextual cues which indirectly influence one's behaviour; or a combination of both (Niedderer et al., 2014).

More recently, acknowledging the contribution of behaviours (of individuals and groups) towards social and environmental problems, 'Design for behaviour change' is being used by the private and public sectors alike to prompt healthy, sustainable and socially desirable behaviours. Examples include interventions to increase energy-saving, reduce littering, reduce crime, improve compliance with tax laws, continued adherence to medication, exercise routines and healthy diets (Lockton, 2013; Niedderer et al., 2014).

While strategies of design and behaviour change are a good starting point to trigger sustainable behaviours (be it a one-time behaviour or a continued habit), a focus on shaping individual's behaviours or small groups of individuals is observed; constraining them in scale of impact. Scaling behaviours of individuals to the communities they are embedded in is crucial to achieving a critical mass towards reaching the sustainable development goals. The need for devising (new) approaches to *scale* behaviour change beyond individuals while activating communities and networks is apparent.

Social Contagion to Scale Behaviour Change

Studies on pro-environmental behaviours and habits, energy use and consumption as well as technology adoption accentuate the role of culture (Lutzenhiser, 1992), social influence (Goldsmith & Goldsmith, 2011), social norms (Trudel, 2018), social proof (Nolan et al., 2008) and social diffusion (Costanzo et al., 1986) in positively affecting behaviours. This follows from people's tendency to use shortcuts (heuristics) to reduce the effort in evaluating and comprehending choices while making decisions. One such shortcut used is to align one's choice with those of similar others; assuming that others have more knowledge, or that if the majority has chosen something it must be correct.

Social influence also arises from people's need to conform to and comply with social norms in order to achieve three self-goals, namely, to act effectively, to build and maintain social relationships and to manage the self-concept (Cialdini & Trost, 1998). They seek social comparison evidence (normative guidance), specifically from similar others to evaluate themselves in terms of the appropriateness of their abilities, behaviours and

beliefs. When the attitudes and actions are shared with the comparison group, they are further reinforced. If there is a discrepancy, the attitudes and actions are altered (Marsden & Friedkin, 1993). People are strongly influenced by the (in)action of others, which implies that one would act only if several others have chosen to act (Buskens & Raub, 2013; Cialdini & Trost, 1998). This also applies to sustainable behaviours, as exemplified by Trudel (2018). He concludes that one's 'personal and social identities' and 'social influence through social norms' are two key factors that 'powerfully, predictably, and pervasively influence sustainable behaviours.'

On the downside, this social influence gives rise to the impasse wherein people wait for others to act first, with no ultimate action. This is problematic as climate science describes a precipice for significant change to human activity now (Williamson et al., 2018). While this interdependency in decision-making is a hurdle, it is also an opportunity to gain traction towards the notion of designing for critical mass. Several 'Design for behaviour change' toolkits include 'providing social proof', 'social traces', 'social support' or 'designing for collective use' (Ploderer et al., 2014) as strategies for change amongst others. However, often these are focussed on shaping individual's (or small groups of individuals) behaviours e.g., providing neighbours' energy saving data to prompt conscious behaviour amongst families or giving social proof (e.g. "90% of guests who stay in this room, reuse the linen and towels") to guests in a hotel to reuse linen. The inherent scaling power of social influence which can be applied to social networks and communities stays underexplored.

Building on these strategies and expanding their scope of application, we explore how to leverage the potential of social influence and social contagion within social networks and communities, using complex contagion theory (Centola, 2018) and a design thinking approach. We try to understand how citizens can be activated not as individuals but as groups (communities) and how activation happens *within* groups in the context of the energy transition.

Case Study: Gas to Green Energy Transition in the Netherlands

Historical Context

"Natural gas is to the Netherlands what oil is to the Gulf States" (Rapid Transition Alliance, 2021). The discovery of large natural gas reserves in 1960s marked the beginning of the economic and industrial legacy of the Netherlands. Amid rising nuclear power which could slash energy prices and cheaper coal imports that rendered Dutch coal unprofitable, exploitation of natural gas became a political priority. Through strong coalitions with private sector oil companies, extensive infrastructure and policy planning and exercise of power by the state, no alternatives could reach the market, any resistance was avoided, and the natural gas regime gained a monopoly in the Dutch economy **(**Correljé et al., 2003; Kemp, 2010; Beckman & van den Beukel, 2019**).** Dutch industries transitioned to natural gas and prospered. Export contracts with neighbouring countries not only gave rise to a positive trade deficit and profits, it gave Netherlands a central position in the energy ecosystem in the European Union. Revenues from gas exports as well as internal supply fuelled the development of the 'Dutch welfare state' **(**Correljé et al., 2003, p.16)**.**

Extensive campaigns and cost advantages were designed and households were sold the idea of increased convenience and comfort. The majority of the households readily bought into this since coal was tedious to use, houses were poorly heated, not insulated and uncomfortable. The post-war economic development gave rise to an increase in personal incomes and well-being, and a widespread sense of modernisation which also contributed to the spontaneous buy-in amongst citizens. Consequently, the Netherlands has become one of the few countries within the European Union with the highest natural gas consumption, especially in the residential sector. Nine in every ten homes in the Netherlands was heated by gas as of 2018; Natural gas contributed 69.3% to the share of fuels in the energy consumption in the residential sector in the Netherlands in 2019, as compared to 38.8% in Germany (Eurostat, 2021).

Policy Directives

The Dutch government recognises that transitioning away from natural gas is a social challenge and acknowledges that acceptance by citizens is a key condition to achieve the transition. It aims to employ a decentralised, district-oriented approach wherein local residents, businesses, civic bodies and other relevant stakeholders are involved in planning and executing the transition (Klimaatakkoord, 2019). It is important to note that although it is citizens who have to actively adopt greener alternatives, the municipalities and local councils must (and are) play(ing) a key role in facilitating, planning, managing and supporting the transition by

bringing together stakeholders, defending the common interests of the public, ensuring viability and overcoming uncertainties.

The government also identifies the affordability of greener technologies and feasible renovation in the built environment as two pillars to drive change. Hence, achieving housing cost neutrality (which entails that monthly financing costs for the transition do not exceed the savings on the energy bill for house owners / tenants) is a key focal point in the energy policy directive. The government aims to reduce costs by bundling supply and demand, working on digitization and innovation, combining transition activities with other neighbourhood development activities as well as re-designing price structures, energy taxes and subsidies. There are several funding schemes, loans with low-interest rates and mortgage options being made available for individual house owners or collective housing associations by the local and central governments to prompt change. The challenge here is that large scale adoption is a necessary condition to regulate prices and have a viable business case for greener technologies. Especially since there are insufficient resources to shape a fully state-funded gas to green transition.

With this backdrop, the Dutch energy transition in the built environment forms an apt real-world context to apply the theory of social contagion to activate residents.

Case Study Site: Reyeroord, Rotterdam

To gain rich insight into people's perceptions and needs and their social networks to stimulate social contagion, we chose to use the neighbourhood scale for our case study. We approached the Rotterdam municipality to select a neighbourhood. The municipality has chosen five pilot neighbourhoods (differing in the types of houses, socio-economic backgrounds of residents and the most suitable type of alternative energy source) to experiment with and learn from. Reyeroord is one such pilot neighbourhood, chosen for its characteristic of having a majority of privately owned houses wherein the household incomes lie below average. Due to the proximity of Reyeroord to the Rotterdam port and since a part of the heat network already exists there, district heating is chosen as the most feasible and viable alternative (municipality recommends it; residents can still opt for other alternatives). For a shift from gas towards district heating, it is essential to get opt-in from a majority of the homeowners. Getting opt-in from each homeowner is tedious and difficult as compared to convincing a housing corporation. The municipality would like to learn how to overcome this challenge.

The Reyeroord community has a diverse demographic composition. Its ethnic composition includes 63% native Dutch residents, 12 % immigrants from eastern European countries and 25% non-western immigrants. 17% of the population comprises of children between the age groups of 0-14 (it is considered a 'Children's Kingdom') and 20% consists of the elderly (Borgman, 2019). This age-wise composition reflects in the social interaction spaces in the neighbourhood, which are mostly directed towards the children or the elderly. People mingle in smaller groups, but the community as a whole is quite inactive. Majority of the people in Reyerood lead traditional lifestyles where they are focused on the status quo and strongly hold onto traditions and material possessions. They find the concept of sustainability vague and inconsequential to their lives (Borgman, 2019).The municipality is in the initial stages of planning and developing a business case for district heating; and is faced with the overarching question –How to motivate the residents to actively participate in the upcoming transition to make Reyeroord natural-gas free? The municipality of Rotterdam is actively looking to use a 'social design' approach to identify resident's needs and design interventions to motivate them. Since the municipality's planning and efforts are at a further stage in Reyeroord as compared to other neighbourhoods and the municipality is motivated to use social design in its approach within Reyeroord, it makes an apt case for this study.

Case Study Methodology

The defining feature of case study research is its focus on 'how' and 'why' questions (Schoch, 2016) and hence, is appropriate to answer our qualitative, exploratory research question – How can social influence/ social contagion activate residents to adopt greener energy alternatives and support the energy transition in Reyeroord? We followed a 'research through design' approach (Stappers & Giaccardi, 2017) wherein the process was inspired by the double-diamond design framework with research and design cross-fertilizing iteratively. The process was guided by three sub-questions:

1. What are the individual residents' motivations and apprehensions towards gas discontinuation?

2. What do the relations within the social networks of residents look like? How can the contagion unfold in the neighbourhood?
3. How can the municipality use social influence/ social contagion to activate residents to switch to greener energy alternatives?

Table 1 gives an overview of the different methods used within the diverging and converging phases of our double-diamond design approach.

Contextual Inquiry

The 'Discover' phase started with a literature review and secondary desk research on social contagion and the energy transition in the built environment in general. This included understanding the historical context of natural gas, the alternative technologies available, the government's plans, strategies, policy directives, efforts until now; tools, frameworks and strategies already being used by different actors, the process of transition for different types of houses and different information channels available for residents. This was followed by Reyeroord-specific contextual inquiry. Older reports and documents published by the municipality as well as other researchers and design agencies working in the neighbourhood were used to gain insight into the neighbourhood and its social structure. 14 semi-structured interviews were carried out with: (6) municipality officials, (1) technology provider, (2) other stakeholders who are involved in the energy transition in Reyeroord, (3) researchers /designers who have previously worked in the neighbourhood and have in-depth knowledge about the residents and (2) experts on the transition. The participants were recruited by the authors based on municipality's advice and represent an expert sampling of key stakeholder groups. The interviews were conducted in English and accompanied by sensitizing exercises to aid the interviewees' in formulating their answers. These helped to overcome the language barrier, since some interviewees found it difficult to articulate their thoughts in English - Dutch being their native language. The interviews were recorded and transcribed for further analysis.

Thematic analysis was used in the 'Define' phase to analyse the secondary data sources and interview transcripts to understand/ define:

1) The municipality and energy provider's current efforts, approach and plan for the transition in Reyeroord as well as the different barriers, dilemmas, tensions they face. SWOT Analysis was used identify the strengths and weaknesses of the current approach.
2) Different residents' profiles and their motivations, apprehensions and decision-making criteria towards gas discontinuation. These motivations and apprehensions found from the interviews were further analysed using models from psychology to categorise them into recurring factors and themes, identify the underlying construction of these themes (as shown in Figures 1, 2) and define the relationships between these themes (Figure 3 shows one such example of the relationship between different themes).
3) Meta-level social identities of the population in Reyeroord based on their affiliations in the neighbourhood and the networks these ensue. Insights about residents' social identities and networks were used to visualise how the contagion can unfold in Reyeroord building on complex contagion theory.

System mapping techniques were used throughout to understand the relationships between different aspects and to visualise the complexity the energy transition in Reyeroord entails. Figure 4 shows an example of one such systems map capturing the tensions, dilemmas and interactions between key stakeholder groups.

Design Intervention

Insights from thematic analysis were used to define design criteria and 'how-to' questions that were answered in the 'Develop' phase through 3 ideation sessions with different participants (Session 1: 6 Design students; Session 2: 2 Design students, 2 Expert designers; Session 3: 2 Expert designers). The sessions included Reyeroord-specific brainstorm to ideate upon strategies regarding how social contagion can support the transition by overcoming residents' apprehensions. Next, these Reyeroord-specific ideas and strategies were translated into a more generalized design approach (concept) to scale up behaviour change. It resulted in the design of the 'Design for social contagion' framework and toolkit which define a design (thinking) approach for the municipality to create interventions and shape the contagion process with a set of design principles, design components and inspiration strategies.

The toolkit underwent 5 iterations, wherein each iteration was validated in-use during a 2 -2.5-hour long workshop each with a combination of design students, expert designers, design teachers and municipality

officials (total 23 participants). Design students, teachers and experts were recruited by the authors from their own design practice networks; and municipal officials based on the municipality's advice. The validation was carried out by organizing co-creation workshops wherein participants used the toolkit to design interventions to stimulate social contagion towards gas discontinuation– just how the toolkit is meant to be used in practice. The co-creation workshops helped to qualitatively test the usability aspects of the toolkit – ease of use, the structure and format of the toolkit, intuitiveness, whether it inspires new ideas and helps municipal officials come up with ways to activate residents and if they will use it in the future. As a part of the 'Deliver' phase, the outcomes were presented to different clusters within the municipality, to the ENRGISED consortium and at the Dutch Design Week 2020. A workshop was organised for a service design agency working on the transition to use the toolkit and brainstorm interventions.

Limitations

Our study is limited to one neighbourhood, hence future research must be done in different contexts (of energy transition and other areas of sustainable transitions) to further strengthen the notion of designing for social contagion towards sustainable lifestyles. Our study is a starting point to give a practical form to theory on social contagion and social influence. Future research should point out which strategies are more effective in achieving which type of sustainable transition goals, and how the strategies can be further customised. The study builds on complex contagion theory by Centola (2018); future research can explore other theories of contagion to strengthen the framework. We take a qualitative approach to intervene in social networks. This can be complemented by quantitative network mapping techniques to improve predictability as well as evaluation of the interventions. Since persuasive techniques, specifically social influence can alter behaviours, designers must be highly reflexive about their intentions as persuaders. Ethical considerations and implications of using social influence strategies must be further researched.

TABLE 1. OVERVIEW OF THE METHODS USED

Phase from the Double diamond design framework	Discover (7 weeks)		Define (4 weeks)		Develop (8 weeks)			Deliver (3 weeks)
Key Activity(s)	Secondary research	Primary research	Analysis of interview transcripts, secondary data	Defining design goals, criteria	Ideation	Synthesis	Concept development, validation	Present outcomes
To answer sub-question(s)	1, 2	1, 2	1, 2	3	3	3	3	
Methods used	Desk research Literature review (Search language-English; Dutch resources Google translated to English)	14 Semi-structured interviews (1-1.5 hours each; audio-recorded) Sensitizing exercises during the interview (on printed templates) Verbatim transcription of interviews (done manually by authors)	Thematic Analysis (specific data was analysed using models from psychology[1]) SWOT Analysis System mapping Personas	Reframing How-to's	3 ideation sessions (2-2.5 hours each) During each session: How-to's, Brainstorming, Braindrawing	Thematic Analysis Comparison with existing 'Design for behaviour change' strategies and toolkits[2]	5 Co-creation workshops (2-2.5 hours each) Insights from each workshop were used to develop the next iteration of the toolkit-leading to 5 total iterations.	Presentations Co-creation workshop
Location		In person at participants' office; Online: Zoom			Online: Zoom, Miro		Online: Zoom, Miro	

[1] Models used: Theory of planned behaviour (Ajzen, 1991); Integrated model of pro-environmental behaviour (Wilson & Dowlatabadi, 2007); MAO (Ölander & Thøgersen, 1995); Fogg's behaviour change model (Fogg, 2009); Diffusion of Innovation (Rogers, 1983).

[2] Design for Behaviour change toolkits used: Design for Intent toolkit (Lockton, 2013); Social influence strategies (Cialdini, 2016); The Brains, Behaviour and Design toolkit (2011); Behavioural intervention design toolkit for service design (van Lieren, 2017); Mindspace framework for behaviour change (Dolan et al., 2011).

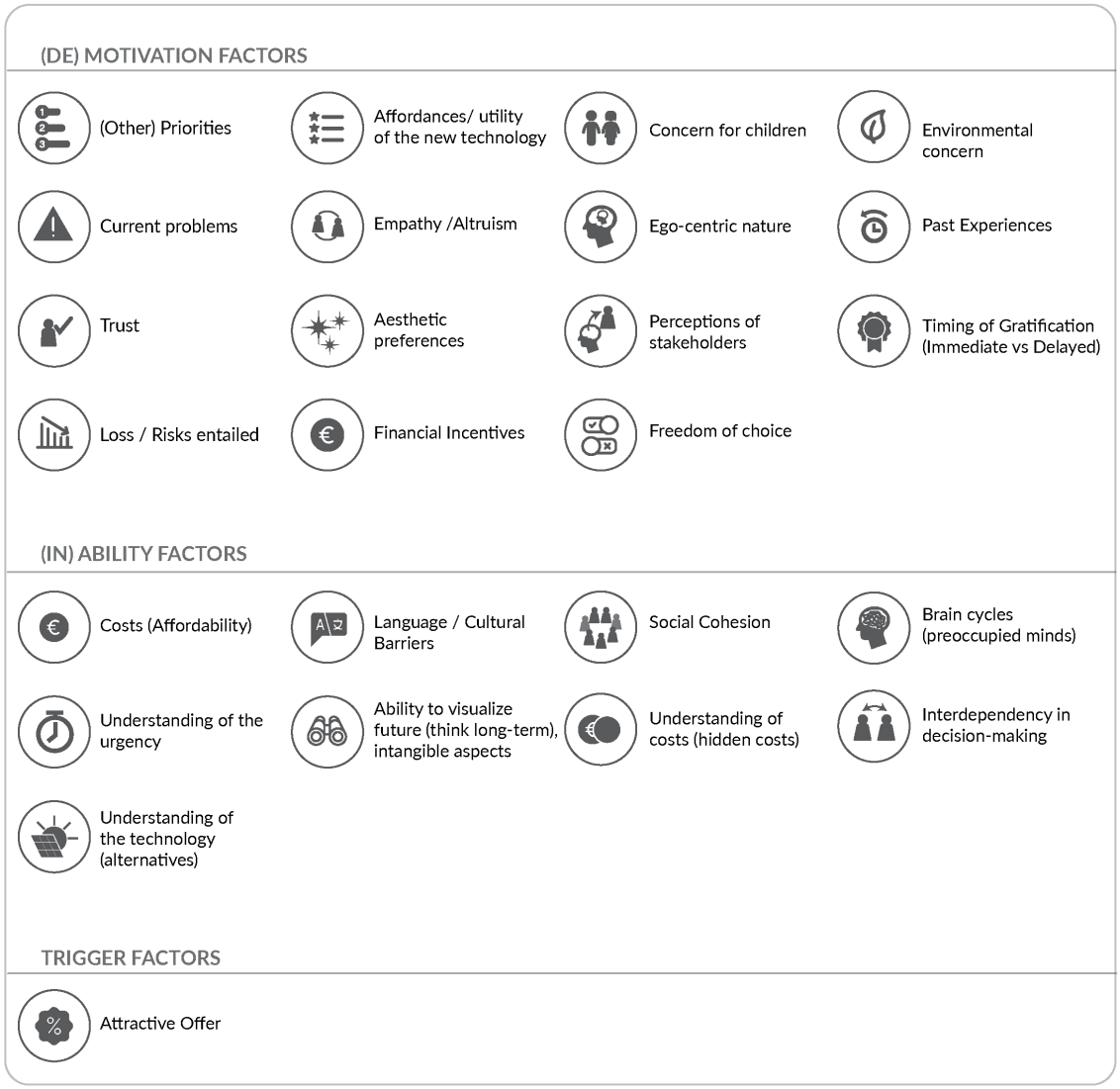

Fig. 1. Residents' motivations and apprehensions identified from interviews were simplified into key factors. These factors are classified into Motivation, Ability and Trigger factors based on Fogg's model for behaviour change (Fogg, 2009) in order to understand whether residents lack motivation or the ability to act towards gas discontinuation. These were used to as input for ideation of interventions.

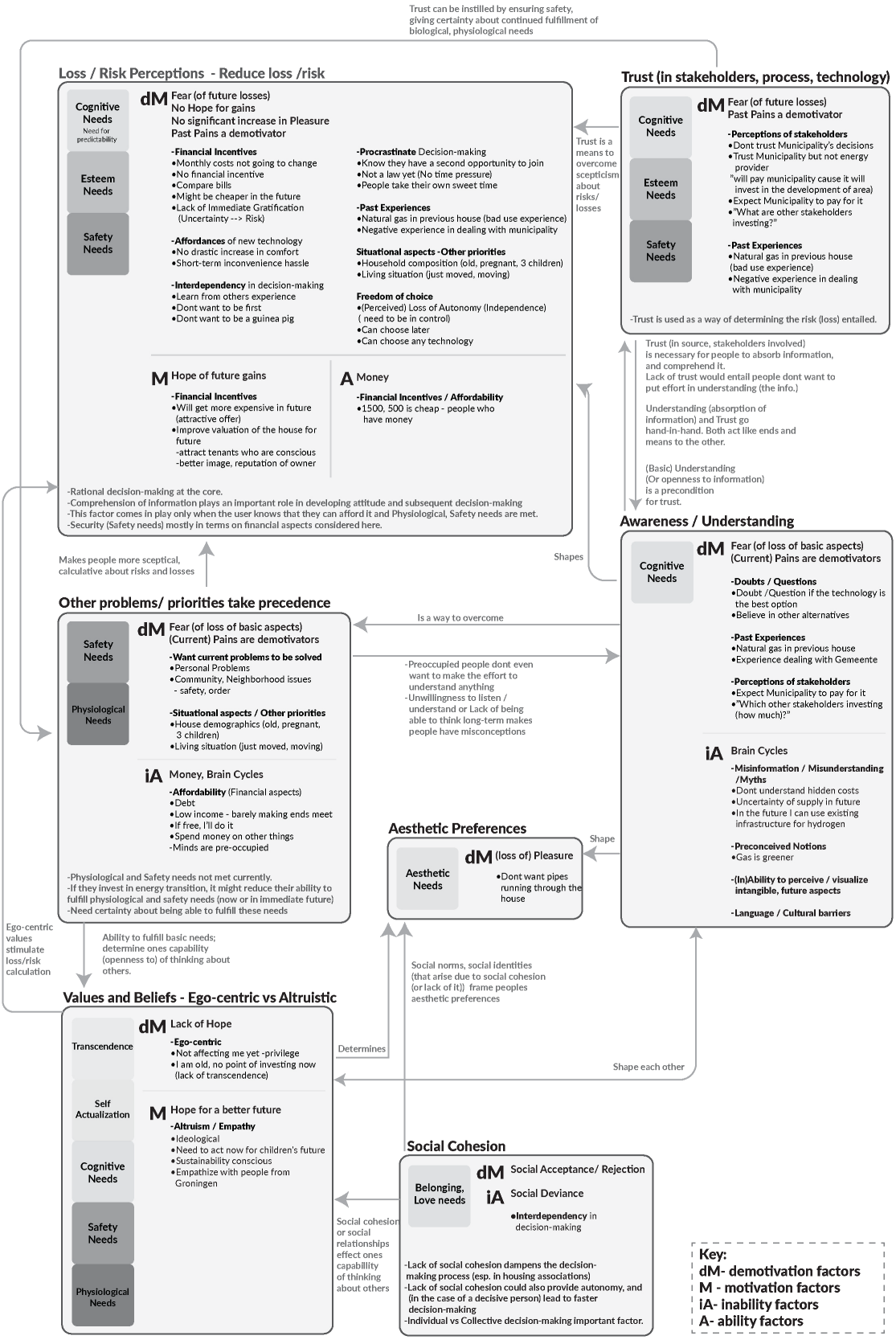

Fig. 2. The factors derived from interviews were clustered together to identify the recurring underlying themes that drive decision-making of residents. 7 such key themes were identified. Maslow's hierarchy of needs (McLeod, 2020) was used to further define which basic needs these decision-making themes cater to. The themes

were used to identify the decision-making process of different resident profiles in Reyeroord.

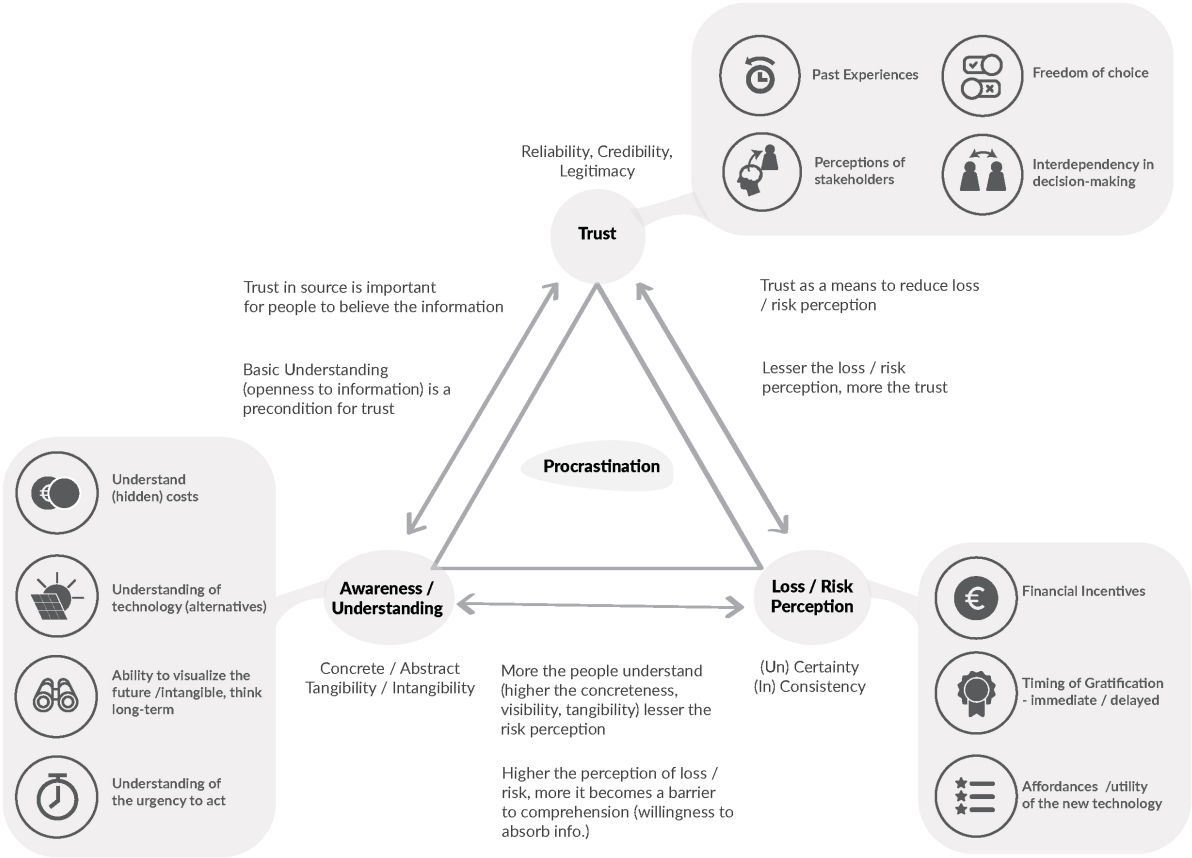

Fig. 3. Deconstructing 'Procrastination' towards gas discontinuation; Procrastination is the result of three interrelated themes (and their underlying factors) according to our findings – Trust, Awareness/ Understanding and Loss/Risk perceptions.

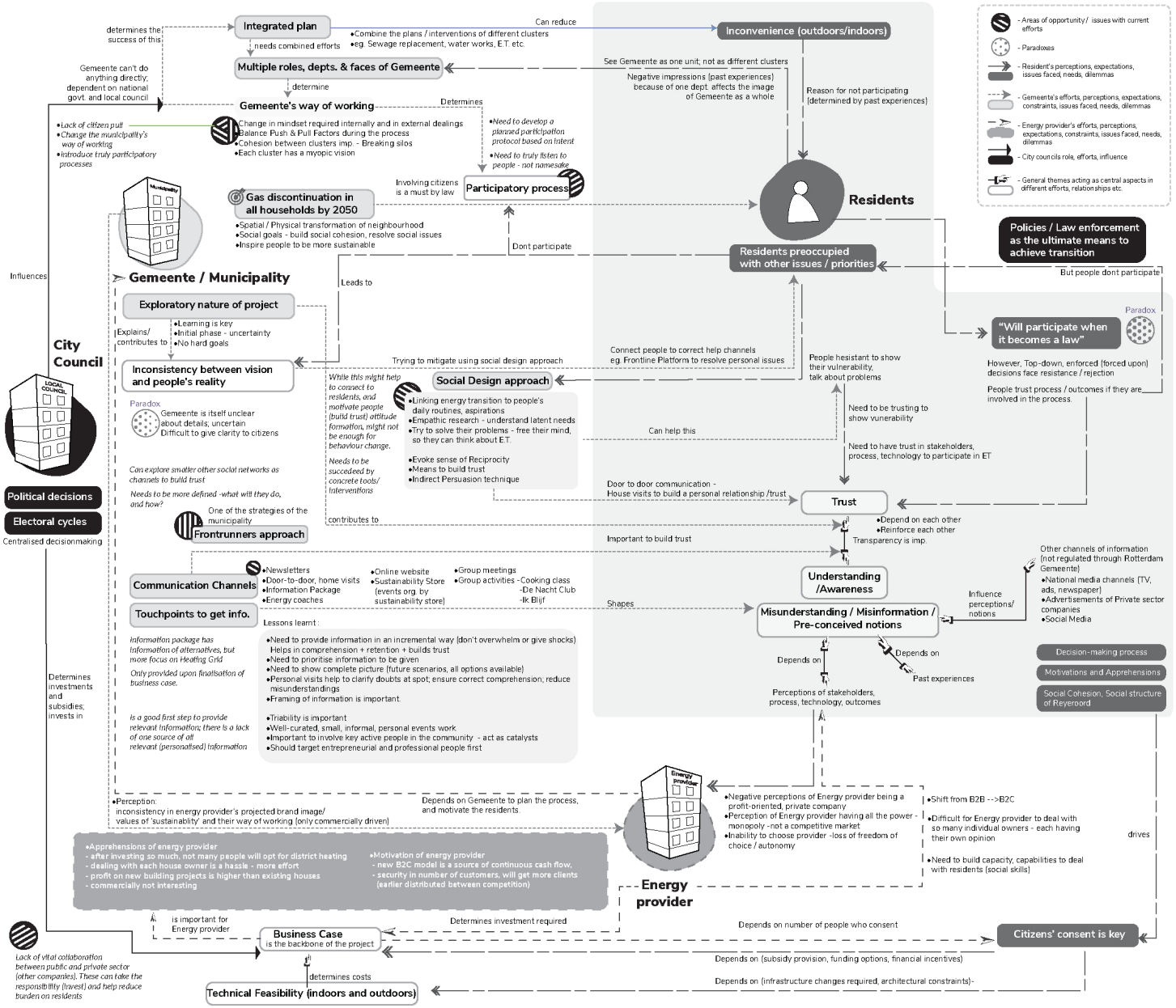

Fig. 4. Example of a system map showing causal relationships between the efforts and perspectives of the key stakeholders involved in the energy transition in Reyeroord.

Results

This results section is divided into three sub-sections, where each section answers one sub-question respectively. The first two sub-sections present the findings from the Reyeroord-specific contextual inquiry regarding the residents' motivation and apprehensions and their social networks. The third sub-section outlines the results of our design intervention answering the third sub-question pertaining to how municipalities can use social contagion to activate residents.

Residents' motivations and apprehensions towards the energy transition in Reyeroord

The interviews show that key factors shaping the motivations and apprehensions towards the energy transition in Reyeroord are affordability, issues of trust, loss/ risk perceptions, traditional lifestyles, concern for the environment and for their children's future.

Research reveals that affordability is the key constraint in this neighbourhood since average disposable income is 30,000 euros per annum; considered to be below average compared to other regions. 57% households in the region fall under low-income category with 13% being below the poverty live. Frugal living is a part of their ethos, which is also exemplified by people's attraction to discounts, coupons, or offers. Since most people are busy making ends meet, their minds are preoccupied and other priorities take precedence. People are unwilling to even hear about the energy transition (e.g., they ignore any letters, mails sent to them). Specific personal situations further compound this hesitation – for example, when one is pregnant, or has just moved to the neighbourhood or plans to move out in the near future; or a common notion amongst the elderly being – "This is not going to happen in my lifetime".

The segment of the population with mid-level incomes (approximately 34%) which can afford the transition procrastinates decision-making. Apprehension amongst these residents stems from lack of trust either in the process, the energy alternatives or stakeholders involved. This lack of trust is due to negative past experiences – say in dealing with the municipality or a specific energy provider, or general scepticism. Lack of awareness and misunderstanding of information (also caused by the lack of a single point of personalised information) is another cause for procrastination. For example, some residents believe that soon they will get hydrogen gas through the existing natural gas infrastructure; or in a glimpse residents think that solar panels are the cheapest and best alternative for them, not knowing the hidden costs involved or infrastructure requirements for their house. Loss/ risk perceptions also fuel procrastination of decision-making since residents do not want to be 'guinea pigs' and want to learn from others' (with similar socio-economic backgrounds or lifestyles) experiences. Residents have a perception that they are losing their freedom of choice. Currently, based on competitive pricing, residents can easily switch between different energy providers. However, with alternatives such as district-heating, only one provider shall cater to a specific neighbourhood. This gives rise to the notion that the energy providers shall have a monopoly and quote exorbitant prices. In reality the providers are being kept under check by the municipality – a fact that residents are unaware of, surfacing in the research. Some residents are waiting for gas discontinuation to become a law in order to have more certainty. Paradoxically, these residents also believe that the government cannot force them to change. A few residents consider it the governments' responsibility to fund and realise the energy transition.

Some residents in Reyeroord are ready to switch to greener alternatives immediately. For these enthusiasts the key motivation is their concern for the environment and for their children's future. This small percentage (approximately 9%) of residents with higher incomes can easily afford the transition and find it an opportune moment to avail the discounts and change infrastructure within their houses at lower costs.On the other hand, there is a group of residents for whom affordability exceeds their motivation. They are open to knowing the different options available, where some even go the extra mile of getting advice from the social department of the municipality to find means to fund the transition. If they find the finances, they will readily opt for gas discontinuation.

It is observed that in previous interventions by the municipality in Reyeroord, residents often participated or were willing to participate only when their neighbours also participated or the neighbours invited them. Given that apart from affordability, residents seek certainty and credibility of change, where they want to learn from their peers' experiences, we hypothesize that socially-driven interventions can play a key role in overcoming apprehensions and stimulating behaviour change.

Resident's social networks and the contagion process

To understand how the social contagion can unfold in Reyeroord, we probed the residents' social identities and the social networks that exist within the community. We find that people's social identities in Reyeroord draw

on their socio-economic background which has high correlation with the type of houses they inhabit. People with similar socio-economic backgrounds live in similar houses (individual bungalows, 3-storey apartments, apartments for the elderly), in close vicinity and know each other well. This gives rise to neighbourhood micro-networks (based on the vicinity of the house) that can be used to seed the contagion and activate residents *within* neighbourhood clusters.

Additionally, people's social identities follow from the activities they pursue and their interests. These activities are related to the social spaces in the neighbourhood they visit– e.g., church, gym, park, centre for the elderly; or other routine habits e.g., while walking their dogs, going for nature walks, picking their kids from school etc. Interactions amongst residents during these activities give rise to practice-based networks where people from different neighbourhood micro-networks interact. These practice-based networks can be used to spread the contagion *across* the different neighbourhood micro-networks.
There are some influencers and active people in the community who can serve as the seed nodes to start the spread of the contagion. Once activated, specific interventions need to be designed to spark interactions between residents such that these seed nodes can spread and reinforce the credibility of the target behaviour to others within their neighbourhood micro-networks. Simultaneously, interventions need to also be designed to enable activated residents from neighbourhood micro-networks to spread and reinforce the behaviour to other residents they meet through their practice-based networks (spreading the behaviour across different neighbourhood micro-networks).

Having identified how social contagion can unfold in Reyeroord, next we present results on how to design interventions to practically spark interactions and activate residents using social contagion.

Design for social contagion framework: using social influence to activate residents

Based upon literature on complex contagions (Centola, 2018), our design process and findings from the Reyeroord case study, we have developed the Design for Social contagion framework presented in Figure 5. The framework outlines an overall process to shape contagions within a community, qualitatively. It shows 3 key elements that need to be defined (based on the context) to shape social contagions, namely:

1) The WHAT: includes defining the content or the target behaviour that needs to be spread amongst a population. In the case of gas discontinuation, it relates to the contagion of a positive attitude or decision towards shifting to greener energy alternatives. The WHAT can also be determined by understanding the residents' specific apprehensions.

2) The HOW: refers to the means or mode of contagion- how the contagion can unfold in a specific context for the target behaviour. This includes visualising and defining the network dynamics of the contagion – the seed nodes (initiators of social influence), clusters (social networks of people), bridges etc. The framework outlines an actionable 6-step process as shown in Figure 5 to define the network dynamics. Note that this process is not explicitly listed or prescribed by Centola (2018). It is derived by the authors based on the examples provided by him.

3) The (Persuasion) STRATEGY: Apart from defining the network dynamics as to who will spread the target behaviour to whom and when, it is essential to define how people will spread the behaviour to their peers and what will activate the target behaviour. This happens in the steps 3, 4 and 5 of the process. It includes devising persuasive and tactical ways of inducing the behaviour (the strategy of contagion), building upon behaviour change strategies to enable the contagion within and across networks.

The framework was used as a high-level compass to guide the design project for the case of Reyeroord. It is developed to guide design processes for municipality officials and designers that want to stimulate social contagion towards gas discontinuation in the future. In order to further aid municipality officials and designers in defining the persuasion strategy and designing practical interventions in step 4, 5 of the framework, we have developed the Design for social contagion toolkit, presented subsequently.

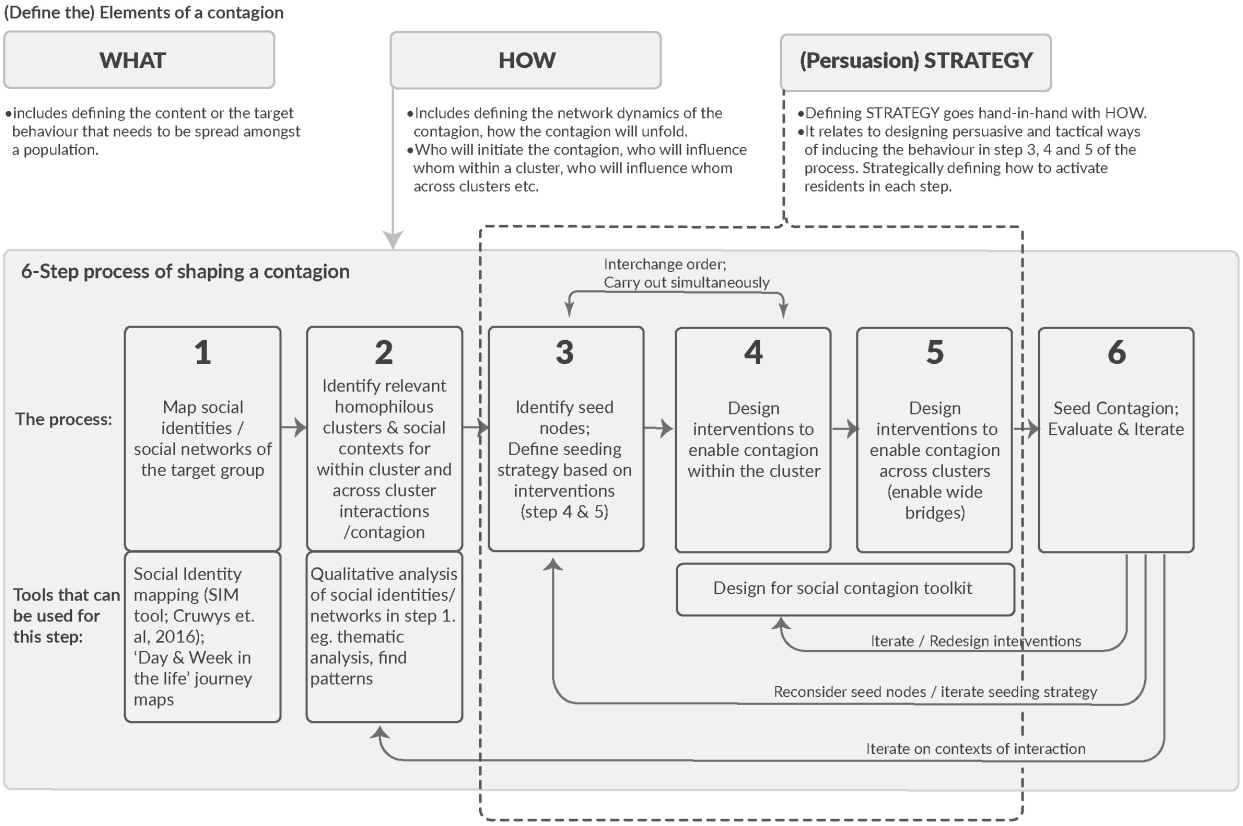

Fig. 5. Design for Social contagion framework

Design for Social contagion toolkit

Next to the framework, we have developed the 'Design for social contagion toolkit' which aids designers in defining the Strategy element, specifically designing social contagion interventions in steps 4 and 5.
The toolkit builds on the 'Anatomy of an intervention' (as shown in Figure 6) which is the logic of designing interventions. The anatomy outlines that each intervention aimed at shaping social contagion needs to fulfil 2 design criteria, follow 4 design principles, and can be designed using 4 intervention components. This anatomy of an intervention is derived by analysing and generalising the concepts developed during ideation.

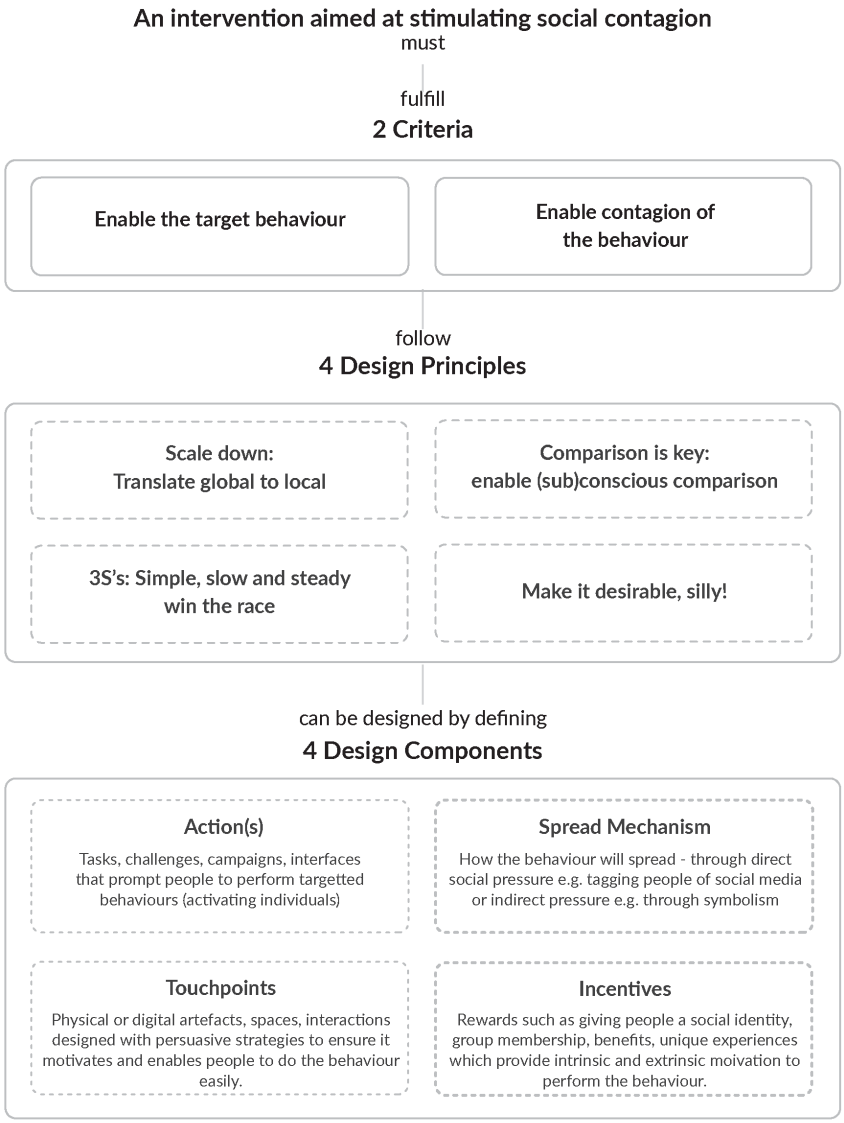

Fig. 6. Anatomy of an intervention aimed at stimulating social contagion of target behaviour.

The two design criteria an intervention must fulfil are: 1) enable the target behaviour, and 2) enable the contagion of the behaviour. The clear distinction between these two steps shows that the activation of the behaviour in people and the spreading of the behaviour (contagion of it) are different processes that both need to be designed for in different ways.

Apart from the two criteria, each intervention must follow 4 design principles: 1) Scale down: translate global to local, 2) 3S's: Simple, Slow and Steady win the race, 3) Comparison is key: enable (sub)conscious comparison, 4) Make it desirable, silly! These principles must be kept in mind while designing interventions and help to ensure that the interventions have impact on the target group. For example, since people find the concept of sustainability vague, it is important that the interventions highlight what this global phenomenon means for people's daily life, their kids, their surroundings. Only if people recognise and relate to something, they will act upon it. The design principles can also be used as qualitative evaluation criteria for the intervention.
Last, the anatomy outlines 4 components that constitute an intervention and give form to the design principles and criteria: 1) Actions, 2) Spread Mechanism, 3) Touchpoints 4) Incentives. Designing the Action and Spread mechanism help to fulfil the two distinct criteria stated above. These must be complemented with apt incentives and well-designed touchpoints that make the target behaviour or spreading the target behaviour more easy, intuitive and desirable. The 4 components are not mutually exclusive; however, they are specified as different components to guide the design process, and to ensure each aspect is explicitly thought about.

The toolkit consists of an inspiration card deck (54 cards), a set of 5 design canvases and a handbook (as shown in Figure 7). The card deck includes a description of the criteria (2x), principles (4x) and components (4x). The card deck also includes a set of design for behaviour change persuasion strategies outlined under each design component (Action, Spread Mechanism, Touchpoint and Incentive). These provide inspiration for and examples of how to design specific components in an intervention. The canvases can be used to facilitate the process of using the inspiration cards to design interventions, from problem definition, brainstorm to conceptualisation, evaluation and detailing. These can be used by individuals or in group sessions. How to use the inspiration cards with the canvases is outlined in a handbook provided with the toolkit[3].

The toolkit was validated with (7) municipal officials in 2 different sessions each of 2-2.5 hours. This validation highlighted that the toolkit familiarises people with behavioural and social constructs of decision-making. It inspires them to think differently and incorporate social innovation in their approach. Initiating this change in mindset is crucial to live through and steer transitions. This points to a dual role of the toolkit; (1) it triggers a change in mindset amongst municipal officials prompting them to be more empathetic, creative and experimental; and, (2) it provides a foundation for municipality employees to better explore, understand, design and implement creative interventions to steer the requisite social transitions using the phenomena of social contagion.

[3] To know more details about the toolkit or to get a physical/ digital copy, contact us at jesalshah92@gmail.com.

Fig. 7. Design for Social contagion toolkit.

Discussion and Conclusion

1) The main research question for this study was – How can social influence/ social contagion activate residents to adopt greener energy alternatives and support the energy transition in Reyeroord? Our research shows that social influence and social contagion can help municipalities in activating communities and networks of citizens using social interventions. Residents have many apprehensions and misconceptions towards the energy transition. Social contagion can help in overcoming these apprehensions, building a positive attitude and commitment towards gas discontinuation. However, in our study the actual implementation and effects of interventions have not yet been tested.

Lying at the intersection of design (thinking), sociology and psychology, our research contributes to the emergent Transition design methodology in two novel ways:

1) Theoretically, the proposal of using the phenomenon of 'social influence and social contagion' to steer transitions adds to the 'theories of (scaling) change' within the field of Transition design (Irwin et al., 2015).
2) As a practical contribution, we present insights into the social factors shaping the energy transition for a specific neighbourhood. We present the first version of a framework and toolkit to design context-specific interventions to activate networks of people to adopt greener alternatives using social contagion. This codified method adds to the limited practical tools and strategies to activate a critical mass by providing local councils and designers a way of designing keeping *scaling human behaviour* in mind. The outcomes add to the qualitative approaches towards designing and intervening in social networks.

With a focus on the collective rather than the individuals, social contagion inherently is a systemic approach. Hence, our case study is an example where systems thinking and design thinking come together. Our methodology which is inspired by design thinking and systemic thinking pushes the boundaries of traditional design thinking applications towards more system-conscious and system-shifting design (as Drew et al. (2021) term it). Next, we draw on the learnings from our case study to reflect on the future of design thinking in the context of systems change.

Design thinking for Systems Change

In the past decade, design thinking has piqued the interest of the business, management community and public sector institutions alike; and is successfully being applied to drive innovation, develop value propositions and address open and complex problems faced by these organisations. However, it has been oversimplified and popularised as a step-wise formula for creativity or customer discovery. While creativity and abductive reasoning (the core of design thinking) are important to tackle the big societal, for systemic challenges that designers are going for, we need to find new ways to apply design thinking specific to the different contexts. Our study shows how design thinking is much more variant than a step-wise approach in its form and must be more morphing to the context. (Systemic) Design thinking entails drawing on different theories and practices from other disciplines and translating this transdisciplinary knowledge into actionable tools and strategies. This is in line with Norman (2020), who highlights the importance of designers' capability of combining the skills and knowledge of other disciplines into novel and powerful strategies to tackle societal problems. Our approach of building on social contagion theory from sociology and psychology to develop practical strategies for activation exemplifies how a design thinking approach can facilitate this combination of transdisciplinary knowledge.

A key aspect of design thinking application being 'morphing to the context' involves engaging with the community. This includes identifying active, creative members within the communities who understand the local culture, needs, capabilities and co-designing solutions with them. With respect to systemic challenges, Norman (2020) observes that community members often have ideas to overcome challenges however, are often focused on alleviating the symptoms rather than tackling the underlying causes. Here, expert design thinking can empower these community members to further utilise their creativity (diffuse design capability) to develop practical solutions to overcome the underlying causes of systemic problems. In our project, by using social contagion we try to use these diffuse design capabilities of the community members as well as the municipality officials by sparking them with strategies in our toolkit. Our expert design practice was combined with co-design methods to develop the strategies. This points to the need for different types of design thinking – expert, diffuse and co-design coming together to shape systemic change and deliberate equitable, just transitions.

In our collaboration with the public sector, we observe that several local councils are inspired by creative ideas and are enthusiastic about using design thinking for their projects. While this highlights the ground for design thinking in the public sector, it needs to be taken seriously and deliberately (and sustainably) incorporated into the approach of local councils to achieve true impact. More often it is noticed that expert designers are brought in for a project to develop new ways of approaching problems. However, these ideas are seldom implemented in practice since the 'implementers' lack a sense of ownership with a 'not invented here' perception. Designing toolkits and processes (such as ours) which involve municipal officials through the whole process of designing and implementing ideas are helpful in building a sense of ownership and ensuring implementation. This role of the toolkit in building ownership amongst municipal officials surfaced during validation, and aligns with the fact that only when ideas are generated by the people themselves, they tend to be implemented. Close collaboration between expert designers and the public sector is essential even while the latter adopts a design thinking mindset.

With respect to expert designers, we see 'reframing' (creation of novel standpoints from which a problematic situation can be tackled (Dorst, 2011)) being a core quality of design thinking practice while designing for systems change. Systemic problems entail a wide range of paradoxes and tensions, be it conflicting views and standpoints or conflicting considerations/ requirements to overcome problematic situations. For example, within the energy transition context, a common paradox we observed is that on one hand residents procrastinate decision-making citing the reason that they will discontinue gas only when it becomes a law, whereas on the other hand they show resistance towards policy-driven, top-down efforts towards change. Uncovering such paradoxes, diving deeper into the latent aspects that drive these paradoxes, understanding the causal effects of different aspects that shape these paradoxes and then finding novel 'frames' or 'leverage points' to tackle these is the core capability that design thinking brings to systems change. Upon uncovering the paradoxes in our study, our reframing process led to using 'social contagion and peer networks' as a means to activate communities and seeing how activation can happen within communities.

In sum, design thinking for systems change is not a mere 5-step formula, rather an integrative, abductive, perspective-taking practice that must be adapted to the context at hand. It involves explicating the implicit, understanding dynamics between various aspects, reframing and probing in systems by combining transdisciplinary knowledge and shifting between the big-picture and detail-oriented mindset. Design thinking can contribute to the strategic, tactical and operational activities of achieving systemic transitions. It is the pluralism of design thinking, its application and approaches that make it adept to tackle complex systemic challenges and realise the transition to sustainable futures.

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