

**Proceedings of the 4th
Biennial Research Through
Design Conference
19–22/03/2019**



Reitsma, L., Wessman, S. 2019. 'A vision of a radical change towards a sustainable future: Speculated and applied'. In: Proceedings of the 4th Biennial Research Through Design Conference, 19-22 March 2019, Delft and Rotterdam, The Netherlands, Article 20, 1-19. DOI: <https://doi.org/10.6084/m9.figshare.7855787.v1>.

**Method&
Critique** *Frictions and Shifts in RTD*



A Vision of a Radical Change Towards a Sustainable Future - Speculated and Applied

Lizette Reitsma¹ and
Stina Wessman¹

¹ RISE Interactive,
Research Institutes of
Sweden, Eskilstuna, Sweden
lizette.reitsma@ri.se,
stina.wessman@ri.se

Abstract: In order to stay within planetary boundaries, it is said that we should change our societies in radical ways. In this paper, we propose and design an alternative future state, acknowledging such a radical change. Embodied as individual climate goals, we take a Speculative Research through Design approach, thereby positioning participants in such a radically different future system.

To shape this speculative system, we engaged experts through interviews and a future vision- and back-casting workshop. We translated this vision of a radical change towards a sustainable future, into the concept *Spilltime*, in which a carbon budget is central. It consists of a CO₂e pulse, a CO₂e coach, an ambient interface and a CO₂e reflection offering detailed information. Utilizing wearable technology, video tracking and a Wizard of Oz approach, we embedded the *Spilltime* concept in the lives of six participants. Thereby, we were able to provide high resolution real time CO₂e feedback in relation to the activities the six participants engaged in.

With this Speculative Research through Design approach, we managed to embody experiences of (radical) future states and enter a deeply reflective space to uncover stories of opportunity and despair around a carbon literacy.

Keywords: Speculative Research through Design; Transition Design; Sustainability; Climate goals; Carbon Budget; Vision



Introduction

The current ways of living within the Western world put enormous pressure on the environment and are, if nothing is changed, putting a risk to the planet as we are stepping over the planetary boundaries for safe living on earth (Rockström *et al.* 2009). Furthermore, there are targets that have been set to reduce carbon emissions. These are of great essence to reduce the risk of severe climate change.

However, these target have not yet been met, which means that the opportunities to limit the average global temperature rise are decreasing (Raftery *et al.* 2017, UNEP 2017).

This is no news, and action is being undertaking by different actors in society, such as governments, various companies, the United Nations, citizens and non profit organisations. For design, there should also be a role in supporting action. Firstly, because designs (the things we use) influence how people act and it is through this that design has such a central part in our lives. But through its centrality in our lives, it accumulates: we keep buying and obtaining new products, in order to fulfill our needs. At the same time, however, Design as a field is crucial in helping our societies out of current crises, since it has the ability to envision new paradigms and ways of doing (Tonkinwise 2015). Design has been pointed out to be especially useful at exploring wicked problems. And, the problems that we are facing are wicked problems, or rather ecologies of wicked problems (Irwin *et al.* 2015). Wicked problems are problems without definite conditions, limits or absolute solutions (Rittel and Webber 1973 and Buchanan 1992). They comprise of different conflicting agendas and concerns often from different stakeholders. They exist at multiple levels of spacio-temporal scale. It is because of these characteristics that they cannot be solved within a single discipline (Irwin *et al.* 2015).

This requires a systems perspective on sustainability (Gaziulusoy 2010). In its entirety, design can already be seen as shifting towards a more holistic, highly collaborative systems approach (Jones 2014). The same can be seen in Design for Sustainability (as articulated by Ceschin and Gaziulusoy (2016)). Design for Sustainability has moved from a focus on sustainable material properties and production (Ecodesign), to a focus on stimulating sustainable behaviour (Design for Behavior Change), to a focus on sustainable practices (a socio-materiality focus) and now, to a focus on sustainability as a system property.

Only by taking a system perspective on sustainability will we be able to address ‘true sustainability’ (as introduced by Power and Mont (2010)). ‘True sustainability’ refers to those initiatives that actually could make a true difference from a sustainability perspective. Rather than focusing on stimulating people to switch off their lights, we should focus on actions that might seem drastic, like an entire nation switching to a vegan diet, but that would help us to actually stay within planetary boundaries (Rockström *et al.* 2009).

However, such radical change is often difficult to envision since it is so detached from our current ways of living, let alone be explored in a way that actually looks critically at the proposed change and the ethics around it. A quote from Dunne and Raby (2014:94) makes this painfully clear: ‘As Frederic Jameson famously remarked, it is now easier for us to imagine the end of the world than an alternative to capitalism. Yet alternatives are exactly what we need.’

In this paper, we propose and design an alternative future policy setting, thereby materialising such a radical change that can be explored within a real life context.

Background

In order to explore radical change on a societal level, we searched for a design approach with a focus on the future and on change. Outside of the field of Design there have been different (emerging) fields focussing on the future (Future Studies, for example) and transitions towards more sustainable societies (Sustainability Transitions, Transition Studies and Transition Management). However, contributions of Design that combine both are still relatively rare (Irwin *et al.* 2015). Irwin *et al.* (2015) defined three areas of Design that they consider particularly relevant to socio-technical Transition Management: Design for Service, Design for Social Innovation and Design for Policy. Like in Design for Policy, in the work that we present in this paper, we incorporated design to help give form to policy in practice through artefacts. Our approach, however, differs from Design for Policy as we did not involve all stakeholders through participatory processes, nor did we aim with our work to develop policies that become directly relevant to current society as *Strange Telemetry*, for example, did in their project *Senescence: Speculative Design at the Policy Interface* where they created visuals of future states and deployed it as tools for political dialogue (Voss *et al.* 2015). This last point, of the policy needing to be directly relevant to the current society, has also been coined as a gap within all three areas by Irwin *et al.* (2015) and that is why they proposed Transition Design. Unlike the other types of Design, Transition Design is based upon longer term visioning and recognition of the need for solutions rooted in new, more sustainable socioeconomic and political paradigms.

At the foundation of Transition Design lies the Transition Design Framework. This framework (Irwin *et al.* 2015) suggests that we as (design) researchers should engage in different theoretical frameworks and explore how to design for radical change or transition. The framework outlines four key mutually reinforcing and co-evolving areas of knowledge, action and self-reflection: vision, theories of change, mindset/posture, and new ways of designing. In this paper, our focus lies on an approach towards vision creation and materialisation in order to enable people to experience it.

Visions for Transition

Design has a rich history of future vision-directed designing. However, visions for transition have three distinct qualities (Irwin *et al.* 2015). The first is that designers envision not only desirable futures but also playful or thought-provoking futures. The second is that designers build scenarios around near-futures in which participants can try out (or imagine themselves trying out) new practices. Furthermore, the iterative nature of Design helps to modify visions of prospective visions to develop a deeper understanding of the context. Transition visions would propose the reconception of entire lifestyles and should not be conceived as blueprints for design. Instead, they remain open-ended and speculative.

What we want from the visions within our study is to create a platform for debate and response, to ask ethical questions through the visions, as well as speak to human needs and emotions. We, furthermore, want to enable people to try out what it would be like to live in such an envisioned future.

Scenario development and Speculative Design have been coined as examples of design approaches towards envisioning future possibilities within the Transition Design Framework.

Scenarios, as stated by Blythe (2014), have been used by designers for a long time as discussion generation tools. However, scenarios do not invite for social or political conflict (Gulliksson 2015:185), since they

are often neutral in their presentation. Furthermore, how a character feels about a situation over what is happening is often not addressed in a scenario, thereby making them hard to emotionally engage with. There are, however, exceptions, for example, Superflux's Uninvited Guests does render a richly emotional scenario through a scenario movie (Superflux 2015).

Speculative Design was introduced by Dunne and Raby (2013), as an approach to present possible, probable or preferred futures, but also to enable people to experience and engage in this future in real life, in order for them to relate to it on a deeper level. The speculative artefacts being promoted by Dunne and Raby, however, are not experienced in everyday life, but instead exist primarily within carefully curated exhibitions, alongside high end photography and textual fragments from the speculated future being exhibited or about the exhibition as a whole. Images of the artefacts as exhibited then circulate in the media. They look like finished designs but do not function. They are, furthermore, often technoscience centred, rather than lifestyle centred, which does not match the Transition Design Framework.

In our approach, we apply Speculative Design in a real life setting. Rather than the passive spectator role of a future that Dunne and Raby (2013) propose, we propose a role of being an actor within a certain future where we construct a vision with functioning interactive speculative design prototypes. In this, we carefully shape a space for response after experiencing the vision. Through the set up and translation of the vision, the vision is not technoscience-centered but instead centered around the holistic everyday life.

New ways of Designing

Although Transition Design can be considered a distinctive way of designing, it is complementary to other design approaches. As Irwin *et al.* (2015) state, these approaches can range from: *'design within existing paradigms to design for radically new paradigms that challenge the status quo and are based upon equity and quality of life'*. They have highlighted the work of Manzini (2003 & 2015), with its grassroots efforts undertaken by local communities and organisations, as examples of approaches that fit within ways of designing within Transition Design. Another example that Irwin *et al.* (2015) highlight is de Sousa Santos' work (2006) which aims to develop powerful narratives of the future or the 'not yet'. We, in our design practice, have taken inspiration from Humble Designing as a way of approaching Design for Sustainability (de Jong *et al.* 2016 and Reitsma *et al.* 2017a).

Humble Designing focuses on challenging existing power structures and roles and relations between actors in design processes. This notion of Humble Designing was shaped through discussions based on Respectful Design (Sheehan 2012 and Reitsma *et al.* 2019a) and Empathic Design approaches (Wright and McCarthy 2008). However, these approaches are not geared towards Design for Sustainability specifically, but are about creating specific relations between a design team and those designed for/with, in terms of focusing on their (indigenous) knowledge system or for understanding users. Instead, Humble Designing aims for creating a system perspective on the role of design in ever changing social practices and to acknowledge that the designer's understanding of the wicked problem (in this case the radical change that is explored) is always incomplete. This notion is central in our understanding of designing for radical change and connects to Transition Design.

A Transition Designer designs something not to be an end-to-itself, a final solution to a problem, but to open up subsequent opportuni-

ties (Tonkinwise 2015). This is much like the role of design within Research through Design, in which the design is not necessarily the aim of the exploration but rather the tool for exploration. We incorporate Research through Design as the core of this research work.

In the work that we present in this paper, we focus mainly on how we designed the vision that we aimed to explore and how we made it tangible as well as experiential using a Wizard of Oz approach (Kelley 1985).

In the Discussion Section, we will address the effort of making Speculative Design experiential in everyday life based on what we learned and on how it was received. We will then reflect on the usefulness as an addition to the area of Transition Design.

is always incomplete. This notion is central in our understanding of designing for radical change and connects to Transition Design.

Process

Through design, we articulated and positioned participants in the experience of a radical future vision. Through this, we aim to understand how people relate to this experience, and give them a tool to articulate their concerns, hopes and despairs in regards to such a future.

Grasping the Vision with Experts

We started the two-year design research project with ten expert interviews to inform the radical change towards a sustainable future to explore. The experts came from different fields with competences such as life cycle assessment, climate research, policy making, and big data. The interviews were transcribed and transcripts analysed. From the knowledge we gained, we framed two visionary Climate Fiction (Cli-Fi) sketch stories, describing different visions of a zero emission society and backcasting, in the plot, how we got to such a society.



Figure 1. Expert workshop. Photo: Elin Önnvall. During the expert-workshop we discussed carbon budgets and climate goals.

Common visions are argued to be a strong tool to envision the future for (stakeholder) engagement (Mont 2010, Dunne and Raby 2013 and Irwin 2015). The Cli-Fi sketch stories described two different paths towards a zero emission society leveraging on *Back to Nature* (Håkansson and Sengers 2013) and *Bright Greens* (Woodruff *et al.* 2008). The stories were introduced during an expert workshop (see Figure 1 and Reitsma *et al.* (2017b) for a more detailed description of the stories and the workshop). The result of the workshop and the interviews highlighted a policy regulation of individual carbon budgets as a potential vision for radical change. Individual carbon budgets have been addressed as one way to stay within the planetary boundaries, a potential way to implement 'true sustainability'. Through individual carbon budgets, people can decide for themselves what they want to spend their budget on. This way, it goes beyond a normative approach, instead, it focuses on what the planet can handle in order to remain a healthy and safe place to live on without jeopardising upcoming generations opportunities to satisfy their needs (Bruntland commission 1987). The policy of individual carbon budgets became the radical vision of this study. The individual carbon budget that we took as the foundation was based on the EU 2020 climate goal. This meant a reduction of CO₂e emissions of 20% compared to the emissions in 1990. Translated to an individual level, this would mean that the yearly individual carbon budget would be about 5 tonne and the daily individual carbon budget would be 13,1 kg CO₂e. (This was prior to the Paris agreement). We are aware that the 2020 goal is not actually on a 'true sustainability' level. However, we decided to take an existing, well-known, climate goal and translate that, in order for it to be relatable.

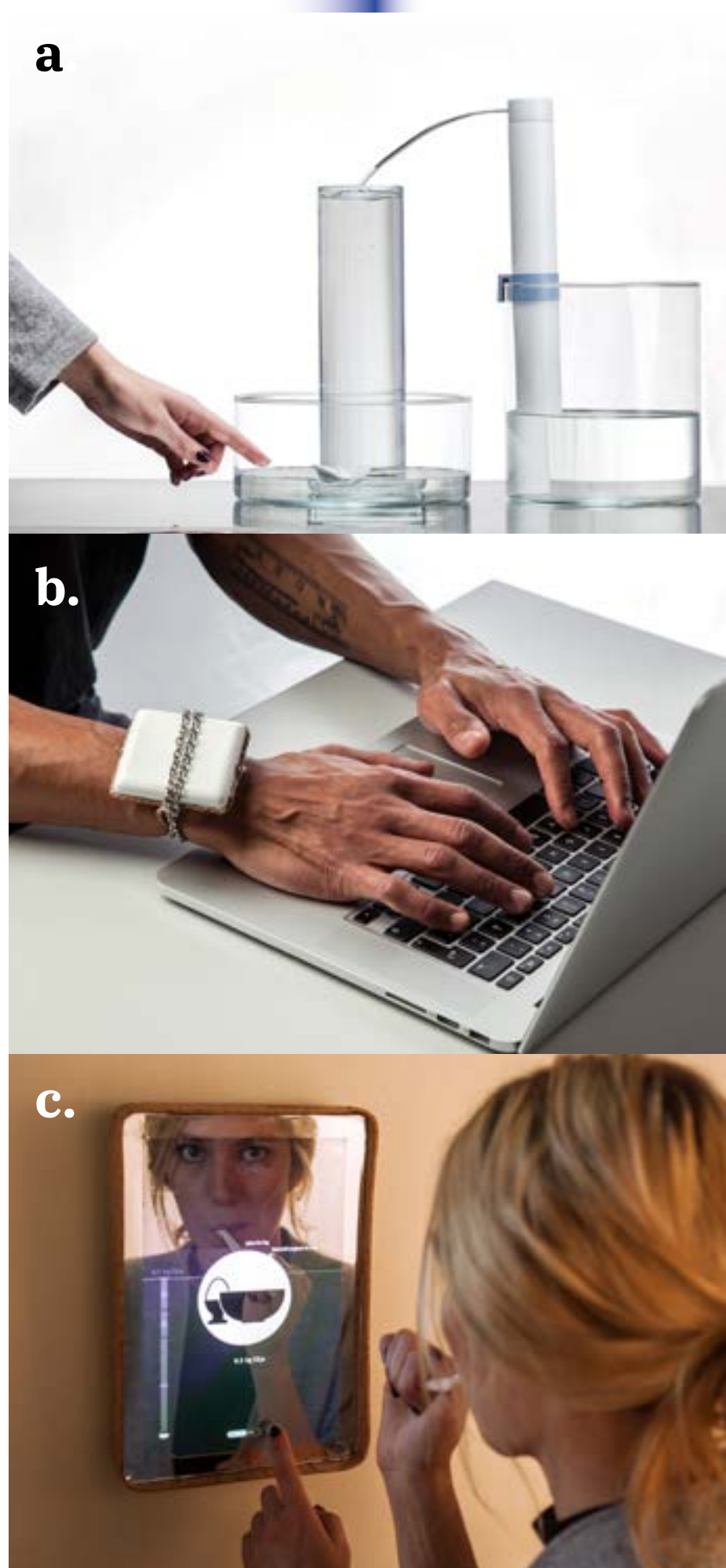
Making the 'Invisible' Speculative Future Vision Visible

We carefully designed the concept *Spilltime* to function as the carrier of the policy regulation (the carbon budget) in order to enable the policy to be experienced.

The *Spilltime* concept refers to the policy of a carbon budget. The moment you go over your budget, you spill. The moment at which this spilling happens can provide a dimension of reflection to your daily carbon footprint during that day. For example, a *Spilltime* at 10.00 o'clock versus a *Spilltime* at 20.00 o'clock signals two completely different things. The concept builds upon the idea of a daily carbon budget set to 13,1 kg CO₂e corresponding to the EU's 2020 goal. Throughout the day, the budget builds up through the activities you are undertaking, like eating, getting from one place to the other (transport) and by how you use your house, how it is heated, and which appliances are used inside.

The concept consist of four parts (see Figure 2a-c) that in different ways communicate the carbon footprint in relation to the 2020 goal and the activities you are engaging in in the course of the day: (a) a physical ambient *Spilltime* artefact, (b) a wearable CO₂e pulse (providing you with real time feedback), a CO₂ coach (for support and advice) and (c) a CO₂e reflection mirror (providing detailed information on the carbon footprint as well as a function to shout out to the coach for help or to just share your frustrations).

The semantic of the design is neutral in colour. The material aims to be gender neutral. The meaning, however, is not neutral and is linked strongly to the rise of the water level and health of the planet due to climate change. As the budget exceeds, the water metaphorically spills over. Reitsma *et al.* (2019b) provide more detail on the design process of the artefacts.



The physical *Spilltime* artefact is located centrally in the home. As an ambient interface, two glass cylinders, are filled up with water from a big glass container, according to your carbon footprint. Activities influence the carbon footprint and thus make the water level rise. The inner cylinder correlates to the 13,1 kg CO₂e budget of the day. When you exceed your daily quota, *Spilltime* occurs and water flows over, into the outer cylinder. A white origami boat is floating on the surface of the water. The participants fold their own boat, in order to stimulate a personal connection to the artefact. They can leave a message or a motivation on the boat, for trying to stay within their budget. Every day, the glass containers are emptied and re-filled manually as an act of reflection.

The wearable CO₂e pulse can be located on the chest, the arm, ankle, leg, and wrist or in your pocket. For each 100 gram CO₂e that the activities generate, the wearable instantly gives a pulse. If a participant, for example, eats 200 grams of beef he/she receives 52 pulses continuously as he/she eats (200 gram meat corresponds to 5200 gram CO₂e). If a participant drinks 2 dl of milk he/she receives 2 pulses (2 dl milk corresponds to 200 gram CO₂e). Going 10 km by metro results in 1 pulse (100 gram CO₂e) while driving a car for 10 km results in 26 pulses (2600 gram CO₂e). 13,1 kg of CO₂e means 131 CO₂e pulses spread out corresponding to activities that affect the carbon footprint (See figure 2.b).

Through the CO₂e reflection mirror, we aimed to merge a (bathroom) mirror with an overview of the carbon footprint data of your day. We see a (bathroom) mirror as an object that you look into at the end of the day, when you are brushing your teeth, while reflecting on the day that has passed. The mirror is a touch screen, using the water level metaphor in a similar way to the physical artefact. The water level indicates the overall carbon footprint of a day. A boat floats on it. When *Spilltime* occurs, the water level simulates a 'spill over' on the screen. On the screen, the participants can access different types of information: The activities they have engaged in during the day are displayed in a timeline with the connected carbon footprint. You can also look at a weekly or monthly overview, through which you can see on which days you had a spillover and on which days you stayed within budget.

Looking at and reflecting upon the CO₂e data during the day might result in strong emotions and frustrations. To channel these emotions, the system also has a coach. The participants decide for themselves when they want to get in contact with the coach. It could be in a certain situation, when they want support to make a choice or whenever they feel demotivated or in despair. In order to reach the coach, they can send a text message by phone or they can send a shout out to the coach through the mirror. A shout out is an audio message that is directly send to the coach. The coach responds as fast as possible, by sending a message back. The coach is an actual person (one of the researchers), who can respond to the participants through text messages.

Figure 2 a, b, c. The *Spilltime* concept. Photo: Edis Potori. The *Spilltime* concept consist of 4 parts: a the physical CO₂e artifact, b the CO₂e reflection, c the Co₂e pulse.

Making the Carbon Budget Vision work and experiential in a real life setting

The lack of accessible CO2e data makes it challenging to provide people with their individual carbon footprint in the first place. Nor is there an existing system that can provide this type of high resolution data in real time. Therefore, we used the Wizard of Oz approach (Kelley 1985). Wizard of Oz enables first hand experiences of systems that are not yet accessible or possible to construct for various reasons (Kelley, 1985). The system which people interact with is often partly operated by unseen human beings. To enable this system and experience we, as researchers, thus, had to take part in the system to enable the study to feel real. We developed a study kit, containing the artefacts and technology that enabled the system to work (see Figure 3). We created a database on CO2e emissions, build up from different available sources with the highest resolution available to enable the study. Sensors were installed in the participants' homes to measure electricity use in the house and the base heating of the house was calculated prior to the study. Each participant wore a video tracking camera device so we, as researchers, could follow what the participant were doing (see Figure 4). If we saw an activity that emitted CO2e, we manually calculated this emission based on the data from the database that we had constructed. We then entered the calculated emission in a constructed platform which then provided feedback through the artefacts to the participants. The electricity and heat emissions were automatically added to the platform. We will not describe this platform here in detail, but we made use of Particle Photon and Particle Electron, and the open-ended time series database software - InfluxDB (<https://www.influxdata.com>). We also used Node-Red to handle and process the prototypes and data coming in from the database.

The contextual study took one week for each participant. Due to the intensity and resources needed for each study and what it would require from the participants, they could choose three days of the week (each day starting from 7 am and ending 10pm) on which they would engage in the study. One researcher installed the *Spilltime* concept and carefully described the setup of the study and functionality of the different parts. The telephone number of the coach was also installed in the participants' mobile phones. The participants, furthermore, got a camera that supported real time streaming. The participants were asked to wear this camera during the study. They could, at any point decide to switch off the camera. The researchers could follow the real time streaming (only through video, not through audio) and used this to get the detailed information on the carbon footprint of the person they were watching. For example, the participant would walk into a coffee bar, ordering a large cappuccino and a cinnamon bun. The researcher, would be able to see this through the real time streaming of the video. The researcher would then look into the database that was created for this project and calculate the footprint of this coffee break. The calculation was entered into the feedback system, after which the participant received the feedback through the pulse that he/she was wearing. The water level in both the simulation on the screen of the mirror as well as in the physical *Spilltime* artefact would rise. If the participant had a question about the feedback he just received or if he wondered whether it would have been better from a budget perspective to take oat milk, he could send a text message to the coach (the researcher), who would then respond as soon as he or she had an answer.



Figure 3. The study kit. Photo: RISE Interactive. The set (from left to right) consisted of sensors, a video tracking camera, the physical ambient *Spilltime* artefact, the CO2e reflection mirror, the CO2e pulse and a CO2e coach (not in image)



Figure 4. Footage of the contextual study that illustrates how the video tracking camera device was utilized. Photo: RISE Interactive.

Each study was concluded by an interview with the participant, conducted by two of the researchers. These interviews lasted one to two hours. The interview was semi-structured around five topics (1) the overall experience of the study, (2) climate goals, CO2e budget and the participant's carbon footprint data, (3) the objects and how they embedded them in their lives, (4) sustainability and Quantified Self technology (technology that focuses on self-improvement) and (5) video tracking.

We recruited participants through a conceptual movie in which we aimed to address different potential participants, eg. technology oriented participants, participants interested in sustainability questions as well as people who their decision-making relied heavily on information. We spread this movie through our extended social media channels. From the responses, we selected 7 different people. 6 people took part in the study. We briefly describe them here:

- Participant 1 is in her thirties and lives in an apartment building just outside of Stockholm, together with her boyfriend. She has an interest in sustainability and the Internet of Things and tries to eat more vegetarian food in order to be eco-friendly. She works as an Interaction Designer.
- Participant 2 is in his forties and lives in a small (39 sqm) apartment in a small village with his five-year old daughter and his wife. In the summer, they live in a cottage on the countryside. He is very passionate about sustainability and makes active choices in order to live in a sustainable manner. He is a vegan and buys almost everything second hand. He is an accountant and is involved in local politics.
- Participant 3 is in her thirties and has recently moved to a two-room apartment just outside the city. She lives together with her boyfriend and they are expecting a baby within a month. She knows a lot about environmental issues, tries to consume only according to her basic needs and grows some of her own food. She is a social worker.
- Participant 4 is in his twenties and lives in a small one-room apartment in central Stockholm, which he currently shares with a friend. He is vegan and well aware of the climate challenges we are facing. He studies theology.
- Participant 5 is in her mid thirties and lives on an island in the archipelago outside of Stockholm. She shares the big house in which she lives with four other people. She has two cats. She is a freelance artist, working with environmental issues, but in order to have a secure income, she has different day jobs.
- Participant 6 is in his mid thirties and lives in a suburb of Stockholm in a one-room apartment. His girlfriend also lives there part of the week. He is working with Quantified Self technology (technology for self-improvement) and the Internet of Things. He is interested in trying out new things and tracking parts of his life to learn more about himself.

Understanding how the Speculated Future Vision was Experienced

We analysed both the transcripts of the interviews, the carbon footprint data that was created during the study as well as visual material (e.g. photos that the participants had send to the coach). We did this in order to get a better understanding of how the participants experienced living a potential future in which an individual carbon footprint was a reality. We coded the material during multiple analysis sessions. Through these sessions, we developed a coding scheme in order to determine patterns in the data. Through this, we found amongst others,

expressions related to the policy, the understanding of the carbon footprint, future society and the experience of taking part in the study. The insights and conversations we then translated into implications for developing the vision further. In the upcoming Section those implications and considerations are presented.

Result

As mentioned in the previous Section, we created a dialogical space to reflect upon the vision and to critically look at it. This space, provided through an interview, brought up different topics that suggested implications to inform our current vision or that could stimulate the development of creating supporting visions that explore the radical change that we are examining in more detail.

Those implications focused mostly on the support participants would see needed in order to enable them to make the vision reality. Below, we will introduce seven implications that we would need to consider in future iterations of the exploration of the radical change we are examining.

Implication 1. ‘Truly’ sustainable goals

Many of the participants reflected on the role of politics in transitioning to a more sustainable society. They, for example, talked about politicians, who should take a firmer stand and have saving the world as their motivation. This could, for example, mean that the goals that we adhere to should be much stronger, limiting it to an even smaller budget than the 13,1 kg which we have taken as the goal for this study based on the 2020 goal. As participant 4 said: *‘There is some kind of political agreement about this level [the 2020 goal and the level of 13,1 kg], but there is no agreement on saving the world.’* (All quotes are translated from Swedish). That this ‘truly sustainable’ goal will be much more difficult to adhere to, was something that several participants also reflected on. One of them (participant 4) felt especially desperate about this, because, if a truly sustainable goal needs to be adhered to, then it would mean that everyone would only get half of the budget that the participants had to adhere to now (5,6 kg rather than 13,1 kg). Since he, and also other participants within the study, already found it very challenging to stay within the project’s 13,1 kg CO2e goal, it would be good to think about supporting structures that have to be put in place (implication 2) as well as reflections on whether the responsibility for change is really at an individual level (implication 5).

Implication 2. Clear Directions to Guide Citizens towards Sustainability Lifestyles

Through the conversations we had with the participants, it became clear that many of them were longing for clearer directions and roadmaps coming from politics in order to guide citizens towards more sustainable lifestyles. As participant 6 said: *‘...I am waiting for the government to put down its foot and spell it [how to make sustainable lifestyle choices] out. But as long as there isn’t something spelled out anywhere, there is not much to build upon.’* The participants were not just asking for guidance on the directions they should think about, but also a support system that would support people on an emotional level (implication 4).

Implication 3. Detailed Information to Support Informed Decision Making

The study revealed many reflections on having and not having access to the details of your carbon footprint data. For example, participants reflected on that only through having detailed information will you be able to make justified decisions; *‘That you make decisions based upon data and not on your gut feeling [...], it is about continuously understanding how you generate*

CO2e and how you could adjust’ (participant 3) and as she also said: *‘That is how I feel, that I, really, like really, need to know more to be able to make smarter decisions and I currently do not know enough’.*

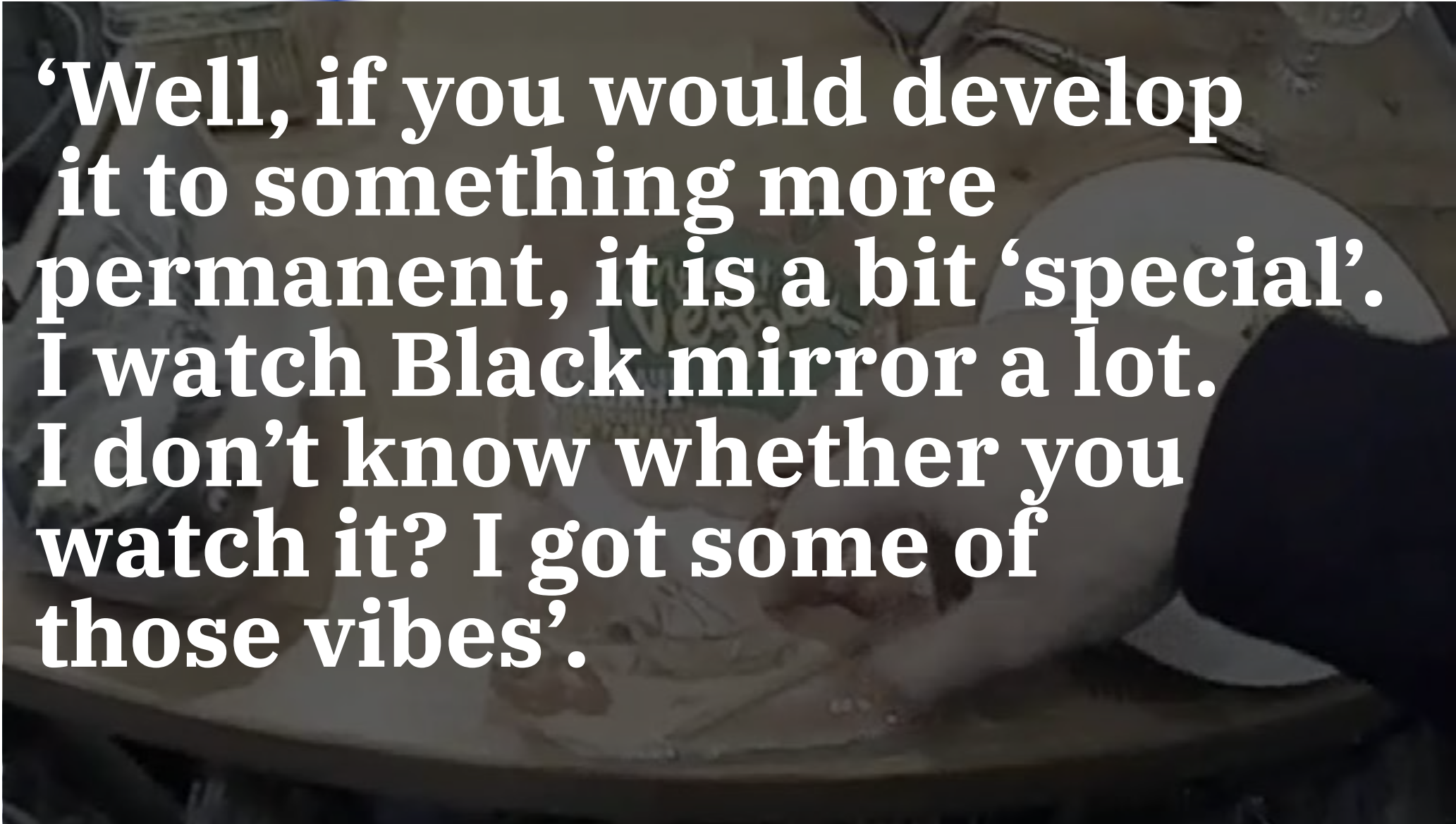
However, as was remarked in parallel by the participants, you do not find any information currently: *‘...about carbon dioxide, it is the opposite [there is not much information] ...or actually there is nothing. There is no data to build upon’* (participant 2).

This non-existing information causes according to one of the participants (participant 2) climate anxiety: *‘I think it [climate anxiety] is a very real problem, and that is probably because it not so concrete. You cannot even touch it. There are no markers, or there should be some more markers...I mean, there are some, like from SJ [the national Swedish train company] but obviously SJ brags about their carbon emissions, since it is their Unique Selling Point in relation to aviation companies’.* A focus on this kind of information could come, for example, from the government, demanding companies to be clear about the carbon footprint of the products and services they are providing.

Implication 4. Support to Deal with Climate Anxiety

Having access to a detailed carbon budget and having at the same time not the agency to act could lead to feelings of despair for some of the participants. As participant 6 described his feelings: *‘Damn, I can’t do this, there is no point in trying’.* These despairs seem to come from the fact that change was not always within their control or the fact that

Figure 5 . Footage and quote from the contextual study. Videotracking footage from the contextual study with one of the participants. Photo: RISE Interactive.



‘Well, if you would develop it to something more permanent, it is a bit ‘special’. I watch Black mirror a lot. I don’t know whether you watch it? I got some of those vibes’.

they do not have the information they feel they need to make an informed decision (Implication 3). Even if they would want to make a difference, they were not able to due to limiting factors within the bigger system: *'And that is where the anxiety kicks in - that there is not a thing you can do [within the structure we are in]'* (participant 4). So, either the government has to focus on those limiting factors (as mentioned within implication 1 & 2) and on stimulating companies to provide more information about their products and services (implication 3), or, if this is not possible, there should be a support system in place in order for people not to be paralysed by climate anxiety.

Implication 5. Public Consumption

From the 13,1 kg budget per day, part of the budget is allocated to public consumption. Public consumption is the consumption of services that we share as citizens in order to make our society work. It is, for example, build up by the emissions of street lights, hospitals, schools and the construction of roads. The public consumption for Sweden (where the study took place), is 5,6 kg per day, per person. The percentage of the individual budget that needs to be spend on public consumption is thus relatively high (43%). Realistically, this meant that every day this part of the budget was outside of the control of the participants. It was seen as a limiting factor, as individuals were not able to change the share of public consumption on an individual level. As one person remarked (participant 2): *'Well, how could one get to the level of one tonne per year [This refers to the goal of only emitting 1 tonne of CO₂e per year, which he had taken up as a personal goal within the study], at 2,7 kg per day and still be part of a society with public consumption...when you are supposed to breath also and maybe eat...? It can not be a realistic level for a Western world citizen, but it really has to work'*.

Implication 6. Fairness of Allocating Everyone the Same Budget

Fairness, especially in relation to the policy of an individual carbon footprint, was reflected on by the participants. Almost everyone asked whether the other participants were either living in the city or outside. The ones living in the city suggested that probably this budget was more difficult to adhere to on the countryside. The ones living on the countryside reflected that probably they ran into higher costs than the ones in the city. As one of the participants (participant 4) highlighted, it might be difficult for all citizens to keep to a same budget: *'It doesn't necessarily mean that we sacrifice the same [have the same budget]. I, who live in the city, can take the metro but if you live on the countryside you might not have access to public transportation...'* He also questioned whether the budget should, on a global level, be similar for everyone. Instead, he proposed that if you would spend under your carbon footprint budget, or below the world average, you would contribute as a world citizen and contribute in this way towards going the right way.

Implication 7. The Notion of a Carbon Budget and Literacy

The concept of budget in relation to carbon footprint was easy to relate to for the participants. So, in that sense it was relevant to focus the vision around this concept. As one of them (participant 1), for example, said: she was happy that something had only 'costed' her this much. Participants reflected around their carbon costs in relation to their everyday life in different ways. Some of them compared actions and practices that played a role in their lives and connected expectations to those. When these expectations did not match the feedback they got, it could be very confusing. For example, one of the participants (participant 3) had the expectation that eating out would result in a higher carbon footprint than eating and cooking at home would. When she ordered a fish burger at a fast food chain, the footprint she got from this was lower than healthy food she had made at home: *'And I was surprised by that it was 398 grams and I was like: wow...it is better to eat out because at home you use more [energy to cook]'*. Other participants used the carbon footprint as a planning

tool. One of the participants (participant 2) had set himself a goal. He aimed to just spent 2,7 kg during the entire day. This way he could easily dedicate a certain budget to, for example, travelling. However, in reality it became more difficult to plan this way:

'At the bus I was thinking that you miscalculated the bus ride to x [Taken out for privacy protection]. However, when you counted it, it was above 1,0 kg. If you go one way and then return... [it would be double]. I was aiming for 2,7 kg [for the entire day] you know, that is my personal aim and then public consumption added to that, but that we have to put aside here. Then, I would only have 700 grams left to eat from [laughing]. How do I do that? Is it lentil soup for breakfast and then all the way through the day?' (see Figure 6).

Discussion & Conclusion

Through the data analysis of which we gave an impression in the Results Section, we learned that the combination of having the actual study in which the participants experienced the radical future through the functioning interactive design objects, and the interviews during which we talked about the experience in depth, enabled the participants to articulate their connections to the future policy. In this way, they could frame their thoughts around, for example, politics, society and fairness. Also, the despairs that they felt, they could articulate, as well as how they understood and related to their own carbon footprint data. By shaping a future policy setting of an individual carbon footprint through functioning design objects, we articulated and positioned participants in the experience of this future. This way, the design became the carrier of the radical future and policy regulation, thereby making it relatable. Even though this study was small in scale, as well as it having only participants of a very specific demography (e.g. being interested in sustainability questions and Quantified Self technology (technology that focuses on self-improvement)), we are not able to make any general



Figure 6. Footage from the contextual study when a participant is commuting by bus to work. Photo: RISE Interactive.

conclusions. We, however, see our work as an iterative evolving effort. It is definitely not a final solution to a problem. Instead, it is a result that is in progress, ready to move on and grow into something more detailed or different. In this way, we will uncover, bit by bit a radical change that could potentially lead to a society that adjusts itself within the limits of our planet. The implications that resulted from the vision could, potentially, help to map, which elements in society are hindering transition towards this radical change. However, at the same time, it could also show that the change that is proposed, is not preferred and that we should do everything within our power to steer away from it. We thus see potential in embedding Speculative Design in everyday life. We consider it valuable because of the nuanced role it can play in exploring radical change visions, in order to support the transition towards a sustainable society. In this Section, we discuss what we can learn from using the approach.

Carbon Budgets and ‘True Sustainability’

The concept of a carbon budget and the designed probes in *Spilltime* link your carbon budget and your everyday activities. Naturally this resulted in many reflections of how much CO₂e different activities generate. The participants expressed a new understanding and a carbon literacy in relation to their everyday life. The idea or concept of climate budgets (for example with a focus on energy use) to compare and relate to budgets is not new (Froehlich *et al.* 2012). However, the uniqueness of our study situated in the future exposes how detailed CO₂e data in realtime could link to a strong understanding relating to everyday life practices and climate goals. Such a new type of literacy is something we might need in order to prepare for, relate to and explore transitions towards ‘true sustainability’. The future policy regulation was exposed through functioning design artefacts carrying the essence of a carbon budget, previously articulated as one means to approach true sustainability (Power and Mont 2010). Our study uncovered despair and hopelessness. The public consumption was perceived as non transparent and unfair as it made up such a big part of the overall footprint (5,5 kg). Disturbing is that the 2020 goal on which the budget was based, is far from a sustainable level. A ‘true sustainability’ would translate to 5,6 kg CO₂e per day (2 tonne) compared to 13,1 kg CO₂e in the study. All of participants were prior to the study already engaged in making active choices to lower their carbon footprint in relation to what they eat, how they live and how they transport themselves. Only some of our participants managed to stay within their budget. The participants were also critical towards the goal that we had set for them and whether it reflected ‘true sustainability’.

One of the participants decided to take it one step further and had set 5,6 kg and at some point 2,8 kg (1 tonne a year) as the CO₂e level towards which he aimed his own carbon footprint of the day. He, thus, set himself a personal goal for the study according to what he considered ‘truly’ sustainable. However, this goal actually put him in a state of despair. So, we ask ourselves, how can we deal with ‘true sustainability’ when even eco-conscious people like the participants in our study have difficulties adhering to goals that actually will enable us as humanity to stay within planetary boundaries. Most of the Western world inhabitants do not live like our participants. Interestingly, the study uncovered many reflections that put a strong emphasis on the role of politics to make drastic changes. The participants expressed a longing for politicians to take brave dramatic decisions that would force change. We reflected on this and ask ourselves: how can we engage political leaders into exploring radical change visions such as the one we proposed within this paper? It is for this reason that our future research will aim on working together with municipalities and explore public consumption and how its emissions can be decreased.

Applying Speculative Design in Real Life

Speculative Design, as well as Transition Design, suggests we should inform our visions by involving experts from other fields, in order to create futures beyond Science Fiction (Dunne and Raby 2013). This we did through the expert interviews and vision/ backcasting workshop. The designed Spilltime artefacts and supporting technology is bulky, but the results indicate that we managed to put the participants in a radical future vision that they could experience and relate to based, for example, on their reflections during the interviews. One participant (participant 1) expressed that ‘*Well if you would develop it to something more permanent, it is a bit ‘special’. I watch Black mirror a lot. I don’t know whether you watch it? I got some of those vibes*’. In this way, we created a Speculative Design vision that you can actually experience and thereby relate to in your everyday life. The connection to everyday life such as expressed by one participant (participant 3) in relation to food practices ‘*And I was surprised by that it was 398 grams and I was like: wow...it is better to eat out because at home you use more [energy to cook]*’, would not have appeared through a scenario. Neither would the bus ride that participant 2 experienced, which resulted in him reflecting on whether he could even afford himself a meal due to the decreased carbon budget (the participant that set his own goal to 2,8kg).

Applying a Wizard of Oz approach, and for the participants to wear a big camera device to record what they are doing, is obviously very inconvenient and maybe even a little unsettling. Even if we would have preferred to have a system that would operate a bit more smoothly, like the camera being less bulky in order for it to be less of a hassle, the aesthetics of the study actually enhanced the futuristic feeling of something that is not yet in place, but that could be. How much the Wizard of Oz approach added is hard to say, but our results indicate that we did manage to make the vision experiential and tangible. We believe that a gallery piece or video scenario would not have resulted in comparable reflections of what it could imply for real daily life. However, as a side note, the scenario approach that was, for example, adopted by Superflux in Uninvited Guests is easily accessible to a large amount of people because of the movie format. Our study is not accessible to a wide public, only six people took part in the study, due to the Wizard of Oz approach.

We conclude by saying that the functioning artefacts that we used, together with the experience we designed around them, were of great value to articulate the radical change that we were exploring. The functioning artefacts and the created experience, invited the participants into alternative realities which enabled them to reflect on these alternative realities and share concerns, reflections and limitations they saw. In this way, we facilitated an approach in which not just the designer, or other stakeholders in society, that are often seen as experts in sustainability, but actual members of society, are empowered to explore alternatives to the current ways we are living.

We see our approach as an addition to the toolkit of Transition Design. It is an approach towards rendering the distant future in a way that helps people to engage with it, by merging it into their real life context through design artefacts and immersive experiences. In applying Speculative Design, we see potential in proposing much more radical futures to open up current ways of thinking in order to stimulate debate. This is important in a time when we will have to face some drastic changes in order to support transitions towards (more) sustainable lifestyles and societies.

References

Blythe, M. (2014). Research through design fiction: narrative in real and imaginary abstracts. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'14)*. New York: ACM Press, pp. 703-712.

Bruntland, G. (1987). Our common future. *The World Commission on Environment 1 and Development*, pp.45-65.

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, 8(2), pp. 5–21.

Ceschin, F. and Gaziulusoy, A. I. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, 47, pp. 118-163. doi:http://dx.doi.org/10.1016/j.destud.2016.09.002

de Sousa Santos, Bonaventura. 2006. *The sociology of emergences, the rise of the global left: The World Social Forum and beyond*. London (UK): Zed Books.

Dunne, A. and Raby, F. (2014). *Speculative everything: Design, fiction, and social dreaming*. Cambridge (MA): MIT Press.

Froehlich J, Findlater L, Landay J. (2010). The design of eco feedback technology. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. New York: ACM Press, pp. 1999-2008.

Gaziulusoy, A. I. (2010). *System innovation for sustainability: A scenario method and a workshop process for product development teams*. (Ph.D.), University of Auckland, Auckland.

Gulliksson, H. (2005). *Pervasive design for sustainability - Convolute*. Umeå, Sweden: Videoiterna.

Håkansson, M. and Sengers, P. (2013). Beyond being green: simple living families and ICT. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. New York: ACM Press, pp. 2725-2734.

Irwin, T., Tonkinwise, C., & Kossoff, G. (2015). Transition Design: An educational framework for advancing the study and design of sustainable transitions. Paper presented at: *the International Sustainability Transitions (IST 2015) Conference, Brighton (UK)*.

Irwin, T. (2015) Transition Design: A proposal for a new area of design practice, study, and research. *Design and Culture*, 7(2), pp. 229-246, DOI: 10.1080/17547075.2015.1051829.

Jones, P. (2014). Systemic design principles for complex social systems. In: *Metcalfe, Gary S., ed., Social Systems and Design*. Tokyo (Japan): Springer, pp. 91-128.

de Jong, A., Örnevall, E., Reitsma, L., & Wessmann, S. (2016). Challenging the Role of Design (ing) in the Sustainability Field: Towards a ‘Humble’ Design Approach. In: *Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. New York: ACM press, pp. 131.

Kelley, J. F. (1985). CAL – A Natural Language program developed with the OZ Paradigm: Implications for Supercomputing Systems. *First International Conference on Supercomputing Systems (St. Petersburg, Florida, 16–20 December 1985)*, New York: ACM press, pp. 238–248.

Manzini, E. (2015). *Design when everybody designs*. London (UK): The MIT Press.

Manzini, E. (2003). *Sustainable everyday: Scenarios of urban life*. Milan (IT): Edizioni Ambiente srl. Available online [accessed 8.2.15] <http://www.sustainable-everydayproject.net/blog/library-sustainable-everyday/>.

Power, K. and Mont, O. (2010). Dispelling the myths about consumption behaviour. Presented at: *the ERSCP-EMSU Conference, Delft, The Netherlands, October 25-29*.

Raftery, A. E., Zimmer, A., Frierson, D. M. W., Startz, R., and Liu, P. (2017). Less than 2 degrees C warming by 2100 unlikely. *Nature Climate Change*, 7 (9), pp. 637-641. doi:10.1038/nclimate3352

Rittel, H.W. and Webber, M.M., (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), pp. 155– 169.

Reitsma, L., Toretta, N., de Jong, A., Örnevall, E. & Wessman, S. (2017a). Humble design-ing: a future perspective on the role of design in design for sustainability. In: *Proceedings of ERSCP 2017*.

Reitsma, L., Wessman, S., & Örnevall, E. (2017b). ‘I Believe in That Version of the Future’. Cli-Fi and Design Fictions as Dialogical Frameworks for Expert Engagements. *The Design Journal*, 20(sup1), 1817-1826.

Reitsma, L., Light, A., Zaman, T., & Rodgers, P. (2019a). A Respectful Design Framework: Incorporating indigenous knowledge in the design process. In: *Proceedings of the 13th EAD Conference*. (In press).

Reitsma, L., Wessman, S., & Nyström, S. (2019b). Spilltime: Designing for the relationship between QS, CO2e and climate goals. In: *Proceedings of the 13th EAD Conference*. (In press).

Rockström, J., Steffen, W., Noone, K., Persson, Å, Chapin III, F.S., Lambin, E., Lenton, T., Scheffer, M., Folke, C., Schellnhuber, H.J. and Nykvist, B. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society*, 14(2).

Sheehan, N. W. (2011). Indigenous Knowledge and Respectful Design: An Evidence-Based Approach. *Design Issues*, 27(4).

Superflux (2015). Uninvited Guests. Retrieved at January 18, 2019 - from: vimeo.com/128873380.

Tonkinwise, C. (2015). Design for transitions - From and to what? *Critical Design / Critical Futures Articles*. Paper 5. http://digitalcommons.risd.edu/critical_futures_symposium_articles/5.

UNEP. (2017). *Emissions Gap Report 2017: A UN environment synthesis report*. United Nations Environment Programme (UNEP).

Voss, G., et al. (2015). Speculative Design and the Future of an Ageing Population. *Report 2: Techniques*. Gov.uk.

Woodruff, A., Hasbrouck, J., & Augustin, S. (2008). A bright green perspective on sustainable choices. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'08)*, New York: ACM Press, pp. 313-322.

Wright, P. and McCarthy, J. (2008). Empathy and experience in HCI. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'08)*, New York: ACM Press, pp. 637–646.