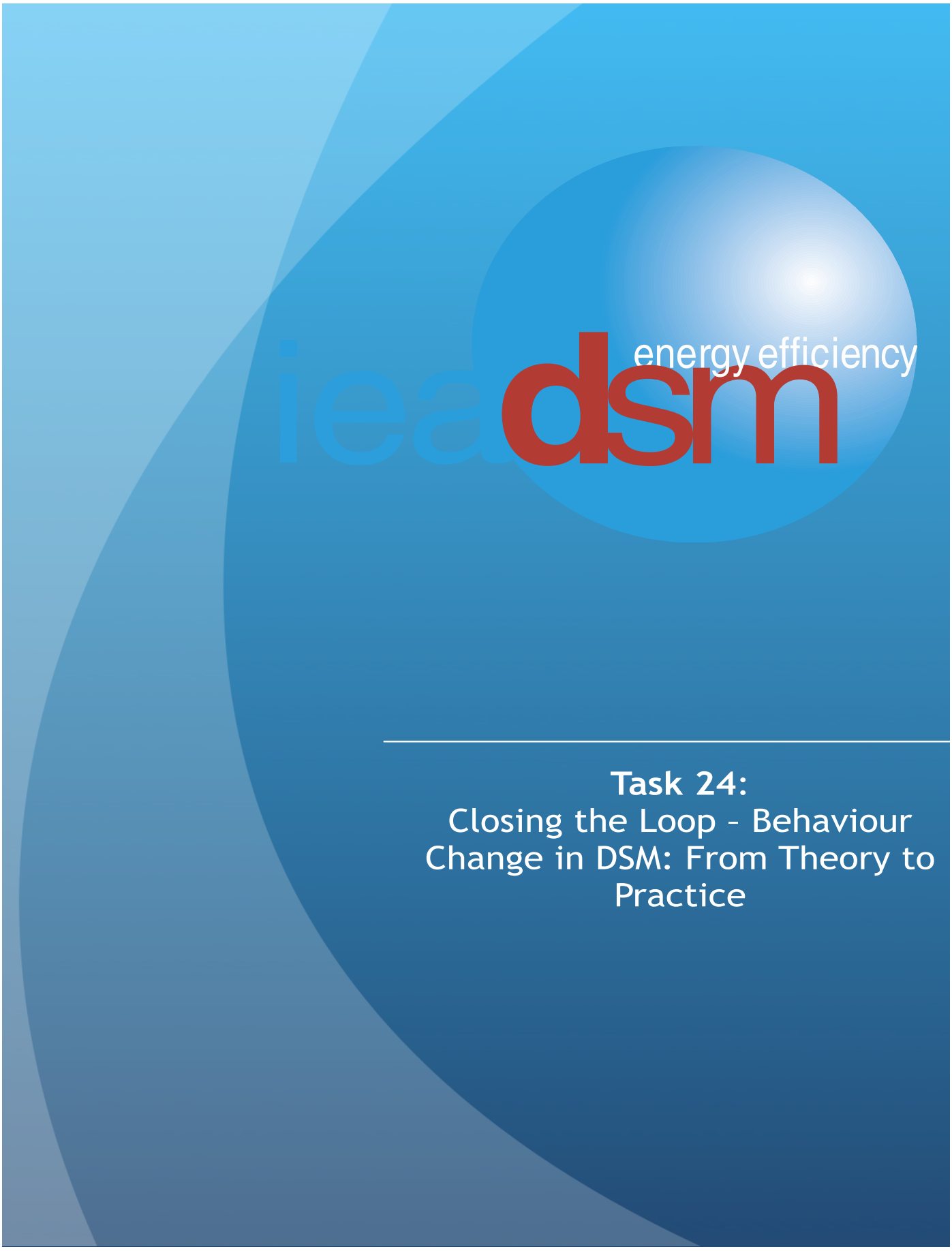


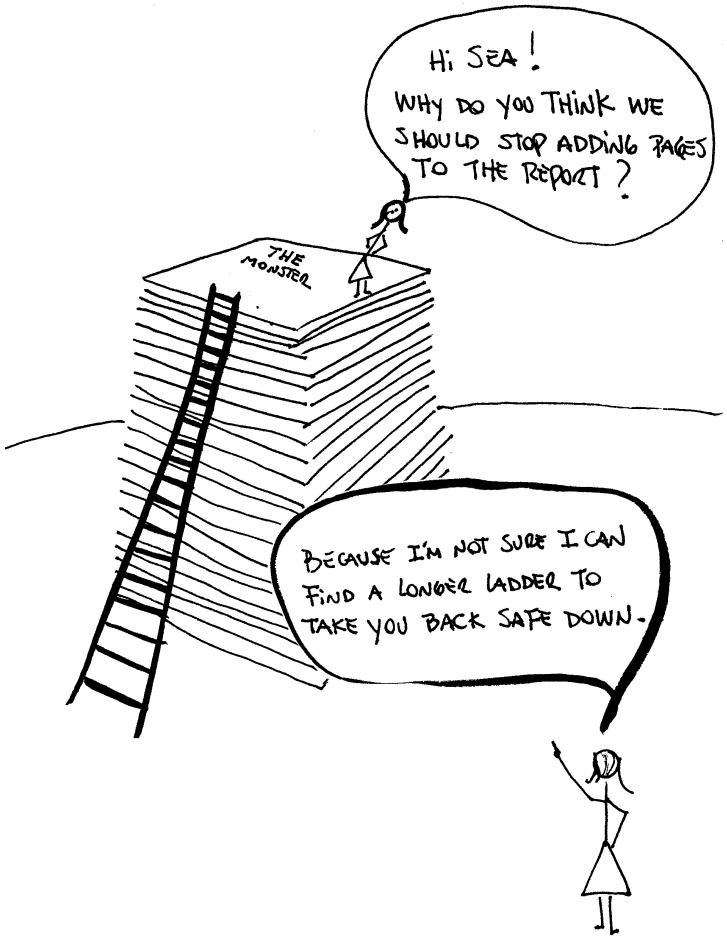
Task 24:
Closing the Loop – Behaviour Change in DSM: From Theory to Practice

Most of the time what we do is what we do most of the time. And sometimes we do something new[1]

Analysis of case studies IEA DSM Task 24 Closing the Loop - Behaviour Change in DSM: From Theory to Practice.

Deliverable 2 for IEA Implementing Agreement DSM Task 24

November 2013



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Contents

Executive Summary

This report is the analysis of Subtask I - Helicopter overview of models, theories, contexts and evaluation metrics. It summarises almost 40 case studies from more than 10 countries. The case studies were provided by our national experts of the 9 participating countries, and other experts from countries that support this Task in-kind. The case studies were based on policies, programmes and pilots, driven from both, the top-down and the bottom-up. They were explicitly or implicitly based on various models of understanding behaviour or theories of change (of behaviour). They were collected from four main domains: transport, building retrofits, SMEs and smart meters, thus encompassing a very wide range of DSM interventions. Some came from government (both national and local), some from the energy industry, some from businesses, some from the third sector and some from researchers. Some have used similar models or similar approaches, but they all encompass a wide variety of themes, contexts and outcomes. There is a lot of shared learning in this report, and there are a lot of great stories.

Due to the large variability and inter-disciplinarity of both the models and the stakeholders applying the models, we have realised early on that we were going to have a potential communication problem. Each model comes from a discipline with very specific jargon: policy speech is very different from business speech and marketers and academics further muddy the waters. End users are often bombarded with information which is either too mathematical as it's based on economics, statistics or engineering, or too generic, warm and fuzzy to be of much meaning or value (people get more and more cynical after all). Thus, we decided to eschew jargon as much as possible, which is quite hard to do when talking about demand side management and behavioural science. During our 'baptism by fire' at our Task 24 workshop in Oxford (October 9-10, 2012), we learned that there was one language tool that surpassed all the inter-disciplinary bickering and infighting. It was more powerfully clear than policy, marketing or business speech and more direct in getting to the gist of it than economics, engineering, sociology or psychology can ever dream of being. It is thousands of years old and probably the one communication tool that remained since before the Tower of Babel crumbled and made us all turn to our own niche jargons and languages. The magical language tool I am talking about is...STORYTELLING.

So, despite not always being able to stop ourselves from engaging in the jargon that came from the different disciplines, sectors, stakeholders and case study interventions, we have made several attempts to translate them via the power of storytelling. There are three types of stories in this report: **Overarching stories**, so wonderfully described by Dr Katy Janda[2] (inspired by some of the work we did at our Oxford workshop), as *hero stories*, *learning stories*, *horror stories* and *love stories*. We have examples of all of these stories here, though we haven't marked them as such yet (we hope it is something we will do together in future workshops). Examples of each of these stories are as follows: Italy's **Time of Use Tariff** is a typical *hero story*, promising a silver bullet technology and solid economic approach (smart meters plus time of use tariff to encourage peak load shifting). However, we often find that a lot of our hero stories are actually *learning stories* - like the neoclassic economics-inspired **EECA SME** programme in New Zealand, that found that it was only successful in getting SMEs to take up their subsidies for energy audits and corresponding interventions, if a trusted industry association ran collaborative learning workshops with the SMEs first. A wonderful *love story* is the New Zealand **WUNZ** building retrofit programme, which realised that it's not about the energy savings but the associated huge health benefits from insulating cold and draughty houses, especially for the poor. The Australian **Energy Efficiency Homes** counterpart (not explained in detail here) is a classic *horror story* - where bad programme design led to gigantic fraud, burning houses and even

[2] http://proceedings.eceee.org/visabstrakt.php?event=3&doc=1-406-13

deaths of insulation installers. Each one of our case studies falls into such a story element, although most of them are learning stories, and that is good for us and this report.

The second way of using storytelling was in telling the **stories of each model** that was used in the various domains from the perspective of both the end user, and the programme designer. For example, the **neoclassical or behavioural economics** approaches which are most common in buildings retrofits and smart metering rollouts are inherently flawed as they assume that **incentives plus information provision** (with maybe some clever **nudges**) will make (rational) people change their behaviour. As most energy use is wholly habitual, and not at all rational, these approaches are often of limited success when outcomes are actually measured, rather than estimated or modeled. But, these approaches lend themselves very well to our current political and economic system, are relatively straightforward to implement and still somewhat successful and thus still have their place. There will also always be some people who are more rational, economically or technically motivated than others. They are, however, not the norm, but rather the exception. The more **systemic, social approaches** have more engaging stories. They sound like something you'd like to be engaged in, rather than a top-down approach that is 'done to you' by a faceless bureaucrat. However, they also bring their unique problems as they usually take a lot of collaboration, are hard to evaluate and at first glance, more costly. The morale of most of our stories is that it depends on who you tell the story for, when, how, why and with what capability at your disposal. There definitely is no silver bullet model or story here, like there is no silver bullet technology that will make us more energy efficient all by itself.

But let this not deter you! We have collected some really good yarns and they all bring us a lot of insight and learnings. In order to make you remember the 35+ case studies we are describing here, we have told little **individual stories**, the way your mom did before you went to sleep, for each of them. This will hopefully keep them fresh in your mind when you read through these cases. Our brains are set up to remember little stories or visual plots much better than facts and numbers and we were lucky to have an amazing cartoonist among our experts - Juan Pablo Garcia's cartoons and pictures from the case studies are also used to illustrate some of our stories here. In addition, some experts provided us with the very short version of their case studies, in form of tweets (140 characters maximum).

Each of the domains also had some unique storylines: For example, **driving** is a very routine behaviour, with built-in capacity for adaptation/adoption to new cars/routes/traffic; **retrofitting**-related behaviour deals with investment decisions at the planning stage where unappealing new behaviours can be quickly rejected or even result in cancelling a planned action. **Smart metering** cases demonstrate that this domain deals with an entirely new behaviour, presenting opportunities for impact through training but also almost no existing behavioural context to use as a starting point. And in the case of **SMEs** many of the behaviours that need to change require a lot of risk taking and senior leadership, with potentially big impacts on staff and productivity.

The evidence presented here suggests that trying to transfer approaches across many different settings without tailoring them to the specifics of the context is itself a cause of failure. The best story we can tell you is that a **mix of interventions that are tailored** to different (national, local, organisational, domestic) levels; tailored at both the **individual and social** level; aiming at changing both the **investment and habitual** behaviour; targeting **multiple motivations** (not only economic and informational ones); adding strong **quantitative and qualitative evaluation** (of actual and perceived/modelled behaviour changes) into project design; and focusing on the **lifestyle** in which energy is key to performing functions will probably get you long-term success. We hope you enjoy the learnings from this report.

Below you find a short list of the lessons we drew for policymakers, intermediaries or other initiators on DSM retrofitting, SME, transport and smart metering interventions (the longer list follows each chapter).

Recommendations to behaviour changers

DSM Retrofitting interventions

1. It's not only about the houses, but first and foremost about the people who live there. Involve , engage and target multiple members of a social group, at the collective level, not only at the level of the individual. FOCUS ON THE SOCIAL SIDE**.**
2. Focus on both investment and habitual behaviour to avoid bad and unnecessary rebound effects. IT'S NOT JUST WHAT WE BUY, IT'S WHAT WE DO.
3. Use insulation as a gateway, not a one-off change. CHANGE LIFESTYLES NOT LIGHTBULBS.
4. Beware if only the supply side or the implementer of the intervention seems to benefit. THINK OF THE BENEFITS FOR THE END USER AS WELL.
5. Trusted messengers are everything. FOCUS YOUR MESSAGING.
6. When targeting the individual need for money and financial support, do not ask for prefinancing. PAY THE SUBSIDY UPFRONT AND DON'T ASK FOR TOO MUCH UPFRONT INFORMATION FROM END USERS.
7. Tailor to your end users' needs which may not be about kWh savings. Cooperate widely and make it about more than money.USE A TOOLBOX OF INTERVENTIONS AND GO BEYOND kWh TARGETS.
8. Pre-scope to find out what is most important to end users. IF YOU KNOW WHAT THEY WANT, MAKE SURE YOU TRY AND GET IT FOR THEM.
9. People don't live according to sectoral divisions, even people in a household have different needs and habits. DON'T BOX PEOPLE IN TOO MUCH.
10. It should not be left to the individual to buy and install metering devices to meter the actual impact of retrofitting. BENCHMARK YOUR HEART OUT, MEASURE, NOT MODEL
11. 'Decliners' or opt-out households are potentially as valuable to survey as those engaged. LEARN FROM THE UNWILLING.

DSM transport interventions

1. Cars mean everything to many people, be careful how you approach them. DON'T TAKE AWAY THEIR WHEELS.
2. An energy efficient car can be sexy (see the Tesla!). CARS REFLECT LIFESTYLES.
3. Use a toolbox of interventions that work together. YOU NEED MORE THAN ONE TOOL TO FIX A CAR.
4. Active coaching by trusted peers is key. TRUST IS EVERYTHING.

5. Focus on concrete actions and capacity building, not sustainability guidelines to change the behavioural routine. PRE-SCOPE AND TRAIN, VISUALISE THE GAP BETWEEN ACTUAL AND GOAL BEHAVIOUR.

6. Make smart driving the social norm. BE SMART, DRIVE SMART.

7. Leverage change moments to normalise the desired behaviour. A NEW CAR/LICENCE IS A GREAT PLACE TO START.

8. Change the institutional and infrastructural environment! IT'S ABOUT MUCH MORE THAN JUST THE CAR.

9. Create a sense of community amongst drivers in an intervention and use social based marketing. YOU'RE NEVER ALONE WHEN YOU'RE DRIVING.

10. Beware of perverse outcomes! RISK MESSAGES CAN BE RISKY.

11. Money is a good start but not enough to affect change in the long run. MONEY AIN'T EVERYTHING.

DSM smart metering interventions

1. In many instances it is clear that economic gains or losses are not necessarily the only trigger necessary. TIME ISN'T ALWAYS MONEY**.**

2. The successful implementation of smart metering is dependent on the creation of an intervention that goes beyond acceptance and aims at creating multiple benefits through the introduction of a smart meter. TECHNOLOGY ISN'T EVERYTHING.

3. Who benefits and who pays (eg with assumed loss of privacy)? MAKE SURE THERE IS CLEAR VALUE FOR THE CUSTOMER.

4. Information isn't everything - it needs to be coupled to active or shared learning. AUTOMATONS DON'T TEACH AS WELL AS REAL PEOPLE.

5. If they want it, they're already convinced it's a good idea and not your main target. FIND AND CONVINCE THE 'LUDDITES' THAT YOUR TECHNOLOGY IS A GOOD IDEA FOR THEM.

6. Don't just tackle the behaviour of people, but also of their home. THE HOME AND THE HOUSEHOLD DYNAMICS HOLD YOUR KEY.

7. Beware of the strong effect of personalities when using intermediaries, champions or advisors. SOCIAL CUES ARE MORE POWERFUL THAN TECHNOLOGY.

8. A home is not where energy is used, it is where people live (comfortably, thanks to energy). MY HOME IS MY CASTLE.

9. Use trusted champions and advisors. SEEING IS DOING.

10. The technology solution needs to match the technology literacy/maturity of the target. DON'T SELL IPHONES TO PEOPLE WITH NO POWER.

11. Focus not on individuals but on their practices. IT'LL TAKE A LONG TIME TO CHANGE 7 BILLION PEOPLE ONE BY ONE.
12. Engage your customers through multiple channels. PARTICIPATION IS KEY.
13. Being wasteful can feel worse than spending money. NO ONE LIKES WASTE.
14. I wanna know what others are up to and where I stand. TELL ME HOW I'M DOING COMPARED TO MY NEIGHBOURS.

DSM SME interventions

1. Top-Down, middle and bottom-up is needed, plus some external validation. IT CAN'T ALL COME FROM THE TOP OR THE BOTTOM.
2. Compare and celebrate successful companies and interventions. BENCHMARK YOUR HEART OUT.
3. Find your champions in your organisation and work with them. IT'S ALL ABOUT THE PEOPLE.
4. If you have shared goals, you're halfway there. I WANT WHAT YOU WANT, SO LET'S DO IT.
5. The 'laggards' can have a powerful negative effect on your staff. DON'T BE AFRAID TO LOSE THE NAY-SAYERS.
6. Nudges can thus support people as reminders about their motivations and attitudes but more (e.g. changing social norms, institutionalisation of norms) is needed to change attitudes and motivations. NUDGING IS WHAT IT IS: A NUDGE, NOT A LIFE SAVER.
7. Validate where possible. SHOW WHO'S A LEADER.
8. Tailor to each SME, they are not all the same. TAILORING IS ESSENTIAL.
9. Be fair, and support innovators. THEY LEAD - OTHERS FOLLOW.
10. Build your own capability if you want to share learnings. CONSULTANTS DON'T CARE AS MUCH ABOUT YOUR COMPANY AS YOUR STAFF DO.
11. Go to trusted intermediaries. TRUST IS EVERYTHING.

Introduction

This document presents the general preliminary observations and lessons learnt based on the empirical analysis of case study templates[3] that have been delivered by the national experts of the participating countries for Subtask 1 (Helicopter Overview) of Task 24. These templates present cases in the different countries for the four themes 'retrofitting', 'transport', 'smart metering' and 'SMEs'. These templates are brief sketches of a project or programme, following a line of questioning that aims to highlight the impact of a chosen theory or model of behaviour change aimed at energy conservation or efficiency for the actual design, implementation, monitoring and evaluation of the project or programme.

Although modest in intention, this report distinguishes itself from other studies that contrast the use and usefulness of diverse social scientific theories and models that underlie interventions by using a diverse set of international empirical case materials. In that sense, this report is a first empirical exploration of the ways in which models and theories underlying interventions may affect particular outcomes and under which circumstances. An important aim of this study is also to arrive at questions for further in-depth empirical case study research (as part of Subtask 2). In addition, it is a start at creating better interventions through a critical assessment of underlying perspectives.

The template[4] used to collect the case studies here was based on a UK report that reviewed various models of understanding behaviour and theories of change[5]. Andrew Darnton (2008) distinguishes the two as follows: *'Models of behaviour help us to understand specific behaviours, by identifying the underlying factors, which influence them. By contrast, theories of change show how behaviours change over time, and can be changed. While behavioural theory is diagnostic, designed to explain the determinant factors underlying behaviour, change theory is more pragmatic, developed in order to support interventions for changing current behaviours or encouraging the adoption of new behaviours. While the two bodies of theory have distinct purposes, they are highly complementary; understanding both is essential in order to develop effective interventions.'*

These theories and models described here do not necessarily have an explicit focus on behavioural change, but always hold a specific perspective on behaviour, energy end users and factors influencing their behaviour. The theories and models are not always explicitly chosen to inform the design of an intervention. Many of them are implicitly used, as often is the case with e.g. neoclassical economic theory which most commonly underpins current policy or programme design. The templates help us to identify potential weaknesses and highlight design strengths based on a variety of theories of change or model of understanding behaviour.

This analysis is not aiming to provide a critical reflection on the theories or models being used and select the "silver bullet" theory or model. This report does also not involve additional literature studies on other cases and project reports from the four domains. It is a document containing observations, some reflections and recommendations, based on the cases provided by the involved national experts. The recommendations are formulated as facts but this is for the sake of the argument and should be seen as tentative.

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[3] The case descriptions can be found on the IEA DSM Task 24 NING site (www.ieadsmtask24.ning.com), and on a Wiki dedicated to Task 24 (see www.ieadsmtask24wiki.info)

[4] https://www.dropbox.com/s/b7ivlhqhrv1uhrc/Merged%20template%20final.doc

[5] Darnton, Andrew (2008). GSR Behaviour Change Knowledge Review. Reference Report: An overview of behavioural models and their uses. 83pp.

Unfortunately, this analysis does not explicitly focus on cultural differences between countries. In Subtask 2 we will explicitly focus on cultural idiosyncrasies. For example, in Norway there is a strong 'do it yourself retrofitting movement' going on. In addition there is almost no rental model for housing stock in Norway, whilst there is strong rental model in the Netherlands or in Sweden. In New Zealand, people are used to living in un(der) insulated, cold and draughty houses and just put on another jumper, rather than heating them to the temperatures their Northern counterparts are used to. These cultural differences and their origin (cultural trait or a particular cultural characteristic) do impact the meaningfulness of recommendations for policymakers. In this document however, we make general recommendations on the level of themes and theoretical underpinnings for interventions. In Subtask 2 (Case-Studies) we will focus more in-depth on cultural issues.

We collected almost forty cases in templates, often they are learning stories, sometimes hero or love stories and sometimes they were horror stories. The analysis presented below is thus based on brief sketches, relatively limited information and internet documentation. The underlying templates do not demonstrate the same level of detail or analysis and therefore these are not attached. This document is further informed by the conceptual framework developed in Task 24 which is reported in the positioning papers published in 2012 for the Brussels and Oxford Task 24 workshops.

The analysis of the cases was conducted with four key questions in mind:

- which underlying theoretical perspectives exist and what sort of programmes do they inform?
- how do the underlying theoretical notions impact on design, implementation and evaluation on interventions?
- which elements of an intervention work across implementation domains (e.g. retrofitting, smart metering, SMEs, transport?)
- What recommendations for designing, implementing and monitoring and evaluating behavioural change interventions can we offer to policymakers and other programme designers and implementers?

This document is a very long document, with a lot of detail and not one clear stakeholder or audience in mind. Our audience are 'behaviour changers', who tend to fall into five main groups, all of which have their own mandates, drivers and barriers: decisionmakers (policy/political), energy salespeople (industry/utilities), intermediaries (tradespeople, energy auditors, ESCO facilitators etc), research experts (from many disciplines) and the third sector (NGOs, community groups etc). We view this document as a background document where information is presented in different ways (brief descriptive elements, some analytical elements, storytelling, bulletpoint lists of recommendations, issues and open questions). This document can therefore serve as a detailed collection of information that can be translated into our Wiki and different presentations or webinar-like dissemination strategies for different audiences.As previously said, one of the ways Task 24 aims at translating research into policy and practice, is through storytelling. Therefore, in this analysis we also add a short narrative demonstrating what approaches based on various theories and models actually tell the end-user. The storyline from an end-user's perspective is based on the following questions that an end-user would ask when confronted with an intervention:

    - How am I motivated or approached or seduced to respond or change my behaviour?
    - Why should I do this?
    - What do I need to do and what will others do?
    - What will it take or what will it 'cost' me?

- Will I get help?
- What behaviour needs to change and how much will I need to change?
- Will it be difficult?
- What will I gain? What is in it for me?
- Will I get feedback that I understand and that I trust and that tells me what the result was of my actions?

On the flipside, in our recommendations for Subtask 4, we will turn these questions around in order to help programme and policy designers (from government, research, industry, the intermediary and the third sectors) ask the right questions when designing interventions that will have the most chance for successful uptake by the public.

In addition, we will tell the case study stories both in a brief sketch and based on the principles of a story spine: http://improvencyclopedia.org/games/Story_Spine.html)

Reading guide

The following chapters are thematic and discuss the themes of retrofitting, transport, smart metering and SMEs. These themes were chosen at the beginning of Task 24 by stakeholders from our participating countries. In each chapter, we discuss the theoretical approaches, and do not repeat that discussion in its full extent in another chapter. This implies that the chapters are not identical in terms of content. We focus our observations on what jumps out in the cases provided here and the domain specificities. It is a bottom-up approach to analysing our material, based on sometimes limited material. In addition, in each chapter we create a short storytelling exercise highlighting the message a certain theoretical approach contains for its end-users, a story on the cases analysed and we distil the key lessons learnt and questions for investigation in Subtask 2 (Country specific in-depth Case Studies).

2. Retrofitting: observations

The cases

Table 1: Retrofitting cases analysed in different participating and supporting countries

Country	case	Theory or model used	Policy or Societally driven
Netherlands	Blok voor Blok aanpak, retrofitting programme	Behavioural economics	policy
	Energy labelling of houses	Behavioural economics	policy
New Zealand	Warm Up New Zealand: Heat Smart	social marketing; social norms; neoclassical economic; TPB	policy
Switzerland	Swiss Building Retrofit Programme	Neoclassical Economics	policy
	2000 Watts Society (housing)	Ethics, long-term visioning	policy
Norway	Myhrerenga Housing Cooperative, a user initiated retrofitting of a housing cooperative	Theory of Planned Behaviour	societally
Sweden	Sustainable Järva (Hållbara Järva).	Systems approach	societally
UK	Kirklees Warmzone	Neoclassical economics	policy

The Dutch Blok voor Blok programme[6]

Blok voor Blok is a policy-initiated programme to encourage energy saving in existing housing stock. There are currently 14 cities in which a Blok voor Blok project is under development. The goal is to achieve energy savings in at least 1500 to 2000 Dutch households by means of extensive retrofitting. Eventually, the market should be able to adopt the concept to spread projects to other regions. The programme aims to learn from different types of implementations and to find success factors to be applied broadly in later stages. Blok voor Blok uses customer segmentation and a tailored approach. Several cities offer different energy-saving packages, suitable for different types of consumers. Consumers have the ability to decide and participate in the process. In Blok voor Blok projects housing corporations, contractors, installers,and municipalities all work together. Some municipalities offer facilitating measures such as low interest loans for energy-saving investments. Knowledge exchange between the various projects is pursued to gain insight into successful factors and training in knowledge exchange is provided for the consortium members. Finally, the programme monitors and evaluates several processes: the approach of residents, satisfaction of residents and the reason of their (decline of) participation. The results will also be used to search for best practices in the follow up of the programme. Blok voor Blok is based on **theories of behavioural economics** (which incorporate social psychology learnings into classical economic theory).

[6] http://www.agentschapnl.nl/onderwerpen/duurzaam-ondernemen/gebouwen/blok-voor-blok

Once upon a time...In the cold Northern country of the Netherlands, people lived in homes built during the rebuild after WWII. These homes had horrible draughts, were badly insulated and people could not put their couches against the walls because they were so cold. Incidentally, this initiated a interior design market...

Every day...thousands of Euros went up the chimney, and a few more were spent on weather strips.

But, one day... The Dutch government felt it was time to retrofit all those badly insulated homes in the Netherlands and get people to live more economically and efficiently.

Because of that...they started a subsidy scheme called 'City Block by Block' and gave money to homeowners who wanted to insulate and retrofit their homes.

But then...those homeowners that submitted a request for funding were asked to provide an enormous amount of paperwork, technical information and, in addition, they had to prefinance the retrofitting! And it was the installation market that profited mostly at first because their sales got up.

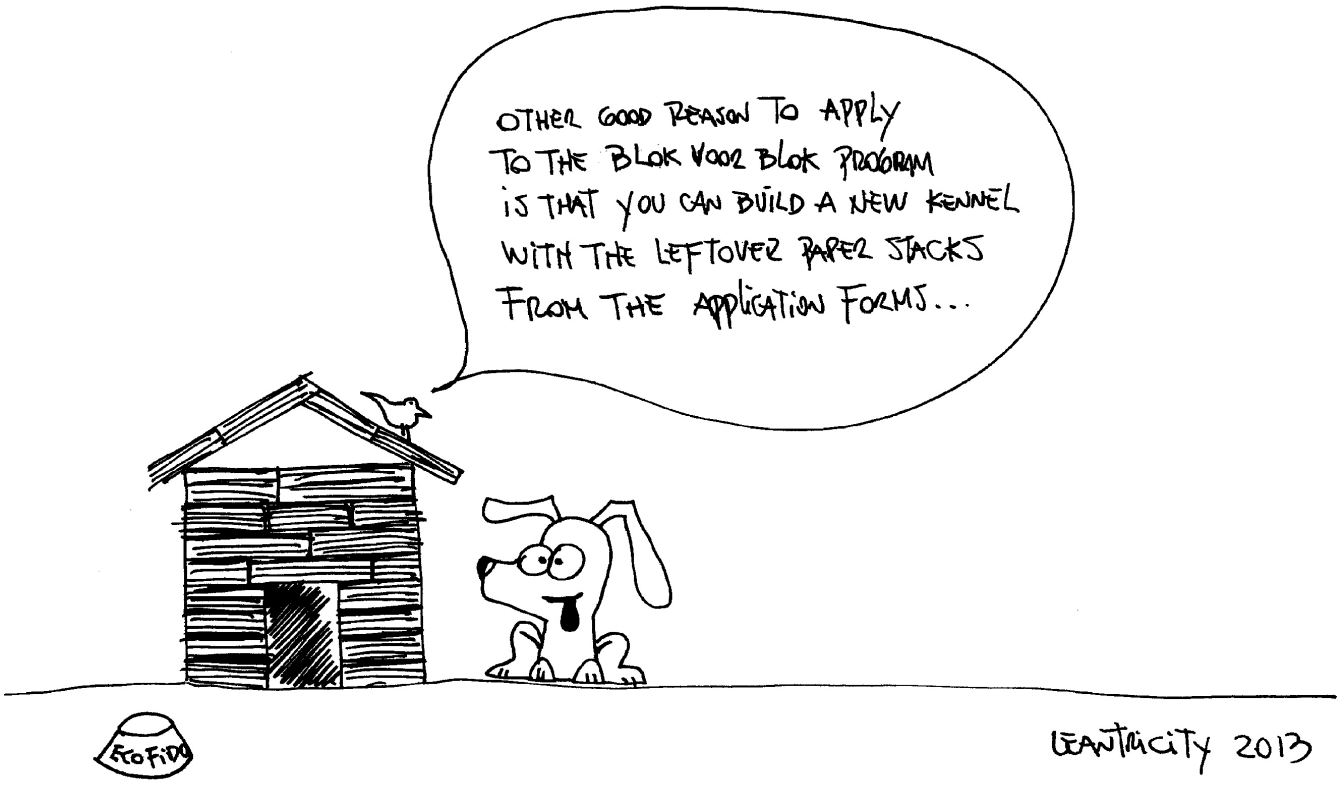
Until, finally...most of the homeowners who did apply got their money, and had warm and comfortable homes. Some even saved some money on their energy bills, although they had no way to monitor or meter if they consumed less energy. The modeled calculations, however, said they did.

And, ever since then...the scheme is seen by the policymakers as a huge success and learnings are translated into new designs for new schemes. **The end.**

The Dutch Blok voor Blok programme in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

Understanding and anticipating human decisionmaking processes can help formulate interventions for energy saving measures in houses #Task24



The Blok voor Blok programme as seen by Juan Pablo Garcia (Leantricity)

The Dutch Energy labelling of houses programme[7]

The **Energy labelling** measure was introduced in 2008 following a wider European regulation, which stated that the use of an energy label was obligatory in the housing market. An energy label is an assessment of the energy use of a building. Energy labels are applied to integrate the energy use of a building as one of the motivations in peoples' purchasing behaviour of a house and to invest in energy saving improvements to increase their ranking. It was up to the national governments to decide on the exact form of the labelling scheme. In The Netherlands, an easy and less expensive scheme was chosen which used simplified calculations to formulate standard/generic labels. An information campaign was used to introduce the label. TV and radio commercials, a website and a brochure informed residents about the label. The focus was first on home buyers and sellers, but since 2009 the labels were available for tenants as well. For a long period of time the plan was to make the label mandatory, in particular when a house was put on the market for sale. A lot of negative publicity emerged around the label initiated by real estate organisations and home owner associations that criticised the label for being inconsistent and ambiguous. This lead, initially, to an improvement of the assessment and the transparency of the energy label and in 2010 to a revised version of the label. However, there were no sanctions for not having a label and after several months of heated debate in Parliament it was decided that the label was no longer mandatory. The amount of available energy labels therefore dropped from 25% in 2008 to 15% in 2009. In 2010, the percentage of energy labels increased again to 20%. Also, the green labelled houses were sold in that year with premium of almost 3%. The implementation strategy for energy labels was based on the **Information Deficit Model (IDM)**. The model states that the following linear relationship is imperative: Information --> knowledge --> attitude --> behaviour. It forms part of neoclassical economic thinking which is based on a rational human being who will change their behaviour if given the right (financial) incentives and information.

[7] http://www.tudelft.nl/en/current/dossiers/archive/energy-label/

Once upon a time... in a label-less land called The Netherlands, the citizens had no idea about the energy use of their buildings.

Every day... the European Union was wondering how energy could be saved through investments in houses and how energy efficiency might be a consideration for Europeans when purchasing a house.

But, one day... The European Commission decided that an energy label should be assigned to all dwellings within the EU countries. The wicked Dutch government, however, wanted to have their cake and eat it, implementing a very simple system called the 'energy label', using only information to promote it. The label was obligatory, but no sanctions were introduced to make sure the citizens would adopt it. Moreover, the label was very superficial and (therefore) assessed differently by different experts.

Because of that... the label received bad publicity and was discouraged by real estate agents, an important (trusted) intermediary. Only 30% of the Dutch population trusted the label, causing only 25% to submit a request for it. That percentage dropped even lower, to 15% after a year!

But then... the wicked Government acknowledged its sins and repented. It saw the failure of the intervention and decided to improve the label. A more elaborate and transparent label replaced the old label, also paying more attention to measures that could improve energy efficiency.

Because of that... Bad publicity faded, the adoption of labels increased to 20% and the monetary value of 'green' houses increased by 3%. But still, a large part of the population was not triggered by the labelling system, primarily because the intervention still consists of only information supply as a motivation. People value comfort and money as important aspects of households/living conditions. Although there is a correlation between these values and energy labels, it was not visible to residents.

And, ever since then... the label is still not considered to offer too much of an added value to the citizens of The Netherlands. So the moral of the story is: achieving the right outcome takes more than just information supply. **The end.**

The Dutch Energylabelling programme in a tweet:

Campaign image energy label (source: Ministry VROM)

The Warm Up New Zealand: Heat Smart project[8]

Warm Up New Zealand: Heat Smart (WUNZ) is a Government programme providing house owners and tenants with grants for insulation and clean heat. Funding was originally available for approximately 200,000 houses over 4 years, worth more than €230m Euros. This has now been extended by another €60m due to the success of the programme. All homeowners can get 33% off the cost of installing ceiling and under floor insulation, and other insulating measures. A low income household can get 60% off the total cost of insulation. In some regions, local organisations, including district health boards, contribute additional third party funding for low income groups. A number of barriers existed to uptake of the improved insulation including cultural issues, alternative priorities, financial hurdles, implementation difficulties, insufficient knowledge, insufficient or contradictory regulations, and compliance problems. In response, the Government of New Zealand made the programme its flagship social effort and focused on improving uptake by the public, ensuring effective delivery, increasing third-party funding, changing behaviour on energy use, improving health benefits, and stimulating demand for further home improvements. These changes were achieved by expanding the programme to include stakeholders such as landlords and making the grants available for any house constructed before 2000, regardless of the residents' income.

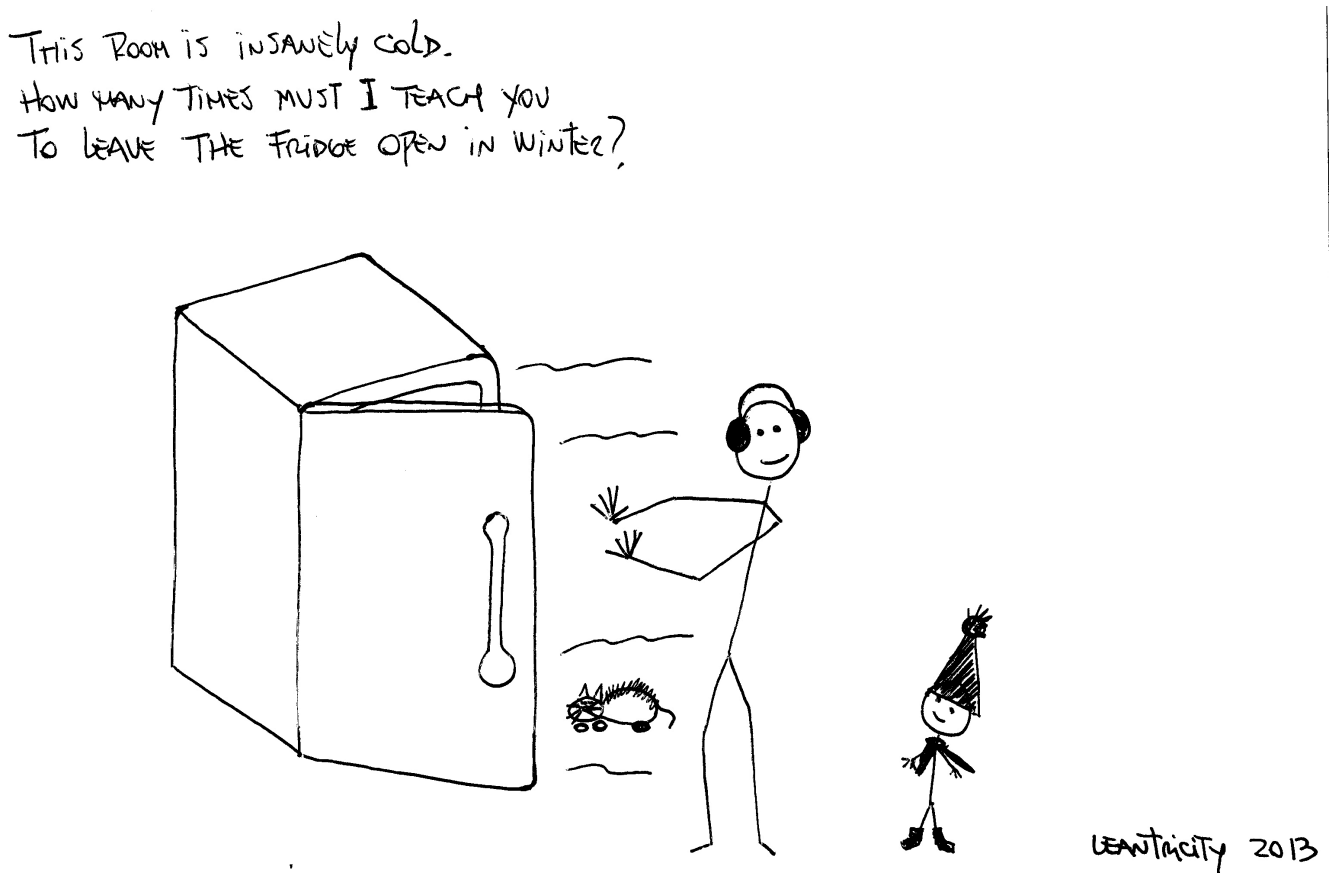
The government has been able to ensure both a range of options for efficiency upgrades and quality by contracting with service providers and by setting quality standards and scrutinising performance via audits. Increased awareness and uptake has been achieved through widespread marketing on TV, internet and radio; encouraging service providers to inform their customers of efficiency options; and making the programme available to a large portion of the population. The government standards address requirements for insulation products and installation techniques through strengthened building codes. Indeed, the improved standards have led to the formation of an industry body which develops and maintains the installer training scheme. Finally, continual research and monitoring and evaluating the programme's key performance indicators will ensure continued success, i.e. that the scheme has created a market and skilled

[8] http://www.eeca.govt.nz/eeca-programmes-and-funding/programmes/homes/insulation

tradespeople so that it will now continue to roll out in the absence of government intervention. The programme is mainly based on **neoclassical economic theory**, but also includes **social marketing** (marketing to achieve behavioural goals for a social good)**, social norming** (group-held beliefs about how members should behave in a given context) and aspects of the **Theory of Planned Behaviour** (states that attitude toward behaviour, subjective norms, and perceived behavioural control, together shape an individual's behavioral intentions and behaviours).

The Australian Government undertook a similar project, but instead of the love story from New Zealand, it ended up being a horror story of gigantic proportions[9].

Warm Up New Zealand: Heat Smart in a tweet:



Warm Up New Zealand as seen by Juan Pablo Garcia (Leantricity)

[9] http://en.wikipedia.org/wiki/Energy_Efficient_Homes_Package

Once upon a time... there was a beautiful country called New Zealand, which had very cold and damp houses. Some of them - often student houses - were so cold that the inside of the fridge was warmer than the living room!

Every day... people in New Zealand shivered and coughed, but they just told each other to 'stop being a sissy' and 'put on another jumper'. So they did.

But, one day... the new, right-wing Government needed to show that they still cared for the people and the environment when they proposed a very tough budget that had a lot of cuts in these areas. So they created a programme called Warm Up New Zealand: Heat Smart, which was meant to insulate 200,000 homes, save energy and CO2, create jobs and an independent insulation industry and have multiple health and comfort benefits to the people of New Zealand.

Because of that... the Energy Efficiency and Conservation Authority set about tendering for the best contractors in the country in order to achieve these goals. They initially used the idea that people were economically rational and would start insulating their homes when they were given a 33% (or 66-100% if they were poor) subsidy and information on why insulating your home was important.

But then... they realised that people weren't as interested in doing the right thing than what they initially thought. So they worked hard with Third Party Providers and other community groups to ensure that particularly the most needy and vulnerable people in the country were helped with insulation and clean heating.

Because of that... it became obvious that the most important outcomes of the WUNZ programme weren't the energy savings at all, in fact the energy use sometimes went up, because people finally started to learn about living in warm, dry homes and heating them to higher temperatures.

So, finally... the evaluation of the programme showed that the macro-economic health benefits to New Zealand from the WUNZ programme were $5 to every $1 spent! What a great success!

And, ever since then... the people of New Zealand have slowly started to expect to be able to sit in their living room without having to be wrapped in a sleeping bag and 10 layers of clothing and are generally healthier, happier and more comfortable. Not all of the other Key Performance Indicators were met (for example, the insulation industry still needs help), so the Government has decided to extend the programme for another $100m as we still have 700,000 homes that need to be fixed. The new programme is now called Warm Up New Zealand: Healthy Homes. **The end.**

The Swiss Building retrofit programme[10]

The Swiss **building retrofit programme** promotes retrofits of buildings and investments in renewable energies, the use of waste heat and optimisations in building technology. The programme gives financial incentives (aid money) for house owners to retrofit their buildings in an energy efficient way. The successful programme started in 2010 and will last 10 years. The legal basis for the programme is the Federal Act on the Reduction of CO2-emissions (1999, "CO2-Law"). This law enforces a fee on combustibles. A maximum of one third of the revenues of the fee are used for the Federal Building Retrofit Programme. Cantonal

[10] http://www.dasgebaeudeprogramm.ch/index.php/de/

subsidies complement this amount. In 2011, roughly 136 million Swiss francs were used for building retrofits and 75 million Swiss francs to facilitate investments in renewable energies, use of waste heat and optimisations in building technology. To get subsidies for a renovation households have to submit a detailed application of the planned renovation measures. This application is checked by the authorities. If the measures do comply with the requirements, the application is accepted and households can get the money after they have realised the measures and proven their realisation with a final documentation. This has to happen within 2 years after the acceptance of subsidies. The realisation of the measure is randomly checked on site. This programme is based on straightforward **neoclassical economic theory**.

Once upon a time....the building industry in Switzerland did not really care about the energy effiency of their house constructions. So they built nice, long-lasting and comfortable houses which were, however, pretty inefficient.

Every day....these houses and their owners used a lot of energy, especially dirty fossil energy, for their heating and warm-water supply.

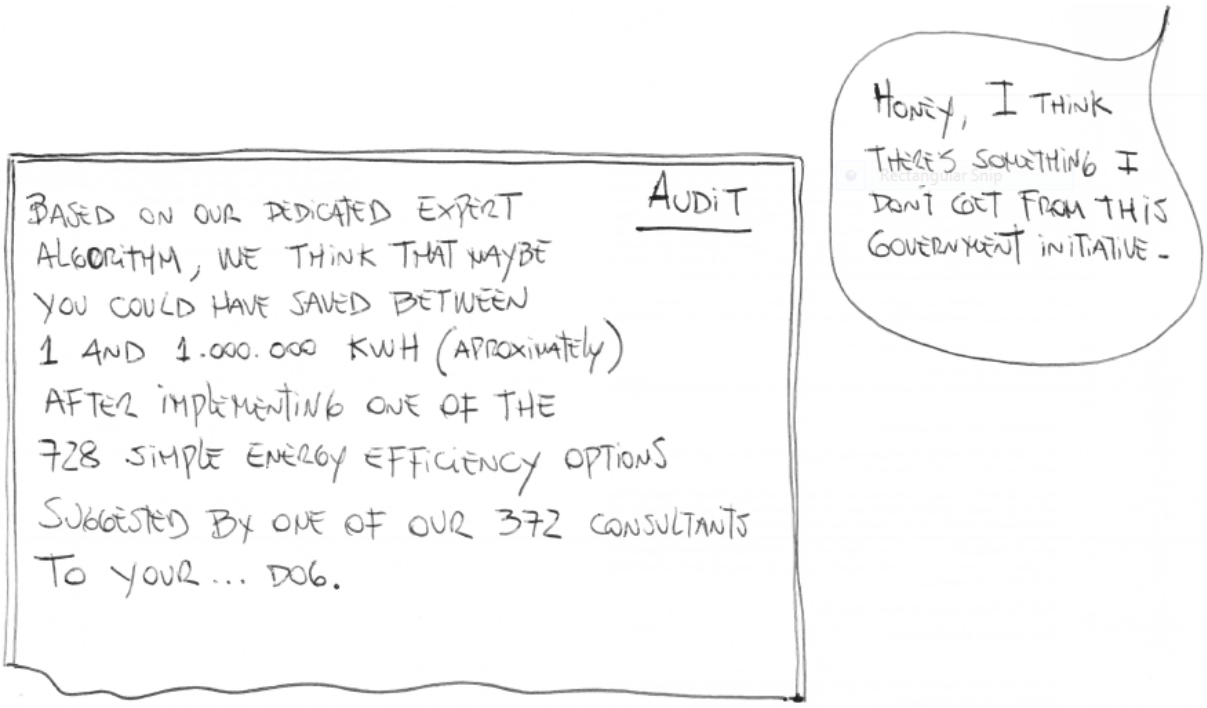
But, one day... the public awareness and the political urgency were high enough to set up a new legislation, which financially supported the retro-fitting of existing buildings. The energy- and CO2-saving potential in this area was huge - almost 50% could be saved through state-of-the-art heating and insulation technology without any degradation in comfort or lifestyle. That's why this potential is seen as the low hanging fruits of energy saving.

Because of that...the Swiss Building retrofit-programme was initiated in 2010. The aim is to encourage energy efficient retrofitting by giving people extra money for it.

But then....the Government realised that they have to lower their administrative effort, so now they only support bigger and more comprehensive investments in energy-efficiency of buildings.

Until, finally...1% of the existing Swiss buildings are retrofitted every year. Windows with triple glazing are now required in the programme and have thus become a cheap standard.

And, ever since then...the programme is planned to continue until 2020 and there are now a lot more people investing in energy efficient retrofitting! **The end.**



Leantricity (2013) on the issues with asking for too much information to fill the information deficit

The Swiss 2000 Watt society programme[11]

The **2000 Watt Society** is a vision that helps to focus on a sustainable way of living. The vision is motivated by the belief that all regions of the world should enjoy equal opportunities for economic development and a high standard of living, i.e. these should not be reserved for a selected group of industrialised countries. The Competence Centre of the 2000 Watt Society ("Fachstelle 2000 Watt Gesellschaft") is funded by the Swiss Federal Office of Energy (SFOE). The aim of the Competence Centre is to encourage an active approach to the issue of sustainability in municipalities, enterprises, schools, and other organisations. In performing its advisory work, the Competence Centre has access to a network of certified 2000 Watt consultants who provide resources and expertise to help meet the requirements of the 2000 Watt Society. These experts plan together with the administrations measures in many different topics and can arrange contacts to specialised experts for the different areas (building, heating, regional planning, mobility systems, food, policies) The Zurich City Council moved to place the initiative "Sustainable City of Zurich – on the Way to the 2000 Watt Society" on its main agenda for the 2006 − 2010 legislative period, thereby underscoring its intention to begin the work of implementing suitable environmental, energy and climate policies. As a complement to this resolve at the level of city government the citizens of Zurich have also demonstrated their concern to secure an intact environment for future generations. In a referendum held in the fall of 2008, the citizens of Zurich voted in favour of writing the objective of the 2000 Watt Society into the city's constitution by over 75%. According to the provisions that have now been entered into the municipal code, per capita energy consumption is to be reduced by a factor of three and CO2 emissions by a factor of four to six by the year 2050. For example the administration developed a concept for 2000 watt-conform buildings and areas, which helps and encourage planners and owner to create energy-efficient housing and office space. This programme is based on something more akin to ethics (a branch of philosophy that involves systematising, defending and recommending concepts of right and wrong conduct) and long-term visioning.

[11] http://www.novatlantis.ch/en/2000-watt-society.html

Once upon a time....Swiss researchers and fore-thinkers had a vision for a world in which energy resources are not depleted, but used in a sustainable way. This is possible if every human being only has a constant demand of energy of 2000 Watt. At the moment some countries – mostly industrialised ones - have a much larger demand. In the future all nations should have more or less an equal consumption namely 2000 Watt – this insight was the start of the vision "2000 Watt-Society"

Every day....Swiss people use a lot of energy for food, housing, mobility and public infrastructure.

But, one day... politicians, researchers and the public realised that there are already a lot of available technologies which would make our lives more energy efficient, e.g. energy efficient lighting, buildings, washing machines, fridges and cars. But despite their efficiency, they don't have a huge market yet.

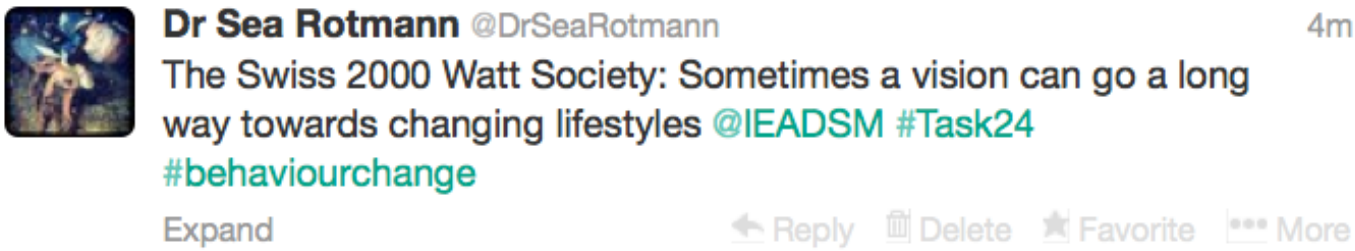
Because of that...politics decided to set goals and draw a picture of Switzerland with an overall energy demand of less than one third of the current one. A lot of cities, including all the big ones, held winning and binding referenda which meant that the 2000 Watt Society became part of the constitution. One has to have visions, even if they are quite far away – 2150 is a long way to go after all!

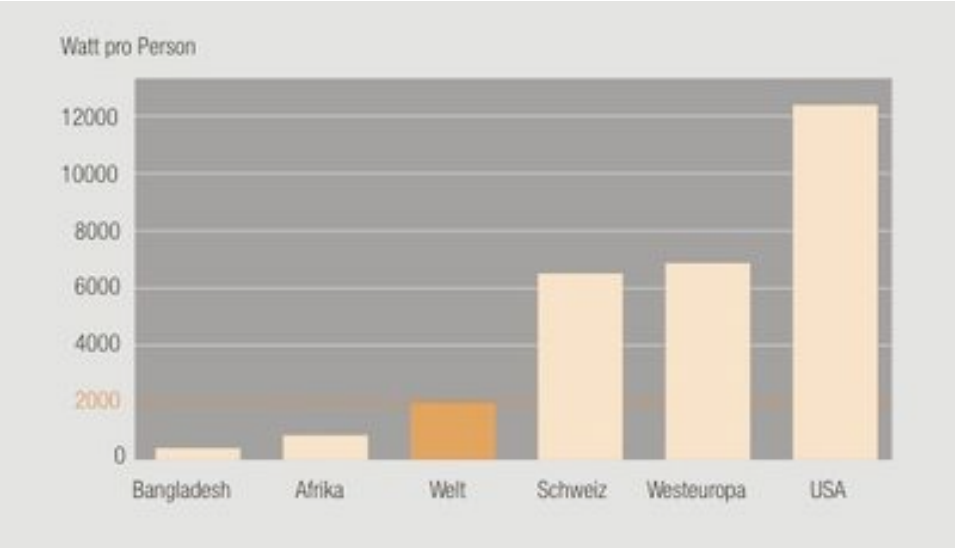
But now....we have a target, which unites everybody: people, companies, local and central government, politicians, teachers…This is at least a start, which will help to create a market for all these technologies.

Until, finally...we are able to reach the target, there is a hell of a lot of work to do. Everybody has to think about their contribution to the target! And it is not only about energy-efficient technologies but also about sufficiency and systems: do I really need all these electronic devices, do I really have to drive with my own car by myself to the recycling site?

And, ever since then...politicians, government authorities, SMEs and the Swiss people are developing concepts and measures to reduce the overall energy demand in Switzerland. **The end.**

The 2000 Watt Society in a tweet:





The 2000 Watt Society - what the world is currently using per person on average (from website)

The Norwegian Myhrerenga Housing project[12]

After long-term dissatisfaction with the current standard of housing in terms of draughts, heating, energy bills, and ice damage to outside surfaces, a relatively large (by Norwegian standards) housing cooperative decided to look into retrofitting their houses to passive house standards. After putting it up for a general vote they called in an architect to produce detailed plans for retrofitting and applied to Enova (a Norwegian government agency that is responsible for promotion of sustainable energy consumption and production) for extraordinary project funding. This was well received by the funding agency, and the project was partially funded by project funds from Enova. Houses were fitted with extra insulation, central heat pumps, new ventilation and highly reflexive solar thermal energy systems. Although the newly refurbished buildings are not technically eligible for passive house status, the standard of insulation and ventilation are such that it can be described as such. In terms of models of behaviour, it can be said to be a combination of the **theory of planned behaviour** (change in motivation leading to change in behaviour) and a more bottom up, **user-initiated model**. However, the main policy innovation in the process was the willingness of the funding body to overlook their usual funding model when a bottom-up initiative was proposed to them.

[12] http://www.sintef.no/Projectweb/Eksbo/Forbildeprosjekter/Myhrereuga-BRL/

Once upon a time....the inhabitants of a Norwegian housing collective that was built a long time ago were starting to get fed up with their cold, draughty houses.

Every day....they would wake up to cold living rooms and damp bathrooms, and not infrequently with colds or sore throats. Most were resigned to the situation, thinking that they had gotten the houses cheaply for a reason. And after all, Norwegians are a hardy lot who should be able to stand a little bit of cold.

But, one day...one of the neighbours who was a trained architect thought to himself that this was no way to live. He called a meeting of all the apartments to discuss what they could do about the draughts and the chills. At the meeting, he presented the idea to improve insulation and the general indoor climate, which would both improve health and reduce their heating bills. The neighbours asked how they could possibly afford the costly retrofit? But the architect had a plan – they could fund some of it themselves, and the rest they could get from the government! Everyone liked that plan.

Because of that...they decided to ask a friend of a friend who worked in the municipal administration where they could go to get a little help. After all, the Norwegian government had said it was willing to provide some funds to improve the insulation of Norwegian homes and most friends of friends are friends of someone important in Norway.

But then....they ran into the problem of not fitting into the standard funding categories. Still, they decided to try petitioning Enova anyway.

Until, finally...in a stroke of luck, the funding body decided that this could make an excellent demonstration project for their new passive house programme. They gave an extraordinary grant in order to get a model project, and the retrofitting went through.

And, ever since then...the inhabitants of Myhrerenga have enjoyed vastly improved living conditions, and are in the process of paying back the loan they took up using money saved on electricity.

The Myhrerenga (now Passive!) Housing project - from website

The Swedish Sustainable Järva project[13]

Sustainable Järva is a five-year rehabilitation project where the neighbourhoods around Järvafältet, (largely formed during the Swedish “one million home programme”, 1965-75), are being renovated and developed into a “new” urban district with a strong environmental profile. The project is part of Järvalyftet (Vision Järva 2030), which is a programme initiated by the City of Stockholm, to promote social, economic, and ecologic development in the area. It is a joint investment, including several different actors (local stakeholders, politicians, government administrators, entrepreneurs, residents, etc), where the overall goal of the project is to make Järva into a national and international model for sustainable rehabilitation - that promotes environmental responsibility - while still preserving the area’s unique and historical values. The project revolves around several working areas, where energy-efficient renovations of seven selected apartment blocks (350 homes) constitute a major and important part. Other areas of focus are about renewable energy, as well as sustainable transportation and cycling promotion measurements. In order to promote a sustainable lifestyle the project also (apart from technical solutions) has a **Whole System** focus on social aspects such as information, involvement, and education. The ambition is that with better knowledge and more influence the residents will become inspired and capable of making use of “new possibilities” that comes with the technological advancement.

From the website http://www.jarvadialogen.se/

[13] http://www.stockholm.se/hallbarajarva

Once upon a time.... There were six neighborhoods around the field of Järva that were in urgent need of improvement. The area had been constructed during the 1960s and 70s as part of the one-million-home-programme, initiated by the Swedish government to tackle a growing housing deficit in the country's urban areas. The neighborhoods contained housing units for more than 60 000 people, but the socio-cultural context had changed and the buildings were turning old and outdated.

Every day.... People in the area were experiencing economic as well as social challenges. Many of the foreign residents were unemployed, had difficulties learning the Swedish language, and the younger generations were lacking good opportunities for education. The houses they lived in were terribly inefficient, and the area in general did not work for the needs of its current residents. Several investments had been undertaken during the years to improve the situation, but nothing helped and the people felt no one was listening to them.

But, one day... The city of Stockholm decided that it would once again invest in the area, and to improve the living conditions for the people living there. But this time it would be different, this time they had realised that the circumstances were radically different to the 1960s and 70s. They realised that in order for the "upgrading" to be successful they needed to include the residents in the process - from the beginning.

Because of that... The Järva dialogue was initiated during the fall 2009 and for one week 10 000 residents contributed with more than 30 000 opinions and suggestions about how the area should be developed and improved. Based on these contributions the vision Järva 2030 was formulated and measures were planned to address the four areas of 1) improved housing and urban environment, 2) everyday security, 3) better education and language teaching, as well as 4) more jobs and entrepreneurship.

But then... It was also realised that the area and the buildings had been constructed before the energy crisis without considering the environment, and thus the project Sustainable Järva was introduced to also bring about an environment-, climate- and energy- focus in the development.

Until, finally... The dialogue with the residents continued and together with all stakeholders many great measures were planned to promote sustainable lifestyles, satisfaction and well-being. The ultimate goal with the project is for Järva to serve as model and inspiration for sustainable development of similar areas both nationally and internationally.

And, ever since then... The neighborhoods around the field of Järva have become a place where people want to live! **The end.**

The UK My Eco Home project[14]

The project used a series of videotaped interviews and home visits to understand the response of occupants to innovative low energy and renewable energy housing. In addition, in doing this, it offers a contribution about how the home might best be conceptualised in relation to patterns of consumption and use. The emphasis of the project is on the response to innovative housing, rather than the architectural or technological details of the properties. Three case studies were investigated: Green Street (Nottingham), developed, in 2011 and 2012, by a public/ private company for sale, Henley Way (Rotherham) developed in 2007 and 2008 by a social housing agency for a combination of sale and rent and two groups of houses developed in 2011 and owned by the same social landlord in Manchester and Salford, with three volunteers. Respondents were asked to describe their housing histories; their motivations for moving to current home; their feelings towards their current home and its technology; their sense of comfort; their attitudes and practices in relation to sustainability. The respondents were then asked to provide a guided tour of the home explaining the features of different rooms, together with the technology and how they understood this. This was filmed and the videos were put on a facebook page. The aim was to enable designers and developers to think from the users' point of view. **Abductive reasoning, practice theory and identity theory** all feature in the analytical framework developed to make sense of the attitudes and behaviours demonstrated by participants.

Once upon a time... there were many bad housing estates in the UK.

Every day... people lived in appalling conditions and used way too much money for staying warm. So some clever architects decided to build a whole lot of eco-estates with all the bells and whistles that are needed to be eco-friendly and warm.

But, one day... the researchers of the University of Sheffield decided to see how people living in these estates coped with the high-tech eco houses they were sold.

Because of that...they undertook four case studies in eco estates, where they interviewed people about their housing history, their feelings towards their current home, why they moved or stayed there. The people were also asked to provide their own guided tour of their home explaining its energy features the way they saw them.

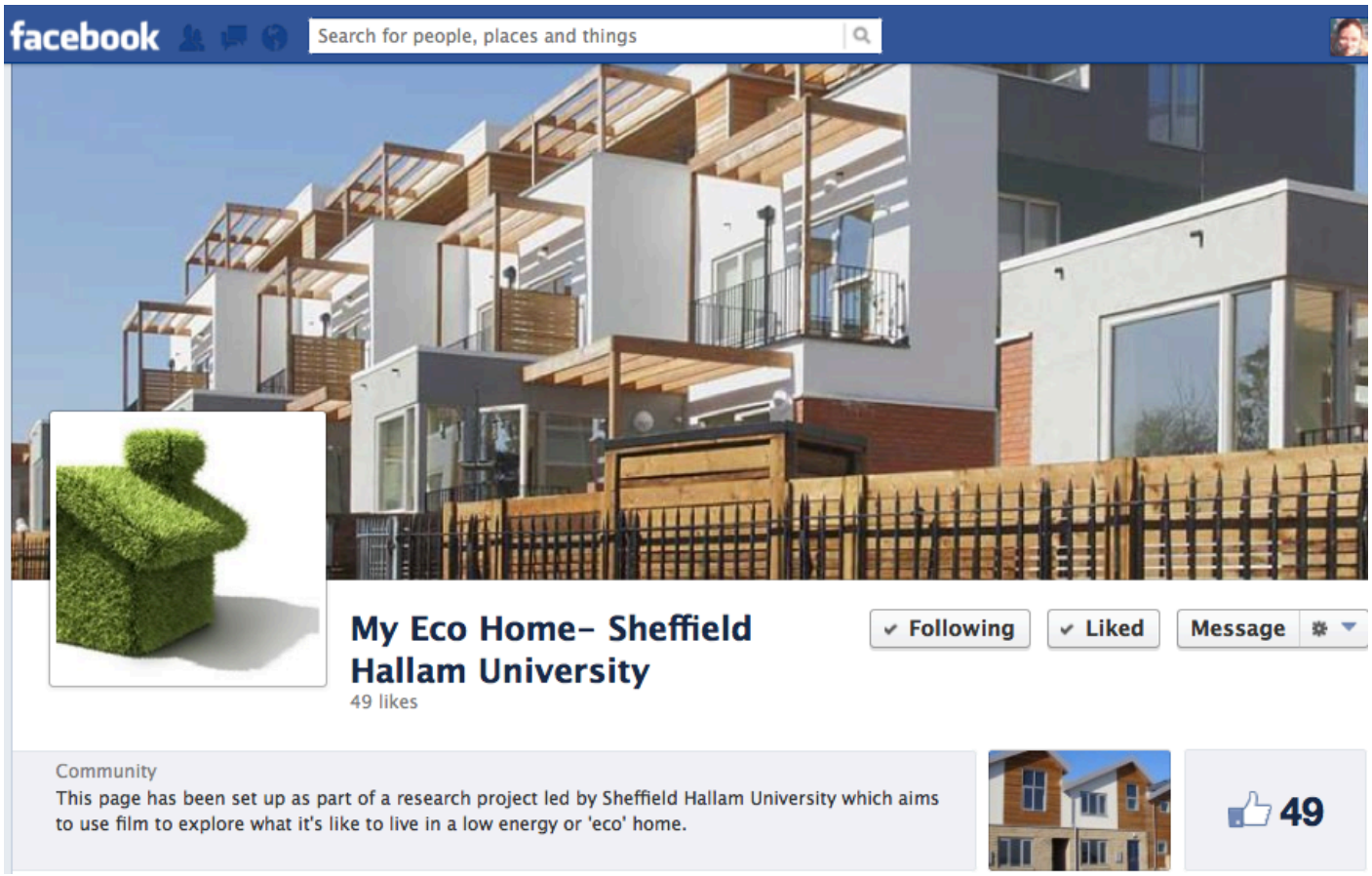
But then... it became really apparent that people living in homes had very different understanding of its features and technologies than the people designing energy efficient technologies and retrofit programmes. They often didn't care or know they were eco homes but liked the look of them. They also complained that no one had explained to them all the eco features and how to use them properly.

Until, finally... The films were all put online to provide a shared learning platform for everyone involved in building, selling and living in eco estates.

And, ever since then...architects, builders and other important intermediaries that have viewed these interviews have gotten a little bit wiser about what is important to the end users of their products. **The end.**

[14] https://www.facebook.com/MyEcoHomeSHU

The My Eco Home Project in a tweet:



From the My Eco Home facebook page

The UK My Kirklees Warmzone Project

The United Kingdom has a policy aimed at reducing housing costs through energy savings, motivated by the wish to combat energy poverty. Since 2000, low-income households in low efficiency homes are equipped with efficient heating and insulation through the *Warm Front* scheme. At present, the scheme has been used in more than 2.2 million households, with an average savings of more than £650 per year per household. The number of homes with roof insulation increased between April 2007 and April 2011 by 39% (13.2 million of the 23.3 million homes), with a penetration rate of 57%.

Kirklees Warm Zone (2007-2010) is one of the largest area household energy programmes in British history. In Kirklees (located southwest of Leeds), energy poverty and the number of cases of carbon monoxide poisoning was relatively high. In 2007, the municipality launched the Warm Zone project, which offered each property in Kirklees free cavity wall and roof insulation and CFL lamps. Participants were also eligible for free upgrades to their heating and homeowners could use an interest-free loan. The project involved an investment of £24 million. Kirklees Warm Zone thus clearly was a supply-side oriented approach consisting of **information and financial incentives**.

In studies and evaluations, **Warm Zone Kirklees** is labeled as a success since it provided environmental and health benefits, the safety of homes has improved and the project contributed to poverty reduction and job creation. The actual CO2 reduction is estimated at 934 tonnes in 40 years. The Economic Impact Assessment calculates that the total investment of £24 million yielded £248.8 million. 165 686 households were approached (both rental and owner-occupied), of which 81% got an energy audit and 31% actually installed insulation. 129 986 carbon monoxide detectors were installed which increased fire safety. 16,111 households have been helped out of debt with an estimated annual return of £1.6 million and the project delivered 126 jobs.

However, more than 60,000 homes were not insulated for several reasons: some houses were already insulated, but many households did not want to go through the hassle of cleaning out their attics - a typical example where inconvenience trumps energy efficiency and 'rational' choice (from a pure financial point). Several success factors were identified: the powerful and committed partnerships (with as a result that implementation stayed within planning and budget), the broad political support (all parties were visibly associated with the project) and the availability of sufficient capital. Although objectives are achieved, not more than 31% of households were reached with a free offer that should additionally lead to lower housing costs and more comfort.

Kirklees Warmzone from website

Once upon a time...in 2001 in the UK, a country with many energy poor people, the government though that the best way to help millions of households reach a level of comfort concerning access to energy was to offer a free insulation and heating equipment scheme, the Warm Front Scheme.

Every day... new towns started participating in the scheme, and not long after, 2.2 million households lived more comfortably and paid less for energy.

But, one day.... in 2007 the municipality of Kirklees, one of the regions with more than 50% of households living in energy poverty and with a high number of deaths due to carbon monoxide poisoning, decided to join the scheme and become the biggest UK scheme ever. The municipality offered all of its inhabitants an offer they could not refuse: free cavity wall and roof insulation and CFL lamps. Households were also eligible for free upgrades to their heating equipment and homeowners could use an interest-free loan for any other retrofitting. In studies and evaluations Warm Zone Kirklees was labeled a success and the municipality was really happy

Because of that... environment and health benefitted, the safety of homes improved and the project contributed to poverty reduction and creation of 126 jobs. CO2 reduction is enormous, the investment had a fantastic return rate of 10 times what was invested and a lot of lives were saved with the installment of more than one hundred thousand carbon monoxide detectors.

But then... some critics remarked that although 165 686 households were approached (both rental and owner-occupied), which was great, and although 81% got an energy audit only 31% actually installed insulation, which was free and should have been an offer they could not refuse.

Because of that....reflections started on what people actually needed, and what made them refuse the offer and the free upgrade of their home. And barriers were identified such as the fact that people feared the clutter, were elderly and did not feel it was worth the trouble to go through the process in their (short) lifetime or did not want to have to clean out their attic.

And, ever since then...it became clear that free insulation only appeals to a maximum of 30% of people and that other things are needed to reach the rest of the majority. Other projects are learning from this case, and now think about what services they need to provide alongside free insulation. Like de-cluttering their attics first. **The end.**

Theories and models of behaviour and behavioural change used in retrofitting interventions

Many programmes collected (**Blok voor Blok Netherlands, Warm Up New Zealand, Kirklees UK, Swiss Building Retrofit Programme**) used (often implicitly, as part of the standard way of thinking about behavioural change) economic theories and the **information deficit model** to inform their interventions.

The usual incentives that follow such theoretical base are financial and informational, and as such only a limited number of motivations or benefits are targeted, namely only those related to (instrumental or rational decisions related to) financial benefits and information deficits. Consequently, interventions designed from these perspectives include offering financial subsidies (e.g. **Warm Up New Zealand** Programme); offering retrofitting services for free (**Kirklees Warmzone**); and penalise low energy performance standards of houses at the moment of selling due to lack of retrofitting (Dutch **energy labelling** case). Often these interventions are accompanied by information provision and/or social marketing to assist the decision-making process. There are also several programmes, such as the Dutch **Blok voor Blok** programme and the Kirklees case that are based more on behavioural economics and that use **'nudging'** (a form of choice architecture where people will be nudged to make the right decision without taking away their ability to choose differently) as an approach. These programmes also focus on the technological and/or infrastructural environment that can encourage behavioural change.

Lastly, several of our projects and programmes also use other than economical perspectives. These projects therefore result in very different designs, which we will discuss in more detail in the next section.

Influence of choice of theory on design of intervention

Influence of economic theories on design

The programmes based (explicitly and implicitly) on economic theories usually translate into approaches that:

- focus mainly or even solely on individuals
- focus (indirectly but mainly) on generating biggest benefits for the supply side when based on subsidies and technological innovations
- regard individuals as instrumentally/economically rational creatures ('Homo economicus') that aim at maximising financial benefits and act largely in a self-interested manner
- regard information deficits as an important cause of 'non-rational' behaviours (and consequently view information provision, along with financial incentives, as imperative to enable economically rational choices by individuals)
- focus often on short and one-off financial incentives
- focus on extrinsic motivations mainly[15]

[15] **Intrinsic values** attribute inherent worth to phenomena, like e.g. sense of community. **Extrinsic values** are dependent on the response they evoke from others, such as social status (e.g. praise or reward). Paraphrased from Chatterton, T. (2011) An introduction to Thinking about 'Energy Behaviour': a Multi Model Approach. A paper for the Department of Energy and Climate. December 2011.

- do not tailor their approach to the individual characteristics, except for (sometimes) some financial or technological tailoring
- lack flexibility and room for engagement, co-creation and participation
- monitor mainly quantitative aspects and work with calculated or modeled savings

Behavioural economics-based approaches also include insights from social psychology, and for instance focus on the power of nudging people into different behaviours through their infrastructural, institutional or design environment.

See the insert below for the story of interventions in retrofitting informed by economic theory:

A Story on an economic theory-based approach in retrofitting

Money makes the world go round

You need to change your home's energy use and we will help you by paying (part of) its retrofitting

By the way, you need to pay up first and it might take a while before we pay you back

The info we need from you will teach you all you need to know

You only need to make a one-off decision to invest

We have the technology you need, contractors or installers (you need to find/ choose) will put it in and that's it!

If you do not understand the technology, just don't touch the buttons…

You will save money for a nice weekend to the Bahamas

You only need to give us a bill from your installer, we probably won't check how much energy you actually saved

What counts for us is how many m2 are insulated, how many homes are retrofitted or how much money is spent. Oh yes, and how many kWh are saved of course!

We will do the number crunching, don't worry, we do not need to know what you actually saved, we will use models to calculate all energy savings

But if you want to know how much energy you saved, buy a metering device.

Or, when based on behavioural economics, the story goes as follows:

A Story on an behavioural economics (Nudge) approach in retrofitting

Money still makes the world go round

By the way, you still need to pay up first and it might take a while before we pay you back

The info we need from you will teach you all you need to know

You have many choices but we will design choice architecture to ensure you make the right one to retrofit your home

You only need, not only for yourself but for the sake of everyone, to make a one-off decision to invest

And to do so, we have the money and technology you need and we will design rules, regulations, institutions, or infrastructure that will nudge you in the right direction

You will save money, or the environment or whatever matters to you

You only need to give us a bill from your installer, we won't check how much actual energy was saved

What counts for us is how many m2 are insulated, how many homes are retrofitted or how much money is spent. Oh yes, and how many kWh are saved of course!

We will do the number crunching, don't worry, we do not need to know what you actually saved, we will use models to calculate all energy savings

But if you want to know how much energy, CO2, trees or polar bears you saved, buy a metering device.

Below, we elaborate on the above set of characteristics and their translation into design:

Focus on individuals, not society

Programmes that are (often implicitly) based on theories based in neoclassical economics target only the level of individual behaviour and do not tackle the collective level (household, neighbourhood, other social groups). These programmes are based on a line of thinking that finds its origin in the neoclassical economic 'Expected Utility Theory' where information deficit and lack of economic benefits are understood as main barriers for end-users to start retrofitting their homes.

The Dutch **energy labelling** case also very explicitly focused on individual home owners, and tenants. It was the sole focus on the individual level, without attention to the issue of trust and role models and the way trust can nudge people that demonstrated a weak spot in this economic approach. Not building on that trust might have caused part of the uneasiness homeowners felt. Behavioural economics does point out the importance of having a 'trusted messenger' and applying this instrument could have prevented this problem.

Homeowners did not trust the messages and information provided, and therefore turned to collectives such as home owner associations to investigate the objectivity of the label. This investigation demonstrated the bias in the label and was the beginning of a critical discussion of the label that in the end also resulted in Parliament deciding not to make the label obligatory.

Focus on creating biggest benefits for the supply side

Mostly, the conventional economic approaches are technocratic in their focus (e.g. retrofitting homes with insulation, double glazed windows, smart metering) and consequently the focus (subsidies for home owners which are used to pay builders and installers) and often also the real economic benefits appear to lie with the supply side (e.g. builders and providers of demand side management or retrofitting technologies get most of the money in one batch whilst it takes the home owners years to get a return on investment from reduced energy bills). This may have led to the perception that the demand side reaps fewer benefits from such top-down programmes. If successful, these approaches may actually result in creating new consumption patterns (via the supply side) after convincing end-users once into making a one-off decision (to invest in retrofitting). Such a decision asks for a significant financial investment in advance from the side of the end-users. If successful, changes in routine behaviours may subsequently result in some financial savings. Or, a perverse outcome may be that people think they have done their bit, and now don't have to do anything else, like changing their habitual energy use. However, despite these important issues, insufficient attention is usually paid to this part. We wonder how conventional economic approaches address issues around actual use of the installed measures, the actual use of the house in daily life and how this is influenced by social and institutional contexts. This is relevant since evaluations show that there often is a gap between modeled and metered savings.

In principle, the Dutch **energy labeling** case was primarily aimed at creating benefits for home owners that had invested in energy efficiency measures for their home. These houses would receive a higher label and the assumption was that the buyers of homes would start favouring these efficient homes above others because of the energy bill and comfort benefits accompanying these labels. However, this market mechanism did not work as intended, and in the end the ones benefitting the most were installers and providers of insulation or energy efficient measures. In addition, this market was not further stimulated to innovate and provide even better insulation or energy efficiency technologies.

Information deficits do not singularly cause non-rational behaviours

Economic theories regard information deficits as an important cause of non-rational behaviours and consequently view information provision, along with financial incentives, as imperative to enable economically rational choices by individuals. However, many of the programmes influenced by economic theories require an enormous effort from end-users in terms of collecting technical and financial information and making users go through formalities. The paradox here is that while many projects aim to solve the information deficit, they in fact ask people to deliver the kind of information which is considered to be a barrier because end-users lack that knowledge. Ironically, in the effort of securing financial incentives people are 'forced' to collect and provide a lot of information. This may ironically solve the information barrier, but can be seen as inconvenient and thus may present a barrier for uptake. In the Swiss **building retrofit** programme and the Dutch **Blok voor Blok** programme, for example, participants must fill in very detailed application forms and provide final technical proof of the retrofitting before getting any money from the Government.

The Dutch **energy labelling** case was built entirely on the information deficit model that states that people act irrationally because of lack of adequate information. What this case demonstrates is that the information needs to be unbiased, transparent, replicable and understandable and that different trusted messengers need to deliver the same message. The Dutch label suffered a critical blow when a critical TV show called 'Radar' had a building assessed by three different label advisors, resulting in three different labels. It was concluded that the calculation method and therefore the labels themselves were too generic or ambiguous.

After this bad publicity only 30% of the Dutch population trusted the energy label. The lesson to be learnt is that information not only needs to be transparent and replicable but that the societal stakeholders relevant to disseminating the information and implementing a scheme such as the label need to be trusted, involved, committed and collaborating with the implementer of the scheme. If relevant stakeholders distance themselves from a certain type of information or scheme, this can be the end of a programme.

An additional problem emerging in the Dutch **energy labeling** case was that the visibility of the information was poor. The information about the label was usually not available to prospective buyers, at the time of making a decision; the labels were not displayed in advertisements or during home improvements.

One-off incentives

The duration and consistency of the programme differs widely from 3 (**Blok voor Blok** Netherlands) to more than 40 years (**2000 Watt Society** Switzerland). Usually there are distinct one-off rounds for application for subsidies that are closed as soon as the subsidy is spent and no clear follow-up takes place, and incremental growth of efforts is not targeted or asked for. As such it is usually a one-off effort that does not necessarily change the actual use of a home, nor does it change the building industry. It only alters the home, but research has demonstrated that similar homes can still produce differences in energy use that amount to over 300%. To conclude, many projects (but this is not necessarily a design fault following the use of economic theories only) do not appreciate the need for long-term repeated and (incrementally) growing efforts to change a system, but instead focus on one-off, short term and disconnected efforts.

Perceiving individuals as aiming at maximising (financial) benefits

An additional paradox is that although financial issues are seen as a barrier and providing financial incentives is seen as the solution, often programmes require prefinancing from end-users who get refunded only after the measures have been implemented and final documented proof has been handed over such as in the Swiss **Building retrofitting** programme. In this intervention, the 'behavioural changes' are not made easy for the end-user. What should not be forgotten is that money is an enabler, not a motivator per se, and that people are not investing in their house, but in their living environment, in comfort, in health, in status, and thus potentially also in other benefits than purely financial ones. What can clearly be seen in the UK **My Eco Home** interviews is that people don't care that much about the 'eco-ness' of their home, or the energy or money savings. They care about how the house looks, feels and responds to their needs.

The Dutch **energy labelling** case also highlights the pitfalls of focusing only on energy savings. A survey showed that the energy label is tenth on the list of considerations for people when purchasing a house. People value comfort and money as important aspects of households/living conditions. Although there is a correlation between these values and energy labels, it was not made very easily visible to residents.

Focus on extrinsic motivations

Also, several researchers have warned of the dangers of fostering energy efficiency via means that solely focus on extrinsic motivations, rather than intrinsic ones[16]. However, the difficulty with designing programmes using intrinsic motivations is that these motivations are in part created during/by participation. And extrinsic motivations might still be required to 'sell' participation. Here may be some justification for using points, badges & leaderboards of a gamification approach to get users involved initially, then allowing intrinsic motivations to develop from participation. The 'pleasure centre' (nucleus accumbens) lights up when people are presented with self-interested incentives such as the possibility of financial rewards. It cannot light up at the same time as the 'altruism centre' (posterior superior temporal sulcus) which motivates intrinsic values.

[16] Eg in the book SWAY by Ori and Rom Brafman (2008). Broadway Books. 208pp.

At risk of going over old ground given that the altruism over self-interest route been dismissed as flawed (Owens, 2000) [17] one can question what the impact on programmes is if energy efficiency is constantly coupled to self-interested rewards and incentives. Will the bigger message why it is an important social or a global issue, get lost and ignored, thus enhancing the changes of rebound? One could also ask whether programmes potentially veer towards appealing to self-interest because otherwise they drown in a sea of marketing encouraging consumption practices that work against altruistic motivations?

Lack of tailoring expectations

In interventions based on economic theories tailoring is usually done in the form of adjusting the subsidy or technological level to the income level (e.g. choosing for less comprehensive measures or increasing the subsidy for lower incomes such as was the case in the **Warm Up New Zealand** programme, allowing higher subsidies for lower incomes groups, or allowing for technologies better tailored to the building characteristics to be installed. Actually tailoring the intervention to the needs of the end-users – which presupposed that these needs can be diverse and need to be inquired into beforehand - is hardly ever done in programmes based on economic theories of behavioural change. Many other needs or worries, however, do play a role and could be taken into account: having 'strangers' in their homes during the retrofitting; this and physical disruptions (the 'mess-factor') to their daily routines; the fact that benefits only become visible after some time in the form of increased comfort or reduced energy bills etc. In the **Kirklees Warmzone** case, the expected inconvenience of clearing out the loft was a barrier to retrofitting for many people, despite the fact that it was completely free. Social issues, health, comfort, control and (in)convenience all play a role as drivers or barriers to peoples' willingness to consider retrofitting their homes.

Lack of flexibility and participation

Finally, most of these types of programmes are not participatory or flexible. They have a fixed set of goals and ambitions and hardly ever deviate from them, unless the subsidy money dries up too quickly. An exception is the Dutch **Blok voor Blok** case, where some flexibility is allowed for piloting and social learning occurs between programme implementers about their experience with tailoring the intervention to a specific neighbourhood.[18]The Dutch Blok voor Blok programme had the intention to learn from different types of implementations and find success factors to be applied broadly in later stages and to facilitate the up-scaling or larger scale roll-out. Social learning needed to be arranged (by the programme designer) to secure the transfer of knowledge and experience and the alignment of expectations and needs such that the project is fully supported by a set of committed stakeholders that are ready to learn and adapt.

What are the upsides of this approach?

Even though we have made some strong criticism of the most-commonly used economic approach here, they obviously have some positives as well:

- They do well within what they intend to do and fit well within the current economic and political system and way of thinking

- The programmes are relatively easy to evaluate in quantitative terms and often show good results

- The retrofitting market can grow

- Subsidies are often used up to the max

- Many homes do get insulated

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[18] It is not clear yet what the social learning actually brought about, and which types of lessons were learnt,.

- Behavioural economics does manage to nudge a certain percentage

- Free riders upgrade their plans and retrofit more comprehensively

- Sometimes even a new norm seems to be emerging…

Influence of theories and models that have other than economic and informational incentives

Several of our analysed projects and programmes go beyond economic theory-based approaches. Social marketing, or insights from social psychology, sociology and collaborative learning and practice theory approaches are increasingly being used in programmes or projects focusing on retrofitting such as in the Swedish **Sustainable Järva,** UK **My Eco Home** or Norwegian **Myhrerenga** cases. These programmes are often cross-sectoral and – next to retrofitting - also address smart metering, mobility or other energy-related behaviours. These types of programmes use elements of theories and models in an eclectic manner and very often user engagement is central to the design of more sociological, collaborative learning and practice theory-based approaches. They do take account of the impact of the social environment and social norms and are thus clearly based on a more systemic perspective/theory or model. These projects can have the following design characteristics. They:

- focus on collaboration and institutional capacity building
- focus on building trust in market parties and information sources
- target end user needs and multiple benefits
- use multiple definitions of success
- perform pre-scoping
- allow for engagement and participation
- allow for flexibility and iteration of programmes
- focus on institutional change
- focus on lifestyles
- use the power of social norms

A Story on a more system-based approach in retrofitting

Together we will make the world go round

You embody what we need to know and change: do, feel, learn

We will help you understand and use the technology, and train those that install and sell it to you

We will create a supportive material, institutional and social environment

Your needs are important so we need to do this together, as if this were your kitchen or bathroom

Your life will change

It's all about us now, and our grandchildren and their future

Quality matters and we will keep learning and sharing

If we need to be flexible we will

This is only the start of a long way and your home is the first step

We will monitor, calculate and report on energy, money, health, welfare, comfort, wellbeing

And learnings based on qualitative and quantitative inputs will be shared (with you)

We will help you figure out what your impact is to be able to make sure you get where we collectively want to!

Collaboration & institutional capacity building

In the more systemic programmes such as the Swedish **Sustainable Järva**, the UK **My Eco Home** Project or the Norwegian **Myhrerenga** project or (in part) also the New Zealand **WUNZ** programme, cooperation between multiple parties - from governmental agencies to landlords and NGOs such as district health boards - is aimed for. This cooperation can result in more tailored and context-sensitive programmes.

This cooperation also results in a more diverse set of instruments being deployed, from more segmented financial incentives to certifying contractors, enhanced building codes and quality, installer trainings, and TV marketing campaigns, and including instruments targeting outcomes that are not directly related to energy efficiency, e.g. health and comfort improvements.

Building trust in market parties and information sources

One way to tailor the intervention to the individual household level is by accompanying retrofitting programmes with energy audits by certified and trusted parties that provide tailored advice on the home level. This approach instead was not part of any of the retrofitting cases except for the Dutch energy label

case, however, the energy audits were performed by uncertified agents that used different types of tools and data and came with diverging advice on the same house.

The Dutch **energy labelling** programme showed that one of the key problems households faced was that they were unable to decide whether the information they searched for on the internet (their preferred source of information) was correct and trustworthy, which made it difficult for them to make a well-informed decision.

One of the things the **Warm Up New Zealand** programme got right (particularly in comparison with the hugely problematic Australian counterpart), was to create a very solid tendering and insulation provider training and auditing regime. This was a way to avoid the rampant fraud that the 'cowboy' installers conducted in Australia, which tragically also led to 4 deaths and over 100 houses which burnt down due to improper installation of insulation[19]. It also worked to install a level of trust in homeowners, which is witnessed by the successful uptake of the programme (a quarter of the NZ housing stock has been insulated, with the programme extended for another 3 years by a right-wing government) and the positive media coverage of the programme, as well as the fact that politicians from all colours like to present themselves as supporters of the programme.

Targeting needs and multiple benefits

In the **Blok voor Blok** programme, comfort was identified as a need of homeowners, but the intervention did not focus on this aspect. Performing research to find out about homeowners' needs and preferences prior to implementation is thus only conducive to success when the needs that were identified are actually then also targeted in the intervention.

The **Warm Up New Zealand** programme, on the other hand, always had health benefits as its primary target (although it also had targets around job creation, supporting the creation of an insulation market, kWh savings and CO2 reduction). Cold and draughty housing is such a problem in New Zealand, that the health benefits from installing insulation alone were calculated to be 5 dollars saved for every dollar spent on the subsidy. The focus on health and comfort helped 'sell' the programme to a right-wing government , as well as to the public and the media. It is a big reason why it is now generally regarded by almost all New Zealanders as a positive outcome and a big success. It also just received another $100m by the National Government to be extended to cover more houses - aptly renamed to 'Warm Up New Zealand: Healthy Homes'.

In addition, some programmes (**Myhrenenga Housing** Norway) actually go beyond setting quantitative targets on emissions or retrofitting, which are relevant for the funding parties, but also set targets that create meaningful additional benefits to the end-users, e.g. increasing comfort and warmth. This form of ambition also needs funding bodies such as Enova in Norway that actually allow funding for such alternative programmes.

Allowing for more diverse stakeholders to partake in a programme and its design can thus also create room for a more diverse set of targets to go beyond the kWh monitoring.

Using multiple definitions of success

In **Warm Up New Zealand**, for example, the programme's success in terms of number of homes insulated was already good, but its actual success lay more in the gained health level, decreased sick leave from work and school (thus increased productivity), decreased respiratory problems and decreased costs related GP visits/improvement in health. There were even studies that showed decreased numbers of domestic violence incidents and an improvement in general mental health - not something one would expect to evaluate for when designing an energy efficiency subsidy!

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[19] http://epress.anu.edu.au/wp-content/uploads/2012/08/ch082.pdf

There is a general fear that financial incentives also attract 'free riders' (people who would have taken measures also without the subsidy). However, some of our cases demonstrate that the funding then motivates towards even better or more comprehensive retrofitting, e.g. the Swiss **Building Retrofitting** programme incentivised the uptake of windows with 3 instead of 2 layers of glass, and retrofit of windows and walls instead of windows only.

Another clear outcome of non-energy benefits that can occur is when ambitiously set programmes create technological innovations and even professionalise a market, with accompanying job growth. Especially when the retrofitting is aimed at the comprehensive level of the house, not only small aspects (**Building retrofit** programme Switzerland, **Warm Up New Zealand**), this effect can occur.

Focus on institutional changes

The more systemic projects (e.g. **Warm Up New Zealand**) demonstrate more political commitment than several of the financial incentives-only programmes. Policymakers can initiate institutional changes, e.g. setting quality standards for contracting service providers or building codes or institutionalised training schemes for installers such as occurred in Warm Up New Zealand, and other institutional arrangements such as the creation of a performance contracting scheme, or an energy label for homes (**Energy labelling** Netherlands) or low interest bank loans as was the case in the **Blok voor Blok** retrofitting case in the Netherlands. In Switzerland there is a label for buildings called **"Minergie"**. There are different levels of the Minergie-Label, depending on the energy demand per m2. The Minergie-label is often set as standard for buildings owned by local/regional governments. In addition, the most important association of the housing industry also sets standards and gives recommendations which are quite ambitious in terms of energy demand of buildings.

Institutionalisation of elements such as building codes or certifying installers not only make the behavioural change 'safe' and thus easier to households but this institutionalisation also helps to create a social norm and to upscale the behavioural change efforts. The creation of this new social norm results in situations where it becomes normal for people to ask if a house is insulated before buying it (**Warm Up New Zealand** and **Energy Labelling** Netherlands). On the flipside, the lack of institutionalisation or even opposition to a scheme by societal organisations and political lack of commitment such as witnessed in the Dutch **energy labelling** programme can prevent the formation of a new social norm. However, latest reports indicate that in spite of lacking political and institutional and societal support in the Netherlands, homes with an energy label do sell quicker and for on average >3% more than similar homes without a label which poses interesting questions about the need for institutional commitment to still be able to create a new social norm. One could ask whether this would encourage more retrofitting? Or is it simply rewarding already the better performing homes (based on work irrespective of programme) leaving poor performing homes unsold, with owner/sellers unable to invest in improvements?[20]

Performing pre-scoping

Another design characteristic of programmes that aim for more than economic and information incentives and that are more sensitive to the social environment of behaviour change often perform pre-scoping to analyse the problem to be solved. This pre-scoping can allow for a more broad or integral approach focusing also on other, e.g. health, comfort and social benefits (as can be witnessed in cases in **New Zealand** and **Sweden and Norway**). However, as in the Dutch **Blok voor Blok** programme, the pre-scoping was not actually translated fully in the intervention, and the programme remained mainly focused on financial benefits.

Programmes more sensitive to the non-economic aspects of behavioural change aim to match their intervention to the actual behaviour that needs to be changed (e.g.), or the motivation that needs to be targeted. To undertake such outcome- based monitoring qualitative methodologies (surveys, observations,

[20] critical comments by Matt Batey

interviews) are commonly used. For example the Swedish **Sustainable Järva** Programme was initiated by the City of Stockholm, to promote social, economic, and ecological development in the area. It is a joint investment, including incorporating several different actors (local stakeholders, politicians, government administrators, entrepreneurs, residents, etc), where the overall goal of the project was to make Järva into a national and international model for sustainable rehabilitation - one that promotes environmental responsibility whilst still preserving the area's unique and historical values. As such, the programme combines many stakeholders with many interests and takes a more systemic perspective as starting point.

Focus on lifestyles

The programmes that have a more systemic perspective as starting point acknowledge that retrofitting can be a 'gateway' into other more habitual behaviour changes around, for example, lighting and appliance use (**Warm Up New Zealand**) but even domains beyond the residential energy domain such as waste and transportation behaviour (**Järva** Sweden). A few housing estates in Switzerland, which are developed by different stakeholders under the **2000 Watt Society**, also focus on lifestyles (mobility, housing, social aspects). But it is not a national programme, they are single initiatives. Often these projects stem from collective ownerships.

Programmes that integrally target all relevant aspects conducive to durable behavioural change can manage to create a lifestyle change. An added benefit of this more systemic approach is that potential rebound effects are anticipated because the explicit focus on sustainable lifestyles inherently appeals to extrinsic behaviour, and stimulate a focus beyond the self, as lifestyles are about creating social relationships. In addition, the focus on changing energy and water use, and modes of transport and waste/ sorting/recycling behaviour asks for a systemic thinking by the end-user and stimulates thinking beyond energy type borders.

When lifestyle is acknowledged as the necessary entrance point for achieving durable behavioural change, this translates into programmes that do not focus on the individual level only, but also involve the social level and make use of peer to peer education or the neighbour effect. The **Sustainable Järva** programme in Sweden for example used tenants to educate (new) other tenants on their energy using behaviour. And these programmes, including the Swiss **2000 Watt Society** do not stop at energy behaviour but also include mobility, waste, health, food, living together, social inclusion/mixture etcetera.[21] This is also an example of implicitly using one of the most successful theories of changing habits - namely, during 'Moments of Change'[22]. The UK **My Eco Home** project explicitly stated that for some people, moving into an eco home was the reason why their general appreciation for environmental values changed. The project used a **practice theory** lens to analyse the videos of the homeowners. Practice theory enabled them to appreciate that the home is not a practice or set of practices even though it incorporates a variety of different building technologies, heating systems and appliances. The home is, instead, a means of supporting, preventing or discouraging practices, as the case may be, as well as providing the background to those practices. However, this application of practice theory is not sufficient in isolation to explain the relationship between occupant and low energy home as the home is more than just a functional object- it is a means of forming and projecting a social identity. Identity and social practices simultaneously interact with one another and with the built environment and the technology of daily life.

Allowing for engagement and participation

Where many different benefits are aimed for (and monitored) - economic, social and environmental, health - more people are likely to become engaged. These type of projects (e.g. the New Zealand **WUNZ**

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[21] We need to collect more information on how succesful these are at achieving this.

[22] Darnton, A, Verplanken, B, White, P and Whitmarsh, L (2011). Habits, Routines and Sustainable Lifestyles: A summary report to the Department for Environment, Food and Rural Affairs. AD Research & Analysis for Defra, London.

programme, Swiss **2000 Watt Society** and Swedish **Sustainable Järva**) also often allow for (more) participation and flexibility which is quintessential to ensure tailoring to end-user needs and demands and providing multiple benefits for all involved. The UK **My Eco Home** project shows what perverse outcomes and misunderstandings can happen when eco homes are designed without end user involvement. Some of the tenants complained that it took them 12 months to figure out by themselves what the actual eco features were and how to use them right.

At the same time, when so many benefits are aimed for it is also imperative that the actual end-users are engaged and allowed to co-design the intervention to prevent perverse outcomes. The Swedish **Sustainable Järva** project, for example, started from the belief that, with better knowledge and more influence the residents would become inspired and capable of making use of the "new possibilities" that come with the technological advancement. The Swedish Sustainable Järva also explicitly focused on aspects other than only energy indicators. Järva is a multifaceted area that presents many challenges. There are about 60 000 people living in the district, and the unemployment rate is around 50%. The population is younger than the national average and the percentage with foreign background is higher than in the city in total. Creating good conditions for integration, social inclusion and equal possibilities were important parameters. That this approach worked follows from the fact that during the first six month of the first year of the project all residents were invited for a follow-up dialogue. Every dialogue lasted 4 days in total, and the residents in Järva were given an opportunity to comment on and participate in decisions about the renovation. 10 000 people participated and contributed with about 30 000 separate viewpoints. The practice has been continued and the results are continuously incorporated in the project. Making Järva into a place where people like to live was an important target to be monitored next to halving the annual energy consumption reduction.

The origin of a programme is important, as well as the societal acceptance of the intended measures. Housing cooperations such as **Myhrenenga Housing** Norway are used to involving their tenants early on, sometimes even because they are institutionally forced to gain majority acceptance before being allowed to implement a measure and as such a logical step is to tailor the programme to needs and outcomes meaningful to the end-users. There are, however, also many voluntary retrofitting programmes, such as **Blok voor Blok** in the Netherlands and the Swiss **building retrofitting** programme, initiated by the government and governmental agencies. These programmes simply offer a financial incentive to interested parties, and therefore are less challenged to make the programme tailored to the needs of end-users. In the UK **My Eco Home**, the eco homes were retrofitted almost in complete exclusion of the people who ended up actually living in them.

Often these programmes do not aim for tenants, but for house owners that might have only a financial barrier to invest in their homes but do not have to live in them. However, when programmes take a region as target, such as **Kirklees Warm Zone** in the UK, then tailoring becomes more important to actually reach sufficient people and gain sufficient societal acceptance to retrofit a large section of the homes in a dedicated target region. In Kirklees, the programme, even though it offered free insulation to all, did not reach a 100% penetration. This was to a small extent due to the fact that some buildings were simply not suited for some of the retrofitting measures, but most refusals can be linked to other reasons such as e.g. fear of inconvenience and hassle, age of home owners (elderly people did not feel targeted), distrust of installers, not wanting to clear out decades of accumulated stuff from the loft spaces etc.

Allowing for flexibility

Flexibility of a programme that allows for changes such as occurred in the Swiss building retrofitting case can be conducive to success. E.g. because of the high administrative costs in the Swiss **building retrofitting** programme, the minimum amount of subsidies per case had to be raised from 1000 CHF to 3000 CHF so that only comprehensive retrofits were subsidised and not small ones. When they changed the level of ambition to allow only for subsidies for comprehensive retrofitting, they increased the potential

savings to be achieved. It is worthwhile to investigate if flexibility has a clear tension with the size and scope of a programme, e.g. if large size projects with a clear scope run the risk of being less flexible.

In **Warm Up New Zealand**, the energy saving targets (in kWh and reduced CO2 emissions) got revised when it became clear that, in order to achieve the desirable health targets, people needed to switch to cleaner heating and increase their energy expenditure to warm up their homes. The programme's success in terms of number of homes insulated was already good, but its actual success lay more in the gained health level, decreased sick leave from work and school (thus increased productivity), decreased respiratory problems and decreased costs related GP visits/improvement in health. A small rebound effect from better and cleaner heating of the insulated houses to WHO standards, was regarded as a positive side effect.

Using the power of social norms

Finally, some of these programmes focus more explicitly on creating a new social norm. Although changes in the technological and infrastructural environment can help to visualise the social norm aimed for, with retrofitting this is difficult since insulation and weatherisation are not highly visible. The Dutch **Blok voor Blok** programme, for example, aimed to use social norm effects by targeting whole neighbourhoods at once. The designers hoped that a "neighbour effect" would take place, but the financial incentives were not sufficient enough to create this social norm effect, and potentially did not appeal enough to more social or altruistic motivations.

Programmes that also used campaigns making the effects of the insulation open for discussion at the start and visible during the programme such as undertaken in for example **Warm Up New Zealand** and **Sustainable Järva** Sweden helped create a new social norm. A social marketing-focused information campaign to change the prevailing social norm of ‘just putting on another jumper’ and living in, on average, 14C cold houses, has also been shown to be somewhat successful, although NZ still has a long way to go before housing becomes anywhere near as comfortable as in Europe. One rare criticism of the Warm Up New Zealand programme is that it failed to capitalise on the potential to make insulated homes more desirable (e.g. by providing a sticker or label for homes that were insulated under the scheme). With insulation being invisible, some further social marketing campaign to point out the benefits would have increased the pace of change of the cultural norm. This is something that was reiterated by the home owners of the UK’s **My Eco Home** project.

Involving all relevant stakeholders in the form of diverse partnerships is also conducive to the creation of a social norm because their interaction has the potential for social learning, and their often diverging needs and key performance indicators demand alignment of interests. Monitoring and evaluation and feedback can be used to further build a sense of community and thus a new social norm.

Programmes that focus on lifestyle implicitly or explicitly acknowledge that end-users do not live according to sectoral divisions, even when governmental agencies do, and allow for an approach that focuses on the function of the use of energy in the life of end-users instead of on the use of energy.The focus on lifestyle does require a cross-thematic approach, and this can be very successful. In 2010 energy use of six different cities which had the **2000-Watt-Society** as a long term goal embedded in their constitution (thanks to the Swiss cultural norm of using binding referenda to make big decisions) was compared with the average Swiss energy use. The stunning finding was that these cities used 20-45% less energy than other cities (although it often isn’t straightforward to compare different cities).

What are the downsides to this approach?

This approach’ storyline sounds more appealing to most and its systematic approach makes inherent sense. Also, the participants of such programmes often report more satisfaction with being engaged in this way.

However, as there is no silver bullet, if we want to tell a learning story:

- These types of interventions are very complex with many partners who have different mandates, needs and restrictions

- They cannot be driven by policy alone, need all levels collaborating

- Not everyone wants to change everything or their lifestyle

- Not everyone wants to engage but it is important to ensure that the naysayers are not becoming the over-riding voice

- The flexibility of changing goals, aims and interrelatedness of issues etc makes it difficult to evaluate

Monitoring and evaluation of retrofitting programmes

In general, monitoring and evaluation is rarely undertaken at all, and if, then only in a very limited manner, mainly focusing on saving energy or CO2. In addition, programmes often do not reserve sufficient funds for monitoring and evaluation, which should be at least 10-15% of total project costs. Evaluation is also made difficult by the lack of benchmarking at the beginning of a programme. For example, when it comes to more difficult to measure indicators such as job creation or improvement of health or indoor climate it is important to benchmark to be able to then monitor the increase attributed to the programme. In addition, if monitoring or evaluation is undertaken it is usually a 'once-off' evaluation that takes place at the end of a programme. Hardly any intermediate evaluation ever takes place. The Dutch **Blok voor Blok** programme is an exception where monitoring and evaluating at intermediate moments was undertaken as part of their social learning strategy. **Warm Up New Zealand** also had an annual monitoring regime put in place. The UK **My Eco Home** Project shows very clearly what can happen when you only evaluate home owners' needs and concerns after the fact.

Below we discuss several observations concerning monitoring and evaluation of all retrofitting projects or programmes analysed, and discuss clear impacts of theories or models informing these interventions.

What to monitor? From quantitative to qualitative indicators

In retrofitting programmes generally the following issues are monitored:

- Total area of insulated building parts (windows, walls, ceilings,…),
- Type of retrofit investment, type of heating system (c.f. "unit of analysis").
- Area and type of insulated building parts (windows, walls, ceilings, …)
- Type of heating system installed/replaced
- Type of building
- Reduction of CO2-emissions (calculated from type of heating system and type of insulation and expected calculated reduced demand for heat)
- Costs of measure (euro or other coin per saved ton of CO2)
- Total number of houses renovated.
- Reduction of energy consumption (kWh, PJ, GW etc)

One problem with this quantitative way of evaluating the effect of a retrofitting programme is that it is very complex for external parties, including policymakers, to establish the full success of the programme, especially when there is no set frame of reference or benchmark. Calculating the cost of the programme per CO2 reduced only makes sense when you then compare the effect to other forms of reducing CO2 emissions and as such only focus on costs. Hardly ever is the actual reduction of gas-or electricity used for heating after retrofitting compared to the situation prior to retrofitting.

In addition, it is a limited way of measuring success and does not appreciate other non-financial or CO2-related outcomes that could be counted as success.

Some programmes such as the Dutch **Blok voor Blok** and **Myhrenenga** Housing Norway also evaluate issues and outcomes that are more relevant to end-users, e.g. the opinion of residents and the reasons for (not) participating, the way in which residents are approached and by whom, and the satisfaction of residents participating in the project and reporting on increased level of comfort and warmth or sensitivity to other energy efficiency measures. A focus on this type of evaluation actually allows to create more effective programmes in the future because important aspects other than economic and informational barriers are potentially identified, namely issues relating to trust (in the initiator or communicator), perceptions of comfort, warmth, wellbeing, environmental motivation.

Other programmes such as **Warm Up New Zealand** or **Sustainable Järva** go beyond the above and explicitly focus on non-energy indicators of success such as number (and $) of third party providers that contribute financially to the scheme, reduction in energy use, reduction in doctor visits/improvement in health, number of jobs created. A focus on these type of indicators is the consequence or reason of the participation of other stakeholders in a programme, who all have their own key performance indicators. For example, in **Warm Up New Zealand** the Minister of Energy wanted (and got) the maximum number of houses to insulate for the given budget; The Energy Efficiency and Conservation Authority needed to maintain high quality installations, and reduce fraud and danger e.g. due to down light fires but also establish a new, high-quality insulation installation industry and change social norms; the insulation industry wanted support to increase insulation activities and grow jobs and a market (not yet self-sustaining); homeowners wanted warmer, drier homes for minimal costs (perception-wise, this was largely achieved); social and health services wanted to see fewer doctor visits and incidents of asthma and other respiratory diseases (minus 43%), 23% fewer days off school and 39% fewer sick days etc. At the same time, exactly this diversity of participating stakeholders is also key to a programme with a focus that appeals to more end-users and is more meaningful to them.

Another issue related to taking a systems approach is that energy needs to provide basic services to people. In some instances such as in New Zealand where the service level was actually below WHO recommendation (minimum of 16C in bedrooms, 18C in living rooms), e.g. average home temperatures are 14C. Student houses in Dunedin were found to be under 4C (colder than their fridges!). Retrofitting thus could actually increase total energy consumption, or at least the consumption of energy that can be monitored (e.g compared to wood stoves or downlights). If the monitoring is then only focusing on energy reduction the programme will be labelled a failure, whilst other (energy) costs, e.g. related to treatment health problems can be decreased significantly. Also, firewood consumption is not monitored in New Zealand, so in situations where an open fire was replaced with e.g. a heat pump, the switch in fuel was actually only shown as overall increased energy consumption. Benchmarking is thus necessary to assess the prior level.

Flexibility

Several issues impact on the monitoring and evaluation process. Flexibility is one. If a programme is flexible in the sense that it forms and grows organically it is logical that monitoring and evaluation of pre-set goals and ambitions does not make sense. For small projects that are locally initiated such as the Norwegian

Myhrenenga retrofitting case, and which are often are highly flexible and work with other than financial resources, it is very difficult to perform monitoring and evaluation that follows the conventional efficiency and cost-effectiveness focus and that assesses progress only in view of pre-set goals.

Evaluation based on modelled versus metered real impact

Most monitoring and evaluation is mainly, probably to keep it simple and low cost, focused on technological, financial and quantitative aspects. Ambition levels and thus monitoring indicators are often set only on the technological level in terms of floor area of installed measures or insulation, amount of subsidies paid for measures, number of houses insulated, the insulation area and calculated CO2 reduced emissions, but not with their actual metered impact on household energy consumption. Metered impact of measures on household energy consumption is needed (set against the consumption before the measures were taken). However, even that might not provide an adequate picture of the impact of the technology/measures installed. Usually, there is only attention for investment behaviours and not the behavioural routines that might change in interacting with the measures after they were installed (for example very good insulation measures might have been installed but if the home owners then ventilate their home with the heating turned on this might offset any reduction the installation creates). Given the above lack of attention to repeated energy behaviours, it is understandable that programmes usually prefer evaluation methods where energy savings are modelled, rather than actually measured. The actual behavioural change in the sense of investment behaviours is thus derived from self-reported documentation for subsidy applications and the realisation of the measure is usually only randomly checked on site, e.g. in the Swiss **building retrofitting** programme.

There, however, lies a great danger in focusing only on these modelled and not metered or actual savings: misuse, fraud or rebound effects can offset the potential reduction. For example, energy efficient homes see usually more use of all their rooms. The lack of monitoring after the implementation, e.g. of actual energy savings by means of a e.g. smart meter, limits the calculation of success to a theoretical one, because it is not clear if the retrofitting actually had a real impact and overall results in an absolute reduction of energy demand. Maybe households have increased their level of comfort and because of insulation feel less bad about having the thermostat one degree higher than before, or other households might have been activated by the retrofitting and decided to also put solar panels on the roof and become more energy conscious. In New Zealand, increased energy use by providing clean heating and switching e.g. inefficient and unhealthy open fireplaces and unflued gas heaters with heat pumps, may have purposely led to a rebound effect. However, it has not been monitored to what extent. Furthermore the so-called grey energy of retrofitting measurements is also not evaluated.

If the real savings are not monitored than at least the quality of implementation should be monitored. Especially when the ambition is formulated in terms of number of measures installed or number of homes insulated the quality of the implementation can be endangered. A solid auditing or surveying process afterwards could ensure that the implementation indeed performs as is being calculated in the evaluation.

Monitoring of voluntary participation: biased?

Another omission that many programmes have is that they only focus on evaluating motivations of those actually engaged. The 'decliners' or opt-out households are not asked why they have not participated. The Dutch **Blok voor Blok** programme in the Netherlands and UK **Kirklees** are the only programme that actually used this type of evaluation. Learning about these motives might actually contribute to a much better embedding of future rounds or editions of a programme. This is increasingly appreciated, and for example in Switzerland they just made a survey with homeowners about their investment plans and barriers for renewable energies in the housing area[23].

[23] http://www.unisg.ch/~/media/Internet/Content/Dateien/InstituteUndCenters/IWOE/Forum%202012/IWOE_Kundenbarometer_2012.ashx

Feeding back monitoring and evaluation results

Since financial and information deficits were seen as main barriers in many of the programmes, it is understandable that monitoring and evaluation is hardly communicated back to the participants. Feedback is not taken care of: after installation of EE measures, no monitoring or feedback is provided on the effect of an intervention which is logical when modelled savings are simply calculated based on installed measures. Monitoring of the actual impact of the measures is not done and if the home owners wants a more quantitative assessment than their perception of improved quality, improved health etc they will often need to install a metering device themselves.

External evaluation of the programme as a whole

External evaluations of the programme are hardly ever conducted. The Dutch programme **Blok voor Blok** and **New Zealand's WUNZ** programme did perform an external evaluation and this evaluation actually provided means to improve the programme ex-durante. Another successful exception is the Swedish **Sustainable Järva** project that commissioned Sweden's Royal Institute of Technology for monitoring and evaluating the entire project, both from a technical, social and economic perspective. They are working with all the stakeholders, and the purpose is to give feedback as well as to see to that the project is carried out in line with its goals. A further purpose is to compare the project to similar others, and to be used as a point of reference/pilot project in the big challenge to rehabilitate the larger housing stock in Järva.

Social learning and mainstreaming

Social learning through building on previous programmes and with the goal of creating more effective programmes is key to successful mainstreaming of retrofitting initiatives. The Dutch **Blok voor Blok** programme is designed to learn from different types of implementations and find success factors to be applied broadly in later stages and works with voluntary participation and allows the 14 participating cities to adjust the implementation to home owners' needs. In addition, social learning between the different programme developers and implementers is explicitly aimed for in this programme, with the pursuit of knowledge exchange between the various projects to gain insight into successful factors. Even courses on knowledge exchange are provided for the consortia and as such social learning becomes institutionalised.

Collective learning can, however, also take place un-orchestrated. The impact of seeing your neighbours retrofitting their home with the aid of a financial incentive can have significant follow-up in spite of a "narrow" intervention that would not monitor the neighbour effect or only focus on collaborative learning between programme implementers and not users and their neighbours. Subsidies are perhaps a 'small' incentive, but they can be enablers to create a new social norm. And parties like installers can have a crucial role to play.

To conclude: Monitoring should therefore be more systemic and include metrics other than energy-related indicators or key performance indicators, e.g. health benefits.

Conventional monitoring of retrofitting success	More systemic monitoring of retrofitting success
· Total area of insulated building parts (windows, walls, ceilings,…), · Type of retrofit investment, type of heating system (c.f. “unit of analysis“). · Area and type of insulated building parts (windows, walls, ceilings, …) · Type of heating system installed/replaced · Type of building · Reduction of CO2-emissions (calculated from type of heating system and type of insulation and expected calculated reduced demand for heat) · Costs of measure (euro or other coin per saved ton of CO2) · Total number of houses renovated.	• all of the issues listed left, plus: • changes in room temperature • humidity • wellbeing • trust • number of third parties involved • actual reduction in energy consumption • social cohesion • satisfaction of residents • opinion of residents • sensitivity to (other) energy efficiency measures • comfort level • reduction in doctor visits/ • improvement in health, decrease asthma and respiratory diseases • number of jobs created • quality of industry before and after • creation of standards • days off school • sick days

Recommendations: Key DSM retrofitting interventions lessons and questions for further research

The lessons below are tailored to policymakers, intermediaries or other initiators of DSM retrofitting interventions.

1. Focusing retrofitting interventions on the level of individuals and individual households ignores the need of individuals to be part of a social group or society. Addressing the collective level of e.g. home owner associations can upscale the impact and create more lasting changes. Rather than thinking in terms of technology (which is a means) think about and inquire into end-user needs and their way of life so that these form the point of departure and make use of peer to peer education or the neighbour effect. I**t's not only about the houses, but first and foremost about the people who live there. Involve, engage and target multiple members of a social group, at the collective level, not only at the level of the individual.** FOCUS ON THE SOCIAL SIDE**.**

2. Subsidies and incentives focus mainly on investment behaviour and alter the home but do not address the use of the building and its installations or appliances. **Focus on both investment and habitual behaviour to avoid bad and unnecessary rebound effects.** IT'S NOT JUST WHAT WE BUY, IT'S WHAT WE DO.

3. Programmes that have a more systemic perspective as starting point acknowledge that retrofitting can be a 'gateway' into other more habitual behaviour changes around for example lighting and appliance use and even domains beyond the energy domain such as waste and transportation behaviour. **Use insulation as a gateway, not a one-off.** CHANGE LIFESTYLES NOT LIGHTBULBS

4. An approach focused on incentivising and subsidising individuals to invest in technologies and measures actually benefits mainly and mostly the supply side (economically and on the short term). **Beware if only the supply side or the implementer of the intervention seems to benefit.** THINK OF THE BENEFITS FOR THE END USER AS WELL

5. Providing information only works if relevant stakeholders agree on the truthfulness of the information e.g. through a trusted consortium of societal and policy stakeholders. **Trusted messengers are everything.** FOCUS YOUR MESSAGING.

6. When a project aims to solve an information deficit, it should not request this information from the end-users, but arrange for training or intermediaries to help the end-users find this information. **And when targeting the individual need for money and financial support, do not ask for prefinancing.** PAY THE SUBSIDY UPFRONT

7. Targeting the individual need for maximising financial benefit ignores that comfort and other benefits often rank higher on the priority list. Focusing first on financial rewards might create serious barriers for (follow-up) interventions also aiming at getting the bigger message why it is an important social or a global issue will likely fail. Cooperation between multiple parties - from governmental agencies to landlords and NGOs such as district health boards - can result in more tailored and context-sensitive programmes. Cooperation between multiple parties can also result in a more diverse set of instruments being deployed, from more segmented financial incentives to certifying contractors, enhance building codes quality, installer trainings, and TV marketing campaigns, and including instruments targeting outcomes that are not directly related to energy efficiency, e.g. health improvements. **Tailor**

to your end users' needs which may not be about kWh savings. Cooperate widely and make it about more than money. USE A TOOLBOX OF INTERVENTIONS AND GO BEYOND kWh TARGETS.

8. Pre-scoping to analyse the problem to be solved can allow for a more broad or integral approach focusing also on other, e.g. health, comfort and social benefits. However. performing research to find out about homeowners' needs and preferences prior to implementation is only conducive to success when the needs that were identified are also targeted in the intervention. **Pre-scope to find out what is most important to end users.** IF YOU KNOW WHAT THEY WANT, MAKE SURE YOU TRY AND GET IT FOR THEM.

9. Programmes that focus on lifestyle implicitly or explicitly acknowledge that end-users do not live according to sectoral divisions, even when governmental agencies do. **They allow for an approach that focuses on the function of the use of energy in the life of end-users instead of on the use of energy.** DON'T BOX PEOPLE IN TOO MUCH

10. Metered instead of modelled saving calculations are necessary to assess the real impact of the measures on energy consumption. Benchmarking and monitoring of the actual impact of the measures on the energy use, living quality, reduced costs, improved health etc should be part of the programme. **It should not be left to the individual to buy and install metering devices to meter the actual impact of retrofitting.** BENCHMARK YOUR HEART OUT, MEASURE, NOT MODEL

11. **'Decliners' or opt-out households are potentially as valuable to survey as those engaged.** LEARN FROM THE UNWILLING

Key Questions on retrofitting

1. Can ambitiously set programmes create technological innovations and even professionalise a market, including the accompanying job growth? And do interventions aimed at retrofitting at the comprehensive level of the house generate more impact on the market, than e.g. simple insulation measures?

2. Does institutionalised longer-term support help to foster new markets and provide clarity and security/certainty for both end users and market parties? (e.g. setting quality standards for contracting service providers, building codes, training schemes for installers, performance contracting schemes, energy label for homes or low interest bank loans)

3. Is involving all relevant stakeholders in the form of diverse partnerships conducive to the creation of a new social norm? Has their interaction, and their often diverging needs and key performance indicators demanded alignment of interests with the potential for social learning?

4. Has social learning through building on previous programmes resulted in more effective programmes? And is this key to successful mainstreaming of retrofitting initiatives?

5. Should 'free riders' (people who would have taken measures without the subsidy) be welcome too? Can incentives actually motivate towards even better or more comprehensive retrofitting than planned without the incentive?

6. What is the potential of un-orchestrated collective learning? What could be the impact of seeing your neighbours retrofitting their home with the aid of a financial incentive?

7. With overly extrinsically motivated interventions, will the bigger message why it is an important social or a global issue, get lost and ignored, thus enhancing the changes of rebound? One could also ask whether programmes potentially veer towards appealing to self-interest because otherwise they drown in a sea of marketing encouraging consumption practices that work against altruistic motivations?

3. Transport: observations

Country	Project or programme	Theory or model used	Policy or Societally driven
Netherlands	The New Driving, Het nieuwe Rijden	Psychological theories on motivations	Policy
	Congestion pricing, spitsmijden	Cialdini's Social psychology	policy
New Zealand	Fuel Efficient Driver Training Programme	Value Action gap	societally
	Active A2B programme	Norm Activation Theory, Lewin's unfreezing-refreezing, Stern's Principles of Intervening, McKenzie-Mohr's social marketing	policy
Switzerland	2000Watts mobility		policy
	Purchasing of fuel efficient cars	Theory Planned Behaviour Norm Activation Theory	policy
Norway	Nobil : a database for an EV charging grid informational system	Theory Planned Behaviour	policy
Sweden	Stockholm congestion pricing transport project	Activity based models	policy

The case studies

The New Zealand Active a2b programme[24]

The New Zealand **Active a2b programme** is primarily based on the **Norm Activation Theory**. Active a2b is a health and wellbeing initiative, not an energy initiative, that was delivered in 2013 for the fourth consecutive summer by the Sustainable Transport Team at Greater Wellington Regional Council (GWRC). The programme aims to reduce congestion in urban areas through increasing travel to work by active modes. It offers participants personalised support and resources to encourage them to walk and cycle to work. Participants are recruited from large workplaces in the region. Upon registration in January and February, they are able to request a number of resources and choose from a range of workshops and challenges. Participants also receive a weekly e-newsletter sharing success stories from the programme and providing information on upcoming events.

[24] www.activea2b.ning.com

Once upon a time... there was the 'coolest little capital in the world' called Wellington. One of the things that wasn't so cool about Wellington was the traffic.

Every day...there were a lot of people driving their cars to the city for commuting. A lot of them were alone inside their car and often got stuck in traffic during peak hour.

But, one day...in 2010, the Greater Wellington Regional Council and a bunch of partners, came up with the great idea to start a mode-switching programme that focused on getting a specific target group of people to walk or cycle more instead of drive.

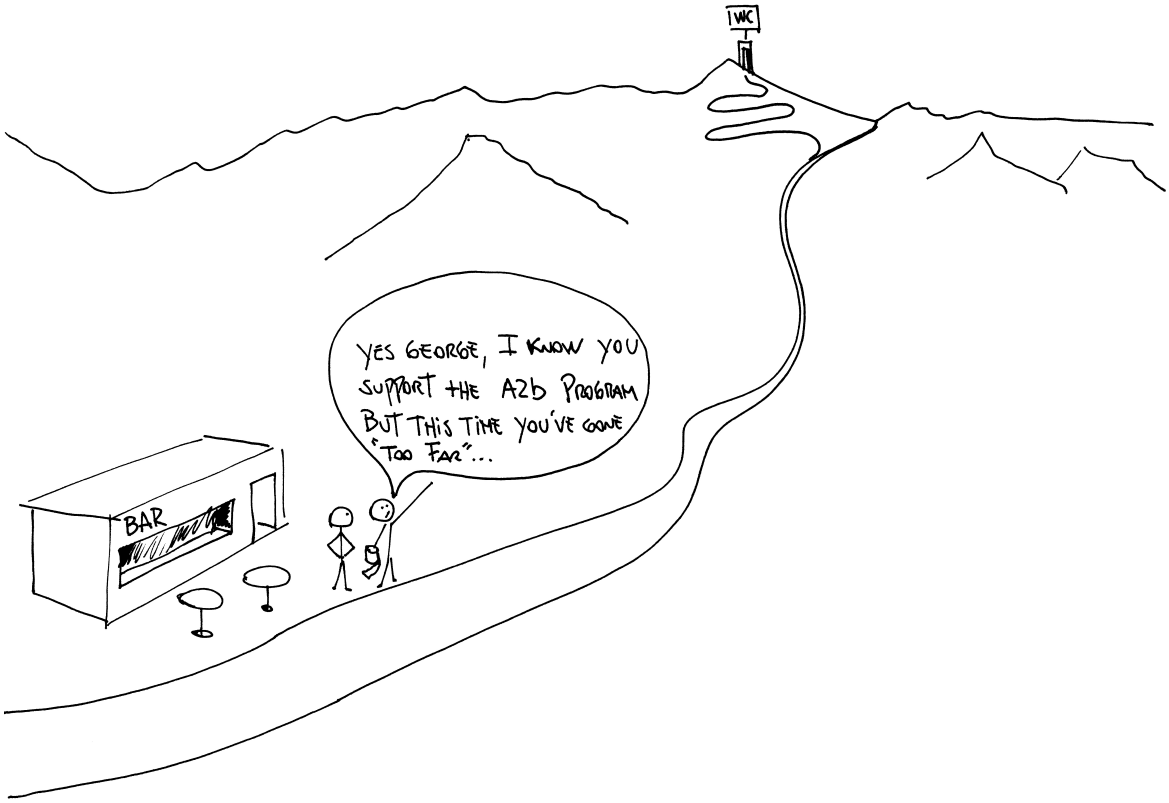
Because of that...they started competitions, goal setting, motivational groups and used a whole big toolbox of different models and theories of change in order to get the best results.

But then...they realised that people weren't very interested in being super sporty, or reduce CO2 if the tradeoff was feeling inconvenienced.

Until, finally...they came at it with a health and wellbeing angle, and talking about what 'normal' people could achieve, rather than boasting about cycling 50km a day clad in lurid lycra.

And, ever since then...it was shown that the target group of people indeed took the programme lessons to heart and they walked and cycled much more than they did before (A reduction in car trips of 20% and a corresponding increase in active travel have been consistently achieved with this group since the programme's launch in 2010). However, the big issue remaining is still that the coolest little capital needs better public transport and cycleways before this becomes the real social norm. **The end.**

Active A2B in a tweet:



Leantricity (2013) on the A2B programme

The Norwegian Nobil EV programme [25]

The Norwegian **Nobil programme** is an online database of all charging stations for electric vehicles nationwide (more than 4000), which uses GPS coordinates and a web API to provide real-time information to users of EVs on things like distance to charging stations, accessibility, connector types, charging capacity, map coordinates, pictures etc. The point of the database is to facilitate the further adoption of EVs by making it easier to overcome the problem of lacking information on distance and on the availability of charging stations, which again can lead to a more efficient use of the stations and hence to more efficient electricity use – not to mention greatly increasing the desirability of using EVs. It is based on the **Theory of Planned Behaviour**.

[25] http://www.nobil.no/index.php/english

Once upon a time....there was a very long country with very sparse population centers and a lot of roads, called Norway. Norway also had 100% renewable electricity and a lot of money and willingness to do something about climate change. Thus, the government which had already put into place some of the world's best incentive schemes for electric vehicles (EV) was interested in finding out how to lower barriers for adoption of EVs. Similarly, they wanted to get people to be able to time their charging better as it would mean a real efficiency gain for the electricity system.

Every day....there were problems with the EV charging stations somewhere, and Norway's EV users were despairing of never knowing when and where they could charge their cars.

But, one day...someone came up with the idea of making a list of all the charging stations in the entire country and to hook them up into a single network, so that one would be able to moniter how each charging point functioned, and make maps for EV users to see where they could find stations, and thus plan for how long they could drive before charging again.

Because of that...some funding was set aside to make an App that would be open and real-time, and developers were hired to create it.

But then....they ran into some serious technical problems, especially with the provision that the information should be real-time in addition to being place-specific.

Until, finally...they got the technical details ironed out by making a whole new protocol for the handling of the data, and were ready to roll out the new software, which was promptly taken up by a number of EV services and phone apps all over the country.

And, ever since then...Norway has been the world leader in EV adoption, with some of the best infrastructure for charging (including the first Tesla charging chain) in addition to lucrative incentives for buying EVs, which has paradoxically led to congestion problems in the car pooling lanes. But that is another story…

The theory of planned behaviour as used by Nobil in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

#TheoryOfPlannedBehaviour: #behaviourchange comes from changes in intentions, which can be affected by outside interventions #Task24 #Nobil

The Dutch New Driving Programme[26]

The Dutch **New Driving Programme** is based on a psychological model called **Murray's and Sachs' descriptive psychological theory** that attempts to describe the motivations for car use. The intervention therefore focused on reducing the feeling of power of young male users by increasing the power of those without cars. The idea was to make pedestrians and cyclists more powerful in the traffic system and train young users in traffic norms that put more emphasis on other road users.

[26] www.hetnieuwerijden.nl

Once upon a time... in a country full of speedsters called The Netherlands, eco-driving was a practice for organic, whole-grain musli-eating animal rights activists - or hippies. 'If there's even the slightest bit of testosterone in your blood, you'll make your engine roar' they'd say.

Every day... these proud Dutchmen would spill way too much gasoline during their drives, so as to feel their freedom and protect their status as the alpha male in the concrete jungle.

But, one day... the national government decided to start a campaign to promote more economical driving. After all, too much gas was spilled, too many greenhouse gasses were emitted and too many particles were set free to pollute the cities. The campaign basically showed that you can be a tough guy even when driving economically. A parody of The Dukes of Hazard was used in advertisements on eco-driving to support this message. Furthermore, training sessions were offered to learn the new way of driving, these techniques became a part of the driving school curriculum and fuel saving technology (such as feedback systems) and tire pressure controls were promoted.

Because of that... between 2,2 and 3,75 Mton of CO_2 emission were avoided through HNR between 2000 and 2009. The costs for the campaign were below 10 €/ton CO_2, which is a very cheap solution to the problem! 69% of all drivers in The Netherlands used one or more principles of eco-driving in 2009, and 84% were familiar with the concept. The campaign was a roaring success.

But then...due to a change in government after 2008, this success declined. This can be largely ascribed to the budget cuts and the changing course of the Dutch policy (technology instead of behaviour as a solution; increasing the speed limit from 120 km/h to 130 km/h which sends a very confusing message to drivers!).

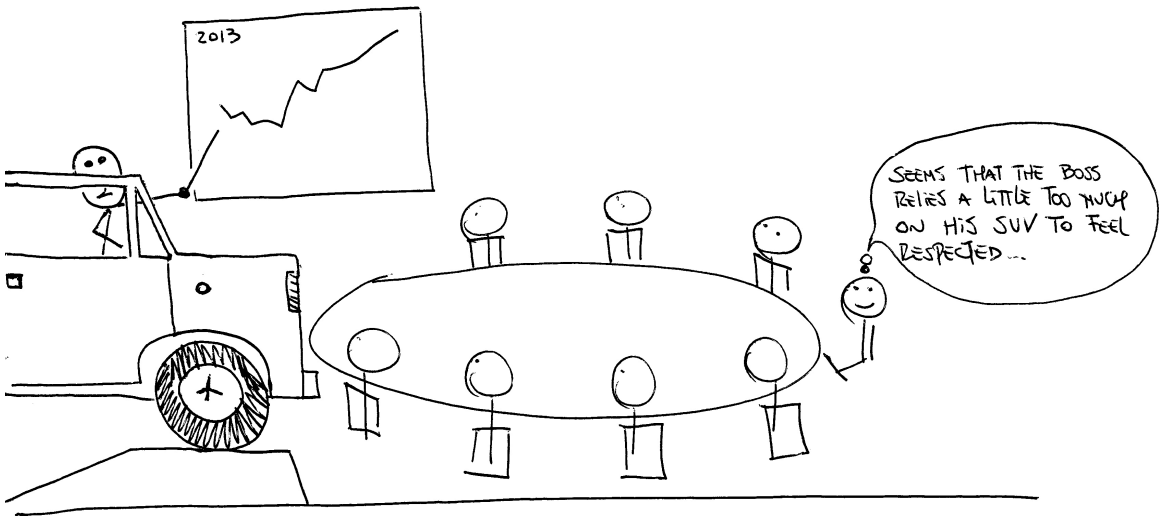
But still… eco-driving is now embedded in the Dutch society. The implementation on different levels, such as the integration of the techniques in driving schools and the support of sector organisations such as ANWB (AA patrol) were a key factor of this change in social norm.

And, ever since then... you can be a tough guy whilst driving economically. And a nice addition: it will save you some money too. **The end.**

The Dutch New Driving programme in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

The Dutch Het Nieuwe Rijden reduces fuel consumption, CO_2 emission and induces safer driving behaviour by tackling the car as status #Task24



The car as status symbol in the Dutch New Driving Programme as seen by Leantricity (2013)

From the HNR website - the Dukes of Hazard parody campaign

The New Zealand Post Fuel Efficient Driver Training Programme[27]

The New Zealand Post **Fuel Efficient Driver Training Programme** is implicitly based on the **Value Action Gap** theory, which argues that behaviours are based on peoples' attitudes. The programme used selected contracted courier drivers as trainers to train other courier drivers in more fuel efficient driving behaviours. The prime motivation was because it made economic sense, rather than for environmental reasons.

[27] http://www.nzpost.co.nz/sites/default/files/uploads/shared/annual%20reports/2013-annual-review.pdf

Once upon a time... there was a great, big organisation that was delivering mail and parcels all over New Zealand, called New Zealand Post.

Every day...100s of courier drivers were driving 13million kms every year to deliver these parcels to Kiwis.

But, one day...NZ Post realised that it was spending way too much money on fuel and that its drivers weren't being as efficient as they could be.

Because of that...they decided to start a fuel efficient driver training programme, in order to teach their contractors to drive more efficiently (and safely).

But then...they realised that a lot of the drivers didn't like being told what to do!

Because of that... they very cleverly used their most respected contractors to become trainers of the other drivers and made it all about being good business sense.

So, finally... They took them on test drives and showed them that they could save between 5-40% of their fuel just by changing simple behaviours.

And, ever since then...there was an overall, ongoing reduction in fuel consumption of 5% among the drivers that have taken part in the programme. **The end.**

The New Zealand Post Driver Training programme in a tweet

Dr Sea Rotmann @DrSeaRotmann 4m

The successful @nzpost Fuel Efficient Driver Training Programme is based on trusted peer-to-peer learning #Task24 #behaviourchange

The New Zealand Post driver training programme

The Swedish Congestion Pilot[28]

The Swedish pilot on a **congestion pricing system** was performed in Stockholm in 2006. The system was implemented as a tax levied on most vehicles entering and exiting central Stockholm. The trial also involved, apart from the taxing, new parking areas ("park-and-ride") within walking distance to public transportations, and also enhanced public transportation (bus lines etc.). The primary purpose of the congestion tax was to reduce traffic congestion and improve the environmental situation and air quality in central Stockholm. The funds collected were to be used for new road constructions in and around Stockholm. In addition, toll stations were placed around the central Stockholm area and all vehicles that entered or exited the so called "tax zone" during weekdays between 6.30 AM and 6:30 PM were imposed to pay the congestion fee. The main partners in the project were the City Council of Stockholm, the Swedish Road Administration and the Stockholm public transport (SL). It was financed by the Swedish Government. The Swedish Secretariat for Environmental tax was responsible for project management, execution and evaluation. It was based on **Activity Based Models.**

[28] http://www.stockholmsforsoket.se/

Once upon a time....there was the City of Stockholm, which was gorgeous but had way too many traffic jams.

Every day...more and more Volvos and Saabs tried to drive in the not-so-well-planned City (well, the Vikings didn't have cars!) and people got very frustrated.

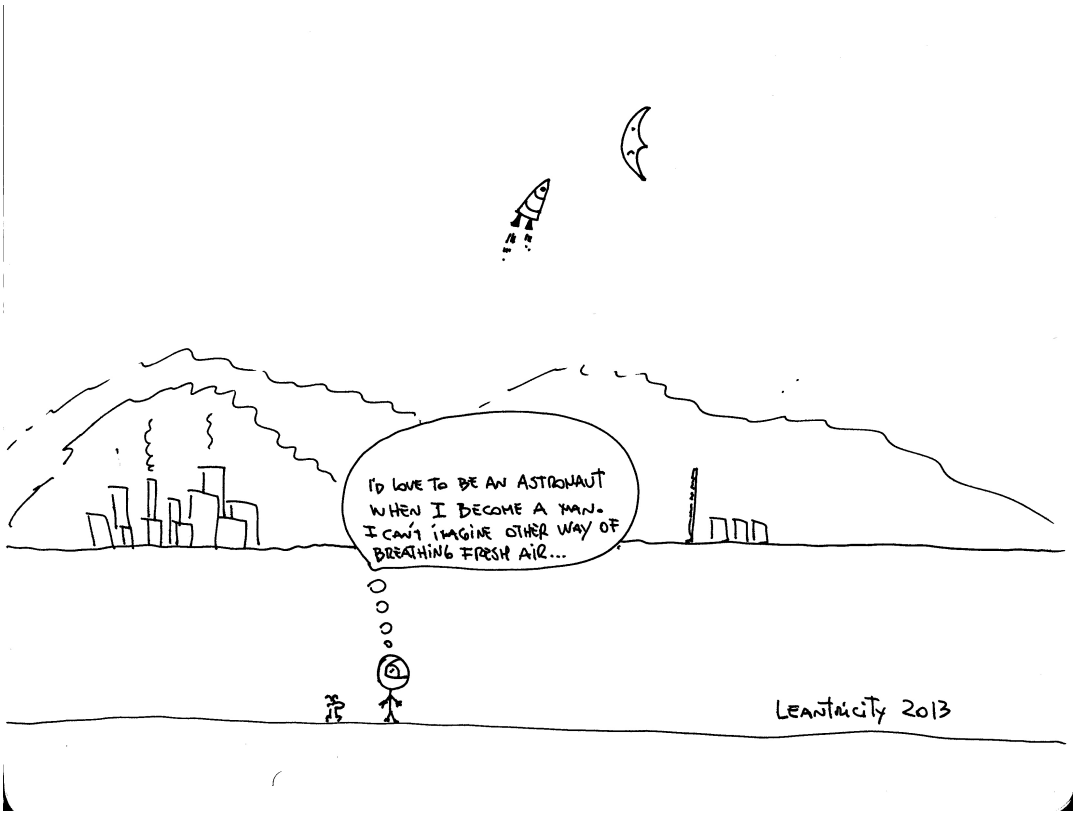
But, one day...the national and local governments decided to try to kill the behemoth that was the traffic chaos in Stockholm.

Because of that...a comprehensive congestion charge pilot was introduced.

But then! Car commuters who travelled in from the outside and (felt that) they had no alternatives, turned sour, for several reasons.

Because of that...the policymakers realised that they should also improve public transport, park and ride schemes etc to make it easier to travel without car.

So, finally...the improved social acceptability thanks to the comprehensive toolbox of measures enabled the politicians to implement congestion charges on a permanent basis. And Stockholm's air is almost as fresh as when the Vikings lived. **The End.**



Issues of air quality which can be fixed by a toolbox of interventions like in Stockholm congestion pilot

The Swiss fuel efficient purchasing project[29]

Energy consumption isanalysed here in terms of fossil fuel consumption of cars (explicitly not electricity). The model analyses the determinants of the purchase of fuel-efficient vehicles. It does not analyse the amount of energy consumption of operating the car. Research questions of this study were in particular:

- What are the determinants of the purchase of fuel-efficient vehicles?
- What are the consequences people associate with the purchase of fuel-efficient vehicles?

These hypotheses were tested in the study:

- PBC (perceived behavioural control), attitude, and personal norm have a positive direct influence on the purchase of a fuel-efficient vehicle.
- Problem awareness, response efficacy, and social norm have a positive indirect influence on the purchase of a fuel-efficient vehicle.

Results of the study were that a car can be a symbol for one's status and image (from outside and/or inside). Fuel-efficient vehicles are often associated with smaller size, and less power and acceleration. People should be informed that such vehicles do not necessarily need to be smaller or accelerate less in most everyday situations. In general, fuel efficiency should be promoted as a popular feature. In the case of car purchasing, personal norms influence the purchase of a fuel-efficient car. These factors are again influenced by other factors - including symbolic motives which have an important influence.

[29] Anja Peters, Heinz Gutscher, Roland W. Scholz (2011): Psychological determinants of fuel consumption of purchased new cars, Transportation Research Part F 14 (2011) 229–239

As a consequence, the following recommendation are given:

- Information and prompts, such as fuel efficiency labels, could be effective to help consumers to better identify fuel-efficient vehicles and to make them aware that fuel-efficient versions of almost every vehicle model exist.
- The results on the characteristics associated with fuel-efficient vehicles (smaller size or less power and acceleration) suggest better informing people that such vehicles do not necessarily need to be smaller or accelerate less in most everyday situations.
- In general, fuel efficiency should be promoted as a popular feature.
- The public sector could take a leading role and make fuel efficiency a prominent selection criterion for its car fleets.
- Financial incentives could emphasize the social desirability of a change of purchase behaviour.
- As prerequisite, consumers should be better informed about the problems related to fuel consumption and about the broad range of own action within car purchase to reduce these problems

The Dutch congestion pricing programme[30]

Spitsmijden (rush hour avoidance) is a national programme, initiated by business, several universities and national governments.[31] It ran from September 2010 to September 2012. Research was conducted on how to circumvent city centers during rush hour. Four ways were identified: travel on a different moment of the day, choose another route, avoid travelling (working at home) or choose another travel modality. Two types of incentives are used to achieve these behaviour changes: a price incentive for every avoided drive in the city and information supply through a hand computer in the form of navigation and suggestions for other modalities. The specific case in Noord Brabant (Eindhoven and Den Bosch) adds another incentive to the national Spitsmijden program, which is the construction of a 'personal avoidance plan'. The purpose of this plan is to determine when and how the rush hour is avoided. The initiators of the pilot gave feedback to the avoidance plans of the participants. After the pilot was finished, the economic incentives were removed and feedback mails were used to continue the behavior. Furthermore, former participants were asked through questionnaires how they experienced the project. Positive reactions were used in publications, on the website and in feedback mails after the pilot. The avoidance plan is based on the principle of commitment and consistency by **Cialdini**.[32]

[30] http://www.spitsmijden.nl/

[31] D&B Applied Behavioural Sciences, *Verdieping gedragsonderzoek Spitsmijden in Brabant*, March 2013

[32] Cialdini, *Influence; the psychology of persuasion*, Collins 1993

Once upon a time... in a small county with many cars, enthusiastic hardworking Dutch people left every morning around 9 o'clock, five days of the week to go off to work, to be returning just as eagerly around five o'clock in the afternoon.

Every day... they would bore themselves to death driving in rush hour in the morning and the afternoon. Such a waste of time, that could otherwise be spent on making wooden clogs and picking tulips, the favourite activities of every Dutchman.

But, one day... a cooperation between universities, governments and business started a project called Spitsmijden (congestion pricing) to engage people in avoiding congestion. Two types of incentives were used to achieve this change in behaviour: a price incentive for every avoided drive in the city and information supply through a hand computer in the form of navigation and suggestions for other modalities.

Because of that... several pilots in The Netherlands were set up to see if it would help people in avoiding rush hour. And indeed, people were tempted: four months after the pilots, when the financial incentive was gone, 47% of the participants were still avoiding rush hour one way or another!

But then... the initiators came up with an additional incentive: the personal avoidance plan. People were told to plan their congestion avoidance behaviour, using a scheme of when and how the behaviour would be conducted. A theory of Cialdini states that when a person commits itself to something, he or she is inclined to be consistent with that commitment. But if the theory would apply to this specific case was still uncertain.

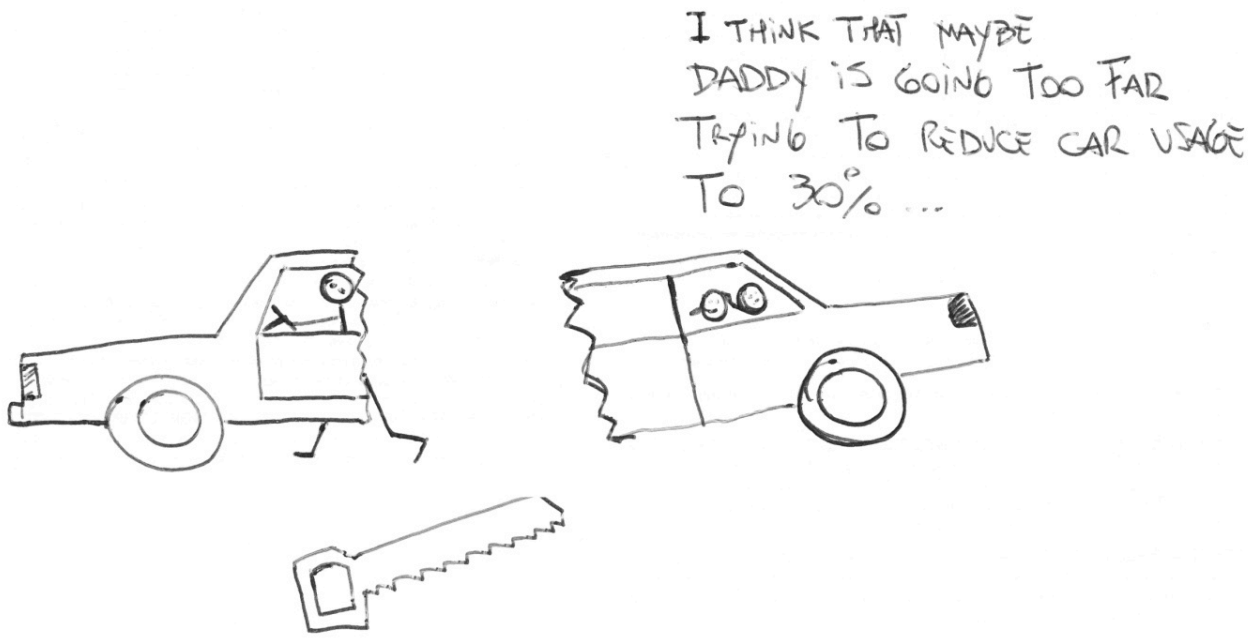
Until, finally... the results showed that the avoidance plan indeed caused an additional effect on rush hour avoidance behaviour: the percentage of rush hour avoidance was 27% higher than in the cases with absence of the personal avoidance plan.

And, ever since then... former participants are still omitting traffic jam. Although the percentage slightly dropped after the project, an increased (and increasing) number of Dutchmen now have more time to do what they really like: making wooden clogs and picking tulips. **The end.**

Spitsmijden in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

Dutch #Spitsmijden: Avoidance of rush hours can be stimulated by a personal plan, in which people commit themselves by setting goals #Task24



Spitsmijden or avoiding peak traffic, as seen by Leantricity (2013)

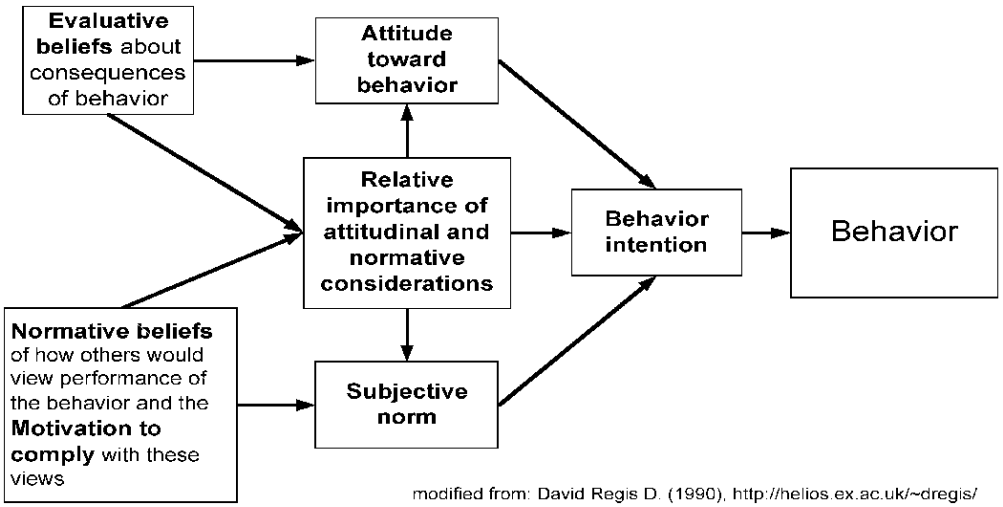
Theories and models used in transport interventions

When dealing with driving and refuelling or car purchasing behaviour, and time of use or sharing of cars, the focus turns to the meaning the car and mobility has to people, from status to control or freedom, and how the car is an essential part of lifestyle and a way to express this lifestyle. Several mobility programmes identified in this Task do indeed recognise this intimate relationship between car, meaning and owners, and build their intervention very explicitly on psychological theories. However, these are still mainly focused on the individual and the intervention does not often involve or target the social environment of the vehicle owner.

When taking a look at theories and models that underpin mobility interventions we see many different theories and models being used to address different types of mobility behaviour: driving (using) and fuel or vehicle purchasing behaviour. The Dutch **New Driving** intervention is based on **Murray's and Sachs' descriptive psychological theory** which combines the social-historical value of the car with the innate psychological needs of the human being. Next to the need for transportation, according to this theory, car use satisfies many more psychological needs. An intervention should therefore aim at reducing the psychological needs and motivations related to the 'power' that the use of a car provides for the young male segment. In addition, according to this descriptive psychological theory, the acceptability of and accessibility to cars should be questioned.

The Swiss and Norwegian projects focused on fuel efficient vehicle or EV purchasing behaviour used the **Theory of Planned Behaviour** to target this behaviour. According to the Theory of Planned Behaviour, a person's intention to perform a particular behaviour is the best predictor of that behaviour to actually occur. Intention, in turn, is determined by (1) a person's attitude towards the behaviour, defined as an overall evaluation of its possible consequences, (2) subjective norms, referring to the perceived expectations of other important persons (we will speak of social norms in the following), and (3) the perceived behavioural

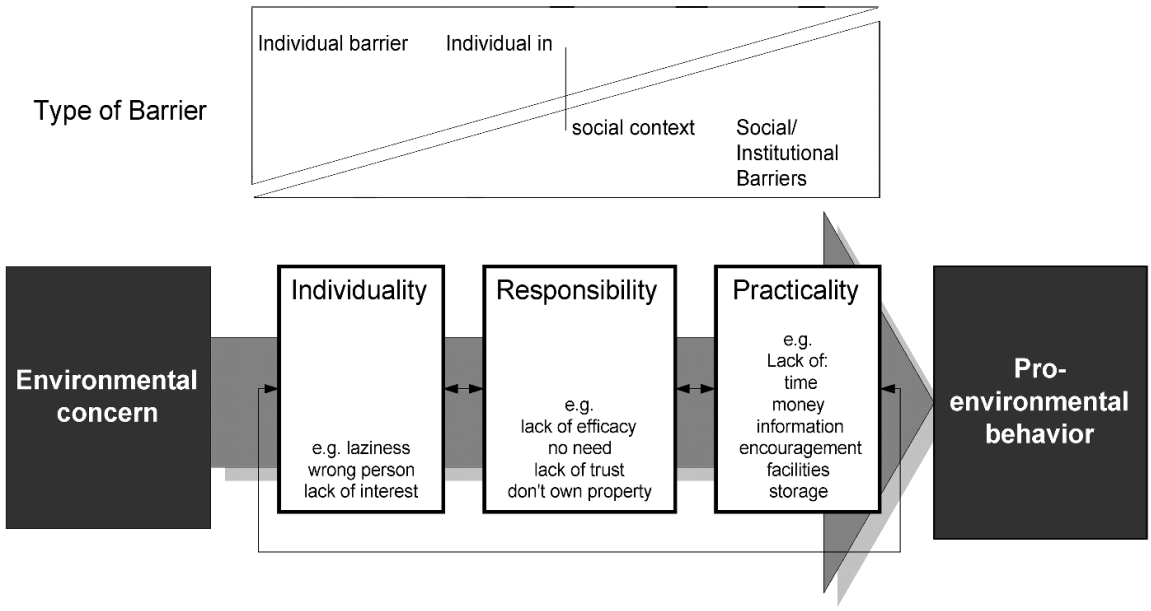
control (PBC), defined as a person's perceived power to perform the behaviour due to non-motivational factors, such as availability of opportunities and resources. Besides the indirect influence of PBC on behaviour via intention, a direct one can also be assumed to the extent that the person perceives his or her objective power to perform the behaviour accurately. External interventions should therefore be targeted at these three factors, and among them the outside behavioural control is the easiest to change from the outside. These include things such as price incentives, informational barriers and infrastructure. And changing norms need to occur as well, for example, via increased peer-to-peer information.



Theory of Planned Behaviour by Ajzen & Fishbein (1980)

Another theory used in the mobility cases, e.g. the **New Zealand Post driver training** programme, is the **Value- Action Gap theory**. This theory is a criticism on theories of reasoned action that state that attitudes shape and influence behavioural intention, which in term shape actions and thus that behavioural intention is dependent on attitudes surrounding that behaviour and social norms. Against this, the Value-Action Gap theory argues that people act in accordance to their attitudes. So in principle, behaviour could be predicted by the attitudes. However, pro-environmental attitudes do not necessarily translate into enhanced pro-environmental behaviours. The Value-action-gap theory builds on the argument that attitudes are not always a clear prediction of behaviour, and that what shapes behaviour is a complex process. Barriers that need to be tackled are social, individual and institutional constraints and can be divided in three categories: individual, responsibility and practical constraints.[33]

[33] Blake (1999) Overcoming the 'value-action gap' in environmental policy: Tensions between national policy and local experience". Local Environment: The International Journal of Justice and Sustainability **4** (3): 257–278.



Blake's (1999) Value Action Gap

The Swedish congestion pricing project was built on **activity-based models from time geography disciplines**.[34] The fascinating aspect of the Swedish congestion pricing project was that it included social scientists from the beginning - traffic economists and ethnologists were included in the design and evaluation of the project. This was important as Shove and Walker[35] discussed on the issues of the London congestion charges that the role of people cultivating their practices (in this case, driving their cars into a congested town) can be obscured in the design and evaluation of policy instruments.

Another theory that was used several times is the **Norm Activation Theory.** Briefly summarised this theory states that people's behaviour is influenced by their perception of what the norms are of other members of their social group and what that means in terms of how they behave. However, these social norms, strong as they can be in determining peoples' behaviour need to be 'activated'. This activation occurs by means of reminders or by subtle cues. Norms can be enforced through punishment or reward.

See Henrikssen et al (2012). Environmental Policy Instruments Seen as Negotiations. In: Negotiating Environmental Conflicts: Local communities, global policies. Welz et al (Editors). p83-105

[35] Shove and Walker (2010). Governing transitions in the sustainability of everyday life. Research Policy 39(4): 471-476.

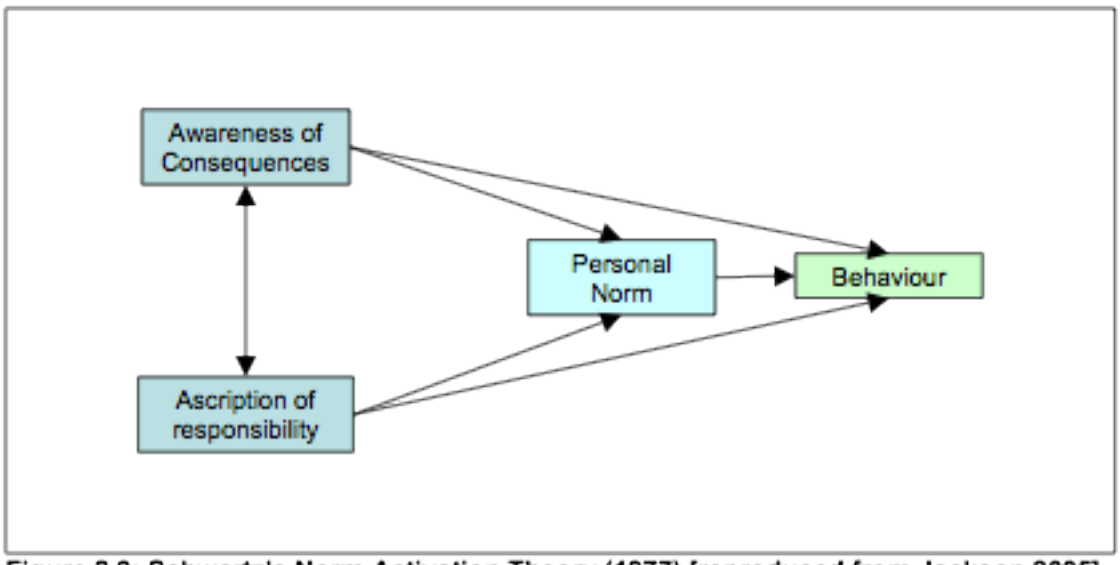


Figure 2.9: Schwartz's Norm Activation Theory (1977) [reproduced from Jackson 2005]

Finally, the **Social Psychology theory by Cialdini** informed the Dutch **Spitsmijden** case. In his book Influence: the psychology of persuasion, Cialdini describes six ways to influence and persuade people. One of those ways is commitment and consistency, which is the main theory behind the personal avoidance plan. The idea is that when people commit themselves to something, they tend to conduct the behaviour to be consistent. Consistency is socially desirable and seen as a personal quality. Moreover, it is a shortcut to avoid complex considerations. Many communication strategies are based on this idea to persuade people in conducting the target behaviour.

Influence of theories and models on design of the intervention

Influence of psychological theories and models on the design of the intervention

Many of the psychological theories underpinning (explicitly or implicitly) the interventions can be described to result in the below listed design characteristics of interventions. We have made one list for all psychological theory-underpinned interventions because the theories more or less contain these elements with differences in emphasis.

- focus on needs and the meaning attribution of the car (use)
- prescoping = essential
- focus on concrete actions, capacity building, not sustainability guidelines
- targeting and visualising the information deficit
- leveraging moments of change
- Nudging: creating supportive institutional and infrastructural environments
- focus on lifestyles
- use social norms and commitment

The stories these different theories tell are listed in the inserts below.

A Story on value Action Gap informed transport interventions

You can make the wheels of your car go round more efficiently

You are good driver and should be proud, but you can become the best!

You only need the right attitude and the motivation to act, we know you will want to act as soon as you see what you can do

We will pull down the barriers you experience, may they be social, individual or institutional

We know you also experience constraints such as lack of time, money, information, encouragement, facilities or whatever

We will help you take responsibility and do away with your laziness or lack of interest, or lack of trust and the feeling that you cannot be efficient at changing your behaviour

So we will make sure a peer you respect and trust will show you how to drive more efficiently

Don't worry, only your driving will change, you and your car will still be cool

It's all about you and your car and your driving and of course your money

We will monitor your driving, we got really cool gadgets to do that

You will see how easy you can save money, fuel and become an even better driver!

A Story on Theory of Planned Behaviour informed transport interventions

You can make the wheels of your car go round more efficiently

You can become the proud owner of a fuel efficient or even electric vehicle, you only need to intend to do it, want to join the others already ahead and feel that you can do it!

We know you will act as soon as we remove whatever makes you feel you cannot do the right thing

And of course what makes you feel you cannot do is due to money, lack of information or lack of availability of the fuel or car, so we will tackle that for you!

We know you also experience constraints such as lack of time,, encouragement, facilities or whatever

As soon as we give you and your peers more information you will of course all want to go get a green car! Right?

Don't worry, only your car will change, nothing else needs to change

It's all about you and your car and of course your money and what you know

We will only monitor the sales figures, we do not need to know if your driving is ok, or if you use the car right or even if you need a car at all….

You will see you can save money, fuel and nothing else changes!

A Story on Murray & Sachs descriptive theory informed transport interventions

We know your car makes your world go round

And it still can, but slightly differently, and guess what, you will be even more in control than before!

You just need to rethink if the way you drive really is the best way to treat your car…

We know you will act as soon as we train you and show you how to take even better care of your beloved car

Do not worry about those other drivers, they form the 99.9% that are really bad at driving, do not compare yourself to them..

You know, there are really cool ways to find out how good this new driving is for your car, its engine and your wallet too!

Don't worry, only your driving will change, the car stays the same, you might even pimp it with the savings you yield!

It's all about you and your car and of course your money

The environment and road safety? Oh well, you will contribute to that as well, sorry about that...

You can do all the monitoring, and even compete with yourself or pals on the road. Do not worry we will not touch your car, we know what it means to you!

If we want to know what your impact is we will use boring stats such as traffic accidents (not saying you caused them before) or emission reductions (that is good for the kids with asthma)

A Story on Norm Activation Theory informed transport interventions

We know you care about your wheels, but you also care about the planet/other drivers/your boss/your kids...

You like to help, even if there isn't any money in it for you

You like to feel that you are doing the right thing, and some of that you may have learned from others in society

You may even feel guilty if you don't do the right thing

We can activate your altruistic nature by making you aware of the consequences of your own actions for others

But you will weigh up the personal costs of acting, which may stop you from taking responsibility

A Story on Cialdini's Social Psychology informed transport interventions

We know you care about your wheels, but you also care about the planet/other drivers/your boss/your kids...

You like to help, even if there isn't any money in it for you

You like to feel that you are doing the right thing, and some of that you may have learned from others in society. Some of that is what you feel ought to be done.

If other drivers around you are speeding, you may do the same. If you see a police car up ahead, he will probably reduce your speed.

If we tell you how much the 'average' driver consumes in fuel, it should make you want to change. However, if you use a lot less fuel you may be inclined to increase your use!

Norms can mediate between your own identity and that of a group. But your car as a status symbol may over-rule social motives and instead make you feel more powerful and better than others

Focus on needs and the meaning attribution of the car (use)

Murray's and Sachs' descriptive psychological theory on behaviour, and in particular the meaning of the car to users provided a clear entrance point to intervene in the Dutch **New Driving** programme: the motivations and meaning attributions of young male users all had to do with status and thus with a feeling of power. The intervention consequently translated this in a proposal for necessary actions that aimed at

reducing the psychological needs and meaning attribution related to the 'power' as a traffic participant that the use of a car provides for the young male segment.

The feeling of power was also used strategically by increasing the user's insight into the car and its use by means of technical measures such as speed limiters, feedback systems such as emission meters, ecometers and ‘taximeters’, giving feedback on costs per km. As such the intervention aimed to shift what was considered 'power': instead of "aggressive driving" a more social, easy going, relaxed type of driving was promoted as a new social norm. And finally the plan was (it was not implemented) that availability and acceptability of using a car would be questioned by distributive and fiscal measures: kilometre quotas, tax relief on collective ownership of cars.

What the design of this intervention highlights is an appreciation by the programme developers that, to change user behaviour, much more is needed than only targeting motivations. Technological, infrastructural, institutional and cultural aspects need to be tackled as well. In practice, the campaign and the actual interventions were focusing mainly on creating a new meaning of 'power' for young car users, e.g. by not mentioning the government in the campaign. The focus was on providing concrete actions (shift gear below 2500 rpm), not just framing these actions as sustainable guidelines and creating a new habitual driving behaviour by means of physical training. The institutional embedding was achieved by means of getting driving schools to incorporate ecodriving as the new norm.

The campaign did reach the mass of already experienced and habitual drivers, (in 2009, 84% of the population heard of HNR and 69% uses one or more principles), but the young new drivers were not socially stimulated to use all new driving techniques. In addition, many technological market-ready and easy options, such as setting the fuel per kilometre monitoring as default instead of the temperature or RPM were not used to the fullest.

The New Zealand **Active a2b programme** also focused explicitly on non-energy related benefits. Previously, transport behaviour change programmes in New Zealand have been marketed from a sustainability perspective but this often has had little appeal for individuals. It was important for Active a2b to be attractive to a wide range of people and for this reason it was marketed as a health and wellbeing programme aiming to bring direct benefits to individuals. This was an acknowledgment that from the actor’s perspective, individual health and wellbeing improvements (which could be seen/felt after a short period) are more likely to be a motivating factor, than less tangible, more long-term, more invisible environmental benefits. This focus on multiple non-energy benefits was achieved with support from health partners the Cancer Society, Compass Primary Health Care Network and Regional Public Health. While congestion-related outcomes were still the primary aim, the partnered programme took a more holistic approach to health and wellbeing by including nutrition and smoking cessation information in addition to the focus on walking and cycling for transport.

Tailoring is yet another way of focusing on needs and meaning attribution. Tailoring is essential to intervene in driving behaviours, certainly when designed from value and norm based theories. The **New Zealand Post fuel efficient driver training programme** highlights this. The programme was specifically developed to meet the demographic composition of the target group and take into account specific attitudes and contractual and structural constraints. The existing target audience of courier drivers are contractors to the NZ Post Group rather than employees. This brings complexity in participation, as this could be perceived as one business dictating the terms of another’s operation. To mitigate this perception, the trainers were all contractors as well and generally own sizable businesses. The trainers were chosen for their trusted status and respect within the driver community, which adds significant credibility to the programme as the contractors are being instructed by peers rather than employers. Many of the target audience have been driving for many years, and have considerable professional pride making them reluctant to taking instruction. The use of respected contractors as trainers is important in the programme's success, as well

as ensuring that the results are visible. For example, the trainer often opens a session by explaining the gains that they have experienced through the programme (5-10% reductions in fuel use in the trainer group). A target of a 5% reduction in fuel use was sought, and is being achieved in a sustained manner. Reductions in fuel use by an individual can be up to 40% in a training session, which demonstrates that the potential for reduction is much higher than the target. Another clear success in tailoring is the selling of the programme using a key message that resonates with the audience e.g. saving fuel means increased profitability for their business.

The **Swedish congestion** pilot shows the importance of smart policy design. The policy decision is a catalyst for how decision makers view the public, but also for how those affected by decisions respond and sometimes reposition themselves. Policy instruments can be evaluated on how they interact with, or conflict with, basic cultural patterns of everyday life. So it is very important to understand that the way that introduced policy instruments are perceived depends on the local context. It must be perceived and experienced as meaningful for the recipients of the intervention. This means it must be grounded in everyday life, must be fairly easy to do and understand and must give real or abstract gain. The Stockholm congestion trial, even though it was seen as pretty radical, served as a 'stage for reflection', where Stockholmers had an opportunity to experience what a congestion charge meant on an individual and city-wide level. When introducing a measure designed to mitigate practices with heavy environmental and social consequences (congestion seen as a dilemma of urban commons), the affected public demanded that alternative patterns of actions should be improved. Somewhat paradoxically, negative publicity from eg dramatic political processes or conflicting interests can lead to public debate or media coverage which enhances the public understanding how the policy instrument works.

Prescoping = essential

What all programmes based on value and meaning attribution changes have in common is that they explicitly build on the existing behaviour, and try to understand where this behaviour stems from. This is a very important and evidence-based approach which allows tailoring to personal norms, values and motivations.

The New Zealand **Active a2b programme** pre-scoped the target group by means of opening the programme primarily to those participants who drove to work in a vehicle at least twice a week at the time of registration. This 'Active a2b Plus' group received a higher level of personalised support than other participants, including individual phone calls where goal setting and motivational support was provided.

The **Swedish congestion pricing pilot** also performed a very extensive pre-scoping exercise. The following issues were identified before, during and after the trial: the travel pattern of Stockholm inhabitants, car traffic, public transport traffic, pedestrian- and bike traffic, environmental- and health effects, traffic safety, allocation effects, business and regional economy, benefits and costs of the toll system, national economy, and finally the attitudes towards environmental tolls/taxes were pre-scoped.

Focus on concrete actions, capacity building, not sustainability guidelines

Interesting enough, mobility DSM rarely seems to focus on sustainability as primary aim and does not appeal to sustainability goals. In the **New Driving programme** in the Netherlands, the theory used clearly stated to focus on meaning attribution of the car and not on impact issues such as the environment. The new drivers were targeted on their 'power' related motivations. In fact, sustainability was not mentioned at all in the campaign and although it is an ecodriving programme, the title of the programme focuses on the newness of the driving, not its ecological aspects. What this highlights is that a DSM programme can be successful without explicitly or primarily mentioning ecological or energy issues.

The New Zealand **Active a2b programme** was primarily a health and wellbeing initiative, whereas the **New Zealand Post Driver Training Programme** focused on business profitability.

There is almost nothing as habitual as driving. It is embodied and very often we shift gear or take a look in the mirror on a very unconscious level. The **Theory of Planned Behaviour** hypothesises that the perceived behavioural control is strongly influencing behaviour, in particular the extent that the person perceives his or her objective power to perform the behaviour accurately. When a new behaviour needs to be learnt, training a new behaviour such as is occurring in the Dutch **New Driving** programme or the **Driver Training** programme in New Zealand is extremely important, and the reward in the form of a diploma or drivers license is key to reaffirming the actual behaviour control and capacity to perform the behaviour accurately. Such 'training' is only just beginning to emerge in the retrofitting (eg **Sustainable Järva**) or smart metering domain (eg the 'Energy Masters' in **Energy Neighbourhoods**) and is a lesson to be learnt on how to create and affirm new behaviour.

When an existing habit needs to be changed such as is the case with experienced drivers, active coaching to break habits of a driver and set new normal behaviours is key. The New Zealand **Fuel Efficient Driver Training Programme** asks the participants (drivers for New Zealand Post) to drive a vehicle and they are actively coached in fuel efficient techniques by the trainer, with participants generally showing improvements of 5%, but often up to 40% between the two drives. This is a very powerful, immediate, direct way of showing the effectiveness of fuel efficient driving techniques and previously sceptical or obtuse drivers often turned into very enthusiastic proponents of these techniques. It also helped that an added, competitive element (including competition with oneself) came to the fore, where drivers were trying to beat each others', or their own, fuel savings.

Targeting the information deficit

According to the **Theory of Planned Behaviour** external interventions should be targeting norms, values and perceived behavioural control. All three can be targeted by means of price incentives, tackling informational barriers and infrastructural changes. The **Swiss fuel efficient car purchasing project** (survey) focusing on understanding fuel-efficient car purchasing behaviour, and the Norwegian **Nobil programme** both used the psychological **Theory of Planned Behaviour** and both aimed at increasing the uptake of a specific type of car. In both programmes, focusing on closing the informational deficit was the primary intervention activity.

The hypothesis in the **Swiss fuel efficient car purchasing project** was that perceived behavioural control, response efficacy, problem awareness, and personal and social norms have a direct influence on the purchase of a fuel-efficient vehicle. The behaviour of buying a fuel-efficient car was found to be influenced by the association of fuel-efficient vehicles with smaller size, and reduced power and acceleration. This symbolic meaning attributed to fuel efficient cars had significant negative influence on their purchase. In addition, these claims have to be believable: Smart cars have done well, though their environmental credentials are questionable – depending on the model. An outcome of that Swiss study was that communication managers should promote their energy efficient products from another perspective, that is to praise them as "cool and sexy and powerful" products.

The Norwegian **Nobil programme** also aimed to close an information deficit with its extensive database.

Visualising is another means of targeting the information deficit. The New Zealand Fuel Efficient Driver Training programme used the **Value Action Gap theory** and this led to a design focused on all three social-institutional barriers as identified in this theory: individuality, responsibility and practicality. Individuality was targeted by demonstrating that fuel efficiency is a mark of driving professionalism, and to get the drivers responsible and interested. Senior Leadership in the form of well-known model drivers provided support (responsibility); and furthermore the intervention tackled the practicality barrier by aiming at showing how actual performance differs from best practice. Training sessions and feedback were provided to the drivers, thus targeting the lack of information on actual versus goal behaviour. Direct feedback in those sessions

identified the gap between values and intentions and actual behaviour. After the training confirmed that there was no gap anymore, it showed that it supported a sustained change.

The Dutch **congestion pricing pilot Spitsmijden** also used the power of providing information that was seen to be lacking to participants and causing their lack of avoiding rush hour. In addition, practical issues such as the costs of taking a longer route or paying more for public transport, or the lack of information about alternative routes which might stop people from pursuing their values were tackled through economic incentives and information. However, this case took additional steps in terms of visualising the behaviour and goal behaviour. Research was conducted on how to circumvent city centers during rush hour. Four ways were identified: traveling on a different moment of the day, choosing another route, avoid traveling (working at home) or choosing another travel modality. Two types of incentives were used to achieve these behaviour changes: a price incentive for every avoided drive in the city and information supply through a hand computer in the form of navigation and suggestions for other modalities. In addition, the specific project used the construction of a 'personal avoidance plan'. The purpose of this plan was to determine when and how the rush hour was avoided.

The personal avoidance plan is based on the principle of commitment and consistency by **Cialdini**[36]. It is one of the six principles Cialdini describes in his book *Influence: the psychology of persuasion.* The principle of commitment and consistency states that when people commit themselves to something, they want to be consistent and comply with it. Feedback (in the form of emails) was provided to the participants on the effectiveness of their avoidance plans. Participants were monitored through measuring devices that were built in the car and given a hand computer that would suggest alternative routes. in the end the majority of the participants did not use these, because they already had a computer on board, the computer did not function or the routine drives did not require that level of feedback. Feedback on the personal avoidance plan described which intended rush hour was actually avoided and which one was not. It is a factual description to see if the targets have been met and therefore quantitative negative feedback. However, the targets that were met were coloured green, the unmet targets red. This also adds a qualitative character to the feedback. The feedback mails reminded and reaffirmed participants to be consistent with their personal avoidance plan. After the termination of the project, feedback was used to remind former participants of the desired behaviour. In addition, the participants could provide feedback in the form of questionnaires.

Providing feedback helped to perpetuate rush hour avoidance through self-persuasion. The idea behind self-persuasion is that formulating your own positive perception in e.g. in questionnaires helps to continue conducting the desired behaviour in the future. Self-persuasion can be seen as a way of complying with earlier statements. This computer-aided form of visualising proved very effective, so effective that when the pilot was finished, the economic incentives were removed but feedback mails were continued to support lasting behavior change. In the end, there were on average 53% fewer drives during rush hour amongst the 2300 participants. After four months (no more economic incentives), this percentage was still 47%. The personal avoidance plan had a positive effect on the target behaviour: a 27% higher rush hour avoidance compared to participants of the national program (without the personal avoidance plan). The percentage dropped to 18% after the stop of the project.

Leveraging change moments

Part of the **Norm Activation Approach** is to create a new norm and the New Zealand **Active a2b programme** is fundamentally a social programme based on 'normalising' active transport. A key aspect of the programme is that it makes use of natural 'change' moments where an old behaviour can be 'unfrozen' (based on **Lewin's unfreezing/refreezing** theory of change). Travel patterns are primarily habitual. The journey to work is a very habitual routine and in most situations it is a behaviour that is

[36] Cialdini, *Infulence; the psychology of persuasion*, Collins 1993

explained by peripheral processing and does not undergo central processing. Active a2b is launched every year in the first few days that workplaces return to work in the new year. The recruitment message is strongly focused on helping people achieve their New Year's resolutions and comes at a time where people are out of their normal routines, and more receptive to making changes. It offers an opportunity to re-consider their travel patterns and how they can incorporate regular exercise into their daily routines. The programme is four months long, a sufficient length of time for 'refreezing' of a new behaviour to occur. The Active a2b programme, and its timing based on supporting New Year's resolutions, leverages a 'change moment' and offers a chance to jolt people out of their driving habits and reassess their choices.

Focus on lifestyles

Some mobility initiatives actually target the level of lifestyles and how lifestyle can be targeted to create appropriate changes in our consumption behaviour (e.g. **2000 Watt Society** CH). Targeting lifestyles also generates attention for the meaning of things and behaviour practices in our lives. This implies that, in order to change lifestyles, we also need to change the meaning we get out of our behaviour. To do so, a new social norm needs to be created, and products and things from which people derive meaningfulness need to be manufactured and made available in an energy-efficient manner. The Dutch **New Driving** programme demonstrates that this case missed the technological aspects of lifestyle, where the car and its design need to create new meaning to its users, or allow for the same meaningfulness but in a more energy-efficient manner.

Some projects that focus on lifestyles actually go beyond a theme-specific boundary. The Swedish case on retrofitting demonstrates how the whole neighbourhood was re-planned towards favouring bicycling. This also shows the importance of urban design and decadal infrastructural decisions such as roading and town planning. Policymakers should think if they are more successful at the 'normal type of policymaking' attempting to change individual behaviours one by one, which needs to be kept up for many years in order to become a social norms (e.g. the Dutch **New Driving**, and the **New Zealand Post driver training**) or rather take a politically radical systematic, long-term approach when it comes to building institutions and infrastructures that last decades or generations.

Focusing on lifestyles also implies that multiple interventions are necessary to address behaviour in its many complex interrelated contexts. The New Zealand **Active a2b** programme appreciated this and followed **Stern's Principals for Intervening** by offering multiple intervention types. Active a2b offered a range of information resources, as well as practical ways to overcome physical barriers (cycle skills workshops), individualised support (through one-on-one phone calls), social support through newsletters and goal setting. The Swedish **Congestion Pilot** also tackled multiple interventions, especially after feedback from the residents was received.

The Dutch congestion pricing project **Spitsmijden** demonstrates the importance of focusing on lifestyle to change the consumption behaviour. During the project most of the participants still used their car, but drove on different routes and/or times. Only 4% shifted to bicycle or public transport. To actually get people to change the behaviour of using a car, more is needed than information provision and commitment. Infrastructural changes would be needed, allowing for a better connection between bus and work or train and work, and even the involvement of the social environment, e.g. the employers and fellow employees might be needed to allow for different working hours, or more remote work from home, or free train subscriptions.

Using social norms

Although all initiatives target the social environment implicitly by attempting to create a new social driving or buying or mobility norm, all demonstrate great challenges. The Dutch **New Driving** programme for example, witnessed a mass media campaign to change the social norm of the specific targeted group of young male drivers and this new social norm was trained at driving schools. However, the rest of society, in

particular the already experienced drivers, were not targeted. This created a situation where new young drivers did not feel comfortable performing all driving actions of the new driving since the other road users did not demonstrate the same driving behaviour.

The **2000 Watt Society** also targeted the societal environment, and the political commitment and engagement through a referendum of the citizens was a good step towards creating a new norm, but a key criticism of the inhabitants of participating cities is that the programme faced great challenges in tailoring the overall social norm to the different types of inhabitants and their sub norms.

The New Zealand **Active a2b** provides personalised support to people, but is fundamentally a social programme that uses **Norm Activitation theory** that is translated into an intervention based on 'normalising' active transport. This approach builds on the assumption that for behaviours to change in the long term, the "whole social field" will need to be adjusted. Cycling in particular often has a negative stigma attached, with many people associating it with lycra-clad sports people irritating drivers. One of the main features of the programme, and something that receives positive feedback, is the sharing of participant success stories through a weekly newsletter. With these stories, participants were profiled to highlight how 'normal' it was to walk or cycle to work. In Year 2 of the programme, the stories steered away from heroics of people walking or cycling 50kms and focussed on more modest changes people were making, that were easy for others to relate to. This appealed to participants and was favoured over the more 'sporty' type achievements seen by those travelling very large distances.

Initially, the New Zealand Active a2b programme targeted those people that were previously driving to work. Regardless of this target, many of the people attracted to the programme were already walking or cycling to work. However, the programme developers found that having a large number of people already doing the desired activity, helped to create a strong community feel, where new active commuters felt supported by the many people in Wellington already doing it. This sense of community, and new norms, have been one of the successes of the programme. For a third consecutive year, the programme's target audience of drivers, referred to as the **Active a2b Plus** group, significantly decreased their car journeys to work. A reduction in car trips of 20 percentage points and a corresponding increase in active travel have been consistently achieved with this group since the programme's launch in 2010. While the resources and social support provided by Active a2b are well received by the standard group, and 47% of them report that the programme helps them increase their walking and cycling to work, main mode data gathered from registration and follow-up surveys have not shown significant increases in levels of active travel since 2010. However, the fact that this group shows no decrease in levels of walking and cycling despite seasonal changes from January to May indicates that the programme is nonetheless having an effect for these participants. Active a2b thus aims to start changing perceptions around the normality of active travel to increase its acceptability. The programme uses constant positive messaging and images to counter negative stereotypes portrayed in other media.

Active a2b is furthermore an example of **community-based social marketing**, delivered through a workplace setting. Many of the elements that Doug McKenzie-Mohr refers to were designed into Active a2b including: commitments (through over the phone conversations, team challenges and goal magnets), social norms (through positive messaging and newsletter stories), incentives (freebies e.g. desktop calendar and discount card) and visual prompts (welcome letter, desktop calendar and fridge magnet). One of the main purposes of the individual phone conversations is to work through peoples' barriers and identify ways to overcome them, a technique recommended by Doug McKenzie-Mohr.

A final lessons learnt with the New Zealand Active a2b programme is that focusing too much on safety issues might not work well in establishing a behaviour as desirable. Most cycling-related initiatives in NZ, are extremely focused on safety and are implicitly not portraying cycling behaviours as desirable. For

example, cycling numbers declined after the helmet law was introduced and people started to consider it something dangerous that required safety equipment, making it less desirable.

A paradox is that programmes that explicitly target the social norm to support behavioural change of individuals, such as the Dutch **New Driving**, the Dutch and Swedish **congestion pricing** projects and the Norwegian and Swiss **fuel-efficient or EV car purchasing** programme do not explicitly involve the direct social environment of the group targeted, i.e. the family, colleagues etc. The Dutch congestion pricing pilot did use the social norm in their feedback mails as a comparison with other participants was presented. In addition peoples' positive citations from questionnaires were used in publications, on the website and in feedback mails.

They do aim to change the social norm of the individual but often fail to involve the other stakeholders necessary to support and embed the new behaviour. The use of a group of peers in the **NZ Post driver training** programme was a clear exception, since the programme thus became a social activity with the aim to create a social norm amongst the immediate relevant social environment, by drawing on the participants sense of competition. And another way the Dutch New Driving programme and the New Zealand Post driver training programme focused on the social level was through linkages between fuel efficient driving and safe driving, which inherently puts drivers in a social relation with other traffic end-users.

The influence of Nudging on the design of the intervention

*"**@Perspective_pic**: Amazing Illusion To Slow Down Drivers and thus nudge their behaviour change. pic.twitter.com/RhDd1OoQEj"*

The **Nudge Theory** is proposed by Thaler and Sunstein in their 2008 book Nudge: Improving Decisions about Health, Wealth, and Happiness. A nudge is described as a positive reinforcement or indirect suggestion to influence motives. Nudges can facilitate (sustainable) behaviour by making it more

convenient or making alternative behaviour less attractive. This formulation is very broad and so is nudging. The creation and in particular the sustaining of a new behaviour and a new norm need the accompanying institutionalisation of this new norm and associated changes in the infrastructure and technologies.

Although the Dutch **New Driving** programme integrated the principles of the new driving in driving schools and got them endorsed by a network of several related organisations such as ANWB (motoring organisation), BP and consumers' associations, a key change was not undertaken. The effectiveness could have been enhanced by means of nudging users to behave more sustainably. The initiative did not make sufficient use of the physical and technological environment to support the requested behavioural change, it had no default option or choice architecture. People still had to 'look' for the information on the speed and rpm meters. This nudging could have been achieved by means of strong collaborations with relevant stakeholders such as vehicle manufacturers that could set feedback of in-car displays on fuel per kilometre as default instead of temperature or RPM. Also in the Swiss **fuel efficient car purchasing** programme, car manufacturers could have nudged potential buyers with the creation of information and prompts, such as fuel efficiency labels, to help consumers to better identify fuel-efficient vehicles and to make them aware that fuel-efficient versions of almost every vehicle model exist. Nudging can also be achieved by means of role modelling. The public sector could take a leading role and make fuel efficiency a prominent selection criterion for its car fleets.

In the new Zealand **Active a2b** programme, integrating public and active transport was a common theme throughout the programme to allow people traveling longer distances to still incorporate walking or cycling into their commute. 'Walk to the railway station' was a preferred message to 'Toughen up and cycle those 25 kilometres!' In spite of the messages, the lack of actual changes in the infrastructural support system was a problem. The programme developers received some feedback from participants that they found the soft measures confounding when there doesn't seem to be any on-the-ground investment in infrastructure.

The Swedish trial for a **congestion pricing system** performed in Stockholm in 2006 made a real effort at also creating a supporting infrastructural environment to nudge people to avoid the congestion. The strong combination of stakeholders made it possible to create this. The extensive pre-scoping and thus tailoring of the pilot and the accompanying institutional and infrastructural measures did contribute to the achievement of most aims of the trial: traffic was reduced at intended times of day, the environmental goals were achieved. Pollution has decreased. According to an estimation, the health effect of the improved air quality is three times higher than an effect that would be caused by a rise in price for fuel. The Stockholm congestion tax was later implemented on a permanent basis on August 1, 2007 (after winning a referendum) and is currently in use.

As was also the case in the **Dutch congestion pricing** project, participants did not increase working from home/by distance and did not increase the use of car-pools. However, compared to the Dutch congestion pricing, the Swedish inhabitants did travel more on public transport or organised their travelling into fewer trips. This is clearly related to the supportive infrastructural environment created. In the Netherlands, the project provided information and taxes or levies, but no infrastructural changes were performed.

Financial incentives as enablers

Financial incentives in the mobility DSM, e.g. pricing congestion or tax exemptions for the purchase of fuel efficient cars have potentially a strong role to play in emphasising the social desirability of a time of use change of purchase behaviour and thus support the creation of a new social norm.

Monitoring and evaluation of transport interventions

Is evaluating impact sensible at all in transport DSM?

Monitoring and evaluating mobility DSM programmes projects poses very distinct challenges. Many of the intended outcomes, e.g. changes in the symbolic meaning attributed to a car or a bike, or increased positive perceptions of urban traffic, are extremely difficult to assess, and can actually only be assessed by qualitative inquiries making use of e.g. surveys or interviews.

In addition, many other goals and aims related to mobility DSM are difficult to decouple from other societal trends or events. Mobility DSM is not deployed in a laboratory situation, or the confined space of a home, so other (changing) conditions always interfere with the intervention. For example, decreased air pollution, the number of fuel efficient cars bought, increased car sharing etc are all very much also linked to the economic circumstances (e.g. global financial crisis) and other societal conditions, which can be quite localised. The direct causal effects of mobility DSM programmes or projects on decreased traffic victims and/or on increased transport safety are also very difficult to assess. Even more difficult is to relate new driving behaviour to decreased accidents.

It is virtually impossible to monitor the actual change in driving behaviour on the individual level. Self-reported change in behaviour or indicators such as familiarity with a campaign (number of people that say that know a campaign) are the best information available on actual driving changes. These evaluation metrics, however, say very little about the actual and sustained impact of an intervention and actual behaviour change. In addition, many other changes could have had an impact on road safety, e.g. changed rules with respect to cyclist or pedestrian rights.

Whether or not clear evaluation of impacts is possible strongly depends on the theory or model the intervention was built on, for example, the **Theory of Planned Behaviour** deals mostly with discrete, isolated behaviours. This makes monitoring relatively easy. However, the better a clear causal relationship can be identified, the less meaningful the evaluation becomes because it does not (or only in a limited way) account for the many types of contextual influences on intention and behaviour (most importantly various types of physical influences). But accounting for, and appreciating different types of contextual influences on mobility behaviour, actually makes it practically impossible to monitor and evaluate the effectiveness of any intervention focused on discrete isolated behaviours. In addition, even quantitative indicators such as emission reduction or avoided emissions need to be modelled, and the impact of an intervention on those indicators cannot be singled out. It is therefore important to make a very broad evaluation, containing indicators ranging from changed meaning attribution to decrease in traffic accidents and emission reduction or congestion decrease.

Goal Setting and benchmarking key to breaking a habit

When an existing behaviour, such as driving behaviour needs to be changed, setting goals and benchmarking are essential. Drivers need to be affirmed of the impact of their behavioural changes. The New Zealand Post **Fuel efficient driver training** programme works with benchmarks: a pre-training and post-training comparison of fuel burned over a test route is used as the testing for achievement and actual fuel burn rate before and after the training is considered to be the most important indicator from a business perspective. Currently, the programme is delivering a return on investment that exceeds any other possible intervention to achieve a similar reduction in fuel burn.

The New Zealand **Active a2b** programme used goal setting as an important motivator to change. The programme is focused on everyday changes and achieving modest goals helping to stay within peoples' tolerance for change. Participants were encouraged to set themselves a realistic and specific goal. One of the tools available for participants is a goal magnet, that is designed to be placed on their fridge. This not

only allows people to set a specific intention for the programme, it provides a visual prompt and commitment to achieving that intention.

There is a clear underused opportunity in a technological sense: in cars, the market -ready and rather standard monitoring opportunities provide exceptional opportunities for real time monitoring and feedback with fuel/km meters and red marked RPM zones.

Matching end-users with targets

In many of the initiatives we investigated, the primary targets are located on a societal level: for example the Dutch **New Driving** programme, the Swedish and Dutch **Congestion Pricing** projects, the Norwegian **Nobil EV grid** platform, the Swiss **2000 Watt** programme all focused on societal targets such as reduction of CO2 emission or GHG emission, increasing traffic safety, decreasing congestion, increasing regional economy. Often these are societal 'needs' but individual behaviour change is asked for, thus creating a social dilemma issue (a situation where people feel they are alone in their efforts and thus bear the costs or risk individually whilst society at large benefits from their effort. CO2 reduction is purely a societal benefit, the other benefits mentioned above do include benefits to individuals, even if not direct return to individuals taking part in the programme. Some initiatives, e.g. the New Zealand **Active a2b** programme, and the New Zealand Post **driver training** programme did explicitly focus on the other multiple benefits, ranging from health, economic, social benefits for the individual.

Monitoring distribution of costs

The cost-efficiency of a programme is an often used evaluation metric to assess the effectiveness of an intervention, but actually this is an unfair metric. The cost of campaigns are not the only costs of interventions. Generally, only costs on the supply side are calculated. But the individual drivers themselves potentially have additional costs in terms of lost time, problems with getting negative comments or social stigma, but these costs can hardly be calculated.

Conventional monitoring of transport intervention success	More systemic monitoring of transport intervention success
· Reduction of CO2-emissions by traffic · Costs of measure (euro or other coin per saved ton of CO2) · Total number of efficient cars sold · congestion decrease · familiarity with a campaign	• all of the issues listed left, plus: • decrease the traffic load during rush hour in the city centers • number of drives in rush hour • higher safety due to higher accessibility of the city • improvement of air quality due to the shift to less polluting modalities and more economic driving (less acceleration and braking) • commitment and persistence of commitment • changes in the symbolic meaning attributed to a car or a bike, bus or train • fuel burn rate • increasing regional economy • perceptions of urban traffic • increased car sharing • changed rules with respect to cyclist or pedestrian rights, • health benefits • economic benefits for drivers • time saved for drivers • social benefits • changes in driving behaviour (less breaking, quicker change of gear) • incorporation of regular exercise in daily activities (when focusing on modal shift) • smoking cessation (when focusing on modal shift) • nutrition changes (when focusing on modal shift) • changes in social norms on normal travelling modes • decreased car journeys

Recommendations: Key transport interventions lessons and questions

The lessons below are tailored to policymakers, intermediaries or other initiators of DSM retrofitting interventions.

1. Creating new meanings for the car might allow for more sustainable driving behaviour and purchasing behaviour. Focus on what is meaningful to drivers, and that probably will not be the environment or traffic accidents, but their health, wellbeing, comfort, health of their car, their status, feelings of power. **Cars mean everything to many people, be careful how you approach them.** DON'T TAKE AWAY THEIR WHEELS.

2. Focusing on lifestyle and the role of the car is key but do not forget that life is also very much about the technological thing called car. Allow for the same meaningfulness but in a more energy-efficient manner by producing and providing things from which people derive meaningfulness in an energy-efficient manner. **An energy efficient car can be sexy (see the Tesla!).** CARS REFLECT LIFESTYLES.

3. Focusing on lifestyles also implies that multiple interventions are necessary to address behaviour in its many complex interrelated contexts. **Use a toolbox of interventions that work together.** YOU NEED MORE THAN ONE TOOL TO FIX A CAR.

4. Used trusted and respected peers to deliver the message and show the alternative. **Active coaching by trusted peers is key.** TRUST IS EVERYTHING.There is not much as habitual as driving and traveling patterns. It is truly embodied in seasoned drivers and very often we shift gear or take a look in the mirror on a very unconscious level. **Training is essential. Prescope** to understand where the drivers behaviour comes from. Set goals and visualise the gap between the actual and the goal behaviour and confirm when the gap is closed. **Focus on concrete actions, capacity building, not sustainability guidelines to change the behavioural routine.** PRE-SCOPE AND TRAIN, VISUALISE THE GAP BETWEEN ACTUAL AND GOAL BEHAVIOUR.

5. Driving is an individual but also a very social activity, so it is important to demonstrate how normal the desired behaviour is and get people to commit to it and become proponents. **Reward good behaviour** with a diploma or license, or making them driver of the week, to reaffirm the new behaviour. **Make smart driving the social norm.** BE SMART, DRIVE SMART.

6. Leverage change moments to normalise the desired behaviour. **The New Year/new car/new licence is great place to start!** SOMETHING CHANGED, SO I THINK ABOUT HOW I TRAVEL.

7. Urban design and decadal infrastructural decisions such as roading and town planning can be a real obstruction or a big opportunity. The creation and in particular the sustaining of a new behaviour and a new norm need the accompanying institutionalisation of this new norm and associated changes in the infrastructure and technologies. **Change the institutional and infrastructural environment!** IT'S ABOUT SO MUCH MORE THAN JUST THE CAR.

8. When you use the social norm as a lever, do not forget to also involve the social environment of your target (family, friends, coworkers). **Create a sense of community amongst drivers in an intervention and use social based marketing.** YOU'RE NEVER ALONE WHEN YOU'RE DRIVING.

9. Beware that the use of risk messages is a very difficult matter with many potential unexpected impacts, e.g. people can feel that cycling is life threatening when you require them to wear a helmet for safety reasons. **Beware of perverse outcomes.** RISK MESSAGES CAN BE RISKY.

10. Money might not do the trick or create lasting change, but economic incentives can play a strong role play in starting and emphasising the social desirability of a new social norm and accompanying behaviour. **Money is a good start but not enough in the long run.** MONEY AIN'T EVERYTHING.

Key questions for further investigation in transport interventions

1. Many of the intended outcomes, e.g. changes in the symbolic meaning attributed to a car or a bike, or increased positive perceptions of urban traffic, can only be assessed by qualitative inquiries making use of e.g. surveys or interviews. Changing the meaning attribution can, however, be a very effective way to change driver behaviour. **What methods are best to assess the changes in meaning attribution of the car?**

2. It is very difficult to monitor the actual change in driving behaviour on the individual level. Mobility DSM is not deployed in a laboratory situation, or in the confined space of a home, so other (changing) conditions always interfere with the intervention. **How could a comprehensive monitoring regime look like that focuses on both the individual and societal level and on quantitative and qualitative changes?**

3. The costs of transport campaigns are most likely not the only costs of interventions. Generally, only costs on the supply side are calculated. But the individual drivers themselves potentially have additional costs in terms of lost time, problems with getting negative comments or social stigma, but these costs can hardly be calculated**. How can the costs of transport interventions incurred on the end-user side be calculated and weighted?**

4. Smart metering: observations

Country	case	Theory or model used	Policy or Societally driven
Netherlands	Jouw Energie Moment	Expectancy Value Theory; Design with Intent, Interpretation for sustainable behaviour	societally
	PowerMatching City Hoogkerk	Value action gap theory	Mixed, subsidy from policy and part of larger policy programme
New Zealand	Responses to Time Varying Prices for Electricity (Otago Uni)	Classical Economics and marketing	societally
Switzerland	Smart Metering Zurich Pilot EWZ	behavioural economics and social norms/comparisons	societally
	Smart Metering EKT Dietikon	behavioural economics	societally
Norway	Demosteinkjer	Theory of Planned Behaviour	societally
Italy	Time of Use Tariff	Classical Economics	societally
Austria	€CO2-Management	Classical economics	policy
	Energy neighbourhoods 2	Shared learning	societally
Sweden	Clockwise	Constructivist Learning Theory, collaborative learning	societally
Portugal	CoopRoriz	Combination of participatory and sociological approaches	societally
USA	Opower	Cialdini's social psychology theory	societally
UK	CHARM	social norms approach, practice theory	societally

The cases

The New Zealand Time of Use case[37]

In New Zealand, the wholesale price of electricity varies enormously by time of day but most retail pricing is set on flat rate pricing. This presents problems for power companies who can lose money on sales at peak periods. Shifting some demand from peak to off peak periods would help alleviate these issues. The **time of use tariff study** shows experimental evidence of the household response to weekday differentials in peak and off-peak electricity prices and is based on **neoclassical economic theory**. The data come from Auckland, New Zealand, where peak residential electricity consumption occurs in winter for heating. Peak/ off-peak price differentials ranged over four randomly selected groups from 1.0 to 3.5.

[37] http://www.business.otago.ac.nz/econ/research/discussionpapers/DP_1116.pdf

Once upon a time... there was a country that had a very deregulated electricity industry.

Every day...Kiwis were using a lot of power during peak periods, as most retail pricing is on a flat rate.

But, one day...Mercury Energy, a large gentailer, decided it needed to get its customers to shift some demand from peak to off peak periods. The roll-out of new smart meters that record electricity consumption at half hourly intervals provided opportunities to tune prices more closely to production costs.

Because of that...they did a time of use tariff trial where peak/off peak price differentials ranged over 4 random groups from 4c/kWh to 20c/kWh.

But then...they realised that most of the smart meter data wasn't usable.

Because of that... they also did a household survey. In that, they found that the people with the most environmental values consumed less electricity, but not a lot less.

So, finally... They found out that there was some conservation effort, especially in winter, but it wasn't related to the different prices at all! They also found that the people with the most environmental values weren't the ones conserving more energy during the trial. A simple bar chart showing peak and off-peak consumption each day of the month appears to have encouraged significant conservation during the months of most stress on the supply system.

And, ever since then...They realised this seems likely to represent 'low-hanging fruit': households who haven't given much thought to electricity consumption that does not demand a large part of their household budget apparently give it some thought. But ToU tariffs on their own do not change behaviours. **The end.**

The Portuguese project 'On Demand'[38]

The project intended to test the impact of utility-led residential demand side management response in the service area of Cooproriz. Clients were offered electricity feedback technology and a cut-off current device, which, with the approval of the clients, could be turned on or off by the utility.

The target population was very challenging, mostly because the internet penetration rate was very low. Preliminary efforts to acquire client participation were disappointing, with opt-in rates as low as 1%. The following engagement strategy was changed to opt out (a classic '**nudge'**), and consisted of phone calling residential clients to book an appointment to install the interface and its cut-off current device (plug). From the 1800 low voltage clients of the service area, those with contracted power less than 10.35 kW were selected as potential participants. Of those, only 1088 had registered phone numbers, and of which 419 have agreed to receive the installers. The overall participation rate was 38%.

[38] http://www.erse.pt/pt/planodepromocaodaeficiencianoconsumoppec/siteppec1112/medidasimplementacao/Documents/Sistemas%20gest%C3%A3o%20procura%20Roriz.pdf

Those individuals who would opt out of the demand response pilot could still benefit from the plug, because it could register the consumption of individual appliances. Those families who accepted to install the full package, were randomly assigned to control and two treatment groups. Control participants and were not exposed to any other form of contact from the project team.

The demand response experiment was held in March 2013 and lasted 7 days, each for 2 hours. Before the beginning of the demand response experiment, each treatment group was called for a meeting. One group was asked to agree to participate in the demand response experiment for the benefit of the whole community. It was also explained that the price of electricity was expected to rise, and this test was useful to evaluate the efficacy of residential demand response as a way to keep prices low.

People assigned to the economic incentive group, were told something slightly different: they were told that, if they would be part of the experiment they would be assigned to a raffle, which would consist of the accumulated savings of the whole group of participants, which we estimate to be 100€. Customers were instructed to connect the cut-off device to appliances that could have higher impact and decrease overall consumption substantially, for a period of two hours. The appliances suggested were those that would significantly decrease consumption if connected, and would have the least impact in everyday practices of participants. These were: electrical water heaters and freezers.

Results showed statistically significant difference between treatment groups and control, but the significance was not proved between treatments. However, the group that didn't receive the economic incentive, only the altruistic message, appears to have connected the cut-off current device to higher power appliances.

Once upon a time... in a country called Portugal, there was a region serviced by a very conscious retailer, that was willing to take chances for the benefit of its clients.

Every day... the clients would struggle to pay the bills, with rising unemployment.

But, one day... the retailer teamed with an electricity feedback company, ISA, and its proprietary technology Cloogy™, and both designed a pilot that was sponsored by the government's energy efficiency incentive scheme.

Because of that... they designed an experiment to test the impact of residential demand response, which could provide the necessary flexibility for the community to become resilient to the increase in prices. The experiment tested the impact of two modes of communication, with and without economic incentives.

But then! Hardly anyone opted into the experiment, so a classic 'nudge' was utilised - the opt out default setting. In the end, it meant a 38% participation rate.

So, finally... we found that those who were economically incentivized participate didn't do any better than the control or altruistically motivated groups. And curtailment was 10%, on average.

And, ever since then... the retailer has different options to respond to the needs of their population, in an economically and efficient way. **The end.**

The Portuguese On Demand in a tweet:

Dr Sea Rotmann @DrSeaRotmann 28m

The Portuguese 'On Demand' programme: a classic example of an opt-out default setting nudging participation #behaviourchange #Task24 #nudge

The Cloogy™ as used by the Portuguese On Demand programme

The Norwegian Demo Steinkjer[39]

The Norwegian **Demo Steinkjer**, initiated by the regional grid company in Nord-Trøndelag county in Norway to roll out smart meters to a total of 4500 households, implicitly makes use of the **theory of planned behaviour**. The pilot project features 700 households and 66 SMEs and is designed to give information to the grid operator (NTE) and government regulators about what type of interventions consumers accept in the name of energy efficiency. The pilot part is testing different meter solutions in 700 households, by installing different meters in different households.

The fear that smart meters are getting too smart for us (Leantricity 2013)

[39] http://smartgrids.no/wp-content/uploads/2012/11/Sluttrapport_fase_1_delprosjekt_2_Demo_Steinkjer1.pdf

Once upon a time... there was a Nordic government who was eager to implement smart grid solutions, so it mandated all electricity companies to install smart meters in Norwegian homes by 2017. But they would not say what type of meters they were going to mandate, or specify the rules under which the scheme would work.

Every day...the network operators in the central part of Norway cursed their lack of information about the grid load, and gritted their teeth thinking about how slow the central government was in deciding which meter design to go with.

But, one day...they decided that they could start their own pilot project to test meters. Which they did, with 700 households.

Because of that...hundreds of homes in Nord-Trøndelag now have an experimental setup of smart meters that they can use to check their electricity consumption, and compare it with their own previous consumption as well as that of their neighbours. Some are using it in a sort of competition with themselves, trying out techniques to lower their year-by-year consumption.

But then...someone asked why the grid operator was so eager to implement the smart grid in the first place. Maybe the information provided was more in their interest? And did the consumers really make use of the information?

Because of that...some homes have fallen back to their old habits, with the meter happily ticking away in a corner. Others, however, still like to play with the meter, seeing how they can keep reducing their electricity consumption.

So, finally...it remains to see what types of efficiency gains there will be, but this is a case of the TPB working as well as it ever will. **The end.**

The UK CHARM project[40]

The UK **CHARM** project explicitly used the **social norms approach** to stimulate behaviour change. Fieldwork was based in Bristol, UK. Over 400 households were professionally recruited, door-to-door, from one poorer and one richer area of the city, using an £80 incentive. CHARM developed a version of the SNA that used digital technologies (i.e. energy monitors, websites, email and SMS) to collect and feed back behaviour data. This was an example of a personalised SNA: those participants who received social norms feedback (i.e. average and best 20% figures for a group of others) also received feedback about their own behaviour. In addition, the project used injunctive norms, in the form of 'smiley face' emoticons, to discourage regression to the norm. The approach taken differed from most previous work in a number of ways: 1) feedback was based on actual behaviour rather than claimed behaviour; 2) as well as snapshots of behaviour, feedback included graphs showing how behaviour changed over time; 3) it compared two types of feedback: one that only included individual-level data and one that also included social-level data, and 4) evaluation included analysis of behavioural data and substantial qualitative research as well as the analysis of survey data.

[40] www.projectcharm.info

Once upon a time… the residents of Bristol, UK, had no idea how much electricity they were using by the various activities they did at home or how their total consumption of electricity compared to that of their neighbours. Because electricity was invisible, they treated it as if it was limitless and free.

Every day... they used washing machines, lights, computers, fridges and other devices as if it didn't matter how efficiently they were using them or that the energy was largely generated from dirty, fossil fuels.

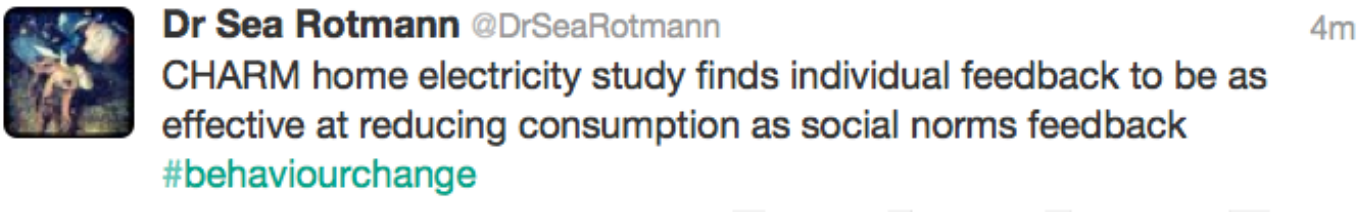
But, one day... social scientists from the CHARM project offered to show them graphs depicting how their consumption varied throughout the day and how it compared to that of other households. The people of Bristol found it fascinating to see their normal lives converted into scientific-looking graphs. They loved to try to work out which parts of their lives were responsible for which parts of the charts. They were surprised to see how their consumption varied throughout the day and how much electricity they appeared to be wasting.

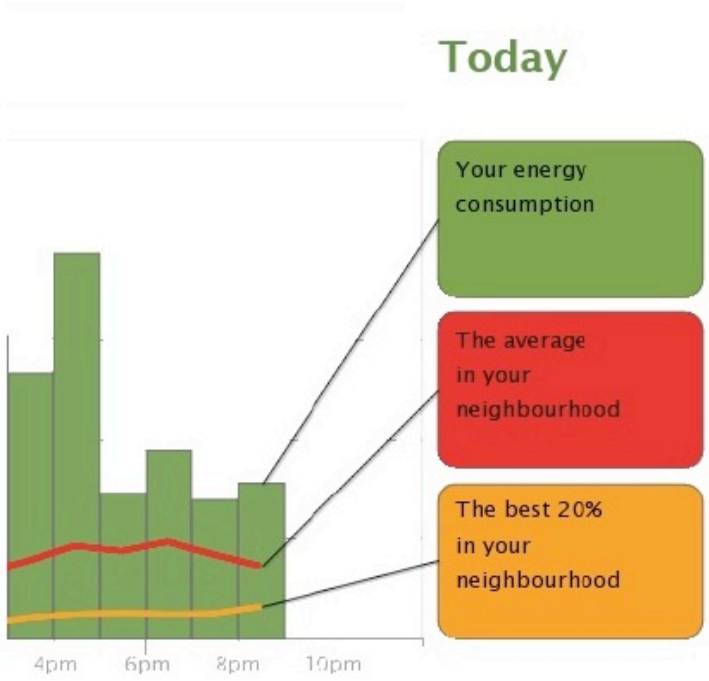
Because of that... some of them started to change their behaviours, switching things off when they weren't using them, sharing meals so as to use the oven less often and buying more energy efficient fridges and freezers.

But then... the project fininshed and the good.people of Bristol could no longer see any graphs.

So, finally... Electricity became invisible again for some but others stayed true to the memory of the graphs by continuing to eschew waste make better use of that most precious of commodities, electricity. **The end.**

Project CHARM in a tweet:





A household's energy consumption as shown in Project CHARM

The Opower Home energy reporting platform programme[41]

One of the largest, longest running (7 years and counting) and rigorously monitored and evaluated programmes in the world is the **Opower Home energy reporting** platform programme. This programme is inspired by a behavioural science experiment run by Robert **Cialdini** (Understanding and motivating energy conservation via social norms, Cialdini and Schultz, 2004). First Opower wanted to expand the impact of the Cialdini study by using mailed reports, and then moved to other channels of communication. Opower has achieved 85 deployments in the US. Opower is currently rolling out programmes in an additional six countries around the world.

[41] http://www.opower.com/

Once upon a time... there was a very clever little company in the US, called Opower.

Every day... the clever people at Opower were thinking how they could use the psychologist Robert Cialdini's studies on normative feedback and behaviour to help utilities and their customers save more energy.

But, one day... they designed the Opower Home Energy Management Platform which is designed to deliver better information to customers in way that not only informs, but also motivates customers to take action.

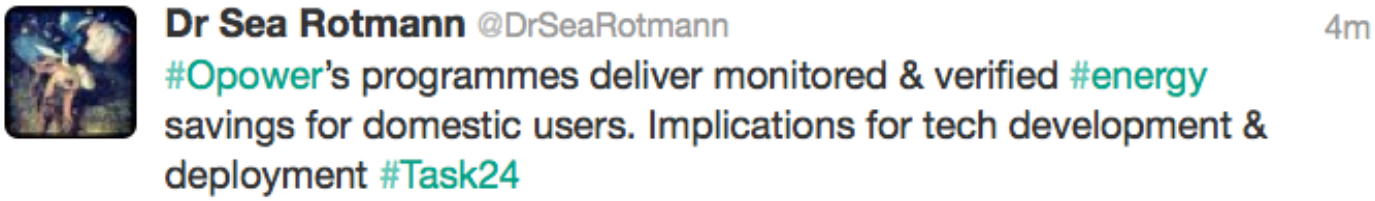
Because of that...they rolled it out to millions of utility customers in the United States, helping them answer two crucial questions: How am I using energy and how I can save energy and money (without impeding on my lifestyle)?.

But then... they realised that some customers actually increased their energy use so they would become the norm! Some of that was even divided between political lines (Republicans increasing their energy use compared with Democrats). And some customers really didn't like to see frowny faces on their utility bills.

Because of that... they designed a whole range of feedback that suited their different customers' needs.

And, ever since then... their customers saved an average of 2% of all their household energy and Opower now operates in 30 States and 7 other countries internationally. **The end.**

Opower in a tweet:



The Swedish project Clockwise[42]

The Swedish project **Clockwise** investigated whether a central power display (Energy AWARE Clock: a real-time display with a graphical image of the households electrical consumption) could support a more energy efficient behavior. The project started in September 2008 and continued to August 2009. Energy AWARE Clock was tested in 9 households in Ursvik for three months from January to March 2009. The

[42] https://www.tii.se/projects/clockwise

artifact Energy AWARE Clock was developed during an earlier project Aware and is a new kind of energy display that uses a time (i.e. an analogue clock) metaphor to visualise a homes' electricity consumption. Just as a clock, the EAC may be hung on the wall. Providing the ambient feedback on electricity consumption drew the attention to high-consuming activities and products. Providing electricity consumption feedback in an aesthetically attractive way motivated people to engage in using electricity more efficiently (**Emotional Design** – e.g. Norman "Emotional Design", 2004).

Once upon a time... There were nine families living in nine identical houses in Ursvik – a small, small suburb in a very cold and dark country called Sweden.

Every day... The families used their electrically heated bathroom floor, their electrical coffee maker, their dishwasher, their tumble dryer and their spotlights without reflecting about the amount of electricity they used.

But, one day... The families were contacted by the people who had built the houses the families lived in. They were asked if they would like to participate in an experiment organised by a creative research institute. The experiment would place a funny object called The Energy AWARE Clock in each house and after three months researchers from the creative research institute would interview the families about their experience with the clock. The clock was no ordinary clock. In fact, it was connected to the energy meter of the house and measured the household's electricity use. It displayed this in inspiring circular graphs so that the family could follow their own behavioural pattern on the level of one minute, one day and one week. Of course, the families said yes, they would love to participate in the experiment.

Because of that... The families learned about how much electricity their individual appliances used and reflected about what a kWh really is and started to discuss energy use with their neighbours. During the first three weeks they really learned a lot about their own household.

But then... They didn't use the clock for learning anymore. Rather, the clock was domesticised into the households and was subsequently used to check that everything was normal and that no unnecessary electricity use was going on. They clock became like a member of the family.

Because of that... The nine families in Ursvik got interested in energy use, reduced their use of some appliances and increased their use of others.

And, ever since then... The Energy AWARE Clock was developed into a product, which may now be bought off the shelf in the shop. **The end.**

The Energy AWARE Clock in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

The Energy AWARE Clock: Clever, emotional design leading to large #energy savings and #behaviourchange in the household @IEADSM #Task24

The Energy AWARE Clock

The Dutch project Your Energy Moment[43]

The Dutch project **Your Energy Moment** runs in three neighbourhoods in the Netherlands. In Your Energy Moment, participating residents receive a smart meter, an energy computer, solar PV panel and a smart washing machine/dryer/heat pump. Participants can indicate what their preferences are for consuming electricity. These smart machines will turn on automatically when conditions are favourable (e.g. when the sun is shining or when the electricity tariff is low). With feedback and feed forward on the display of the energy computer, participating residents can shift other appliances as well. To stimulate consumers to shift their demand, a variable tariff is used. The project is performed with neighbours collectively to encourage participation. The project is (implicitly) built on the **Design with Intent** (DwI) Toolkit and explicitly built on insights from a previous pilot called **'Smart Wash'.** These insights are used to develop the smart grid technology of this pilot. A combination of theories and models further implicitly underlie the pilot and the project, most of them derivatives and interpretations of the **Expectancy Value Theory** (EVT). Expectancy Value Theory (EVT) assumes that the sum of positive and negative beliefs and the strengths of those beliefs about a certain behaviour, determine the attitude towards that behaviour. Attitudes – among others - result in behavioural intention, which leads to actual behaviour. Energy consumption is habitual behaviour and information about it is indirect and obscured. Energy efficient behaviour can be achieved by disturbing the pattern of energy consumption.

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[43] www.jouwenergiemoment.nl

Once upon a time… Dutch people were accustomed to the fact that electricity could flow at a constant rate through their sockets on demand, every hour of the day. A luxury that was embedded to such an extent in the Dutch households, that people would hardly think about it anymore.

Every day... people used electricity whenever, wherever and as much as was needed to fulfil their needs like hygiene, entertainment, cooking, safety etc.

But, one day... scientists realised that this continuous and inexhaustible source of energy might not be that continuous and inexhaustible in the future. You see, the fossil fuel sources that were used back then were running out and mankind was urged to search for alternatives. Alternatives that were more uncertain in supply and, during the introduction phase, scarce.

Because of that... the Dutch population (amongst others) needed to change their energy demand to use the available energy more efficiently. More specifically, energy had to be used in times where energy was most available. Enexis started a project to see if people are willing to shift their demand, using incentives such as variable tariffs.

But then... they realised that not all people were enthused by the same incentives. They knew that indeed a part of the participants were triggered by money, but others felt the need to help the earth a little. Their primary concern is sustainability. Therefore, a system was used that monitored both the amount of energy, as well as the amount of money that was saved. Furthermore, the system could be used to determine at what time of the day appliances such as a washing machines should run, to choose the most suitable 'energy moment'.

So, finally... consumers also got a whole lot of fancy technology like a smart washing machine, PV panel, feedback displays etc but they were also encouraged to trial this technology and talk to their neighbours about it.

And, ever since then... both the sustainable consumer and the financial consumer lived happily ever after. **The end.**

The Your Energy Moment in a tweet:

From the Jouw Energie Moment website

The Dutch PowerMatching City project[44]

The Dutch PowerMatching City project is a living lab in Hoogkerk (Netherlands) to test an integral smart grid with innovative technology and appliances. The project ran between 2010 and 2011. As opposed to the current continuous supply of current energy, the supply of renewable energy sources is more uncertain and arbitrary. Furthermore, our demand is fluctuating during the day, consisting of two peaks (morning and in the end of the afternoon). To maintain a stable energy supply, supply and demand of energy have to be adjusted to one another. Power Matching City offered a real life experiment in 25 households, using technology such as solar panels, micro CHP, smart appliances and electric vehicles to test the feasibility of this future scenario on a small scale.

[44] http://www.dnvkema.com/innovations/smart-grids/powermatching-city/default.aspx

Once upon a time... a country called The Netherlands used centralised energy supply, such as coal fired power plants and natural gas.

Every day... energy would flow from just a few places in the country to the homes of the citizens. Coal and gas was abundant, so there was nothing to worry about.

But, one day... scientists realised that these fossil fuels were finite and damaging the environment. People were searching for other solutions and found that energy can also be extracted from the wind and the sun. They experimented and implemented renewable technologies into society. Although still not dominant, solar cells and wind turbines are increasingly contributing to the total energy supply of the country. The main difference with fossil fuels is the distributed generation and the dynamic, intermittent supply due to weather conditions of renewable energy sources.

Because of that... energy demand had to be adapted to energy supply, in order to avoid an energy deficit and network failures. A pilot called 'Power Matching City' was set up to test real life conditions of smart appliances and smart meters to match sustainable (in this case solar) energy supply. A neighbourhood was provided with these technologies. Amongst them were washing machines with a timer, to adjust the scheme to a period in which the supply is highest (and/or cheapest; variable tariffs were used to trigger people to shift their demand). Also, an interface called a 'user portal' was provided to give feedback on energy consumption and cost.

However... humans were assumed to be a 'Homo economicus', triggered primarily by economic incentives. This was an incorrect simplification of the human species, since they are also triggered by social pressure, the ease to act, commitment, and so on. In addition, the representativeness of the sample is at stake. Innovative and green minded people volunteered for this project, but the majority of the – possibly more resistant –citizens is not (yet) represented.

Because of that... we have to be very careful when we think that the smart grid and associated smart technologies are ready to be rolled out, as there might still be a lot of resistence to them in society.

And, ever since then... the pilot might show the technological application of such a system, but could not fully reveal the desires and attitude of the Dutch consumers. Maybe a follow-up pilot will focus more on the consumer side. **To be continued…?**

From the Dutch Power Matching City website

The Italian Time of Use project

The Italian **Time of Use** project, jointly initiated by RSE and the Italian Regulatory Authority for Electricity and Gas (AEEG) analyses the monthly electricity consumption of 28,000 residential customers (a panel of randomly selected families). It started in July 2009, i.e. one year before the introduction of the ToU tariff. The data is collected by smart meters during both peak and off-peak hours, so as to allow for an analysis of the change of consumption behaviour before and after the introduction of the ToU tariff.

Once upon a time... there was a beautiful country called Italy, which had a very interesting electricity system.

Every day... Most Italian households use only 3kW of electricity at any given time and Italians know not to cook and wash the laundry at the same time!

But, one day... Italian regulators decided to see if a Time of Use tariff would work on the residential customers that haven't moved to the free market yet.

Because of that... They measured and analysed 28000 residential customers' monthly consumption in order to have before/after comparisons. They used the almost complete rollout of smart meters in Italy to do so.

But then... They realised that there wasn't really a big shift in consumption from peak to off-peak hours in the period following the mandatory ToU tariff.

Because of that... It became clear to the regulators that old consumption habits are hard to change and that financial incentives alone would not do it.

So, finally... Decisionmakers learnt that they would need to design smarter interventions. **To be continued...**

Italy's ToU tariff in a tweet:

Dr Sea Rotmann @DrSeaRotmann

Italy's time of use tariff lessons: Decision makers should learn that energy customers do not merely respond to economic incentives #Task24

The Austrian € CO2-Management project[45]

The Austrian € CO2-Management project has been set up as a leader-project of the FFG Austria. It consisted of 3 sub-projects: Sub1: dealing with technical implementation of smart meters, Sub2: field test in the area of 3 energy suppliers (electricity, district heating, gas), supported by individual energy consultancy and technical devices like inhome display, green plug, webportal, Sub3: accompanying research. The research on behaviour change tried to find out if the provided instant information about energy consumption through the technical devices can improve energy efficiency in households. Moreover the test households received an individual and independent energy consultancy regarding their living object and support in the usage of the technical devices. The project was implicitly based on **neoclassical economic theory**.

Once upon a time... Many people in Austria lived side by side and didn't care much about energy. They paid their energy bills without thinking, no matter how high they were.

Every day... They behaved like the day before, because they didn't see any difference on their annual bill if they tried to save some energy in their household.

But one day... They got a smart meter installed and wise men came to their house and gave them advice how to save energy and the wise men showed them how to use the smart meter to see the impact of their changed behaviour. They even gave them an ipod with a feedback App installed. The wise men also gave them brochures about energy efficiency and told them that there are different tariffs for their electricity and then the wise men left.

Because of that... The people were quite motivated to save energy and made many plans to change their behaviour.

But then... After a while they forgot about their plans. They also forgot about the smart meter and the wise men and even about the intelligent ipod with the feedback App, which ended up in their kitchen drawers.

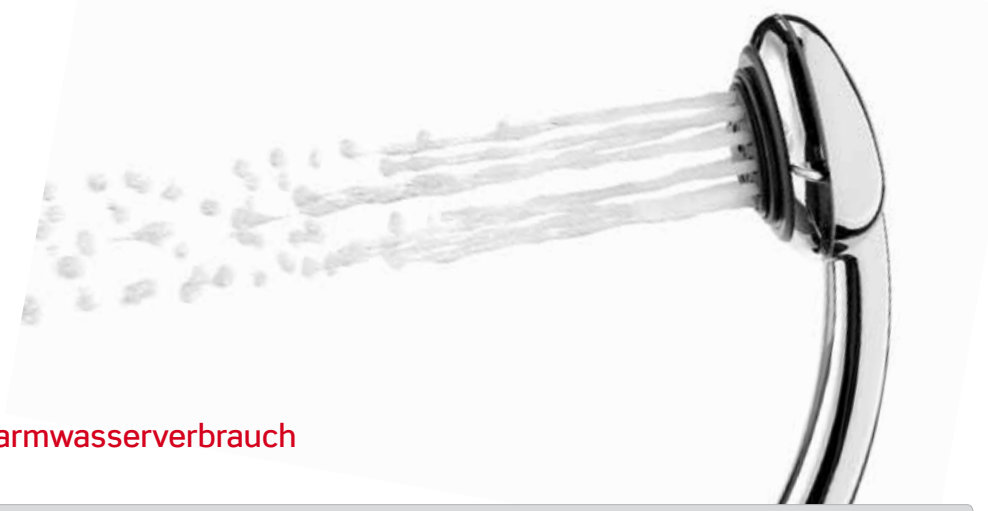
Because of that... The savings went down and only increased again when the wise men announced that they would return and ask them how it was going. So overall, the savings were around 6%, which was better than changing nothing, but the effort was huge compared to the savings.

So finally... The wise men realised that only giving technical advice and providing the technical devices is not enough to be successful, but keeping the attention level high over a long period is one of the real challenges. **The end.**

€CO2 Management in a tweet:

Dr Sea Rotmann @DrSeaRotmann
In the €CO2 Management project in Austria, it became clear that simple neoclassical #economic approaches did not lead to #behaviourchange

[45] www.grazer-ea.at



Warmwasserverbrauch

Anwendung	Warmwasserbedarf 45°C	Strombedarf in kWh
Sparsamer Tagesbedarf (nur duschen)	ca. 30 Liter/Person	1 kWh
Tagesbedarf inkl. 1 Vollbad pro Woche	ca. 50 Liter/Person	2 kWh
1x Baden	150-180 Liter/Person	5-6 kWh

A typical example of the type of information provided by the €CO2 Management energy savers

The Austrian Energy Neighbourhood 2 project[46]

The Austrian **Energy Neighbourhood 2 ('Die Energiejagd')** is the successor of the IEE project Energy Neighbourhood and builds on the idea of an energy saving bet between cities and groups of citizens. Cities challenge these groups in two consecutive years to save at least 9% of energy in 4 months compared to the previous year. The average energy saving of all households in the first year was 8.94% and in the second year: 9.28 % (best group: 25.7 %!). The project's main targets are thus reduced energy consumption in private households and raised awareness for energy efficient products and climate protection policies. It is implicitly strongly based on **shared learning theory** but has also used the framework designed by **Chatterton and Wilson** (2010) in its design.

From www.energiejagd.at

[46] www.energiejagd.at

Once upon a time.... Households all over Europe were very energy inefficient. Austria was slightly better than some other countries but people still liked to have 23C inside their flats when it was -20C outside.

Every day... Clever policymakers were trying to come up with new ways to make people be more energy efficient.

But, one day... The European Commission's Intelligent Energy Europe programme had a great idea and funded an 'Energy Hunt' programme where neighbourhoods from 16 countries all over Europe were pitted against their City Council with the goal to save 9% energy.

Because of that... 8 Styrian cities took part in this programme for Austria, called Energy Neighbourhoods 2 (the first one already having been finished successfully), with 35 neighbourhoods participating in the 'hunt'.

But then! They realised that it was quite difficult to get people to monitor their own energy consumption, as this project was done without clever smart meter technology. So they needed to find the early adopters and make them into 'Energy Masters' who were leading the other households in the neighbourhood in the competition and made sure that they were monitoring their consumption.

So, finally... they realised that bringing people together in a group with a common goal and a strong social learning component inspired them to save quite a lot of energy - up to 26% in the winning household! 20 households saved more than the 9% that was their bet against the city.

And, ever since then... some energy saving habits that were learned during the competition are still embedded in the households as are some of the friendships made during the hunt. **The end.**

Austrian Energy Neighbourhoods in a tweet:

Dr Sea Rotmann @DrSeaRotmann 4m

In #EnergyNeighbourhoods households are forming groups in order to save at least 9% #energy and to win a bet against their city #Task24

The Swiss Smart Metering case study Uttwil (EKT)[47]

The Swiss Smart Metering case study Uttwil (EKT) was based on research on a comprehensive smart meter rollout in two municipalities in the east of Switzerland. The main goal was to analyse the impact of a real time feedback system on energy consumption behaviour of pilot households as well as to test several incentive measures. This included the monitoring of load profiles as well as conducting surveys among participants on a regular basis (n=200). A further aspect of the study was to gain insight in acceptance and perceived benefits of smart meters.

Zürcher Fachhochschule

From the EKT case study: http://www.slideshare.net/drsea/2013-dsm-switzerland

[47] http://arno.uvt.nl/show.cgi?fid=10412

Once upon a time...electricity was simply coming out of the socket, and nobody had to think about it, because it was cheap and negative effects of electricity production – like greenhouse gas-emissions, land use, nuclear waste or catastrophes - were not yet discussed at the "Stammtisch" in Switzerland, nor in the pubs of London.

Every day...people were using electricity, paying their invoices for power, water and gas supply without even looking at the amount, neither of kWh nor of Swiss francs.

But, one day...people began to think about future energy supply, negative effects of conventional energy supply and renewable forms of energy and how to integrate them in the energy system.

Because of that...the local energy utilities began to rethink their role in the energy economy and some of them jumped in to the strategy of helping their customers to reduce electricity demand and increase efficiency in their use.

But then... the "Smart-Meter-Wave" also hit Switzerland (sometimes things take a bit longer in Switzerland, because we don't have a coast and too many mountains…)

Because of that... the regional energy utility EKT started a smart meter programme with 200 participants, who could monitor their electricity demand via a smartphone app or a website. They also answered questions about their opinions (risks and benefits) on smart meters.

So, finally...EKT got insight in impacts of smart meters on energy demand (on average minus 1.7%) and what concerns their customers have in terms of smart meters (data security and economic advantages for utilities).

And ever since then...customer concerns and probable success rates in future smart meter projects are taken into account more appropriately by the utilities. **The end.**

The Swiss EWZ smart metering project[48]

The **Swiss EWZ smart metering project** analyses electricity consumption over a 15 month period for around 5000 randomly selected households in Zurich. The objective of the study is to assess the role of information on electricity consumption. Information is improved in four different dimensions: (i) continuous and detailed feedback about the electricity consumption by Smart Meters, (ii) expert advice on electricity conservation, (iii) unilateral information about electricity consumption of others (social comparison), and (iv) bilateral information about the electricity consumption of a comparable household (social competition). The design allows to estimate the causal impact of each type of information on behaviour. Surveys before, during and after the field experiment allow to collect information on values, attitudes, and further household characteristics of the participants and to assess the impact of the treatments on outcomes beyond energy consumption, such as awareness of energy conservation potentials, and customer satisfaction with the services provided by ewz. The project builds on behavioural economics and social norm theory.

[48] http://www.stadt-zuerich.ch/ewz/de/index/netz/smart_metering/ewz-Studie_Smartmetering.html

Once upon a time electricity was just coming out of the socket, nobody had to think about it, because it was cheap and negative effects of electricity production – like greenhouse gas-emissions, land use, nuclear waste or catastrophes - were not yet discussed at the “Stammtisch” in Switzerland nor in the pubs of London.

Every day... people were using electricity, paying their invoices for power, water and gas supply without even looking at the amount, neither of kWh nor of Swiss francs.

But, one day...politicians decided a more efficient and sensible use of electricity was in order and asked researchers and energy experts how to influence electricity behaviour of households.

Because of that...researchers and the energy utility of Zurich (EWZ) tested different measures to influence households: smart meter displays, energy consulting, comparison or competition with other households.

But then...after a year of measuring and analysing, they found out that the continuous smart meter information had the largest impact (average 3%, in peak-times: 8% reduction) on electricity consumption.

Because of that... EWZ is continuing the installation of smart meters especially in new houses or in case of substitution of a conventional electricity meter.

So, finally...it seems that - for energy utilities - smart meters have a good potential to optimise energy demand, in terms of the total amount, but also over time. This is maybe an important fact concerning integration of renewable energies in the grid.

And, ever since then...people in Zurich will get more and more information about their electricity demand and conservation possibilities. And EWZ will have more and more information about demand profiles over time. **The end.**

Smart meter feedback used in Swiss EWZ case study (www.ness.ch)

Theories and models used in smart metering interventions

In the smart metering interventions collected for this task, we found a variety of theories and models being used. **Neo-classical economics** and **behavioural economics** are a dominant approach in smart metering projects (e.g. in the Austrian **€CO2 Management** project and the **Swiss EKT** and **EWZ projects, Time of Use tariffs in NZ and Italy**), but psychological theories (**value action gap, social norming**) and even **constructivist (shared) learning** theories are present as well in interventions (e.g. in the Austrian **Energy neighbourhoods 2**, the Swedish **Clockwise** project, the **Opower** case). Finally, some projects explicitly used **design theories** to change the behaviour of households (**Your energy moment, Clockwise**).

The smart metering interventions mostly target individual households and often involve technical testing and implementation issues and field trialling. Lastly, the smart meters are almost always accompanied by a wide array of hardware and software such as in home displays, webportals, plugs and sometimes also by external advice and audits. In addition, many of these projects are set-up as leader or lighthouse projects and are accompanied by research. As such, smart metering projects are very different from retrofitting or mobility interventions.

Influence of theory on design of the intervention

Note for the reader: many of the smart metering projects and programmes used an eclectic mix of psychological, constructivist, learning or economic theories and models. As a consequence, the cases provided as examples in the next section will be used in multiple sections.

Influence of economic theories on smart metering interventions design

Several of the analysed interventions were informed by economic theories such as **neoclassical economics** and or **behavioural economics**. The design characteristics of such programmes were already

mostly discussed under the theme of retrofitting. Below follows a discussion of smart metering specific design characteristics of interventions based on economic theories.

- Time is money
- Strong technology push focus
- distributional issues

Time is money

Programmes that are most clearly based on an image of a neoclassical or even behavioural economics *Homo economicus*, where people are expected to largely act upon financial information and triggers, are **Time of Use projects** using smart metering. These projects mainly have the goal of monitoring and analysing the effects of a (mandatory enforcement of a) Time of Use electricity rate among residential customers. Said tariff usually has two rate periods: “peak hours” and “off-peak hours” during which the price of electricity is, respectively, higher and lower than the previous flat tariff. These projects are driven by the idea that households will shift their consumption when confronted with either the opportunity of saving money by using electricity in off-peak hours or with the 'threat' of having to pay more in peak hours.

The research performed usually focuses on finding out if the provided (real time information) about energy consumption through the technical devices can improve energy efficiency in households.

Projects based on neoclassical or behavioural economics assume that people react 'rationally' when stimulated with the right triggers, and financial benefits or threats are such triggers. However, in many instances it is clear that economic gains or losses are not necessarily the only, or the best trigger. In the **Italian Time of Use** project, for example, it was concluded that old consumption habits are hard to change; and that low monetary incentives are not enough to modify customers’ behaviour; but that customers’ education towards energy efficiency should not be neglected.

The Norwegian **Demo Steinkjer** project also starts from the assumption that increased information will sensitise households and larger consumers (SMEs) to their electricity consumption, thus helping them to take measures to lower their consumption. This emphasis on the need for information to make good decisions is also clear in the argument that information will also provide grid operators with better information on usage over time, and aid in the design of load shifting measures.

In the New Zealand **Responses to Time Varying Prices for Electricity** 2009/10 project, an experimental area with an above average income was chosen to experiment with time of use to shift peak and off-peak demand. It was not viewed as an area where economic or social obstacles might restrict the ability to respond to time varying prices. This project was built on economic and marketing theories and assumed people would react either to the pricing signals or the information provided. On average, there was no response except in winter. In winter, participant households reduced electricity consumption by at least 10%, took advantage of lower off-peak prices but did not respond to the peak price differentials. Responses varied with house and household size, time spent away from home, and whether water was heated with electricity. Despite a strong liking for the scheme there was a strong resistance to changing meaningful behaviours that influenced the amount of electricity consumed in total or the proportions used off and on-peak. In contrast, a significant response was obtained from the information provided to participants.

The Portuguese **On Demand** project also investigated the impact of financial incentives on behavioural change. In this project, each participant with a mobile phone received a short message before and after the event to make sure the electronic plug and communications hub were correctly plugged in. These messages included a descriptive normative component (“join the majority of your neighbours“), an altruistic component (“support the supplier programme”), and for the economic incentive subgroup, a reminder of the final prize. Results showed that the control and two treatment groups were statistically similar. There was a

statistical difference between the treatment and control, proving that it was not by chance, that for the period of the experiment, treatment groups were more frequently connected to the feedback devices than the control group. However, it was not possible to prove beyond doubt that the economic incentive had a positive effect over its specific group. The economic incentive group (EIG) participants' did place the electronic plug into appliances that consumed more electricity than the participants of the treatment group without an economic incentive (W/O EIG). As a result, average curtailment per hour for EIG was 0.065 kWh against 0.044 kWh for the W/O EIG. Curtailment percentage for EIG was 10%, and for W/O EIG it was 9%. However, in terms of connections the counts showed a higher frequency of hubs connected for seven days in a row for the treatment group without an economic incentive.

Strong Technology push focus

Smart metering projects are, by definition, projects that push a technology that is deemed necessary to create a more robust or resilient and therefore, 'smart' grid but for which the benefits for households are less clearly felt. The standard 'marketing' of the smart meter is that people need insight and knowledge, preferably in real time and therefore, that people need smart metering technology to start and sustain behavioural changes. In addition, most projects are built on the assumption that insight into costs and financial waste will trigger people to change.

What automatically follows from this approach is that the only two challenges for smart metering are its adoption, and the education of people into its economic benefits.

A potentially missed opportunity in the Portuguese **On Demand** project was the fact that the project did not actually succeed to create multiple benefits for the participants because of this strong technology-driven approach. It was, for example, required from clients that the project modems would be used strictly for the project during the time of the project. However, understandable for methodological purposes, it could have engaged participants more if they were allowed to surf the internet with the modem as well. This is a typical case of 'do not push the button' - which, in this case, was a mistake.

Distributional issues

The **Swiss EKT smart metering** project highlights one of the most poignant issues in smart metering and smart grid deployment which might very well lead to difficulties in end-user engagement and acceptance. The issue of distribution of costs, risk and rewards and benefits is key but not very often addressed. In particular, end-users can start to feel that the distribution of costs and benefits actually benefit the utilities and DSOs more (in terms of customer loyalty, avoided investments in the grid, more information on customers) than the end-users themselves.

In the **Swiss EKT smart metering** pilot, an average reduction of 1.7% of electricity consumption could be reached for the participants who used the smart meter (electricity use displayed on a smart phone). The frequency of checking the smart meter display and thus to control electricity consumption, however, declined rapidly after the first month (an issue discussed in a later section). Perceived benefits of smart meters were lower after a year of pilot-use and concerns against it even rose a little bit. Concerns about data security and economic advantages for utilities were the most important ones for the participants. Control over electricity consumption and simpler billing of electricity were the biggest perceived benefits of smart meters.

Influence of psychological theories on smart metering interventions design

The design characteristics of programmes based on psychological theories such as **value action gap** theory were already discussed under the theme of transport. Below follows a discussion of smart metering specific design characteristics of interventions based on psychological theories.

- visualising behaviour and information deficits

- targetting the behaviour in context
- from smart metering to meaning attribution of living in one's home
- social norms are key
- segment, tailor, motivate, act!

Feedback: visualising behaviour and information deficits

Automated feedback on actual energy use and potential for changing one's energy consumption behaviour is at the core of most smart metering projects. This stems from the assumption present in almost all economic and psychological theories or models that information is key, and lack of information is a key barrier. The Norwegian project **Demo Steinkjer**, is such an example. Public policy in Norway often adopts some version of **TPB** in matters of behaviour change. As discussed before, this theory, developed by Ajzen, posits that, although humans are not perfectly rational actors, most change comes about as the result of changes in intentions, which in turn are influenced by attitudes, norms and various sorts of behavioural control. External interventions should therefore be targeted at these three factors, and among them the behavioural control is the easiest to change. Interventions should, according to this theory, therefore include things such as price incentives, removal of informational barriers and the creation of new norms through information - in the case of the **Norwegian Demo Steinkjer** project, information and feedback delivered by the smart meter.

Almost all smart metering projects aim for reduction of energy consumption and improvement of energy related know-how and not necessarily in that order. In fact, most projects run on the premise that increased knowledge and know-how about energy and energy consuming behaviour will lead to a reduction of energy. Interestingly, the savings Austrian **€CO2-Management** project on average were 8.5% with high extremes on the positive and the negative side, but no real increase in the know-how of participants could be established. Individual consulting turned out not to be for new know-how but to affirm established opinions of the clients.

When information provision is coupled to active learning and shared learning through peers, than this approach can indeed be highly effective. In the Austrian **Energy Neighbourhoods 2** project, people got informed by the project organisation team (via printed information material, homepage, newsletters and meetings and by informing/training representatives of the cities and energy masters), by the cities and energy masters and by discussions within meetings of the groups.

The **Swiss EKZ project** demonstrates that visualising alone is sometimes sufficient, but this case dealt with households that were voluntarily participating which might create a bias in the results. The project concludes that smart meters with displays have a certain potential to induce electricity reduction. But it also concluded that an offer for expert advice for conservation potentials was not very well used, and only a third of the study-participants took advantage of the expert advice. Even people who benefitted from the experts didn't change their energy behaviour and knowledge accordingly. Results of the different groups in the study on electricity reduction were: that continuous and detailed feedback about the electricity consumption by smart meters created long-term (over 1 year) reduction of electricity of about 3 %, in peak-times (8-9 p.m.) reduction was especially high (nearly 8%). However, expert advice on electricity conservation showed only slight short-term reduction of electricity consumption and both unilateral and bilateral information about electricity consumption of others or of a comparable household (social comparison) created only slight, not statistically relevant reduction (less than 1%). This is of course slightly more effective in the **Opower** case, with average sustained energy reduction of around 1.5 - 3.5%.

Target the behaviour in context

Smart metering targets the home, its inhabitants and their electricity, gas, and sometimes water consumption. The behaviours that should therefore be targeted in projects are:

- **habitual actions:** adapted day-to-day behaviours, like preparing hot water for cooking with an electric kettle, avoiding stand-by energy consumption by applying power strips, turning off the lights, reduced use of laundry dryer ...
- **one-off actions:** deciding to buy only new, energy efficient appliances (refrigerators, deep-freezers, dishwashers, washing machines ...); adapting settings or activating energy saving settings of household appliances, like hot water boiler, heat pumps, computers, etc.; replacement or removal of old inefficient appliances.
- **Retrofitting actions**: insulation or weatherisation of the home and making operation technology such as ventilation, heat pumps etc. more efficient.

Smart metering projects, however, usually target the behaviour of people, not of the home. The home and its technologies are left untouched. Many projects only address the behaviour of the household, providing detailed and often real time feedback on the usage patterns of the households. More rare are projects such as the Austrian **€CO2-Management** project where the test households also received an individual and independent energy consultancy regarding their living object (home) and support in the usage of the technical devices. This tailored advice that also takes into account the impact of the house on the capabilities and capacities of households to change the use patterns is very important to allow a realistic assessment of the potential savings a household can achieve with their behaviour and use of technologies and appliances. In addition, is also tackles potential savings that can be achieved through investment behaviour in retrofitting.

From smart metering to meaning attribution of living in one's home

The smart meter is not necessarily a meaningful device for household members. Often households do not (feel they) need it.

In the Austrian **Energy Neighbourhood 2** project a valuable lesson was learnt concerning target groups and the impact of the design of a project on the type of target group being triggered. The project mainly triggered participation from people described to be generally open minded for environmental issues including all educational levels and ages. People that have not been reached so far are, in particular, migrants and vulnerable people.

One way to make metering and accompanying behavioural changes meaningful is a focus on mutual and collective benefits. This does, however, potentially require a smaller community. The Portuguese **On Demand** project did use this approach. Communication with the population tried to focus on the characteristics of the community. Since the supplier is a cooperative with a very small service area (with less than 2000 clients), it was possible to convey a message about joint benefits, and about the role of planning demand flexibility into the client-supplier relationship. As a result, the message to the participants focused specifically on resilience, and fighting-off forecasted electricity price increases.

The project used many different approaches, from a portfolio of actions ranging from a general dissemination campaign using leaflets, participation in a workshop about how to conserve electricity in the home, participation in dedicated workshops (designed fo each treatment) to local champions explaining how the feedback devices helped them monitor their homes or find waste, and discussing the design, expectations and benefits of participation in the project. In addition, the project aimed to improve the local capacity using innovative methods of client engagement, organised procedures, and an online reporting tool that allowed the installers and technical team to monitor the installation campaign day by day. Finally, the

project contributed to building up local capacity for engagement with the residential client through the use of two installers.

What became apparent in this project is that the devil is in the detail: the personalities of each installer had an influence on the understanding of clients about the technology, and on their "happiness" regarding the technology. Small differences were found to be key explanatory variables.

The Dutch **Power Matching City** project worked with variable energy prices, coupled to decentralised generation. But, although this project does describe the end user as a 'Homo economicus'[49], the initiators actually appreciated that households potentially need more than merely financial rewards as an incentive to shift demand. The project managers based their intervention on the **Value Action Gap theory**. Within the VAG theory, several reasons are given that impede the link between e.g. environmental concern and pro-environmental behaviour. Blake (1999)[50] describes three barriers: individuality, responsibility and practicality. Individuality refers to laziness or lack of interest to act. Lack of trust or efficacy are examples of responsibility issues. Practicality might be the lack of time or money to engage in pro-environmental behaviour. In the Power Matching City project, information in the form of feedback and financial incentives in the form of variable tariffs were used to lower the above mentioned barriers and create meaningful feedback. In addition, social comparison was another type of feedback on the user portal, which can be argued to tackle the responsibility and individuality barriers. However, this incentive was merely present, but not evaluated.

In addition, potentially implicitly, the Power Matching City project used an important element from the **Diffusion of Innovations** model by Rogers. Rogers distinguished five factors that may lower the barriers / increase motivations to adopt a certain innovation. The most important one is the relative advantage of an innovation as opposed to its predecessor. Comfort is seen as the most important value of a home. Therefore, Power Matching City had one important criteria: to maintain or even increase comfort levels of the home for end users. This links to the meaning attribution central to many **psychological theories**. People do not invest in their home but live in them, and the home means different things for different people and means different things at different times. One fairly constant meaning the home often has is comfort.

The Austrian **Energy Neighbourhoods 2 (EN2)** project also designed its project around the notion that meaningfulness is key. The project also explicitly set other types of targets to make the project meaningful to the end users: the social target is to bring people together to define and reach a common goal and to give support to the participants (at least to those of the own group). The individual target is to change some behaviours of the participants also after the campaign, e.g. buying new energy efficient appliances, checking and fitting the settings of appliances, computers, hot water boilers, heat pumps, turning down indoor temperature etc. and to change some daily routines (like turning off the lights, cooking with pressure cooker, applying power strips to avoid stand-by...). As a consequence, not only the savings achieved are to be evaluated but there is also attention for the broader socio-economic aspects of those involved in the EN2 programme. This includes an analysis how, why and if the participants changed their behaviour during the course of the project.

The process of **meaning attribution** can also take place through the use of role models. The **Energy Neighbourhood 2** project explicitly used this approach. The project combines a very bottom-up monitoring regime with information. Participating groups of households (consisting of 5 to 12 households) are organising their activities to save energy among themselves and are supported by specially trained "Energy Masters", volunteers within the groups that motivate, supervise monitoring and provide material, such as

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[49] DNV KEMA Energy & Sustainability, PowerMatching Cities, October 2012

[50] J. Blake, Overcoming the 'value-action gap' in environmental policy: Tensions between national policy and local experience, Local Environment Volume 4, Issue 3, 1999

'DIY energy audits'. These Energy Masters are organising meetings of the groups to discuss current energy saving issues of these households (**Lewin's Theory of Unfreezing/Refreezing**). The display of current energy consumption of a household is provided by an internet tool, which estimates the forecast of the energy savings of a group. In this way, participating households get personal feedback by the members of their groups and a hard-fact-feedback by the internet tool.

Yet another way of creating a meaningful project is by providing benefits to participants and deliver the project almost as a secondary thing. This can be witnessed partly in the Portuguese **On Demand** project. The high level of unemployment, illiteracy and very low internet penetration rate caused a real problem for the project. Although the relationship with the retailer and local DSO was personal and direct, electricity feedback interfaces were not a concern for clients and interest for the project was low. In addition, feedback interfaces and electronic plugs to control appliances require Internet and therefore the project team had to provide modems to ¾ of the target population. The DSO/retailer was highly supportive of the project and provided every resource possible to improve communication with the target population. Due to the technology immaturity and lack of interest from the population, the project was held back for almost a year and a half. Seven months before its due date, everything was still left to be done. What can be concluded is that, participation and good engagement is not the only element of importance, technological maturity of a region or target group needs to be matched to the ambitions of a project. In this case, the high ambitions of testing the acceptance to automated cycling of appliances directly by the supplier, testing the acceptance and flexibility of residential clients to automated demand response controlled by the utility (in this case retailer & DSO) and evaluating potential benefits of ADR flexibility for the DSO/retailer and clients given the forecasted growth in the price of electricity in the coming years, might have been too far a reach.

Social norms are key, or not?

Some projects used social norms as a way to influence the behaviour of their participants, but in a limited way, only including comparison of households' energy use with that of their neighbours or fellow participants and as a mere addition to more economic theory based approaches.

The UK **CHARM** Home Energy Study project went a long way further in using the **social norms** approach, and coupled it with **practice theory**. Because of this use of practice theory, the project not so much focused on individuals but on their practices. This delivered very different and unexpected results (see later section for details). Developed in the 1980s in the US, the social norms approach attempts to influence behaviour by providing individuals with information about what most people do, or think should be done. CHARM ran quasi-randomised controlled trials to measure the changes that occur when people are provided with feedback either about their own behaviour or about their own behaviour and that of others.

Interestingly enough, unexpected results came out of this approach, with valuable insights for future use of social norms approach. Linear regression analysis showed that average consumption levels reduced by 3% more for those who received feedback than for those who did not. The sample was not large enough to test the statistical significance of this unexpectedly small effect, but comments by participants in the interviews suggest that the feedback did lead to changes in energy-consuming behaviours. For example, some participants reduced their use of tumble driers; some purchased low-energy white goods, and some reduced their use of standby. The interviews suggest that the main reason the feedback had this effect was that the graphs provided householders with benchmarks against which to compare their usage – i.e. their own consumption at other times or the consumption of other people. This made it easier for users to see when their usage was higher than usual; to relate this usage to particular practices; to see this usage as potentially wasteful, and to make changes to their behaviour.

Contrary to expectations, regression analysis showed no evidence that those receiving the social feedback reduced their consumption by more than those only receiving the individual feedback. One explanation for this might be that, while the social norms feedback encouraged some participants to consume less, it also

prompted some of those below the norm to consume more (see Schultz et al, 2007, on the **'boomerang effect'**). However, there is no evidence of this in the qualitative interviews. A second possible explanation lies in the distinction between overall energy consumption and energy-related behaviours. Much previous research into the social norms approach measured behaviours, whereas in this study the object of measurement was total electricity consumption, which is an outcome of many different energy consuming behaviours.

CHARM researchers Ruth Rettie and Tim Harries conclude that had they provided social norms feedback on particular behaviours (for example, how often people used tumble driers), this might have had a clearer impact on behaviour. Although those in the social norms condition did not, on average, change their consumption any more than those who only received individual feedback, they did download the emailed graphs significantly more often. This indicates that the social norms feedback may have been more engaging than the individual feedback and suggests that there may yet be advantages to using the two forms of feedback in combination. The research provides some support for the role of feedback in reducing electricity consumption but questions the need to complement feedback on individual usage with social norms feedback. Furthermore, it suggests that in order to facilitate the identification of particular behaviours that are 'wasteful', feedback should be shown at a level of disaggregation that allows users to relate it to their own practices – for instance, in hourly or half-hourly time periods. More research into this area is clearly needed. Researchers should consider providing feedback on particular behaviours or practices rather than on the more abstract level of overall electricity consumption. Furthermore, the CHARM study demonstrates the importance of including an individual feedback condition in any evaluation of social norms feedback.

While infrastructure, norms, values, etc vary dramatically by region, the **Opower** programme concludes that proactive communications leveraging direct marketing and behavioural science lead to 1.5-3.5% savings, irrespective of these different circumstances. The model affects individuals in different ways—some change habits, and others buy more efficient appliances. The aggregate result is savings that extend as long as the treatment continues. The OPower team have seen that results persist and increase slightly over the seven years they have been running their oldest programmes.

The Austrian **€CO2-Management** project did not use comparative feedback (feedback based on comparison with other participants) but concluded that it would probably have been more motivating.

The other Austrian project **Energy Neighbourhoods 2** (EN2) faced the challenge to win over citizens to participate in the campaign. The main success factor for bringing people into the campaign was to convince "early adopters" to become an 'Energy Master'. Afterwards this person looked for suitable or interested households within his circle of friends, colleagues at work or family members to build an energy neighbourhoods group. It has been shown that more or less only personal contacts with early adopters motivated them to build up their own energy neighbourhoods group. Articles in newspapers, posters in the public, electronic newsletters etc were helpful in order to inform people but they did not lead to action so far.

Segment, tailor, motivate and act!

The **Opower Home Energy Reporting** platform (initiated from USA but now used in 7 countries) is designed to deliver better information to customers in way that not only informs, but also motivates customers to take action, a key element of an intervention informed by psychological theory. Four key principles guide the design of Opower's product suite:

» **Simple**—Opower presents energy data in easily understood displays across multiple channels (print Home Energy Reports, customer web portal, mobile phone and interactive marketing tools) with specific and targeted tips on how customers can save energy and money.

» **Relevant**—Opower's platform uses customer-segmentation analysis, enriched by outside data sources, to deliver customised messaging and tips to each household based on their specific situation.

» **Actionable**—A call to action is coupled with all data presentation. Opower goes beyond data display and ensures that communications effectively motivate customers to take energy-efficient action and that they are aligned with the utility company's specific program goals.

» **Motivating**—Opower's platform leverages behavioural science to deliver normative comparisons and cultivate user-generated content, which encourages the average customer to emulate their most energy-efficient peers.

Opower applies these principles through multiple communication channels, ranging from printed Home Energy Reports, to customer web portals and mobile communication.Deployment of the Opower programme includes delivering a periodic energy consumption report ("Home Energy Report") to the customer that contains key information, including:

- Normative comparison of a customer's home energy usage compared to similar homes' in the same geographical area.
- A grade on energy consumption (e.g., Good, Average, or Below Average).
- A simple process to opt-out of the program.
- Comparison of a customer's energy usage in the current period with a past period and commenting on increased/decreased energy utilization. Typically this compares the current month or quarter with the same month or quarter from the prior year, adjusted for climate.
- Personalised suggestions for improving household energy efficiency, including low/no cost actions, as well as higher impact ideas that may require some capital expense.
- Targeted conservation and peak reduction tips and real-time alerts based on an analysis of a customer's past usage and individual profile.
- Encouragement to participate in other energy efficiency programmes based on previous usage patterns and the customer's profile.

Influence of design theories on smart metering interventions design

Design with Intent (DwI) is a theory by Dan Lockton which states that through the design of products or services, behaviour is designed as well. Lockton created a toolkit for designers to adapt the design in order to influence and steer behaviour. It is a composition of various findings from several (psychological) disciplines. The combination resulted in 101 suggestions in the form of questions ('did you take ... into account?') to steer behaviour. Suggestions vary from strategic positioning of the design to decoying alternatives. According to Design with Intent, technology and architecture can contain scripts; it has the ability to steer users towards a certain behaviour. And the use of norms and values to influence behaviour is proposed, for example motivators as 'guilt', 'expert's choice' and 'social proof' can be used to change behaviour.

A Story on Design Theories informed smart metering interventions

We will design a product or technology which will also design your behaviour

Don't worry, in most cases this doesn't mean we will blatantly manipulate you in order to get data or other valuable information for utilities or to push a technology on you that's pretty useless to you!

Trust us, we know what is best for you and the economy. Oh, and the planet of course!

So, we may need to stop thinking like engineers cause then we only design for other engineers - you may not be as interested in graphs or kWh as we are

We know you like design that is clean, easy to understand, engaging and fun

The more fun it is, the more you will engage with it and the more energy you will save

Energy doesn't need to be boring or invisible anymore, a key goal is to show you when you are using energy and how (much)

Feedback needs to be in a prominent position, so the design of the feedback system will impact on where it is located in the house - we need to design something you want to have hanging on your best wall

And we need to make sure you will want to keep checking it automatically and alter your behaviour, even after its initial fun factor has worn off

If we could only design something as clever and engaging as Apple products - everyone would love saving energy then, right?

The (implicit or explicit) use of design theories result in several design characteristics for smart metering interventions:

- electricity meters and home displays need to visualise energy and thus make energy use more understandable to the common person
- Feedback should be delivered in the household's central locations, to create an awareness of electricity consuming household activities
- keep engaging your end users, feedback often gets boring quickly

Electricity meters and home displays need to visualise energy in an understandable form.
The Swedish **Clockwise** project used **design with intent** in a total of 20 households in Ursvik outside Sundbyberg. Nine households participated in the main, qualitative part of the study, and were equipped with the prototype of the Energy Aware Clock over 3 months. The other 10 households received only the electricity meter fitted to their fuse box, and served as reference households in the quantitative

measurement of household electricity consumption. Despite prevailing uncertainties in the data there were indications that the participating households reduced their use of electricity by up to about 10%.

Feedback should be delivered in the household's central locations

The Swedish **Clockwise** project put the Energy Aware Clock in a central location, between the living room and the kitchen, and designed it aesthetically in such a way that households wanted to keep looking at it and engaging with it.

The Dutch project **Your Energy Moment** also makes explicit use of the notion that design can create, limit, direct, avoid specific behavioural patterns.

Keep engaging!

A key design challenge is to create a smart metering system that keeps engaging with the household members.

One main challenge with current field trial smart metering projects is that sometimes there is a long time between start on paper, and recruitment of test households, and the actual implementations of the smart meter. In later stages, when mass roll-out will take place, the problem will still exist although in a different form: then it will be difficult to motivate the households that have not asked for the smart meter, and who are not necessary interested in this technology to still engage with it and use it to create more sustainable energy behaviour patterns.

The Austrian **€CO2 Management** listed three different challenges related to this span of attention of the end-user:

The first challenge was to transfer all technical devices (smart meter, inhome display,...) to the clients in a timely fashion and to provide the individual advice soon after implementation to keep the clients' attention. The second challenge was to keep the households interested in their consumption over some period, at least until a sustainable change of behaviour had taken place. The third challenge was related to communication: how to format the energy data for clients so it was understandable, informative and could lead to changes in the majority of the clients households.

Keeping the attention and engagement of participants at a high level is done differently in the Austrian **Energy Neighbourhoods 2** project. In this project, engagement is achieved through the organisation of participation and local interaction between participants and Energy Masters. A comprehensive communication strategy ensures that participants themselves become multipliers of the project idea when being interviewed and presented in local media channels, by presenting their activities through a blog and by using social media applications. All together, 359 articles, radio and TV clips were created in the first year of the project. See other sections for more information on this participatory approach.

However, even with this high level of participation the project still faced the challenge of motivating, and keeping participants motivated to meter their energy consumption during 4 months and not to drop out before the end of the campaign. As meter readings were not working automatically, participants had to notice their meter standings and to insert these data into the online tool of EN2. For some participants this procedure was too complicated. In addition, people tended to drop out of the project if their current energy consumption increased or resulted only in small savings. A drop out quote of approximately 10% had been noticed in the first and the second round in Austria.

Those that stayed tuned in into the project, however, demonstrated interesting **spill-over effects**. After having established certain behavioural patterns throughout the campaign, it was experienced that the participants established energy efficient behaviour as a routine in their lives in the long term as well and beyond the set targets. The implementation of CO_2-challenges, conversations and exchange of experiences

between the EN2 participants led to the defining of various further ambitions, such as travelling by electric cars to EN2 events, providing CO_2-friendly catering or organising a seasonal cooking class to allow for fun, demonstration, chat and wider thinking.

The Portuguese project **On Demand** experienced that they had to keep changing the motivating messages in the course of time. When the project started it was focused on direct control of appliances and the population was provided with feedback interfaces. At this point the message was focused on fighting waste. As the programme evolved, the number of disconnected interfaces / routers was growing. Initially, the acceptance rate was 40% but the drop-off rate (out of those who accepted the equipment) was almost 65%. Since the project relied on technology that trend had to be stopped. Therefore, the communication messages now focused on "doing the right thing", by cooperating with the utility. In addition, the messages focused on community benefits that would be converted into individual benefits (resilience against the expected rise of tariffs, by trying out a common response).

Influence of collaborative learning theories on smart metering interventions design

Projects using elements of collaborative learning theories have the following distinct characteristics:

- piloting and building on previous experiences
- participation matters

A Story on collaborative learning approaches in smart metering interventions

This will only work if you actively participate and engage with us on the project

We want to make sure that we build on your learnings, so we're trying to keep you open-minded so you can see the learnings and past mistakes and don't repeat them

It is important that you trust us and the other people you are learning with so you are happy to share the good and maybe not-so-good stories

The 'horror stories' are often the ones we can all learn the most from but no one likes to look like a fool... especially not public servants!

Trust us - we're not trying to patronise you, we are really interested in hearing what you say, think, feel

We can make you change your habits easier in a group setting - by freezing and unfreezing them

Learning from your peers can be both good and bad, competition with your neighbours can be healthy... or really annoying!

We don't need all the fancy technology to create learning opportunities - it is much more important that we involve your whole household, your kids and your neighbours

You'll be a significantly tougher nut for us to crack if you are not already motivated to save energy or the environment. But we'd be smart to make sure we at least learn from your misgivings or issues with our project

We understand that you have too much other important stuff to deal with than to have time to learn about energy efficiency, which is why it's up to us to design it so it's fun for the whole family

Piloting and building on previous experiences

Smart metering projects usually consist of complex combinations of different add-on technologies such as in home displays, web portals and plug-ins. In addition, many different parties undertake these projects, often as part of developing a tool or an app or other client retention proposition. As a result the projects are technically challenging, and to prove the technology and its uptake and acceptability, piloting is essential. The pilot households often participate in projects that experience several technical challenges and problems. One of those types of projects is **PowerMatching City** (PMC). Like in many of these complex projects, users were early adopters and had a green mindset before participation which makes a translation of their response to technical issues different. In addition, as described in another section, this project was very participatory which changes the way people relate to and engage with the technologies. A new project has started in 2011 to scale up the last PMC project to test the system in a larger setting.

The Dutch **Your Energy Moment** project also explicitly built on an earlier pilot that was very much an action research, exploratory-type project, grounded in theory. In **Smart Wash**, several lessons were deduced that were translated into the design of Your Energy Moment. For example, in Smart Wash some participants felt

that the technology was too complex. As a result in Your Energy Moment different energy management systems and different pilots were used to find out how to better tailor the system to the user. The analysis of Smart Wash led to the conclusion that the participants missed the **social norm** component, this is now an explicit element of Your Energy Moment. And Your Energy Moment will be monitored for a much longer period, based on lessons from Smart Wash, to be able to assess longer term impact and motivations, including in the winter period.

Similarly the Norwegian project **Demo Steinkjer** is explicitly piloting its smart metering roll-out in different subpilots. After evaluation, the chosen meters will be installed in all 4500 households in the area. The design allows for supplier control of “low priority consumption such as hot water heating and underfloor heating cables”. Hourly billing and increased monitoring will be provided to customers. “The ultimate aim of the demo is that after ten years Steinkjer will have a community of active, aware and adaptable energy customers.” The findings so far deal more with technical challenges in the roll-out phase, and less with actual savings. The reports detail a long list of improvements and adjustments that needs to be made to iron out the chinks in the implementing phase, among them improving communications between end users, installers and grid company.

Participation matters

In the Austrian **Energy Neighbourhoods 2** project, participation was key to its operation. Participating groups of households (consisting of 5 to 12 households) were organising their own activities to save energy among themselves and were supported by specially trained "Energy Masters", volunteers within the groups that motivated, supervised monitoring and provided material, such as ‘DIY energy audits’. These Energy Masters were organising meetings of the groups to discuss current energy saving issues of these households (**Unfreezing/Refreezing**). The display of current energy consumption of a household was provided by an internet tool, which estimated the forecast of the energy savings of a group. In this way, participating households got personal feedback by the members of their groups and a hard-fact-feedback by the internet tool.

In the Dutch **Powermatching City** project, participation was also a key success factor. Users were provided with technology and a feedback system, called a ‘user portal’: a digital interface which can be visualised on tablet, smart phone and an in-house display. The user portal shows information about energy use in different forms and for different time periods (also real time). The type of interface and feedback was chosen in deliberation with the end users. The user portal provided information about the average energy use and compared performance with other participants. In addition, as an incentive for users to shift energy demand, the energy price was variable, dependent on the supply of energy. For example on sunny days, electricity was cheaper since more was produced through solar panels. Users had the opportunity to adapt the programme of appliances (such as washing machines) to act when energy price was lowest, in other words, to concentrate energy use during the production peak. Finally, the positive assessment of the comfort levels by participants was attributed to the users’ co-development of criteria and evaluation of the comfort levels. The small scale of this project (25 households) also allowed for close interaction between the participants.

In addition, we argue that, given that there is a shift from centralised to de-centralised energy generation, consumers and residents are becoming producers as well, generating energy (prosumers). This influences the grid loads and the way in which the grid needs to be managed. Moreover, loads are increasing since electricity is becoming the main energy carrier (replacing gas through heat pumps, transition towards electric vehicles). Peak loads might be shaved using demand side management as was done in the project. And to effectively engage these prosumers in a smart grid or several microgrids, participation is key.

Monitoring and evaluating

Some projects, like the Austrian **€CO2-Management** project used the historic data of energy consumption of the last 3 years to be compared with the actual readings of the smart meter over a period of approximately 1 year.

Most projects make use of qualitative and quantitative questionnaires to be answered by the participating households. In addition some projects like the Austrian **€CO2-Management** project also use focus groups or interviews with the households. The questionnaires include the following kinds of questions:

- Personal motivation to participate in the competition
- Some questions on energy-related behaviours
- Recent purchases in energy technologies (like energy efficient boilers, new windows...)
- The information level on energy efficiency and renewable energy sources
- Sources on information on energy issues
- Attitudes on energy and climate protection issues
- Estimation of the level of own energy costs
- Individual information on the household/persons of the household

What is not monitored or evaluated is the actual behaviour, rather than the reported behaviour. However, monitoring this actual behaviour is very valuable and important because it allows to focus on the lifestyle and the standard practices that often are different in terms of duration and frequency than what people think when asked about it.

The Italian **Time of Use** project shows that 'benchmarking' is extremely important and a very effective way of determining the actual behavioural change before and after, providing data which would not have been available through mere questionnaires and surveys. In addition, what these types of monitoring provide is insight not only into how many savings or, in this case, peak load shifting was achieved compared to real metered previous behaviour, but also what percentage of people shifted. However, many smart metering projects do not allow for a whole year of monitoring prior to the actual implementation of an intervention, and consequently need to work with self-reported behavioural change in the form of surveys and questionnaires.

The shortcoming of merely metering, however, is that the reasons behind the behavioural change are not questioned, and therefore it is not clear if the financial trigger did the trick, or if the increase in awareness did, or if a different reason triggered people into shifting their consumption. For example, in the **Italian Time of Use** project there has been a limited shift of consumption from peak hours to off-peak hours in the period following the introduction of the mandatory ToU tariff, but the change in the behaviour of the users was deemed not negligible because about 60% of the customers modified their consumption habits according to the dictates of the ToU tariff. For these type of projects, therefore, the key indicators usually are the metered shift.

The Dutch project **Your Energy Moment** did appreciate the need to understand why people are motivated and behave the way they do, and qualitative research using interviews/questionnaires was used. The

results are expected to reveal more information (categorisation of motivations and feedback to segmentation and lifestyles) to better adapt smart grids to the local context.

Matching evaluation metrics to ambitions and targets seems a fairly logical recommendation, however, many projects only monitor and evaluate the quantitative aspects of a project. For example, the Portuguese **On Demand** project only monitored how many feedback interfaces were indeed installed, and what the load shift per client was in kWh a day. The ambitions of building of capacity, and creating engagement were not monitored or evaluated.

The UK **CHARM** research combined qualitative analysis of interviews and focus groups with the statistical analysis of survey data and data collected in a real-world, quasi-randomised controlled trial. The CHARM researchers recommend this approach for its rigour, its triangulation and its ability to provide in-depth insights into behaviour change. The CHARM study tested the impacts of two types of feedback over a period of 18 weeks: feedback of a household's own consumption and feedback that also included average figures for others in the neighbourhood. After a two-week baseline period without feedback, participants were sent weekly emails, each of which contained a tip on how to save electricity, a graph showing their consumption and an invitation to access similar graphs on specially-provided, password-protected web pages. The project monitored how much electricity participants used and recorded how often they looked at the feedback provided. In addition, participants completed pre- and post-study surveys and a number of householders were interviewed one-to-one or in focus groups. CHARM employed practice theory as an analytical frame, using it to understand how participants responded to the digital intervention. **Practice theory** treats practices rather than individuals or societies as the primary unit of social analysis. Although authors differ on the issue, practices are generally understood as interlinked 'bundles' of behaviours, meanings, rules, things and skills. For example, the practice of doing the laundry includes rules (e.g. 'wash similar colours together'), things (e.g. washing machines), meanings (e.g. 'clean' and 'dirty') and skills (e.g. recognising that something is 'dirty').

Another programme that undertook rigorous monitoring and evaluation, and at the same time being one of the largest and longest running programmes in the world, is the **Opower** Home reporting energy platform programme. One of the consequences of this very well thought-through monitoring and evaluation is that the Opower programme has been evaluated many times by at least 20 independent evaluations. For example, after evaluating nearly 22 million utility bills from over 600,000 households across 17 of the longest running deployments of energy usage statement programmes, MIT's Hunt Allcott concluded that Opower's behavioural energy efficiency programmes generated electricity and gas savings of 1.4 – 3.3% for all targeted households, with an average of 2.0%. (Allcott, Hunt, October 2011, "Social Norms and Energy Conservation," Journal of Public Economics). According to Opower, the key things to measure are energy savings, customer sentiment, and participation in other energy efficiency programs. They use surveys and utility data to measure this.

Conventional monitoring of smart metering success	More systemic monitoring of smart metering success
• number of smart meters and or feedback interfaces installed • load shift per client • number of times clients looked at the feedback provided • acceptance and attitudes towards smart meters • Electricity consumption over a year • level of technology affinity concerning the use of the technical feedback equipment	• all of the issues listed left, and those mentioned under systemic retrofitting monitoring plus: • Personal motivation to participate in the competition • Actual energy-related behaviours • Recent purchases in energy technologies (like energy efficient boilers, new windows, tec.) • The information level on energy efficiency and renewable energy sources • Sources on information on energy issues • Attitudes on energy and climate protection issues • Estimation of the level of own energy costs • building of capacity, · creation of engagement · customer sentiment, · participation in other energy efficiency programs · feeling of control (over energy bills, the home, energy) · level of unemployment, · level of illiteracy · Internet penetration rate

Recommendations: key lessons and questions for smart metering interventions

The lessons below are tailored to policymakers, intermediaries or other initiators of DSM retrofitting interventions.

1. Projects based on neoclassical or behavioural economics assume that people react 'rationally' when stimulated with the right triggers, and financial benefits or threats are such triggers. **However, in many instances it is clear that economic gains or losses are not necessarily the only trigger necessary.** TIME ISN'T ALWAYS MONEY

2. Smart metering projects are, by definition, projects that push a technology. But, a smart meter is not necessarily a meaningful device for household members. Often households do not (feel they) need it. Usually the only two challenges identified for smart metering projects are its adoption, and the education of people of its economic benefits. **The successful implementation of smart metering is dependent on the creation of an intervention that goes beyond acceptance and aims at creating multiple benefits through the introduction of a smart meter.** TECHNOLOGY ISN'T EVERYTHING

3. The issue of distribution of costs, risk and rewards and benefits is key but not very often addressed. End-users can start to feel that the distribution of costs and benefits actually benefit the utilities and DSOs more (in terms of customer loyalty, avoided investments in the grid, more information on customers) than the end-users themselves. **Who benefits and who pays (eg with assumed loss of privacy)?** MAKE SURE THERE IS CLEAR VALUE FOR THE CUSTOMER

4. Automated feedback on actual energy use and potential for changing one's energy consumption behaviour is at the core of most smart metering projects. This stems from the assumption present in almost all economic and psychological theories or models that increased knowledge and know-how about energy and energy consuming behaviour will lead to a reduction of energy. It is mainly when information provision is coupled to active learning, coaching and shared learning through peers, that this approach can indeed be effective. **Information isn't everything - it needs to be coupled to active or shared learning. AUTOMATONS SHOWING kWh DON'T TEACH NEARLY AS WELL AS REAL PEOPLE AND THEIR OWN STORIES**

5. Beware the self-selecting participants, they cloud results on acceptance and acceptability of smart meters. **If they want it, they're already convinced it's a good idea and not your main target.** FIND AND CONVINCE THE 'LUDDITES' THAT YOUR TECHNOLOGY IS GOOD FOR THEM

6. Smart metering targets the home, its inhabitants and their electricity and gas, and sometimes water consumption. The behaviours that should therefore target habitual actions AND investment behaviour (including retrofitting actions). Smart metering projects, however, usually target the behaviour of people, not of the home. The home and its technologies are left untouched. Tailored advice should also take into account the impact of the house on the capabilities and capacities of households to change the use patterns and its impact on the energy bill. **Don't just tackle the behaviour of people, but also of their home.** HOUSEHOLD DYNAMICS HOLD YOUR KEY

7. The devil is in the detail: the personalities of installers can have an influence on the understanding of clients about the technology, and on their "happiness" regarding the technology. Small differences are found to be key explanatory variables. **Beware of the strong effect of personalities when using intermediaries, champions or advisors.** SOCIAL CUES ARE MORE POWERFUL THAN TECHNOLOGY - FOR GOOD AND BAD.

8. People do not invest in their home but live in them, and the home means different things for different people and means different things at different times. One fairly constant meaning the home often has is comfort. **A home is not where energy is used, it is where people live (comfortably, thanks to energy).** MY HOME IS MY CASTLE.

9. Seeing is doing. Specially trained "Energy Masters", volunteers within the groups that motivate, supervise monitoring and provide material, such as 'DIY energy audits' can be a key to success. **Use trusted champions and advisors.** SEEING IS DOING.

10. Technological maturity of a region or target group needs to be matched to the ambitions of a project. **The technology solution needs to match the technology literacy/maturity of the target.** DON'T SELL IPHONES TO PEOPLE WITH NO POWER

11. Providing feedback on particular behaviours or practices rather than on the more abstract level of overall electricity consumption facilitates the identification of particular behaviours that are 'wasteful'. **Focus not on individuals but on their practices.** IT WILL TAKE A LONG TIME TO CHANGE 7 BILLION PEOPLE INDIVIDUALLY

12. Participation can be a key success factor. Co-development can have a strong impact on satisfaction levels. **Engage your customers through multiple channels.** PARTICIPATION IS KEY

13. Talking about "wastefulness" in interventions may be more effective than talking about saving money. **Being wasteful can be worse than spending money.** NO ONE LIKES WASTE

14. Social norming information about the consumption of others is engaging and interesting. Potentially disaggregated social norming information could encourage energy reduction. It is important to provide detailed feedback in hourly or half-hourly consumption, and in graphs which display peaks and troughs to enable users to identify high–consuming energy practices. Regular emails displaying users' own recent consumption over time, and access to personalised websites are a useful complements to real-time energy monitors. **I wanna know what others are up to and where I stand.** TELL ME IF I'M DOING BETTER THAN MY NEIGHBOUR

Key questions

A key design challenge is to create a smart metering system that keeps engaging with the household members. Changing the messages and feedback in the course of time following energy literacy can be key. Information should thus be dynamic over time. What designs work well for whom?

5. SMEs: observations

Country	case	Theory or model used	Policy or Societally driven
Netherlands	De Groene Daad (The Green Deed)	Nudge	society
New Zealand	EECA SME Crown Loans Scheme	Originally based on TPB; changed to social learning and social norm theories	policy
	Timber industry	Energy Cultures Framework	society
Switzerland	Energy-Model and SME-Model from (EnAW)	Neoclassical Economics Social norm	policy
Norway	Finnfjord AS	Economics, Rogers Diffusion of Innovation	society
Sweden	Energy Save	Collaborative engagement	society
Spain	Verdiem	Economics	society
Belgium	Build4Change	Nudge	society

The cases

The Belgian Build4Change project[51]

The Belgian project, referred to in the research as **Build4Change** concerns the decision by a Belgian real estate consultant (project management, audits, assessment) to instigate a green transformation to its practices. Central to this plan was to relocate from an out-of-town Industrial Estate to a city (Ghent) centre location, despite the fact that the former location was convenient for access to main roads to get to site meetings. The new site is a large city house, which was renovated to high standards (BREEAM Excellent) and also included the home of the owner. He used implicit **Nudge** principles to foster a mode switch in travel behaviour by his staff - from the company cars to using fold-up bikes.

[51] Build4Change is a pseudonym used to protect personal data, as research was interview-based.

Once upon a time... The real estate management industry in Belgium was only interested in money, spending as little as possible on its buildings and charging as much as possible to its clients.

Every day... Belgian occupants would shiver or sweat, complain to themselves, old boilers would pump heat straight out the chimney, the leaky walls or the open doors, before crawling home in traffic, all together at the same times. Real estate owners would only shrug and say 'can't afford to upgrade' and 'it's a prime location' and 'the rent's going up.'

But, one day...EU policy (EPBD) & voluntary eco-labelling (BREEAM) started to push for building quality standards, both for their users and the environment.

Because of that...The new regulatory standards brought about an improvement in building performance, the voluntary labels started, though only slowly in the beginning to create a market differentiation for greener real estate. One consultant decided to promote the highest standards to his clients by setting the norm he wanted them to follow: he moved his company HQ from a car-convenient out-of-town site to an existing inner-city conversion, renovated it to the highest green performance and started attending his meetings by train & bike.

But then...His staff were not all so easily convinced to take up biking to work or to meetings, even though it was a busy drive through the centre every morning and difficult to park. But he needed to convince them because it was necessary for his staff to bike to meetings to demonstrate to his clients that he put his money where his mouth was.

Because of that...He bought them all folding-bikes and used his influence as their boss to suggest they try it, 'next sunny day', maybe not all the way from home, but at least from the park & ride, to avoid the city rush hour, get free parking and see how it makes you feel

So, finally...the staff all tried it, they all rather enjoyed the fresh air, riding through the city as it woke and having the time to look around, feeling young again like the students they were sharing the cycle paths with. Soon they felt fitter, started going to meetings by bike and by train and telling their clients about how good it feels. **The end.**

Build4Change in a tweet:

Dr Sea Rotmann @DrSeaRotmann

Build4Change: #Nudge works best coming from people you know & respect, who invest their time & effort to help you achieve #behaviourchange

The Dutch Green Deed project[52]

The Dutch **Green Deed** project, initiated by Liander, DSO for gas and electricity, was inspired by ideas from a **Nudge** database, set up by the Dutch Nudge Community.[53] In this Nudge-based intervention, SMEs were stimulated to come up with simple energy saving measures, called deeds. A 'deed' is a nudge to facilitate or stimulate the energy saving behaviour (using post-its as a reminder for example). The project started October 10th 2011 and lasted for five weeks. In total, 76 offices participated and 3500 deeds were executed. The goal was to stimulate actions to reduce energy consumption, typically a change in behaviour such as taking the stairs instead of the elevator or turning off the lights. Taping the buttons of an elevator to stimulate people into taking the stairs is an example of making the alternative behaviour less attractive.

Once upon a time... Dutch society became more and more sustainable, using more sustainable energy sources and carry out energy saving behaviour…at home. But somehow, this green behaviour didn't really translate into offices.

Every day... employers and employees would leave their lights and monitors on unnecessarily and used the elevator for only going down a floor.

But, one day... Liander organised a contest between SMEs to become the most sustainable office in The Netherlands. Sustainability was measured through posting their 'deeds' on a website. These deeds are simple energy saving measures, based on a theory called Nudge. Using creative prompts, people were alerted and reminded to conduct sustainable behaviour. Every deed that was uploaded received points and the better the deeds, the more points were awarded. After 11 weeks of competing, the SMEs with the highest scores would win prices ranging from additional advice on energy saving measures to electric scooters.

Because of that... 76 firms participated and 3500 good deeds were performed. 75% of the participating SMEs rated the project as 'good' (overall score) and 43% of the SMEs perceived themselves as more green or sustainable than before the contest.

But then... The contest stopped, and it became quiet. Very quiet. The website with the good deeds was closed. No follow-up projects were initiated and no evaluation of long term effects was performed.

Until, finally... Nothing else happened. A good idea to increase sustainability and goodwill in SMEs and the potential to grow and optimise using additional incentives was simply wasted.

And, ever since then... SMEs are still a hard target for energy savings. A sad, but true story. They did not live happily nor sustainably ever after. **The end.**

De Groene Daad in a tweet:

Dr Sea Rotmann @DrSeaRotmann
The Dutch 'De Groene Daad' tried to achieve #energy #saving #behaviourchange in offices, using #nudge, a contest & social comparison #Task24

[52] www.groenedaad.nl

[53] www.nudge.nl

De Groene Daad from the website

The Spanish Verdiem project in Barcelona City Council's computers[54]

The Spanish **Verdiem** project used a software tool to stop computers' unnecessary (and frequently unnoticed) energy waste because of devices that were left powered on when not in use. The goal was to reduce the energy waste of the connected devices without disturbing current users' habits. The project started with computers, and it was planned to follow with networking equipment. For this purpose, a software tool named "Verdiem Surveyor" was centrally installed. It consists of a server that acts as an aggregator of devices and users information, a client agent that configures the final devices with energy saving configurations scheduled hourly to adapt them to users' behaviour (and not the other way around) and an engine capable of delivering energy, utilisation, monetary and environmental information. A rare, important and positive condition of this project was to find an IT manager who was worried about energy waste and decided to fight it at all costs. An IT department in a big network (around 8000 computers in hundreds of buildings) is usually mainly worried about PCs not stopping, and energy usage is not seen as critical as maintaining business continuity. In this type of projects, the fear of users complaining about energy policies interfering in their daily tasks is usually the main showstopper. It played its part once the project was started, delaying the final deployment, but it is now in full production and without any important problems for users or IT administrators.

[54] www.verdiem.com

Once upon a time... Barcelona, a large, gorgeous city in Spain had lots of computers left ON all day long without many users working on them.

Every day...Computers where wasting more than 40% of the energy they used, equivalent to 1MWh yearly.

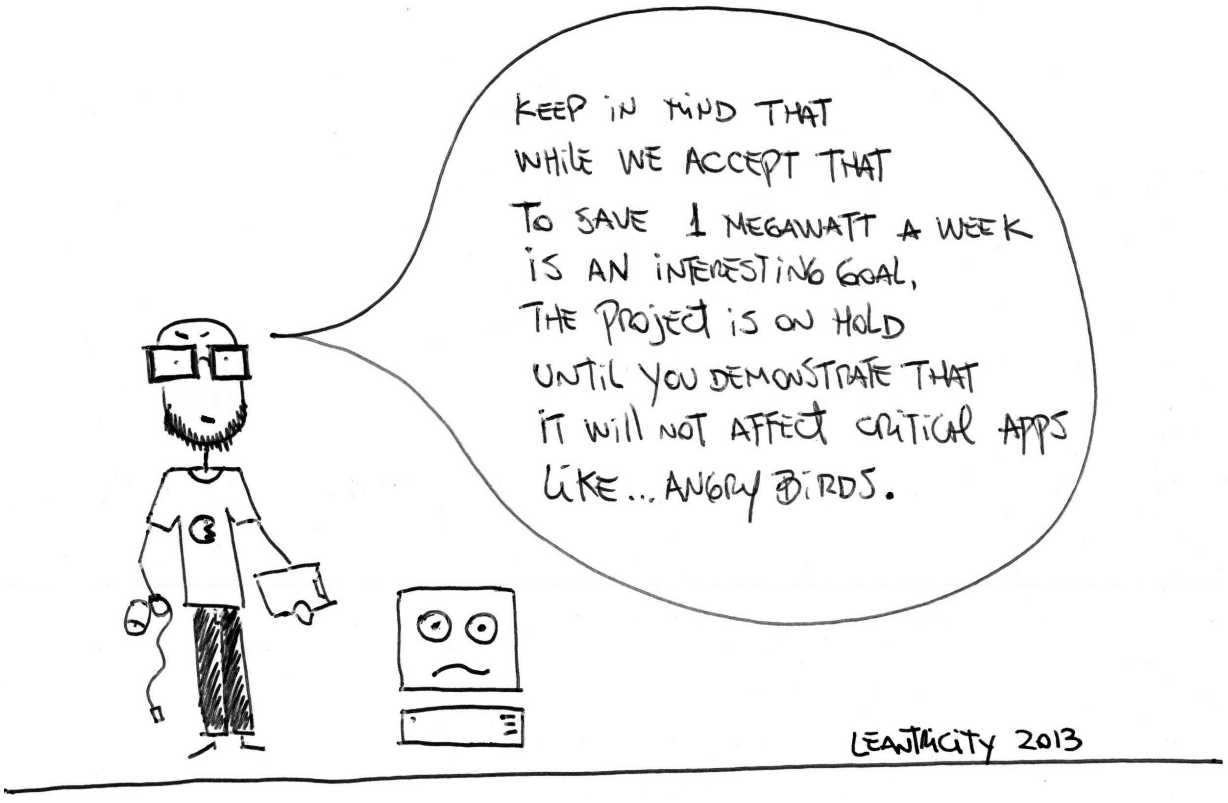
But, one day...The boss of production systems in Barcelona City's IT Department became very worried about his computers' energy spending.

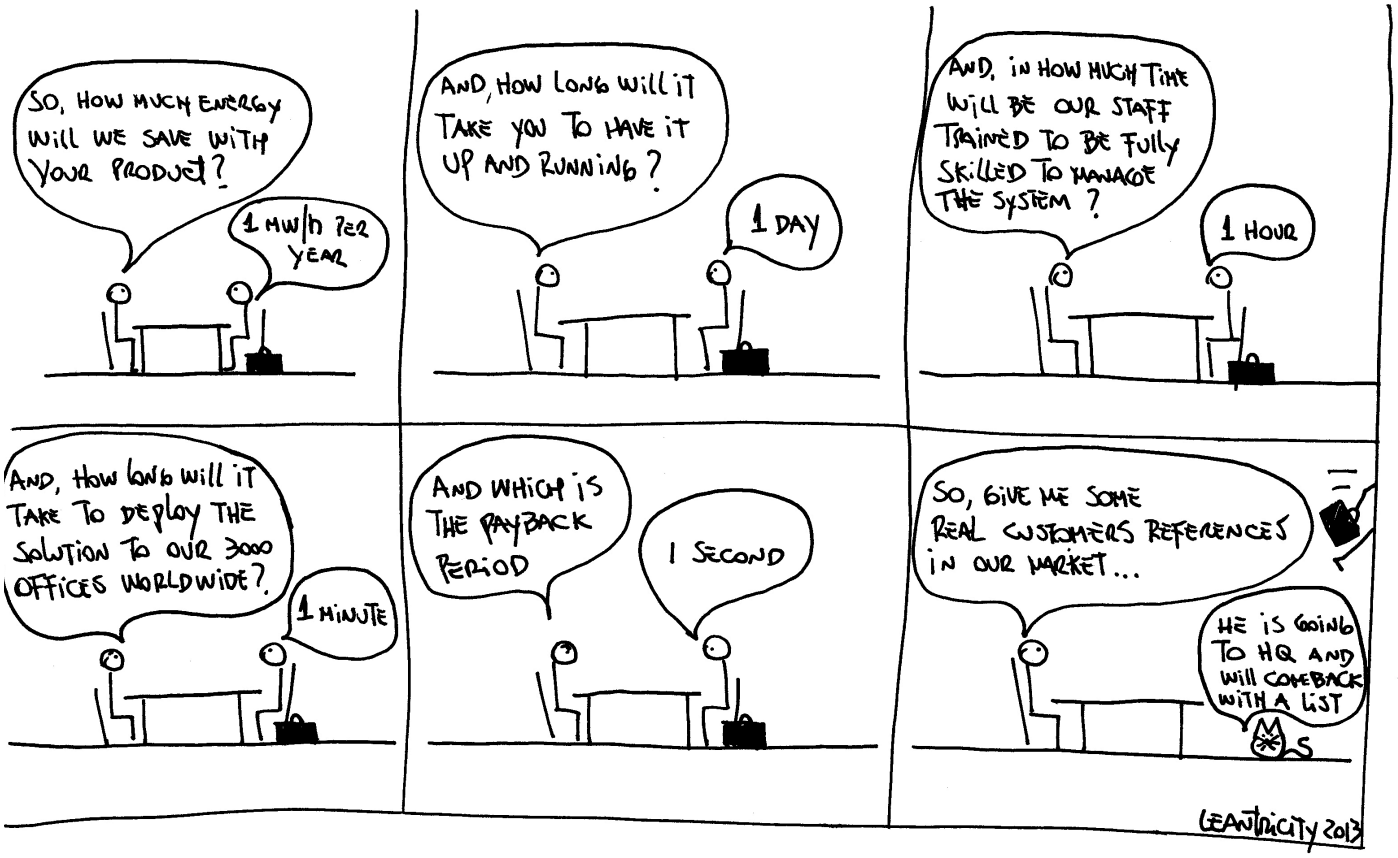
Because of that...He decided to buy a software solution to end this problem. His main concern was reducing waste without affecting the users.

But then...Several well-meaning HR Managers raised a whole lot of reasons to be afraid about advancing with the project without doing reassuring tests around users' disruption.

Because of that...The project got stuck in limbo until really comprehensive tests where done. The main portion of delays were created by "paralysis by analysis", not by solid findings of any real problems.

So, finally... After people felt safe about the harmless benefits of the measures, they were rushing to deploy the energy savings software to all the computers they have. **The end.**





The Verdiem project, as seen by its implementer, Juan Pablo Garcia (2013)

The SwissEnAW project[55]

The Swiss Energy Agency of the Economy (Energie Agentur der Wirtschaft, **EnAW**) is an association of the most important inter-trade organisations of the Swiss economy and has a public-private-partnership agreement with the Swiss Federal Office of Energy (SFOE). The Agency as a partnership between economic and governmental organisations is a good institution to promote energy efficiency in enterprises. The Agency is financed by the participating enterprises itself (85%), by partners (9%) and by federal institutions (6%). The large contribution from industry is a sign that activities of the EnAW are highly valued by Swiss companies. The facilitators from the Agency engaged in the target-setting and the design of interventions in the participating companies are well respected. With their technical and process-related knowledge they contribute to higher energy efficiency in the enterprises. Facilitators play an important role in the programme, since they have to fulfill expectations from two sides: the ones from the enterprise (cost-effective measures, not too high (i.e. expensive) targets) and the ones from the ENAW/SFOE (high/strong targets). The Swiss Agency's target is to reduce energy consumption and CO_2-emissions of Swiss enterprises by voluntary and profitable measures of the companies themselves. The Agency has mainly three different programmes to support companies in this area. One is for companies, who use a lot of energy (called Energy-Model), two are particularly for SMEs (called SME-Model and Benchmarking-Model). The main approach is based on **neoclassical economics** and some **social norming**.

[55] http://www.enaw.ch/de/

Once upon a time...the Kyoto protocol targets also became relevant for Switzerland. Everyone had to cut CO2-emissions which meant that Swiss companies also had to make their contributions.

Every day...a few SMEs do their best to not only work cost-effectively but also energy efficiently. But not every SME has the knowledge, the competencies and the will to make their business climate-friendly.

But, one day...this was exactly what the government wanted the companies to do.

Because of that...the government introduced a CO_2-fee on combustibles and gas.

But then... the Swiss Energy Agency of the Economy started their work to help large companies but also SMEs in getting greener. And they made a deal with the government to support these SMEs, who take voluntary actions of getting energy- and CO2-efficient.

Because of that... there are now 2313 SMEs involved in the ENAW-program, which sounds pretty good. However, this is not even 1% of all SMEs and larger companies in Switzerland! But those few participants reached the CO2-emissions-reduction goal of the government.

So, finally...the program is a success in terms of CO2 and energy reduction. But there are still 99% of all companies, who have to be motivated for the programme! **The end.**

From the Swiss enaw brochure

The Swedish Eskilstuna project[56]

Energy Efficient (Companies in) **Eskilstuna** is a project developed in collaboration between the Eskilstuna municipality and the Factory Association (Fabriksförening) – with the goal of reducing energy use among companies in the commune. The project was first launched in 2009 as part of a broader investment initiated by the Swedish Energy Agency's – Sustainable municipality (Uthållig kommun); aimed at getting existing players in Eskilstuna to develop activities that contribute to reduced energy usage. It has since then been run several times and in several places in Sweden. The Eskilstuna project essentially builds on a **"collaborative approach"**, where entrepreneurs, municipality and energy expertise work together in networks.

Once upon a time... In the ancient kingdom of Sweden...

Every day... people went to work in SMEs not reflecting on their energy use.

But, one day... the Swedish Energy Agency introduced a support scheme for energy audits.

Because of that... wasteful energy use became more visible.

But then...still nothing much happened!

Because of that... the Swedish Energy Agency promoted demand for facilitators like procurement consultants that could help build collaborative networks.

So, finally...the SMEs started to make use of the audits and carry out corresponding measures based on their needs.

And, ever since then... many Swedish SMEs now have a successful energy management system. **The end.**

[56] http://www.eskilstuna.se/sv/Naringsliv-och-arbete/Fakta-om-naringslivet/Naringslivsutveckling/Energieffektiva-foretag/

Eskiltuna is growing - from project website

The Norwegian Finnfjord AS project[57]

Finnfjord AS is a Norwegian ferrosilicon processing company operating a plant in Finnsnes in the far north of Norway. With the aid of a large grant from the Norwegian energy efficiency agency, Enova, Finnfjord has recently installed a new heat recovery plant to convert excess heat from the smelting process into electricity, which has resulted in a 35% reduction in electricity consumption. At a total cost of about € 150 million, the project was costly for an SME, even for one in an extremely high-revenue industry like the ferrosilicon industry. It had cost overruns of about 15% and a year's delay, a testament to the complexity of the project. The project implicitly worked from a **neoclassical economics** perspective, although it would not have been possible if it wasn't driven by a family-owned business and **vision** to become the first carbon neutral ferrosilicon plant on earth. Some of the ensueing issues with Enova are a reminiscent of **Roger's diffusion of innovation**, where forerunners, as important as they are to be energy efficiency innovators, are not always rewarded the same way as fast followers.

[57] http://www.finnfjord.no/

Once upon a time...Finnfjord, a small, family-owned business far north of the Arctic Circle decided to become the world's first carbon neutral ferrosilicon plant.

Every day...its owners and clever staff pondered how to go about this immensely difficult task (seeing ferrosilicon plants use an enormous amount of energy for their processes).

But, one day...they found a way to make use of the excess heat and offgases from the production to power a steam turbine, which would produce electricity for the company, significantly reduce their demand and vastly increase their electricity efficiency.

Because of that...they struck an agreement with Enova, the Norwegian government enterprise responsible for promotion of environmentally friendly production and consumption of energy, that they would receive a sizable grant which would help them implement their grandiose idea..

But then...they discovered that there were a lot of technical difficulties in getting the technology to work, resulting in a year's delay of work and a large budget overrun. Still, when it was finally started, the new boilers immediately lowered demand by a large amount, thus proving the feasibility of the project.

Because of that... other, larger, multi-national companies are now making use of Finnfjord's innovativeness to improve their own efficiency, but of course at much less risk. This has unlocked significantly more funds from Enova, which makes sense from the Government agency's perspective as they use public money to fund these projects. The less risky a project - the easier it is to justify using taxpayer money. However, it does not seem fair from the forerunners' perspective, as Finnfjord took on most of the risk and developed and trialled the technology in the first place.

So, ultimately...there was a clash between two Norwegian policies – one stimulating increased energy efficiency, the other stimulating innovation. This also showcases the difficulty in deciding how to bridge the 'valley of death' - with government push or market pull?

But finally, the end result was very successful, with energy savings of up to 35% for an upfront investment with a payback time of 7-8 years. Norway's ferrosilicon plants are fast becoming the most environmentally friendly in the world, thanks to our small family business with its big ideas (and some help by the government). **The end.**

The beautiful setting of Finnfjord, the world's most energy efficient ferrosilicon plant

New Zealand's EECA SME Crown Loans Scheme[58]

The Energising Business Programme was launched in 2010. It was a $1.46m programme. It was designed to provide energy management expertise and assistance to Small and Medium Enterprises (SMEs) with an annual energy spend of less than $300,000. Priority was given to food production and tourism. It estimated that there were over 250,000 SMEs in New Zealand with the potential to save over $400 million over the next 8 years (between 10-20% of their operating costs). SMEs with an energy spend of less than $300,000 pa per site could qualify for 33% of the cost of an energy assessment and 33% of the cost of investing in the recommended improvements up to a total of $30,000. 11 Service Providers were contracted to provide the services and two councils, the Wellington City Council and the Auckland Council provided support for the programme. The approach was to: Identify the potential, understand the barriers to natural uptake, design and deliver a cost-effective programme, raise market awareness and demand (information), enhance industry capability (training programmes) and fast track uptake of efficiency projects (financial assistance). Large third party providers didn't perform as well as expected. Smaller ones were successful one-on-one but did not reach many businesses. Only one small provider had some success as they stuck to one industry (wine growing). The industry association was the most successful: over 80 business signed up over 2 years, some achieved a 40% saving of total energy costs, in the first year a total of 175MWh were saved, in year two 1GWh. Those companies that participated in the project succeeded in making energy savings and the benefit to cost ratio was 4:1. However, the uptake of the programme was not as high as EECA anticipated at the outset of the programme and so the agency finished it at 30 June 2013. The programme was built on a **neoclassical economics** perspective, with some elements of **collaborative learning theory**.

58

Once upon a time... There was a small agency in a small country called New Zealand, which looked after energy efficiency and conservation efforts in households, transport and businesses.

Every day... Small to medium enterprises in NZ (all 250,000 of them) were using too much energy and paying too much for their bills.

But, one day...EECA decided to build on its Energywise Business programme and design a programme focusing mainly on SMEs.

Because of that...they contracted service providers around the country to engage with SMEs, pay towards their energy audits and 1/3 of the improvements they could make from the audit recommendations.

But then...it became really clear that these service providers didn't end up getting many audits done, only one little one that concentrated on only one industry (smartly enough, the wine industry!) got a lot of response. One big outlier was the Manufacturing Association, who brought businesses together in a shared learning environment where they could talk about their energy use and learn together.

Because of that... Many more businesses took up audits and their recommendations.

So, finally...EECA decided to contract these kind of business associations to do their work in a shared learning environment, rather than tackling only individual businesses.

And, ever since then... the businesses that participated saved up to 40% of energy, in total over one GWh. However, despite the 4:1 payback ratio, EECA decided the programme wasn't successful engouh and canned it. What a shame. **The end.**

EECA's SME Crown Loan case in a tweet:

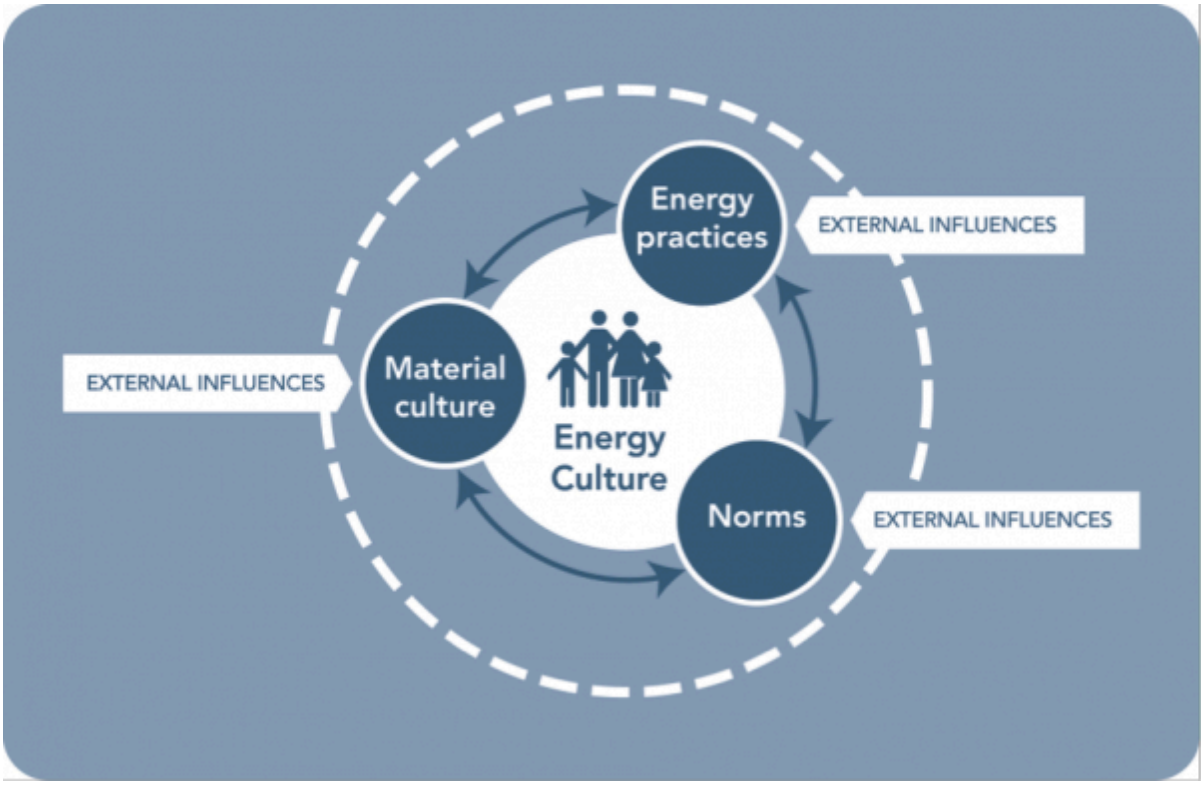
Dr Sea Rotmann @DrSeaRotmann
Changing #SME's #energy use works best if you use trusted industry associations, shared learning and have CEO buy-in @EECAbusiness #Task24

The New Zealand Energy Cultures framework[59]

EC2 is a 4-year research project, led by the University of Otago, that aims to develop the knowledge and tools to achieve a sustainable energy transition in New Zealand's households, businesses and our transport system. 'Energy Cultures' are the ways that technologies, practices and norms lock us into certain patterns of (often unsustainable) energy use. The research is about how to support businesses and households break out of these habitual patterns, and achieve greater productivity and improved wellbeing. The work

[59] http://www.otago.ac.nz/csafe/research/otago049909.html

builds on Energy Cultures 1, which focused on household energy cultures relating to space and water heating. EC2 has two parts: Efficiency Transitions in Households and Businesses and Future Transport. It is funded by MBIE, with co-funding from EECA, Z Energy and Mercury Energy. It runs from 1 October 2012 to 30 September 2016.



The Energy Cultures framework

Once upon a time in New Zealand... there was an economist, a physicist, a sociologist, a lawyer and a consumer psychologist**.**

Every day... they were trying to understand why people got locked in to certain patterns of behaviour in their energy use, even when it seemed logical to change. But each of their disciplines had a different explanation for this.

Because of that… they developed a model that made sense to all of them. It said that people develop a distinctive 'energy culture' from the interactions between their norms (what they think is normal or appropriate), their material culture (their technologies and infrastructure), and their energy practices (what they do that uses energy). They called this model the Energy Cultures framework.

But then… even though it was first just meant to help them work together, they realized that the model could help them understand why people behaved the ways they did, and how to help change behaviour. Firstly, they applied it to households' heating behaviours. Secondly, they applied it to all energy behaviour in households. Thirdly, they found that they could identify several clusters of quite distinctive 'energy cultures' across NZ households. And then, they used the model to help understand why timber firms used different drying technologies.

Because of that … they are now using the model to help understand how transport systems are changing, and to understand the energy cultures of SMEs, and to compare NZ's energy culture to other countries.

And, to their surprise... people all over the world thought the model was really helpful, and they had many invitations to talk about it, and other people wanting to apply it in other situations

Until, finally… the Energy Cultures Framework became quite well known as a new way of thinking about behaviour and change, and the Energy Cultures team grew to include many more disciplines. Now the team is working with other people in NZ and internationally to test and apply the model in different contexts. **Watch this space to see what happens next!**

Energy cultures in a tweet:

Dr Sea Rotmann @DrSeaRotmann
Energy Cultures 2: improving the resilience of New Zealand's households, businesses and transport systems #EC2 #behaviourchange #Task24

Theories and models used in SME interventions

The domain of Small and Medium Enterprises is very diverse, as SMEs can be offices, shopfronts or even small industrial plants. In addition, the focus of interventions in SMEs can vary from reducing the energy consumption of the ICT equipment, to changing the energy consumption patterns of its users and getting employees to switch off the lights or certain machines. In some cases, interventions initiated by SMEs can also cross the boundaries of the office, and focus on changing the outside-work behaviour, or staff travelling behaviour.

The theories or models underpinning the cases we collected are also rather diverse.

The Belgian **Build4Change** and Dutch **Green Deed** projects for example implicitly used elements of **Nudge** principles, though perhaps they didn't apply the model in full. It was certainly an attempt to 'alter people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives'. However, it was carried out on a micro-scale, not at policy level, and the behaviour change was managed, rather than predicted. It was not a systematic approach to affecting behaviour change, rather cases of practically enabling change and providing incentives and further nudging if required.

The Spanish Barcelona City Council PC power management **Verdiem** project also used a behavioural economics approach, and as such is related to the **Nudge** approaches.

The Swiss **Energy-Model and SME-Model** from the Energy Agency of the Economy EnAW had an eclectic combination of **social norm approaches** with leading inter-trade partners and big companies involved in the EnAW, and visibility of participating firms as an important part of the communication strategy. It also used **economic theories** focusing on measures helping companies to save money through energy savings and remove the burdens from CO_2-fees, and a **corporate responsibility** model where enterprises are expected to contribute to long-lasting resource availability for the society/economy.

The **Swedish and New Zealand** projects aimed at stimulating a community of SMEs to become more energy efficient and conserve energy both used **collaborative learning** approaches.

Influence of theories or models on the design of interventions

The influence of Nudge on the intervention

Below follows a discussion of SME-specific design characteristics of interventions based on behavioural economics, nudge theories and approaches.

- from nudging to nudgers: get high level involvement
- losing some, winning some
- Intervening in the specific decision-making context
- Energy or the environment might not be the magic words to nudge people…
- Nudging needs continuity
- Nudging is what it is: it is a nudge, not a life changer

From nudging to nudgers

A strong general policy incentive for greening SMEs might have limited applications. Interventions focused on changing employee behaviour need very active top-down support, involvement of the management level and, in fact, even clients. It also needs 'champions' among the staff who will provide bottom-up enthusiasm and showcase good behaviours. Most important are the competent implementers in the middle: IT, building, energy managers that know the business, its technology and its energy saving potential and any associated risks.

The Belgian **Build4Change** case highlights the imperative role of the company management in motivating the change. This project was driven by a 'dark green' owner, who recognised that the model of gentle persuasion and steady adaption, such as **Nudge**, was most appropriate to not damage business, upset staff or clients. The owner did not chose the Nudge model explicitly, but intuitively followed the guidelines provided by Nudge. Nudge appreciates the need to attempt small systematic changes to context, social norms, infrastructure, and technology to redirect or guide behaviour. The owner appreciated that company cars are an industry standard 'perk' in Belgium, so to force staff to give them up would have been HR suicide. The owner therefore bought company fold-up bikes for staff to enable them to travel between sites and train stations. Company cars were still provided. The owner used his influence to personally 'nudge' staff to begin using the bikes. Key to this success was the persuasion of the owner, acting as environmental champion, both in providing the bikes and in to an extent using his 'authority' to oblige staff to adapt. There is no evidence that change was forced by authority, but it infers that 'nudging' should be accompanied by personal influence/high-level management involvement to deliver adaption along the desired pro-environmental lines.

The Spanish Barcelona City Council PC Power management project **Verdiem** also highlights the importance of key persons in achieving the desired change. The success of projects like the Verdiem project has a lot to do with the consciousness (or lack of it) of the ICT staff regarding energy usage. This ICT staff can block or stop the initiatives or delay them forever mentioning too much work pending or "other, more important" technical problems. As an anecdote: the Spanish researcher mentions having a customer where the purchasing agent was not especially friendly with the implementing one. The audit phase gave a prediction of €1000 saved each day and the solution was bought but never implemented. This led to lost savings during 3 years with the investment already made. The reason for not finishing the project was that they had some quirks with shared folders in the network while computers came back from suspension. The problem was real and has a solution, but the effort from the ICT staff to solve it was below minimum. What this anecdote highlights is how important it therefore is to target the key staff or champions or champion nudgers in an organisation and work with them. The lesson to be learnt here is that economics as an approach is not sufficient to deal with the often implicit power plays, personal relationships in an office and between different layers of staff. Creating ownership amongst relevant staff is therefore key.

Creating ownership amongst relevant staff is also at the core of the Norwegian **Finnfjord** project which is also largely implicitly informed by **behavioural economics** but also **organisational sociology**. The change is supported by means of a subsidy. The main point of the subsidy schemes for more industrial or commercial projects is not to act as innovation support but rather to help ensure that energy efficiency projects that would not have gone through by normal cost-reducing efforts will be realised. Finnfjord itself is not a typical industrial company. With its 125 employees but sizable income it stretches the definition of an SME, but it is still one of the smallest such plants in the world. It is a family business, with the current CEO being third-generation operator of the plant. The combination of small operation and family ownership means that the operating management of Finnfjord is able to make decisions that more investor-based, short-term profit-oriented industrial companies would not take, due to risk or long payback time. While this means that the company takes on a lot more risk than most openly traded companies, it also means that the organisation can respond to new developments more rapidly and is able to set other types of goals. Institutional change will seldom be effected entirely top-down; it requires the enrolment of support from all

levels of an organisation. Reluctant or outright hostile employees can sabotage the most carefully planned change in corporate culture or workplace habits.

Work done within **organisational sociology** on the role of institutional expectations points to the way that mobilising towards shared goals can help increase internal support for reforms or organisational changes[60]. In the parlance, shared visions and goals are said to be performative, in that formulating a new vision can have an effect on the actions of employees in itself, if management can garner support for the new vision. This ties into the initial decision of the Finnfjord board in 2007 to become the world's first carbon neutral ferrosilicon plant. While the new heat recovery plant is mainly a technical question and not something that relies heavily on support from employees in itself, it represents a substantial share of the company's economy and thus a liability for its continued existence. By taking on a risky project, management was effectively putting the jobs of their employees on the line, something which in itself involves them. Keeping in mind that this comes from an interview with management itself, they claimed that the project was met with great support from employees. The idea that they were part of making their workplace a greener, more energy efficient place and achieving this lofty goal of being world first and best seemed to go over well.

Actually, this commitment and engagement at the highest level of the organisation is not something only, or typically, connected to a behavioral economics or neoclassical economics approach. Projects that worked with a combination of **economics** approaches and e.g. **collaborative learning**, i.e. the New Zealand **EECA SME** project, also conclude that it is important to have the highest management committed and engaged.

Losing some, winning some

In SMEs, a multitude of people work, in different roles, and not everyone will feel comfortable with the requested changes in the company. It is natural to 'lose' some along the road, and potentially this self-selection will strengthen the new social norms emerging amongst those that stay. In the **Build4Change** project for example it is mentioned that small percentage of staff left the company, not agreeing with the approach.

Intervening in the specific decision-making context

Nudge targets mainly discrete 'bad' behaviours, though in context, not in isolation. The Belgian **Build4Change** project was focused on altering the decision-making context to make work travel by bike/ public transport the preferable option, essentially by providing bikes and making the starting point (the office) less car-friendly. In this sense, it is a successful demonstration of the **Nudge** model, although chosen implicitly. A potential lesson for successful application of the model is perhaps that it was a specific approach applied to the specific context of the single SME, rather than a general policy measure.

Energy or the environment might not be the magic words to nudge people…

Organisational changes target many different stakeholders and behaviours. For these multiple end users different motivations can apply – e.g. 'we should do this to show we are a serious green company' – is significant for the company management levels, but may be less significant for staff. Building or energy managers may have cost or energy efficiency drivers, but a solid appreciation and fear of risk when changing processes or technologies. Staff may get swept up in the excitement of their CEO or leadership (see Ray Anderson's truly outstanding life work at Interface Carpets[61]), or they may fear for their routines, or even their jobs, as was the possible case with **Finnfjord**. The **Build4Change** project appreciated the multilayered aspect of 'greening' a company. It had multiple aims, ranging from reducing energy use, reducing the GHG footprint, improving quality of working life for employees, to creating a positive

[60] Borup et al. (2006)

[61] http://en.wikipedia.org/wiki/Ray_Anderson_%28entrepreneur%29

impression to encourage clients/partner firms to consider doing the same. The SME even contracted research to study the effect of the move on staff travel, working and outside-work behaviour, plus how any new practices affect interaction with clients. Also of interest is the role played by quality of life improvements in sustaining pro-environmental behaviour change. In the **Build4Change** project even staff who do not have strong pro-environmental attitudes have been persuaded to use the bikes on a park&ride basis, avoiding the city centre traffic, and are also feeling positive fitness and well-being benefits of approaching work in the 'fresh air', doing exercise and getting in touch with their surroundings.

However, vice versa, for SMEs, energy and CO2 might not be the magic words either. For the SMEs participating in the Swiss **EnAW** programme, for example, the strengthening of their company image as an ecologically and socially responsible company was a more important driver.

Nudging needs continuity

The Dutch **Green Deed** project had a short time span of 5 weeks, concluded with a award ceremony, but after that the project was discontinued, even the website where the different deeds were described was terminated. This is not only a pity because the lessons learnt could no longer be shared amongst the participating SMEs, it was a pity because the created momentum was not used for further spreading of the initiative and in addition it did not match with one of the project goals, namely to sustain saving behaviours in offices.

Nudging is what it is: it is a nudge, not a life changer

Nudges can support the easy change and start up of a behaviour, but without additional measures, after a nudge is discontinued, the achieved changes in behaviour will decrease due to the absence of the motivator. Nudges do not necessarily act on the internal motivations, the attitudes or the intention to change behaviour. They are external stimuli to facilitate or discourage certain behaviour. Nudges can thus support people as reminders about their motivations and attitudes but more (e.g. changing social norms, institutionalisation of norms) is needed to change attitudes and motivations.

Influence of using social norms approach

Below follows a discussion of SME-specific design characteristics of interventions based on social norms theories and approaches.

- Institutionalising social norms
- Even social norms need to take account of specific implementation context
- Distributional issues and social norms
- Competition and social comparison creates committed communities, at the start..

Institutionalising social norms

The creation of a dedicated institution or intermediary can be key to successful implementation in a certain branch of SMEs. In the Swiss **EnAW** programme, it becomes clear that the presence of such an overarching association that testifies of the **'social' corporate norms** around energy consumption reduction is key to the success of the programmes. Not only does this association monitor and collect all individual company results, it shares these results and this generates the further establishment of the social norm of energy efficiency and conservation. In addition, because each year new goals are set, an integral part of the social norm is the temporal incremental approach to savings.

The effect of this collective approach, mediated by an appreciated and collectively 'owned' institution can be seen in the participation rate. Since the beginning of the programme, a lot of companies (mainly high-

energy-consuming companies) began to participate. In 2010, these participating enterprises were responsible for 45% of energy consumption of the whole economic sector. The SME-Model (mainly on a voluntary base) exists only since 2006 and doesn't represent a large amount of emissions compared to the Energy-Model, but has a big potential and the number of participating companies is growing by 20-30% a year. In 2011, a total of 2232 companies were participating. The CO_2-intensitiy of the involved enterprises was lowered since 2000 (until 2011: by ca. 35%), and the energy efficiency of the involved enterprises has increased since 2000 (until 2011: by ca. 23%). In New Zealand's **EECA SME** programme, however, it was seen that not having the 'right' facilitators did not lead to a high uptake of the Crown Loans, which were based entirely on the neoclassical economic **incentive deficit** model. Only when collaborative learning was fostered by the intermediary, a trusted manufacturing association that could bring businesses it personally knew together in a workshop environment, did uptake significantly increase.

Another important form of institutionalisation is clear commitment from policy and government, translated into incentives or unburdening from obligations. The Swiss Government has to fulfil Kyoto-targets relative to CO2-emissions (reduction of 10% in comparison to emissions of 1990). With the Federal Act on the Reduction of CO2-emissions (1999, "CO2-Law") the Government sets the framework and measures to meet this goal. Swiss companies, especially the ones in the industrial sector, have a big potential for energy and CO_2-emission savings and have to make their contribution to this goal. Therefore, the Swiss Government involves them in reducing CO_2-emissions with own reduction goals. The Federal Act and the corresponding energy policies of Switzerland give the (economy) enterprises the chance to fulfil their goals by voluntary actions. If these voluntary actions do not reduce enough emissions, the State is considering introducing a CO_2-fee on combustibles. Trade associations founded the **EnAW** to support voluntary actions of the Swiss enterprises, so that the economic sector as a whole meets its emission-reduction goal. The EnAW focus is not only on CO2-emissions but also on energy consumption (electricity), which is often correlated and has a money-saving potential for the enterprises. In 2008, a CO_2-fee was introduced on combustibles and gas, because the emission reduction targets of all sectors were not reachable by voluntary actions only. Companies who declare their own ambitious targets on energy and emission savings according to the mentioned law (e.g with the EnAW-program) are released from the fee. This is one of the main incentives to participate in one of the EnAW-programs, especially for companies with high energy consumption.

Another example of regulation promoting sustainability efforts of SMEs is the implementation of the EU directive ISO 26000 November 1st of 2010. ISO 26000 is a directive aimed at increasing sustainable management in SMEs using Corporate Social Responsibility (CSR). The added value of sustainable business models, both in financial and social/sustainable terms, is since becoming more and more perceived by firms and this was a context issue motivating the Dutch SME firms to participate in the **Green Deed** project.

In addition, a sustainable image is an increasingly valuable asset for SMEs, also due to institutional changes such as the implementation of the Ecolabel (EU) and the Dutch 'MKB prestatieladder' (SME performance ladder). These labels make a visual statement and show whether or not an SME is adhering to a new social norm on sustainable and responsible corporate behaviour.

Even social norms need to take account of context specific implementation context

The Swiss **EnAW** programmes help companies to define goals and corresponding measures concerning the reduction of energy and CO2-emissions. Facilitators from the EnAW are consulting the enterprises in defining specific goals and corresponding measures for the enterprise. They take into account the particular situation of the firm. This tailoring leads to actionable goals and recommendations.

Distributional issues and social norms

The Swiss **EnAW** programme experienced the issue of distribution of burdens and costs first hand, and equality is key to creating a shared **social norm**. Target-setting related to energy and CO_2-savings was not very ambitious, especially in the beginning (until 2004/2005) and was tightened afterwards (for agreements with new enterprises). This caused unequal conditions for earlier and later agreements, which resulted in major negative response to the programme. This problem could not really be solved, but as time passed by all the older target-settings had to be renewed based on the more ambitious regulations.

A similar issue arose in the Norwegian **Finnfjord** project. In the time since it became clear that the heat recovery project would go through without too many teething problems, the funding body, Enova has changed their risk calculations of these types of projects. Because of the way their support structure is designed, this has made it possible for them to support similar projects with a larger sum of money than what they gave Finnfjord. This has, understandably, annoyed executives at Finnfjord, who took a large initial risk in order to increase competitiveness through increasing efficiency. Enova say that it is not their job to act as funders of innovation or to deal with questions regarding fair competition – they are mandated to fund projects that deliver the maximum amount of kWh saved per NOK invested. Since the decision to support a project depends on the project's score on a set of variables such as payback time, projected savings, scope relative to the size of the company's budget and risk of failure (to mention a few), a change in any of these variables will affect Enova's possibility for funding the project. In this particular case, the actual demonstration of the viability of the project that came from the successful implementation at Finnfjord made it possible for Enova to downgrade the riskiness of these types of projects. Since the risk calculations exist to provide a funder with an estimate of the actual cost of the kWh saved (risk of the project failing against the projected savings), a lowered risk decreases the projected cost per kWh. This does fit with **Roger's Diffusion of Innovation** theory which shows an s-curve of innovation adoption by a society or network. In this case, Finnfjord was clearly an innovator, whereas the takeoff of an innovation will start at around 10-20% of (early) adoption, which is where more of the Enova seed funding (Enova being the 'change agents' sitting outside the model but who enourage the uptake of the innovation) was pushed. The theory says that soon, there will be uptake from the early and late majority, and finally, the laggards - when 80-90% of businesses will have adopted the innovation and it becomes a norm. It is of course a shame that this system seems to penalise innovators and reward early adopters, who did not have to assume anywhere near the risk to their company. However, from a government agency's perspective with a specific mandate, and of course using tax payer money, this is just prudent investment.

Competition and social comparison creates committed communities, at the start..

The Dutch **Green Deed** project used the element of **competition** to nudge the participating SMEs to really make an effort. With this competition, implicitly, the SMEs individually became a social community that could position them self against other social communities. The competition required that every deed should be captured using a photo or a video and uploaded on the webpage (discontinued after the end of the project). By uploading the photo or video, credit points were added to the score of the SMEs. The ratings of all SMEs were published on the website and this functioned as social comparison, which further motivated the participants. At the end of the competition, the winning SME was announced and awarded prices for the best scoring SMEs, ranging from additional advice on energy saving measures to electric scooters.

Contests and social comparison can be valuable additions in a **nudge** approach. A contest is a way of reinforcing behaviour through rewarding. Contests can be a motivator in energy saving behaviour, but results will reduce on the long term once the reward is gone.[62] Therefore, contests are potentially most

[62] L. McClelland, S. Cook, Promoting Energy Conservation in Master-Metered Apartments through Group Financial Incentives, Journal of Applied Social Psychology, February 1980

effective as an early incentive[63] to familiarise the public with a (social) innovation and start up initial behaviour. In this particular context, social comparison was used as a motivator for behavioural change. SMEs were able to see feedback and results of other SMEs on the website and to compare points and ranking with other offices. Social comparison is seen as a motivation for 'behavioural willingness' in the **Prototype/Willingness Model** (PWM) by Gibbons and Gerrard. Where attitudes are a motivator for behavioural intention and part of the 'rational path', the route from social comparison to 'behavioural willingness' is called 'the social path' (behavioural willingness then influences behaviour directly or indirectly via behavioural intention). Bandura supplements this theory by stating that social comparison is also a tool for self judgment. Social comparison is then used to set a standard for one's own performance.[64]

Influence of the Energy Cultures approach

Below follows a discussion of SME specific design characteristics of interventions based on the energy cultures approach.

- Energy cultures differ from company to company

Energy Cultures of timber companies[65]

Small and medium-sized timber processing firms in New Zealand typically use more than 95% of their energy on drying freshly-sawn timber. Most is dried using conventional vented dryers, but around 3% of timber is dried using heat pump kilns. These are more energy efficient, have fewer emissions, and produce a better quality product than vented kilns and the costs of drying by the two methods are essentially the same. In-depth interviews were undertaken with 20 timber companies to try and understand why firms in this particular industry reject heat pump technology so comprehensively. The data was then analysed using the **Energy Cultures framework**.[66]

The Energy Cultures framework distinguishes the external drivers of a firm's behaviour from the internal, over which the firm has some control. The external drivers include commercial pressures, technology networks and supply firm interventions. The internal drivers are grouped into energy-using activities ("practices"), physical technologies and infrastructure ("material culture"), and mental models of what is normal or appropriate ("norms"), which tend to become self-reinforcing.

The analysis found 'energy cultures' at the level of both the individual firms and at the sector level. While individual firms using vented kilns perceived that they were simply making rational economic decisions, they were strongly influenced by the industry-wide culture which legitimised vented kilns over heat pump kilns, and made it hard for individual firms to change their own energy cultures. The prevailing technologies, practices and norms are deeply embedded in the socio-technical context, hindering technological learning, improved energy efficiency and business innovation. Influential stakeholders in the industry are thus part of, and locked into, the industry-wide energy culture, and are not in a position to effect change. We concluded that actors external to the prevailing industry energy culture were needed to leverage change in the industry norms, practices and/or technologies in order to reap the advantages of energy-efficient drying

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[63] C. Egmond et al., Target group segmentation makes sense: If one sheep leaps over the ditch, all the rest will follow, Energy Policy Elsevier, July 2005

[64] Bandura's Social Cognitive Theory of Self Regulation (1991)

[65] Martha Bell, Gerry Carrington, Rob Lawson, Janet Stephenson (under review) Socio-technical barriers to the use of energy-efficient timber drying technology in New Zealand. Energy Policy
(We've just done the final changes following review and hope that the editor likes it … hopefully we will have a reference by the time this report is completed.

[66] Stephenson, J, B Barton, G Carrington, D Gnoth, R Lawson, P Thorsnes (2010): Energy Cultures: A framework for understanding energy behaviours. Energy Policy. 38: 6120–6129

technology, assist its continued evolution, and avoid the risks of path-dependency. For effective policy responses, it is important to understand the interactive nature of socio-technical barriers that affect the deployment of energy efficient technologies, so that they can be addressed effectively.

A Story on Energy Cultures in SMEs

We know that there are different Energy Cultures in each SME and that someone coming from the outside, telling you what to do according to some generalist scheme, is not going to go down well

You may like the way you do things and think you are doing them in a rather capable manner already

Or you may be stuck in a way of doing things because that's how all other SMEs in your sector are doing it

So, it is important that you help us understand how your business works by listening to you and your staff

We can then use a framework to explain the different elements that need to work together

There are external drivers including commercial pressures, technology networks and supply firm interventions which you can't do anything about

But there are also internal drivers, how you use energy ("practices"), your physical technologies and infrastructure ("material culture"), and mental models of what is normal or appropriate ("norms"), which tend to become self-reinforcing

The best way to break through these locked-in Energy Cultures is to bring in trusted outside expertise and to find a CEO who is willing to take a risk and be an innovator

Then we also need someone capable who can introduce the new technology or process into the business

There may need to be some money in it for you in order to nudge you to do it

Or there may be some competitive element, that you simply want to be the first or the best

Influence of using Collaborative learning approaches

Below follows a discussion of SME-specific design characteristics of interventions based on a collaborative learning approach.

- Building collective capability
- Getting the right intermediary in place to lead the group learning

- Shared learning needs time
- Shared learning requires connected goals
- Anchoring and owning the learnings
- Shared learning is only really successful once sharing takes place again

Both the Swedish Energy Efficient Companies in **Eskilstuna** project and the New Zealand **EECA SME** project used a collaborative learning approach to energy-related demand side management of SMEs.

Building collective Capability

Whereas energy efficiency efforts are often a matter of external consultants coming and going (along with the knowledge) – the Swedish **Eskilstuna** project wants to equip the participating companies with the capability, methods and tools to themselves take control of, and reduce, their energy use.

One important element in the process (which takes place via a course over 10 months), is about education, mapping and evaluation, where representatives from the participating companies, under the guidance and support of an external expert consultant, engage collectively in conducting energy analysis on each other's company. These analyses then result in further activity plans and actions. Moreover, anchoring the idea among the senior management, sharing experiences among the participants, as well as further training and continuous reporting also constitutes important elements of the process. Ultimately, the project idea is about creating the best possible conditions for the companies to 'own' the process of becoming more energy efficient, and to promote collaboration between geographically close companies in order for them to support and learn from each other.

Getting the right intermediary in place to lead the group learning

The New Zealand **EECA SME** project was the continuation of an earlier project that did not run as well. In the second round the collaborative learning was added to the project, as it was shown to be the most successful approach in the first round. Thus, the industry association delivered a year-long education and support programme which included:

- A trusted advisor
- Peers/competitors (businesses in the same association)
- Workshop based - a group learning environment
- Led from the top - CEO involvement was mandatory for the first workshop
- Ongoing mentoring - homework between sessions and regular phone contact
- Something to show for it - EcoWarranty or ISO 14001 certification

It only started working well once this shared learning aspect was taken into account, plus the strong use of the right third party/intermediary (industry associations). The role of the industry associations was key as they provide a more homogenous group of SMEs that can more easily benchmark each other against their progress. In addition, these type of associations are closer to their members and have already trusted advisors. Industry sector programmes are now in place with other industry associations in order to promote shared learning and group approaches. This key learning was also translated in new programmes.

Shared learning needs time

Building projects on learnings requires either good analysis of previous projects and designing the new project around the lessons learnt, or piloting a project first, or both. The Swedish Energy Efficient (Companies in) **Eskilstuna** project takes a point of departure in conclusions derived from an energy analysis conducted by the University of Linköping as a pilot study within the broader program Sustainable Municipality (Uthållig kommun). What is important to appreciate is that a collaborative learning approach also require a lot of continuous monitoring, reporting and consequently training.

Shared learning requires connected goals

To allow for shared learning, the different participants need to share at least collective goals, or very clearly see how their efforts fit in the aims, strategies or goals of the other partners. For example, a strong point in the Swedish Energy Efficient (Companies in) **Eskilstuna** project was that the project was part of a boarder programme aiming at creating a sustainable municipality. The project has a clear connection to the municipality's energy plan; stating that the municipality should encourage reduction of energy use in the business sector, and the initiative has therefore been strongly supported by the municipality. The project idea of "networking" also builds on a general strategy by Eskilstuna municipality to encourage business development through networking, clusters and associations.

Anchoring and owning the learnings

The collaborations in the Swedish Energy Efficient (Companies in) **Eskilstuna** project have resulted in networks among the participating companies, where it has been a "natural process" to ask for advice and supporting each other. By working in groups/networks the participants have gained from the support and input of ideas from each other, but have also gained from the competitive climate, and the urge of being the "best in class". Since the companies have gained education and guidance from energy consultants in how to conduct the analysis themselves, their energy plans have been more integrated and more likely to actually be implemented than otherwise. The fact that the companies "own" the process themselves and that it has been strongly anchored in the companies' respective management group have made it more "legitimate" to work with these questions.

Shared learning is only really successful once sharing takes place again

A project aimed at facilitating learning amongst its participants is naturally successful when this learning takes place amongst the participating community. And the Swedish Energy Efficient (Companies in) **Eskilstuna** project did manage that. But the project was clearly more successful than that and resulted in a number of spin offs beyond the participants and the municipality. Within the community in total (during the first round in 2009), 136 actions were identified, and 72 out of those where implemented during the first 6 months. The measures taken for the nine participating companies represented a total decrease of idle energy usage by 33 percent (the decrease ranged from 7 to 86 percent between the companies). The total saving (of idle energy usage) at the completion of the project was worth about 4.5 million SEK. However, the model has also successfully run over several rounds and has been implemented in other municipalities as well (i.a. Köping, Norrköping, Linköping och Västerås). In addition, the project idea (and model) has resulted in the creation and establishment of EnergySave, a company that works with supporting companies in optimizing their energy use, reduce carbon footprint, strengthen the company's environmental profile and save money.

Monitoring and evaluation

According to the **Nudge** model, statistical analysis is a preferred way to evaluate the impact of nudge-based interventions. However, in the Belgian **Build4Change** project, which is a micro-scale application of Nudge, and has only a small-scale & unevenness of data, interviews were found to be most useful approach to critically assess impact.

The Swiss **EnAW** programme highlighted the importance of having goals and being measured year-by-year to lead to action. This programme has been going since 2001. Targets of the participating firms are controlled and monitored by the Agency and by the Swiss Federal Office of Energy (SFOE). Companies participating in the Energy-Model programme who reach their audited targets get a certificate, and they are allowed to ask for reimbursement of the CO_2-tax from combustibles they have used (according to the Federal Act on the Reduction of CO2 Emissions). This exemption of the fee for CO2 emission is a high incentive for enterprises to join the energy model.

The New Zealand **EECA SME** programme demonstrates the difficulty in monitoring and evaluating achieved savings and efficiency. The programme concluded end of 2012 that the estimated energy savings from the assessments had not necessarily been realised. In only two instances have energy savings from implemented projects been measured rather than estimated, resulting in measured savings of $11,345. This relatively low level of verification is assumed to be a result of the early termination of the Service Provider contracts with those third parties that did not perform well. The early termination of these contracts has prevented measurement of the longer-term energy savings resulting from the assessments and implemented projects. Another problem with the lack of long-term evaluation has to do with the use of more qualitative instruments versus the simple implementation of technological measures. About 20% of the estimated savings from the assessments involve training programmes (EMA and CCS Innovation). It is unclear (without long-term evaluation and monitoring) if any savings from these programmes persist for a shorter time than those involving the permanent installation of energy efficient equipment.

A last issue related to monitoring and evaluation has to do with the aspect of 'freeriding'[67]. The Swiss **EnAW** programme and the Dutch **Green Deed** project demonstrate a general problem with evaluating the impact of programmes in which SMEs partake that might already have considered greening their business. For example, in the Swiss **EnAW** programme, it became clear that the impact of the programme in several cases was an earlier realisation of measures that were already in the investment planning of the firms and therefore it is difficult to measure which amount of savings is directly saved because of the programme.

The Dutch **Green Deed** project aimed to get at least 100 SMEs to participate in the contest and that 70% of the participants would perceive themselves as more green or sustainable than before the project. Evaluation showed that merely 43% of the SMEs perceived themselves as more green or sustainable than before the project. The low score was partly ascribed to the already-planned or ongoing transition of participating SMEs towards a more sustainable office environment, which was independent of the project.

For a better evaluation, therefore, a more detailed analysis of different enterprises and their future plans need to be undertaken, and the data comparability and benchmarking of all enterprises has to be up to date. This of course throws up a major issue with the whole SME sector, which is the immense variability of it, including the different definitions in countries of what constitutes an SME. In most countries, SMEs comprise a huge amount of businesses (eg in Australia and New Zealand, over 90% of all businesses are SMEs) and often contribute a large amount to GDP, albeit their potentially very small sizes. In terms of greening SMEs, there is no one-size-fits-all model, as there are completely different challenges between eg a shopfront in a retail park to the Finnfjord processing plant example or an office environment or restaurant. Rather than attempting to design interventions and evaluation measures for the whole SME sector, it may be advisable to concentrate on similar businesses, particularly in shared learning approaches.

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[67] A **free rider**, in economics, refers to someone who benefits from resources, goods, or services without paying for the cost of the benefit. In policy terms, it can also refer to someone who would have eg installed an energy efficient measure anyway but is using a public subsidy to do it cheaper or for free, thus potentially using up someone else's provision, who would not have installed the measure without the subsidy.

Conventional monitoring in SME interventions	More systemic monitoring in SME interventions
• cost savings • energy savings; • a reduction in carbon emissions • energy-efficiency related to productivity, • CO_2-intensity related to productivity	• Group learning • Establishment of industry associations • Establishment of follow up collaborative learning programmes in different sectors • improved energy intensity, • earlier realisation of measures that were already in the investment planning • deferred energy supply investment • reduced GHG intensity • enhanced business growth • competitiveness from energy intensity improvements • culture of effective business energy management in business • job growth • supplier up-skilling • growth in the energy services industry including new players into the market • perceptions of being green as a company • improving quality of working life for employees • the creation of a positive impression to encourage clients/partner firms to consider greening their business • fitness and well-being benefits for employees of approaching work in the ‘fresh air’ • the emergence of networks among participating companies, where it is a “natural process” to ask for advice and supporting each other

Recommendations: Key DSM SME interventions lessons and questions for further research

The lessons below are tailored to policymakers, intermediaries or other initiators of DSM SME interventions.

1. Interventions focused on changing employee behaviour need a very active support or even involvement of the management level, implementation level, staff and even from clients. **Top-Down, middle and bottom-up is needed, plus some external validation.** IT CAN'T ALL COME FROM THE TOP OR THE BOTTOM.

2. For a better evaluation comparing successes between SMEs a more detailed analysis of different enterprises and their future plans need to be undertaken, and the data comparability with all enterprises has to be up to date. **Compare and celebrate successful companies and interventions.** BENCHMARK YOUR HEART OUT.

3. Target the key staff or champions or champion nudgers in an organisation and work with them. Economics as an approach is not sufficient to deal with the often implicit power plays and personal relationships in an office and between different layers of staff. Creating ownership amongst relevant staff is therefore key. **Find your champions in your organisation and work with them.** IT'S ALL ABOUT THE PEOPLE.

4. Mobilising towards shared goals can help increase internal support for reforms or organizational changes. **If you have shared goals, you're halfway there.** I WANT WHAT YOU WANT, SO LET'S DO IT.

5. In SMEs a multitude of people work, in different roles, and not everyone will feel comfortable with changes in the company, or with required changes. It is natural to 'lose' some along the road, and potentially this self-selection will strengthen the new social norms emerging amongst those that stay. **The 'laggards' can have a powerful negative effect on your staff.** DON'T BE AFRAID TO LOSE THE NAY-SAYERS.

6. Nudges do not necessarily act on the internal motivations, the attitudes or the intention to change behaviour. They are external stimuli to facilitate or discourage certain behaviour. **Nudges can thus support people as reminders about their motivations and attitudes but more (e.g. changing social norms, institutionalisation of norms) is needed to change attitudes and motivations.** NUDGING IS WHAT IT IS: A NUDGE, NOT A LIFE SAVER.

7. The creation of a dedicated institution or intermediary por label/certification such as the Ecolabel (EU) and the Dutch 'MKB prestatieladder' (SME performance ladder) can be key to successful implementation in a certain branch of SMEs. **Validate where possible.** SHOW WHO'S A LEADER.

8. There are many competing demands when addressing SME energy consumption behaviour. individual visits and tailoring leads to actionable goals and recommendations. **Tailor to each SME, they are not all the same.** TAILORING IS ESSENTIAL.

9. The equitable distribution of burdens and costs and the continued use of the same subsidy rules is key to creating movement amongst SMEs. **Be fair, support innovators.** THEY LEAD SO OTHERS CAN FOLLOW.

10. Whereas energy efficiency efforts are often a matter of external consultants coming and going (along with the knowledge) equipping companies with the capability, methods and tools to

themselves take control of and reduce their energy use through a collaborative learning approach might be more effective. **Build your own capability if you want to share learnings.** CONSULTANTS DON'T CARE AS MUCH ABOUT YOUR COMPANY AS YOUR STAFF DO.

11. Getting the right intermediary in place to lead the group learning is key. Industry associations, e.g. provide a more homogenous group of SMEs that can more easily benchmark each other against their progress. **Go to trusted intermediairies.** TRUST IS EVERYTHING.

Key Research Questions

1. How to evaluate the savings (energy, CO2, cost) or increased productivity of the earlier (due to the intervention) implementation of already-planned measures?
2. Concerning the application of Nudge it would be interesting to see if a specific approach applied to the specific context of a single SME is more effective rather than a general policy measure aimed at all SMEs.
3. Are competitions potentially most effective as an early incentive to familiarise the public with a (social) innovation and start up initial behaviour?

6. Discussion, Conclusions and Recommendations

This document presented the general preliminary observations and lessons learnt based on the analysis of empirical case study templates that have been delivered by the national experts of the participating countries for Subtask 1 (Helicopter Overview) of Task 24. These templates present cases in the different countries for the four themes 'retrofitting', 'transport', 'smart metering' and 'SMEs'.

Although modest in intention, this report distinguishes itself from other studies that contrast the use and usefulness of diverse social scientific theories and models that underlie interventions by using a diverse set of international empirical case materials. In that sense, this report is a first empirical exploration of the ways in which models and theories underlying interventions may affect particular outcomes and under which circumstances. An important aim of this study was also to arrive at questions for further in-depth empirical case study research (as part of Subtask 2) and to provide specific recommendations to the participating countries (Subtask 4). The section on evaluation, including the collection of different evaluation metrics that were used in each case study will feed into the development of an evaluation tool (Subtask 3). In addition, it is a start at creating better interventions through a critical assessment of underlying perspectives.

The analysis of how a wide variety of theories and models were used implicitly or explicitly in the cases resulted in two general related observations. The choice (implicitly or explicitly) for any model or theory bears consequences for the design, the implementation and the monitoring and evaluation. In addition, each theory or model addresses end-users and their behaviour in a specific way, allowing for different levels of engagement by the end-users, creating different distributional issues and allowing for different levels of tailoring.

On a scale of extremes we could say that some approaches allow for a ‘take it or leave it’ (**incentive and information**) choice from end-users. These interventions are designed for, not with, end-users using a top-down approach with very clear sets of responsibilities. The government or commercial party designs the intervention and thus has a clear role in taking the lead although sometimes requesting third parties to implement the intervention. The message sent with these interventions is that money is key, that authority knows better, and that people simply need to take action to make the changes that government asks of them. It is a simple and clear message that works well for many, although it can lead to issues if it is seen as a ‘nanny state’ involvement of where the Government is telling the public how to live their lives. This is a bigger issue in countries that have a strong distrust of politicians and other public servants than in countries where the public service is regarded highly.

These type of interventions tend to be oriented towards technology implementation, not routine behaviour change (and if, only on a very small scale). In terms of distributive issues, the side supplying the technology or services gains the most economically, and in the short term. The end-users, on the other hand, often have a long return of investment period and a lot of prefinancing and only small, visible economic gains. When evaluating the impact of these type of programmes which are purely focusing on cost effectiveness they perform really well in terms of their objectives. The programmes are also relatively easy to evaluate in quantitative terms and often show satisfying results for their designers. They are cost-effective, the technological market usually grows, subsidies are often used to the max, and many homes or end-users (ie voters) are reached. However, the actual impacts are often unknown because the savings are estimated, not measured, and there are many examples of rebound effects that offset the estimated savings. The general outcomes usually seem better for the programme designers and implementers than for the end users, as the programmes do not have the flexibility to tailor their approach to their needs.

On the other side of the spectrum are more **systemic and participatory** programmes that work on people setting their own achievable targets coupled with a clear, managed, participatory procedure for attaining them, including coaching, training and co-design. These programmes are based on theories and models that see humans and behaviours as being locked-in to a certain lifestyle. To change this behaviour, a

comprehensive approach incorporating informational, economic but also infrastructural, regulatory, social and institutional interventions is needed. Both investment as well as habitual behaviours are targeted. When policy facilitates demand-driven interventions and tackles the systemic issues such as infrastructure, institutional aspects and technological market development, providing continuity, role modelling and political commitment, the actual impact of a behaviour change intervention is maximised. These more systemic and participatory programmes enable continuous self-improvement and are most successful in getting end-users to achieve real savings (cost and energy) with both energy efficiency improvements and habitual behavioural change. In addition, these approaches have more potential to change the lifestyle of end-users thus also creating spill-overs in other domains than just energy, like health. However, these approaches are rather costly and labour intensive and require strong collaboration amongst a variety of sectors, rather than a top-down approach. In addition, these programmes are often not easily replicable but only applicable for a specific issue, not general behaviour change, because it creates a 'silo' effect around the specific targeted behaviour. The flexibility of changing goals, aims etc makes it difficult to evaluate with conventional metrics. The interrelatedness of a large number of variables, not all of which can be tested or foreseen, makes evaluation in quantitative terms very difficult. Thus, different evaluation metrics to measure successful outcomes are required.

Between these two extremes lie a variety of different approaches and combinations. It would be too easy to just contrast the systemic and often societal approaches with the narrow economic incentive-based individualistic approaches. However, given the costs, the labour intensity and effectiveness there is an understandable political preference for the latter. Seeing most policies and programmes are led top-down (often by the government) and based on detailed, albeit not very realistic, cost benefit models and estimates, it is relatively easy to continue using the same approach based on the flawed idea of a ‘rational human being’. However, energy use is 90-95% habitual and thus not part of rational decision-making (except during moments of change, which are thus such powerful habit breakers). This simplistic approach is thus set to fail in most cases, as it does not penetrate habitual usage and improve the understanding of wastefulness and the need to manage demand. As we have seen with the New Zealand **EECA SME** model, the actual savings are often significantly below the estimated potentials - this is where policymakers can engage in (shared) learning and improve their programmes based on observing what works elsewhere or has previously worked better. It also shows that it is really important to benchmark, use control groups and evaluate before, during and after an intervention. Even though it seems cheaper to chose these ‘simple’, well-known models over more complex, systemic approaches, we assume that the actual costs of continuing to do so are hidden and probably enormous. This includes the dual cost to the end user (the taxpayer) - both in limited return of investment due to a lack of tailoring to their individual needs, and the fact that their taxpayer money is spent on overly simplistic programmes that only use estimates to calculate costs and benefits and ignore ‘soft’ costs and benefits to the end user.

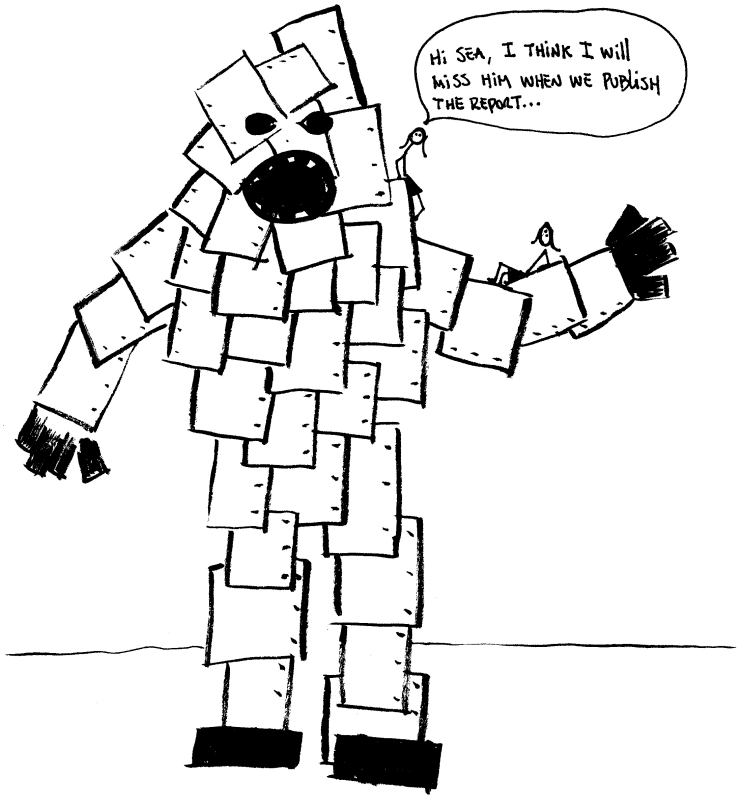
Despite this, we will not make a choice towards one or the other in terms of recommending a certain theory or approach to be used in certain domains. What our analysis showed is that different cases have different national, local, organisational, and domestic contexts. In addition, different behaviours, in different domains require different interventions. For example, driving is an existing *routine behaviour*, with built-in capacity for adaptation/adoption to new cars/routes/traffic; retrofitting-related behaviour deals with one-off, rational *investment decisions* at the planning stage where unappealing new behaviours can be quickly rejected or even result in cancelling planned action. Smart metering cases demonstrate that this domain deals with an *entirely new behaviour* and an important interaction with technology in order to break old habits, thus presenting opportunities for impact through training but also almost no existing behavioural context to use as a starting point. And in the case of SMEs many of the behaviours that need to change (both *habitual and investment/purchasing behaviours*) require a lot of risk taking and senior leadership, with potentially big impact on productivity.

Research/empirical evidence presented here suggests that trying to transfer approaches across implementation contexts without tailoring them to the specifics of the context is itself a cause of failure. A **mix of measures that are tailored** to different (national, local, organisational, household) **levels** and tailored at both the **individual and social/societal** level, aiming at changing both the i**nvestment and habitual behaviour**, targeting **multiple motivations** (not only economic and informational ones) and focusing on the **lifestyle** in which energy is key to performing functions is therefore perhaps best.

So what we hope to have achieved, is to have demonstrated that no model in itself is right or wrong, but some are more successful in fitting with their implementation context and objectives than others. In addition, we hope to have created an appreciation of the importance of thoughtfully reflecting on the theory or approach or perspective that underlies the design and implementation of an intervention, and the impacts of that choice on the participation, engagement and distribution of costs and benefits.

The main lesson we could thus take from a broad international evaluation like this is the need for more in-depth research based on detailed case studies trying to answer the different research questions identified in each chapter, and aimed at creating recommendations for policy makers on how to create flexible energy management policies, allowing for case-by-case interpretation, rather than asking for 'one-size fits all solutions. This is what will be undertaken in the following Subtasks of Task 24: Subtask 2 will engage in in-depth case studies that will attempt to answer some of the questions posed here; Subtask 3 will use the learnings on monitoring and evaluation, including the many different metrics used here; and Subtask 4 will draw it all together in country- and stakeholder-specific recommendations and will provide a decision-making tool that help design, implement and evaluate better DSM policies, programmes and projects.

The end (for now)...



The Task began in February 2012 and will end December 2014.

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