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Task 24 – Phase II
Behaviour Change in DSM: Helping the Behaviour Changers

POWERCo

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Council
Te Kaunihera o Tāmaki Makaurau

Contents

Introduction

The IEA Demand-Side Management Task 24 aims at sharing knowledge between multiple stakeholder sectors and developing policy recommendations about the influence of behaviour change on effective implementation of energy-efficiency policies[1]. After a period of building the scientific framework and collecting practical cases (Phase I), Task 24 entered the phase (Phase II) of engaging actual "Behaviour Changers" in real live interventions, supporting them with evidence-based scientific approaches and practical case study comparisons from various countries along the way.

Task 24 and New Zealand

New Zealand has participated in Task 24 since its inception in 2012 and has been leading this first, global behaviour change research collaboration via its Operating Agent, Dr Sea Rotmann of SEA – Sustainable Energy Advice Ltd. It is also one of the participating countries in Phase II of Task 24, together with Sweden, the Netherlands, Austria, Ireland and, in Subtasks 9 and 11 and Year 3, the United States / Canada. The New Zealand contribution is co-funded with the 2nd largest lines company, *PowerCo* and the *Ministry of Business, Innovation and Employment* (MBIE). This report will concentrate on the NZ-specific interventions related to all Subtasks of Task 24. For in-depth discussion of the second phase of Task 24, the approach, and the detailed overview on Subtasks, please refer to the Work Plan.
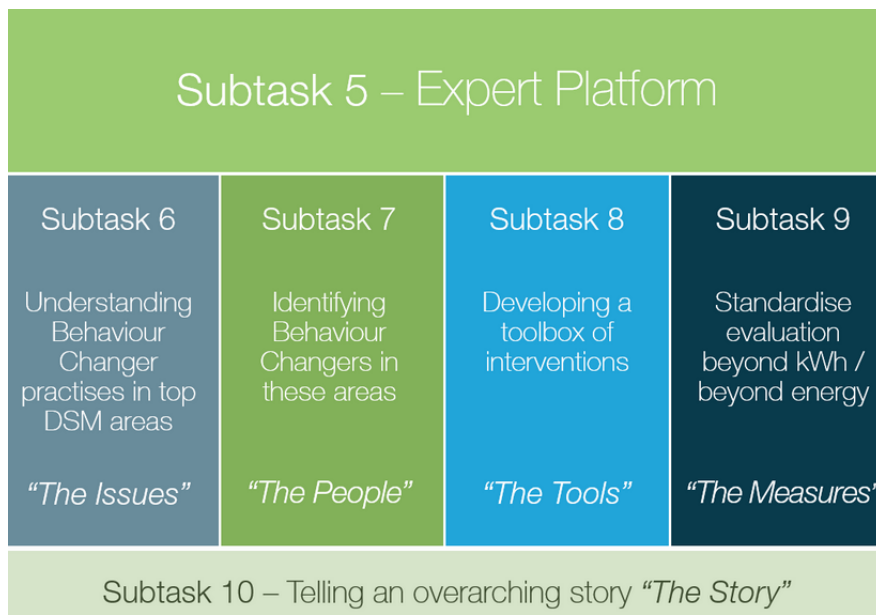
Fig 1. Task 24 Phase II Subtask overview

Background and Overview

Task 24 is aimed at improving demand-side management and sustainable energy use by influencing human behaviour. During Phase I (2012 - 2015), the teams in the different participating countries focussed on translating behavioural theory into practice. They built a network of >250 behaviour change experts who made an inventory of available theories, models and approaches, gathering over 60 practical examples and case studies from 20+ countries (for more details, see Rotmann 2016a).

Main lessons learned from Phase I (see Mourik and Rotmann, 2013):

- There are a variety of applicable theories and models that are currently underutilised when designing behavioural interventions (especially from sociology and multi-disciplinary studies);

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[1] See Task 24 Policy Brief: http://www.ieadsm.org/wp/files/task24policybrief.pdf

- There is much to be gained by using combinations of approaches, and moving from the current, overwhelmingly technocratic approaches to consider more the 'human' perspectives. This includes fostering and facilitating multi-stakeholder collaborations;

- Many of the collected stories and case studies showed a lack of in-depth understanding turning behavioural theory into practice and a clear need of further field research and validated tools;

- Most countries had not clearly prioritised their top behavioural DSM issues for further research, or failed to include all relevant stakeholders ('Behaviour Changers') in the selection process;

- There were some top behavioural DSM issues in each country where the theory from Phase I could be turned into best practice in Phase II, using *Participatory Action Research* (PAR) approaches (e.g. see Bergold, 2012).

In 2015, Task 24 continued with a new Phase II based on these insights. First, the national teams selected their countries' top-priority areas in behaviour change in DSM (**Subtask 6** – "The Issues"). This selection of top areas was performed with the IEA DSM Executive Committee (*ExCo*) member of each participating country, the appointed *National Experts* and other country experts (*Behaviour Changers*). The DSM priorities differed between countries, as did their (technical, economic, political and societal) potentials and risks due to different national contexts. We will ascertain and highlight these country differences in **Subtask 10** ("Overarching story").

After having identified the top priority areas for energy efficiency within a country, one area was selected for further research in detail. Once the top areas were chosen in each country, the national teams brought the relevant *Behaviour Changers* together to explore the key issues supporting and hindering the uptake of DSM in the current system (**Subtask 7** – "The People"). The key systemic issues were then explored in facilitated multi-stakeholder workshops. Finally, in some countries, we could then engage the relevant *Behaviour Changers* in designing a "real-life intervention" (**Subtask 11**). We also developed more focused intervention approaches and a "Toolbox for behaviour change" (**Subtask 8**) as well as "Beyond kWh" evaluation tools (**Subtask 9**). The latter are discussed in depth elsewhere but will be mentioned here regarding their application in Subtasks 6 and 7.

The major hypothesis of the Task 24 Phase II approach is that *a Collective Impact Approach* (Kania and Kramer, 2011) *which fosters collaboration among a variety of stakeholders - together with whole-system visualisation exercises in participatory action research settings, and using storytelling as overarching 'language' - will lead to more successful behavioural interventions where multiple benefits to the end users and each* Behaviour Changer *can be clearly evaluated*.

Benefits of an IEA research collaboration

Most analyses of behavioural interventions do not explicitly focus on cultural differences between countries. This is a major reason why IEA research contracts between different countries were established. In Subtask 2 (Phase I), we focused explicitly on such cultural idiosyncrasies. For example, in Norway there is a strong 'do it yourself' retrofitting movement. In addition, there is almost no rental model for housing stock in Norway, whilst there is a 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 origins (cultural traits or a particular cultural characteristic) do impact on the meaningfulness of generic policy recommendations for *Behaviour Changers*. Identifying various cultural contexts, and designing and testing a toolbox of behavioural interventions that works in many different countries, sectors, and DSM issues, was a major objective of this Task. Policy briefings specific to the participating countries' policy makers will be developed including for New Zealand. On the NZ top issue of *home energy audit tool (HEAT) kits* (see Rotmann 2018a) we were provided by international experts with cross-country comparisons for the US, Canada, Ireland and Australia.

The added value to having an International Energy Agency Expert Platform (**ST 5**) is a highly experienced global network of *Behaviour* Changers in many different countries, sectors, disciplines and industries. They all bring different insights, learnings and perspectives, many of them do so in-kind. We facilitated their collaboration with national *Behaviour Changers* by using and testing the *Collective Impact Approach,* for the first time in the energy system. The *Behaviour Changers* participating in this Task have assessed the effectiveness of this approach and the Task 24 toolbox of behaviour change interventions (Rotmann 2018b). This approach allows them to take an integral part in the development of the methodologies, guidelines and overarching 'language' to aid whole-system, societal change by proving, and improving the impact and uptake of behavioural DSM interventions.

Task definitions

During the first international Task 24 workshop at Oxford University in October 2012 (Churchhouse, Mahoney & Rotmann 2012), it became apparent that we had to be very careful with language and the jargon that was used in this Task. Seeing that the Task does not follow any specific research discipline or sectoral approach to behaviour change, it is easy to confuse meanings and terminology. Long, and often difficult discussions were had at this workshop around the meaning of e.g. 'behaviour', 'behavioural models' or 'demand-side management'. In order to clarify up front what 'language' the Task was using, we had to create our own definitions for the main terms *energy behaviour, behaviour change, Behaviour Changer, behavioural models, demand-side management, evaluation, monitoring, effectiveness, efficiency, investment vs habitual behaviours, outputs vs outcomes, single- and double-loop learning and DSM tools and benchmarks* (found in Mourik et al, 2015). The most important definitions used here are replicated below.

Energy behaviour refers to all human actions that affect the way that fuels (electricity, gas, petroleum, coal, etc.) are used to achieve desired services, including the acquisition or disposal of energy-related technologies and materials, the ways in which these are used, and the mental processes that relate to these actions.

Behaviour Change in the context of this Task thus refers to any changes in said human actions which were directly or indirectly influenced by a variety of interventions (e.g. legislation, regulation, incentives, subsidies, information campaigns, word-of-mouth etc.) aimed at fulfilling specific behaviour change outcomes. These outcomes can include any changes in energy efficiency, total energy consumption, energy technology uptake or demand-side management but should be identified and specified by the *Behaviour Changer* designing the intervention for the purpose of outcome evaluation.

Behaviour Changer is a person or agency tasked with the goal of designing, implementing, evaluating and/or disseminating interventions geared at changing energy *End User* behaviours. In this Task, we differentiate between five *Behaviour Changer* sectors: "the Decision-maker" (usually government on all levels), "the Provider" (usually energy- and energy technology-providing industry on all levels), "the Expert" (researchers and consultants from a multitude of disciplines, especially economics, psychology, sociology and engineering), "the Conscience" (the Third sector including NGOs, community organisations, consumer groups etc.) and "the Middle Actor" (usually service providers in direct contact with the End Users).

Objective of Task 24

The main objective of Phase II is to take good theory into practice to allow *Behaviour Changers* to:
1) Engage in an international expert network (**Subtask (ST) 5** 'THE EXPERTS')
2) Identify the most appropriate DSM themes to focus on (**ST 6** 'THE ISSUES')
3) Identify and engage countries' networks for at least one of the top 3 DSM themes (**ST 7** 'THE PEOPLE')
4) Use and test a *Collective Impact Approach* to develop shared methodologies, guidelines and a common 'language' based on narratives to aid *Behaviour Changers* (**ST 8** 'THE TOOLS')
5) Standardise how to evaluate behaviour change programmes 'Beyond kWh' and 'Beyond Energy' including multiple benefits analysis (**ST 9** 'THE MEASURE')
6) Collate national learnings into an overarching (international) story to understand, compare and contrast the different behaviour change approaches, risks and opportunities and which recommendations can be universally applied (**ST 10** 'THE STORY').
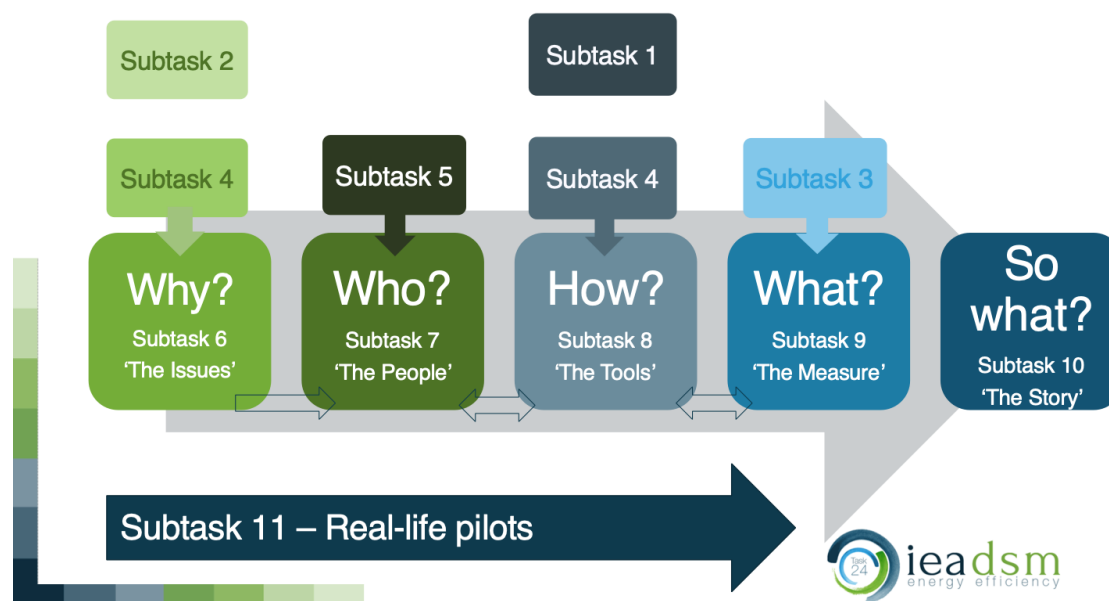
Fig 2. Overview of how Subtasks fit together (In Phases I & II)

Methodology of Task 24

We describe the individual approaches used in **Subtasks 6 & 7** in more detail below. The overarching tools that were developed and tested in Task 24 Phase 2 (**ST 8 & 9**) are summarised first.

Subtask 8 - The main tools in the Task 24 toolbox

The Task 24 Toolbox for Behaviour Changers has a strong focus on tools that support the appropriate context for the *Behaviour Changers* and which are more conducive to developing systemic interventions, with stories and case studies illustrating their application. The workshop sessions with the *Behaviour Changers* focused on testing the tools on a variety of countries, sectors, contexts and behavioural issues.

Objectives
- Use the *Collective Impact Approach* to unite *Behaviour Changers* from five sectors on a specific DSM issue (both chosen in ST 6 & 7).
- Collect information for a Decision-making Tree to pick the most appropriate case studies and models of understanding analysed by Task 24 (ST 1, 2 & 6).
- Develop the common language of storytelling further and provide different examples of using storytelling and narratives in practice and how to best do it in the specific areas of focus and each of the *Behaviour Changers'* sectors.
- Identify the tools in each *Behaviour Changer's* Toolbox of Interventions, analyse their pros and cons, risks and opportunities, where they fall short and how another tool from another *Behaviour Changer* could overcome this deficit (see combined Workshop minutes).
- Continued testing and development of the Evaluation Tools (ST 3 & 9) that can prove if a (toolbox of) intervention/s leads to actual, ongoing behaviour changes in practice.
- Collaborative development of a testable Toolbox for each top DSM focus area, where each *Behaviour Changer* sector has clearly identified and measurable roles and responsibilities. This intervention may then be taken into a real-life setting and trialed in practice (either as ST 11 or outside of Task 24).
- The toolbox is built on national and sectoral context specificities but will be synthesised and tested (e.g. in international conferences - ST5) for the general aspects that are of international validity (ST10 - the overarching story).

Deliverables

D 12: Testable toolbox of interventions of each country and their top areas of DSM focus This includes:

- A description and evaluation of the validity and effectiveness of the *Collective Impact Approach* in the energy arena, as a peer-reviewed paper (Rotmann, 2016a and b).
- A Decision-making Tree that enables *Behaviour Changers* to better utilise the findings of ST1 & 2 (de Zeeuw, 2017).
- A peer-reviewed paper on the impact of storytelling in energy research (Rotmann, 2017; Moezzi, Janda and Rotmann, 2017).
- A collection of sector stories from each *Behaviour Changer* (NZ stories in Appendix 1).
- This includes a list of behavioural intervention tools each *Behaviour Changer* has at their disposal in each of their national and sectoral contexts (see NZ workshop minutes).
- Continued testing and development of evaluation tools created in ST 3 and 9 (e.g. Chapman and Rotmann 2018).
- Testable toolbox for national *Behaviour Changers* (when choosing to take part in ST11, see Cowan et al 2018) and/or synthesis of internationally-valid tools (Rotmann 2018b) to feed into the Overarching Story (ST10, to be published).

Storytelling

We discussed the importance of language, definitions and jargon, and need to clearly define it, above. We also needed to find an overarching 'language' in order to bridge the many different disciplines, sectors and *Behaviour Changers* we were dealing with: this language was *storytelling*.

The Task thus embarked on a journey of using various narratives and storytelling tools to simplify learnings, bridge silos and 'translate' between different *Behaviour Changers*. Some of the approaches are discussed in Rotmann, Goodchild and Mourik (2015). The main Task 24 approach of using a fairy tale story spine to elicit stories from 100s of *Behaviour Changers* in over 20 countries was detailed in a Special Issue on "Narratives and Storytelling in Energy and Climate Change Research" in *Energy Research and Social Science* (Rotmann, 2017). Task 24 Operating Agent Dr Sea Rotmann co-edited this Special Issue with Drs. Mithra Moezzi and Kathryn Janda (see Moezzi, Janda & Rotmann, 2017 for an introduction and summary). 35 excellent papers are showcased in this Special Issue, which forms the ultimate collection on storytelling in energy and climate change research to date. Our introduction to the Special Issue became the Number 1 most downloaded article in ERSS in 2018 and got glowing reviews from the likes of Paul Stern. In addition, we published a "The A to Z of Storytelling in Task 24 " report which provides further detail and analysis of the fairy tale story spine and its use in the Task (Rotmann 2018c).

The "Collective Impact Approach"

Task 24 uses two different, yet complimentary, approaches to facilitate multi-stakeholder collaboration in the more practice-oriented Phase II: *The Collective Impact Approach* (Kania and Kramer, 2011) and the *Behaviour Changer Framework* (Rotmann, 2016a). The *Collective Impact Approach* (CIA) was first developed to aid social entrepreneurs deal with complex social problems. This approach, aimed at long-term social change, proposes a collective, rather than an individual approach for solving difficult problems. Walzer et al. (2016) argue that complex situations which would normally be difficult to solve, can be solved using the CIA. This CIA is described by Collaboration for Impact as: *"…an innovative and structured approach to making collaboration work across government, business, philanthropy, non-profit organisations and citizens to achieve significant and lasting social change."*

Five conditions are listed that are needed to create such a collective impact (Fig. 3):
- A common agenda,
- Mutually-reinforcing activities,
- A shared measurement system,
- Continuous communication and
- A backbone support organisation.

The Five Conditions of Collective Impact

Common Agenda	All participants have a **shared vision for change** including a common understanding of the problem and a joint approach to solving it through agreed upon actions.
Shared Measurement	**Collecting data and measuring results consistently** across all participants ensures efforts remain aligned and participants hold each other accountable.
Mutually Reinforcing Activities	Participant activities must be **differentiated while still being coordinated** through a mutually reinforcing plan of action.
Continuous Communication	**Consistent and open communication** is needed across the many players to build trust, assure mutual objectives, and appreciate common motivation.
Backbone Support	Creating and managing collective impact requires a dedicated staff and a specific set of skills to **serve as the backbone for the entire initiative and coordinate participating organizations and agencies.**

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Figure 3. The 5 conditions of the Collective Impact Approach (from Kania and Kramer 2011)

A **common agenda** is important to create a common understanding of the problem and the solution to make sure all *Behaviour Changers* agree on taking the same road to the common goal. Secondly, it is also important that the relevant *Behaviour Changers* perform **mutually-reinforcing activities**, making sure that they do not impede other *Behaviour Changers* or their stakeholders. Thirdly, it is also important that there is a **shared measurement system** so that outcomes of all *Behaviour Changer's* actions are measured and reported in the same way to share and learn from each other. To create trust and a common vocabulary, it is of high importance that actors **communicate continuously**. Lastly, a separate **backbone support organisation** needs to be created that facilitates a change of mind set, creates publicity and mobilises resources. Kania and Kramer (2011) explain that **backbone organisations** are especially important for providing direction, facilitation of the dialogue, mobilising funding and handling all the different layers of linked collaboration. *Behaviour Changers* are interdependent on each other, on other stakeholders, and they also operate in different and sometimes very complex contexts confronted with various political, financial and social pressures. Their mandates may be insufficient to affect large-scale behaviour change, or in direct conflict to it. Hence, complex problems that include technical, organisational, social and behavioural dimensions ask for collectively addressing the challenges. To do so successfully and to enable shared learning, a trusted *Facilitator* and 'translator' is crucial (e.g. Measham, 2009). In Phase II, Task 24 took on these important roles.

CIA offers a way to implement change via a top-down/bottom-up mixed approach. Most research on this approach focuses on situations in which a collective impact is created by organisations that are independent units. The first version of the CIA did mention the five principles on which successful collective impact should be based. However, nothing was said on further steps that should be taken or what institutions could function as backbone organisations. In 2012, they wrote a second article in which they remedied both shortcomings. Hanleybrown, Kania and Kramer (2012) state that there are three phases that should be fulfilled for creating collective impact: In the first stage, **action should be initiated**. To do so, the landscape of the social problem must be understood first and a **champion** should stand up. The importance of **champions** is to take care of attracting financial resources and creating a sense of urgency, striving for collaboration. It is also important to **organise for impact**. This means that common goals, a shared measurement system and backbone organisation should be arranged. In the third and last phase **action must be sustained** and impact should arise. **Active learning and coordination** is described to be essential for success (ibid).

For more detail on how the *Collective Impact Approach* is utilised in Task 24 and how it can be assessed in real-life applications, see e.g. Cobben (2017), Cowan et al (2017) and Rotmann (2018d).

The Task 24 Behaviour Changer Framework

To create a more hands-on tool to identify and work on the five conditions of the CIA, Task 24 developed the so-called "Behaviour Changer Framework", which was later dubbed "the magic carpet of behaviour change" by a major US utility during a Task 24 workshop. This framework was created to provide a visual overview of the social ecosystem, focusing on all relevant stakeholders, i.e. the *Behaviour Changers* from the different sectors and their relationships with one another, and the *End User*. This framework focuses on a chosen issue (**ST 6**) from the perspective of the *End Users* and their behaviour, as well as their context in terms of technology, social aspects, infrastructure and the wider environment (including political and regulatory). It also focuses on each of the *Behaviour Changers* in the system, what their main mandates, stakeholders, restrictions and tools are and how they interact with one another and with the *End User* (for detailed description of the process and actor types, see Rotmann 2016a).

An alternative view of our Energy System

An important point of departure from the current technocratic view of the Energy System is that in Task 24, we pose that *our energy system begins and ends with the human need for the services derived from energy (warmth, comfort, entertainment, mobility, hygiene, safety, etc.) and that behavioural interventions using technology, market and business models and changes to supply and delivery of energy are the all-important means to that end*.

The *Behaviour Changer Framework* operates on a different 'model of understanding' of the energy system, one based on *behavioural socio-ecology* (e.g. Moore, de Silva Sanigorski & Moore, 2013). The socio-ecological framework encourages both whole-system interventions, and also the explicit understanding of how more focused interventions might depend on factors at other levels (including the various human actors in a given system) for their effectiveness, acceptability or sustainability to be achieved (ibid, p1002). Here, this means first exploring the views, values and experiences of the various experts and decision-makers engaged in a given 'energy socio-ecosystem' (often also including the energy *End User* whose behaviour they are ultimately trying to change), before deciding upon, collectively, which (technological) approach or solution for change to focus on in a pilot intervention. It offers a pragmatic approach for how we propose to further improve the co-creation of knowledge, learning, sharing and translation into practice among practitioners in the energy field. The way the energy system is currently established in a very top-down manner does not easily permit such a whole-system view which puts human needs, behaviours and (ir)rationalities at the center of interventions geared at system change. Instead, if we look at the energy system through the human lens, we can see that it isn't necessarily a linear relationship starting with supply and ending with the *End User*, but rather a circular relationship which actually starts with the *End User's* need for an energy service. Amongst (rather than sitting above as is usually the way) this view of the system sit the 5 *Behaviour Changers* (the *Decisionmaker, Provider, Expert, Middle Actor* and *the Conscience*, Fig 4).

What is the Behaviour Changer Framework?

The *Behaviour Changer Framework* (BCF) is meant to be used as a 'heuristic' to make the mandates and relationships of the *Behaviour Changers* and their interaction with the *End User* clearer. It also enables storytelling for each of the *Behaviour Changers* who are working on a specific behavioural intervention in different domains, contexts and countries.

The "magic carpet", an actual 1.4m^2 piece of cloth, was used in intensive workshops to explore the stories of different *Behaviour Changers* who are working towards a very specific common intervention goal – e.g. in the Swedish example, how to promote green leasing between commercial office landlords and their tenants – see Janda, Rotmann et al (2017). The framework was used to explore and visually describe the current situation, different mandates, drivers, barriers, conflicts and intervention tools each *Behaviour Changer* has and their relationships with each other, their primary stakeholders and the *End User*. It is then used to explore what the system should look like and collectively develop a roadmap towards a best practice, real-life intervention. Each additional country workshop (up to two workshops per year, per country) explored the changes between BAU and best practice and used the framework to evaluate, re-iterate and test completion towards the collectively agreed-upon roadmap.
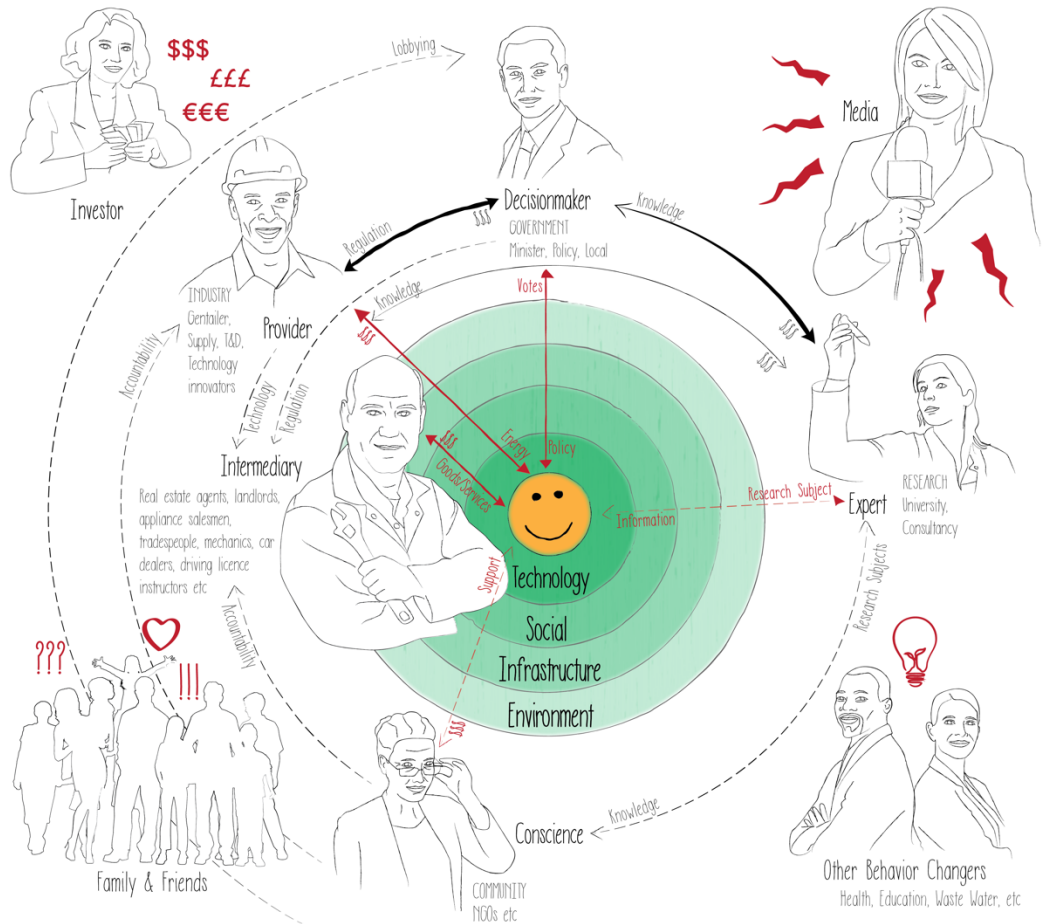
Figure 4. Diagram of the Behaviour Changer Framework *that works on behavioural interventions on the Energy* End User *in a generalised Energy System[2].*

The *Behaviour Changer Framework* thus:
- Acts as a collective impact tool (the process comes before the outcome)
- Helps visualise the energy system through the human lens, showing the current status and barriers, and what is needed in order to achieve a common goal/best practice
- Helps different stakeholders agree on the best possible scenario and then collectively work on solving problems and co-create the right intervention to change the chosen behaviour/s
- Helps to evaluate and measure agreed best practice outcomes and how to iterate, if necessary
- Helps identify multiple benefits and how to measure them
- Helps us appreciate each other's world, the lock-ins, restrictions, and relationships both good and bad which the system throws up.

The human actors in the energy system

To be able to change the behaviour of *End Users*, an overview of the social playing field including conflicts and barriers is invaluable knowledge for *Behaviour Changers*. This *Behaviour Changer Framework* allows an end-user perspective with a focus on their behaviour and on the technological and social aspects, infrastructure and wider environment (including political pressures) that need to be changed when solving a complex social problem (Rotmann, 2016a). Next to this end-user perspective, a strong focus is given to the *Behaviour Changers* themselves - and their mandates, tools or instruments, restrictions, and stakeholders they need or depend on to perform their role.

The *Behaviour Changers* with often the most 'powerful' impact, the *Decision-makers*, have tools like **policies, taxes and incentives and legislation** to influence behaviour. The second actor-type is the *Provider*, usually focused on providing energy or energy-using technologies. They have different tools,

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[2] For a short explanatory video, go here: https://youtu.be/E3A92eFyvNw?list=PLoZ9-YO7tGnoDbnOLmu-cLGC9geztJ0F9

e.g., **marketing campaigns or changes to billing systems**, with which they can influence *End Users*. The third group, the *Experts*, can develop, validate and criticise technologies and their impact on consumers. Their tools range from **scientific papers, to (big) data collection and analysis, undertaking interviews, surveys and focus groups** in real life or experimental settings. The fourth group is the *Conscience*, usually consisting of non-profit organisations mandated to reduce the social and environmental impacts of the energy system. They use tools like the **media, mass marketing and activist campaigns** to change behaviour. The last group are the *Middle Actors*, often from a service sector in direct contact with the *End User*. They have behaviour change tools like **direct access to consumers, trusted advice, technological information and labels**. In addition to various relationships and resource flows (e.g. money for energy or services) between the *End Users* and *Behaviour Changers*, the *Behaviour Changers* also have various relationships of various strengths with one another. Indirect influencers are the *Media, Investors, Family and Friends* and *Other Behaviour Changers*.

Behaviour Changer Framework as a heuristic

Our Behaviour Changer Framework (BCF) is meant to be used as a 'heuristic' to make the mandates and relationships of the *Behaviour Changers* and their interaction with the *End User* more clear and to enable storytelling of each of the *Behaviour Changers* working on a specific behavioural intervention in a specific domain, context and country. It was used in workshops to explore the stories of each relevant *Behaviour Changers* working towards a very specific common intervention goal (for example, how to improve uptake of peer-to-peer PV sharing networks in neighbourhoods). The *End User* is placed at the centre in our approach. Usually, behaviour change interventions target the behaviours of *End Users*. However, addressing end-use also entails attention for behaviours, norms and practices which shape and are shaped by the environment in which these are embedded. In the New Zealand example you can think of social culture at a neighbourhood level, including the many varied social norms that different individual households in a neighbourhood bring. And you can think of practices as ways of doing when it comes to the management of households, building infrastructure and appliances. Changes in *End User* behaviours – e.g. towards using less energy or utilising their solar power most effectively – are strongly influenced by all these contextual characteristics.

We used this framework to explore the current situation, the different mandates, drivers, barriers, conflicts and intervention tools each *Behaviour Changer* has and their relationships with each other, their primary stakeholders and the *End User*. Then we explored what the system should look like and were hoping to collectively develop a roadmap towards best practice. Unfortunately, changes in the New Zealand power market in recent years have stopped our co-funders from pursuing a specific pilot (see more below). This is why we switched to residential energy saving kits with Auckland Council, as we had the ability to compare and contrast it with a very similar Task 24 pilot run by our Irish co-funders, the Sustainable Energy Agency Ireland (SEAI).

Why have two collaboration tools?

The *Collective Impact Approach* is mostly a top-down approach working on the higher levels of social change, whereas the *Behaviour Changer Framework* can be used complementarily as a way to directly focus on changing the behaviour of *End Users* via a bottom-up approach in collaboration with the relevant *Behaviour Changers,* also enabling a middle-out approach. The *Behaviour Changer Framework* thus offers important additional aspects that should be taken into consideration when creating a collective impact, namely the end-user perspective and a clear visualisation of the current energy system, as viewed through the human lens. This includes different conflicts and mandates and different flows of goods and services leading to different strengths in relationships and different tools that each *Behaviour Changer* brings to the table. The *Behaviour Changer Framework* also includes those who often do not have a direct say in decision-making processes. Incorporating the knowledge about problems that *End Users* experience, the additional bottom-up and middle-out approach and collaboration among *Behaviour Changers*, a "collective" is created which stimulates a feeling of cohesion and empathy. This is a good start for successful communication. Thus the *Behaviour Changer Framework* and *Collective Impact Approach* are able to create a stronger collective impact when combined.

Subtask 9 – Evaluating behaviour change interventions
Beyond kWh, double-loop learning and multiple benefit evaluation tools

When we developed the work plan for Task 24 one of the starting points was the appreciation that DSM projects demonstrate great diversity in goals, scope, participants, resources etc. to match the diversity of *Behaviour Changers'* contexts and needs and their wider environment. As a consequence, developing a generic evaluation and monitoring framework that is widely applicable, yet does justice to this diversity, is very difficult indeed. We realised that finding more appropriate, effective and possibly, validated standardised ways of monitoring, evaluating and learning about successful behavioural DSM implementations was a real and urgent need. Currently, DSM policymakers and other relevant *Behaviour Changers* usually fund and/or support DSM programmes on a rather ad-hoc basis because they lack these means of assessing their impact on contributing towards a more sustainable energy system.

Beyond kWh evaluation tool

We undertook a review of state of the art research findings and current best practice and potential standardised ways of monitoring and evaluating could identify what roles and actions policymakers, investors and other *Behaviour Changers* might play to make behaviour change successful. This review of over 350 residential behaviour change studies published from 2003-2013 was undertaken under the umbrella of the Task by Karlin et al, 2015a ("Methodological Review"). They found that there is no standardised way of monitoring the impact of behavioural change DSM interventions beyond kWh type of indicators (and often even they are not measured in a standardised way): 85% of studies did collect some data "beyond kWh", but there was little consistency in the way that these variables were collected or measured. Data on demographics (64%), behaviour (62%), user experience (58%), attitudes (27%), and knowledge (21%) were collected, but there was significant variation in the questions used within each category. No standard tool currently exists to conduct such assessment comprehensively and consistently. Such consistency would improve our overall ability to account for variation in treatment effects and verify savings. One of the consequences of not having a bank of standardised and psychometrically-validated survey questions is that research funders lack clear evaluation frameworks to decide on funding practical behaviour change research efforts and thus continue relying on the 'easier', technological fixes to our energy problems and the more common economic or psychological theory-underpinned type of interventions (see also Kallsperger and Rotmann, 2017 for a discussion of the difficulties in measuring and claiming energy savings from behaviour change interventions under the new Austrian Energy Efficiency Law).

The more complex systemic type of interventions that go beyond mere kWh type of outputs thus face severe start-up issues. In order for such a tool to be of maximum usefulness, it will need to be further developed in collaboration across a variety of *Behaviour Changers*, countries/cultures and with input from different research disciplines. This tool was first proposed by Karlin et al (2015a) and called the "Beyond kWh evaluation tool". The *Beyond kWh* tool was further developed in **Subtask 9** and framed around the NZ-led *Energy Cultures*[3] framework. Karlin et al, 2016 state that "*Energy behaviour is embedded within the physical and social contexts of daily life; the interplay between behaviour and its contextual influences can be thought of as an "energy culture". Behaviour-based energy interventions aim to impact demand through influencing some aspect of energy culture - what people have, think, and/or do. Understanding how a programme does (or doesn't) work requires an understanding of changes in these elements of energy culture.*" The paper presented and tested a set of instruments that evaluate household energy culture before and after an intervention. The tool then underwent further psychometric testing with >600 Californian utility consumers (Southern California Edison, 2016).

The tool was then being tested in Ireland for a real-life pilot using public libraries in Dublin as *Middle Actors* to loan out "Energy Saving Kits"[4] (Rotmann and Chapman, 2018). These kits are meant to improve energy literacy and education about people's own household energy consumption and potential infrastructural issues (such as thermal leakage). So far, the tool has only been developed for the residential sector. We hope that future iterations will allow us to create modules for e.g. the

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[3] http://energycultures.org/

[4] http://www.codema.ie/think-energy-home-hub/what-is-the-home-energy-saving-kit/

hospital, commercial office or transport sectors as well. In BELOK (2018), a form of the pre- and post-"beyond kWh" survey was adapted for the commercial office sector. It was meant to be trialed with the Swedish Energy Agency when it moved offices and entered a collaborate Green Leasing Agreement with its new landlord. However, we did not have the resources to implement it at that time.

Objectives

- The goal of this research is to develop and validate a set of tools and metrics that can be used consistently for the evaluation of behaviour-based energy programmes.
- An in-depth assessment of current (best) practice, cultural and disciplinary idiosyncrasies, country drivers and needs and the best possible international standard.

Deliverables

D 13: An internationally-validated set of tools and metrics for evaluating behaviour-based energy programmes 'beyond kWh' (see SCE, 2016)

Double-loop learning

We initiated an expert discussion in 2014 on how a more standardised, practical, robust, generic evaluation and monitoring framework to evaluate both kWh-type of outputs as well as longer-term behavioural outcomes contributing to a more energy-efficient DSM system would look like. We provided a first attempt at initiating and contributing to such a discussion with our second ST3 deliverable, a "Positioning Paper" (Mourik et al, 2015). In this paper we briefly explain what monitoring and evaluation (M&E) mean, current M&E practice and how different disciplinary underpinnings of behaviour change interventions influence this. We also discussed the many challenges *Behaviour Changers* currently face when attempting to monitor and evaluate behavioural change in DSM interventions. These challenges led us to conclude that the traditional quantitative proxies used at present (which are often collected ad hoc and in a non-standard way, see Karlin et al, 2015a) do not correctly reflect if real behavioural changes actually occur. Solely quantitative assessments often miss the details of what exactly is going on, for different people (*End Users* and *Behaviour Changers*) and in different contexts. This is problematic for multiple reasons, and we concluded with proposing an alternative to the current mainstream approach. This alternative includes a focus on *double-loop learning*, allowing for different definitions of success and creating a more participatory approach focused on both process and outcome that makes use of a combination of qualitative and quantitative metrics to evaluate a multitude of parameters for success.

Even though we have not completed a full evaluation 'tool' that can be applied to all possible combinations of interventions in different sectors and domains, we have developed some fact sheets based on the insight that, instead of only undertaking 'single-loop learning', we also need to delve more deeply into the 'double-loop learning' process (see Figure 5 below for explanation). This is especially the case in more systemic, collaborative interventions, as promoted by this Task (after analysis of the case studies in **ST 1 & 2** showed how successful such interventions were, compared with siloed, individually-focused, top-down approaches).
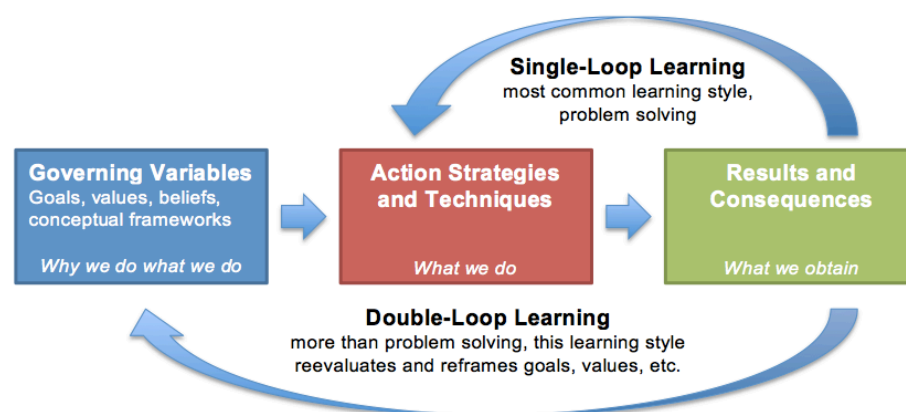

Figure 5. Double- vs single-loop learning. Retrieved from http://www.afs.org/blog/icl/?p=2653

In our third **ST3** Deliverable (Van Summeren et al, 2015), the factsheet document, we attempted to develop a practical, context-specific monitoring and evaluation template for various DSM tools (which can be used alone or in combination in behavioural interventions), with the specific aim to meet various *Behaviour Changers'* needs for outcome evaluation. This template is developed to match the monitoring and evaluation analysis in **ST 1 & 2** of Task 24. The factsheets are a template (completed for 3 types of intervention tools in the **Building Retrofit** domain: *Energy Performance Certificates, mass marketing campaigns and subsidy schemes*) which aims at providing indicators, metrics and ways to monitor and evaluate long-term, identifiable and/or measurable behaviour change outcomes of DSM programmes. These indicators aim to be context-sensitive and contingent on the sector/goals/target groups of behaviour change interventions. However, it became clear that these fact sheets were somewhat confusing and thus of little use to policymakers. Therefore, we focused on the "beyond kWh" tool and "beyond energy" metrics for multiple benefits (see combined workshop notes).

Multiple benefit evaluation

To prove ongoing success of behaviour change outcomes leading not only to energy savings, but also health, societal and environmental benefits such as e.g. community engagement or increased species diversity, we also need to look at the additional benefits of behavioural DSM interventions. The multiple benefits of energy efficiency are outlined, with examples, in IEA (2014).
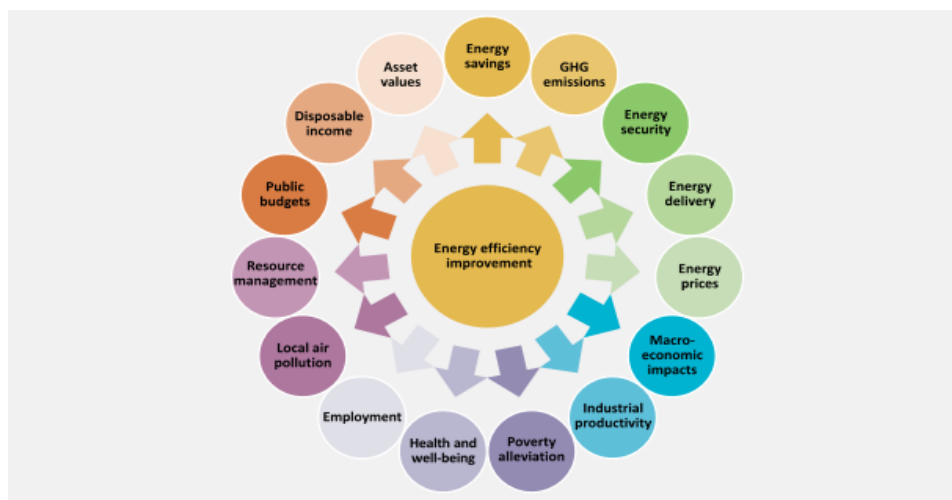
Figure 6. The multiple benefits of energy efficiency improvements. From IEA (2014).

The success of an intervention is usually evaluated on the basis of its cost-effectiveness or its kWh savings (which are often modelled, not measured). However, this does not provide insights about whether or not long-term behavioural change is achieved. Cost-effectiveness and kWh reduction may also fail to capture many of the potential social welfare outcomes and/or impacts such as job creation, positive health effects, reduced environmental externalities etc. Moreover, interventions may have positive spill-over effects that not only influence the target *End User* group (e.g. neighbouring effect) but have larger systemic impact, and longer-term effects.

Two different types of spill-over might be of particular interest, namely spill-over to:
- Other people, e.g., peers, neighbours, family and friends; and
- Other types of energy-related behaviour.

In addition, energy end users often value other features beside cost reductions which are not included in these cost-benefit calculations (e.g. health or safety improvements). This demonstrates that evaluating success of an intervention should allow the identification of multiple definitions of success – by the *End User* the intervention is targeted at, and the *Behaviour Changers* who helped co-create it. It is thus considered valuable in large national programmes such as insulation subsidy schemes, to do some pre-testing of what outcomes would mean a successful programme and to whom (e.g. NZ's *Warm Up New Zealand: Heat Smart* programme, see Mourik and Rotmann, 2013; IEA, 2014).

Figure 7. Multiple benefits in the transport sector (Austrian case study, Kallsperger & Rotmann, 2017).

Of course, a problem with focusing on multiple benefits for different *Behaviour Changers* also leads to the question of weighing up the different (perceived) outcomes. In interventions that take a more comprehensive or systemic approach from the onset, with participation of multiple stakeholders, the whole process of aligning all these interests and needs becomes a challenge in itself. A solid understanding of where the different *Behaviour Changers* in such a systemic intervention sit in terms of their perceptions of successful outcomes and the intervention meeting their needs, will help design interventions and their M&E regimes better from the outset. A *Collective Impact Approach*, as used here, can go a long way to aid collecting and analysing these different mandates, drivers, needs and perceptions from the outset. We have thus collected the multiple benefits each *Behaviour Changer* perceived as part of the *Behaviour Changer Framework* exercise in Task 24 workshops (see e.g. Fig 7 above for multiple benefits from mobility-sharing platforms, Workshop 2 in Graz, September 2017).

Subtask 6 – Understanding the main DSM issues

Background

As part of **ST 2 & 4** of Task 24[5], many DSM stories and issues were being identified that lack in-depth understanding and are in need of further research to account for context specificities. Most countries have not clearly identified these top questions with the input from the whole range of *Behaviour Changers*. We acknowledge that the priorities differ between countries, due to different national contexts. We have ascertained and will highlight these country differences (in **ST 10**). The focus in each country is on three overall priority areas which is then further narrowed down to the top DSM priority that the relevant *Behaviour Changers* (**ST 7**) will be selected for. This decision-making process of focusing onto top DSM priority areas, collaboratively, is already an important step to foster engagement, empathy with multiple stakeholders and builds on the *Collective Impact Approach* (see above). Collating the relevant group of *Behaviour Changers* from all five Sectors for at the top priority area in each country enables shared learnings and the co-creation of more focused intervention approaches and case studies according to each of their insights (**ST 8 & 11**).

Objectives

- Develop lists of top 3 DSM implementable issues and their potentials in each country
- Use the *Collective Impact Approach* and the Task 24 Expert Platform to research and review current approaches and practices, nationally and internationally, on these top issues and provide feedback from the different disciplinary perspectives (**ST 7**)
  Feed these cases, and the ones analysed in **ST 1 & 2** into a Toolbox of Interventions (**ST 8**).

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[5] www.ieadsm.org/task/task-24-phase-1/

Deliverables
- D 8: List of top 3 DSM issues, including analysis of case studies elsewhere and their approximate contribution to each participating country's load management (economic, technological, political and societal potentials)
- D 9: Continued collection of case studies and stories to add to the "Monster" Wiki (**ST 1 & 8**).

Subtask 7 – Who are the relevant *Behaviour Changers*?

Background
In addition to the **ST5** expert platform, we have developed more focused networks in the participating countries. The *National Experts* are coordinating this second layer of country experts. In New Zealand, we have focused on two main DSM topics, initially, **peer-to-peer sharing of PV in neighbourhoods** and later, due to changes in the NZ energy market, **home energy audit tool (HEAT) kits.**

Objectives
- Identify, with help of the ExCo and National Experts the most appropriate *Behaviour Changers* focusing on at least one of the top 3 DSM issues chosen by each participating country.
- Collect detailed information on their specific interests, organisations and roles.
- Use the *Collective Impact Approach* to initiate discussions between different disciplinary perspectives and sectoral contexts. An explicit focus will be on deepening the understanding of the political-institutional context *Behaviour Changers* are operating in and what it means for their capacity to take a more systemic approach to behavioral change.
- Develop national *Behaviour Changer* dialogues in each participating country by holding (bi) annual workshops (**ST 6 & 8**) to foster mutual engagement, collaboration and shared learning and enable them to build relationships on neutral, trusted ground.
- Backbone support to set a common agenda, measurement systems, mutually reinforcing activities and ongoing communication between the *Behaviour Changers*
- Evaluate *Behaviour Changers'* impressions on the effectiveness of the *Collective Impact Approach* and use of narratives as a common language to overcome barriers
- Collect examples of successful matchmaking stories.

Deliverables
D 10: National networks of *Behaviour Changers* from all 5 sectors (government, industry, research, the third and service sectors) in at least one of the top 3 DSM focus areas (chosen in **ST 6**); including workshop reports, videos, presentations, stories, blogs, Wiki etc.

D 11: Evaluation Report based on stakeholder analyses on the effectiveness of the
Collective Impact Approach and use of narratives as a common language to overcome barriers.

In summary, the NZ contribution to Task 24 was shaped with the following steps:

Step	Procedure	Method
1	Identification of the top 3 DSM issues in NZ ("The Issues")	Workshop 1, informal talks, networking, expert data bases
2	Identification of the *Behaviour Changers* in NZ; national & international expert network ("The People")	Workshop 2, NZ funding partners, BEHAVE & Energy Cultures conference workshops 2016, Task 24 expert network
3	Application and testing of Task 24 tools ("The Tools and Stories")	Four Task 24 Workshops in Wellington, BEHAVE & Energy Cultures conferences 2016
4	Input for the pilot of HEAT kits in Auckland ("The Case Study")	Focus group, stakeholder interviews, evaluation of HEAT kit programme

Outcomes

The main outcomes from New Zealand are structured into three main parts, which are 1) Main DSM-issues, 2) Top Issue on P2P neighbourhood sharing, 3) Top Issue on residential HEAT kits including evaluation of Auckland Council's HEAT kit programme and cross-country comparison of similar kits.

Overview of Main DSM Issues in New Zealand

Decision-making process leading to the NZ Themes

The focus or test bed for New Zealand initially were *residential neighbourhoods upgraded with smart house technology, including PV and storage units*. It fits into the Task 24 main domain of **'Smart Technology/Feedback'** though also has overlaps with the domains of **'Building Retrofits'** and **'Transport'** as well (from retrofitting homes with energy efficiency measures other than feedback technology and the potential use of Electric Vehicles (EVs) as storage units).

This decision was taken in close cooperation with the Co-Funders (*PowerCo* and *Ministry of Business, Innovation and Employment*) and National Experts for New Zealand (Dr Sea Rotmann, Prof Janet Stephenson and Jamie Silk), and was further discussed with representatives from the *Energy Efficiency and Conservation Authority* and the ExCo representative (*National Institute of Energy Research*).

New Zealands electricity market saw many changes during the trial periods for example (2017 Electricity Authority consultation and decision paper), *PowerCo* maintained the role of enabler as participants in the NZ energy market began undertaking P2P pilots, this limited the ability to share outcomes of commercial products being tested by third parties (see Workshop 4 notes and informal communication with Daniel Gnoth).

As part of the Irish Task 24 pilot of *residential energy saving kits*, we interviewed the Auckland Council HEAT kit programme manager for a cross-country case study comparison (see Rotmann, 2018d). She funded Task 24 to undertake an evaluation of their programme (Rotmann, 2018a) and to compare it with the Irish "beyond kWh" pre / post evaluation (see Rotmann and Chapman, 2018). This then became our second New Zealand Top DSM Issue (in Austria, we also had two top issues due to a change in National Experts – see Kallsperger and Rotmann, 2017).

National potential for Energy Efficiency and Demand-Side Management

We have collected some lists of the top DSM and energy efficiency measures *End Users* can take in NZ. They are not ranked by priority. These lists, and their sources can be found in Appendix 1.

A 2016 conference by the **Green Grid** research project ('The Experts') has presentations of interest for many of our top[6], and other important NZ issues: http://www.epecentre.ac.nz/events/index.shtml. Another one of our *Behaviour Changers* ('the Conscience'), the **Smart Grid Forum**, also held a conference with presentations from several *Experts*: http://www.mbie.govt.nz/info-services/sectors-industries/energy/electricity-market/nz-smart-grid-forum/meeting-9. A list of smart grid case studies and trials in New Zealand is given here – it is a non-exhaustive catalogue of technology and applications in NZ – especially the chapter on load management: http://www.mbie.govt.nz/info-services/sectors-industries/energy/electricity-market/nz-smart-grid-forum/meeting-4/workstream-a.pdf. Our 'Decisionmakers' at *Transpower* are also already doing exciting work and case studies in the demand response area for the purpose of avoiding or deferring transmission investment: https://www.transpower.co.nz/about-us/demand-response/our-current-demand-response-programme. Another 'Decisionmaker', the *Electricity Authority*, is investigating dispatchable demand - currently a limited wholesale market mechanism suitable for industrial consumers but there are plans to extend it to participants who can aggregate controllable load from numerous small consumers: https://www.ea.govt.nz/operations/wholesale/spot-pricing/dispatchable-demand/. The former NZ ExCo, the *National Energy Research Institute* (NERI) developed an energy research strategy in 2017.

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[6] http://www.epecentre.ac.nz/docs/green%20grid%20conf%20presentations/2.UO-GG-16-CP-RF-01_Smart%20Grid%20Edge%20Technologies.pdf

The other top issues

At the September 2015 workshop, it was decided that the other two top issues in New Zealand concerned **building insulation** (especially in the residential sector) and **transport**.

Insulation

In the context of insulation, the official estimate is that 600,000 houses still need insulation (from 1.7m total houses). Of the 1.7m homes, EECA have done around 300,000 under various programmes and the Residential Tenancy Act (RTA) amendments offer the potential of another 180,000 (if they get all rentals done). So, there are still over 400,000 under-insulated homes out there (status: 2016).

The new Government has just launched a new, **Warmer Kiwi Homes** insulation programme[7], with subsidies starting in July 2019. It is a four-year Government programme offering grants covering two-thirds of the cost of ceiling and underfloor insulation, as well as ground moisture barriers. Additional contributions from community organisations will make the cost to homeowners as low as possible in many areas. The original **Warm Up New Zealand: Heat Smart (WUNZ)** programme finished up in July 2018 and its success, particularly by focusing on health rather than only a reduction in kWh was discussed in-depth in Mourik and Rotmann, 2013. However, Nick Preval's PhD thesis[8] (he was on the original evaluation team that calculated the programme's multiple benefits (see also IEA, 2014[9]) postulates that Motu underestimated the benefits of WUNZ and it was closer to 6.5:1 (rather than the 4:1 that was previously used).

Transport

In the context of transport in NZ, it is all about attempting to de-carbonise the sector. In 2014, total consumption of energy in NZ was 13.7 Mtoe of which transport accounted for 36% (4.9 Mtoe).

Road transport makes up more than 90% of overall transport energy use. With New Zealand vehicles running almost entirely on fossil fuels, the road transport sector is responsible for more than 40% of energy-related emissions (and about 18% of New Zealand's total greenhouse gas emissions).

In June 2009, the Government passed legislation to provide an exemption from road user charges for electric vehicles (EVs) from October 2009 until July 2013. This was done in recognition of the role EVs will play in assisting with the reduction of greenhouse gas emissions from the transport sector. The exemption has subsequently been extended to June 2020.

A Life Cycle Analysis report[10] commissioned by EECA in 2015 found that EVs are better for the environment than petrol or diesel powered vehicles, across the lifecycle of the vehicle as well as in use. Across the lifecycle, pure EVs have around 60% fewer CO_2 emissions than petrol vehicles. In relation to emissions, the high proportion of renewable electricity generation in New Zealand means EVs have around 80% fewer emissions here. As the renewable proportion of New Zealand's electricity continues to grow, the emissions from an EV will reduce further.

To help realise these benefits, the Government is developing a package of measures to encourage uptake of EVs in New Zealand. An announcement about the outcome of this work will be made in mid-2016.

Total Cost of Ownership Tool

This tool was launched by EECA to enable fleet owners to compare EVs to ICE vehicles (between 60-80% of all new light vehicles in New Zealand are purchased by fleet owners). For more information see https://www.eecabusiness.govt.nz/tools/vehicle-total-cost-of-ownership-tool

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[7] https://www.energywise.govt.nz/funding-and-support/funding-for-insulation/

[8] Nick Preval (2014). Statistical and Policy Analysis of Large-scale Public Health Interventions. PhD Thesis University of Otago. 317pp.

[9] http://www.iea.org/publications/freepublications/publication/capturing-the-multiple-benefits-of-energy-efficiency.html

[10] https://www.eecabusiness.govt.nz/technologies/electric-vehicles/benefits-and-considerations/

Choosing the initial behavioural focus: Energy Neighbourhoods

The project **Powering tomorrow's neighbourhoods** was meant to enable novel electricity supply consumer choices and services that promote energy community and energy "sharing"by investigating how it may enable peer-to-peer trading across a distribution network. The study sought to create a test bed to trial demand-side management services to facilitate new and better consumer outcomes through energy communities/neighbourhoods or energy-sharing thinking (rather than the consumer focus on the individual home). New Zealand has a long history and enviable capability of demand-side management through its ripple control systems, but these have not yet been adapted to emerging consumer opportunities from changing social norms (collective and sustainable consumption and peer-to-peer trends), new technologies (the Internet of Things, PV and storage) and more dynamic retailer models (with smart meters and market changes).

New Zealand produces 75%+ of its electricity from renewable resources. Though it will benefit from ongoing developments that drive the efficient use of energy (to reduce the remaining carbon component), for a significant part of consumption it is increasingly important to influence when energy is used. The hypothesis is that such incentives will increase infrastructure utilisation and support better matching of demand to renewables. An anticipated consumer take-up of PV further re-enforces this due to its intra-day variability and mismatch of generation to current consumer consumption.

One of New Zealand's major energy research initiatives is the _Green Grid Project_ looking at the efficient integration of renewables and a significant component of this is looking at the demand-side response or change capacity of consumers. This was primarily motivated by the goal of ensuring that large amounts of distributed generation can be efficiently handled on networks and a perspective that changing demand profiles can reduce capacity constraints. Green Grid (and the Smart Grid Forum) reports have progressively analysed the consumer load profile and related energy behaviours, attitudes and available appliances to indicate the capacity that can exist for residential demand-side management in New Zealand.

Working in parallel with the Green Grid work, the Powering Tomorrow's Homes project analysed in-depth the response of consumers in smart homes to new technologies and the market signals (see also Subtask 2 NZ case study). As expected, the programme confirmed that, as consumers adapt to PV with smarter appliances, cloud-based tools and energy storage, the current market drives them to focus on increasing their self-consumption to ever higher levels (and using the existing fixed infrastructure with little marginal cost to use less - a potentially inefficient outcome). This was as the consumer looked at their personal position (bill) and became frustrated at exporting PV for 5-6 cents/kWh only to buy back later at 4-5 times this price. To achieve high self-consumption, consumers had to invest more in their control systems, appliances and changes in lifestyle.

However, when the programme looked across homes, with some demand-side changes, it was seen that much of the time, most of the PV exported from one home could be consumed instantaneously in neighbouring homes. Layering in the Energy Cultures research project analysis, it was noted that there could be a natural opportunity to match prosumers (whose profiles suggest a lower tolerance to demand-side changes) with energy efficient, budget constrained or green consumers (with a greater propensity to demand-side changes).

Connecting the consumer groups (via the market and attractive services) shifts thinking from optimising a single home to rather a community via energy sharing. It creates value and more optimal outcomes including prosumers needing to invest less in change and technologies, allow demand-responsive consumers to access their energy at better rates and allow PV to be installed where it is most cost-effective (as well as creating a pool of demand response resource that can manage PV capacity challenges on networks). The physical connections for these consumers already exists in the local electricity networks.

The focus for the first theme was a test bed to trial demand-side management services to facilitate new and better consumer outcomes through energy community- or energy-sharing thinking (rather than consumer focus on the individual home). In studying the design of the trial (that is planned to develop iteratively through the programme) with the perspective of _Behaviour Changers_ through the

value chain (who may or may not be direct participants but are also independently pursuing innovation in response to the same trends), we gain key insights on the barriers and opportunities.

Choosing the test bed in New Zealand (Subtask 6 – "The Issues")

Introduction

Task 24 Phase 2 has formulated two further areas of attention:
The need to elaborate our empirical knowledge base (elaborate on who, why, how?)

This is based on the realisation that different participants within a supply chain (e.g. the electricity supply chain) looking at disruptive technologies face very different challenges, future expectations and motivations. Traditional players within sectors may face similar practices, norms, organisational structures and physical characteristics but still respond differently based on their position in that chain, ownership structure or regulatory model. New entrants enabled by the disruption bring often even more diverse responses. However, we also expect that within sectors some similar practices, norms, organisational structures, physical and infrastructure characteristics etc. may apply. Thus, it makes sense to broaden our empirical knowledge base and this will be done looking at evolving services within the changing electricity supply sector.

The need to strengthen and support the community/platform of experts into co-creating improved interventions, using storytelling and a collective impact approach as process tools to overcome language/jargon barriers, inherent systemic barriers and silos

The electricity supply chain merits focus (see NZ Workshop 4 notes). It is vertically disintegrated, still dominated by a handful of major players, has a major component regulated and may therefore face both different incentives and real or perceived limitations on its area of activity but is seeing the rapid evolution of new players (whether in retail or offering alternatives such as home generation). Consumer capability is also very heavily influenced by their material environments and norms set by other supply chains (i.e. home appliance, insulation or heating suppliers). We will briefly address some very obvious challenges:

- Split incentives especially between tenants and landlords (or spreading of the value stack across many participants such that none is motivated to act)
- Benefits or constraints from the regulatory environment (such as Energy Distribution Business (EDB) regulation or access to smart meter data)
- History of buildings and residential neighbourhood developments and of consumers' material environment
- Smart meter roll-out including issues around technology lock-in
- Household and organisational structures of decision-making
- Role of tradition, social norms and room for radical change in/challenge to these characteristics of the *End Users*

- Core work (e.g. research and education) that can contribute (e.g. research on energy-efficiency options and/or behavioural change, smart house technology, **Green Grid** and **Energy Cultures 2** research, EECA's **WUNZ** insulation programme and education and marketing campaigns etc.)

These characteristics will be elaborated on in general terms and with reference to specific cases, below.

Background: types of behaviour, the role of smart (feedback) technology, distributed energy generation and buildings

Centre stage, ultimately, is to affect more sustainable energy behaviour of *End Users* – individuals, households and neighbourhoods.

The roles of Smart Technology

Smart technology as a supporter:
- Smart meters enable better measurement of energy use for gentailers (in New Zealand, there are often generator/retailers, called "gentailers") and lines companies
- They may – with relevant in-house technology - provide end users with support for energy and building management by giving feedback on behaviours and routines and can encourage changes in them (e.g. turning off equipment, shifting load use, lowering the thermostat).
- Mapping of user patterns in buildings, monitoring and evaluation of behavioural interventions
- Incorporate renewable distributed generation (e.g. solar photovoltaics (PV)) with in-home technology, increasing potential for demand response and demand side management
- Enable self-sufficiency and empower consumers to become prosumers

Smart technology as a potential problem:
- It can be a big consumer of energy (directly and indirectly)
- Privacy concerns
- Complicated hardware and software
- Feedback needs to be delivered in relevant form to many different types of end users
- Dependent on underlying awareness among households on energy efficiency opportunities
- Technology lock-in, technology is still being developed
- Inconvenience and greater cost (especially initial investment) to end users
- Needs to have similar technology among neighbourhoods to enable sharing and feedback
- Inherent resistance to change, social and cultural norms and values – needs paradigm shift

Buildings and the use of the buildings

Building-related energy is energy that is associated with the daily use of the building:
- Heating, cooling
- Ventilation systems
- Lighting
- Control / monitoring systems
- Own generation through e.g. panels on the roof
- Savings through insulation, double-glazing, weatherisation
- Appliances, including smart appliances

The building-specific energy consumption can be addressed through measures such as retrofitting, more efficient systems, new technology, own energy generation and storage.

Users and their dealings with the building
- Ability to operate heating thermostat or air conditioner
- Ability to open windows (ventilation/cooling) and other routine behaviours
- Routine purchasing decisions e.g. energy efficient light bulbs
- Larger, one-off investment decisions e.g. retrofitting insulation, double glazing, installing PV and storage units...
- Larger investment decisions on smart appliances
- Possibility to have a feedback application providing advice in specific situations

Using part of the energy savings will be achieved through a better understanding and use of the systems, through changes in daily routines and by changes in the procurement and use of non-building-related equipment and appliances.

Inviting relevant *Behaviour Changers* (Subtask 7 - "The People")

The aim of the entire process:

To develop a mutually agreeable approach to address the relevant challenges to the industry when dealing with end user needs and concerns during the Smart House trials (see Rotmann, 2014). This includes the many aspects that involve multiple actors such as regulation, incentives, education, technology development and deployment etc. This is why *Behaviour Changers* from all sectors were included in the original pilot design.

The aim of the initial stakeholder interviews:

Some interviews were undertaken for the case study analysis on *PowerCo's Powering Tomorrow's Homes* Trial in Subtask 2 (Phase 1). In-depth interviews of members of all the participating households and the project team and the case study analysis are outlined in this report.
The interviews were used to:

- Provide insights into the specific situation of each household (buildings, appliances, behaviours, attitudes, values, knowledge);
- Understand the roles of different people in the household;
- Better understand what opportunities there are to achieve energy conservation and efficiency, and what behaviours and changes are required, who plays a role in this, and in what way / with what technology at their disposal;
- Gain insight into the most important questions in terms of energy and behaviour that exist for the participants and where they would like to gain more insight, have complaints or concerns about the trial.

Purpose of the Task 24 workshops:

- Allow all relevant *Behaviour Changers* to have an open and constructive discussion
- Visualise the NZ energy system using the Task 24 Behaviour Changer Framework
- To come to a better understanding of the opportunities and barriers (with the emphasis on behavioural, social, institutional and organisational aspects herein) that each stakeholder faces in their specific part of the energy system
- Aim to achieve a joint, mutually reinforced approach to tackle the barriers and co-design a behavioural intervention towards a common goal[11].

The workshops were run in each participating country 1-2 times per year for the duration of Phase II. We invited the identified relevant *Behaviour Changers* from each sector to each of the workshops. The first two workshops in New Zealand focused on the **Powering Tomorrow's Neighbourhoods** case study, the 3rd on storytelling as part of the **Energy Cultures** conference and the 4th on the wider issues in the NZ energy system (see combined workshop minutes for details).

Case study analysis and cross-country comparison:

We have already undertaken an in-depth case study on the original *PowerCo Smart House Trial* (Subtask 2). There are also case studies from other countries (notably, the Dutch Subtask 2 analysis on *PowerMatching City*, the *Jouw Energy Moment* case study and the Italian *Energy @ Home* trial, Subtask 4 report, page 10-11) to draw on. It had initially been planned to undertake a case study analysis following on the Subtask 2 *Powering Tomorrow's Homes Trial* called '*Empowering Tomorrow's Neighbourhoods*'.

For all Task 24 case studies, we have a generic format of issues and research questions based on the Behaviour Changer Framework (see Subtask 8 Case Study Template, Rotmann, 2018e). The questions were also intended to outline the situation as it is, and to identify lock-ins at institutional, organisational, infrastructural, physical and technological levels that may need to be tackled as a first step towards enabling behavioural changes.

The Issues Exercise (Subtask 6):

This exercise helped all *Behaviour Changers* to undertake a quick analysis of the potential (positive and negative, called "potentials and risks" in the technological, economic, social and political spheres).

Technological Potential and Risks: It is important that we are talking about in-house, not external communication technology. Two issues relate to proprietary vs open standard route. There is a technology interpretation risk which is greater with the open standard route (around 65% vs 20% on proprietary). Trust in the technology (meters) is a risk, it is important there is sufficient energy at home at the time that it is required. More work needs to be done on what consumer loads are acceptable to shift. People on the demand side need to be willing to shift profiles so they match what people on the supply side can offer and when. Technical devices may not yet be set up to respond to the signals we are discussing here.

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[11] For more detail, see combined workshop minutes (only available to funders and National Experts)

Economic potential and risks: Reputational risk if we don't deliver the right technology that meets consumer expectations.

Social potential and risks: This is still a learning market, there will be changes over the next 5 years and a shifting baseline. The **Green Grid** research can help provide data on that.

Political potential and risks: The regulatory environment is still set up for the 20th century and this is decidedly 21st century technology. There are many potential market players, including new ones, and the regulatory regime is struggling to catch up to technological progress and market interests. Local government, which owns many of the assets, also needs to be involved.

(Em)Powering Tomorrow's Homes

Technological risk (lock-in): 20% with open standard, 90% with proprietary

Technological potential: 100% (R&D there now, in 1-2 years we'll have technology)

Political risk (industry engagement but manageable for a pilot): 90%

Economic potential (varying on parts of country): 6-20% Flick E has 100% potential

Social risk (from complaints): 15%

Social potential: 75% buy-in for pilot

Political potential: 30%

■ Potential
■ Risk

Economic risk (of not doing something now): 1% - of not doing something in 15y: 100%

Issues redux (more in-depth issues discussion in Workshop 2):

We looked at two periods: Transitional and Future, and discussed possible technological, economic, societal and political risks and opportunities (informed guesses by experts).

Transitional (1 July 2016 until 2020 - second regulatory review period, but could happen sooner):

Technology

Opportunity: There is continued rapid development of consumer appliances and rapid digital enablement of everything including demand response (DR) on behalf of the consumer. There is ability to access technology including standards and platforms to engage (inter-operability), which also includes EVs and PV, local wind at household level, micro-hydro etc., but economic feasibility is yet to be determined. Lines capacity and data capability are connected, sharing real-time information across the network is possible, strictly technically-speaking: - **100% possible**

Risk: There are different technologies being tested in the moment, but by 2020 there will be inter-operability and open data access. More work needs to be done around algorithms, and sufficient data sizes. Quality and time increments we are currently working with (e.g. still half hour data from smart meters) need to be reassessed. Some of the data risk is due to the disaggregated market, different distributors and retailers with different consequences of sharing it. Inertia and unwillingness to change can be a problem. Risk perception can be a big issue in e.g. technology lock-in, which is relevant in actual terms and needs to be managed. Safety, reliability challenges from aggregate behaviours – can be managed but may be an issue in terms of coordinating it. Privacy concerns are the biggest barriers to uptake of smart technology, but may be more perceived than actual. **Actual risk: 5%** (choosing the wrong tech is biggest risk). **Perceived risk: over 50%** in some areas.

Economic

Opportunity: **100% economic potential** (for some companies).

Risk: **80% risk** of that not happening. It all depends who does the investment and that will depend on how the market is shaped.

Societal

Opportunity: Behaviour change potential is a positive side effect. It also has a feel-good motivator. Prosumers usually think they will save money and gain independence. There is perceived value e.g. economic, security, control, altruism, status and other social aspirations. Trust in electricity companies is rather low in NZ. There is a big appetite for PV and a reasonable one for EV. There is definite interest in smart technologies and an appetite for being off-grid. Better neighbourhood connections and relationships are a strong co-benefit. There is strength in the power of word of mouth. As PV takes off people will shape their behaviours differently, including to be more inclusive and sharing. **Potential for that right now: 5%**

Risk: There can be perception issues around freeloaders and prosumer behaviours. Currently, this story is rather complex, and few people will get it. **Risk: 80% perceived**, actual is smaller.

Political

Opportunity: Disrupters know that people see change coming, there are different degrees of willingness on changing. However, wanting to control the change is the political arm wrestle. Partnerships and collaborative business models are very important. The NZ Energy Efficiency and Conservation Strategy (NZEECS), is very important. The taxpayer still has a big interest in power generation (seeing most gentailers are crown-owned), so any trade-off around generation will need to be found somewhere else. COP21 and the Paris Accord have an impact. Social equity benefits, if it is used to alleviate fuel poverty, can have an impact. There is a definite planning gain and mileage to enable transactions politically for the social good. There will be more value for businesses who stay competitive and are collaborating. This could be sold as an upgrade to 'Electricity 2.0'. The smart grid idea has cogency although this is less technical and high level and much more grounded and real and visible. Removing regulatory barriers and signalling is an important aspect. **Potential: 100%** (especially with the change in Government)

Risk: Innovation needs to be fair to all retailers from the distributors' perspective – but unless the big retailers wanted it there wasn't much point in doing it (political). Potential for all of this to lead to greater inequity for consumers (also sits across economic and societal risk). The cost of technology in the short term could lead to reluctance to change. The Commerce Commission may also restrict where to invest. It is easy to sell a story about a new silver bullet technology, but this is talking about systemic change which is a lot more complex and needs to align all the players first. However, the more players get involved can also mean more risk. Dry year scenarios could also increase political risk. **Risk: 10%**

Future goal (2025 on):

Technology

Opportunity: Very high. **100% opportunity**.
Risk: Less risk around lock-in. **0% actual risk**.

Economic

Opportunity: Most cost-effective way to take up the technologies and avoid the risk of stranding assets. Long-term thinking around stranded assets drives short-term thinking of solutions. **100% opportunity.**
Risk: Poorly utilised, instead of stranded assets. Greater risk in not doing it. **5% risk**.

Societal

Opportunity: **30% or less** unless there is another technology shift.
Risk: People will be getting very upset if stranded assets lead to repricing. Greater risk in not doing it. **30% risk**.

Political

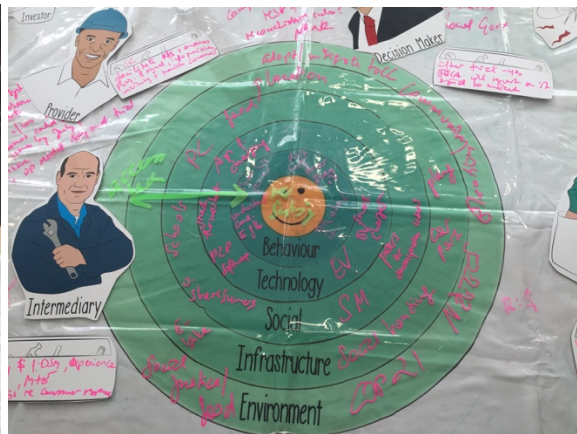Opportunity: May be necessary due to COP21 or at least provide leadership potential. **Opportunity: 100%**

Risk: Higher, seeing it is going to be systemic and may need discussions around user rates, what gentailers do to get the best out of it etc. Greater risk in not doing it. **15% risk**.

The Behaviour Changer Framework in New Zealand

The role playing exercise where everyone tried to explain someone else's mandates, restrictions etc. worked really well and was generally regarded as very useful to show how well everyone understood each other already. Everyone was generally quite good at picking each other's main issues. The animated Prezi of 'our' NZ Energy System can be found here. In the second workshop, we went through the initial exercise again to update things and have a more in-depth discussion.

The first New Zealand BCF   *The second NZ Behaviour Changer Framework*

Who were our Behaviour Changers?

We went around the table and each wrote down our main mandates, stakeholders, restrictions and tools we brought to this solution. Then we chose different *Behaviour Changers* to imagine each other's point of view. This exercise helps build empathy but also shows that everyone in the room was already well-acquainted with each other and their main roles and positions.

Decisionmakers – Policymakers
Providers – Utilities or solar PV providers
Experts – Academics
Middle Actors – Lines company
Conscience – National collectives and think tanks

Behaviour Changer representatives who partook in all or any of the four New Zealand workshops:

Energy Efficiency and Conservation Authority	Sustainability Trust
Ministry of Business, Innovation and Employment	Kapiti Council Eco Design Advisor
Electricity Authority	Front End Solar
Transpower	UTAS
Flick Energy	BRANZ
Solar City	Sussex University
Genesis Energy	Wellington Zoo
PowerCo	Ancell Consulting
Vector Energy	He Kainga Oranga
Smart Grid Forum	Green Living Centre
National Energy Research Institute	Linköping University
Otago University (*Energy Cultures & Green Grid*)	Energy News
Oxford University	Domestic Electricity User Group
EmH Trade	Blueskin Bay Resilient Community Trust

DECISIONMAKERS: POLICYMAKERS

MANDATE:

- Keep Minister/s happy
- Do public good, spend taxpayer money wisely
- Develop Energy and EE Strategies
- Reduce regulatory barriers
- Test behaviour change interventions
- MV&E, data

STAKEHOLDERS:

- The public
- Minister and MPs
- Their CEO and board
- Energy utilites and providers
- Third Party Providers

RESTRICTIONS:

- Politics/re-election
- Funding
- Tasks and views of different parties are often incompatible and hard to unify, especially e.g. fossil fuel lobby
- International obligations

- EECA – Energy Efficiency and Conservation Authority
- MBIE – Ministry of Business, Innovation and Employment
- EA – Electricity Authority

TOOLS:

- Information
- Subsidies and incentives
- Regulation/Tax/Law change
- Policy interventions
- Signalling/leadership
- Auditing / training /educatation

PROVIDERS: ENERGY UTILITIES & SOLAR PROVIDER

MANDATE:

- Reconcile impact from cost and usage information
- Highlight value to customers, attract more customers
- Keep them happy
- Kill the competition, make money
- Increase acceptance and value of solar energy

STAKEHOLDERS:

- Equity investors
- Customers
- Other utilities
- Lines companies
- Shareholders
- Regulators

RESTRICTIONS:

- Incumbent behaviours especially of grid companies
- Trust in value of solar and installers
- Lack of standards
- Competitive environment means lack of trust and inability to work together

- Flick Energy
- Solar City

TOOLS:

- Marketing
- Contract model
- Spot pricing, future pricing changes, feedback
- Self-sufficiency
- A good conscience
- Ability to learn about powering your own house
- Research and thought leaadership

EXPERTS: OTAGO & OXFORD UNIVERSITIES

MANDATE:
- Behaviour change
- Sustainable energy system transition
- Validate data, models and simulations
- Attract funding and resources
- Publications and dissemination of know-how

STAKEHOLDERS:
- Politicians, research funders
- Citizens, iwi and other research users
- International colleagues, academics
- Universities
- Industry and technology providers

RESTRICTIONS:
- Financial and resource restrictions
- Lack of knowledge or misinformation in public
- Resistence from end users , ethics, lack of access
- Unify trans- and multi-disciplinary research approaches
- Not enough courage from political and industry leaders to move away from current system
- Difficult to recreate international best practice examples in NZ

- Otago & Canterbury University – Energy Cultures and Green Grid Projects
- Oxford University – Energy and Power Group

TOOLS:
- Reports
- Data and practical knowledge
- Trusted expertise
- Research and Development
- Materials
- Co-create change systemically
- Best-Practice Examples
- Case studies and testing
- Innovation

MIDDLE ACTOR: LINES COMPANY (in this trial)

MANDATE:
- Secure jobs and staff employment
- Create value for shareholders
- Protect future asset value
- Research and data management
- Modelling, simulations, conduct small-scale pilots
- Safely, securely, cost-effectively provide power through lines

STAKEHOLDERS:
- Shareholders
- Customers (via utilities)
- Retailers
- Regulators, Commerce Commission

RESTRICTIONS:
- Short-termism
- Lack of knowledge/mis-information of end users
- Regulators setting prices
- Fears of Innovation
- Lock-in of technology risks
- System change is very difficult to achieve

- PowerCo
- Sustainability Trust (later)

TOOLS:
- Information and case studies
- Concept of proof (theory to praxis)
- Infrastructure
- Data, evaluation, metrics & measurements
- Big data
- Standards/rules

CONSCIENCE: NGOs, THINK TANKS etc.

MANDATE:

- Ensure transition to future energy system is well-informed
- Convene power
- Enable and facilitate multi-stakeholder dialogue to benefit end users

STAKEHOLDERS:

- Members
- Researchers, nationally and internationally
- Funders
- Politicians/public service

RESTRICTIONS:

- Multi-stakeholder collaboration is difficult
- Financial and research limitations
- Trust issues
- Commercial sensitivity issues

- *National Energy Research Institute (NERI)*
- *Smart Grid Forum (SGF)*

TOOLS:
- Conferences
- Workshops
- Think Tank
- Future thinking
- Influence Behaviour Changers
- Reports
- Visibility

The End User Context (PV owners in NZ neighbourhoods)

BEHAVIOUR	Goal: Create a PV power-sharing culture in NZ neighbourhoods and improve general energy literacy
TECHNOLOGY	1. P2P software 2. Solar PV 3. Electric Vehicles 4. Battery storage 5. Smart thermostats 6. HEMS device 7. Smart EV chargers 8. Smart appliances 9. Remote controllers
SOCIAL	1. Family 2. Utilities / Gentailers 3. Other „sharesumers" among neighbours 4. Social media 5. Peers or anonymous users of P2P platform 6. Schools 7. PowerCo
INFRASTRUCTURE	1. Transport 2. Social housing 3. Car ports 4. Roof with space for PV 5. Space for batteries 6. P2P setup
WIDER ENVIRONMENT (geographic, political, regulatory etc.)	1. 3 climate zones 2. Social justice / inequality 3. Political system / elections 4. Paris Accord 5. NZ climate targets 6. Electricity Authority decision paper

Potential Conflicts between Behaviour Changers

Between the End User and the Provider, which can lead to End Users switching retailers. It could be either a benefit or a conflict, depending on how open retailers are to participate and especially to help determine the feasibility of this pilot. Retailers don't have to go backwards to adopt new technology. If they lose customers because of this, they will have to re-consider.

Between the Provider (retailer) and the Middle Actor (network company in this case):
In general, retailers and network companies are in an uneasy relationship. The retailers have the direct line to the *End User*, yet are dependent on the lines company operating and maintaining the network.

Between the Provider and the Decisionmaker (Government):
This is a generic conflict, but not a problem in this trial. Often, retailers are also crown-owned enterprises and the Minister of Energy has an in-built conflict by being in charge of the security and reliability of the system, energy efficiency and conservation, resource extraction and increasing the shareholding of the crown.

Between the End User and the Decisionmaker:
Not really in this trial, except maybe via Goods and Service Tax (GST) implications.

Between the End User and the Expert:
Mainly around ensuring privacy of any big data mining. Any research on the behaviour of pro- or sharesumers will be done ethically (including with ethics approval).

Because this trial is looking at rather small value (hot water cylinders), there are not that many conflicts. However, once it is scaled up there could be many more bombs and complexities to contend with. For example:

- How will we engage low-income families who live in social housing? There is potential for this sector in this trial, but from a retailer's perspective, there could be issues around credit checking, or medical dependencies of the *End Users*
- Could we start with charitable giving apps to make it acceptable with the *End User* and educate them on how the new system could work?
- Would other retailers be willing to trial something off-system with a small number of consumers to iron out any issues before going bigger? The retailer willingness to do so will depend on what the solution looks like.
- The technology for this trial poses no problem, but data analysis could. It needs to be discussed with each participant.

Multiple Benefits Exercise

We then undertook an exercise discussion potential co-benefits from this pilot, how to measure them and who would benefit.

Co-Benefit	Measure or metric	Who benefits/measures/reports it?
Expand business model now constrained to single properties and zero export	New business model, higher uptake, new consumers	Providers
Support distributed generation, strengthens proposition to customers	New customers	Providers
CO_2 reduction	Carbon emissions avoided	Decisionmakers
Loyalty, good PR	Customer retention	Providers
Negawatts will drive down wholesale price of electricity	Price changes	Decisionmakers
Avoids need for new generation	# of new power plants built	Decisionmakers
Potential for a different transport strategy	Uptake of EVs	Decisionmakers
Shows how smart grid can be realised without much Govt intervention	NZ having a 'smart grid'	Decisionmakers
New opportunities for research/industry engagement	Increased research funding or collaborations by industry	Experts
System research potential (energy/transport system)	New research areas and disciplines arising	Experts
Future proofing: what does it mean for the DC grid? Will it be a bottom-up grid? Or a fractal grid?	New strategies for grid management	Decisionmakers, Providers
Greater uptake of RS&T will lead to economic growth	GDP increase from R&ST related to smart technology	Decisionmakers
Greater resilience in the grid	Reduced cost, fewer complaints, less maintenance	Decisionmakers, Middle Actors
No new investment needed	Reduced cost	Middle Actors
Big data, new visibility about customers and opportunities to interact with them differently	More customers, better products	Middle Actors, Providers
Ability to segment and target customers differently	More customers, higher retention, more satisfaction	Middle Actors, Providers
New options for consumers which allows them more efficient use of resources	Improved energy efficiency	Decisionmakers
Move away from centrally-planned industry but not a laissez-faire network	Amount of DG and community sharing schemes	Decisionmakers
Patch protection, grow your value chain	Customer retention, growth of business	Middle Actors, Providers
Reduce volatility, uncertainty and complexity	Investment in grid before/after	Decisionmakers
Long-term network utilisation, de-risks the asset	Reduction in long-term maintenance costs	Middle Actors
Feeling in control of your own usage	Consumer satisfaction	End User
Sense of community	Neighbourhood connections	End User

Storytelling

Other NZ stories can be found in Appendix 2. Here is a collection of the most relevant ones, to this trial.

The Middle Actor (Research leader)

Once upon a time… Jack and Jill, who lived up the hill, took power from the grid. They got a power bill, they paid it even though they didn't understand but they thought if they wanted to save the planet all they could do was shiver…

Every day… They used more and more power at peak time and used bigger and bigger appliances which sat around idle most of the time. They were unhappy and uncomfortable, and very inefficient.

But one day… Some clever wizards from the network company looked at what Jack and Jill really wanted and realised that with some 21st century engagement, like smart apps, a conversation in Jack and Jill's language and change in the rules that the people could choose, they could help them get happier, more comfortable and more efficient. All plus sharing their energy with their family and friends!

Because of that… Jack and Jill decided to go with this network company and its wizards and used their network which was designed to connect everyone so much more efficiently.

But then! Some evil engineers said "Hold on! You can't trust fickle End Users to do all this stuff!" So they built competitors who are automating the system and got regulators to question why the network was doing stuff with the customer where the customer was really doing their job.

Because of that… The network wizards had to demonstrate how their work actually helped customers and created value for both them and Jack and Jill. They did a pilot and showed that by creating value for people to have better lives by working with them and helping them connect with everyone else, it created a bigger pie for all.

Until finally… The engineers lost their fight to create automatons and remove the customer from the equation and the network changed how they looked at their customers and started putting their needs first. They started discussions around 'assets' that were relevant to them and how they could best create value that delivered, for the long-term, the most efficient network.

And, ever since then… Kiwis like Jack and Jill cleverly shared energy rather than everyone doing their own thing and just paying the evil engineers to do their thinking for them. They felt better about being in charge and being able to connect really efficiently those who had power with those who needed it most. And this was the birthplace of empowered neighbourhoods full of green, power-smart kiwis. **The end**.

The End User

Once upon a time… There was a household who wanted to reduce its carbon footprint to feel better about their legacy to the world, and save some money in the process.

Every day… Some householders had too long showers that were way too hot. Some left the lights on or let the TV running but others didn't even turn the heater on when it was clearly cold, because they were afraid of the cost.

But one day… They were blessed by a magical fairy who installed solar PV, a more efficient heating system and a range of cool and easy gadget to manage it all.

Because of that… They could now have a longer, even hotter shower, comfortable in the knowledge that their solar system had heated the hot water cylinder, and it didn't cost them anything. The heating could go on and stay on when it was cold and the house stayed warm thanks to the increased insulation. The householders slept well in the knowledge that they were greener and making a difference to the world and their wallet.

But then! They suddenly realised that they had too much solar to use all of it! The payback price to export it back to the grid was laughable and they felt let down that their lovely, self-generated solar wasn't worth more.

Because of that… They started doing silly things, like turning the lights on during the day and the heat pump to cool down the house on the weekend when you're not at home just so you don't have to sell back your power to the grid at basement bargain prices.

Until finally… A clever, innovative power company came along and offered the option to share their excess electricity with their neighbours.

And, ever since then… The household felt that solar was the best investment ever. Not only did they feel good about their lower impact on the planet but they are now also helping their neighbours to minimise their impact, and their costs. All this while also getting a greater sense of being involved in a happy community. **The end**.

The Middle Actor (Distributor researcher in charge of making sense of the data)

Once upon a time… A small network company built a big database with all of its assets and transactions.

Every day… They counted how many poles and wires it had, worked out how much those were worth, and went off to tell their shareholders all about it. When a wire broke, they recorded the work done and placed it into the database. But they weren't allowed to speak to their customers and didn't know how different customers created opportunities or problems to their network.

But one day… The customers at the end of those lives were able to send information back to the utility about how much energy they actually needed. But even more than this, they could tell the company what was important to them in their everyday lives.

Because of that… The company was able to learn about what loads could be shifted to reduce utility costs and help customers to use energy in ways which increased their authority, improve their community and make them feel special.

But then! They found out that the smart meters couldn't tell the utility enough about what was important or what actually used energy!

Because of that… The utility came up with a web app which interacted with the customer to help them share their excess solar PV energy with other customers who didn't have solar PV. It also helped those who didn't have it be able to contact ones that did and buy or borrow it off them.

Until finally… The company, its shareholders and the customers were all able to share energy with each other through a new, smarter application that was based on community understanding.

And, ever since then… The whole country was able to share energy across communities, for when they needed it. People were able to fund new ways to save money by using this app and the network company was able to get closer to their customers and provide them with a service they felt happy and empowered with. **The end**.

The Provider

Once upon a time… There was a country called New Zealand.

Every day… People used power from the grid the way it had been done for 100 years already.

But one day… Flick Energy joined PowerCo in helping them power tomorrow's homes better. They set up a new system to support DG and buy-back at spot rates.

Because of that… New solar customers joined Flick and they could identify by going back to PowerCo, what their low voltage circuit was and match them with the nearest existing customers on the same circuit. Now new customers that joined Flick could be matched with existing prosumers who had their own solar PV on the same network.

But then! Not all customers wanted to join this new scheme! The majority didn't want to change from what they knew, and their parents and grandparents had known…

Because of that… Flick started getting more clever about showing customers how they used their local electricity and the benefit of doing so – not just in their wallets, but on their impact on the environment and their ability to help others who needed it. Flick also talked to PowerCo about how to incentivise uptake and use of this locally-produced electricity instead of buying it from the grid.

Until finally… Solar and non-solar customers can see what they have gained through the scheme. PowerCo can measure how much better utilised their assets now are and Flick is becoming the biggest retailer with the happiest 'sharesumers' in the country.

And, ever since then… This provided the benchmark for other retailers and network companies to start working together to roll out this great scheme across all of New Zealand. **The end**.

The Provider

Once Upon a Time… A visionary man with a mission to save the world from Climate Change decided to stop just protesting about it and to start making a real, practical, reproduce-able difference. He gathered a team of innovative engineering, financial and business thinkers together and said "let's drive the change to zero-fuel cost, zero-carbon cost energy and make it affordable for everyone. Moreover, let's do so in a way that works for the individual, the country and investors without political distortion so that it can become a model others can copy to drive carbon out of their energy systems too. Let's give power to the people!"

Every Day… They thought, and challenged and talked and liaised and partnered and innovated. Every day they faced doubters and critics and cynics and blockers. But every day they also found supporters and allies and ideas and options. True, they birthed a few turkeys and some ideas never lived but the vision was clear and the mandate was strong, so every day they continued to strive towards their big goal.

But One Day… the technology blinkers fell away and they realised they way to make a difference to climate change wasn't about making the technology available to the masses. It was about making the technology accessible to the masses along with support and guidance to maximise its use and value. Energy use and behaviour was much more important than lots of shiny toys. They launched an energy services answer into the market, solarZero, with the goal of embedding energy assets into clients' homes that maximised the value of the asset and minimised the grid cost of energy - big banks and big investors and end users all liked it.

Because of That… they changed the way they spoke to people, both clients, partners and market participants. They tried to identify where the points of connection were and how to create mutual wins. They were always focussed on making a difference to climate change and creating better futures. So other people with the same goal engaged with them.

But Then! People started to attack them, either because they were focussed on the technology, not the service, or because their goals were different. Enabling a technology change that drives generation to the edges challenged the infrastructure and the market set-up. Some Behaviour Changers appeared to only want changes that helped them do what they already did. They appeared not to want change that required them to change too.

Because of That… The team tried harder to engage, bought forward technology innovations to ameliorate some of the issues others were attacking us with. They used more and more data to get smarter and understand the world better.

Until, finally…(We're not here yet!) People felt in control of their power and understood the impact of using it. The market understood the new opportunities and the system could engage in new ways of trading energy and the spare capacity could even be used to economically drive carbon out of the transport system.

And, Ever Since Then… People have actively looked to always use the zero-carbon option. Four of the top 5 imports by GDP have changed and hydrocarbons no longer dominate NZ's balance of trade. **The End.**

The Decisionmakers

Once upon a time… Two government agencies in New Zealand were tasked with monitoring and managing the electricity network and to make sure it ran as efficiently as possible. They were both always challenged by the market players and the inertia of the end users.

Every day… They tried to make the people understand how their energy use impacted the environment and how it mattered at a personal, community, societal and national level how each of them chose to behave. But the people wouldn't listen to the government agencies.

But one day… The opportunity came along for the people to generate their own power, share it between themselves and donate their excess to those that needed it the most. Suddenly people stopped and started thinking because they were told they could 'really make a difference'. The government agencies helped this trend by adapting regulation and educating the public.

Because of that… The people learned to talk to each more and see how small things could add up to a lot of great deeds. They suddenly understood the 'power' they were generating and that sharing 'people power', not just electricity was the real benefit of this scheme.

But then! The incumbents began increasing their prices and charged more for transmission to block the ability of the people to share and donate their power.

Because of that… The people took their control back. They started boycotting the incumbents who penalised their communities. The government stepped in to stop price gouging and kept educating the public about the

new possibilities. The peoples' knowledge of the market was now as good as the incumbents' and this really leveled the playing field. So, the 'people power' started dispatching the 'corporate power' slowly but surely.

Until finally… The people now looked to themselves first and foremost in order to find a solution and they used their own power to help their communities choose the environment over corporate greed.

And, ever since then… All energy networks are built from the ground up with communities, the environment and the disadvantaged in society as the first order of importance. Profit is now a happy co-benefit rather than the driver of how power works in New Zealand. **The end**.

The Expert

Once upon a time… There was a group of researchers interested in how people behave in relation to energy. They called this 'Energy Cultures'.

Every day… They carried out research and talked to households, industry and policy makers about changes happening in technologies, intelligent systems, consumer aspirations and how to change behaviours. But they weren't always fully understood and their findings weren't always clearly used to change things.

And little by little… They realised that these changes they were talking about had the potential to bring about transformational change in the way people interact with each other, with their energy companies and that there was real potential with new relationships with different players.

Because of that… They saw that new relationships offered multiple co-benefits: to households investing in PV; to households who can't invest in PV; to the management of electricity peaks; to the management and longevity of the lines network; to greater resilience and a sense of security in the grid; to social cohesion and the long-term cost of power.

But then! So many players started getting involved and changes were needed to so many parts of the system, that it would lead to very slow take-up. Unless the experts were asked to help think ahead about potential roadblocks and barriers.

Because of that… The experts realised that their research needed to help identify pathways and enable the support of change, taking a systemic view. They realised they needed to change the way they told their story so it was easier to understand. And they realised that they could tell New Zealand's change stories internationally, so other countries could also learn from our experience.

Until finally… The experts have helped the transition come about through their careful science and sharing their findings widely in ways that were easily understood. Now they feel respected and connected.

And, ever since then… The energy industry sees research as a valuable tool to help deal with the complex, systemic issues and a new beautiful relationship has bloomed. **The end**.

The NZ case study: Auckland Council's HEAT kits

Cross-country comparison of residential energy saving kit efforts

The Sustainable Energy Agency Ireland (SEAI) decided to focus on *Middle Actors to promote residential behaviour change efforts* in their Task 24 Subtask 6 case study. The chose to improve an energy saving kit pilot, undertaken by CODEMA, the Dublin Energy Agency, using public libraries as *Middle Actors* to loan out the kits.

Energy Saving Kit Programmes have enjoyed wide popularity in several countries, and have been part of the behaviour change repertoire for over 2 decades now (see Task 24 Cross-Country Case Study Comparison and database of different saving kit programmes). Many have been regarded as highly successful by their programme managers, but few could point to actual, proven behavioural change. The Irish Energy Saving Kit programme was thus reiterated following Task 24's *Collective Impact Approach* and co-designed with all relevant *Behaviour Changers* (read details in the Irish Final Report, to be published). We also tested the Subtask 9 *Beyond kWh tool* for the first time in Ireland (see Rotmann and Chapman, to be published), undertaking pre- and post-intervention surveys in Sustainable Energy Communities. We believe that these approaches, built on the learnings and toolkit of Task 24, have improved the Irish programme showing actual behavioural changes have taken place and where barriers and sticking points lay. The programme is currently being reiterated following a *double-loop learning process* and to be rolled out nationally, including in schools.

Auckland Council's HEAT kit programme

Auckland Council's Home Energy Audit Tool (HEAT) kit programme is also clearly very successful in terms of how many people have loaned the kits from libraries (over 750 over a one year period) and how long waiting lists were (several months for some). However, in order to know if any actual behavioural change has taken place in Auckland because of the kits we needed to undertake more in-depth evaluation. The detailed report has been published by Task 24 (Subtask 6&7 – New Zealand's HEAT kit programme).

From February to April 2018, the Auckland Council and Task 24 Operating Agent collected and analysed data from 77 surveys, 9 interviews and one focus group. However, only relatively few (<10%) people who loaned out the kits responded to the included survey that this evaluation is based on. From the survey, focus group and interview responses it is clear that the people who wanted to provide feedback were among the "early adopter" category and already highly motivated to save energy. This has created an inherent bias in this evaluation but does not detract from the fact that their feedback was overwhelmingly positive, very detailed and clearly showed that at least this highly-motivated group of participants had learned and actioned new knowledge on energy-saving opportunities and energy-efficiency investments in their households. The role of Auckland Council in establishing this programme was widely applauded.

The Kit contains four tools

| **Infrared thermometer** for finding hot spots or cold spots to identify areas of poor insulation or air leaks. | **Thermometer/ hygrometer** - for measuring air temperature and moisture levels in different parts of your home | **Stopwatch** – for checking your shower flow rate | **Power meter** – for checking the energy use and running costs of your major appliances such as fridge, freezer etc |

From the Auckland Council HEAT kit manual

Snapshot of Findings

We give some high-level snapshot results below, and compare them with a similar evaluation scheme that was undertaken by Task 24 on the Irish Energy Saving Kit programme, where applicable.

87% AWARENESS – made me think how I use energy at home

100% WOULD RECOMMEND the kit to someone else

85% MET EXPECTATIONS – majority were happy with the kit

100% HAPPY WITH COUNCIL ROLE – many want more kits/tools
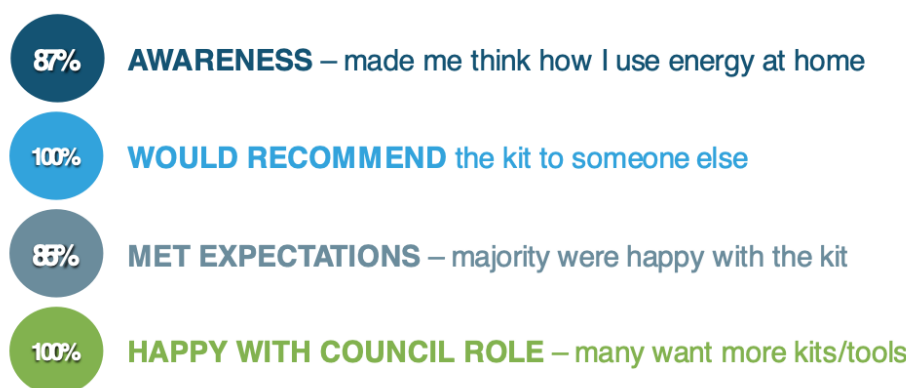
Motivations

36% Financial (c.f. 30% in Ireland)
36% Educational (not mentioned specifically in Ireland)
16% Warmth or Home improvement (c.f. 22% *each* in Ireland)
12% Environmental concerns (c.f. 18% in Ireland, higher in a Sustainable Energy Community)
The big country difference on the educational motivations of kit users could be due to more emphasis being placed on the educational value in the NZ toolkit.

Intention to act vs actual actions taken

34% think about home upgrades (c.f. 60% in Ireland)
19% think about appliance upgrades (c.f. 51% in Ireland)
28% think about habitual changes (not specifically measured in Ireland)
13% think about maintenance/repair changes (not specifically measured in Ireland)
7% think about changing settings (not specifically measured in Ireland)

160 intended and **84 actual** actions that were taken were recorded during the NZ evaluation. Most of the people who reported taking actions rather than just intending them were from the focus groups and interviews.

Top Actions

The top actions that Kiwi respondents mentioned related to **windows/curtains** and reducing **dampness**, followed by **hot water use, insulation, heating and appliance use**. **Lighting upgrades** were only mentioned 3 times overall in New Zealand. In Ireland, however, the purchase of energy-saving **light bulbs and insulation** were the most commonly-mentioned actions. *These differences between the two countries reflect both, differences in housing stock and the energy-saving tips and guidelines provided in the supporting materials with the kits, as well as the survey design.*

Awareness

The majority of people heard of kits through the **library, advertising or word-of-mouth**. In Ireland, a large number (28%) of survey respondents heard of the kits in their workplace or Sustainable Energy Community (SEC). *In New Zealand, the kits were only loaned out in public libraries.*

Emerging energy personas

8 Interviews & qualitative responses from survey and focus groups showed the following energy personas (the first 4 were also observed in Ireland):
1. Assessor: Verifying quality work done
2. Savvy: Confirming suspicions
3. Energy saver: Looking for direction
4. Aspirational: Environmentally conscious
5. Educators: Wanting to talk about energy and teach others

Summarised Recommendations for Auckland Council

For the ongoing Auckland Council HEAT Kit Programme, I have the following recommendations (more detailed recommendations to be found in the back of the report):

1. *Continue stocking the kits* *in all public libraries in Auckland.*

2. *Increase the number* *of kits and* *promotion* *of the kits, especially towards the winter months.*

3. *Re-assess the information materials* *provided with the kit, including accessibility for non-English speakers.*

4. *Get a* *different plug-in meter* *– one that is less difficult to use and read and less prone to fail.*

5. *Provide* *on-going training for library staff* *and supplies for restocking kits when they are returned.*

6. *Undertake a short pilot with* *thermal imaging cameras* *as they were found to have some of the highest behaviour change impact.*

7. *Make it more clear that the* *infrared thermometer* *could also be used to measure* *fridge/freezer temperature, door leaks and wall temperature behind the fridge.*

8. *Undertake a short pilot with a* *lumen meter and free LED light bulb* *to get people more interested and aware of lighting upgrades.*

9. *Remove the magnifying glass* *– especially if a better plug-in meter with larger display can be found.*

10. *Engage other* *Middle Actors* *who can promote and loan out the kit and assess which are the most trusted, especially to vulnerable communities.*

11. *Change the survey and adopt the Task 24* *"Beyond kWh"* *Pre- and Post-survey methodology used in Ireland instead.*

12. *Let people* *go into a draw* *for a Bunnings voucher instead of sending out light bulbs (see also Recommendation 6).*

13. *Partner with SEA* *– Sustainable Energy Advice Ltd to develop an improved HEAT kit programme to be piloted in the Auckland Region, including development of a gamified App to be trialled in EnviroSchools.*

Recommendations for New Zealand

The table below summarises the recommendations for the two chosen DSM-problems, which we focussed on in the second phase of Task 24 in NZ. In general, to solve any DSM-intervention all *Behaviour Changers* need to collaborate and communicate with each other and with the *End Users*.

Behaviour Changers	Recommendations
Decisionmakers	• Seeing this is such a novel and innovate space, with high system transformation capability, it was prudent for the NZ government to step in and undertake market participation consultation • The government can support local government and smaller players in improving the uptake of home energy saving kits, by ensuring the process is gamified, simplified and tailored to support householders' needs
Experts	• The P2P neighbourhood-sharing space is relatively new and offers a lot of potential for more research, particularly field-based trials. Including behaviour change experts to study the perceptions and actions taken by the various players in such schemes, is essential for successful roll-out • HEAT kits are currently not meeting their full potential and further research, particularly into what drives households' energy use and perceptions of what they can and cannot do to change it, is essential
Provider	• The role of the Provider is to provide services which are in the best interest of customers. As customers are finding ways to engage and participate in the energy industry that is challenging the established market structures and forges new relationships. • Providing energy efficiency widgets and tools alone is not enough to ensure people actually get the most benefit out of them. It is imperative to collaborate with other Behaviour Changers and coordinate different industry and service sector participants to ensure multiple benefits for all.
Middle Actors	• Identifying, and including the right Middle Actors is difficult yet important in an innovative approach such as P2P sharing. Who are the trusted agents that can support prosumers and end users to engage in such schemes? • Public libraries are great Middle Actors in terms of reach but may not be the most adequate to HEAT kits are utilised to their fullest potential. We suggest using EnviroSchools as Middle Actors to promote energy education from childhood and to ensure the whole family is included
Conscience	• It isn't always clear who the most appropriate "Conscience" should be – in the case of P2P-sharing schemes it was the *Electricity Authority* who intervened by engaging in mass participation market consultation • It would be good to involve community groups / sustainability organisations in the development of an improved HEAT kit (including the App)

Conclusions

Now that the New Zealand participation in the second Phase of Task 24 ends, the following main conclusions can be drawn:

• *Make people the main focus of energy system transition*

The necessary transformation of our energy system can only work sustainably and effectively, if all concerned stakeholder groups are involved. Most systems do not consider *End Users* and most policy interventions do not include stakeholders from 'the Conscience' or 'Middle Actor' sectors. It is absolutely necessary to include these groups more consciously and to involve them to co-create behavioural interventions based on their needs and requirements, as well as the other *Behaviour Changers*. Particularly in novel and highly innovative schemes that aim at system transformation, it is best to enable shared learning and open and trusted communication channels.

• *Collaboratively identify and work on Top DSM-issues*

Many of the DSM-issues in New Zealand, similar to other countries, are related to energy system transition, the transport sector, increasing the energy efficiency of the SMEs, and conducting energy efficiency retrofits in buildings. The three specific issues that were discussed and highlighted in the

workshops were: split incentives with landlords and tenants; the move to a sustainable transport system including integration of EVs into a "smarter" grid; and peer-to-peer sharing of PV and distributed generation, creating "prosumer" or "sharesumer" networks. Even though the latter was chosen, market changes in response to this highly innovative topic meant that our co-funders had to put their planned trial on hold. Fortunately, we found an interesting case study (from undertaking interviews of programme managers for the Irish cross-country comparison) that could help improve energy literacy and bottom-up engagement of Kiwi households in behavioural interventions – including ones that address the landlord / tenant dilemma.

- *Evaluation of (multiple) benefits and costs is required*

Although many behavioural issues target these outcomes, financial gains or the saved kWh should not be their sole focus. The *Warm Up New Zealand* example (IEA 2014; Mourik & Rotmann 2013) is a perfect one to highlight how important other drivers and benefits, like improving health and comfort, can be. It is therefore critical that all parties, but particularly *Decisionmakers* and funders have a wide and long-term perspective to successfully assess the longer-term outcomes and look beyond just financial and energy savings. This is particularly important when driving a highly technical change to the energy system, such as when creating prosumer / end user networks. Both, the potential benefits and costs of undertaking such system transitions, need to be understood before engaging in national roll-out.

- *Following best practice social science and design thinking is crucial*

The energy system (in the human, technological and financial domains) is currently dominated by engineering and economic thinking. There is nothing fundamentally wrong with these disciplines and they have led to unparalleled innovation and improvement in people's lifestyles. However, with the looming devastating consequences of runaway climate change, this deliberately 'simple' and relatively linear view of the energy users in particular, is not going to lead to the necessary changes in behaviours, practice, energy culture and lifestyles that we so urgently need to meet our climate targets.

In order to truly understand and comprehend the complexity of the energy system, including the complexities of human behaviour, society and socio-technological interactions, "behavioural socio-ecology" (see e.g. Moore et al, 2013 in the health sector), as the underpinning discipline used in Phase II in this Task, is a good framework to use. "It is based upon ecological systems theory (EST), which espouses that human development is shaped by several systems or contexts. These include:
- the immediate settings in which an individual participates (e.g. home, school, workplace) and relationships within and between them;
- relationships between settings in which the individual person does not participate but which affect the immediate environment (e.g. the education system); and
- generalised patterns that define the substance and structure of other systems (e.g. societies, social groups) but which are modifiable (e.g. by public policy).

The McLeroy et al (1988) framework identifies multiple, interdependent leverage or evaluative points at policy, community, organisational, interpersonal and intrapersonal levels and has been recommended as a theoretical, methodological and evaluative tool capable of supporting a consistent, holistic approach during the design, implementation and evaluation of health improvement interventions. The socio-ecological framework encourages both whole-system interventions, such as promoted by the settings approach to health promotion, and also the explicit understanding of how more focused interventions might depend on factors at other levels for their effectiveness, acceptability or sustainability to be achieved.

There is nothing that stops us from taking a similar, holistic approach to the energy system, which can be viewed like a socio-technical ecosystem. We have shown, in real-life case studies in Phase II of this Task (like the largest hospital network in North America, or the energy saving kit trials in NZ and Ireland) that this approach works to design better, more holistic and inclusive behaviour change interventions that work for the end users (as they are included in the design and evaluation) whose behaviour we are ultimate trying to change.

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Appendix 1. List of DSM and EE interventions in NZ

From Ford et al (2015), University of Otago. Personalised Energy Priorities:
A User-Centric Application for Energy Advice:

Upgrade refrigerator an ENERGY STAR qualified or high energy-rated model

Upgrade dishwasher to an ENERGY STAR qualified or high energy-rated model

Upgrade washing machine to an ENERGY STAR qualified or high energy-rated model

Upgrade dryer to an ENERGY STAR qualified or high energy-rated model
Duct exhaust of dryer outside

Install/upgrade ceiling insulation
Install/upgrade under-floor insulation
Install/upgrade wall insulation

Install renewable micro-generation technology

Install double-glazed windows
Install secondary glazing to windows
Apply DIY window insulation film
Install heavy-duty curtains and pelmets
Window improvements

Draught stopping around doors and windows
1.   Seal gaps around window frames, skirting boards and cornices with appropriate sealant.
2.   Seal wall, floor and ceiling penetrations for electrical and plumbing services to avoid draughts.
Block unused open fireplaces.
Make sure the ceiling hatch is correctly fitted and use weather stripping to seal it.

Replace heating system with one that is more efficient
          1.   Heat pump ENERGY STAR qualified heat pump (or high energy rating)
          2.   Modern wood burner Modern woodburner
          3.   Pellet fire Modern wood pellet burner
          4.   ENERGY STAR qualified flued gas heater
          5.   Electric heater (fan, convection, radiant)
3.   Avoid using unflued gas heaters.

Thermostat setbacks (heat pump)/ Set comfortable but realistic temperature settings on heat pumps
(ie don't have it so high you are sitting in shorts and a t-shirt in the middle of winter!)/ Heat to healthy
and comfortable temperatures…

Clean heat pump air filters and outdoor unit fins.

Turn heaters off when you're not using the space/ If portable heaters are in use, only use them to heat
the rooms that are occupied when they are occupied.

Close doors to unused rooms

Where a wood burner is used – only burn dry firewood (there are air quality benefits in this too + never
damp the fire down overnight).

Remove or disconnect your heated towel rail.

Open doors and windows for passive cooling in summer.

When using your heat pump/air conditioner for cooling in summer, try using it in 'fan only' or
'dehumidify' mode first before switching into 'cooling' mode.

Use the timer on heat pumps and electric heaters

Replace lights with more energy efficient ones
1.   Compact Fluorescent Bulbs (ENERGY STAR qualified for best performance)
2.   LEDs (ENERGY STAR qualified for best performance)
3.   Linear fluorescent tubes
4.   New generation halogen light bulbs
5.   IRC halogen bulbs

Replace water heater with a more efficient model
        1.   Solar Water Heater
        2.   Wetback (dependent on location in country and local rules)
        3.   Electric hot water cylinder connected to controlled electricity supply
        4.   Condensing gas continuous flow water heater
        5.   Condensing gas hot water cylinder
        6.   ENERGY STAR qualified Solar water heater
        7.   Heat pump water heater

Install low-flow (efficient) showerheads (3 star Water Efficiency rating (<= 9 l/min))

Install a shower dome (dependent on the style of the shower cabinet/**Put a lid on your shower cubicle**

Install a heat recovery unit on your shower system (available space is a big limiter here.)

Take shorter showers

Check that your hot water cylinder thermostat is set to 60 deg C.

Turn off the hot water cylinder in the guest room en-suite if this is present.

Turn your hot water cylinder off when you go away for more than a week.

Wrap your hot water cylinder and pipes

Fix dripping hot taps/Fix leaky pipes and taps

Fill the sink with hot water rather than leaving the hot water running when doing certain tasks like shaving.

Turning off lights in unused rooms

Turn off appliances at the wall rather than leaving in standby mode

Line-dry your laundry outside

Use lower temperature settings on the washing machine

Wait for a full load before you use the washing machine

Cover pots with lids when cooking

Fill kettle appropriately/Don't put the kettle on and forget about it and have to boil it again half an hour later.

Watch less TV
De-ice the refrigerator

Remove unused stuff in the refrigerator and freezer to allow good airflow to occur

Check under your house for dampness issues.

Storm-water drainage issues: Clear subfloor vents/Install an on-ground vapour barrier.

Install externally vented extraction fans in bathroom and laundry and kitchen areas. Ensure these are maintained and cleaned regularly
Keep furniture away from uninsulated walls to avoid mould growth.

Look for mould regularly and remove it if you find any.

Ventilate your house regularly/ Open doors and windows frequently to air your house/Leave a window slightly ajar in your bedroom overnight.

Install and use externally vented extract fans in your kitchen, bathrooms.

Use the power management settings of your computer to reduce running costs

Set sleep mode on your computer

From Uni of Otago work for EECA's website:

1.	Efficient glazing
2.	Ceiling insulation
3.	Underfloor insulation
4.	Wall insulation
5.	Floor coverings (carpet/rugs) – Although: Floor coverings don't typically add much from an energy sense – and can be counterproductive if it covers (exposed) thermal mass that gets direct sunlight (EECA comment).
6.	Solar hot water panels
7.	Water proof membrane between ground and house - although a waterproof membrane isn't always necessary – no need unless you have a moisture issue (EECA comment).
8.	Efficient heating rather than 'heat pump' – although heat pumps would be the answer in many situations (but are driving increased energy use in summer). In some big old/high stud draughty villas (that have been insulated), a wood burner is the go (and they are the only thing it is worth putting a heat transfer system in for (and even then, gains can be marginal due to the poor ability of air to transfer heat). Perfect world is ultra-low emissions wood burner with a water heat exchanger and radiators (EECA comment).
9.	Efficient water heaters – e.g. Heat pump hot water cylinder. Houses are now being seen as 'systems' and appliances are a necessary component of the system (EECA comment).
10.	Shading – especially external, eg awnings (EECA comment)
11.	'Ventilation at source' – showers, ovens (not HRVs etc.)
12.	Timers on heaters
13.	Externally vented drier
14.	Externally vented cooking rangehood
15.	Energy efficient shower head
16.	Washing line outside
17.	Energy efficient light bulbs in all main rooms
18.	Thermally lined/heavy curtains installed
19.	Wrap installed on hot water cylinder
20.	Lagging (insulation) on hot water pipes - certainly the first metre off the cylinder but not all hot water pipes (unless you were in a particularly cold area) – EECA comment.
21.	Heat transfer system between rooms
22.	Behaviours (EECA comment).

Many additional things you could also do for new construction – EECA comment.

Appendix 2. The Story Spine and collected NZ stories

Please fill in the story spine below with your (organisation's) own story of how you foresee our issue to pan out over the next 3 years. Try to use no more than 3 sentences per paragraph. You can be as whimsical, tongue-in-cheek and creative as you want (see our example below), this is about how you would tell the story of your best case scenario - but not without foreseeing some pitfalls in the middle of the tale. I have provided some prompts following our Behaviour Changer Framework.

All stories from the different Behaviour Changers will be collected, analysed and written up for a paper in the special edition of the highly prestigious *Journal of Energy Research and Social Science*, which we are co-editing. These stories help to provide an engaging narrative about our intervention that covers all the main aspects of a case study: The what, who, why, how, how it is measured, how it was changed, what the results were and the final lesson/moral of the story.

Once Upon a Time… [this is the background, where you outline the setting and who you are – including your mandate, your main stakeholder/s and your main restrictions]

Every Day… [this is where you outline the problem and the End Users' behaviours you/we are trying to change. It may include some of the End Users' technological, social, environmental etc context/s – the ones that are most important to this issue]

But One Day… [this is where you outline the idea/solution and how it is meant to change the End Users' behaviours – concentrate on your specific tools you will bring to the table]

Because of That… [this is where you outline the implementation of the intervention and the opportunities for success – think of the love hearts/good relationships in the Behaviour Changer Framework here, especially between you and the other Behaviour Changers or you and the End User]

But Then! [this is where you outline what can/will/has gone wrong and why – think of the bombs/conflicts in the Behaviour Changer Framework here, especially between you and the other Behaviour Changers or you and the End User]

Because of That… [this is where you outline how you have reiterated the intervention because of what you have learned – which new/different tools are you using to diffuse some bombs and strengthen some of the love hearts]

Until, finally… [this is where you outline how you have measured the multiple benefits that accrued to you/r organisation/sector and what the main results are]

And, Ever Since Then… [this is where you outline the wider (eg national) change that has occurred because of this intervention and any possible lessons going forward or future research that needs to follow]

Storytelling exercise from the Energy Cultures Task 24 workshop

Google form of the collected energy stories (before the workshop). They can also be found here.

Example story from Felicity Woolfe, Journalist representing *Energy News"*

*Once upon a time...*there was a journalist writing about all the things that are happening in the energy sector.

Every day... the people in that sector got to share their stories about the things they built to send electricity to people, something they had been doing quite well for 100 or so years.

But, one day... some new guys came along and said "our new technology shall make you obsolete. People won't want your nasty centralised power system, they want to put solar panels on their roofs and batteries in their homes."

Because of that... the energy industry people got worried. If people didn't want their power anymore what would happen to all their shiny generation/lines/transmission/retail customer data bases they had spent so much time and money putting together, over the past century? How would they be able to provide power to their own homes?

So... the journalist got to write a lot of interesting stories. But there didn't seem to be much consensus in the industry about the best way forward and it was hard to know if people were reading the stories and keeping up with the changes.

Because of that... the industry people began to use the Energy News website as a forum to debate and discuss the topics raised in the stories. The journalist could see that the industry people were reading the information but also thinking about it.

But then... they all started heading off into their own little groups to find answers. Pretty soon there were some which wanted to play along with the new guys, and another lot which didn't and still more that wanted a bet either way. It also became clear that the mainstream journalists – who write about 34, or less different things every week – were getting confused by all the different stories out there. It didn't help that a lot of the industry stuff was really technical and explained by engineers and regulators.

Because of that... the people outside the energy industry don't know what to think, except they suspect that maybe the industry people are all out to get them (or their money).

Until, finally... the industry realised it needs to actually make friends with people.

And, ever since then... The journalist was happy they wanted to play more nicely with their "customers" but saw that they really did not know how or how to explain what they wanted to do to the energy system and the people using it. Also, there really weren't enough journalists who spoke their language who could help explain this better.

What is the moral of the story? That there are companies across the energy sector which want to work better with people, or will want to once they get over their initial fears/knee-jerk reactions. But there needs to be a forum for real discussion which also provides credible information to the public. Some of the industry are taking steps to try contact and deal with customers more (and have stopped calling them consumers) but are at core still engineers and not communicators. Specialist journalists could be needed to help disseminate this information and also for related topics such as climate science to develop a broader understanding among the population. These journalists need credible platforms which can provide discussion forums and host education resources to encourage people to explore further.

IEA Demand Side Management Energy Technology Initiative

The Demand-Side Management (DSM) Energy Technology Initiative is one of more than 40 Co-operative Energy Technology Initiatives within the framework of the International Energy Agency (IEA). The Demand-Side Management (DSM) Energy Technology Initiative, which was initiated in 1993, deals with a variety of strategies to reduce energy demand. The following member countries and sponsors have been working to identify and promote opportunities for DSM: Australia, Austria, Belgium, Canada, Finland, India, Ireland, Italy, Republic of Korea, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, United States, ECI (sponsor), RAP (sponsor)

Programme Vision: Demand-side activities should be active elements and the first choice in all energy policy decisions designed to create more reliable and more sustainable energy systems
Programme Mission: Deliver to its stakeholders, materials that are readily applicable for them in crafting and implementing policies and measures. The Programme should also deliver technology and applications that either facilitate operations of energy systems or facilitate necessary market transformations

The DSM Energy Technology Initiative's work is organized into two clusters:
The **load shape cluster**, and
The **load level cluster**.

The 'load shape" cluster will include Tasks that seek to impact the shape of the load curve over very short (minutes-hours-day) to longer (days-week-season) time periods. Work within this cluster primarily increases the reliability of systems. The "load level" will include Tasks that seek to shift the load curve to lower demand levels or shift between loads from one energy system to another. Work within this cluster primarily targets the reduction of emissions.

A total of 24 projects or "Tasks" have been initiated since the beginning of the DSM Programme. The overall program is monitored by an Executive Committee consisting of representatives from each contracting party to the DSM Energy Technology Initiative. The leadership and management of the individual Tasks are the responsibility of Operating Agents.

These Tasks and their respective Operating Agents are:
Task 1 International Database on Demand-Side Management & Evaluation Guidebook on the Impact of DSM and EE for Kyoto's GHG Targets – Completed
Harry Vreuls, RVO, the Netherlands

Task 2 Communications Technologies for Demand-Side Management – Completed
Richard Formby, EA Technology, United Kingdom

Task 3 Cooperative Procurement of Innovative Technologies for Demand-Side Management – Completed
Hans Westling, Promandat AB, Sweden

Task 4 Development of Improved Methods for Integrating Demand-Side Management into Resource Planning – Completed
Grayson Heffner, EPRI, United States

Task 5 Techniques for Implementation of Demand-Side Management Technology in the Marketplace – Completed
Juan Comas, FECSA, Spain

Task 6 DSM and Energy Efficiency in Changing Electricity Business Environments – Completed
David Crossley, Energy Futures, Australia Pty. Ltd., Australia

Task 7 International Collaboration on Market Transformation – Completed
Verney Ryan, BRE, United Kingdom

Task 8 Demand-Side Bidding in a Competitive Electricity Market – Completed
Linda Hull, EA Technology Ltd, United Kingdom

Task 9 The Role of Municipalities in a Liberalised System – Completed
Martin Cahn, Energie Cites, France

Task 10 Performance Contracting – Completed
Hans Westling, Promandat AB, Sweden

Task 11 Time of Use Pricing and Energy Use for Demand Management Delivery- Completed
Richard Formby, EA Technology Ltd, United Kingdom

Task 12 Energy Standards - to be determined

Task 13 Demand Response Resources - Completed
Ross Malme, RETX, United States

Task 14 White Certificates – Completed
Antonio Capozza, CESI, Italy

Task 15 Network-Driven DSM - Completed
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 16 Competitive Energy Services
Jan W. Bleyl, Graz Energy Agency, Austria / Seppo Silvonen/Pertti Koski, Motiva, Finland

Task 17 Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages
Seppo Kärkkäinen, Elektraflex Oy, Finland

Task 18 Demand Side Management and Climate Change - Completed
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 19 Micro Demand Response and Energy Saving - Completed
Linda Hull, EA Technology Ltd, United Kingdom

Task 20 Branding of Energy Efficiency - Completed
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 21 Standardisation of Energy Savings Calculations - Completed
Harry Vreuls, SenterNovem, Netherlands

Task 22 Energy Efficiency Portfolio Standards - Completed
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 23 The Role of Customers in Delivering Effective Smart Grids - Completed
Linda Hull. EA Technology Ltd, United Kingdom

Task 24 Behaviour Change in DSM: Phase 1 - From theory to practice
Phase 2 – Helping the Behaviour Changers
Dr Sea Rotmann, SEA, New Zealand

Task 25 Business Models for a more Effective Market Uptake of DSM Energy Services
Ruth Mourik, DuneWorks, The Netherlands

For additional Information contact the DSM Executive Secretary, Anne Bengtson, E-mail:
anne.bengtson@telia.com and visit the IEA DSM website: http://www.ieadsm.org