Publizierbarer Endbericht

Gilt für Studien aus der Programmlinie Forschung

A) Projektdaten

Allgemeines zum Projekt	
Kurztitel:	coDesign
Langtitel:	Addressing Energy Transition Gaps in Climate and Energy Model Regions of Austria Through Policy Co-Design
Zitiervorschlag:	Manguszewski, P.; Mochizuki, J; Bednar-Friedl, B; Schinko, T; Irshaid, J; Henninghausen, H; Marbler, A.; Heß, V. (2019) Addressing Energy Transition Gaps in Climate and Energy Model Regions of Austria Through Policy Co-Design. Enbeciht ACRP Forschungsprojekte
Programm inkl. Jahr:	ACRP 9h Call for Proposals
Dauer:	01.06.2017 bis 31.05.2019
KoordinatorIn/ ProjekteinreicherIn:	International Institute for Applied Systems Analysis (IIASA) Dr. Piotr Magnuszewski Dr. Junko Mochizuki
Kontaktperson Name:	Dr. Junko Mochizuki
Kontaktperson Adresse:	Schlossplatz 1 - A-2361 Laxenburg, Österreich
Kontaktperson Telefon:	(+43 2236) 807 576
Kontaktperson E-Mail:	mochizuki@iiasa.ac.at
Projekt- und KooperationspartnerIn (inkl. Bundesland):	The Wegener Centre for Climate and Global Change, Graz Steiermark Centrum Rozwiazan Systemowych/Centre for Systems Solutions (CRS)
Schlagwörter:	Co-design; agent-based modelling; Energiewende; energy transition; KEM; social simulation;
Projektgesamtkosten:	249,286.42 €
Fördersumme:	249,251.00 €
Klimafonds-Nr:	B670275
Erstellt am:	23.09.2019

B) Projektübersicht

1 Kurzfassung

Im Kontext der österreichischen Energiewende Das coDesign-Projekt untersuchte die bestehende Umsetzungslücke zwischen der Politik- und Umsetzungsebenen anhand der österreichischen Klima-und Energiemodelregionen. Das Forschungsprojekt verfolgte dabei drei Hauptziele: i) Charakterisierung und Identifizierung der Umsetzungslücken in den Klimamodellregionen sowie des Verständnis für heterogene Stakeholder-Motivationen; ii) Verständnis der strategischen Stakeholder-Interaktionen, welche zur Enstehung der Lücken bei der Umsetzung von Richtlinien beitragen; und Identifizierung der Portfolios von Richtlinienoptionen, die die Stakeholder auf unterschiedliche Weise zur Umsetzung von Maßnahmen motivieren, und iii) Mitgestaltung kohlenstoffarmer Umsetzungsoptionen, die zur Schließung der Umsetzungslücke in einem partizipativen co-Design Prozess beitragen.

Zwei KEM-Regionen, eine urbane (KEM Baden) und eine ländliche (KEM Freistadt), wurden gezielt als Fallstudien ausgewählt, da sie einerseits verschiedene innovative Projekte in der Region erfolgreich umsetzten, und ausserdem im Hinblick auf ihre vordefinierten Herausforderungen forschungsrelevant waren.

Das Forschungsprojekt umfasste drei miteinander verbundene Arbeitspakete (AP), in denen die drei oben genannten Ziele mit quantitativen und qualitativen Analysen behandelt wurden. aP1 zeigte die komplexen Hintergründe für die Umsetzungslücke in den KEM Regionen auf. Eine Studie der institutionellen Landschaft in Österreich und eingehenden Befragungen von Stakeholdern ergab beispielsweise, dass die Umsetzung von Maßnahmen durch das Fehlen von längerfristig sichtbaren Verpflichtungen für einen CO2-armen Übergang gehindert wird. Ausserdem bieten politische und institutionelle Rahmenbedingungen wenig Motivation für die Umsetzung der politischen Ziele (z. B. Nutzungsbeschränkungen, Vorschriften für die öffentlichen Finanzen). Aufgrund dieser bestehenden ungünstigen Bedingungen sind signifikante Durchbrüche bei der Umstellung auf kohlenstoffarme Technologien immer noch selten. Dieses Projekt konnte jedoch auch einige „Lichtblicke“ in Bezug auf die Energiewende identifizieren: Aktive lokale Akteure (Change Agents) finden innovative Lösungsansätze, um mit den zahlreichen Herausforderungen umzugehen, die sich aus ungünstigen Governanceansätzen ergeben und können die Energiewende in ihrer Region vorantreiben (z. B. kommunale Erzeugung erneuerbarer Energien und Online-Vermarktung erneuerbarer Energien usw.).

In Rahmen von AP2 wurde die Wirksamkeit von politischen Instrumenten auf verschiedene Haushaltsgruppen durch ein spieltheoretisches Modell analysiert. Die Modellanalyse wurde durch umweltpsychologische Untersuchungen ergänzt. Die Modellierung zeigte auf, dass Haushalte mit unterschiedlichen Umweltpräferenzen nicht nur unterschiedliche Motive haben ihre CO2-Emissionen zu reduzieren, sondern, dass ihre Handlungen sich gegenseitig bedingen. Minderungen durch „grüne" Haushalte tragen wenig zu der lokalen Emissionsminderung bei, da andere Haushalte Anreize für emissionsintensive Aktivitäten wahrnehmen. Weiteres stellten wir fest, dass politische Eingriffe wie technologische Mandate (z. B. ein Mindeststandard für die Energieeffizienz) und Subventionen (z. B. für kohlenstofffreie Antriebstechnologien oder die Isolierung von Gebäuden) die Maßnahmen zur Emissionsminderung für beide Arten von Haushalten verstärken können, fiskale Anreize haben allerdings höhere Minderungspotentiale.

Darüber hinaus wurde im Rahmen vonAP2 im Oktober 2018 in der KEM Freistadt eine soziale Simulationsübung durchgeführt, Die soziale Simulationsübung für die KEM Baden fand im März 2019 in Zusammenarbeit mit dem Wegener-Zentrum für Klima und Globalen Wandel statt.

InAP3 wurde auf der Grundlage weiterer Diskussionen mit dem KEM-Management Badens und Freistadts jeweils ein zweitägiger Design-Thinking Workshop veranstaltet, in denen relevante Herausforderungen bearbeitet wurden (für Baden die Dekarbonisierung der Raumwärme bis 2050; für Freistadt die Einrichtung einer Online-Plattform für den fairen und regionalen Vertrieb der regional produzierten erneuerbaren Energie). Im Rahmen der Design-Thinking Workshops konnte beobachtet werden, dass die AkteureInnen in den KEMs „Lösungen" häufig als untrennbar mit einer Veränderung der Werte und der sozialen Identität sehen und dass eine nachhaltig motivierende Unterstützung für ein kontinuierliches Engagement der BürgerInnen erforderlich ist. Kohlenstoffarme Lösungen werden von den BürgerInnen weder als einmalige Technologieinvestition noch als bloße Verschiebung der politischen Ziele wahrgenommen.

Das CoDesign-Projekt weist daher auf wichtige weitere Studienbereiche hin, einschließlich Möglichkeiten zur Förderung des politischen Lernens und der sozialen Innovation.

2 Executive Summary

The coDesign project analyses the existing policy implementation gap, or the gap between the policy and implementation levels, in context of the Austrian energy transition through the cases of Austria's Climate and Energy model regions (CEM) program. The coDesign project pursued three main objectives: i) to characterize the policy implementation gap facing Austria's Climate Energy Model regions and to understand heterogeneous stakeholder motivations; ii) to clarify strategic stakeholder interactions that contribute to policy implementation gaps, and to identify portfolios of policy options that will differently motivate stakeholders to take actions, and iii) co-design and co-generate low-carbon transition implementation options that will help to close the policy implementation gap in the CEM regions and beyond.

Two CEM regions, KEM Baden and KEM Freistadt, were chosen to join the project as case study regions. These CEM regions were chosen based on several factors including their long track

record for successful implementation, their representativeness for both rural and urban CEM regions, as well as in regards to their predefined challenges.

The project comprised three interrelated work packages (WP) addressing the three objectives identified above with a mix of quantitative and qualitative analyses. In WP1, and institutional review and in-depth stakeholder interviews revealed complex reasons behind the policy implementation gap of Austria's climate energy model region such as the lack of longer-term visible commitments to a low carbon transition. At the national level and many other contradictory regulations (e.g.land use restrictions, public finance regulation). Due to these existing unfavorable conditions, significant breakthroughs in low carbon transition are still rare, though the study also found a few 'bright spots' where committed local actors (change agents) have creatively found solutions to circumvent the many challenges posed by unfavorable governance environments and implemented innovative solutions to further the energy transition in their region (e.g. community owned renewable energy production, and online marketing of renewable energy etc).

In WP2, the effectiveness of policy instruments targeting different household groups was analyzed within a game-theoretic model. The model analysis was complemented by environmental psychological insights on instrument design. The game-theoretic modeling demonstrated that households differing in their environmental preferences not only have differing motivations to reduce their carbon emissions, but that their actions are mutually dependent. While "green" households are more ambitious than households that are less environmentally conscious, we find that even "green" households who have high moral expectations on their emission abatement actions do fall short of these expectations because of an incentive to free-ride on emission reductions achieved by other households in the community. Policy interventions such technological mandates (e.g. a minimum energy efficiency standard) and subsidies (e.g. for carbon-free propulsion technologies or insulation of buildings) can increase abatement activities, but that only the latter instrument is effective in reducing emissions of both types of households (unless the minimum energy efficiency standard is very demanding and therefore also binding for the "green" households).

Furthermore, a social simulation exercise was conducted in October 2018 in the KEM Freistadt and the social simulation exercise for the KEM Baden was played in collaboration with the Wegener Center for Climate and Global Change in March 2019.

In WP3, based on further discussions with the CEM management, the research team set up two 2-day design-thinking workshops that are deemed timely and relevant to the case areas (i.e. to work on decarbonizing heating systems in buildings by 2050 in Baden and creating an online platform to promote community generated renewable energy in Freistadt). Design-thinking workshops revealed that CEM stakeholders often perceived 'solutions' to low-carbon transition inseparable from changes in values and social identities and that sustained motivational support is needed for citizens to continuously engage. Low carbon solutions are perceived by citizens as neither a one-time technology investment nor a mere shift in policy goal or parameter. The CoDesign project hence points to important further areas of study including ways to foster policy learning and social innovation.

3 Hintergrund und Zielsetzung

While public opinion polls show overwhelming support for climate change actions in Austria, Austria's innovative community-based energy transition program known as the Climate Energy Model (CEM) program is not sufficiently motivating stakeholders. Despite many cost-effective and healthier lifestyle options (such as a reduction in meat consumption and a shift to biking and teleworking) yet these have hardly translated into widespread behavioral changes. Achieving the low-carbon transition -and doing so quickly enough -is thus a grand policy challenge; one that requires the broadest involvement of policy-makers, citizens and private and public enterprises, and their willingness to invest in, and to embrace, low-carbon technology and lifestyle options.

coDesign thus analyzes the existing policy implementation gap of Austria's Climate Energy Model Region (CEM) program from the three angles as a way to further accelerate Austria's transition to low carbon future: The first is underlying contextual factors including overarching governance landscape and heterogeneous actor group motivation. The second is strategic considerations that hinder energy transition as a collective action problem. The third is user-experience and design considerations that facilitate voluntary actions.

The three objectives of coDesign are:

- Objective 1: to characterize the policy implementation gap facing Austria's Climate Energy Model regions and to understand heterogeneous stakeholder motivations.
- Objective 2: to clarify strategic stakeholder interactions that con-tribute to policy implementation gaps, and to identify portfolios of policy options that will differently motivate stakeholders to take actions.
- Objective 3: co-design and co-generate low-carbon transition implementation options that will help to close the policy implementation gap.

Project structure and methodology

coDesign comprises three interrelated workpackages addressing the three objectives identified above. It develops and employs a mix of quantitative and qualitative analysis.

WP1 addresses the first objective by (1) studying the governance and institutional context of Austria's energy transition challenges and (2) eliciting perceived implementation challenges of stakeholders at local, regional and national scales and their underlying motivations to invest in energy transition policy options.

WP2 addresses the second objective by designing and implementing an experimental policy exercise complemented by an applied game-theoretical model. A policy exercise will express complex interactions of actors, policies, and contexts, closely resembling energy transition challenges of the CEM region, while a game theoretic model captures core decision challenges in a stylized form.

WP3 addresses the third objective, to co-design and test policy implementation measures using a design-thinking process. Design thinking is user-centered brainstorming and prototyping process that can generate innovative solutions.

4 Projektinhalt und Ergebnis(se)

In pursuing objective 1, following milestones were met within work package 1:

<u>Detailed stakeholder mapping of four CEM regions</u>

A stakeholder mapping analysed four CEM regions: Baden, Vöckla-Ager, Freistadt and Graz Umgebung Nord (GUNord) with the aim of creating realistic stakeholder mapping both in those

regions, and also at the federal state and national levels. This mapping has guided case study area selections and other research tasks including development of applied game-theoretical models and policy exercise concept. The regions were chosen to represent regions of various location, size, CEM phase, and topography. The stakeholder mapping is conducted via literature analysis and in-depth interviews with the CEM managers from the respective regions to obtain a realistic representation of the stakeholders involved.

CEM Baden

Baden is located on the eastern boundaries of the Wiener Wald and with a surface area of 26.89 km2 can be considered amongst the smallest CEM regions in Austria (Klimaundenergiemodellregionen.at b.). However, due to its large population size, 25,698, Baden qualified as a CEM region The management of the CEM Baden is integrated into the climate and energy department (Klima- und Energiereferat) of the Baden council, where the CEM manager further takes on the management of other programs and initiatives such as the e5-Programm, a program for energy efficiency in municipalities in Lower Austria by the Energie & Umweltagentur (CEM Baden, 2011). The department is also responsible for raising awareness, soliciting and fostering cooperation with partners, and other similar tasks. Additionally, CEM management collaborates with a working group where planning and evaluation of CEM activities are discussed. CEM management reports to the municipality committee on environmental protection during six annual meetings (Riegler et al., 2017). Additionally, the CEM management meets with the e-5 team in Baden two to three times annually and holds weekly meetings with community representatives (Riegler et al., 2017).

CEM Freistadt

The CEM Freistadt is located in the northeastern Upper Austrian district of Freistadt and can be further divided into two LEADER regions, Mühlviertler Kernland and Mühlviertler Alm. These can be further broken down into 27 municipalities, including an array of rural and urban municipalities. The CEM region has an overall population of 65,521 and spans a surface area of 993.9 km2, of which 428.2 km2 is forest area and 531,3 km2 is agricultural land. According to the district's chamber of commerce, there are 2,846 companies registered in Freistadt, as of 2008, of which 62% are single person operations (CEM Freistadt, 2011). The long-term goal of the CEM Freistadt is 100% RE coverage (CEM Freistadt, 2011). The vision emphasizes the importance of a sustainable transition that will create the largest possible benefit for the residents and the sustainable use of local resources and potentials.

CEM Vöckla-Ager

The CEM region of Vöckla–Ager is located in Upper Austria along the rivers Vöckla and Ager. It consists of 17 munici alitities (Attnang-Puchheim, Atzbach, Desselbrunn, Lenzing, Niederthalheim, Oberndorf, Pilsbach, Pitzenberg Pühert, Regau, Redlham, Rüstorf, Rutzenham, Schlatt, Schwanenstadt, Timelkam, Vöcklabruck) with an overall area of 310.2km2 and a population of 54,977, as of 2015 (Klimaundenergiemodellregionen.at, 2017c). The CEM Vöckla-Ager joined the CEM program in 2009 and is currently in its third extension phase. The CEM region is an economically strong region. During the interview with the CEM manager, one main implementation challenge was addressed. The CEM region is planning to improve the cycling infrastructures within the region. This includes expanding the network of cycling paths, as well as installing secure bicycle parking. However, the municipalities are reluctant to invest in cycling infrastructure, because the current cycling rate is only 3-4%. On the other hand, potential cyclers argue that they are discouraged by a lack of safe cycling paths.

CEM Graz Umgebung Nord

Graz Umgebung Nord (GUNord) is, in relative terms, a fairly new CEM region. GUNord, which refers to the northern municipalities surrounding Graz, became a CEM region in 2015 and started the implementation phase in 2016 (Schloffer et al., 2016)).In this respect, the interaction and participation of stakeholders in this region is not yet fully comprehensible, as the implementation is still in its early stages. Furthermore, the region itself came together within this CEM concept and has, therefore, not yet developed deep interregional connections. This, however, is expected to change as the CEM region scheme continues (interviews with CEM management). The municipalities Deutschfeistritz, Frohnleiten, Übelbach, and Peggau are considered part of the suburbs of Graz, the second biggest city in Austria. In 2015 the municipality of Frohnleiten was reorganised as a town and now includes the previous municipalities of Frohnleiten, Schrems bei Frohnleiten, and Röthelstein. The municipality Deutschfeistritz is also a fusion of the previous municipalities of Deutschfeistritz and Großstübing. Due to trans-municipal societies, police, and other activities, the CEM GUNord has an excellent social infrastructure.

A scoping study on the policy and institutional landscape

A scoping study analysed relevant institutional and regulatory settings together with detailed policy instruments and measures implemented in Austrian climate and energy policy. The scoping study builds on the study conducted by an earlier ACRP project titled Linking Climate Change Mitigation, Energy Security and Regional Development in Climate and Energy Model regions in Austria (LINKS), expanding on detailed descriptions of policy instruments and measures such as information campaigns, feed in tariffs and other subsidies, taxes etc. (Truger et al.,2016). The analysis informs further stakeholder engagement planned in the CoDesign project.

In the scoping study, legal, and regulatory as well as institutional frameworks of the CEM regions are described. Parliamentary reports, together with those statues establishing the Klima-und Energiefonds (KLIEN) and other related frameworks were studied. The development over time are of the CEM program isanalyzed by reviewing proposal guidelines for the CEM regions from 2009, when the program was first established, and 2016, when the most recent guidelines were published, The report identifies major changes that have occurred in the CEM Program including the recent establishment of a CEM quality management mechanism, CEM-QM, and audit.

To understand the detailed implementation of CEM concepts including multiple-layers of actors involved, we conducted four in-depth analyses of CEM regions (Baden, Freistadt, Vöckla-Ager and Graz Umgebung Nord) including reviews of their concept development and management structure. In addition, we analysed the concept development and management of selected CEM regions covering eight federal states, excluding Vienna as the capital is not eligible for CEM funding. In six states- Upper Austria, Tyrol, Vorarlberg, Styria, Lower Austria and Salzburg- energy agencies operate as an independent entity.

<u>Key informant interviews completed (M1.2)</u>

The results of the key informant stakeholder interviews conducted in the two CEM case study regions Baden and Freistadt lay the foundation for the upcoming work packages. The selection of local stakeholders for interviews is based on the stakeholder mapping described above and was in addition conducted in close cooperation with stakeholders at the national level, as well as the CEM managers of the two case study regions. Once the case study regions were chosen, the CEM Managers were consulted to review the stakeholder mapping and comment on it, paying attention especially to the local stakeholder groups. In a next step, the CEM managers were asked to provide a list of possible interview partners representative of each of the stakeholder groups. These interview partners were stakeholders who are crucial to a successful implementation of concrete measures or stakeholders who are familiar with the

KEM program in the region. The stakeholders selected did not necessarily have to have only positive opinions regarding climate change and energy transition issues.

Similarities in stakeholders and their roles and contributions to the KEM region can be observed through the comparison of the final stakeholder mapping of both study regions and the knowledge gained in the key informant interviews. In both regions, the local finance and banking sector was instrumental to the success of the financial citizen participation for large scale PV projects. Furthermore, stakeholders in the mobility sectors are faced with similar issues in both regions, such as inadequate public transportation to incentivize residents to change from individual to public transport. Both Freistadt and Baden have also implemented a small scale e-car sharing system. Finally, in both regions residents are major stakeholders that are essential to the success of the CEM region. Small differences can be observed in regards to the building sector. While in Baden challenges in the building sector involves, among others, aspects of historical preservation, the building sector in the CEM Freistadt includes aspects of sustainable construction and spatial planning. Further differences, such as the importance of the agriculture and forestry sectors in the CEM Freistadt and the tourism sector in Baden, are specific to the regional economy. Further differences between the two CEMs in the composition of local stakeholders can be attributed to the fact that CEM Freistadt is a rural CEM region with several participating municipalities, while the CEM Baden is consisting of a single, urban city.

Qualitative analysis and synthesis are completed (M 1.3)

The initial field notes taken during the interview process pointed out six key aspects that were mentioned throughout. The majority of interviewees, for example, referred to the importance of fiscal policy instruments and to negative experiences with insufficient, unsustainable or inefficient incentives, especially regarding subsidies. Legal and institutional framework conditions in regards to issues such as historical preservation, public transport and public transport were also said to often be counterproductive. Furthermore, it was mentioned that binding regulations should ideally be put in place at the national level. In this respect most interviewees voiced concerns in regards to decision making at all governance levels to be guided by politicians' ambition for short-term re-election. This causes political decision makers to be apprehensive of making unpopular, but in terms of climate protection necessary, decisions. The issue of problem framing has also been mentioned in several interviews and it has been suggested that instead of "climate protection" the emphasis shall be put on "sustainability". CEM managers were mentioned to be the driving force by nearly all interviewees. The importance of a CEM manager who is engaged and well-connected in the region was often emphasized. Finally, mobility was often mentioned as a main challenge and several times stakeholders pointed out the difference in possibilities for e-mobility and public transport in large cities compared to smaller towns and regions.

Lessons learned

The interview coding aimed to include codes on actors and governance levels, interests and motivation, as well as challenges, solutions, and perception of the CEM program. The sub-set "challenges" increased significantly during the coding process. Due to the changes and expansion of codes, the interviews were coded in two cycles.

The preliminary results discussed within this section are derived from the analysis of interviews conducted at the national and federal levels, and for interviews related to the CEM Freistadt. A general coding analysis found that the challenges related to framework conditions and mobility were mentioned significantly more often than other challenges. Furthermore, the same analysis shows that statements on financial motivation were significantly more numerous than statements about political, moral, or other kinds of motivation for climate action.

In the next stage, a comparative coding analysis identified statements where codes for the challenges mobility and framework conditions, and financial motivations overlapped with statements coded for implementation and regulatory policy instruments. The content of these statements were then analysed in the next step:

- Mobility: Challenges regarding the energy transition in the mobility sector are mainly attributed to regulatory instruments and to a lesser degree to implementation challenges. However, there seemed to be little connection between mobility challenges and financial motivation. Interviewees point out, that the lacking and contradicting regulatory instruments such as the "Pendlerpauschale", commuter allowance, or the taxation of new real estate purchases which encourage residents to live further away from their place of employment, lead to increasing numbers of commuters and housing sprawl. Interviewees mentioned that measures, including soft measures, are needed to make alternatives more attractive. Such measures have, however, be directed top-down to create stable framework conditions for municipal politics to implement these measures.

Findings from the CEM Freistadt include:

- Framework conditions: Challenges related to legal and institutional framework conditions are closely related to those which are affected by financial motivation. Statements on such challenges could be grouped into five clusters: CEM framework conditions, municipal spending, funding schemes and top down regulatory instruments.

The current CEM framework conditions were said to be challenging mainly due to aspects such as the short term funding for CEM managers, which encourages competent staff to leave for more secure careers, the lack of staff available for the CEM regions to seek project funding and implement the projects, as well as a limited scope of action regarding possible measures. Furthermore, the necessity for CEM regions to pay for the CEM quality management is perceived to further increase the challenges for CEM regions as local funds are already regarded to be limited.

In Upper Austria, framework conditions regarding municipal spending have led to several municipalities to withdraw from the CEM program. Here, similarly as with the mobility challenge, policies seem to be contradictory and counterproductive.

Subsidy programs and schemes (e.g. feed in tariffs), or rather the perceived inefficiency of those, creates further challenges, especially regarding renewable energy projects. Examples mentioned include PV installation, wind power parks but specifically biogas plants which are rendered economically infeasible once the subsidy scheme concludes. This experiences seem to discourage new investments.

Furthermore, stakeholders emphasise the importance for top-down regulatory measures such as taxes, funding schemes and effective framework conditions are necessary for CEM regions to implement and impact change on the regional level.

While challenges regarding framework conditions and policy instruments are multifaceted, challenges related to financial and economic interests and motivations are rather straightforward. For finance and market actors it is crucial for investments to pay off within two to three years while renewable energy investments require longer pay-back periods. This significantly hinders market actors in investing in green technologies.

Challenges in the CEM Baden further included:

- The main challenge in the CEM region Baden is the refurbishment of local public buildings which are owned by the Immobilien Baden GmbH. Here the challenge is two-fold. First, priorities must be set in cooperation with the Immobilien Baden GmbH to raise and distribute funds. Second, refurbishment efforts for approximately 100 buildings are constricted by historical preservation orders.

- Related to these refurbishment challenges, Baden is currently applying to a UNESCO World Heritage status. Once this is achieved, further restrictions will be placed on building refurbishment and the installation of alternative energy technologies.
- The region has significant potential for geothermal energy installations, but this causes conflicts of interest between stakeholders including the spa owners the city who own the springs, and electricity suppliers.
- Around 12.000 commuters commute out and into Baden on a daily basis. In the next few years the city busses are to be exchanged and the region is currently looking into the option of changing to e-busses. However, the cost of procuring these e-busses is currently approximately three times higher than conventional diesel busses and operational reliability is also unknown.
- The CEM Baden varies greatly from other CEM region as it is an urban region with a large population. Hence the CEM management struggles with addressing and communicating with the population directly. Despite efforts through mass communication, which might not be available in smaller regions, it has been difficult to reach the population.
- It has also been difficult to effectively reach and involve small and medium enterprises in the region.

Game Design concept and roadmap developed (M.2.1)

.

The project team explained the concept of social simulation to CEM management. They conducted a series of discussions to identify a topic that will be timely and relevant for a CEM region and for which WP2 may design a tailor-made social simulation game that could be used to foster social learning among a range of stakeholders within the community. The selected topics are:

- *Sustainable Urban Heating Simulation (CEM Baden)*

The city of Baden faces a number of implementation challenges including the presence of historical buildings, principal-agent problems of apartment buildings and the presence of low income households who may struggle to refurbish their buildings towards a low-carbon transition. Given these problems are also common to many cities across Europe, the project team felt that creating an abstract representation of low-carbon transition challenges based on the case of Baden presents a promising option for inter-local learning across many similar cities. The team had a series of discussions with CEM management to co-develop a gaming concept, a design roadmap as well as prototyping, including a facilitation guide (see Appendex 1 for a more complete reporting on simulation gaming).

Design objective

The main goal or purpose of the policy exercise was to identify solutions for the energy transformation. The player's goal during the exercise is to lower the fossil fuel percentage in the energy mix. Other objectives include identifying various stakeholders' roles in the transformation, increasing the dialogue between stakeholders, testing known policies and infrastructure solutions, experimenting with new solutions, understanding the complex transformation process, and increasing creativity and out of box thinking.

General game assumptions:

- Type: Policy exercise/strategic simulation.
- Participants: various stakeholders, including members of the government (Municipality of Baden), community members

- Number of participants: 8-12 users & owners of the objects (4 types of buildings)
- Number of moderators: 2
- Language: German, English (prototype)
- Time to play (+ assumed time needed for debriefing): 3 hours

- *Community-based Electricity Market Simulation (CEM Freistadt)*

The project team collaborated with a newly-formed Freistadt-based known as Our Power to design a social simulation of community-based electricity market simulation. OurPower – Online electricity market place is the initiative that will allow energy producers and consumers to form peer-to-peer (P2P) energy trading arrangements. To ensure that research collaboration did not result in disclosure of sensitive business information, the team signed a non-disclosure agreement prior to the design of the social simulation game. The simulation was designed as a way for potential local renewable energy producers and consumers to learn about the online market system that was planned for a launch in April 2019.

Design objective

The main objective of the policy exercise was to accurately depict the daily operations of the OurPower platform. It would address the complexity connected with creating and fulfilling arrangements between producers and consumers regarding the P2P energy trading. The strategic simulation tackles both social and technical aspects of such operation - various energy needs as well as various capacities to produce energy and to balance it within the system. Participants of the strategic simulation are divided into: producers, consumers and OurPower (dispatcher).

The research team organized a social simulation workshop on October 15 2018 in Freistadt. The workshop was attended by founding members of Our Power as well as other regional stakeholders and additional CEM mangers from neighboring regions. The workshop was facilitated in German by CRS staff member Ms. Sarah Nobis, who walked participants through briefing, gaming play and debriefing (Figure 3).

Pre- and Post evaluation survey

To test the success of the simulation exercise on the participants subjective views towards low-carbon transition a pre- and post evaluation survey was distributed. The major outcome of the surveys are as follows:

- Familiarity with the Peer-to-Peer energy market place and how it works improved after completing the simulation exercise;
- There was an increased willingness to pay for electricity if it is produced by people that one knows.
- There was an increased belief that a Peer-to-Peer energy market place could enhance local energy independence.

Game-theoretic modelling (M2.2)

Complementary to the serious game developed in M 2.1, a game-theoretic model (public good game) is developed to better understand the energy transition implementation gap in CEM regions. In particular, the goal is to contribute to a better understanding of motivations of different groups of people in the CEM regions and to examine the effectiveness of different policy instruments in supporting energy savings and the adoption of greener technologies by these groups. The game-theoretic model differentiates between two groups of households by building on the concept of moral preferences according to which individuals with moral preferences care for deviations from their ideal level of abatement (Akerlof and Kranton, 2000; Brekke, et al., 2003). In the model, we distinguish therefore between one group with such moral preferences and a second without them. The key insight is that there is an incentive for additional abatement by the first group. We find that total abatement increases, but there is partial crowding out: the group without moral preferences free-rides on the higher abatement by the group with moral preferences. In fulfillment of M2.1., the model setup and its analysis has been published as master thesis at University of Graz (Marbler, 2018).

The goal of the game-theoretic model was to understand why implementation gaps arise in the low-carbon transition at the local level (Task 2.2), and how effective different (policy) instruments are in leveraging low-carbon behaviour (2.4). We therefore decided to build a stylized game theoretic model that is less detailed but captures important features that are relevant in many low carbon initiatives: that some households are very active in reducing emissions while others do not engage (at all); that households do less than they would like to do ideally; and that public authorities strive for policy interventions to reduce free-riding behaviour and close the policy implementation gap.
In Task 2.2 we therefore developed an emission reduction game with two types of households: one with strong environmental preferences and one without such preferences. Regarding environmental preferences, we build on the concept of morally ideal behaviour and social identity according to which agents derive disutility when they deviate from their morally desired behaviour (feeling of guilt). Despite this disutility, they have, however, an incentive to free-ride on emission reduction activities by others because they observe that other agents do not behave as environmentally friendly as themselves. As a consequence, even though each pro-environmental household reduces emissions by more than a non-environmentally oriented household, total emissions are reduced by less than what pro-environmental households would ideally like to reduce. In a next step, we investigated how a larger share of pro-environmental households affects total emission reduction efforts. We find that total emissions decrease with the number of pro-environmental households, but even if all households are pro-environmental, total emissions are higher than in the social optimum. Due to the stylized structure of the game theoretic model, we were able to solve it analytically and to derive clear insights (in the form of mathematical propositions) without the need to resort to numeric simulations (Marbler, 2018).

Regarding task 2.4, the initial plan was to use outcomes of the gaming simulation to quantitatively assess the effectiveness of different policy instruments. In the gaming simulations, participants identified fiscal policies (like a carbon tax and subsidies on low-carbon behaviour), regulations (such as minimum standards for energy efficiency) and informational policies (campaigns on low carbon options, leading-by-example etc.) as useful instruments. In the game-theoretic model, we therefore analysed the effectiveness of subsidies relative to minimum energy efficiency requirements. We find that both instruments reduce total emissions in the CEM region, but that subsidies incentivize both groups of households to reduce their emissions whereas the minimum energy efficiency requirement is only binding for the households without environmental preferences and reinforces moreover the free-riding behaviour of the households with pro-environmental behaviour (Marbler and Bednar-Friedl, 2019).

Regarding informational policies, we compiled a report on informational, social-influence and psychological approaches that promote a change in behaviour (Babcicky et al., 2019). Informational interventions affect people's knowledge, attitude and beliefs, allowing them to better understand the consequences of their actions. The report draws on latest research from environmental psychology and is rich in practical examples and identifies best-practice implementations at the international level. We conclude that a good informational intervention provides feedback to previously set goals, is designed with an appropriate framing of the target group and possibly aligns with life events. Social-influence interventions are considered with building social capital and establishing and maintaining social norms. Social capital can be increased by hosting public events, connecting important actors and establishing trust in social groups. Social norms are influenced by endorsements of good practices and taking leadership in new solutions. Psychological interventions build on several psychological mechanisms that shift people's attitude through values and emotions and make them conscious about the tangible and intangible benefits or their actions. Interventions targeting individuals with a specific attitude are more likely to succeed by building on positive emotions associated with a certain behaviour and affirming their self-efficacy. We find that international experiences of successful initiatives combine these different intervention approaches, which leads to strong synergetic benefits. We provide the core concepts, mechanisms and practical examples in tables, which can be used to leverage intervention designs.

Design-thinking kick-start workshop completed (M3.1)

Based on further discussions with the CEM management, the research team set up two 2-day design-thinking workshops that were deemed timely and relevant to the case areas (i.e. to work on decarbonizing heating systems in buildings by 2050 in Baden and creating an online platform to promote community generated renewable energy in Freistadt).

Design-thinking workshop in Baden

Local interviews with stakeholders revealed a number of challenges in Baden's low carbon transition such as the need to address the transport energy demand related to commuting needs to the nearby capital of Vienna; competing use of geothermal energy between the local hot spring industry and clean energy production; the appropriate use of waste heat from local industry. Among many issues discussed, the promotion of low carbon heating in private and public buildings was identified as an issue that is particularly timely and controversial in the city, which could benefit from the use of a design-thinking approach to ideate and test potential solution options.

The city of Baden is currently in the process of applying for status as the UNESCO World Heritage site for being in the "Great Spas of Europe" category. Then other European spa towns are also applying. The city hopes that tourism will increase should Baden become a UNESCO World Heritage spa town (Baden.at 2019). Yet, once this is achieved, further restrictions will be placed on refurbishment efforts to the city's historical buildings. At the same time, other public and private buildings also face challenges such as a lack of awareness and knowledge, dis-incentivizing legal and regulatory framework conditions, and disinterest/ lack of long term planning. Given this timely need to address a low-carbon transition in the building sector, the research team and CEM management decided to jointly set-up an urban innovation lab to brainstorm ways to facilitate low carbon heating options with the aim and scope as shown in Table 1.

Table 1 Design-Thinking Workshop CEM Baden

	Contents
Design question	How can Baden achieve zero fossil fueled heating by 2050?
Intended outputs	Recommendations to be delivered to the city of Baden.
Participants	24 participants across public, private (commercial/energy), civil society stakeholders and academics split into a) design teams and b) end-users
Tools	Customer journey map, field visits, personas, brainstorming, protype

Participants recruited from various age- gender-and stakeholder groups participated in the workshop. Within the participant selection process specific attention was paid to include a representative sample of different local actors as well as having a balanced gender representation. In order to facilitate cross-region learn, CEM managers of two additional localities (Unteres Traisental-Fladnitztal, and Vöckla-Ager - both of whom have been previous voted as CEM managers of the year for their active leadership in CEM program) were also invited to participate and observe the process.

The two-day workshop walked participants through the five steps of design-thinking: empathize, define, ideate, prototype and test: Workshop Day 1 began with participants' introduction among the design teams followed by a session on empathy and definition. Design team participants were split into four groups representing major building types in Baden, namely: 1) public building (including historical buildings); 2) single-family houses, 3) apartment houses and 4) small and medium enterprises buildings. A design-thinking facilitator used a customer journey map to delve into issues facing low-carbon energy adoption in the heating sector.

Equipped with this initial understanding of customer journey maps, each group was then instructed to think of questions to ask the end-user groups during their field visits scheduled in the afternoon of Day 1. Participants then visited four pre-selected sites to conduct approximately two hours of interviews with four end-user groups each with one representative for one building type. Participants then returned to a workshop venue to share their learning and to summarise key end-user issues identified during the interviews.

Day 2 began with an ideation exercise using a fictitious character or personas. Personas are a common method used in design-thinking to "reveal deeper insights into the various kinds of experiences that users are having (Tschimmel 2012, p.13) ," with an aim towards great ideas to improve end-user experiences. Based on the public housing example described above, the group created a persona known as Michi.

Based on these characteristics, the group then ideated on the potential options to improve Michi's personal experience. Each participant in the group wrote individual ideas that came to mind including: a negative campaign on GHG emissions (similar to anti-smoking messages tied to cigarettes) to accompany heating bills as a way to alter the public perception of 'shame' given to greener choices as well as designation of community champions who can serve as a positive role model (hence altering the public perception of shame attached to greener living).

Each participant was then instructed to pick 1-2 promising ideas generated by others and expand further to describe how this could be operationalised in the community. Each group generated around 10-15 solution options first, then elaborated further on 4-6 solution options.

Out of these elaborated solution options, each group was then instructed to pick 1-2 options that looked the most promising and to generate their visual representation using LEGO Serious Play. Once prototypes were created, end-user participants were invited to the workshop to give their critique on each idea created .The design groups were then given time to adjust and revise their ideas before these were presented to the mayor of Baden toward the end of the workshop.

Once the teams received all feedback, the last hours of the workshop were used for debriefing and discussion of the next steps. Table 2 provides and overview of the solutions prototyped

Table 2 Design-Thinking Workshop CEM Baden solution prototypes

Building types	Solutions prototyped
Public Buildings	A Binding Energy Strategy for Baden - to be drafted and agreed upon in a participatory process involving citizens, private sectors and public administration. Sector specific low-carbon targets should be broken down into smaller sub-goals that are implemented over shorter time horizons.
	Pledge for Baden - a political declaration, or pledge, of intent of all parties should be represented in the municipal council as “green” and “eco” themes have traditionally come only from a minority of representatives in the city council.
	Implement a new motto "Do good and talk about it" - to foster positive competition amongst initiatives by reporting successfully implemented flagship projects in the media.
	Establishment of a facility management team to monitor energy use and reduce energy consumption in public buildings- to be integrated into the Mayor’s office.
Rented apartments	Involvement of active pensioners and other agents of change -Pensioners, it was observed, are often difficult to motivate and mobilise to take action towards the energy transition. However in towns such as Baden with a high senior, and (upper-) middle class population pensioners were argued to be crucial as they had the time to participate and the funds to invest in energy transition measures. Including them more actively in energy transition efforts would promote acceptance among senior citizens as well as increase awareness.
	Local carbon tax - households are assigned an emission allowance according to their needs and any excess emissions will be taxed.

Commercial enterprise buildings	Business sustainability coach - a person who guides and offers information and support to co-develop sustainable business strategies that are comprehensive. SMEs in Baden are often deterred from implementing sustainable business practices as they lack understanding and certainty about their options. Thus, businesses would be consulted and coached with minimal costs to them and therefore be encouraged to implement sustainable and low-carbon business practices.
	Ways of showcasing good practice - choosing one to two showcases in the region. Also, organizing "pop-up learning events" where entrepreneurs can share and discuss ideas and lessons learned.
Single family homes	Comprehensive support (information, consultation and financing) package for homeowners - establishing a comprehensive "one-stop shop" address for alternative financing and implementation concepts in cooperation with other CEMs, communities and/ or federal actors such as the Energie- und Umweltagentur Niederösterreich (ENU).

Qualitative Evaluation

In addition to quantitative evaluation, two rounds of interviews were conducted 10 months apart to understand the immediate and medium-term outcome of the workshop. In the immediate days following the workshop, the research team had phone interviews with CEM management to receive their feedback regarding workshop outputs, including how they are planning to use these ideas generated.

Baden CEM decided to pursue two projects. The first is to establish a dedicated working group consisting of citizens that systematically target issues in public buildings and brainstorm ideas. This group should not be like existing groups (Stammtischdiskussionen/ alehouse discussions). Rather the goal is to establish a group that could inform regional decision-making. The second is a project targeted at improving cooperation with business enterprises.

In Vöckla-Ager, the CEM manager has started organising two design-thinking processes because she has witnessed that the design-thinking can significantly contribute to finding solutions to specific but complex problems in her region. The envisioned design-thinking processes are organised in cooperation with the local Cleantech cluster. In the first process she aims to re-design the town centre in an e-mobility future. A second process aims to address mobility to the Attersee, a regional lake which becomes a recreational hotspot in summer (as problems occur in summer when the traffic to and from the lake causes frequent gridlocks). The CEM manager aims to find innovative and green solutions to this problem. Furthermore, the CEM manager aims to implement one of the solutions generated for Baden in her region, namely, the business coach idea generated by the commercial enterprise building group.

Based on common issues identified during the Baden Design-thinking Process, the CEM Unteres Traisental-Fladnitztal has submitted a project proposal to address issues regarding "motivators" or social entrepreneurs in its region, by setting up networks and support for such actors. In Unteres Traisental-Fladnitztal, just like in Baden, there exists a group of actors who are motivated to change to fossil-free energy options but are reliant on other actors' buy-in to promote low carbon investment (such as was seen in the case of public apartment residents

interviewed in the Baden design-thinking process). These actors often fail to motivate their neighbours or fellow citizens and feel frustrated and demotivated. By setting up networks and support, the project is aimed at enhancing legitimisation and attention paid to these actors and to help them approach and motivate their fellow citizens.

Other qualitative comments collected:
The design-thinking workshop was generally very well received by participants who have felt that this participatory approach provided effective means to generate new solutions ideas that are embedded in the local context. At the same time, other views were expressed in which participants remained skeptical of the implementation barriers to solution options generated.

Design-thinking workshop in Freistadt

Interviews with Freistadt CEM management identified the challenges associated with the setting up of the local online renewable energy market platform *OurPower* to be a timely issues that they would like to focus in the design-thinking process. The research team hence decided to proceed with this idea and began workshop planning with CEM Freistadt and OurPower members.

The design-thinking process took place over two days in Freistadt and was attended by 10 participants including Ourpower executives and renewable energy plant operators. [1]

Five exercises were conducted with the goal of creating innovative solutions to the issues at hand. The first exercise consisted of splitting into groups led by one Ourpower executive each. Within this exercise the groups were tasked with identifying key problems. The discussions within all three groups revolved mainly around difficulties in marketing and explaining the platform functions to producers. Further issues raised were initial cash flow problems, smooth transitions of contracts and addressing uncertainty concerns of producers.

The second step involved in-depth interviews with renewable energy producers and narrowing the initial brainstorming down to one problem setting. Each group interviewed two energy producers. Based on these interviews a "persona" was created in the third step that portrayed the problems and concerns of the energy producers and specific questions were identified.

The fourth step focused brainstorming ideas on how to solve the set questions and then prototyping one to two of these ideas. The prototypes were then presented to the previous interviewees within the fifth step and then adjusted according to the feedback received.

Group 1: Small scale hydro power plant & biogas plant
According hydro power plant operator the power plant needs little investment and maintenance. The operator was concerned with the need to have to marketing campaign and sign customers, stating that the added profit he might make through the Ourpower platform might still not incentivise him to take up the effort to do the marketing especially as the power plant is not a significant source of income.

On the other hand, the biogas plant operator claimed that the biogas planter contributes to his main income and that he worries about the future of the biogas plant once it is no longer subsidised. The biogas plant needs constant upkeep and maintenance. Therefore, Ourpower

[1] Excluding scientific staff.

must be committed to take on the entire energy production as well as offer a minimum price of 18c/Kwh. This amount is necessary for funding future maintenance work and investments.
Lead questions for prototyping:

How can Ourpower be presented to the producers so that they would be convinced to join the platform? How can Ourpower be presented to persuade producers that not a large amount of additional effort is needed from their part? How can the benefits of the platform be conveyed in a simple and comprehensive manner?

- Prototype1: Produce customised advertisement materials for each producers to distribute at local events etc.
- Prototype 2: Create and add a "Benefit Calculator" to the homepage that calculates increasing revenues in few simple steps.

Group 2: Small scale hydro power plant & wind power plant
The manager of a 1.3GW wind power operator saw Ourpower as an opportunity to revitalise the wind power plant, especially since current energy prices have significantly lowered profits. The manager is willing to do awareness raising and marketing in his community and believes such efforts would be successful. He does however argue that he does not want long-term contracts and prefers to remain flexible. Similar to the hydro power plant in Group 1, this small scale hydro power plant operator has little need for maintenance. He would participate in Ourpower if given a minimum of 7c/Kwh.

Lead questions for prototyping:
How can individual producers and regionality be marketed to larger urban population?

- Prototype: The website could show videos, or provide written information to encourage people to think regionally and to buy their energy from local, renewable providers.

Group 3: Small scale wind power plant & biogas plant
This group interviewed a small wind power operator and a biogas plant operator. Both producers agreed that they would need support from Ourpower for marketing. Similar to other interviewees they voiced concerns regarding the uncertainty of sales and contracts. They suggested a fixed feed-in price and long-term contract. Furthermore, the changing of the contracts have to be smooth. The biogas operator also mentioned the necessity of calculating maintenance work into the profit margin. Like the biogas plant operator in Group 1, the minimum price for profitable biogas would be 18c/ Kwh. Lastly the interviewees discussed the marketing and campaigning work necessary and argued that this would require too much effort
Lead questions for prototyping:
How can we support producers in specifying a price and to become active market participants?

- Prototype: Publish individual stories of producers to "bring the idea of Ourpower to live"

Follow-up interviews with key actors
The design-thinking process is seen as a fitting approach to identify open questions and weak points within the undertaking, as well as to think about solutions in a systematic manner. The CEM management and Ourpower, further added the importance of understanding how other actors act and react. At the point of writing Ourpower is in the final phase of gathering start-up funding and is planning to officially begin trading energy by autumn 2019. Therefore, many of the prototypes and suggestions developed within the design-thinking process have not yet been implemented. They are however planned to be implemented. The information material is already in production process. Further, website add-ons are currently considered. They however will require longer periods of programming and testing before being ready to publication.

C) Projektdetails

6 Methodik

Qualitative data analysis of stakeholder interviews

The semi-structured interviews conducted within this project were mainly conducted face to face or in few cases where this was not possible, interviews were conducted over the phone. The interviewees where chosen according to a preceeding stakeholder mapping.

All interviews followed the same interview protocol, with additional questions asked depending on the interviewee's stakeholder group. The protocol, which was designed by the WP1 team in close cooperation with other project partners, was divided into five parts:

i. Part 1 is general to all interviewees and starts the interview by exploring general views on the energy transition and specifically in Austria, the role of the CEM program within the energy transition and the general benefits and downsides of participating in the CEM program.

ii. Part 2 is also general to all interviewees and asks about successful and unsuccessful measures implemented in the CEM region as well as associated challenges and how these were dealt with. This section seeks to explore challenges as they are perceived by the interviewee as well as the causes for failed, or successful, implementation.

iii. Part 3 focuses on the governance of the CEM region and program itself as well as the institutions involved. The questions within this section are only posed to stakeholders with a direct connection to implementation. These stakeholders include almost all stakeholders except local residents.

iv. Part 4 is posed to potential investors in climate friendly technologies. This set of questions aims to provide an understanding of the main motivations for investment and also stakeholder definitions of successful investment. These questions are subsequently included in interviews with local residents but also businesses and municipalities who are also considered investors in green technologies.

v. Part 5 is posed only to CEM mangers, CEM-QM mangers and others involved in the administration of the CEM program, and specifically focuses on the newly established CEM-QM and audit.

The interviews where recorded and transcribed. Subsequently, the transcriptions where analysed using a qualitative data analysis approach where the interviews where coded within two rounds to answer three main questions:

- Why and how do actors and stakeholders take action towards climate protection?
- Which challenges do these actors face? (How) Are these challenges overcome?
- Are the current instruments provided to CEM managers adequate to successfully implement climate protection projects?

Based on these questions a design framework has been drafted to guide the coding of the interviews using the qualitative data analysis software, QSR Nvivo. Subsequently the coding foci have been predetermined by the themes and sub-themes.

Game Theoretic Modelling

Within WP2, a game theoretic model was developed and analysed. The goal of the model ws to create a deeper understanding of the underlying causes for implementation gaps and the effectiveness of various policy instruments. We therefore decided to build a stylized game theoretic model that is less detailed but captures important features that are relevant in many low carbon initiatives: that some households are very active in reducing emissions while others

do not engage (at all); that households do less than they would like to do ideally; and that public authorities strive for policy interventions to reduce free-riding behaviour and close the policy implementation gap.

Social Simulation Exercise

The social simulation exercise was greatly based on the preliminary analysis of the context of the policy exercise based WP1 outcomes and additional research has been finalized for both CEM regions. It involved expanding on results from WP1 by investigating deeper into situation of the stakeholders as well as finding possibilities and opportunities that are not presently considered in the region, but were introduced or tested in other areas. Additional information about the situation in CEM regions that further clarifies context, goals and the scope was obtained during the additional interviews with CEM managers.

For the CEM Freistadt a pre- and post- evaluation suvey were designed to ascertain how participating in the social simulation has impacted the participants' subjective views towards a low carbon transition.

Design-Thinking Workshop

From a research perspective the evaluation of the design-thinking method for research and policy was given special attention within WP3. A pre-post workshop evaluation was conducted in the CEM Baden.

Ten likert-scale perception statements were designed to capture participants views on the potential challenges related to a community-based low-carbon transition and the respective roles of government, private sector and community members in facilitating it (Table 3). The pre-workshop survey revealed that the participants in general were motivated to contribute to a low-carbon transition and, on average, believed that phasing-out fossil-fuel is largely possible and that their participation will contribute to the energy transition. This is perhaps unsurprising given one of the criteria for identification of participants was to involve those who were active and open-minded regarding citizen collaboration towards a low-carbon transition.

Table 3 Pre- and Post Workshop Perceptions on Low Carbon Transition

	Mean		P-value (T<=t) two-tail
Perception statements (1 - not at all 10 - very much)	Pre	Post	
I believe we can phase-out the use of fossil fuels in public buildings, single-family homes, rental apartments and companies in Baden.	7.9	8.5	0.26
I think citizens can offer innovative policy ideas for energy transition	7.7	9.1	0.01*

I think that individual efforts to the energy transition have little impact or influence.	2.5	4.3	0.06***
I think that citizen participation in the energy transition is a waste of time because it is shaped by economic and political interests.	2.3	2.5	0.64
I feel that my participation will contribute to the energy transition.	7.6	7.8	0.76
I think the government should be taking the leading role in the energy transition.	8.0	9.0	0.22
I think communities should be taking a leading role in the energy transition.	8.9	9.3	0.44
I think energy transition is too complex and I sometimes doubt that we can manage it.	4.0	4.5	0.62
I think businesses should be taking a leading role in the energy transition.	7.5	8.6	0.10
n: 11			

Note: significant at *1%,**5% and ***10% thresholds.

Likely due to the prevailing sense of high motivation and efficacy, the design-thinking workshop did not result in significant changes in perceptions regarding the roles of actors and general feasibility of a low carbon transition. A significant increase was, however, observed regarding a more specific statement regarding the citizen's contribution to policy innovation namely: "I think citizens can offer innovative policy ideas for energy transition (t-stat: -3.01)." A marginal change was also observed regarding the statement: "I think that individual efforts to the energy transition have little impact or influence (t-stat:-2.11)" though it is possible that this item was not clearly understood as it appears to contradict with the constant scores observed for the belief that individual participation will contribute to the energy transition.

In addition to quantitative evaluation, two rounds of interviews were conducted 10 months apart to understand the immediate and medium-term outcome of the workshop. In the immediate days following the workshop, the research team had phone interviews with CEM management to receive their feedback regarding workshop outputs, including how they are planning to use these ideas generated.

References:

Marbler, A (2018) Heterogeneous environmental preferences and emission abatement at the local level. A game-theoretic analysis. Master thesis, University of Graz, March 2018. Available online at: https://unikat.uni-graz.at:443/UGR:Gesamtbestand:UGR_alma21329420030003339

Marbler, A., Bednar-Friedl, B. (2019) The low carbon transition at the local level: "Greenness" is not enough. To be submitted to Environmental and Resource Economics in September 2019.

Babcicky, P. Wolkinger, B., Heß, V. (2019) An Overview of interventions to encourage low-carbon lifestyles at the household level, coDesign Working Paper 2.1, May 2019.

7 Arbeits- und Zeitplan

Milestones	Dates planned	Dates completed
M1.1 A scoping study is completed	August. 2017	Feb 2018
M1.2 Key informant interviews completed	Nov. 2017	March 2018
M1.3 Qualitative analysis and synthesis are completed	Feb. 2018	April 2018
M2.1 Game design concept and roadmap developed	Feb 2018	June 2018
M2.2 An applied game-theoretical model built	June 2018	April 2018 for Task 2.2, May 2019 for Task 2.4.
M2.3 Prototyping and testing completed	June 2018	August 2018 for Freistadt, February 2019 for Graz.
M2.4 Stakeholder workshop completed	Aug 2018	September 2018 for Freistadt, March 2019 for Graz.
M2.5 Quantitative and qualitative data analysis completed	Nov 2018	Nov 2018 for Freistadt. Analysis was not conducted for Baden.
M3.1 Design-thinking kick-start workshop completed	Nov 2018	October 2018 -Baden; January 2019 Freistadt
M3.2 Follow-up observations made	Jan 2019	May 2019
M3.3 Analysis and synthesis of observations made	March 2019	May 2019

8 Publikationen und Disseminierungsaktivitäten

Tabellarische Angabe von wissenschaftlichen Publikationen, die aus dem Projekt entstanden sind, sowie sonstiger relevanter Disseminierungsaktivitäten.

Conference Presentations	Jenan Irshaid:"Fostering social innovation towards carbon neutral spatial heating through policy co-design" presented at ECCA 2019 28th-31st May in Lisbon.
	Alexander Marbler (2018) Heterogeneous environmental preferences and emission abatement at the local level. A game-theoretic analysis. SOWI im Diaolog, Universität Graz, November 14th 2018, Graz, Austria.
	Alexander Marbler, Birgit Bednar-Friedl (2019) How to overcome the energy transition gap at the local level. A game-theoretic analysis with heterogeneous environmental preferences across households. Jahrestagung der Nationalökonomischen Gesellschaft (NÖG), April 25th – 26th 2019, Graz, Austria.
	Alexander Marbler, Birgit Bednar-Friedl (2019) How to overcome the energy transition gap at the local level. A game-theoretic analysis with heterogeneous environmental preferences across households. Conference of the European Association of Environmental and Resource Economists (EAERE) June 26th –29th 2019, Manchester, UK.
	Liu Wei, Junko Mochizuki, Schinko Thomas (2019) Governance research update including the results of Co-Design Project. July 9h 2019. Risk and resilience program seminar, International Institute for Applied Systems Analysis
	Mochizuki J, Schinko T, Magnuszewski P, Pajak M, Bednar-Friedl B, & Irshaid J (2018). Addressing energy transition gaps in climate and energy model regions of Austria through policy co-design. In: 19. Österreichischer Klimatag, 23 –25 April 2018, Salzburg, Austria.
Publications	Alexander Marbler (2018) Heterogeneous environmental preferences and emission abatement at the local level. A game-theoretic analysis. Master thesis, University of Graz, March 2018. Available online at: https://unikat.uni-graz.at:443/UGR:Gesamtbestand:UGR_alma21329420030003339
	Alexander Marbler, Birgit Bednar-Friedl (2019) The low carbon transition at the local level: "Greenness" is not enough. To be submitted to *Environmental and Resource Economics* in September 2019.
	Philipp Babcicky, Brigitte Wolkinger, Vincent Heß (2019) An Overview of interventions to encourage low-carbon lifestyles at the household level, coDesign Working Paper 2.1, May 2019.
	Junko Mochizuki, Jenan Irshaid, Kara Pasmore, Klaus Weissmann, Piotr Magnuszewski, Thomas Schinko (2019) Design Thinking for Low-Carbon Transition: Urban Innovation Lab in Austria's Climate Energy Model Region. –In preparation
	Jenan Irshaid, Junko Mochizuki, Thomas Schinko (2019) Challenges to regional implementation of energy transition measures: The tale of two Austrian regions. – In preparation
Doctoral dissertations:	Alexander Marbler, master thesis completed in March 2018, Department of Economics, University of Graz. The thesis received the Best Master Thesis Award of the School of Economics, Management and Social Sciences, University of Graz, in November 2018.
	Hannah Hennighausen, dissertation in progress, Wegener Center for Climate and Global Change, University of Graz.
	Vincent Heß, dissertation in progress, Wegener Center for Climate and Global Change, University of Graz.

	Jenan Irshaid, dissertation in progress, Institute of Science and Technology at Alpen Adria University in Klagenfurt.

In addition to dissemination through peer-reviewed publications and conference presentations, the team has also used a number of online channels including social media to widely disseminate the progress and results of the project.

These include:

http://www.iiasa.ac.at/web/home/research/researchPrograms/RISK/news/181024-DesignThinking.html

http://www.iiasa.ac.at/web/home/research/researchPrograms/RISK/190306-socialsimulation.html

https://systemssolutions.org/2019/03/06/sustainable-urban-heating-graz/

https://systemssolutions.org/2019/02/13/suhs-iiasa/

https://systemssolutions.org/2018/08/02/codesign-test-iiasa/

Diese Projektbeschreibung wurde von der Fördernehmerin/dem Fördernehmer erstellt. Für die Richtigkeit, Vollständigkeit und Aktualität der Inhalte sowie die barrierefreie Gestaltung der Projektbeschreibung, übernimmt der Klima- und Energiefonds keine Haftung.

Die Fördernehmerin/der Fördernehmer erklärt mit Übermittlung der Projektbeschreibung ausdrücklich über die Rechte am bereitgestellten Bildmaterial frei zu verfügen und dem Klima- und Energiefonds das unentgeltliche, nicht exklusive, zeitlich und örtlich unbeschränkte sowie unwiderrufliche Recht einräumen zu können, das Bildmaterial auf jede bekannte und zukünftig bekanntwerdende Verwertungsart zu nutzen. Für den Fall einer Inanspruchnahme des Klima- und Energiefonds durch Dritte, die die Rechtinhaberschaft am Bildmaterial behaupten, verpflichtet sich die Fördernehmerin/der Fördernehmer den Klima- und Energiefonds vollumfänglich schad- und klaglos zu halten.