Low Carbon Societies Network

Engaging Civil Society and Stakeholders in Low-carbon Scenarios

Synthesis report of the ENCI-LowCarb Project

Project: ENCI-LowCarb

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March 2012

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This report summarises the results of the ENCI-LowCarb project that five partners carried out 2009-2012 with support from European Commission's research program ”FP7”. The main part of the report is a description and comparison of the scenarios and the stakeholder involvement processes for France and Germany that were developed within the Project. The report also describes other project results with wider interest, including low-carbon scenarios in EU and existing networking among researchers and NGOs for low-carbon scenarios and strategies.

For a more concise description of the modelling tools and stakeholder involvement processes that were used for the scenario development, please consult the scientific reports available from www.enci-lowcarb.eu.
See also list of project reports at the end of this report.

There are no sources included in the text in this report, but the entire report is based on the project reports listed at the end.

Some parts of this final report are available in shorter forms like fact-sheets, posters and newsletter articles, available from www.lowcarbon-societies.eu. On this website there are also conference proceedings from the ENCI-LowCarb events, information on low-carbon scenarios and scenario networks, and information on the activities of the Low Carbon Societies Network established in the framework of the project.

We would like to thank the financial supporter as well as everybody involved in the project, making this work possible and advancing the development of low-carbon scenarios in a time when such roadmaps are ever more needed to plan for a sustainable future.

March 2012

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1. Introduction, the ENCI-LowCarb Project

The ENCI-LowCarb Project (Engaging Civil Society in Low-Carbon scenarios) started in April 2009 to develop partnerships between NGOs and Research Institutes for the elaboration of national climate policy scenarios and ends in March 2012. In some way, the project had already started 2 years earlier, in April 2007 when the project partners applied for support from the EU's research programme FP7.

The Project's aim was to develop a network and partnerships between research institutions and CSOs and to develop low-carbon policy scenarios based on contributions of national stakeholders (associations, trade unions, firms etc.). The central position of stakeholders in the creation process allowed the integration of the degree of acceptance for specific policy measures or technology decisions needed to reach ambitious greenhouse gas (GHG) emission reduction objectives. In particular, the project should create two such partnerships for elaboration of cases related to France and Germany. These two partnerships consisted of four of the five project partners:

- Germanwatch and Potsdam Institute for Climate Impact Research (PIK) made a partnership to develop scenarios for Germany.
- Climate Action Network France (RAC-France) and International Research Center on Environment and Development (CIRED) made a partnership to develop scenarios for France.

International Network for Sustainable Energy - Europe (INFORSE-Europe), the fifth partner of the Project, started to develop a network of researchers and NGOs that could lead to similar partnerships in other countries, and that could disseminate information from the project. Among the network activities have been European NGO and stakeholder seminars, newsletters, website, and development of online contact and mailing lists for the network.

The low-carbon scenario database developed during the Project targeted primarily scenarios with 75% reduction or more of CO_2 emissions from energy use until 2050 or earlier.

Multi-disciplinary teams were created to deal with the cross-cutting issues of quantitative modelling, stakeholder involvement and social / stakeholder acceptance, mainly by the participation of sociologists and energy experts in the project steering committee.

The Project developed and employed state-of-the-art energy-economy models, in form of hard-linked hybrid models.

The project partners also developed scenarios that have achieved the represented stakeholders' acceptance for large reductions of national CO_2 emissions from energy supply and use, scenarios that would transform Germany and France into low-carbon societies in many key aspects.

The GHG emission reduction objective in 2050 for the project scenarios was set to 75% reductions of greenhouse gas (GHG) emissions with respect to 1990 from energy use as fixed as official target by the French government. However, for the German scenarios, it was decided to adhere to the German Government's target of 80-95% CO_2 emission reduction, resulting in the objective to 85% reduction of CO_2 emissions from energy use over the time span 1990 – 2050.

The Project ends by the end of March 2012 and has achieved the development of a network, two partnerships and low-carbon scenarios with stakeholders' involvement in Germany and France.

This report starts with a description (in chapter 2) of the collaborative scenario processes that were central for the project. The description covers the main elements of the processes, with most in-depth descriptions of researcher – NGO cooperation and of the stakeholder involvement process. Then follows descriptions of some choices in an energy-economy modelling process that are not necessarily linked to the stakeholder involvement process (in chapter 3), descriptions of the energy – economy models used (chapter 4), and the scenarios developed (chapter 5). The next chapter (chapter 6) summarises joint conclusions and lessons learned from the collaborative scenario process. The last part of the report is dedicated to other project results: an overview of low-carbon scenarios in EU (chapter 7) and networks of researchers and NGOs working on low-carbon scenarios and societies (chapter 8). The report ends with a list of the reports produced for the ENCI-LowCarb project (chapter 9).

2. Collaborative Scenario Creation Process, Comparing German and French Process

One of the main activities of this project was the development and the application of a methodology for the transparent integration of stakeholders' contributions in the scenario design to enhance the stakeholders' acceptance of the resulting low carbon pathways. This attempt at integrating the aspect of acceptability in the scenario design constitutes an important step in distinguishing what is technically and economically feasible from what is socially and politically acceptable. Today, a wide range of published scenarios emphasize the fact that they are built on public consultations or stakeholders' contributions. However, transparency is lacking concerning the methods used to take the contributions into account and translate them into assumptions that can be used by the modelling tool. The Project aimed at exploring this scientif c gap.

The project hypothesis consisted in stating that if national stakeholders can recognize their contributions in the resulting scenarios (even if those were amended by the contributions of others); they would eventually be more supportive of this scenario than in a case where a non-transparent procedure was followed.

The collaborative scenario design process that was applied within the project included the participation of a wide range of stakeholders (civil society organizations including trade unions and non-governmental organizations, private companies, banks, state and local authorities). Participating stakeholders were asked to def ne or select acceptable CO_2 emissions mitigation measures and their contributions were implemented in the energy economic model Imaclim-R France and REMIND-D respectively to create scenarios that are economically and technically consistent as well as acceptable by stakeholders.

The process involved the following steps: team building, expert workshops, selection of stakeholders, first round of stakeholder dialogue meetings, second round of stakeholder dialogue meetings, and the modelling process between the meetings.

This chapter gives an overview on the different steps of the process highlighting differences between the German and the French stakeholders' processes. Further details on the models used in the processes and the scenarios are in chapter 4 and 5.

2.1 Researcher / NGO Cooperation – Team Building Process

The Project's activities for development of scenarios for France and Germany were done in each country with cooperation between a research institute with expertise in energy-economy modelling and a NGO. In addition social scientists in the form of sociologists were involved in the activities. This cooperation of different scientists and civil society was an important basis for the Project's scenario development activities.

The involvement of researchers that operate an energy-economy model was essential for the project. In order to integrate the element of "social or stakeholder acceptance" in the modelling process, it was an advantage to involve social scientists that are proficient in both quantitative and qualitative research methods to evaluate social acceptance of the elements of a low-carbon transitions. Additionally, it adds value to include civil society partners that are well embedded within the CSO landscape and that can be facilitators between scientists and other CSOs.
As civil society partners, well established NGOs[1] constitute good candidates, as they are formal entities with continues activities, which cannot necessarily be generalized to all CSOs.

To include NGOs and scientists of different traditions in a successful cooperation, it is important to build a team. It cannot be expected that they will cooperate optimally on a joint project without some team-building process.

1 For this project the term civil society and civil society organisations (CSOs) was used as the umbrella term and NGOs are considered as a subset of CSOs.

Establishing Functional Project Teams With Researchers and CSOs

Given the challenges for successful cooperation, the project adopted methodologies to establish fully functional project teams with NGOs and different researchers that could adopt an interdisciplinary approach and were able to produce quantitative energy-economy model scenarios with underlying political framework conditions.

A simplified organizational structure of the French and German project teams is shown in figure 2.1.1

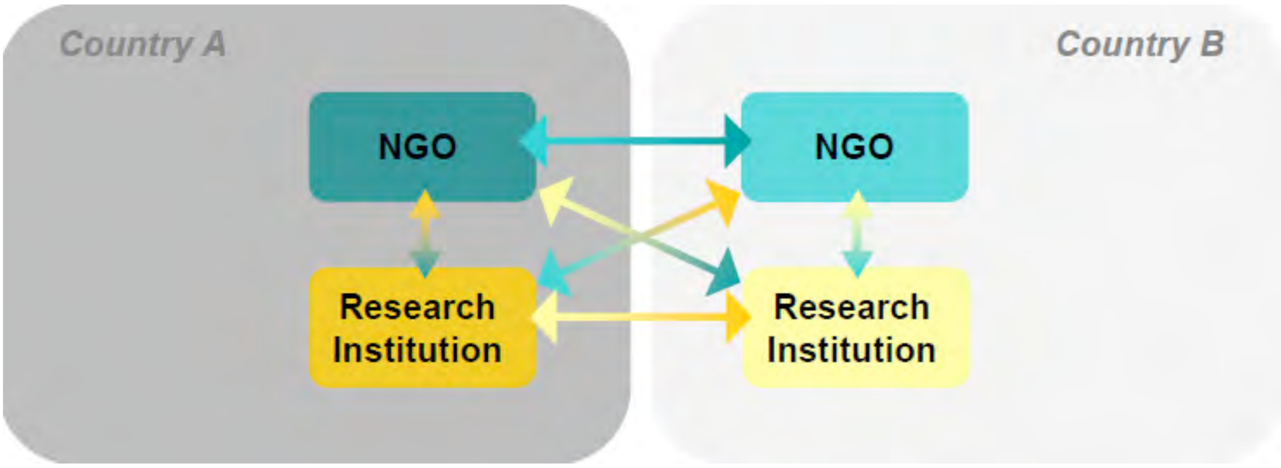


Figure 2.1.1 Organizational structure of the project teams for development of scenarios with civil society involvement in more countries in parallel.

The figure shows the adopted structure enabling vigorous communication flows between all project partners; the colour codes visualize the different communities and countries.

Wish-lists to Build Cooperation

For the German team, a special challenge was that the model used could not directly represent many of the policy measures proposed by the NGO in the project team as well as by stakeholders as the sectoral representation of for example the building stock is not explicit. To address this, the team employed a "wish-list" method that became part of the team-building process between the NGO members and the researchers in charge of the quantitative model.

With this method the quantitative modellers receive a "wish-list" with model features that the other partner would like to see in the model and what kind of results they expect. The NGO members receive considerations on what kind of stakeholders to consult. Thereby, each project partner gets a good understanding on how the others perceive his/her discipline. Each partner then presents what he/she originally planned to contribute in the project and relates this to the "wish-list" items. Such an exercise will reveal the considerations and thinking patterns of the project partners. After each presentation, some time is reserved for clarifying terms that were unclear or non-familiar to one or more partners. Here, project partners have a chance to realize potential barriers to communication. Finally, in thematic sessions, the history and status quo of the domestic energy system can be presented, to develop a common understanding of the facts and context of the other country's challenges.

During the "wish-list" process, the project partners have a chance to develop a common language and gain realistic expectations of the abilities of the quantitative model, the concept of social acceptance and the stakeholder landscape. In repetitive exchange, project partners develop a joint idea of the research methods they will employ. This leads to a state characterized by cohesiveness and in-group feeling, where the group is ready to perform joint tasks.

2.2 Expert Workshops

The next step was the organisation of expert workshops in France and Germany. In France there were three project workshops covering the residential, transport and power supply sectors, while in Germany there were two expert workshops covering the transport and power supply sectors.

In the expert workshops, the modellers in the project clarified with sector experts that the assumptions of the model were technically and economically realistic (costs, potentials, learning curves etc.). Also the dynamics of the models themselves were discussed. The contributions of the experts have shown to be very helpful for the modellers in the project.
The meetings also revealed that in some sectors no consensus on a vision for decarbonisation exists. This was for instance prominent in the transport export workshops, for Germany as well as for France.
The outcomes of the expert workshops were then integrated in the modelling tools.

2.3 Selection of the Stakeholders

In the ENCI-LowCarb Project, the two NGO-partners played an active role in the selection of the stakeholders. Due to their political work, the NGOs often knew many of the important players on the field and have experiences with them. Also experts of the different sectors were interviewed in order to identify core actors.

To identify stakeholders for the sectoral meetings, a "Power versus Interest Grid"[2] was used. From a list of stakeholders, those placed highest along the interest axis in the grid were selected. The stakeholders that were selected included trade unions, energy companies, environmental NGOs, consumer NGOs, industries and banks.

The maximum number of participants in the stakeholders' meetings was set to 15 for each sector to ensure in-depth discussions.

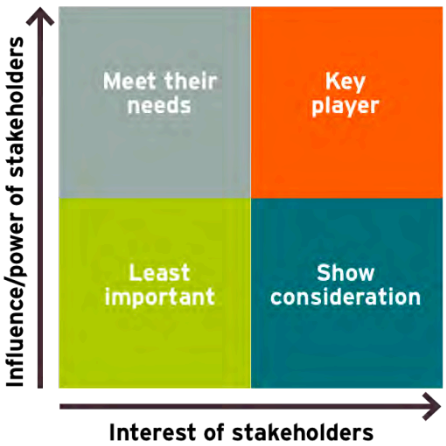


Figure 2.3.1 "Power-Interest-Grid"

2.4 Stakeholders' Dialogue Meetings

Stakeholders' dialogue meetings were held in two rounds. In Germany, during the first round of stakeholders' meetings, the two sectoral meetings included 12 to 15 stakeholders from the transport sector and the electricity supply sector respectively. The second round of sectoral meetings was again two meeting, one for the transport sector and one for the electricity supply sector. In France, the first round of stakeholders' meetings consisted of three sectoral meetings on transport, electricity and the residential sector with 15 stakeholders each. The second round consisted of one joint meeting for the stakeholders from all

2 Bryson, J. (1995) Strategic Planning for Public and Nonprofit Organizations, San Francisco, CA: Jossey- Bass

three sectors. This joint meeting allowed cross-sectoral feedback discussions on the scenario developed with the policy measures agreed during the first round of meetings.

In the first round of stakeholders' meetings, the ENCI-LowCarb Project was presented, including the project's methodology. Then the main questions and challenges for the sector in question were introduced, followed by detailed presentations and discussions of the selected sub-themes. At the end, the stakeholders filled out prepared questionnaires.

The information collected at the meetings was then translated into the model's relevant parameters and the scenario(s) was/were amended.

In the second round of the stakeholders' meetings (in France: one joint meeting), first the revised scenarios were presented, including a description of how the feedback from the first round had been included in the new scenarios. Then the new scenarios were examined closely and the feasibility and possible social and political effects were discussed. Following this round, again the results of the stakeholder inputs were integrated into the model.

In this way the dialogues contributed to construct the scenarios around more realistic and socio-political acceptable elements, and it also provided knowledge on the strength of support and opposition that a given scenario can expect in the consulted sectors.

For both rounds of stakeholder meetings, it was important that a professional moderator was involved and that the discussion was divided into sub-themes. With these, the meetings were considered effective from all participants.

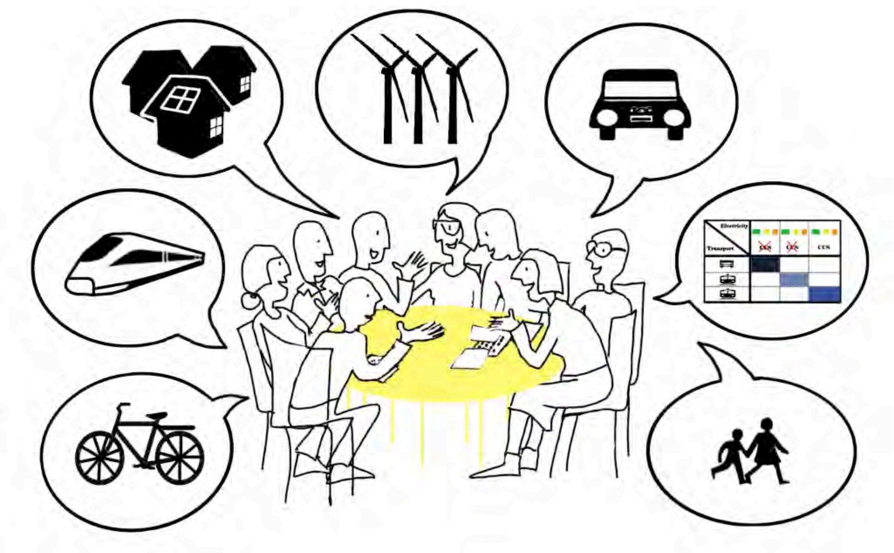


Figure 5.3.1 Illustrative impression of stakeholders' dialogue meeting

2.5 Translation of Stakeholders Contributions in Modelling Parameters

Between the evaluation of the contributions of stakeholders and the modelling exercise, an important step was the translation of the stakeholder visions into model parameters.

The information gathered within the sector-specif c stakeholder meetings was translated by the project team into model parameters. Points of disagreement were laid open and handled by the development of scenario variants.

Here is one example for a translation process of the French study:

Example of the translation process: residential sector – refurbishment

One of the main obstacles for the refurbishment of houses identif ed by the stakeholders' is the still predominant aversion of homeowners to refurbish their houses or apartments even if many f nancial incentives exist. The aversion is even higher if one is non-occupying homeowner. A barrier for owners is that the access to tax incentives and subsidies is on the condition of a high personal f nancial contribution. Even the access to a zero-interest loan is difficult without collaterals. The stakeholders' recommended solutions to overcome this barrier: the creation of an obligatory refurbishment fund for jointly-owned buildings and a long-term third party f nancing. As these solutions cannot be integrated one-to-one into the modelling tool, alternative modelling strategies had to be developed. For instance it is possible within the Imaclim-R tool to change the specif c "risk-aversion level" of the different agents (occupying and non-occupying homeowners etc.).

Here is a description of the German translation process:

For the German study, the outcomes of the stakeholder workshops were translated into scenario elements, called parsimonious narratives. Those scenario parameters that were judged to be realistic by the stakeholders constituted the "continuation scenario" and those that were desirable constituted the "Paradigm shift scenario". The "Paradigm shift + scenario" included additional elements that were not widely accepted by the stakeholders.

In the following table are listed some of the most important differences between the three scenarios

Model Constraint	Continuation	Paradigm Shift	Paradigm Shift +
Decoupling FT&GDP	No	Yes	Yes
PT share in MS	Constant	Increase	Increase
REG potential	Medium	High	High
Energy efficiency	Medium	High	High
Decommission Coal PP	No	Yes	Yes
CCS by 2025	No	No	Yes
Biofuel potential	Low	Low	High

Figure 2.5.1 Table with important differences between the three scenarios developed for Germany. FT is freight transport, PT is public transport, MS is modal split of transport , REG is renewable energy generation, PP is power plants, CCS is Carbon Capture and Storage

2.6 Comparing the French and German Stakeholder Processes

The processes of stakeholder involvement in Germany and France were in many ways parallel, but there were also differences mainly induced by the different nature of the modelling tools. The formal differences were that there were more sectors involved in the French stakeholder process (housing was included) and that the last round was made as one joint cross-sectoral meeting in France.

A remarkable difference between the German and French process was that the German scenario reaches a higher reduction of emissions (-85% compared to -68% in France, both relative to emissions in 1990). One way of explaining this is by the choice of different approaches for the decision on the emission reductions: In the German study a fixed emission budget for the whole period was used. So the modelling tool was constrained to an 85% reduction. Stakeholders had no influence on this target. In France no emission target in 2050 was fixed but the stakeholders decided on policy measures and technology choices that were acceptable following to their judgment. The representation of all measures judges acceptable by the stakeholders led to a reduction about 68%. A supplementary explanation of the difference in relative emission reductions is the difference in per capita emissions in 1990 (7 tons in France versus 12 tons in Germany, see 3.1).

Another difference was that the German stakeholders reflected both on the likeliness and desirability of a number of developments, while in French stakeholders only commented on the acceptability of measures. In the German study this led to the definition of different scenarios: the "continuation" scenario and the "paradigm shift" scenario, resembling the developments in the electricity and transport sector that stakeholders judge as likely and desirable, respectively.

3. Elements of the Modelling Process

The modelling process in itself was a crucial part of the scenario creation process.
The choice of the modelling tools partly determines the results of the scenarios as well as several aspects of how the project can be organised. Even if the project was focused on national scenarios the definition of a global vision was for instance an important prerequisite for the use of energy-economy models, as the global vision is setting framework conditions.

This chapter gives an overview on some methodological aspects linked to the choice of the modelling tools.

3.1 Definition of the Emission Target in 2050

One of the first project discussions was on the definition of the emission target in 2050.
The French project team aimed at reaching a 75% reduction (”Factor Four”) of CO_2 emissions for the period 1990 – 2050, which is consistent with the official national long-term climate target. The German team used a target of 85% reduction of CO_2 emissions from energy 1990-2050 based on the German (and EU) objective of 80-95% reduction of greenhouse gas emissions and the assumption that energy – related emissions should be reduced some more than 80% to reach a national reduction of all greenhouse gases of at least 80%.

This discussion was largely formatted by the different nature of the modelling tools: The German model REMIND-D worked with predefined constraint emission budgets. So the respect of the fixed emission reduction target was from the beginning on assured. The French team decided to only represent policy measures that were judged to be acceptable by the invited stakeholders in the scenario. As these measures were not strong enough to reach the aimed target (-75%) a second scenario (less acceptable in the eyes of the stakeholders) with additional measures was developed.

While the reduction objectives for France and Germany are different in relative terms, the emissions per capita were substantial lower in France than in Germany in 1990 (7 tons versus 12 tons). Because of this, the reduction objectives are similar in absolute terms in the two countries. The objective both equals emissions in 2050 to 1.8 t/CO_2 per capita - based on the assumption of a stable population. Because the population is decreasing in Germany (expected 12% decrease for 2010-2050) and increasing in France (expected 15% increase for 2010-2050), the per capita emissions will actually be almost 30% smaller in 2050 for France than for Germany with the emission reduction objectives used in this project.

Also the choice of the emission scope is an important topic: In France a 68% CO_2 emissions reduction in 2050 represents only a 46% decrease of the total French green house gas (GHG) emissions and only -29% of the total consumption-related French GHG emissions. The focus of energy related CO2 emissions in the ENCI-LowCarb project was determined by the choice of the modelling tools.

In Chapter 5 there are detailed descriptions and comparisons of German and French scenarios.

3.2 Impact of the use of Hybrid Energy-Economy Models

The choice of energy model is an important methodological choice for development of energy scenarios. Traditionally, energy-economy models for scenarios have been either top-down, macro-economic models or bottom-up engineering models. Both concepts have their specific strengths and weaknesses. Basically, they focus on different aspects of the energy economy. The project tries to overcome this by using hybrid energy-economy models that combines both elements. The REMIND-D model, developed at the Potsdam Institute for Climate Impact Research, and the Imaclim-R France model developed by CIRED are hybrid models that integrate a detailed bottom-up energy system into a top-down representation of the macro-economy. Such models are known as hard-linked hybrid models.

On the one hand, the choice of this type of modelling tools allowed creating a coherent low carbon pathway including the description of technology developments, economic evolutions, and impacts on the households. On the other hand, these modelling tools are often considered as black boxes, due to their complex nature. It was so very important to address this potential challenge with a transparent communication on the potentials and limits of the models and transparent access to modelling parameters (cost assumptions, potentials etc.).
In Chapter 4 are further descriptions of the two models and a comparison of them.

3.3 Global Vision as Framework for National Scenarios

Before an energy-economy model generates meaningful national scenarios over longer periods, the development of certain parameters on the global level must be defined. As a country is not an island, hermetically closed towards the open world economy, global evolutions influence the national developments and conversely national scenarios have to be embedded in global structures. Such a set of assumptions, which describes the evolution of certain parameters on the global level, is called a “global vision” or “world vision”. For this project we used similar global visions for the German and French scenarios. Among the assumptions were that developments in Germany and in France do not influence the world market, but that they can influence the costs of technologies to some degree if they are considered as important actors. Fossil fuels prices for instance are not influenced by the national scenarios, while the costs of renewable energy technology can be influenced as learning rates are considered to have a worldwide impact. For the French national scenarios the stakeholders discussed the development of scenarios with different global visions. The global vision they considered to be realistic (not acceptable or desirable) describes a world without a global climate agreement, high fossil fuel prices, and with consumption styles that remain material intensive. Emerging and developing countries mimic this western consumption pattern over the scenario period, thereby even increasing the pressure on natural resources and the challenge to respect ambitious climate targets.

It is interesting to compare this global vision with the one used by the European Commission for the “Energy roadmap 2011” which is drawing a quite different picture: The adoption of an ambitious international climate treaty reduces fossil fuel consumption and by this their prices which will be in 2050 under today’s level.

The global vision is one determinant for the result of a scenario, but by far not the only one. Descriptions of the national situations, model architecture, and of course stakeholder choices are other major factors determining the scenarios.

4. Models Used, Comparing REMIND-D & Imaclim-R France and their Baseline Scenarios

While the two models used were both hard-linked hybrid models, combining a macro-economic module and energy system modules, they were in many ways different. In this chapter are short descriptions of the two models, followed by a comparison of their main features.

4.1 Remind-D

The model used for the German scenarios by the ENCI-LowCarb project partners is the REMIND-D model (Refined Model of Investment and Technological Development - Deutschland). The model was developed at the Potsdam Institute for Climate Impact Research for this project based on the global REMIND-R model.

The macro-economic module is a neoclassical growth model based on a production function. GDP is produced by aggregating the production factors capital, labour and energy. The production factor "energy" is subdivided into the final energy demands of the industry and of the residential & service sector, as well as the energy service demand of the transport sector. The model maximizes the welfare, i.e. the inter-temporal sum of logarithmic per capita consumption. CO_2 emission reductions are enforced with an emission budget over the optimization period. Constraints, including emission budgets, always lead to net mitigation costs in optimization models. These are expressed in the model output as discounted GDP losses over the scenario period. Thus, with this model, scenarios with forced emission reductions will always result in net costs.

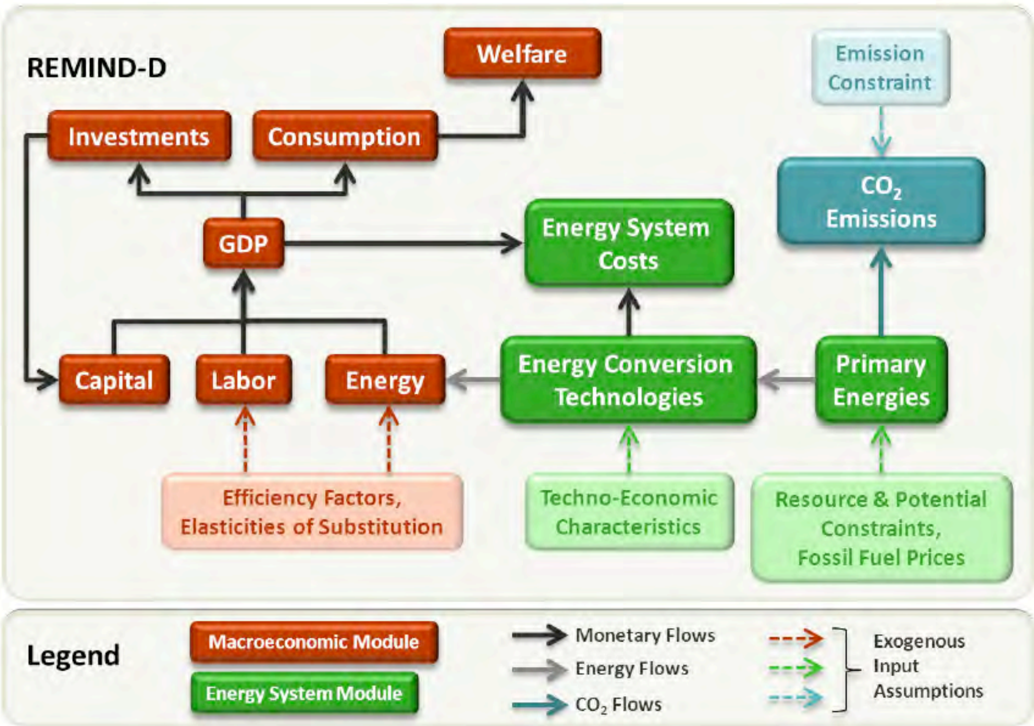


Figure 4.1.1: Overview of the REMIND-D model with physical and monetary flows. Source: Schmid, Bauer & Knopf, 2012 (http://www.feem.it/userfiles/attach/20122211032394NDL2012-009.pdf).

The energy system module in REMIND-D converts primary to secondary and final energies, as well as energy services in the transport sector. It includes for example power plants that convert coal or solar radiation to electricity, which is demanded by the macroeconomic module. Inputs include renewable energy potentials, price forecasts for fossil fuels, investment costs, and operating costs as well as efficiencies of energy conversion technologies and of transport vehicles.

The model has an advanced transport module that converts transport demands for persons and goods into final energy demands with information of present and future vehicles for individual and collective transport. In this was transportation becomes the output of the model's combined energy and transport systems. For the stationary sectors the model use final energy as the ”product” of the energy system.

The model is a one region model, covering Germany. With the input data used, the model's baseline scenarios will lead to about 40% CO_2 reductions in 2050 relative to 1990. The 40% was chosen as this is roughly the emission reduction that can be expected to take place based on today’s measures. The baseline scenarios are only used to determine the GDP losses of the mitigation policy scenarios as compared to the baseline, in order to understand the differential impact of ambitious mitigation targets.

4.2 Imaclim-R France

For the scenarios for France, the partners in the ENCI-LowCarb project used the Imaclim-R France model developed at CIRED. It is a dynamic, hybrid-model with 15 sectors. It simulates the economic impact of changes, which occur in the energy sector both in the macro- economic level (change in energy policies, climate policies or loss of competitiveness) and the micro-economic level (weight of energy in the structure of production costs or in households’ expenditures).

Like any conventional general equilibrium model, Imaclim-R France provides a consistent macro-economic framework to assess the energy-economy relationship. It is based on a description of the economy both in monetary terms and in physical quantities, linked by a price vector. This dual vision of the economy is included to guarantee that the projected economy is supported by a realistic technical background and, conversely, that any projected technical system corresponds to realistic economic flows and consistent sets of relative prices.

The model allows the incorporation of technological information coming from bottom-up models and experts’ judgement. It can handle a number of different proposals for policy measures. A policy measure can be a CO_2 tax that increases the price of fossil fuels and that is re-injected in the economy to reduce costs of energy efficiency, or it can be a building renovation programme that reduces heat consumption over time.

The model relies on recursive architecture (see figure 4.2.1) with exchange of information between a macro-economic module and several dynamic sectoral modules.

- For each year, the macro-economic module in the model establishes equilibrium of the economy and of the energy flows described. The markets have fixed equipment stocks and fixed intensity of labour, energy and other intermediary inputs, but have flexible utilization rates. The market’s equilibrium gives information of the levels of production, consumption, international exchanges, investments, relative prices, and profitability rates of sectors. It gives a snapshot of the economy, year by year, in monetary terms (in currency) and in physical quantities (unit: Mtoe) for energy.
- The dynamic modules describe demography, capital dynamics, and sectors with bottom-up technical descriptions. The sector modules take into account the economic values of the previous static equilibrium, assess the reaction of the technical systems and send back this information to the macro-economic module in the form of revised descriptions of the sectors (new input-output coefficients). Each year, technical choices are flexible but they modify only at the margin the input-output coefficients and labour productivity of the next year. This gives a “clay-putty” description of the world, where parameters gradually develop over time.

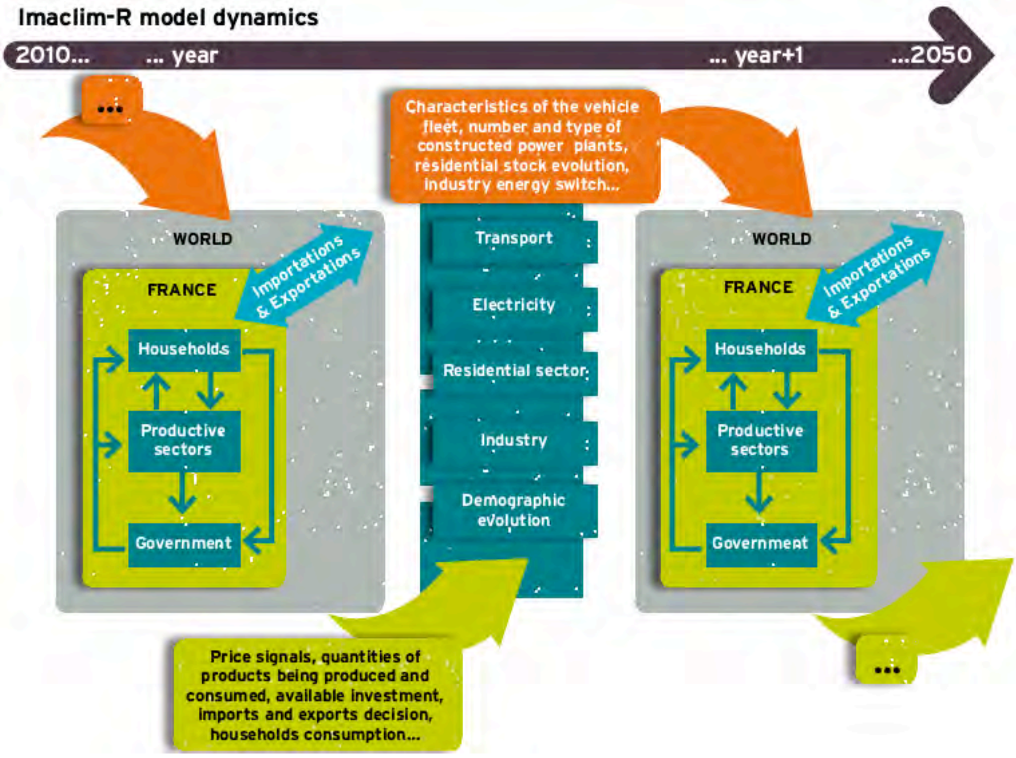


Figure 4.2.1: The recursive structure of the Imaclim-R France model, linking the main modules of the model in the evolution from one year to the next.

With the recursive structure, the model is well adapted to describe large departures from the reference equilibrium, which a radical low-carbon transition can be.

The model does not have a global, inter-temporal production function, and does not produce inter-temporally optimized scenarios. Instead the scenarios describe a development resulting from decisions made with the information that is available at the time of each decision. With this structure the baseline scenario does not represent an inter-temporal optimisation. Therefore the policy measures can lead to economic gains, if they increase investments that are cost-effective over their lifetime. This can happen if the measures give decision-makers signals that lead them to choose more cost-effective investments. An example of this is a CO_2-tax that increases the energy costs for the decision-makers leading to increased investments in energy efficiency, and later years an increase in energy costs that will make energy efficiency investments more cost-effective over their lifetime.

With the policy measures approach and the recursive structure, the resulting Imaclim-R France scenarios might not meet an emission reduction target, but if a target is not met, a new scenario with more and/or stronger policy measures can be made. This process can continue until the agreed target is met.

The model includes a number of constraints, with the capacity-restriction of production as probably the most important, because of inertia. Investments in capacity can only increase production capacity in the given sector in the following year. An example of another constraint is a travel-time budget that limits the personal travel time, based on the empirical finding that there is a constant average travel time over decades.

4.3 Comparison of the REMIND-D and Imaclim-R France

Fundamentally the REMIND-D's macro-economic module is a neoclassical optimal growth model with energy added as a third production factor in addition to capital and labour as input to the production function.

The Imaclim-R France, on the other hand, does not have a global, inter-temporal production function, but use a recursive structure, where for each year the annual static equilibrium is optimised and the step from one year to the next is made with dynamic modules, including sector-specific technology descriptions that assess the reactions of technical systems (such as investments) and send back this information to the static module in the form of new input-output coefficients to calculate the static equilibrium at the next year.

With this fundamental difference the REMIND-D can find the welfare-optimal path over a long period of time (it optimises inter-temporally) while the Imaclim-R France can mimic the behaviour of decision-makers that make sequential decisions based on information from the current year while the resulting scenario will not be inter-temporally optimised.

To develop a scenario for a low-carbon transition, REMIND-D can run with the constraint of a CO_2 emission budget, while the Imaclim-R France was run with representations of policy measures that change the economic and physical conditions in order to reduce emissions over time. Examples of policy measures can be a CO_2 tax that increase the price of fossil fuels and that is re-injected in the economy to reduce costs of energy efficiency, or it can be a building renovation programme that reduces heat consumption over time. With the emission budget constraint, the resulting REMIND-D scenarios will always stay within the emission limit, but the economic loss can be large. With the policy measure approach and the recursive structure, the resulting Imaclim-R France scenarios might not meet the emission reduction target, but the policy measure can lead to economic gains, if they increase investments that are cost-effective over their lifetime, or they can lead to losses if climate policies hinder growth. If the target is not met, a new scenario with more and/or stronger policy measures can be made, a process than can continue until the target is met.

Thus the REMIND-D can describe the welfare-optimal scenario within the given constraints while the Imaclim-R France can describe the scenario that is the result of sequential decisions made with the information that is available at the time of each decision.

There are a number of other differences between REMIND-D and Imaclim-R France:

- REMIND-D basically has two sectors: households and firms, while Imaclim-R France has 15 sectors including households, the government, and several production sectors.
- The Imaclim-R France model develop the power sector by choosing the combination of base-load, intermediate-load and peak-load plants, following a load-duration curve, choosing between nuclear and fossil fuel power plants, while the development of the renewable electricity is exogenously given and influenced by the existing feed-in tariffs. The REMIND-D model optimises the development within all allowed options, including renewable energy.
- The inertia to change the physical infrastructure is represented in the Imaclim-R France model by allowing only limited changes of the technical systems from year to year while the REMIND-D model use adjustments costs that are added to fast changes in technology. Both result in scenarios with gradual changes rather than unrealistic flip-flop behaviour.
- The Imaclim-R France has a number of other features, such as a travel-time budget that limits the daily travel time and thereby the possible modal shift in passenger transport.

While some changes can have little influence on the scenarios, such as the way inertia in the technical infrastructure is represented, the basic difference between the inter-temporal optimisation and the optimisation year by year gives the main difference in characteristics of the models.

5. The Low-Carbon Scenarios Developed for Germany and France, and their Role during the Stakeholder Processes

This chapter describes the low carbon scenarios elaborated within the ENCI-LowCarb project by using the developed collaborative scenario creation process. It starts with short presentations of the scenarios for Germany and France. The last part of the chapter is a comparison of the scenarios.

5.1 German Scenarios

Following the first stakeholder dialogues, three scenarios were developed, all with a carbon budget constraint that lead to 85% reduction of CO_2 emissions from the energy sector:

- The 'Continuation' scenario, which enforced the developments that were deemed likely by stakeholders in the transport and electricity sectors
- The 'Paradigm Shift' scenario, which included the developments that were perceived as desirable by the majority of the stakeholders.
- The 'Paradigm Shift +' scenario, which additionally allowed for the deployment of several technological mitigation options, that stakeholders judged as undesirable or discussed controversially. This included liquid biofuels as well as carbon capture and storage (CCS).

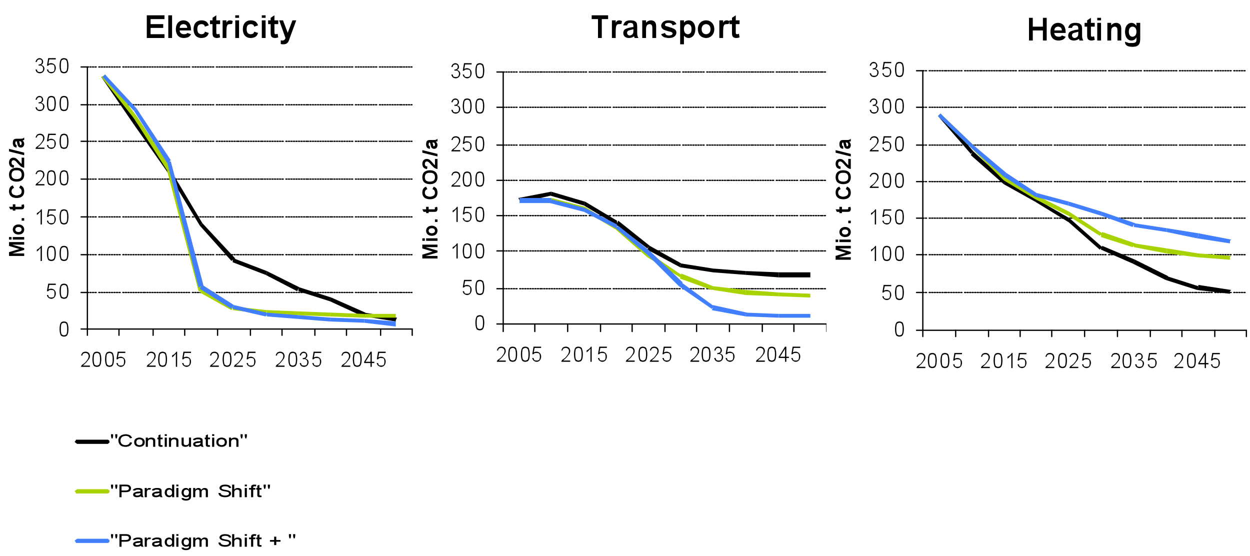


Figure 5.1.1: Sectoral emissions of the three scenarios with 85% reduction requirement. In particular the differences between the scenarios are remarkable for the electricity and transport sectors.

The model results indicate that the 'Continuation' scenario leads to a carbon lock-in, where the majority of the cumulative CO_2 emissions by 2050 are used for road transport and coal-power plants. This lock-in and the CO_2 reduction requirements combined to slow down economic growth with a cumulative GDP loss of 3.5% until 2050 (compared to the baseline with about -40% reduction in 2050), leading to undesired effects for society. One such undesired effect is that personal transport is forced to decrease from 13000 person-km (p-km) per year today to 9000 p-km by 2050. This renders ambitious domestic mitigation extremely challenging.

Moving to the 'Paradigm Shift' scenario, where the carbon lock-in is resolved, while energy efficiency and renewable energy growth rates increase, the cumulative GDP losses are reduced to 1.4%. As an example, in this scenario the personal, motorised transport is reduced from 13,000 p-km today to 11,000 p-km by 2050, and additionally it is assumed that the gap is filled by non-motorized transport, e.g. bicycling or walking.

In the ’Paradigm Shift + ’ scenario, the mitigation costs decrease further to 0.8% cumulative GDP losses, a minor decrease from the ’Paradigm Shift’. The small economic difference between these two scenarios suggests that the choice of the contested technologies can be left to further analysis of their viability.

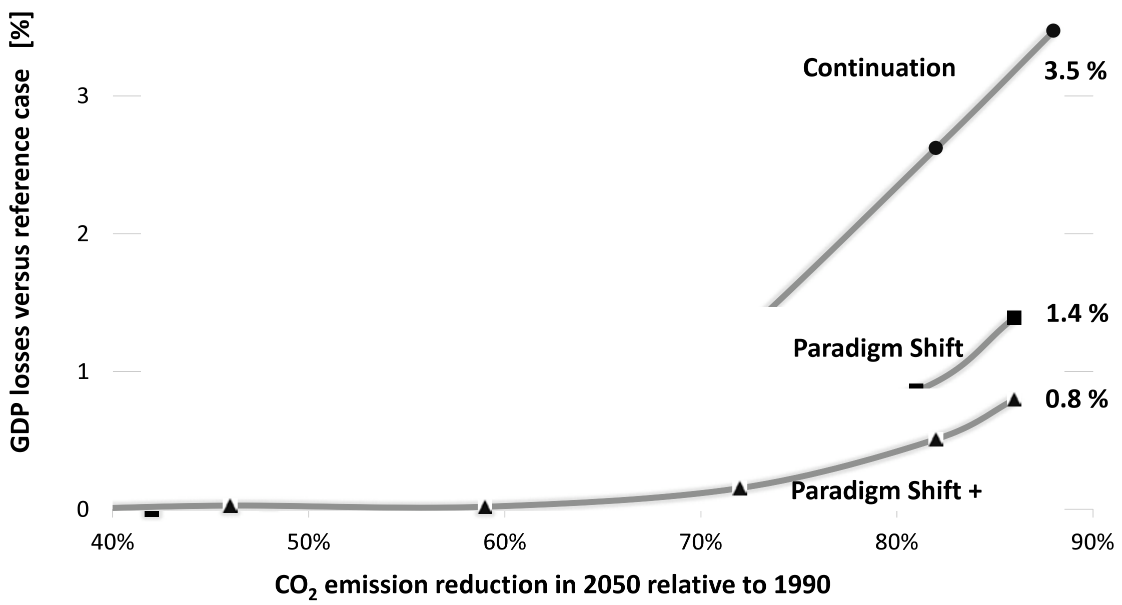


Figure 5.1.2 Mitigation costs in cumulative GDP losses for the three scenarios. The curves show the benefit of overcoming the carbon lock-in in coal-based power production and fossil-fuel based freight transport, once the CO_2 emission reduction requirements are higher than 70% reduction in 2050 relative to 1990.

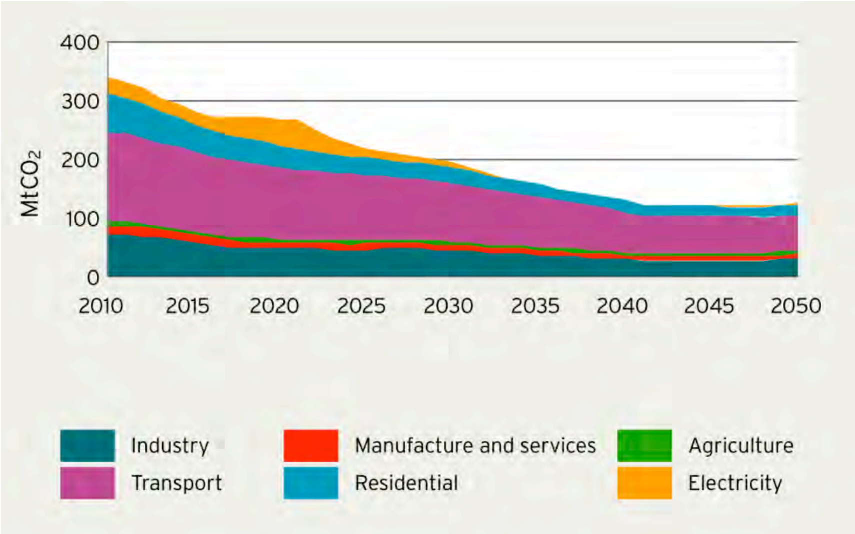
In conclusion, the scenario based on the development that stakeholders find likely will lead to carbon lock-ins that makes the transition to a low-carbon society expensive, and also politically and socially difficult. Choosing a scenario that is perceived as desirable but not likely by most stakeholders, however, can achieve the transition at lower economic costs.

Further analysis would be useful investigating together with stakeholders what would be necessary developments to move evaluations from desirable to realistic.

5.2 French Scenarios

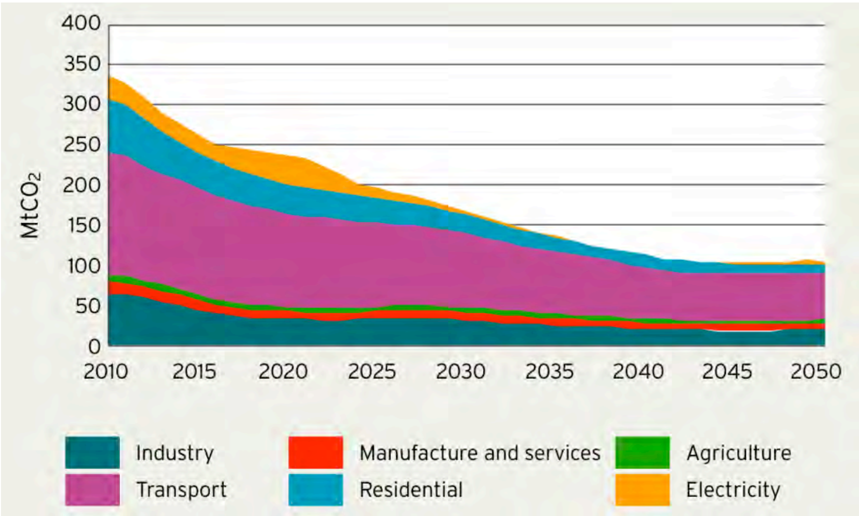
The Imaclim-R France model was used to develop a low-carbon scenario for France, where inputs were defined by French stakeholders during stakeholder meetings. The modelling team included measures that were supported by at least a majority of stakeholders. This acceptable mitigation scenario results in a reduction of energy related CO_2 emissions of 68% over the 1990-2050 period. Compared with the reference scenario, the mitigation scenario has a number of positive effects for society over the period 2010-2050 including higher GDP, a lower unemployment rate, lower energy imports and lower households’ energy expenditures, even including the costs of energy-renovations. The positive effects for GDP only start in 2015 and household budgets only become lower from around 2025. Until then there is an “investment period” with up to 0.3% lower GDP in one year. Unfortunately, the CO_2 reductions are below the objective of a “Factor Four” - 75% reduction of emissions over the 1990-2050 period.

Because the reductions did not meet the reduction objective, the modelling team designed an “additional measures scenario” with renovation obligations for buildings and with an energy/CO_2 tax instead of a CO_2 tax only. Both measures were not supported by a majority of stakeholders. This alternative scenario leads to 73% emission reductions instead of 68%, over the 1990-2050 period.



Sectoral CO_2 emissions of the "Acceptable Scenario"

(-68% in 2050)



Sectoral CO_2 emissions in the "Additional Measures Scenario" (-73% in 2050)

Figure 5.2.1 Development of CO_2 emissions in the Mitigation Scenario and the Additional Measures Scenario

The stakeholders asked for sensitivity analyses. The modelling team carried out sensitivity analyses for fossil fuel prices, for a less materialistic lifestyle, and for "re-shoring", where consumption styles imply for more domestically produced goods. These gave the following resulting emission reductions 1990-2050:

- 68% reductions with standard assumptions
- 74% reductions with 30% higher oil price
- About 70% reductions with 30% less material demands and higher service sector demand instead
- About 66% reductions with "re-shoring" of productions

Also the impact of a different use of the carbon tax revenues was investigated with sensitivity analyses.

The results were based on three sectoral dialogue meetings with stakeholders:

1) Residential sector, where stakeholders agreed to a series of measures including tax credits and zero-interest loans for energy renovations, a carbon tax. These measures lead to the renovation of most buildings up to a level “C” (annual heat consumption 91-150 kWh), while new buildings will have heat consumption below 50 kWh/year.

2) Transport sector, where stakeholders agreed to a series of measures including eco-taxes, urban planning, promotion of tele-working, a rail investment program, together leading to a smaller shift from road to rail, but a large-scale introduction of hybrid-electric vehicles. Hybrid-electric vehicles represent 50% of the car fleet in 2040 with most of the rest being fuel-driven cars with consumption better than 3L/100 km.

3) Electricity sector, where stakeholders agreed to ban shale gas, and keep nuclear and Carbon Capture Storage (CCS). Agreed policy measures included progressive tariffs (higher tariffs above a given consumption level), feed-in tariffs, and taxes. This package of measures leads to a gradual increase in renewable electricity, gradual decrease in nuclear power production, and some fossil fuel use to meet the remaining demand. Electricity exports were drastically reduced compared to the today’s situation.

The policy and incentive measures in the mitigation scenario are listed in the table below

Residential sector	**Tax credits:** The purchase of refurbishment elements is eligible to income tax credits. Increased rates and an extended eligibility base are modeled from 2009 until 2050 through a uniform tax rebate of 30% of the investment.
	Zero-interest loans for retrofitting actions: 0% interest rates apply for retrofit packages with a maximum amount at 30,000€ per dwelling. The credit duration period is about 10 -15 years.
	Thermal regulation for new buildings: From 2012 maximum primary energy consumption level: 50 kWh/m²/year of primary energy. After 2020: new buildings have to be net producers of energy.
	Implicit representation of **obligatory renovation funds for jointly-owned buildings** availability of **third-party financing** which reduces the risk aversion of the agents
	Biogas: The biogas penetrates gradually between 2012 and 2050. Its share reaches 17% in the gas in 2050.
Transport sector	**Urban planning:** Economic incentives and regulations slow down urban sprawl until 2030. After 2030 urban density increases again.
	Urban transports investment program: Investments in urban transports (buses, tramways) are doubled during 15 years from 2012
	Tele-working: one day of work out of ten
	Vehicles occupation rate: increase of the cars occupation rate for urban transport from 1.25 to 1.5.
	Kerosene tax: A tax on kerosene consumption for air transport is introduced in 2012. It represents 400€/toe.
	Heavy truck environmental tax: an eco-tax on the liquid fuel consumption of heavy trucks is introduced in 2012. It is calibrated to bring in 1.2 billion € in 2012.
	Rail investment program: Investments in road infrastructures are limited to maintenance of infrastructures. Investments are shifted from road to rail for 20 years.
	All collective transports investments are deducted to the road **infrastructures investments**.
	Bonus-malus: is extended until 2050. A positive annual financial balance for the government budget or at least close to 0 is obtained.
	Logistics: annual decoupling of freight transport needs of 1% for all sectors.
	Infrastructures: the modal share of rail transport in freight reaches only 20% in 2030
	Biofuels: Biofuels penetrate following the biofuel development in the WEO 2006

Electricity	**Feed-in tariffs:** Feed-in tariffs for renewable energies are economic incentives to facilitate the market penetration of these technologies to accelerate the learning effect. Feed-in tariffs are normally decreasing over time and end when the technologies achieve price competitiveness with other technologies.
	Demand side management: implicit measures (interruptible contracts, smart metering) are used to flatten the load demand curve.
	Interdiction of electric heating: Electric heating is not globally banned but the implementation of the thermal regulation up from 2012 is *de facto* excluding electric heating (exception heat pumps).
	Grid construction: The construction of renewables triggers additional grid investments, thus increasing the electricity price for 3€/MWh in the mitigation scenario
	Expectations: The electricity sector is assumed to receive clear carbon tax signals and expects the exact value of the carbon tax for the whole period.
	Existing nuclear plants lifetime extensions: 40 GW out of 63 GW have their lifetime extended for 0.7 billion €/GW.
Overall policy measures	**Carbon tax:** 32€/tCO_2 in 2012, 56€/tCO_2 in 2020, 100€/tCO_2 in 2030, to 200€/tCO_2 in 2040 and to 300€/tCO_2 in 2050
	Progressive tariff: For all households, any consumption above 60 kWh/m2 is more expensive: 5% after 2014 and of 10% after 2030.
	Carbon tax recycling: The carbon tax is recycled in a lump sum towards households

Figure 5.2.2 Table with policy measures in the Mitigation Scenario

5.3 Comparing the German and the French Scenarios

There are substantial differences between the German and the French scenarios. This is not only caused by the difference between the two countries and the different decisions of the stakeholders involved. Also the different models used in the project and the different approaches for stakeholder involvement is important for the differences. Because of the variations of several factors that influenced the scenarios, a comparison of the French and the German scenario cannot be used to draw conclusions on specific differences between the results. Instead the following comparison explains major reasons for some of the observed differences between the scenarios.

The German scenarios consist of a set of three scenarios that are results of stakeholder preferences and judgements, while the French scenarios consists of a central scenario (acceptable mitigation scenario), integrating stakeholder opinions, an additional measures scenario that does not have support of a majority of the consulted stakeholders, and sensitivity analyses for the scenarios.

The French “Mitigation Scenario” has a positive influence on GDP compared with the reference scenario with limited emission reductions; while all German scenarios show GDP losses against a counterfactual baseline case with only limited reduction efforts (see Figure 5.1.2). This difference has its reason in the difference of the modelling tools: the REMIND-D’s baseline is inter-temporally optimised, so it is not possible to generate another scenario with lower costs, while this is possible for the Imaclim-R France.

Another important difference between the French and the German scenarios is the continued use of nuclear power in the French scenarios, though on a lower level than today. The French stakeholder-majority wished the maintenance of nuclear power in the electricity mix.

The French scenarios include an “Additional Measures Scenario” that reaches the “Factor Four” emission reduction objective with two additional measures, which were not consensual among stakeholders. This is similar to the German “paradigm shift+” scenario that reaches lower mitigation costs but includes technologies, e.g. CCS, that are not well accepted by the stakeholders.

In conclusion, the different models produced different scenarios that are not comparable in details, e.g. it is not possible to compare the cost or benefit of the transition between scenarios made with REMIND-D and Imaclim-R France. But the similar approaches of stakeholder involvement showed the benefit of this approach by producing scenarios that are acceptable for a large number of stakeholders.

6. Joint Conclusions and Lessons Learned from French and German Project Parts

This chapter gives an overview of the main conclusions from the stakeholder-based scenario creation process that can be useful for others intending to elaborate low-carbon strategies and scenarios with stakeholder involvement. It summarises some of the analysis and conclusions from the previous chapters, but it also uses materials from other project reports.

One factor that cannot be influenced but represents nonetheless a crucial element is the evolution of the political framework due to government changes after elections or events like the nuclear disaster in Fukushima that influenced the public debate and opinion and so the project process.

6.1 NGO - Research Institute Cooperation

An important feature of the project was the cooperation between researchers and NGOs for the scenario development. This cooperation opened the discussions between researchers and NGO representatives, enabling to bridge between the two viewpoints. In addition, the approach taken to tackle issues is often very different, and the interaction was to our mutual benefit.

The German and French team, each consisting of one NGO and one research organisation, found it also useful not only to have a national NGO - researcher cooperation, but also to have international cooperation between two similar teams within one project.

To foster viable cross-cultural communication, in the German team, the NGO-partner expressed the expectations in the form of “wish-lists”. At the beginning of a project each partner should write a wish list with expectations concerning outcomes. So, everyone can get a good understanding on how the others perceive his/her discipline. This is described in chapter 2.1 and in more detail in the article ”Social Acceptance in Quantitative Low Carbon Scenarios”, Eva Schmid, et al, 2011, available on the project’s website.

The German and French partners agree that it is important for successful cooperation between scientists and NGOs to plan a team-building process, and that the method with “wish-lists” worked well in this Project.

6.2 Choice of Energy-Economy Models for Scenarios

The ENCI-LowCarb project used hard-linked hybrid models that integrate energy-system modelling into a top-down representation of the macro economy. This is state-of-the-art modelling for national energy paths, similar to the models used by national energy planners and the EU.

The competent use of the hard-linked hybrid models increases the credibility of the scenarios and allows the integration of more aspects of future developments than it is possible with simpler modelling tools. Once developed and tested, the hard-linked hybrid models also allow quick developments of new scenarios that are similar to the ones already developed.

A detailed description of the dynamics of the modelling tools for all project partners was indispensable in order to have a common understanding of their potentials and limits. Globally the structure of these advanced modelling tools shaped clearly the scenario creation process and explains the differences between the outcomes of the German and French study.

The use of hard-linked hybrid models requires some resources, mainly in the form of research time. It also requires experienced researchers that are able to handle the model in a competent way. Further, it requires good input data; the quality of the model outputs depends on those of the inputs. In the project, the research teams in Germany and France each consisted of an experienced researcher and a Ph.D. student who spent the majority of his/her Ph.D. project on the adaptation and use of the model.

In Germany many scenarios have already been developed for reduction of fossil fuel use, and the use of advanced scenarios can bring new information to the debate. France is characterised by a less diversified scenario landscape.

In other countries, where even fewer energy scenarios are available, it is important first to establish good data for scenarios, including renewable energy potentials, potentials for energy efficiency, costs, etc., and maybe start with simpler modelling tools.

6.3 Stakeholder Involvement:

A core activity of the project was the development of a method for the transparent integration of stakeholders' contributions into the scenario design process to enhance the acceptance of the resulting low-carbon pathways. This is useful to strengthen the foundation of the scenarios, to increase their realism, and also to provide knowledge of the kind of support and opposition that a given scenario can expect in the sectors involved.

Who should be involved?

The first step in order to define who to invite was to decide which aspect of "acceptability" should be assessed?

Within the frame of the ENCI-LowCarb project it was not possible to evaluate "social acceptance", and the focus was rather on "stakeholders' acceptance". Social acceptance has different aspects that cannot be assessed with the available project tools.

In the context of energy system strategies, social acceptance can have three dimensions: (i) socio-political acceptance, referring to the acceptance of technologies and policies by the public, key stakeholders and policy-makers, (ii) community acceptance of site-specif c local projects and (iii) market acceptance, referring to the process of the adoption by consumers and investors of innovative low-emission products. Community acceptance is a highly important topic concerning the building of new energy infrastructure (electricity grid, windmills, nuclear waste deposals etc.) but it cannot be directly represented in a modelling tool with no spatial dimension.

So it was decided to invite national stakeholders.

The project partners decided to involve a small group of stakeholders (associations, trade unions, banks, enterprises, local authorities etc.) based on their importance in their respective sectors and on their interests by using a "Power-Interest-Grid". These choices led to stakeholders discussions including contrasted viewpoints. In some cases, a consensus on measures to reach the proposed CO_2 emissions reduction was not found. In France it was decided to highlight these non-consensual points with sensitivity analyses and scenario variants.

How to Involve Stakeholders?

The project partners adopted a process that started with expert workshops in key sectors. These expert workshops were followed by stakeholders' dialogue meetings in the same key sectors. For Germany, then followed a final round of feedback on each sector in stakeholders' meetings, whereas it was followed by a cross-sectoral dialogue meeting in France. Each stakeholder representative was invited to the two stakeholders' meetings. This provided the option of informing the first scenarios with the expert meetings and of adjusting scenarios between the first and the second dialogues with the stakeholders.

Good preparation and facilitation of the stakeholder meetings is important. In the project professional facilitators were used for the events.

Recommendations

- From the project we can recommend to integrate further interaction and feedback rounds with the stakeholders.
- Stakeholders want to understand the model dynamics. So sufficient time should be taken to explain the functioning of the modelling tools and to differentiate clearly between exogenous and endogenous variables.
- The more complex the modelling tool is, the more it appears like a black box. It is important to tackle this impression by being extremely transparent on modelling hypothesis and parameters.
- The development of modelling tools and scenarios needs time, which should be duly calculated in the project schedule.
- Projects are always embedded in a lively and changing political surrounding: the project framework should be sufficiently flexible to integrate policy changes.
- Basing a scenario on a limited number of stakeholders is limiting the number of possible views (even if the stakeholders are well selected). It is important to effectuate regular public opinion checks in order to avoid that the scenario is guided by a minority opinion.
- Stakeholders are also individuals belonging to a certain socio-economic environment. As most of the stakeholders have high education and a more than average income this will influence their judgment concerning for example the limit for increasing electricity prices.

For readers that are considering to start a stakeholder process, we invite you to consult the detailed descriptions of the stakeholder process in the reports on the project website. www.enci-lowcarb.eu

The processes used to select the stakeholders will depend on the situation. The method used to select stakeholders according to power/influence and interests worked well in this project.

7. Low-carbon Scenarios throughout the EU

The project went beyond the scenario creation activities in Germany and France. This included an outlook to other scenario work and to other countries. A large number of low-carbon scenarios, leading to 75% or higher reductions of greenhouse gases from 1990 to 2050 or earlier were identified: 7 scenarios for the EU countries, two other scenarios covering several countries in Europe, and 32 national scenarios. Several of these scenarios were made with some form of stakeholder involvement, but beside the scenarios developed in this project, none of them described the stakeholder process in a transparent way.

The scenarios are very different: purely technical scenarios (Negawatt in France, ZeroCarbon Britain for the UK, and INFORSE-scenarios for a number of countries), micro & macro-economic scenarios, and a few scenarios made with hybrid-models as in the ENCI-LowCarb project and the EU Roadmap 2050.

Because of the difference between the modelling tools and hypothesis, it is difficult and sometimes impossible to compare scenarios. We have documented this in the reports "Energy Scenarios in Germany and France – Comparing Apples to Oranges.", 2010 and "French Greenhouse Gas Emission Reduction Scenarios", Mathy, Bibas, Fink 2010, available from the project website.

Not all countries have the same number of ambitious low-carbon scenarios. Many scenarios are available for Germany, and also for France and Denmark. In other countries, such as Latvia, there are many scenarios, but most of them do not lead to at least 75% reduction of green house gas emissions, and are therefore not included in the project's database of low-carbon scenarios.

The project team has only identified a few low-carbon scenarios for the Eastern EU countries and none for some Southern European countries (Portugal). The project outreach via the INFORSE network has identified substantial interest among NGOs in the Eastern part of the EU for development of low-carbon scenarios.

One group of scenarios stands out: the European Commission Roadmap 2050 scenarios, published in 2011 and showing how the 27 EU countries jointly can transform their energy supply and achieve 80% greenhouse gas reductions 1990 – 2050. This roadmap includes five decarbonisation scenarios based on different technology choices (CCS delayed, low nuclear development, high renewable energy potential etc.).

The Roadmap2050 is based on an online consultation process, but it is not clear how the inputs received have been taken into account in the development of the roadmaps and anyhow this kind of consultation remains one sided as no real discussion can take place.

In addition to national scenarios and scenarios for more countries, a large number of local and regional scenarios have been developed in Europe, each covering for instance a municipality. The project has discussed this aspect in the report "Local and Regional Scenarios Methodology, Challenges and Opportunities", Meike Fink et al, 2011, available on the project's website.

8. Networking among NGOs and Researchers for Transition to Low-Carbon Societies

A special part of the ENCI-LowCarb Project was dedicated to networking for the creation of researcher-NGO cooperation for development low-carbon scenarios and strategies with civil society and stakeholder involvement. As part of that a number of existing networks of primarily researchers working for low-carbon scenarios were identified. The networks all include European participation, but are generally of a more global nature. Each network has its special function and many of them are quite loose. The Project also formed a network to create a platform for exchange between researchers and NGOs working on low-carbon societies, scenarios, and strategies, the *Low Carbon Societies Network*.

In this chapter a short overview is given on the main networks identified. On the Low Carbon Societies Network website a longer description of many of the networks is available.

The **Low Carbon Societies Network** was started during ENCI-LowCarb project as a meeting place between NGOs and researcher involved in low-carbon scenarios & strategies, and as a vehicle for promotion of development of low-carbon scenarios with stakeholder involvement. One Project partner, INFORSE-Europe, is committed to continue the network after the ENCI-LowCarb Project ends. www.lowcarbon-socities.eu

Energy Modeling Forum (EMF) is a research network bringing together some of world's leading researchers in energy models, primarily macro-economic models. It is coordinated from the Stanford University in the USA. EMF participates in the Integrated Assessment Consortium (IAMC) that assists the Intergovernmental Panel on Climate Change (IPCC) in the development of scenarios http://emf.stanford.edu/

Dubrovnik Conference on Sustainable Development of Energy, Water, and Environment Systems is organizing an international conference every second year and is promoting sustainable development of energy, water and environment systems trough seminars and workshops and by providing professional opinion on sustainability. It is an important meeting point for researchers working on scenarios, primarily micro-economic scenarios. The latest conference was in 2011. http://www.dubrovnik2011.sdewes.org/

The Balaton Group – (formally: The International Network of Resource Information Centers) is an international network of researchers and practitioners in fields related to systems and sustainability, started by the authors of the ground-breaking "Limits to Growth" . They group meets every year at Lake Balaton in Hungary. http://www.balatongroup.org

COMMEND is an international initiative designed to foster a community among energy analysts working with the LEAP model on energy scenarios for sustainable development. It is headed by the Stockholm Environmental Institute in Boston, USA.

http://www.energycommunity.org

International Research Network for Low Carbon Societies (LCS-RNet) The network is a platform to support and to encourage information sharing and voluntary cooperation among for research institutes and governmental agencies specifically in the field of LCS research. It is established as an international cooperation between EU, Japan, and others.

http://lcs-rnet.org/index.html

Climate Neutral Network (CN Net) launched in February 2008 is an initiative of the United Nations Environment Programme (UNEP) to promote national, regional and global action and involvement in climate neutrality at all levels of society. Today, the CN Net numbers among its participants countries, cities, major international companies, UN agencies and leading NGOs. They are the trailblazers on the route to zero emission economies, communities.

http://www.unep.org/climateneutral/About/tabid/95/Default.aspx

Global Footprint Network is a network for developments of global footprints (land, carbon water) is formed a network of partners that are expanding the use of the footprint methodology. http://www.footprintnetwork.org

9. Project Reports of the ENCI-LowCarb Project

The sources for this report are the other reports and articles with the results of the ENCI-LowCarb Project. The ENCI-LowCarb reports as well as the project's fact sheets, posters, newsletters, conference proceedings, and articles that are all available from the Project's websites: www.lowcarbon-societies.eu and www.enci-lowcarb.eu. There are the following project reports, in addition to this report.

9.1 Acceptable low-carbon energy scenarios for France and Germany

- Bibas, Ruben / Mathy, Sandrine / Fink, Meike (2012) **Building a Low Carbon Scenario for France: How a Participatory Approach Can Enhance Social and Economic Acceptability,** ENCI-LowCarb project report
- Bibas, Ruben / Mathy, Sandrine / Fink, Meike (2012) **Elaboration d'un scénario bas carbone pour la France: une approche participative pour intégrer l'acceptabilité sociale et économique**, ENCI-LowCarb project report, French version of above report

Presentation of model-based mitigation scenarios for France developed within the project ENCI-LowCarb representing the outcome of a collaborative scenario design process. The modelling tool Imaclim-R has been used for this exercise. The scenario is based alone on the contributions of the consulted French stakeholders. The emissions reductions following the implementation of all the measures that were judged acceptable by the stakeholders only leads to a 68% CO_2 emissions reduction in 2050 compared to 1990. This report reveals the need for a strong political commitment to leverage the decarbonisation of the energy system. Additional measures are presented that can significantly impact the CO_2 emissions trajectory, namely the uncertainties around fossil energy prices, a border tax adjustment and a change of the development styles.

- Schmid, Eva / Knopf, Brigitte (2012) **Ambitious Mitigation Scenarios for Germany: A Participatory Approach**, ENCI-LowCarb project report

Presentation of model-based mitigation scenarios for Germany developed within the project ENCI-LowCarb. The scenarios integrate the technological, economic and socio-political dimensions of ambitious domestic CO2 abatement. Civil society stakeholders from the transport and electricity sector framed the boundary conditions for the energy-economy model REMIND-D and evaluated the scenarios by means of a participatory approach. All scenarios achieve 85% CO_2 emission reduction in 2050 relative to 1990.

- Burck, Jan / Schmid, Eva / Knopf, Brigitte (2012) **Building Ambitious Low Carbon Scenarios - A Participatory Approach Applied to Germany,** ENCI-LowCarb project report
- Burck, Jan / Schmid, Eva / Knopf, Brigitte (2012) **Ambitionierte Klimaschutzszenarien für Deutschland – ein partizipativer Ansatz**, ENCI-LowCarb project report, German version of above report

Presentation of three model-based mitigation scenarios for Germany developed within the project ENCI-LowCarb. All scenarios achieve 85% CO_2 emission reduction in 2050 relative to 1990. The scenarios are based on contributions of national stakeholders.

9.2 Reports on the project methodology and the modelling tools

- Schmid, Eva / Knopf, Brigitte / Branche La, Stéphane / Fink, Meike (2012) **Social Acceptance in Quantitative Low Carbon Scenarios**, ENCI-LowCarb project report and published in «Civil Society for Sustainability - A Guidebook for Connecting Science And Society » Renn, O., Reichel, A. ,Bauer, J. (Eds.) Civil Society for Sustainability - A Guidebook for Connecting Science And Society, Europäischer Hochschulverlag, Bremen

Description of a conceptual innovative project design, intended to foster collaboration between civil society and science in the field of introducing social acceptance in mitigation scenarios. It is based on the experience from the EU project ENCI-LowCarb.

- Schmid, Eva / Knopf, Brigitte / Bauer, Nico (2012) **REMIND-D: A Hybrid Energy-Economy Model of Germany**, ENCI-LowCarb project report

Description of the modelling tool REMIND-D used for scenario creation process of the project ENCI-LowCarb in Germany. REMIND-D has been developed by the Potsdam Institute for Climate Impact Research. The basic purpose of REMIND-D is to provide a quantitative framework for analyzing long-term domestic mitigation scenarios for Germany. REMIND-D facilitates an integrated analysis of the long-term interplay between technological mitigation options in the different sectors as well as macroeconomic dynamics.

- Bibas, Ruben / Mathy, Sandrine / Fink, Meike (2012) **Scientific Report - Building Socially and Economically Acceptable Energy Scenario - A Participatory Approach Applied to France**, ENCI-LowCarb project report

Scientific description of the modelling tool Imaclim-R and the collaborative scenario creation methodology used for the co-construction of a low carbon scenarios for France based on the contributions of national stakeholders. Besides the “acceptable” scenario that only includes policy measures judged to be acceptable by stakeholders (-68% of CO2 emissions reduction), sensitivity analysis are presented and an more ambitious scenario with additional measures is explored.

- Burck, Jan / Schmid, Eva / Knopf, Brigitte (2012) **Expert & Stakeholder Meetings in Germany within a Collaborative Scenario Creation Process**, ENCI-LowCarb project report

Summary report of the expert and stakeholder dialogues that were organised within the ENCI-LowCarb project in Germany. Two sectoral expert meetings were organized in order to assure technical and economic realism of the scenario assumptions. The contributions of two rounds of sectoral stakeholder (trade unions, enterprises, consumer associations) workshops allowed the creation of “desirable” mitigation scenarios.

- Fink, Meike/ Bibas, Ruben / Mathy, Sandrine (2012) **Expert & Stakeholder Meetings in France within a Collaborative Scenario Creation Process**, ENCI-LowCarb project report

Summary report of the expert and stakeholder dialogues that were held within the ENCI-LowCarb project in France. Three sectoral expert meetings were organized in order to assure technical and economic realism of the scenario assumptions. The contributions of two rounds of sectoral stakeholder (trade unions, enterprises, consumer associations) workshops allowed the creation of an “acceptable” mitigation scenario.

9.3 Scenario Comparisons for Germany and France

- Burck, Jan Blücher von, Felix / Fabian, Theresa (2010) **Welche Energiezukunft ist möglich?** ENCI-LowCarb project report

A detailed analysis of four German energy scenarios has been carried out on: (1) the modelling methodologies, (2) the underlying economic and technological assumptions, (3) the represented political and economic measures to reduce emissions as well as, (4) the evolution of energy consumption and emissions reductions of the different sectors (transport, industry etc.) and (5) the technological and energy pathways involved to follow the specific emission trajectories.

- Bibas, Ruben / Mathy, Sandrine / Fink, Meike (2010) **Scénarios de reduction d'émissions de gas à effet de serre pour la France**, ENCI-LowCarb project report

A detailed analysis of eleven French energy scenarios and visions has been carried out on: (1) the modelling methodologies, (2) the underlying economic and technological assumptions, (3) the represented political and economic measures to reduce emissions as well as, (4) the evolution of energy consumption and emissions reductions of the different sectors (transport, industry etc.) and (5) the technological and energy pathways involved to follow the specific emission trajectories. In French with abstract (11 pages) in English

- Burck, Jan / Fink, Meike (2010) **Energy Scenarios in Germany and France – Comparing Apples to Oranges.** ENCI-LowCarb project report

This paper summarizes the main results of the detailed analysis exercise of existing German and French energy scenarios effectuated in the frame of the ENCI- LowCarb project.

9.4 Local & regional scenarios

- Fink, Meike (2011) **Local and Regional Scenarios Methodology, Challenges and Opportunities**, ENCI-LowCarb project report

This publication on local and regional energy scenario aims at giving a methodological and practical overview on what can, should and is happening concerning the development of infra-national energy future visions. It includes chapters on the importance of choosing the emission scope, on the reduction potentials of energy sufficiency and on the concept of 100% renewable energy regions.

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