EUROPEAN
# pathways

NEWSLETTER FROM »PATHWAYS TO SUSTAINABLE EUROPEAN ENERGY SYSTEMS«

#2/2009

## Two disputations


*"I am proud that there are two new PhD dissertations from the project. On May 20, Julia Hansson defended her thesis on future bioenergy use in Europe, a highly relevant work considering recent debates on the prospects of bioenergy. On June 9, Mikael Odenberger will present his thesis on pathways for the European electricity supply sector under stringent $CO_2$ reductions."*

*Filip Johnsson, project manager*

*page 8*






*Pathways to Sustainable European Energy Systems* is a project within THE AGS The Alliance for Global Sustainability

# Two European Pathways

**Two Pathways to Sustainable European Energy Systems are presented in brief, based on the results developed in the different research groups within the Pathways project.**

**Pathway "Policy 1.0"**
This pathway is based on a development that to a great part is policy driven: the "climate and energy package" of EU sets the aim for 2020.

**Pathway "Market 1.0"**
An alternative pathway is based on a development that to a higher degree is market driven.

In this pathway, system changes of the energy system are important.

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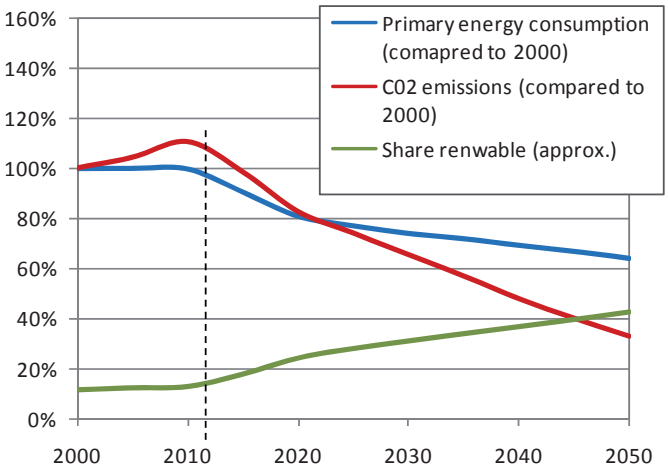


The development of the $CO_2$ emissions, renewables and primary energy use in Pathway "Policy 1.0"

## Path-to-RES
# 2nd Consortium meeting, Arnheim, March 2009

An optional opening event for the Path-To-RES meeting was held at Villa Sonsbeek in Arnhem arranged by the host of the meeting, Mr Jaap Huurman. Besides consortium members of Path-To-RES, some special guests were invited, for example the Vice-Mayor of Arnhem for Energy and Economics of the City of Arnhem, Mrs. Rita Weeda and the National Minister of Spatial Planning and Environment, Mrs. Jacqueline Cramer.

*cont'd on page 7*

## Energy market scenarios

The industrial group has now completed their work with developing energy market scenarios. The scenarios have been constructed by using a new tool developed within the Pathways project.

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# Project status

**In spite of the economic recession there is a growing interest in the area of energy and on sustainable development and, thus, we have seen significant interest in recent results presented from our project. Examples are possibilities with electrification of the transportation sector, such as how plug-in hybrid electric vehicles can act on the control power market which was presented in a recent study. Another important issue is local and regional energy planning.**

Below are some examples of activities in focus during the last quarter.

## Two new PhD dissertations

First, I am proud that there are two new PhD dissertations from the project. On May 20, Julia Hansson defended her thesis on future bioenergy use in Europe, a highly relevant work considering recent debates on the prospects of bioenergy. On June 9, Mikael Odenberger will present his thesis on pathways for the European electricity supply sector under stringent $CO_2$ reductions. A significant part of Odenbergers work has been devoted to development of an energy systems model. The work presented in the two theses is very representative for the methodology chosen in the Pathway project, namely that they try to assess the energy system in a detailed way, including how the present energy infrastructure influences the Pathways into the future.

## Sustainable Pathways

We have now started the process of formulating Pathways for the entire European energy system up to the year 2050. This is a work that was initiated recently and will continue with the aim to put together a good synthesis from the various works in the Pathway project.

## The Path-to-RES project

The Path-to-RES project has held its second workshop in Arnhem in Holland. The project deals with local and regional energy planning and is based on six case studies. The project is carried out in connection to the Pathway project and gives a very different perspective on pathways to sustainable energy system than is obtained from the analysis on the overall European level with models as the ones mentioned above.

## Attitudes on CCS

A previous work on stakeholder attitudes on Carbon Capture and Storage has been followed up and the results were compared with those of the previous work. The results are presented in a paper “Stakeholder Attitudes on Carbon Capture and Storage - an international comparison”. The results of the follow-up shows that respondents consider CCS to play an increased role in the national climate debate. For example, in Japan there was a clear trend in that an increased fraction of respondents claimed that their organization has a clear position on CCS compared to the result of the original survey. Thus, this and other information clearly show that CCS is becoming higher and higher up on the agenda. Yet, as shown in modeling work in the project, it is a great challenge for society to implement a CCS infrastructure in a timely manner. The question of timely investments in CCS infrastructure is something we plan to address in more depth in upcoming work on CCS infrastructure, not only for the electricity generation system but also for the heavy industries in Europe.

## Conferences and workshops

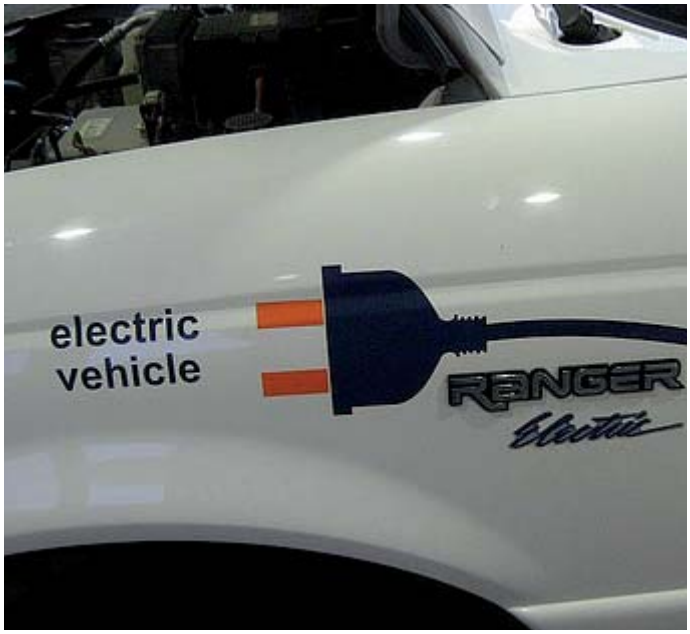
As during previous periods, results from the project have been presented to different audiences in conferences and workshops. An example is the Swedish Energitinget, the main Swedish energy conference arranged by the Swedish Energy Agency. In the conference, Julia Hansson presented her results from an analysis of the EU goals on 20% renewable energy, 20% $CO_2$ emission reductions and a 20% increase in energy efficiency.

An internal Pathways workshop on interdisciplinary topics was held on March 3, in Göteborg. The workshop discussed various items related to implementation of technologies and systems such as siting issues with experiences from wind power.

The project follows the plan and I am looking forward to the continued activities during 2009!

**Prof. Filip Johnsson**
Project manager of the Pathway project

# Profit for PHEVs as providers of frequency control

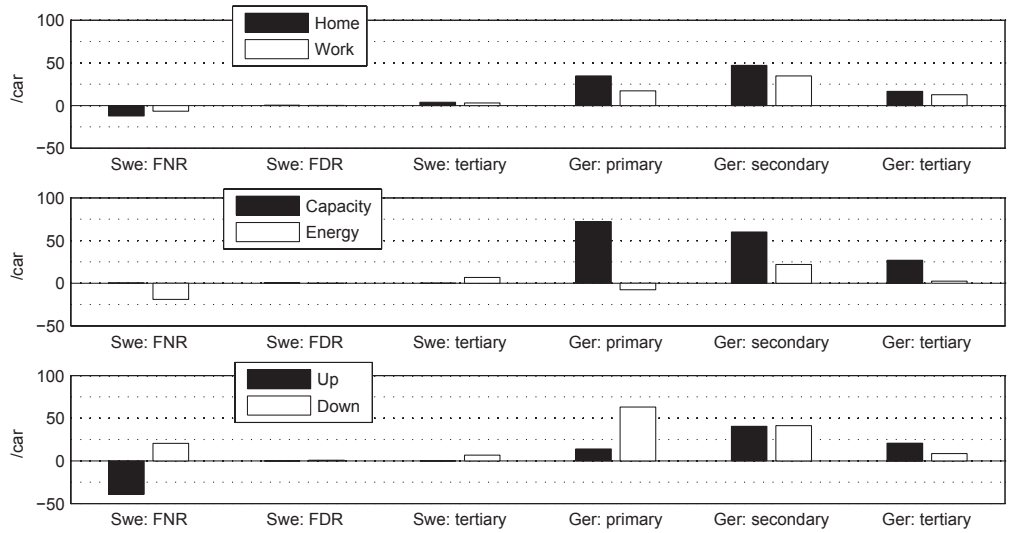



**In their Master's thesis, Anna and Sara Linnea Andersson show that Hybrid Electric Vehicles can profit by providing real time frequency control in the electricity grid. The work is about to be finished and will be published on the Pathways homepage soon.**

This study investigates the profit for Plug-in Hybrid Electric Vehicles (PHEVs) as providers of real time frequency control. One benefit of using PHEVs as control power is that it allows increased share of renewable intermittent power production in the system. A simulation model was constructed to estimate the maximum possible profits that PHEVs could generate by participating on the control power markets.

PHEVs can regulate both up and down by discharging and charging their battery, respectively. A capacity price can be paid to an actor (e.g. PHEVs) that is ready to deliver control power with short notice. In the case of regulation up, the energy price is paid to the actor that delivers energy. In the case of regulation down, the actor pays for the energy it extracts from the grid as regulation down, but it pays a lower price than it would have done if buying the energy in a conventional way.

The results indicate that PHEVs cannot generate a profit while acting as control power on the Swedish control power markets, but that maximum average profits generated on the German markets lie in the range of 30-80 € per vehicle and month. The higher profits in Germany can be explained by higher price levels on both capacity and energy for control power in Germany.




Top: Comparison of average profit generated by one PHEV one month from the time parked at home and the time parked at work. Middle: Comparison of average profit generated by one PHEV one month originating from capacity and energy payments. Bottom: Comparison of average profit generated by one PHEV one month by providing regulation up and down

# Two European Pathways

**Work has been initiated to fomulate Pathways for the entire European energy system. As a first work, two Pathways to Sustainable European Energy Systems have been developed. The two pathways are based on the results developed in the different research groups within the Pathways project.**

Main tasks in the Pathway project are:
• Develop "Pathways to Sustainable Energy Systems".
• Identify key measures for these Pathways.

Two possible pathways are presented in brief, based on the results developed in the different research groups within the Pathways project. In some research groups energy models are used. In cases where the results from the research groups were not enough to give a complete picture (e.g. in the transport sector), results from e.g. the Primes model of the European Commission where used.

## Pathway "Policy 1.0"

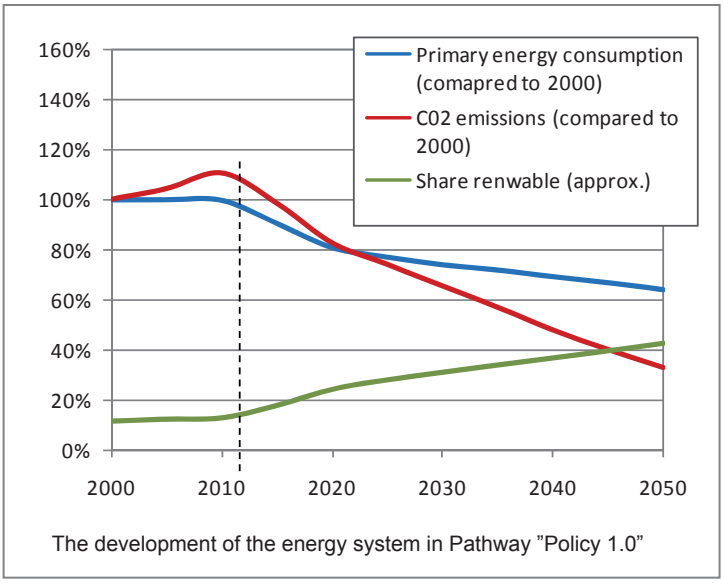
This pathway is based on a development that to a great part is policy driven: the "climate and energy package" of EU sets the aim for 2020. This policy package has the climate issue as the main focus, but also includes targets for share of renewable fuel and energy efficiency. However, a stimulus for system changes – e.g. conversion to clean electricity and expansion of district heating - is not included. After 2020, the policy driven development is assumed to continue until at least 2050 in this pathway.

## Pathway "Market 1.0"

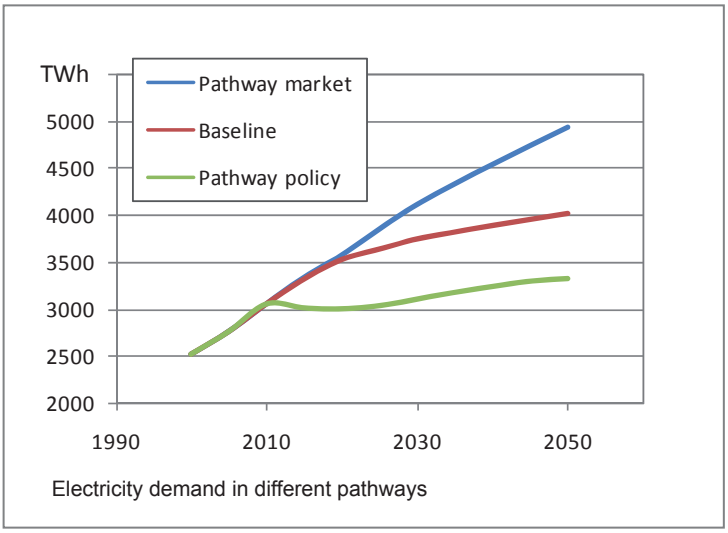
An alternative pathway is based on a development that to a higher degree is market driven. The aim for reduction of carbon emissions is the same as in Pathway "Policy 1.0", but the measures to reach the target are more supply oriented. In this pathway, system changes of the energy system are important. The system changes include increased use of electricity and district heating. Production of electricity can be carbon free by 2050. Hence, a shift to these energy sources is a path for sustainability.

In Pathway "Market 1.0", there are no separate targets for energy efficiency and renewable energy as in the policy driven pathway. Exclusion of policy driven energy efficiency targets is motivated by the fact that policy driven energy efficiency has shown to be difficult: the result is often far less than estimated potential. Hence, the measures in this pathway are focused on the supply side instead of the demand side. Also the share of renewable alternatives is assumed to be market driven in this pathway and only the renewable alternatives which are compatible to fossil alternatives with $CO_2$ charge are included.

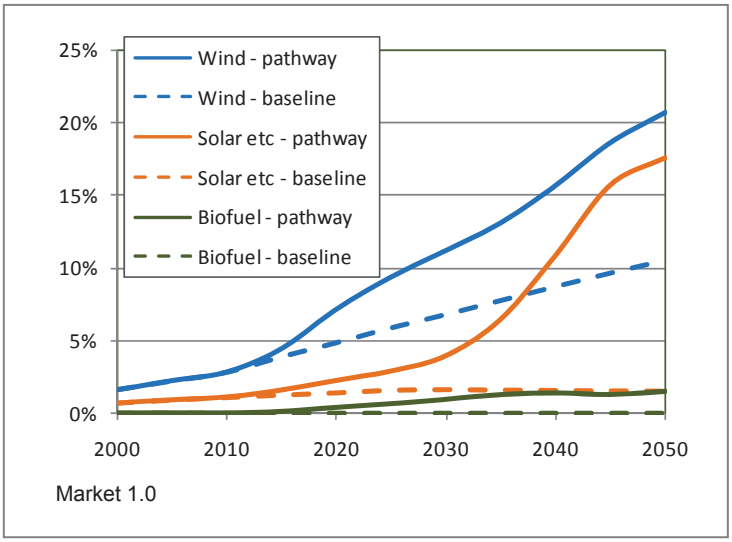
*For further information:*
Erik Axelsson and Bo Rydén, Profu and Filip Johnsson, Chalmers University of Technology




The development of the energy system in Pathway "Policy 1.0"




Electricity demand in different pathways

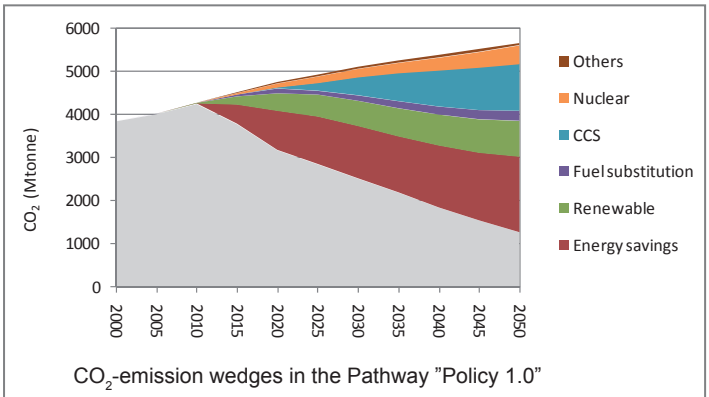



Market 1.0

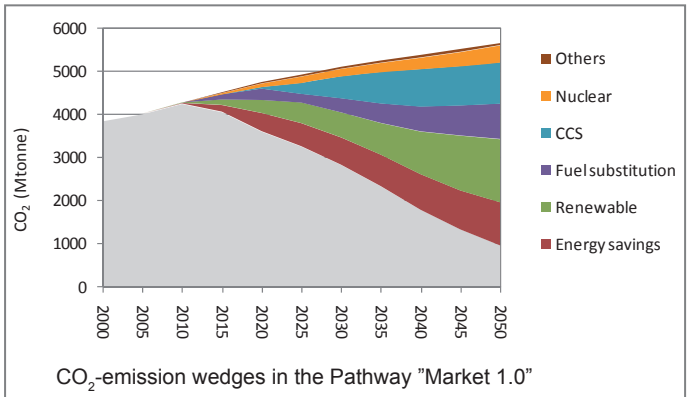
# Bridging technologies in Pathways

## Total $CO_2$ emissions "wedges" in all sectors, by type of measures

The measures that decrease the $CO_2$ emissions in the two pathways are presented in the two figures as "wedges". As can be seen, "Policy 1.0" is much more dependent on energy efficiency measures than "Market 1.0", which is more supply side oriented.




$CO_2$-emission wedges in the Pathway "Policy 1.0"




$CO_2$-emission wedges in the Pathway "Market 1.0"

## The most important measures to decrease the $CO_2$ emissions

Below, the most important measures to decrease the $CO_2$ emissions to 2020 and 2050 are presented and ranked qualitatively in order of importance (importance= $CO_2$ reduction in tonnes). As can be seen, energy efficiency measures top the list in "Policy 1.0". In "Market 1.0", the measures are much more supply side oriented, but the most cost effective energy efficiency measures are still implemented.

| Patway Policy 1.0 | | | | Patway Market 1.0 | | |
|---|---|---|---|---|---|---|
| 2020 | 2030 | 2050 | Energy efficiency measures | 2020 | 2030 | 2050 |
| 182 | 218 | 326 | Electricity saving in industr. sector | 0 | 0 | 0 |
| 314 | 414 | 547 | Electricity saving in domestic sector | 0 | 0 | 0 |
| 48 | 61 | 101 | Fuel efficiency in industrial sector | 48 | 61 | 101 |
| 120 | 207 | 309 | Heat saving in dom. sector | 49 | 82 | 138 |
| 259 | 318 | 425 | Energy effficiency in transport | 189 | 225 | 290 |
| | | | Renewable energy | | | |
| 47 | 65 | 53 | Wind power | 70 | 141 | 355 |
| 35 | 73 | 147 | Solar, wave, tidal etc. | 27 | 88 | 541 |
| 46 | 70 | 116 | Biomass & waste in el/dh-production | 37 | 115 | 233 |
| 46 | 66 | 111 | Biomass in ind. & dom. sector | 36 | 52 | 86 |
| 99 | 140 | 163 | Biofuel in transports | 82 | 110 | 124 |
| | | | Other measures | | | |
| 96 | 199 | 429 | Nuclear power | 84 | 177 | 395 |
| 20 | 355 | 949 | CSS | 35 | 444 | 823 |
| 52 | 0 | 0 | Coal to gas in el. sector | 184 | 0 | 0 |
| 37 | 79 | 149 | Expansion of district heating | 45 | 93 | 184 |
| 0 | 0 | 0 | Heat pumps in dom. sector | 61 | 141 | 256 |
| 1 | 16 | 49 | Electric vehicles | 39 | 240 | 641 |

*The $CO_2$ reduction (Mtonne) for the different measures and years in the two different pathways. The color intensity (from yellow to green) indicates the relative importance of a measure in that year and pathway. Energy efficiency measures dominate in the policy pathway, while the market pathway is much more supplier oriented*

# The co-ordination of private and public interests regarding new energy infrastructure

## - research workshop in the Pathways project

**In March 2009, Pathways researchers held a workshop on the themes: Policy processes and implementation, location problems and energy infrastructure, wind power and land use. This workshop concluded a preliminary strategy for the work around these subjects within Pathways, including the following steps.**

### Key issues in policy implementation

Review lessons from research on facility siting and the planning and organization of infrastructure mega-projects; the interplay of politics and administration; and some key issues in policy implementation.

### The concept of "path dependency"

The concept of "path dependency" has been used in the policy literature to explain historical trajectories of "reform" or policy making-implementation, nested decision making and co-operation among institutional actors. Review and discussion of the concept of "path dependency"; how can this concept contribute to investigate the shaping of commitment and co-operation (or lack of)?

### "Governance"-networks

Discuss governance and the assumptions about the role of "governance"-networks, which imply a "need" for co-ordinated (co-operative) action. Empirical questions:

- How are networks (essential for implementation) formed in land use planning?
- What actors are included?
- How is collective commitment built and maintained?
- How is implementation planned?

### Aim

Analyze all these problems in the light of empirical findings regarding land use planning processes. Outline some basic features of infrastructure facility planning in a policy and regulatory context.


*Important starting points for the reserach work around policy processes in Pathways (from a slide in Swedish)*


"From government to governance". Making the public sector more effective ...

### Study

Compare infrastructure mega-projects (e.g. railway planning) and energy planning (in case of wind farms) with regard to the role of the "public interest" and how this interest is weighed against other specific (sectorial) interests (conservation: biology, archeology, landscape etc). Systematically assess similarities/ differences between these two kinds of planning.

### Wind power development

Energy planning such as wind power development is driven by private actors and the public interest must be continually argued for. The public interest is not intrinsic to the project. It is external and can (and is) often questioned by the County Board, the EPA or in the end the Government, who identifies conservation values that the project put at risk and comes to the conclusion that the public interest is too weak to motivate giving license to the project.

*For further information:*
Åsa Boholm, CEFOS and Maria Pettersson, Luleå University of Technology

# Path-to-RES

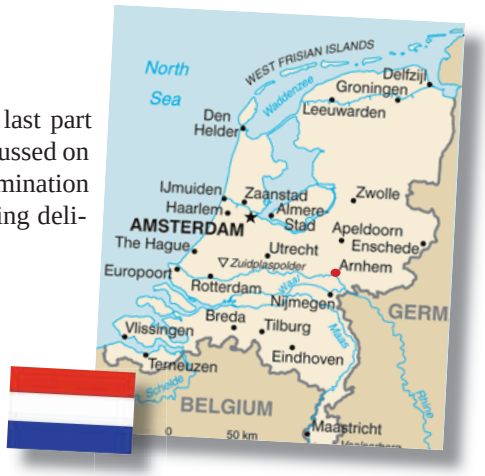
## 2nd Consortium meeting, Arnheim, March 2009

**The main focus of the meeting was to present and discuss the 2nd tentative road maps performed by each case study. The first day also included information from the coordinators, information on other EU activities and finally some information of the analysis work and the 7-step methodology.**

### The case study roadmaps

The second day included discussions of the work of the case study roadmaps and how they can be established in the case study locations. The last part of the second day focussed on presentation of dissemination activities and upcoming deliverables.

Participants at the 2nd Consortium meeting in Arnheim




*For further information:*
Jonas Nässén and Filip Johnsson, Chalmers University of Technology

## The Stoere Houtman Statements
### - Communities for a Sustainable Europe

An optional opening event for the Path-To-RES meeting was held at Villa Sonsbeek in Arnhem arranged by the host of the meeting, Mr Jaap Huurman. Besides consortium members of Path-To-RES, some special guests were invited, for example the Vice-Mayor of Arnhem for Energy and Economics of the City of Arnhem, Mrs. Rita Weeda and the National Minister of Spatial Planning and Environment, Mrs. Jacqueline Cramer.


Besides speeches from Mrs. Weeda and Mrs. Cramer the main event of the evening was presentation of the initiatives of the home owner association "De Stoere Houtman" and handouts of the first copies of the booklet 'The Stoere Houtman Statements - Communities for a Sustainable Europe' to the Minister and the other guests. In all, the afternoon illustrated the great interest and relevance of the topic of the Path-To-RES project.

## A roadmap towards sustainability

Many decisions on the future of our energy system are taken on a local level and it is therefore important to assess tools to perform local energy planning. This is the topic of the EU project "Path-to-RES" which has the aim to develop a "manual" on how to perform local energy planning. We see a growing interest in this topic and since the project is based on six case studies around Europe it gives the Pathway project a unique possibility to interact with the "real world" where the development of the energy system also depends on everyday decisions, not only on overall goals and targets set by EU.

The Path-to-RES project is very much related to daily decision making and planning by local stakeholders, including politicians and individual citizens. Obviously, such local decisions have significant impact on the possibilities to transform the energy system, especially on the end use side. Clearly, municipalities often lack long term strategies on how to develop the energy system and it is not always clear who are in charge of the decisions on such strategy. The Path-to-RES project will try to develop a clear checklist to be used by practitioners in local energy planning.

### The seven steps

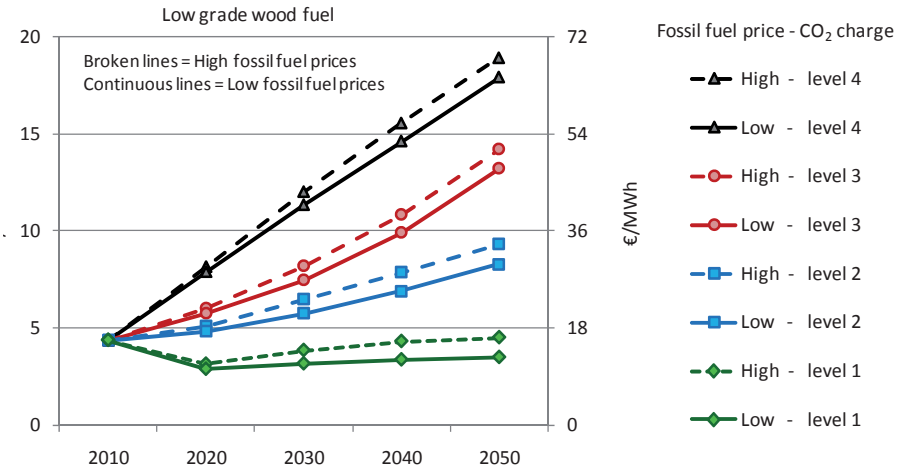
Main objective with the project:
*"To develop a 7-step checklist, which can be used to evaluate and define pathways to renewable and efficient energy systems, based on real data from six local/ regional energy systems within the European Union"*

# Energy market scenarios from the industrial group

**The industrial group has now completed their work with developing energy market scenarios for the Pathway project and the next step is to present the results in a report that will be available on the Pathways homepage.**

To assess profitability and net $CO_2$ emissions reduction potential of energy efficiency investments, considerations of future energy market conditions are needed to be taken. Energy market scenarios can be used to reflect different possible future energy market conditions. By using the energy market scenarios that represent the corner-stones of the future energy market, robust energy efficiency measures can be found.

Consistent energy market scenarios have been constructed by using a tool which connects the fossil fuel prices on the world market to energy end user prices. Required user inputs to the tool include fossil fuel prices and charge for emitting $CO_2$, and the outputs are energy market prices and $CO_2$ consequences of import/export of different energy streams (e.g. electric power, biomass and heat) to/from an industrial process site. Based on output from the tool, eight energy market scenarios from 2010 to 2050 have been constructed; see figure at the left.




Example of energy market scenarios: Sell price of low grade wood fuel for two different price setting marginal users of wood fuel

*For further information:*
Johanna Jönsson, Stefan Wirsenius, Chalmers University of Technology and Erik Axelsson, Profu

## Two disputations

### Julia Hansson

*"Perspectives on future bioenergy use and trade in a European policy context"*

The thesis provides insights on selected bioenergy issues: the use of biofuels for transportation versus heat and electricity and the possibilities for (i) biomass co-firing with coal for electricity generation, (ii) co-generation of biofuels for transportation and heat for district heating systems, (iii) an increased international biofuels trade and (iv) different bioenergy trading options, all in relation to policy targets. It is based on energy system analyses, in particular energy systems modelling and energy technology assessments.

Opponent: Gregg Marland, Distinguished Scientist, Oak Ridge National Laboratory, USA

*May, 20, 10 a.m., HC1 (Hörsalsvägen, Chalmers Univeristy of Technology, Göteborg)*

### Mikael Odenberger

*"Pathways for the European electricity supply system to 2050 – implications from stringent $CO_2$ reductions"*

The objective with the work presented in this thesis is to produce knowledge and insights of how the electricity supply system might develop under stringent $CO_2$ reduction targets.

Opponent: Professor Mark Jaccard, School of Resource and Environmental Management, Simon Fraser University

*June, 9, 13.15 a.m., HC2 (Hörsalsvägen, Chalmers Univeristy of Technology, Göteborg)*