EUROPEAN
pathways

NEWSLETTER FROM »PATHWAYS TO SUSTAINABLE EUROPEAN ENERGY SYSTEMS«

#2/2010

Project status

"The work with synthesizing the results and insights obtained from the project has been intensified during recent months. This work involves all researchers in the project and is a truly interdisciplinary exercise which, so far, has been very healthy for all of us. There are obviously no simple solutions to find Pathways towards a sustainable energy system."

cont'd on page 2

Prof. Filip Johnsson
Project manager of
the Pathway project

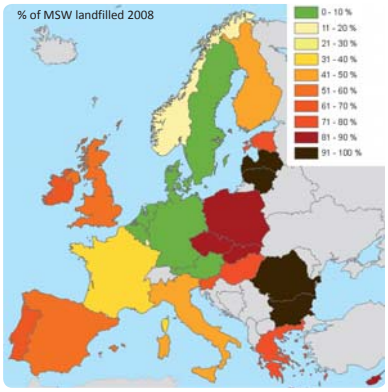
Pathways to Sustainable European Energy Systems is a project within THE AGS The Alliance for Global Sustainability

Waste can contribute to sustainability targets

European waste management is required to undergo extensive changes in order to reduce its environmental impact. Instead of being put on landfill, waste could be utilized, e.g. as fuel. This would give a double greenhouse gas reducing effect, contributing significantly to the EU202020 targets.

The current European waste management system is to a large extent based on landfilling of waste, which generally is the worst alternative from an environmental perspective. Not only is the material and energy resources of the waste not utilized, but there are also emissions to air and water, for example when organic waste fractions are decomposed to methane.

read more on page 7



Share of municipal solid waste (MSW) landfilled in 2005. MSW mainly originates from households.

Legal preconditions crucial for wind expansion

The design of legal and administrative systems related to issues of spatial planning, location, permits and operation, are crucial for the development of wind power. In Swedish law there are several counteracting factors and other barriers for wind power expansion. Less permits and a strengthened state controlled planning, as in some other counties, could facilitate expansion.

Large-scale wind power calls for power management

Wind power can be integrated into our electricity supply systems to decrease the amount of CO_2 emissions associated with the generation of electricity as well as to enhance security of supply. However, the electricity generated by wind varies in time whereas thermal units are most efficient if run continuously at rated power. Thus, depending on the characteristics of the wind-thermal system, part of the decrease in emissions realized by introducing wind power is offset by a reduced efficiency in operation of the thermal units due to the variations in wind power generation.

cont'd on pages 4-5

Project status – we are approaching the end of the project

The work with synthesizing the results and insights obtained from the project has been intensified during recent months. This work involves all researchers in the project and is a truly interdisciplinary exercise which, so far, has been very healthy for all of us. There are obviously no simple solutions to find Pathways towards a sustainable energy system. Yet, there are many possibilities and the project shows that it is possible to meet the required climate goals but that this will require that all technologies and measures are used, especially if considering security of supply and competitiveness. In addition to the scientific publications from the project, the aim is to convey the project results to a broad group of stakeholders, in industry and in governmental organizations. The aim of the synthesizing work is to find a good way to do this and in this context I am happy that we can show many opportunities for transforming the European energy system. It seems as a key message from our project could be "Yes, we can!"

Prof. Filip Johnsson
Project manager of the Pathway project

PLANETS final workshop
"Energy and climate scenarios to 2050"
for policy makers, June 8, 2010 in Brussels

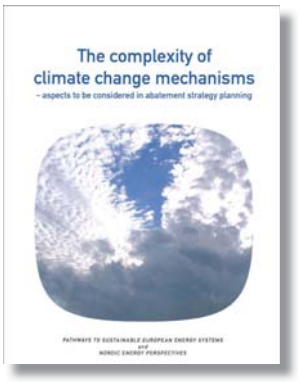
The workshop was a half day event with the aim to disseminate and discuss the main results of the PLANETS project. PLANETS is a research project funded by the European Commission under the Seventh Framework Programme with the scope of devising robust scenarios for the evolution of low carbon energy technologies in the next 50 years. The project has involved researchers from the Pathway project to assess bridging technologies with focus on biomass conversion technologies and technologies and infrastructure for carbon capture and storage. The workshop discussed implications of climate change policies on economic competitiveness and technology development at European and global level with a wide audience of experts. In the workshop, Filip Johnsson gave a talk on the role of CCS and biomass in meeting the EU climate objectives.

PLANETS project website: http://www.feem-project.net/planets/

Pathways research workshop 10-11 May, 2010

In May, a two-day Pathways workshop took place at the beautifully situated Stensjöhill in Mölndal. Prior to this meeting, all researches in the project had prepared a "two-pager" describing their most important findings. All together, these two-pager constitute an over 100 pages long document with condensed Pathways results. The two-pagers also provided an important basis for the group-discussion activities at the workshop. On the first day, the groups were divided more or less in accordance to research within energy sector. On the second day, the groups composition were more mixed, allowing for a more inter-sectoral and inter-disciplinary approach, and the main task was to reflect on the overall findings. The workshop ended with an interactive plenary discussion regarding the most important findings and conclusions of the Pathways project. The structure of the workshop proved successful in not only encouraging animated discussion grasping over a large range of subjects, from technical details to philosophical questions about the future energy system, but also resulting in specific statements and conclusions for each research area and sector discussed. The outcomes of the workshop are also essential stepping stones in preparing the final reporting of the Pathways project.

Stensjöhill in Mölndal



The report can be downloaded at:
www.energy-pathways.org/publ.htm

New report!
"The complexity of climate change mechanisms
- aspects to be considered in abatement strategy planning**"**

Climate models indicate how greenhouse-gas emissions may interfere with climate processes and the potential temperature increases of different emission scenarios. Based on a literature review, the aim of this report is to illuminate some of the findings related to climate-change mechanism. Examples of aspects discussed are the complexity of the climate system, the atmospheric constituents and their effect on the climate, sources and sinks of non greenhouse gases, and abatement measures and mitigation potentials for non-CO_2 greenhouse gas emissions.

For further information: GUN LÖFBLAD and EBBA LÖFBLAD, Profu

Pathways implies higher degree of self sufficiency

Looking at a longer perspective, indigenous fossil fuel production within EU27 will most likely continue to decrease. However, with concerted efforts to maximize production, the production decrease can be partly mitigated. This, combined with decreased fuel demand in the analysed pathways, implies that EU can become self sufficient in coal and, close to so, in gas.

Concise analysis of the reserves, resources and other premises for fossil fuel production within EU27 has been carried out by Jan Kjärstad. Based on these facts, projections of future fossil fuel production in a base case as well as in cases with concerted effort for maximum fossil fuel production within EU were constructed. These production projections are compared with the fuel demand of the two Pathways analysed in the synthesis of the Pathway project. The two Pathways - Market and Policy - has been presented in Newsletter #2/2009.

Coal self sufficiency by 2020

To reach the EU sustainability targets to 2020 and forwards, a drastic decrease in use of coal is expected. Reduced coal demand combined with the possibility of increased production of lignite, offer an opportunity for EU to become self sufficient in coal already by 2020.

EU could also be more or less self sufficient in gas. However, this cannot be achieved as early as 2020, but has to wait until 2050. The keys for attaining gas self sufficiency are reduced gas demand and possible utilization of unconventional sources; see Figure 1. Assuming that unconventional gas production can dominate the production by the end of the period studied, and that the gas demand will be halved by 2050 compared to current levels, the gap between demand and EU production will be very small. However, in the intermediate period, the need for import can increase, especially in the Market Pathway where there is a heavy reliance on gas power in the period 2020 to 2040.

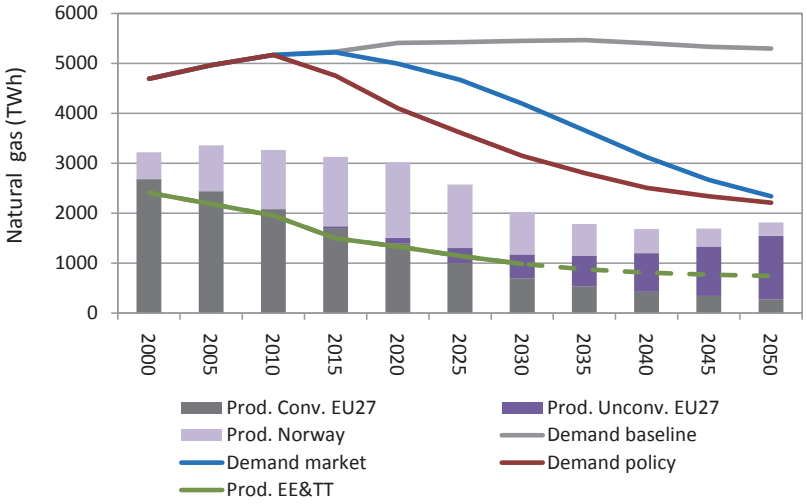


Figure 1: Indigenous gas production (conventional and unconventional) in EU27 and Norway and gas demand for the Policy and Market Pathways analysed.

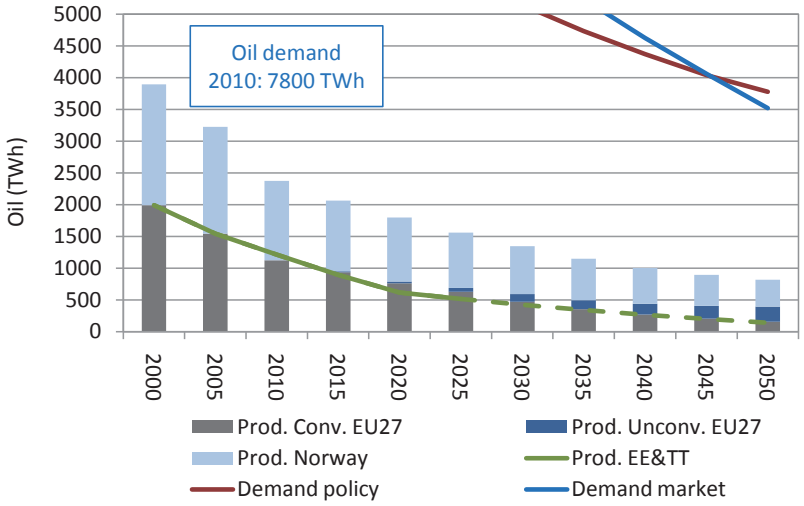


Figure 2: Indigenous oil production (conventional and unconventional) in EU27 and Norway and oil demand for the Policy and Market Pathways.

The fact that both the gas and the coal demand decrease in the Market and Policy Pathways is partly explained by energy efficiency measures which reduces the fuel demand and partly by the conversion to renewable alternatives, there among increased utilization of biomass. The use of biomass will more than threefold in the two Pathways and reach about 3600 TWh by 2050. This production is assumed to be realistic for a biomass production level within EU.

Need for oil import will persist

The production of conventional oil within EU27 will most probably decrease rapidly to just a fraction of today's production by 2050; see Figure 2. The opportunities for unconventional oil production are associated with high uncertainties, but even for high production projections a dramatic decrease of the total production is to be expected. The projections for Norway's production are similar, even though the decrease is not as rapid. The oil demand of EU27 is today about 7800 TWh, of which just a minor part is covered with indigenous production. This picture will maintain also for the two suggested pathways towards sustainability, even if the oil demand can decrease to less than half of current levels, see Figure 2.

For further information:
ERIK AXELSSON, Profu and
JAN KJÄRSTAD, Chalmers University of Technology

Legal preconditions are crucial for wind power expansion

The design of legal and administrative systems is crucial for the development of wind power. In Swedish law there are several counteracting factors and other barriers for wind power expansion. Less permits and strengthened state controlled planning, as in some other counties, could facilitate expansion.

A slow Swedish wind power development

One starting point for this study is that the Swedish wind power development has been relatively slow in a European perspective, despite the good economic conditions compared to other energy sources, and despite the political objectives existing since the 1970's to increase Swedish wind power production. Another starting point is that the law (legislation, legal principles, etc.) determine the key conditions for the construction and operation of wind turbines. This includes, for example, permits and other decisions required as well as environmental standards that must be met to allow the expansion.

Comparative study of legal conditions including Denmark, Norway and England

The work is carried out as a comparative study of the Swedish judicial system with respect to the development of wind power compared with the corresponding legal functions in Denmark, Norway and England. The purpose is to clarify features in the legal system that may explain differences in the rate of expansion between the countries and, subsequently, in a general way to discuss the appropriate legal instruments for the implementation of wind power development.

Legal barriers for wind expansion in Sweden

The results of the analysis of the Swedish law demonstrate active barriers to an expansion of Swedish wind power. The combined system of concessions and physical planning is probably the main obstacle. Demands for several permits according to the Environmental Code and the Planning and Building Act, and sometimes even detail building plans, implies that the procedure from initial application to final decision often takes more than five years, occasionally ten years or more. The reason is not only the number of permits needed, but also the right to appeal to these decisions, often in several instances.

General rules of consideration (environmental standards) are another important barrier. Quite often, the environmental objective to promote renewable energy is set against other environmental objectives such as protecting the landscape or culture historic environment, or preserving the biodiversity.

Municipalities have strong influence

Another important conclusion is that Swedish municipalities have strong influence over the decisions on wind farms, through the municipal monopoly of land use planning under the Planning and Building Act and by the municipal right of veto under the Environmental Code. A legislative amendment of the Code in 2009 means the municipality must approve any wind project of significance. Moreover, the municipality need not disclose a reason for refusing a wind project.

Long processing might discourage investors

An overall conclusion is that the willingness to invest in wind power is likely to be adversely affected by the risk of long legal/administrative processing and, simultaneously, that the outcome is uncertain because of imprecise rules of consideration (legal uncertainty). Another conclusion is that the location of wind mills in Sweden is not determined solely by the wind conditions and the expected impact on the environment but also, and perhaps more, of which municipality that is in favour of wind power development.

More straight forward in other countries

The examination of the corresponding legal functions in other countries show major differences compared to Sweden, not least with regard to spatial planning systems. It is likely that the overarching control over the physical planning in Denmark has facilitated the strong wind power expansion. Generally should be noted that there seems to be a connection between state control over land use planning and the ability to effectively implement national objectives at the local level. In addition, municipal veto exists only in Sweden among the countries studied and the number of permits required is lower in Denmark and England than in Sweden.

A realization of the Swedish wind power planning goal will presumably require changes of the law. The legal framework governing the planning and installation processes could be improved by removing the general permit requirement for large wind mills and by breaching the municipal planning monopoly.

For further information:
MARIA PETTERSSON, Luleå University of Technology

Large-scale wind power calls for power management

Wind power is a promising alternative to decrease the CO_2 emissions from power generation. However, part of the emission decrease is offset by a reduced efficiency in operation of the thermal units as a result of the variations in generation from wind. To reduce the variations a moderator or some demand side management strategy, such as a fleet of PHEV:s, can be integrated in the wind-thermal system. By this, the operation of the thermal units can be more efficient saving both money and emissions. Daily balanced moderators are sufficient for a system with up to 20% wind power. Weekly balanced moderators are needed in a system with 40% wind power to avoid wind power curtailment. New transmission lines, being the cheapest moderator option, can be a profitable option at a CO_2 price of 20 EUR/tonne.

Optimization add-on for BALMORE to describe western Denmark

Lisa Göransson has developed an optimization tool to describe the interaction between wind power and thermal units. The model is a unit commitment model with the objective to find a least cost strategy to meet the electric load. In order to get a good description on the relation between the heat and power market the model is integrated as an add-on to BALMOREL, (a consumer utility maximizing model of the heat and power markets around the Baltic Sea). The model and its add-on are initially applied on Western Denmark in isolation.

Daily balanced moderators are sufficient for 20% wind power

Results from the model shows that in a wind-thermal system a daily balanced moderator with modest power rating is sufficient to reduce a significant share of the emissions due to start-ups and part load operation on the fossil-fuelled thermal units, whereas higher power ratings and storage capacities are required to avoid wind power curtailment. In a wind-thermal system with up to 20% wind power, wind power curtailment is modest and the advantage of a weekly balanced moderator with high power rating compared to a daily balanced moderator with low power rating are small. There is obviously no difference from a wind power integration perspective if variations are managed by shifting power in time compared to if they are met by shifting load in time. Thus, both variation management through storage and demand-side management are applicable.

In a system with up to 40% wind power, however, wind power curtailment is substantial and avoiding this curtailment is the main contributor in reducing emissions through moderation. Systems with such high wind power penetration benefit greatly from weekly balanced moderators. Moderators suitable for weekly balance are typically pumped hydro or transmission. Some flexible generation such as hydro power or co-generation might also be applicable. Demand side management is difficult to apply for wind power variation management at these grid penetration levels as it is, obviously, difficult to find a demand for electricity which can be delayed with a week.

Can be profitable at a CO_2 cost of 20 Euro/tonne

A comparison between the costs and emission savings due to moderation to the costs and emissions associated with five available moderation technologies (transmission, pumped hydro, compressed air energy storage, sodium sulphur batteries and flow batteries) indicate that all these moderators are able to decrease system emissions but only transmission lines is a cost-efficient option at a CO_2 price level of 20 Euro/tonne (i.e. higher CO_2 prices are required to make the other moderators profitable for the system exemplified).

An active integration strategy of PHEV:s is desirable

The ability of a fleet of PHEV:s to reduce emissions depend on integration strategy and the PHEV share of the total electricity consumption. An active integration strategy (rather than charging vehicles as they return home in the evening) is desirable already at moderate shares of consumption. An integration strategy which gives the power system full flexibility in distributing the charging is particularly desirable at high PHEV shares (about 20% of the total electricity consumption). However, such a strategy is perceived as difficult to implement for two reasons; the high implementation cost relative to the system savings from moderation and the uncertainty of the car owner with respect to the state in which he/she will find the battery.

For further information:
LISA GÖRANSSON, Chalmers University of Technology

Land use change is an important aspect of biofuel use

15% of the CO_2 emissions from LUC

Land use change (LUC) leading to losses of biospheric carbon (i.e., carbon in aboveground biomass and in soils) presently accounts for about 15 percent of total anthropogenic CO_2 emissions globally and has historically contributed a substantial share of total cumulative emissions. However, fossil CO_2 emissions dominate; see Figure 1. Increased bioenergy supply can reduce the fossil carbon emissions and can lead to LUC causing both gains and losses in biospheric carbon stocks. This can be through changed land management practices, converting land to produce biofuel feedstocks or by displacing activities to other areas and thus causing land use change somewhere else (indirect LUC, or iLUC).

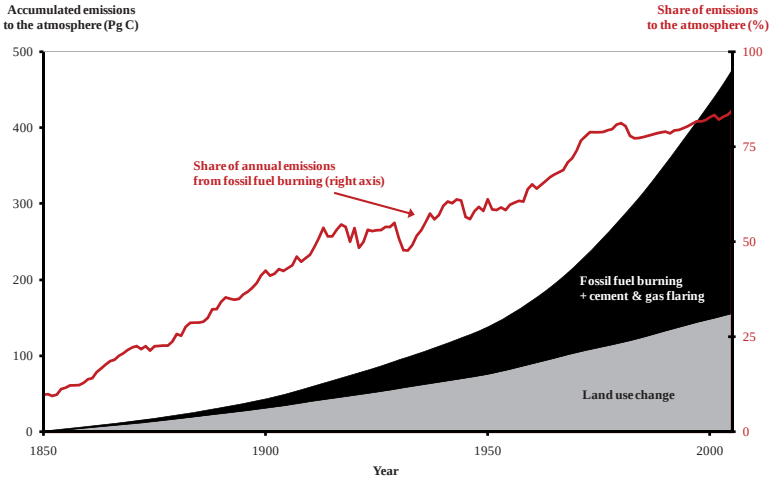


Figure 1: The anthropogenic CO_2 emissions to the atmosphere since 1850 (expressed as carbon in CO_2).

LUC emissions can cancel out near term climate benefits of using biofuels

Studies show that conversion of dense forests or other ecosystems containing significant carbon stocks into conventional crop cultivations for biofuels (i.e. cereals, oil seeds, sugar beet) can cause up-front greenhouse gas (GHG) emissions that reduce the near term mitigation benefit of the biofuels initiative; see Figure 2. However, unless they are very high, near term LUC emissions do not automatically disqualify bioenergy options from being part of a long term solution to the climate problem.

Forest bioenergy projects can lead to changes in forest carbon stocks in the same way as changed cropland management and crop shifts can induce changes in how much carbon that is stored in soil and aboveground biomass. Increased biomass extraction for bioenergy is commonly associated with decreases in forest carbon stocks. But increased bioenergy demand does not only induce higher extraction rates but also changed forest management regimes. Examples of changed management leading to increased forest carbon stocks include fertilization of forest land resulting in an increase in forest growth and postponed early thinning leading to additional carbon accumulation so as to produce a larger bioenergy sortiment at the time of removal.

Some biomass sources, such as aquatic biomass, post-consumer waste and agriculture/forest industry by-flows, have better prospects for use as biofuel feedstock while avoiding LUC and related biospheric C stock changes. However, if these biomass sources were earlier used for other purposes its use for biofuels production can indirectly lead to LUC as the earlier users switch to using new raw materials.

Policymakers need to address LUC

Scientists are challenged by quantifying LUC and linking it to specific biofuel projects. The uncertainties makes consideration of LUC effects a controversial matter when policy instruments are developed. On the other hand, policy makers have to respond to the concerns that LUC can drastically reduce the climate benefit of ambitious bioenergy initiatives. Current policies driving the biofuel demand may otherwise lose public support. Finally, costs and benefits of LUC for bioenergy need to be weighted using a wider set of indicators – including security of supply benefits, job creation and income generation, and consequences for biodiversity, water and soils.

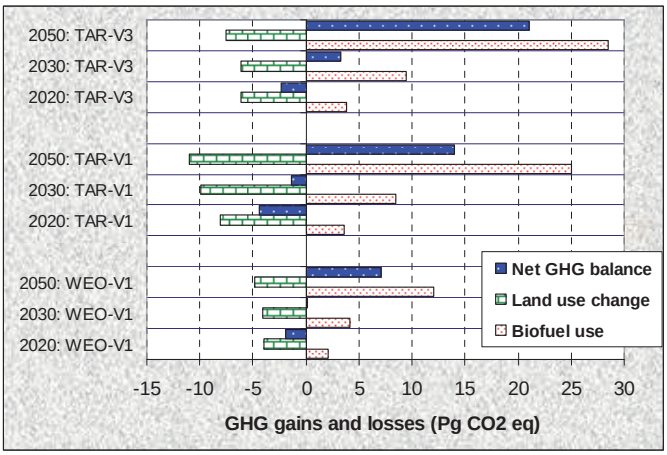


Figure 2. Cumulated net GHG savings of biofuel scenarios (Pg CO_2eq) based on biofuel expansion in World Energy Outlook (WEO) and a more ambitious target scenario (TAR).

For further information:
GÖRAN BERNDES, Chalmers University of Technology

Waste can contribute to sustainability targets

According to current EU Directives, European waste management is required to undergo extensive changes. For instance, renewable waste fractions to landfill are to be reduced. Instead of being put on landfill, waste can be utilized, e.g. as fuel. This has a double greenhouse gas reducing effect, contributing significantly to the EU202020 targets.

From landfills to energy production

Jenny Sahlin has studied the potential for energy recovery from renewable waste fractions and to what extent this can contribute to accomplishing the European renewable energy- and climate targets for year 2020 (EU202020).

The current European waste management system is to a large extent based on landfilling of waste, which generally is the worst alternative from an environmental perspective. Not only is the material and energy resources of the waste not utilized, but there are also emissions to air and water, such as organic waste fractions decomposed into methane. The current European waste management system, presented in Figure 1, was the starting point of the study. Instead of being put on landfills, the renewable waste, that remain after biological treatment and material recycling, could be incinerated to produce heat for district heating and electricity.

About 20% of the GHG and renewable target

The results show that energy from waste has the potential of being an important energy source in Europe. If all the renewable waste fractions could be utilized as fuel, the total GHG emissions decrease would correspond to 25% of the EU reduction target to 2020 ("High" in Figure 2). However, this would require a heavy expansion of both incineration plants and district heating. If applying a historic expansion rate (last 10-15 years) of waste to energy plants in EU, the GHG reduction would still be significant: 14% of the total reduction target ("Low" Figure 2). The corresponding contribution to the target to increase the use of renewable energy would be 20% and 4%, for the high and low case respectively.

Double reduction impact

There are two explainations to the large reduction of greenhouse gases that results from energy recovery from waste: (1) the avoidance of landfilling the waste and thus avoiding methane emissions from the landfills; and (2) the replacement of fossil fuels for heat and electricity production. Both contribute about 50% each and both come from the indirect emissions reduced when energy from waste increases.

Conclusively, the ongoing transformation of the European waste management system could enable large energy recovery from waste, which in turn could contribute significantly to the targets to reduce GHG emissions and increase the use of renewable energy.

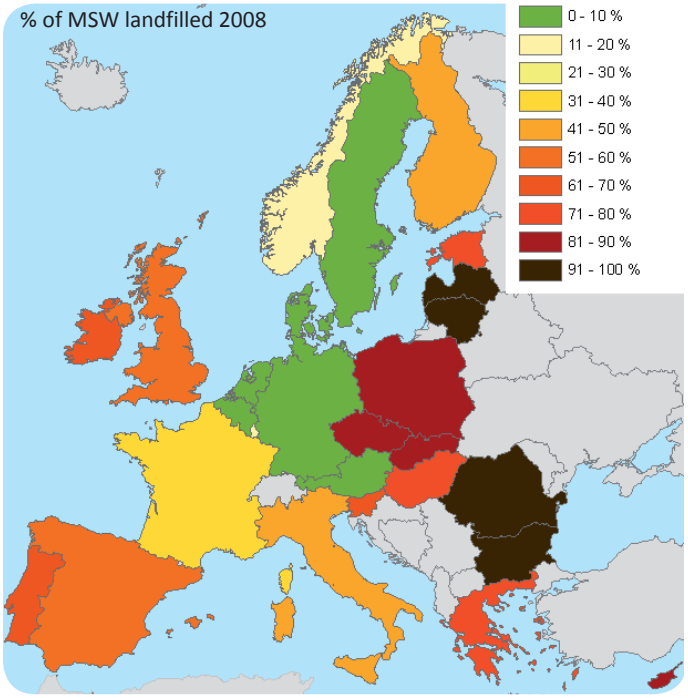


Figure 1: Share of municipal solid waste (MSW) landfilled in 2008. MSW mainly originates from households.

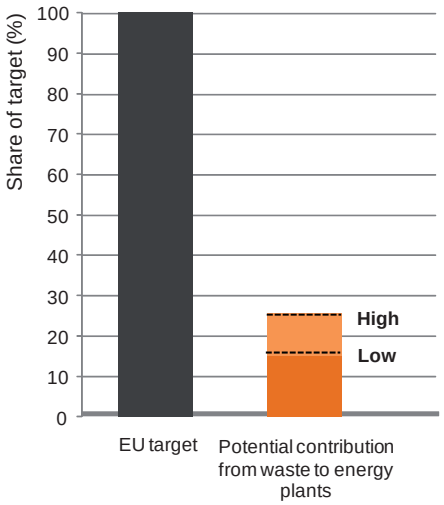


Figure 2: Potential contribution to the target of GHG reduction until 2020

For further information:
JENNY SAHLIN, Profu

New licentiate thesis:

Corporate strategies to mititgate climate change
- two essays on practices in Swedish energy-intensive companies

Gabriela Schaad

The seminar will take place:
June 14, 2010, 13-15,
(C33, School of Business, Economics and Law, Gothenburg University, Vasagatan 1.)

Opponent: Docent Fredrik von Malmborg

Climate change mitigation has turned into an urgent issue and corporations play an important role in implementing the changes necessary to reduce greenhouse gas emissions. Although Sweden is a forerunner in environmental issues, strategies to mitigate climate change by Swedish firms have not received much scholarly attention. This licentiate thesis sheds light on such practices in a Swedish context from two angles. The first essay studies corporate responses to the European Emissions Trading Scheme (EU ETS) by trading sector participants early in the first trading period. Using a survey, three generic firm activities are examined: the organization of allowance management, allowance trading and carbon mitigation strategies. The study shows that many corporations prefer internal measures for carbon mitigation without paying close attention to allowance prices. It is concluded that, if widespread, this practice could affect the efficiency of the system negatively.

In view of the high environmental impact of energy conversion the second essay aims at creating understanding of what the transition towards sustainable practices involves in an energy business context. To this end, the strategy for environmental sustainability of a municipal energy company with a strong environmental commitment is explored. By examining environmentally-oriented activities and practices a comprehensive picture of carbon mitigation efforts is given, following four conceptual areas of an environmentally sustainable strategy: emission reduction, product stewardship, clean technology and sustainability vision. It is concluded that municipal energy companies are well-positioned to facilitate the changeover to a sustainable energy system and society, although coordinated actions by many stakeholders are required.

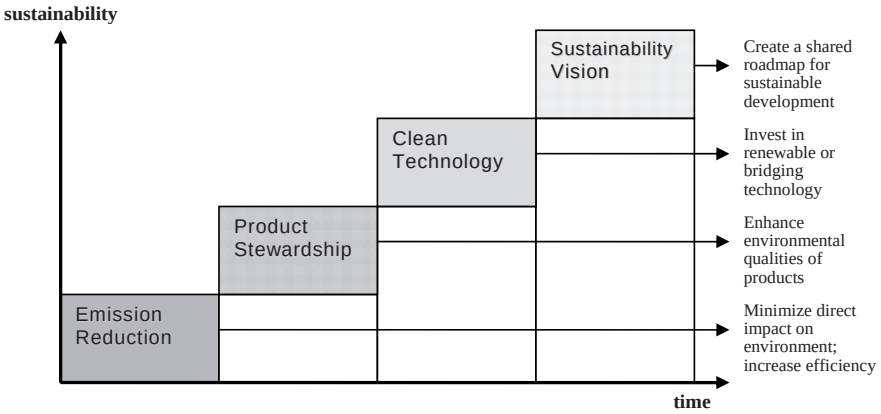


Figure 1: Strategic areas of proactive strategies for environmental sustainability

New licentiate thesis:

Integrating Biomass in Existing Natural Gas-Fired Power Plants
- a techno-economic assessment

Erik Pihl

Using biomass for utility heat and electricity generation can be done more efficiently when integrated with existing gas power plants. Biomass as energy source is a limited resource. It is, therefore, important to find highly efficient and reliable biomass conversion technologies. The thesis was presented February, 23. Read more in European Pathways **"Newsletter #1/2010"** which can be downloaded at: www.energy-pathways.org

THE AGS The Alliance for Global Sustainability

More information about the Pathways project:
www.energy-pathways.org