CEESA –project

WP 4: Market Development and Public Regulation

Working Paper
on WP4 of the CEESA project to be presented and discussed at the
3rd consortium meeting, 2-4 June 2008 at Gl. Avernæs Castle.

Status for the work carried out in WP4

by

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May 17, 2008

The work in WP4 is focused on the use of policy measures and markets as to achieve a high share of renewable energy sources in the energy system in the most economic efficient way. During the last year the following issues have been addressed in the WP and these issues will also form the basic input to the presentations at the consortium meeting:

1. *The future EU energy policy framework*
   Binding targets for CO_2-emissions and the use of renewable energy sources until 2020 have been decided in the EU. At present the burden sharing between member states is being discussed and will probably be in place at the end of 2008. Except for the European Trading System for CO_2 no common EU policy measures are expected to be introduced. Nevertheless these targets might prove to be highly important for the national policy measures to be put in place.

2. *Utilization of personal carbon allowances (PCA)*
   The future requires strong reductions in CO_2-emissions and this in turn will require the use of effective instruments. A new and heavily discussed instrument is the use of personal carbon allowances, which covers CO_2-emissions from the private consumption of energy, that is the consumption of heat, electricity and transport.

3. *Framework conditions for the future scenarios*
   These framework conditions include the boundary conditions for the market design and how this influences the technology path towards a 100% renewable energy system, including the development of oil prices etc.

In the following sections these three issues will be further discussed in working papers prepared in WP4.

May 18, 2008

CEESA PROJECT WP4

The future EU energy policy framework

By Poul Erik Morthorst, Risø DTU

EU energy policy targets

By 2007 the EU member states adopted long term targets in three different areas: 1) The EU has agreed on a binding reduction of greenhouse gases of 20% by 2020 compared to 1990; this target can be raised to 30% subject to the conclusion of binding international climate change agreements. 2) A mandatory target for the development of renewable energy sources; by 2020 20% of final energy demand in EU has to be supplied by renewable technologies as wind power, solar and biomass. 3) A voluntary agreement on energy efficiency with the objective of saving 20% of EU energy consumption by 2020 compared to a reference projection. Finally, EU has a target of achieving a share of 10% of biofuels in transport by 2020, where the biofuels have to be produced according to a strict set of sustainability criteria.

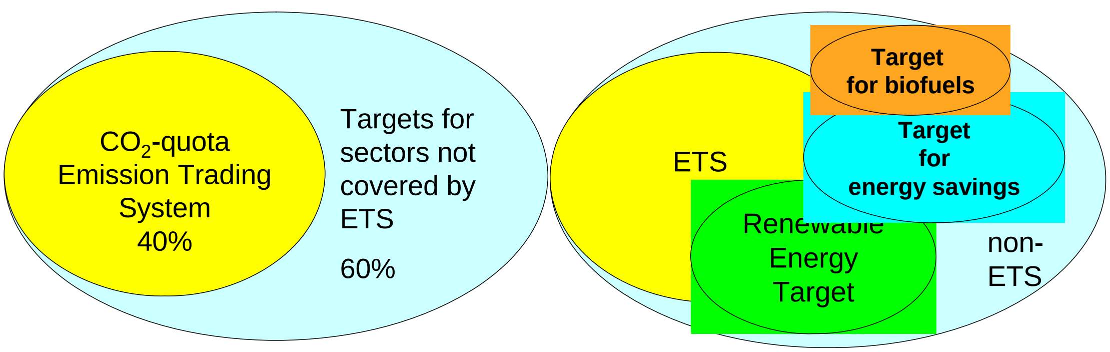

Figure 1: Interplay of the ETS with targets for CO_2-reduction, renewables, energy savings and biofuels. Left: ETS vs. non-ETS. Right: How the other targets help reducing greenhouse gases.

The Emissions Trading System (ETS) is the basic framework for achieving CO_2-emissions in EU, covering the power industry and the energy intensive industry in general. At present allowances are given for free (grandfathered), but from 2012 all allowances in ETS will be auctioned. The annual amount of allowances will gradually be reduced so as to achieve a decrease in allowances of 21% by 2020 compared to 2005. For sectors not covered by ETS EU has agreed on a binding target of 10% by 2020 compared to 2005. For the non-ETS sectors the reduction has mainly to be achieved utilising national measures. The split between ETS and non-ETS is shown in Figure 1 – left part. The burden sharing of the non-ETS part is currently being negotiated and there is quite a range in the proposed shares: From a 20% decrease as for countries as Denmark, Ireland and Luxembourg to an increase of 20% for Bulgaria and 19% for Romania.

To help the national policies on the way EU has as mentioned agreed on targets for other areas:

- The renewable energy target states that 20% of final energy consumption in EU by 2020 has to be supplied by renewable sources. This target will be achieved utilising national instruments. Observe that the renewable target help reduce CO_2 both within ETS (grid connected power and heat production) and in non-ETS by promoting individual technologies as thermal solar collectors and renewables in transport.

- The target for energy efficiency of 20% by 2020 is only compared to a reference – not an absolute reduction – and it is not binding. This target will also be achieved by national policy measures. The energy efficiency target will also help achieving CO_2-reductions both in ETS and non-ETS.
- The biofuel target of 10% of transport fuel by 2020 will mainly influence the non-ETS part, because most transport is based on individual solutions. Observe that this targets is widely discussed at present and that the criteria for sustainability is not yet totally agreed upon.

The burden sharing of the renewable target.

This EU renewable target has to be implemented mainly by national initiatives[1] and at the start of 2008 the EU commission presented a proposal for burden sharing among the member states. The mandates for the share of renewable sources by 2020 vary significantly for the individual member states from an increase of 13% to total 30% as for Denmark to an increase of only 6.9% to a total of 13% as for the Czech Republic. The burden sharing is presently being negotiated in EU. Nevertheless, there is no doubt that the binding targets for renewable sources will be a strong incentive for inventors to continue the rapid European development of renewable technologies.

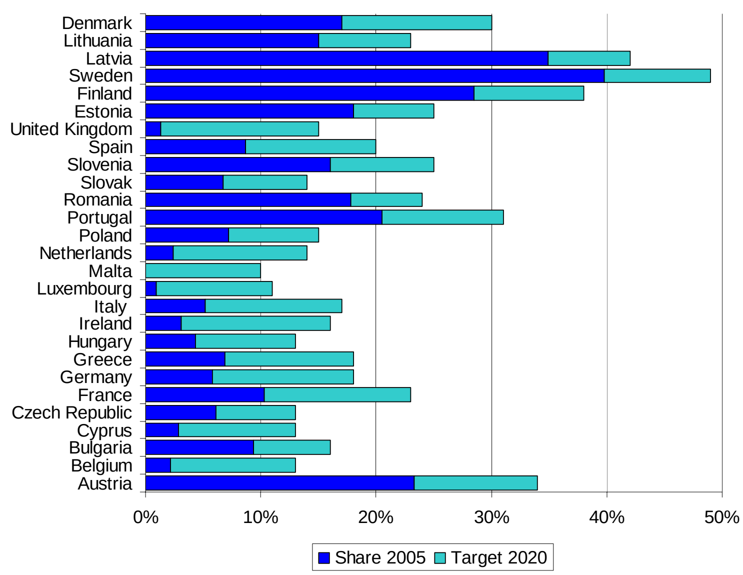

Figure 2: Suggested national renewable energy targets as % of final energy consumption.

Policies used to promote renewables in EU member states

Quite a number of different instruments are presently used in the Member States in supporting the development of renewable energy sources. Quota obligations with tradable green certificates, feed-in tariffs, tender procedures, and tax measures are the most discussed schemes, dominating

[1] The European Trading System for CO_2-allowances will be part of the regulatory framework.

the national support systems at the moment. At present most support schemes are based on a national entity and trade across the borders explicitly of green power is limited. The only exception was the Dutch case some years ago, where green certificates were imported to the Netherlands. However this system had some adverse effects, and was abandoned a few years later, among other things because most of the certificates imported came from existing plants. Thus in general the EU picture of support mechanisms is rather fragmented, as shown in Figure 3 below.

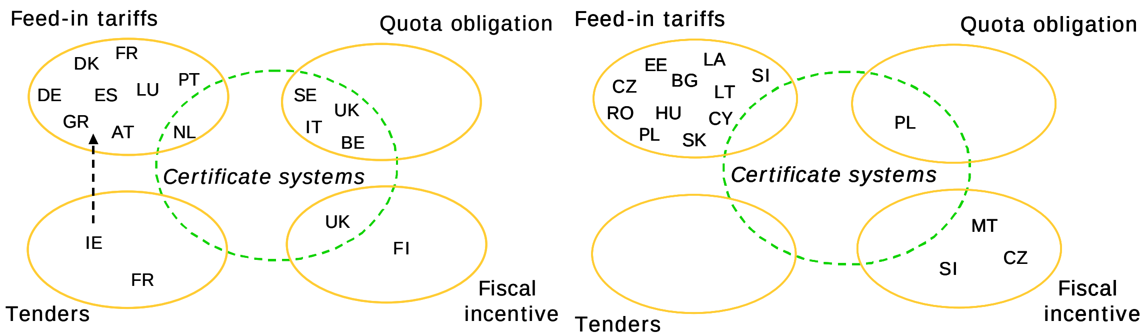

Figure 3: Overview of renewable electricity support systems, the "old" EU-15 to the left and the "new" EU-10 to the right.

As shown in Figure 3 the most common support system is the feed-in tariff, followed by the quota obligation scheme (accompanied by green certificates). According to the recent EU communication on support for renewable sources (EU-Commission, 2005) the most effective scheme in general is the feed-in tariff that has the lowest risk as perceived by investors. Feed-in tariffs have been highly effective in the deployment of wind power in Germany, Spain and Denmark and also in photovoltaics in Germany. Nevertheless, the effectiveness of the support system depends heavily on the specific design of the scheme. Thus other schemes might prove to be effective in particular cases, e.g. tendering in the development of offshore wind farms.

Not only the support schemes are quite different in the Member States but also the level of support varies significantly between countries. This could to a certain extent match the different opportunities for renewable sources in the countries. Though this is not always the case, as is exemplified for biomass in Figure 4 below.

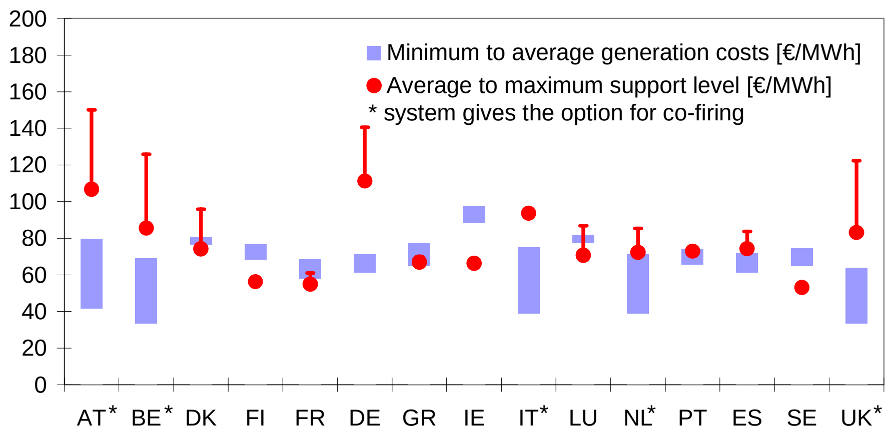

Figure 4: Support levels compared to the long term marginal generation costs for biomass electricity based on forestry residues in the "old" EU-15.

As shown in Figure 4 the levels of support do not necessarily match the long term generation costs. In a number of countries the support levels are either below or significantly above generation costs, signaling that there still is room for improvement of support policies for renewables in the EU.

Future EU energy policy

At present heavy discussions are going on in the EU concerning the pros et cons of a harmonised support system for renewables. The most economic efficient system is expected to be a full harmonised system, e.g. a green certificate system, where certificates could be traded across borders. However, strong national interests are vested in the development of national/international renewable manufacturing industries, as seen in countries as Denmark, Germany and Spain. At the same time it is observed that the successful development of renewables until now has taken place in countries with strong national policies. A harmonised approach could jeopardise the strong development in these countries, drawing back the total renewable development in EU. Thus, the EU Commission has accepted that national policies will be the driving forces behind the achievement of the renewable targets. This is supported by calculations showing that approximately 70% of all economic benefits could be achieved by optimised national policies.

Thus, the future points to a strong and EU determined ETS for reducing CO_2 combined with strong national policies for achieving the targets for renewable and energy efficiency. Amounts of allowances for auction will gradually decline in the ETS. Because of large potentials for substitution towards low or non-CO_2 emitting technologies within ETS, this will probably happen at a faster pace than outside the ETS. If Denmark is to be ahead of average EU member states this calls for strong national initiatives for implementing renewables, low CO_2-emitting transport solutions and energy efficiency in the non-ETS area.

In the following Table 1 is stated a proposal for how the Danish and the EU framework could develop in the future. As shown Denmark is at the lead in the EU with regard to CO_2-reduction and implementation of renewables. Of course, this table is preliminary and the proposed development is mainly for discussion.

	Denmark	EU	RES-E in EU power system	Corresponding CO_2-price
CO_2-reduction				
- 2020	30%	20%	-	30-40 €/t
- 2030	50%	35%	-	> 50 €/t
- 2050	100%	70%	-	75-100 €/t
Share renewables				
- 2020	30%	20% (15%)	30%	
- 2030	50%	35%	60%	
- 2050	100%	70%	100%	

Table 1: Proposal for the development of targets and the corresponding CO_2-price. In parenthesis is shown the percentage of renewables that will be achieved with the mentioned CO_2-price – the residual to fulfill the target will have to be achieved by national regulation and/or support schemes

A proposal for an outline of the future energy policy within EU can be summarised as:

- The emission trading system (ETS) will continue as the core of EU energy policy. Expectedly emissions from air and sea transport will both be covered by ETS. Annual amounts of allowances will gradually decline.
- After 2020 the targets for both emission reduction and renewables will be extended (see proposal in Table 1). By 2050 EU will still be relying on fossil fuels, although to much less extent.
- The power market in Europe will gradually be liberalised and by 2020 merge into one single market with an EU TSO coordinator.
- Although renewables are improving their economic competitiveness by 2020 there still is a need for support. The current trend of national policy reliance will continue, although regional collaboration (common support schemes for e.g. the Nordic countries or Spain/Germany) will be more frequent.
- Assuming a high CO_2-price of 50 €/t or above and correspondingly high fossil fuel prices (equivalent to a crude oil price of 150 $/bbl or above) support for renewables will in general diminish by 2030. Of course there might still be a need to support new emerging technologies.

May 6, 2008

CEESA PROJECT

Summary concerning the use of Personal Carbon Allowances (PCAs)

By Frede Hvelplund and Niels I. Meyer

BACKGROUND:

Recent results on the melting of polar ice [1] are illustrating that the consequences of global warming are happening in a faster pace than anticipated by the IPCC reports from 2007 [2]. This knowledge is not reflected, however, in the international political negotiations on mitigation of global warming. On this background there is an urgent need for investigating new and efficient means for reducing emission of greenhouse gases (GHGs).

In the EU there is already some experience with caps (quota) for industrial emissions of CO2. Another important source of CO2 emission is the private household sector. Typically, the household sector is responsible for 25 to 40 % of the total emission in industrial countries in relation to the use of heat and electricity in private houses and to fuel use in connection with private transport. By far, most of the emission in the household sector is related to the use of fossil fuels as a basis for the energy services.

The traditional methods for reducing the consumption of fossil fuel based services in the household sector are norms (e.g. building codes) and economic means (e.g. pollution taxes or subsidies for "green" technologies).

There are, however, a number of problems with these traditional methods. Firstly, the quantitative effects of the methods are rather uncertain and the desired targets for the energy reduction are often not attained. Secondly, the economic methods (e.g. pollution taxes) are not socially balanced and require complicated administrative systems in order to reduce social unbalance.

In order to overcome these problems it has been proposed to introduce a new form of regulation of the energy use by private people called Personal Carbon Allowances (PCAs). Compared with the cap system used in the industrial sector allotting emission caps on the different industrial plants, the PCAs are given to individual human beings.

The proponents of PCAs are implicitly assuming that all grown-up individuals in a country will get the same cap (and people below 18 years will get reduced caps), in order to support the social balance of the system. It is normally also assumed that the system works on a cap-and-trade basis like the case of the cap system in the industrial sector. The reason for this is amongst others that if trade were not allowed people would have to change lifestyle too quickly which would generate political resistance towards the system. Furthermore experience with rationing systems during the Second World War has demonstrated that if trade is not allowed this quickly creates an illegal “Black Market”. An additional argument for allowing trade of emission allowances is based on the experience, that in general low income people are using less energy than wealthy people. Thus, trade of allowances will typically reduce economic inequalities in society.

The efficiency of a PCA system is dependent on the particular energy system in the country and on the institutional arrangements. In the CEESA project we have chosen the UK and Denmark as case studies because both the energy situation and the institutional set-up are quite different between the two countries. The evaluation results from these two countries are thus expected to illuminate a broad spectrum of possibilities and barriers for the PCA system.

Another point to be evaluated is the question of cross-boundary effects in case of different PCA systems in different countries. This involves questions concerning the need to harmonize PCA schemes for all Member States in the EU in order to avoid undesired effects if trading of allowances across the boarders is allowed.

POLICY GOALS, GOVERNANCE ALTERNATIVES AND INSTITUTIONAL SETTINGS

In this section we shall summarize some of the analyses that are involved in evaluation of the PCA systems.

Firstly the usefulness of an Energy Policy Governance System has to be evaluated against energy policy goals. In this case we are evaluating whether the PCA system is:

- *Eco-efficient* and *significant* with regard to being an efficient governance tool for the household reduction of greenhouse gas emission.
- *Economic efficient* by reducing greenhouse gasses at relatively low costs.
- *Bureaucratic efficient* by having relatively low transaction costs.
- *Innovation efficient* by promoting the development and implementation of an “optimal mix” of energy conservation and energy supply technologies.
- *Democratic and educational efficient* by inducing a better understanding of the greenhouse problems at the consumer level.
- *Social efficient* by reducing greenhouse gasses in a socially balanced fashion.

Secondly the effects of the implementation of the PCA system are dependent on the *specific techno-institutional conditions* in the country in which it might be implemented. In a technological energy system, where a large proportion of the energy consumption is linked to individual decisions, the effects of a PCA Governance system will differ from the effects in an energy system, where the energy consumption to a lesser degree is linked to concrete decisions at the household level.

We have started to analyze these questions using the UK and Denmark as case studies.

Our preliminary conclusions are the following:

A PCA system should address the household consumption of energy for heat-, electricity-, and transportation. Altogether this consumption in 2006 amounts to an emission of approximately 17 mill. Tons CO_2 emission, or around 30% of the Danish emission of 53 mill. Tons.

The remaining 70% emission has to be targeted by other schemes like norms, energy taxes, and the EU emission cap system for industries.

A PCA system addressing the above 17 mill. Tons CO_2 does not, however, represent an efficient incentive system if the institutional conditions in which the households are embedded hinders or hampers energy conservation or the shift to renewable energy systems. Therefore it is important to introduce specific policy reforms that make the consumers able to react upon the PCA incentive systems. This is what the policy reforms 1- 6 in the following aims at doing.

A PCA system in Denmark would be embedded in the specific Danish techno-institutional system with around 70% of the heat coming from cogeneration systems, and with high energy taxes. The consequences of this are:

Incentive problem 1. It is difficult to define the exact CO_2 emission linked to a person in a cogeneration system. How should the CO_2 emission be divided between heat and electricity?
Incentive policy 1. Division principles that are accepted by the consumers have to be established.

Incentive problem 2. The conservation incentive in a coal based cogeneration system is usually quite low, due to a price system with around 40% as fixed tariff.
Incentive policy 2. A legislation that reduces the fixed tariff share should be introduced.

Incentive problem 3. The conservation incentive in a coal- and waste incineration based cogeneration system is often linked to the average price signal of the system. This calculations is distorted by the fact , that the waste fraction has no energy taxation in contrast to the coal fraction, Thus, the prices do not reflect the marginal CO_2 consumption and CO_2 costs linked to the coal based fuel fraction.
Incentive policy 3. A legislation that allocates the marginal CO_2 emission per kWh heat on the persons in a coal based cogeneration system should be implemented.

Incentive problem 4. The taxation on wind based electricity for heating based on a heat pump heat and storage system is around 7 eurocent per kWh. In comparison there is zero tax upon biomass.
Incentive policy 4. The same energy tax for wind energy based heat in connection with heat pumps and heat storage as for biomass should be introduced.

Incentive problem 5. There is no "feed in" legislation for cogeneration systems, resulting in a favorable tariff, when feeding renewable energy into cogeneration

systems. Households linked to a cogeneration system are forced to use the fuel mix of this system, and cannot reduce their CO_2 emission by shifting to renewable energy supply in the cogeneration system.
Incentive policy 5. "Open access" for renewable technologies in cogeneration systems in combination with a "feed in "legislation should be introduced for cogeneration systems, making it possible for consumers to shift to renewable energy in these systems.

Incentive problem 6. It is not possible for consumers to buy renewable energy based electricity directly from the producers.
Incentive policy 6. Legislation should be introduced that makes it possible for a household to buy electricity directly from renewable energy suppliers.

The evaluation of a Danish PCA scheme should take into account the above six incentive policies. Otherwise there is a risk that a PCA system will fulfill the energy policy goals mentioned above.

CEESA – project Market Design

Peter Karnøe 20/5 2008

Boundary conditions for a market design that differentiate economization of different energy technologies in the process towards a composition of the Danish energy system with a 50% share of RE in 2025

1.0 Explicate boundary conditions: Neither in vivo market economies nor in vitro market design modelling works in a vacuum

A central task for the 'Market Design Group' is to make explicit and articulate as well as possible the choices and assumptions that become the boundary conditions in our experiments (Callon and Muniesa 2007) with imagined and simulated 'in vitro' market design towards a 50% RE-share in the Danish energy system by 2025.

This paper focuses on two critical boundary conditions – or assumptions – for the work and conclusions of the market design group in the CEESA-project[2].

1. The first boundary condition stems from the 'convention of economic theory' that perform and legitimate our ways of thinking about efficiency and optimality in the existing techno-economic market arrangement – and how to imagine, test and propose market designs for alternative futures, i.e. alternative techno-economic arrangements. The paper contrasts the Convention of Given Optimality and Efficiency (CGOE) and the Convention of Dynamic Efficiencies (CDE) (see Hodgson 1994/2004, Weinstein 20xx, Callon 2007, XX)[3].

2. The second boundary conditions concerns the average oil-price from 2010-2025, as the reference oil-/energy price influences the 'transformation cost/gains' when creative destruction is induced to move the Danish energy systems towards a 50% RE-share. If the average cost per RE-unit of energy (2010-2025) is higher than the average cost of the existing energy system there will be a net-cost to make the transformation. If the average cost per RE-unit is lower then there will be a net-gain. The oil-price is the reference price, and externalities are excluded.

2.0 When economic conventions perform boundary conditions for market regulation and design-parameters

Neither 'in vivo' market economies nor 'in vitro' market design modelling works in a vacuum.

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[2] Ceesa's groups work: Through the mobilization of various economists, social scientist, engineers with their 'tool-boxes' of theories, models, assumptions etc. to imagine and make an 'in vitro' market design proposal (that present our actor-world/world-view) that may transform the current Danish 'in vivo' market.

[3] CDE does not refer to a homogenous group of scholars, and one main difference is whether they pursue substantialist definitions of the economy and political, or they study and conceptualize how an entity called 'economy' and the involved 'politics' come into existence in the first place, and what role economic theory play in this process (Callon 2007).

This paper compares two different conventions of economic thinking and their very different implications for market regulation and design-parameters. The two conventions differ in the view of the:

1. evaluation of efficiency and optimality in the existing techno-economic arrangement,
2. the role of institutional regulatory arrangements (IRA), if IRA are exogenous or endogenous to the techno-economic arrangements
3. and how efficiencies in new techno-economic arrangements may be imagined and achieved.

CGOE	**CDE**
Convention of given optimality and efficiency. Efficiency given in the present order of economic arrangements	Convention of dynamic efficiency and non-optimality. Efficiency is a possibility in a negotiated and politically sanctioned economic arrangement.

The CGOE convention (economic paradigm) is inherent in the economic models used in the Ministry of Finance and by the Economic Council. This economic convention also is behind the official Danish energy policy. The CEESA market design group follows the convention of CDE.

2.1 Implications of economic conventions as boundary condition for evaluation of techno-economic arrangements and policy design

This section presents shortly a few implications of the 'choice' of convention for a policy of market design.
In the CGOE convention it is assumed that the existing techno-economic arrangement is the optimum and efficient state.

1. Existing techno-economic arrangements seen as efficient and optimal. This means the existing IRA is seen as part of an efficient and optimal techno-economic structure.
2. Static versus (versus the CDE dynamic view)
3. The IRA is seen as exogenous to economic re-design.
4. There is a strong belief that price-based incentives are sufficient to stimulate transformations.

Ad 1 and 2
As stated above CDE does not mean that the existing techno-economic arrangement of energy production and consumption is optimal in some pure sense. However, the presumed efficiency of the present arrangement is implicitly part of making a comparison between 'present' and alternative'.
A dominant way of calculating, talking and meaning something about the economics of the climate challenge is to say that average energy cost must be low in order not to hamper economic growth in DK. This way of presenting the argument assumes that this s a normal net-present value calculation where the 'do nothing scenario' really is the alternative, in the sense that nothing else will happen if we do nothing…(..and we assume that future costs and prices can be estimated with some relevance, i.e. that the future is knowable so 'correct' calculation is possible.

The recent increases in oil prices, the sub-prima market collapse, the dollar-collapse, and the growth of the DK wind power industry illustrates that there is not ground to be too optimistic in terms of predictability of narrow economic parameters).
The Stern report and other reports from NGO's would question if there is a 'do nothing or little scenario' due to the acceleration of climate change and the impact on socio-economic-bio development. They mobilize in various ways claims based on economic, climate related biosphere developments, and moral grounds to their support.

The Stern report also mentions the critical role of the discount rate in Net Present Value calculations, as a too high discount rate dis-favours the future and the alternative. And that it cannot take into account dynamic learning effects.

The CEESA market group find it much too narrow to talk and calculate the costs and rewards alone form a 'cost more-cost less' perspective. We try to strike a balance between 'un-disciplined economic thinking' and 'un-disciplined climate change thinking', but maintain that a high de facto penetration rate of RE in the Danish energy system is the near term goal (2025). Even EU now talks about a 30% CO2 reduction by 2020 and not 20%.

Ad 3 Endogenize IRA in the re-design

It must also be taken into account that the Danish energy and environmental policies from 1980s and onwards have resulted in what most economists would claim to be impossible: From 1985-2005 the GDP grew by 50% with a constant energy consumption (excl. ships). Danish policies broke the 'naturalized' and taken for granted 1:1 correlation between economic growth and energy growth, that has a prominent place in all economic textbooks. Taxes increased fuel prices and this (and R&D) induced an innovation path of energy conservation and new clean technologies.

As a contrast of May 2008 it is interesting to see how the American economy, the average auto-owner, and the auto-makers of gasoline-drinking automobile are 'hit' by the oil-price increases. The US panic and economic mal-adaptation results from an ideology and policy of no-involvement and pre-preparation to the current and future trajectory of high fuel prices and needed energy efficiency. Of course what we see now is 'raw' market adaptation to the new situation of high fuel prices – but where car-owners and automakers are stuck with sunk cost in the in-efficient technology. Chrysler has so many SUV's and truck in stock (sunk cost) that they offer a three year maximum fuel price (3,80 kr/liter) if you buy one of their cars now. So the market actors do make re-sponses to higher prices.
The Danish policy with taxes from 1980's created an induced innovation approach to market economization may be compared to the dramatic panic wake-up type of market economization in the US:

1. First, the gradual increase allowed users/families to adapt gradually to higher prices in their economic budgets,
2. Second, the taxes induced higher prices that gradually became a convention and a reference point in investment decisions (energy prices will never become lower than xx),
3. Third the relative impact of the current increase in oil price is lower for DK than for US users (for US a 30% price increase, for DK lower AND politicians may reduce energy tax if they evaluate that high fuel prices have a negative impact on the economy).

Ad 2 and 4
CDE does assume and accept that price-based incentives are relevant to stimulate transformations. However, the CEESA market group work with the premise a mix of policy instruments are needed to generate high penetration rates. Instruments like CO2-quota market and CDM is one way of adding cost to the fossil regime taxes, but taxes, standards, and caps must also be considered. This is not discussed further in this paper as the mix of policy instruments is the theme of another market group paper.

A central difference between CGOE and CDE, is CGOE's 'comparative static analysis' versus CDE's 'dynamic efficiency and learning approach'. The comparative static approach makes it difficult to include, and give relevance and value to the dynamic multiplier (on supply and demand side) effects of new technologies, firms and users. These cannot be taking into account by the CGOE convention as their models cannot endogenize entrepreneurship and shifts in user preferences.[4]

Further, the neoclassical CGOE convention does not work with real historical time and processes, as it is assumed that 'curves shift nice and neat' due to marginal shifts in price incentives. Even if the assumption of homogeneus products is relaxed, there is 'no time' needed to the competence building and learning effects linked to new technologies. It just 'will' happen, and needed solutions show up. Efficient wind power, heat pumps, solar energy, fuel cells, energy efficient (saving) technologies (pumps) etc. will just 'show up when needed. It is often forgotten that nuclear power is the most state subsidized energy technology (Basalla 1988), and that learning effects in coal based electricity production reduced amount of coal o produce 1 kwh with a factor 5 from 1900 to 1960s (Rosenberg 1982).

3.0 Economic boundary conditions for investments in RE-technologies

In DK the transformation began slowly in the late 1970's-1980s, intensified in the 1990s, and has almost stalled from 2001 – 2007.
The assignment for the Ceesa-project is to imagine and design a process where the Danish Energy system in 2025 is based on 50%-reneabaler energy.
The transformation is going to happen in a dynamic process of creative destruction *where CO2-heavy energy technologies and patterns of consumption are phased out (destructed), while more and more CO2-free renewable energy solutions are phased in (created).* The dynamics of creative destruction is linked to investment and consumption patterns among actors in the energy system.

[4] In the new CDE terminology (Callon 2007) of 'constructed markets' Sterns statement illustrates that the way objects like energy technologies become 'economic' is not pre-given or natural, but must be seen as an outcome of a process of 'economization'. And even though the process of becoming economic for any energy technology is historical, contested, and contingent it may nevertheless become so robust, durable or irreversible that it is seen as a natural (techno-economic) order of things. This is what happened when conventional fuels and the Edison-electricity system became 'economic' within a particular configuration of regulation. An outcome that is now highly contested due to the (long process of) articulation of such overflows as climate change problems. …"markets trigger the emergence of matters of concern to which they are not always able to provide satisfactory answers. These matters of concern may then evolve into many (potentially) political issues whose solutions may, in trun, impact on the organization of economic activities." (Callon 2007).

The premises for these design parameters are:

- To accomplish a high de facto penetration-rate of RE in the Danish energy systems
- Continue an energy savings-strategy
- To keep average energy cost low in order not to hamper economic growth in DK. This is the trade off between short term econ. Growth and long term economic growth that also the Stern report mentions. The report states that the ‘do nothing scenario’ will result in negative economic growth (-3%) whereas the climate change transformation scenario will make a x% growth.

From a private investment perspective the expected energy prices matter in relation to investments in future energy supply capacity. The value of any investment in energy technology is determined by the reference case of the expected energy prices which are linked to expected patterns of consumptions or alternative energy costs.

Due to externalities the societal return on investments are in general different from private investments because positive/negative effects from factors that are not internalized in the private value calculation. Positive/negative externalities (or overflows) stems form ‘effects of economic activities on other parts that are not directly involved in the business transaction’ (and effect their abilities to act), because these effects are not reflected in prices/costs’.
Positive externalities may be patents that make knowledge publicly available (overflow) for others while still being ‘privatized’ for exploitation. Pollution is the general example of negative externalities because harmful effects overflow to other actors: clean up/restoring nature after open coal mining; radiation from nuclear power, green-house gas emissions from fossil fuels etc..
However, externalities are not recognized as a general part of he economic process. They can only be articulated and valued if the are identified and accepted, and this is in general a process of high contestations among economist and politicians.
The Stern report stated in 2006 that leaving out the cost of green-house gas pollution from the cost functions of fossil fuels was the biggest market failure in the last century. And still the general debate assumes that the cost/price structures of the existing techno-economic arrangement is efficient. For example the actual debate about feed-in tariffs for RE-techs, that have to compete against existing and ‘efficient’ fossil fuel solutions that have benefit of not including the negative externalities.

One can imagine several scenarios for the creative destruction. In a market economy private investors will in general – and not in large scale - not invest in RE if there is no positive economic return on the investment. So if prices on fossil fuels are low then RE technologies must also have low prices – or have investment and/or operational subsidies to be attractive. The EU-project on externalities ‘ExterneE’ from 2003 showed that for example wind power had lower social cost than fossil fuel energy technologies, but the report also stated that ‘due to political concerns it was impossible to tax fossil fuels’. Therefore RE-techs end up with the reputation and identity of being the ‘subsidized’ energy technology.
The CO2-quota market and CDM is one way of adding cost to the fossil regime taxes, standards, and caps are others, but they are not discussed further in this paper as the mix of policy instruments is the theme of another market group paper.

However, it is clearly important for CEESA to break the current way of calculation, of talking and meanings of the state of affair that pre-dominantly s defined by CGOE. This being said it is also clear that RE-techs are not equally cost-efficient and therefore need more time to foster the learning curve effects. These dynamic learning effects that can help RE-techs have already been taken by the existing techno-economic energy system.

3.1 Which Oil price is the boundary condition for the claim 'economic growth' versus 'RE-investment' scenario?

A dominant way of calculating, talking and meaning something about the economics of the climate challenge is to say that average energy cost must be low in order not to hamper economic growth in DK. This way of presenting the argument assumes that this s a normal net-present value calculation where the 'do nothing scenario' really is the alternative, in the sense that nothing else will happen if we do nothing.[5]
The Stern report and other reports from NGO's would question if there is a 'do nothing or little scenario' due to the acceleration of climate change and the impact on socio-economic-bio development. They mobilize in various ways claims based on economic, climate related biosphere developments, and moral grounds to their support.

The CEESA market group find it much too narrow to talk and calculate the costs and rewards alone form a 'cost more-cost less' perspective. We try to strike a balance between 'un-disciplined economic thinking' and 'un-disciplined climate change thinking', but maintain that a high de facto penetration rate of RE in the Danish energy system is the near term goal (2025). Even EU now talks about a 30% CO2 reduction by 2020 and not 20%.

It must also be taken into account that the Danish energy and environmental policies from 1980s and onwards have resulted in what most economists would claim to be impossible: From 1985-2005 the GDP grew by 50% with a constant energy consumption (excl. ships). Danish policies broke the 'naturalized' and taken for granted 1:1 correlation between economic growth and energy growth, that has a prominent place in all economic textbooks. Taxes increased fuel prices and this (and R&D) induced an innovation path of energy conservation and new clean technologies.

The expected oil-price is the critical parameter used to estimate the 'cost more or less' and the potential impact on economic growth. The Danish and (EU) base scenarios from February 2008 are based on low oil-price increase scenario. The expected average oil-price towards 2020 is 60USD/barrel, and both DK and EU build their scenario on IEA.
The recently published scenarios[6] from February-March 2008 are already obsolete.
By May 2008 the actual oil price was $124 – and the 12 month forecast was $161.[7] Therefore the realistic prices for the scenarios are likely to be:

1. The modest price increase scenario with 80-90 (USD/Barrel)
2. The middle price increase scenario with 100-110 (USD/Barrel)
3. The high price increase scenario with 130-140 (USD/Barrel)

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[5] ...and we assume that future costs and prices can be estimated with some relevance, and the discount rate is 'fair'.

[6] Sources:
* Forudsætninger for Samfundsøkonomiske analyser på energiområdet, Februar 2008, Energistyrelsen. (Table 2)
** Arbejdsdokument fra Kommissionens Tjenestegrene, *KONSEKVENSANALYSE*, som ledsager 'Pakken af gennemførelsesforanstaltninger med henblik på opfyldelsen af EU's målsætninger om klimaændringer og vedvarende energi frem til 2020. Bruxelles 23.1.2008
*** Greenpeace – Nedtrapning af CO2-udslippet, Udarbejdet af Klaus Illum, ECO Consult

[7] http://oil-price.net/. Visited May 9, 2008.

4. The extremely high increase scenario with 150-160 (USD/Barrel)

This reflects the various effects on energy demand based on substitution and savings. The dollar-rate is assumed to be between 4,20 kr/1 US $ and 4,80/1 US $.

The CEESA-market group find that DK, EU and IEA use unrealistic low future oil-prices in their scenarios. The three agencies do have some interest in keeping the scenario-oil price low in order to keep ‘RE-transformation cost high’.

CESA Criteria to be used for the evaluation of societal investments in renewable energy sources versus fossil fuels:
Assumption: Our economy and society are better off with access to CO2-neutral quantities of energy that are stable and secure and if the energy sources have stable prices

1. the average energy prices for the society/economy in a RE-scenario versus scenarios with alternative prices for oil/gas/coal.
2. Reward form investment in RE: Avoid the uncertainty linked to unstable oil/energy prices. Additional investments in Risk avoidance (i.e. extra generators) is not needed.
3. High oil prices (average energy prices) and concern for climate changes stimulate entrepreneurial activity and innovation that foster new technologies and new users with different preference structures of price/value (like the first private investors in wind power). These dynamic multiplier effects of new technologies, firms and sectors cannot be taking into account by the CGOE convention as their models cannot endogenize entrepreneurship and shifts in preferences.

Implications for the CEESA market design group

The CEESA-market design group belongs to the CDE-convention and advocates for a dynamic learning effect perspective, as one important basis for regulatory instruments used in the transformation and creative destruction of the Danish energy system’s supply and demand side.

However, following the CDE convention it is an open ended experimental process to propose techno-economic transformations and the associated IRA-transformations. The design choices are subject to the uncertainty about future outcomes as there are too many unknown variables in the ‘equation’. Like the former DK investments in the natural system and co-generation of electricity and heat, the new investments will become sunk costs and irreversible shape the techno-economic efficiency and relevance of other complementary RE-tech’s.

The more specific instrument mix that can foster the type of ‘creative destruction’ in the energy system that we advocate on the supply and demand side is what we work on in the next period.