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The Economic Crisis and Sustainable Development

The design of Job Creation Strategies by use of Concrete Institutional Economics

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ABSTRACT

This paper presents Concrete Institutional Economics as an economic paradigm to understand how the wish for sustainable energy in times of economic crisis can be used to generate jobs as well as economic growth. In most countries, including European countries, the USA and China, the implementation of sustainable energy solutions involves the replacement of imported fossil fuels by substantial investments in energy conservation and renewable energy. In such situation, it becomes increasingly essential to develop economic thinking and economic models that can analyse the concrete institutions in which the market is embedded. This paper presents such tools and methodologies and applies them to the case of the Danish heating sector. The case shows how investments in decreasing fossil fuels and CO_2 emissions can be made in a way in which they have a positive influence on job creation and economic development as well as public expenditures.

Keywords: Sustainable Energy Planning, Energy and Job Creation, Renewable Energy and Economic Growth.

INTRODUCTION

Several official reports, books and journal papers address the relationship between economic development and the implementation of sustainable energy systems. Some papers address the relationship between economic growth and growth in energy demands [1, 2], however, without having a particular focus on the influence of job creation or the import of fossil fuels. Other papers quantify job creation of certain energy investments [3-5] or include job creation as a parameter in multi-criteria decision-making [6], however, without relating such quantification to economic growth or public expenditures.

Several papers concern the relationship between economic growth and the abatement of greenhouse gasses [7-9]. They see the market as basically in balance at a macro level, though, not including the external costs of greenhouse gas emissions in the production functions. Consequently, they assume that long-term unemployment will not exist and that the costs of labour for society will therefore be equal to the costs of labour on the market. The exclusion of greenhouse gas emission costs from the production can be characterised as a market failure. These authors assume that such a market failure can be eliminated by integrating the external costs into the prices. In the present period of extensive unemployment in Europe and many other regions, they overestimate the costs of labour and therefore also the costs related to labour intensive energy conservation and renewable energy investments. In addition to this, they underestimate the market failures on the energy market, and thus also the need for detailed energy policy reforms in addition to the integration of the external costs of greenhouse gas emissions. However, an increasing number of authors also emphasise that economic growth can only be achieved in the long term if sustainable energy solutions are implemented, and therefore also implicitly state that the costs of greenhouse gas abatement are often overestimated in the public discourse. Moreover, data suggests that countries that have prevented vested interests from blocking change have been far more successful in fostering a symbiosis between energy and industry than those countries that have not [10]. Based on a similar approach, the implementation of sustainable energy may be used to foster industrial development [11], as illustrated among others in [12, 13].

This paper addresses the development of strategies for how to use the economic crisis together with the wish for sustainable energy as a driver of job creation and economic development. In most countries, including European countries, the USA and China, the basic assumption is that the implementation of sustainable energy solutions involves the replacement of imported fossil fuels by substantial investments in energy conservation and renewable energy. Consequently, it is essential to include the consequences of such a change in the cost structure of the economy in question as well as to develop the potential for exploiting such a change in terms of technological and industrial development including the creation of jobs.

This element is essential, among others, because a country or a society may have to choose between alternative strategies of which the one option provides relatively low energy production costs but a high element of imported fuel; and the other has high energy production costs but also a high element of domestic investments and jobs. In such a situation, it is essential to include all relevant factors and consequences in the evaluation.

Especially one element should be highlighted, i.e., the dynamics of fuel prices. Most socio-economic feasibility studies will compare two alternative strategies using expectations of future fossil fuel costs. It is well known that such expectations have a considerable element of uncertainty and are, at the same time, often essential to the outcome of the feasibility study. However, if a substantial part of the countries in the world succeed in the implementation of sustainable energy solutions, one of the important outcomes will be a decrease in the demand for fossil fuels and thereby a reduction in the world market prices. While, on the other hand, if such strategies are not implemented, the demand will expand and lead to increasing world market prices. This places the fossil fuel importing countries in a catch-22 situation. IF all such countries make strategies on the assumption that future fuel prices will be high and, consequently, make large investments in decreasing demands, THEN the consequence will be decreasing world market prices; and post-conducted economic studies will show that the single country actually made a bad decision. However, IF the same countries make strategies assuming low future fuel prices and, consequently, make no investments in decreasing demands, THEN the consequence will be increasing world market prices, and economic studies will again be able to show that the single country made a bad decision.

As an additional aspect of the catch-22 situation, one may add that the fossil fuel importing part of the world will not be able to make huge investments in decreasing fossil fuel demands without introducing some sort of taxes on fossil fuel and/or subsidies to energy conservation and renewable energy measures. The president/chairman of the International Energy Agency [14] has put it this way: The fossil fuel importing countries basically have to choose between two fundamentally different strategies; i.e., either to implement sustainable solutions or not. However, no matter which strategy they choose, the future consumer energy prices will be high. If reductions in demand are not implemented, the prices will be high due to increasing world market prices. However, if reductions in demand are implemented, the prices will be high due to the introduction of the taxes necessary to make investments feasible on the market.

Seen from the view of the fossil fuel importing countries, the main point is that, in both strategies, the energy prices will be high. However, if investments are made in reducing demands, the high prices are caused by taxes; in which case, the money will stay in the country in question. In the other situation, the high prices are caused by high world market prices of imported fuels; in which case, the money will leave the country.

This paper focuses on how to make feasibility studies in a situation with environmental and energy security concerns, in which technological innovation and institutional changes are among the objectives. In such a situation, the feasibility study should include the design of feasible technological alternatives; an evaluation of the social, environmental and economic costs; the innovative potentials of these alternatives; and an analysis of the institutional conditions which influence the implementation of the alternatives. Therefore, the scope and focus of the feasibility studies referred to in this paper are much broader than in the conventional cost-effectiveness and cost-benefit analysis approach.

In the present situation, it becomes essential to be able to include economic growth related to import/export and job creation in the evaluation of different strategies and options. However, the neo-classically based cost-benefit analyses typically used are not able to include such important elements. One has to look for other methodologies and theoretical points of departure.

THEORY

At present, most energy planning activities and their associated economic analyses are based on a neo-classical economic paradigm, in which a detailed analysis of concrete market institutions and their effects on the general economic development in a specific country and period of time is neglected. Instead of analysing the concrete institutions of society, neo-classically inspired economic thinking describes societal institutions at a very aggregated level and, in the economic models, subordinate them to the basic assumptions that the economy will always establish a *balance* between the supply and demand of goods and production factors, and will generate a growth process that *optimizes* economic welfare and thus establishes an optimal use of resources, i.e., “the best of all worlds”.

These *balance* and *optimization* assumptions are only (partly) valid, if it is assumed that consumers and producers optimize their individual profits on a market with the following “free market” institutional characteristics: Many mutually independent suppliers of a product; many mutually independent buyers of a product; full information regarding quality and prices of products available; agents in the market, acting with rational behaviour; sellers who maximize profits and buyers who maximize utility.

Therefore, despite the fact that neo-classical economy does deal with present-day societal institutions (although at an aggregated level), these basically represent the dog’s tail, with the dog being the above “free market” institutional conditions. As a consequence of being subjected to the above *balance* and *optimization* criteria, the feasibility studies inspired by neoclassical economy have, amongst others, the following characteristics:

From the premise that society is characterised by an optimal allocation of resources (the best of all worlds), we can deduce that any change away from this optimum represents socio-economic losses to society. For instance, any policy implemented to reduce greenhouse gas emissions is regarded as causing extra costs to society in all computations. In these econometric models, systematic institutional mistakes in the economic process do not exist. Meanwhile, in real life, this premise is wrong.

Moreover, the calculation of employment and public finance effects of alternative energy scenarios is not relevant, as the economy per definition will reach an optimal balance.

The neo-classical approach is increasingly obsolete, as there is a need for a basic technological transformation from fossil fuel – and nuclear technologies – to energy conservation and renewable energy technologies, and this change requires fundamental changes in the concrete institutions that design the future technical systems.

Therefore, it becomes increasingly necessary to develop economic thinking and economic models that can analyse the concrete institutions in which the market is embedded. Consequently, it is necessary to see the economy as an institutional economy, in which the present institutions may very well not generate the optimal economic situation. The necessary technical changes require new organizations and new institutions. An economic paradigm should, therefore, include the understanding that any market is embedded in a number of concrete market institutions that differ from one country to another and change from one period to another as a result of decisions and actions made both by the Parliament and actors on the market. These institutions are essential both for the generation of technological winners and losers on the market and for the outcome of feasibility studies used in planning procedures.

When studying the market institutions in detail, it becomes clear that the "real market" does not fulfil the institutional preconditions of the "free market" of the textbooks. The interplay between the "real market" and the "free market" is often one of ideology, in which the strongest actors on an oligopolistic "real market" use the ideology of the "free market" to argue for no public regulation, without removing their own private regulation of the market. In the real world, the argument "let the free market decide" is synonymous with the sentence "let us decide". "Us" means the strongest actors on an oligopolistic market with a few dominating companies. This description is especially valid, when dealing with energy markets.

Even if the market was "free" in the sense of the textbook on economics, the market would still not be free, due to the losses linked to individual optimization. This is described in game theory, which shows that an equilibrium based on individual decisions (NASH equilibrium), in many cases, does not lead to maximum welfare, or the Pareto optimum, for society. As a consequence of this, organisations, such as for instance the state, municipalities, etc., have been introduced to minimize the above losses linked to a "society" with 100% individual optimization on a market.

Therefore, it may be concluded that, in the world of market realities, there is always some form of either public or private hierarchal regulation, where regulation is defined as any organised, purpose-directed influence on the framework of the market and the organisation of cooperation within the market.

The economic paradigm described above is here called ***Concrete Institutional Economics***.

METHODOLOGY

Feasibility studies of energy planning linked to Concrete Institutional Economics involve the following procedures:

1. *Analyse the technical scenarios and find the best ones.*
   Concrete Institutional Economics recognize that an economic balance of products and production factors such as labour will not be established automatically. Unemployment can develop and persist for years and decades. Deficits on the state budget can increase and lead countries into a debt trap without any automatic processes re-establishing financial balances. Therefore, feasibility studies of energy scenarios should also take into account and evaluate the effects of different technical scenarios on employment and public finances. And positive effects on these macro-economic indicators should be a part of the project evaluation process, when looking for the best alternative.

2. *Analyse the present institutional and political contexts and find the hindrances to the best technical scenarios*.
   This could be tariff and tax conditions supporting an increased energy consumption; ownership design that hinders the local acceptance of wind power projects; the lack of financial possibilities for people wanting to improve the energy standard of their houses; tax deduction rules supporting accelerating traffic development, etc. Altogether, these different institutional conditions may identify projects which are not implemented under present institutional conditions, despite being both economically and environmentally feasible from a social and economic point of view.

3. *Design the needed institutional scenarios in order to implement the best technical solutions as described under item 1.*

CASE

To illustrate the theoretical point of departure and methodologies described above, a case is reported in the following. The case involves the heating of 24 per cent of the Danish building stock, which is now being heated by individual boilers fuelled by oil, natural gas or biomass, and which is located relatively close to existing district heating areas. The case concerns the replacement of such boilers by district heating in urban areas in combination with individual heat pumps in the remaining buildings during a period of 10 years.

As carefully analysed and explained in [15, 16], such an investment programme is considered to be an essential part of the transformation of the Danish energy supply into a future sustainable energy system without fossil fuels. At present, the share of renewable energy in Denmark is reaching almost 20 per cent. From such point of departure, [15] define a scenario framework in which the Danish system is converted to a system based 100 per cent on renewable energy sources (RES) by the year 2060, including reductions in space heating demands by 75 per cent. By the use of a detailed energy system analysis of the complete national energy system, the consequences in relation to fuel demand, CO_2 emissions, and cost are calculated for various heating options, including district heating as well as individual heat pumps and micro CHPs (Combined Heat and Power). The study includes the above-mentioned 24 per cent of the Danish building stock, namely those buildings which have individual gas or oil boilers today that could be substituted by district heating or a more efficient individual heat source. In such overall perspective, the study [15] concludes that the best solution will be to combine a gradual expansion of district heating with individual heat pumps in the remaining houses. Such conclusion is valid in the present systems, which are mainly based on fossil fuels, as well as in a potential future system based 100 per cent on renewable energy.

Based on these analyses, a ten-year implementation plan has been defined:

- Expansion of district heating from the present 46% to 65% of the Danish heat market, equal to 80% of the buildings in question.
- Individual heat pumps in the remaining buildings, equal to 20% of the buildings in question.
- Gradual improvement of the district heating technology and operation introduced, among others, by lowering the temperature in the distribution system along with implementing energy conservation in the buildings.
- Additional investments in the district heating production plants including the addition of heat pumps, solar thermal, geothermal and biomass boilers to the existing CHP plants (Combined heat and power production units).

Such investment programme has been compared to a reference in which the existing boilers are kept and the system is expected to be gradually improved and transformed into a future sustainable energy system. Compared to the existing system (anno 2010), the system in 2020 is assumed to have undergone the following main changes:

- Implementation of energy conservation measures resulting in a 25% reduction of space heating demands and a 10% cut in the current electricity demands.
- Slightly improved average efficiencies of CHP and power plants.
- Conversion of 10% of the transport fleet into electricity-driven vehicles.
- Efficiency and capacity improvements of CHP waste incineration plants.

Energy system analysis methodology and assumptions

The technical and socio-economic study has been conducted on the basis of the same assumptions as the previous study described in the following. More information on a number of specific details can be found in [15-17].

The calculation of consequences for fuel consumption and electricity exchange in the national Danish energy system as well as the analysis and design of suitable investments in different combinations of district heating production units have been carried out in the energy system analysis tool, EnergyPLAN, using a model of the complete national Danish energy system. This tool, which has been developed at Aalborg University, can be freely accessed from the website www.energyplan.eu. On the same website, one can find links to documentation, journal papers and a training programme. Fig. 1 shows an overview of the model.

EnergyPLAN is described and compared to other models in [18]. The main purpose of the model is to assist the design of national or regional energy planning strategies, encompassing the whole energy system including heat and electricity supplies as well as the transport and industrial sectors. The model is a deterministic input/output model. General inputs are demands, renewable energy sources, energy station capacities, cost and a number of optional different regulation strategies emphasising import/export and excess electricity production. Outputs are energy balances and resulting annual productions, fuel consumption, import/export of electricity, and total cost including income from the exchange of electricity.

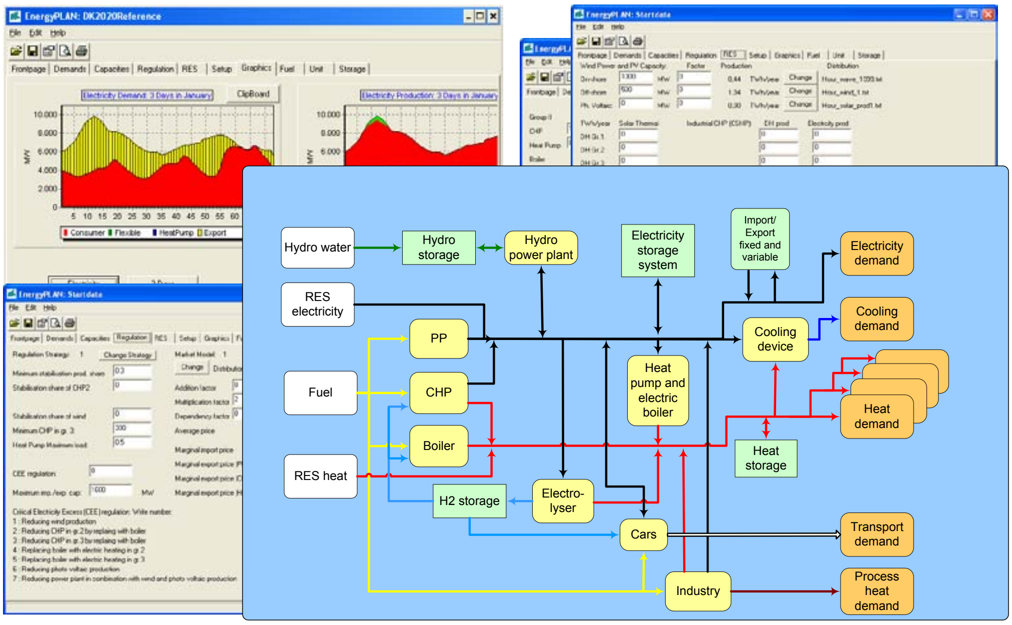

Figure 1. The user interface of the EnergyPLAN model

As further described in [15,17] , the energy system model was calibrated in order to adjust it to the output of Danish energy statistics from 2006 as well as a Business-as-usual (BAU) projection made by the Danish Energy Agency (17 January 2008). Moreover, in the present analysis, special attention has been paid to the hourly modelling of district heating demands in relation to reductions in the demand for space heating. The starting point is the annual district heating demand in the current system. Such a demand has been subject to a typical hourly distribution. However, in the scenarios of reduced space heating demands, the shape of the duration curve as well as the hourly distribution have been adjusted, as shown in Fig. 2, in the case of a 25 per cent reduction in the space heating demand. In this case, the district heating share depending on the outdoor temperature decreases and the fixed share (on a seasonal basis) for district heating losses and hot water supply increases.

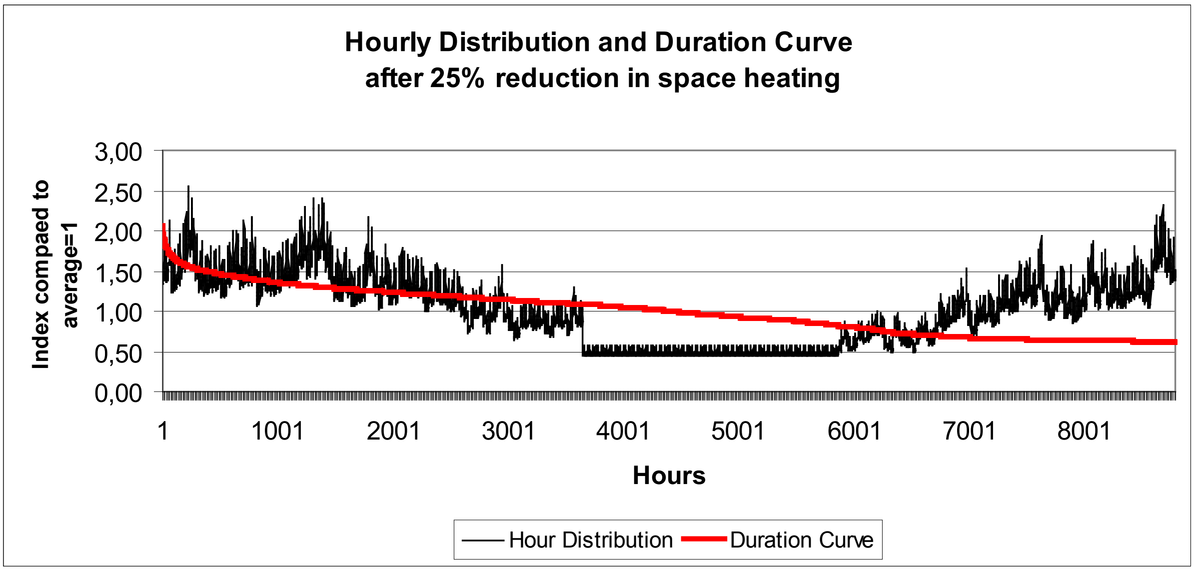

Figure 2. Duration curve with a 25 % reduction of the heat demand

In the economic calculations, a real rate of 3 per cent has been used in combination with a relatively moderate world market fuel price level equal to an oil price of 76 USD/barrel, given an exchange rate of 0,8 USD/EUR.

In the calculation of consequences for the balance of payment and job creation, all investments are assumed to have an import share of 40 per cent; operation and maintenance an import share of 20 per cent; and fossil fuels an import share of 80 per cent. In the 40 per cent assumption regarding investments, it has been taken into consideration that investments in district heating in two surveys [19, 20] have proven to have a relatively low share of the import in Denmark, since a substantial share of the manufactories of district heating pipes and components are located in Denmark. The remaining costs are assumed to generate jobs in Denmark at an average of 2 person-years per 1 Million DKK (equal to approx. 135.000 EUR). 80% is salary and the rest is capital income or savings.

In the analyses of the influence on governmental expenditures including saved unemployment benefits as well as increases in income taxes, a net plus of 300.000 DKK (40.000 EUR) is used per person year, equal to the general expectations used by the Danish Ministry of Finance. Such amount includes any additional effects arising from VAT, etc.

With regard to the evaluation of taxes, the calculation becomes rather complicated, since it must reflect the Danish taxation system. The following taxes have been included:

- A CO_2 tax of 175 DKK/ton, equal to 23 EUR/ton.
- Taxes on natural gas for heating purpose for industrial and individual users: 2,629 DKK/Nm3 (0.35 EUR/Nm3)
- Taxes on natural gas for small CHP plants: 238 DKK/MWh (32 EUR/MWh).
- Taxes on oil for heating in individual boilers: 2.47 DKK/litre or 247 DKK/MWh (33 EUR/MWh).
- Taxes on electricity for individual heat pumps = 545 DKK/MWh (73 EUR/MWh).
- Taxes on natural gas boilers and large heat pumps in district heating: 208 DKK/MWh per unit of produced heat (28 EUR/MWh).

Most of these taxes have already been announced to increase by 1,8% per year until 2015. Since this is more or less the same as the expected increases in prices in general, all calculations have been carried out in year 2010 prices using the above listed figures.

Results

As a first approach, the aforementioned tools and assumptions have been used to evaluate and design a suitable implementation plan, in which the reference of the existing individual boilers (called "***Ref***" in the diagrams) has been compared to the implementation of 80% district heating and 20% individual heat pumps. The following list of different alternative investments in the district heating production units was analysed (The short name refers to the indicators in the three diagrams):

- ***VP-0***: 80% of the buildings in question convert to district heating and the rest to individual heat pumps. The buildings are added to the existing district heating systems and only peak load boilers are added to the district heating supply.
- ***VP-300*** and ***VP-400***: The same as VP-0 just added the investment in large-scale heat pumps distributed among the district heating plants of a total of 300 or 400 MW electric input (COP = 3).
- ***VP-300-Bio***: The same as above but the current natural gas boilers are replaced by biomass boilers.

- ***VP-300-Sol***: The same as VP-300 just added 40% solar thermal energy in 90% of the district heating systems without CHP in combination with seasonal thermal heat storage and 10% in 50% of the remaining systems.
- ***VP-Sol-Geo*:** The same as VP-300-Sol just added the use of central geothermal energy from 1-2 km into the ground in large urban areas. These installations are combined with waste incineration CHP plants and use steam to operate absorption heat pumps. The scenario includes the installation of a total of 230 MW of thermal power.
- ***VP-Sol-Geo-Bio:*** The same as VP-Sol-Geo just added biomass boilers. A limit to the operation of these boilers is assumed.

The resulting fuel consumption, CO_2 emissions and total annual operation costs of the different alternatives are illustrated in Figures 3, 4 and 5 and explained in the following.

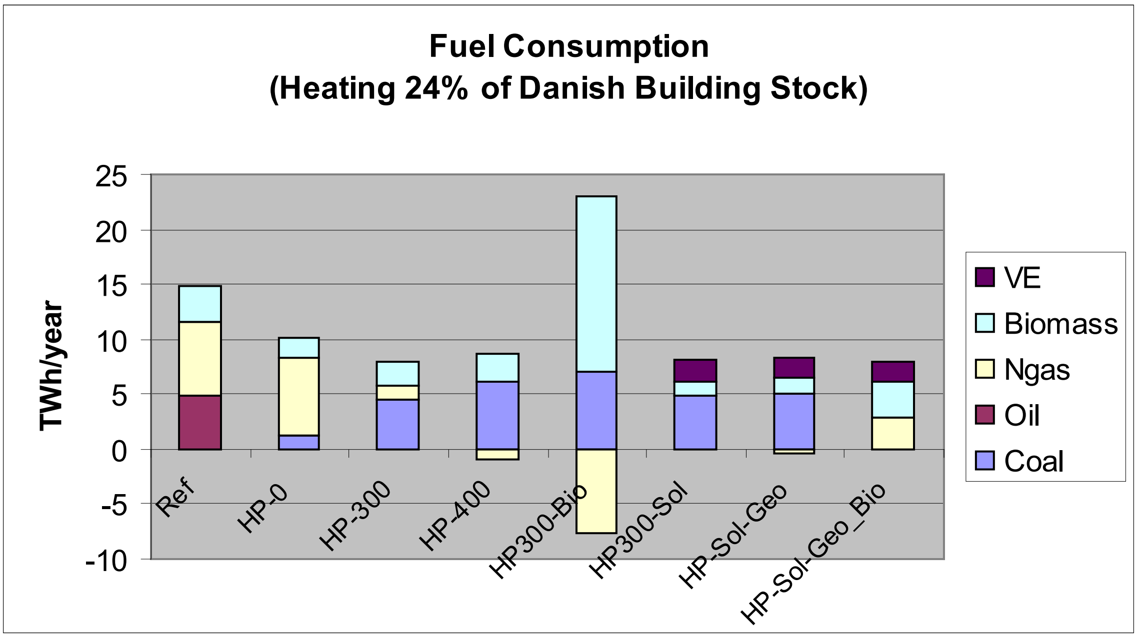

Figure 3. Fuel consumption in 2020 in a closed system

Fig. 3 shows the fuel consumption of supplying the buildings in question with heat. It should be emphasised that the calculations identify the total fuel consumption in the complete national energy system for each alternative. The fuel used for heating is then identified by comparing the demand to a similar calculation in which the heating of the buildings is not included.

As illustrated in Fig. 3, the fuel consumption in the reference situation is oil, natural gas and biomass in individual boilers. The replacement of these with district heating and individual heat pumps (HP-0) reduces the fuel consumption due to an increase in the use of CHP on the existing plants. The addition of heat pumps (HP300 and HP400) results in further reductions. This is caused by the fact that the heat pumps can replace some of the boilers in the district heating production plants. However, the introduction of heat pumps also results in a reduction in natural gas and an increase in coal. This is due to the fact that coal prices are lower than natural gas prices and, therefore, the electricity supplying the heat pumps is mainly produced from coal. Moreover, this is also caused by the fact that the heat pumps replace natural gas boilers rather than coal boilers.

If the current peak load boilers on natural gas are replaced by biomass (VP300+Bio), the biomass boilers will take over the production from both the CHP plants and the heat pumps. This is solely due to the Danish tax system in which CHP and natural gas are heavily taxed, while there is no tax on biomass. However, in this case, the result is an increase in the total fuel consumption and no fuel is saved compared to the reference situation.

If solar thermal (VP300-Sol) and/or geothermal heat (VP-Sol-Geo) are added instead of biomass, the use of natural gas is reduced further. When the results show that it is the natural gas and not the coal which is replaced again, this is explained by the assumption that coal is substantially cheaper than gas.

In the final option (VP-Sol-Geo-Bio), the alternative has been adjusted so that the use of coal and biomass is the same as in the reference. This is achieved by increasing the use of biomass in the coal-fired large steam turbine CHP and power stations as well as the natural gas peak load boilers in the small CHP plants. Moreover, some of the coal has been replaced by natural gas.

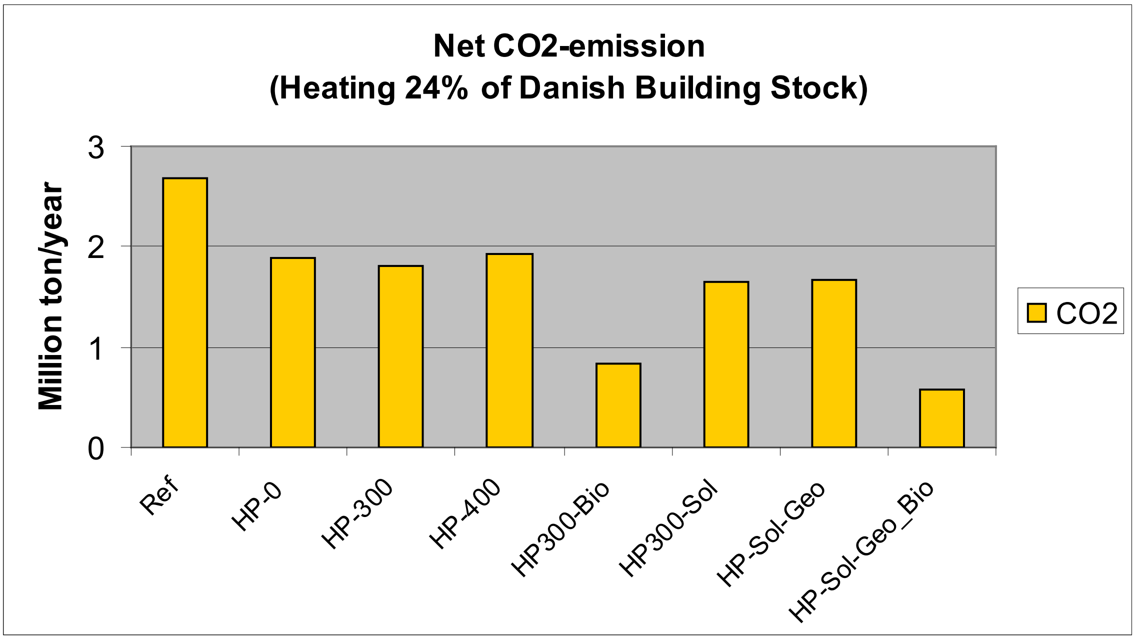

Figure 4. Net CO_2 emissions in 2020 in a closed system

Fig. 4 shows the corresponding CO_2 emissions from the heating of the buildings in question. As illustrated, the replacement of boilers by district heating and individual heat pumps reduces the CO_2 emissions, but not very much. On the other hand, substantial amounts of biomass are saved, which can be used to replace fossil fuels in other places. The addition of heat pumps reduces the fuel consumption of the system, but the use of coal increases and so do the CO_2 emissions. The addition of biomass boilers reduces the CO_2 emissions but also the use of biomass, which must be considered a limited resource. The alternative VP-Sol-Geo-Bio is comparable to the reference in terms of biomass amounts. It illustrates how the implementation of district heating and individual heat pumps under such circumstances can reduce CO_2 emissions from approx. 2,5 million t/year in the reference to only 0,5 million t/year.

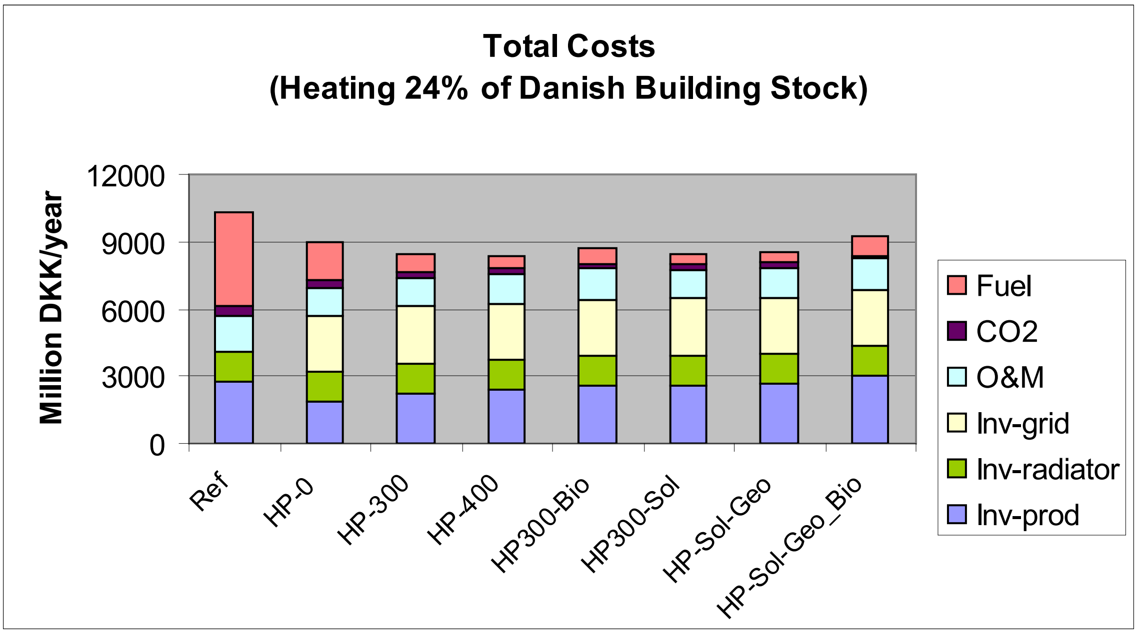

Figure 5. Socio-economic costs in 2020 in a closed system

Fig. 5 shows the total costs and illustrates how the Danish society in general will be able to decrease the cost of heating the buildings in question by investing in district heating and individual heat pumps. As illustrated, fuel costs are replaced by investments. The figure shows the annual costs in a fully implemented system in 2020 in which all investments are paid during their technical lifetime using a real interest of 3 per cent.

As illustrated above, the Danish society can choose to implement a district heating and individual heat pump strategy in different ways in terms of the system integration and the production meeting the increased demand for district heating. In the following, it has been chosen to continue with the VP-Sol-Geo-Bio alternative. Here, this option serves as a good example, since the use of biomass and coal are the same as in the reference.

As illustrated in Fig. 5, the implementation of the VP-Sol-Geo-Bio alternative will slightly decrease the annual cost of heating the houses in question compared to the reference, when all investments are paid for during the technical lifetime. The total net investment amounts to approximately 9 billion EUR. 13 billion EUR must be invested, but 4 billion EUR of investments can be saved compared to the reference.

Table 1 illustrates the annual investments and operation cost, given that the alternative is implemented over a period of 10 years from 2011 to 2020. As shown, such implementation plan requires substantial net investments, which will gradually result in substantial savings in fuel costs.

The net investments will have a negative influence (positive net import) on the balance of payment in the beginning. However, due to the saved import of fossil fuels, this influence is reduced and will end up being positive (negative net import). When measured over the total lifetime of the investment, the effect is both substantial and positive.

The net investments made during the 10-year implementation period also result in the creation of approximately 7-8.000 jobs in total for the 10-year period.

Table 1. Costs and job creation

MDKK	All years	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
District heating grid	58.000	5800	5800	5800	5800	5800	5800	5800	5800	5800	5800	0
DH house installations	9240	924	924	924	924	924	924	924	924	924	924	0
Individual heat pumps	11550	1155	1155	1155	1155	1155	1155	1155	1155	1155	1155	0
Large scale heat pumps	6000	600	600	600	600	600	600	600	600	600	600	0
Peak load boilers	4000	400	400	400	400	400	400	400	400	400	400	0
Biomass boilers	5000	500	500	500	500	500	500	500	500	500	500	0
Solar thermal	5600	560	560	560	560	560	560	560	560	560	560	0
Geothermal	1400	140	140	140	140	140	140	140	140	140	140	0
Total new investments	***100.790***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***10.079***	***0***
Saved oil boilers	11400	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	0
Saved biomass boilers	8400	840	840	840	840	840	840	840	840	840	840	0
Saved Ngas boilers	10460	1046	1046	1046	1046	1046	1046	1046	1046	1046	1046	0
Total saved investments	***30260***	***3026***	***3026***	***3026***	***3026***	***3026***	***3026***	***3026***	***3026***	***3026***	***3026***	***0***
Net investments	**70.530**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**7.053**	**0**
Increased O&M	8438	70	211	352	492	633	774	914	1055	1195	1336	1406
Saved O&M	-9609	-80	-240	-400	-561	-721	-881	-1041	-1201	-1361	-1521	-1602
O&M net change	**-1171**	**-10**	**-29**	**-49**	**-68**	**-88**	**-107**	**-127**	**-146**	**-166**	**-185**	**-195**
Fuel net change	**-19722**	**-164**	**-493**	**-822**	**-1150**	**-1479**	**-1808**	**-2137**	**-2465**	**-2794**	**-3123**	**-3287**
Total costs	49637	6879	6531	6182	5834	5486	5138	4790	4441	4093	3745	-3482
Import costs	12200	2688	2421	2154	1887	1620	1353	1087	820	553	286	-2669
Employment	74874	8382	8220	8057	7894	7731	7569	7406	7243	7081	6918	-1627

However, the implementation of the alternative has an influence on the governmental expenditures in several ways. First of all, the alternative cannot be implemented without the formulation of an active energy policy, since some of the investments are not feasible to the investors with the current taxes and subsidies. Secondly, since the oil and natural gas consumptions are currently taxed, the government will lack this income when these fuels are replaced. Finally, the creation of jobs will generate additional income taxes.

Table 2. Net effects on the governmental expenditures

				DKK/M3	DKK/kWh	MDKK/GWh
Input data	Saved unemployment benefits:	0,12 MDKK/Manyear	Individual natural gas	2,629	0,239	0,239
	Increased income taxes	0,18 MDKK/Manyear	Industry natural gas	2,629	0,239	0,239
			heat from heat pump		0,208	0,208
			heat from boilers		0,208	0,208
			heat from CHP	2,620	0,238	0,238
			individual gas oil	2,469	0,247	0,247
			Industry oil	2,469	0,247	0,247
			individual HP (elec.)		0,545	0,545

MDKK	All years	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Subsidy (solar and HP)		20	20	15	15	10	10	5	5	0	0	0
Employment	74874	8382	8220	8057	7894	7731	7569	7406	7243	7081	6918	-1627
GWh/year												
Natural gas (individual)	-24600	-205	-615	-1025	-1435	-1845	-2255	-2665	-3075	-3485	-3895	-4100
Natural gas (industry)	-15240	-127	-381	-635	-889	-1143	-1397	-1651	-1905	-2159	-2413	-2540
Total natural gas CHP	*-3060*	*-26*	*-77*	*-128*	*-179*	*-230*	*-281*	*-332*	*-383*	*-434*	*-485*	*-510*
tax free part (0,38/0,62)	*-1875*	*-16*	*-47*	*-78*	*-109*	*-141*	*-172*	*-203*	*-234*	*-266*	*-297*	*-313*
Taxed natural gas CHP	-1185	-10	-30	-49	-69	-89	-109	-128	-148	-168	-188	-197
Natural gas (boiler)	-9360	-78	-234	-390	-546	-702	-858	-1014	-1170	-1326	-1482	-1560
Gas oil (boiler)	-12420	-104	-311	-518	-725	-932	-1139	-1346	-1553	-1760	-1967	-2070
Oil (industry)	-17160	-143	-429	-715	-1001	-1287	-1573	-1859	-2145	-2431	-2717	-2860
Heat from heat pump	38700	323	968	1613	2258	2903	3548	4193	4838	5483	6128	6450
Elec. To individual HP	4878	41	122	203	285	366	447	528	610	691	772	813
MDKK												
losess in taxes		-140	-421	-701	-981	-1262	-1542	-1823	-2103	-2384	-2664	-2804
Additional taxes		71	212	353	495	636	777	919	1060	1201	1343	1413
Net decrease in taxes		**-70**	**-209**	**-348**	**-487**	**-626**	**-765**	**-904**	**-1043**	**-1182**	**-1321**	**-1391**
Saved benefits		1006	986	967	947	928	908	889	869	850	830	-195
Increased income taxes		1509	1480	1450	1421	1392	1362	1333	1304	1275	1245	-293
Net influence before policy means		**2445**	**2257**	**2069**	**1881**	**1693**	**1506**	**1318**	**1130**	**942**	**754**	**-1879**
Subsidy solar and heat pumps		-232	-232	-174	-174	-116	-116	-58	-58	0	0	0
Compensation natural gas companies		-56	-56	-56	-56	-56	-56	-56	-56	-56	-56	-56
Tax release individual heat pumps		-14	-41	-68	-96	-123	-151	-178	-205	-233	-260	-274
Tax release large heat pumps		-23	-68	-114	-159	-204	-250	-295	-341	-386	-431	-454
Policy means Total		**-325**	**-397**	**-412**	**-485**	**-499**	**-573**	**-587**	**-660**	**-675**	**-747**	**-784**
Net influence on Gov. expenditures		**2120**	**1860**	**1657**	**1396**	**1194**	**933**	**731**	**470**	**267**	**7**	**-2663**

In Table 2, an estimate is made of the extent of the different consequences. This is an estimate, since VAT and multiplication effects have not been included. Moreover, due to the very complex taxation system in Denmark, all effects have not been calculated in detail.

However, the table provides a good overview of the magnitude of the influence of the different measures.

The table is read in the following way: In the top, the current taxes are listed as input, as already explained in the section on data and assumptions. All the changes in relevant fossil fuel consumption are listed and divided into the relevant taxation categories.

Based on these two types of input, a calculation is made; first, of the decreases in taxes on oil and natural gas for individual boilers compared to the reference, and, secondly, of the increases in other taxes, i.e., on electricity for heat pumps. As can be seen, the government will miss taxes on oil and natural gas of 140 MDKK in the first year, gradually rising to 2800 MDKK after ten years, when the strategy is fully implemented. However, approx. 50 per cent of this loss is compensated for by increases in the taxation of electricity for heat pumps.

However, in return for the net loss in fuel taxes, the government benefits from the job creation in two ways. First, governmental contributions to unemployment benefits are saved. Next, the income taxes are increased. In total, this effect raises the income by 2500 MDKK/year, in the beginning, slightly decreasing to 2000 MDKK in year 2020.

The net effect (if the plan could be implemented without any subsidies or similar) is a positive contribution to the governmental expenditures of approx. 2500 MDKK in 2011, decreasing to approx. 750 MDKK in 2020.

A survey of the barriers to making the investments feasible on the market has resulted in the following public regulation measures to be taken:

- A subsidy for heat pumps and solar thermal power of 20% in the first two years should be introduced and gradually decreased to 15, 10 and 5%, respectively, over the period.
- The natural gas companies should be compensated for loans in the natural gas grid which have not yet been paid, so that the remaining consumers will not have to pay for those who leave the system.
- Current taxes on electricity for small as well as large-scale heat pumps should be reduced.

All in all, these subsidies and tax reductions will increase the governmental expenditures by approx. 300 MDKK/year in the first year, increasing to approx. 800 MDKK/year after 10 years.

As shown in Table 2, when all these measures are introduced and calculated, the net consequences for the government ends at a plus of approx. 2 Billion DKK in year one, gradually decreasing to zero over a period of ten years.

CONCLUSION

This paper has described and promoted Concrete Institutional Economics as a tool and methodology of designing strategies for how to use the present economic crisis and investments in sustainable energy as a driver of job creation and industrial development and, thereby, economic growth. The paper argues that, in order to do so, it becomes increasingly necessary to develop economic thinking and economic models that can analyse the concrete institutions in which the market is embedded. An economic paradigm should therefore include the understanding that any market is embedded in a number of concrete market institutions. These institutions differ from one country to another and change from one period to another, as a result of decisions and actions both made by the Parliament and actors on the market. These institutions are essential both for the generation of technological winners and losers on the market and for the outcome of feasibility studies used in planning procedures. Based on such discussion, this paper describes an economic paradigm, here called ***Concrete Institutional Economics,*** and provides tools and methodologies for the use of such a paradigm.

The applications of such an analytical paradigm is here illustrated by the case of a recent study entitled "Heating Plan Denmark 2010", which shows that the implementation of a district heating and individual heat pump scenario over a period of 10 years involves a net investment of 70 billion DKK, which will create 7-8000 jobs in the 10-year period. In 2020, it will reduce the burning of fossil fuels by 32 PJ/year and reduce CO_2 emissions by 2.1 million ton/year. The total costs for the Danish society will decrease by approx. 1 billion DKK/year, assuming fuel prices equal to a world market oil price of 76 USD/barrel (0.8 USD/EUR).

Given the current economic crisis with relatively high unemployment rates and assuming that additional jobs will reduce the unemployment, the net influence on the governmental expenditures is positive and will provide an additional income of approx. 2 billion DKK/year in the first year, gradually decreasing to zero during the 10-year period.

Consequently, the case illustrates how the economic crisis enables the implementation of essential elements of future sustainable energy solutions, which generate jobs without having a negative influence on the governmental expenditures.

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