Can energy saving policy survive in a market economy?

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1. SYNOPSIS

An attempt to explain why energy savings might be incompatible with an unregulated market economy and an attempt to analyse the main market regulations required.

2. ABSTRACT

The paper deals with the conflicts between energy savings on the one side and a market economy on the other side. The current high emphasis on free markets is sometimes perceived, as if the goal should be a totally unregulated global market. On second thought nobody would probably subscribe to that model. It would disregard the main environmental problems, because they are basically *collective* and have a *long-term* effect, and none of these aspects are well cared for by a free market.

Energy savings are environmentally often superior to renewable energy, and should be treated correspondingly. A simple graphic model is used to illustrate the consequences of a government policy based on that criterion and economic rationality. For the sake of the environment, energy savings should be promoted to a level where the marginal cost per saved unit of energy is higher than the cost of providing a unit from renewable resources.

Those energy savings, which are *cost-effective*, can be considered a productivity increase. They will, through the rebound effect, tend to spur the economy in a society where production capacity is the limiting factor. In affluent societies, however, where consumption capacity or demand somehow is the constraint for growth in GDP, cost-effective energy savings seem to be in conflict with an aim for growth in general consumption. This will be illustrated by various cases.

Most experts would agree that GDP is a poor indicator of the welfare of people. Therefore attempts are made to adjust the GDP to better reflect at least the *real economic* welfare, for instance by what is termed the Genuine Progress Indicator, GPI. The general trend is that energy savings will reduce GDP and increase GPI.

3. INTRODUCTION

In this paper I pursue openly some truths about the possibilities for energy savings in a market economy, especially a market economy, which are aiming at a forever expanding Gross Domestic Production, GDP. We are all playing different roles in the societies, and it is not possible to conduct totally value free or objective research, especially not in political fields like implementing energy savings. My own dedication is towards a global society, which provides its citizens with a decent and equitable life in an environmentally sustainable economy, and with economic systems adapting to such aims. I find that too much research efforts are spent on attempts to show how a so-called “free market” structures could be compatible with efforts to save energy, or even automatically could promote such savings. Too little research efforts are directed towards investigating how and where the existing structures and goals are in conflict with energy savings and therefore should be regulated to reflect the *environmental realities*.

This paper is a modest attempt to stir up the debate and indicate areas where more research and discussion should take place. My personal background is a long career at a university where I have had extensive freedom to choose subjects of research as well as freedom to communicate the results to colleagues and to the public. This independence of business interests and government’s interests should be the noble characteristic of a university, responsible to its scientific and ethical integrity only. Unfortunately these virtues have faded in recent decades, when universities increasingly have been forced to finance their research through grants and sponsorships, reflecting the interests of the established market forces.

Environmentally Sustainable Development

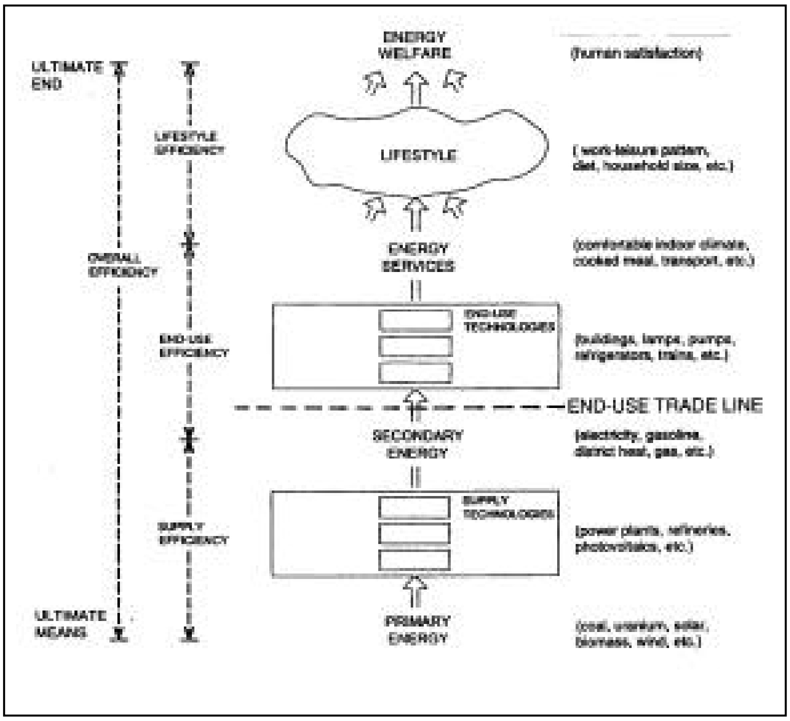
The background for the paper is an assumption that the energy policy should be aiming for a development, which is environmentally sustainable. Nobody would probably disagree on this goal, especially in a forum of energy efficiency experts. Since, however, the term s*ustainable development* has often been abused or watered down to suit vested interests or personal ideologies, I will briefly define what I here mean by this term. The American

economist H. Daly has, on the basis of Hicks' economic theories of income [Hicks 1948], defined a sustainable development with respect to energy and other resources as *a development, which does not reduce the development options of the future by deteriorating the natural environment* [Daly 1990].
This definition seems rather logical and implies that the use of fossil fuels and nuclear power is incompatible with a sustainable development, both because of the resource depletion and because of the waste emissions or depositing. The consequences are enormous, which of course should not lead us to redefine or abandon sustainability as a goal, but rather to maintain it as the long term goal and make sure we are working in the right direction.
CO_2-emission is one important example of a pollutant, which in a sustainable development should not be emitted at faster rate than the environment can absorb or neutralise it. As a reasonable target, although with no guarantee against severe climatic changes, the UN Intergovernmental Panel on Climate Change, IPCC, suggest stabilising the atmospheric *concentration* of CO_2 at a level of 450 ppmv, which is around 25 percent higher than today. To achieve this stabilisation the global CO_2-*emission* must soon be reduced substantially [IPCC 1995]. If we ascribe all humans the same right to use the atmosphere, this would for most industrialised countries imply reductions in per capita CO_2-emission by 80–95 percent, dependent on their present emissions. A 90 percent reduction is the long term target for the Danish Governmental energy policy, counting on a 20 percent reduction by 2010 as compared to 1990, and 50 percent by 2030 [Danish Energy Agency 1995].
Since the path we in the industrialised countries have followed till now, and still pursue, is very far from a sustainable development, we *either* have to seriously reconsider our political and personal goals, means, and ideologies, - *or* somehow ignore the environment problems. In this paper I assume we take the problems seriously and therefore remain open to basic changes in market regulations in order to facilitate a humane and sustainable development.
I will try, through three aspects of the energy saving policy, to illuminate some of the conflicts between energy savings and the present market policy. The three aspects presented are 1) the balance between investing in energy savings versus in renewable energy supply, 2) the rebound effect, and 3) the effect of energy savings on the economy. Whether changes in the present policy are "realistic" cannot be judged as long as the options are kept in the dark. They must first be analysed and presented to the public in the form of consistent scenarios before it is possible to evaluate, which is the more realistic path to pursue in a future democracy: the present policy or any of the environmentally sustainable alternatives. Energy savings could play an important role in mitigating the environmental problems, but the solutions require a holistic view at the way that we live in general - not just at the way we directly use energy.

Energy Savings versus Efficiencies

Throughout this paper the term energy *savings* will be used to indicate a reducing effect on energy consumption. But in the debate and the literature the term energy *efficiency* is usually preferred, partly because it sounds more politically correct and is easier to "sell" in the growth oriented societies, which most of us are living in. Energy efficiency could also be a proper term, if we consider the whole energy chain, see Figure 1, including the "efficiency" of the way we live and of the economic structure. But normally energy efficiency is confined to indicate efficiency of *technology* only, and while this efficiency is gradually increasing, there are many indications that efficiency of the *lifestyles* and the *economy* in general is declining in terms of the satisfaction obtained per energy service input, as discussed elsewhere [Nørgård 1995].
There are many pitfalls in focusing on technical energy efficiency. It is, for instance possible to increase energy efficiency at the same time as increasing energy consumption, e.g. when buying a larger freezer or a larger house. They will both consume more energy, but normally be termed more efficient in annual GJ consumed per liter volume or square meter floor space, respectively. The larger, typically the more energy efficient (and the more energy consuming). This *efficiency of scale* effect is also reflected when GDP is increasing for an industrialised country, which is moving to a service or information society. This transition will *automatically* lead to an increasing efficiency (or reciprocally, declining energy intensity in terms of energy consumption per GDP), but unfortunately also towards higher energy consumption [Jespersen 1999].
Another, but related, catch of focusing on technical efficiency improvement only and ignoring the efficiency of the economy is the rebound effect, discussed later.

Figure 1. The Energy Chain Model,
showing the conversion of the ultimate means, the Primary Energy, into ultimate end, the Energy Welfare.



The environmental carrying capacity is not given per GDP (and not per capita). It is a certain capacity for the Earth. Period! How the global citizens should share this capacity is a crucial political question, but there seems to be no logic in ascribing any higher right to utilise the Earth's carrying capacity to the high GDP countries than to the low GDP countries.
To conclude this part: From the point of view of aiming for an environmentally sustainable development, it is irrelevant how energy *efficient* our technology or our economy is. What is relevant is how *much* energy we use.

End-Use Savings in the Energy Chain

Figure 1 shows the chain of technologies and structures, which converts the ultimate means to the ultimate end, to use Daly's terms [Daly 1973]. The natural energy resource, primary energy, is converted into human *energy welfare*, here used to denote simply the ultimate end of using energy, however one wants to define it. The catch is that we often get so eager, so dedicated, so clever, and euphoric by successes towards providing some of the *intermediate* ends, such as secondary energy (electricity) or even energy services, that we forget what are the ultimate end. What is it we really need and want. To *optimise* in a very broad sense the efficiency of the whole chain should be the ultimate goal of (energy) politics. This can, with the limited natural resource base available, in mathematical terms be expressed as maximising human satisfaction. Or with some kind of *sufficient* human satisfaction, the optimal efficiency can leave wider margins to the carrying capacity of the environment. In these considerations population is of course also a crucial factor. Globally as well as nationally in the industrialised countries, we are presently quite far from the optimal efficiency of our energy systems.
It has repeatedly been shown that substantial end-use savings are available at prices that are highly competitive with supplying energy, as indicated later in Figure 2. Improving the efficiencies by a factor three to ten are discussed [Weizsäcker *et al.* 1998, Nørgård and Viegand 1994, Goldemberg *et al.* 1988]. It is often questioned, especially by market economists, whether these large end-use saving options could really be cost-effective. According to simple market *theory* these options would automatically have been implemented if that were the case. The explanation of the non-exploited saving options is mostly that the conditions for the market theory is not fulfilled at all. These conditions include availability of full information and a large number of participants on both sides of the market, the consumers and the suppliers. None of these conditions are fulfilled. At the side of the consumers, the information about all end-use efficiency options and their consequences are not available and hence the average efficiency is far below the optimal level. At the side of the suppliers the very so-called "liberalization", which should lead to more competition, also promotes the merger of suppliers and hence

undermines the market theory condition of a large number of suppliers [Hvelplund 1997]. Also, the access to capital to invest in energy savings is more favourable to the suppliers than to the consumers. In that light it ought not to surprise anybody that the market does not act optimally. The market is imperfect and will somehow always be.

These imperfections of the energy market on the consumers' side have been recognised for decades, and in the 1980s this lead to the introduction of the concept of demand side management, DSM. It is striking that this need to regulate the market economy was first recognised in USA, the nation, which had so far always been a vigorous advocate of a free market economy. In USA the government interference with market through the many DSM projects seems first to be motivated mainly by concern for security of supply [Sioshani 1995], but internationally the market's waste of energy was becoming also environmentally intolerable to the societies as reflected in the Kyoto agreement.

The importance of full information as a condition for market theory was demonstrated in a Danish project. A campaign to promote efficient appliances included the establishing of a website (www.hvidevarepriser.dk), (also in English) telling consumers at which retailer they can get the most energy efficient (A-rated) refrigerators, etc. at the lowest price [Karbo 2000]. The general result was a price decline of 10-15 percent for the A-model and an increase of these model's market share from 10 percent before the campaign to 50 percent during the campaign, before reaching a probably more permanent 25 percent market share the following year [Karbo *et al.* 2001].

End-use energy saving actors

The *end-use trade line* in Figure 1 is a crucial border in the energy chain, indicating where secondary energy is *sold* to the final consumers, the end-users, which can be any consumer of energy. As for other businesses, energy suppliers are in a competitive market economy expected to devote the main efforts towards making the system *below the end-use trade line*, their own production system, *more efficient* in terms of economy. This will help to make their products more competitive on price, and this *could* be an environmental benefit from the so-called liberalised energy market that the primary energy will be converted efficiently into secondary energy. At the same time, however, with the prices for secondary energy set by the market, the most obvious way to increase the turnover and the profit is by expanding the sale of their product. One way this can happen is when the end-users, *above* the end-use trade line, act *less efficiently*. This is the dilemma facing the policy of leaving energy saving responsibilities to suppliers, who are naturally at the same time busy campaigning to sell more energy [Nørgård 2000].

The energy suppliers in an energy market might also have an interest in improving their image, for instance by subsidising energy savings, as a way to attract consumers. But here the catch could be that in a liberalised market, a consumer might for some years choose a supplier who has a relatively high energy price but provides energy saving services. After having benefited from that service and got the end-use technology replaced, the consumer could then switch to a "discount" supplier with low rates and no services. In general what can be expected is a decreasing efficiency above and increasing efficiency below the end-use sale line.

A couple of decades ago, it was implied that electricity savings in California was pursued by the electricity suppliers, simply because it was good market business to do so, since it was cheaper to save a kWh than to produce one. Somehow this simple argument did not seem right. Imagine the meat companies running campaigns to get people to eat less meat, because it would be cheaper in that way to avoid selling one kg beef than to provide one kg. The truth in the Californian case was that the savings were due to *a strong and dedicated government policy*. Through their price control at that time the Californian government was able to compensate or subsidise the suppliers generously for each kWh they claimed to have saved, by allowing them to charge a higher price per kWh sold to all consumers [Sioshansi 1995]. This seems like a reasonable and responsible end-use saving policy by the government. But the point to make here is that in the capitalistic USA, the real and very appropriate "socialistic" governmental interference with the market was de-emphasised in the *presentation* of this policy, giving the impression that market economy could solve also the environmental problems. In that spirit the concept of keeping the energy suppliers responsible for reducing their own sale has spread to many other countries. In unregulated energy markets, which are also proliferating today, the former Californian government model is not applicable, and there is a general confusion internationally about the way to run or not run an energy end-use saving policy.

The Danish Electricity Saving Trust, established in 1996 by the Danish Government [Danish Energy Agency 1996] is a new model for implementing energy savings, which by independent evaluators has been denoted a success [Carl Bro *et al.* 1999]. The trust is financed by a small extra energy tax, 0.001 _ per kWh of that half of Denmark's electricity consumption, which is sold to private households and the public service sector. The annual budget is around 15 million _, - or 3 _ per capita in Denmark. Most of this has so far been used to subsidise the conversion of electrically heated houses to use more appropriate forms of energy like district heat or natural gas.

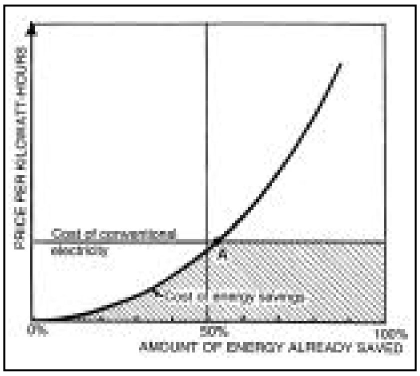
But also campaigns to promote sale of energy efficient appliances and CFLs have worked out well [Karbo et al. 2001]. The apparent success of the trust can probably mainly be ascribed to the fact that this trust is in no dilemma or trade off position, since its clear and sole purpose is to promote electricity savings.

The reason for mentioning the problems of energy saving actors is to point out the difficulties in implementing energy savings, when governments are “allergic” to using taxpayers’ money on energy savings. Instead they let the taxpayer pay via their electricity bill (and leave the control of the money to the suppliers), even if the cost for the taxpayers might be higher with such “tax cosmetic” policy. The situation can easily be that with the suppliers heavily engaged in international competition to sell electricity, their energy savings programs will be dominated more by image creating activities, paralleled with marketing strategies to sell more electricity, than by dedicated efforts to really reducing their own energy sale. It is a clear responsibility of a government to secure the common goods like the global climate, which an individually based market economy per definition cannot provide. Finances for promoting energy saving activities should therefore be made available from general income taxes (and the use controlled by the government). Or even better, the money can come from taxing the energy consumption in one way or another. This can be considered adding the hidden external environmental cost and will further motivate the consumers to save.

4. ENERGY SAVINGS VERSUS CLEANER SUPPLY

End-use energy savings should be considered as an environmental protection measure, actually one of the better types, namely the *preventive* type. Energy savings will in general be environmentally more benign than any clean energy supply system. With this in mind it is striking that most energy saving policies do not specifically ascribe any value to these environmental benefits from end-use savings, as they often do when subsidising renewable energy. Energy taxes in some countries do of course account for some of this, but usually they are small and insufficient, especially for the industry. In the following a very simplified model will be used to illustrate some basic features about the role of energy savings in an *economically rational* energy policy, aiming at environmental sustainability.

Figure 2. Illustrative diagram showing optimal investment in energy savings with conventional supply



Increased marginal cost of energy savings

It is generally accepted that the socio-economic cost of saving a kWh of energy in the presently prevailing energy systems is much lower than providing one. However, the cost of saving another kWh of energy is increasing, the more energy has already been saved. This is qualitatively illustrated by the marginal cost of energy savings curve in Figure 2. There are of course a lot of leap-frogging and “tunnelling” options, as for example when insulating a house in a cold climate up to a level, where it will require no investment in heat distribution system and therefore becomes cheaper than a somewhat less insulated house. And the shape of the curve can be different from the one shown. But still the overall macroeconomic picture will be that not all of a country’s energy consumption can be saved and that there are differences in the cost of savings. In Figure 2 the measures are ranked, assuming the economic cream of end-use efficiencies will be skimmed first, although this is not always the case.

Optimal Level of Saving in a Conventional Energy System

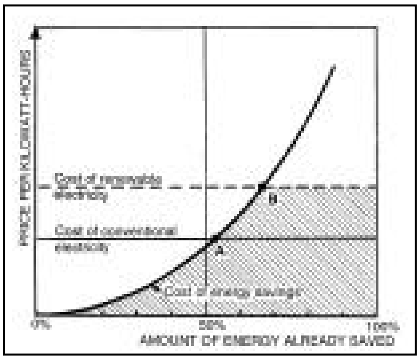
From the energy saving cost curve in Figure 2 it seems obvious, that from a conventional economic point of view the optimal level of energy savings is at the point “A”. This is where the curve crosses the line indicating the cost of providing a kWh from a conventional supply system based on fossil fuels, nuclear or other non-sustainable resources, assuming no external environmental cost is included. Even though the scales and curve shape is not documented here, the intersection point around 50 per cent savings may rather well illustrate the situation for electricity savings.

The outcome of implementing this choice is an energy system that still leaves half of the former energy demand to be supplied by coal and other non-sustainable sources. The total annual cost of the original system would be represented by the square under the line “cost of conventional electricity”. But the total annual cost after savings is in Figure 2 the shaded area under the curve for “cost of energy savings” up to the point “A”, and after that the horizontal conventional supply line. The total annual money saving is around one third of the original cost.

Optimal Savings when comparing to Renewable Energy

It is of course not satisfactory in the long run to have half of the original energy consumption supplied by conventional non-sustainable energy sources, as indicated in Figure 2. For long term sustainability most of the remaining part should, as discussed above in the first section of chapter 3, be supplied by renewable energy, even if this is anticipated being more expensive. For that reason governments already consider it necessary to subsidy renewable energy supply systems. In Figure 3 renewable electricity is assumed to cost about 60 per cent more than the conventional supply, just for illustration.

Figure 3. As for Figure 2, but now optimizing savings at ”B” with renewable supply



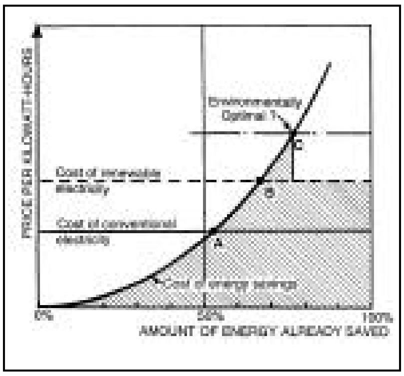
To reach the optimal mix of savings and renewable energy supply, savings should be carried to point “B”, see Figure 3., where the marginal cost of saving another kWh equals the cost of providing a kWh from renewable energy sources.

For simplification, we here ignore the fact, that exploitation of renewable energy also has a growing marginal cost. The more to be supplied from renewable energy systems, the more will be the cost of providing a kWh *when wanted*. This is partly due to the randomly fluctuating character of most renewable sources like solar and wind, which require additional storage, conversion and control systems, and partly the environmental limitation for the acceptable flow of some renewable sources like biomass and hydro.

Environmentally Optimal Mix

If a more general environmental optimisation view should be applied, it should recognise the energy savings as being environmentally more benign than even renewable energy supply. Consequently savings should be continued up to the point, where in Figure 4, the savings curve at point “C” intersects the horizontal cost line for renewable energy supply, when including external environmental costs of the renewable supply systems. The shaded area represents the cost of this system.

Figure 4. As for Figure 3, but now also including the environmental costs of renewable energy



In other words, an economically rational energy policy towards sustainability should in this simple model be based on accepting a marginal cost of saving a kWh higher than the cost of providing a kWh, even from renewable energy sources. In a report from the Danish Energy Agency this viewpoint is now suggested as a basis for the coming energy saving policy in Denmark [Danish Energy Agency 2000].

Comparing with Actual Policy

Needless to say, the above considerations are very simplified, but the purpose is to use the figures for discussing the balance between investing in energy savings and in clean energy supply. The rational economic arguments applied above do not reflect the real world behaviour. No doubt that environmental organisations as well as established politicians and many other people are often more attracted by the supply technology, be it a windmill or a nuclear power plant, than by introducing houses with almost no need for heating, for instance. Economists might also claim that when people behave that way this reflects their overall preferences. (In this way the market economy is always perfect and the market theory self-fulfilling!). A couple of examples will illustrate the love affair with supply side. An international environmental organisation seriously suggested a policy in which the money saved by investing in *cost-effective* energy savings should not be used to support less economically attractive savings, but rather to subsidise the expensive and *non-cost-effective* renewable energy supply forms [IIEC–Asia 1999]. Another example is from a city in Japan, Kawagoe, where the city administration launched an admirable campaign aimed at reducing their annual electricity consumption by one percent every year. After 4 years the city had at essentially no investment saved 5 percents or more than 10 million kWh of electricity and around 2.5 millions _ [Kawagoe City 2000]. The money saved was spent on paper recycling and other environmental purposes, but including 0.35 millions _ in subsidies to very expensive photo-voltaic systems. None of the money saved was planned to be spend on furthering energy savings, which could probably save ten times more than the output from the investment in photo-voltaic systems. In other words, they jump from the cheapest options to the left in Figure 4 into the expensive right side.

An argument for this non-rational energy policy, is the very correct one that photo-voltaic systems constitute a new technology in need for governmental subsidies to make it to the market. But also much energy saving technologies are in need for governmental subsidies to make it to the market. It seems that because many energy saving options *are* in fact cost-effective, the energy saving policies are often limited to those savings only, ignoring the many other options after point "A" in Figure 4, not to mention those beyond point “B”.

Policy should of course not be based only on such rational arguments, but some more honesty about the arguments should be anticipated, instead of claiming to aim for most CO_2-reduction per _. If environmentalists and politicians favour a certain energy technology or policy because they find it exciting and fun, this is of course perfectly legal, but these aspects should be brought more out in the open debate.

To conclude this part, the market economy is not working towards an environmentally sustainable energy system with the monetarily optimal mix of energy supply and energy savings.

5. MITIGATING REBOUND EFFECT

Once in a while a concept called the *rebound effect* is debated vigorously in the literature about energy savings [Herring 1999]. In brief terms the concept refers to the effect, that when *cost effective* energy savings are implemented the result is also money savings. This money is then spent on other consumer goods or services with some built-in energy consumption. In macroeconomic terms the cost-effective energy savings constitutes a productivity increase, which spurs the general economic growth with its associated increase in energy consumption. The result of the rebound effect is that the direct energy saving from a more efficient end-use technology is modified by extra energy embodied in the extra consumption or GDP. The evaluation of the extent of this adjustment ranges from being insignificant [Lovins 1988] to amounting to more than hundred percent [Saunders 1992]. The latter implies that energy efficiency improvements, which are cost-effective, could lead to higher energy consumption.

Solutions to the Rebound Effect

The rebound effect plays a role, but most likely only a small role. It is clear that most of the technological end-use savings over the past couple of decades have been eaten up by the *general* increase in the productivity of the economy, which is then providing more energy services and thereby pushing energy demand upwards. Part of this productivity growth, but probably a very small part, is from the rebound effect. So in countries with basic economic needs, energy savings can speed up real economic progress. In industrialised countries, however, energy savings can also through the rebound effect speed up growth in GDP, but not necessarily in real progress, as discussed later in chapter 6. If energy saving politics are dedicated to only promoting more energy efficient *technologies* and ignore the need for energy efficient *lifestyles* and *economies*, energy savings will continue to be a Sisyphean task. Much progress has been achieved in the field of developing more efficient technologies. So one could provocatively argue that the engineers have done their part well in *restructuring the technology,* while the economists so far have ignored their part of the environmental job of *restructuring the economy*.

In the short run the solution to the rebound effect is to ensure that not only the cost-effective energy savings are implemented, those before “A” in Figure 4. These savings must be accompanied by some energy savings, which are *not* cost-effective in the conventional sense, but attractive to society because of their environmental benefits. This can for instance imply going to the point “C” in Figure 4. The way to implement such savings can obviously not be left to the free market.

One way to implement energy savings up to “C” level is by enforcing *minimum efficiency standards.* For new buildings minimum efficiency standards have for long been common practice in many countries. Another way is for government to offer subsidies to energy saving activities to the part exceeding “A” in Figure 4, but only if the whole saving is implemented. If for instance 25 cm insulation of buildings is the optimal thickness with present energy prices, government could offer to pay the extra cost of going to say 40 cm. A third way to implement high energy saving standards could be to offer subsidies to individual renewable energy supply systems only after the energy efficiency is carried to say level “C”.

In these ways the money saved from the cost-effective energy savings are invested in further environmental protection and nothing left for a rebound effect. The programs could be financed by general income taxes, or by energy taxes, as described in section “End-use energy saving actors” (chapter 3).

The long term solution to the rebound effect is related to the long term solution to our environmental problems in general, which is to de-emphasise growth in GDP and accept a satiation, especially in countries with a high GDP per capita like most European countries [Nørgård 1995]. This is discussed later in the section “Improving indicators of progress” of chapter 6. For the rebound effect from energy savings, the economic satiation could take the form of people converting a drastic saving on their energy bill into the freedom of working for instance one month less every year.

6. PROGRESS THROUGH ENERGY SAVINGS

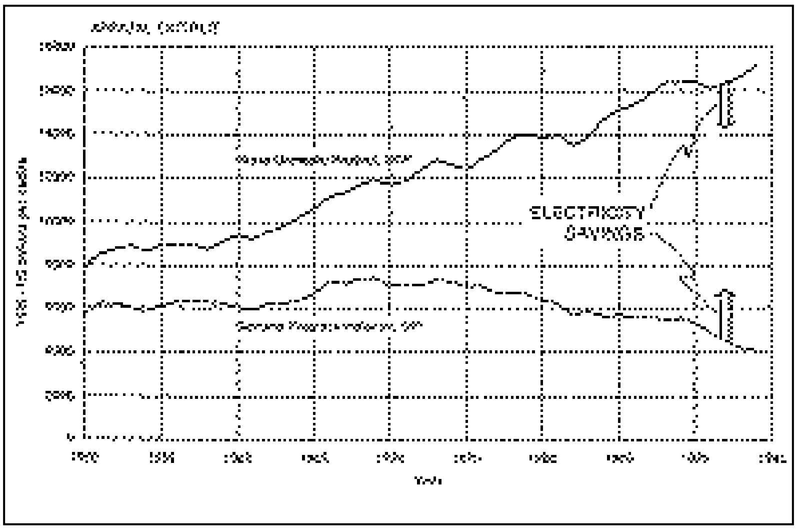
During the early stages of industrial development, progresses are usually very obvious, taking the form of better nutrition, better and larger dwellings, better health, more social security, etc. In the 1930s international standards were established to express the monetary activities and transactions all added into one single indicator for a country, Gross Domestic Product or GDP. As such it might still be useful for fiscal planning and monetary policy. However, GDP was never meant to reflect the wellbeing of people, and still today hardly any economist or statisticians would claim so. Three reasons for the discrepancy between GDP and real economic welfare, especially in affluent countries like the OECD countries, are the following:

1. Activities necessary to *remedy* accidents, diseases, crime, drug abuse, environmental pollution, etc. counts positive in GDP and constitute an increasing part of the growth in GDP. Consequently cost-effective or non-economic measures to *prevent* these problems will reduce GDP, but obviously improve the welfare.
2. The *maintenance* of our stock of capital through replacement and repair counts positive in GDP. The real service or welfare is, however, obtained from the *possession* of the goods, which does not show up in GDP. This is discussed in more details by Daly [1996]. Consequently, a policy to maintain the welfare by extending the lifetime of these goods in cost-effective ways will lower GDP.
3. The flow of *energy* and other resources counts positive in GDP, which, however, ignores the *energy services* provided by the end-use of energy, see Figure 1. Consequently, a cost-effective reduction in the use of energy will lower GDP, even when the satisfaction from energy services remains the same or increases.

In general, as expressed by Boulding [1949] "..the objective of economic policy should not be to maximise consumption or production, but rather to minimise it, i.e., to enable us to maintain our capital stock with as little consumption and production as possible".

Nevertheless, it has become common practice for politicians to use GDP, made to indicate the production, to show whether a country is making progress, or whether one country is doing better than another is. Despite all its obvious shortcomings, increasing GDP is still perceived synonymous with economic progress and furthermore with progress in peoples' wellbeing. In energy policy the energy intensity is often referring to the energy consumption per GDP. Since both the energy consumption and the GDP are irrelevant indicators, this practice is misleading as a guideline for progress and hence also for choosing the proper energy policy, especially the energy saving policy, as will be discussed later.

Figure 5. Development in GDP in USA is here compared to the indicator GPI, Genuine Progress Indicator [Redefining Progress 1995]. Impact of energy savings is suggested qualitatively by arrows.



Improving Indicators of Progress

Various researchers have proposed indicators better suited to reflect the wellbeing of people. No doubt the best would be to rely on several indicators of the various aspects of a development, as proposed by researchers [Meadows 1998, Bossel 1999], and then leave the weighing of these aspects to the public and the *democratic political process*. But since there seems to be a high demand for one single indicator to describe the economic aspects of progress, attempts have been made to correct GDP for the features most misleading as indicator of progress [Daly and Cobb 1989]. Genuine Progress Indicator, GPI, is one such single indicator established [Redefining Progress 1995, Rowe and Anielski 1999], and applied to USA as shown in Figure 5. Some of the adjustments relevant in this connection are the following.

In GPI the *stock* of durable goods is ascribed a positive value, since this is what provides the service to people, while the money spend on *replacing* durable goods is considered a cost and hence counts negative and not positive, as it does in the GDP. The cost of solving social and environmental problems is counted negative in GPI instead of positive as in GDP. *Leisure* as well as *equity* is counted positive in GPI, but not in GDP. Resources in the ground is ascribed a certain value in GPI but not in GDP, and their depletion is in GPI counted as a certain depreciation cost.

As seen in Figure 5, since around 1970 the GPI has in USA been declining to a level below that of 1950, while GDP has grown rapidly. The situation is different in other countries, especially in developing countries. But in the long run the trend will probably be the same, and in the energy and environmental policy the difference between GDP and GPI is important, as discussed later.

It should be stressed that GPI in no way is a perfect measure of how good a life people are enjoying. But most people would probably agree that it is better than GDP's *monetary* accounting of activities in reflecting the *real economic* conditions for people. While *quality of life* contains many other aspects, which are reflected in neither GDP nor GPI, the latter is nevertheless a step in the right direction. Mainly, GPI and other similar alternative indicators, show how meaningless GDP per capita is as a measure of people's conditions, also judged by the public reaction described in the following.

Satiation Trends

There are many signs that the shortcomings of GDP to indicate welfare are reflected also in people's attitudes towards income, consumption, and work. Especially in countries with a high material standard of living and a rather even distribution, most people tend to prefer more freedom in the form of less working time, rather than increased income and consumption, if offered the choice [Nørgård 1998]. Such satiation trend has also affected the labour market negotiations where more vacation increasingly ranks higher than more salary. Instead of welcoming such satiation trends, governments are usually opposing these wishes by allowing and even supporting counteracts by market forces in the form of more advertisement, credit cards, and other marketing efforts, plus a rigid labour market. "Only if an individual has a choice to the length of his working week or year, along with the option of taking unpaid leave for longer periods, does he or she have an effective choice between income and leisure", as expressed by Galbraith [1973]. The following is based on the assumption that people do get such freedom of choices to reach a higher satisfaction through satiation, and that for the environmental common goods the satiation choice is not counteracted, but rather promoted and encouraged by governments.

A government policy to accept and even promote economic satiation is not only satisfying an increasing demand from individuals, but also satisfying an increasing need to de-emphasise GDP growth to secure the environment we all share. Many economists, including two Nobel laureates have stressed this need. Jan Tinbergen, who received the Nobel prize in economics expresses the urgent need to give the highest priority to "implementing economic policies which: 1. Accelerate development of new technologies, such as flow energy and recycling. 2. Permit no further production growth in rich countries. 3. Stabilise the global population as soon as possible. 4. Improve international income distribution." [Tinbergen and Huiting 1991]. Similarly, the 1989 Nobel prize winner in economics, Trygve Haavelmo from Norway states the "A policy, which is not aiming at reducing consumption and population cannot be termed sustainable" and "More growth in the rich countries is terrible thought. It is incompatible with the environment" [Vermes 1990].

One essential prerequisite for promoting a satiation economy is to *increase the general equity* in income and wealth. The economists J.M. Keynes wrote in 1930 that only the relative needs related to inequities are insatiable. About the absolute needs he writes: "a point may soon be reached, much sooner perhaps than we are all of us aware of, when these needs are satisfied in the sense that we prefer to devote our further energies to non-economic purposes", and he continues: "We shall once more value ends above means and prefer the good to the useful" [Keynes 1931].

Energy Savings' Impact on Economic Indicators

Energy saving is as mentioned not only a matter of more efficient *technology* in the end-use or in the supply, see Figure 1. Also people's *behaviour and lifestyle* at home as well as at work is important for a path towards sustainable energy systems. Top politicians do occasionally express a need for more environmentally benign and energy saving *behaviour* as well as *technology*, but implementing the measures necessary is getting a very low priority. The following can explain the politicians' hesitation as caused by their *higher priority to GDP than to "real progress"*.

This section discusses the immediately *cost-effective measures* to save energy and why they are only modestly implemented in the market economy of today. Such measures may be able to save half of our energy consumption or more. The savings do in fact constitute increase in productivity, as discussed in chapter 5.

In countries with high GDP, such as the OECD countries, growth in GDP is *constrained mainly by demand.* In this situation energy savings can provide progress in *real economy,* but hamper the growth in GDP, as indicated by the following examples.

Direct energy savings, which are cost-effective, is the type of energy saving mostly considered. Despite some rebound effect, they tend to lower demand for energy. Such measures could be:

1. Using more energy efficient appliances, houses, cars and other end-use technologies. The trend will be a decline in GDP due to lower production of energy, but an increase in GPI due to less depletion of resources and less pollution to clean up. Also the option for working less due to the lower energy bill will tend to increase the GPI.
2. Adapting habits and daily behaviour to use the end-use technologies more cautiously. The same effect as 1) with decline in GDP and growth in GPI.
3. Limiting the stock of the various end-use technologies. This will lower GDP, while it is hard to tell whether GPI will grow or decline. The point is that the energy service level will be lower, but this is counteracted by a decline in resource depletion and pollution, as well as an increase in leisure time, assuming that the lower need to buy and produce the goods is converted into less working hours.

Indirect energy savings would consist of a number of various measures:

4. Encouraging people to extend the lifetime of their stock of durable goods like clothes, houses, furniture, vehicles, etc. is one way to indirectly save energy, since production of these goods can be reduced. Because of more repairs this might increase or decrease GDP, but definitely increase GPI due to its lower pollution, less resource depletion and more leisure time, under the same assumptions as in 3). For those durable goods, which are energy consuming, the energy saving from extending lifetime should be balanced with the delay it causes in the switch to more energy efficient models, see 1).
5. Choose residence and working place closer to each other to reduce commuting, and even manage it by walking or bicycling. The GDP will decline, but GPI grow for the same reasons as for 3).
6. Switch away from material consumption to non-material activities within the monetary economy. Such activities can be public or marketed home service, tourism, education, entertainment, bodybuilding, etc. and the switch might not affect the GDP. But the switch will provide energy savings, since the service sector of the economy is less energy intensive than the manufacturing sector [Jespersen 1999], and this will increase GPI.
7. Switch to non-material activities outside the monetary economy like hiking, playing with children, gardening, etc. This can have a profound negative impact on GDP and still more positive on GPI.

More examples of energy saving measures can be listed, and the general trend is, as indicated in Figure 5, that true energy savings will in affluent countries tend to reduce GDP but increase the real economic welfare as expressed better by GPI.
The conclusion of this section is that energy savings in general will be incompatible with a GDP-growth oriented market economy. To put it differently: In an affluent country, growth in GDP must be achieved mainly by increasing “waste” in one form or another, since human basic needs are finite. The growth policy is therefore incompatible with a policy aimed at reducing waste (of energy).

In developing countries and newly industrialised countries the economy is *constrained mainly by production capacity.* This is the case in most regions of the world, and here the productivity increase from cost-effective energy savings can for a while speed up the economy and provide real economic progress in the form of better housing, better education, etc. The discrepancy between the two indicators GDP and GPI might for some time be less marked in such regions and the productivity gain arising from energy savings can increase both indicators. But, still it is worth to be aware of not getting into the trap of measuring progress by GDP, because it can hamper the real economic progress as well as well-fare progress.

7. CONCLUDING REMARKS

The paper points out some serious conflicts between a policy aiming at saving energy in the sense of reducing energy consumption and a policy aiming at expanding GDP. There seems, however, to be much less of a conflict between saving energy and improving real economic welfare. The following suggestions can only give some hints for the direction in energy saving policies.

- Ensure by energy taxes and subsidies that energy savings are implemented all the way to the cost level where the marginal socio-economic cost of saving a unit of energy exceeds the marginal cost of providing a unit of energy from renewable.
- Encourage and liberate the consumption satiation by increasing equity in income, wealth, work, etc., and by constraining consumption increasing actions like advertisement, increased shopping hours, etc.
- Use other indicators than the conventional GDP to evaluate the economic development.

A lot of effort in research and policy is devoted towards finding ways to show how energy saving policies could be in harmony with an unregulated market economy. But very little efforts are devoted towards analysing where energy savings are in conflict with market economy, and how a democratic regulation of the market is essential for a policy aiming for a sustainable energy system.

After the euphoric wave of free market dogmatism swept the world in the early 1990s, it is time to think twice and "reinvent government" as was said in the title of the 1995 ECEEE summer conference. Time to look for a proper balance between democratic regulation and market regulation, with our global environment high on the agenda.

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