A case for self-deception in energy policy

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Abstract
European energy policy and policy makers have not faced up to something about which there is increasingly little doubt: global reduction, or even stabilisation in energy use will not be achieved unless Europe and the other rich OECD countries aim at significantly reducing their growth in energy services (heat, light, motive power, mobility and so on). The policy and research at the centre of the policy discourse on energy sustainability suffer from a form for self-deception which revolves around the equation of 'efficiency' with 'sustainability', i.e., the untenable contention that technological and market efficiency alone will offset continued growth in energy services to the extent that deep reductions in energy use are possible. We use results from India and China, with more than one third of the world population, to show how there is likely to be dramatic increases in energy use and greenhouse gas emissions in those countries over the next half-century. Much of this increase will be in conjunction with the development of basic services and infrastructure for homes, businesses, transport, health and public services, so that it is neither ethical nor even practical to argue for restrictions in overall energy growth in these and other developing countries. This places the onus for deep reductions in energy use on Europe, North America and the other affluent countries. The paper explores what such a change of focus would mean for policy and research agendas, and why there is friction to moving the policy envelope from 'efficiency' to also include 'sufficiency'.

Introduction
Energy use has grown in the OECD countries over the past 20 years, in spite of research and policy efforts to move towards energy sustainability. In addition, energy use has been growing rapidly in developing countries over the past decade and will continue to grow. We argue in this paper that European energy policy and policy makers have not faced up to something about which there is increasingly little doubt: global energy use will continue to increase unless Europe and the other rich OECD countries aim at significantly reducing their growth in energy services (heated space, illuminated space, mobility and so on). We recognize that some of this growth can be contained in the long term by a choice of energy supply sources which favours renewable and bio-energy. We draw attention to the fact, however, that global warming is not the only energy related environmental problem, and that essentially all forms of energy supply have associated environmental impacts. (Johansson, et al 2001). We contend that the policy and research at the centre of the discourse on energy sustainability suffer from a self-deception, which revolves around the equation of 'efficiency' with 'sufficiency'. It is a form for self-deception in the sense defined by Pierre Bourdieu (1998:119), "a collective work, sustained by a whole set of social institutions of assistance, the first and most powerful of which is language…" In this case, the deception supports the language of efficiency and the untenable contention that technological efficiency alone will offset continued growth in energy services to the extent that deep reductions in energy use are possible. This perception has often been expressed by another erroneous contention, namely that there has been a de-coupling between energy consumption and aggregate economic activities as expressed by Gross Domestic Pro-

duction (GDP), just because their growth rates are different. The truth is that energy consumption, no matter how efficient, is positively linked to economic activities, in the sense that growth in activities pushes energy consumption upwards.

Recent surveys show that since 1980, the OECD countries have increased their energy use by 27%, from 194 EJ (4 300 Mtoe) to 235 EJ (5 300 Mtoe) (BP 2002). During the same period, energy use in Asia has doubled from 55 EJ to 110 EJ. As we will develop below, energy use in China and India will continue to grow rapidly in both countries for decades to come. While an aggressive policy for technical efficiency ought to be pursued in these and other emerging countries, it would be neither ethical nor even practical to argue for restrictions in overall energy growth in these countries or other parts of the developing world. The unavoidable conclusion is that from an environmental point of view, a substantial reduction in energy consumption will be necessary in Europe and the other rich regions of the world over the next decades if climate changes and other disasters are to be confined.

With a few rare exceptions, European energy policy has regarded energy efficiency as a policy end, rather than a means to achieve energy reductions. Policies have been directed at more or less aggressive implementation of efficient technology. Technology optimists have time and again put forward efficiency scenarios (best technology, best practice, and so on) which capture the potential for significant reductions in energy use. But while production, transmission and end-use technologies have all improved in efficiency, total energy use in the OECD countries has continued to increase, simply because growth in economic activities ate up the efficiency gains. Based on past experience and future prospects, we claim that better technology alone has not, nor will not achieve the necessary reductions to avoid significant environmental damage. A reduction in energy use will only come about by reining in the demand for energy services (indoor comfort, illumination, mobility, etc.). Attention needs to be given to how the volume of energy service demand can be checked in Europe as well as in other OECD countries.

In this paper we explore why technological efficiency is too narrow a focus for an energy policy seriously aimed at a reduction in energy use. We discuss energy developments in China and India, which from a global perspective increase the urgency for change in policy orientation in Europe. Finally, we explore what a change from efficiency to sufficiency would mean for policy and research agendas, and why there is so much friction to moving the policy envelope.

Efficiency has never been sufficient

TECHNICAL EFFICIENCY OPTIONS AND LIMITATIONS

Over the past few centuries industrialized countries have successfully developed a number of technological solutions for the purpose of providing energy for essential requirements of every day life. As an example, cooking on a simple wood stove has an efficiency of typically 5-10%, while gas cooking today has a 40% efficiency. One hundred years ago, electricity was produced at efficiencies around 5-10%, where today's modern power plants have achieved more than 40% efficiencies. Everywhere in industrialized societies technological efficiencies have improved dramatically, and it is tempting to assume that this will continue into the indefinite future. Indeed, we press on with efforts to improve the energy efficiency of these technologies, but the truth is that we are approaching some practical or even theoretical limits. It is not possible to make the cooking and the power plants more than 100% efficient, and in fact the practical limitations are closer to half of that.

In some domains, there is still room for significant gains in technological energy efficiency, especially in the end-use technologies (Norgard 1989, Goldemberg et al 1988, Weizsäcker et al 1997). Houses are for instance being built, which use only around 10% of the heat which is normally required today, even in cold climates (Feist 1996). In fact several studies over the past 30 years have shown how it is technologically possible to maintain our high material comfort standard with around a third of present energy consumption or even less. Nonetheless, what we are actually experiencing is that these technical options are exploited only slowly and modestly. Even worse, the gains obtained from more efficient technologies are steadily being used to justify and promote unconstrained growth in the consumption of energy services. When energy efficiency promoters claim that we can *get more out of less*, we must conclude that focus so far has been to *get more out, period!*

The improvements in technological energy efficiency have been regarded as an improvement in the economic efficiency or productivity in the sense of getting more out the resources. This is counteracted by what has been termed the *rebound effect*. An example of this is when consumers or manufacturers save on their energy bill, but spend the surplus on other consumption or investments, which in turn increases energy consumption. Consequently the actual energy savings from the technological efficiency gains in the economy as a whole are somewhat lower than their direct impact. How much of the energy savings is eaten up in this way has been heavily discussed, estimates ranging from almost nothing to more than 100% (the latter figure is based on a form for economic modeling indicating that more efficient use of energy could actually lead to a higher energy consumption in society by making the economy more efficient). The rebound effect is based on the assumption of an insatiable and unconstrained demand for energy services. The full direct savings could be stabilized if consumption of energy services were stabilized. One way to do this is would be to make it easier for people to direct time into leisure. Another tactic (at least for the short term) would be to invest the savings in less energy intensive forms for supplying energy services, such as smaller and more efficient refrigerators, or passive space heat and cooling designs for buildings.

TECHNOLOGICAL EFFICIENCY TRAP

Energy conservation policies are often blinded by what on the surface appear to be huge technological efficiency potentials and thereby embrace the paradox that the solutions they encourage may actually increase energy use. For instance the technological energy efficiency of heating a house is normally expressed by its annual energy consumption for heating *per square meter floor space*. A larger house will usually consume more energy for space heating, but, due to geometrical effects, consume less energy per square meter floor space, and hence be termed more efficient. Similarly, to sustain low temperatures, a larger refrigerator will require more electricity per year, but it will use less per liter of refrigerated space available. Hence, from a technical point of view it will be considered more energy efficient. Driving longer distances will improve the fuel efficiency in km driven per liter fuel, but it will nevertheless lead to more fuel consumed.

Another trap is that for an industrialized economy, the larger the economy is, the more energy efficient it will be in terms of GDP per GJ, due to economy of scale, and due to the ongoing structural change towards more service dominated GDP. Nonetheless, a bigger economy will be more energy consuming. Another expression of the efficiency of a national economy is its reciprocal parameter, the energy intensity in GJ per GDP. This intensity is often used by politicians as a measure of success of their economic programs. Environmental problems arise, however, not from how much energy is consumed per GDP, but how much is consumed - period.

The concept of economic efficiency is relative and problematic when applied in the areas where economy and environment interact. An act or decision is regarded as economically efficient if the positive economic consequences outweigh the negative. But what is positive or negative implies a value judgment, however implicit. In the modernist development paradigm which still dominates national politics, growth in GDP is viewed as positive. A development goal which incorporates environmental sustainability is indifferent to growth but sensitive to its side-effects (pollution, climate gas, land-use for renewable energy, extraction of resources). This leads to a fundamental set of cross-purposes, or what one could even call a schizophrenia at the heart of sustainable energy policy, where both growth (seen as economically efficient) and reduction (seen as environmentally efficient) are positive . This forces policy makers to embrace the deception that over the long term one can achieve both a continued growth in energy services and a reduction in energy use.

We look more closely at some of these pitfalls in the domains of food preservation and space heating and cooling.

REFRIGERATORS

People have always had a need to preserve and store food, whether it be for hours, days, weeks or even months. Great culinary inventions have developed out of this need, like cheese, yogurt, pickled cucumbers, smoked fish, dried fruit, jam, and so on, not to mention beverages like wine or beer. In cold and temperate regions a cellar could serve as cool storage space, even during a warm summer. Today mechanical refrigeration has become widespread as a means to provide a cold or even freezing storage space. In the period after the introduction of the new technology in Northern Europe in the mid-1900s, it was common to turn off the refrigerator during winter, since cool storage space was readily available. Soon, however, the refrigerator and freezer became standard equipment in increasingly well-heated kitchens. Recent growth in the availability and consumption of frozen foods has contributed to the increasing use and volume of freezer units.

The oil crisis of the 1970s stimulated work on the technical efficiency of refrigerators. Today, one can have the same storage space using less than one fifth of the energy (Norgard and Guldbrandsen 1999). On the demand side, the main energy saving effort has been to promote or provide incentives for the purchase of more efficient versions. However, the replacement of old refrigerators has not resulted in a drop in energy use to one fifth or anything close to that. This is because the technical options have not been fully exploited and the technical gains have been counteracted by a substantial increase in the number and size of the cold storage units. The numbers of refrigerators are increasing in spite of a stable population because household sizes are getting smaller (i.e., there are fewer people in each household). Refrigerators are also getting bigger. One contributor is the increase in the consumption of bottle drinks and an increase in their size (Wilhite and Lutzenhiser 1997). Another is that refrigerators are increasingly being used as a storage place for food which does not need cool temperatures for preservation, such as jams and yogurt. In fact many food products actually loose quality when stored at low temperatures and loose flavor when eaten cold. There is also a trend to use refrigerator space as storage for canned and otherwise preserved foods which were intended to be stored at room temperature.

Cold appliances have been heavily targeted in energy saving policy and programs. The focus has been on developing better technologies and on using minimum efficiency standards and labels to convince consumers to buy the most efficient technology. This effort has been successful, but the efficiency gains in the refrigeration technologies have been outstripped by numbers and size. In spite of this, to our knowledge no energy saving policy efforts have been devoted to the size issue, either in the promotion of small refrigerators or placing emphasis in the technical development of more efficient versions of small refrigerators.

SPACE HEATING AND COOLING

Space heating and cooling are good examples of energy services for which efficiency gains have only made a small dent in the growth of energy use. Space heating in Denmark is an exception, at least during the 1970s and 1980s, when there was a 25% drop in heat consumption, but this soon came to a halt, and for two decades the heat consumption has not declined. The targets of policy and programs in Denmark and elsewhere in Europe have been the thermal efficiency of the building envelope and the efficiency of the appliances which provide heat or cooling. Other developments, such as increasing sizes of dwellings, increasing volume of heated or cooled space within a dwelling, and implementation of alternative or passive solutions, have been given little or no attention.

Concerning space heating, there has been an evolution in all the northern European countries from the practice of heating parts of a room, to heating the whole room, to heating the whole dwelling (and from heating part of the dwelling part of the time to heating the whole dwelling all the time). These developments affect energy consumption in two significant ways. First, the amount of space to be heated is increased for a given dwelling. Second, there are increasingly spaces which are seldom used but yet are heated all the time. Third, there has been a steady decline in the number of persons per household in most OECD countries. In both Denmark and Norway, the per person living space today exceeds 50 sq. meter (compared with 22 sq. meters per person in 1960). Finally, there has been an upward trend in preferred indoor evening temperatures. These trends mean that in Norway, while thermal efficiency has more than doubled since 1960, the amount of energy for residential space heating has grown slightly over that same period (Hille 1995).

There have been similar developments in space cooling. Homes in Europe and North America are getting bigger, there has been an increase in central air conditioning and preferred indoor temperatures have been falling. Yet another issue, and perhaps the most important in terms of future global energy growth is the change from natural to mechanical cooling. Shove and Wilhite (1999) use this change as an illustration of how energy policy has failed to either acknowledge or address the reasons for increasing energy demand. In Japan, air conditioning almost completely displaced natural cooling in homes over the course of a 30 year period. This was not a change which came from consumers who suddenly changed their ideas about comfort, but rather by a constellation of actors and media, including public policy, banks, financial institutions and the building industry. The typical Japanese house was socially reconstructed and its new physical parameters made any other choice than air conditioning totally unrealistic. This re-making of space-cooling in Japan from natural to mechanical lead to a peak-load crises in virtually all major urban areas. A similar reconstruction occurred earlier in the United States and is in progress in many other parts of the world, including Indonesia, China, and as we return to below, India. Improved efficiency cooling equipment as a stand-alone policy will not prevent an enormous future increase in energy use and climate gas emissions. Attention must be given to retaining or recapturing natural solutions to cooling, something which has been largely ignored in policy (Koch-Nielsen 2002).

The case of energy use in developing countries

The challenge of reducing global climate-gas emissions would be big enough if the global economic status quo of the past half century were to continue on into the future. It becomes even more difficult given probable developments in the emerging economies of Asia, Latin America and Africa. We will discuss the cases of India and China, highlighting likely energy futures and drawing attention to the dynamics of changing energy use.

ENERGY USE IN INDIA

Over the past decade, energy use in India has increased at 6-7% per year. Much of that growth has been based on the use of fossil fuels for gasoline and electricity. 70% of electricity production is from coal-fired thermal power. There are three ongoing developments which will drive an inevitable continuation of growth in the consumption of energy services.

(1) Electrification of households. Only about 50% of households are electrified. The connection of the remaining 100 to 200 million households will lead to a substantial incremental jump in electricity use as houses are plugged into minimal services like light and refrigeration.

(2) Energy for health and social services. The public service infrastructure in many parts of India is underdeveloped. There will be growth in this sector as more infrastructure for health, education and other essential services is expanded.

(3) Increased consumption in the growing middle class. The middle class is large and growing. Today it is estimated to consist of around 300 million people. Their demand for energy services is growing rapidly.

It would be difficult to use an environmental argument to justify curtailing (1) or (2). Concerning point (3), middle class consumption is still far below that of Europe and North America. An argument to curtail Indian middle class consumption based on global environmental concerns will not find much quarter unless and until the rich countries begin leading by example, taking bigger steps to curtail their own consumption.

In India much of the future energy growth will go to adding new energy services and the technologies which accompany them. An emphasis on efficient technology will not compensate for growth in services. Product ownership levels for cars and appliances are low (appliance ownership is zero in places which are not connected to the grid), so that every addition of an electrical appliance in the domains of cooking, washing, cleaning, space comfort, bathing, entertainment and mobility, will kick energy consumption up to a new plateau.

Some of the biggest jumps will come for refrigeration, air conditioning, heating and cars. Over the last decade, the biggest growth in refrigerator sales is in the larger refrigerators (300-600 liters) (Bullis 1997:116). There is a similar trend in car sales. Sales of cars grew by 900% between 1980 and 2000, and sport utility vehicles (SUV's) are taking an increasing part of new sales. A recent automobile industry survey predicted that sales of SUV's will grow at the same rate as passenger cars over the next 4 years (both will increase at about 9% per year). The combined automobile sales in 2005-2006 is estimated to be about 1.7 million units compared to 1 million in 2001 (Rajashree 2001).

In Kerala, where one of the authors recently completed a year of field research (supported by the Norwegian Council of Research and the University of Oslo), energy use has grown slightly faster than the Indian average over the past decade (about 8% per year) in spite of a slow down in economic growth. Much of the increase has been in the residential sector. Residential energy use increased at 10% per year and thereby tripled over the decade from 1991 to 2001 (Vijaykumar 2001). Part of this can be attributed to a growth in the number of electrified homes. The number of household customers connected to the grid grew at 6% per year in Kerala over the last half of the 1990s. However, the majority of the growth is in middle class families.

In what follows, we examine some of the reasons for that growth. Much of this is applicable for other countries in the South and East.

Opening of India to foreign products and media

A watershed in consumption came in 1991, when India opened for increased foreign investment and foreign products, at the same time reducing trade and commercial barriers. Foreign investment increased from about 1 billion USD in 1991 to over 7 billion in 1996 (Lall 2001). Duties for foreign products were reduced by as much as 80%. Foreign manufacturers rushed in with their products. Today, appliance sales are dominated by U.S., European and Korean companies. Their entry has been accompanied by heavy marketing, assisted by television and print advertising. Advertising revenues for India as a whole have been growing by 30-35% per year since 1992 (Bullis 1997:53). There are now 100 cable television channels available to homes in all the cities of Kerala, many of them foreign based and all of them commercial. In a set of structured interviews with 400 families in the capital Trivandrum, 20% said they had been directly stimulated to buy something by a television advertisement (Wilhite 2002). It is clear that media, global competition and the marketing of a greater variety of products after 1992 has lead to a significant increase in consumption of products that use electricity.

Social changes

Social changes in Kerala and the rest of the developing world have importance for understanding increasing consumption there. Joint families cohabiting under the same roof are increasingly separating into nuclear-family households. The change has to do with urban crowding and a reduction in physical space available for housing, but also with new ideas about independence and privacy. Structurally, this trend towards fewer numbers of people living under the same roof means fewer people are served by the same number of appliances and furnishings. The per person energy use is thereby increased.

Another important social change concerns the role of women. Women are increasingly entering the work force, but still have exclusive responsibility for home, chores and taking care of children. Since female relatives in the joint family are no longer in the home and available to share chores, women rely increasingly on appliances for accomplishing tasks like cleaning, washing and cooking.

The recent growth of air conditioning might be seen as the beginning of a major social change. There was virtually no air conditioning in Kerala before 1990, but as we pointed out above, today it is growing at 20-30% per year. The change can be related to changing practices in the construction industry, to new ideas about house design and to the problems typical of urban development such as overcrowding, de-greening and stagnation of water and sewage. Major changes in the practices surrounding home construction began in the 1960s and 1970s. Prior to this, local building-artisans, who were specialists in carpentry, masonry and so on, used locally available materials to construct houses. New public rules were put into place in the 1970s and 1980s which required building permits, site plans, and fee breakdowns. These written plans and the interactive process with government bureaucracy were gradually taken over by contractors and architects. The resulting designs were no longer adapted to local knowledge about natural cooling. By the 1990s it was standard procedure for architects to incorporate air conditioners into their blueprints for house design for middle an upper income families. The increased competition among manufacturers after 1991 (from 3 to 18 companies marketing and selling air conditioners) lead to heavy media and advertising campaigns and falling prices. At the retail end, new alliances were struck between retailers and finance institutions which allowed people to spread payment over three years, with no interest. Today, the use of one or more room air conditioners is gradually becoming normal practice.

These changes will contribute to a steady increase in Indian energy use and CO_2 emissions over the coming decades. The IEA's World Energy Outlook predicts an increase in primary energy supply by 3.1% per year to the year 2030, and that "Final demand for oil, gas and electricity will increase rapidly" during the whole period (IEA 2002:69).

ENERGY USE IN CHINA

China is rapidly moving towards what is termed a socialist market economy, and has recently joined the World Trade Organization.

The government in China is more aware than most governments in developing countries of the national as well as the international environmental problems we are facing. It has long had an active population policy, aimed at stabilizing and eventually reducing its population to a level at which the country could provide a decent life for every citizen (Keyfitz 1984). There is hardly any other country with such an environmental-oriented population policy. Despite this, China's demographic structure due to earlier high birth rates is estimated to push a continued growth in population. The 1 294 millions in 2000 is expected to grow to 1 495 by 2020 and peak in 2040 with 1 590 million people. From then on it will turn downwards again to 1 575 million in the year 2050 (Zongxin et al. 2001). There is a steady but somehow controlled migration from rural areas to cities.

Over the last couple of decades, China has been successful with its top priority, which is economic growth, achieving growth rates of 8-10% per year in GDP. Today hundreds of millions Chinese enjoy a material standard of living not too different from that in Southern Europe a few decades ago. For instance, by 1999 refrigerators were found in 70% of the urban homes, and ownership is growing rapidly (UNDP/GEF 1999). By 1996 people in rural areas could each enjoy 22 square meter of residential floor space on average (the Norwegian and Danish average in 1960), while for urban dwellers the floor space per capita was 8.5 square meter. Both are growing rapidly, adding roughly one square meter residential floor space per capita every year (UNDP 2002).

China's unique opportunities

During the 1980s China became fully aware of the fact that using energy more efficiently makes good sense, also for a developing country. Since about 70% of the energy was used in the industry, most attention has since been devoted to replacing old first generation industrial equipment, which was very inefficient in the use of energy, with larger and more up to date production equipment. The immediate impact was impressive, with real energy intensities dropping to less than half from 1985 to 2000 (Farinelli et al 2001). Despite China's vigorous economic growth rates, the country's total energy consumption was actually declining for part of the 1990s.

Like most developing countries, China has the opportunity to jump over many of the industrialized countries' development stages in technology as well as in infrastructure. Houses now being built by the millions and to last for maybe one hundred years can be designed to be energy efficient. The same applies to city structures, including the urban transport systems. This is so much easier and cheaper to do from the beginning, rather than having to replace or alter it later on as is often the case in the rich countries.

Not only can China benefit from this leapfrogging in the *technical* sense. What might be even more important is the opportunity the country has to shape the structure of its market economy to provide incentives for using energy cautiously. Rather than following the European example of letting the whole market loose and afterwards trying to catch some of the lost regulation options, China has the opportunity to move in the direction of a 'real' market economy based on the full cost and benefits. This would imply internalizing external costs into the market, including *both the social and the environmental costs*. Some of the policy measures which would support this are energy and pollution taxes, subsidies for energy saving measures, and improved information (a prerequisite in market theory for a functioning market).

It would still be naive, however, to base an energy conservation policy on market forces alone. Firstly the market-driven efforts must be supplemented with various direct legislative regulations and standards, such as speed limits, minimum efficiencies for electric equipment of end-use equipment, building codes, etc. all of which can help in reaching long term optimal efficiencies. China is likely to adapt such policies in its move towards market economy, and in 1998 an energy efficiency law was passed as a frame for implementing energy conserving technologies. The question is, however, whether China in the longer run would accept a policy of limiting the material standard of living as expressed by the energy service.

Future Outlook for Energy Consumption in China

A number of forecasts and scenarios have been worked out for China's need for primary energy to provide the energy service level planned for. An important consideration to take into account is the structural change as the economy grows. Over the past couple of decades, China's economy has moved from being dominated by agriculture to now having industry as the largest sector. As the economy develops further, the expected pattern is that the industrial sectors will grow slower and become less energy intensive in the future, as has happened in Europe, while the service sector and the domestic sector in China will develop faster.

Data for China's present total energy consumption, as well as its distribution pattern are quite uncertain. Consequently, the various attempts to make forecasts and scenarios come up with even greater deviations. A quantified idea about China's total energy demand is that in the year 2000 the country consumed between 1 200 and 1 600 Mtce or 35 to 50 EJ (BP 2002, Zongxin et al 2001 and UNEP2002). Obviously, the future demand is much more uncertain and indeed also flexible, since it will depend very much on, for instance the energy conservation policy pursued. For the year 2020 a typical suggestion is 70 EJ (2 400 Mtce) if a rather aggressive energy efficiency policy is implemented, and for 2050 the corresponding figure is 110 EJ (3 800 Mtce).

OVERALL GLOBAL TRENDS

To summarize, by 2020 India's and China's total anticipated 2.7 billion people (UN Population Div. 2002) can be expected to consume 95 EJ, or 35 GJ per capita, even given moderate efforts to implement efficient technology. By 2050 the expected 3.0 billion Indian and Chinese together could consume 175 EJ, corresponding to 58 GJ per capita. By comparison, in 2000 the global energy consumption of all the 6.055 billion people on earth was around 400 EJ, making the global average 65 GJ per capita or about the same as what China and India might consume in 50 years. Out of the 400 EJ consumed globally in 2000, the 1.140 billion people living in the OECD countries (USA, Europe, Japan and other rich industrialized countries) consumed more than half, namely around 235 EJ, which amounts to about 200 MJ per capita, or three to four times the per capita consumption anticipated in 50 years in India and China.

Our assessment is that an aggressive policy for technical efficiency ought to be pursued in developing countries, but that it would be neither ethical nor even practical to argue for restriction in overall energy growth in these countries. The onus is on Europe and other rich countries to change path.

Changes in priorities in research and policy

Recapitulating the argument thus far, a policy which relies on efficiency in technology and markets for reining in energy growth and climate-gas emission in Europe will not be sufficient, given past experience and developments in other parts of the world. A new policy paradigm is needed for Europe and the other rich countries of the world, one that aims at *sufficiency in energy services*. This will entail broadening the whole field of investigation and shaking up some of our most deeply-seated assumptions about energy policy and its relationship to environmental, economic and social development.

A first step is to recognize the need for change and to begin seriously working on a new agenda. The spirit of this paper is to lay out an argument for new thinking and to invite new ideas on specific policies, programs and incentives. In the following we give some suggestions for what a change of focus would mean for research and policy. We conclude with some observations on why there is friction to change and what can be done about it from inside the world of energy policy.

EXAMPLES OF NEW RESEARCH AND POLICY DIRECTIONS

The main challenge for new research and policy agendas will be how to re-direct the focus from the means – efficiency, to the ends – reducing consumption. For problematic energy services this will mean retooling incentives so that they target the amount, volume or numbers of things consumed. We provide some examples of this shift in emphasis.

Progressive tariffs

We begin with a well-known measure that is vastly underutilized today, a progressive electricity tariff which penalizes over-consumption. Progressive tariffs have been in use in many parts of the world for decades. They provide a "lifeline" amount of electricity at a given price, but progressively increase the price per unit for higher levels of consumption. The Danish Energy Authorities have proposed to combine this principle with energy taxes by allowing for a tax free lifeline supply (making progressive tariffing simpler in a liberalized energy market (Energistyrelsen 2000). One of the unexpected consequences of progressive tariffs observed in Japan in the late 1980s was that these tariffs affected the sale of electrical appliances (this may be the reason why Japan was on the verge of dropping the progressive tariff system (Rate System Committee 1987, Chubu Electric Power Company 1988). Experience shows that if we are truly interested in mitigating the demand for energy services, this could be a useful tool.

Quotas

A similar but more stringent instrument is quotas, based on energy consumption targets (Johansson et al 2001). Amounts consumed in excess of the allocated quota would increase dramatically in cost. Another effort could be made not on the consumer, but rather on distribution companies, allocating an annual declining quota of electricity sales. Finally, a milder form for quota would be in the form of a political target or goal for declining consumption, backed by a package of incentives and policy instruments. In the Japanese city of Kawagoe, the government has adopted a target of a 1% reduction in annual electricity consumption in all governmental activities. After the first 4 years about 5% has been saved by changes in final consumption at no cost, saving the government between 0.5 and one million Euro per year (Kawagoe City Government 2000).

Codes

In cold regions there is a tradition for minimum efficiency codes for heat consumption. These codes could be progressively tightened to approach what is termed Passive Houses, implying a heat demand so low that no specific heat distribution systems are needed at all (Feist 1996). In warm climates, building codes could be aimed at achieving buildings designed to provide a comfortable indoor climate with very little or no active cooling systems (Koch-Nielsen 2002). At a minimum, codes ought to specify a minimum required standard for a dwelling's thermal envelop before air conditioning systems can be installed (Pagliano 2000).

Labelling

The change of focus in energy programs which we recommend would imply changes in the principles behind standards and labelling systems. When it comes to appliances, and for those few labelling programs which have been developed for resale of houses, embodied energy and annual consumption (independent of size) ought to be accounted for in labels and standards.

As an example of the latter we take the labelling of refrigerators. Today, refrigerators are labelled within size categories. Among big refrigerators, there are A refrigerators, which consume 2-3 times the amount of electricity as a C or D refrigerator in the smaller size classes. If size classes were dropped and refrigerators were labelled according to annual energy consumption, period, consumers would have a much less ambiguous overview of relative energy use and annual costs.

Work

Surveys in OECD countries have indicated an increasing wish for more time (less working hours) even if it means sacrificing some income (Norgard 1995). More attention in research and policy needs to be given to this issue of time use, leisure, its impacts on consumption and its conflicts with GDP growth.

Indicators: Means or ends?

For the reasons we explored above, the Gross Domestic Product, GDP is a very poor indicator of well being, either for the society as a whole or for its members, and in many ways promotes increased energy use and environmental problems. Efforts have been made to modify the GDP in ways which reflect more genuine well being, for example the Genuine Progress Indicator, GPI (Rowe and Anielski 1999). This effort, which involves a rethinking of means, ends, and relationships between well being and environmental sustainability should be pursued.

Start with service, not device

One of the most important changes of focus is from technology to service. Much of sustainable energy policy is concerned with taking a technology trajectory, such as clothes driers or air conditioners, and applying policy and incentives to the task of improving energy or environment efficiency. We propose to change the starting point of the analysis from the technology to what we actually want to achieve (call it service such as dry clothes), then working through what role technology, infrastructure, and creative leasing or sharing arrangements can contribute. Car sharing is an example of such an approach (Wilhite and Attali 2000). A more general methodology which incorporates sharing and leasing approaches are explored in Manzini and Vezzoli 2002).

POLITICAL FRICTION

Why is there friction to change in the direction which the above examples imply? One reason is inertia. It is easier to make a case for doing more of the same than it is to explore new directions. This is especially true since energy policy in almost every country in the developed world is nested in a national political agenda which equates 'more' with progress: more growth, more production, more work, more consumption. The sustainable agenda has never rested easily on that fundament. Energy policy is itself torn between more and less, and the only strategy that can be rationalized as serving both is one that premiers efficiency. But as we have argued, the environmental demands on energy policy, especially that of climate change, are not going away, and the rich countries will have to take their large share of the responsibility if energy reductions are to be achieved.

To many people from other parts of the world, North Americans and Europeans are insatiable and greedy with respect to material consumption. To the extent that it is true, it would be wrong to put the blame only on individuals, who are awash in a sea of images which positively value high consumption lifestyles, and who must make life go around in social and technical infrastructures which trap people in to high consumption trajectories. Political change will be necessary and it is incumbent on energy researchers and policy makers to be active agents in that change. There is evidence from many parts of the world that people are ready for a change, not only, or even mainly because of environmental considerations, but due to being overworked, overstressed and undernourished with free or leisure time. This angle may provide an opening for a political acceptance for 'turning down' work, programmed time and consumption.

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