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(Background for this chapter. Rebound Effect is not defined in this chapter, since the whole book is about Rebound Effect. It refers to the effect, that when you save energy in a cost effective way by better technology, say a better insulated house, a more fuel efficient car, etc., you also save money, and the extra "income" is spent on extra energy services such as for instance increasing indoor temperature, driving more km, buying an extra TV, freezer, etc. This extra service eats up some of the energy savings from the more efficient technologies. Macro-economically it affects the whole economy, and some even claims that more efficient technology leads to more energy consumption. All this applies to societies, as the present, where growth in the economy is the dominating goal. The chapter deals with a future with different priorities.)

Chapter 10

Avoiding Rebound through a Steady-State Economy

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The debate on the *rebound effect* as presented in most chapters in this book is based upon experience from the *past* more than visions of the *future*. The analyses are dominated by conventional economic theory, which implicitly assumes insatiable demand for energy services. Material consumption is considered to be limited primarily by productive capacity with little concern for ecological costs and limits. In such a development aiming at unlimited growth it would from a long term environmental perspective be close to irrelevant to reach for more efficient use of energy at the *end-users*, since it would only buy some time. From this perspective, the environmental problem with the rebound effect is not the higher energy efficiency, which pushes towards *lower flows* of resources through the economy, but rather the conventional economy which rebounds the savings, because of its quest for *higher flows*.

In this chapter, I shall take the rebound debate further by discussing the possible role of energy efficiency in a sustainable economy that is based on the notion of 'sufficiency'. The assumption is that globally we need to achieve a 'steady-state economy'. Considering the urgent need for better material conditions in many parts of the world, the transition towards a steady-state economy needs to begin first in the affluent countries, including the Nordic countries from where most of the information in this chapter is drawn. The politicians in these countries are not seeking a steady-state economy, but some social and cultural traditions may provide prerequisites for such a society, including public attitudes towards low birth rates, equity, consumption and work. Although this chapter presents a Nordic perspective, the options and trends described are relevant worldwide.

It is assumed that absolute reductions in energy consumption are desirable, since most energy supply options involve environmental problems. While renewable energy sources are generally more environmentally benign than fossil fuels and nuclear, they nevertheless constitute a very direct intrusion on nature, as it is already apparent where hydropower and biomass is used intensively.

Efficiency in growth economies

The economic growth experienced in parts of the world for the last two centuries has been driven in part by 'rebound effects' arising from substantial increases in efficiency (or productivity) in the use of various resources. For example, only a small fraction of the increase in labour productivity has been converted into less labour input; the rest has rebound as more production. Rebound effects from the more efficient use of energy have also spurred economic activities. However, it

would be wrong to ascribe all the growth in the use of energy service to energy efficiency alone. While energy use for lighting, for instance, has increased *alongside* improvements in energy efficiency, it is not only *because* of those efficiency improvements that energy use has increased (Herring 2006 a). The proportion of the growth that is due specifically to improved energy efficiency is what the rebound debate is largely about. But as will be discussed in this chapter, in a future steady-state economy the outcome of such improvements may be quite different.

The delusion of decoupling

In the 1980s it became popular to claim that energy consumption was - or in the future could be – decoupled from economic activity, as measured by GDP. However, the decoupling of energy consumption from economic activities is largely a statistical delusion. Physically the economy has very real links to energy consumption, although not necessarily to carbon dioxide emissions. Every economic activity requires some energy consumption and all energy consumption is rooted in some economic activity, be it on the consumer or producer side. The observation that the two parameters can grow at different rates, which over history is quite normal, does not imply any decoupling. Whether a car is running in first or second gear, there is still a coupling between the engine and the wheels, and speeding up the engine will speed up the car. Unfortunately, the notion of a decoupling has served as peacemaker between environmentalists and growth-oriented politicians by conveniently exempting economic growth of any responsibility for environmental problems.

An example often used in support of decoupling is the fact that, over the last thirty years, energy consumption in Denmark has remained approximately constant while GDP has grown by more than seventy per cent. This is partly the result of government policy to promote the more efficient use of energy, beginning with the oil crisis in 1973 and including energy taxes, subsidies for energy saving investments, building regulations and information campaigns. Energy savings have been achieved by both end-users and suppliers, with the latter replacing electrical space heating and individual boilers with district heat from combined heat and power generation. The reduction in energy consumption for space heating has, however, been offset by the rapid growth in car traffic where efficiency gains have been modest. In total, economic development has eaten up what could have been a reduction of more than a quarter of energy consumption over the last thirty years, if there had been no growth *or if there had been no coupling to the growth.*

In addition, the above figures follow the Kyoto Protocol in excluding energy consumption used for air travel and merchant shipping. The latter is per capita exceptionally high for Denmark and if included, Danish energy consumption and carbon dioxide emissions are found to have *increased* by more than 50 per cent over the last thirty years – to become one of the largest per capita in the world.

Given continued economic growth and the associated assumption that people can never have enough goods and services, energy savings from better technology can only temporarily offset the drive towards higher energy consumption (Nørgård 1974). Hence, in an ever growing economy, relying on technology alone to provide a lasting and significant reduction in energy consumption will trap us in an eternal Sisyphean task.

A political predicament

The contradictions between pursuing sustainable development and yet insisting on continued economic growth is illustrated by a comment from a parliamentary spokesperson from one of the Danish governing parties. When asked whether the government’s policy would achieve energy

savings, he replied: ‘We can reduce energy consumption, we can reduce our transport, we can buy fewer goods with large energy content. But all this also implies a reduction in the level of activities, and we are not interested in putting the brakes on the general economy, as a consequence of people’s concerns’ (Nielsen 2006). This is a surprisingly frank expression of the dominant political preference. When the development path requires a choice between growth and sustainability, the former is invariably preferred.

The policy makers’ predicament partly explains the half-heartedness of many energy saving policies. For example, information campaigns never encourage savings of the *indirect* energy consumption as embedded in all consumer goods and services. For instance, policy makers could urge consumers to save energy by postponing replacement of furniture, clothes or other durable goods, which would be an obvious step towards environmental sustainability (Nørgård, 2006a). However, this would conflict with the promotion of increased consumption.

Private businesses aim to make profits and consequently have an interest in using resources efficiently in their business of providing products to consumers. On the other hand, they also benefit from higher sales if customers use the products wastefully. With this in mind, it is striking that governments world wide frequently turn energy saving responsibility over to energy suppliers! Although there are examples of energy supply businesses taking this responsibility seriously, this model introduces an organisational conflict of interest - like letting the wolf watch the sheep. Not surprisingly the suppliers’ strategies are often half-hearted and actual savings have been hard to detect. A particularly unfortunate example is an information campaign by one Danish power utility, which recommended that customers switch to the three times more efficient low energy lamps and then suggest to use three times as much light. In other words, they were encouraging a 100 per cent direct rebound effect (Norgard 2000).

A better political option for reducing energy consumption would be an independent agency with the sole obligation to save energy. This option was chosen by the Danish government in 1996, after they lost patience with power utilities that had refused to subsidise the conversion of electrically heated buildings to district heating. The Government then established the Danish Electricity Savings Trust (Nørgård et al 2007).

The conflict between continuing economic growth and a shift towards a sustainable development is well illustrated by Brookes (1990) who advocates the view that improvements in energy efficiency will in general lead to an increase in energy consumption. Brookes does admit that energy efficiency could reduce energy consumption in some circumstances, but warns that this would be at the expense of a loss in economic output (Brookes 1990). The latter point is correct, but should not be taken as a warning, but rather as a hope, since maintaining human well-being with a lower economic output can and should be considered as a realistic goal for the future. Like many other conventional economists, Brookes confuses a *large* output with a *good* economy. This perception is a key problem in debating sustainability, not to mention achieving it.

Misplaced end-use efficiency?

Does this mean that our efforts to develop energy efficient technologies are in vain from an environmental point of view? Certainly not, but putting faith in technological efficiency improvements as *the first and the sole means* to reduce energy consumption would be very short-sighted. Nevertheless, the extent to which the potential for technological efficiency improvements are utilized will determine the level of energy consumption, environmental impact and human welfare we can ultimately choose from. Experience has shown that, first, the energy savings from efficiency gains are being eroded by various rebound effects, and second the efficiency gains themselves are being used as a pretext for doing nothing to change the basic driving forces behind

the problem - namely the growth in population and consumption. A more valid approach would be to give first priority to start the long term economic, social and psychological transition towards a steady state, as described below, and then along the way gradually implement more energy efficient technologies (Nørgård 1974).

Sustainability targets and definitions

The contemporary problems of climate change and depletion of oil reserves ('peak oil') are examples of trends that were largely anticipated by the path-breaking 1972 report, *The Limits to Growth* (Meadows et al 1972, Meadows et al 2004). This study used a dynamic model to analyse the interconnection between important global parameters and the consequences of different development options, some sustainable and some unsustainable. The continued pursuit of economic growth was in the model found to be unsustainable and likely to result in severe problems in the twenty-first century, for instance with pollution and resource shortages. After being ignored and criticized, often on erroneous grounds, the basic messages of *The Limits to Growth* report now seem more relevant than ever - see for instance Simmons (2000). Unfortunately, so far we have missed thirty-five years for a gradual transition towards a sustainable economy.

While the 1987 Brundtland report introduced the concept of sustainable development, the proposed definition is open to varying interpretations (WCED 1987, 43). An alternative approach is offered by Herman Daly, who borrows the economic definition of income, namely the maximum amount that a person or a community can consume over some time and still be as well off at the end of the period as at the beginning (Hicks 1948). From this can be deduced that an environmentally sustainable development is a development which does not reduce the development options of the future by deteriorating the natural environment (Daly, 1990; Daly, 1996). This implies that the exploitation of renewable resources and emission of pollutants must be kept below nature's capacity to provide and neutralize them respectively. Non-renewable resources should in principle not be used, but to the extent that we accept substitutability between man-made and natural capital, they can be used but only at a rate below that of establishing appropriate substitutes such as energy conservation and sustainable renewable energy supplies. In any case, these rules should be seen only as *necessary* biophysical conditions for the sustainable use of the natural environment, not as *sufficient* conditions.

Sustainability and the steady state

In the infancy of economics as a science, the British philosopher and liberal economist John Stuart Mill in 1848 expressed his concern for the environmental consequences of economic growth. He hoped that people 'would be content to be stationary, long before necessity compels them to it' (Mill 1900, 264). Since that time, several economists have argued that growth should be considered a transition to maturity where a stationary or *steady state* is reached. Two Nobel laureates in economics have separately expressed the need to stop growth: Trygve Haavelmo by saying that 'further growth in the rich countries would be a terrible thought. It is inconsistent with the environment' (Vermes 1990), and Jan Tinbergen stating that in order to reach sustainability the highest priority is to 'permit no further production growth in rich countries' (Tinbergen and Huiting 1991: 41).

According to Herman Daly (1977, 17; 2007, 27), a steady state implies a constant physical stocks of people and artifacts. It is useful here to distinguish between *growth*, meaning physical

expansion, and *development* which can be non-physical. In natural systems, periods of growth always comes to an end (as for a human being or a natural forest) while dynamic development continues, including individual cycles of growth and decay. It is therefore self-deceptive and un-natural to anticipate an ever lasting expansion, as modern economies appear to require.

Having recognized the need to reach a steady-state economy, the next question is to identify the appropriate size of the economy. The *maximum* possible stock of people and artefacts which can be maintained depends upon the carrying capacity of the environment and the efficiency with which energy and resources are used. But the *desirable*, or *optimum* level, will no doubt be considerably lower than this, since the ecological sacrifices required for maintaining the maximum possible stock are likely to be both socially and psychologically intolerable.

A number of studies have suggested that the present biophysical throughput of the global economy is exceeding the carrying capacity of the Earth. For example, estimates of the 'ecological footprint' of the global economy suggest that we are exceeding the planet's carrying capacity by around a quarter, which is clearly unsustainable (Wackernagel et al 2005). Comparable indicators developed by the Wuppertal Institute suggest that we are currently using natural resources at twice the sustainable rate (Schmidt-Bleek 2000).

Globally there is enormous inequality in the consumption of natural resources, with twenty percent of the world's population accounting for about eighty percent of the world's resource use.. This suggests the need for major reductions in resource consumption in the affluent countries. For example, if a global target to halve resource use and environmental impacts were to be combined with a principle of equal per-capita rights to use nature, European countries would need to reduce their load on nature by approximately a factor of ten (Schmidt-Bleek 2000).

Absolute savings, not just efficiencies

Often targets for energy savings are expressed in terms of energy efficiency, which is a relative term - for example, kilometres travelled per litre of fuel. For a whole nation, energy efficiency is typically expressed as GDP per unit of energy consumption. But from an environmental point of view, it makes little sense to set overall environmental goals in terms of efficiencies, since improvements in efficiencies can easily go hand in hand with growing energy consumption. Impacts on the natural environment are only affected by *how much* energy we consume, and no credit is offered to getting more output or GDP out of each unit of energy consumption.

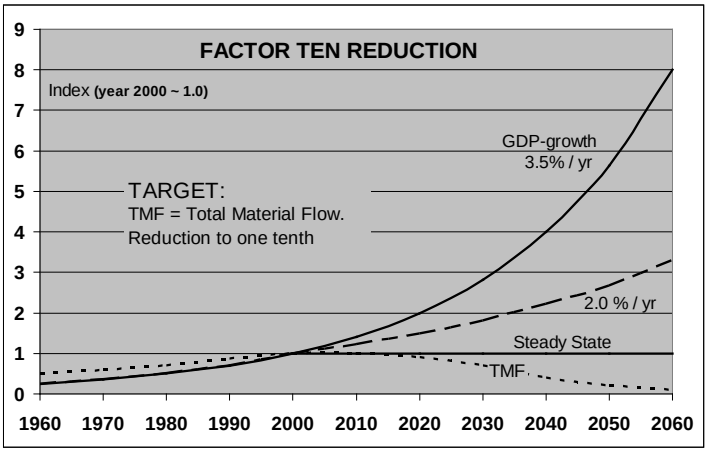

Figure 10.1 Factor 10 reduction
Note: With 3.5% annual growth in GDP, a factor ten reduction in the absolute use of nature (TMF) by 2060 requires a factor 80 improvement in eco-efficiency compared to 2000. With a 2% annual growth in GDP, the factor would be 35 and in a steady state economy, just factor 10.

One illustrative and striking example of how difficult it is to distinguish between energy efficiency and energy savings – and to choose between the two - is found in the *Factor 10 Manifesto* mentioned above (Schmidt-Bleek 2000). In some paragraphs, the authors stress that the factor 10 target refers to the absolute use of nature, while in other paragraphs the target is described as a factor 10 increase in efficiency - meaning a reduction in material input

per unit of service. From an environmental perspective, only the former makes sense. A factor 10 target on efficiency would allow a growing economy to increase material use infinitely, see Figure 1. Such confusions and contradictions are common in the sustainability debate.

Figure 1 illustrates the dilemma growth economists are facing, when confronted with a requirement to reduce the absolute use of nature by a factor of ten, while at the same time maintaining a GDP growth rate of say three and a half per cent per year. Within a few decades, *eco-efficiency* would need to increase by a factor of eighty.

Rather than setting targets for a reduction in energy use relative to some anticipated and highly uncertain growth in output or consumption, targets should be expressed instead in terms of *absolute* energy consumption (Herring 2006 b; Nørgård 2001), as is now increasingly common in carbon dioxide emission policy. A change in terminology is also required. Soon after the energy crises of the 1970s, the terms *energy conservation* or *energy savings* were widely used by environmentally engaged politicians, environmentalists and researchers. But these were later replaced by the misleading term *energy efficiency*, since this was more acceptable to conventional economics and established interests (see for example Chapter 9). Denmark is one of the few countries, where the term energy savings has survived, even in policy debates.

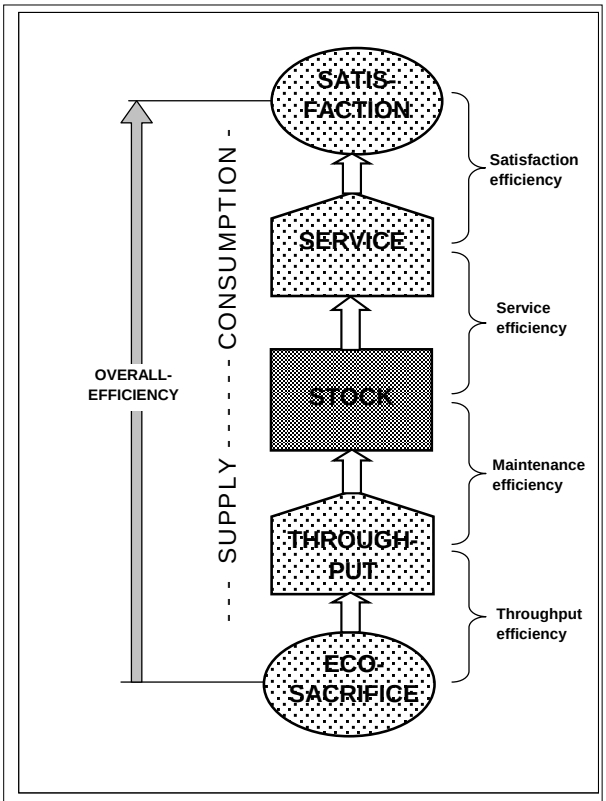

Figure 10.2 The whole economy
Note: The economy is here illustrated by a chain converting the means, ecological sacrifice, into the end, human satisfaction. Stock can be owned by either consumers or suppliers. The diagram can be applied to just energy or to the whole economy.

Whole economic system chain

Figure 2 shows a flow diagram of the whole economy, inspired by a model by Herman Daly (1996, 69), but here unfolded beyond services. This illustrates how the ultimate means - 'ecological sacrifice' - is converted into the ultimate ends, defined here as happiness, or human satisfaction. The diagram allows four different efficiency measures to be defined, including 'satisfaction efficiency' representing the ratio of human satisfaction to the level of services available (Nørgård 2006a). The product of these gives the 'overall efficiency' of the economy.

For a sustainable economy, a steady-state stock of material artefacts needs to be maintained with a minimal throughput of resources. A reduction in this throughput can come about in three ways:

1. *Forced* upon the *supply* side when the environment cannot sustain sufficient throughput to maintain the stock, causing the economy to shrink or collapse.

2. *Voluntarily* chosen on the *consumption* side, as when people feel they have sufficient services and seek satisfaction in other ways, such as more free time. This should throttle the economy's throughput.
3. *Merging* the two limiting factors, as when it is collectively recognized that the benefits from increasing consumption are more than offset by the costs in terms of both work effort and eco-sacrifice. Trade-offs such as these are a major ethical issue in the quest for sustainable development.

The collective and voluntary choice of such an approach, based upon the notion of sufficiency', is the assumption behind this chapter. The alternative is considered to be the collapse of the world economy as a consequence of resource depletion and environmental pollution.

It is notable that the two extreme links in the chain, *satisfaction* and *eco-sacrifice*, are both difficult to measure. Nevertheless, they are the most essential elements in analyzing the options for a humane and sustainable development. As Albert Einstein observed: '*Not everything that can be counted counts, and not everything that counts can be counted'*. The inadequacies of conventional measures of GDP in capturing both benefits (satisfaction) and costs (eco-sacrifice*)* have led several researchers to seek better measures of welfare and progress, discussed below.

Modifying gross domestic product

A variety of indicators have been developed based upon modifications to conventional measures of GDP. One is the Genuine Progress Indicator (GPI) which adjusts GDP to reflect environmental costs, income distribution, and the benefit of leisure time. According to the GPI, people in the United States are no better off today with respect to real economic welfare than in 1970, despite per capita GDP more than doubling over this period (Talberth et al 2006). While there have been no GPI studies of the Nordic countries, the comparable Index of Sustainable Economic Welfare (ISEW) shows very similar trends for Sweden (Jackson and Stymme 1996).

Both the GPI and the ISEW measure welfare in monetary terms and therefore do not break out of the straightjacket in the middle of Figure 2, to include the ultimate ends and means. But in recent decades, a number of researchers have begun to investigate the relationship between GDP and people's satisfaction or happiness (Layard 2006; OECD 2006). These studies include time series in single countries as well as comparisons of different countries. Very roughly, the studies conclude that beyond a certain minimum level, people are not made better off by higher incomes and increased consumption (Layard 2006, 32). As an example, the number of Americans who report being 'very happy' has remained relatively constant since 1950 (around one third), although real income per capita has almost tripled over this period. The picture is similar in other Western countries and fits with the results of the GPI above.

Even the international Organization for Economic Cooperation and Development (OECD) has begun to doubt the value of using GDP as a measure of welfare. One chapter of a recent report examined various indicators of happiness and life satisfaction in member countries and concluded that they were only weakly related to GDP. Noting that well-being is a more fundamental goal than GDP, the report observed that: 'It would be perverse to strive for faster growth in output if this entailed reducing the well-being of current and future generations' (OECD 2006, 130). Nevertheless, the title of the report is still *Going for Growth!*

Overall economic efficiencies

While some of the alternative economic indicators like the GPI include measures of human welfare and environmental costs, few have attempted to measure the *overall efficiency* of the economy, as indicated in Figure 2. A measure of overall efficiency would be the ratio of some measure of satisfaction, or happiness to some measure of ultimate cost in terms of ecological sacrifice. The Happy Planet Index, HPI, (Marks et al 2006) is such an overall efficiency indicator, with ecological footprints as the denominator (the cost) and the product of life expectancy and an index for the more subjective human satisfaction as the numerator (the benefit). The results from the HPI in different countries are often counter intuitive. For example, a ranking of 178 countries places most Western countries near the bottom, with the US as number 150, France 129, Canada 111, UK 108, Japan 95 and Germany 81 - mostly due to these countries' high ecological footprint. In general the Central American countries score the highest, because they manage to combine a long life expectancy and high life satisfaction with a low ecological footprint. The clear implication is that a high well-being does not necessarily require high level of consumption, just as high consumption does not guarantee high well-being. (Marks et al 2006; Jackson 2005). A more consistent result is that high consumption invariably leads to high footprints.

No doubt, the transition to a sustainable and steady-state society will require significant economic and social changes: 'a modification of society comparable in scale to only two other changes: the Agricultural Revolution of the late Neolithic and the Industrial Revolution of the past two centuries' (Meadows et al 2004, 265). Social values will need to change somewhat, both to bring about this transition and to adapt to the new situation (Christensen and Nørgård 1976). Nevertheless the transition need not lead to a net human sacrifice - on the contrary (Jalas 2002; Jackson 2005; Sanne 2007). While the cost of achieving a sustainable economy is often calculated to be substantial in narrow, monetary terms, once human satisfaction and eco-sacrifice are considered (Figure 2), the balance appears quite different.

The above mentioned attempts to quantify overall efficiency should not obscure the fact that the path of development needs to be decided through open dialogue and democracy, rather than dictated by what happens to be easily quantifiable. As argued in the next section, it should not be difficult to achieve a sustainable economy with a net gain in human welfare. This derives from a number of sources, but in particular from a rebalancing between consumption and leisure.

Sufficiency and less work

Economic satiation seldom implies that people don't want any more improvement in their lives. It just indicates that their development has reached a level where consumption is sufficient, and their marginal demand is outside the monetary frame (Johansson 2007). The most obvious example of such non-economic human welfare is reduced work and increased leisure time, which furthermore is a key to lowering environmental impacts (Sanne 2000).

Work-time reduction revived

Working time has historically been a variable production factor, although a sluggish one, with changes taking decades or even centuries. It reached a peak during industrialization in the 1800s when more than seventy hours of hard work per week, or 3500 hours per year, were common (Sanne 1995 p 145; Schor 2005; Beder 2000). Since then, average work time has declined to around half, and in the 1950s the future was commonly envisioned as a leisure society with for

instance only fourteen hours' work per week, as suggested by US Senate subcommittee (Honoré 2004, 163). Such visions have not materialised however. Despite continuous technological productivity gains and substantial increases in affluence, the decline in work time per employee in Western Europe came to an end after 1980 and was in 2000 around 1500-1600 hours per year (Schor 2005). In the Nordic countries, paid work hours per working-age person are essentially the same as thirty years ago (Schor 2005), and working hours *per family* have greatly increased as a result of women entering the work force (Sanne 1995, 42).

For politicians pursuing high GDP growth, the situation in affluent countries can seem challenging. With no growth in population and nearly all women in the labour force, growth can be obtained only from labour productivity gains, which can be hard to maintain at 2 per cent per year. For politicians aiming at a steady-state economy, however, the outlook is much more positive, especially if the drive towards less work time can be revived. The productivity gains from improved technology, including that from energy efficiency, could then be used to slow down instead of consuming more goods and services. Fortunately, this sustainability quest appears to fit well with trends in public preferences.

Since 1964, the National Institute of Social Research in Denmark has conducted extensive surveys of how Danes use their time, and how they would like to use it (Platz 1988; Körmendi 1990). One of the questions concerns the choice between more income and reduced work time. The results are shown in Figure 3. The fraction preferring less work appears to have grown over time, reaching seventy per cent in 1987. In their next survey in 2002 the National Institute of Social Research for unclear reasons left out just this question. Fortunately, in 2007, another institute, IFKA (2007), took up the question and showed a continuation of the trend, now reaching seventy three per cent preferring less work.

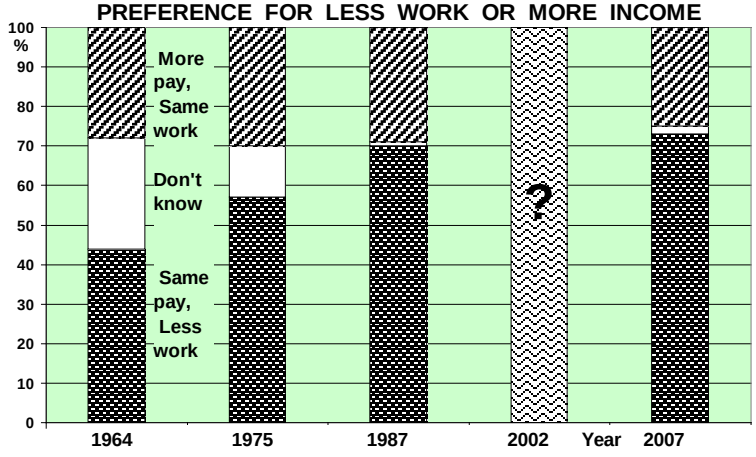

Figure 10.3 The choice between more income and reduced work time
Note: Sociological surveys over 43 years show for Denmark an increased interest in turning productivity increase into more leisure rather than more consumption. (Platz 1988 and IFKA 2007), See text.

Similar trends towards consumption saturation are found in other affluent countries, and particularly in the Nordic countries (Sanne 1995, 53; 2007, 49). The attitudes indicated by such surveys are unsettling to most politicians, who tend to be primarily concerned with increasing production and consumption. Similarly, these results are usually ignored by labour unions, even though they have historically fought for shorter work time.

Why don't people work less, if they want to? The answer is partly that few employers offer such choice and partly social pressures (Sanne 1995, 74; Galbraith 1973, 236). The work market is not free and usually involves a choice between thirty-five to forty hours per week or zero. Also, the quest for equity and solidarity in sustainable development calls for collective agreements on work time.

Spending leisure time

A common misunderstanding of the above survey results is that with more leisure people will consume more. This, of course is not possible. If people choose to have more leisure *instead* of more income, their level of consumption will remain constant. Whether more leisure time will result in higher *energy* consumption obviously depends on how the time is spent. For example, car driving has one of the highest rates of energy consumption per hour, about five litres of petrol or fifty kWh, while in contrast, reading only consumes around one kWh (Jalas 2002). For comparison an hour less at work in Denmark is estimated to save an average of roughly twenty-five kWh of energy consumption, derived from total energy consumption for workplaces (Danish Energy Authority 2007) divided by the total volume of working hours in the country (Statistics Denmark 2007).

Extra leisure time can be spent not only with low energy intensity, but even with a 'negative' intensity as when the net reductions in energy consumption are obtained from slowing down. For example, reducing car speeds from 130 km to 80 km per hour not only saves around half of the fuel used per km, but considering slower car driving as a way to spend extra free time, it saves about two-thirds of the fuel per hour. Choosing to spend some of the extra free time to replace commuting by car with walking and cycling, possibly combined with public transport, is an option with significant 'negative' energy consumption - as well as improved health and well-being (Nørgård 2005). Not surprisingly, since the *rate* of material throughput is the primary source of environmental impacts (Figure 2), 'slowing down' in general may be considered a necessary strategy to achieve sustainability.

Equity and other sufficiency drivers

The end goal of satisfaction and the trends in people's aspirations shown (see Figure 2 and 3) suggests that *less work* rather than more consumption is a key to higher satisfaction. Even though preferences for less work may not be guided by moral wishes to preserve the environment, a trend towards voluntarily desisting from increasing consumption is environmentally beneficial and should be encouraged and supported by policy.

Higher equity may play a double role in the quest for sustainable development. First, the recognition of a limited world will tend to make demands for equal rights to the use of natural resources more morally and politically legitimate. Secondly, in affluent countries the growth in consumption appears to be primarily driven by differences in *relative* income (Jespersen 2004; Keynes 1931). Consequently high equity in affluent economies tends to hamper consumption growth - that is, promote economic satiation - as suggested in a warning to Denmark from the OECD (1982). Compared to other regions, Nordic countries have been characterized by relatively high equity and public welfare, financed by high and progressive income taxes that have the additional advantage of discouraging people from becoming too addicted to work (Layard 2006, 155). Global redistribution of wealth could in part be achieved through voluntary means, such through fair trade schemes which pay producers in developing countries higher prices than what market forces dictate.

Another driver of limiting consumption and working less in the affluent countries could be health considerations. As the economist J.K. Galbraith noted: 'Virtually all of the increase in health hazards is the result of increased consumption' (Galbraith 1973, 279). Support for this view can be found, for instance, with the obesity problem in the US. This causes 400,000 premature deaths annually and in the view of a US minister of health: 'is definitely one side effect of getting

wealthier' (Samuelson 2004). Increased wealth tempts people to use cars excessively and to eat too much food (Nørgård 2005).

Sharing work more equally is a key issue. Recent research in happiness reveals that being unemployed is a significant source of misery (Layard 2006, 67). On the other hand, working fewer hours seems to be a high wish, see Figure 3. All this new investigation into happiness and satisfaction has the potential to direct attention towards non-economic welfare options, rather than simply focusing on maximizing income.

So far we have not discussed reducing consumption, only ceasing its growth. But already, more than twenty per cent of employed people in Denmark would prefer to work less even with a corresponding decline in income (Bonke 2002, 51). The general low and declining preference for more consumption is even more remarkable in light of the continuing commercial and political pressure in opposite direction with longer shopping hours, electronic payment, increased advertisement budgets, globalisation, etc., not to mention the on-going 'selling of the work ethic' (Beder 2000). Considering this pressure to work and consume more, it could be argued that people in affluent countries are not only saturated but effectively 'super-saturated' in terms of consumption. Once the option for working less is let lose and encouraged as a contribution to achieving sustainability, the balance between work time and consumption might settle at a new and lower level. Having more time free from paid work could in a kind of virtuous circle reduce the need for paid child care, for cars, for private deep freezers and so on, and thereby further reduce the need for income and work time.

What is discussed here as reducing work time, for instance as hours per year, should be interpreted broadly as work input into production. In some tasks, it could take the form of the same (or even longer) working time, but with a lower productivity, provided this led to a higher degree of human satisfaction, better health and personal development (Nørgård 2006 b). A reduction in labour productivity can reduce energy consumption per economic output.

Sufficiency and the productivity elasticity of leisure

The income elasticity of a consumer good is the percentage increase in consumption of that good following a percentage increase in income. Estimates of income elasticities have been used by number of authors to quantify the rebound effect from savings on energy bills (Nässén and Holmberg 2007).

Aggregate increases in income normally result from improvements in labour productivity (output per hour worked). But as we have seen, people could potentially benefit from productivity increases in other ways - notably by working fewer hours. If, for instance, one tenth of the annual productivity gains was turned into reduced working time, while ninety per cent ended up as higher income (and hence consumption), leisure could be said to have a 'productivity elasticity' of 0.1 while total consumption had a 'productivity elasticity' of 0.9. Such values might approximately reflect the experience of the past fifty years in Europe, but may not necessarily reflect the patterns people would have preferred. If the choice between income and increased leisure better reflected the preferences suggested by Figure 3, the productivity elasticity of leisure would increase. This elasticity could then be included when estimating the rebound effects from productivity improvements. In a 'fully satiated' economy, the productivity elasticity of leisure would be unity, meaning that all increases in productivity would end up as increased leisure time, with no net increase in production, real income and hence consumption.

Concluding reflections

Where basic needs are not satisfied, it is reasonable for economic growth to take priority over environmental benefits and energy savings. In these circumstances, the rebound effect should be beneficial for human welfare, since it speeds up economic development. And when the economy has reached a state of collective sufficiency, such as outlined in this chapter, there may be no rebound effect, since all productivity gains (including those from energy efficiency) should be turned into forms of welfare beyond the money economy, such as increased leisure. In these circumstances, the full environmental benefits of technological efficiency gains should be realised. Hence the rebound effect is only a problem when we argue for sustainability but dare not face the fundamental issue, our mania for economic growth.

Political and economic thinking in a sufficiency based steady-state economy will be very different from that at present. Fortunately, in affluent countries there are some signs that public attitudes may encourage a shift towards sufficiency. These include preferences for exchanging consumption growth for less work time and a willingness to have fewer children to ease population pressures. These changes can thus create opportunities for a gradual democratic transition towards sustainability, but so far these options are not on the political agenda.

Policies to pursue a sustainable steady-state economy based on sufficiency, may frequently be the opposite of current policies, which aim primarily at increasing GDP and aggregate consumption. Socially, a sustainable economy will no doubt require more equal sharing of income as well as of work to prevent unemployment and poverty.

In discussing visions for the future, it is important to take a holistic approach, instead of expecting significant changes by just dropping one measure like energy efficiency into an otherwise unchanged society. In our present endeavour towards a sustainable future, the problem is not that we strive for higher technical energy efficiency. The problem arises from *only* striving for such higher efficiency, and in a technological ecstasy leaving morality and sufficiency behind.

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