Chapter 15
Between Green Growth and Degrowth: Decoupling, Rebound Effects and the Politics for Long-Term Sustainability

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Abstract Taking the simple equation: I(impact) = P(population) · A(affluence) · T(technology) as the point of departure, this chapter discusses the delusion of decoupling economic activities from environmental impacts by resorting to reduce eco-intensities through technological advancement alone. It is argued that the rebound effect is both a natural consequence of the growth dedicated society and a driver of further economic growth. Through rebound effects, labour productivity and eco-efficiency technologies in the growth society tend to contradict the goal of achieving environmental sustainability. To address the environmental problems, attention should therefore be redirected to the growth ideology and policy in current society. Drawing on the emerging degrowth debates in the affluent countries, the chapter proposes pathways towards a degrowth transformation by, respectively, discussing the role of population, affluence and technology in the attempts at reducing environmental impacts. Overall, it is suggested that from an analysis not confined to monetary terms, but with real cost and real benefits represented by environmental damage and human satisfaction, respectively, a degrowth in affluent countries can be achieved at no net cost.

Keywords Degrowth · Delusion of decoupling · Rebound effect · $I = PAT$

The equation $I = P \cdot A \cdot T$, which combines population P, affluence level A and technological eco-intensity factor T into the consideration of total environmental impacts I, has been well-known for a long time. Since the equation's development by Ehrlich and Holdren in 1971, the focus on how to lower environmental impacts has

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shifted within the three right-side factors. Although Ehrlich and Holdren at the initial stage emphasized the impacts of population (*P*) on the environment (Ehrlich and Holdren 1971), today, the factor *T* is almost totally dominating the debates about solutions to resolve the environmental deterioration (e.g. von Weizsäcker et al. 1998; WCED 1987; OECD 2011). Population (*P*) is often tabooed and rarely included as a variable in the analyses and debates, although it obviously is still a key factor. In more recent debates, particularly in affluent regions, the factor *A* is highlighted as key to solve the ecological crisis (Martinez-Alier et al. 2010). For instance, a call for reducing affluence level is well-captured in current discussions on 'degrowth'.

The quest for reducing the affluence level (*A*) in rich nations, measured as per capita level of consumption of goods and services, is partly based on the impossibility of reducing resource consumption and pollution (*I*) to a level necessary for environmental sustainability by resorting to technological advancement (*T*) alone. This failure is to some extent attributed to the ignorance of the rebound effects from increasing resource use efficiency, which pushes upwards (*P*) and (*A*). In other words, the right-side factors in the equation are not constants, but mutually interdependent and dynamic (Alcott 2008, 2010). This chapter goes beyond this explanation, and points towards the infinite political quest for economic growth, i.e. growth in $P \cdot A$, as the fundamental problem. Consequently it is difficult to eliminate rebound effects and sufficiently reduce environmental impacts without addressing directly the developments of the *A* and *P* factors, in addition to lowering the eco-intensities. Invoking the term 'degrowth', we also propose an alternative society beyond the ideology of growth and suggest pathways towards approaching this desirable future.

In this chapter, the environmental impact (*I*) is mostly exemplified by energy consumption and carbon emissions, but it does as well refer to all other degradation of nature, such as biodiversity loss, resource depletion, pollution of air, water and soil. By definition, a degrowth society "*challenges the hegemony of growth and calls for a democratically led redistributive downscaling of production and consumption in industrialised countries as a means to achieve environmental sustainability, social justice and well-being*" (Demaria et al. 2013: 209). Degrowth therefore calls for strategies to decline the aggregate impact from $P \cdot A$ in addition to lowering technologically the eco-intensities (*T*). A degrowth society cannot be interpreted merely as a downscaled economy in the quantitative sense. It also implies a qualitatively different society with different socio-economic structures and institutional settings from the current growth society (Asara et al. 2015). In addition, degrowth has the ethical premise of distributive justice and intergenerational equity. Although today, the *P* factor is not given sufficient attention in the degrowth debates, and the propositions on population development among degrowth proponents are inconsistent (Kerschner 2010; Latouche 2009; Martinez-Alier 2009), we believe that reducing the size of the global population is essential for bringing human economic scale down to a sustainable level and thus should be advocated as a strong part of the solutions.

The chapter will proceed as follows. In Sect. 15.1, the 'growth and decoupling' approach for environmental sustainability is criticised as a delusion. Section 15.2

analyses how rebound effects are associated with the growth economy, and proceeds by arguing that attempts at enhancing labour and resource efficiencies in a growth society tend to contradict the goal of environmental sustainability. We therefore call for shifting the focus of critique from rebound effects to the growth ideology and policy itself in order to resolve environmental problems. This is followed by proposing a degrowth society. Drawing on the equation $I = P \cdot A \cdot T$ as an analytical framework, the chapter in Sects. 15.3, 15.4, and 15.5 discusses options for degrowth of all three right-side factors, as well as some of their dynamics. Finally, the concluding section provides some reflections on the need for a concerted degrowth strategy taking into account capping the left-side factor I and emphasizes the importance of addressing the deep socio-economic structures as part of the degrowth transformation apart from the factors in the $I = P \cdot A \cdot T$ equation.

15.1 The Delusion of Decoupling Economic Activities from Environmental Impacts

During the 1960s and 1970s ecological crises attributed to an exponential economic growth triggered a critical discussion on environmental and social consequences of growth. The criticism culminated with the publication of a report from the Club of Rome, *The Limits to Growth* (Meadows et al. 1972), together with a number of other reports and books presenting similar growth critique (e.g. Daly 1973; Goldsmith and Allen 1972; Schumacher 1973). During the 1980s, the growth critique was played down as the economy regained its momentum, and was gradually replaced by the view of 'decoupling' economic growth from environmental deterioration. This 'decoupling' view was emphasized, for instance, by the World Commission on Environment and Development as a key strategy of sustainable development in their report *Our Common Future* (WCED 1987) as well as in a number of publications that developed the concept 'Ecological Modernization' (Huber 1985; Spaargaren and Mol 1992; Hajer 1995). More recently, however, the possibility of maintaining environmentally sustainable economic growth through decoupling has been questioned by critics. Together with the multiple socio-economic political crises, this has revitalized the criticisms of economic growth, manifested in the increasingly heated debates on degrowth (Asara et al. 2015; Jackson 2009; Martinez-Alier et al. 2010).

According to the decoupling view, economic growth and environmental sustainability are *not* incompatible, but can be combined. To illustrate the decoupling notion with the $I = P \cdot A \cdot T$ equation, it means that ecological impact (I) grows at a different, usually a lower, rate than the growth in economic affluence level of whole population, i.e. $P \cdot A$. In order to materialize decoupling, the T factor becomes the key solution. The belief in decoupling has been formed along with an efficiency progress in the wake of the 1970s' oil crises. Many analyses then showed remarkable potentials for increasing the efficiencies of energy use (e.g. Goldemberg et al. 1985; Lovins 1977; Nørgård 1979a, b). In the 1990s, the concepts of Factor 4 (von Weizsäcker et al. 1998) and Factor 10 (Schmidt-Bleek 2001) emerged and became popularized specifications of the options and goals of de-materialization in national environmental policies. Factor 4 means that the same amount of commodity can be produced with only a quarter of the previous resource consumption (thus, factor 10 means using one tenth of the previous resource consumption). At an aggregate level, Factor 4 implies ‘doubling wealth while halving resource use’.

These large potentials in reducing eco-intensities were mainly low-hanging fruits from the neglect of resource efficiency options during the post-war period with almost free oil. This, however, results in a strong faith in the possibility of decoupling endless economic growth from environmental damage by resorting to eco-efficiency technologies. ‘Reviving growth’ was pointed out as an essential objective, and the suggestion was just that the quality of growth should be changed (WCED 1987). The Western euphoric faith in technology as the solution to reduce environmental impacts has now for half a century shaped environmental policies.

This decoupling notion can be challenged in several different ways and is subject to serious criticisms. The conventional use of the term distinguishes ‘relative decoupling’ from ‘absolute decoupling’. If the ecological impact (I) grows at a lower rate than economic growth measured as GDP or $P \cdot A$, relative decoupling occurs. Absolute decoupling requires that growth in GDP—or $P \cdot A$—does not result in an increase in the overall ecological impact, i.e. (I) is kept stable or even declines. What matters for the ecological sustainability is whether the absolute environmental impacts increase or decrease. From this perspective, absolute decoupling is of fundamental concern in most cases. However, a broad range of empirical evidence substantiates a low achievement of absolute decoupling. At the aggregate economy level, the total emissions of CO_2 in OECD countries showed relative decoupling from economic growth during the 1990s (OECD 2002). Similar modest relative decoupling has been observed at sector level in traffic volume versus CO_2 emissions (Tapio 2005), as well as in housing sector’s growth versus growth in residential energy consumption and land use (Xue 2014). The general picture is that the drop in environmental impacts per unit of product is cancelled out by rising scale of the economy. Only if the speed of T going down equals the growth rate of $P \cdot A$, can environmental impacts I be stabilized. But, this will not suffice.

Among environmentally concerned scholars it is generally agreed that present global environmental impact is not sustainable. Taking Ecological Footprint as the indicator, we are presently overloading the Earth by a factor around 1.5 (WWF 2014), implying a need to reduce the ecological footprint by at least 35 percent. Another study shows that four out of nine planetary boundaries have already been crossed by human activities, including climate change, biosphere integrity, biogeochemical flows and land system change, which might push the Earth system into a new state (Steffen et al. 2015). This means that for some specific environmental damages, a more drastic reduction is required in order to reverse the unsustainable trend. For the emissions of CO_2 and other greenhouse gases, the reduction has to be “net 100 %” by 2100 if we are going to achieve the goal of keeping global warming below 2° (IPCC 2014).

By ascribing all humanity equal right to use the environment, it is argued that people in affluent countries, such as USA, EU, and Japan, would need to reduce their impacts (*I*) down to only around one tenth the present to reach world-wide sustainability (Schmidt-Bleek 2001). To achieve such reduction target in the course of 50 years with an annual economic growth of 3 % would require the overall eco-intensity (*T*) to be reduced to only around 2 % of present levels, i.e. reduced by a factor 40 (Nørgård 2009; Jackson 2009). In comparison, the much praised environmental efforts in Denmark's energy system have over the past 25 years managed only to reduce *T* by around 28 %, i.e. by a factor of 1.4! (Danish Energy Agency 2015) And this has been achieved by 'picking the very low-hanging fruits'. It therefore seems even theoretically implausible to reduce the environmental impacts to reach a sustainable level by relying on the *T* factor alone.

Linguistically, decoupling implies that the two parameters—economic activity and environmental impact—are separated (Webster 1986) or with no coupling at all. OECD (2002) in their energy analyses defines 'decoupling' as breaking the links between 'environmental bads' and 'economic goods'. Physically, there will always be some amount of 'coupling', since every economic activity is—directly or indirectly—reliant on a minimum of resource supply from nature and emission of wastes back into nature. Vice versa, all eco-impacts have their roots in economic activity. The fact that economic activity and the eco-impacts grow at different rates does not imply that the two parameters are not coupled.

The misleading term 'decoupling' should therefore not be used in analyses and debates about economic growth and the environment. Instead, the term 'relative decoupling' can be referred to as a reduction in eco-intensity (*T*), while the term 'absolute decoupling' can be referred to as a decline in eco-impact (*I*). These are not just some linguistic trifles. The real problem is that the very use of the term 'decoupling' might—probably sometimes intentionally—leave the readers with the false perception that we can let economic activities grow forever, without having to worry about ecological constraints. The use of this term can therefore be seen as a false 'peacemaker' between environmentalists and growth-dedicated politicians, and thereby contributes to the maintenance of growth far beyond the economy's optimal size (Nørgård 2009).

15.2 Rebound Effects in a Growth Society

Normally the concept 'rebound effect' depicts the phenomenon that eco-efficiency improvements through technological advancement do not reduce the adverse environmental impacts as much as expected due to induced increase in production and consumption. It was already observed by British economist Jevons in the nineteenth century that increasing efficiency in the use of coal was not accompanied by corresponding reduction in the use of that resource at the aggregate level, rather the opposite (Alcott 2005).

Here, we extend the efficiency improvement to embrace other production factors, which we merge into just labour input by considering capital as stored labour. Throughout industrialisation, technology has increased labour efficiency (productivity) in the sense of less work being needed per unit of output. A substantial part of the labour efficiency gains were in early days of Western industrialization utilized to reduce the more than 80 h labour input per week. However, later on, more of the labour efficiency gains were turned into growth in overall production and consumption $A \cdot P$. In recent decades this rebound effect has approached 100 %, as illustrated by the average work time in the USA, which has since the 1930s roughly been frozen around 40 h per week despite substantial gains in labour productivity (Schor 2005). Almost all labour productivity gains are presently used to increase GDP and consumption in general, rather than to relieve the environmental impacts by lowering consumption. Also, instead of reducing the input of labour, during the past 50 years, global *workforce* has enlarged substantially, partly by general population growth, and partly by absorbing ever more men and (in particular for the case of affluent countries) women into the economic (monetary) production sectors.

The direct and micro-level causes of rebound effects from eco-efficiency technologies can be ascribed to the ignorance of the socio-cultural elements and the neglect of individual's subjectivity in consumption behaviour (see Chaps. 5, 6, and 7). In addition, increasing productivity through technological advancements involves a general trend of social acceleration, where the speed of production, consumption, and mobility increases, leading to more consumption of resources (see Chap. 8). Nevertheless, there is nothing deterministic about the growth impact of improving resource and labour efficiency through technologies. As shown above, labour productivity gains can be employed to shorten work time instead of increasing production levels. It is, therefore, an open choice of which way we utilize the benefits of efficiency improvements.

Arguably, the conversion of efficiency gains predominantly into higher levels of production and consumption is attributed to the ideology of economic growth and the structural growth imperative of a market-dominated socio-economic system. In the growth society, 'quality of life' and 'well-being' are interpreted as possession of material wealth and consumerism is a dominant value entrenched in the society. Continuously enhancing material living standards becomes a widely accepted social norm without being questioned. When basic needs are satisfied, as in affluent societies, positional goods and conspicuous consumption are promoted as new engines of growth through advertisements and consumption-stimulating policies (Hirsch 1976). This growth path was after pressure from big business, 'deliberately' picked in 1933 by US president F.D. Roosevelt as a way out of economic depression (Hunnicutt 1988; Cross 1993). For consumers under the hegemony of the growth discourse, it is very likely that the reduced cost due to lower *resource intensity* per unit of product is harnessed to secure higher material standards, just as the case with rebound from higher *labour efficiency*. In other words, the growing purchasing power derived from either of the two efficiency gains has to be channelled to somewhere, leading to higher levels of consumption (Schneider 2008).

Furthermore, the fact that most of the efficiency improvements are turned into drivers of growth is highly associated with the market economy characterised by a structural necessity of growth. Several authors have pointed out that the growth imperative is intrinsic to the market-dominated socio-economic system (Gordon and Rosenthal 2003; Griethuysen 2010; Harvey 2010). Fierce competition in the market economy sets the 'grow or die' dynamic in motion and forms the profit-driven economy. Individual corporations through enhancing resource use efficiency and labour efficiency are able to reduce the costs of products so as to gain excess profits compared to their competitors and increase their market shares (see Chap. 3). Therefore, the rebound effect on the production side is an intentional pursuit of producers who consider imperative to seek higher profitability. Eco-efficiency and labour-saving technologies are employed as a business strategy to increase profits rather than a way to benefit the environment and the well-being of people. Not only business sectors, governments also seek high rebound effects. The Danish government earlier has directly *required* that "*Energy savings should contribute to growth and commercial development*" (Danish Energy Agency 2004).

Based on the discussion above, it can be argued that the rebound effect is both a natural consequence of a growth society and an important contributor to spurring further economic growth. It is received with welcome in current growth society and cannot be considered as a problem from a perspective of economic growth. Only when being examined from an environmental perspective is rebound effect regarded as problematic, as it increases the level of production and consumption which offsets intended environmental gains from efficiency strategies. But does not a growth society aim at a perpetual growth in output? This suggests that the rebound effect is not the fundamental problem—and thus it is neither "good" nor "bad". What remains as the fundamental problem is the strong commitment to economic growth and its contradiction with environmental sustainability. Both labour- and eco-efficiency strategies tend to be 'co-opted' by the growth ideology and serve the purpose of maintaining growth. The more we reduce the eco-intensity (T), the more difficult it will be to decrease the aggregate impact of $A \cdot P$, as technologies for efficiency and productivity are a key driver of economic growth. Attempts at enhancing labour and resource efficiencies *in a growth society* tend to contradict the requirements for environmental sustainability. It is thus impossible to reduce environmental impacts as much as needed by resorting to eco-efficiency strategies in a growth society. It becomes necessary to address the growth issue if the intention is to get rid of rebound effects and achieve long-term environmental sustainability (Nørgård 2009).

Focusing on the growth issue means the adoption of a degrowth strategy that seeks to stabilize or even lower the affluence level (A), and the population size (P). Besides pursuing lower eco-intensities, the technology factor T will be redirected towards prolonging the durability of products. What would such a degrowth society look like? Which policies are necessary to implement in order to avoid problems like unemployment, poverty and inequality, during the process of shrinkage? The following sections aim to sketch some suggestions for achieving a prosperous degrowth society by exploring the role of each of the right side factors in the $I = P \cdot A \cdot T$ equation.

15.3 Population Development in a Degrowth Society

Global population has over recent decades moved from exponential growth into what appears more like linear growth. But this growth is still annually adding a staggering 80 million people to the limited planet. With a continuous growth in population, a sufficiently low level of environmental impact can hardly ever be reached and maintained. Despite the significance of the population size in affecting the environment, today there is a taboo about including human population development as a variable when analysing future options for sustainability (Nicholson-Lord 2008). Analyses on future scenarios typically start out by just referring to the latest UN medium estimate of future population development (see Fig. 15.1), and accept this one population scenario as a fact. This lack of scientific and political courage by experts to include a reduction in population size as one solution option, constitutes one of the most serious flaws in present environmental debates.

When politicians in Europe in rare cases do touch the issue of population, it is usually from a growth promoting viewpoint, as for instance about how to encourage higher birth rates to secure sufficient labourers and consumers for continuing GDP growth. Such growth strategy will, as historically hinted by philosophers in the 1700s (Lütken 1760; Malthus 1798), sooner or later through rebound effects from productivity increase, result in ecological and human misery and starvation for part of the world population.

Demographers and politicians contend that, when peoples' standard of living in developing countries approaches a Western level, birth rates would by itself drop and thus prevent a global overpopulation. One problem was that in many poor regions of the world, economic growth could hardly keep pace with population growth, which has resulted in stagnating or even declining standards of living, blocking the way for the 'automatic' decline in birth rates. Furthermore, it is often forgotten that the

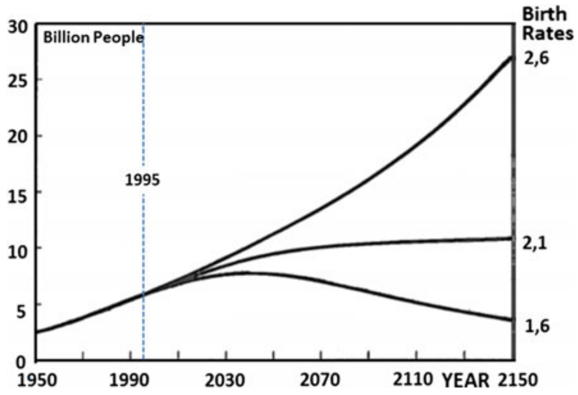

Fig. 15.1 UN scenarios for future world population development as a consequence of three average fertility rates (*Source* The Population Division of the UNs Secretariat 1998)

European population ‘explosion’ in the 1800s and 1900s was partly ‘resolved’ by millions of Europeans migrating and taking control of 3–4 ‘empty’ continents, North America, South and Middle America, Australia and parts of Asia and Africa. Only recently has such population ‘explosion’ crowded other world regions, e.g. Africa, but there are no more ‘empty’ continents for people to migrate to.

What is then the *optimal* number of people living simultaneously on the earth that could balance the number of people with the resource intensity of their lives? It seems evident that there is a trade-off between the two aspects, since with more people (*P*) follows lower options for a good life (*A*).

A number of estimates of optimal population have been carried out. One such analysis was in the 1990s based on energy needed for high quality of life versus the environmental problems from using fossil fuels. Given the average energy consumption of 7.5 and 1 kW per capita in, respectively, industrialized and developing nations at that time, researchers suggested 3 kW to suffice, and found an optimal population of 1.5–2 billion people (Daily et al. 1994). More recent analysis, based on the lifestyle’s ecological footprint versus the earth’s bio-capacity and ecological space for biodiversity, found that future optimal population levels range from 2.7 to 5.1 billion people (Desveaux 2008). This depends on average footprints, maintenance of bio-capacity and allowances for biodiversity. The lowest, 2.7 billion allows for 20 % margin for biodiversity. Despite the variations in these estimates, they all indicate an optimal world population size significantly below the present 7.3 billion. This underlines the urgency of starting a gentle reduction of the number of people on the planet.

The taboo on population is practiced by decision makers in an attempt to appear neutral on this sensitive issue of people’s choice of family sizes. It should be stressed, however, that no policy can be neutral on population development. All political decisions have indirect effects on fertility rates through tax system, education, health care, social security, etc. Some decision makers defend their silence on the urgency of active population limitation policies by the fact that population policies mainly have long-term effect. This is an odd way to justify the postponing of action.

Suppose we decide to aim for half as many people as today, as the lowest UN scenario for world population development suggests (Fig. 15.1). If we act now, we could reach this goal around 2150 by convincing all women to have on average 1.6 children, rather than the present average of 2.6. Reaching a worldwide birth rate of just 1.6 should not be ruled out politically, considering that it is in fact the present average in two politically quite different regions of the world, namely Europe and China. In Europe the low birth rate and the resulting contraction of population has been reached voluntarily as a consequence of the general economic and welfare policy. In China, the low fertility has been promoted by a more direct and active family planning policy.

Although China’s family planning policy is effective in slowing population growth, it has been criticised for its authoritarian and coercive approaches (Dietz and O’Neill 2013). Later optimistic experiences from a number of developing countries, mainly in Asia, have shown, how similar effects as those in China has be achieved based on non-coercive means, e.g. through education and empowerment of women (Kingholz and Töpfer 2012).

It is hard to see any disadvantages of living in a future world with say half as many people as today. On the contrary, all the basic problems mankind is facing today will be easier to solve. Even in monetary terms, reducing population is the most cost-effective strategy for mitigating climate change. This also applies to biodiversity loss and other resource and pollution problems, and even international conflicts that are often derived from shortage of land, food, resources, etc. Lowering fertility rate to be below the replacement rate 2.1 and stabilizing a nation's population at lower level will improve material standards of living in general and provide a prospective continuous environmental benefit in the form of the saved ecological footprint from the unborn children and all their descendants.

Usually, politicians associate monetary cost with the transition adjustments of GDP, where the ageing population will need more care to be provided by a shrinking productive workforce. Considering the gentle pace in the transition these problems are manageable, especially when remembering that a shrinking population will require less childcare and educational services, and a lot of infrastructures like highways, buildings, power systems, libraries, schools, etc., will be inherited in plenty from the earlier, larger generations. This heritage will cost maintenance and replacement, but a lot of investment for expansion can be spared, reducing also environmental impacts.

15.4 Affluence and Work in a Degrowth Society

In the Western economies average consumption per capita (A) has reached a level which qualifies as a dominant and very obvious factor in the environmental impact $I = P \cdot A \cdot T$. According to the Living Planet Report 2014 (WWF 2014), the ecological footprint per capita of high-income countries is about five times more than that of low-income countries, and furthermore these high income countries often rely on the bio-capacity of other nations or the global commons to meet their consumption demands. Growth in this affluence does not primarily serve to satisfy human basic needs or even deep wants, but rather to satisfy the basic needs of a debt-based financial economy designed for unlimited GDP expansion. This explains why, not only private businesses through massive commercial advertisement, but also governments and most politicians encourage people to consume still more.

When aiming at a degrowth economy, the quests will be contrary to those voiced for a growth economy. Fortunately, a call for curbing people's excessive consumption offers some rewards in return, mainly in the form of more free time, less stress, better health, more options for meaningful life, in addition to a better rather than worse environment.

The affluence level (*A*) is not only coupled to environmental impact, but also affects our own health. Obviously economic growth in wealthy countries might still bring about some health improvement through better technology, medicine, etc., but at this stage, overconsumption has also caused negative health impacts in the form of lifestyle diseases. These diseases are caused by overconsumption of food and motorized transport, heavy smoking, alcohol abuse, excessive sugar and animal fat intake and various narcotic drugs. Overconsumption alone in USA was in 2004 found to result in more than one million premature deaths every year, and in that connection U.S. Secretary of Health made the point by 'a slip of the tongue', that these and other "social problems and complaints stem from our affluence not our poverty" (Samuelson 2004), admitting severe and rising human cost of the growth policy.

If we assume that consumption can be expressed by people's annual income, study shows that a growing income gives a diminishing return in the form of wellbeing or happiness, particularly when annual income exceeds $10,000 per person (Jackson 2009). When observing the historical relationship between economic growth and happiness in USA, it is found that the percentage of people who report being very happy has stabilized at around 30 percent during the years 1945–2005, although income has more than tripled (Dietz and O' Neill 2013). This indicates that there are other aspects of life, which are more important for people's wellbeing than their level of consumption or income. Some of them are equity in income, education, job guarantee, etc. (Wilkinson and Pickett 2010). This discussion demonstrates that further economic growth in the developed countries is not a necessary condition for human progress.

Apart from arguing for continuously increasing the affluence level in terms of its social benefits, the most common political argument for increasing consumption is to avoid involuntary unemployment as a result of productivity increase. In general, there are three ways to accommodate the gains from labour productivity increase: increasing public and private investments, increasing consumption, and reducing work time to fit the production wanted. So the simple long term, obvious solution to secure a full employment is to share the work to be done annually by lowering the work time instead of creating more jobs by increasing consumption.

Annual work time in various nations is quite different, with people in USA, Russia, Korea and Japan working about 20 % more than the Europeans. This suggests that Europeans, as in the population issue, are on the right track towards degrowth. In addition, in a future degrowth society, productivity increase can be slowed down to below zero, as a means for adapting production to a declining consumption and simultaneously making working condition better and more meaningful in various ways.

Lowering affluence can appear like an impossible task, given the dominance of the growth ideology in the current societies. After lifelong exposure to intensive commercial advertisement, political urge to buy more and neighbours buying new cars and bigger houses, it is understandable that people may be reluctant to shrink their consumption. But several surveys on work time preferences have actually indicated an increasing wish among people for less work time (Gorz 1983;

Hayden 2000; Sanne 2000; Schor 1991). A series of surveys conducted regularly in Denmark over some decades showed that the fraction preferring less work over more income increased from 44 percent in 1964 to 73 percent by 2007 (Nørgård 2009).

People's preferences for more leisure over more income, as illustrated above, might well be based on concern for their own near future, but not explicitly based on the environmental benefits of their choice (Hayden 2000). With this argument added, the preference would probably be higher. However, increase in leisure activities cannot be supposed to necessarily lead to fewer environmental problems, due to the possibility of time-use rebound in terms of resource use (see Chap. 9). Spare-time activities are not equally environmentally friendly (Aall 2011). However, stabilization or even decline of income due to reduction in working hours constitutes one of the mechanisms counteracting the tendency to increase the total consumption level. In addition, tax policies can be adopted to encourage people to engage in leisure activities that are relatively less resource intensive and environmentally harmful.

The fact that most people in affluent Western nation express a wish to use productivity gains to get more free time rather than more income, if given the choice, should be seen as a welcome opportunity for politicians to gently change economic path away from the money dominated growth economy to a degrowth economy. In a degrowth society, the environmental impact from the affluence level will decline in combination with an improvement in quality of life in the form of better health, more freedom and non-material sources of happiness.

15.5 Technology in a Degrowth Society

The existence of rebound effects of eco-efficiency technologies should not lead us to reject technological advancement as one part of the strategy for environmental sustainability in the degrowth society. Nowadays, the problem with the technical solutions is that they often overshadow many more effective 'soft' solutions, including political regulations and social innovations. Arguably, technological advancement in a degrowth society with a cap on the affluence level (A) and a control on population size (P) will not lead to rebound effects and thus will effectively contribute to reducing environmental impacts. Besides seeking for higher efficiency in *direct use* of resources, this section will also address how technologies on the consumer side can be utilised in interplay with lifestyle and behavioural issues to contribute substantially to reducing also the *indirect resource use and pollution*. In this regard, the technological potential includes enhancing consumer efficiency by sharing and prolonging the useful life expectancy of durable consumer goods. Such policies have been neglected or counteracted in economies dedicated to growth in GDP.

People's material affluence (A) can be expressed by the consumption of three types of goods and services: (1) flows of non-durable goods, defined as consumption of goods, the value of which lies in actually being consumed, such as food, water, electricity, heat, etc., (2) stocks of durable goods, defined as physical goods, e.g. houses, clothes, appliances and cars, the value of which lies in having a stock of them at one's disposal, and (3) services, such as trade, entertainment, education, administration, health care, etc., which are provided to people by durable and non-durable goods outside their personal daily sphere (Nørgård 2006).

Most awareness on energy saving options has been devoted to the non-durable flow of direct energy used for providing services like transport, light, comfort, meals, etc., that is caused by operating energy consuming durables like cars, lamps, houses, refrigerators, TVs, etc. In these fields substantial room for energy efficiency improvements has been pointed out and to some extent also implemented. These efficiency gains have led to many examples of rebound effects, as for instance when a saving on the energy bill has been spent on energy intensive travels.

However, investigating indirect energy consumption, defined as the energy used to produce and provide the durable goods, opens up more room for reduction in environmental impacts, in particular when technological improvements are integrated with behaviour and lifestyle adaptions. The potentials for these savings lie in: improving energy efficiency in the whole chain of the system providing the durables; reducing the number of durable goods people possess, e.g. by more sharing of goods; and finally, extending their useful lifetime before being scrapped. In the following the focus is on the latter.

The useful lifetime of durable goods is determined by three factors (Nørgård 1979a, b): *technological obsolescence,* meaning the physical wear and tear and inability to fulfil the basic purposes of the products; *functional obsolescence,* in the sense that new products can fulfil the purpose in a better way, for instance by being more energy efficient or providing better service options; and *psychological obsolescence,* or becoming out of fashion compared to novel designs on the market. The most striking example of fashion driven purchase is clothes, but today the sale of most items, is to a large extent driven by changing fashion design. Obviously, when considering these three, the first occurring obsolescence of a product will determine the factual useful lifetime of the product.

In the growth economy, a *planned obsolescence* that deliberately makes products obsolete faster in any or all of the three ways is a business strategy towards accelerating capital accumulation and at the macro-economy level boosting growth in GDP (Slade 2006). There is therefore a basic conflict between increase in the consumption of durable goods and preservation of the environment. In a growth dedicated economy, public campaigns aimed at saving energy or the environment have been half-hearted in emphasizing the indirect use of energy, because this would imply a general curb on economic activities. This argument can obviously not hold if sustainability is given higher priority. In contrast to the call for speeding up the flow of durable goods in the growth society, a degrowth society aims at slowing down this flow and reducing the total amount of durable goods people possess.

Extending the useful lifetime of durable goods might be the most fruitful effort in lowering environmental impacts, through combining behavioural and technical changes. This could apply to electronic products, clothes, buildings, plastic and much else. Manufacturers could use their technical expertise to design more durable products with longer intervals between functional and fashion changes. Sharing various durable goods also constitutes a significant potential for reducing energy use and other environmental impacts, since this will substantially reduce the size of the stock of durable goods. Besides examples like cars, tools, and clothes, the concept can also include architectural design to facilitate flexibility and co-housing (Lietaert 2010).

The main obstacle for beginning the path towards such indirect energy saving is not technology, which is readily available. We do not need new invention before starting the transition. As an example electronic devices like mobile phones now often scrapped after a year or two can easily last for 10 or 20 years. Similarly, with clothes. In certain areas, e.g. urban sustainable development, it is also a matter of reinvigorating well known environmentally friendly options, such as bikes, buses and apartment buildings or cohousing to reduce the predominance of private cars and individual houses (Næss and Vogel 2012). What seems to be more challenging is the change in economic and financial targets, in work pattern as discussed in Sect. 15.5, and in culture and lifestyle. Fashion and advertisement can, as demonstrated in recent decades, be quite effective in changing people's consumer behaviour towards faster obsolescence replacement. We could then use the advertising experts to explain to consumers, little by little, the benefits of focusing more on the physical services or use values provided by the car, the clothes, and the other durable goods, and less on fashions and novelty.

To summarize, attempts at enhancing eco-efficiencies through technological advancement should not be abandoned in a degrowth society. However, technological innovation should to a higher degree be reoriented in the direction of use values and longevity of durable products. This should accompany an emphasis on cultural and lifestyle change.

15.6 Concluding Remarks

In this chapter, we have argued that although the phenomenon of rebound effect constitutes a barrier to achieve environmental sustainability, we should instead direct our critical attention to the growth economy which is both a fundamental causal mechanism of the rebound effect and partly a consequence of it. Throughout this chapter, we have employed the $I = P \cdot A \cdot T$ equation to illustrate and develop our argument. We first criticised the belief in decoupling economic growth from environmental impacts and the misleading use of the term 'decoupling' that seems to suggest the material independence of economic activities. We then argued that the options for utilizing efficiency improvements in resource and labour hold much larger potentials than just being rebounded into increased levels of production and consumption. It is the growth ideology and the structural necessity of growth in a market economy that constantly converts efficiency gains into drivers of further economic growth. Therefore, rebound effects are more than welcomed in a growth society and efficiency improvements in a growth economy are likely to contradict the goal of environmental sustainability, leading only to increased consumption elsewhere. In the light of this argument, we further proposed a degrowth society which addresses simultaneously decreasing population size, reducing affluence levels by work sharing and redirecting technology towards longevity of goods in addition to increasing resource use efficiency as pathways towards reducing environmental impacts to a sustainable level. Such a degrowth society not only reduces environmental and resource problems, but may also contribute to a happier and more meaningful life.

Apart from addressing the right-side factors in the equation, the pathway towards the degrowth society requires combining this with policies of directly capping the resource use and environmental impacts (*I*) on the left side of the equation. As Alcott (2010) suggested, the cap strategy can take the form of (1) production caps where limits are imposed on the input of raw materials to production, (2) consumption caps restricting the end-use of energy and other resources, and (3) pollution/emission impact caps. A multi-scalar cap system can be developed where individual and municipal caps are deduced from the national and global maximum. The capping strategy should be adopted in a concerted and coordinated way with the right-side factors. This will avoid potential rebound effects, which are generated by focusing separately on the factors regardless of the dynamics between them.

To build the degrowth society also requires a profound socio-economic transformation apart from adopting the strategies targeting the four factors in the equation. As discussed earlier, the growth commitment and the consumer culture emanates from the 'grow or die' dynamic in the market economy. Without confronting the hegemony of this economic structure, it is hard to eradicate the growth imperative; any policy aiming at, e.g. slowing down productivity, curbing the demand for consumption, redirecting the technology towards use value and durability, will meet resistance from business and financial sectors. Today's world wide neoliberal agenda is at odds with the policy suggestions for a degrowth society. However, the weaknesses of this system have been increasingly manifested through its failures in tackling the social, ecological, political and economic crises it has generated. There is an urgency to transform the economy and society not only for a better environment but also for long-term human prosperity.

The degrowth transformation should be first pursued in the developed countries where the current economic volume has qualified the so-called 'uneconomic growth' (Daly 1999). For less developed countries where economic growth still plays an important role in enhancing people's wellbeing, increases in consumption levels is acceptable, but only temporarily. After a period of growth leading to a point safely within the planet's ecological capabilities, these countries should also prepare for a long-term development with no-growth.

The cost for a degrowth transition can be very low or negative if analysed in *real economy terms,* i.e. not confined to what happens to be measured in money. In the real economy, *real benefits* are measured in people's satisfaction and *real cost* in the destruction of the natural environment. In that case, most of the actions needed in the affluent nations towards humane and environmentally sustainable societies as proposed in this chapter are available at no *real net cost*. If people prefer to have no more than two children, it makes no sense to ascribe a real human *cost* to this essential ecological *benefit*. Similarly, if people at a certain affluence level prefer more relaxed work condition over more material consumption, a degrowth economy can give them more of what they really want, again at no real *cost* and with *benefit to* the environment and quality of life. And if technological development is directed towards longevity and eco-efficiency in general, it is possible to provide decent and comfortable lives to all humans and preserve or even enhance natural ecosystems.

References

C. Aall, Energy use and leisure consumption in Norway: an analysis and reduction strategy. J. Sustain. Tourism **19**(6), 729–745 (2011)

B. Alcott, Jevons' paradox. Ecol. Econ. **54**(1), 9–21 (2005)

B. Alcott, The sufficiency strategy: Would rich-world frugality lower environmental impact? Ecol. Econ. **64**(4), 770–786 (2008)

B. Alcott, Impact caps: Why population, affluence and technology strategies should be abandoned. J. Clean. Prod. **18**(6), 552–560 (2010)

V. Asara, I. Otero, F. Demaria, E. Corbera, Socially sustainable degrowth as a social-ecological transformation: repoliticizing sustainability. Sustain. Sci. **10**(3), 376–384 (2015)

G. Cross, *Time and money. The making of consumer culture* (Routledge, London/New York, 1993)

G.C. Daily, A.H. Ehrlich, P.R. Ehrlich, Optimal population size. Popul. Environ. **15**(6), 469–475 (1994)

H. Daly (ed.), *Towards a Steady State Economy* (Freeman, San Fransisco, CA, 1973)

H.E. Daly, Uneconomic growth in theory and in fact. FEASTA review 1—The First Annual Feasta Lecture. Trinity College, Dublin 26th April, 1999. Downloaded September 2015 from http://www.feasta.org/documents/feastareview/daly1.pdf, (1999)

Danish Energy Agency, *Energy Saving Policies* (Danish Energy Agency, Copenhagen, 2004)

Danish Energy Agency, Energy Statistics 2013. (Danish Energy Agency, Copenhagen, 2015)

F. Demaria, F. Schneider, F. Sekulova, J. Martinez-Alier, What is degrowth? From an activist slogan to a social movement. Environ. Values **22**(2), 191–215 (2013)

M. Desveaux, Towards sustainable and optimal populations. http://populationmatters.org/resources/articles-reports-papers/population/. Population Matters. (Station Road, London E4 6AG, UK, 2008), pp. 135–137

R. Dietz, D. O'Neill, *Enough is Enough. Building a Sustainable Economy in a World of Finite Resources* (Routledge, Oxon, 2013)

P. Ehrlich, J.P. Holdren, Impact of population growth. Science (New Series), **171**(3977), 1212–1217 (1971)

J. Goldemberg, ThB Johansson, A.K.N. Reddy, R. Williams, Basic needs and much more with one kilowatt per capita. Ambio **14**(4–5), 190–200 (1985)

E. Goldsmith, R. Allen, A Blueprint for Survival. *Ecologist* **2**(1) (1972)

M.J. Gordon, J.S. Rosenthal, Capitalism's growth imperative. Camb. J. Econ. **27**(1), 25–48 (2003)

A. Gorz, *Les Chemins du Paradis. L'agonie.du Capital* (Edition Galilée, Paris, 1983)

P. Griethuysen, Why are we growth-addicted? The hard way towards de-growth in the involutionary western development path. J. Clean. Prod. **18**(6), 590–595 (2010)

M.A. Hajer, *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process* (Clarendon Press, Oxford, 1995)

D. Harvey, *The Enigma of Capital: And the Crisis of Capitalism* (Profile Books Ltd, London, 2010)
A. Hayden, Sharing the Work, Sparing the Planet. Work time, Consumption and Ecology. (Zed Books, New York, 2000)
R. Hirsch, *Social Limits to Growth* (Routledge, London, 1976)
J. Huber, *Die Regenbogengesellschaft: Ökologie und Sozialpolitik. Frankfurt am Main* (S. Fischer, Germany, 1985)
B.K. Hunnicutt, *Work without end. Abandoning shorter hours for the right to work* (Temple University Press, Philadelphia, USA, 1988)
IPCC, in Core Writing Team, R.K. Pachauri, L.A. Meyer *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, Geneva, Switzerland, 2014)
T. Jackson, *Prosperity Without Growth: Economics for a Finite Planet* (Earth Scan, London, 2009)
C. Kerschner, Economic de-growth vs. steady-state economy. J. Clean. Prod. **18**(6), 544–551 (2010)
R. Kingholz, K. Töpfer, Das Trilemma des Wachstum. Discussion Papers. Berlin Institut für Bevölkerung und Entwicklung. (www.berlin-institut.org, 2012)
S. Latouche, *Farewell to Growth* (Polity Press, Cambridge, 2009)
M. Lietaert, Cohousing's relevance to de-growth theories. J. Clean. Prod. **18**(6), 576–580 (2010)
A. Lovins, *Soft Energy Paths. Towards a Durable Peace* (Penguin Books, London, 1977)
O.D. Lütken, Undersøgninger angaaende Statens almindelige Oekonomie (Investigations Concerning the State's general Economy). (Sorøe, Denmark 1760)
T.R. Malthus, An essay on the principles of population (orig. publ. 1798). (Oxford University Press, UK, 2008)
J. Martinez-Alier, Social metabolism, ecological distribution conflicts and languages of valuation. Capitalism Nat. Socialism **20**(1), 58–87 (2009)
J. Martinez-Alier, U. Pascual, F. Vivien, E. Zaccai, Sustainable de-growth: mapping the context, criticisms and future prospects of an emergent paradigm. Ecol. Econ. **69**(9), 1741–1747 (2010)
D.H. Meadows, D.L. Meadows, J. Randers, W.W. Behrens III, *The Limits to Growth* (Universe Books, New York, 1972)
P. Næss, N. Vogel, Sustainable urban development and the multi-level transition perspective. Environ. Innovation Societal Transit. **4**, 36–50 (2012)
D. Nicholson-Lord, The silence of the greens. Resurgence. 251, November/December (2008)
J.S. Nørgård, *Husholdninger og energi (Households and energy)* (Polyteknisk Forlag, Lyngby, Denmark, 1979a)
J.S. Nørgård, Improved efficiency in domestic electricity use. Energy Policy **7**(1), 43–56 (1979b)
J.S. Nørgård, Consumer efficiency in conflict with GDP growth. Ecol. Econ. **57**(1), 15–29 (2006)
J.S. Nørgård, in *Avoiding rebound through a steady state economy*, ed. by H. Herring, S. Sorrell. Energy Efficiency and Sustainable Consumption. The Rebound Effect. (Palgrave Macmillan, UK, 2009)) pp. 204–223 (Chapter 10)
OECD, *Indicators to Measure Decoupling of Environmental Pressure from Economic Growth* (OECD, Paris, 2002)
OECD, *Towards Green Growth. A Summary for Policy Makers* (OECD, Paris, 2011)
R.J. Samuelson, The afflictions of affluence. Newsweek **204** (2004)
C. Sanne, Dealing with environmental savings in a dynamic economy. Energy Policy **28**(6–7), 487–495 (2000)
F.B. Schmidt-Bleek, The story of factor 10 and MIPS. (Factor 10 Institute, Carnoules, Provence, 2001)
F. Schneider, Macroscopic rebound effects as argument for economic degrowth, in *Proceedings of the First Degrowth Conference for Ecological Sustainability and Social Equity*. (Paris, 2008)
J.B. Schor, *The Overworked American. The Unexpected Decline of Leisure* (Basic Books, USA, 1991)
J.B. Schor, Sustainable consumption and worktime reduction. J. Ind. Ecol. **9**(1–2), 37–50 (2005)

E.F. Schumacher, *Small is Beautiful. Economics as if People Mattered* (Blond and Briggs, London, 1973)
G. Slade, Made to Break. Technology and Obsolescence in America. (Harvard University Press, Cambridge, Massachusetts, USA, 2006)
G. Spaargaren, A.P.J. Mol, Sociology, environment, and modernity: ecological modernization as a theory of social change. Soc. Nat. Res. **5**(4), 323–344 (1992)
W. Steffen et al., Planetary boundaries: guiding human development on a changing planet. Science 347(6223) (2015)
P. Tapio, Towards a theory of decoupling: degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001. Transp. Policy **12**(2), 137–151 (2005)
The Population Division of the UNs Secretariat, United nations world population projections to 2150. Population and Dev. Rev. 24(1), 183–189 (1998). Population Council. http://www.jstor.org/stable/2808146
E. von Weizsäcker, A.B. Lovins, H. Lovins, *Factor Four: Doubling Wealth, Halving Resource Use* (A Report to the Club of Rome. London, Earthscan, 1998)
Webster, *Webster's New World Dictionary of American English. Third*, College edn. (Prentice Hall, New York, 1986)
R. Wilkinson, K. Pickett, *The Spirit Level. Why Equality Is Better for Everyone* (Penquin Books, London, 2010)
World Commission on Environment and Development, Our common future. (Oxford University Press, Oxford, 1987)
WWF, Living Planet Report 2014. (WWF, Gland, www.factor10-institute.org, 2014)
J. Xue, *Economic Growth and Sustainable Housing: An Uneasy Relationship* (Routledge, London, 2014)