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TRANSITION TO A NEW SOCIETY – RESOURCE EFFICIENCY PERSPECTIVE

Abstract: Sustainability is a building block of a new development paradigm. Many aspects of a new society: political, social, economic, ecological, etc. assume sustainable development and better natural resources management. Developing resource efficient technologies and products became a global challenge. However, according to the Javon's paradox, that process has counter-intuitive effects and creates new problems concerning resource usage. This intriguing fact challenges researchers to explore net effect of this techno driven phenomena of resource valuation.

Along with conceptual frameworks for and technological impact on resource usage, very important issue in the context of transition to a new i. e. resource efficient society is the concept of circular economy. Apart from its great contribution to the resource preservation, its implementation has shown a lot of difficulties which need to be elaborated in the context of a new economic and societal vision of the future society.

Key words: *sustainable development, circular economy, resource efficiency*

INTRODUCTION

Traditional approach to resources was based on the understanding that after the process of economic use of resources has started, resources cease being resources and become economic goods that have new value. However, taking into account the life cycle of the product and technological processes used to get the final products, it is clear that this approach to defining the notion of resource is not comprehensive enough and therefore not accurate either. Even after the expiry of the life cycle of a product there is a significant potential for generating new value. And that is where we come to the key observation related to the perception of the resource potential – rethinking and reassessing the values we discover that material or energy contained in the used product can be returned in the process of economic valuation frequently even several times. This transition in perception was caused by excessive

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use of natural resources, enormous increase in the global population and a serious threat to the environment that developed as a consequence of the pressure created by the scope and pace of the contemporary economic growth and development.

There are different classifications of resources, depending on the selected criteria used in the classification. These criteria can be natural, economic and combined. Figure 1 presents different forms of natural resources, where the classification is done on the basis of the criterion of their renewability [1].

Permanent resources (continuous or inexhaustible) are always available, regardless of the form of human activity exerted on them. Their characteristics are permanence, or inexhaustibility and that is why they pose the greatest challenge for exploitation.

Renewable resources have the power of regeneration, under the condition that the intensity of their regeneration is not jeopardized by the scope of their use. Therefore, the use of these resources can be limited in time, in spite of their renewability. This classification is only conditional since it is not possible to draw clear lines between renewable and non-renewable resources.

Non-renewable resources exist in a limited quantity in nature. Their basic feature is a long process of geological formation, and therefore, from the aspect of foreseeable future, their regeneration is not considered possible. Therefore, this type of resources poses the greatest challenge for long-term resource management and their protection.

Renewable and non-renewable resources are, each in their own way, limited: renewable resources are limited due to the mismatch of the rate of their regeneration and the rate of their use, while non-renewable resources are limited in their quantity and quality.

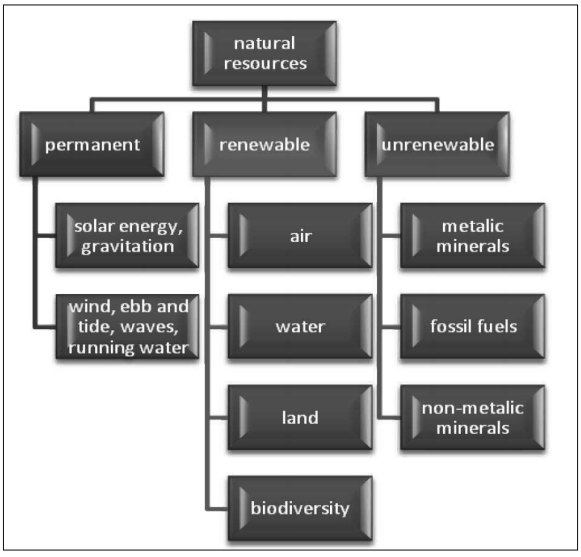

Figure 1. Classification of natural resources

The basic feature of resources is their scarcity. It is frequently interpreted in its most narrow meaning – in terms of physical availability of resources. However, scarcity does not refer only to the limited physical availability of the materials. It has a geo-political dimension (trade barriers can hinder trade in materials) and economic dimension (limitations in the supply chain, problems in the distribution or problems related to the imperfections of the market). Scarcity also refers to the quality of resources, in terms of their substantial structure or energy contents, which increases or reduces the potential benefits of the resources. Qualitative dimension of the resources can be observed also from the aspect of environmental or social circumstances (for example, the level of air pollution or the level of soil fertility).

In the article that focuses on the typology of resource scarcity, J. Bell and a group of authors [2] warn that the impact of the reduced renewability and increased scarcity of resources on the supply chain is such that managers find it difficult to ignore. Although technology and substitution undoubtedly reduced i. e. postponed scarcity of natural resources in the past, the pressures that come from use and degradation of resource base lead to the situation where most of the natural resources are losing the status of renewable and getting the status or non-renewable resources, as well as that they move from the category of available to the category of scarce resources (Figure 2).

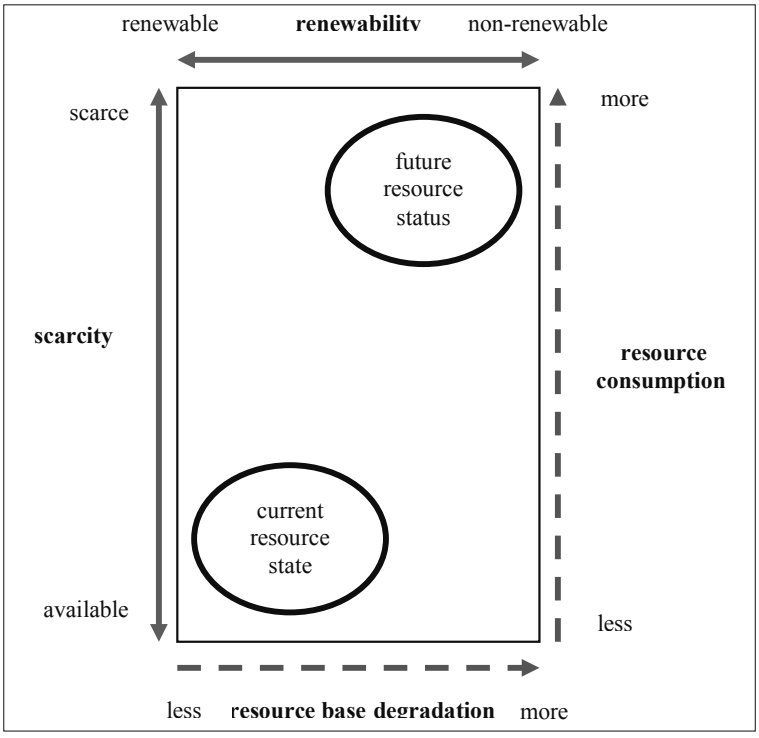

Figure 2. Natural resource scarcity typology

Janez Potočnik, European Commissioner for Environment Protection, offers an explanation of the fact that we still use resources in an inefficient manner: "The reason is the fact that we are closed into systems, infrastructures, policies and habits that were created for the days when resources and eco-systems were not so vulnerable." [3] Potočnik indicated to the importance of the efficient use or resources by saying: "Do not misunderstand resource efficiency. It is not about our resources lasting longer – that would significantly reduce the level of the necessary changes, which would only mean postponing the inevitable. It is about the need to make the use of resources sustainable, so that we can stay within the limits of the planet Earth in the long run." [3]

As stated in the document *The Awake Consumption Guide* resource efficiency is about the use of resources in a sustainable way – produce more with less input and the lowest possible impact on the environment [4]. Using the jargon of economy, we can say that efficiency in the use of resources means the economic use of resources, and respect for natural and social environment where the use is taking place.

But can we achieve efficient or productive use of resources only by technological change? Jevon's paradox is a counterintuitive evidence that as technology progresses, the increase in efficiency with which a resource is used tends to increase the rate of consumption of that resource. This paradox argue that improving resource use typically reduces costs of resource use and thereby increased rather than decreased its usage. So, what we gain on relative scale, we lose on absolute scale. As Joseph Tainter noted: "This implies that it is very naive to expect that technical improvement in efficiency will lead "per se" to lower consumption of energy. The truth is that sustainability is not a technical issue, but a cultural one." [5]

1. GLOBAL AND EU VISION OF A RESOURCE EFFICIENT SOCIETY

Resources include everything that is input for economy: metals, minerals, fuels, fish, timber, water, agricultural land, clean air, biomass, biodiversity, space and sea. Resource efficiency is a synonym for resource productivity, which assumes resources are used with respect to their natural limits (sustainability), minimizing of the impact that using one resource has on the environment.

At the global level, i. e. in the processes that take place within the system of the United Nations, more attention is dedicated to the concept of green economy (and sustainable consumption and production) while European policies, particularly recently, are more dedicated to the concept of resource efficiency.

UN conference Rio + 20 adopted the document *The Future We Want* [6] which recognizes the importance of the efficient use of resources as one of the ways to achieve transition to green economy and to ensure sustainable development. The UN members recognized the importance of adopting a life-cycle approach and of further development and implementation of policies for resource efficiency and environmentally sound waste management. They commit to improve waste management in accordance to the 3 R principle as well as to increase energy recovery from waste.

Table 1. Synergies to be used and compromises to be achieved in the policies for resource efficient Europe

Synergies	Choices/compromises (in case of competing priorities)
– implementation of measures in the areas of climate change and energy efficiency can improve energy security, – taxes and subsidies for using energy or other resources can bring to changes in behaviour and to more efficient consumption, but they can also contribute to the reduction of taxes on labour, which can encourage generation of new jobs and economic growth, – the growing level of recycling reduces demand for primary raw materials, helps to reuse valuable materials and to reduce energy consumption and GHG emissions – improvement of product design can reduce demand for energy and raw materials and make the products more durable and easier for recycling; the improved design also stimulates innovations, create business opportunities and new jobs.	– using "green" vehicles reduces the use of fossil fuels but increases demand for electricity and rare/limited raw materials, – land that is used for food production can present "competition" to the land used for energy purposes, and they both can present competition to the land used to support biodiversity or to provide ecosystem services, – materials for improving insulation can significantly reduce the amount of energy necessary for heating the buildings but their production can be more energy-intensive, – desalination can be a solution to the problem of water supply but it can also increase the consumption of fossil fuels and GHG emission,

Recently published *High Level Panel (HLP) Report* [7] recognizes that global community faces the growing challenge of scarcity of resources and underlines the need for more sustainable and more efficient production. HLP's set of post-2015 development goals includes sustainable management of natural resources, taking into account their value and value of biodiversity. According to the Report standard measure of progress used by the countries is the Gross Domestic Product (GDP), while on the level of a company it is the profit. These measures do not include the value of natural resources. Exploitation of natural resources (depletion of the resource basis) or generation of pollution are simply not presented within the measures of economic progress, although it is absolutely clear that growth and welfare are closely related with them.

Vision of a resource efficient society is also embodied into the key determinants of EU policies. The Strategy *Europe 2020* [8] presents the basis for achieving smart growth (with more effective investments in education, research and development), sustainable growth (shift towards the low carbon emission economy) and inclusive growth (generating new jobs and poverty reduction). One of the seven Key Initiatives of this Strategy is *A Resource-Efficient Europe* [9]. Development of a re-

source-efficient Europe requires a mix of policies that will use synergies and make adequate choices (achieve compromises) in case of competing priorities in various areas. Examples of policies that function in synergy, i. e. policies where compromises should be achieved (as identified in the document *A Resource-Efficient Europe*) are presented in the Table 1.

Roadmap to the Resource-Efficient Europe [10] elaborates strategic issues identified in the Key Initiative and the need to transform economy focusing on the natural capital and ecosystem services, key sectors, and the way to conduct the process of transformation and monitoring. The document gives an outline of the structural and technological changes needed by 2050 and contains targets and benchmarks/indicators that should be achieved by 2020. Here is the vision defined in the EU Road Map: "By 2050 the EU's economy has grown in a way that respects resource constraints and planetary boundaries, thus contributing to global economic transformation. Our economy is competitive, inclusive and provides a high standard of living with much lower environmental impacts. All resources are sustainably managed, from raw materials to energy, water, air, land and soil. Climate change milestones have been reached, while biodiversity and the ecosystem services it underpins have been protected, valued and sustainably restored."

2. FROM LINEAR TO CIRCULAR ECONOMY – A PATHWAY TO A NEW SOCIETY

Efficient resource management is the basis of the concept of circular economy that is offered as an adequate response to development challenges of the modern world. It is therefore necessary to learn about the principles of this concept and to indicate to the basic directions and concrete activities that have to be undertaken in order to understand this concept and to accept it as the basis of the future sustainable socio-economic development.

The report of the Rome Club *Limits to Growth* [11] published in 1972 seriously drew global attention to the problem of impact of economic activity to natural and social environment. That document and its subsequent supplements clearly stated that development paths of the use of resources, economic activity and social welfare have to start diverging, and particularly that these three paths should all have inverse divergence in relation to environment pollution. These types of divergence are known as the process of decoupling of impacts.

The report *Unleashing the Power of the Circular Economy* [12] prepared by IMSA Amsterdam analyses three forms of decoupling of impacts (Figure 3).

Generally speaking, there are two ways to implement the processes of decoupling of impacts:

1. to guide economic activity, both national and on the global level, to lower use of natural resources with the simultaneous reduction of negative impacts on the environment;

2. to introduce concepts competitive to the concept of gross domestic product – these are the concepts that quantify economic activity not only through mone-

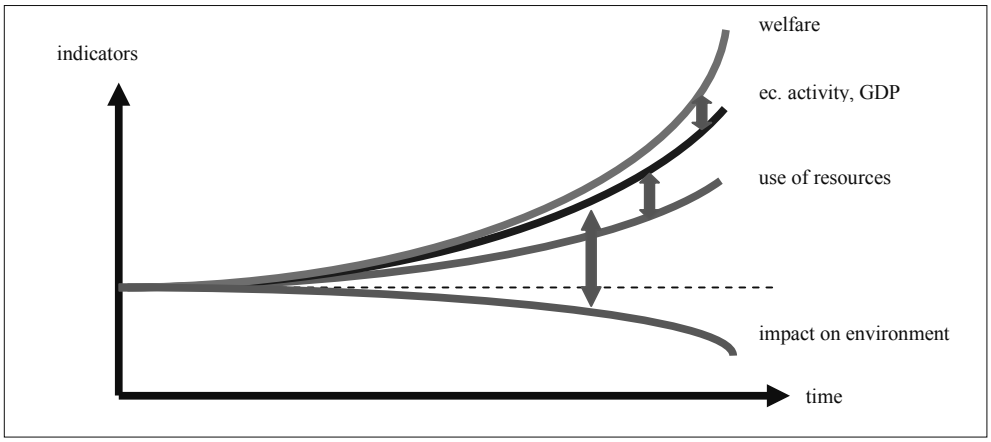

Figure 3. Stylized presentation of decoupling of impacts

tary measurements, but also through alternative measurements and the concepts that will ensure decoupling of the impact of economic growth on the social welfare.

Concept of circular economy, in its broadest sense, is the replica of a functional optimisation of the flow of matter and energy that is characteristic for the nature, i. e. for living organisms. [13] In the foundations of this concept lies a holistic approach, i. e. the need to reflect on the problem of the organization of economic activity in a broader context, with the intention to optimize the overall system man-nature-society, and not only its individual elements.

From today's perspective it is clear that global economy follows a linear pattern of production and consumption: resources are used for production; production results in products; after their life cycle the products become waste and as such are disposed in the environment. This model, known as *take-make-dispose* model is presented in the Figure 4.

This simple pattern of organizing economic activity has shown to have great power in generating new value and reducing poverty, but it reached its limits in the conditions of enormous depreciation of natural resources. David Palmer-Jones, the chairman of the *Environmental Services Association* (ESA), stated: "Linear economy simply cannot ensure growth which could sustain the growing living standard of the global fast-growing population".

Figure 4. Traditional (linear) model of economic activity

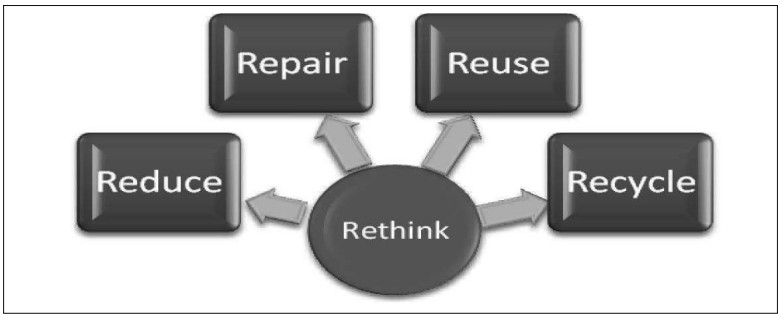

Figure 5: 4R approach to treating waste

Traditional linear approach to industrial production proved to be unsustainable in the following aspects:

– relying on the current availability of resources, without taking into account the problem of their future scarcity;
– price instability and market oscillations;
– environment pollution on the local and on the global level.

That is why it proved to be necessary to transform the linear model of economic activity into the circular one, on the basis of the 4R approach (Figure 5).

The effects of circular economy for the environment, economy and human beings pay out in the long run and undoubtedly lead to a higher sustainability level in the future. Figure 6 presents the multiple positive impacts of the implementation of the concept of circular economy.

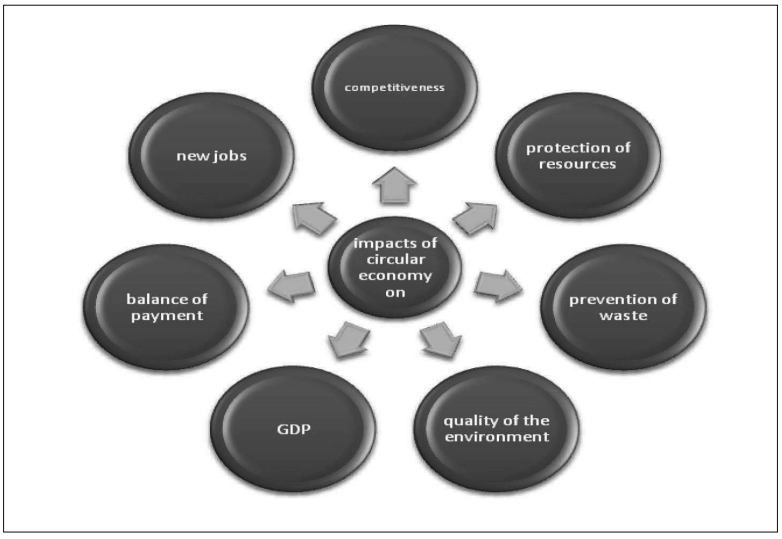

Figure 6: Different impacts of circular economy

The experience that various countries have had so far in the implementation of the concept of circular economy can in a nutshell be presented by the following problems and obstacles that most of the countries had to face:

- *Incoherent concept.* As some scholars rightly say, there is still no unified opinion on what the circular economy actually is and how it can actually be achieved [14]. It is believed that development of the concept of circular economy and its basic elements that would be understandable to everyone in the same way would help to more general acceptance of the concept, which would, in its turn, encourage cooperation and prevent confusion [15].
- *Inadequate policies.* In order to see the market being efficient in putting to good use the efforts aimed at the implementation of circular economy, it is necessary to build all the externalities in the prices of resources and energy through appropriate policies. This is frequently not done and therefore the products that are not resource efficient become economically more affordable to the consumer, which leads to stronger pressure on the exhaustion of primary resources. On the other side, the high expectations for the institutions of the system do not come together with the appropriate knowledge and experience of the administration bodies, business and citizens.
- *Instable market of recycled products.* Combination of the limited demand and expensive extraction of marketable recycled products leads to the situation that the market of recycled products is more instable than the market of goods, which means high risks for the potential investors. High risks, in their nature, demand higher rates of yield, and if they cannot be achieved, then investment into managing recycled products stops being opportune.
- *Characteristics of recycled products.* Flows of waste are heterogeneous and their composition is subject to changes due to the changes in the consumption and production patterns. This can be very demanding from the point of view of management, since plants and machines are efficient within certain composition limits. The volume of waste can also be very unpredictable and it can become uncorrelated with economic performances.
- *Transition costs.* Although assessments confirm that savings made through circular economy are large on the macro-level, the costs of transition of a company from linear to circular economy can still significantly influence the increase of their operation costs. On one side, they can present a barrier to the existing businesses and, on the other, they can discourage potential investments in the infrastructure of circular economy.
- *Lack of enthusiasm in consumers.* Consumers have an extremely important role in the process of implementation of circular economy. Through their attitudes related to ecological characteristics of products and production processes they give a financial value to the efficient use or resources. The fact is that implementation of circular economy primarily presupposes a change in the awareness and development of new consumption patterns. It is also the fact that the scope of influence of technological development cannot be adequately anticipated. These two facts together lead to the conclusion that it would

not be reasonable to expect linear implementation of an inherently non-linear model, as circular economy is.

3. ARE TRENDS OUR FRIENDS?

Current analyses show that the global patterns of the use of resources, production, consumption and generation of waste are unsustainable. Total demand for resources is growing at a concerning speed due to the increase in the size of population and improvement of the standard of living. In the 20th century the size of the global population increased about 4 times, consumption of fossil fuels increased about 12 times, consumption of water 9 times; the extraction of ore and minerals 23 times and overfishing even 35 times [16]. Use of resources creates an increasingly strong pressure on the environment and results in the global warming, pollution, degradation of eco-systems and biodiversity.

According to the *Global Europe 2050* [17], in the future people will face increased energy and natural resources constraints. On a global scale oil and gas demand is growing faster than new reserves are being found. This is the reason why oil and gas became both physically and politically constrained resources. Over the next twen-

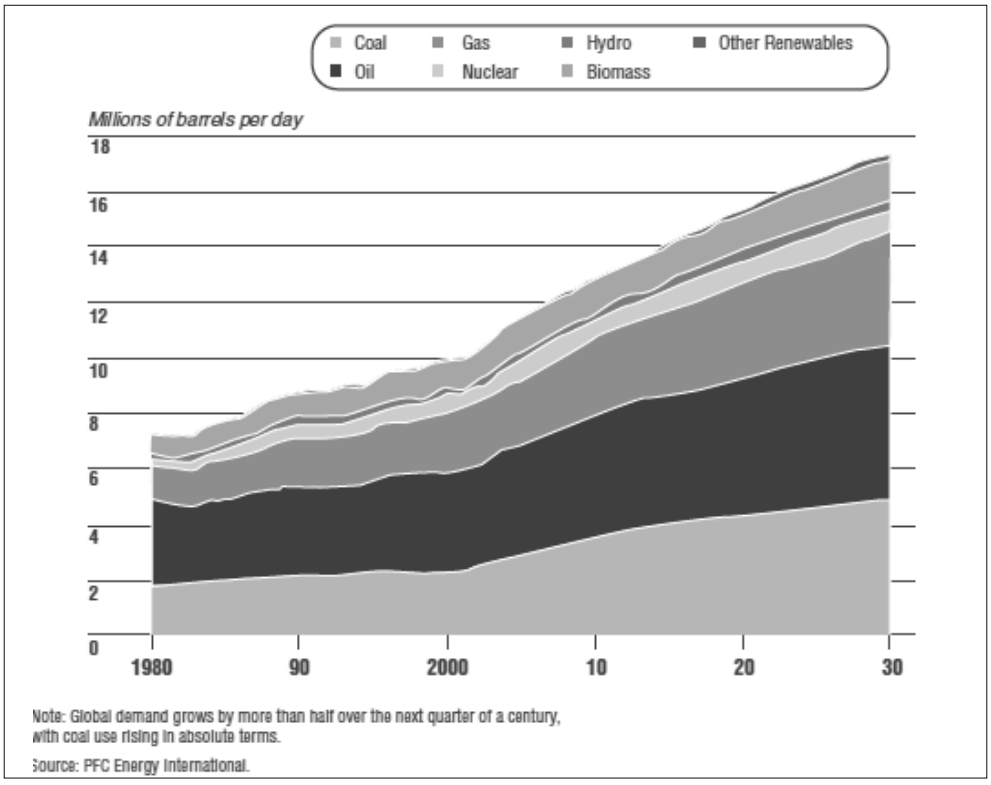

Figure 7. Breakdown of likely energy sources

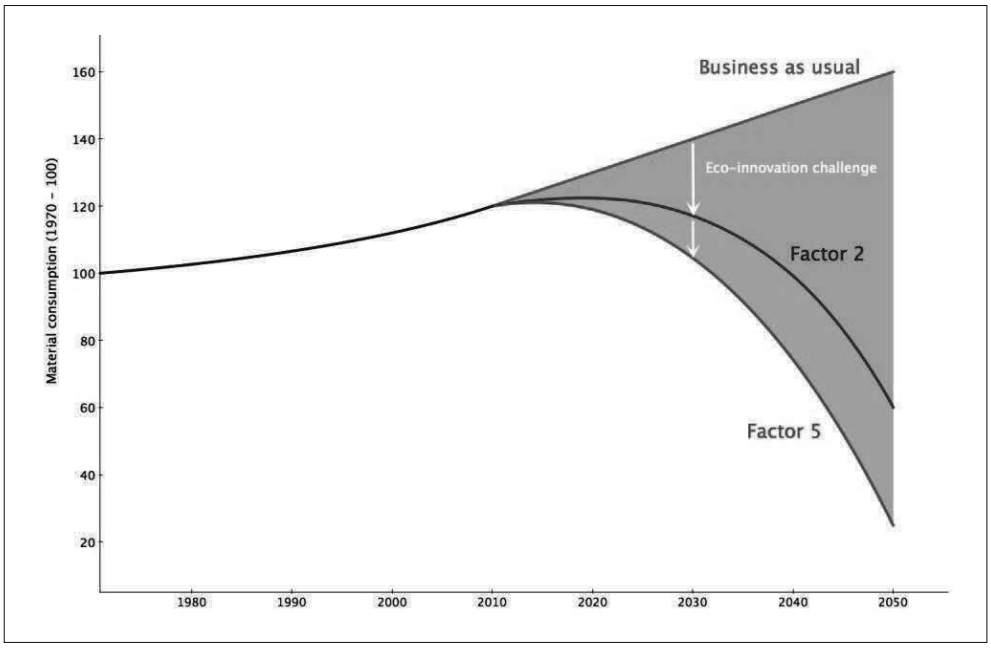

Figure 8. The "eco-innovation challenge" in future trends of natural resources use

ty years global energy demand will increase by around 40%, i. e. on average 1.5% a year. Oil will remain the largest single fuel, providing 30% of the total energy mix. Global gas supply will also increase by around 45% by 2030 to proved just over a fifth of the world energy needs. Associated to this type of energy prospect, there is a continued rise in carbon emissions. By 2020, an additional 5 billion tones will be being emitted annually, and double that by 2030. So, without a massive and fundamental global shift in energy consumption behavior, any chance of slowing CO_2 emissions is years away. *Global Trends 2025,* published by US National Intelligence Council, has the same predictions of rising global demand for energy (Figure 7).

Alongside energy, the growth in consumption of raw materials is also in rise. From now till 2030 we will consume more cooper, more aluminium, and more steel than we have in history. For example, China's demand for steel is expected to double by the 2020 s, while in India the government targets for steel production in 2020 is four times the level of 2010. Rare metals becoming increasingly important due to their use in production of advanced electronics equipment. Such a predictions of enormous economic and technological demand for use of natural resources are inevitably reflected on rising pressure on water, land, food production and biodiversity.

How can we revert such a pessimistic trends in natural resource exploitation? By setting medium and long-term targets on resource use, followed by set of appropriate indicators to measure achievements, we can significantly change the predicted trends of energy and material consumption in the future as well as patterns of natu-

ral resource flows inside economy and society. Albeit science can provide the background information for an informed political discussion, the setting of targets is a normative and political procedure, which make this process politically vulnerable. A study *Resource Efficiency in European Industry* [18] offers a brief overview of specific targets of material use, proposed by leading thinkers, such as von Weizsäcker et al. 1997, 2009; Schmidt-Bleek et al. 1993; Ekins et al. 2009; Bringezu 2011). Proposals include e. g. a Factor 4, or a doubling of income while reducing material consumption by 50% (von Weizsäcker et al. 1997); a Factor 5, i. e. an 80% increase in resource productivity (von Weizsäcker et al. 2009); a Factor 10, or a ten-fold reduction in material consumption in industrialised countries (Schmidt-Bleek et al. 1993)

Figure 8 visualizes Factor 2 to Factor 5 targets for resource consumption. The "eco-innovation challenge" is depicted as the difference between business-as-usual and achieving targets. This implies a combination of innovations improving resource efficiency in companies, across material value chains and in the consumption behaviors of consumers, as well as greater transformative change toward resource efficiency at the systems level.

CONCLUSION

There are several conclusions we can draw from elaborating a transition to a new society from a resource efficiency standpoint:

- GDP is not adequate measure of economic development since it ignores environmental issues.
- When considering non-renewable resources we need to take into account their quantity and quality which both refer to the concept of resource scarcity.
- Environment and environmentality – we need to put more stress to cultural issues.
- Psychology – transition in perception (there is no "outer space", cities as urban mines, waste equals profit, etc.).
- Technological change alone cannot protect resource devastation (Javon's paradox).
- Total demand for natural resources is fast growing process and global society is facing more and more ecological overshooting.
- The concept of circular economy could be appropriate response to resource depletion and to development challenges of the modern world.

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