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# The Green Development as a New Sustainability Model – Advantages and Critical Issues of Resource Management and Environmental Protection

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## Abstract

The ongoing transformation of global prospects for the future of humanity is burdened with a number of uncertainties that apply to Hungary as well. The challenge is to identify factors influencing the future, to examine and analyze the driving forces behind international trends and their consequences in Hungary. On the one hand this paper provides a brief overview of the literature dealing with green economy focusing on its background and terminology, the possibilities of measuring green growth and the current situation of green economy. On the other hand, the study seeks to answer the following questions: how to observe the signs of the present and future implementation of the green economy in Hungary; how rotating economy represents and alternative in the transition towards sustainability; what are the benefits and risks of resource management in the new sustainability model; what social, economic and environmental challenges are expected in the green development of various scenarios in the coming decades, and what are the most prominent security issues?

The above questions are answered with the help of research conducted by the author, statistical data analysis, national and international scientific literature. Because the problem is extremely complex, the study, without intending to be exhaustive, focuses on issues that are more prominent in the future.

*Keywords:* green economy, circular economy, performance of green growth, sustainability, risk, benefit

## Green economy: concept and characteristics

A wide variety of definitions have been worked out for the term “green economy” since 1995, however, none of them has gained universal acceptance yet. The concept got to be increasingly widely adopted in the wake of the financial and economic crisis that hit the world in 2008, as a solution that may be a way out of the crisis, under the aegis of which the UN

can assist and support countries in a more consistently harmonized way (EMG/SOM.15/02). The transition towards green economy is also promoted and assisted by the World Bank and the OECD. It is referred to by Opschoor (1995) as a sustainability model, while the UNEP (*United Nations Environment Programme*) identifies it with zero $CO_2$ emission and the coverage of the total energy requirement from renewable sources. Sach (2010) argues that it is nothing like a free lunch, but it is a lot better and cheaper than doing nothing and watching the environment being destroyed. The achievements of green economy contribute to human welfare and social equity, while environmental risks and ecological scarcity are decreasing considerably (Burkart, 2009). A green economy is environmentally sustainable, socially equitable and promotes economic, environmental and social welfare (Bapna–Talberth, 2011; Danaher, 2012). Gouvea et al. (2012) claim that green economy is the appearance of green resources, green competitiveness and green products in the global economy where green entrepreneurs and green jobs create a $CO_2$-neutral economy. Carfì and Schilirò (2012) worked out a green model links it with the climate change policy because it involves low $CO_2$-emission technologies involving competitive *win-win* solutions. Fedrigo (2012) proposed a schematic model in which a transition is required first towards a green economy by removing the unsustainable trading system from the conventional business model (BAU) and an active environmental management is exercised, involving risk analysis and proactive natural capital investment. Eco-efficient solutions may enable environmental sustainability and, by resorting to innovation and changing demands a radical *decoupling* may be achieved, together with an acceptable green economy, where the economy's use of resources is accompanied by decreasing environmental impacts. Innovation has a key role to play in such transition, with a positive impact on job creation as well.

The relatively new and increasingly fashionable concept of circular economy lays emphasis on waste management, waste prevention and resource-efficiency; but is not the same as what is referred to as green economy. It is characterized by closing processes instead of the continued application of open circuit models; it reduces environmental pollution by recovering valuable materials from waste, by reuse or recycling of products, saving materials and resources at the same time. In addition to the above, green economy also focuses on well-being and on the protection of the ecosystem (EEA, 2015). At present the Union's green economy facilitating programmes support the efficiency use of resources, along with eco-efficiency, sustainable production and consumption, up-to-date waste management, waste prevention and the management of aquatic resources.

## Green economy after of Rio+20

Particular emphasis was laid on expectations concerning the green economy during the preparations for the Rio+20 conference. It was envisaged as practically the only solution, promising certain success, for a way out of the crisis, provided that a global governance can be developed on the basis of a global consensus, under the aegis of a green global economy, which will also enable progress towards the sustainability goals (Biermann et al., 2012). By 2012 it was clear that despite progress having been made, the objectives that had been set beforehand, could not be achieved. The conference revealed a deepening antagonism between the interests of the North and the South and no consensus was reached. No matter

how the priority topics of the conference included sustainability and green economy, energy, sustainable cities, food safety, agriculture, natural waters and oceans; no compromise could be reached in terms of truly critical issues. Consequently, the conference was closed without a breakthrough; indeed, one may safely say that it was a venue of yet another failure. It was expressed in the closing document that the post-2015 goals and the available instruments towards them should be reconsidered once again. It was confirmed that the achievement of sustainability could be promoted through the 17 sustainable development goals and the further 169 targets if adequate political will exists. The 17 sustainable development goals are as follows:

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. Reduce income inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.[1]

"The green economy has become one of the most important strategic concepts, which is considered to play a just as important role in the accomplishment of sustainable development, as being a possible alternative for a way out of the neoliberal economic crisis. The very essence of green growth is that it can ensure development and competitiveness, while at the same time it enables the retaining and future use of resources and preserving the

[1] www.unis.unvienna.org/unis/hu/topics/sustainable_development_goals.html

environment's biocapacity. All these are achieved with the help of new sources of growth where the improvement of productivity is provided for by efficient resource utilization, the potentials lying in innovation are exploited and, by selling green products and technologies new markets are conquered, strengthening confidence and stability" (Tóthné Szita, 2013: 3.). At the same time, the equivalence of green economy with sustainability is called into question by many, because green economy focuses solely on the economic benefits and does not deal with preserving biocapacity and well-being, even if the three pillars underlying sustainability continue to be relied on.

The benefits of the green economy appear primarily at a micro and a mezzo (sectoral) level, while the macro-economic aspects of the transition into a green economy are also important, but much less extensively discussed. At a macro level there are four specific fields that need to be discussed in particular, where impacts may be encountered. On the other hand the *impacts* of today's decisions on the *welfare of the future generation*, on the other hand, the impact generated by aggregated demand and supply appearing as a consequence of *environmental investments*, together with its advantages and contradictions. Thirdly, there is the future macro-economic impact of *structural changes in production and consumption.* Finally, the impacts stemming from debates pertaining to the financing of the green economy, concerning the extent and scope of support to be given to the developing world's green transition (Ocampo, 2013).

The question is, if green economy has so many advantages and benefits, whether it is possible to pinpoint a particular country whose practices in the development of a green economy are definitely worth following. Is it possible to build up a green global economy, or is it just a dream? Approaching the issue from multiple angles may help finding an answer to the question.

One may start by analyzing statistics on green growth in the global economy, for example by the calculation based on the IPAT formula worked out by Chertow (2001), where impact = population x affluence (consumption/capita) x technology (impact/consumption). Seri's world atlas may also be used (Seri, 2012). Global environmental pollution has increased, the total global population has exceeded 7 billion and ecosystem services have been diminishing. By 2050 the total population of the world will be over 9 billion and ecosystem services will continue to shrink. The total global material use has doubled during the past 30 years. Mankind is still increasingly dependent on non-renewable materials (including fossil fuels, metals and minerals). The world's equilibrium has been upset: more than three quarters of the total global resource use is accounted for by 18 countries, while the 100 least consuming countries use a mere 1.5%. An average Austrian citizen consumes 10.2 tonnes of resources each year, while the corresponding figure is significantly lower in most other countries. Man has never traded so much in resources at a global level as today, and Europe will have to compete increasingly fiercely for raw materials in the future (including, primarily, fossil fuels and metals). Europe's high living standards are enabled by raw materials brought in from other continents, with all of its negative impacts on the regions concerned. Among the global regions Europe depends most heavily upon resource imports (Seri, 2012). The current state of developments – particularly: urban development – all over the world is anything but promising, as it moving not in a direction towards sustainable planning. Consumption is not diminishing at a satisfactory rate either. If the goal is to

achieve zero emission through changing consumption, the amount of resources used must be reduced first, and it must be accompanied by efficiency improvements (Jackson, 2013).

Green economy development programmes are to be found all over the world, including the European Union and Hungary. The Union promotes green economy objectives, however, implementation requires a thorough revision of the entire system of its economy because no long term goals can be accomplished by efficiency improvements alone (EEA, 2014). It is true that major progress has been made since 1990 in cutting $CO_2$-emissions and reducing the consumption of fossil and other resources, the waste output has decreased and the ratio of recovery has increased, however, in absolute terms the amounts of resources used are still too large, and levels of hazardous emissions are still too high. Moreover, the Union's environmental policy goals are still not always in line with ecosystem resilience or with the aim of mitigating people's health and welfare risks. It is enough just to take a look at statistics showing the health issues caused by pollution, primarily as regards urban populations. A total of 430,000 people died in 2011 as a consequence of airborne particulate matter pollution and noise pollution, while some 10,000 deaths occur each year as a result of coronary artery disorders and stroke. For this reason, more attention need to be paid in decision making to the environmental carrying capacity and risks, uncertainties, benefits and costs must be assessed and evaluated together (EEA, 2016).

To enable structural changes required for creating a green economy environmental and climate policies must be more closely integrated and more effectively promoted for accomplishing long term goals. These provide a comprehensive framework for creating a new economic model in which focus is on energy efficiency, energy conservation and the use of renewable resources and own resources (Széchenyi 2020; UNEP, 2011).

Demand grew stronger after Rio+20 for discussing certain critical areas at international conferences where the issuing of joint position statements seems to be a more effective tool and where it is easier to reach a consensus on issues. The participants of the Budapest World Water Summit agreed that "a new approach is required to water management, social and economic matters, particularly from the aspect of health, food and energy supply. They highlighted that water management should be governed by sustainability. The sustainability development goals to be prescribed for the period after 2015 should include one or ones specifically relating to water and wastewater treatment. They also agreed that actions need to be taken to reduce water pollution and to provide for reuse, and the goal to be worked out would lay emphasis on managing, and protection against, natural disasters relating to water. A new mechanism is required, one that will facilitate cooperation among governments in matters relating to water" (WBCSD, 2014: 8.).

The sustainability goals for the next period were adopted in September 2015:

1. Eradicate extreme poverty & hunger.
2. Achieve universal primary education.
3. Promote gender equality & empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria & other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

The most important international organization promoting green economy is the one called *(Global Green Growth Institute, GGGI),*, which was established by OECD, UNEP and the World Bank on the basis of an agreement reached in Rio de Janeiro in 2012. Its founding treaty was signed by Hungary as well. The primary objective of the GGGI is to facilitate sustainable development in developing and emerging countries, including even the least well developed countries. Hungary joined the institute in 2015, and concluded an agreement on the legal standpoint concerning the institution's privileges and exemptions, as announced in Act VII of 2016.

The *(Green Growth Knowledge Platform, GGKP)* is a global network of international organizations and experts, set up by the GGGI, whose primary objectives include sharing knowledge accumulated in relation to green growth, presenting and disseminating best practices and generating new research subjects relating to how the benefits of green growth can be incorporated in business and country strategies, as well as the management of all of the knowledge and information that has been amassed in regard to green economy and green growth (GGKP, 2015). Its conferences so far have discussed topics such as green value chains, green public procurement programmes, experiences relating to green labelling, eco-towns, green growth measurement, the role of financial policy in the transformation of the green economy etc. (Pomázi, 2013). The 2016 conference focuses on the transformation of development through inclusive green growth. World Green Economy Summit (2016) was aimed at strengthening partnership involving governmental financial policy, business and civil organizations to enhance green growth's contribution to the accomplishment of the goals of sustainable development by 2030, the climate policy and the Dubai Clean Energy Strategy (2050) (GGGI, 2015).

The results of the green economy are more palpable at a micro and mezzo level – such as green universities, green towns *smart cities* and green chemical industry – but it is not possible to specify countries that are operating green economies at a national level.

## Measuring green economy performance in OECD countries and Hungary

*OECD green growth indicators*

In parallel with the adoption of the concept and endorsing the introduction of green economy the question of how green growth could be measured was also raised. Measuring the green economy means the selection of indicators and methods developed for the monitoring and assessment/evaluation of the transition to green economy. An attempt at measuring green economy was made on the basis of green growth indicators assigned to five different groups. There are further indicators within the main themes, each of which contribute to the economy's becoming increasingly green. Accordingly, the establishment of the degree of growing greener requires an extremely complex and careful analysis. Moreover, a more exact measurement of green growth necessitates joint management of the economic and environmental accounting systems, a system of national accounts expanded by the introduction of an environmental accounts *(National Accounting Matrix with Environmental Accounts, NAMEA)* (Pomázi–Szabó, 2013).

Table 1
*Green indicator groups and themes*

| | |
|---|---|
| Productivity of the economy's environmental resources | • Carbon and energy productivity,<br>• resource productivity: material, nutrient, water, multi-factor productivity. |
| The natural asset base | • Renewable stocks,<br>• non-renewable stocks,<br>• biodiversity and ecosystems. |
| The environmental dimensions of quality of life | • Environmental health and risks<br>• environmental services and amenities. |
| Economic opportunities and policy responses. | • Technology and innovation,<br>• environmental goods and services,<br>• international financial flows,<br>• prices and transfers,<br>• skills and training,<br>• regulation and management approaches. |
| Social and economic context and characteristics of growth | • Economic growth and structure, productivity and labour market, education, income, socio-demographic patterns. |

*Source:* www.oecd.org/greengrowthindicators.htm

*In regard to the productivity of the economy's environmental resources* the OECD is assessing $CO_2$- and energy productivity, resource and material efficiency and environmentally adjusted multi-factor productivity. *The natural resource* index covers changes in land use and surface cover, renewable and non-renewable stocks as well as biodiversity. *The* heading of life quality comprises people's exposure to air pollution. *The subject of economic opportunities and policy responses* involves tools and instruments facilitating green economic transformation. The indicators reflecting the *social and economic features* of *growth* appear in a separate group (OECD, 2014).

*The green index of our own development*

In the course of a research project carried out under the aegis of the Hungarian Science Research Fund (*Országos Tudományos Kutatási Alapprogram, OTKA*) we studied what is happening in the globalized world and how the green economy concept appears and what are the characteristics of its development. One question that cropped up was whether it is possible to express the position of the green economy with just one indicator. Based on the OECD's green indicators we created a *green index* (GI), with the help of which we evaluated the performance of each OECD country, and compared it to the values of the FEI index[2] – also developed by ourselves to keep tracks of changes in the future external and internal

[2] FEI: future external and internal factors determining development. The FEI index is an indicator calculated on the basis of factors of development assigned to three dimensions, such as Future, External and Internal. The calculation and values of the FEI the GI indicators are presented and discussed in detail in *Intézményi változások és fejlesztési modellek* (Institutional Changes and Development Models), a study produced as a result of the OTKA research project (Bartha et al., 2013).

potentials of the OECD countries – in order to establish the countries whose development models may be worth following in the interests of future generations.

Calculation of the green index (Tóthné Szita, 2013b; 2014):

1. The first step is the calculation of the various countries' indicator indices with the help of the minimum-maximum statistics model, using the OECD green growth indicators:

$$Ii = (Xi - X_{min})/(X_{max} - X_{min}),$$

where *Ii* is the index of the various indicators (1–n);

*Xi:* the indicator under review;

$X_{min}$*:* the minimum value of the indicator under review in the OECD countries in the given year;

$X_{min}$*:* the maximum value of the indicator under review in the OECD countries in the given year.

This step also removes dimensions at the same time and produces a ranking order of the OECD countries in terms of the indicator concerned, on a scale of zero to one.

2. Thereafter, taking the average of the various indicator indices, we arrive at the green index of each country:

$$ZI = \sum_{i=1}^{n} Ii/n$$

The green growth index of each country varies from year to year because the various indicators are changing along different development paths. The countries ranking order in terms of the indicator indices also varies from year to year, as a consequence of which the ZI ranking order also keeps changing. What is surprising is, however, that the degrees of growing greener fell short of the expectations according to the method we used. The green growth indicator of even the most vigorously "greening" country did not exceed 0.5. Nonetheless, one advantage of the method is that it enables relative comparisons across countries. The factors playing a dominant role in the development of the green index are also worth looking at.

Table 2

*The countries with the best green performance ratios in terms of the green index*

| **2005** | **2008** | **2010** | **2012** |
|---|---|---|---|
| ZI = 0.41 – 0.51 | ZI = 0.43 – 0.48 | ZI = 0.41 – 0.46 | ZI = 0.39 – 0.43 |
| Luxembourg | Netherlands | Netherlands | Austria |
| Netherlands | Norway | Korea | Korea |
| Norway | Luxembourg | Norway | Netherlands |
| Austria | Austria | Switzerland | Germany |
| Korea | Switzerland | Austria | Norway |
| Japan | Israel | Japan | Luxembourg |
| Germany | Germany | Israel | Japan |

*Source:* Own calculations, based on OECD database

Hungary's Green Indices: 0.3; 0.33; 0.315; 0.31. The best performing countries in terms of FEI and GI: Austria, Denmark, Norway, Switzerland and Sweden. These are the countries that we found to have achieved the most vigorous green development based on eco-innovation, facilitating the development of a sustainable society. These countries may therefore be regarded as setting an example to be followed in order to provide for the welfare of the coming generations. Higher green indices are calculated, of course, if an emphasis is laid on the efficiency of environmental resources or the elements of natural capital. It is also clear, however, that the dynamic of growing greener varies across countries and the various countries' "greening" ratios relative to other countries seems to stabilize after reaching a given level.

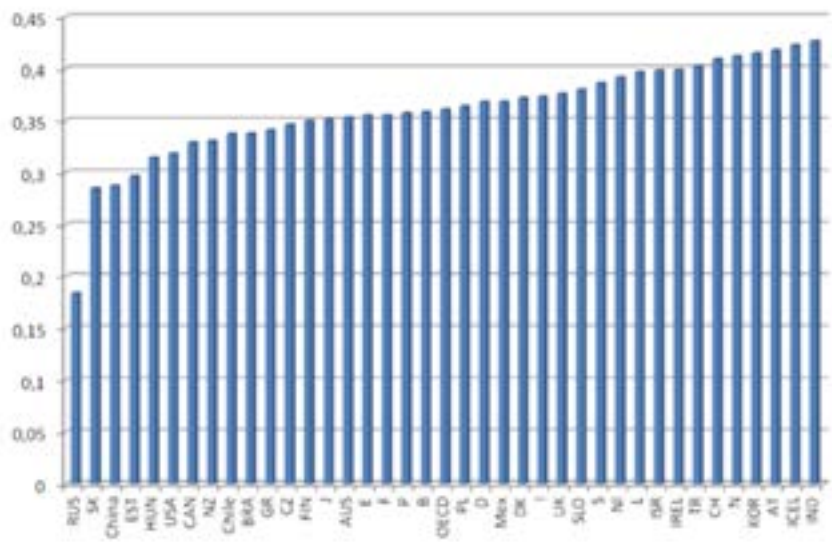


Figure 1

*Green indices of OECD and BRICS countries in 2013*

*Source:* Own chart based on OECD data

*Hungary's green performance*

Hungary has higher than average indicators among OECD countries in terms of the following indicators: in state-funded R&D expenditures in 2007 and in green patents in 2008, as well as the ratio of the patent applications submitted relative to the total number of patent applications. The composition of patents is in a significant relationship with R&D subsidies pertaining to energy efficiency and water quality improvement. Interestingly, environmental taxes in Hungary approximated 3% of GDP up to 2007. This percentage rate has decreased since then but it is still over the OECD average.

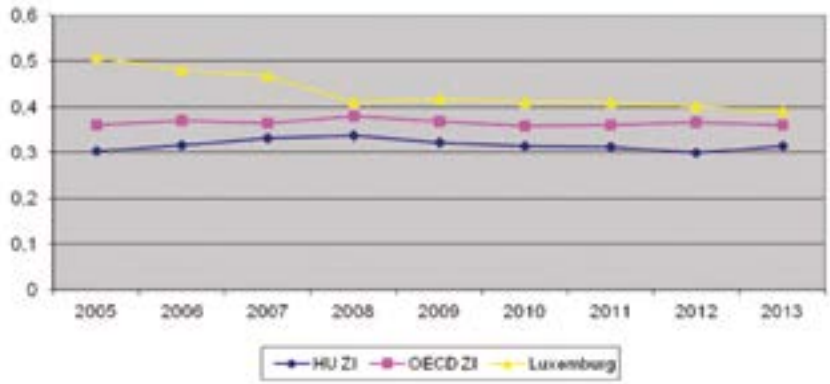


Figure 2

*Changes in the green indices of Hungary, Luxembourg and the OECD*

*Source:* Own chart, based on OECD database

Based on the changes in the green indices, a view of the values of Luxembourg, which was in the best position in 2005, those of Hungary and the OECD countries, reveals that the average green index of the OECD countries peaked in 2008, thereafter it decreased somewhat, while that of Luxembourg dropped dramatically, while Hungary's index remained more or less unchanged. At the same time, by looking at the trends in the changes of the various index elements in the various countries one can identify a gradual eco-efficiency improvement and a *decoupling* effect as well.

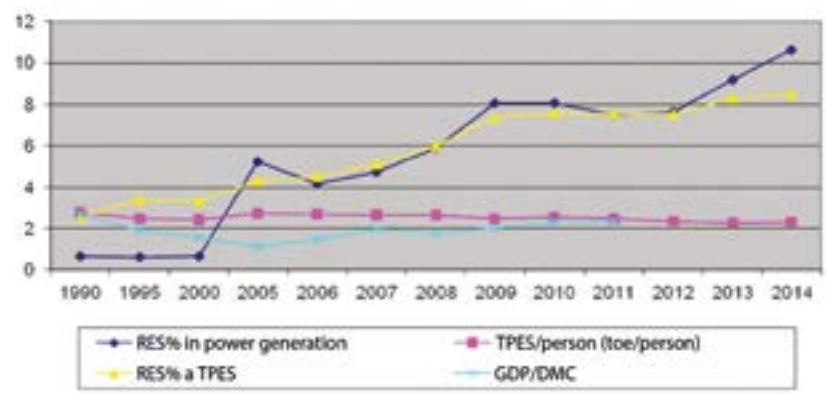


Figure 3

*Changes in some of Hungary's efficiency-related indicators*

*Source:* Own chart, based on OECD database

Resource-efficiency, direct material use and the ratio of renewable resources – playing a dominant role in becoming greener – are showing favourable changes. No such marked changes have occurred in resource-efficiency and in direct material use as in the generation of energy from renewable energy sources, the ratio of which have increased from 3% to 9% and to 11% during the past 25 years.

Green performance is also driven by such projects facilitating the greening process that are focused on towns, specific institutions or sectors. In relation to the Zöld Nyíl *(Green Arrow)* project the town of Miskolc worked out its future vision on the basis of a movement called Zöldebb Városokért *(for greener cities)* and it may become the first green model town. Miskolc has embarked on a road towards sustainability: it has had its sustainable development strategy worked out.[3] A green town is one which generates immense economic and social benefits, using nature's free services. The following basic principles need to be taken into account in the projects announced in 2016 with the aim of creating green towns TOP 2.1.2-15):

- reintegration of Hungary's settlements into their surrounding ecosystems,
- aiming at achieving sustainability,
- integration,
- interdisciplinarity.

In its green office programme launched in 2010 the University of Szeged has become Central Europe's greenest university, according to a survey carried out by an Indonesian university. It was ranked among the 20 greenest of 360 universities of the world in 2014. Five other Hungarian universities have also joined the green university programme. The University of Szeged is committed to sustainable infrastructure development and awareness raising. A geothermal cascade system has been put in place, they have created a greywater system for the secondary utilization of rainwater, their solar cell capacity exceeds 1 MW and they have put in place a unique thermal pump system for utilising waste water heat, with a 100% EU aid intensity.

*The green index in the context of other indices*

A look at the green index in the context of human development index and the ecological footprint shows that a higher green index may be accompanied by a higher ecological footprint and HDI *Human Development Index* or even by a biocapacity overrun. Nearly every one of the EU member states exceed their biocapacities, except for Sweden and Norway where there are biocapacity savings. High welfare ratios expressed in terms of the HDI results, in the majority of cases, in environmental deficits. Hungary has a HDI of 0.823 but its ecological footprint is only 2.9 global hectare per person, its biocapacity is 2.2 global hectares, i.e. even though the deficit has decreased, Hungary was still 34% beyond its biocapacity in 2012.[4]

[3] www.green-city.hu/green-city-mozgalom-elso-magyarorszagi-mintavarosa

[4] www.footprintnetwork.org/ecological_footprint_nations/; http://hdr.undp.org/en/data

Table 3
*Ecological footprint, biocapacity, HDI and GI in certain countries, in 2012*

| | Eco-footprint gha/person | Biocapacity gha/person | Deficit of biocapacity savings (gha) | HDI | Green Index (2012) |
|---|---|---|---|---|---|
| Austria | 6.1 | 3.1 | –3 | 0.884 | 0.435 |
| Belgium | 7.4 | 1.2 | –6.2 | 0.889 | 0.35 |
| Denmark | 5.5 | 4.8 | –0.7 | 0.921 | 0.379 |
| Netherlands | 5.3 | 1.2 | –4.1 | 0.92 | 0.427 |
| Poland | 4.4 | 2.1 | –2.4 | 0.838 | 0.317 |
| Luxembourg | 15.8 | 1.7 | –14.7 | 0.888 | 0.4 |
| Hungary | 2.9 | 2.2 | –0.7 | 0.823 | 0.3 |
| Germany | 5.3 | 2.3 | –3 | 0.915 | 0.413 |
| Norway | 5 | 8.2 | 3.2 | 0.942 | 0.409 |
| Switzerland | 5.8 | 1.3 | –4.5 | 0.924 | 0.369 |
| Sweden | 7.3 | 10.6 | 3.4 | 0.904 | 0.384 |

*Source:* Own edition, based on footprintnetwork, HDI and own research findings

*Global green index*

The global green index *(Global Green Economy Index, GGEI)* monitors green performance ratios of 60 countries on the basis of four main criteria: management and climate change, sector efficiency, market and investments, environment and natural capital (Tamanini et al., 2014). The results of the evaluation show that some emerging countries produce remarkable green performance ratios, while developed countries are not always up to the expectations. The green performance ratios of some countries are actually over-estimated. Of the 60 countries South Korea and Japan are in the 39th and the 44th position, respectively. The United Kingdom is also making good efforts, yet it falls behind its Scandinavian peers. Table 4 shows the 10 best performing countries in the areas under review, showing that countries perform differently in the various categories. A comparison with our green index results however, reveals that the best performing countries are nearly always the same.

Table 4

*The 10 best performing countries in terms of the GGEI (2014)*

| | Efficiency of the sectors | Sustainable architecture | Market and investment | Country ranking order (green towns) | Ranking order of green towns |
|---|---|---|---|---|---|
| **The 10 first ranking countries** | Sweden, Costa Rica, Norway, Columbia, Austria, Switzerland, Zambia, Portugal, Germany, Chile, | USA, Finland, EAE, Canada, Taiwan, Sweden, Costa Rica, India, South Korea, Chile, | Denmark, Germany, Finland, Sweden, Spain, USA, Austria, Greenland, Brazil, Ireland, | Denmark, Netherlands, Sweden, Canada, UK, Germany ,USA, Finland | Copenhagen, Amsterdam, Stockholm, Vancouver, London, Berlin, New York, Singapore, Helsinki, Oslo |

*Source:* Tamanini et al., 2014

It was also revealed by the study that the performance of green towns in the United States and in Norway fall short of the green performance of their respective countries as a whole. The above examples prove how difficult it is to measure, and compare the performance of green economies across countries. Although the GI makes it easier to compare countries with one another, yet it does not, in itself, fully express the transition to a green economy, because GDP growth may counterbalance the decrease in biodiversity, or health impairments, while the index itself remains unchanged.

*Measuring the EU's green performance*

In its internal market the EU has introduced the technique of measuring and comparing the *Product Environmental Footprint, PEF* and the *(Organization Environmental Footprint, OEF).* These indicators specify the emission of greenhouse gases that can be linked to the product or organization concerned, and their respective resource use, as the most important environmental stress factors, on the basis of life cycle analyses (EC, 2013).

Table 5

*Ranking order of the 27 EU member states in terms of eco-innovation and environmental performance*

| Country | Ecological indicator | Material productivity | Energy productivity | Water productivity | $CO_2$-emission |
|---|---|---|---|---|---|
| Finland | 1 | 26 | 26 | 18 | 24 |
| Denmark | 2 | 24 | 17 | 12 | 19 |
| Germany | 3 | 10 | 19 | 14 | 17 |
| Austria | 4 | 20 | 18 | 16 | 15 |
| Sweden | 5 | 18 | 25 | 17 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Belgium | 6 | 13 | 24 | 21 | 20 |
| Netherlands | 7 | 2 | 23 | 10 | 21 |
| United Kingdom | 8 | 4 | 14 | 11 | 16 |
| Ireland | 9 | 27 | 16 | – | 25 |
| Spain | 10 | 16 | 11 | 23 | 11 |
| Italy | 11 | 6 | 10 | 27 | 10 |
| France | 12 | 7 | 20 | 19 | 8 |
| Luxembourg | 13 | 8 | 27 | – | 27 |
| Slovenia | 14 | 25 | 15 | – | 13 |
| Czech Republic | 15 | 15 | 21 | 15 | 23 |
| Portugal | 16 | 19 | 4 | 24 | 7 |
| Hungary | 17 | 3 | 7 | 7 | 5 |
| Malta | 18 | 1 | 3 | 22 | 4 |
| Cyprus | 19 | 22 | 13 | 25 | 22 |
| Latvia | 20 | 21 | 2 | 6 | 1 |
| Bulgaria | 21 | 14 | 6 | 13 | 12 |
| Estonia | 22 | 23 | 22 | – | 26 |
| Greece | 23 | 11 | 9 | 26 | 18 |
| Poland | 24 | 12 | 5 | 8 | 14 |
| Romania | 25 | 17 | 1 | 20 | 2 |
| Slovakia | 26 | 5 | 12 | – | 9 |
| Latvia | 27 | 9 | 8 | 9 | 6 |

*Source:* www.soltub.hu/karbonlabnyom/?hu_oko-innovacio,19

The data in the table show that the ecological performance of the countries ranked ahead in terms of the ecological indicator falls short of lower ranking countries. It is also concluded from these data that there is no country that could be looked upon as a model, showing good practices worthy of following in all respects. Hungary's environmental performance is relatively good but in eco-innovation its performance is just about average.

*Arguments for* the green economy, *and concerns faced*

The main objectives of green growth and green economy include increasing well-being and reducing social inequalities, while achieving material reductions in environmental stresses. Meeting such objectives means that even requirements of green development are being met, which amounts to a quality quantum leap relative to green (economic) growth, in the direction of sustainable development, i.e. it entails aggregated results for the environment, the economy and the society alike.

In Europe's green future vision human activities are performed with a view to the fact that we are parts of a rich but finite and fragile ecosystem that is based on mutual dependencies and that the economy is only a means that can be used for satisfying basic needs and requirements and for improving the quality of life, for all, today and in the future. No healthy

economy is possible without a healthy Earth. *A future vision of green economy focuses on social and environmental justice and equality within and among nations.* This involves just utilization of the Earth's resources, bringing the widening of the gap between the rich and the poor to a stop and reversing the process. We are making efforts to reduce inequalities in the distribution of energy and in access to resources. Everyone has a right to have his or her basic needs (for clean air, water, food, soil, shelter, energy, health and freedom) satisfied. All people have a right to solidarity, democracy, self-determination, autonomy, responsibility, dignity and self-actualization. The economy should increase, rather than decrease, welfare. Green economy is an innovative and creative economy in which a central role is played by investment in sustainable development and green technology. This is an adaptive economy, which creates a host of new opportunities, particularly in the labour market, and enables everyone to make full use of his or her talent. Reduction of the intensity of the use of natural resources is the key to making the economy green.[5]

All sectors of the economy are affected by environmental issues, particularly the ongoing climate change, which is being driven by the use of fossil resources. Agriculture, food and water supplies are among the most heavily affected sectors. Air pollution, the acidification of ecosystems, shrinking biodiversity and climate change are environmental issues materially affecting people's well-being. Each of these can be alleviated by green economy, however, besides the benefits it also raises certain security issues (Green Capital, 2010).

All anthropogenic activities – from the extraction of resources through production to waste treatment and disposal – carry some environmental risk. Let us just think of mining and the disasters and emergency situations occurring during mining operations, such as Chernobyl, the cyanide poisoning of the river Tisza, or the red sludge disaster of Ajka. The designing of products and technologies based on environmental awareness in environmental protection and nature conservation is crucially important for national security. This is because citizens' perception of safety is fundamentally determined by whether they can access the energy, food and water required for their day-to-day activities, their very lives, together with other necessary and indispensable goods as required for their normal ways of living and for their health, along with whether these are available at affordable prices.

The proportions of green goods, green jobs and green technologies increase in a green economy. Their acceptance however, is not quite self-evident. A questionnaire based survey conducted by Eurobarometer has found that Hungarian respondents are more sceptical about green products than the average European respondent; about 60% of Hungarian respondents do not trust green products.

## Circular economy as an European alternative to green economy

The concept of *Circular Economy (CE)* takes an approach to embarking on a sustainable path and greening the economy from the perspective of waste. Its basic philosophy is that the use using of the waste output of one system as the input to another system enables resource savings and reduces environmental stress. This approach is a combination of multiple theoretical

[5] Európa zöld gazdasági jövőképe (Europe's green economic future vision) https://europeangreens.eu/euroarchive/fileadmin/logos/pdf/policy_documents/economic/743660HU_Europa_zoeld_gazdasagi_joevokepe.pdf.

concepts and practical solutions, such as ‘cradle to cradle, “blue economy” (Pauli, 2010) or biomimicri. The processes of the metabolism of a circular economy take place in a closed system where nearly 100% of all waste and by-products are reused or recycled. Accordingly, biological components and resources are not mixed with technical ones. Social and economic metabolic processes are organized similarly to processes of environmental metabolism, forming a typical industrial ecological system. People in the European Union use some 15 tonnes of materials per year per person, of which 4.5 tonnes of waste is produced, more than half of which is deposited in landfills. Switching to a circular economy lays emphasis on reuse, repairs and recycling, turning waste into resources. According to some estimates ecodesign and waste prevention may help businesses in Europe save up to EUR 604 billion, equalling some 8% of their turnover and reducing GHG emission by 2–4%. Proponents of circular economy find the model to be offering opportunities for benefits in sustainable economic growth, job creation and efficiency improvements (Ulmann, 2015). The MacArthur Foundation (EMF, 2015) is the most prominent champion of the cause of Circular Economy.

## The circular economy model

The idea of the CE is based on three key principles. The first one is the protection and development of natural capital through controlled use of decreasing stocks and balancing the flows of renewable resources. This assumes a marked reduction in materials and creates, for instance, the conditions required for soil regeneration. The second basic principle is improving the efficiency of resource utilization through developing a circle of products, components and materials, maximising their involvement in the technical and biological cycle. In other words, this involves a highly organized scheme of remanufacturing, refurbishment and maintenance in order to maximize the time materials are kept inside economic processes. The third basic principle is minimising negative external effects through eliminating or substituting, or reducing the use of, toxic materials/substances. Careful selection of substances and materials in the design phase enables reduction of waste and harmful emissions, while fossil resources may be replaced by resorting to energy from renewable energy sources (EMF, 2015).

The European Commission’s interpretation of circular economy is an economy involving the following:

- increased recovery/recycling and prevention of the loss of valuable materials,
- job creation and economic growth,
- with the help of new business models, ecodesign and industrial symbiosis, transition towards the implementation of the “zero waste” concept,
- reduction of GHG emission and environmental impacts.

The circular economy model is based on closing open economic flows (EMF, 2015). According to proponents of circular economy:

- waste is nutrient,
- diversity is virtue,
- energy must be derived from renewable energy sources,
- prices should reflect reality,
- one must think in terms of systems (EMF, 2015).

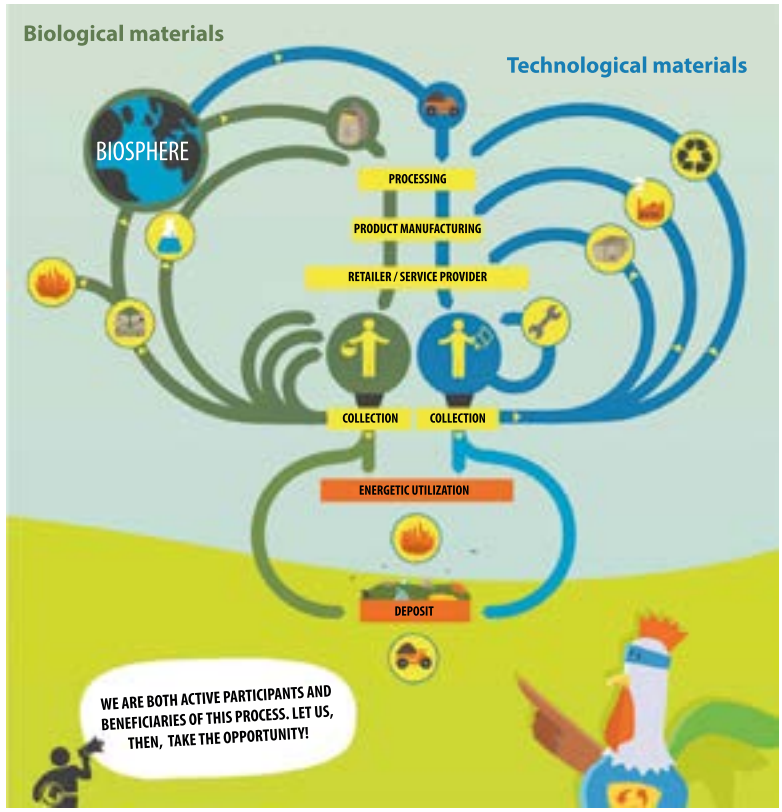


Figure 4

*The circular economy model*

*Source:* http://vallalkozas.hulladekboltermek.hu/tudastar/korforgasos_gazdasag/

The purpose of the package of legislation adopted by the European Commission on 2 December 2015 concerning the circular economy is to "stimulate Europe's transition towards a circular economy, boost global competitiveness, foster sustainable economic growth and generate new jobs" (EB, 2015). It is in view of long term considerations that the package aims at reconsidering waste management and building up a new regulatory background by integrating the life cycle approach, encouraging best solutions adapted to life cycle phases and closing processes. Businesses' introduction of circular economic processes should result in estimated savings of 8% for them, while cutting GHG emissions by 2–4%.

A number of requirements have been identified and regulations have been introduced concerning the implementation of the action plan, such as the directive on ecodesign, regulations pertaining to product requirements, the regulation of manufacturers' responsibility and liability, specification of policy requirements etc. In Europe, for instance, the Netherlands is a committed proponent of the circular economy, which presented a number of positive examples at a conference organized in Budapest in 2016 by the Dutch Embassy and its four partner organizations. At the end of the conference the participants concluded that there are highly inspiring solutions, the spreading of which requires continuous knowledge transfer.

People's attitudes need to be changed if the method is to gain wide acceptance. Although new solutions of sustainable resource management are available for businesses, their application in practice and the development of adequate and suitable incentives depend on governmental and EU action plans.[6]

### The circular economy and security

Experience drawn from processes implemented so far shows that the following benefits are offered by what is called circular economy (Rower, 2016):

- material and energy saving,
- decreasing prices and increasingly reliable availability of raw materials,
- decreasing/elimination of negative external environmental impacts,
- new job creation,
- fostering innovation,
- improving international economic competitiveness,
- durable benefits for a resilient and sustainable economy.

*Security depends on whether in order to enjoy the benefits economic operators adapt fair practices and procedures to fully observe considerations relating to the processes of production, green jobs, product quality, labour safety, occupational health and environmental protection.*

## Resource management and environmental protection

Providing for the availability of resources is a critical issue for green economy, and specifically, circular economy. Resources – raw materials and primary sources of energy – are an indispensable input factor for the operation of any economy and the basis of the welfare of any society. The extraction/production of resources is a drastic intervention in the environment and their use results in imposing a stress on the environment through the waste output of the production chain.

Access to energy sources has, throughout human history, always been among the most prominent causes of war. Adequate energy supply is indispensable for the safe and reliable functioning of any economy. The *National Energy Strategy* ensures long term sustainability and security of Hungary's energy supply and it is the basis of economic competitiveness. In line with Hungary's primary national interests the Strategy guarantees the security of supply, applies the least cost principle, observes environmental aspect and makes it possible for Hungary to make a contribution to the resolving of global issues to an extent that is in proportion with its international weight and the scale of its resources. To achieve the above objectives, it specifies five key endeavours:

- enhancing energy conservation and energy efficiency,
- boosting the proportion of renewable energy sources,

[6] http://hungary-hu.nlembassy.org/news/2016/05/korforgasos-gazdasag-konferencia.html

- integration of the Central-European pipeline/transmission line networks and putting in place the necessary cross-border capacities,
- maintaining the existing nuclear energy capacities and
- enhancing the state's role in the energy market.

The most important objectives of the 4th National Environmental Programme[7] are to protect the quality of life and human health, to protect natural values, to promote economical management and use of resources, to improve efficiency and to make processes increasingly green. These objectives are intended to be accomplished through operational programmes between 2014 and 2020. Climate change is a central element of the programme. Resource management and environmental protection are closely linked to each other. Different authors have, of course, worked out different future visions as well, outlining the energy management for the coming period on the basis of different priorities.

Based on a 1.5% increase in demand for electricity *MAVIR's 2030 projection* uses two possible scenarios, in each of which a key role is assigned to nuclear energy. In the best-case scenario all of the potentially expected power plant investments are actually implemented and the future operation of the existing units is also adapted to the positive expectations. The scenario based on a scarcity of resources factors in a variety of unfavourable trends affecting gas-fired power plants and it also expects that some envisaged investment projects fail to be implemented. Interestingly, this includes up to 1.4–4 times the figures contained in the renewable action plan (Jávor, 2016).

The *Vision Hungary 2040* scenario of the *Erre van előre!* (This way forward) Project outlines an ideal future vision, encompassing all economic sectors, assuming optimum development possibilities for sustainable energy efficiency solutions right from the outset (2005), primarily in regard to the regulatory environment and the commitment of decision makers. A holistic approach was applied in particular in the design of the future vision, including, for instance, cooperation with other sectors, and the human factor. Based on their own research the authors adjusted the existing biomass potential figures, removing a number of inconsistencies, and they also noted that the use of renewable resources alone cannot not guarantee sustainable utilization of resources. The key elements of the future vision include efficiency, modesty and the application of strict sustainability restrictions concerning renewable energy sources (wind, solar, hydro energy, biomass, ambient heat and geothermal energy). According to their future vision "an energy system, operating solely on the basis of renewable energy sources in a sustainable way even from strict ecological considerations, could be put in place in a matter of 30–50 years" (Jávor, 2016: 28

*Greenpeace* prepared its Scenario 1, covering the period up to 2050, using the so-called *backcasting* method, that is, by determining future objectives and target figures, such as that Europe's $CO_2$-emission should be reduced to 3 t/year/capita, and that nuclear energy should be phased out with the help of energy efficiency improvements. In Version 2 of 2011 "they reduced the economic useful life of coal-fired power plants from 40 to 20 years, while in regard to renewable energy sources they used the renewable industry's progressive calculations: in transport they brought forward the introduction of electrical vehicles by

[7] The 4th NEP for 2015–2020 was adopted by Parliament as late as in 2015, by Parliament Resolution No. 27/2015. (VI. 17.), which was published in Magyar Közlöny in its edition 083 of 2015.

10 years, they factored in a faster spreading of smart networks and they assumed that no enhancement in the generation and use of energy from fossil fuels would take place from 2015 on" (Jávor, 2016: 28.).

The structure of the energy portfolio is of particular importance for environmental safety and $CO_2$-emission. Climate policy objectives include increased reliance on renewable energy sources, primarily to cut GHG emissions. However, the fact that some 80% of the total renewable energy used is of agricultural origin, that is, biomass for the most part, and that more than half of the total renewable energy used is based on burning wood at power plants and by households, constitutes a sustainability risk. According to the target figures the share of biomass is expected to drop from 86% in 2010 to 69% in 2020 on the whole within the use of renewable energy for heating and cooling, while the target figure of the use of solid biomass for individual heating will remain extremely high, with all other ways of renewable energy use lagging way behind.

From a social perspective, a shift towards renewable energy sources in resource management will entail the creation of new jobs. According to the renewable energy strategy the entire system of the utilization of renewable energy may result in 103,000 new jobs up to 2030, 80% of which should be created in rural areas. The strategy identifies the use of by-products and organic waste for energy production as the most important source of jobs, for more than 23,000 people (Buday–Malik et al., 2012).

Eco-innovation is expected to play an outstanding role in resource management (efficiency improvement) and in environmental protection as well, as is also reflected in the EU 2020 strategy. Human resources will, accordingly, grow more and more important, because no innovation is possible without highly qualified and creative professionals. Eco-innovation comprises innovation activities reducing the use of natural resources, and harmful emissions, during the entire lifetime of any given product or service. It is an approach to creating products and services based on optimized resource use in all phases of their respective life cycles, striving for zero emission through the circular management of resources. Eco-innovation is practised in awareness of the need for cutting GHG emissions by 20%, for raising the share of reusable resources to 20% and increasing energy efficiency by 20%. The reduction in the use of materials through eco-innovation decreases the exposure which is associated with the risks of material and resource supplies and the rising of prices as a consequence of dependence on imports.

Economic considerations are today some of the most important motors of eco-innovation. A recent survey found that about half (52%) of the businesses introducing eco-innovation considered the current or the future energy prices to be a crucial factor (52% and 50%, respectively). High material prices was also found to be a key consideration (45%). Many of the businesses had introduced eco-innovation in order to be able to comply with regulations, including rules on taxation.[8] Solutions produced by eco-innovation positively affect resource management and material flows as well as the environmental impacts of consumption (Dombi et al., 2015). Another question, is, of course, how eco-innovation solutions can be evaluated and how they affect the three pillars of sustainability. This is why there is a need for reviewing the methods that can be possibly applied in the assessment of the impacts of eco-innovation solutions.

[8] www.soltub.hu/karbonlabnyom/?hu_oko-innovacio,19


Figure 5
*Methods applied in examining eco-innovation*

*Source:* Szita Tóth, 2013

On the other hand, the practical introduction of even the most promising solutions produced by eco-innovation (even award-winning innovations) may be hindered by considerations of operational safety.

## Environmental, economic and social impacts of resource management

Improvements in efficiency and increased reliance on renewable energy sources are among the key indicators of green economy, besides the economical (conserving) use of resources. But what implications do these have from a social, economic or environmental aspect, besides increased green economic performance? How is it possible to single out the resources that should be prioritized? Which one offers more social and economic benefits while entailing reduced environmental impacts? Such questions may be answered with the help of the method called *Life Cycle Sustainability Assessment, (LCSA).* In the life cycle sustainable assessment of fossil fuels and renewable energy sources one must examine the extent of the environmental impact entailed by the generation of a unit (1 MJ) of usable energy, together with its cost and its social impact. Life cycle sustainability is, according to the following formula, determined – in view of the three pillars of sustainability – by the aggregate of the environmental LCA *(Life Cycle Assessment)*, life cycle cost and the social LCA (Szita–Roncz, 2017).

$$LCSA = LCA + LCC + SLCA$$

Regarding the sustainability ratios of the current situation to be 100% for each pillar, their aggregation and the calculation of their average also produces a 100% life cycle sustainability ratio. This will then be the basis of the assessment of the sustainability of various scenarios, because their environmental indicators (the impact category indicator values), economic indicators (*Life Cycle Costing, LCC*) and social indicators (*Social Life Cycle Assessment, SLCA*) concerning the prevailing situation (Scenario 1) are specified as a percentage of the relevant values. The dimensions having been removed, the values can be aggregated and by calculating an average we have produced a single indicator expressing the efforts made towards sustainability. With existing cost figures taken into account together

with the savings from the assumed 50–75% recovery/recycling ratios and the supplementary material and energy requirements it is possible to specify the expected input costs for the various scenarios, along with the relevant environmental impact changes and the social impacts as well (e.g. job creation). These steps enable the evaluation and comparison of development scenarios and the elimination of any risk.

### Advantages

The advantage offered by this method is the possibility of optimising the technology and establishment of sustainability parameters. With the help of some innovative technology, by introducing a new production line, a company extracts (50–75% of the) valuable material from its production residues that should be treated as waste, saving raw material and cost, creating new jobs, but the process takes added energy entailing additional environmental stress, while at the same time the amount of disposable waste is significantly reduced. In this case it is possible to make an assessment of the complex impact relative to the basic technology and it is possible to avoid the risk of increased environmental impact in comparison with the basic scenario. This method can be equally applied to technologies, products and sectors.

### Risks

Making resource management increasingly green, particularly by introducing circular economy, entails a risk of recovery from waste generating unknown impacts which may have harmful consequences in terms of labour safety (fire, explosion, toxic substances), health and environment (soil, water, air). The designing, implementation and licensing of such technologies takes particular attention and precautions. As can be concluded from the circular economic model, the chain of production interacts with environmental elements in a variety of phases, where potential environmental impacts can be avoided by applying suitable technologies, eliminating the fire and explosion hazards and by the introduction of labour safety equipment.

## The most important safety issues

Resilience can be strengthened through multiple channels in the context of green growth: through economic diversity, by conserving the ecosystem, by achieving energy security, sustainable production and consumption and/or by improving resource-efficiency. Moreover, consistent implementation of green growth strategies mitigates shocks caused by harmful impacts and enables the satisfaction of the growing demand of communities in terms of housing, energy, food, transport and water. While emphasis is laid on development and on reducing poverty, risks may be mitigated by reliable scientific projections comprising an ecosystem based approach.[9]

[9] www.greengrowthknowledge.org/theme/risk-resilience 2012

The transition to green economy facilitates the achievement of a variety of sustainable development goals. Greener transport, increasingly resilient agriculture, infrastructure and towns, all contribute to the accomplishment of sustainability. All strategies towards greener economies and practices have, as their central elements, issues such as energy, climate change, the use of renewable resources, environmental improvement – with a focus on aquatic resources and water use – as well as, in regard to business and economy, reduction of $CO_2$-emissions and making transports greener. Based on strategies and scenarios worked out in relation to energy management we have made an attempt to discuss the motors of green society development, together with the associated potential gains and hazards, which may also be interpreted as pros and cons.

Table 6

*Motors of green economy – gains and risks*

| Motor | Gain | Threat |
|---|---|---|
| Economy | • preference of solutions enabling material and energy savings,<br>• access to support schemes, increased profits,<br>• cost cutting resulting from reduced waste output | • risky investment unless technological parameters are optimized,<br>• lost profits on invested assets,<br>• operating licence denied in the absence of safety measures |
| High material and energy prices | • cheaper raw materials and more reliable supplies through closing processes into cycles,<br>• extraction of valuable materials by urban mining,<br>• energy supply from renewable resources (solar panels, collectors, heat pumps, geothermal energy), cost saving,<br>• building insulation, design of buildings with optimized energy consumption, reduced energy dependence,<br>• introduction of new materials, growing markets,<br>• cost savings | • quality degradation, appearance of new types of hazardous waste,<br>• increased demand for energy, the wrong combination of different types of energy,<br>• unknown health hazards,<br>• energy supply issues,<br>• loss of market position,<br>• food supply issues as a consequence of increased use of primary biomass,<br>• increased air pollution due to direct biomass or waste incineration,<br>• high degree of uncertainty as to long term effects,<br>• decreasing lifetime and safety/security |
| Society | • new jobs,<br>• more liveable environment, more secure livelihood, new green jobs,<br>• expanding professional profile,<br>• products of the 4th industrial revolution gaining ground,<br>• knowledge intensive technologies | • accidents, health impairment, breach of labour safety regulations,<br>• absence of labour safety training/ briefings, lack of protective equipment,<br>• loss of jobs |

| | | |
|---|---|---|
| Resources | • expanding/increasing stocks of resources, through landfill mining, extraction of rare element content of refuse dumps<br>• increase in the value of human resources, increasingly extensive education and training | • unpredictable impacts and effects of special – unorthodox – technologies,<br>• emergency situations, water pollution, land use, shrinking biodiversity,<br>• decrease in natural capital,<br>• poor motivation of those without adequate qualifications |
| Environment | • decreasing environmental stress of waste,<br>• no decrease in biodiversity,<br>• conservation of natural values,<br>• retaining of ecosystem service | • polluting effects of new technologies, their material and resource requirements,<br>• decrease in natural capital,<br>• degrading environment,<br>• new pollutants,<br>• loss of biodiversity,<br>• health impairment |
| Technology | • development and sale of new technological lines, job creation | • special treatment of dangerous substances and hazardous waste, emissions, health impairment, water and soil contamination, health hazards,<br>• decrease in natural capital |

*Source:* Own edition

It is clear that besides economic benefits, decreasing natural capital and health hazards faced by the population concerned can in many cases be associated with the factors driving the transition. And the impacts and effects of natural capital – directly in the value change and through the supply chain – cannot be disregarded, indeed, its decrease triggers a variety of ripple effects.

Table 7

*Effects of natural capital in the value change*

| | **Direct** | **Supply chain** |
|---|---|---|
| financial services | 2 | 98 |
| food and beverages | 2 | 98 |
| banks | 3 | 97 |
| vehicles and components | 3 | 97 |
| technologies | 4 | 96 |
| personal and household products | 5 | 95 |
| telecommunication | 5 | 95 |
| media | 6 | 94 |
| trade | 6 | 94 |
| health protection | 10 | 90 |
| real estate | 14 | 86 |

| | | |
|---|---|---|
| industrial goods, services | 30 | 70 |
| insurance | 33 | 67 |
| construction, construction materials | 35 | 65 |
| chemicals | 40 | 60 |
| oil and gas | 47 | 53 |
| travelling and recreation | 49 | 51 |
| basic resources | 63 | 47 |
| consumer goods | 92 | 8 |

*Source:* TRUCOST DATA

The safety of the introduction of green economy lies in the following:

- Are we going to be able – on the basis of technological projections – to get prepared for risks entailed by the various development alternatives?
- Can we acquire knowledge required for the development and use of new technologies and for the reuse/recovery/recycling of products and services created with the help such technologies?
- Can we adopt the philosophy of green economy and circular economy?
- Can we identify and objectively measure the actually advantageous green economy solutions?
- Will there be sufficient governmental will and support concerning the introduction and operation of solutions facilitating the green economy and for the necessary knowledge transfer?

In order to see the green economy, as a new sustainability strategy, prevail, there is a need for a supporting institution system, for supports to help funding the developments, for loans and a coherent regulatory system that is suitably adapted to development strategies affecting the various specific fields (economic, environmental, education, health etc.) and that can manage these based on a systemic approach. There is a need for a good coordinating role on the part of the institution system and, instead of parallel functions, for increased synergies. There is a need for implementing R&D activities in a triple-helix structure. There is a need for new consumer attitudes that accepts a transition towards a green economy, for a new production culture and new competences.

Education has an important role to play in creating competences required for creating eco-innovative production systems, but also in having the importance of retaining ecosystem-services in the long term integrated in the system of social values. Particular attention must be paid to development based on eco-design, to ensure material and energy conservation and improve eco-efficiency. Besides coordination and a holistic approach, there is a need in planning for laying down objective and life-cycle based foundations for rational decisions. In addition to the above, attention must be paid in both resource management and environmental protection to general national security issues that have an impact on, and that keep delaying, the successful achievement of the goals in these two areas (biological and nuclear weapons, cyber-attacks, climate change, crime – as the main threats of the coming decade).

## Summary

It is difficult to give straightforward answers to the questions raised in the introduction. Green economy is expanding, no longer only as an alternative economic arrangement for a way out of the crisis but also as one of the guarantees for a transition towards sustainable development. Efforts aimed at boosting the performance of green economy are supported by international organizations, and attempts have been and are being made to measure this performance, contributing, at the same time, to improving the perception of sustainability. The green economy can be measured by a variety of ways: in addition to the green growth indicators worked out by the OECD they include the green index, the eco-innovation index, the product footprint, the ecological footprint, the assessment of biocapacity, energy efficiency, land use as well as the comparison of the indicators with other types of ratios. On the other hand, any assessment of the performance of green economy requires complex and careful analysis. Definite signs of the green economy – or rather, the economy's growing increasingly green – in the chemical industry, in construction, waste management, at education institutions and municipal governments, along with signs visible in transport and tourism. The green transition has also been facilitated by the availability of funds through application schemes. Its expansion in the future depends to a large extent – besides decision makers and people familiarising themselves with the essence of the concept, and besides its acceptance – on the supportive influence of the regulatory environment and the availability of funds through application schemes. The assessment of the benefits and the impacts of the risks of the green economy, the promotion of comparative studies based on life cycle analysis, have a positive impact on the population's environmental sensitiveness. Civil society organizations may also play a role in this type of awareness raising. It is important that the consequences of decisions are identified and that their environmental, economic and social impacts are managed together. The risk mitigation of objective assessments should be based on the correct identification of the life cycle, on the designation of the phase that actually spans between cradle and grave or between cradle and cradle.

Preference has lately be given to what is termed as circular economy over green economy, together with the development of programmes for this newly adopted concept. Besides economic gains (through cutting costs of waste treatment and raw materials) circular economy achieves reductions in environmental impacts through suitably chosen technologies. A comparison of the two alternatives reveals that the concept of circular economy is narrower than that of green economy. Having received targeted funds through application schemes, with innovative waste treatment technologies businesses may move towards sustainable production. It is a clear benefit when through circular management – recovering part of the materials required for the technology from waste – they need to purchase less materials and have their waste output reduced, but it must also be noted that such technological solutions generally entail additional resource inputs. An assessment must be made of the additional investment required for enjoying the benefits of material recovery and whether the emissions of the new technology entail even greater pollution than those of the original technology. The introduction of circular technologies is justified when the combined environmental, social and economic impacts over the entire life cycle of the resulting product do not exceed those of the original technology. Such an assessment is not possible without

a comparative impact assessment based on life cycle analysis. An increase in the aggregate energy consumption may be offset, to some extent by using renewable energy sources.

The justification of the introduction of green and/or circular economy cannot be called into question. Their basic underlying concepts include material and energy conservation, the substitution of dangerous substances with less dangerous ones and the recovery and reuse of value from waste. This however, entails a safety hazard as well. New technologies often require new expertise, along with new or unusual working conditions and methods, or even health hazards. These must be duly taken into account from design to implementation. At the same time, such new technologies create new jobs, contributing to the reduction of unemployment rates. Education, training, the development of safety systems and briefing workers concerning their use, are among top priority issues. Identifying hitherto unknown effects of innovative new technologies, and making available the workforce required for them, are perhaps among the most important safety and security issues for the decades to come, in the various scenarios of green development.

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