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RESOURCE EFFICIENCY IN MONTENEGRO - SCENARIOS FOR THE FUTURE

РЕСУРСНА ЕФИКАСНОСТ У ЦРНОЈ ГОРИ – СЦЕНАРИЈИ ЗА БУДУЋНОСТ

Summary: *Resource efficiency means management and use of limited resources in a sustainable manner, whilst minimizing negative impact on environment. Sustainable management of resources assumes monitoring of whole process, from resources extraction, transport, transformation and consumption, to the disposal of waste. In plainer words, it means finding ways of producing more with fewer inputs and less impact and consuming differently, to limit the risks of scarcity or pollution. Moving towards a growth path which will have the dual benefit of stimulating the growth needed to provide jobs and wellbeing for its citizens and of ensuring that the quality of this growth leads to a sustainable future, will require the country to tackle these challenges and turn them into opportunities. Preparing the Montenegrin economy for this transformation in a timely, predictable and controlled manner, will enable it to further develop its wealth and wellbeing, whilst reducing the levels and impact of its resource use. Ensuring a sustainable development path in Montenegro would mean gradual transition towards achievement of European targets, competitiveness, permanent decoupling of economic growth from the use of resources and environmental impacts and keeping the promise to be an ecological state.*

The research in this paper is a partial outcome of the UNDP project Resource Efficiency and Sustainable Human Development. The scenario of the future use of natural resources in Montenegro, presented in this paper, is a pioneering attempt to assess its resource productivity (RP), which may serve as a rough illustration of the degree of efficiency in the use of natural resources in the national economy. As such, they may serve as the basis for policy directions and for fostering discussion on this issue which is important for future socio-economic profile of Montenegro.

Key words: *resource efficiency; sustainable development; domestic material consumption (DMC); Montenegro*

JEL classification: *Q2, Q5*

Резиме: *Ресурсна ефикасност подразумијева управљање оскудним ресурсима на одрживи начин, уз истовремено минимизирање негативних утицаја на природно окружење. Одрживо управљање ресурсима подразумијева мониторинг читавог процеса, од екстракције ресурса, траснпорта, прераде и употребе, до одлагања отпада који његовом употребом настаје. Прецизније, то значи тражење начина за постизање веће производње уз мању употребу ресурса и мањи негативни утицај на окружење, као и другачији начин употребе ресурса, како би се смањио ризик оскудности или загађења. Тражење начина за остварење привредног раста који ће имати двоструке користи, у смислу стимулације раста потребног за генерисање нових радних мјеста и благостања грађана као и обезбјеђивање да такав раст буде одржив у будућности, захтијеваће да одређена земља ове изазове претвори у предности. Црногорска привреда, у намјери да се за овакав раст правовремено припреми, на предвидив и контролисан начин, мора омогућити њен даљњи развој благостања, истовремено смањујући ниво употребе својих природних ресурса. Достизање одрживог развоја у Црној Гори значило би даљу постепену транзицију ка достизању таргета Европске уније, конкурентност, стално раздвајање утицаја економског раста на употребу ресурса и деградацију природног окружења и одржање политичког обећања да ће постати еколошка држава.*

Истраживање приказано у овом раду је парцијални исход УНП пројекта Ресурсна ефикасност и одрживи развој по мјери човјека, Сценарији будуће употребе природних ресурса у Црној Гори, презентирани у овом раду, чине пионирски покушај процјене ресурсне проду- ктивности у Црној Гори, који могу послужити као груба илустрација степена ефикасности употребе природних ресурса у националној економији. Као такви, ови сценарији могу послужити као основа за креирање политика и унапређивање научне дебате о могућим правилима повећања ресурсне ефкиасности, овог важног питања будућег социоекономског профила Црне Горе.

Кључне ријечи: *ресурсна ефикасност, одрживи развој, домаћа потрошња материјала (ДМЦ), Црна Гора.*

JEL класификација: *Q2, Q5*

1. INTRODUCTION

The long-term aim of each country is to reduce the amount of waste generated and to promote it as a resource and achieve higher levels of recycling and the safe disposal of waste. In order to improve the resource efficiency, each country has to reduce the environmental and health impacts of waste. This paper goes in-depth into one important area of sustainability – resource efficiency reflected in Domestic Material Consumption (DMC) indicator.

The analysis in this paper targets different potential scenarios, which are of relevance for efficient use of resources In Montenegro. Official development documents, Statistical office of Montenegro, Customs Administration and Department of Public Revenues data (Ministarstvo poljoprivrede, šumarstva i vodoprivrede 2001; Ministarstvo turizma i životne sredine 2008; MONSTAT 2012)[1] and data from individual businesses served as the background for developing them, along with statistical extrapolations of the trends of relevant indicators. Time series of the available data in Montenegro is not sufficiently long to enable reliable conclusions concerning the development of specific indicators. Instead of complex calculations, extrapolated data is compared, wherever possible, with the data from reference scenarios (e.g. for energy) or with the outcomes of other development paths that may be expected to materialize if the currently existing development documents of the EU and Montenegro are implemented.

The scenarios are not intended to precisely forecast the future of resource efficiency in MNE. Instead, their purpose is to roughly assess possible options and to illustrate the outcomes of different policy choices related to the use of specific resources, identify challenges and enable comparison with EU trends. Based on this the scenarios may serve as the basis to propose specific targets and measures to achieve greater resource efficiency in the country. In preparing scenarios, attention was focused on resource productivity, measured by the GDP/DMC ratio, as it is both a composite indicator for economic efficiency and a lead indicator of the EU Roadmap.

This paper is organized as follows.

Section 2 describes composition and calculation of DMC for Montenegro. Also, the decoupling of the impact of economic growth from the use of resources will be conducted on the one side, and the existence of the inverse impact of economic growth on environmental degradation, on the other sid.

Section 3 represents comparison of future scenarios. According to the available input data, we created 5 possible scenarios, for the 2005–2012 period. This period was characterized by significant changes in intensity of trend in economic activities in Montenegro - the investment boom (2005–2008) followed by an abnormal economic decline caused by the impact of the global economic crisis (2009–2012).

Section 4 concludes and proposes the best scenario for resource efficiency in Montenegro.

2. DOMESTIC MATERIAL CONSUMPTION (DMC) IN MONTENEGRO - COMPOSITION AND CALCULATION

Cost-effective and efficient use of natural resources is the key to any sustainable development strategy. Sustainability is directly influenced by the way in which economic activity in a country is organized and by its strategic orientation, sector policies and, ultimately, awareness of the need for sustainable natural resource management. It is very important to focus efforts on decoupling the impact of economic growth from the use of resources on the one hand, and on the existence of the inverse impact of economic growth on environmental degradation on the other.(Crnogorska akademija nauka i umjetnosti 2010)

EUROSTAT developed the *Economy-Wide Material Flow Accounts* (EW-MFA) (Ministarstvo ekonomije 2010) as a harmonized accounting tool for material inputs, stock and outputs of the socio-economic system. It refers to solid, liquid and gaseous materials, excluding water and air; while material flows are presented in this system in physical units of measurement (mainly tonnes). MFA follows the logic of the System of National Accounts (SNA) and is compiled based on official statistics, depending on the relevant material category.

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[1] Data from Customs Administration and Department of Public Revenues was obtained directly from these institutions, on author's request.

The productivity of natural resources within the national economy can be determined using the aggregate Domestic Material Consumption indicator (Domestic Material Consumption, DMC), in absolute and relative terms. GDP divided by absolute DMC shows the value of the resource productivity indicator (Resource Productivity, RP). Resource Productivity – RP has been selected as the lead indicator out of a set of indicators measuring resource efficiency (Eurostat 2010)

It is therefore very important to monitor in regular statistical reports the DMC and RP levels and tendencies, both within the national economy and in comparisons (between sectors and/or countries).

Economy-Wide Material Flow Accounts methodology for DMC calculation

The assessment of material flows in Montenegro was conducted following two main objectives:

- To provide a rough estimate of the DMC and of the lead RP indicator, as the GDP/DMC ratio (€/t), identify their trends over time and assess the productivity of the use of natural resources in Montenegro on the basis of the available data.
- To promote, in line with the conditions in Montenegro, the usage of such indicators for informing policy making on the long-term strategies of sustainable human development in the future processes.

The materials that provide inputs for DMC calculation fall into four categories (European Commission 2011d; 2011f; 2012a; 2012b; 2013b; Ministry of economy 2011; Ministarstvo finansija 2013; Ministarstvo održivog razvoja i turizma 2010):

- *Biomass* – as a group of materials, it includes all the plant-based raw materials derived from nature: all agricultural products and all crop residues, such as straw, hay, biomass for livestock grazing and wood. In the EW-MFA, animal products of domestic agriculture (meat, milk, eggs and farmed fish) are considered to be internal flows within a society, thus not directly derived from nature, since the resource basis (fodder) has already been taken into account once. Contrary to this, animal products originating from hunting and fishing are taken into account as domestic extraction from nature. This group does not include fossil fuels derived from biomass.
- *Fossil fuels* - are minerals generated by plant and animal decomposition in the Earth crust over millions of years and are primarily used to produce energy.
- *Metals* – include mineral materials in a range from ores to the produced metals. Ores are considered to be minerals from which it is possible to extract metals and generate economic benefit.
- *Non-metallic minerals* – are a group of materials which includes construction minerals (e.g. sand and gravel) and industrial minerals (phosphates, salt, etc.).
- *Exports and imports of material* – unlike Domestic Material Extraction, these are calculated by taking into account not only international trade in raw materials, but also products during different stages of processing, such as semi-finished and finished products.

According to EUROSTAT, the indicator Domestic Material Consumption (DMC) is expressed in tonnes per capita (t/per capita). It is defined as the total quantity of the material directly used in the economy and equals Direct Material Inputs (DMI) minus exports (E). The DMI measures direct material inputs into the national economy and equals domestic extraction (DE) plus imports (I). The per-capita calculation uses the population mean (arithmetic mean for the population on 1st January for two consecutive years). The theory of national material flow accounts includes a compilation of all the material inputs in the national economy, changes in the stock of materials in the economy and material outputs directed towards other economies or towards the natural environment. It is worth noting that the term "consumption" in the context of DMC means consumption in the literal sense, rather than final consumption.

Resource Productivity (RP) has been selected as the lead indicator out of a set of indicators measuring resource efficiency. It assesses progress in achieving the objectives and targets set in the *Europe 2020* strategy, the key initiative on resource efficiency. When examining the RP trend over time within a single geographical zone, GDP should be expressed in chain-linked Euros against the

reference year (2000 or 2005), using the exchange rate from 2000 or 2005, respectively. In case of comparing the RPs of several countries in a single time interval, GDP should be used according to the purchase power parity standards[2].

The assessment of DMC and RP for Montenegro was constrained by a number of factors, namely:

- The period observed (2005–2012) is primarily restricted by the length of available time series on domestic extraction, imports and exports of natural resources in Montenegro. This particularly refers to the records on imports and exports in physical units of measurement and to certain categories of biomass, fossil fuels, metals and non-metallic minerals.
- The period 2005–2012 is characterized by a significant change in trends and the intensity of economic activity in Montenegro caused by the global economic crisis of 2008. The period preceding 2008 did not include ordinary development trends, but was marked by an investment boom and an overheating of the national economy which was not recorded as a global trend, but as a specificity of the transition of the Montenegrin economy.
- Small economies, such as the Montenegrin one, are more vulnerable to external shocks and that is why extrapolation of the economic development trend in a "rollercoaster" scenario is largely unreliable.
- Due to the lack of an adequate system of material flow accounts in the national statistics, it was impossible to obtain complete time series on material flows in the national economy. This had an impact on the scope of data, length of the available time series and the DMC and RP results inevitably leading to an underestimation of the real DMC value, in both total and per-capita terms and consequently to an overrating of the RP value for Montenegro.
- Given the above, only a simulation of DMC and RP calculation was carried out for Montenegro for the period 2005–2012, for the purpose of identifying their trends based on the available sample from certain categories of materials. The calculated data does not reflect the actual levels of the DMC and RP for Montenegro and they should not be used as final values.

According to the available data on material flows in 2012, total material extraction (DE) in the areas of agriculture, mining and forestry in Montenegro amounted to around 2.4 million tonnes. Extraction of fossil fuels (coal) accounted for the majority of this amount – 75.6%, followed by non-metallic minerals (industrial and construction minerals) – 15.1%, while metals and biomass accounted for 4.8% and 4.5% of total domestic material extraction, respectively. Compared to 2005, total Domestic Material Extraction in 2012 dropped by almost a quarter (24.5%), and this drop over the eight-year period was mainly due to the 91% drop in metal extraction, followed by the 28% drop in biomass extraction and approximately 19% drop in non-metallic mineral extraction, while extraction of fossil fuels (coal) rose by approximately 38% during the same period. (Ministarstvo održivog razvoja i turizma 2012; Ministarstvo održivog razvoja i turizma 2014b; Ministarstvo poljoprivrede, šumarstva i vodoprivrede 2001; Ministarstvo turizma i životne sredine 2008; MONSTAT 2011, 2012):

The following conclusion may be reached on the basis of available data:

- between 2005 and 2012, Montenegro recorded a one-quarter drop in Domestic Material Extraction;
- coal and industrial and construction materials (non-metallic minerals) accounted for approximately 90% of total Domestic Material Extraction in Montenegro in 2012;
- biomass, as a renewable natural resource, accounted for less than 5% of total Domestic Material Extraction in 2012.

According to the available data, total imports (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austrian Federal Ministry of Economy, Family and Youth 2011) of materials to Montenegro in 2012 were 1.5 million tonnes. Out of the total imports of materials in the same year, imports of biomass accounted for almost two-thirds (62%), while imports of fossil fuels accounted for approximately 20%, imports of metal accounted for approximately 7%, and non-metallic minerals 11.5%. Compared to 2005, imports of materials in 2012 increased by 13% in total, driven by the increased imports of biomass (37%) and non-metallic minerals (13%); during the same period, imports of metal dropped by some 39% and that of fossil fuels by more than 10%.

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[2] The basis for assessment of material resources in Montenegro was the *Global Material Flow Database Technical Report*, version 2013. [24]

The following is the general conclusion:

- imports of materials increased in the period 2005–2012, while those categories of materials whose domestic extraction was very low compared to the total extraction (biomass and non-metallic minerals) accounted for major share of such imports;
- imports of fossil fuels (oil) increased by one-fifth in the period 2005–2012.

According to the available data, exports (E) of materials from Montenegro amounted to 1.2 million tonnes in 2012 (Table 1). Out of the total exports of material during that same year, exports of biomass accounted for almost two-thirds (62%), exports of fossil fuels accounted for approximately 6%, while exports of metal and non-metallic minerals accounted for approximately 16%, respectively. Exports of material in 2012 dropped by around 46% compared to 2005. A drop was recorded in all the categories of materials in this period: the biggest one was that of non-metallic minerals (77%), followed by metals (approximately 55%), biomass 12%, and fossil fuels, approximately 11%.

The following is the general conclusion:

- exports of materials almost halved between 2005 and 2012;
- the share of exports of biomass in total exports equalled the share of imports of biomass out of total imports;
- an enormous decline in exports of non-metallic minerals (more than two-thirds) and exports of metal (more than a half) was recorded.

DMC in Montenegro in 2012 (Table 1) amounted to 2.74 million tonnes. Out of the total domestic material consumption during that same year, fossil fuel consumption accounted for some 74%, consumption of biomass and non-metallic minerals accounted for approximately 13% respectively, while consumption of metal accounted for 1.2%. Domestic Material Consumption in 2012 rose by around 16% compared to 2005. There was a drop in domestic consumption of non-metallic minerals (by 1.5 times) and metals (by almost 2 times), while domestic consumption of biomass grew roughly nine-fold and that of fossil fuels by some 30% (Ministarstvo ekonomije 2013b; Ministarstvo održivog razvoja i turizma 2011; MONSTAT 2011, 2012; Vlada Republike Crne Gore i Ministarstvo turizma i zaštite životne sredine 2007).

The following is the general conclusion:

- in DMC in Montenegro, consumption of metal accounted for somewhat above 1% in 2012, indicating that the major share of domestic extraction of metals and metal ores did not remain within the national economy, instead it was exported thus resulting in a material drain;
- consumption of non-metallic minerals (industrial and construction minerals) dropped by 1.5 times in the period 2005–2012;
- domestic consumption of biomass in the period 2005–2012 increased almost nine-fold.

Table 1: Material Flows Overview (DE, I, E, DMC)

	Material flow in thousands of tonnes		Change (%)	Share of total flow %	
	2005	2012		2005	2012
Domestic Extraction (DE)	3 129	2 361	−24.5	100	100
Biomass (B)	146	106	−27.7	4.7	4.5
Fossil fuels (FF)	1 297	1 786	37.7	41.4	75.6
Metals (M)	1 247	113	−91.0	39.8	4.8
Non-metallic minerals	439	357	−18.8	14.0	15.1
Imports (I)	1 327	1 500	13.0	100	100
Biomass (B)	677	930	37.4	51.0	62.0
Fossil fuels (FF)	331	295	−10.9	24.9	19.7
Metals (M)	166	102	−38.7	12.5	6.8
Non-metallic minerals (NM)	153	173	13.0	11.5	11.5
Exports (E)	2 090	1 125	−46.2	100	100
Biomass (B)	785	689	−12.2	37.5	61.2
Fossil fuels (FF)	75	67	−10.7	3.6	6.0
Metals (M)	401	182	−54.7	19.2	16.1
Non-metallic minerals (NM)	829	188	−77.4	39.7	16.7

Domestic Material Consumption (DMC=DE+I-E)	2 366	2 736	15.6	100	100
Biomass (B)	39	347	797.2	1.6	12.7
Fossil fuels (FF))	1 553	2 014	29.7	65.6	73.6
Metals (M)	1011	33	−96.8	42.7	1.2
Non-metallic minerals (NM)	-237	342	−244.6	−10.0	12.5

Remarks: The presented values are rounded up; the presented data shows differences as a result of rounding up. The negative value for non-metallic minerals in 2005 is a consequence of the impossibility of calculating precisely the elements DE, E and I in this category of material. Domestic material consumption (DMC) = Domestic Extraction (DE) + Imports (I) − Exports (E).

Estimates of DMP and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data, which is why they should be used only for illustration purposes.

Source: Author's calculation

Figure 1: Structure of Domestic Material Consumption (DMC) in Montenegro in 2012, in thousands of tonnes
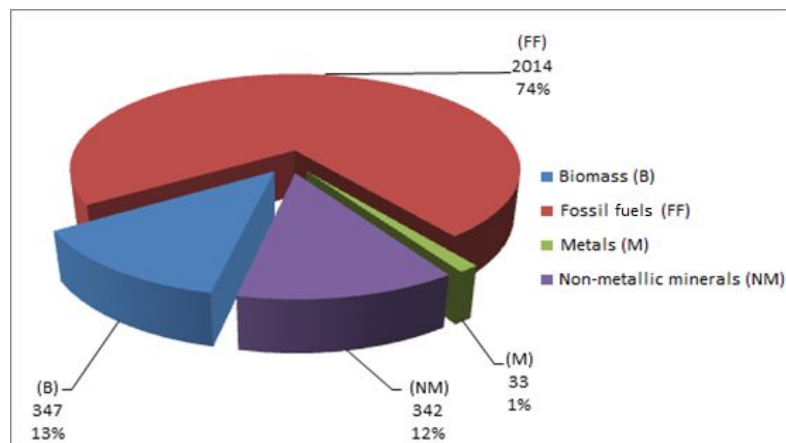
Source: Author's calculation

DMC per capita is a complementary indicator of the absolute value of DMS, as shown in Table 2. This indicator enables comparison of Domestic Material Consumption across countries.

According to the methodology, DMC per capita should be calculated as a relative indicator. However, given the insufficient reliability of the input data used for the calculation, the results presented in Table 2 should be treated with caution as indicative illustrations, and should definitely not be considered as final.

Table 2: Domestic Material Consumption (DMC) per capita

	Material flow per capita, in tonnes		Change (%)
	2005	2012	
Domestic Material Consumption (DMC)	3.8	4.4	15.8
Biomass (B)	0.1	0.6	500.0
Fossil fuels (FE)	2.5	3.2	28.0
Metals (M)	1.6	0.1	−93.8
Non-metallic minerals (NM)	-0.4	0.6	−250.0

Remarks: The presented values are rounded up; the presented data shows differences as a result of rounding up. The negative value for non-metallic minerals in 2005 is a consequence of the impossibility of calculating precisely the elements DE, E and I in this category of material. Domestic material consumption (DMC) = Domestic Extraction (DE) + Imports (I) − Exports (E).

Estimates of DMP and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.

Source: Author's calculation

Table 3 shows RP for Montenegro. This indicator is calculated by relating GDP to DMC, and is expressed in thousands of €/t or €/kg. The RP for Montenegro in 2012 amounted to 1 151 €/t, which is a 50% increase compared to 767 €/t in 2005. Such an impressive increase in RP comes as a consequence of a significantly slower DMC increase (15%) against the GDP increase (73.5%) in Montenegro in the period 2005–2012.

*Table 3: Domestic Material Consumption (DMC) and Resource Productivity (RP)*

	GDP, DMC, RP		
	2005	2012	Growth %
Domestic Material Consumption (DMC) in thousands of tonnes	2 366	2 736	15.6
Gross Domestic Product (GDP) in millions of Euros	1 815[*]	3 149[*]	73.5
Resource productivity (RP) in €/t	767	1151	50
[*] GDP is expressed in current prices, while the data on GDP expressed in constant prices are used for drawing comparisons by years. The presented values are rounded up; the presented data show differences as a result of rounding up. Domestic Material Consumption (DMC) = Domestic Extraction (DE) +Imports (I) − Exports (E). Resource Productivity (RP) = GDP/DMC. Estimates of DMP and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.			

Source: Author's calculation

Figure 2: Real GDP, DMC and RP trends in Montenegro 2005–2012
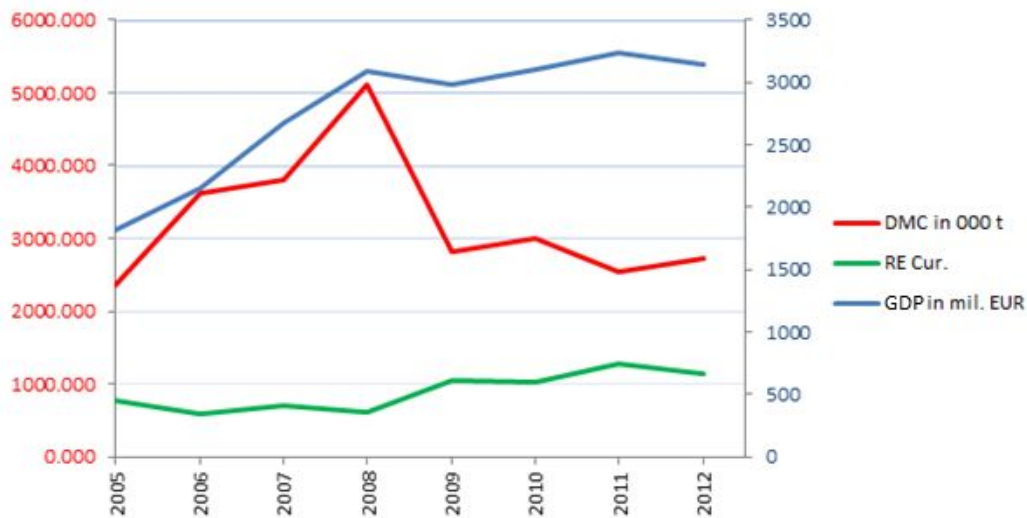
Source: Author's calculation

The figure above leads to a conclusion that there are three stages in the real GDP and DMC trends, as well as in their mutual relation (RP) which measures resource productivity:

▪ from 2005 to 2008 there was evident high real GDP growth, and DMC follows the same pattern. All this is a consequence of the economic boom in this period, while it is also noted that there was no major decoupling in this period. The RE trend was relatively moderate in this period, steadily below 1,000 €/t;

▪ from 2008 to 2011, annual real GDP growth rates were negative (2009) and were considerably slowed down by the global economic crisis. The level of GDP was maintained due to the service sector, while DMC experienced the rollercoaster effect, a sudden plummet after sudden growth. This GDP–DMC relationship created major decoupling; however it is not the consequence of better natural resource management in Montenegro, but of the sharp decline in material consumption, along with relatively stable GDP trends. This was the reason for the RP breaking the 1,000 €/t ceiling for the first time in 2009;

▪ in 2011–2012, the worst-case scenario for natural resource management took place: GDP dropped, paralleled by a DMC increase (recoupling). This GDP–DMC relationship resulted in the RP declining to 1 152 €/t in 2012. If these trends continue, there is serious risk of the RP once again dropping below 1 000 €/t, which is a major step back in terms of resource productivity.

3. RESOURCE PRODUCTIVITY IN MONTENEGRO – COMPARATIVE ANALYSIS OF FUTURE SCENARIOS

Although some countries, such as Austria, carried out assessments of future RP scenarios in 2011, due to the effects of the global crisis since 2008 they have used only the trends from before 2008 for the baseline scenario, and not later ones (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austrian Federal Ministry of Economy, Family and Youth. 2011) However, such an approach would not be suitable for Montenegro as it experienced abnormally high economic growth rates prior to 2008 (annual real GDP growth higher than 10%) and natural resource exploitation, so that period would not be reliable when designing the baseline scenario.

As highlighted earlier, the 2005–2012 period was characterized by a significant shift in the trend and intensity of economic activity in Montenegro. The country first experienced an abnormal economic growth caused by the investment boom (2005–2008), which was followed by an abnormal economic decline caused by the effects of the global economic crisis (2009–2012). Since the extrapolation of trends in the analysis of scenarios was carried out on the basis of data for the entire period, the interpretation of scenarios raises the issue of the relevance of the input data when projecting future DMC and RP scenarios for Montenegro.

The input data used for the five scenarios is summarized in Table 4:

Table 4: Scenarios' input data

Use of resources, Montenegro, average 2005–2012	
GDP=Gross Domestic Product (steady prices)	€2 713 million
Average annual growth rate of real GDP (2005–2012)	3.5% per annum (pa)
DMC=Domestic Material Consumption (000 t)	3 247 959 t
DMC per capita	5.2 t
Average annual growth rate (2005–2012)	2.0% pa
RP=Resource productivity (GDP/DMC)	835 €/t
Total growth (2005–2012)	56.7 %
Average annual growth rate of RP (2005–2012)	7.1% pa
Population size: 2005–2012	625,460
2020*	642,352
2030*	655,000
* Projections according to the Energy Development Strategy of Montenegro by 2030, Table 18.2. (15)	
Estimates of DMC and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.	

Source: Author's calculation

Based on the projections of the input data presented in Table 4, five scenarios have been elaborated and analysed below. (See Appendix)

Scenario 1: "Business as usual"

The first scenario assumes that the trends recorded in the period 2005–2012 will continue until 2020 and 2030, with the past trends continuing at average annual growth rates. Under this scenario real GDP is expected to grow by an average of 3.5% annually, which was the average real GDP growth rate in the period 2005–2012. During the eight-year period from 2012 to 2020, real GDP in Montenegro would increase by 28% which matches the average annual growth of 3.5%. Under this assumption the average annual DMC growth rate amounts to 2%, equalling the average annual DMC growth rate in the period 2005–2012; this results in a total DMC increase of 16% in 2020 compared to

2012, or 2% on average per year. RP increases by around 10%, at an average annual rate of 1.3%, while in 2020 it is 922 €/t, compared to the average of 835 €/t in the period 2005–2012.

If these trends continue until 2030, that is eighteen years from 2012, the RP per capita will increase considerably: from 5.2 t/capita (average for 2005–2012) to 6.7 t/capita (2030).

Scenario 2: Freeze the natural resources use

This second scenario assumes that the use of resources, measured by DMC levels in both absolute and per-capita terms, remains frozen at the average level from the period 2005–2012. Constant DMC levels over the following eight-year (2020) and eighteen-year (2030) period are observed against the continued trend of real GDP as recorded in the period 2005–2012 i.e. at an average annual rate of 3.5%.

As a result of these assumptions, the RP trend is in a perfectly positive correlation with the real GDP trend: total real GDP growth until 2020 amounts to 28% (3.5% per year), while RP grows by that same value. Due to the assumed population increase, the DMC per capita drops from the average of 5.2 t/capita in 2005–2012 to 5.1 t/capita in 2020. In this scenario, the main driver of the RP increase from the average of 835 €/t in 2005–2012 to 1 069 €/t in 2020 is the real GDP growth, rather than the quality of resource management.

Comparison between results for 2030 and 2020 clearly shows that the absolute DMC remains the same, while the DMC per capita experiences a slight decline over the ten-year interval. The RP increase of 68% in 2030 is a consequence of GDP growth by that same amount.

Scenario 3: Modest resource productivity growth

If it is assumed that it is possible to ensure an average annual RP growth rate of 3% per year, that would correspond to an RP increase from 835 €/t (2005–2012) to 1 036 €/t in 2020 (a total increase of 24%), and to 1 286 €/t in 2030 (a total increase of 54%). Since both GDP and DMC are recording an increase, but DMC is rising slower, this scenario reveals a relative decoupling of the relation between economic growth and use of material resources in the country. It is interesting that there is no change in DMC per capita with the increase in population and total output of economy; eight or eighteen years later, DMC per capita would remain equal to the average recorded in the period 2005–2012 of 5.2 t per capita. Until 2020, DMC is growing at an average annual rate of 0.4%; eight years later, and this results in a total increase of 3.2%. If this trend continues until 2030, total DMC growth for the eighteen-year period would amount to only 5.8%, which means that it would grow on average by 0.3% per year.

Scenario 4: Moderate reduction in use of resources

Unlike scenario 3, this scenario takes a more intensive and more ambitious approach to the resource management. The target is set in a way that the absolute reduction in the use of resources by 2020 should amount to 20% compared to the average value in the period 2005–2012. This means that DMC will be reduced progressively by 2.5% per year, which would lead to a decline in DMC from 5.3 t/capita (2005–2012) to 4.0 t/capita in 2020 and 2030. Resource productivity growth over an eight-year period (2012–2020) would amount to a total of 60%, while over an eighteen-year period (2012–2030) RP would be doubled, i.e. it would grow by 103.8%.

Scenario 5: Dramatic reduction in use of resources by 2050

This scenario sets demanding requirements in natural resource management in Montenegro. By 2050, the value of DMC per capita will be more than halved, from an average of 5.2 t/capita in the period 2005–2012 to 2.5 t/capita. In that same period, RP would grow by 9.6 times.

Comparative analysis of the five future scenarios

Table 5 summarizes the expected outcomes of individual scenarios for domestic material consumption (DMC) and resource productivity (RP). Comparing them allows for the selection of a targeted scenario for Montenegro.

Table 5: Different scenarios' outcomes

		Use of resources (DMC)		Resource productivity (RP)		
		t	t/capita	RP in €/t	total	pa
2005-12	SCN 0: Average 2005–2012	3 247 959	5.2	835	56.7%	7.1%
2020	SCN 1: Business as usual	3 767 632	4.9	922	10.3%	1.3%
	SCN 2: Frozen DMC	3 247 959	5.1	1 069	28%	3.5%
	SCN 3: Increase in RP by 3%	3 352 731	5.2	1 036	24%	3.0%
	SCN 4: Reduction of DMC by 20%	2 598 367	4.0	1 337	60%	7.5%
2030	SCN 1: Business as usual	4 417 224	5.7	1 001	19.9%	1,1%
	SCN 2: Frozen DMC	3 247 959	5.0	1 362	63%	3.5%
	SCN 3: Increase in RP by 3%	3 437 774	5.2	1 286	54%	3.0%
	SCN 4: Reduction of DMC by 20%	2 598 367	4.0	1 702	103.8 %	5.8%
2050	SCN 5: DMC reduced by 50%	1 623 979	2.5	3 893	366%	9.6%
Estimates of DMC and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.						

Source: Author's calculation

Judging by the data summarized in Table 5, Scenario 4 emerges as the optimal one for a targeted scenario. First and foremost, this scenario envisages an active and ambitious natural resource management policy in Montenegro. By 2020, Montenegro would achieve an absolute reduction in the use of material resources by 20% compared to the average value recorded in the period 2005–2012. Resource productivity would grow at an average annual growth rate of 7.5% which corresponds to the average annual growth rate of 7.1% recorded in the period 2005–2012. Under this scenario resource productivity in 2020 would increase by 60% compared to the average resource productivity in the period 2005–2012. A considerable decrease is also recorded in DMC per capita which amounts to 4 t/capita in 2020.

4 .CONCLUDING REMARKS

The potential benefits from development of a resource-efficient economy are many. Those that are particularly relevant for Montenegro, given its current level of development, include growth and new jobs, competitiveness, improvement of the quality of life by preserving the quality of the environment and contribution to the stability of the economy. Even though detailed analysis of potential effects of implementation of certain resource efficiency polices (*ex-ante* analyses) are unavailable, according to the existing estimates the improvement of energy efficiency in the housing stock alone would stimulate investments, create new employment opportunities and result in significant energy savings.

From the analysis of the 5 scenarios, we derived the following conclusions:

▪ Scenario 1: If the trends recorded in the period 2008–2012 continue, the RP in Montenegro is to increase by a total of 10% by 2020, but this is a consequence of GDP growing faster than DMC rather than better quality of resource management. If these trends do not change by 2030, due to the insignificant growth of RP over the subsequent 10 years (2020–2030) those 10 years will have been wasted from the perspective of natural resource management in Montenegro.

- Scenario 2: This scenario enables us to consider consequences of the requirement not to increase the use of natural resources by 2020 and 2030 any further than the average recorded in the period 2005–2012. RP is in a perfectly positive linear correlation with GDP. There is an absolute decoupling of economic growth from resource productivity. However, freezing the use of resources is not a good strategy for as long as resource consumption fosters country's development, especially if this generates more value and if negative environmental impacts are carefully managed i.e. if it is ensured that they do not impair considerably the ecosystem stability and resilience.

- Scenario 3: Annual DMC growth rates are considerably lower than the annual real GDP growth rates, although both result in an increase in the figures concerned. This scenario suggests a relative decoupling of economic growth from the use of natural resources. This is a desirable scenario for Montenegro, which may reach relative decoupling by modernizing its economy and formulating explicit policy aimed at reducing resource intensity. This scenario also reveals that an annual average increase in RP of 3% results in rather moderate average annual changes in DMC (0.4% by 2020 and 0.3% by 2030 compared to the average in the period 2005–2012), which leads to the conclusion that this scenario is not based on strict and ambitious policies that would intensify the decoupling mentioned above.

- Scenario 4: If Montenegro wishes to improve resource productivity and thus improve resource management the scenario with the target set in this way represents a proper framework. Reducing DMC by a tonne per capita would present an enormous challenge, though it seems more likely that this target will be achieved over an eighteen-year period (by 2030) since an average annual reduction of DMC by 1.1% would be more realistic to achieve. Therefore, scenario 3 does not represent a sufficient framework for making considerable progress in the use of resources in Montenegro; instead, it should be done in line with scenario 4.

- Scenario 5: The challenge remains to compare this scenario for Montenegro with the relevant indicators of countries with long and high-quality traditions which, at this point, have already achieved considerable results in terms of efficient use of resources. This scenario is not unattainable for such countries.

According to the scenarios description and results, we conclude that scenario 4 is the optimal one to be a targeted scenario. This scenario comprises of an active and ambitious natural resource management policy in Montenegro. By 2020, Montenegro would achieve an absolute reduction in the use of material resources by 20% compared to the average value recorded in the period 2005–2012.

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APPENDIX

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Scenario 1: "Business as Usual"

SCENARIO 1: The average values of GDP and DMC in the period 2005–2012 projected on the basis of trends from that same period)				
2020				
Amount: GDP: DMC: RP:	 €3,473 million **3 767 632** t (**5.9** t per capita) **922** €/t	Growth: 28% 16% 10.3%	total 3.5% 2% 1.3%	annually
2030				
Amount: GDP: DMC: RP:	 €4,423 million **4 417 224** t (**6.7** t per capita) 1 001 €/t	Growth: 63% 36% 19.9%	total 3.5% 2% 1.1%	annually
Calculated data do not reflect actual levels of DMC and RP for Montenegro, they should not be used as final values.				

Source: Author's calculation

Scenario 2: Freeze the natural resources use

SCENARIO 2: The use of resources is frozen at the level of average from the period 2005–2012 ($DM_{2020} = DMC_{2005–2012}$)				
2020				
Amount: GDP: DMC: RP:	 €3 473 million **3 247 959** t (**5.1** t per capita) 1 069 €/t	Growth: 28% 0% 28%	total 3.5% 0% 3.5%	annually
2030				
Amount: GDP: DMC: RP:	 €4 423 million **3 247 959** t (**5.0** t per capita) 1 362 €/t	Growth: 63% 0% 63%	total 3.5% 0% 3.5%	annually
Estimates of DMC and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.				

Source: Author's calculation

Scenario 3: Modest resource productivity growth

SCENARIO 3: Resource productivity growth by 3% per year				
2020				
Amount: GDP: DMC: RP:	 €3 473 million **3 352 731** t (**5.2** t per capita) 1 036 €/t	Growth: 28% 3.2% 24%	total 3.5% 0.4% 3.0%	annually
2030				
Amount: GDP: DMC: RP:	 €4 423 million **3 437 774** t (**5.2** t per capita) 1 286 €/t	Growth: 63% 5.8% 54%	total 3.5% 0.3% 3.0%	annually
Estimates of DMC and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.				

Source: Author's calculation

Scenario 4: Moderate reduction in the use of resources

SCENARIO 4: Absolute reduction in the use of resources by 20% compared to the average in the period 2005–2012				
2020				
Amount:		Growth:	total	annually
GDP:	€3 473 million		28%	3.5%
DMC:	**2 598 367** t (**4.0** t per capita)		-20%	-2.5%
RP:	1 337 €/t		60%	7.5%
2030				
Amount:		Growth:	total	annually
GDP:	€4 423 million		63%	3.5%
DMC:	**2 598 367** t (**4.0** t per capita)		-20%	-1.1%
RP:	1 702 €/t		103.8%	5.8%
Estimates of DMC and RP are indicative, based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.				

Source: Author's calculation

Scenario 5: Dramatic reduction in the use of resources by 2050

SCENARIO 5: Halve the use of resources by 2050 ($DMC_{2050} = \frac{1}{2} DMC_{2005–2012}$)				
2050				
Amount:		Growth:	total	annually
GDP:	€6 322 million		133%	3,5%
DMC:	**1 623 979** t (**2.5** t per capita)		-50%	-1,3%
RP:	3 893 €/t		366%	9,6%
Estimates of DMC and RP are indicative, and they are based on a certain number of prerequisites in cases of incomplete data which is why they should be used only for illustration purposes.				

Source: Author's calculation