RESOURCE EFFICIENT & CLEANER PRODUCTION POLICY:
FOSTERING GREEN INDUSTRY
IN UKRAINE

BACKGROUND REPORT - 2017

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Designed by Athena International/Omnilang (Mauricio Mondragon & Maria Grineva).
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RECP – A TOPIC VALUABLE FOR UKRAINE
The economic, social and environmental context in Ukraine

Ukraine is a sovereign state in Eastern Europe with an area of 603,628 km² and a population of roughly 45 million, which makes it the largest Eastern European country, and the fifth largest country in Europe. From 2000 to 2016, the country showed an increase in GDP of 39%, reaching a per-capita GDP of 2,900 US$ (constant 2010), which was only about 8% of the average EU-28 per-capita GDP and one of the lowest of Eastern Europe and Central Asia (World Bank, 2017b).

Looking at the structure of the Ukrainian economy it becomes apparent that the service sector is responsible for about half of the overall value added created, followed by industry (~40%), and agriculture with about 10%. The two specific sectors contributing the highest share of overall value added are agriculture and defence – with about 10% each of the overall value added created. These are followed by the power sector (8%) and the coal sector (6%). Education accounts for about 4% of total value created (Lenzen et al., 2012).

2016 was a year of modest recovery after economic downturn in the previous years, thanks to decisive reforms as reaction to unprecedented shocks in 2014 and 2015. Value added of agriculture grew by 6% in 2016. Also other sectors showed considerable growth rates, though starting from low levels – for instance, construction by 16.3%, manufacturing by 3.6%, and transport by 3%. A strong rebound from previous years could be seen for fixed capital investment (increase by 20% in 2016), e.g. for manufacturing equipment and imported capital goods. However, as some parts of the services sector, including education, health, and financial services remain rather weak, the overall pace of recovery remains modest (World Bank, 2017b).

With regard to the overall development of the society, the Human Development Index (HDI) of the United Nations combines data on economic wealth, life expectancy and national education levels into one index, where 1 is the maximum to be reached. For Ukraine in the year 2015, the HDI was calculated at 0.743, meaning that Ukraine ranked 84 of all countries in the world (UNDP, 2016). The HDI was increasing since the year 1995, and only from 2014 to 2015 showed a slight drop to arrive just below the threshold for ‘high human development’.

Another index related to social development is the Poverty Index of the World Bank, which shows the percentage of the population living below the national poverty line. In 2015, for Ukraine this value is calculated as 6.4%, signifying a considerable improvement since the early 2000s and a slight improvement since 2008 (World Bank, 2017b).
As identified in its National Environmental Strategy 2020 (NES; Government of Ukraine, 2010) Ukraine is facing a number of environmental challenges. According to the NES, in 2012, 22 cities were characterized by very high and high combined air pollution levels, with nitrogen oxides (NOx), carbon oxide (CO), sulphur dioxide (SO2), and particulate matter being the key air pollutants (World Bank, 2016).

Almost all surface and ground water resources are polluted, with the main sources of pollution being the discharge of contaminated municipal and industrial waste water, polluted runoff water from built-up areas and farmland, and soil erosion in water recharge areas (NES; Government of Ukraine, 2010).

Box 2 Environmental challenges in Ukraine

- Air pollution
- Water pollution
- Waste production
- Forest management
- Climate change

Another environmental challenge in Ukraine is waste management. The risk of ecological accidents is considerable due to large accumulations of toxic wastes from the mining sector, the chemical and metallurgical sector, machine building, the energy sector, wood pulp and paper production, and agriculture. In addition, it is estimated that between 220–350 kg of municipal solid waste is generated per capita and year, of which only 5-7% is recovered, in comparison to about 60% in the EU (World Bank, 2016).

Over 15% of Ukraine’s land area is covered by forests mainly in the northern and western parts of the country (NES 2020). While reforestation is poor, forest contamination is increasing rapidly, and protection from pests and tree diseases is minimal. By 2012 Ukraine emitted 405 million tonnes of CO2 equivalents – a reduction by 58% since the year 1990 (World Bank, 2017b). This reduction was a result of the closing of coal fired power stations, steel mills and high energy consuming industries as a consequence of economic problems. The key sectors for emissions of greenhouse gases in Ukraine, are energy (78%), industrial processes and product use (21%), agriculture (9%), land use, land-use change and forestry, and waste (4%) (UNEP Agency for Ecological Investments of Ukraine, 2015). Key areas regarding their vulnerability to climate change impacts are agriculture, forestry, and human health (World Bank, 2016).

The OECD recognised the relevance of RE and published recommendations to inform governments and other stakeholders on how to improve RE (OECD, 2004, 2008b). The Council also recognised the importance of taking action at various administrative and economic levels.

In 2011, the European Commission launched its ‘Roadmap to a Resource-Efficient Europe’ (European Commission, 2011c), which signified the breakthrough of the topic on the European political agenda.

With increasing application of the concept, also indicator development accelerated, to enable policy makers to monitor progress and identify priority areas of action (e.g., OECD, 2008a, 2015b). Specific measures to be taken to improve resource efficiency were further condensed in the Circular Economy Action Plan by the European Commission (European Commission, 2015c).

But RECP also plays a crucial role in the context of the Sustainable Development Goals (SDGs), and “Green Industry”. This resulted in the broadening of the definition of cleaner production by including resource efficiency (RE) which is a key element of the transitions towards a Green Industry and, more general, a Green Economy. Since the mid-1990s, the United Nations Industrial Development Organization (UNIDO) and UN Environment have collaborated to foster the global uptake of resource efficient and cleaner production. Under the joint flagship Resource Efficient and Cleaner Production Programme, UNIDO and UN Environment have responded to countries’ growing demand to deliver RECP services to industries (UNIDO and UNEP, 2015).

Box 3 Green Industry and Green Economy

Green Industry means economies striving for a more sustainable pathway of growth, by undertaking green public investments and implementing public policy initiatives that encourage environmentally responsible private investments (UNIDO, 2017b). A Green Economy results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient and socially inclusive (UN Environment, 2017b).

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Inclusive and sustainable industrial development

A new vision of inclusive and sustainable industrial development (ISID) and a new focus on the role of industrialization as a driver for development was established in the Lima Declaration, and adopted by UNIDO’s Member States (UNIDO, 2013). UNIDO is promoting industrial development (ISID) as a tool for creating higher-skilled jobs, for building more inclusive societies, and for safeguarding the environment, while sustaining economic growth (UNIDO, 2014).

Promoting cleaner and resource-efficient pathways to production, and the decoupling of economic growth from environmental degradation and environmental-land interventions in manufacturing industries can be highly effective and significantly reduce environmental degradation. Moreover, clean and efficient energy has progressively become core determinants of economic competitiveness and sustained growth (UNIDO, 2014). Apply resource efficient and cleaner production are a condition for sustainable industrial development, and using resources in an efficient way has enormous social, environmental, and economic benefits (UNIDO, 2015).

Positive economic and environmental impacts of RECP actions

As indicated above, RECP measures are characterized by a number of positive impacts, making this concept a multi-return strategy. In the following the main advantages of RECP actions shall be highlighted.

Increased competitiveness / early mover advantage

Advancing industrial performance with regard to RECP reduces production costs and improves the quality of the product or service output, helping to comply with (future) quality standards. As a consequence, a boost in competitiveness can be expected.

“Resource efficiency allows the economy to create more with less, delivering greater value with less input, using resources in a sustainable way and minimizing their impacts on the environment.” (Roadmap to a Resource-Efficient Europe; European Commission, 2011c)

The 2030 Agenda for Sustainable Development adopted as goal 9 “Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation” confirms the provisions of the Lima Declaration and the relevance of ISID for the new global development architecture.
Resource efficient and cleaner production policy: fostering green industries in Ukraine

Box 4
RECP benefits
- Increased Competitiveness
- Early mover advantage
- Green markets and products
- Less pressure on labour costs
- Less pressure on the environment
- Prerequisite for meeting climate change targets cost-effectively

Reduced import / supply dependence With increased efficiency the overall demand for resources used in production processes can be reduced. As a large extent of the resources needed in the Ukrainian industry is imported from abroad (see Chapter 3), RE leads to a reduction in dependence on imports, which is of special relevance in the case of critical raw materials.

Development of eco-innovative green markets and products RECP is at the heart of so-called “green” products and markets. In combination with policies supporting eco-design as well as circularity and longevity of products, such as the Eco-design Directive of the EU (European Parliament and Council, 2009) or the Action Plan for the Circular Economy (European Commission, 2015a), not only a transition towards a material resource-efficient economy can be supported, but also new markets, products and jobs can be created.

Less pressure on labour costs A reduction of production costs through decreasing resource inputs relieves the pressure to save costs via an increase in labour efficiency (i.e. through reducing the number of employees). As a consequence, employment rates can be increased or at least kept stable.

Reduction in resource inputs / pollution outputs – less pressure on the environment Resource efficient and cleaner production leads not only to a reduction on the input side of industrial processes, but also on the output side – meaning less waste, waste water, and emissions. By that means, pressure on the environment can be considerably relieved.

Resource efficiency and climate change In a recent report by the International Resource Panel of UN Environment it was shown that improved resource efficiency is key for meeting climate change targets cost-effectively (UNEP, 2016). Hence, RE is not only a multi-return strategy in this regard, but RE is also a prerequisite for achieving climate targets in a cost-effective way.

Potential values of RECP for Ukraine Setting a reinforced policy focus on RECP in the current economic, environmental, and political setting in Ukraine will have multiple positive impacts on the country. As will be seen especially from the international comparison in Chapter 3, Ukraine still has a lot of potential for improving its RECP performance, which at the same time signifies that short-term positive effects can be expected.

Compliance with (international regulations) – cost savings Ukraine is a party to the UN Framework Convention on Climate Change and the Paris Agreement, which provides provisions and quantitative commitments for energy efficiency and the implementation of measures aimed at reducing anthropogenic emissions of greenhouse gases. Ukraine prepared its Intended Nationally-Determined Contribution to a New Global Climate Agreement (INDC), committing itself to not exceed 64% of 1990 GHG emissions level in 2030. By applying RECP achieving this commitment becomes more likely. But also on the national level, improved environmental performance will decrease damage to the environment and consequently to the national economy and society.

Box 5
RECP in Ukraine
- Cost savings
- Innovation and creation of new markets
- Competitiveness
- Decoupling
- Decreased pressure on stumbling industries

Fostering innovation and creation of new market opportunities A transformation towards a green economy requires re-thinking prevailing processes and practices as well as product design and life cycles as a whole. Supported by specific policy measures, this will trigger innovation processes which will lead to new products and services opening up new market opportunities. Ukraine’s excellent educational system constitutes a fertile ground to trigger, support and accompany research and innovation initiatives.

Increase competitiveness of Ukraine’s industry As mentioned above, RECP helps to reduce production costs and to improve the quality of the product or service output. By that means competitiveness increases. Even more so in cases where new firms are created and development of technological capacity can be realised, allowing to “leap-frog” resource intensive production and consumption systems.

Improved performance regarding headline indicators such as resource efficiency, decoupling, waste/cap, emissions/cap

The decreased input of natural resources into the economic system can be monitored easily with the help of the main headline indicators such as resource efficiency, decoupling, waste/cap, or emissions/cap. By that means, it can be evaluated to what extend Ukraine manages to catch up with other countries that already applied RECP for a longer period of time.

Box 6
Benefits of resource efficiency according to the International Resource Panel
- Reduce per capita natural resource use globally by 28 % in 2050 relative to existing trends, when combined with ambitious global action on climate change
- Reduce global GHG emissions by up to 20% in 2050 compared with existing trends
- More than offset the near-term economic costs of ambitious climate action
- Deliver annual economic benefits of more than US$5,200 billion globally in 2050 relative to existing trends

Decreased pressure on stumbling industries In many cases, industries with declining economic performance, such as the aerospace industry, metallurgy and manufacture of finished metal products, or the chemical and petrochemical industry in the case of Ukraine, are also those with inefficient processes leading to higher production costs or taxes to be paid. Improved production processes in terms of more efficient use of resources will hence decrease the pressure on these industries.
BRIEF ANALYSIS DESCRIBING THE ENVIRONMENTAL REGULATORY FRAMEWORK
Political challenges

Environmental protection in a country is strongly dependent on the overall system of public governance. Ukraine has inherited a certain environmental governance system from its communist past and faces a number of challenges. In 2014, Ukraine adopted a decentralization reform aiming to empower local governments. In its Regional Development Strategy – 2020 three key goals are identified: (1) enhancing regional competitiveness (11 indicators including: reduction of energy consumption by industries and residential sector for 10%, by water supplying companies for 7.6%; reduction of the heat losses by enterprises of housing and communal services for 3.33 percentage points; reduction of the water losses by enterprises of housing and communal services for 5.68 percentage points), (2) territorial socio-economic integration and spatial development (3) indicators including: increasing the number of renovated boiler houses using renewables for 258%; reduction of the length of obsolete heat supplying and water supplying pipelines in 5 times; increasing share of recycled wastes in total amount of wastes for 14.7 percentage points), and (3) effective governance of regional development (3 indicators) (Government of Ukraine, 2014).

Institutional capacity and functions of environmental management were affected considerably by these administrative reforms, as regional departments were abolished and their functions transferred to the state administrations. As a consequence, environmental information and databases as well as experienced personnel got lost and gaps in implementation of environmental policy and legislation were created (World Bank, 2016).

Moreover, apart from achieving appropriate collaboration and distribution of functions between the national and regional levels, there is the need to integrate environmental issues at the sectoral policy level, to build the relationship between the state authority and civil society and to enhance transparency and broader public participation (World Bank, 2016).

Environmental policy making in Ukraine

The general background for national policy and actions for environmental protection and their integration into economic reforms in Ukraine was built by the “Main Directions of the National Policy of Ukraine for Environmental Protection, Natural Resource Use and Environmental Safety” (“Main Directions”) adopted in 1998. On this basis a number of state targeted programs were adopted during 1999–2011, such as the “State Programme on the Development of Mineral & Raw Materials in Ukraine till 2030” (2011) or the “State Programme “Forests of Ukraine” for 2010–2015” (2009) (Centre for RECP Ukraine, 2017; World Bank, 2016).

However, the most prominent strategy to address prevailing environmental challenges is the National Environment Strategy 2020 (NES; Government of Ukraine, 2010). In the NES key environmental challenges are identified and priorities are assigned to air quality, water and land resources, forests and biodiversity, waste management and biosafety. Seven strategic goals encompass 104 strategic tasks. The implementation progress of the NES was evaluated by means of a civil society review in 2015 showing different levels of success with regard to the implementation of the strategic tasks (Table 1).

For the different priority areas targets are identified. Table 2 summarises the targets for each area.

To implement the objectives of the NES, the National Environmental Action Plan 2011–2015 (NEAP) was adopted in 2011. It describes 278 measures for implementation during its five-year period.

In addition, the Ministry of Ecology and Natural Resources of Ukraine prepared and announced a “Draft law on basic principles (strategy) for state environmental policy of Ukraine for the period of 2020” (Government of Ukraine, 2017). The draft law focuses on the importance of resource-efficient technologies and...
cleaner production implementation in the industrial sector of Ukraine. Emphasis is put rather on resource efficiency than only on energy efficiency as well as on insufficient investment mechanisms for new resource-saving and environmentally friendly technologies in environmentally hazardous industries, and also on the significance for cleaner production implementation in the extractive and processing industries. The draft law recommends elaborating and implementing economic and financial mechanisms that would promote positive fiscal, loan and investment environment to facilitate fund raising from the private sector as well as finding donors for further implementation of cleaner production, resource and energy saving technologies.

Realising the need for coherence not only among environmental policies but also between environmental policies and policies in other sectors, apart from creating the system of economic incentives for the implementation of resource efficient options, the RECP Centre together with its partners and respective institutions initiated the elaboration of the draft of amendments to some existing regulations/laws in Ukraine related to the promotion and support of energy and resource efficient production, waste prevention and reduction.

The draft of amendments provides about 20 explicit suggestions how to arrive at an improved integration of policies, such as mandatory usage of sectoral standards and regulations, waste separation, tax incentives, or tax credits (Centre for RECP Ukraine, 2017). Among the sectoral strategies where amendments in terms of integrating environmental with e.g. economic or societal aspects are necessary (see Box 7) one of the most relevant is the National Target Economic Programme for Industrial Development for the period up to 2020 (Government of Ukraine, 2013), which includes the aim to reduce energy consumption in industrial enterprises by means of the modernization of the energy-consuming technological equipment. A cross-check if further integration is needed should also be made for the Sustainable Development Strategy “Ukraine 2020” (Government of Ukraine, 2013), where in various of the defined reform vectors environmental or RECP related programmes are included; for instance, the Energy Efficiency Programme in Vector 1 (Development), the Environmental Protection Programme in Vector 2 (Security), or the Innovation Development Programme in Vector 4 (Pride).

Such integration requires close collaboration between ministries and organizations and detailed reviews of the legislative and normative acts. To implement changes, the consent of the Ministry of Economic Development and Trade of Ukraine, the Ministry of Finance of Ukraine, the Ministry of Ecology and Natural Resources of Ukraine, the Ministry of Regional Development, Construction and Housing and Utility Services of Ukraine is needed.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Goals in National Environment Strategy 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal No.</td>
<td>Goal</td>
</tr>
<tr>
<td>1</td>
<td>Promotion of public environmental awareness</td>
</tr>
<tr>
<td>2</td>
<td>Improvement of ecological situation and promotion of environmental safety</td>
</tr>
<tr>
<td>3</td>
<td>Achievement of a safe level of environmental conditions for the population health</td>
</tr>
<tr>
<td>4</td>
<td>Environmental policy’s integration and improvement of integrated environmental management system</td>
</tr>
<tr>
<td>5</td>
<td>Cessation of losses of biological and landscape biodiversity, and creation of environmental network</td>
</tr>
<tr>
<td>6</td>
<td>Provision of environmentally balanced nature management</td>
</tr>
<tr>
<td>7</td>
<td>Capacity increase in using renewables and alternative energy sources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Priority areas and related targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Area</td>
<td>Target 2015</td>
</tr>
<tr>
<td>Air protection</td>
<td>Reduction of air emissions from stationary sources by 10%</td>
</tr>
<tr>
<td></td>
<td>Reduction of usage of energy sources with low level of carbon dioxide (CO₂) emissions in the energy sector by 10%</td>
</tr>
<tr>
<td>Water resources</td>
<td>Reduction of municipal wastewater pollution by 15%</td>
</tr>
<tr>
<td>Waste management</td>
<td>Increase of municipal solid waste storage capacities by 70%</td>
</tr>
</tbody>
</table>

Available tools and instruments to apply RECP

Some of the available tools and instruments to apply and realise environmental policy making for RECP are mentioned in the NES (Government of Ukraine, 2010). They refer to different levels of societal activity – the political, economic, and scientific level. Some of these measures...
Table 3
Tools and instruments to apply RECP

<table>
<thead>
<tr>
<th>Tool/instrument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersectoral partnership</td>
<td>Realising coherence not only among environmental policies but also between environmental policies and policies in other sectors.</td>
</tr>
<tr>
<td>Target setting</td>
<td>Defining targets to be reached until a specific year ensures planning reliability for enterprises as well as monitoring the distance to target for policy makers.</td>
</tr>
<tr>
<td>Best practice examples</td>
<td>By awarding e.g. a price to best practice examples, incentives (publicity) for front runners are provided, and others start to follow.</td>
</tr>
<tr>
<td>Licensing system</td>
<td>Such as system ensures that companies emit only an environmentally healthy amount.</td>
</tr>
<tr>
<td>Environmental impact assessment (EIA)</td>
<td>EIA is crucial for the ex-ante evaluation of possible negative environmental impacts and the decision if a planned project is environmentally viable.</td>
</tr>
<tr>
<td>Environmental audit</td>
<td>Analogous to financial audits, environmental compliance or management system implementation gaps should be identified, to develop corrective actions.</td>
</tr>
<tr>
<td>Labelling</td>
<td>Labelling systems’ benefits are manifold: producers increase their knowledge about product properties and supply chains; consumers have the possibility of comparison.</td>
</tr>
<tr>
<td>Standardization and reporting</td>
<td>By means of standardisation regarding resource input, emissions (discharges) into the environment, waste production, etc. pressures on the environment can be decreased sector wide.</td>
</tr>
<tr>
<td>Economic and financial mechanisms</td>
<td>Tax incentives: for enterprises using secondary materials, resource efficient technologies and/or equipment, low-waste technologies, waste recycling technologies, etc. Penalties: in combination with measures identified before, such as auditing, standardisation, etc. Emission certificates: to limit overall emissions to a certain amount, in compliance with (inter) national regulations.</td>
</tr>
<tr>
<td>International collaboration</td>
<td>On the policy level, collaboration can result in institutional exchange as well as financial support. On the company level, by means of business partnerships knowledge and technological advancement can be shared.</td>
</tr>
<tr>
<td>Research and innovation (R&amp;I)</td>
<td>Fostering R&amp;I is essential to enhance innovation and new technologies – e.g. by means of business-science partnerships.</td>
</tr>
<tr>
<td>Education / information</td>
<td>Reporting to relevant authorities and customers to improve decision making; Increase media coverage of environmental performance of specific products or sectors to increase awareness; Educate population on benefits of recycling; Improve public access to information to ensure transparency.</td>
</tr>
</tbody>
</table>

Table 4
Tools and instruments and their indicative level of implementation in Ukraine

<table>
<thead>
<tr>
<th>Tool/instrument</th>
<th>Level of implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersectoral partnership</td>
<td>+/±</td>
</tr>
<tr>
<td>Target setting</td>
<td>●</td>
</tr>
<tr>
<td>Best practice examples</td>
<td>●</td>
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</tbody>
</table>

Source: Lytvynchuk, 2017; UNIDO and UNEP, 2015; World Bank, 2016

The need for better RECP regulations

In the following Table 4 an evaluation regarding the level of implementation of possible measures, as identified before, is provided. Table 4 illustrates that there is still large potential in various areas of environmental policy making and management to steer Ukraine in a more sustainable direction, most importantly, in the areas of economic and financial mechanisms, environmental audit and research and innovation. Also, an assessment of the NES’s implementation showed that the foreseen development and implementation by 2015 of incentives for enterprises to introduce clean technology production, various energy-efficient and environmental measures, corporate social responsibility, and environmental audit and certification to stimulate Private Sector Engagement in Environmental Management was not achieved (World Bank, 2016).

These results lead to the overall conclusion that a more comprehensive RECP regulation is needed, as it would be an appropriate response to the requirements as identified in the NES, while making the Ukrainian industry fit for future challenges.

Tools and instruments to steering environmental performance in Ukraine
THE STATUS QUO OF NATURAL RESOURCE USE AND DECOUPLING IN UKRAINE
In this chapter the results of an analysis of the use of material resources in Ukraine at national and economic sector level are shown. The analysis is based on the new UN Environment dataset on material flow analysis (UN Environment, 2017a) which covers the years 1970-2014 – and is extended by estimations to the current year of 2017. For the case of Ukraine, the time series will cover the years 1992-2017. Material use is aggregated into four main groups: (1) fossil fuels, (2) metal ores, (3) industrial and construction minerals, and (4) biomass. Based on this data set, an analysis of the direct material flows related to Ukraine’s economic activities is performed, using the indicators of ‘Domestic material extraction’ and ‘Domestic Material Consumption’.

In addition, an environmental-economic model, i.e. the multi-regional input-output (MRIO) model ‘Eora’ (Lenzen et al., 2013) is applied in combination with the above mentioned UN Environment data set on material flows to calculate materials embodied in Ukraine’s foreign trade and final demand. Thereby, the so-called ‘material footprint’ indicator can be illustrated. The Eora model covers 26 aggregated economic sectors and the years 1992-2013 (see Annex).

**Domestic material extraction**

Domestic extraction of raw materials in Ukraine starts with an accentuated decline at the beginning of the time period in the early 1990s, from more than 700 million tonnes at the time of independence in 1992 to almost half of this level in the year 1999 (Figure 1). Extraction of minerals declined by 75%, and fossil fuel extraction by almost 50%. This development is strongly related to the development of the GDP and reflects the economic downturn in the first years of independency.

With increasing income and wealth, also domestic material extraction accelerated, and continued to rise until 2013 – apart from the noticeable downturn around 2009/2010 due to the financial crisis. Only in recent years the growth in domestic extraction slightly slowed down, but continuing current trends would imply that in a few years from now, 1992 levels
will be reached again. Biomass has the largest share in domestic extraction in Ukraine with about 55% in 2017, of which 40% was crop harvest; followed by non-metallic minerals (23%) and fossil fuels and metal ores with about 10% each.

**Domestic Material Consumption (DMC)**

While domestic extraction is a proxy for a country’s wealth in natural resources as well as the pressure exerted on the domestic environment due to agricultural and mining activities, the quantification of an economy’s resource requirements has to include the associated trade flows. A standard indicator for such an analysis is Domestic Material Consumption (DMC), which adds the weight of direct imports to the weight of domestic material extraction and subtracts the weight of exports. It is calculated as:

\[
\text{DMC} = \text{DE} + \text{IMP} - \text{EXP}
\]

Hence, DMC is an indicator of local pressures due to material use within a specific economic system as well as of the dependence on direct imports, with the trade flows consisting of raw materials, semi-manufactured products, or final products.

The DMC currently is the most prominent indicator for quantifying resource use. GDP/DMC is the headline indicator of the EU’s Roadmap to a Resource Efficient Europe (European Commission, 2011c) and is also one of the indicators used for the monitoring of the Sustainable Development Goals (SDGs; United Nations, 2015).

Ukraine’s DMC shows a similar trend compared to its material extraction pattern (Figure 2). DMC strongly declined until the year 1999, in particular due to a decrease in mineral DMC and fossil fuel DMC, and regains strength since then. However, the overall amounts are lower compared to those for domestic extraction. This means that over the whole time period Ukraine served as a net-exporter of natural resources, i.e. the weight of the exported resources and products exceeded those of the imports. Also, Ukraine’s trade relations slightly shifted the shares of the specific material groups in total DMC compared to the composition of domestic extraction. In 2017, the shares of biomass and fossil fuels increased to about 60% and almost 15% respectively, while the share of metal ores decreased to below 5%.

**Material Footprint (MF)**

The DMC allows for quantifying the amount of materials actually extracted, processed and consumed within a country. However, an apparent improvement of material productivity measured as GDP divided by DMC can be achieved by shifting extraction activities abroad and importing processed materials, while in reality levels of final demand for products and services of the respective country can remain unchanged or even increase. In comparison to DMC, the indicator ‘Raw Material Consumption (RMC)’ is more comprehensive, as the direct imports and exports are converted into so-called raw material equivalents (RME). Following the concept of RME, an imported product is not only accounted for by its actual weight but also by the weight of all materials needed along its production chain. Hence, the “indirect” material flows of the imports and exports are considered (Lutter, 2016). The RMC indicator has also been termed “material footprint” (MF) (Giljum et al., 2015; Wiedmann et al., 2015). The RMC is calculated as:

\[
\text{RMC} = \text{DE} + \text{RME}_{\text{exp}} - \text{RME}_{\text{imp}}
\]

In contrast to the DMC, the MF avoids distortions brought about by outsourcing, as both domestic material extraction and imports are measured on a comparable basis. This is why it is currently discussed as a potential headline indicator on the European level for setting targets for resource productivity in the context of the EU Roadmap (European Commission, 2014) or providing demand-based indicators of material flows in the context of the OECD Green Growth Indicators (OECD, 2014).

Box 8

Material Footprint

The Material Footprint is a consumption-based indicator for raw material requirements of an economy. It takes into account all the materials needed along the supply chain of a specific product. It is calculated as the sum of domestic extraction and imports in raw material equivalents (i.e. upstream requirements) minus exports in raw material equivalents.

Material Footprint (MF) by major material categories

One way of looking at the MF of a country is to analyse the materials embedded in the goods and services of final demand in a country with regard to the main material categories (Figure 3). As Figure 3 illustrates, Ukraine’s MF is characterised by a large share of biomass in its overall MF. It accounted for almost two thirds (65%) in 2013, followed by fossil fuels with almost 20%, and minerals with 13%. This large share of biomass is characteristic for a country where still a large share of household consumption is dedicated to food stuff and biomass-based products. In countries with higher income levels, biomass plays a relatively smaller role. For instance, in Germany, the MF is composed of 44% minerals, 33% fossil fuels; and only 20% biomass, reflecting a higher level of consumer goods which require large infrastructure and energy for their production (UBA, 2016).

Material Footprint (MF) by sector groups

Apart from the disaggregation by material group also the analysis regarding the MF by sector groups provides a relevant insight in a country’s MF. This kind of analysis (Figure 4) is closely related to the one before, though. Ukraine’s MF is dominated by two sectors – ‘Agriculture’ and ‘Products based on biomass’. These two sectors are mainly responsible for the large consumption of biomass as seen in Figure 3.
Material Footprint (MF) by category of final demand

Investigating the MF of Ukraine by category of final demand also delivers a physical depiction of the Ukrainian socio-economic structure (Figure 5). The first characteristic is the dominance of household consumption with regard to material consumption. More than 80% of the materials finally consumed in Ukraine ended up in household consumption in the year 2013. This category was followed by gross fixed capital formation (9%) and government consumption (5%).

This picture reflects very well the economic situation in Ukraine, where household consumption expenditure (in monetary terms) accounts for even 87% of final demand. It can be expected that with increasing investment in machinery for industry as well as with investments by the government in infrastructure, health and security, the share of household consumption will gradually shrink in the future. For instance, in Germany, private household consumption is responsible for only about 50% of the country’s MF, and gross capital formation for 26% (UBA, 2016).

However, especially the shares below 50% indicate that there are a number of countries delivering significant shares to the overall Ukraine MF (Figure 6). For fossil fuels among the main suppliers is Turkmenistan, for minerals it is China, Turkmenistan, and Turkey, and with regard to metals, among others, Kazakhstan, China, and Poland play the most dominant roles. These figures show that Ukraine is to a large extend dependent on its close neighbours, which is still a heritage from former times.
Resource productivity/efficiency and decoupling trends

Comparing GDP with DMC and MF

Aggregated material flow-based indicators are particularly useful for monitoring of broad, overarching policy goals and targets, such as those defined in the context of the SDGs. Most notably, the aggregated indicators allow measuring the overall physical size of an economy and identifying its main constituents in terms of material groups. Further, the aggregated indicators can be set in relation to economic indicators, allowing to assess the overall material productivity and decoupling performance of an economy.

Using the productivity indicator GDP/DMC policy questions such as (1) how much economic value is being generated by a unit of material consumed by the domestic economy or (2) whether an economy achieved a decoupling between economic growth and direct resource use, can be answered. As mentioned above, GDP/DMC is the headline indicator of the EU’s Roadmap to a Resource Efficient Europe (European Commission, 2011c) and is also one of the indicators used for the monitoring of the Sustainable Development Goals No. 8 (Decent Work and Economic Growth; target 8.4) and No. 12 (Responsible Consumption and Production; target 12.2) (SDGs; United Nations, 2015), while for both strategies the use of the MF is currently being discussed. Applying the indicator GDP/RMC broadens the picture and illustrates how much economic value is created per material input along all supply chains and whether decoupling has been achieved. Obviously, the two indicators show different results, as clearly visible for the case of Ukraine (Figure 7).

For Ukraine, the left side of Figure 7 shows a decrease in DMC since the year of independence until the year 1999, followed by a recovery until the year 2013 – with some interruptions, e.g. due to the world economic crisis. GDP took a similar path, but recovered faster, leading to a so-called “relative decoupling”. This means that GDP grew faster than direct material use (see Box 9). However, from 2007 onwards, the overall tendency showed a “re-coupling”, with material use growing faster than GDP. Regarding the GDP curve, it is straight forward to recognise the economic crisis in 2009 and the consecutive economic stabilisation afterwards – although GDP remained below pre-2009 levels, DMC shows a considerable oscillation in recent years. One also recognises the impact of the economic crisis and a general upwards trend afterwards. The worsening productivity (GDP/DMC) can be explained by a slowdown in growth of physical exports in recent years.

In contrast, when looking at the MF in comparison to GDP (right side of Figure 7), Ukraine’s MF did not decrease as distinctively as the DMC (by ~40% vs. ~8%), and grew up to 160% of the 1992 levels in 2013. This development resulted in a decrease in material productivity (i.e. re-coupling) from the year 2003 onwards. This accentuated difference when comparing DMC and MF with GDP trends illustrates very well the difference between the two indicators. Although DMC growth has been stalling in recent years, due to the increasingly complex supply chains of products and related augmenting indirect material requirements, the MF continues showing a very steep upward trend.

Both perspectives illustrate clearly the strong need for policy measures in Ukraine in order not only to return to an increase of material productivity, but also achieve a decrease in absolute material consumption levels. Aiming at decreasing absolute levels of material consumption can be seen as a multi-return strategy, as it results in a reduction of production costs, of dependency on foreign material supply as well as of negative related environmental and social impacts. Achieving this with simultaneous economic growth
is called “absolute decoupling” and is considered the overall goal of any resource efficiency strategy (Box 9).

**Box 9**

**Decoupling**

Decoupling means using less resources per unit of economic output and reducing the environmental impact of any resources that are used or economic activities that are undertaken (UNEP, 2011). While “relative decoupling” is achieved, when economic growth is higher than growth of resource use, “absolute decoupling” signifies achieving economic growth, while at the same time reducing resource use.

**Sector value added (VA) vs. sector MF**

When managing resource productivity, an important level of analysis is the sectoral level (Figure 8). This perspective allows first reflections where so-called “hot-spots” may be – areas where immediate action is required. Figure 8 depicts that the most material-productive sector is the sector ‘Financial services’, with about 3 US$ of created value added per kg material consumed. Hence this sector can be described as very efficient in creating value added per unit of raw material required. At the other end are those sectors consuming most materials – “Agriculture and forestry” and “Products based on biomass” (compare Figure 4). While it can be argued that the primary sectors have relatively low potentials to increase their productivity, sectors like “Construction”, “Products based on metals and minerals” or “Products based on fossil fuels” would have to be analysed more in detail, in order to reveal improvement potentials. However, such an analysis requires sub-sectoral and company-based data and is not within the scope of this study.

It is a general pattern that service sectors show a better resource productivity than other sectors, as they depend mainly indirectly on resource inputs. However, it would be too short-sighted to purely focus on establishing a service economy because with increased service-focus dependency on external production increases, and many services (like financial services) only exist due to dealing with products of other sectors without being allocated a share of these sectors’ resource requirements. Hence, as stated at the beginning of this sub-chapter, such an analysis can be seen as a first pointer towards hot spots of action, but has to be used with care.

**International comparison**

**DMC/cap vs. MF/cap**

Figure 9 shows an international comparison of Ukraine’s per-capita DMC and MF with other countries. It is structured into one part with Eastern European and Central Asian countries (left), emerging economies (middle), and two European Union countries as well as the EU-28 average. Three patterns can be observed. First, DMC and MF levels rise in parallel with industrialisation and income levels. Hence, the European averages are higher than for most emerging economies. The differences between per-capita DMC and MF change depending on resource endowments and economic structure of the respective countries. European countries with little endowments and an established service economy show considerably higher MF than DMC. Resource-rich countries like South Africa or Kazakhstan show higher DMC than MF. Lastly, Ukraine has similar per-capita DMC and MF levels and shows higher value compared to other Eastern European and Central Asian countries.

**Summarising the status quo**

The analyses in Chapter 3 illustrated a few core aspects with regard to the Ukrainian economy and its material requirements. Economic growth in Ukraine is closely linked to material inputs. While there is an established manufacturing and heavy metal sector, the largest share of material requirement is related to agriculture and biomass-processing sectors. This clearly demonstrates the still prevailing high relevance of agriculture in Ukraine.

Importantly, while the DMC has been stabilising in recent years, a more comprehensive view on material requirements as realised by the MF shows that the Ukrainian industry and final demand requires growing amounts of raw materials and increasingly depends on raw materials from abroad, especially in the case of metals. Additionally, it can be expected that with ongoing industrial development material requirements will augment even faster than today.

In order to achieve a more sustainable industrial and consequently social development, (absolute) decoupling has to be achieved, requiring pro-active policy design and planning. RECP fits perfectly to this endeavour, as it aims at further developing industrial activity in ways that improve competitiveness and income, while simultaneously reducing material input and environmental impacts (see Chapter 9).
BRIEF ANALYSIS ON INTERNATIONAL POLICY INITIATIVES IN THE AREA OF RECP
In this chapter, a concise summary of international policy initiatives dealing with RECP is provided, focusing on the EU, the G7/G20, the OECD and the UN (SDGs).

**EU policies**

**A resource efficient Europe**

In 2010 the European Commission published the "Europe 2020 Strategy - a strategy for smart, sustainable and inclusive growth" (European Commission, 2010). Among seven flagship initiatives, one addresses the topic of resource efficiency - entitled "A resource-efficient Europe" (European Commission, 2011b). While the flagship initiative provides the overall, long-term framework, more specific actions, benchmarks and targets are identified in the "Roadmap to a Resource Efficient Europe" (European Commission, 2015c). The Roadmap identifies three key sectors where efforts will result in the largest improvements of resource efficiency – food, construction, and mobility.

**Circular Economy Action Plan**

The EU’s Action Plan for the Circular Economy was adopted by the European Commission in 2015 (European Commission, 2015b). It aims at increasing the longevity of products to maintain natural resources used for production and consumption as long as possible within the economy. By that means, the demand for primary material inputs should be reduced considerably. A focus is set on the product design to enhance reparability. On the output side the objective is to minimise waste generation, with one of the foci set on food waste. The expected benefits from "circularizing" materials within an economy are expected not only environmental but especially economic, stimulating growth and the creation of new jobs. This should be achieved by strengthening competitiveness and fostering innovation. Clear targets with regard to waste reduction are set, including recycling rates and landfill limits.

**Box 10**

**Circular economy**

"Looking beyond the current 'take, make and dispose' extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimising negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital" (Allen McArthur Foundation, 2017).

**Eco-Innovation**

The Eco-Innovation Initiative was launched in 2008 as part of the EU’s Entrepreneurship and Innovation Programme (EIP). The EIP was set up to support innovation among SMEs and to improve their competitiveness. The initiative is a tool for the implementation of the EU’s Eco-Innovation Action Plan (EcoAP; European Commission, 2011a). It bridges the gap between research and the market and fosters ideas for environmentally innovative products, services and processes. In doing so the initiative not only should help the EU meet its environmental objectives but should also boost economic growth.

One central pillar of the Commission’s eco-innovation activities is the “Eco-Innovation Observatory (EIO)” which is a platform for the structured collection and analysis of information and data related to
eco-innovation. While the eco-innovation scoreboard allows for comparative analyses of the eco-innovation performance across all EU Member States, the annual reports present the results of in-depth analyses focused on specific topics. For instance, the 2016 report discusses the role of policy for eco-innovation in the circular economy transition (EIO, 2016).

G7

The G7 adopted its first decisions on resource efficiency under German presidency in 2015. These decisions emphasised the importance of resource efficiency for sustainable development as well as the competitiveness of industries, economic growth and employment and called on G7 countries to take ambitious steps to promote resource efficiency at national level. Next to the improvement of resource efficiency, the promotion of sustainable materials management and material-cycle societies were targeted. Also, the G7 Alliance on Resource Efficiency was established as a new forum for cooperation and concrete common activities, such as a workshop held in 2016 to share best practices and identify further opportunities to use life cycle thinking to achieve resource efficiency across supply chains. In order to create a network, the Alliance collaborates with businesses, SMEs and other relevant stakeholders (G7, 2015). The G7 also gave a mandate to UN Environment’s International Resource Panel (IRP) to elaborate a mandate to UN Environment’s International Resource Panel (IRP) to elaborate a synthetic report called ‘Resource efficiency: Potential and economic implications’. The report discusses the potential of decoupling resource use from both material and energy use, and the related impacts from economic growth. It also includes scenarios illustrating the positive effect of resource efficiency regarding achieving the SDGs, climate change targets, and economic growth (UN Environment, 2017).

G20

In 2017, at the G20 summit under the German G20 presidency, a workshop on resource efficiency was organised. The overarching goal of the resulting G20 Resource Efficiency Dialogue is to strengthen countries’ national resource efficiency policies. Germany, supporting strongly for a dialogue on the sustainable use of natural resources, also presented a resource efficiency programme with guiding ideas. Three main topics were elaborated: a closer cooperation and contribution with regard to the SDGs related to natural resources, an improvement of the scientific basis of resource efficiency policies, and the exchange of policy options and good practice examples regarding resource efficiency (G20, 2017).

China

In 2002, China promulgated the law of Promotion of Cleaner Production (Government of China, 2002). It aims at increasing the utilisation ratio of resources, reducing and preventing pollutant-generating, protecting and improving the environment, protecting human health, and promoting the sustainable development of the country and society. Also China has struck the RECP path by implementing the “circular economy promotion law” (Government of China, 2008), the purpose of which is to promote the development of the circular economy, improve the resource utilisation efficiency, protect the environment and realise sustainable development. Also in the previous Five-Year Plan (2011-2015) one of the objectives was to increase resource productivity by 15% (Government of China, 2011).

OECD

The OECD recognises resource efficiency as one of the top priorities in today’s world and has undertaken various initiatives to foster the implementation of related measures. As mentioned above, recommendations to inform governments and other stakeholders on how to improve resource efficiency were published (OECD, 2004, 2008b). Also, in 2008 the OECD-UN Environment Conference on resource efficiency was organised, focusing on specific flows of materials and key sectors (OECD, 2008c). The conference addressed economic efficiency and environmental effectiveness of resource use, corporate environmental responsibility as well as the related development aspects. The need for systemic thinking and approaches was emphasised as being of utmost importance to help reach environmental, economic and social goals. Further, in 2016, the OECD published a policy guidance on the topic of resource efficiency, providing input for the G7 Leaders. The report aims at improving resource efficiency by considering the 3R principle of resource, reuse and recycle (OECD, 2016).

Box 11

RECP in the UN SDGs

Target 8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead.

Target 12.2: By 2030, achieve the sustainable management and efficient use of natural resources.

The following elaborates on measures and instruments which foster RECP and green industries in Ukraine.

SDGs

RECP is also a highly relevant matter with-in the Sustainable Development Goals (SDGs). RECP is related to six out of 12 Sustainable Development Goals, which underlines the relevance of the concept regarding environmental and social issues. Specific mention is made in two SDGs – Goal 8 “Sustainable economic growth, employment and decent work for all”, with the RE-specific Target 8.4, and Goal 12 (Box 11 refers to both), “Sustainable consumption and production patterns” with the RE-specific target 12.2 (United Nations, 2015). Other relevant goals are Goal 6 “Water and sanitation”, Goal 7 “Sustainable and modern energy”, Goal 9 “Industry, Innovation and Infrastructure”, and Goal 13, “Climate change and its impacts” (United Nations, 2016).
Recognising the various benefits as described in Chapter 1, concrete RECP measures have been taken in a large number of countries. In the following three country/region examples will be presented to provide an insight in RECP strategies and measures around the globe. The examples cover Vietnam/SE-Asia, Germany/EU and Guatemala/Latin America.

**Vietnam**

The Asian and Pacific region accounts for more than half of the world’s population, encompassing six of the ten most populous states in the world. In economic terms, the region has achieved unprecedented growth in the past decades. However, rapid growth and demographic pressures have exerted significant stress on environment and natural resources, transforming South-East Asia into a “hot spot” for activities on RECP. With regard to per-capita resource consumption, Vietnam shows patterns of resource use, which are typical for South-East Asia (Figure 10). Starting from very low levels of per-capita DMC in the 1970’s and 1980es, the economic boost of the 1990es and the new Millennium was accompanied by an increase in per-capita consumption up to almost 13 tonnes.

The material category with by-far the highest growth rates is the category of “non-metallic minerals”, i.e. minerals used in particular for construction purposes for building up infrastructure in the housing, energy and transport sectors. The period 1991-2000 showed an annual growth rate of more than 10% in the housing sector, and also the housing fever in 2000/2001 and 2007/2008 had a significant impact on the construction industry growth and development in the decade 2001-2010. In the period of 2011-2013, interest rates rose to 20% per year due to tight monetary policy, which hampered construction investment (Vinh Nguyen, 2015). This development is reflected in the physical data, where the year 2012 saw an abrupt down-turn to almost 9 tonnes, which can be explained by the fact that new investments and construction projects were postponed, as well as private renovation works at home were stopped due to the very high interest rates.

In 1998, the Vietnam Cleaner Production Centre (VNCPC) was established, today located at the Institute for Environmental Science and Technology (INEST) at Hanoi University of Science and Technology. Its mission is to “disseminate the cleaner production concept and promote its development of per-capita Domestic Material Consumption in Vietnam, 1970-2016

**GERMANY**

- Policy on Conservation, Protection and Improvement of the Environment and Natural Resources (2007)
- National Policy of Cleaner Production (2010)
- Resource Efficiency Network established in 2007

**GUATEMALA**

- National Action Plan on Cleaner Production (in industry for period 2001-2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- National Green Growth Strategy (2012)
- Guatemalan Cleaner Production Centre established in 1999

- German Resource Efficiency Programme (2012 and 2016)
- National platform for resource efficiency (NaRess)
- Waste Management Act (2012)
- National green growth Strategy (2012)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- VNCPC established in 1998

**Guatemala**

- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- National Strategy on Cleaner Production (2001-2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- National Strategy on Cleaner Production (2001-2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- National Strategy on Cleaner Production (2001-2005)

**Source:** UN Environment, 2017a
In order to improve the competitive position of the Vietnamese industry in the context of global economic integration*. Since its establishment, the VNCP has made valuable contributions to policy making related to RECP as well as to the dissemination of relevant information. As such, it has been involved in the design of the policy strategies related to RECP in the last almost 20 years (Box 12).

**Box 12**

**Policy strategies in Vietnam related to RECP**

- National Action Plan on Cleaner Production (In industry for period 2001-2005)
- Revised Environmental Protection Law and National Strategy on Environmental Protection towards 2010 and orientation to 2020 (2005)
- CP Strategy in Industry until 2020 (2009)
- National Green Growth Strategy (2012)

The "Cleaner Production Strategy in Industry until 2020" (Government of Vietnam, 2009) encompasses three main "viewpoints". One viewpoint is to raise awareness of the benefits of RECP as well as to encourage and provide technical support. For two periods (2009-2015 and 2016-2020) specific targets regarding awareness and application of and advice on cleaner production are identified. For instance, for the period 2016-2020 it is envisaged that 90% of all industries are aware of the benefits from cleaner production application, 50% of industries apply cleaner production, and 90% of the provincial industry departments are capable of giving CP advice to industries. The more recent National Green Growth Strategy (Government of Vietnam, 2012) sets one of its focuses on "the efficient utilization of natural resources and energy by sectors aiming at achieving higher added values" as well as on conducting researches and enhancing the application of appropriate advanced technologies.

In line with these political developments, from 2012 onwards a series of projects related to RECP started, funded by different international donors such as UNIDO, UN Environment, World Bank, and the EU (Switch Asia). The most recent project "Implementation of Eco-industrial Park Initiative for Sustainable Industrial Development in Vietnam" funded by GEF and SECO and implemented by UNIDO, started in 2015 and has a strong component on in-plant assessment on Resource Efficiency and Cleaner Production" and capacity building.

**Guatemala**

Latin America and the Caribbean is a region with a wealth of resource endowments, especially in the area of metal ores and biomass, but also with respect to fossil fuels and non-metallic minerals. The comparatively low share of biomass harvest with about 50% of the biomass harvest being sugar crops, almost 25% wood, and 10% fruits; followed by non-metallic minerals. The comparatively low share of non-renewable materials in total material consumption is a characteristics of an economy in development, not yet fully industrialised.

Environmental management in Guatemala started in 1986 with the foundation of the National Commission on the Environment, followed by the establishment of the Ministry for Environment and Natural Resources in 2000. Cleaner production is incorporated in various political strategies – like the Environmental Management Framework Policy from 2003 (Government of Guatemala, 2003), or the Policy on Conservation, Protection and Improvement of the Environment and Natural Resources from 2007 (Government of Guatemala, 2007). The next step in the advancement towards industrial development and environmental protection was the "National Policy of Cleaner Production" (Government of Guatemala, 2010), which is defined as a technical tool for competitiveness and preventive environmental management. The objective of this law is to contribute to the improvement of environmental management by introducing ways of production and consumption building on cleaner production. It is seen as a tool to support, align and coordinate the actions of the public and private sector with regard to actions related to the environment. The policy identifies the relevant actors and related strategies to implement RECP, and sketches how to ensure its own sustainability (Box 13). It is the most relevant RECP-related policy in Guatemala.

**Box 13**

**Principles of Guatemala’s National Policy of Cleaner Production**

- Preventing possible negative impacts
- Material efficiency
- Gradual realisation of actions
- Shared responsibility, differentiated among the involved actors
- Improve competitiveness
- Integration with environmental policies
- Participation of all relevant sector

**Figure 11**

Development of per-capita Domestic Material Consumption in Guatemala, 1970-2016

![Development of per-capita Domestic Material Consumption in Guatemala, 1970-2016](source: UN Environment, 2017a)

*Embedded in this political framework is the Fundación Centro Guatemalteco de Producción MÁs Limpia Guatemala - the Guatemalan Cleaner Production Centre – which was established 1999 as a non-profit technical institution. Supported by UNIDO, UN Environment, SECO and national institutions such as the Guatemalan Chamber of Industry Centre, it has 16 years of experience in implementing RECP, giving technical assistance to more than 375 enterprises from different industrial sectors.*
Germany

The European Commission established various policy initiatives targeting the improvement of resource efficiency, in order to decouple resource use from economic growth, in a region where per-capita consumption is among the highest worldwide (see Chapter 3).

Germany as an EU member has taken a leading role in translating the EU requirements into national law. Germany is one of the few countries whose per-capita resource consumption decreased between 1970 and 2016 (Figure 12). In 1971, Germany reached the highest per-capita material consumption with almost 19 tonnes. Since then, the consumption rate decreased, reaching 14.6 t/cap in 2016. The consumption of especially domestic fossil fuels like anthracite or brown coal – has decreased. The share in overall energy production decreased from 57% in 1992 to 42% in 2015. At the same time, while consumption of non-renewable materials decreased, biomass has become more important and its consumption has increased. This represents the picture of an industrialized economy that has a high material consumption but also focuses on sustainable development, in order to reduce overall levels of environmental pressures.

Already in 2002, Germany’s government established the goal of doubling the resource productivity of the German economy between 1994 and 2020 (Deutsche Bundesregierung, 2002). In 2007, the Resource Efficiency Network was established bringing together people from politics, business and science. The ambitious target of the network is to make Germany’s economy the most resource efficient in the world by 2020. In order to reach this target, the German Resource Efficiency Programme was adopted in 2012 by the Federal Government for the years 2012-2015 (ProgRess I; Deutsche Bundesregierung, 2012a). With this Programme Germany was among the first countries determining targets for a decrease in natural resource use and creating a long-term guiding framework. The overarching goal of this programme was to increase resource efficiency, focusing on biotic and abiotic natural resources such as water, air, land, soil, biodiversity and ecosystems. In 2013, a national platform for resource efficiency (NaRess) was set up in order to ensure a dialogue among institutions with focus on management associations (BMUB, 2017). Based on the evaluations of the ongoing progress, the German Resource Efficiency Programme II (ProgRess II) was adopted for the years 2016 onwards; see Box 14 for the guiding principles of ProgRess II (Deutsche Bundesregierung, 2016).

Box 14
Guiding principles of German Resource Efficiency Programme (ProgRess) II

» Principle 1: Combining ecological necessities with economic opportunities, innovation focus and social responsibility

» Principle 2: Viewing global responsibility as a key focus of our national resource policy

» Principle 3: Gradually making economic practices and production patterns in Germany less dependent on primary resources, developing and expanding circular economy

» Principle 4: Securing sustainable resource utilization for the long term by guiding society towards qualitative growth

Figure 12
Development of per-capita Domestic Material Consumption in Germany, 1970-2016

The relatively recent Action Plan for the Circular Economy by the European Commission (2015b) takes the aim to reduce absolute resource use one step further by proposing specific actions how to increase longevity of products (see Chapter 4). It builds to a certain extend on the EU Waste Framework Directive of the year 2008 (European Parliament, 2008) which was translated into German law by means of the Waste Management Act (KrWG; Deutsche Bundesregierung, 2012b). The latter focuses on tightening resource, climate and environmental protection regulations by adopting the ranking of waste management. Setting priorities on waste management strategies helps expanding the lifespan of used resources.
RECOMMENDATIONS TO FOSTER RECP IN UKRAINE
Based on the analyses above a number of recommendations can be derived – for the more general level of environmental policy making as well as for the level of resource efficient and cleaner production (RECP). Regarding the first, in its Country Environmental Analysis for Ukraine (World Bank, 2016), the World Bank strongly recommends to prepare and implement a precise roadmap towards a reform of environmental management in Ukraine, which would specify the different activities for the next 1-2 years. The World Bank suggests to carry out such a reform in close correlation to EU environmental directives, being the best practice example to be followed; all the more in the light of Ukraine’s approximation to the European Union. For this to happen, a first task would be to cross-check whether Ukraine institutions are capable of implementing EU directives. While environmental priorities and especially their linkage to Ukraine’s growth and development agenda have to be identified, the World Bank further recommends to develop a roadmap for the implementation of necessary legislative and regulatory changes, based on Ukraine’s identified priorities and taking into account its commitments under the EU–Ukraine Agreement (World Bank, 2016).

In the light of Ukraine’s ambition on RECP, one priority is to achieve higher resource efficient and cleaner production in Ukraine’s industrial sectors. The analyses in Chapter 3 revealed three “hot spot” areas where RECP measures would yield the largest success.

Sectors of high material intensity

The sectors “Construction”, “Products based on metals and minerals” or “Products based on fossil fuels” show to be specifically material intensive. This means that their relationship between material input and created value added is higher than in other sectors. Thus measures can be targeted towards two different directions: (1) To decrease material inputs, e.g. through substitution of material-intensive raw materials entering production or after production technologies towards higher RE, and (2) To increase value added: e.g. including measures of “up-grading”, i.e. producing products with a higher level of value added. Also, the performance of the sector’s best company can be used as threshold to aim for by the other sector representatives.

Sectors of large material input

Another hot spots are those sectors where in absolute terms the highest levels of material input are reached. This implies that by taking actions in these sectors, the largest amounts of absolute reduction can be achieved. In Ukraine the sectors with the largest material input are “Agriculture and forestry” and “Production of products based on biomass”. Examples from other countries, for instance Germany, show that especially those sectors producing goods on the basis of raw materials tend to achieve higher productivity rates than observed in Ukraine.

Categories of final demand with large material footprint

It’s not only the production side where RECP has to be aimed for, but also the consumption side is of high relevance as it is the trigger of industrial production. Chapter 3 showed that private consumption is responsible for 83% of overall material footprint. Accordingly, by steering private consumption into a direction where RECP products are demanded for, will trigger increased RECP on the production side. Guidance should be provided by the state: on the one hand, via related subsidies and other incentives and on the other hand by acting as archetype. Government consumption is responsible for 5% of final demand for materials. By implementing standards of RECP, as in the case of Austria and its Action Plan for Sustainable Public Procurement (Box 15; Österreichische Bundesregierung, 2010), public procurement can be a powerful lever for both a change in private consumption as well as a change in production processes would be activated.

But it is certainly not only the hot spots which deserve (political) action. A number of powerful measures have been outlined in Chapter 2. Box 16 shows some of them which have shown to be successful in a number of countries. The following elaborates on measures and instruments which foster RECP and green industries in Ukraine.

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“the World Bank strongly recommends to prepare and implement a precise roadmap towards a reform of environmental management in Ukraine, which would specify the different activities for the next 1-2 years. [...] the World Bank further recommends to develop a roadmap for the implementation of necessary legislative and regulatory changes, based on Ukraine’s identified priorities and taking into account its commitments under the EU-Ukraine Agreement (World Bank, 2016).”
Resource Efficient and Cleaner Production Policy: Fostering Green Industries in Ukraine

Box 15
Austria’s Action Plan for Sustainable Public Procurement

The APSSP (2010) identifies a number of focal areas for which criteria on sustainable public procurement were developed, for instance:

- Construction
- Food
- Vehicles
- Furniture
- Cleaning agents

Box 16
Implementing RECP in Ukraine

- Hot spot analysis
- Target setting
- Incentives/penalties
- Standardisation
- Fostering best practice examples
- Research and Innovation

The following elaborates on measures and instruments which foster RECP and green industries in Ukraine.

Target setting:

The European Commission identified the need for target setting as a means to evaluate progress towards the overarching policy goals. According to the Commission, identifying the right indicators and defining a process for broad resource efficiency targets will “help trace the path to the 2050 resource efficiency vision: public policy can be better designed to take into account the costs and benefits of using resources more efficiently and the private sector will benefit from better signals for their investment plans, the necessary predictability and transparency to drive long-term decisions” (European Commission, 2010).

A prominent examples is the resource productivity target as approved by the German Federal Government. Until 2020 resource productivity has to be doubled, in relation to the 1994 levels (Deutsche Bundesregierung, 2002). And in the European Commission’s Action Plan for the Circular Economy (European Commission, 2015b) the Commission identifies commoditization as one target, for instance, for recycling 65% of municipal waste by 2030; and for recycling 75% of packaging waste by 2030.

Environmental tax reform:

Overall, the share of environmental taxes in Ukraine’s overall tax revenue forms approximately 1.3%, compared to EU average of 3.0% (World Bank, 2016). An environmental tax reform consists of changing the national tax system in a way that the tax burden is shifted from labour to environmentally-damaging activities, for instance, unsustainable resource use or pollution. Analyses of policies in Germany and the Netherlands for the European Environment Agency show that such reforms and other environmental policy instruments have broadly positive effects in increasing innovation. Estimates say that wider economic effects of a tax reform created an estimated 250 000 jobs (EEA, 2016).

Eco-innovation:

There is strong evidence that by means of relatively small investments process innovations reducing natural resource use in companies can be increased. Such innovations save material and energy costs and are called “eco-innovation”, which is defined as any innovation that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle. Cleaner production focuses mainly on process innovation that helps to render production more environmentally friendly. It plays a significant part in eco-innovation. However, eco-innovation has a wider notion, as it includes the development of new products, new business models, new behaviour of consumers, and new policies and frameworks (EIO, 2016; Hinterberger et al., 2013).

Foreign direct investments (FDI):

FDI have the potential of creating spillovers contributing to industrial growth and/or industrialisation. Such spillovers can be diffusion of skills in the labour force, of management practices in business, or through the supply of goods to local producers. Moreover, technology and finance can become easier available. For each investment, costs and benefits for a country need to be calculated and must include possible environmental externalities. One precondition for granting FDIs has to be that applied new technologies are better than the average used in the host country (UNIDO, 2016).

Resource pricing & tax exemption:

Environmental taxes allow to take into consideration the market failure of market ignorance environmental impacts. By increasing the price of a good or activity in a way that it reflects the cost of the environmental harm that it imposes on others is internalised into market prices. This ensures that consumers and firms take these costs into account in their decisions (OECD, 2011a).

In addition to increasing the tax burden, another option is to implement tax incentives. In the context of RECP, this would mean to decrease taxes for those enterprises which are using secondary raw materials, resource efficient technologies and/or equipment, low-waste technologies, waste recycling technologies, etc.

Education policy:

For an industrialized, and even more so for a green economy, education policy is an essential building block. Consequently, it is key that education policy raises awareness in relation to the importance of green industries and the economy. Therefore, education stakeholders should partner with industry to ensure that any new concepts are quickly integrated into present-day curricula (UNIDO, 2016).

Although Ukraine has a high-quality education system, increased focus should be set on RECP and green industry. This can start on the high school level, but should definitely be incorporated in the curricula of the undergraduate and Master’s level at universities. By that means scholars learn the main principles of RECP for economic decision making and production planning.

Knowledge and technology transfer:

New technologies and innovations are often outside of the direct control of enterprises and industries. To enhance the development and dispersion of environmental technologies, partnerships, joint ventures, incubators, clusters, science parks and networks are important means. To build their own innovative capabilities and to harness the benefits that new technologies have to offer, in particular SMEs depend on external sources of information, knowledge, know-how and technologies. The role of the government is to enable the setup of new and maintenance of existing linkages between companies, industries and universities. It can do so by providing infrastructures such as science parks, clusters, incubators, and networks etc. It can implement a system of co-funding public-private partnerships for research, or strengthen linkages with global networks. These can be accompanied by suitable policy frameworks in areas such as education, finance, competition and regulation (UNIDO, 2016).

Technical assistance and development finance institutions (DFIs):

Strategic and direct partnerships with development finance institutions (DFIs) are key for achieving inclusive and sustainable industrial development. The objective here is to effectively support larger flows of resources, and thereby to trigger a stronger impact on the ground. For this purpose, UNIDO has elaborated technical assistance interventions. While UNIDO supports in identifying investment opportunities for DFIs and their partner financial institutions, development impact and financial returns of investment by DFIs and other financial institutions can be enhanced by the Organization’s technical assistance services. Moreover, technical assistance can play a key role in facilitating coordination between private and public investment, as public investors can strategically position their investment projects to unlock and promote private investment (UNIDO, 2017a).

Access to working capital:

Green investments can be encouraged by policies that aim to provide long-term finance to investors. Measures to do so are the introduction of cleaner production and green economy criteria or by redenoting the objectives for making this finance available. For instance, credit lines available for specific industrial sectors may be greened by subjecting the investment to requirements such as ensuring that it contributes to a reduction in GHG emissions and a reduction in the use of water, etc (UNIDO, 2016).
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ANNEX

List of 26 sectors of the multi-regional input-output model Eora

1. Agriculture
2. Fishing
3. Mining and Quarrying
4. Food & Beverages
5. Textiles and Wearing Apparel
6. Wood and Paper
7. Petroleum, Chemical and Non-Metallic Mineral Products
8. Metal Products
9. Electrical and Machinery
10. Transport Equipment
11. Other Manufacturing
12. Recycling
13. Electricity, Gas and Water
14. Construction
15. Maintenance and Repair
16. Wholesale Trade
17. Retail Trade
18. Hotels and Restaurants
19. Transport
20. Post and Telecommunications
21. Financial Intermediation and Business Activities
22. Public Administration
23. Education, Health and Other Services
24. Private Households
25. Others
26. Re-export & Re-import