Brandenburg University of Technology Cottbus-Senftenberg
Dnipro University of Tecnhology

Sustainability in the Industrial Sector

Proceedings of the Study Seminar

under the DAAD programme "Eastern Partnerships"
24th December 2020 – 18th January 2021

Dnipro-Cottbus
Accent 2021

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Brandenburg University of Technology Cottbus-Senftenberg
National Technical University Dnipro Polytechnic

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In this compendium of training materials, the authors took into consideration new trends in understanding the aims and instruments of management for sustainable development in the industrial sector. A special attention in the studies is given to the problem of international voluntary sustainability standards under conditions of Ukrainian transitional economy. For researchers, university students and teaching staff, servants in bodies of public and municipal administration, managers of business structures.

This publication was prepared with support of the DAAD programme "Eastern Partnerships" in the framework of the Study Seminar "Sustainability in the Industrial Sector"

С 76 Сталість у промисловому секторі: Матеріали навчального семінару. НТУ "Дніпровська політехніка" - БТУ Коттбус-Зенфтенберг, 24 груд. 2020 – 18 січ. 2021. За заг. ред. Швеця В., Палєхової Л. Дніпро-Коттбус: Акцент, 2021. 192 с.

У збірнику навчальних матеріалів автори врахували нові тенденції у розумінні цілей та механізмів управління сталим розвитком у промисловості. Особлива увага в дослідженнях приділяється проблемі міжнародних добровільних стандартів сталості в умовах перехідної економіки України. Для дослідників, студентів університетів та викладачів, службовців в органах муніципального управління, менеджерів бізнес-структур.

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INTRODUCTION

This compendium of training material is the result of the training project jointly organised by the Brandenburg University of Technology Cottbus-Senftenberg (BTU), Cottbus, Germany and National Technical University “Dnipro Polytechnic”, Dnipro, Ukraine with the support of the German Academic Exchange Service (DAAD).

The online Study Seminar “Sustainability in the Industrial Sector” was carried out between 24th December 2020 and 18th January 2021 in the framework of the General Agreement on Cooperation between the two universities, and pursuant to the Memorandum of Understanding on implementation of the joint research project on sustainability and e-learning in higher education between the Faculty of Environment and Natural Sciences of BTU and the Institute of Economics of Dnipro Polytechnic.

The cooperation between BTU and Dnipro Polytechnic (former National Mining University) goes back to 1998. Besides the 2020-2021 Study Seminar, several joint educational and research projects, summer and winter schools, internship programmes as well as various training courses have taken place since then.

In accordance with the objectives of the DAAD Programme “Study Seminars for Groups of Foreign Students in Germany 2019/2020”, the objectives of the project were related to the transition to sustainable industrial development under the EU-Ukraine Association Agreement.

While the association process refers to all kinds of sectors of the economy, industry is the main or crucial sector that requires substantial efforts from Ukraine in the context of priorities of the EU Strategy on Sustainable Development up to 2030.

The presented training materials give an insight to the problems, experiences and perspectives in the key areas of industrial sustainability in Ukraine. All contributions in this volume represent the personal opinions of their authors. Despite all reasonable efforts, the editors cannot guarantee the accuracy of all information and data provided in this publication.

Editors
Prof. Vasily Shvets and Dr. Liudmyla Paliekhova

Dnipro, Ukraine February 2021

“We want to change our world. And we can. We want to give the world a more humane face. And we can. That is what the 2030 Agenda is for. To this end, we are adopting new goals which cover the entire spectrum of global development and which apply to all, industrial and developing countries alike”

Dr Angela Merkel, Chancellor of the Federal Republic of Germany,
United Nations Sustainable Development Summit,
New York, 25 September 2015

“27 European Leaders have signed up to the European Commission's proposal for taking climate action to a new level of ambition ...And it is more than cutting emissions. It is about green finance. It is about restoring biodiversity. It is about a new circular economy that creates jobs and prosperity while preserving nature. Many things have to change, so that our planet can remain the same for the next generation .... Let us walk this road together!”

Ursula von der Leyen, President of the European Commission,
Climate Ambition Summit,
Brussels, 12 December 2020

“The Green Deal ... is a comprehensive plan to make our economy and society ready for a climate neutral future. A future where we live in harmony with our natural environment. It applies to every sector and every region and appeals to everyone to grasp the opportunities inherent to the transition”

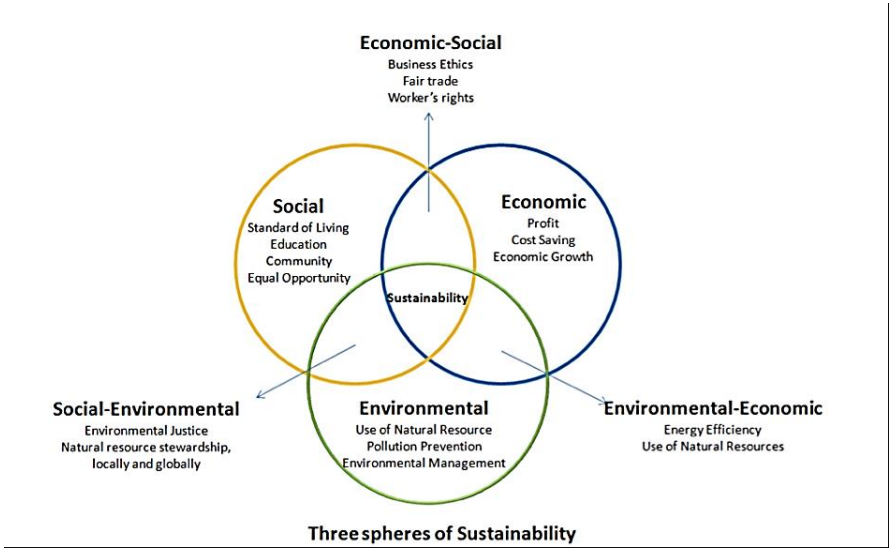
Frans Timmermans, European Commission Executive
Vice-President for the European Green Deal,
Sustainable Development Summit,
12 February 2021

Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Towards sustainable development of industry: prospects for Ukraine

Prof. Vasily Shvets & Dr. Liudmyla Paliekhova
National Technical University Dnipro Polytechnic, Ukraine

1 Definition of Sustainable Development



Three spheres of Sustainability

✓ The triple bottom line means that companies should consider 3 different bottom lines in their businesses

✓ Oganizations should also measure how socially responsible the operations across their value-chain are

✓ In the end, the idea is business needs to be concerned about its impact on people and planet – and not only finance and profit

General concept of sustainable development[1]

- **Sustainable development** takes into account **social** and **environmental** factors along with **economic** goals; living and non-living resources; both long-term and short-term benefits; various alternative actions

International Union for Conservation of Nature and Natural Resources: World Conservation Strategy (1980)

- **Sustainable development** is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs

Brundtland Report: Our Common Future (1987)

(1) needs and human values

(2) restrictions on the use of natural resources

[1]Palekhova L. (2020) Sustainable Development Governance: A Handbook [59]

2 Designation of the Sustainable Development Goals in industry

Sustainable Development Goals in industry [34]:

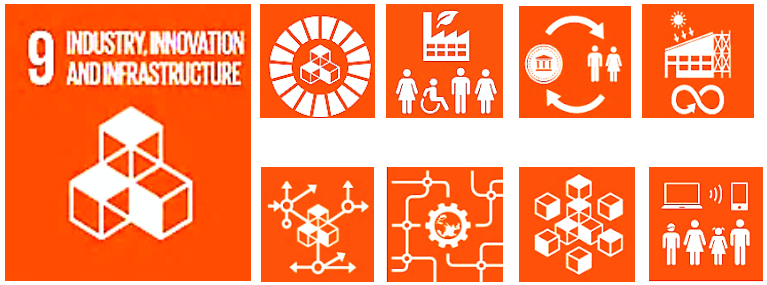
- To meet future sustanability challenges, existing industries and infrastructure must be upgraded. For this, we need to promote innovative sustainable technologies that address today's environmental and social challenges
- Inclusive and sustainable industrialization, together with innovation and infrastructure, can unleash dynamic and competitive economic forces that generate employment and prosperity
- A high technology sectors convey better environmental productivity performances, namely emissions on economic value, with respect to medium-tech sectors
- This effect to be taken into account, in light of the: manufacturing weight of emerging economies; new EU target towards a newly increased 20% GDP manufacturing share; and the higher innovation intensity of manufacturing versus service
- Least developed countries need to accelerate the development of their manufacturing sector towards achieving the 2030 targets , and scale up efforts in scientific research and innovation

Industrial sector



Globally, investment in research and development (R&D) as a proportion of GDP increased from 1.5 per cent in 2000 to 1.7 per cent in 2015 and remained almost unchanged in 2017, but was only less than 1 per cent in developing countries [28]

3 SDG 9 indicators: industrial sector



The importance of this goal for Ukraine

- ✓ SDG 9 plays a special role in ensuring progress in achievement of all the SDGs by providing preconditions for growth of value added and GDP. Emergence and proliferation of the 4th Industrial Revolution technologies is substantially changing the nature of production in the manufacturing industry
- ✓ To go up the technology ladder, Ukraine should restore its industrial base, engage its scientific and innovative potential for that purpose, digitize its production processes, and reconstruct its infrastructure

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation [28]**:**

9.2. Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry’s share of employment and gross domestic product, in with national circumstances, and double its share in least developed countries
Indicator 9.2.1: Manufacturing value added as a proportion of GDP and per capita
Indicator 9.2.2: Manufacturing employment as a proportion of total employment
9.3. Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets
Indicator 9.3.1: Proportion of small-scale industries in total industry value added
Indicator 9.3.2: Proportion of small-scale industries with a loan or line of credit
9.5. Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
Indicator 9.5.1: Research and development expenditure as a proportion of GDP
Indicator 9.5.2: Researchers (in full-time equivalent) per million inhabitants
9.b. Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alias, industrial diversification and value addition to commodities
9.b.1: Proportion of medium and high-tech industry value added in total value added

4 Key business themes addressed by the SDGs 7, 8, 12



SDG 7 covers two key areas: areas:
modernizing the energy and increasing energy efficiency[2]



SDG 8 includes two main areas:
economic growth and decent work



SDG 12 covers three key areas:

reducing resource intensity of the economy and ensuring environmental safety

Key business themes

- ✓ Commit to sourcing 100% of operational electricity needs from renewable sources
- ✓ Reduce the internal demand for transport by prioritizing telecommunications and incentivize less energy intensive modes such as train travel over auto and air travel
- ✓ Invest in R&D related to sustainable energy services, bringing new technologies to the market quickly
- ✓ Integrate renewable energy into employee benefits packages, subsidizing the capital expenditures associated with residential solar or electric vehicle investments
- ✓ Prioritize energy efficiency across operations through tools such as the use of an internal carbon price and science-based target setting to reduce overall demand for energy

Key business themes

- ✓ Offer apprenticeship opportunities
- ✓ Foster entrepreneurial culture and invest in or mentor young entrepreneurs
- ✓ Initiate skills development programs moving down company supply chains
- ✓ Put in place mechanisms to identify child labor and forced labor throughout global supply chains, and implement remediation when abuses are discovered
- ✓ Install a firm policy against unfair hiring *and* recruitment practices, particularly of vulnerable groups such

“Companies that are not demonstrating robust commitments in this space are likely to find themselves being held increasingly accountable by a range of stakeholders [29]

Key business themes

- ✓ Implement product portfolio analysis tools to understand environmental and social footprint of products within lifestyles as well as production
- ✓ Develop innovative business models such as moving from selling products to selling services, to retain ownership of the products and help close the materials loop
- ✓ Reduce manufacturing impacts by substituting virgin raw materials in products with post-consumer materials through recycling and upcycling.
- ✓ Apply modular design, so products’ constituent parts will be easily separated and either re-used without further processing, or easily recycled near the point of disposal.
- ✓ Significantly reduce waste and ensure that any unavoidable waste is utilized to

[2]Sustainable Development Goals - the United Nations Report: The 17 Goals [76]

5 Sustainability: European industry

A new Industrial Strategy for a globally competitive, green and digital Europe[3]

They are three drivers will transform EU industry:

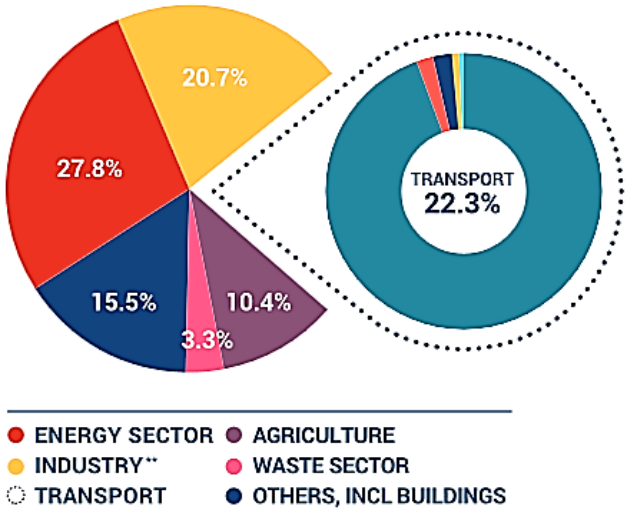
- there are no net emissions of greenhouse gases by 2050
→economic growth is decoupled from resource use
→no person and no place is left behind
- the Digital transition, supported by the **EU's digital strategy**
→open up new opportunities for businesses
encourage the development of trustworthy technology
→foster an open and democratic society
→enable a vibrant and sustainable economy
→help fight climate change and achieve the green transition
- keep Europe sustainable and competitive, and support our small and medium-sized enterprises (SMEs)
→the impact of its single market to set global standards
→competitiveness on the global stage

"We must show solidarity with the most affected regions in Europe, such as coal mining regions and others, to make sure the Green Deal gets everyone's full support and has a chance to become a reality" [83]

!!! EUROPEAN INDUSTRY

- ✓ 20% of total EU value added
- ✓ Industry accounts for 80% of exports
- ✓ 35 million Jobs
- ✓ 99%of European firms are small and medium sized businesses

Share of EU greenhouse gas emissions, by sector[4]



[3] A New Industrial Strategy for Europe (2020) [1]
[4] ACEA (2020) [2]

6 Top 5 successful business models that put the circular economy to work

Top 5 successful business models for circular economy [24]:

1 Circular supplies

Royal DSM has developed a cellulosic bio-ethanol in which agricultural residue (baled corn cobs, husks,
leaves and stalks) is converted into renewable fuel. The cellulosic bio-ethanol created a new source of revenue for DSM, while reducing emissions, creating jobs and strengthening national energy security

2 Resource recovery



Walt Disney World Resort sends food waste from select restaurants in its complex to a nearby 5.4 MW anaerobic digestion facility owned and operated by Harvest Power. The organic waste is converted into renewable biogas to generate electricity, with the remaining solid material processed into fertilizer. The energy generated helps to power Central Florida, including Walt Disney Resort’s hotels and theme parks

3 Product life extension



Caterpillar. Over the past 40 years**,** Caterpillar’s remanufacturing activity, through its Reman Program, has focused on returning components at end of life to same-as-new condition or quality that reduces costs, waste, greenhouse gas emissions and need for raw inputs

4 Sharing platforms



The sharing platform model is centered on the sharing of products and assets that have a low ownership or use rate. Companies that leverage this model can maximize the use of the products they sell, enhance productivity and value creation. Examples of the sharing economy abound, including transportation (**Lyft, RelayRides, BlaBlaCar**), lodging (**Airbnb**), and neighbors helping neighbors (**TaskRabbit, Neighbor Goods**)

5 Product as a service

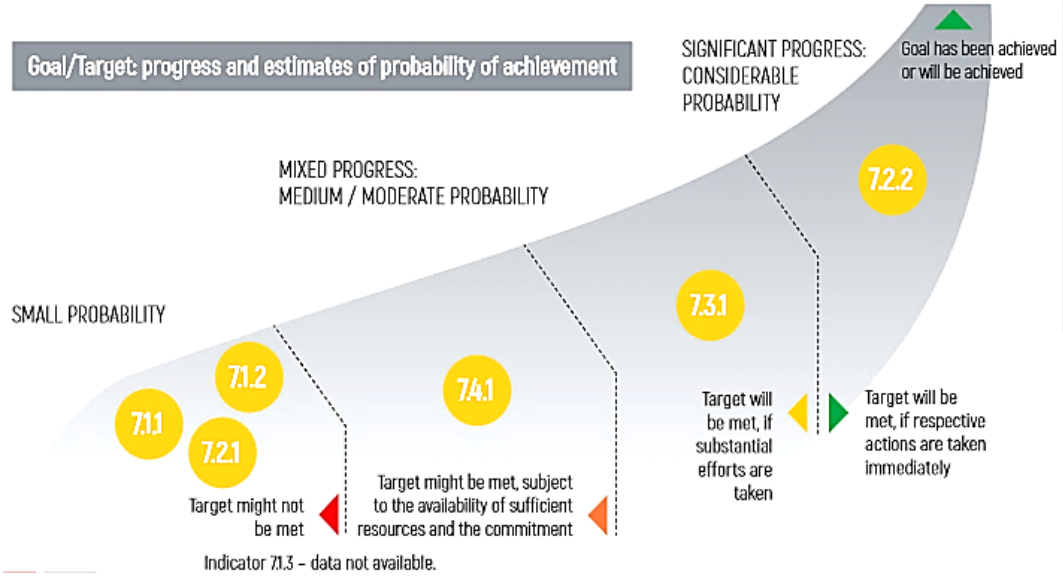


Philips sells lighting as a service, in which the company aims to reach more customers by retaining ownership of the lights and equipment so customers do not have to pay the upfront costs of installation

7 Implementing the SDG 7 in Ukraine

Ukraine has achieved progress in 15 of 17 SDGs [79]:

- Three of the 7 indicators demonstrate positive dynamics; negative dynamics is present for three indicators as compared to 2015
- The Government adopted in 2017 the updated Energy Strategy of Ukraine up to 2035 “Security, energy efficiency, competitiveness” which is currently in implementation





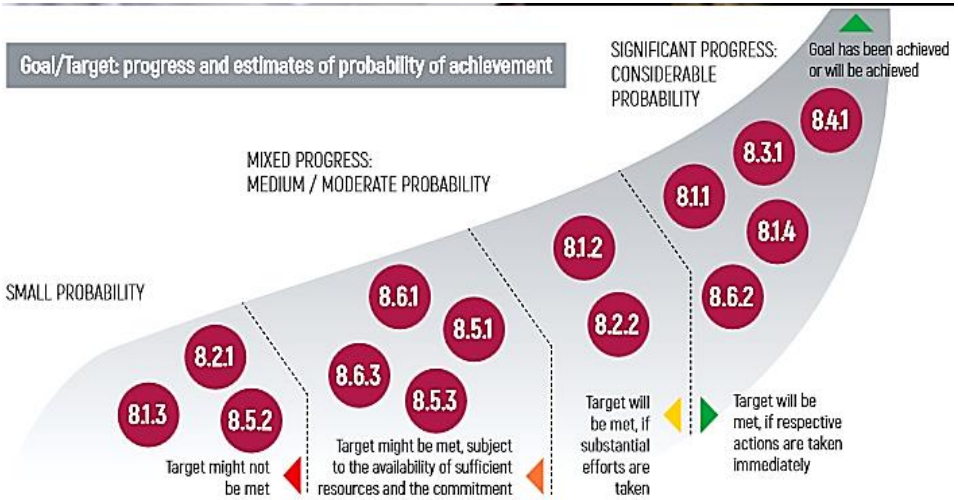
1…….17 2030 SDGs

25 … 100 Percentage of completion

8 Implementing the SDG 8 in Ukraine



- Out of 14 indicators measuring progress in achievement of the national ambitious Goal 8, the target value has been achieved for two; high likelihood of achievement in 2020 exists for three indicators; positive dynamics needing acceleration is present for five indicators; and three indicators demonstrate negative or very weak positive dynamics [79]



The positive trends:

✓ improvement of Ukraine’s position in the Doing Business ranking by 17places to number 64 in 2019 (versus 2015)

✓ a positive upward trend emerged during 2017-2019 in exports of high- and medium-high-tech goods – a 29.7% cumulative increase over the period

✓ Ukraine has changed the geographical structure of exports but has still not made up for the loss of their absolute export volumes.At the same time, export dynamics of high-tech services has gathered substantial pace

The following steps are require:

✓ development of high-tech competitive productions considering the specifics of value added creation along the entire innovation chain

✓ activation of investment processes, realization of infrastructural projects

✓ institutional and financial support for development of innovative processes and products, protection of intellectual property

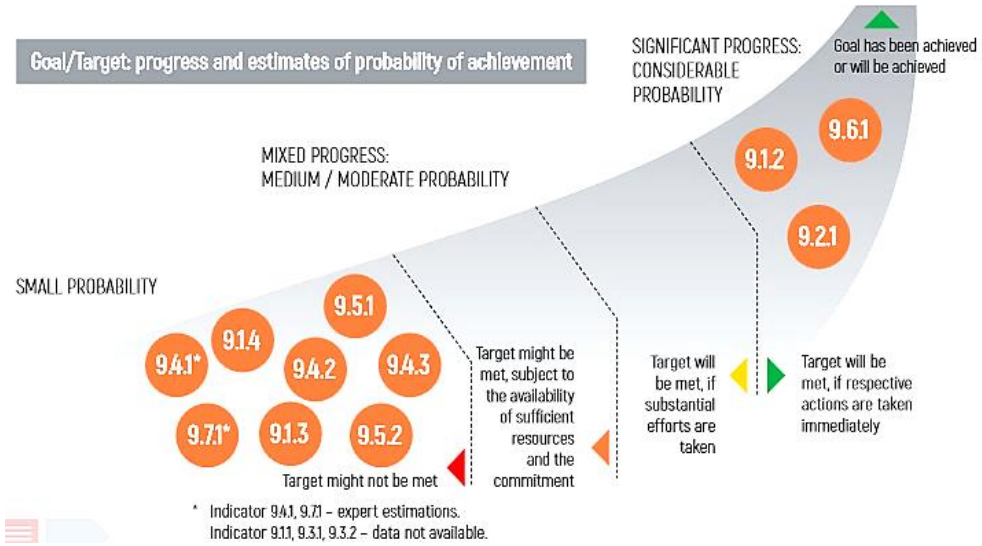
✓ entry into markets of goods and services with a high share of gross value added

✓ financial stability and better conditions of access to domestic and external financial resources for all

9 Implementing the SDG 9 in Ukraine



- Out of 14 indicators measuring progress in achievement of the national ambitious Goal 9, no data for 2015-2019 are so far present for three indicators. Only four of other 11 indicators show positive dynamics [79]



The positive trends:

✓ growth of the share of small enterprises in industry’s total value added from 5.2% in 2015 to 8.5% in 2018, which points to gradual strengthening of the role of small enterprises in industrial development

✓ increase in the share of industry’s total value added in GDP from 19.8%in 2015 to 21.0% in 2018 occurredonly due to a growing share of such sectors as mining and quarrying (from 4.8% in 2015 to 6.0% in 2018) and supply of electricity, gas, steamand conditioned air (from 2.7% in 2015 to 3.1% in 2018)

The following steps are require:

✓ design and implement strategic directions of industry development that will contain innovative approaches and the Industry 4.0 principles to bring industrial production up to date

✓ modernize and expand industrial production, inter alia by developing existing and creating new activities with higher value added, and integrating into global production chains

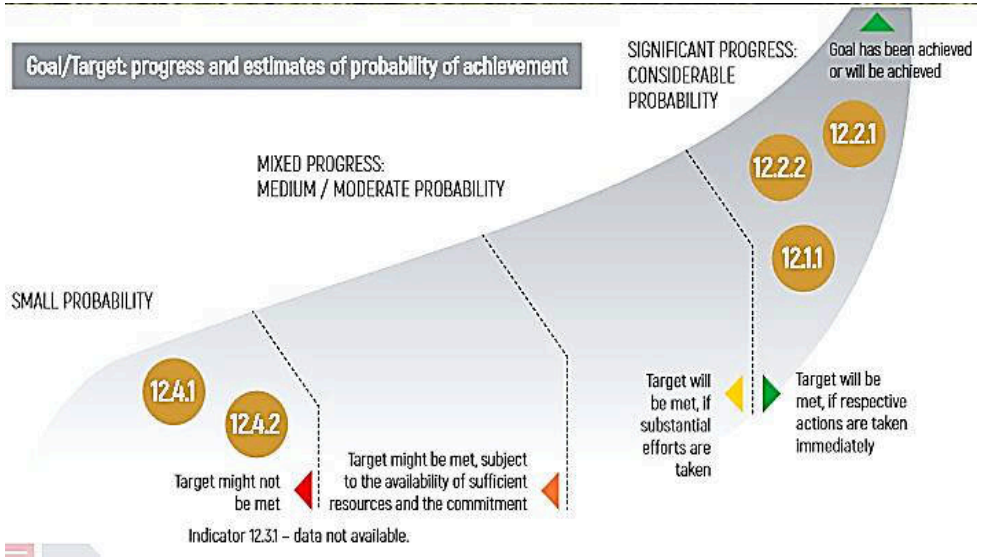
✓ ensure regional development of industry by increasing industrial production and processing outputs strengthening regional production chains, and developing cluster cooperation in industry

✓ enhance resource efficiency of industry by means of encouraging innovations and simplifying access to investment resources for implementation of resource-saving technologies

10 Implementing the SDG 12 in Ukraine



- Out of 6 indicators measuring progress in achievement of the national ambitious Goal 12, positive dynamics is present in three, and for another one achievement of the 2020 target value is quite realistic. For 2 indicators, negative dynamics compared to 2015 is observed [79]



The positive trends:

✓ reduction of resource consumption in GDP in 2018 versus 2015, by component: GDP energy intensity to 95.3%; GDP material intensity to 97.2%; GDP carbon intensity to 83.8%; GDP water intensity to 95.2%

The following steps are require:

✓ ensure sustainable use of chemical substances based on innovative technologies and production facilities

✓ improve the waste management legislation aimed at introducing in Ukraine a new hierarchy of waste management and broader producer liability

✓ preconditions for introduction of a circular economy model, first of all by focusing on resource-efficient and environmentally clean production (including energy saving) and consumption

✓ create cost-effective technologies for solid domestic waste processing to obtain a societally useful end product

✓ improve existing logistic approaches to domestic waste management on national and regional levels

✓ addressing the issue of radioactive waste management

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Challenges faced by Ukrainian industry in accomplishing sustainability goals

Dr. Tetiana Kuvaieva
National Technical University Dnipro Polytechnic, Ukraine

1 SDGs in Ukraine



- ✓ An inclusive process of the SDGs adaptation for Ukraine, tailored to the national development context, resulted in an SDGs system consisting of 86 targets with 183 monitoring indicators
- ✓ The Government established the Inter-Agency Working Group on SDGs to coordinate the goals achievement efforts

The work on the SDGs began in Ukraine in 2015, with adaptation of the SDGs for Ukraine subject to its national development specifics as the first step

In September 2019, the Decree of the President of Ukraine “On the Sustainable Development Goals for Ukraine up to 2030” stated that “the Sustainable Development Goals for Ukraine up to 2030 are benchmarks for drafting of forecast and policy documents and regulatory legal acts to ensure a balanced character of the economic, social and environmental dimensions of Ukraine’s sustainable development” [79]

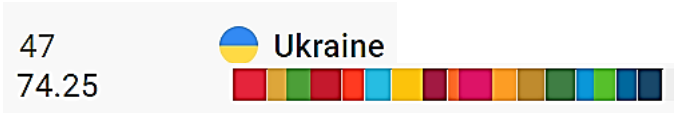
The global SDG indicator framework consists of 232 indicators. However, not all the indicators are relevant to Ukraine, and data sources have gaps on some of them. Priority was given to those indicators data for which are collected and developed on a continuous basis within the official statistical system in accordance with established standards and methodologies

2 The 2020 SDG Index scores

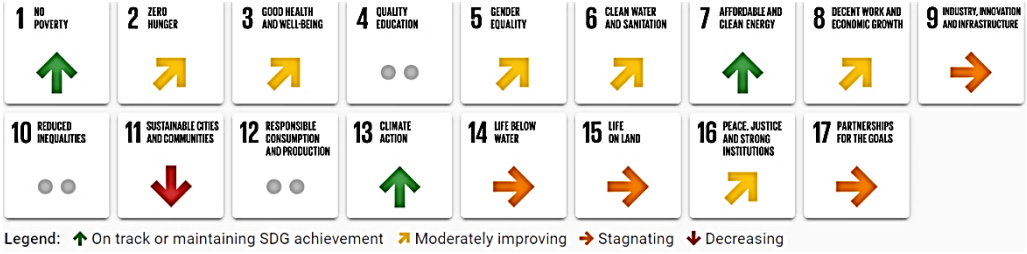
Rank	Country	Score
1	Sweden	84.7
2	Denmark	84.6
3	Finland	83.8
4	France	81.1
5	Germany	80.8
6	Norway	80.8
7	Austria	80.7
8	Czech Republic	80.6
9	Netherlands	80.4
10	Estonia	80.1
43	Greece	74.3
44	Luxembourg	74.3
45	Uruguay	74.3
46	Ecuador	74.3
47	Ukraine	74.2

SDG Index scores[1]

- ✓ OECD countries, which have on average the highest SDG Index score, progressed moderately since 2015
- ✓ On average, progress since 2015 has been faster in low- and middle-income countries compared with high-income countries
- ✓ Ukraine ranks 47th in the global rating in terms of the general SDG indicator but is only at position 73 for SDGs 8, 9, 12 and 17
- ✓ In terms of the SDG 9 achievement, Ukraine ranks 96th
- ✓ SDG 12 has a specific rating. Ukraine ranked 91st in this rating
- ✓ In terms of SDG 17 achievement, Ukraine is at the 29th position



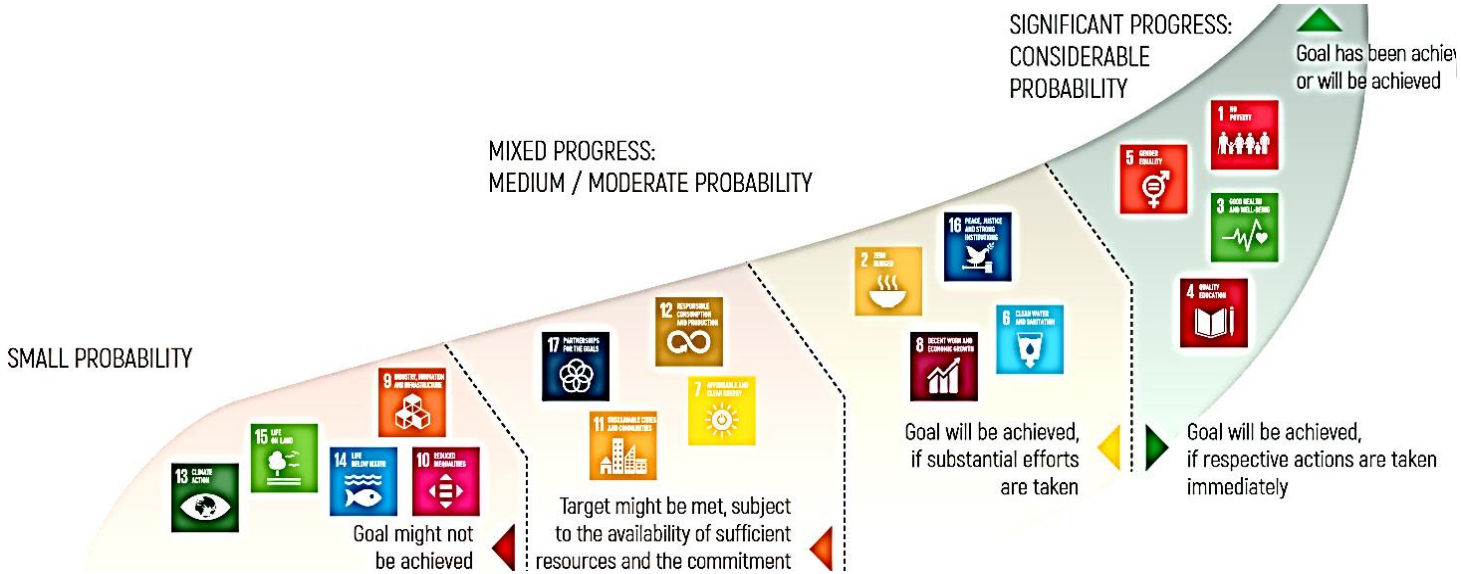
Trends



[1]Sustainable Development Report 2020. Rankings [77]

3 Estimation of SDGs achievement progress

SDGs achievement in Ukraine: progress and challenges [79]



- Ukraine has introduced retail and full-scale electricity markets
- Due to better conditions for development of small and medium-sized business, a positive balance of foreign trade in ICT services has grown 2.5 times
- Major obstacles to development still include thetemporary occupation of the AR of Crimea, Sevastopol city and some part ofterritory in Donetsk and Luhansk oblast by the Russian Federation, obsolete infrastructure, limited financing, ets.
- The lessons learnt as response to COVID-19 indicatethat Ukraine has to ensure: resumption of a full production cycle of somegoods (chemical, pharmaceutical industries), digitalization ofadministration processes, ets

4 Ukraine: vision of transformative pathways for the next decade

Economic dimension:

- ✓ strengthening partnership between government andbusiness in development of science and introduction of innovations
- ✓ updatingpriorities of research and innovative activities for the SDGs
- ✓ adopting thecircular economy basics (principles)
- ✓ implementing infrastructural projects
- ✓ increasing the processing degree and productivity in the agro-industrial complex
- ✓ undertaking structural shifts in economy and industry by means of diversification, digitalization and efficient resource management
- ✓ and creating new decent jobs on that basis

Environmental dimension:

- ✓ actions include amending the environmental policy
- ✓ developing the waste management system to meet European standards
- ✓ terminating unsustainable use of land, forest and water resources

Social dimension:

- ✓ consistent actions within the framework of the reforms undertaken by Ukraine (education, health care, decentralization) are to improve people’s living standards and reduce all forms of inequality
- ✓ the top-priority task is to reduce multi-dimensional poverty, increase average life expectancy, and provide quality education as a foundation of human capital and a pledge of sustainable development

Effective management:

- ✓ actions will be aimed at affirming the rule of law, resetting management as a result of the creation of a transparent and fair system of social lifts, improving the efficiency of public authorities and local governments

5 Progress towards achievement of SDG12

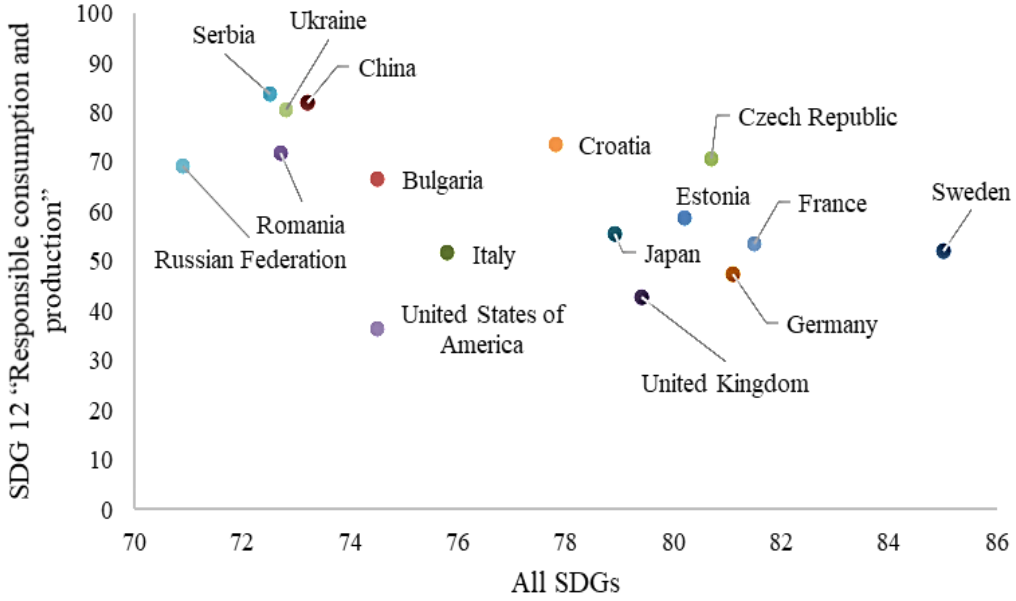
SDG 12 covers three key areas:
reducing resource intensity of the economy and ensuring environmental safety

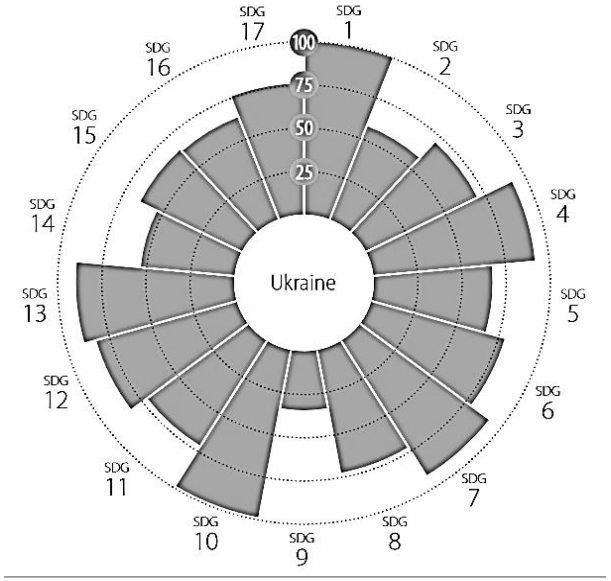
‘In general, out of 6 indicators measuring progress in achievement of the national Goal 12, positive dynamics is present in three, with the 2020 target value for one of them already achieved, and for another one achievement of the 2020 target value is quite realistic’ [79]

SDG12 – Responsible Consumption and Production [77]

Municipal solid waste (kg/capita/day)	1.4	2016	● ●
Electronic waste (kg/capita)	6.5	2016	● ●
Production-based SO_2 emissions (kg/capita)	32.3	2012	● ●
SO_2 emissions embodied in imports (kg/capita)	2.9	2012	● ●
Production-based nitrogen emissions (kg/capita)	23.5	2010	● ●
Nitrogen emissions embodied in imports (kg/capita)	1.6	2010	● ●

Balance in achieving all Sustainable Development Goals and Goal 12





6 Short-term impacts of Covid 19 on the SDGs

Many countries provided details on the potential impact of COVID-19 on the SDGs, noting [8]:

+

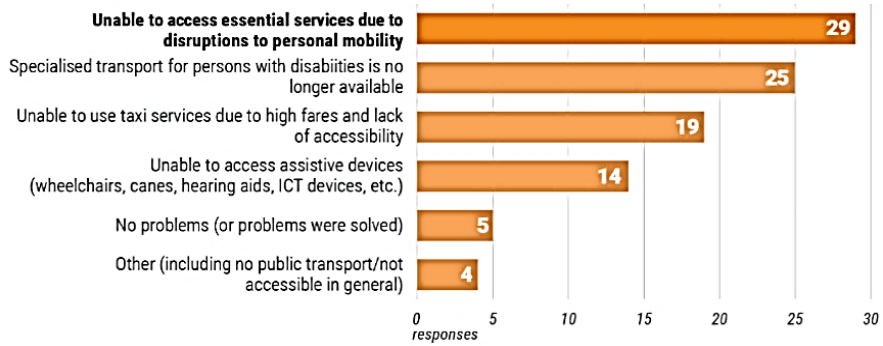
- Pandemic set back SDG progress and is undermining ongoing implementation efforts
- Pandemic adding new challenges to the implementation of the 2030 Agenda
- Adverse impacts on specific dimensions of sustainable development or sectors–economic, environmental, on business and small and medium enterprises (SME), social dimension and vulnerable groups
- Relevance of the principle of LNOB, impact on poverty and effect on children

–

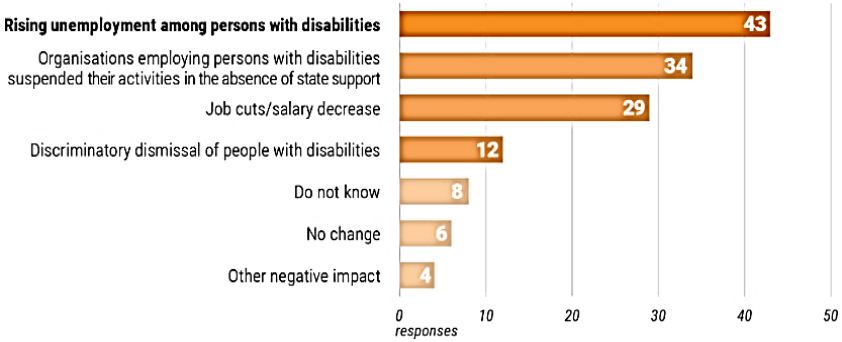
- Some countries, including Ukraine, received new opportunities and valuable lessons from COVID-19:
- Opportunities for digital transformation: e-governance expansion, virtual platforms, upgrading information and communication technology;
- Improving national preparedness for disease outbreaks;
- Scale up localisation efforts
- Calls for global solidarity in the wake of the pandemic

Ukraine: Access to an adequate standard of social protection

How has the personal mobility of persons with disabilities been affected since the start of the quarantine?



Which situations related to work and employment of persons with disabilities have you encountered since the start of the quarantine?



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Kuvaieva T. Challenges faced by Ukrainian industry in accomplishing sustainability goals. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 19-26

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Sustainable Development Indicators

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1 Sustainable Development Indicators (SDIs)

Sustainable Development Indicators (SDIs) are calculated by using the data on the state of economic, social and environmental changes that allow in the aggregate assess progress towards the goals and objectives of sustainable development [36]

The need for reliable and pertinent indicators to guide the sustainable development process was recognised at the Rio Conference. It was reaffirmed in many sections of Agenda 21 the programme document, and was the central theme of Chapter 40, which deals with information required for decision-making

‘40.4. Commonly used indicators such as the gross national product (GNP) and measurements of individual resource or pollution flows do not provide adequate indications of sustainability. Methods for assessing interactions between different sectoral environmental, demographic, social and developmental parameters are not sufficiently developed or applied. Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems’

The importance of indicators for sustainable development

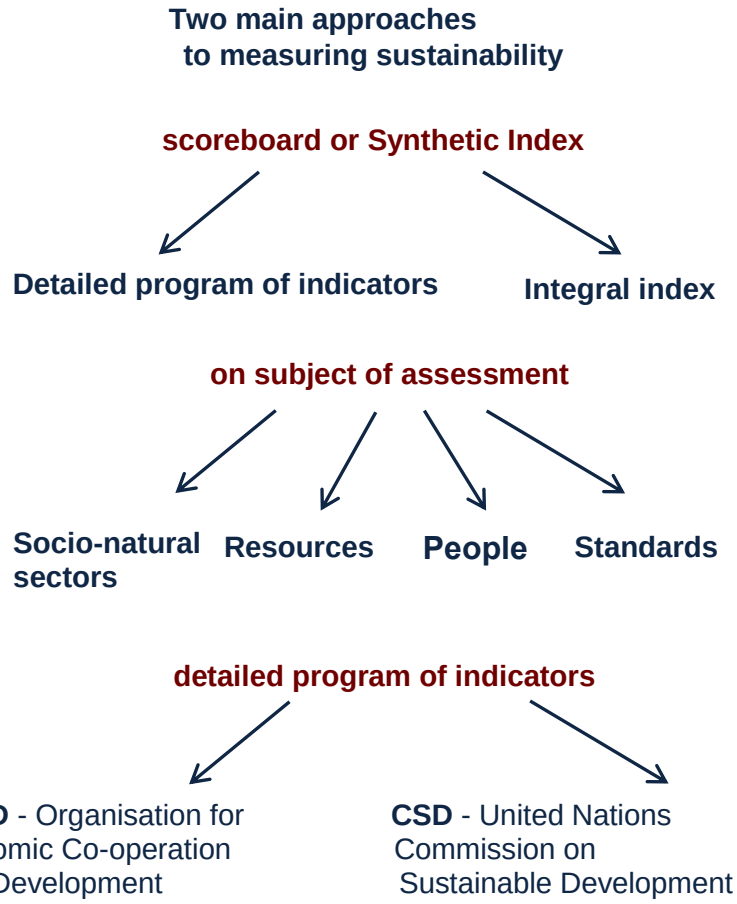
- ✓ Indicators are used to justify decisions made through quantitative evaluation and simplification
- ✓ Indicators help to interpret changes
- ✓ The use of indicators allows you to identify disadvantages in nature management
- ✓ Indicators allow easy access to information for different categories of users
- ✓ Indicators facilitate the exchange of scientific and technical information

‘40.22. Countries and international organizations should review and strengthen information systems and services in sectors related to sustainable development, at the local, provincial, national and international levels. Special emphasis should be placed on the transformation of existing information into forms more useful for decision-making and on targeting information at different user groups. Mechanisms should be strengthened or established for transforming scientific and socio-economic assessments into information suitable for both planning and public information. Electronic and non-electronic formats should be used’

2 The concept of sustainable development indicators

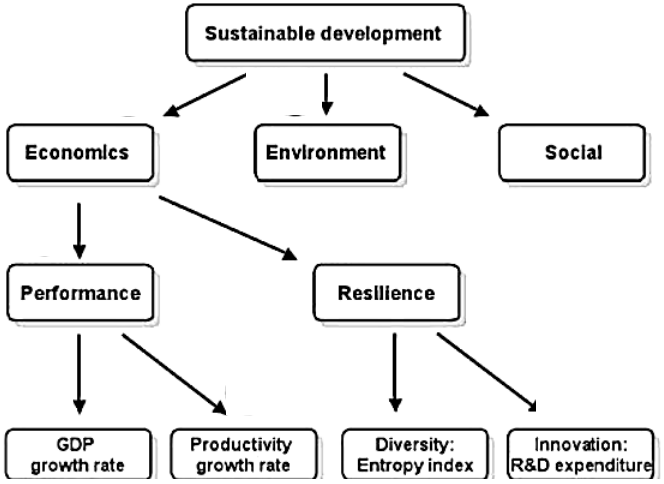
An indicator is an observable variable used to report a non-observable reality [7]:

- ✓ The sustainable development indicators must involve a focus of the essential dimensions of the concept to be made operational
- ✓ If we examine the various lists of sustainable development indicators, we can whittle them down to two major reference classes: detailed program of indicators and integral index
- ✓ The 'index' designates a synthetic indicator constructed by aggregating other so-called 'basic" indicators. Most of the sustainable development indicators are in fact indices
- ✓ There is also a classification according to the subject of assessment: socio-natural sectors (or systems); resources; people; standards. Out of the four perspectives discussed above, only the norms-based one can be considered as complete, since it is as informative on development as on sustainability
- ✓ In practice, the various approaches intermingle



3 Indicators themes for sustainable development

Each of system indicators reflects separate aspects of sustainable development [7]



Three-dimensional aspects of sustainable manufacturing (OECD)[1]



CDS indicator themes [37]

- Poverty
- Governance
- Health
- Education
- Demographics
- Natural hazards
- Atmosphere
- Land
- Oceans, seas and coasts
- Freshwater
- Biodiversity
- Economic development
- Global economic partnership
- Consumption and production patterns

[1] http://www.oecd.org/innovation/green/toolkit/48704993.pdf

4 OECD Sustainable Manufacturing Indicators

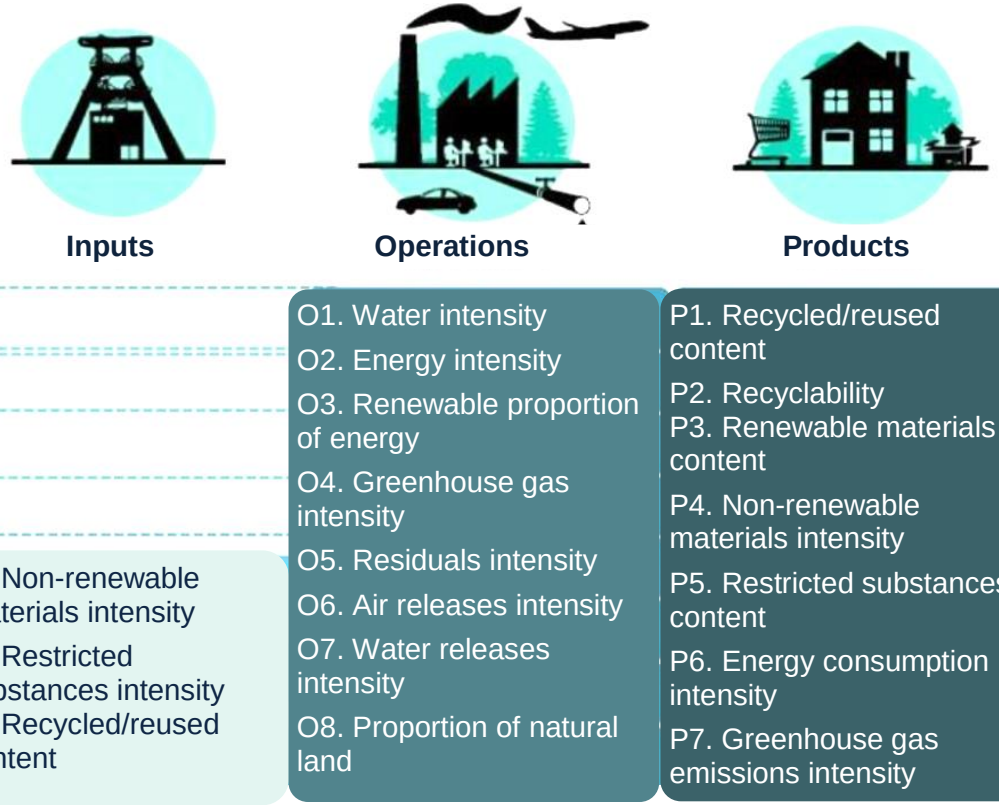
For the industrial sphere, the following 4 types of indicator systems can be distinguished [59]:

Economic sustainability indicators (EcSIs) are used to assess the level of compliance of economic policy with the principles of sustainable development

Social Indicators of Development (SID) are used to judge a country's global status in the main dimensions of social development, including ensuring a decent standard of living and work, the right to a healthy environment, human development opportunities

Environmental Sustainability Indicators (ESIs) are used for monitoring the state of individual elements of the environment (water, land, atmosphere) and natural resources, as well as their impact on socio-economic parameters in the context of sustainable development goals

Environmental Performance Indicators (EPIs) examine environmental issues such as pollution, biodiversity, climate, energy, erosion, ecosystem services, environmental education, and many others. These indicators used to measure the effectiveness of environmental policy, environmental management, programs and actions on environmental management and environmental protection



The OECD indicators have been developed to help measure the environmental impact relating to the production activities of a single facility in business (e.g. site, factory, office) as a starting point for sustainable manufacturing

Indicators O1, O2 and O4 can be extended to measure the impact associated with supply chain as well as the facility: namely, water and energy consumed and greenhouse gas emissions caused during the production of inputs

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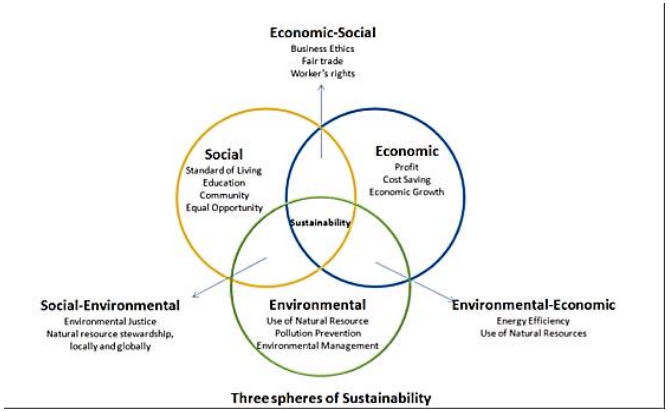
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From supply chains to value chains: sustainability management

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National Technical University Dnipro Polytechnic, Ukraine

1 Significance of the value chain concept for SD



Three spheres of Sustainability

At least two key positions from the Brundtland Report—the priority of basic needs and the idea of restrictions for the benefit of future generations—have formed the ideological platform for a new concept of economic activity and consumption [59]

(1) Needs and human values

(2) Restrictions on the use of natural resources

Principle 8 of the Rio Declaration expressly recognised the obligation of States to reduce and eliminate unsustainable patterns of production and consumption as a means to achieve sustainable development and a higher quality of life. Nevertheless, to this day the full implementation of these principles remains a challenge for all countries [56]



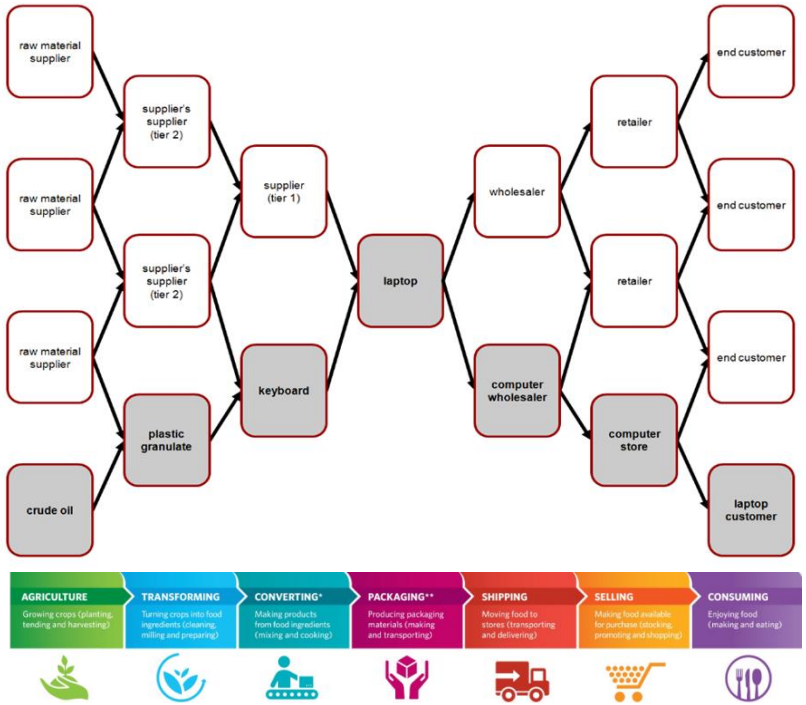


The post-Soviet bloc still remain on the margins of progress towards устойчивых sustainable production and consumption patterns, which also applies to participation in global value chains

2 Value chains are socio-economic systems

- ✓ A value chain is the sequence of related business operations, from the provision of specific inputs for a particular product to primary production, transformation, marketing, up to the final sale of the product to consumers. The term ‘value chain’ reflects the systemic nature of the economy. It denotes a particular subsector or industry in which different enterprises serve the same final consumer markets [74]
- ✓ In commerce, supply chain is a system of organizations, people, activities, information, and resources involved in supplying a product or service to a consumer
- ✓ In contrast to a ‘supply chain’ which always refers to one company only, the value chain is a concept describing the organisation of an entire sector regarding a specific product, with large numbers of enterprises (such as producers, processors, traders and distributors) at every stage of the chain [57]:
  - Product and Operations Design
  - Information exchange
  - Extraction of raw materials, production of materials, etc.
  - Supply and logistics
  - Product manufacturing
  - Sales and Marketing

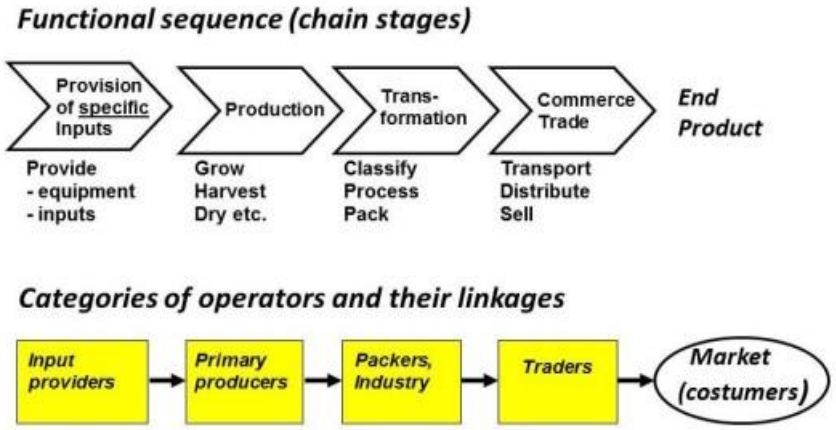
Supply Chains ⟷ Value Chains



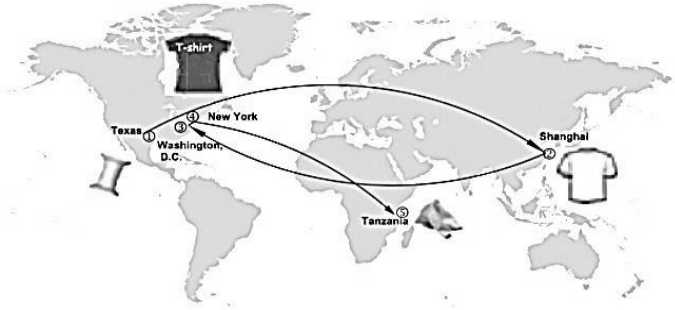
3 Differences between supply chains and value chains

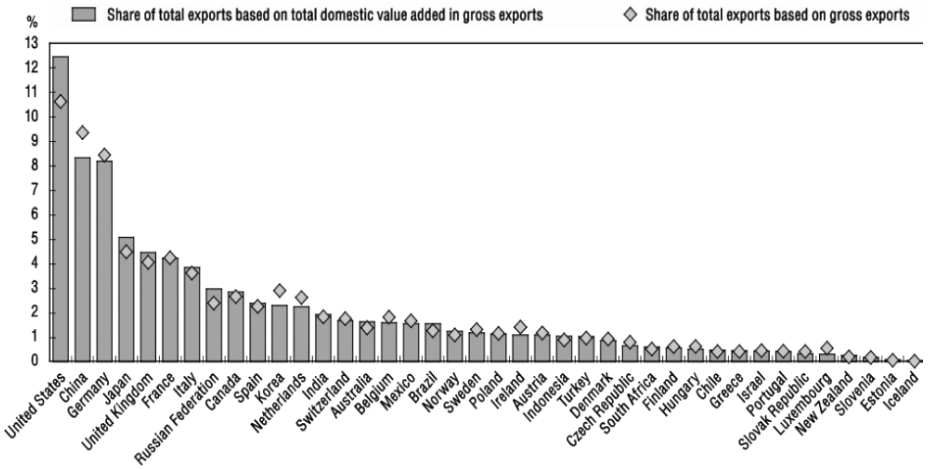
Supply chain activities provide the process of transformation of natural resources, raw materials, and components into a finished product that is delivered to the end customer.
Value chain is a pattern of interaction between the actors to create an aggregate value (product), which provide the process of transformation of natural resources, raw materials, and components into a finished product for the end customer [58]

Basic scheme visualising an agricultural value chain [74]



The OECD report shows that the sales volume does not match the value created [39]



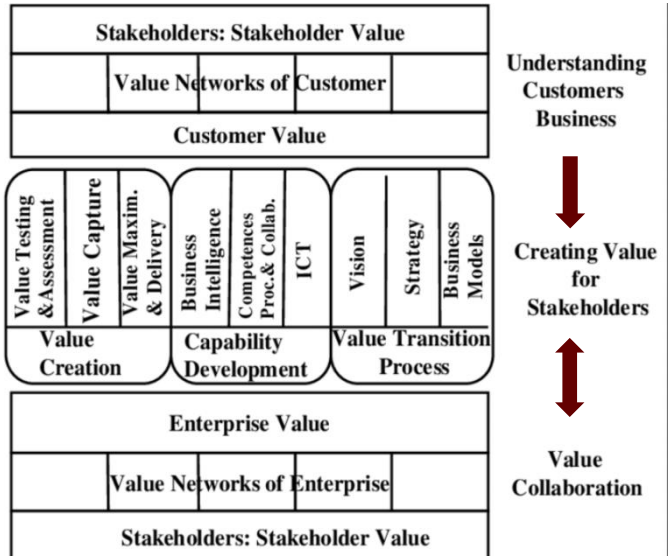


4 Estimation of SDGs achievement progress

The concept of global value chains has gradually transformed into the concept of value networks, which allows for an adequate transition from the ‘one-dimensional’ to ‘multi-dimensional’ business models. Such transition does not only encourage better economic performance but also extents the implementation of sustainable development principles [58]:

- In general value networks are described by nodes (which are representations of the actors or actions within the network) and the relationships between those nodes. The relationships are seen in terms of either tangible or intangible benefits between the nodes
- There are also four common types of value network: Clayton Christensen’s networks, Fjeldstad and Stabells networks, Normann and Ramirex’ constellations and Verna Allee’s networks. Each of these is a slightly different way of looking at value created in a network
- Christensen says: “The collection of upstream suppliers, downstream channels to market, and ancillary providers that support a common business model within an industry. When would-be disruptors enter into existing value networks, they must adapt their business models to conform to the value network and therefore fail that disruption because they become coopted”

Value Model in Value Networks [69]:



5 Responsible supply chain management

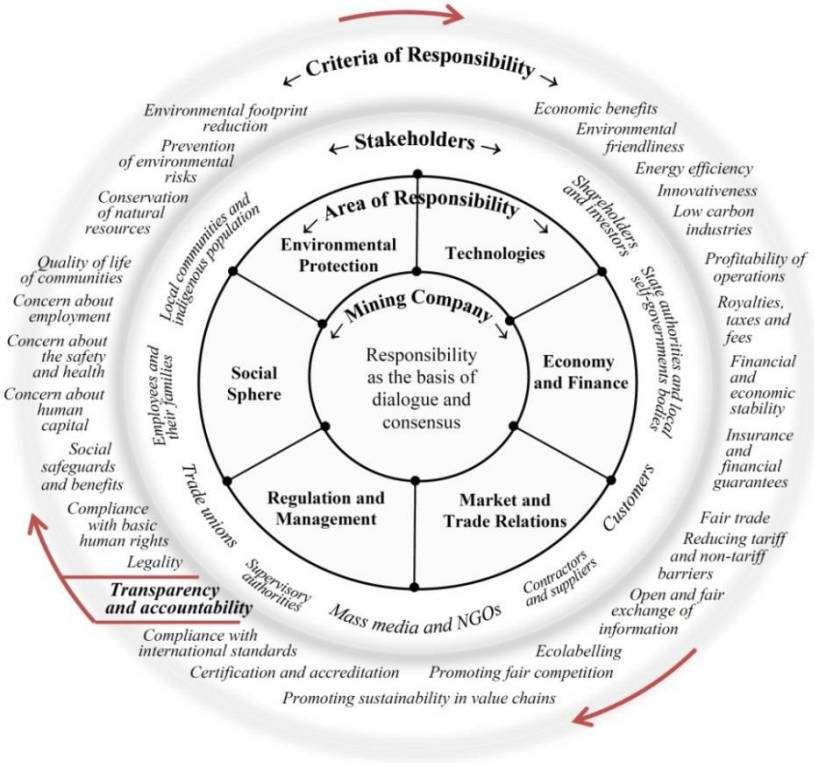
- **Responsible supply chains** meet standards deliberately, always bearing in mind the unique needs of each stakeholder and sustainability’s fundamentally holistic nature
- **Responsible supply chains** must meet standards deliberately, always bearing in mind the unique needs of each stakeholder and sustainability’s fundamentally holistic nature

It is especially important to focus on high-risk suppliers, for example from industries that to face particular challenges, or from countries where national legislation and internationally recognised principles for human rights and labour rights, the environment and anti-corruption, are not fully respected

Create value in mining ⟷ Responsible Supply Chain



Wheel of Mining Responsibility’ in the context of the responsible supply chains [54]



6 Voluntary Sustainability Standards, VSS

VSS (also known as a ’non-government standards’, ‘private standards‘, or ‘private initiatives’ for sustainable development) are developed by non-governmental entities involving multiple stakeholders [55]:

- VSS establish the principles, norms, rules, practices and compliance mechanisms for economic relations in different functional areas to be followed by product manufacturers, distributors and sellers along the value and supply chain
- VSS have various objectives, such as protecting social rights, ensuring a minimum price, conserving the environment, promoting good agricultural practices, regulating supply or ensuring food security



- VSS form a comprehensive concept to embed sustainability in products and supply chains
- VSS are a foundation for development and adoption of an integrated value chain risk management strategy
- VSS facilitate the emergence of a 'conscious consumer', who demands more product information, and the globalization of supply chains
- The implementation of certification requirements leads producers to improve management and monitoring systems, increase productivity, implement good farming practices and improve resource management
- The better access to credit might be the result of the implementation VSS strategies due to an improved credit rating and increased incomes
- Partners may enhance knowledge-sharing activities, allow for joint training and collaborative compliance with requirements (e.g. building storage facilities or developing management systems)

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Paliekhova L. From supply chains to value chains: sustainability management.
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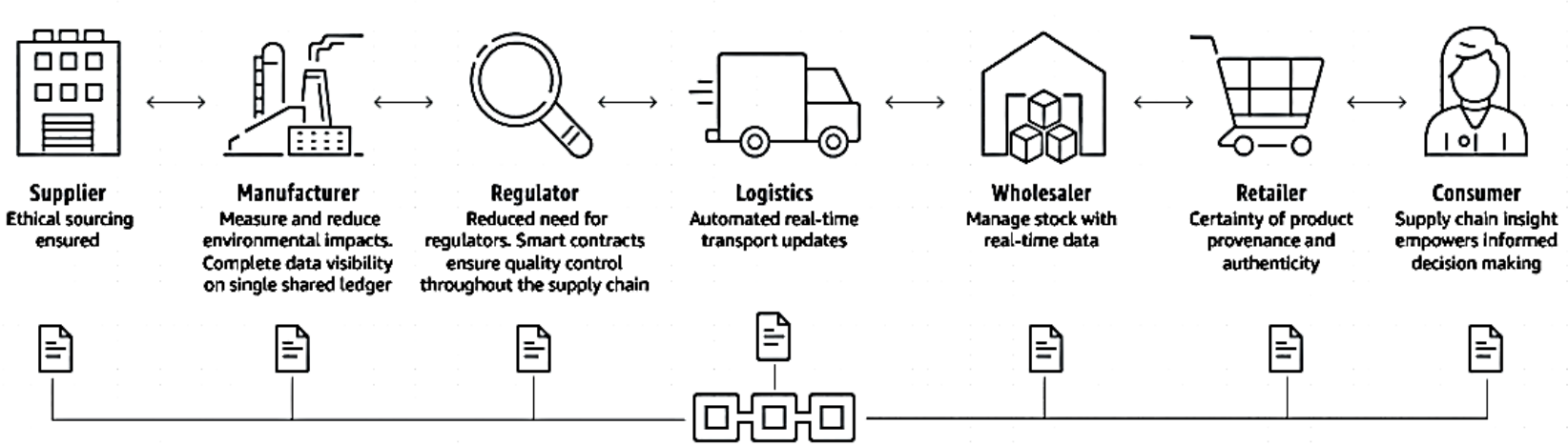
Sustainable supply chain management

Dr. Tetiana Kuvaieva & MSc. Victoriia Ponomarova
National Technical University Dnipro Polytechnic, Ukraine

1 Supply chain definition

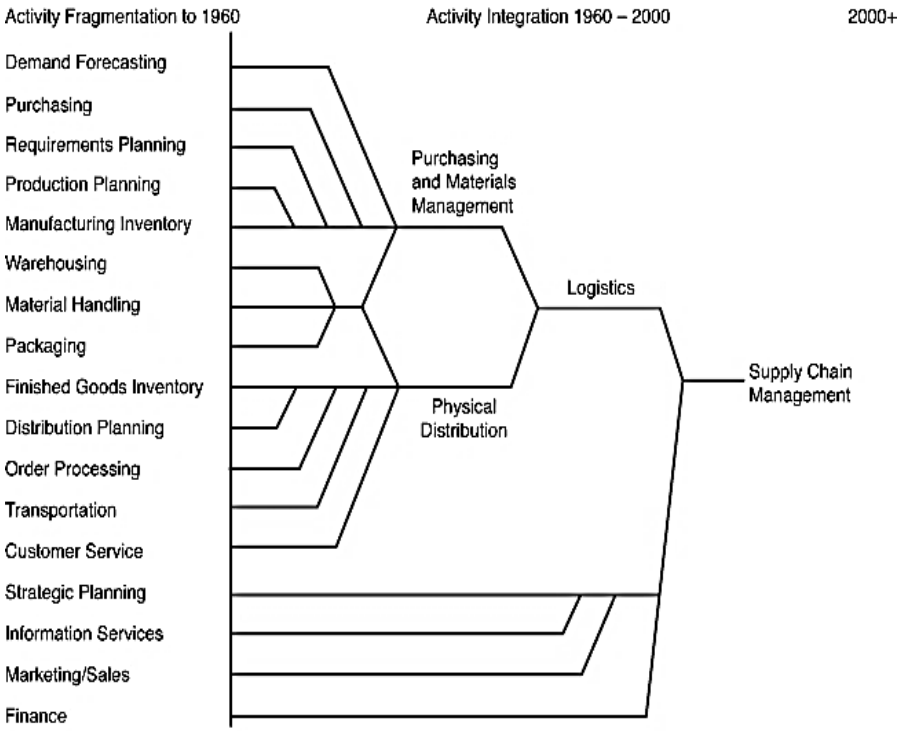
A supply chain is defined as the entire process of making and selling commercial goods, including every stage from the supply of materials and the manufacture of the goods through to their distribution and sale [12]:

- ✓ In its simplest form a supply chain is the activities required by the organisation to deliver goods or services to the consumer
- ✓ In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable.
- ✓ Supply chains include various entities, such as raw material extractors, service and component suppliers, a material product manufacturer or a producer of services, distributors, and end customers
- ✓ A supply chain can take on the form of a product based supply chain or that of a service, where services come together to offer an overall customer service as opposed to a finished product



2 Supply chain management (SCM)

The genesis of supply chain management [10]



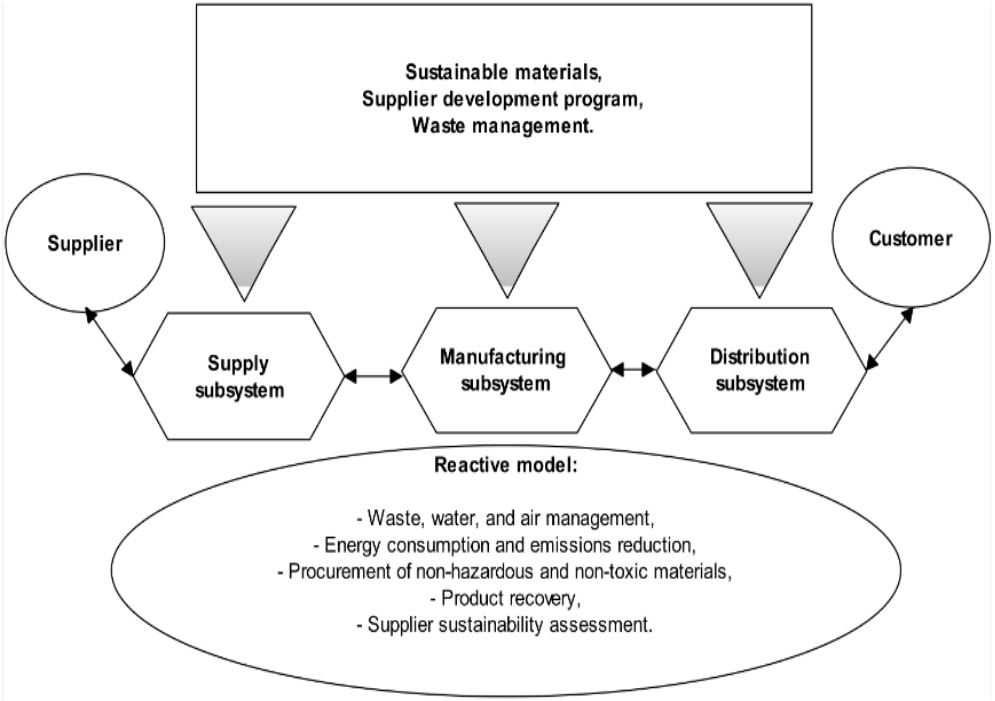
- ✓ Supply chain management is the management of the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace
- ✓ SCM represents an effort by suppliers to develop and implement supply chains that are as efficient and economical as possible. Supply chains cover everything from production to product development to the information systems needed to direct these undertakings
- ✓ SCM can be viewed in terms of processes, such as the gathering and processing of marketing data, distribution and payment of invoices, processing and shipping of materials, scheduling, fulfilment of orders, and so forth
- ✓ Supply chains also run in reverse, starting with the customer who sends back such items as components for replacement or repair, returned goods for re-manufacture, and obsolete goods for recycling or disposal. The reverse chain, like the forward chain, also comprises information flows and cash or credits

3 Sustainable supply chain management (SSCM)

In the context of supply chain management, sustainable supply chain management (SSCM) is a management concept extending beyond a supply chain’s performance metrics of cost, time, and flexibility. SSCM addresses the management of the integration of economic and non-economic issues in a supply chain [89]

Implementation of these practices includes:

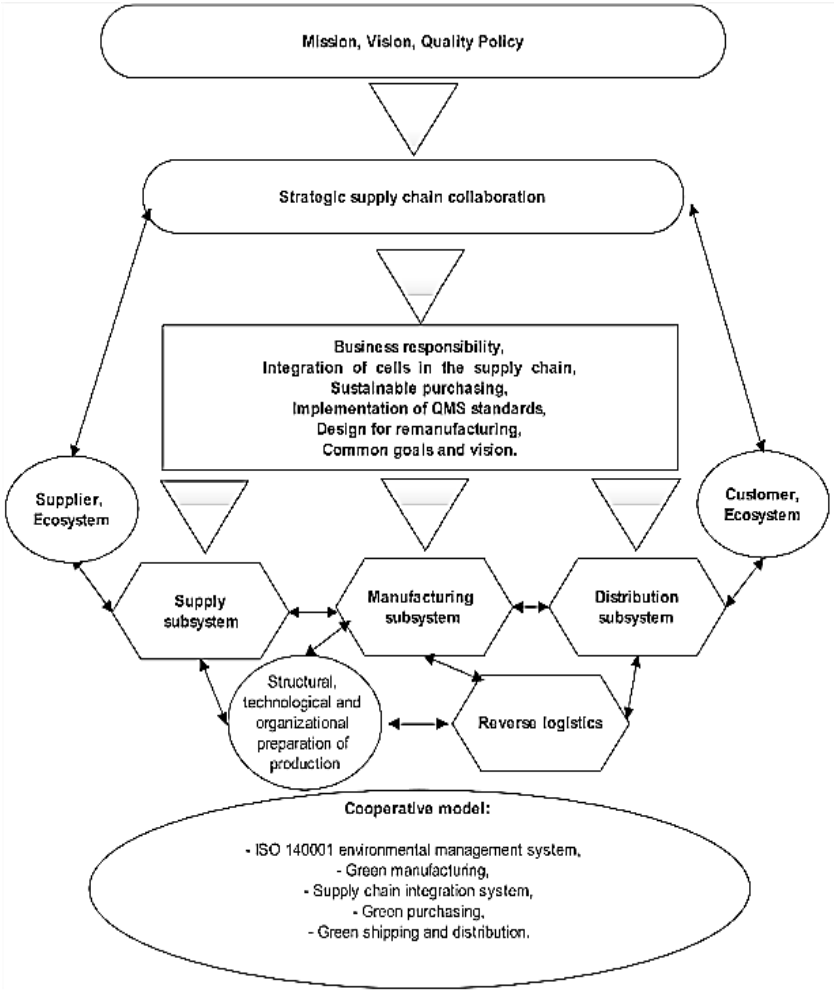
- ✓ Limiting resource consumption, including the use of material-saving and energy-saving technologies
- ✓ Using higher quality components, ensuring a longer product life.
- ✓ Optimizing packaging design: abiding by regulations and utilizing end-of-life of packaging material
- ✓ Replacing harmful materials with less harmful or harmless materials
- ✓ Eliminating toxic materials and reducing emissions
- ✓ Cooperating with suppliers who follow the basic guidelines for sustainable development
- ✓ Suspending cooperation with companies using unethical practices



4 Shift from reactive SCM to cooperative SSCM

The most important improvements include [89]:

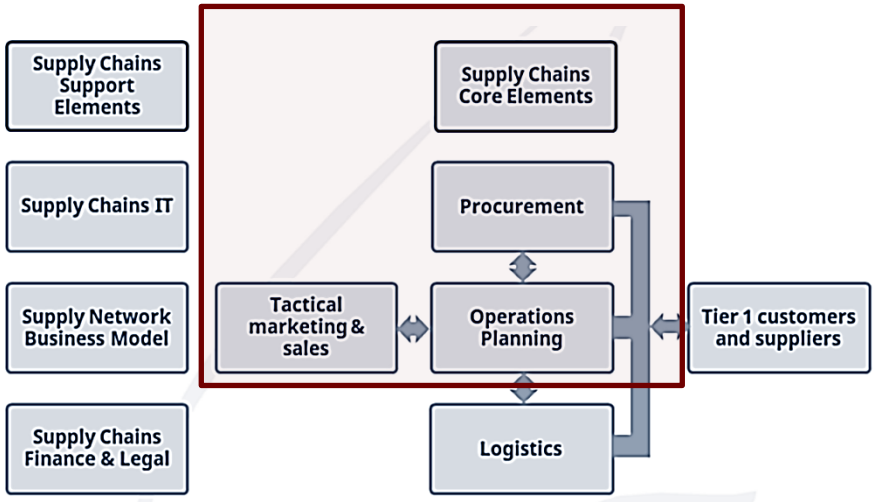
- Development of a common mission, vision, and goals. Supply chain management strategy is perceived as many mutually harmonized elements and processes
- Sustainable procurement. The goal of sustainable procurement extends its basic green purchasing to consider environmental and social aspects of diversity, safety, human rights, philanthropy, and local procurement
- Implementation of the requirements of the ISO 14001 standard. The goal of this standard is to provide organizations co-creating the supply chain with guidelines for the development of an effective environmental management system
- Improvement of reverse logistics. The increased interest in trends such as closed-loop systems and reverse logistics involving products and materials
- Implementation of QMS standards. Quality management, on a large scale, is important to improve key supply chain management processes
- Lasting partnerships. The basis for increasing the competitiveness of the supply chain is wide-ranging integration and cooperation
- Structural, technological and organizational preparation of production. There is a constant need to improve production technologies



5 Assessment of supply chain elements

The core elements and their functional processes that relate directly to suppliers, internal operations and customers are [50]:

- ✓ Procurement
- ✓ Operations planning
- ✓ Logistics
- ✓ Tactical marketing and sales

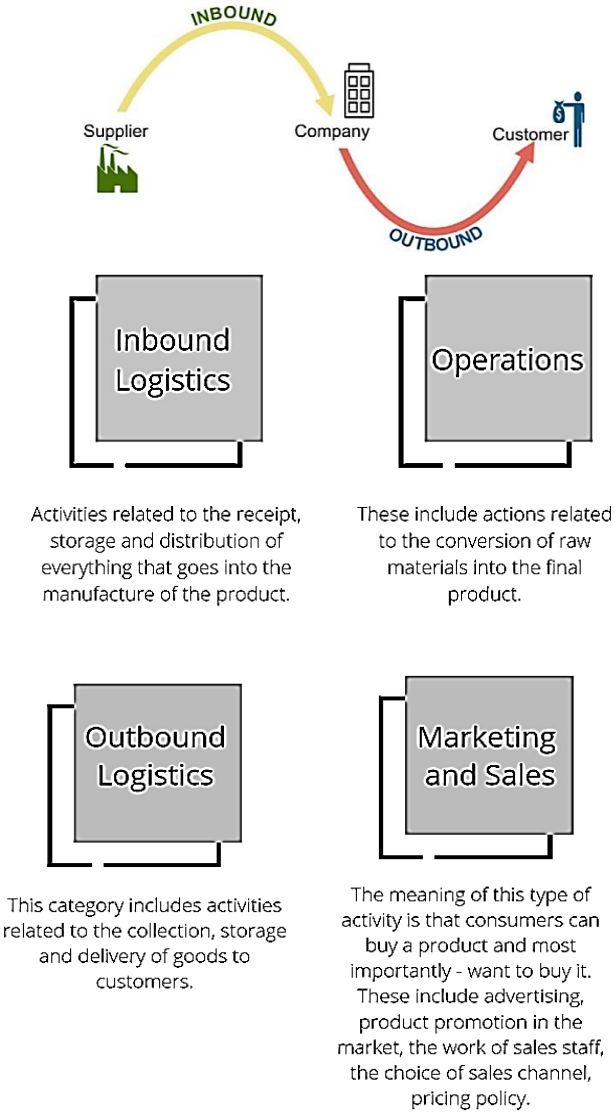


- ➢ The supply chain's traditional view has been developed to sustainable supply chain perspective
- ➢ Organizations that emphasize on the importance of sustainability will benefit from improved performance
- ➢ For assessment of sustainability in core elements, consideration of the dimensions and aspects of sustainability is essential

6 The importance of sustainable logistics

Logistics is the management of the flow of goods, information and other resources, including energy and people, between the point of origin and the point of consumption in order to meet there requirements of consumers[35]

- A sustainable logistics system, which considers three main perspectives and their criteria, addresses issues related to the economic, environmental, and social factors that impact a company
- The first step in this system is to analyze the resource inputs and outputs in order to gain a better understanding of what is needed to create a sustainable logistics system
- In a sustainable logistics system, a company’s inputs and outputs are evaluated based on five categories that impact sustainability: economic resources, material resources, information resources, human resources, and energy resources
- The next step is to study the logistics flows of a sustainable logistics system to determine how they relate to the inputs and outputs of the system
- These flows, which are important components of any logistics system, indicate the point of origin and point of use components and processes of a sustainable logistics system



[35]Wichaisri S., Sopadang A.(2014) Sustainable logistics system: A framework and case study. URL: https://www.researchgate.net/publication/286711215_Sustainable_logistics_system_A_framework_and_case_study

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Managing sustainability via balancing the energy trilemma

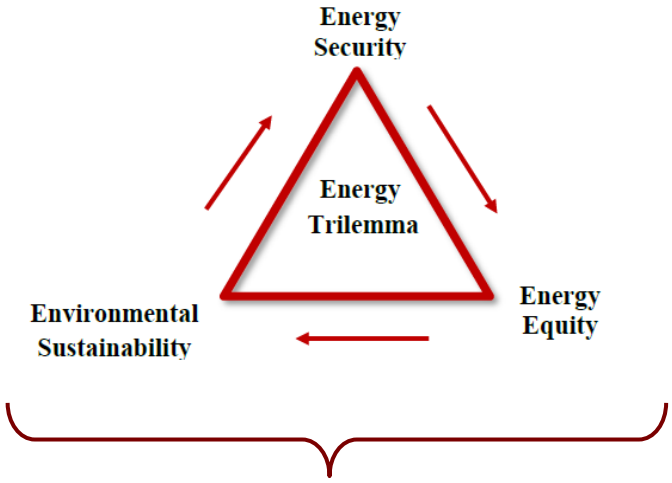
Prof. Vasily Shvets & Dr. Liudmyla Paliekhova
National Technical University Dnipro Polytechnic, Ukraine

1 Energy trilemma definition

The rapid growth in production caused significant increase in energy consumption without any regard for the future. It became apparent that traditional energy sources (mainly oil, gas and coal) are finite, while there is a high level of dependency on fossil fuels [57]:

- ✓ Growth in fossil fuel production and increase in coal consumption for electricity generation, which are inherently risky, have led to major technological accidents and environmental degradation
- ✓ The further concern is a tremendous inequity in the distribution of access to energy resources, and an unfair concentration of the rights to use them as a source of income. Analysts estimated that 10.6% of the world’s population consume about 55% of oil and 40.3% of the total energy; about 80% of the population consume 21.9% of oil and 28.7% of energy
- ✓ Energy efficiency, which is an essential prerequisite for the success of sustainability mission, requires reliable ways to properly assess the energy sustainability of business sector and the country, compare the energy sustainability with that of others, and to measure progress towards achievement of the targets

WEC jointly with Oliver Wyman and the Global Risk Centre of its parent Marsh & McLennan Companies have developed concept of ‘Energy Trilemma’. This concept is based on three core dimensions—energy security, energy equity, and environmental sustainability



Energy Security
- ➢ effective management of energy supply
- ➢ reliability of energy infrastructure
- ➢ ability to meet current and future energy demand

Energy Equity
- ➢ accessibility and affordability of energy supply
- ➢ fair prices and distribution

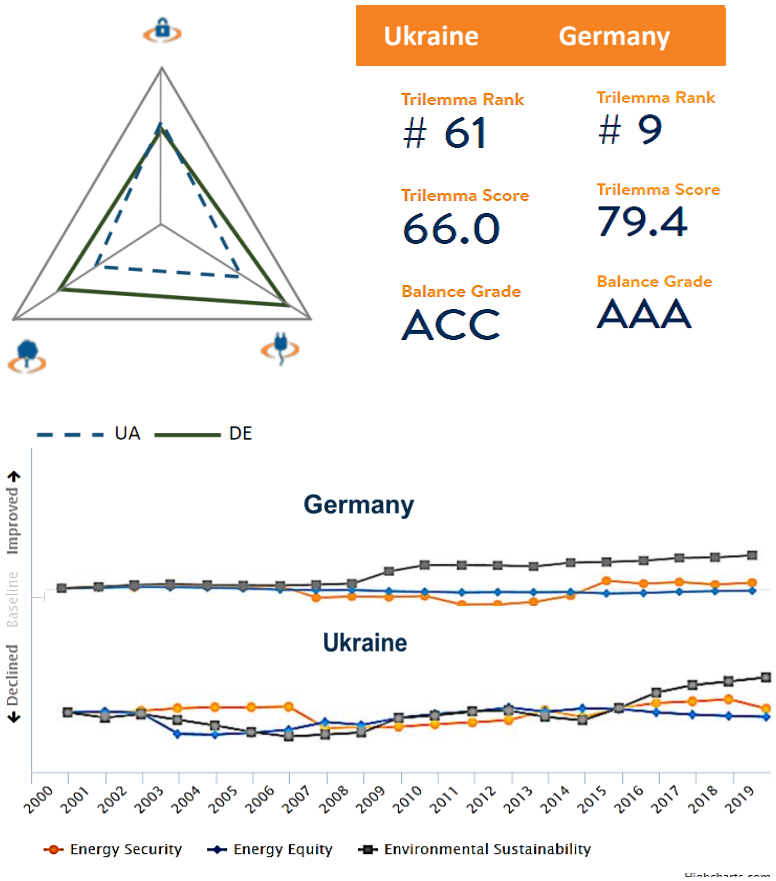
Environmental sustainability
- ➢ clean technologies and production
- ➢ reduction of the emissions greenhouse gases
- ➢ expansion of renewable energy

2 Energy trilemma index in Ukraine and Germany

The objectives of energy efficiency and sustainable development cannot be achieved only through efforts of individual hightech companies, countries or regions. The transition to energy efficient GVCs means the requirement to find ways for significant reductions in greenhouse gas emissions across the whole life cycle through application of eco-efficiency principles, and substitution of traditional materials with less energy-intensive materials [60]

- ✓ The energy trilemma of Germany is excellently balanced in comparison to countries with transitional economies. Since many years its policy was aimed at sustainability and focused on overall reduction in primary energy use and CO2 emissions, and on increasing electricity generation from renewable sources. For example, already in 1991 Germany began promoting renewable electricity using high feed-in tariffs stipulated by the Federal Electricity

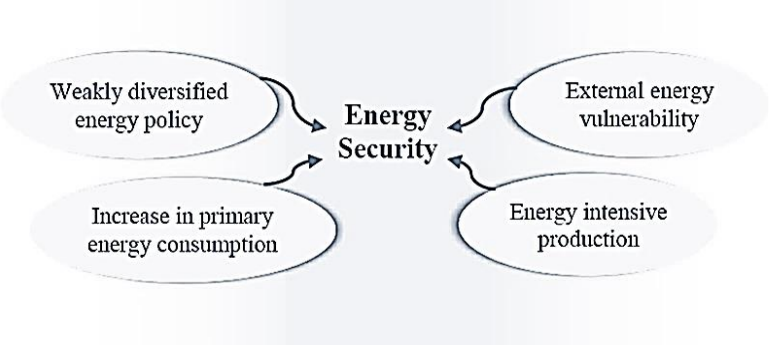
Trilemma Index in Ukraine and Germany, 2019[1]



[1]World Energy Council (2020)

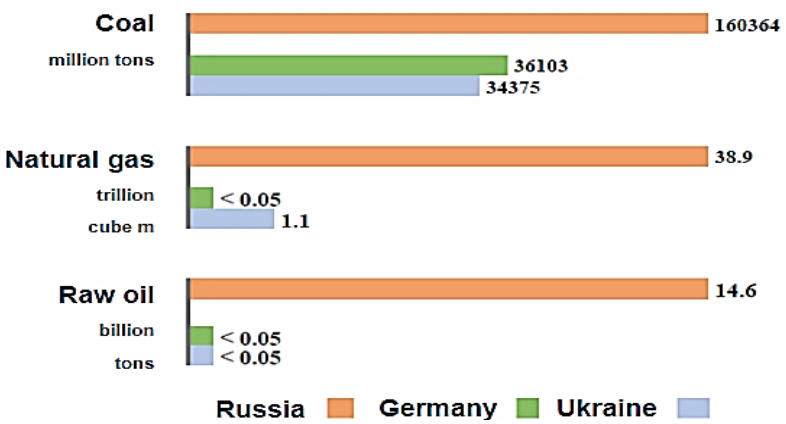
3 Energy security problems in Ukraine

The achievement of energy security requires the effective management of energy supply, the reliability of energy infrastructure, and the responsibility of energy companies operation to meet current and future demand [61]:

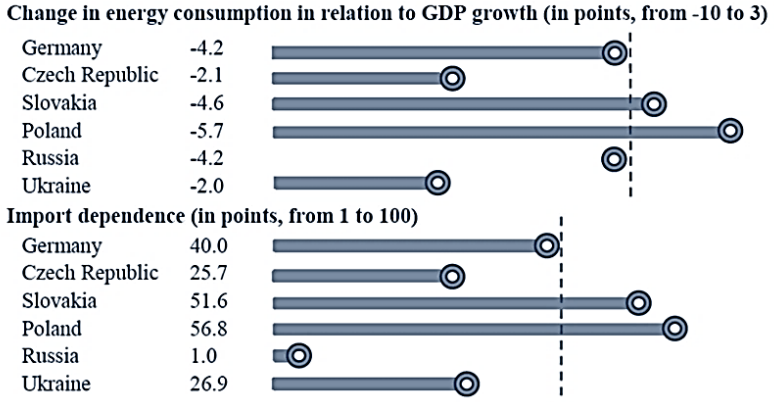


Ukraine faces all main problems typical for the majority of post-Soviet countries, including monopolisation of energy services and weak transparency of energy producers. Ukrainian experience clearly demonstrates that while a more diversified national policy on energy imports contributes to improving the country’s energy security; its positive effects may be diluted by a relative increase in energy consumption, especially in industry sector

Primary Energy Resources in Ukraine, 2019[2]



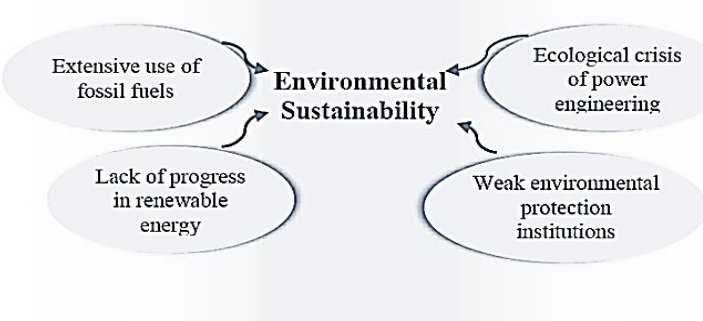




[2]World Energy Council (2020)

4 Energy environmental problems in Ukraine

Environmental sustainability is supported through clean technologies and cleaner production practices, reduction of the emissions of pollutants and greenhouse gases, the transition to renewable energy, the solution of the waste problem and conservation of natural habitats [61]:



Emissions and age of major power plants [85]



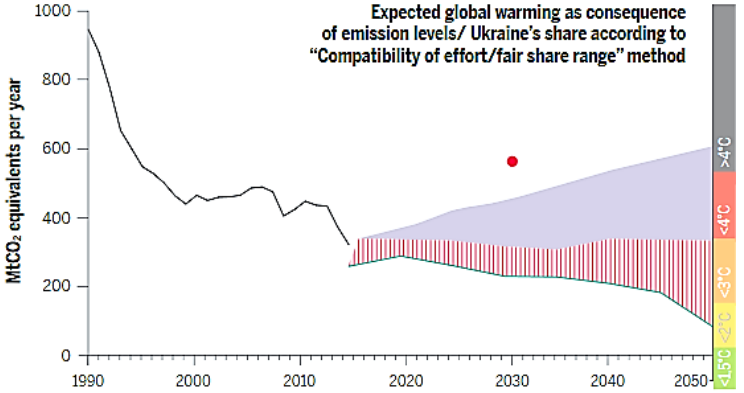
CO2 intensity (kCO2 per US$)

Germany	0.26
Czech Republic	0.38
Slovakia	0.28
Poland	0.42
Russia	0.73
Ukraine	0.79

GHG emissions from energy sector ($MtCO_2e$)

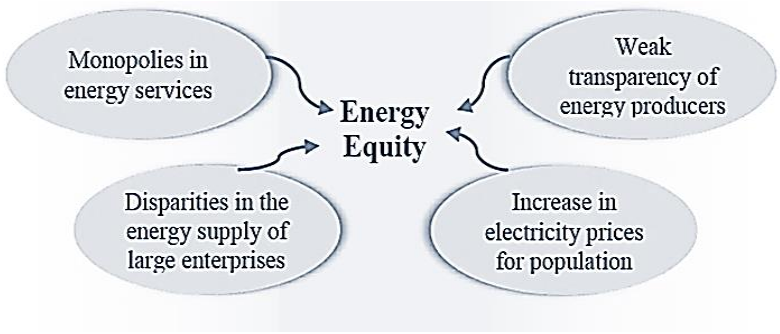
Germany	778
Czech Republic	114
Slovakia	33
Poland	311
Russia	2086
Ukraine	337

Ukraine’s projected CO2 emission



5 Energy equity problems in Ukraine

Energy equity provides the accessibility and affordability of the energy supply to household and business consumers [61]:



Industry electricity price (US cents per KWh)

Germany	12.61
Czech Republic	5.77
Slovakia	6.44
Poland	6.46
Russia	5.00
Ukraine	12.50



An underlying tenet of sustainable energy is that such basic energy needs should be affordably met.

2020 Energy Strategy | Energy - European Commission

Energy Equity evaluates the accessibility and affordability of energy within a country or region

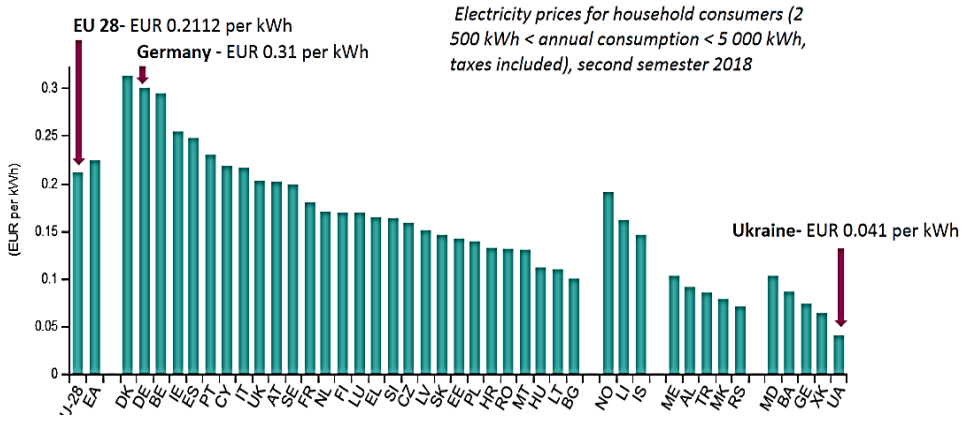
6 Electricity price statistics for household and non-household

Electricity price In Ukraine [70]:

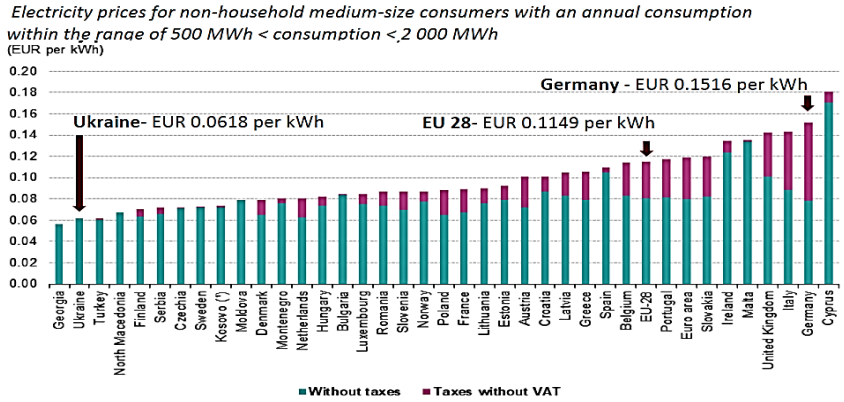
- ✓ Eurostat shows that Household electricity prices in the EU highest in Denmark (EUR 0.3123 per kWh) and Germany (EUR 0.31 per kWh) In Ukraine, the electricity prices for household are more than two times lower
- ✓ With the launch of the new electricity market, Ukrenergo’s tariffs increased as it acquired new functions (for instance, serving as a commercial metering and settlements administrator, while compensating the guaranteed buyer for “green tariffs”
- ✓ Despite introducing bilateral contracts, Ukraine has continued to control electricity costs by maintaining price caps, as well as public service obligations for nuclear and hydro producers to supply electricity at lower rates for residential consumers
- ✓ As part of the energy sector regulation and governance, the Government of Ukraine has continued to provide state support for market players and consumers. In maintaining low energy tariffs for end users, Ukraine has imposed price controls and adopted generous subsidy schemes, with the latter amounting to 7.5% of the country’s GDP

Electricity price statistics for household in Europe

(Database – Eurostat, May 2019 [11])



Electricity price statistics for non-household



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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

New electricity market in Ukraine: transformation of market participants and working conditions

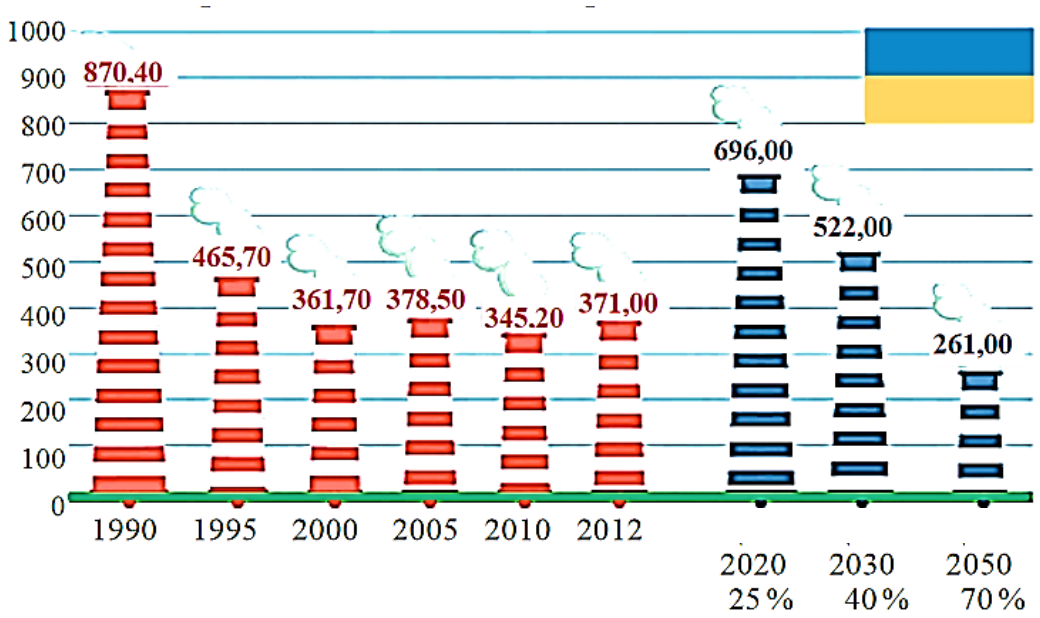
Dr. Natalia Dreshpak & Dr. Liudmyla Paliekhova
National Technical University Dnipro Polytechnic, Ukraine

1 Ukraine energy profile

Paris Climate Agreement: Ukraine's 2050 Goals [59]

Directive 2009/28/EU “On the promotion of the use of energy from renewable sources”
obliged Ukraine to set out a national target for the total share of RES in final energy consumption at 11 % by 2020

Reduction of anthropogenic greenhouse gas emissions[1]



In 2018, Ukraine’s total final consumption (TFC; excludes transformation sector) accounted to 51.5 Mtoe

- ✓ **Industry is the largest final energy consumer** (19.1 Mtoe in 2018). The residential sector is second (16.7 Mtoe), with households being the major users of natural gas (8.7 Mtoe in 2018)
- ✓ **Energy intensity per GDP at purchasing power parity (PPP) is very high:** at 0.25 tons of oil equivalent (toe) per thousand2015 USD PPP, it is the second-highest among EU4Energy countries, after Turkmenistan, and over twice the world average (0.11 toe /1000 USD).
- ✓ The share of coal in final consumption is very small (12%) because most of the coal consumed in the country is used to produce electricity and heat

[1]State Agency on Energy Efficiency and Energy Saving of Ukraine. URL: https://saee.gov.ua/en

2 Ukrainian Energy Strategy up to 2035

In August 2017, the government adopted the new Energy Strategy of Ukraine (ESU) to 2035 [53]

STAGE 1 Reforming the energy sector (by 2020)

The implementation of the Third Energy Package will allow to create full markets for natural gas and electricity according to EU energy laws. Also at this stage, it is planned to complete the institutional integration of Ukraine into ENTSO-G, as well as ENTSO-E energy system

Key tasks:

1 increase of gas production
2 decrease of Gross Domestic Product energy intensity
3 further development of Renewable Energy Sources

→ In the first stage, radical progress in the RES sector is expected to be achieved by increasing their share of final consumption to 11% by pursuing a stable and predictable policy in the field of stimulating the development of RES and attracting investment

STAGE 2 Optimization and innovative development of energy infrastructure (until 2025)

The second stage of the energy strategy will be focused on a new market environment and the actual integration of the Unified Energy System (UES) of Ukraine with the European energy system.

Key tasks:

1 integration of the Ukrainian grid with the ENTSO-E continental Europe in the service mode
2 full integration into the European gas transmission system ENTSO-G, and further deepening cooperation with Central European countries in order to increase the security of energy supply
3 implementation of investment projects within the National Emission Reduction Plan
4 creating local heating supply systems basing on the potential of local fuels, logistics, regional and national energy infrastructures
5 improving the efficiency of the existing local heating systems
6 attracting private investment

3 Key Performance Indicators due to Ukraine's Energy

STAGE 3. Ensuring sustainable development (until 2035)

The third stage is aimed at the innovative development of the energy sector, as well as the construction of a new generation facilities. The selection of the generation type will depend on the expected prices for fuels and the intensity of each generation type development, providing competitive conditions in energy markets

Key tasks:

1. increase in national gas production, including unconventional gas
2. adaptation of GTS capacities to the conditions of the European energy market
3. increase of RES in total supply of primary energy up to 25%

Strategy’s Benchmark Indicators [52]

A.Energy Efficiency Approaching	**2015**	**2020**	**2025**	**2030**	**2035**
GDP energy intensity(t.o.e. /’000$PPP 2005)	0,28	0,20	0,18	0,15	0,13
Losses share in electricitygrids (%)	>12	10	9	8	<7,5
B. Expansion of the RES	**2015**	**2020**	**2025**	**2030**	**2035**
RES share in the Total Primary Energy Supply (%)	4	8*	12	17	25

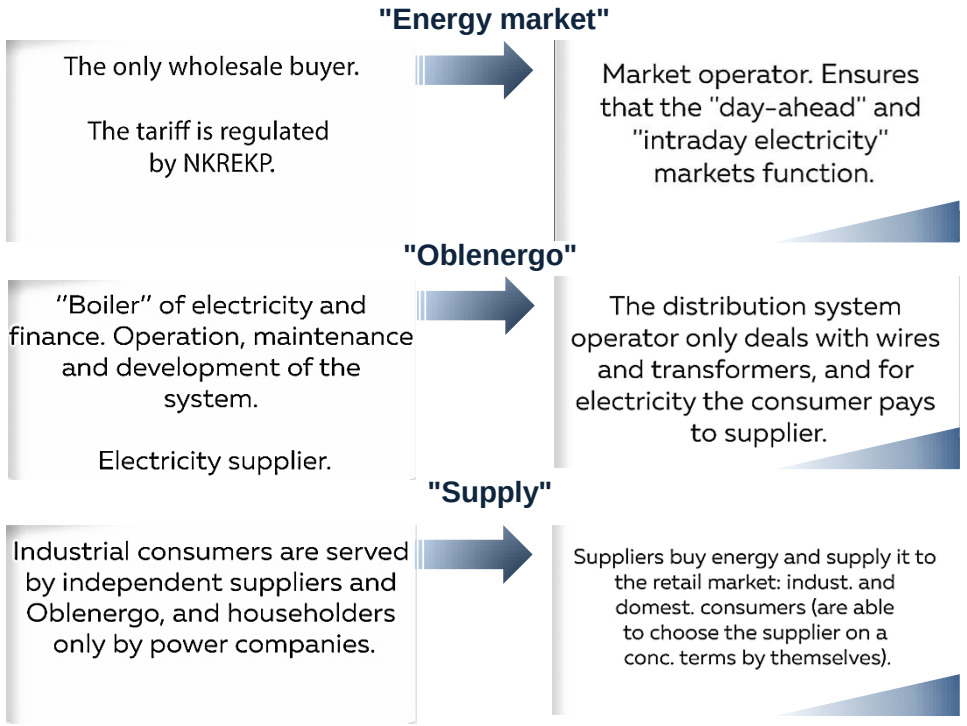
* RES share in the final energy consumption is estimated 11% of the total final energy consumption in 2020

4 New electricity market in Ukraine

Since the July 1, 2019, to sign the contract of sale and purchase of electricity (with the ‘feed-in’ or ‘green’ tariff), it's necessary to follow the next bureaucratic procedures[2]

- ✓ **About auctions shortly:** they don't cancel "feed-in" tariff; are mandatory only for generations implemented after 01/01/2020 with capacity of 5 MW for wind and 1 MW for sun, and those that do not have prepared contracts signed by 12/31/19
- ✓ **Quotas.** As the cost of energy from RES is bigger than cost of energy from traditional sources, the state government is ready to offset the difference by quotas. They will be determined once a year until December 1 (next year's plan) and will be distributed as follows: not less than 15% for the sun, not less than 15% for wind, not less than 15% for other types of RES
- ✓ **Antitrust Restrictions**: setting of annual limits for participating in "green" auctions for companies with a common beneficial owner who have already received a 25% of annual quota this year.

A fair competitive system of pricing and energy supply

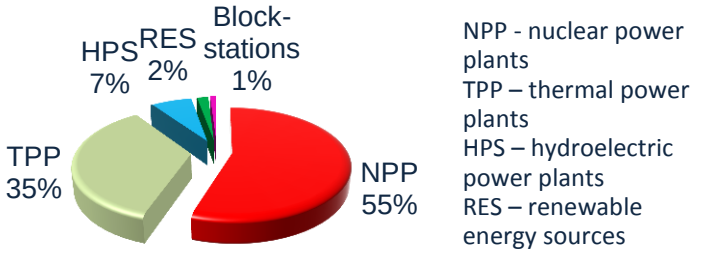


[2]UNDP in Ukraine. URL: https://www.ua.undp.org/content/ukraine/en/home/sustainable-development-goals.html

5 Renewable energy problems in Ukraine

A revision of the Ukrainian legislation on renewable energy implies, in particular, the implementation and enforcement of the RES Directive 2009/28/EC according to the provisions of the Decision D/2012/04/MC-EnC of the Ministerial Council of the Energy Community on the implementation of Directive 2009/28/EC and amending Article 20 of the Energy Community Treaty. Accordingly, the new Energy Strategy of Ukraine until 2035 will ensure the completion of the reform of the energy sector of Ukraine in order to integrate it with the energy sector of the EU [62]

RES facilities commissioned in 2019



Type of energy	Problems
Solar	High cost of panels (lack of government loans); Selection of the optimal location (large network losses); Land acquisition
Wind	High cost of turbines (long payback time); The need for environ mental impact assessments; Land acquisition (the most prospective Azov and Crimean coasts are located in the conflict zone)
Hydro	The need to restore abandoned stations; Land acquisition for hydraulic structures (dams); The need for environmental impact assessments
Biomass	Insufficient number of agricultural bioenergy projects; biomass (in the form of wood pallets) is used for utilities, which contributes to the unfair consumption of forest resources

Some common problems in renewable energy use

→ Imbalance of trade-offs for the inclusion in GVCs in which all interested partners would be more inclined to enter Ukrainian markets for services and investments in the field of energy efficiency and RES

→ Lack of strictly state control over the targeted use of land

→ The RES equipment market is experiencing an excess of demand over supply

→ The problem of balancing electricity when using RES remains in power systems

→ Weak development process of energy management certification in industry

6 New rules of the game for renewables in Ukraine

On 31 July 2020, the President of Ukraine has signed the long-awaited law of Ukraine No. 810 “On Amendments to Certain Laws of Ukraine related to Improvements of the Terms of Support for Production of Electricity from Renewable Energy Sources” [45]

Political measures

- ✓ 25% – The Ukrainian government has committed to increase renewables from around 4 per cent of the energy mix today, to 25 per cent by 2035
- ✓ 87% – During 2018, installed solar power capacity increased by 646MWp (87 per cent)
- ✓ USD 1.4 billion – Investment in renewables from international organisations (2009-2018)

RES facilities commissioned in 2019



3537 MW solar power stations

243 MW solar power stations (households)

637 MW wind power stations

73 MW facilities that produce electricity from biogas

15 MW hydroelectric power stations

Proposed sources of funds to repay the indebtedness of the Guaranteed Buyer to RES producers in the course of 2020 to 2021:

- ✓ State budget funds covering at least 20% of the forecasted revenues of RES producers in the relevant year
- ✓ 35% of funds received by the TSO from cross-border capacity allocation as of 1 July 2020.
- ✓ Proceeds from placement of five-year term domestic state bonds

Green metallurgical enterprises:

Until 31 December 2029, metallurgical enterprises, which satisfy the eligibility criteria for being “green” metallurgical enterprises1 are expressly exempted from paying the TSO transmission tariff component that covers the increase of the renewable energy share.

The Law defines the green metallurgical enterprises as a legal entity engaged in steel production business in compliance with the norms on direct emissions of carbon dioxide as a result of steel production at the level of not more than 250 kilograms per ton of steel products and exclusively by electric arc production method.

7 The ‘green’ tariff in Ukraine

Restructuring of the FiT in Ukraine

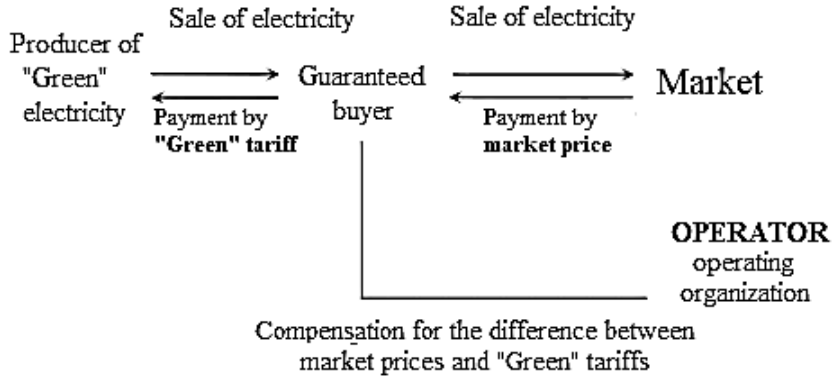
On 21 July 2020, the Parliament passed the law “On Amendments to Certain Laws of Ukraine on the Improvement of Support for the Production of Electricity from Alternative Energy Sources” (the “Law”). The Law is based on the Memorandum of Understanding for the Resolution of Problematic Issues in the Renewable Energy Industry of Ukraine dated 10 June 2020 [67]

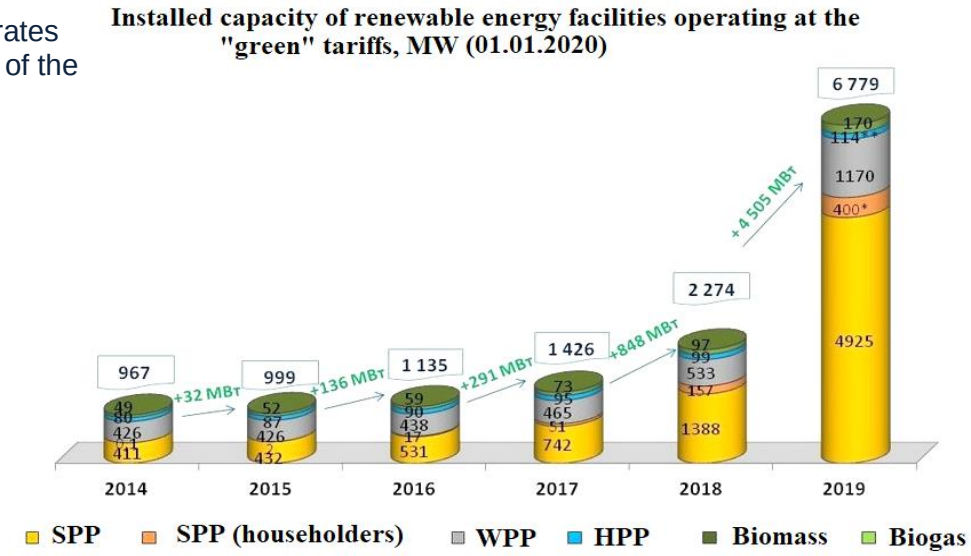
Favourable

- ✓ Stabilization clause for RES producers /investors
- ✓ “Green” auctions to be launched in 2021
- ✓ Strengthening liability for imbalances
- ✓ Curtailment compensation mechanism
- ✓ Certain measures are envisaged to improve settlements with RES producers going forward
- ✓ GoUis instructed to develop law on mechanisms for settlement ofthe Guaranteed buyer’s historical debt (approx. UAH 16 billion as of July 2020)

Unfavourable

- ✓ Strengthening liability for imbalances
- ✓ Reduction of FiT rates without extension of the FiT validity period





8 Feed-in tariff restructuring: new rates

Key terms of the FiT mechanism restructuring

Total capacity		Solar power plants: Small (lower than 1 MW)		Solar power plants: Medium (1 MW – up to 75 MW)		Solar power plants: Large (75 MW and higher)		Wind power plants: Small (lower than 600 kW)		Wind power plants: Medium (600kW – up to 2MW)		Wind power plants: Large (2 MW and higher)	
2015	Jul	15,69		14,41		14,41							
2016	Jan	14,79	-7,5%	13,59	-15%	13,59	-15%	5,82	No change	6,79	No change	9,41	-7,5%
2017	Jan												
2018		13,89		12,77		12,77							
2019													
2020	Jan	19,97	-2,5%	10,97	-2,5%	10,97	-2,5%	5,04	-2,5%	5,88	-2,5%		-2,5%
	Nov			7,88		4,50							
2021	Jan			7,62	-30%								
	Apr	19,61		4,35	-60%	4,35	-60%	4,94		5,78		8,82	
2022	Jan	19,74		FiT rate, € cents/kWh		% reduction of FiT rate		483		5,67			
2023	Jan												

Citation by reference, partial or full reproduction:

Dreshpak N., Paliekhova L. New electricity market in Ukraine: transformation of market participants and working conditions. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 57-66

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Progress and recent trends in wind energy: Ukrainian experience

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National Technical University Dnipro Polytechnic, Ukraine

1 Stages of wind energy development: 1st stage

Wind energy development counts thousands of years, that is, from the starting point of the very first vertical-axis wind machines operating on the basis of drag forces, up until the current time, during which wind turbines under development have reached the scale of tens of MW [42]:

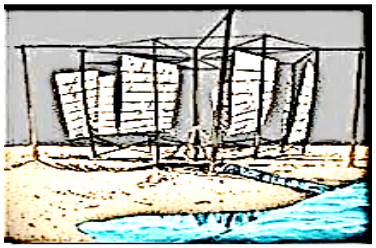
1st stage - from antiquity to the end of the XIX century

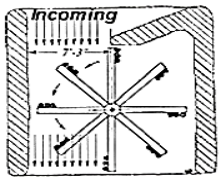
Persian drum-type windmill with a vertical axis of rotation (2nd-1st century BC)

From the early times of wind power exploitation, humankind has encountered numerous types of wind machines and designs, which have always found an important place in the puzzle of technological development













Greek mill
4th century AD



Goat mill
1500-1700



Dutch mill
1700 - 2000

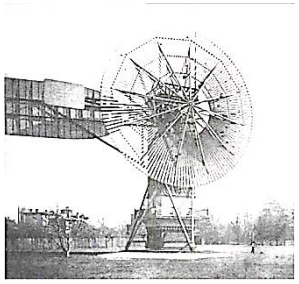
2 Stages of wind energy development: 2nd stage

2nd stage - XIX century - 80s of XX century [42]:

Further evolution and perfection of these systems was performed in the United States during the nineteenth century, when over six million small machines were used for water pumping between 1850 and 1970

The first ‘large’ wind machine to generate electricity (a low-speed and high-solidity wind turbine of 12 kW) was installed in Cleveland, Ohio, in 1888, while during the late stages of World War I, the use of 25 kW machines throughout Denmark was widespread

Further development of wind generators was inspired by the design of airplane propellers and monoplane wings, while subsequent efforts in Denmark, France, Germany, and the United Kingdom during the period between 1935 and 1970 showed that large-scale wind turbines could work



Brash Installation
1888-1908, Cleveland
D_{nom} = 12 kW



Darya rotor
S.J. Savonius
Finland, 1922



Wind pump installations
USA, 1935

2nd stage - XIX century - 80s of XX century

Until this period, emphasis was mainly given to the development of horizontal-axis wind machines operating on the top of adequately high towers and using a small number of blades (normally two or three). In 1931, Georges Darrieus invented the vertical-axis wind turbine, introducing a new power generation concept for wind machines

Country	Events
Denmark	From 1960 to 1980 installed more than 33 thousand units with a capacity of 5 to 25 kW (total capacity of about 200 MW)
England	1950 Vorth Scotland Hydroelectric Board experimental installation with a capacity of 100 kW 1955 - f. Enfield Cable Company is a pilot plant with a capacity of 100 kW with pneumatic power transmission
France	1960 - Experimental installation with a capacity of 600 kV
Germany	1968 - Experimental installation with a capacity of 100 kV
USSR	1937 Installation with a capacity of 100 kW 1940 Project of installation with a capacity of 12 MW 1950-1960 - Installations from 3 to 11 kW. (about 9 thousand units)
USA	1940 Installation f. Smith-Putmann (D = 53 m; m = 16 t; P = 1.25 MW)

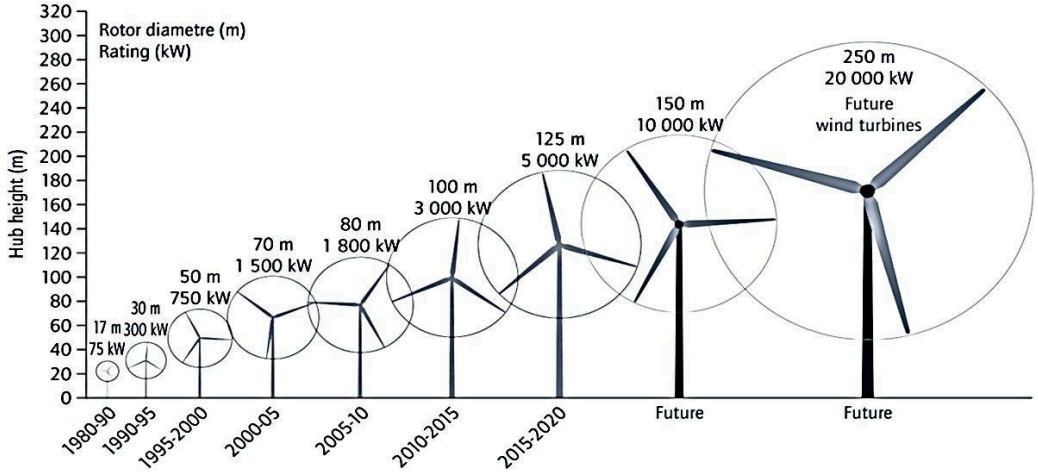
3 Stages of wind energy development: 3rd stage

Stage 3 - the end of the XX century - the beginning of the XXI century [42]:

One of the most important milestones of wind energy history coincides with the US government involvement in wind energy R&D after the oil crisis of 1973. Following this, in the years between 1973 and 1986, the commercial wind turbine market evolved from domestic and agricultural (1–25 kW) to utility-interconnected wind farm applications (50–600 kW). After 1990, most market activity shifted to Europe, with the last 20 years bringing wind energy to the front line of the global scene, with major players from all world regions

During these past 20 years, the wind energy sector has met tremendous growth, not only in terms of market share but also in terms of technological developments, with the latest achievements bringing about the era of offshore wind power generation. The cumulative installed wind power is nowadays mainly concentrated in the European Union, the United States, China, and India, while what should also be noted is that there is a remarkable activity recently recorded in offshore installations, with contemporary machines now reaching or even exceeding 5 MW

Growth in size of wind turbines since 1980 and prospects



Source: adapted from EWEA, 2009.

4 Ukraine in the development of wind energy

Energy from wind was being already used in Ukraine in the 19th century. In 1917, in the territory of Ukraine there were about 30 000 windmills generating up to 200 000 kWh of energy per year. The first phase of development of industrial wind in Ukraine rightfully dates back to the Soviet period of the 1930s [86]:

1937-1941 - creation and operation of Balakliia wind farm: Rnom = 100 kW

Energy from wind was being already used in Ukraine in the 19th century. In 1917, in the territory of Ukraine there were about 30 000 windmills generating up to 200 000 kWh of energy per year. The first phase of development of industrial wind in Ukraine rightfully dates back to the Soviet period of the 1930s. In 1931 in the USSR in Balaklava, with the electricity generated being fed into a small grid that was supplied by a 20 MW steam power station

1940 - The project of the Yalta wind farm: R_{nom} = 12 MW

A horizontal-axis wind turbine similar to the ones we use today is built in Yalta. The wind turbine has 100 kW of capacity, a 32-meter-high tower, and a 32% load factor (which is actually similar to what today’s wind turbines get)







Foundation for support: D = 6.5 m

5 Ukraine in the development of wind energy

The State Complex Program for Construction of Wind Farms in Ukraine was introduced in February 1997.The production of licensed wind turbines has been the main path of the wind energy sector development in Ukraine. Within the framework of the conversion programme, enterprises of military–industrial background were involved in manufacturing wind turbine components. This campaign was launched under the motto “clean energy instead of guns” [45]

By the end of 2010, within the framework of the Complex Program 701 of USW 56-100 (107.5 kW) wind turbines, produced under license of American company Kenetech Windpower, and 20 of T600-48 (600 kW) wind turbines by Belgian producer Turbowinds were installed in Ukraine. As of 1 August 2011, the total installed capacity of wind farms constructed under Program reached 87.5 MW. In 2010 the Complex Program was stopped. Today, we can clearly define main reasons for Complex Program’s failure: miscalculations in the financial model; incompatibility of USW 56-100 wind turbines with Ukrainian wind conditions; poor quality of out-of-date turbines; and unavailability of service and maintenance for the turbines

Powerful wind power plants made in Ukraine



USW 56-100
Uind-energo LTD together with VO Pivdenmash



T-600-48



ABE-250
Design Bureau "Southern"



ТГ-750 (1000)
Concord Industrial

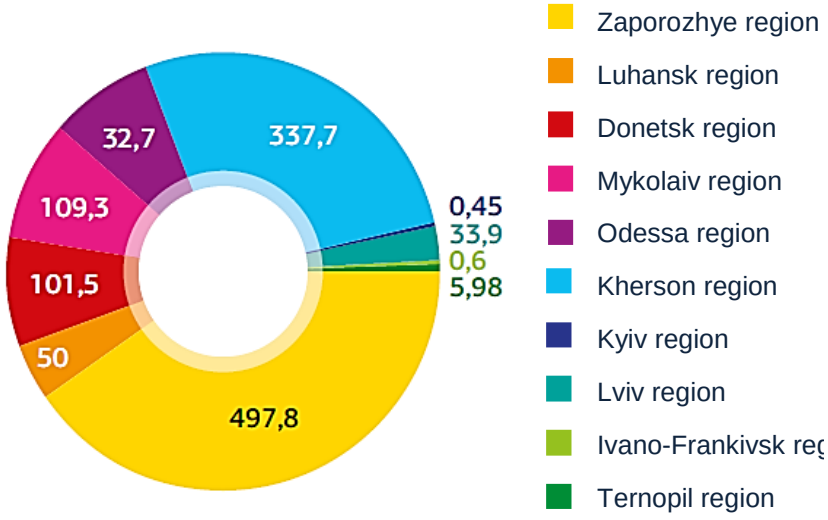


WTU 4,5
«FVT-Ukraine »

6 Prospects for wind power stations in Ukraine

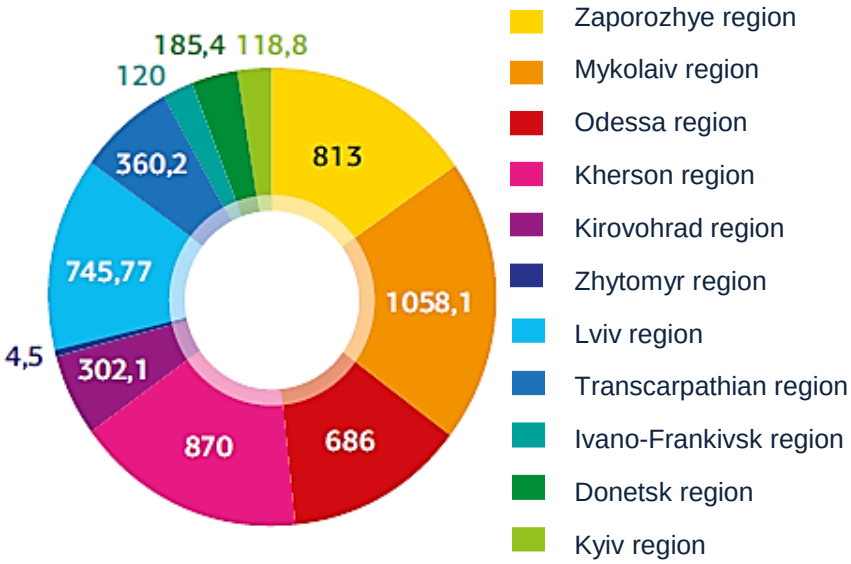
Problems with limited reserves of conventional energy sources and environmental pollutions force Ukrainian government to search for alternative energy sources. Adopted in April 2009, the Law of Ukraine “On Amendments to the Law of Ukraine ”On Electrical Power Industry” as to Stimulation of Alternative Energy Sources Use” №1220-VI (“Green Tariff Law”) created the necessary prerequisites for a transition to the use of renewable energies and wind energy in particular [46]

The capacity of wind power equipment has been installed in the regions of Ukraine, МВт



Since 2011 all the new wind capacities in Ukraine have been put online with private investments. Creation of energy supply o achieve a truly sustainable future based on the unlimited, non-polluting and competitive renewable technologies is a challenge not only for Ukraine, but the entire international community

Wind energy projects are registered for environmental assessment as of 01.01.2020



Citation by reference, partial or full reproduction:

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

A review of wind energy technologies

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National Technical University Dnipro Polytechnic, Ukraine

1 Definition of sustainable energy

✓ **Sustainable energy** is energy produced and used in such a way that it "meets the needs of the present without compromising the ability of future generations to meet their own needs [42]
✓ The lack of access to modern and **sustainable energy** is a major cause of environmental degradation in vast areas of the developing world, and a major impediment to sustainable development
✓ **Sustainable energy** is similar to the concepts of green energy and clean energy in its consideration of environmental impacts, however formal definitions of sustainable energy also include economic and social impacts

Sustainable Energy =

- **Energy security**
- **Energy availability**
- **Environment protection**
- **Resource**

~~Intensive use energy of fossil resources for industrial and consumer society development~~

Alternative energy for sustainable development

The energy transition to meet the world's needs for electricity, heating, cooling, and power for transport in a sustainable way is widely considered to be one of the greatest challenges facing humanity in the 21st century. Production and consumption of energy emits over 70% of the human-caused greenhouse gas emissions that cause climate change

In general, renewable energy sources such as solar, wind, and hydroelectric energy are widely considered to be sustainable. Nuclear power is a low-carbon source and has a safety record comparable to wind and solar, but radioactive waste and the risk of major accidents are disadvantages of this technology

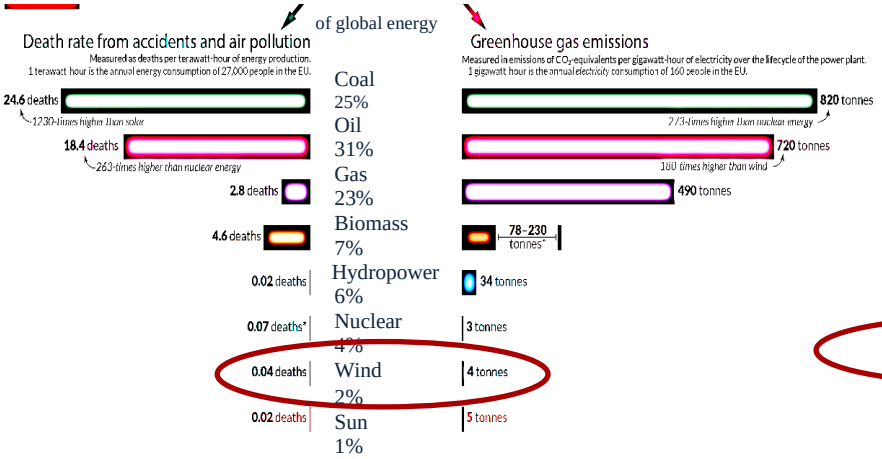
The terms "sustainable energy" and "renewable energy" are often used interchangeably. However, renewable energy projects sometimes raise significant sustainability concerns. Renewable energy technologies are essential contributors to sustainable energy as they generally contribute to world energy security, and reduce dependence on fossil fuel resources thus mitigating greenhouse gas emissions

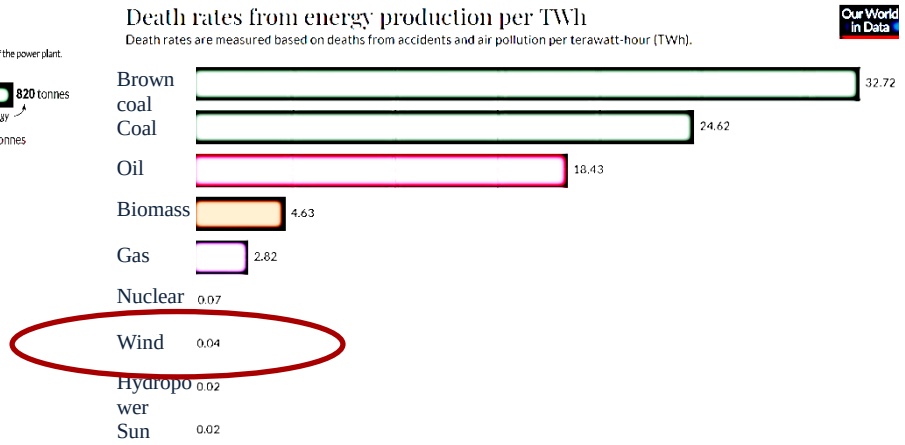
2 Safest and cleanest sources of energy

All energy sources have negative effects. But they differ enormously in size: as we see, in all three aspects, fossil fuels are the dirtiest and most dangerous, while modern renewable energy sources are vastly safer and cleaner[1]

In the chart we see the death rates of each – given as the number of deaths per terawatt-hour of energy. One terawatt-hour of energy is about the same as the annual energy consumption of 27,000 citizens in the European Union. We see massive differences in the death rates of modern renewables compared to fossil fuels

The safest and cleanest sources of energy





*Life-cycle emissions from biomass vary significantly depending on fuel (e.g. crop resides vs. forestry) and the treatment of biogenic sources.
*The death rate for nuclear energy includes deaths from the Fukushima and Chernobyl disasters as well as the deaths from occupational accidents (largely mining and milling).
Energy shares refer to 2019 and are shown in primary energy substitution equivalents to correct for inefficiencies of fossil fuel combustion. Traditional biomass is taken into account.

Nuclear energy, as you can see, results in 99.8% fewer deaths than brown coal; 99.7% fewer than coal; 99.6% fewer than oil; and 97.5% fewer than gas. Wind and solar are more safe yet

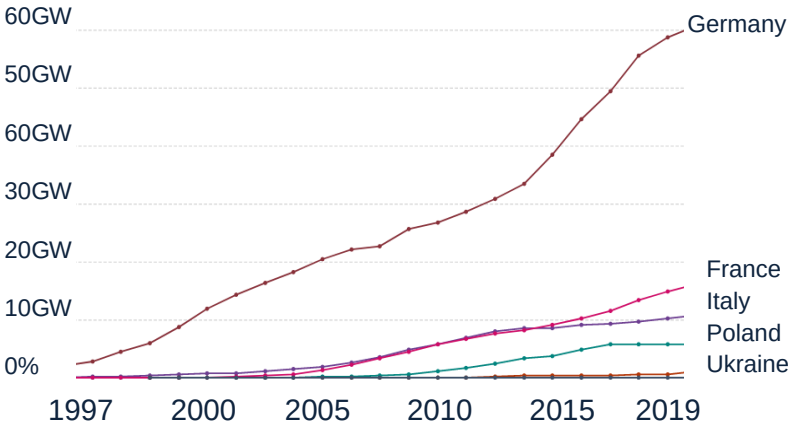
[1]What are the safest and cleanest sources of energy?
URL: https://ourworldindata.org/safest-sources-of-energy

3 Wind energy generation in Ukraine

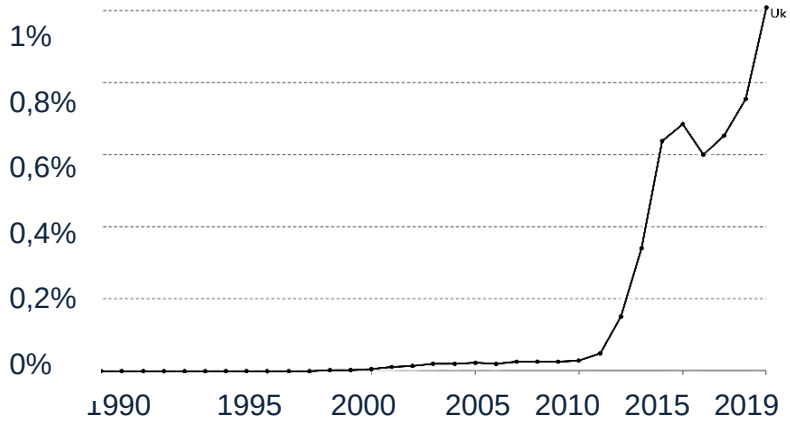
Renewable wind energy capacities in Ukraine (MWp)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Wind	87	151	194	334	426/651,8	426	438	465	533	1,170	1,207
Solar	3	191	326	616	411/818,9	432	531	742	1,388	4,925	5,576
households SPP	-	-	-	-	0,1	2	17	51	157	553	618
Small hydropower plants of Ukraine [uk]			73	75	80	87	90	95	99	114	116
Biomass			6	17	35	35	39	39	52	55.9	91
Biogas			0	7	14	17	20	34	46	70.3	86

Installed wind energy capacity, 2019

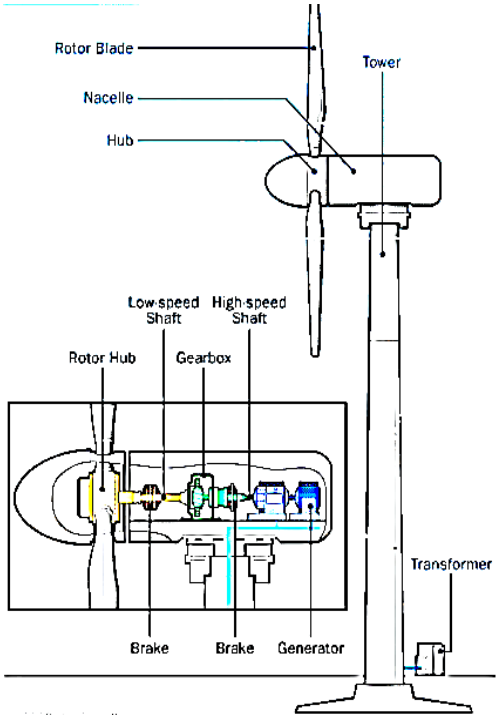


Share of electricity production from wind, Ukraine, 2019



4 The main issues associated with the manufacture of wind turbines

Wind turbines work on a simple principle: wind turns the propeller - like blades of a turbine around a rotor, which spins a generator, which creates electricity. This then passes through a transformer, which steps up the voltage so it can be transported on the National Grid or used by a local site [33]:



- **rotor blades** - capture wind's energy and convert it to rotational energy of shaft
- **shaft** - transfers rotational energy into generator
- **nacelle** - casing that holds the **gearbox** (increases speed of shaft between rotor hub and generator), **generator** {uses rotational energy of shaft to generate electricity using electromagnetism), **electronic control unit** (monitors system, shuts down turbine in case of malfunction and controls yaw mechanism), **yaw controller** (moves rotor to align with direction of wind) and **brakes** (stop rotation of shaft in case of power overload or system failure).
- **tower** - supports rotor and nacelle and lifts entire setup to higher elevation where blades can safely clear the ground
- **electrical equipment** - carries electricity from generator down through tower and controls many safety elements of turbine

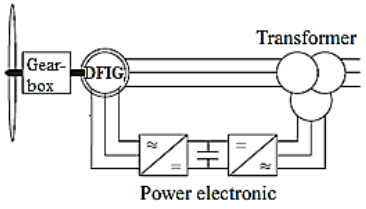
One of the goals of sustainable energy development is to increase reliable, uninterrupted and sufficient energy production to prepare for a more sustainable economic recovery

Types of generators

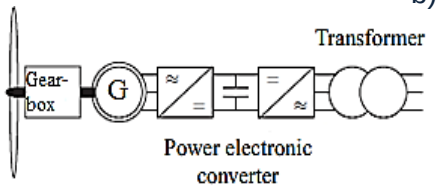
- ✓ asynchronous generators with short-circuited rotor
- ✓ synchronous generators with electromagnetic excitation
- ✓ asynchronous generators with phase rotor
- ✓ doubly-fed induction generators
- ✓ synchronous generators with magnetoelectric excitation
- ✓ special SG synchronous generators

Ensuring stable generation at variable turbine speed

a) Variable-speed doubly-fed induction generator system



b) Variable-speed generator system



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Analysis of the potential solar energy marke in Ukraine

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National Technical University Dnipro Polytechnic, Ukraine

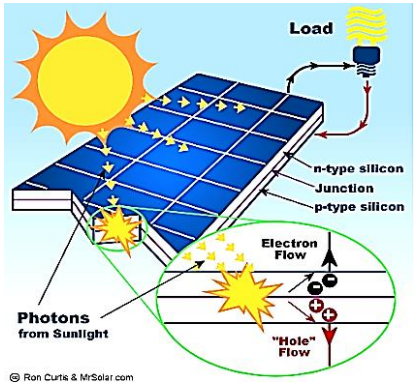
1 Solar energy concept

Pursuant to the Law of Ukraine on Alternative Energy Sources, renewable energy resources - renewable not fossil power sources, namely energy solar, wind, aero thermal, geothermal, hydrothermal, energy of waves and inflows, hydraulic power, energy of biomass, gas from organic waste, gas of sewer treatment plants, biogases [44]

- ✓ Solar power is energy from the sun that is converted into electricity, heat, and chemical reactions
- ✓ In contrast to fossil fuels and greenhouse gases, solar energy can cover all the future’s energy needs if yoked suitably with technology
- ✓ Solar energy is the cleanest and most abundant renewable energy source available in Ukraine

Solar energy is one of the most affordable renewable energy sources [26]:

- ➢ Every hour, the Sun releases energy, which is enough to cover the global energy needs for an entire year
- ➢ Over 96 percent of net new energy generation capacity in 2021 will come from solar and wind sources, according to Deloitte
- ➢ The global solar energy market is expected to reach 422 billion U.S. dollars in 2022, in comparison to 86 billion U.S. dollars in 2015



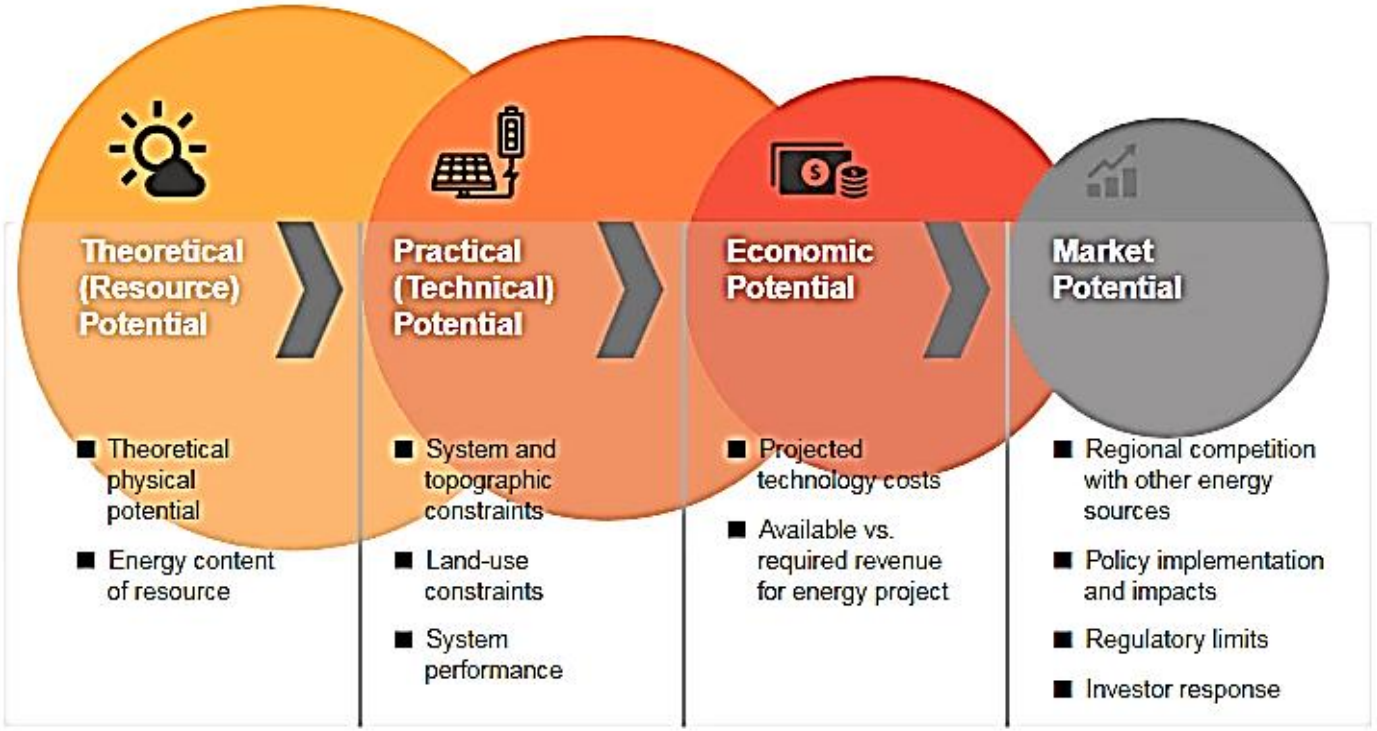
Solar radiation is converted to technology in two parts: active or passive

- ✓ **Active solar technology** increases the supply of energy. Active solar technology practices photovoltaic to transform sunlight into beneficial productions
- ✓ **Passive solar technology** reduces the need for substitute properties. Passive solar technology includes choosing resources with advantageous thermal channels, scheming spaces, and referencing the location of a building to the sun

The practice of using solar energy

- ✓ **Solar thermal energy can** be used to water heating, space cooling, space heating, and other heating processes. Evacuated tube collectors and glazed flat-plates are used for domestic water heating
- ✓ **Solar ponds** are saltwater bodies that are specially designed to capture and collect solar energy, are used in the chemical industry, food industry
- ✓ **Solar ovens** are made to concentrate sunlight by gathering sun radiation from a wide plate to a central point. A black vessel converts it into heat
- ✓ **Solar energy and electricity.** Solar energy is said to be in a substantial excess supply of energy that can surpass the entire world’s electrical energy needs

2 Solar energy potential



[1]**Theoretical (resource) potential** is characterized by the amount of energy physically available, without considering any constraints or a particular PV system

Practical (technical) potential is characterized by the annual average of PV power production, taking into account the theoretical potential, real-world PV system performance, and configuration, as well as topographic and land-use constraints

Economic potential. We assess the costs of PV power generation at the country level based on the practical potential and the concept of LCOE

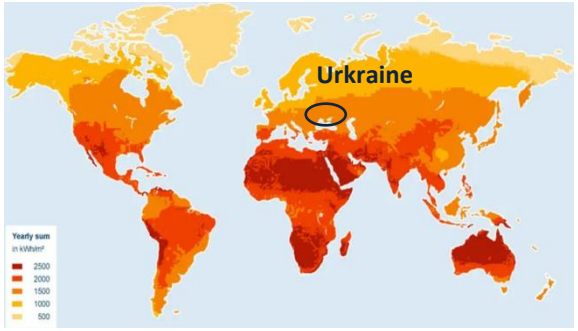
[1]Global Photovoltaic Power Potential by Country. World Bank, 2020 [27]

3 Practical (technical) potential

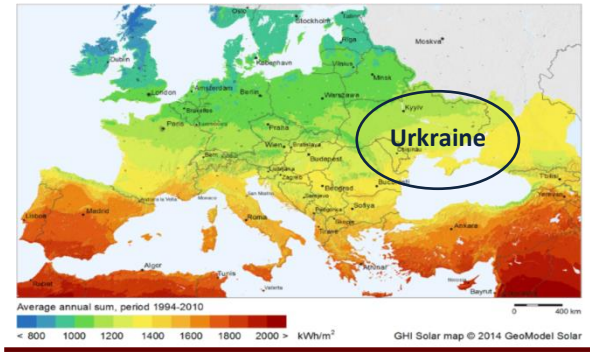
Global map shows practical solar energy potential after excluding for physical, environmental and other factors [27]:

- ✓ The potential for clean, carbon-free electricity generation from solar photovoltaic (PV) sources in most countries dwarfs their current electricity demand
- ✓ Around 20% of the global population lives in 70 countries boasting excellent conditions for solar industry
- ✓ The difference in average practical potential between countries with the highest potential (e.g. Namibia) and the lowest (e.g. Ireland) is slightly less than a factor of two
- ✓ The Economic Bank for Reconstruction and Development estimates that Ukraine has great renewable energy potential: the technical potential for solar energy is estimated at 50 TWh / year

A global solar energy potential



European solar energy map



Top 15 solar PV countries in Europe, 2019

Country	2011	2017	2018	2019
Germany	304.3	512.0	546.9	590.4
Netherlands	7.1	160.9	250.3	400.6
Belgium	165.5	338.4	373.2	395.5
Italy	210.5	325.0	332.4	345.7
Malta	27.4	247.9	276.0	305.1
Greece	55.8	242.2	246.9	260.5
Luxembourg	59.9	215.0	222.6	229.0
United Kingdom	16.2	193.9	197.0	204.3
Czech	186.0	192.9	193.0	197.2
Spain	91.3	109.8	101.8	196.7
Austria	20.7	142.3	162.4	187.5
Denmark	3.0	158.3	173.3	186.0
France	43.5	120.5	141.4	157.9
Bulgaria	17.7	144.8	146.9	152.1
Cyprus	12.5	123.1	130.9	146.9

4 The prospects for solar panels

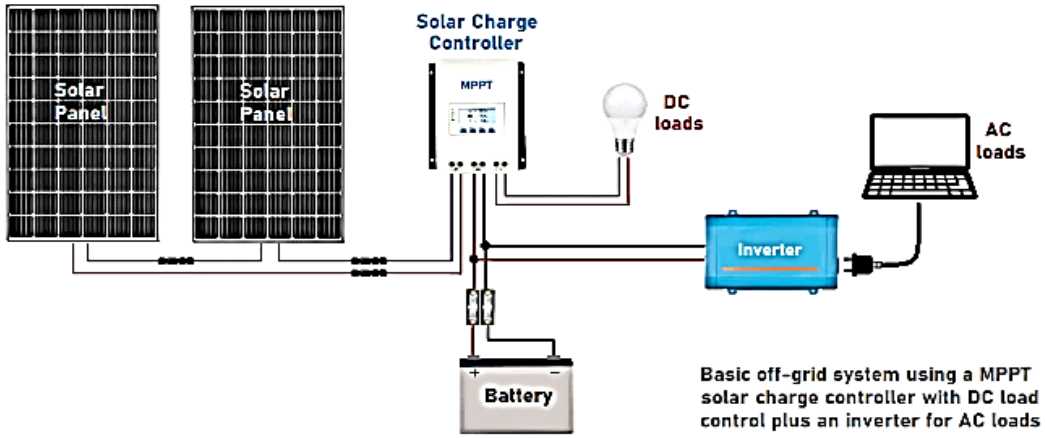
Benefits of modern solar panels [9]:

- ✓ The modern panels don`t pollute the environment
- ✓ Solar panels are noiseless
- ✓ There is a new type of batteries – Smart Flower

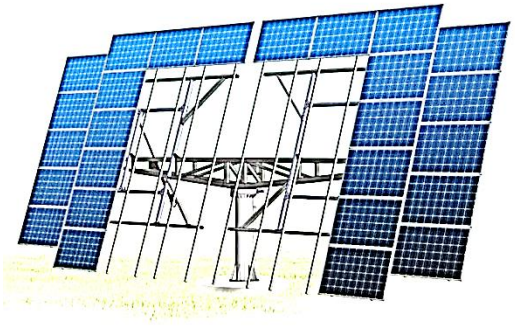
Basic strategies for using solar panels:

- ✓ A few solar panels coupled with a charge controller for DC lights and appliances
- ✓ Many solar panels couples with a solar inverter to offset energy usage
- ✓ Solar panels coupled with off-grid inverter and battery for total energy use

In almost all cases, the best solar panels are made with premium monocrystalline solar cells. Monocrystalline cells are made with a single crystal of silicon instead of many silicon fragments melted together, as is the case with polycrystalline cells. This means that the cells are more efficient at converting sunlight to electricity, plus they have a sleek black tint to them. However, it’s important to keep in mind that premium solar panels with monocrystalline cells generally come with a higher upfront price tag



Basic off-grid system using a MPPT solar charge controller with DC load control plus an inverter for AC loads



5 The offers from the leading manufacturers

Manufacturers / efficiency / temperature coefficient [9]

→	SunPower	22,8%	-0,29
→	LG	22,0%	
→	REC Group	21,7%	-0,26
→	Panasonic	21,2%	-0,26
→	CSUN	21,2%	
→	JinkoSolar		
→	Trina Solar		
→	REC Solar		

Solar panel efficiency refers to how well solar panel can convert sunlight into usable electricity
The temperature coefficient tells how well solar panels will perform in less-than-ideal conditions
Generally speaking, SunPower, LG, and Panasonic make the best solar panels in 2020 due to the high efficiencies, competitive pricing, and 25-year warranty offered by each brand

LG solar panel efficiency:

- ✓ Neon 2 efficiency - up to 20.4% at 350W
- ✓ Neon R efficiency - up to 21.7% at 375W

Neon 2 - 330-355W



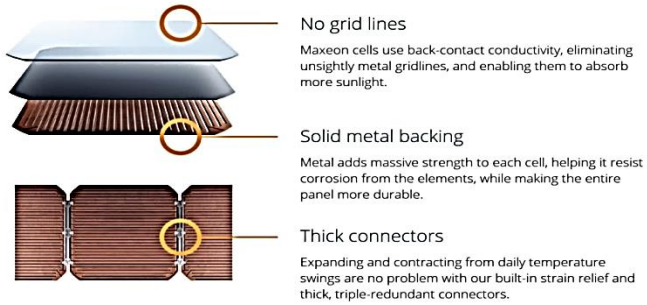
Neon R - 360-375W



While most manufacturers produce a range of both mono and polycrystalline panels, LG only manufacture monocrystalline N-type cells which have greater efficiency and lower degradation compared to more common lower cost poly or multi crystalline P-type cells

SunPower solar panels:

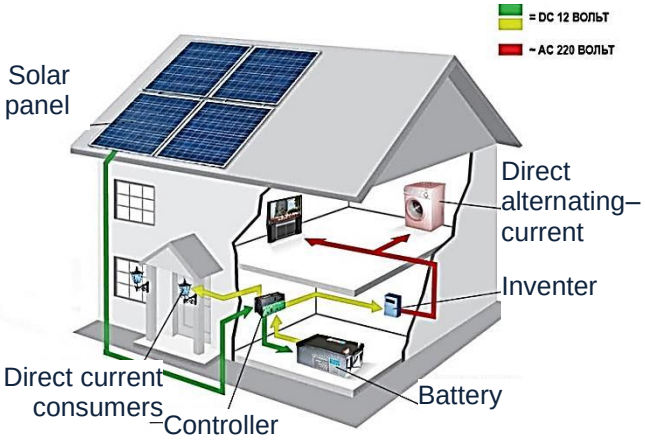
- ✓ Maxeon IBC cells



The latest generation panels from SunPower simply named the Maxeon 2 and Maxeon 3 use even more cells, in a new 104 cell format with 8 rows of 13 generation 3 cells, to create the worlds most powerful residential solar panel at 400Wp. The full series Maxeon 3 panels ranges from 370 to 400W and will replace the X Series while the Maxeon 2 panels ranging from 340W to 360W will replace the E series

6 Rooftop solar panels

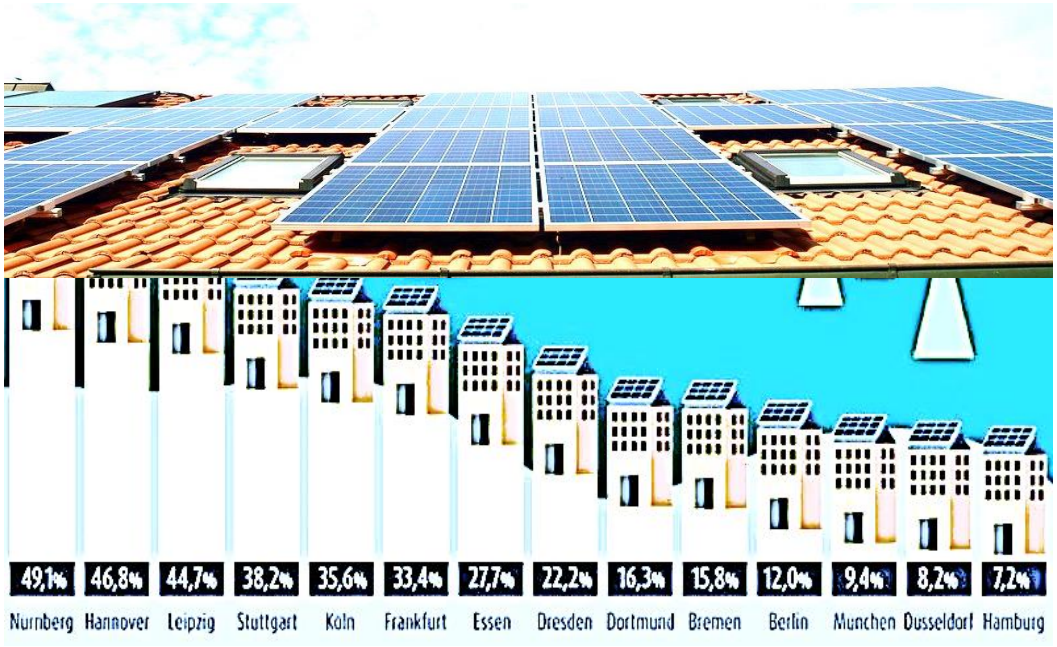
An example of an energy efficient home or zero consumption home [25]



Germany saw a 25% increase in solar rooftop installations in 2020 compared to 2019 and the trend looks set to continue next year, the German Solar Association (BSW) said [25]

In addition to greater climate awareness, the main drivers behind the solar boom include a striving by many consumers for more independence, significantly lower solar technology prices, improved subsidy conditions for the modernization of heating systems, and a switch to electromobility

Germany’s solar boom set to continue in 2020-2021 [49]



With solar power production climbing to unprecedented heights in Germany in 2020, calls are growing louder to better use the potential of the technology that has seen costs falling substantially over the past years. Rooftop installations have been singled out for warranting special attention since they mostly do not compete over area with other forms of use and produce electricity right where it is used, with home storages able to provide extra flexibility to users[2]

[2]Most German cities are wasting vast solar potential on their rooftops – analysis. URL: https://www.cleanenergywire.org/news/most-german-cities-are-wasting-vast-solar-potential-their-rooftops-analysis

7 The solar energy development in the Europe, 2020

The largest solar power plant in Europe [81]



March 19, 2019 February 2, 2020

In late 2019, the Spanish electrical company Iberdrola completed the largest photovoltaic plant in Europe. Comprised of more than 1.4 million solar panels, **the Núñez de Balboa plant** has an installed capacity of 500 megawatts and is expected to supply energy to 250,000 people per year

The largest floating solar farm in Europe



In 2019, France constructed the largest floating solar farm in the continent with 47,000 solar panel.**The O'Mega plant**, which covers 17 of the 50 hectares of an artificial lake in a former quarry, can produce up to 17 megawatts. The solar farm can electrify around 5000 homes



The Waldpolenz Solar Park is a 52-megawatt (MW) photovoltaic power station built at a former military air base near Leipzig, Eastern Germany [72]. Renewable energy is on track to set a new record in Germany in 2020. From PV panels to solar storage and solar collectors, rooftop installations grew 25% in Germany this year as due to increasing consumer demand for greater energy independence, lower solar tech prices, improved subsidy conditions and the rising popularity of electric cars

8 The largest solar power plant in Ukraine

6.182 MWp Solar PV Plant in Dnipropetrovsk Region, Nikopol [73]

Nikopol solar power plant is a 246MW photovoltaic (PV) power facility located in Dnipropetrovsk region of Ukraine. It is one of the biggest solar power facilities in Ukraine and is the second solar project to be developed by DTEK Renewables (DTEK) in the country



Item	Parameter
Installed capacity	6.182 MWp
Module Number of PV modules	Jinko Solar Cheetah 60M JKM320M-60, monocrystalline 60-cell modules 320 Wp each 19,320
Inverter type Number of inverters Nominal AC output power Nominal power ratio	Huawei SUN 2000-60KTLM0 82 60 kW_{AC}, in total 4.920 kW_{AC} 6.182/4.920= 1.26
Transformer stations Number of transformers	1.0 MVA, 0.4/10 kV (PTS-1000-10/0.4 kV) 5
Type of installation	Fixed tilt structures (29° south-tilted)
Grid connection point	150/35/10 kV substation “Zhd”

Plant’s connection point in existing grids
150/35/10 kV substation “Zhd”. The distance between the Plant and the substation is some 1.5 km

Plant’s technical concept
The Plant will be installed on fixed tilt, ground mounted support structures, use 60-cell, monocrystalline modules manufactured by Jinko Solar and 82 string inverters from Huawei with a capacity of 60 kW each. Five transformers 1.0 MVA each will collect the power from the inverters

Project cost
The total capital expenditures for implementation of the Project has been estimated at EUR 4.3 million, hence the specific cost is 0.70 EUR/Wp

Project implementation milestones
•*Plant’s start of construction*: August 2020 •*Plant’s completion of construction*: September 2020 •*Plant’s connection to grid*: September 2020 •Plant’s commissioning: October 2020 •*Plant’s start of commercial operation*: December 2020

Citation by reference, partial or full reproduction:

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Towards a sustainable energy future in Ukraine

Dr. Natalia Dreshpak & BSc. Anton Isaiev
National Technical University Dnipro Polytechnic, Ukraine

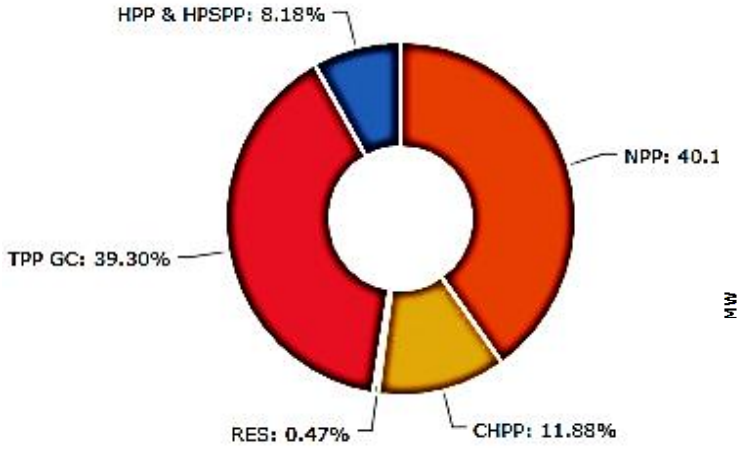
1 Introduction: challenges facing the Ukraine

- Achieving the targets requires not only large investments (approximately € 30 billion according to the State Agency on Energy Efficiency (SAEE)), but also the urgent implementation of technical and regulatory balancing tools and simplification of new generation access to Ukraine’s power grid – the balancing capacity deficit will increase to 2 GW by 2025 [6]

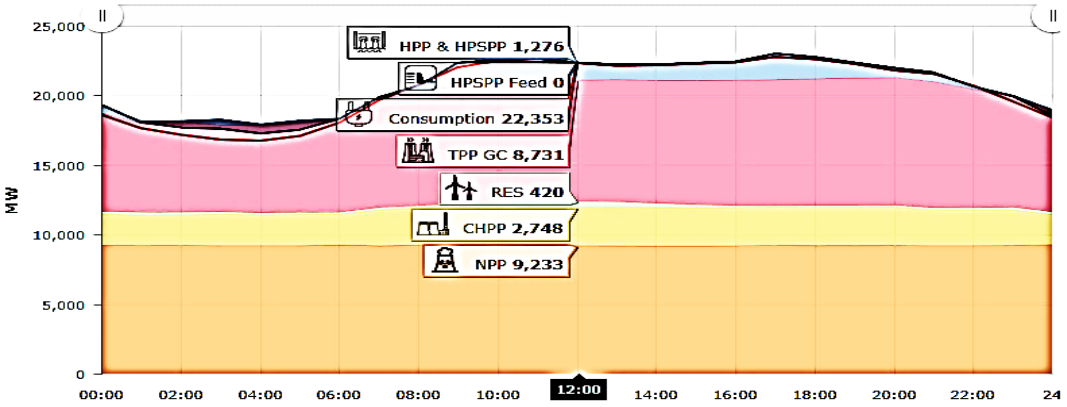
- Unless immediate efforts are made to create the right conditions for the participation of all categories of producers and prosumers in balancing and improving the electricity quality market, Ukraine will soon be included in the category “Other”

The IPS of Ukraine is a system of nuclear, thermal, hydroelectric and pumped storage power plants, cogeneration plants, power plants using renewable sources of energy (wind, solar and other), Ukrenergo’s trunk power grids and power distribution networks (Oblenergo), unified by the common electricity and heat generation, transmission and distribution mode [51]

- ✓ Ukraine has a deficient level of environmental taxation and allows owners of TPP and NPP to receive extra profits due to the deterioration of the environment
- ✓ The situation in HPP includes high specific land costs, additional losses for water treatment for consumption by residents of coastal regions, loss of the recreational potential of the Dnipro coast



Daily electricity generation / consumption schedule



HPP—hydropower plants; BPP—bioenergy power plants; SPP—solar power plants; CPP—coal power plants; WPP—wind power plants

UKRENERGO National power company

2 Performance indicators of IPS operation

Ukrainian renewable energy sector going through accelerated development, growing at least 1.5 times over the past year [27]

November 2019 → November 2020

Installed capacity of the IPS of Ukraine 52352.30 MW

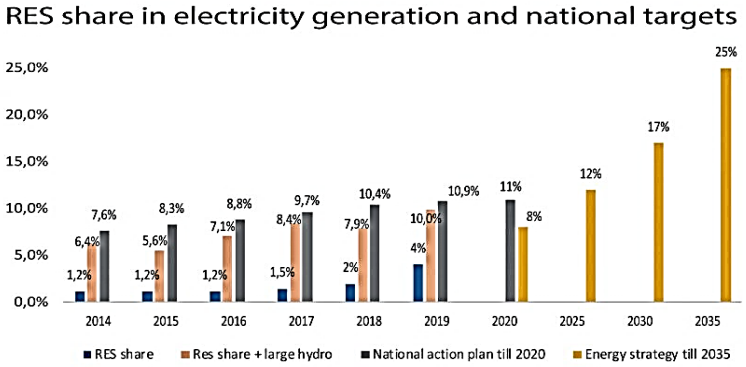
SPP 6,01% → 9,31%
HPP 9,21% → 8,85%
HPSPP 2,81% → 2,74%
NPP 26,43% → 25,45%

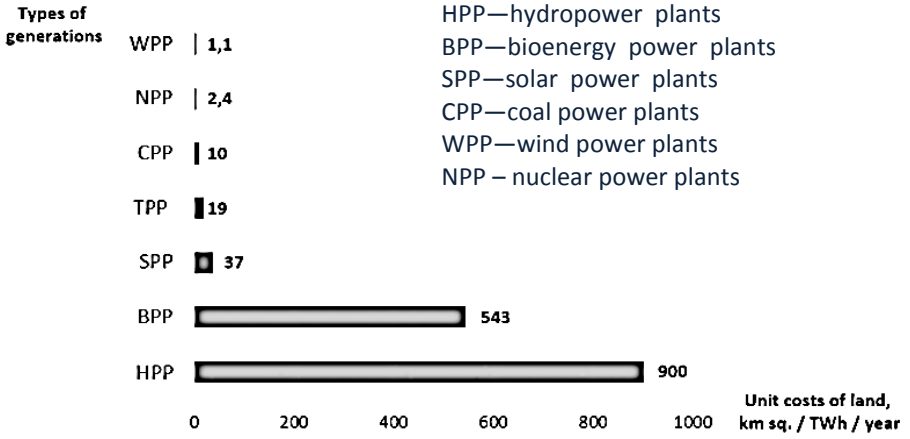
Capacity of RE equipment 4282.10 MW

BPP 2,88% → 2,95%
SPP 73,45% → 80,11%
WPP 23,67% → 16,95%

Performance indicators using different energy sources in Ukraine, 2020

	Year	BPP	WPP		SPP	Concentrated solar energy	Nuclear and thermal energy
			Offshore	Onshore			
Power installation costs (thousand $/kW)	2017	2,7 (1,1-5,0)	4,6 (4,0-5,0)	1,6 (1,5-1,9)	2,5 (1,4-4,4)	5,6 (4,0-7,0)	6,1-6,9
Electricity price (cost price), cents/kWh	2017	0,07 (0,05-0,16)	0,14 (0,10-0,23)	0,06 (0,04-0,20)	0,09 (0,03-0,19)	0,23 (0,20-0,27)	0,05-0,12
	2020	———	0,07 (0,05-0,08)	0,04 (0,02-0,10)	0,04 (0,02-0,12) 2019 year	0,08 (0,07-0,10) 2022 year	———
Scheduled generation TWh (million toe)	2020	47 (4)	9				--------
	2035	128 (11)	25				--------
Investment volumes (billion $)	2020	14,5	9				--------
	2035	39,5	25				———



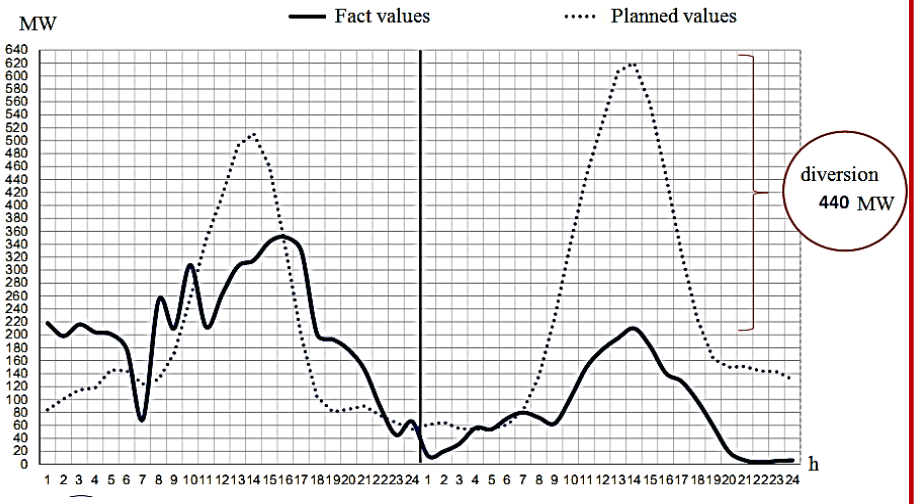


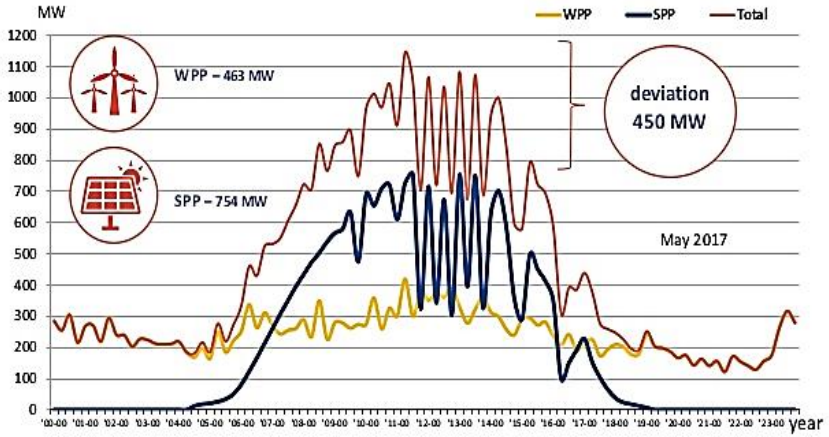
HPP—hydropower plants
BPP—bioenergy power plants
SPP—solar power plants
CPP—coal power plants
WPP—wind power plants
NPP – nuclear power plants

3 Practical (technical) potential

Volatility of «Green» generation: key challenges

The inaccuracy of the existing forecasting system causes Ukrenergo to attract additional ones balancing reserves [51]

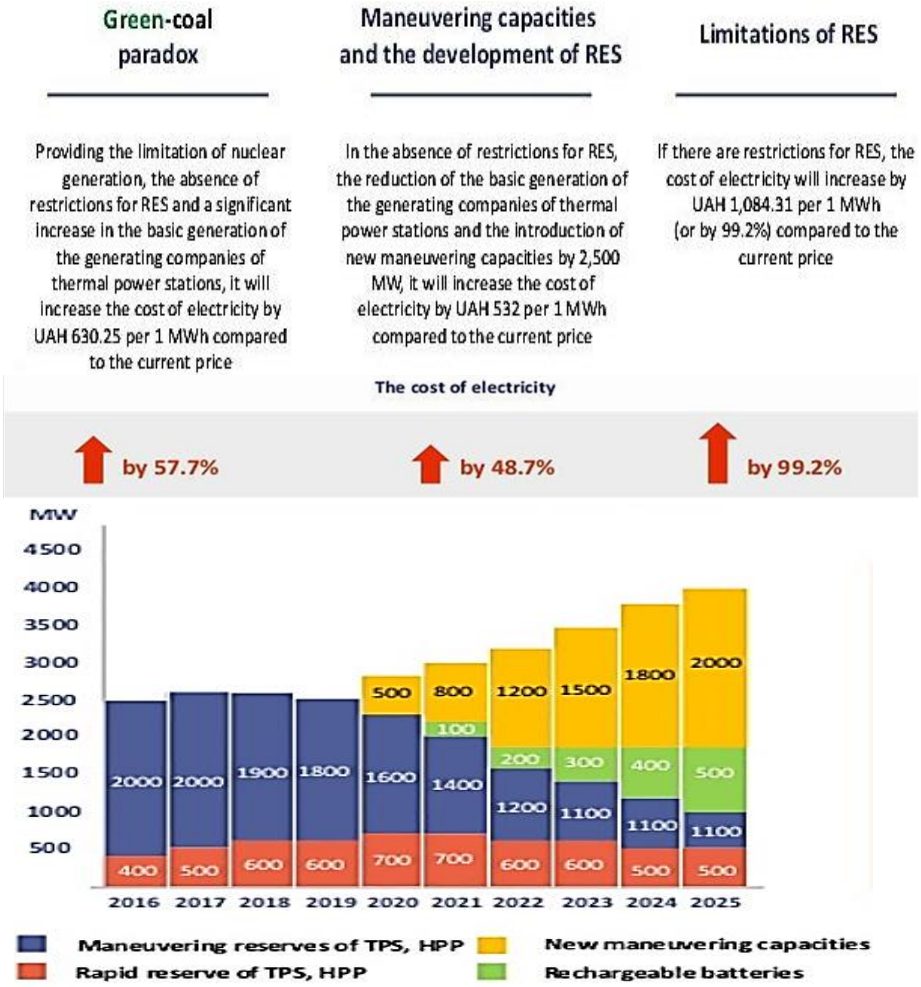




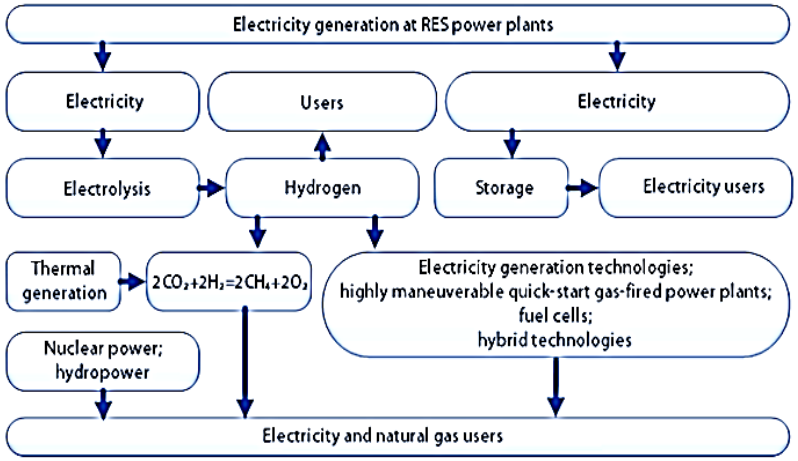
The regulatory volume of reserves in the IPS (Intrusion Prevention System) of Ukraine should be 650 MW.
The planned fluctuations in the generation of RES up to 450 MW should be taken into account when forming the daily schedule

4 Key issues of development RES in Ukraine

Key issues of development with RES at the level of 7,500 MW [51]:



Concept of GHG Emission-Fee Electricity Generation



- ✓ Highly manoeuvrable gas generation with fast start
- ✓ Highly manoeuvrable pumped storage power plant
- ✓ Systems based on electrical energy storage systems for frequency maintenance and control
- ✓ Consumer regulators based on thermal energy storage technologies
- ✓ Systems that use solar and wind energy for electrolysis production, and implement the concept of "Power to Gas”

Citation by reference, partial or full reproduction:

Dreshpak N., Isaiev A. Towards a sustainable energy future in Ukraine.
In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021.
Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 91-96

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Winter School “Sustainability in the Industrial Sector”
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Enabling sustainable management for industrial enterprises

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National Technical University Dnipro Polytechnic, Ukraine

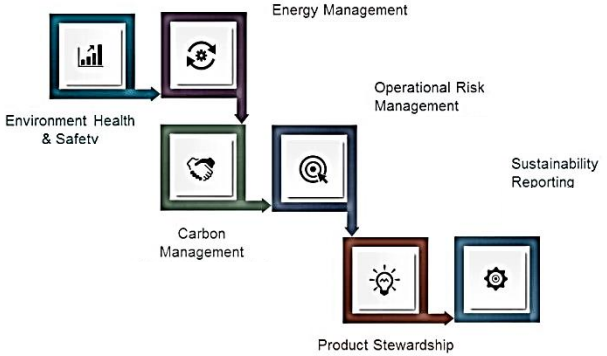
1 The concept of sustainable management

Sustainability management is the practice of managing a firm’s impact on the three bottom lines – people, planet, and profit – so that all three can prosper in the future [59]

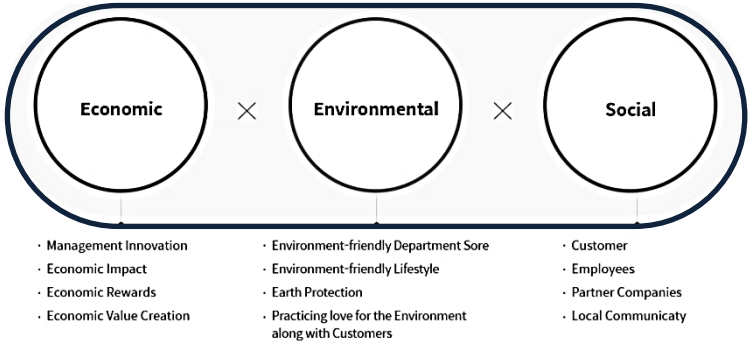
Sustainable managers drive sustainable business efforts at their organizations:

- ✓ **Environment, Health, and Safety (EHS).** In response to an increasing number of environmental and public concerns, companies are putting EHS processes in place
- ✓ **Energy Management** can be done at multiple levels of granularity (plant down to machine), providing the needed data for reducing costs and environmental impacts
- ✓ **Carbon Management.** Similar to energy management, its processes are being used to improve business performance and protect the environment across the value chain
- ✓ **Operational Risk Management (ORM).** Providing visibility into operations, ORM is being utilized to establish risk-related business processes, manage change, monitoring risk analytics, and leverage the effectiveness of Corrective and Preventive Actions (CAPA).
- ✓ **Product Stewardship.** Focused around creating environmentally friendly manufacturing and industrial processes and products, product stewardship is the concept of taking a sustainability-based approach to the product lifecycle and supply chain
- ✓ **Sustainability Reporting.** Many companies are now managing sustainability reporting with same precision and rigor as with financial reporting.

Sustainable development management system



Sustainable management can take many forms including investing in fair-trade products, reducing packaging materials, and ensuring humane working conditions at supplier factories



2 Sustainable management: German experience

The Initiative Blue Competence [80]

VDMA





Code of conduct

(1) Human rights and laws
(2) Discrimination
(3) Child labor
(4) Forced labor and punishment
(5) Corruption
(6) Freedom of self-determination
(7) Decent work and pay
(8) Health and safety
(9) Environmental Protection

Kärcher [43]



(1) Environmental responsibility
(2) Product responsibility
(3) Responsibility in supply chains
(4) Responsibility for the development of the organization
(5) Corporate social responsibility
(6) Responsibility for the company's employees
(7) Accountability to society for sustainable development

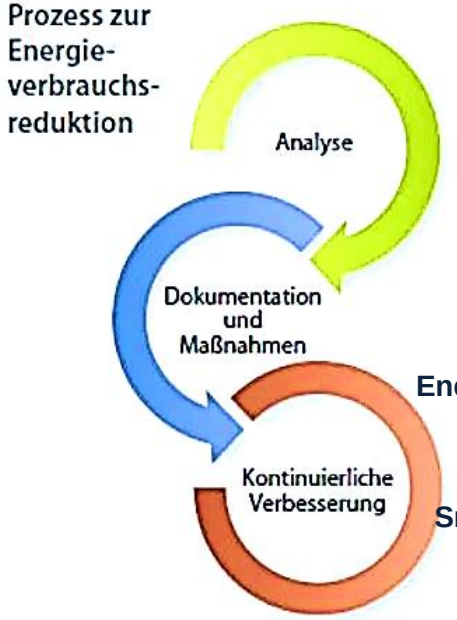
3 Sustainable management: GEBHARDT Fördertechnik

The Gebhardt Intralogistics Group [5]
is one of the leading companies for intralogistics today

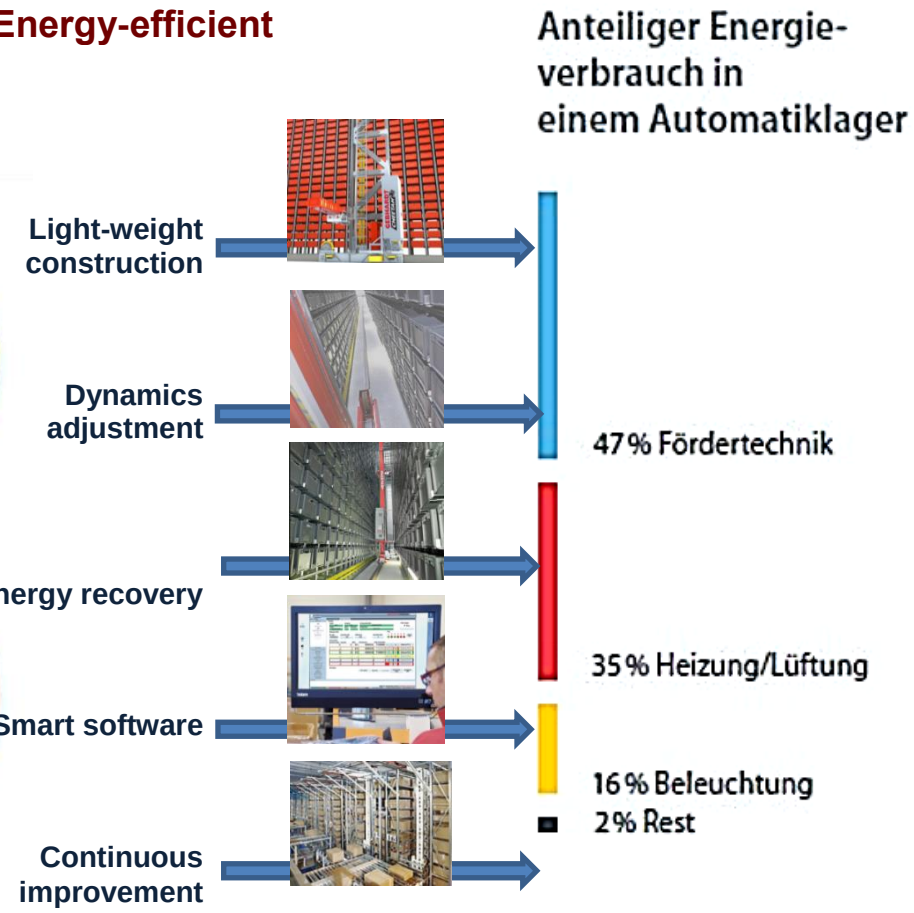








Energy-efficient

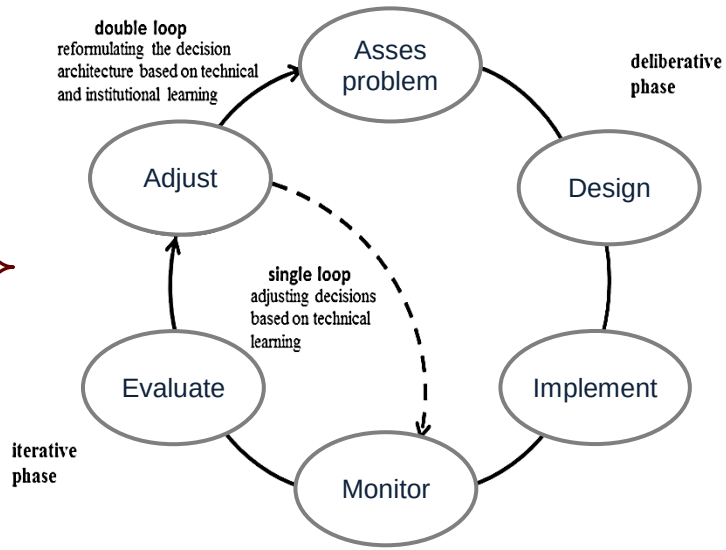


4 Tools for sustainable management: Adaptive management

- ✓ **Adaptive management, AM** – also known as adaptive resource management (ARM) or adaptive environmental assessment and management (AEAM), is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring [59]
- ✓ **Adaptive management** is defined in ADS 201.6 as “an intentional approach to making decisions and adjustments in response to new information and changes in context”
- ✓ **Adaptive management** is not about changing goals during implementation, it is about changing the path being used to achieve the goals in response to changes
- ✓ **Adaptive management** – “learning by doing”

Adaptive management displayed as a cycle with double-loop learning. A deliberative phase includes problem assessment, design of the decision architecture, and implementation. An iterative phase includes monitoring, evaluation of monitoring results, and adjustment of management strategy [59]

Adaptive management scheme[1]



[1]Williams BK, Brown ED (2014) Adaptive management: From more talk to real action. Environ Manag 53:465–479

Citation by reference, partial or full reproduction:

Tryfonova O., Paliekhova L. Enabling sustainable management for industrial enterprises. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 97-102

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Energy saving and energy efficiency principles for policymaking in industry

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National Technical University Dnipro Polytechnic, Ukraine

1 Energy efficiency and energy saving in Ukrainian industry

Industry is the largest final energy consumer (19.1 Mtoe in 2018). Energy intensity per GDP at purchasing power parity (PPP) is very high: at 0.25 tons of oil equivalent (toe) per thousand2015 USD PPP, it is the second-highest among EU4Energy countries, after Turkmenistan, and over twice the world average (0.11 toe /1000 USD) [65]

The program of optimizing energy consumption systems in Ukrainian industry

- Development of a series of national standards harmonized with international ones in the field of energy management and energy efficiency (ISO50001)
- Conducting trainings for auditors of energy management system
- Preparation of the White Book on the implementation of Article 8 "Energy audits and energy management systems" of Directive 2012/27 / EU - together with the GIZ project "Reform in the field of energy efficiency in Ukraine"
- Technical support for the establishment of an energy efficiency monitoring center for industry in the Agency
- Preparation of a Green book on the promotion of industrial enterprises to energy efficiency, in conjunction with the GIZ project "Consulting of enterprises on energy efficiency"
- Support of the Agency for the establishment of the Decarbonization Fund and the implementation of the voluntary agreement system for industrial enterprises

Green Energy Agency of Ukraine

Current functions

- ✓ Energy Certification of Buildings
- ✓ Technical regulations for energy labeling and eco-design
- ✓ Energy Community, IRENA, IEA
- ✓ State expertise on energy saving
- ✓ Verification of fuel, qualification cogeneration plants

Perspective functions

- → Fund for decarbonisation
- → "Green" bonds
- → Solid biofuel exchange
- → Energy waste disposal
- → Registers of biomass installations
- → " Green" loans
- → Green Investment Fund UA
- → "Green" hydrogen (H2)

2 Review of Energy management Standard (ISO 50000)

Energy management system [41]

- ✓ A management system is the way in which an organization manages the interrelated parts of its business in order to achieve its objectives
- ✓ The objectives on management systems can relate to a number of different topics, including product or service quality, operational efficiency, environmental performance, health and safety in the workplace and ets.
- ✓ The level of complexity of the management systems is depend on each organization’s specific context

ISO management system standards (MSS) are the result of consensus among international experts with expertise in global management, leadership strategies, and efficient and effective processes and practices. MSS standards can be implemented by any organization, large or small

- ✓ ISO standards set out requirements or guidance to help organizations manage their policies and processes to achieve specific objectives
- ✓ MSS are designed to be applicable across all economic sectors, various types and sizes of organizations and diverse geographical, cultural and social conditions.
- ✓ Many ISO MSS have the same structure and contain many of the same terms & definitions and requirements

After the adoption of the DSTU ISO 50001:2014 standard “Energy saving — Energy management systems — Requirements with guidance for use (ISO 50001:2011, IDT)” eight standards from the ISO 50000 series were implemented with the support of the Project:

(1) DSTU ISO 50002:2016 Energy audits — Requirements with guidance for use
(2) DSTU ISO 50003:2016 Energy management systems — Requirements for bodies providing audit and certification of energy management systems
(3) DSTU ISO 50004:2016 Energy management systems — Guidance for the implementation, maintenance and improvement of an energy management system
(4) DSTU ISO 50006:2016 Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance
(5) DSTU ISO 50015:2016 Energy management systems — Measurement and verification of energy performance of organizations — General principles and guidance
(6) DSTU ISO 50001: 2020 Energy management systems — Requirement with guidance for use (this standard replaces DSTU ISO 50001: 2014)
(7) DSTU ISO 50007: 2020 Energy services — Guidelines for the assessment and improvement of the energy service to users
(8) DSTU ISO 50047: 2020 Energy savings — Determination of energy savings in organizations

3 Ukrainian experience: UNIDO-GEF Project

Main purpose of the Project [84]

Improving the energy efficiency of Ukraine's industry by encouraging the widespread introduction of energy management systems in accordance with the requirements of the international standard ISO 50001 "Energy Management Systems"

- ✓ ISO 50000 series standards have been nationalized
- ✓ Increasing the national capacity for the implementation of Energy Management System
- ✓ Has been completed the launch of the Financial Mechanism of the project in the form of a Revolving Guarantee Fund –Credit Guarantee Fund

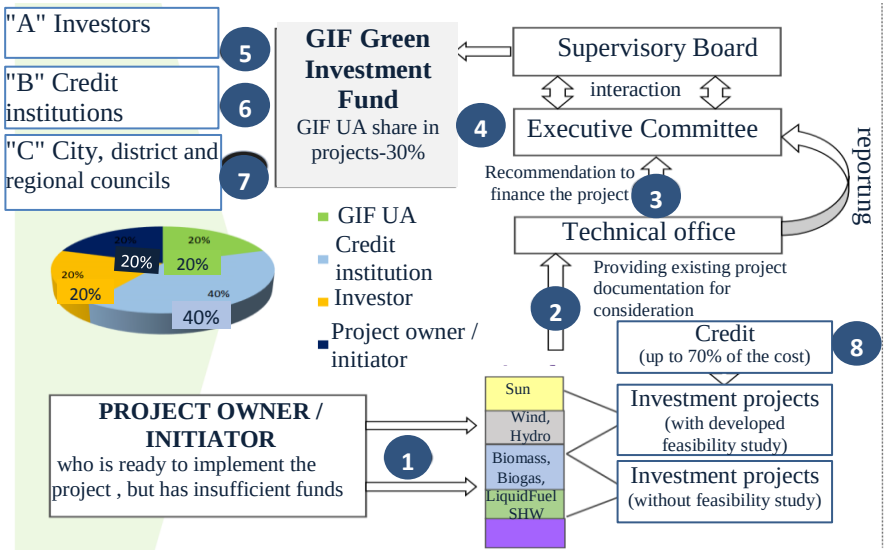
Funding is issued for:

- ➢ Implementation and certification of energy management system (according to ISO 50001)
- ➢ Implementation of measures to optimize energy consumption

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GLOBAL ENVIRONMENT FACILITY INVESTING IN OUR PLANET

GIF UA Green Investment Fund



1. The customer applies to the Fund and chooses a project of interest to him or offers his own
2. The application is processed by the Technical Office of GIF UA
3. Decisions on the form of financing and work with the project
4. GIF UA analyzes and offers a stake in the RES project
5-7. Institutions "A", "B", "C" fill the project with funding:
   - ✓Concluding the Agreement
   - ✓Londing and co-financing
8. ✓Implementation of the project

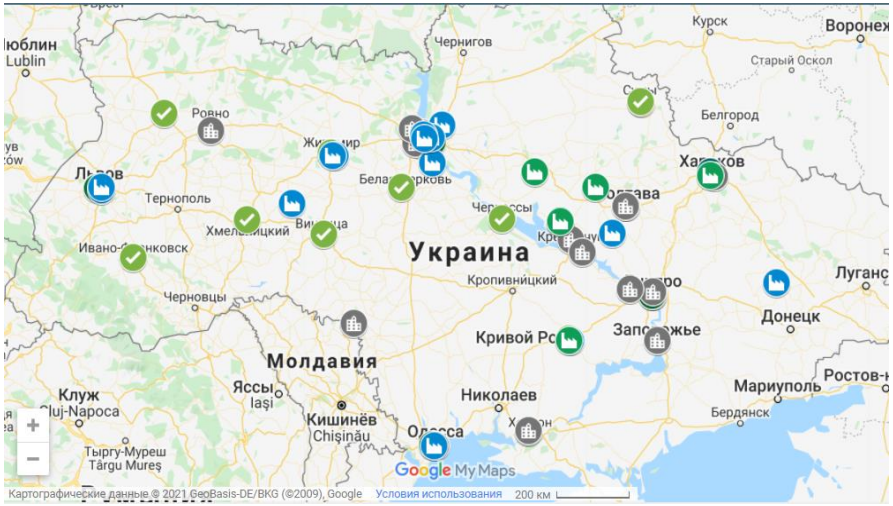
Banks provide loans to these projects

4 Companies that started implementation of EMS and ESO

Within the framework of the program for the development of the expert potential of Ukraine in the field of implementation of the ISO 50001 standard in industry during 2015-2019, more than 250 specialists – representatives of companies in various fields of activity (industrial enterprises, certification bodies, educational institutions) were trained under different training programs

Enterprises that expressed their interest in EE, ESO, EnMS; their employees participated in trainings, were consulted by the Project:

- Juice Plant Kodymskiy
- Dneprometiz
- Antonov State Enterprise
- Naftogaz of Ukraine
- UkrGasVydobuvannya
- Ukrtatnafta
- Turboatom
- Ferrexpo Poltava Mining
- Metinvest Holding
- Siltek – Terminal-M (Industrial and Construction Group Kovalska)
- Zaporizhstal
- “Odessa Railways” – regional branch of “Ukrainian railways”
- Volyn-Cement
- PepsiCo Ukraine
- Wimm-Bill-Dann Ukraine
- Mekhanicheskiy Zavod Ltd
- Dneprovsky Integrated Iron & Steel Works
- Askona Pivden
- Obolon
- Vetropack Gostomel Glass Factory
- Poltava Oil Extraction Plant – Kernel Group



26 Certification bodies:

15 Companies have implemented EnMS with the support of the project:

21 companies started implementing EnMS and ESO with the support of the project:

7 Companies have implemented EnMS & ISO 50001with the support of the project:

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PP. 103-108

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Introduction of energy management system standards in Ukrainian industry

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National Technical University Dnipro Polytechnic, Ukraine

1 Challenges for Ukraine: energy efficiency and low carbon future

«Decarbonization of Energy in Ukraine» makes the key section of LEDS as the energy sector's share into total emissions of GHG amounts to 65%, and if taken together with GHG generated by the “Industrial processes sector,” the share totals at 82% [84] According to Baseline (business as usual) scenario, which envisions that the characteristics for most of technologies that consumers of energy resources applied throughout all the stages of goods and services production remain unchanged up to 2050, projections of GHG emissions in «Energy» and «Industrial processes» are the following:

	2012*	2015*	2020	2025	2030	2035	2040	2045	2050
Emissions, million tons *of CO_2-equivalent*	367	265	347	408	455	500	540	570	592
Share of 1990 level, %	44	31	41	48	54	59	64	68	70



- ✓ Being committed to achieving Paris Agreement goals and being guided by national priorities, Ukraine will ensure doing its best to achieve the indicative GHG emissions target of 31-34% by 2050, compare to 1990 level
- ✓ Ukraine is planning to review its strategy at least every five years in order to measure its progress, and to increase the level of its ambitions in accordance to national circumstances

4.1.1 Energy efficiency

Implementation of policies and measures which aim to increase efficiency in the use of energy resources and energy saving accompanied with enhanced quality in energy services and energy resources supply will enable to cumulatively reduce GHG emissions over 2012-2050 by 3 677 million tons of CO2-eequivalent compared to Baseline scenario. According to «Energy efficiency scenario, » in 2050 the share of GHG emissions will amount to 53% of 1990 level

Scenario	Unit	2012*	2015*	2020	2025	2030	2035	2040	2045	2050
Scenario «Energy efficiency»	Million. tons of CO_2 -equivalent	367	265	294	335	344	363	406	429	448
	% *of 1990 level*	44	31	35	40	41	43	48	51	53
Scenario «Energy efficiency and renewable energy»	Million. tons of CO_2 -equivalent	367	265	282	315	312	291	299	288	278
	% *of 1990 level*	44	31	33	37	37	34	35	34	33
Scenario «Energy efficiency, renewable energy, modernization and innovation»	Million. tons of CO_2 -equivalent	367	265	265	361	244	242	274	284	285
	% *of 1990 level*	44	31	31	31	29	29	32	34	34
Scenario «Energy efficiency, renewable energy, modernization and innovation, transformation of market and institutions»	Million. tons of CO_2 -equivalent	367	265	265	259	242	236	264	265	261
	% *of 1990 level*	44	31	31	31	29	28	31	31	31

2 Energy Efficiency Projects in Ukraine

- Energy Management System (EnMS) provides structured and systematic approach for integration of energy efficiency concept into enterprise management culture and day-to-day practices. EnMS delivers:
  (i) A framework for understanding significant energy uses
  (ii) Action plans for continuous improvement of energy use performance, and
  (iii) Documentation to sustain and demonstrate energy performance improvements over time
- EnMS establishes a proper linkage between energy management business practices and core industrial values, such as cost reduction, increased productivity, environmental compliance, and competitiveness.
- Practical experience demonstrates that for companies that are totally new to energy management concepts, average energy efficiency gains through the adoption of EnMS in the first several years in the range between 10 and 20% and with minimal investment costs. The Initiative Blue Competence [35]

Examples of International Energy Efficiency Projects / Funds in Ukraine

Project	Website URL
Ukraine Energy Efficiency Programme (UKEEP)	**http://www.ukeep.org/en/**
Energy efficiency in municipalities	https://www.giz.de/en/worldwide/30658.html
Eastern Europe Energy Efficiency and Environment Partnership (E5P) in Ukraine	http://ukraine.e5p.eu/about-e5p/
IQ energy	http://www.iqenergy.org.ua/en
The Nordic Environment Finance Corporation (NEFCO)	https://www.nefco.org/

UNIDO/GEF UKR IEE Project in Ukraine [65]

The **UNIDO/GEF UKR IEE Project** “Introduction of Energy Management System Standard in Ukrainian Industry” (UKR IEE Project)aims to assist the Government of Ukraine to achieve a sustainable transformation of industrial energy usage practices within the country. In order to do this, the project is establishing and promoting the industrial Energy Efficiency (IEE) concepts of Energy Management System (EnMS) and Energy Systems Optimization (ESO), along with the promotion and deployment of the ISO 50000 Energy Management Standard Series

Project Donor: Global Environment Facility (GEF)

National Beneficiaries and Partners:
- → Ministry of Economic Development, Trade, and Agriculture of Ukraine
- → State Agency on Energy Efficiency and Energy Saving of Ukraine
- → Resource Efficiency and Cleaner Production Center

The Project activities aim at substantial GHGs reduction

Project budget: 5,5 mio USD

Project lifetime: Operational activities started in 2015 and, expected, to be realized until the end of 2021

3 Policy of the UNIDO/GEF UKR IEE Project

Policy and Institutional Support [16]

Within the component Policy and Institutional Support for the introduction of National EnMS Standards compatible with ISO 50000 series. Support of legislation adaptation and transposition of EED 2012/27 the following measures are being implemented:

1 Support for the reform in energy and energy efficiency sectors
2 Support of legislation adaptation and transposition of EED 2012/27 in the form of the Law of Ukraine “On Energy Efficiency”
3 Eight standards from the ISO 50000 series were implemented
4 Seven energy efficiency standards were implemented
5 Accredited certification bodies

!!! *The United Nations Industrial Development Organization (UNIDO) – is a specialized agency in the United Nations system. The mission of UNIDO is to promote and accelerate inclusive and sustainable industrial development (ISID) in Member States*

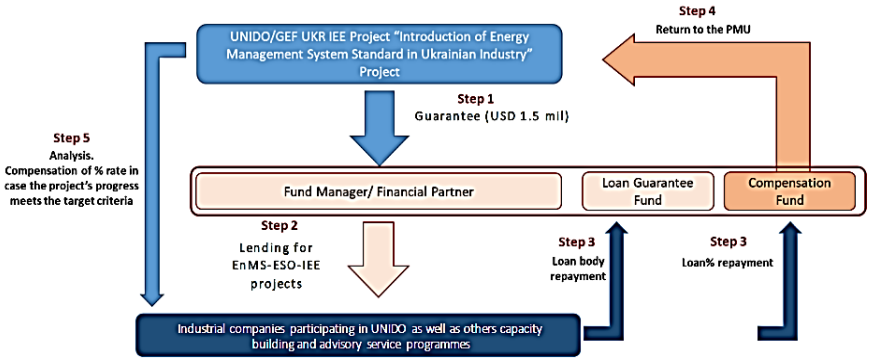
Financial mechanism characteristics

Loan Guarantee Fund (LGF)

Portfolio guarantee or bank deposit (cash) will be used as a guarantee for a Financial Partner, covering the potential risks and losses of loans. This will allow to introduce a new loan product for the IEE market.

Guarantee size: up to USD 1.5million.

Guarantee coverage ratio: initially up to 100% of the loan portfolio amount during the first Project cycle. Further, the coverage ratio will depend on the level of financial risks



✓ *The Loan Guarantee Fund (LGF)is a financial instrument aimed to facilitate access to capital (loans) for industrial enterprises, including small and medium-sized, via the provision of loan guarantees for financial institutions to mitigate the risk of non-repayment*

4 Companies that have implemented EnMS with the support of the Project

Companies that were implementing EnMS with support of the Project [65]

Enterprises where the Project carried out practical work on the implementation of EnMS: representatives of these enterprises participated in trainings and, in the formed groups of experts, worked with data from enterprises to create EnMS in accordance with ISO 50001:

- Coca-Cola Beverages Ukraine Limited (Coca-Cola Hellenic Group)
- Zhytomyr Butter Plant – Company “Rud”
- TetraPak Ukraine
- Zhytomyr Cilica Plant
- Enzym
- HeidelbergCement Ukraine
- Lviv insulator company
- Vitmark Ukraine
- Zhdanivsnky Sugar Plant (Agro-industrial holding “Astarta-Kyiv”)
- Kobelyatsky Sugar Plant (Agro-industrial holding “Astarta-Kyiv”)
- Kyiv Cardboard and Paper Mill
- UKRORGSYNTEZ
- Ukrposhta
- Corum Druzhkovsky Machine-Building Plant (“Corum Group”)
- Udacha

Companies that have implemented EnMS & ISO 50001 with support of the project

Enterprises where the Project carried out practical work on the implementation of EnMS: representatives of these enterprises participated in trainings and, in the formed groups of experts, worked with data from enterprises to create EnMS in accordance with ISO 50001. These enterprises later have been certified according to ISO 50001:

- ArcelorMittal Kryvyi Rih – **Certificate ISO 50001**
- Novoorzhytsky sugar plant (Agro-industrial holding “Astarta-Kyiv”) – **Certificate ISO 50001**
- Globinsky Sugar Plant (Agro-industrial holding “Astarta-Kyiv”) – **Certificate ISO 50001**
- Globinsky processing plant (Agro-industrial holding “Astarta-Kyiv”) – **Certificate ISO 50001**
- Globinsky bioenergy complex (Agro-industrial holding “Astarta-Kyiv”) – **Certificate ISO 50001**
- Kharkiv Machine Building Plant “Svitlo Shakhtarya” (“Corum Group”) – **Certificate ISO 50001**
- Yareskivsky Sugar Plant (Agro-industrial holding “Astarta-Kyiv”) – **Certificate ISO 50001**

ASTARTA-KYIV agri-industrial holding



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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Ukrainian public policies to support the energy sustainability under global stress

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1 Ukrainian Government’s efforts in the energy sector reform

Energy Strategy of Ukraine to 2035 “Security, Energy Efficiency, Competitiveness” was approved by the Cabinet of Ministers in Order No. 605-p dated 18 August 2017 [17]

Action Plan was approved by the Cabinet of Ministers in Order No. 497-p dated 06 June 2018

The reform will be performed by achieving five key strategic goals:

Goal I → to ensure the proper functioning of energy markets
Goal II → to ensure continuous energy supply to consumers
Goal III → to reform the coal industry
Goal IV → **to improve energy efficiency**
Goal V → to introduce an integrated approach to setting energy and environmental policies

Priorities in government responses

- ✓ Energy efficiency
- ✓ Energy transparency
- ✓ Renewable Energy
- ✓ Investment
- ✓ Access to Energy

In accordance with the decisions of the Energy Community made in December 2009, September 2010, and in October 2011, the Contracting Parties of the Energy Community (including Ukraine) are in the process of implementation of the European Directives on energy efficiency:
1. Directive 2006/32/EC on energy end-use efficiency and energy services
2. Directive 2010/31/EC on the energy performance of buildings
3. Directive 2010/30/EC on labelling of energy products

The most energy-intensive industries in Ukraine are the mining and metallurgical complex, chemical industry, cement industry and mechanical engineering

Metallurgy

- Thus energy-intensity of production of the pig iron in the Ukrainian industry is almost 33% higher than at the leading global companies

Chemical industry

- cost of natural gas accounts for 60% of the production cost of ammonium nitrate, whereas in Europe this figure is not more than 50%
- actual energy consumption at most local chemical plants is higher than comparable figures for the leading state-of-the art technologies in the production of:- ammonia – by 1.4 – 1.8 times;- caustic soda – by 1.3 – 1.4 times;- caustic ash – by 2.0 – 2.3 times;- methanol – by 2.0 – 2.3 times;- ethylene – by 2.8 – 3.0 times;- carbon black – by 1.5 – 2.5 times

Machine building industry

- the average annual gas consumption in the industry was about 11.1 billion m3, electricity – 66.7 billion kWt/h, coal – about 12.6 mil-lion ton.
- the share of renewable energy sources, as in other sectors, is very small, while the potential is quite extensive, only industrial waste, solar and geothermal energy can be used effective

2 Ukrainian government responses to energy challenges

Main vectors of energy efficiency policy which the government of Ukraine is working on:

- Financing mechanisms
- Communication mechanisms
- Energy management at enterprises
- Institutional mechanisms

International projects to barriers of ISO 50001: 2011 implementation:

- ✓ Ukraine - District Heating Energy Efficiency Project : Environmental Assessment (Vol. 3) - with funding from the International Bank for Reconstruction and Development in the amount of US$ 382.00 million (Project ID P132741)
- ✓ UNIDO project Introduction of Energy Management System Standard in Ukrainian Industry - with funding from Trust Fund GEF in the amount of US$ 39.630 million (GEF Project ID 4784)

Problems	State regulation measures
Financing mechanisms ➢ Lack of working capital ➢ High rates of bank loans ➢ Insufficient investment	✓ Implementation of rational rates for loan repayment terms in accordance with energy saving indicators ✓ Compliance with foreign requirements to energy saving requirements ✓ Dissemination of performance contracting in industry and the budgetary system by improving the regulatory framework ✓ Improvement of the work of the State Fund for Energy Saving
Communication mechanisms ➢ Low consumer awareness	✓ Creation of a single database ✓ Creation of advisory centers on the economical use of energy and water ✓ Creation of a system of informing enterprise managers about the cost of resources and the possibilities of their saving
Energy management at enterprises ➢ Prioritizing investment to improve profitability over investment to improve energy efficiency ➢ High regulatory process costs ➢ Lack or imperfection of energy management systems	✓ Creation of conditions under which state and investment support occurs under conditions of compliance with modern energy management requirements
Institutional mechanisms ➢ Energy management system does not meet market challenges ➢ Complexity of technical and technological regulation of energy consumption	✓ Creating strong institutional mechanisms at national, regional and local levels that are to support the implementation of ISO 50001: 2011 in all manufacturing plants ✓ Creating strong institutional mechanisms to support energy labeling of equipment for energy efficiency

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Circular economy: the concept and its barriers in Ukraine

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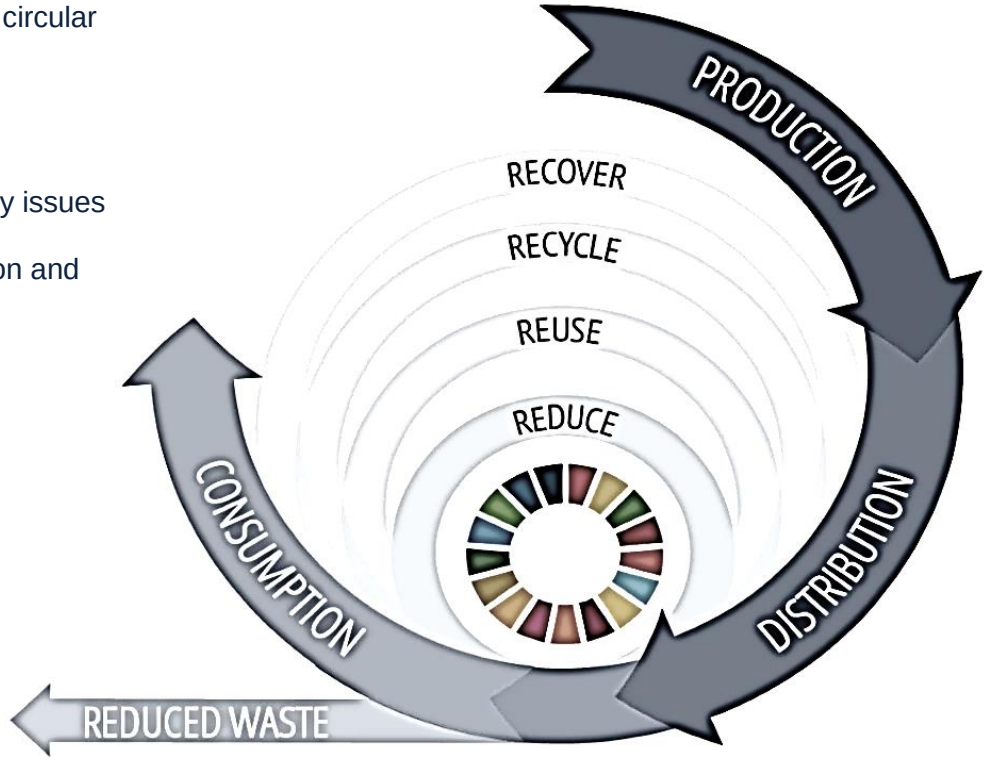
1 What is a Circular Economy?

The circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life [88]

As well as creating new opportunities for growth, a more circular economy will:

- reduce the waste of resources
- drive greater resource productivity
- deliver a more competitive national economy
- better address emerging resource security / scarcity issues in the future
- help reduce the environmental impacts of production and consumption inside the country and abroad

The circular economy is a key pathway for sustainable development. The EC states "This (circular economy) action plan will be instrumental in reaching Sustainable Development Goals". Specifically it shall contribute to lowering resource demands, thereby increasing resource security and lowering pressures on the environment domestically and abroad



2 Circular economy indicators in EU

There is no indicator that can be a single measurement for the Circular Economy. However a number of existing indicators can help to measure performance in several areas that directly or indirectly contribute to the Circular Economy development.

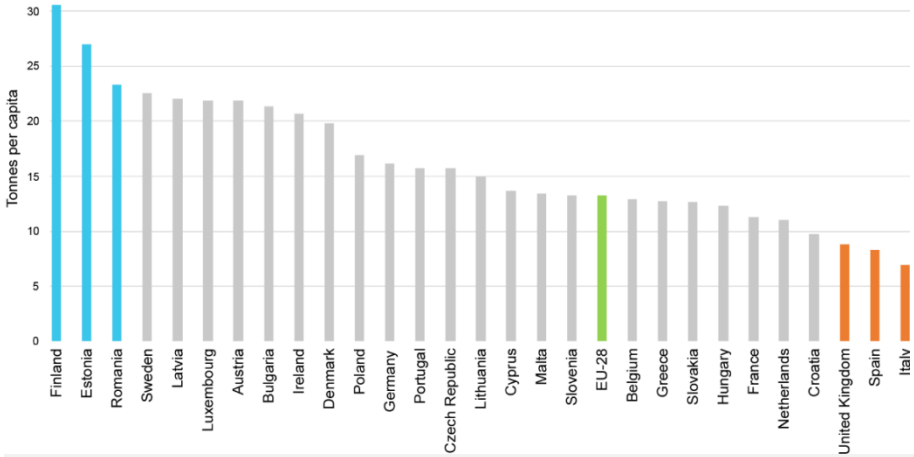
They can be grouped into the following groups [20]:

- Sustainable resource management
- Societal behavior
- Business operations

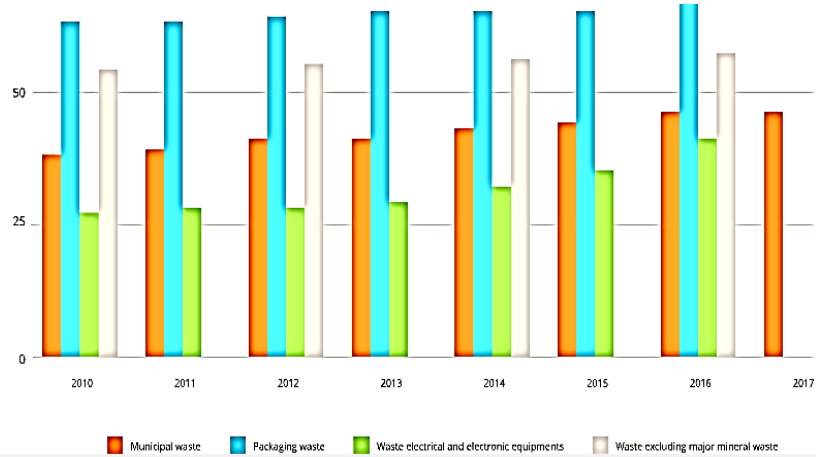
This set of indicators examines the performance of EU Member States toward transforming their economies toward circularity (macro level indicators).

Material footprints quantify the demand for material extractions (biomass, metal ores, non-metallic minerals and fossil energy materials/carriers) triggered by consumption and investment by households, governments and businesses in the EU. Several indicators are provided by Eurostat to provide good insights on the EU’s material flow accounts[104]

Material Footprint: Domestic material consumption, tonnes per capita, 2015



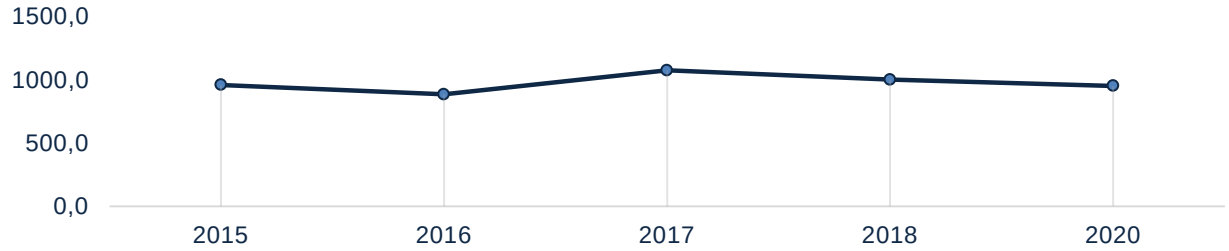
Recycling rates in Europe by waste stream, 2019



3 Problems of circular economy in Ukraine

- Most production systems in Ukraine are far from achieving circular economy principles. Compared to many EU countries, sorting and recycling practices in Ukraine are significantly less developed: 93% of household waste in Ukraine is being buried into the ground, only 5.6% recycled and neglectable 1.4% incinerated

The amount of waste generated by all types of economic actvity per unit of GDP Purchase Power Parity, kg per USD 1000

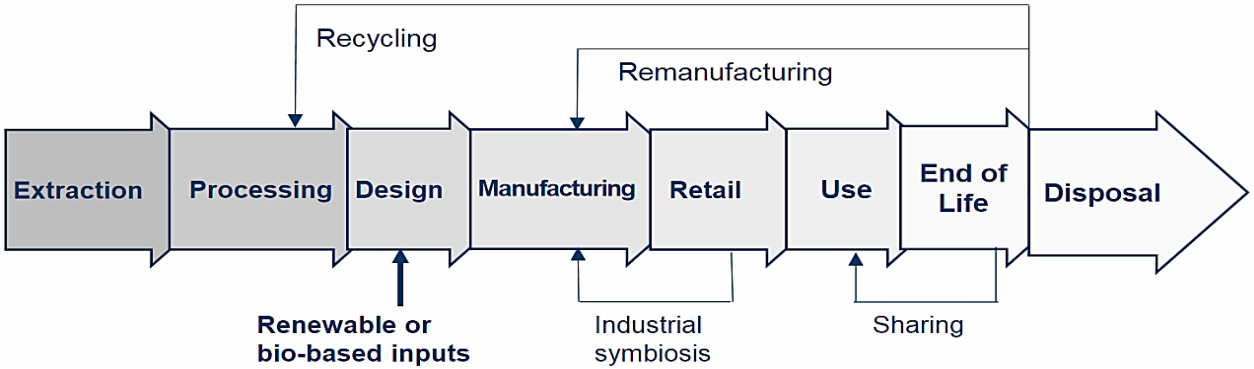


Circular economy indicators in Ukraine [13-14]

Indicators	Units of measurement	2015	2020
Share of Renewable Energy Sources	% of total energy consumption	4	8
Water Capacity of GDP	Cubic meters of used water per 1000 UAH GDP in actual prices	3.6	3.2
Energy Capacity of GDP	Cost ratio of primary energy on unit of GDP	0.28	0.2
Wastewaters Discharge in Water Bodies	% of total discharge	15.7	13
Buried Wastes Proportion	% of total amount of generated wastes	50	45
Greenhouse Gas Emissions	Compared to 1990 level, %	37.8	24

4 Business models for circular economy

Circular business models operate in different parts of the value chain



An economic activity can contribute substantially to the sustainability through transitioning to a circular economy in several ways [66]:

- to increase the durability, reparability, upgradability and reusability of products
- to reduce the use of resources through the design and choice of materials, disassembly and deconstruction in the buildings and construction sector, in particular to reduce the use of building materials and promote the reuse of building materials
- the developing ‘product-as-a-service’ business models and circular value chains, with the aim of keeping products, components and materials at their highest utility and value for as long as possible
- the reduction in the content of hazardous substances in materials and products throughout the life cycle, including by replacing them with safer alternatives
- the reducing food waste in the production, processing, manufacturing or distribution of food

Headline business models for circular economy:

- ✓ Circular supply models,
- ✓ Resource recovery models
- ✓ Product life extension models
- ✓ Sharing models

5 circular business model categories

- ✓ Coordinating circular value chains through data
- ✓ Circular product design
- ✓ Use, reuse, share, and repair
- ✓ Collection & reverse logistics
- ✓ Sorting & preprocessing

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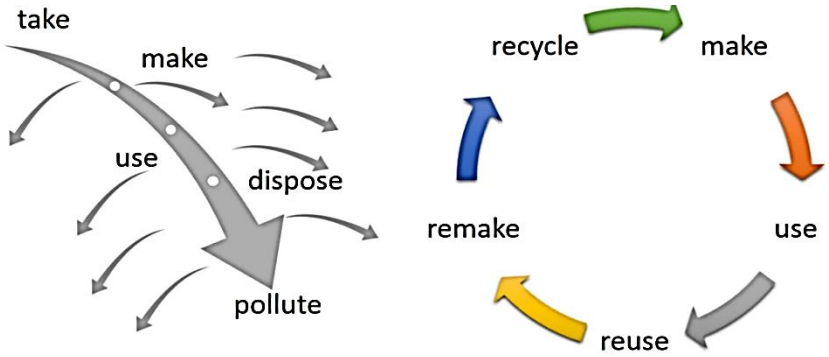
Technological transitioning to circular economy: mechanical engineering sector

Dr. Yuliia Dubiei & MSc. Nataliia Kruchinina
National Technical University Dnipro Polytechnic, Ukraine

1 Key principles of circular economy

- The linear production model is understood as material flow in which only virgin material enters in the beginning of value chain
- The linear production model incurs unnecessary resource losses in several ways: production chain and end-of-life waste, excessive energy use and erosion of ecosystems
- The circular economy has been defined as an industrial system that is restorative or regenerative by intention and design

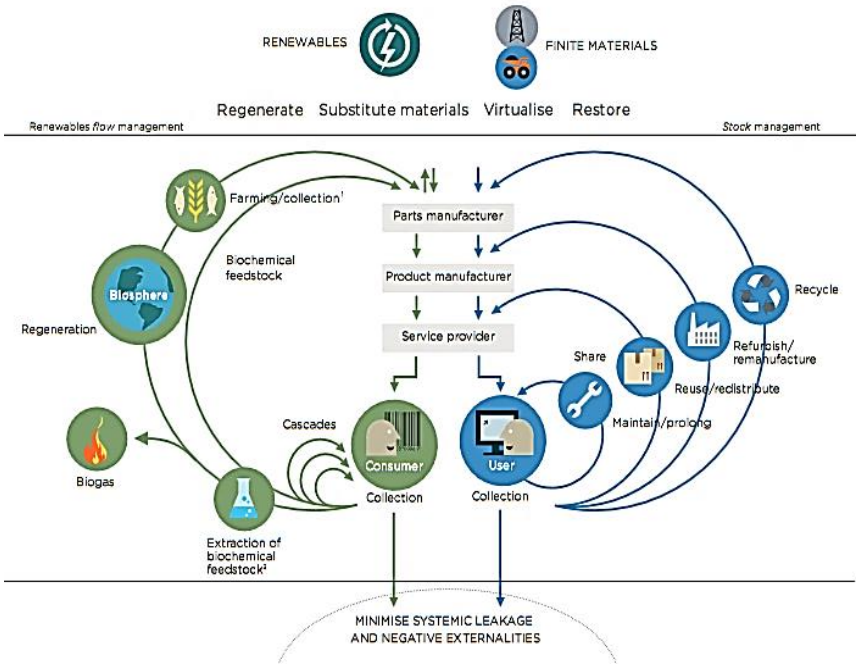
Transition from linear to circular economy [47]



Key principles of circular economy

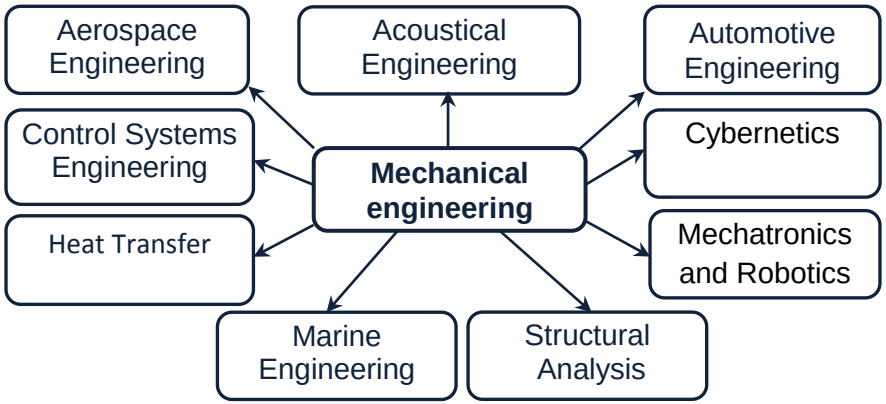
- ✓ Preserve and enhance natural capital
- ✓ Optimise resource yields
- ✓ Foster system effectiveness by revealing and designing out negative externalities

The circular economy tools and instruments [59]



- Circular supplies
- Resource recovery
- Product life extension
- Re-sale platforms
- Product as a service
- Recycling in value chains
- Energy saving
- ……

2 Technological transitioning to circular economy in mechanical engineering sector



Mechanical engineering sector

Heavy engineering
- Metallurgical engineering
- Mining engineering
- Energy engineering

Medium engineering
- Transport engineering
- Agricultural and tractor engineering
- Machine tool engineering
- Equipment for light and food industry

Precision engineering
- Instrument engineering
- Electrical engineering

Transitioning to circular economy [87]



Design and manufacturing issues



Digital technologies

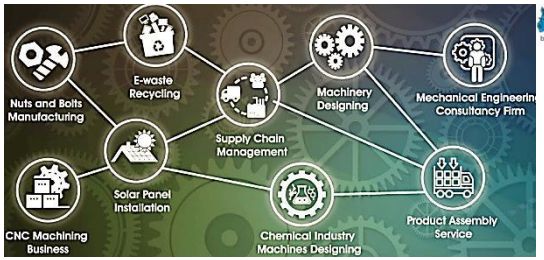


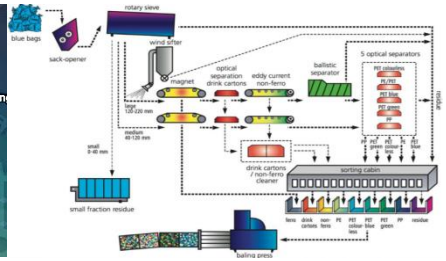
Recycling & less energy consumption

3 Recycling in mechanical engineering sector

Recycling is the collection, sorting and processing of disposed materials for use in other manufacturing processes

- ✓ Brand owners can accelerate the process towards circular economy, with new solutions for more easily recyclable products
- ✓ In terms of technology, efficiency, functionality and recyclability must be compatible
- ✓ If there are regulations for recycling, there must be markets and infrastructures for recycled materials





Additive manufacturing

Additive manufacturing (AM), also known as **3D printing**, is the general term used to refer to technologies that, based on **a 3D digital model**, build up parts by adding material **layer by layer**

Example ⟶ **machine tools**

Benefits of implementation of AM in machine tools sector:

- ✓ lightweight design and enhanced durability and functionality of components
- ✓ increasing material efficiency and recycling
- ✓ enabling on-demand and distributed manufacturing
- ✓ reparability and remanufacturing becomes easier and more cost-effective

Example ⟶ **vehicle recycling**

Evaluation of the efficiency of vehicle recycling

$$P_R = E \cdot I_E \cdot K \cdot U_R$$

where:

P_R - recycling efficiency indicator (0,1 – 1);

E - economic efficiency indicator of recycling;

I_E - indicator of environmental importance of recycling;

K - indicator of the relative volume of intended recycling;

U_R - the level of reuse in the national economy of parts obtained during disassembly of vehicles for recycling.

Digital technologies for circular economy

Digital twin is **a virtual model** of a process, product or service, pairing virtual and physical worlds. This allows the **analysis** of data and **monitoring** of systems to develop new solutions or conduct predictive maintenance

Benefits of implementation of digital twin technology

- ✓ recognition of any behaviour deviations and influence on the development of future products
- ✓ reduction of the amount of testing and experiments of the products → more new products on the market in a short period of time; optimisation of products in advance, reduction of the resources used
- ✓ enabling of intelligent, machine-level decision-making at a factory level

4 Barriers to the introduction of a circular economy in the mechanical engineering sector in Ukraine

Barriers in Ukraine
Opportunities for development / experience of other countries

Using of outdated equipment and technologies
Replacing equipment with a more modern one, which will allow the implementation of the basic principles of the circular economy: reducing the amount of resources used, recycling, etc.; advanced software for process optimisation; digitalisation; 3D-printing

Internal barriers on the enterprise
Implementation of new organizational competences (e.g., team motivation, organizational culture, participation)

Market barriers
Measures within the policy and management of the enterprise, providing an increase in the indicators in the direction of production cooperation of industrial enterprises

Institutional, regulatory and social barriers
The state should stimulate enterprises to increase their level of competitiveness and provide state-owned enterprises with updated equipment and highly qualified personnel

Low investment attractiveness of Ukrainian machine-building enterprises
Technological modification of production systems, application of elements of the digital economy → enterprises can become more attractive for investments

Lack of qualified personnel
Participation of enterprises in the system of specialized education, advanced training and retraining of personnel

Obstacles for recycling
- ✓ used cars contain a number of harmful substances → special recycling technologies are required
- ✓ impossibility of recycling of metals that are corroded, rust
- ✓ the complexity of the design of some vehicles
- ✓ transportation costs and others

Barriers in the areas of digital technologies:
- → Inability to experiment quickly
- → Failure to change out legacy systems for new technology
- → Inability to work together across for resources and funding
- → Inadequate collaboration between IT and lines of business
- → Risk-aversive culture
- → Change management capabilities
- → Lack of a corporate vision for digital
- → Lack of high-quality training of employees of enterprises
- → Insufficient budget and difficulties in implementation in small enterprises

Organisations need to ensure that teams are working together in their attempt to transform, because digital transformation does not exist in siloes – in just one location or in one team. It is a single strategy that spans the full breadth of an enterprise

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Dubiei Y., Kruchinina N. Technological transitioning to circular economy: mechanical engineering sector. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 125-130

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Air pollution assessment and control in industrial sector

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1 National standards in the sphere of air pollution assessment in industrial sector

Main National standards in the sphere of air pollution assessment in industrial sector

- ✓ National Law “About Atmospheric Air Protection”[1]
- ✓ National sanitary regulations (DSP-201-97) of air pollution control in populated areas (from chemical and biological pollution)[2]
- ✓ Instruction for the design and content of the Project of maximum permissible emissions of atmospheric pollutants from stationary sources[3]
- ✓ The standard technique of air pollution assessment from the point source (Branch Normative Document OND-86)
- ✓ and other documents

National sanitary regulations (DSP-201-97) of air pollution control in populated areas (from chemical and biological pollution)

- Main criteria of air quality for establishing permissible emissions:

$\frac{C}{MAC} \le 1$, where C – concentration of the pollutant in the ground layer of the atmosphere, mg/m^3

MPC – maximum permissible concentration, mg/m^3

- In the case of several pollutants:

$\frac{C_1}{MAC_1} + \frac{C_2}{MAC_2} + ... + \frac{C_n}{MAC_n} \le 1$, where C_1, C_2, C_n – concentrations of several pollutants in the ground layer of atmosphere, mg/m^3

MPC_1, MPC_2, MPC_n – maximum permissible concentrations, mg/m^3

Maximum Permissible Concentrations (thresholds) for main pollutants in the air of industrial and urban territories

Air pollutant		Maximum Permissible Concentration (MPC), mg/m^3		
		Maximum Single Concentration (20 min)	Average daily concentration	Hazard Rate
Mercury	Hg	-	0,0003	1
Lead inorganic	Pb	0,001	0,0003	1
Hydrogen sulphide	H_2S	0,008	-	2
Nitrogen dioxide	NO_2	0,085	0,04	2
Phenol C_6H_5OH		0,01	0,003	2
Formaldehyde CH_2O		0,035	0,003	2
Nitrogen oxide	NO	0,4	0,06	3
Soot		0,15	0,05	3
Dust (with 20% SiO_2)		0,5	0,15	3
Sulphur dioxide	SO_2	0,6	0,05	3
Ammonia	NH_3	0,2	0,04	4
Carbon oxide	CO	5	3	4

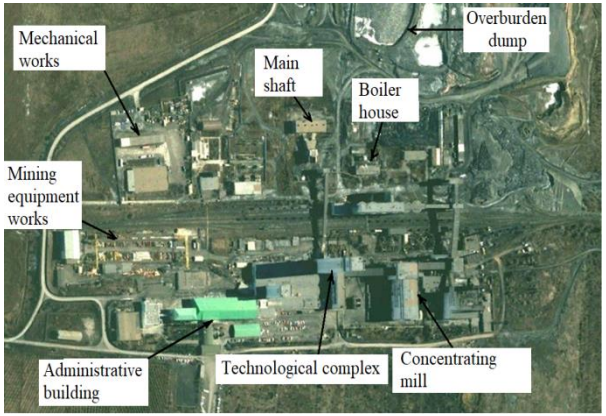
[1]https://zakon.rada.gov.ua/laws/show/2707-12#Text
[2]https://zakon.rada.gov.ua/rada/show/v0201282-97#Text
[3]https://zakon.rada.gov.ua/laws/show/z0442-96#Text

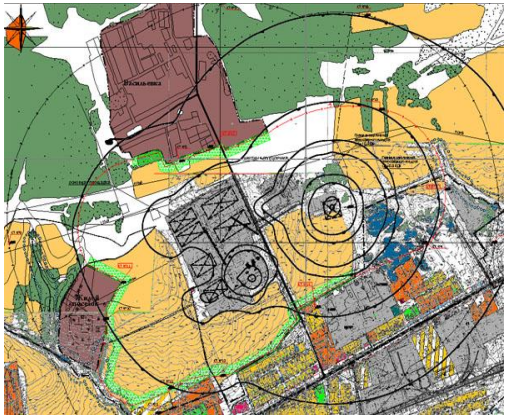
2 Correction of the SPZ according to the Enterprise Hazard Rate (EHR)

Correction of the SPZ according to the Enterprise Hazard Rate (EHR)

A Sanitary Protection Zone (SPZ) is an area that separates special designation zones, industrial enterprises and other industrial, public utility and storage facilities from nearby residential areas, buildings and facilities to reduce exposure to adverse factors

- ✓ On the border of the SPZ of all air pollutants should achieve the values of Maximum Permissible Concentrations
- ✓ SPZ is established according to DSP 173-96 “State sanitary rules of planning and development of settlements”





Type of industries (enterprises)	Enterprise Hazard Rate (EHR)	Sanitary Protection Zone (Design value), m
Protein-vitamin producing plant	I (A)	3000
Production of mineral fertilizers	I (B)	1000
Petroleum processing industries	I (B)	1000
Rolling-mill shop (metallurgy)	II	500
Production of lead batteries	II	500
Plastic production	III	300
Galvanic works	III	300
Mining enterprises	III	300
Production of construction materials	IV	100
Food industry, confectioner's shops etc.	V	50
Bread-baking plant	V	50
Brewing industry	V	50

When developing standards for maximum permissible emissions (MPE), their volume and content depends on the Enterprise Hazard Rate (EHR). This parameter is calculated using the values of gross emissions for each atmospheric pollutant from the stationary sources of the enterprise by the formula:

$$EDH = \sum_{i=1}^{n} \left(\frac{M_i}{MPC_{av.daily}} \right)^{a}$$

where: M_i – gross emission of certain air pollutant, t/year; $MPC_{av.daily}$ – average daily MPC for certain air pollutant, mg/m^3; n – number of air pollutant, a_i – dimensionless coefficient that allows compare the level of toxicity of *i*- air pollutant with toxicity of SO_2

Values of dimensionless constant a_i

Constant	Hazard Rate for certain pollutant			
	1	2	3	4
a_i	1,7	1,3	1	0,9

Enterprise Hazard Rate (EHR)	Calculated EHR values	Sanitary Protection Zone (SPZ), m
1	$\geq 10^8$	1000
2	$10^8 > EHR \geq 10^4$	500
3	$10^4 > EHR \geq 10^3$	300
4	$< 10^3$	100

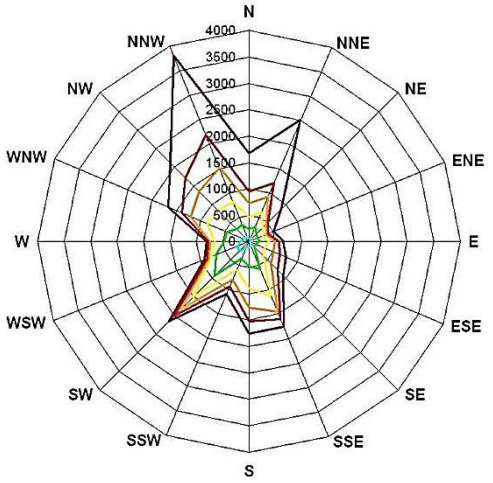
3 Correction of the SPZ depending on epy average annual recurrence of winds (windrose)

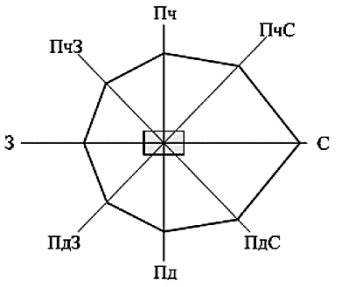
The corrected size of the SPZ (l, m) should be also amended according to the windrose for selected region via formula:

$$l = l_0 \frac{P}{P_0}$$

, where:
l_0 is the calculated SPZ size without the windrose;
P is annual recurrence of certain wind point, %
P_0 is average recurrence of each wind point (P_0 =100/8=12.5%)

Wind direction	N	NE	E	SE	S	SW	W	NW
Recurrence	12	14	18	14	12	10	10	10





Assessment of the spreading air pollutants from the point source in the ground layer of atmosphere (OND-86 technique)

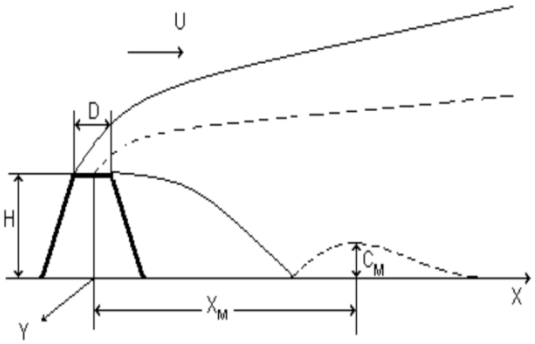
Necessary data for establishing permissible emissions

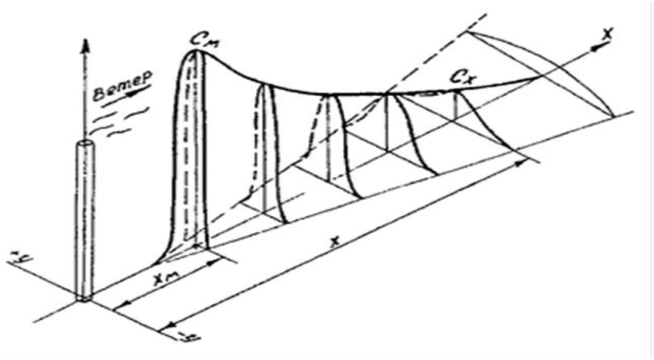
1. *Sources of emission:*
   - Height and diameter of a chimney
   - Gas velocity (m/s) and flow rate (m^3/s)
   - Gas temperature etc.
2. *Air pollution control equipment:*
   - Qualitative and quantitative characteristics of emissions
   - Flow-in and flow-out assessment
   - Effectiveness of cleaning
3. *Mapping of ground level concentrations*

The technique allows to calculate…

1. the maximum ground concentration C_m on the distance X_m from the point source
2. the dangerous wind velocity U_m and the distance X_m to the point with the maximum ground concentration of air pollutant
3. ground concentrations along the **axis of** exhaust plume
4. ground concentrations perpendicular to the axis of exhaust plume
5. the maximum acceptable exhaust (MAE), required efficiency of clean up, and chimney height for air pollution control

4 Scheme of air pollutants spreading from the point source





Step 1: Calculation of a maximum ground concentration C_m on the distance X_m from the point source

$$C_M = \frac{A \cdot M \cdot F \cdot m \cdot n}{H^2 \cdot \sqrt[3]{V_1 \cdot \Delta T}} \quad \text{mg/m}^3 ; \qquad m = \frac{1}{0{,}67 + 0{,}34 \cdot \sqrt[3]{f} + 0{,}1 \cdot \sqrt{f}} ; \qquad f = \frac{1000 \cdot W_0^2 \cdot D}{H^2 \cdot \Delta T};$$

where:

A – coefficient of air temperature stratification that determines conditions of vertical and horizontal spreading of air pollutants, с$^{1/3}$ •м^{3} •град$^{1/3}$ /г (for subtropical zone of Central Asia – 240; for Kazakhstan, Lower Volga region, Caucasus, Moldova, Siberia, Far East and other regions of Central Asia - 200; for North and Northern European regions of Russia, Ural and **Ukraine** – 160; for Central regions of Russia – 120);
M – pollutant emission, g/s;
F – coefficient for settling pollutants, dimensionless, *F*=1 for gases; *F*=2…3 for particulate matter depending on clean-up coefficient;
m and ***n*** are the coefficients conditioning outflow of emission from the point source;
H – height of a chimney, m;
η – relief coefficient, dimensionless;
ΔT – temperature difference, grad. C;
V_1 - flow rate, м^3 /s

Parameter *f* is calculated through equations:

$$\text{if} \quad V_m > 2 \quad \text{then} \quad n = 1$$

$$\text{if} \quad V_m \le 0{,}5 \quad \text{then} \quad n = 3$$

$$\text{if} \quad V_m \le 0{,}5 \quad \text{then} \quad n = 3$$

The coefficient *VM* is defined as:

$$V_м = 0{,}65 \cdot \sqrt[3]{\frac{V_1 \cdot \Delta T}{H}}$$

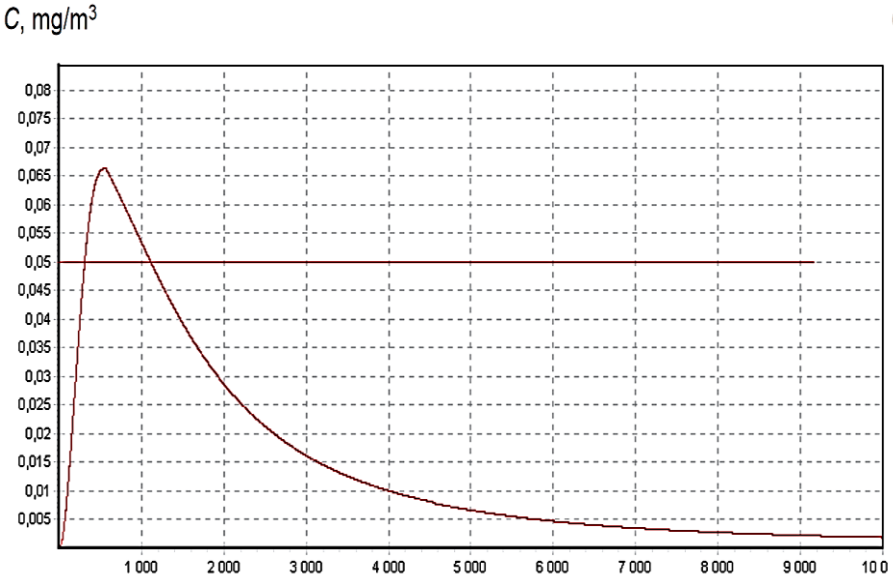
and

$$V_1 = \frac{\pi \cdot D^2}{4} \cdot W_0$$

5 Example of calculations

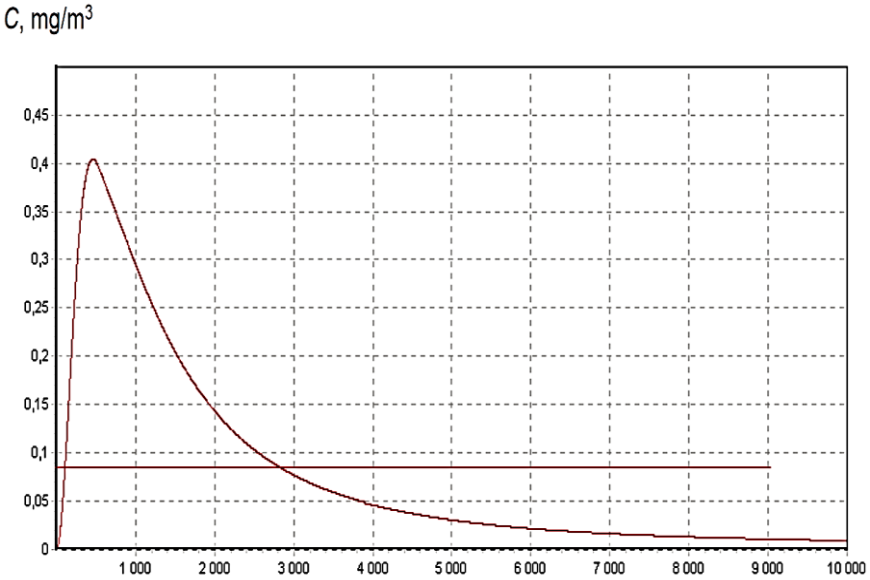
For NO_2 (MPC = 0.085 mg/m^3)

Maximum ground concentration C_m= 0.4 mg/m^3 on the distance X_m= 480 m



For NO2 (MPC = 0.085 mg/m3)

Maximum ground concentration Cm= 0.4 mg/m3 on the distance Xm= 480 m



6 Step 2: Calculation of the dangerous wind velocity U_m and the distance X_m to the point with the maximum ground concentration of air pollutant

$$X_м = d \cdot H; \quad d = 4{,}95 \cdot V_м \cdot \left(1 + 0{,}28 \cdot \sqrt[3]{f}\right) \text{ if } V_m \le 2;$$

$$d = 7 \cdot \sqrt{V_м} \cdot \left(1 + 0{,}28 \cdot \sqrt[3]{f}\right) \text{ if } V_m > 2.$$

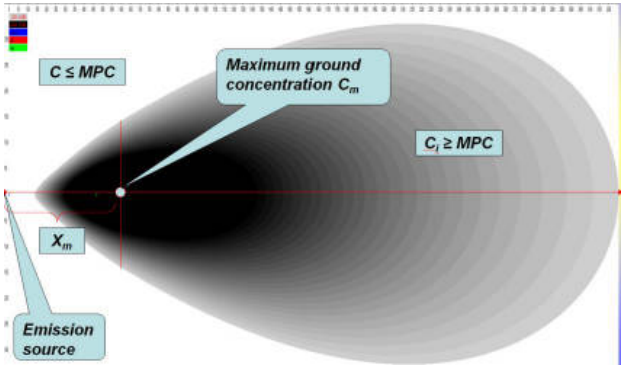
If the coefficient $F \ge 2$ (for dust emissions) the value of $X_м$ is defined through the formula:

$$X_м = \frac{5 - F}{4} \cdot d \cdot H$$

The dangerous wind velocity *Um depends on the* V_m parameter and equal to:

$$U_м = 0{,}5 \text{ if } V_m \le 0{,}5; \quad U_м = V_м \text{ if } 0{,}5 < V_m \le 2; \quad U_m = V_m \cdot \left(1 + 0{,}12 \cdot \sqrt[3]{f}\right) \text{ if } V_m > 2$$

Distance Xm to the point with the maximum ground concentration Cm



7 Step 3: Calculation of ground concentrations along the axis of exhaust plume

$C = s_1 \cdot C_{мп}$, where s_1 is dimensionless coefficient defined as:

$if \left(\frac{x}{x_i}\right) \le 1$ $\quad s_1 = 3\cdot\left(\frac{x}{x_i}\right)^4 - 8\cdot\left(\frac{x}{x_i}\right)^3 + 6\cdot\left(\frac{x}{x_i}\right)^2$ - x is any point along the exhaust plume

$if\ 1 < \left(\frac{x}{x_i}\right) \le 8$ $\quad s_1 = \frac{1{,}13}{0{,}13\cdot\left(\frac{x}{x_i}\right)^2 + 1}$

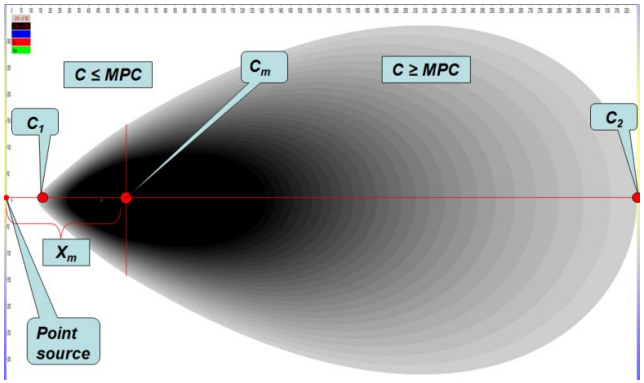
$if \quad \left(\frac{x}{x_i}\right) > 8 \quad and \quad F = 1, \ the \ S_1 \ is \ defined \ as:$

$$s_1 = \frac{\left(\frac{x}{x_i}\right)}{3{,}58\cdot\left(\frac{x}{x_i}\right)^2 - 35{,}2\cdot\left(\frac{x}{x_i}\right) + 120}$$

$if \quad \left(\frac{x}{x_i}\right) > 8 \quad and \quad F \ge 2, \ the \ S_1 \ i \ defined \ as:$

$$s_1 = \frac{1}{0{,}1\cdot\left(\frac{x}{x_i}\right)^2 + 2{,}47\cdot\left(\frac{x}{x_i}\right) - 17{,}8}$$

Ground concentrations (C_1, C_m, $C \ldots C_2$) along the axis of exhaust plume



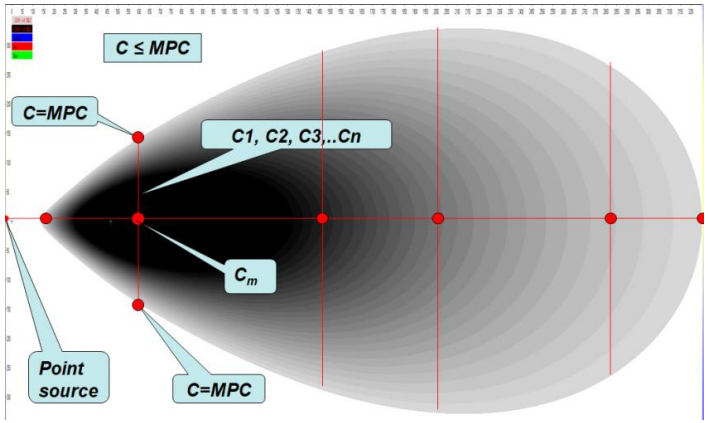
8 Step 4: Calculation of ground concentrations perpendicular to the axis of exhaust plume

$C_y = s_2 \cdot C$, where s_2 is dimensionless coefficient defined as:

$$s_2 = \frac{1}{\left[1+8{,}4 \cdot u \cdot \left(y/x\right)^2\right] \cdot \left[1+28{,}2 \cdot u^2 \cdot \left(y/x\right)^4\right]}$$

u is a fixed value of wind velocity;
x is a fixed distance from the point source along the exhaust plume;
y is any point on the line perpendicular to the axis of exhaust plume.

Ground concentrations perpendicular to the axis of exhaust plume



9 Step 5: Calculation of the Maximum Permissible Emissions (MPE), required efficiency of clean-up, and chimney height

Maximum permissible emissions (MPE), g/s:

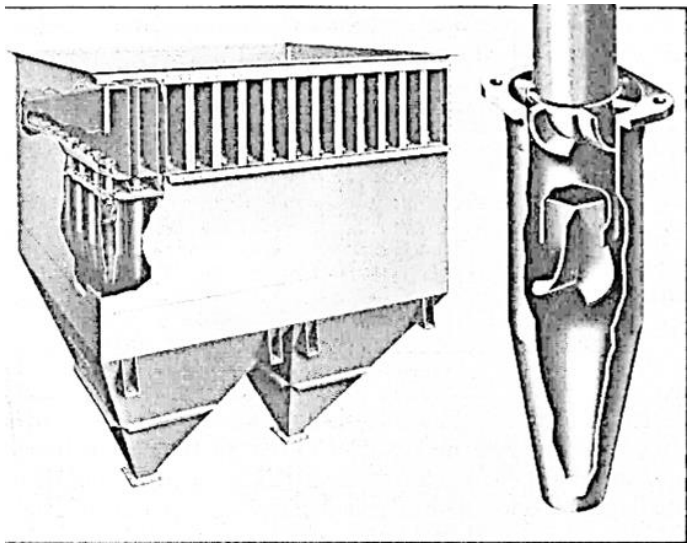
$$MPE = \frac{MPC \cdot H^2 \cdot \sqrt[3]{V_1 \cdot \Delta T}}{A \cdot F \cdot m \cdot n}$$

Required efficiency of clean up, %:

$$X_f = 100 - \frac{MPE \cdot 100}{M}$$

The height of a chimney, m:

$$H_m = \sqrt{\frac{A \cdot M \cdot F \cdot m \cdot n}{MAC \cdot \sqrt[3]{V_1 \cdot \Delta T}}}$$



10 Assessment and control mechanisms

Administrative mechanism for air pollution assessment and control

1 Inventory of air pollution sources with qualitative and quantitative analysis of gas flows and mapping

2 Calculation of **spreading air pollutants** and mapping polluted areas

3 Elaboration of the **Project of Maximum Permissible Emissions (MPE)** as a main normative document that regulates technological and allowable emission rates

4 Approval of the Permission for Emission Rates (obtained from the Ministry of Ecology and Natural Resources)

5 Obtaining Limits for emissions from stationary sources

Economic mechanism of emission limitation for typical enterprise

Pollutants	*Emissions, tons per year*		*Exceeding limits*		*Standard rate of payment for emission Euro/ton*	*Pay for emission in limits Euro/yr*	*Pay for exceeded limits Euro/yr*
	Approved limits	*Real emissions*	*tons*	*%*			
Dust (with 20% SiO_2)	56.280	61.570	**5.29**	9.4	2.8	**157.6**	**74.1**
Sulphur dioxide SO_2	187.190	294.790	**107.6**	57.5	73.2	**13702.3**	**39381.6**
Carbon oxide CO	51.460	49.270	0	0	2.8	138.0	0
Nitrogen oxides NO_x	28.930	20.050	0	0	73.2	1467.7	0
TOTAL:	**323.86**	**425.68**	**112.9**			**15465.6**	**39455.7**

Citation by reference, partial or full reproduction:

Kovrov O. Air pollution assessment and control in industrial sector. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 131-142

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Analysis of the ecological situation and trends in a typical mining town

PhD st. Serhii Krasovskyi
National Technical University Dnipro Polytechnic, Ukraine

1 Horishni Plavni as a typical mining town in Ukraine



- ✓ The Horishni Plavni was built as the residential and civic area for the Poltava Mining and Extraction Combinat - the most important iron ore-mining company in Ukraine
- ✓ 80% of the city residents are employed by the mining industry.
- ✓ There are two gigantic open pit mines and several spoil tips on the city territory, to the north-east and south of the residential area

FERREXPO
Poltava Mining

- ✓ Ferrexpo plc is a Swiss-based commodity trading and mining company which is the third largest exporter of iron ore pellets in the world
- ✓ Ferrexpo's operating base is in central Ukraine, where it operates three iron-ore mines and an iron ore pellet production facility

Key environmental problems in Ukraine [15]

- → Air pollution by emissions from industrial enterprises
- → Water pollution by emissions from industrial enterprises
- → High energy and resource consumption of production
- → Insufficient efficiency of sewage treatment plants
- → Low level of ecological culture among representatives of business and the population
- → Low level of use of alternative energy sources
- → Disposal and utilization of waste from mining and other industries
- → Imperfection of the environmental

Key environmental problems in the Horishni Plavni [32]

Strengths side

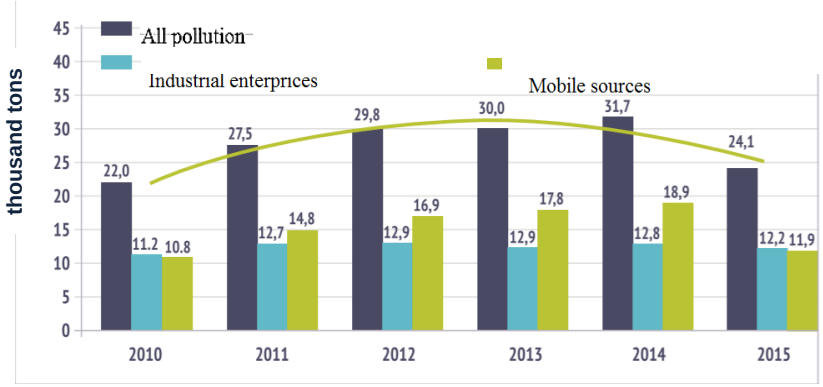
1) Water recourses
2) Iron recourses
3) Large reserves of granites, migmatites, gneisses, quartzite, marble, crystalline shale, manifestations of non-ferrous metal ores, semiprecious stones, diabases, sands, loams, mineral paints, clays, mineral waters
4) Sustainable Energy Development - Action Plan
5) The city is surrounded by pine forests
6) Active environmental education

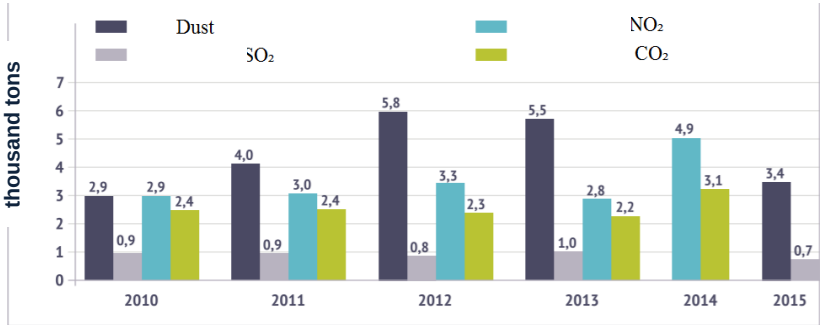
Weak sides

1) Presence of environmentally hazardous facilities
2) The presence of sources of man-made seismicity
3) The presence of man-made dumps
4) Violation of the hydrological regime of soil and groundwater
5) Processes of destruction of river banks
6) Air, water and land pollution
7) Large volumes of industrial and household waste
8) Low level of energy efficiency and energy consumption management

2 Analysis of environmental trends in the Horishni Plavni

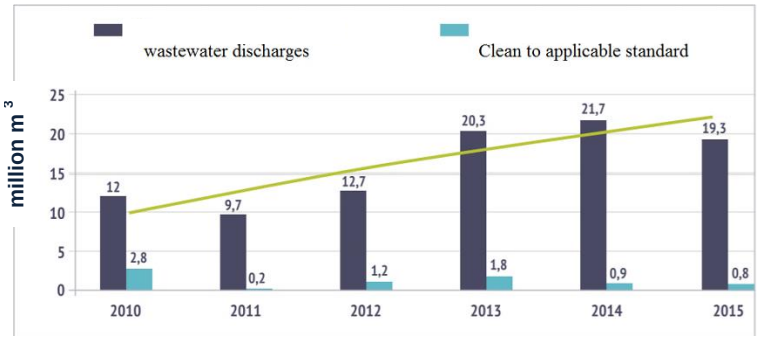
Dynamics of emissions of pollutants into the atmosphere in the Horishni Plavni, 2010-2015 [32]



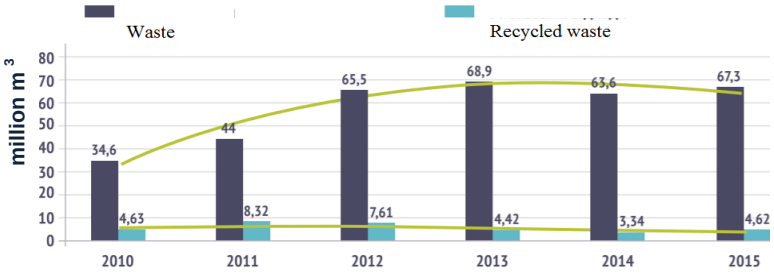


The main sources of air pollution in the town of Horishni Plavni are mobile sources whose emissions account for 50-60% of total gross pollutant emissions substances, and industrial enterprises (emissions are 40-50%)

Dynamics of return water discharge in Dnieper River, million m³ [32]



Dynamics of waste generation and utilization



The total area of greenery in the city is 508.03 hectares (98.0 m2 per capita), including the area of green areas for public use 208.8 ha (40.3 m2 of greenery per capita)

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Krasovskyi S. Analysis of the ecological situation and trends in a typical mining town. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. Ed.: Shvets V., Paliekhova L. Dnipro: Accent, 2021. PP. 131-146

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Mainstreaming biodiversity in industry development

Prof. Vasily Shvets & Dr. Kateryna Kolesnykova
National Technical University Dnipro Polytechnic, Ukraine

1 General characteristics of Ukraine

Occupying less than 6 per cent of the area of Europe, Ukraine possesses about 35 per cent of its biodiversity [22]

✓ **Landscape of Ukraine**

- Forest zone 10%
- Forest-steppe Zone - 30%
- Steppe Zone - 40%
- Mountains (Carpathian & Crimean) 20%
- More than 40 per cent of the area of Ukraine was occupied in the past by step landscapes. At present they are about 3 per cent. 30 per cent of all species of flora and fauna, included in the Red Book of Ukraine, are concentrated on these territories
- Agricultural development of the territory reached 72% and the level of ploughing of the land area–56%. The highest stock of arable lands is attributed to oblasts, which are located in forest-steppe and steppe zones where ploughing reaching 80% and higher
- An extensive development of agriculture caused a considerable decrease of landscape diversity
- The nature and reserve fund of Ukraine consists of more than 7608 territories and sites with a total area of 3,2 million hectares (5,4 per cent of the total area of the country); but its share is insufficient and remains considerably smaller than in the most countries of Europe, where the areas occupied by nature and reserve territories are, in average, 15 per cent

Forest cover of Ukraine’s Territory per Administrative Oblasts (2011)



Ploughing of Ukraine’s Territory per Administrative Oblast



Flora and fauna in Ukraine

- ✓ Among the over 16,000 species of plants that are now found in Ukraine there are over 4,400 species of higher plants
- ✓ The nature and reserve fund of Ukraine consists of more than 7608 territories and sites with a total area of 3,2 million hectares (5,4 per cent of the total area of the country); but its share is insufficient and remains considerably smaller than in the most countries of Europe, where the areas occupied by nature and reserve territories are, in average, 15 per cent
- ✓ Biosphere of Ukraine counts more than 70 thousand of species, of those flora – over 27 thousand, fauna – over 45 thousand of species
- ✓ Ukraine is situated at the crossing of migration ways of many species of fauna
- ✓ During the last years one could observe an increase of number of species of plants and animals, which are included in the Red Book of Ukraine

2 Biodiversity is essential for sustainable development

- Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems
- Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being
- Ecosystems provide the basic necessities of life (e.g., food, water and the very air we breathe), offer protection from natural disasters and disease (e.g., by regulating climate, floods and pests), provide a foundation for human cultures and worldviews
- Decisions humans make that influence biodiversity affect the well-being of



- The changes in biodiversity due to human activities were occurring more rapidly in the past 50 years than at any time in human history
- In effect, we are currently responsible for the sixth major extinction event in the history of the Earth, and the greatest since the dinosaurs disappeared, 65 million years ago
- Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biological evolutionary history
- Biodiversity is at the center of many economic activities, particularly those related to crop and livestock agriculture, forestry, and fisheries
- Globally, nearly half of the human population is directly dependent on natural resources for its livelihood, and many of the most vulnerable people depend directly on biodiversity to fulfil their daily subsistence needs

- ✓ Over half of global GDP depends on nature and the services it provides, with three key economic sectors – industry, agriculture and construction – all highly dependent on it [82]
- ✓ Biodiversity conservation has potential direct economic benefits. For example, more than 75% of global food crop types rely on animal pollination
- ✓ The overall benefit/cost ratio of an effective global programme for the conservation of remaining wild nature worldwide is estimated to be at least 100 to 1
- ✓ 15 of 24 Ecosystem services are in decline, including provision of fresh water, marine fishery production, the number and quality of places of spiritual and religious value, the ability of the atmosphere to cleanse itself of pollutants, natural hazard regulation, pollination, and the capacity of agricultural

3 Biodiversity and the 2030 Sustainable Development Goals

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems [4]:

- ✓ Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being
- ✓ Ecosystems provide the basic necessities of life (e.g., food, water and the very air we breathe), offer protection from natural disasters and disease (e.g., by regulating climate, floods and pests), provide a foundation for human cultures and worldviews
- ✓ Decisions humans make that influence biodiversity affect the well-being of themselves and others
- ✓ Studies show that areas with a high level of biodiversity have richer natural resources and are also able to cope more quickly with the effects of natural disasters

To improve management effectiveness, the following elements should be strengthened:

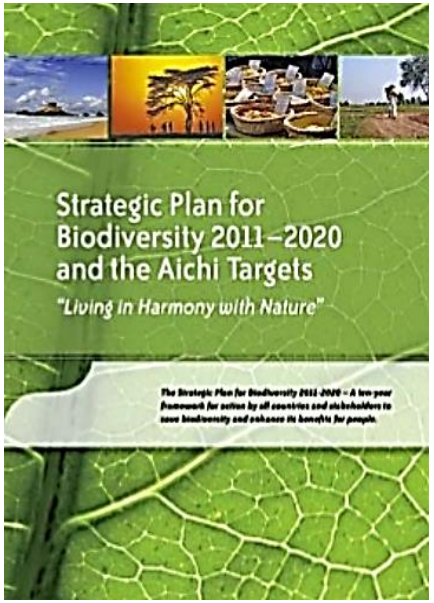
- ➢ **Management Planning:** Management plans with biodiversity conservation objectives, based on science, and adequate conservation measures to meet these objectives
- ➢ **Stakeholder engagement**: Working across sectors and at all levels in equitable and participatory processes, with involvement of all interested parties, land users, inhabitants and communities aiming to increase ownership of the conservation goals
- ✓ **Monitoring of biodiversity outcomes in the field**: Regular, systematic , standardised monitoring of habitat and species condition to check the effectiveness of the measures; and to stimulate and direct corrective action in case of insufficient progress
- ✓ **Funding:** Proper financial and other incentives must be established so land and sea users have a benefit for treating their land and sea in a way that delivers conservation outcomes
- ✓ **Capacity building and Communication**: Managers need to provide professional leadership and direction and to secure and wisely use the resources needed

4 Strategic Plan for Biodiversity 2011-2020 and Aichi Targets

The role of biodiversity protection for Sustainable Development Goals [4; 59]

- Without effective measures to conserve biodiversity and use its components in a sustainable manner, the 2030 Agenda for Sustainable Development will not be achievable
- There are critical biodiversity dependencies for SDG 2: Zero Hunger, SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 11: Sustainable Cities and Communities, SDG 12: Responsible Consumption and Production, SDG 14: Life below Water, SDG 15: Life on Land





- The Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets adopted under the Convention on Biological Diversity has been recognized as setting the global framework for priority actions on biodiversity
- The 2030 SDGs and the Strategic Plan are mutually supportive and reinforcing, and therefore the implementation of one contributes to the achievement of the other



5 The fourth ‘One Planet Summit for Biodiversity’ – 2021

Organized by France, in cooperation with the United Nations and the World Bank, the ‘One Planet Summit’ for biodiversity on 11 January 2021 aims to advance the protection of nature

The fourth ‘One Planet Summit’ was focus on biodiversity to mobilize commitments to protect ecosystems and make links to human health

1 Protection of terrestrial and marine ecosystems:

- France and Costa Rica launched the “High Ambition Coalition for Nature and People”, which aims to create the conditions for the adoption of an ambitious nature protection target by the Conference of the Parties to the Convention on Biological Diversity at the end of the year. To date, these efforts have brought 52 States behind the Coalition, committing to work for the protection of 30% of terrestrial and marine spaces by 2030
- Germany confirmed the launch of the Legacy Landscape Fund, a new global public-private coalition aimed at providing sustainable public and private finance to the most valuable protected areas in developing countries and emerging economies. It was recently established by Germany in collaboration with various partners, including France, and will support long-lasting cooperation between authorities responsible for protected areas, experienced NGOs, and indigenous and local communities

2 Promotion of agroecology

- Acknowledging that agroecology helps preserve biodiversity while addressing the Sustainable Development Goals, a programme has been established, called the “Great Green Wall Accelerator” (GGW Accelerator)

3 Finance for biodiversity

- The Summit laid the foundations for a coalition for convergence of climate and biodiversity finance, aimed at building more synergies between climate action and biosphere conservation. Its members will work to increase the share of their climate finance that also benefits biodiversity. This principle was supported at the One Planet Summit by Canada, France, Norway and the United Kingdom
- The Summit generated political momentum, particularly from Canada, France and the United Kingdom, for the Taskforce on Nature-related Financial Disclosure (TNFD). This initiative, promoted by public and private stakeholders, including 50-odd leading financial institutions, will develop a framework for measuring the risks, impacts and benefits of economic activities with regard to biodiversity – like the TCFD for the climate.

4 Protecting forests, species and human health

- France launched the PREZODE (PREventing ZOonotic Diseases Emergence) initiative, which will establish unprecedented international cooperation between research actors and health vigilance networks, supported notably by the FAO, for the prevention of new pandemics originating from animal reservoirs
- The One Planet Summit was the occasion for a stock take of the Alliance for Rainforests, announced at the 2019 G7. Germany and the Democratic Republic of the Congo announced their membership of the Alliance

6 European Union biodiversity strategy for 2030

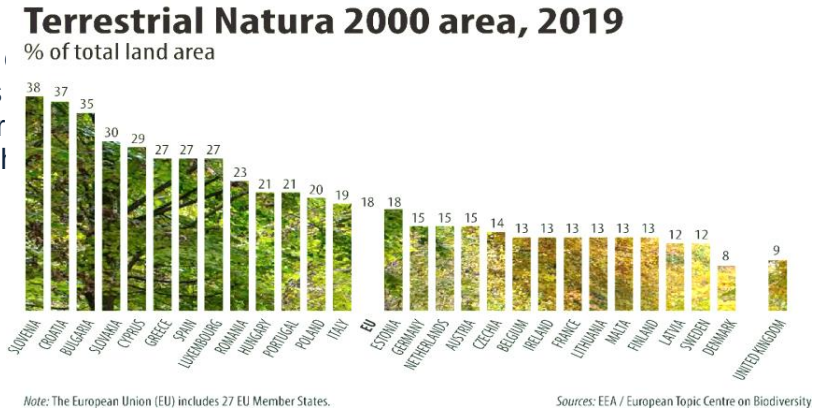
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions
Brussels, 20.5.2020 [19]

- At the end of 2019, the European Commission adopted The European Green Deal, an ambitious vision for a sustainable, green transition that is just and socially fair
- On 20 May 2020 the European Commission adopted the EU Biodiversity Strategy for 2030 to halt the decline in biodiversity and bring nature back into our lives
- In 2020, the Commission launched a review of the reporting obligations of businesses under the Non-Financial Reporting Directive, with a view to improving the quality and scope of non-financial disclosures, including on environmental aspects such as biodiversity
- The Commission will put forward a new initiative in 2021 on sustainable corporate governance. This initiative, which may take the form of a legislative proposal, will address human rights and environmental duty of care and due diligence across economic value chains
- Through its existing platforms, the Commission will help to build a European Business for Biodiversity movement, taking inspiration from recent initiatives and making this movement an integral part of the European Climate Pact
- To support the long-term sustainability of both nature and farming, this strategy will work in tandem with the new Farm to Fork Strategy and the new Common Agricultural Policy (CAP), including by promoting eco-schemes and result-based payment schemes
- In addition to CAP measures, the Commission will put forward an Action Plan on organic farming, helping Member States stimulate both supply and demand of organic products
- As set out in the Farm to Fork Strategy, the Commission will take action to reduce by 50% the overall use of – and risk from – chemical pesticides by 2030 and reduce by 50% the use of more hazardous pesticides by 2030

EU - Natura 2000

EU Project proposes and implements policies that ensure a high level environmental protection and preserve the quality of life of EU citizens

- Natura 2000 is a network of core breeding and resting sites for rar and threatened species, and some rare natural habitat types whicl are protected in their own right. It stretches across all 27 EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive



7 Ukraine: to save biodiversity

Sixth National Report of Ukraine on the implementation of the Convention on Biological Diversity December, 2018

- The Convention on Biological Diversity (CBD) was open for signature in 1992 in Rio de Janeiro. Ukraine signed the CBD in 1992 and ratified it in 1994
- Ukraine has adopted national biodiversity targets or equivalent commitments in line with the Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets
- Ukraine has presented the Law of Ukraine “On the Main Principles (Strategy) of the National Environmental Policy of Ukraine for the Period until the Year 2020” (as of 2010) as the officially approved National Action Plan for implementing the global Strategic Plan for Biodiversity and the Aichi Biodiversity Targets (ABT). This document identifies seven national targets
- The Law of Ukraine “On General Principles and Standards of Organic Production, Trade and Labeling of Organic Products” (2018) defines the directions of the state policy in terms of organic production, trade, and labeling of organic products, particularly in “safeguarding genetic safety, biodiversity and sustainable use of natural resources and their restoration”, “ensuring environmental safety in organic production processes”
- Ukraine implemented a set of measures consistent with the implementation of the CBD and the Strategic Plan for Biodiversity 2011–2020 with the twenty Aichi Biodiversity Targets

The Main Principles (Strategy) of the National Environmental Policy of Ukraine until 2020
Law of Ukraine No.2818, adoption - December 21,2010

- Destruction of environment takes place due to cultivation of lands, deforestation with further change of target use of lands, drainage or watering of territories, industrial, housing and cottage construction etc.
- To terminate the processes of worsening of condition of environment it is necessary to increase the areas of lands of ecological network that is a strategic task in achieving the ecological balance of the territory of Ukraine
- The tasks in terms of protection of biodiversity are not resolved during privatization of lands, preparation and implementation of programmes of sectoral, regional and local development
- Lack of boundaries of sites settled on terrain under the procedure established by law results in breaching of requirements of the reserve regime
- The paces of demarcation of littoral protection shelter-belts along seas, rivers and around water bodies, which perform the role of ecological corridors, are slow
- The development of a national biodiversity monitoring system is vital (currently, insufficient financial sup-port is the primary problem). The existing monitoring programs concern individual species (or groups of species) at the regional level

EU instruments ratified by Ukraine:

- ✓ 2000 European Landscape Convention
- ✓ 2001 Declaration on Environment and Sustainable Development in the Carpathian and Danube Region
- ✓ 2003 Framework Convention on the Protection and Sustainable Development of the Carpathians
- ✓ 2008 Protocol to the Carpathian Convention
- ✓ 2009 Directive 2009/147/EC on the conservation of wild birds
- ✓ 2013 New EU forestry strategy for forests and the forest-based sector
- ✓ 2011 EU Biodiversity Strategy to 2020
- ✓ EU's biodiversity strategy for 2030

8 The biodiversity protection in industry: Toshiba Group experience

- **MISSION:** Be customers' number one choice in air conditioning, heating, ventilation and commercial applications throughout the area in which we operate
- **PURPOSE:** To create a comfortable and productive environment, whatever the climatic conditions, offering solutions that ensure high quality indoor air

Toshiba Group's biodiversity conservation: Risks and opportunities of not taking or taking action

Risks : Unstable, costly resource procurement (e.g., water and minerals); damage to the company's reputation

Opportunities : Avoidance of risks due to unstable, costly resource procurement; increased corporate value; heightened employee motivation



Category of Aichi Targets		Aichi Targets	Toshiba Group's Activity Targets	
			Theme	Description
Strategic Goal A	Address the underlying causes of biodiversity loss by mainstreaming biodiversity	Target 1	Raising awareness	Environmental education, information disclosure, and collaboration with outside organizations
		Target 2	Incorporating targets into strategies and plans	Incorporation of targets into environmental policies, Environmental Action Plans, and ISO 14001 goals and targets
		Target 4	Sustainable production	Mitigation of climate change and efficient use of resources
Strategic Goal B	Reduce the direct pressures on biodiversity and promote sustainable use	Target 5	Reducing habitat loss	Building ecosystem networks that connect natural habitats with Toshiba Group sites, planting trees
		Target 8	Reducing chemical pollution	Management of chemicals
		Target 9	Eliminating alien species	Elimination of alien species at company sites
Strategic Goal C	Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	Target 11	Conserving protected areas	Activities that contribute to preserving protected areas outside Toshiba Group sites
		Target 12	Conserving endangered species	Protecting rare plant and animal species, ex-situ conservation
Strategic Goal D	Enhance the benefits to all from biodiversity and ecosystem services	Target 14	Maintaining and managing ecosystem services	Maintenance and improvement of cultural services
Strategic Goal E	Boost implementation through participatory planning, knowledge management and capacity building	Target 19	Improving and spreading knowledge and technology	Accumulating and disclosing ecosystem survey data (including habitat maps) and creating biodiversity conservation technologies

TOSHIBA

- ✓ In FY2019, activities to achieve the 10 Aichi Targets were implemented at an average of 71% of sites. Implementation rates were high for Targets 1, 2, 4, 5, 8, 11, and 12 but low for Targets 9, 14, and 19

Citation by reference, partial or full reproduction:

Shvets V., Kolesnykova K. Mainstreaming biodiversity in industry development.
In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.:
Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 147-156

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Environmental challenges for PJSC "ArcelorMittal Kryvyi Rih"

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1 Environmental challenges for PJSC "ArcelorMittal Kryvyi Rih"

Steel production relates to the significant environmental footprint. The main goals of PJSC ArcelorMittal Kryvyi Rih in ecological area are fulfillment of the environmental obligations and ecological safety. Due to these goals the enterprise improves its environmental management system, renovates environmental facilities and develops new methods of waste processing and storage. PJSC ArcelorMittal Kryvyi Rih is one of the first steel plants in Ukraine adopted environmental management system for the efficient management of the environmental issues. Every year the plant proves that environmental management system meets requirements of the international standard ISO 14001:2015, which testifies high reliability and productivity of environmental management system. The enterprise approved Environmental Policy, which states main principles of our attitude to the environmental protection



Main principles of Environmental Policy for PJSC "ArcelorMittal Kryvyi Rih"

Our values:

- life and health of a person in an ecologically clean environment

Our code:

- compliance, consistency and transparency
- impact prevention and willingness
- awareness and responsibility



Our responsibilities:

- ✓ Develop ecological strategy based on the best existing technologies and methods of environmental safety management considering social interests and Company`s possibilities
- ✓ Perform ecological programs for continuous improvement of ecological figures and achieving ecological standards
- ✓ Rationally and effectively use subsoil and land resources
- ✓ Gradually implement system of ecological monitoring with data ware
- ✓ Effectively manage ecological risks basing on modern concepts
- ✓ Provide ecological education and general engagement into ecological activity of the company`s employees
- ✓ Demonstrate commitment of mangers of all levels to fulfillment of environmental policy, compliance with legislation and regulations and create conditions for implementation of environmental goals and
- ✓ Constantly improve system of ecological management to reduce the significance of ecological aspects

2 Tests aimed at reducing environmental pollution from the operation for PJSC "ArcelorMittal Kryvyi Rih"

Before using an eco-fixer[1]



After using an eco-fixer



Conclusions:

1 Eco-fixators PG 100 (DP), PG 200 (DP) have confirmed the effectiveness of dust suppression during testing

2 The declared warranty period (three months) of the eco-fixers PG 100 (DP), PG 200 (DP) has been passed, which is sufficient for the season of the greatest dust formation in the hot and dry months of the year

Before using reagent «PELENA»



After using reagent «PELENA»



Conclusions:

1 Experimental reagent «PELENA» for dust suppression of open pit roads in the conditions of "ArcelorMittal Kryvyi Rih" showed an effect in the context of less than 1 (one) day

2 Based on the studies carried out in the open pits of the PJSC "ArcelorMittal Kryvyi Rih", it is advisable to observe the watering schedule

[1]Photo from industrial tests of the «PELENA» technology to prevent dusting of the road surface when trucks move on the technological roads of open pit mines in the conditions of the MD of PJSC "ArcelorMittal Kryvyi Rih"

Citation by reference, partial or full reproduction:

Mekshun M. Environmental challenges for PJSC "ArcelorMittal Kryvyi Rih".
In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 157-160

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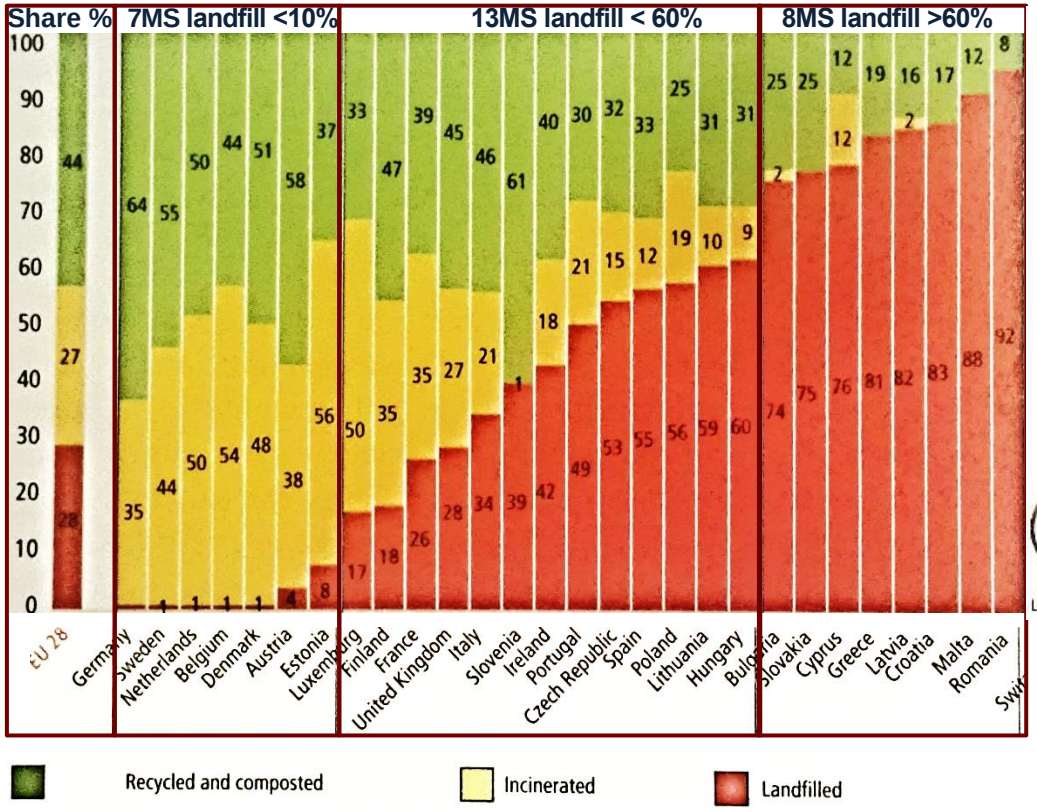
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Waste management situation in urban areas of Ukraine

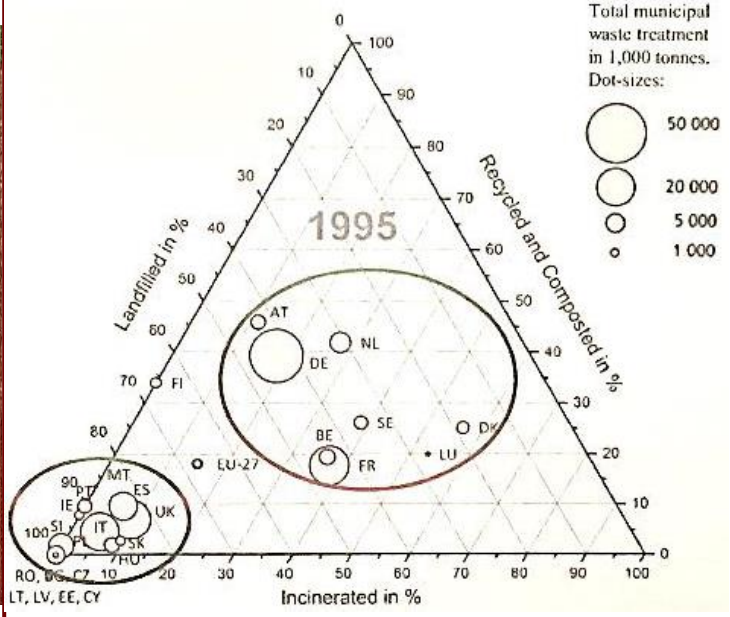
PhD st. Kyrylo Zvoryhin
National Technical University Dnipro Polytechnic, Ukraine

1 Waste situation in EU

Waste management in EU [38]



Evaluation of municipal waste management performance of single member states and EU27[1]



[1]Pomberger R. et al. (2017) [64]

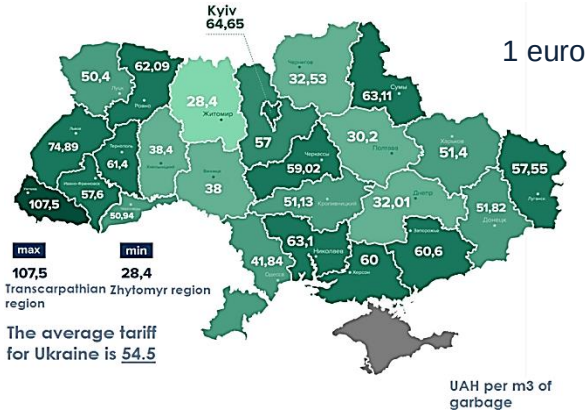
2 The National Waste Management Plan up to 2030

The Ukrainian Government approved the National Waste Management Plan until 2030. This is a detailed roadmap for the implementation of the National Waste Management Strategy aimed at building a waste management system in Ukraine based on EU standards and a closed-loop economy

Among the key lines are:

- ✓ a package of targets for each type of waste: from the adoption of the necessary legal framework to specific measures to collect, recycle and dispose
- ✓ development of regional waste management plans
- ✓ construction of non-hazardous waste landfills
- ✓ construction of regional complexes for the recycling of household wastes
- ✓ adoption of the bill on municipal waste
- ✓ development of new state building standards for landfills

Tariff for the export of waste in cities



1 euro = 33,23 UAH

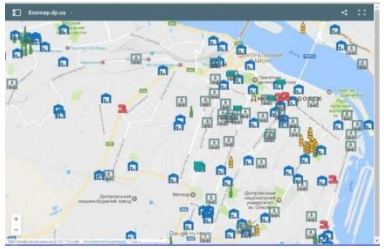
Secondary raw materials in Ukraine

In Ukraine, in addition to the state system for collecting secondary raw materials, there is also a system of private collection points for recyclables

Points in Kyiv



Points in Dnipro



(in the image only the right bank)

People receive money for the fact that they hand in these items recyclable materials:

Paper; Cans; PET; Solid wrap film; Colored wrap film; Stretch wrapping film; Plastic bags; Chemistry cans; Bottles for shampoo; Plastic buckets, basins; Scrap of fruit box; Scrap box for beer, vodka, milk

!!! As of today, more than 15%of the objects of burial waste is overloaded and not give sanitary standards. Opportunities the expansion of existing landfills is significant limited

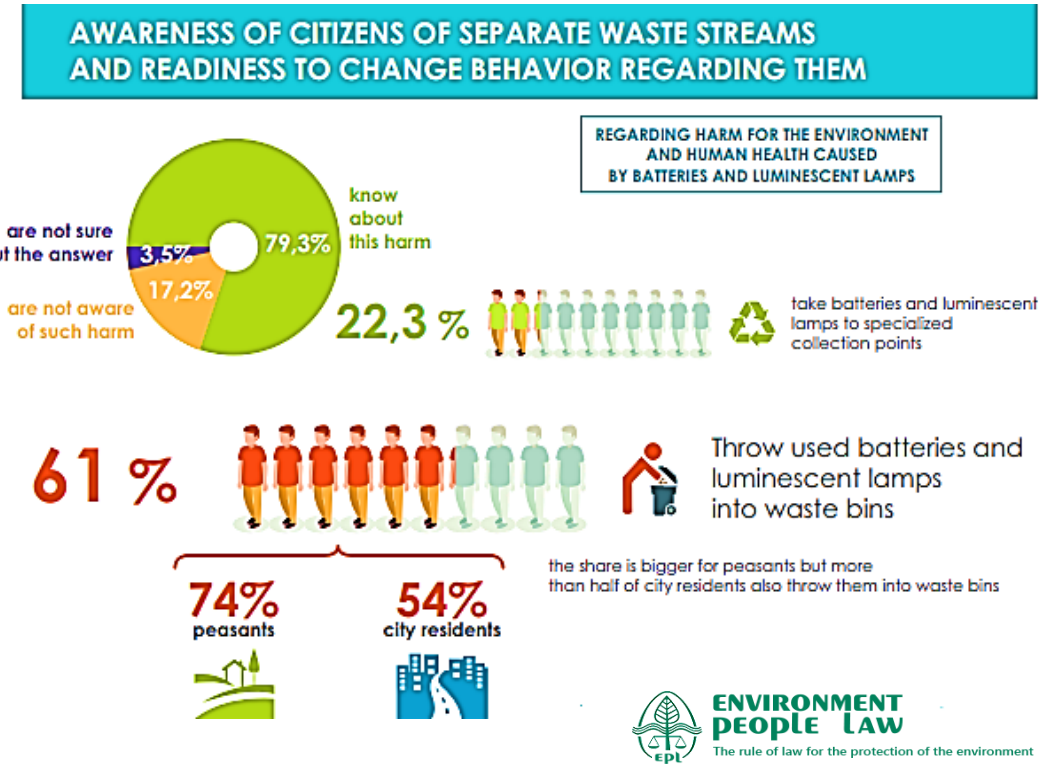
3 Morphological composition of waste in cities

Component of solid waste	Content,%		Weight of education, t / year				Percentage of recycling,%		Recycling mass, t / year		
			Residential building of Dnipro	Dnipro					Residential building of Dnipro	Dnipro	
				min		max				min	max
Food waste	39,36		117 718,77		131 845,02	144 794,08		0,00			
Paper and cardboard	5,74		17 176,45		19 237,63	21 127,04	50%	2,87	8 588,23	9 618,81	10 563,52
Polymers:							80%				
PET	2,14		6 399,67		7 167,63	7 871,59					
Transparency		50,27		3 216,87	3 602,90	3 956,76		0,86	2 573,50	2 882,32	3 165,40
Blue		18,49		1 183,22	1 325,21	1 455,36		0,32	946,58	1 060,17	1 164,29
Green, brown		25,50		1 631,81	1 827,62	2 007,12		0,44	1 305,45	1 462,10	1 605,70
White		2,42		154,79	173,36	190,39		0,04	123,83	138,69	152,31
From under the oil		3,33		212,97	238,53	261,96		0,06	170,38	190,83	209,57
Film, packs	3,66		10 940,35		12 253,19	13 456,63					
PET		20,42		2 234,32	2 502,44	2 748,22		0,60	1 787,46	2 001,95	2 198,57
The other one		79,58		8 706,02	9 750,75	10 708,41		2,33	6 964,82	7 800,60	8 566,73
Other polymers	3,17		9 487,70		10 626,22	11 669,87					
detergent packaging		12,78		1 212,12	1 357,57	1 490,90		0,32	969,69	1 086,06	1 192,72
scrap polymers		87,22		8 275,58	9 268,65	10 178,96		2,21	6 620,46	7 414,92	8 143,17
Glass	8,00		23 927,67		26 798,99	29 431,04	85%	6,80	20 338,52	22 779,14	25 016,38
Ferrous metals	1,01		3 012,24		3 373,71	3 705,05	100%	1,01	3 012,24	3 373,71	3 705,05
Non-ferrous metals	0,18		534,44		598,57	657,36	100%	0,18	534,44	598,57	657,36
Textile	4,03		12 041,08		13 486,01	14 810,53					
Wood	2,53		7 559,09		8 466,18	9 297,68	40%	1,01	3 023,63	3 386,47	3 719,07
Dangerous waste	0,07		215,57		241,44	265,16					
Bones, leather, rubber	2,21		6 612,34		7 405,82	8 133,18					
Packing is combined	2,44		7 301,94		8 178,17	8 981,39					
Street scum, stones	14,72		44 025,53		49 308,59	54 151,40					
Other	10,75		32 140,55		35 997,41	39 532,87					

Annual quantity (by mass) of formation of resource-valuable components of solid waste in Dnipro and foreclosure forecast for recycling

4 How ready are people ready in Ukraine?

- ✓ From what is known, the split collection in Myrgorod is quite successful. Also in Chop, Lviv, Kharkiv, Kyiv, Kropivnitsky, Uzhhorod, Mukachevo…
- ✓ According to the same report, in 2016, 575 settlements implemented a separate collection of garbage, worked 1 waste incinerator and 3 incinerators.





!!! The biggest problem is administrative in the first place, and the plus is still in many places, corruption component that inhibits this

The public project in Kyiv "Ukraine without Garbage" aims to improve the state of the environment by involving communities in the sorting of garbage. Volunteers have a mobile station for receiving secondary raw materials, conduct educational establishments, and carry out environmental audits

EPL is a public interest environmental law organization which since 1994 has been protecting environmental rights, supporting, restoring and improving the environment and providing legal help in protecting other human rights, especially those which overlap with environmental rights

Citation by reference, partial or full reproduction:

Zvoryhin K. Waste management situation in urban areas of Ukraine. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 161-166

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A survey of sustainability reporting initiatives

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1 Sustainability reporting concept

Sustainability reporting is the practice of measuring, also reporting for domestic and foreign stakeholders, where enterprise`s activities results are main subject in relation to the sustainable development goals [59]

Sustainability reporting is including both the economic, environmental and social aspects of an organization

A sustainability report can be considered as synonymous with other terms for non-financial reporting; triple bottom line reporting and corporate social responsibility (CSR) reporting

Sustainability reporting is the key platform for communicating sustainability performance and impacts [75]

- to compare and also assessment of sustainability development results in relation to the laws, regulations, standards and voluntary initiatives;
- impact demonstration of the organization on sustainability expectations and the impact of these expectations on the organization;
- comparing the activities results parts of the organization and others different organizations, as well as performance at different points in time.

Among the international standards for sustainable development reports, plays an important role the United Nations International Platforms – the United Nations Global Compact (GC) and the Global Reporting Initiative (GRI)

Reports of organizations for sustainable development are addressed to

- ✓ Partners and clients
- ✓ Employees
- ✓ Public and environmental organizations
- ✓ Investors
- ✓ Representatives of public and municipal authorities

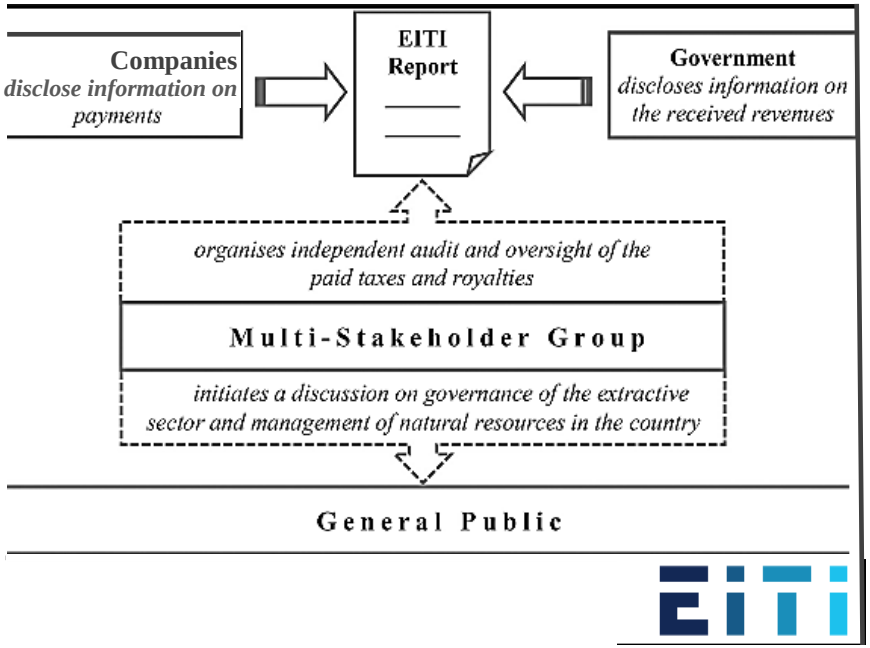
International initiatives and voluntary sustainability reporting initiatives are need to provide a common understanding of the indicators of such reports and to unify the procedures

The global initiatives examples

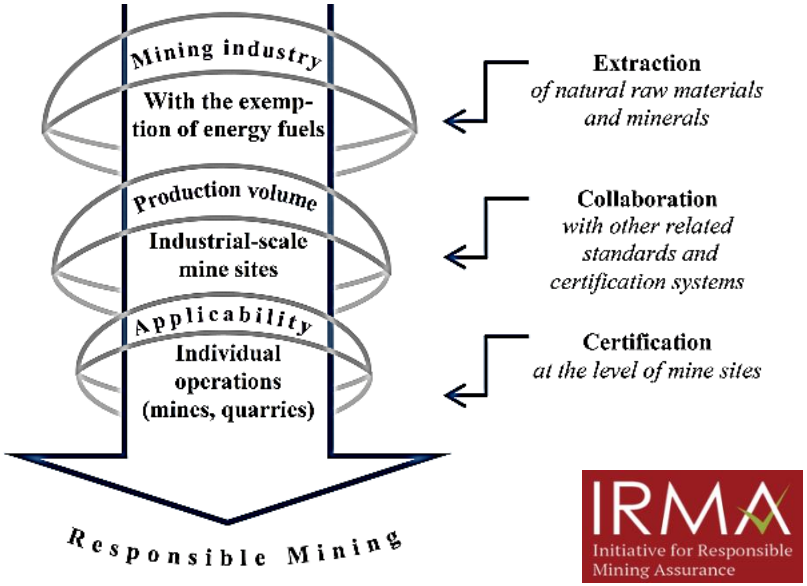
UN Global Compact	GC
Global Reporting Initiative	GRI
Climate Disclosure Standarts Board	CDSB
International Integrated Reporting Council	IIRC

2 The main standards for "informal" reporting on sustainable development in extractive industry

Extractive Industries Transparency Initiative (EITI) is the global standard to promote the open and accountable management of oil, gas and mineral resources [54]



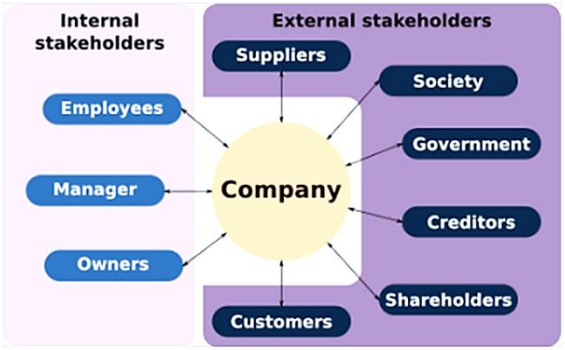
IRMA’s Standard for Responsible Mining defines good practices for what responsible mining should look like at the industrial-scale. It provides the list of expectations that independent auditors will use as the benchmark for responsible mines [54]



3 Transparency Initiatives: Global Reporting Initiative (GRI)

The Global Reporting Initiative (GRI) Standards represent global best practice for reporting publicly on a range of economic, environmental and social impacts. Sustainability reporting based on the Standards provides information about an organization’s positive or negative contributions to sustainable development [58]

- ✓ The modular, interrelated GRI Standards are designed primarily to be used as a set, to prepare a sustainability report focused on material topics
- ✓ The three universal Standards are used by every organization that prepares a sustainability report
- ✓ An organization also chooses from the topic-specific Standards to report on its material topics – economic, environmental or social



Examples of a company's internal and external stakeholders.

“GRI helps businesses and governments worldwide understand and communicate their impact on critical sustainability issues such as climate change, human rights, governance and social well-being. This enables real action to create social, environmental and economic benefits for everyone”[1]



[1]Global Reporting Initiative. URL: https://www.globalreporting.org/

4 Transparency Initiatives: United Nations Global Compact

The United Nations Global Compact (UNGC) is a voluntary initiative based on CEO commitments to implement universal sustainability principles and to take steps to support UN goals[2]

The UN Global Compact is a leadership platform for the development, implementation and disclosure of responsible corporate practices

UN Global Compact supports companies to:

- ✓ do business responsibly by aligning their strategies and operations with Ten Principles on human rights, labour, environment and anti-corruption; and
- ✓ take strategic actions to advance broader societal goals, such as the UN Sustainable Development Goals, with an emphasis on collaboration and innovation

Global Compact Network Ukraine

Human Rights

Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights

Principle 2: make sure that they are not complicit in human rights abuses

Labour

Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining

Principle 4: the elimination of all forms of forced and compulsory labour

Principle 5: the effective abolition of child labour

Principle 6: the elimination of discrimination in respect of employment and occupation

Environment

Principle 7: Businesses should support a precautionary approach to environmental challenges

Principle 8: undertake initiatives to promote greater environmental responsibility

Principle 9: encourage the development and diffusion of environmentally friendly technologies

Anti-Corruption

Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery

[2]UN Global Compact: Homepage. URL: https://www.unglobalcompact.org/

Citation by reference, partial or full reproduction:

Diachenko O. A survey of sustainability reporting initiatives. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 167-172

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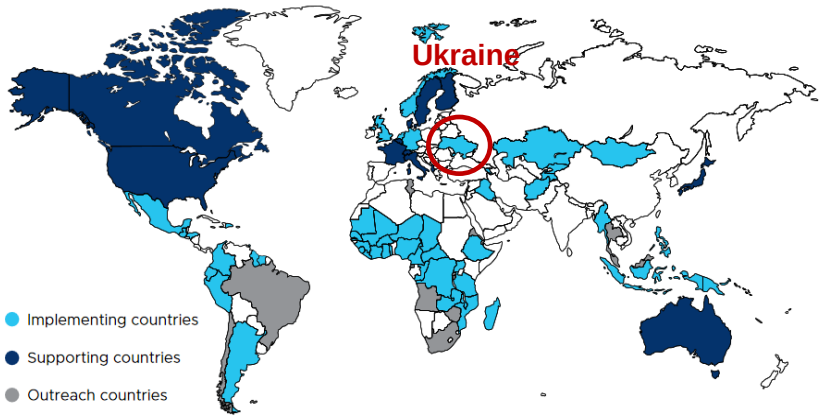
Disclosure as governance: Extractive Industries Transparency Initiative (EITI) in Ukraine

Prof. Vasily Shvets & BSc. Yuliia Honcharenko
National Technical University Dnipro Polytechnic, Ukraine

1 Extractive Industries Transparency Initiative - EITI

- ✓ The EITI is the global standard for the good governance of oil, gas and mineral resources [44]
- ✓ The EITI seeks to strengthen public and corporate governance, promote understanding of natural resource management, and provide the data to inform reforms for greater transparency and accountability in the extractives sector
- ✓ The EITI requires the disclosure of information along the extractive industry value chain from the point of extraction, to how revenues make their way through the government, and how they benefit the public

!!!! Stronger institutions and governance frameworks will help reduce the scope for corruption and mobilise domestic resources for sustainable development



Using of standards for sustainable management will be the beginning of fundamental reforms in the field of Extractive Industries

- ✓ EITI requires not only the disclosure of payments by companies, but also of revenues received by governments with an independent verification of all the data
- ✓ EITI applies to all companies operating in the jurisdiction of EITI member countries, regardless of their ownership
- ✓ EITI coordinates relations and activities at an international level
- ✓ (4) EITI does not restrict access to reports and other relevant information about the initiative and participating countries

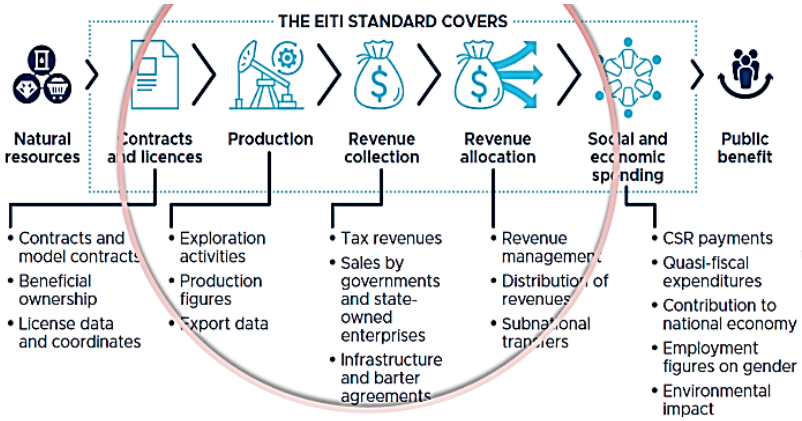
55 countries implement the EITI Standard [21]

Implementing country. To become an EITI implementing country, a country must complete five sign-up steps.
Supporting Countries are committed to help the EITI through financial, technical, and political support at the international level and in implementing the EITI Standard in resource-rich countries
Outreach countries recently committed to implement the EITI

2 The organisational structure of the EITI mechanisms

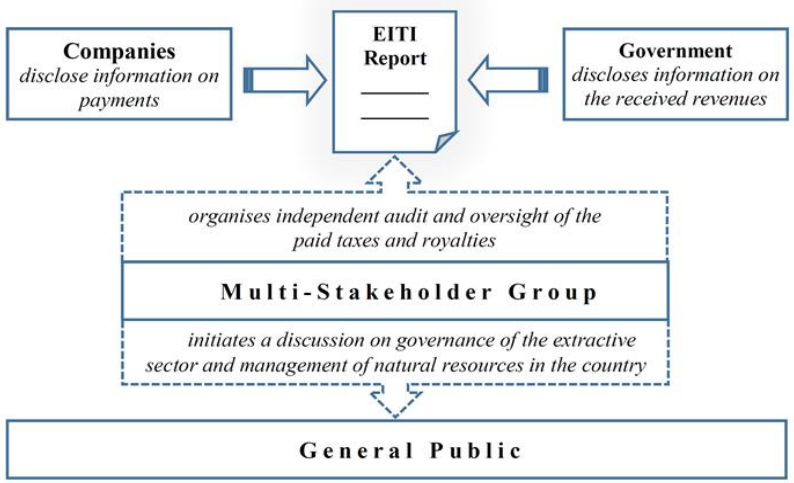
- ✓ The EITI Standard takes place at the level of national states
- ✓ In committing to EITI implementation, governments agree to disclose information along the extractives
- ✓ industry value chain, from how extraction rights are awarded to how revenues are managed and allocated by government

The eight categories of data that are revealed in the EITI report



!!!! 95% of EITI data is publicly available in open data format

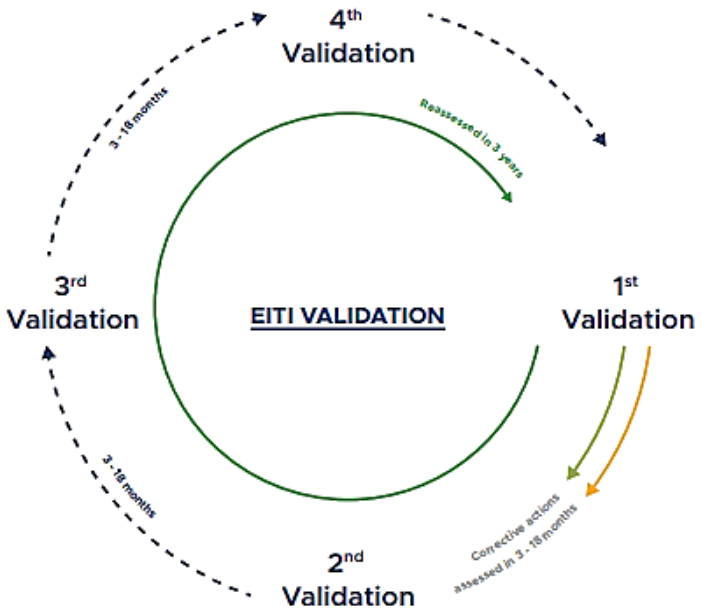
You can see that National multi-stakeholder groups are the key feature of this initiative. They consist of government, civil society, and company representatives, who manage the functioning of EITI mechanisms in a particular country [54]



Unlike some of the voluntary sustainability standards systems that allow for the national or regional adaptation of the global requirements and criteria, all EITI member countries are held to the same global standard

3 EITI Implementing country - Validation

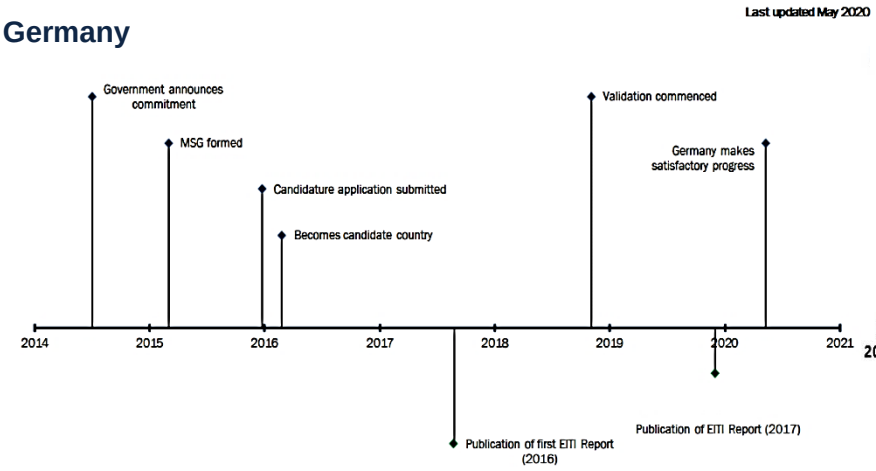
Validation is an essential element of the EITI process. Its purpose is to evaluate the progress of implementing countries in achieving the requirements of the EITI Standard [21]:



1. **Preparation for Validation:** The multi-stakeholder group (MSG) is encouraged to conduct a self-assessment of adherence to the EITI Standard. The national secretariat collates the documentation and other sources that demonstrate compliance. Stakeholders are invited to prepare any other documentation they consider relevant.
2. **Initial data collection and stakeholder consultation undertaken by the EITI International Secretariat:** The International Secretariat reviews the relevant documentation, visits the country being validated and consults stakeholders, including MSG. Based on the consultations, the International Secretariat prepares a report making an initial assessment of progress in implementing the EITI Standard, which is submitted to the Validator. The initial assessment does not include an overall assessment of compliance.
3. **Independent Validation:** The Board appoints an Independent Validator through a competitive tendering process. The Validator reports to the EITI Board via the Validation Committee. The Validator comments on the Secretariat's initial assessment and prepares a Draft Validation Report. The MSG comments on the Draft Validation Report. Considering these comments, the Validator compiles a Final Validation Report, which includes the Validator's assessment of compliance with each provision, but not an overall assessment of compliance. The Validator presents the findings to the Validation Committee.
4. **Board Review:** The Validation Committee reviews the Final Validation Report and makes a recommendation to the EITI Board on the country's compliance with the EITI Standard and, where applicable, any corrective actions required. The EITI Board makes the final decision if the EITI requirements are met and determines the country's overall compliance with The EITI Standard, which is expressed as a degree of progress and compliance.

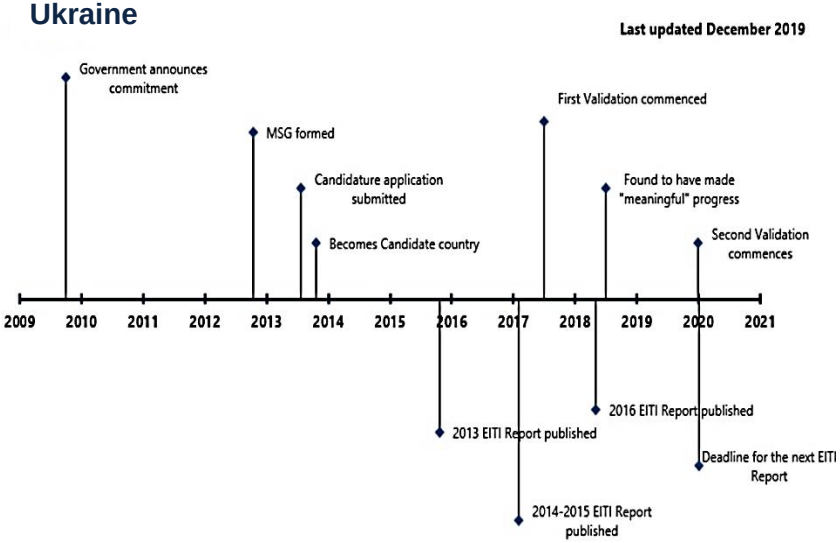
4 EITI in Germany & Ukraine

Germany



The extractive industries contribution to Germany's GDP is below 0.2% (2016 EITI Report, for 2015). Extraction holds regional importance because of employment in the open pit mines. Germany-wide, extractive companies in Germany generate sales of around €9.2 billion with 71,000 employees [21]

Ukraine



The extractive sector plays an important role in Ukraine’s economy, amounting to 5.9% of GDP. The industry contributed UAH 120 billion to the state budget, representing 41% of government's revenues from 100 biggest taxpayers in 2018. The major extractive companies operating in the country are UkrGasVydobuvannya PJSC (gas), Ukrnafta PJSC (oil) and DTEK PJSC (coal). The Ukraine began preparations for joining the EITI in 2009 and became a member in 2013

Citation by reference, partial or full reproduction:

Shvets V., Honcharenko Y. Disclosure as governance: Extractive Industries Transparency Initiative (EITI) in Ukraine. In: Sustainability in the industrial sector: Proceedings of the Study Seminar at NTU Dnipro Polytechnic - BTU Cottbus-Senftenberg, 24th Dec. 2020 - 18th Jan. 2021. Ed.: Shvets V., Paliekhova L. Dnipro-Cottbus: Accent, 2021. PP. 173-178

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Circular innovation in small business: German and Ukrainian experience

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National Technical University Dnipro Polytechnic, Ukraine

1 Local in Global - Prosperity with growth

Perspectives of the environmental limitations on economic growth can be divided into the three categories [30]:

1) infinite economic growth is possible driven by technological progress and human ingenuity
2) growth will continue but environmental limits will exert a ‘drag’
3) environmental limitations will eventually bring growth to a halt

- ✓ Sustainable development means the complex relationships between economic growth, environmental security and social prosperity
- ✓ Instead of trying to work out how to stop growth at least cost, the significant and important question is how to stimulate a structural shift and a radical change in it

The material economy is bounded by the ecosystem – the intellectual economy is not [63]

We need ‘green growth’, not ‘no growth’[1]

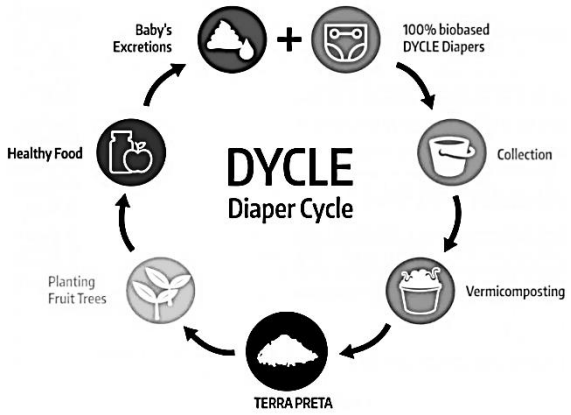
- to protect employment
- to promote and facilitate social investment
- to reduce inequality
- to support both ecological and financial stability

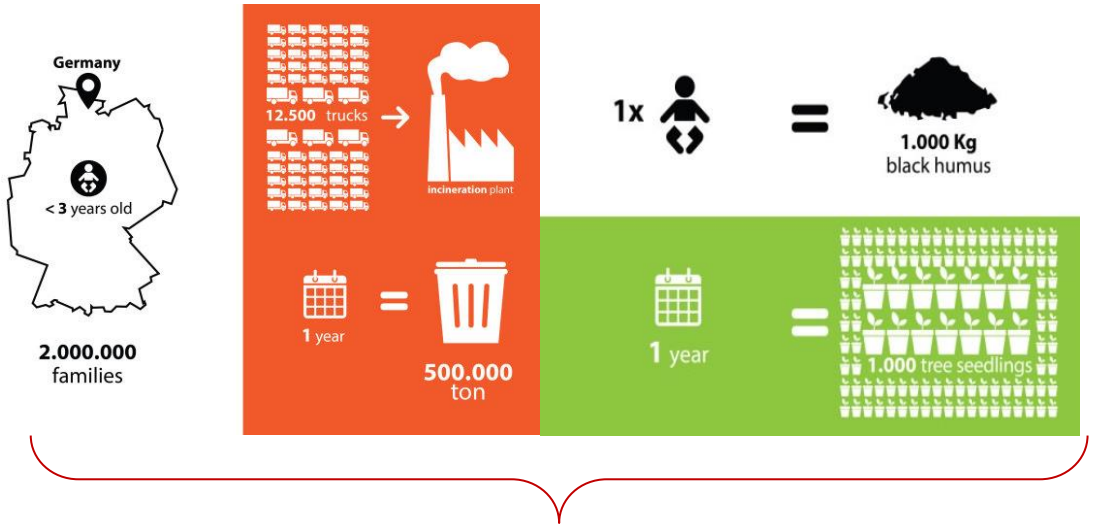


[1]European Forum for Studies of Policies for Research and Innovation EUSPRI Conference, URL: https://ip4sustainability.org/

2 Smart production and consumption: German experience

DYCLE is a fundamentally new way of how baby diapers are to be produced, used and recycled, or rather upcycled, when they are no longer a waste but a nutrient for plants, transformed into fertile soil[2]





Each child produces around 500kg of diaper waste in their first two and half years of life that translates into around 1400 litres of crude oil used for plastic components according to DYCLE’s estimations

Many people’s small change in everyday life can bring bigger changes towards sustainable consumption. We assess the costs of PV power generation at the country level based on the practical potential and the concept of LCOE [18]

[2]DYCLE - https://dycle.org/en

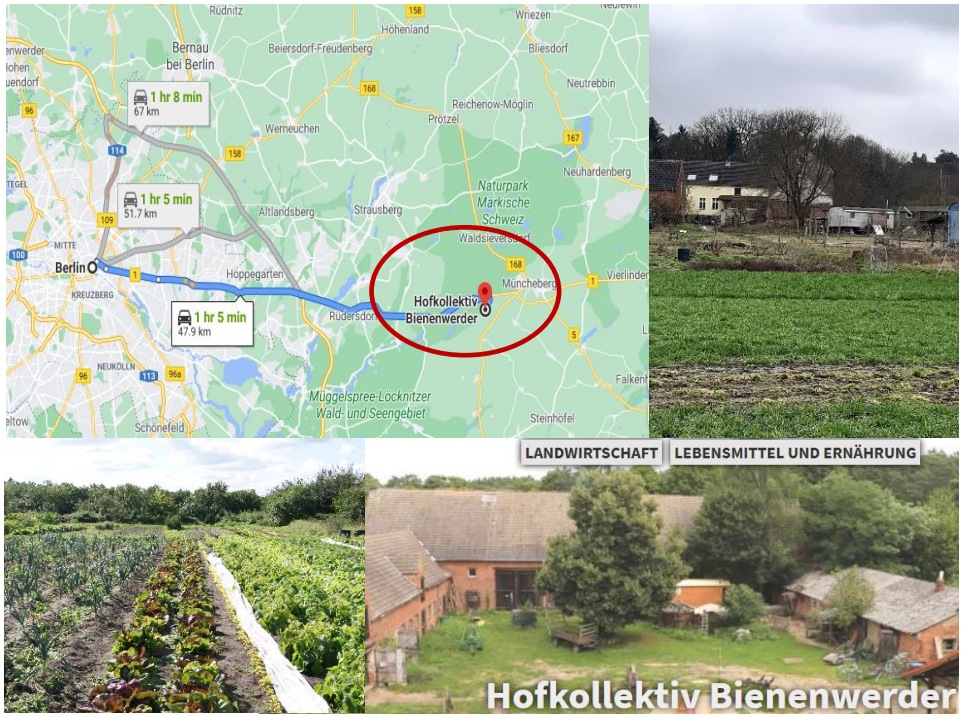
3 Organic farming: German experience

What is the future of food in cities?[3]

- ✓ Food comes from outside of cities for the overwhelming majority of people (only 1/5 of food is produced in cities globally)
- ✓ Circular or organic farming is a sustainable, resource-friendly and environment and animal-friendly way of farming
- ✓ With annual sales revenues of Euro 11.97 billion (2019) Germany has the largest organic food market in Europe

The farming collective Bienenwerder, in operation for over 10 years, has been growing organic vegetables, raising dairy goats, horses, cows, ducks, chickens and bees. 15 people live and manage the 50 hectares of land supplying vegetables to Kreuzberg in Berlin [23]

Sustainable farming: Hofkollektiv Bienenwerder



50-hectare area, started in 2004 by 4 people solidarity-based agriculture organic farming, i.e. soil-conserving & humus-increasing, no pesticides

[3] Food, Agriculture and Cities. The challenges offood and nutrition security,agriculture and ecosystem managementin an urbanizing world. URL: http://www.fao.org/3/au725e/au725e.pdf

4 Organic farming in Ukraine

- ✓ In 2007, at the initiative of public organizations of the organic movement, with the support of the Ministry of Agrarian Policy of Ukraine, the certification body, Organic Standard, was established to deal with the review and issuance of licenses to enterprises and farmers who want to produce and sell organic products[4]
- ✓ In October 2020, the Government has adopted the Procedure for Certification of Organic Production and/or Circulation of Organic Products (Resolution №1032), which has been developed taking into account the requirements of EU legislation [68]

- ➢ Sokolovo FOOD FOREST is a farm with 7 hectares located several kilometers from Sokolovo village (Novomoskovsk district, Dnipropetrovsk region) [71]

- ➢ Since 2016 Sokolovo FOOD FOREST has been growing vegetables, fruits, berries and herbs. All products are certified by Organic Standard

- ✓ In 2019 the total area of organic land amounted to 468 thousand hectares (1.1% of the total area of agricultural land in Ukraine), which is by 20% more than in 2018. At the same time, there were 617 operators of the organic market, 470 of them were agricultural producer

- ✓ In 2019 Ukraine ranked 1st in Europe and 2nd in the world (out of 123 countries) in terms of exports of organic products to the EU, rising two points compared to the previous year



The farm strictly adheres to natural farming technology. Annual scheduled and unscheduled inspections ensure quality and compliance with the highest standards

[4]In October 2020, Ukraine took another important step towards the shaping of appropriate legislation in the field of organic production. Thus, the Government has adopted the Procedure for Certification of Organic Production and/or Circulation of Organic Products (Resolution №1032), which has been developed taking into account the requirements of EU legislation. URL: https://www.kmu.gov.ua/en/ news/pidsumki-2020-vpershe-v-ukrayini-zaprovadzheno-vlasnu-sistemu-sertifikaciyi-organichnogo-virobnictva

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Winter School “Sustainability in the Industrial Sector”
Cottbus, Germany – Dnipro, Ukraine

Network effects of sustainability in high-tech markets

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1 Sustainable development of Industry 4.0

What is Industry 4.0?[1]

- ✓ Industry 4.0 is a term applied toa group ofrapid transformations in thedesign,manufacture, operation and service of manufacturing systems and products
- ✓ Industry 4.0 is 'the comprehensive transformation of the whole sphere of industrial production through the merging of digital technology andthe internet with conventional industry' (*according to German Chancellor Angela Merkel*)
- ✓ Everything in and around a manufacturing operation (suppliers, the plant, distributors,even the product itself) isdigitallyconnected, providing a highly integrated value chain
- ✓ Industry 4.0 concept may variously be labelled: Smart factories,the Industrial Internet of Things, Smartindustry, or Advanced manufacturing

Industry 4.0 depends ona number of new and innovative technological developments:

- → Information and communication technology (ICT)
- → Cyber-physical systems
- → Network communications
- → Simulation
- → Big data analysis and cloud computing
- → Robots, augmented reality and intelligent tools

- ✓ Industry 4.0 can reduce the environmental impact of a product, a process, or a service based on footprint data availability and traceable analysis
- ✓ Industry 4.0, could boost the productivity and value added of industries and stimulate economic growth

The experience in the EU

- → In **Italy**, the **Fabbrica del Futuro project (2011-13)** supported research initiatives in areas including customisation of products, reconfigurable factories, high performance and sustainability
- → The **UK** has initiated a number of policies to make manufacturing more responsive, more sustainable, more open to new markets and more dependent on skilled worker
- → In April 2015, **France** launched a plan for the Factory of the Future to create demonstration centres (vitrines technologiques) to show case new products and services.
- → Starting in 2010, **the German government** has contributed €200 million to the Industrie 4.0 initiative (one of ten projects within the German High Tech Strategy 2020 Action Plan), to encourage the development of 'smart factories'.

[1]Industry 4.0: Digitalisation for productivity and growth. Briefing - September 2015 EPRS.
URL: https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf

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Наукове видання

Сталість у промисловому секторі
Матеріали навчального семінару

За заг. ред. Швеця В., Палєхової Л.

Англійською мовою

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Національний технічний університет
ДНІПРОВСЬКА ПОЛІТЕХНІКА
1899

Dnipro University of Technology supports the Sustainable Development Goals!

In this compendium of training materials, the authors took into consideration new trends in understanding the aims and instruments of management for sustainable development in the industrial sector. A special attention in the studies is given to the problem of international voluntary sustainability standards under conditions of Ukrainian transitional economy. For researchers, university students and teaching staff, servants in bodies of public and municipal administration, managers of business structures.

Національний технічний університет "Дніпровська політехніка" підтримує Цілі сталого розвитку!

У збірнику навчальних матеріалів автори врахували нові тенденції у розумінні цілей та механізмів управління сталим розвитком у промисловості. Особлива увага в дослідженнях приділяється проблемі міжнародних добровільних стандартів сталості в умовах перехідної економіки України. Для дослідників, студентів університетів та викладачів, службовців в органах муніципального управління, менеджерів бізнес-структур.

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