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Development, maintenance and implementation of the United Nations

Framework Classification for Resources and the United Nations Resource Management System:

Development of the United Nations Resource Management System

United Nations Resource Management System Concept Note: Objectives, requirements, outline and way forward

Prepared by the Expert Group on Resource Management

Summary

This document discusses the objectives, requirements, outline and way forward for the development of the United Nations Resource Management System (UNRMS), which will be based on the United Nations Framework Classification for Resources (UNFC). UNRMS will be a comprehensive, sustainable resource management system that is expected to be future-facing and support stakeholders in various goals, including aiding the progress towards a circular economy. The key goal of UNRMS is to support the United Nations Decade of Action (2020–2030) for accelerating sustainable solutions for resource management. UNRMS will be a voluntary global standard for integrated resource management, within the framework of public, public-private and civil society partnerships, that is uniformly applicable to all resources. UNRMS will consider various resources not as isolated or independent sectors, but as part of the whole resource base of an area, region or country. This document advances the initial ideas presented in other documents such as “Transforming our world’s natural resources: A step change for the United Nations Framework Classification for Resources?” (ECE/ENERGY/GE.3/2018/7); “United Nations Resource Management System: Concept and design” (ECE/ENERGY/GE.3/2019/10) and “The United Nations Framework Classification for Resources Applied to Commercial Assessments – Update” (ECE/ENERGY/GE.3/2020/5).

I. Introduction

1. Governmental organizations and companies have been using the United Nations Framework Classification for Resources (UNFC) since 1997 to classify and report mineral resources. Petroleum, nuclear fuel, injection renewable and anthropogenic resources were subsequently included in UNFC. Specifications for the use of UNFC for groundwater are under development. Thus, over the years, UNFC has become a unified system for the classification of a broad range of resources.

2. Since 2015, with the adoption of the 2030 Agenda for Sustainable Development, which enumerates the 17 Sustainable Development Goals (SDGs), a new direction has been universally adopted for the management of all activities in the social and economic space. The SDGs call for the “integrated and indivisible” management and development of the planet’s resources for the benefit of the present, without compromising the ability of future generations to meet their own needs.

3. Societal development needs are primarily satisfied by the production and use of natural resources, which also constitutes the core of the natural capital of the planet. Essential ecosystem services to the society comprise, for example, access to food, raw materials, energy, carbon sequestration, purification of water and air, nutrient recycling and soil formation. The dependency of natural resources on development places the Expert Group on Resource Management of the United Nations Economic Commission for Europe (ECE) in a unique position to provide a unified and holistic framework for assuring that resources are produced and used in a manner that is consistent with the SDGs. The Expert Group recognized this strength during the discussions that started in 2012 on formulating social and environmental guidelines for UNFC applications.

4. However, it was soon recognized that UNFC, being a classification and reporting standard of product quantities, will not be a sufficient standard for the holistic management of resources for the attainment of the SDGs. Hence, based on the deliberations of the Expert Group since 2017, a decision was taken to develop the United Nations Resource Management System (UNRMS), which will be rooted in UNFC, but will extend to the integrated and holistic management and development of all resources including management information beyond just product quantities (see concept notes “Transforming our world’s natural resources: A step change for the United Nations Framework Classification for Resources?” (2018) (ECE/ENERGY/GE.3/2018/7), “United Nations Resource Management System: Concept and design” (2019) (ECE/ENERGY/GE.3/2019/10) and “The United Nations Framework Classification for Resources Applied to Commercial Assessments – Update” (2020) (ECE/ENERGY/GE.3/2020/5)).

5. This note builds on the previous concept notes and provides requirements and objectives for UNRMS, as well as a provisional outline and way forward for the system.

II. Requirements, Users and Objectives of UNRMS

6. UNRMS will be a comprehensive, sustainable resource management system that is expected to be future-facing and support stakeholders in attaining various goals, including aiding the progress towards a circular economy. UNRMS is largely intended to support the UN Decade of Action (2020–2030)¹ for accelerating sustainable solutions for resource management.

7. The process of sustainable resource management starts from an understanding of the world’s natural capital and natural resources, including the efforts required to refine and use them, and how this relates to societal needs. Natural capital is the world’s stocks of natural assets. It is a concept for a plurality of connected, heterogeneous stocks that perform various functions and services for human society. Natural capital includes a variety of components such as water, geology, biodiversity, soil, ozone layer and properties like ecological resilience, ecosystem health and integrity.

¹ UN Decade of Action <https://www.un.org/sustainabledevelopment/decade-of-action/>

8. Natural resources are parts of the natural capital that can be used in economic activities to produce goods and services. Material resources such as minerals, petroleum, nuclear fuels, injection projects², anthropogenic resources³, renewable energy resources such as geothermal, solar, wind, biofuels and water resources could be considered as natural resources. However, the natural resource base extends beyond what is referred to here and could include elements such as land, soil, crops, forests and timber.

9. Sustainable resource management is defined as the total of policies, strategies, regulations investments, operations and capabilities within the framework of public, public-private and civil society partnerships, and based on environmental-socio-economic viability and technical feasibility, which determine what, when and how resources are developed, produced, consumed, reused and recycled by the society.

10. However, sustainable resource management, as defined previously faces a myriad of challenges today. These challenges include economic aspects like such as market volatilities, long-term decline⁴ and fluctuation of commodity prices, persistent issues in maintaining demand and supply balance, eroding investor confidence, failure to address social and environmental impacts, geo-political issues and conflicts, and widespread social dissatisfaction. While recognizing that some of the challenges mentioned above are widespread in the general economy and industrial sectors, the resource management undertaken by governments, combined with the efforts of the industry as financed by the capital market is what can change the situation.

11. It is also recognized that material resource consumption is increasing at a steady rate of 2.5 to 3 per cent per annum. Current global use of material resources (biomass, metals, fossil fuels and non-metallic minerals) is about 90 billion tonnes per annum.⁵ At the rate of growth previously mentioned, production and use of resources will likely breach the carrying capacity of the planet very soon. Therefore, there is an urgent need to decouple economic growth, resource use and environmental impacts, recognizing the needs of a large and growing population coming out of poverty so that human well-being improves while environmental impacts remain manageable.

12. The social and environmental issues associated with resource projects include the impacts of climate change, water stress, desertification and biodiversity loss. About 50 per cent of carbon emissions and 90 per cent of biodiversity loss are caused by production and use of resources⁶. Population growth and accelerated rates of urbanization further exacerbate these impacts. Because of all these impacts, the resource industry faces huge uncertainties, which is reflected in investor and social dissatisfaction.

13. There needs to be a fundamental change in how resources are managed. The transformation should embrace the essential need to improve resource efficiency and reduce the impact on the environment, climate change and biodiversity.

14. Resource management decisions have historically been made on a project-by-project or sector-by-sector basis, and usually by a single government entity and companies involved in the respective sectors. This fragmented approach has come up significantly short, lacking a broad, “bird’s-eye” perspective and often with a limited diversity of knowledge and viewpoints used to support informed decision-making.

² For Injection Projects for the purpose of Geological Storage, the resource is the reservoir available for geological storage.

³ Anthropogenic resources are natural resources that are modified by humans. As with many resources that are modified by the biological systems, anthropogenic resources too are intimate part of the natural resource base.

⁴ UNCTAD (2017) Commodities and Development Report 2017 - Commodity Markets, Economic Growth and Development (UNCTAD/SUC/2017/01)
https://unctad.org/en/PublicationsLibrary/suc2017d1_en.pdf

⁵ International Resource Panel (2019) Global Resources Outlook 2019
<https://www.resourcepanel.org/reports/global-resources-outlook>

⁶ International Resource Panel (2019) Global Resources Outlook 2019
<https://www.resourcepanel.org/reports/global-resources-outlook>

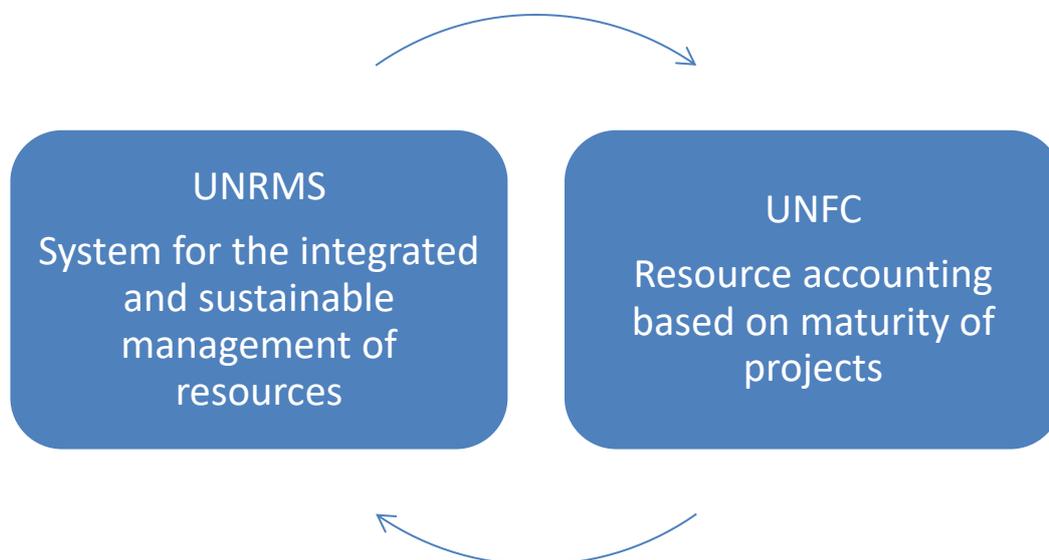
15. The limitations of siloed management practices are becoming more evident, leading to conflict, delays and severe losses to natural capital. The world needs to shift the way it plans and manages resources from siloed processes toward more integrated approaches.

16. Integrated management of resources is the key to overcoming the challenges faced by the world. UNRMS will, therefore, embrace the critical concept of integrated resource management that considers complexity, multiple scales, and competing interests, and brings these together to make informed decisions.

17. One of the benefits of UNRMS will be to support higher-order decision-making that encompasses land-use planning and strategic assessment of resources at national or regional scales hence enabling better and more efficient decision-making at project-specific level. In this manner, UNRMS will bring a holistic, programmatic, systems and life cycle view of resource management that will plug into the resource-specific and project-based classification of UNFC and implementation of the projects (Figure I). UNFC enables resource accounting (present situation or current snapshot), whereas UNRMS addresses its holistic management.

Figure I

Schematic connection of UNRMS to UNFC and project-level implementation



18. UNRMS will be a voluntary global standard for integrated resource management, within the framework of public, public-private and civil society partnerships, and will be uniformly applicable to all resources. States have sovereignty over all resources located on their territory, have independent legislation and full rights to manage their resources. UNRMS provides only the principles of good governance, which can be applied by States on the principle of voluntariness. UNRMS will consider various resources not as isolated or independent sectors, but only as of the part of the whole resource base of an area, region or country. However, various resource sectors will have many aspects that may have to be considered independently. Discussion will be required on what is the appropriate universal model, but one perspective is:

- (a) Governments set framework conditions allowing;
- (b) Resource industry to deploy their best capabilities in ways that;
- (c) The capital market can finance.

19. Primary users of UNRMS will be:

- (a) Governments/Regional bodies;
- (b) Resource industry;

- (c) Capital investment entities including stock exchanges and banking sectors;
 - (d) Academia, Non-profit organizations, Communities including Indigenous Communities and the Public to the extent they influence the first three.
20. A provisional view on the needs of these different stakeholders is given in Annex I.
21. In general, UNRMS will provide different stakeholders with:
- (a) Information for integrated resource management for realization of the 2030 Agenda for Sustainable Development;
 - (b) Standards and conditions for shaping dynamic and integrative public, public-private and civil society partnerships including:
 - (i) Appropriate regulations;
 - (ii) Standards and requirements for capital investment;
 - (iii) Standards and conditions for the industry to operate;
 - (c) Gaps and needs for further regulation and standards.
22. Sustainable resource management using UNRMS will have to optimize sustainable benefits to all stakeholders within the people-planet-prosperity⁷ triad and with cross-sectoral nexus linkages and minimize all potential adverse impacts. Sustainable resource management by governments and across governments thus needs to operate with long-term objectives.
23. It is expected that UNRMS will be widely used by resource management stakeholders across sectors and jurisdictions. It will serve as a voluntary global standard recognized by relevant stakeholders for transparent, consistent, and complete management of resources within the framework of public, public-private and civil society partnerships. It is most relevant to governments, regulators, investors and industries for integrated management of resources. The expected and actual performance of a wide variety of projects are reported and compared in terms of their environmental, social and economic impacts (triple bottom line reporting), thereby informing decision makers, and those impacted by resource projects, how these contribute to the SDGs and their situations.

III. Outline of UNRMS and way forward

24. UNRMS will have an integrated view of all resources and will comprise:
- (a) Fundamental principles;
 - (b) Language – concepts and terminology;
 - (c) Structure and specifications – a framework to describe, classify, compare and show what is needed to progress projects;
 - (d) Data, analyses and standards – required by stakeholders to assess and compare options, make choices and monitor performance;
 - (e) Guidelines – how to reach decisions leading to the desired developments.
25. Annex II provides a provisional list of fundamental principles.
26. The Expert Group on Resource Management intends to develop a system for resource management, which is useful for and applicable by all stakeholders. For this to be successful, a top-down developmental model would be premature and could be self-defeating. The system should be developed, to the extent possible, addressing the challenges and requirements of resource management at a user level. For this reason, UNRMS development should be ideally done with substantial stakeholder consultations, including pilot studies at

⁷ “This Agenda is a plan of action for people, planet and prosperity.” See Preamble Transforming our world: the 2030 Agenda for Sustainable Development <https://sustainabledevelopment.un.org/post2015/transformingourworld>

regional or national levels. The system needs to grow organically with a build-measure-learn model of iterative development.

27. The components of UNRMS and proposed activities needed to develop the system are shown in Figure II. As far as practical, UNRMS will be built on the United Nations Framework Classification for Resources (UNFC), but extensions, modifications and additional tools and guidelines will be required.

Figure II
Provisional outline of UNRMS and initial activities

Elements of UNRMS		Initial activities to Develop UNRMS				
Principles	Fundamental principles for sustainable resource management	Questionnaire to understand stakeholder needs and priorities, and to gather ideas for solutions	Follow-up discussions with stakeholders	Pilot studies to develop requirements and test solutions, in cooperation with interested stakeholders	Design preliminary solutions, building on existing principles, methods and tools where appropriate	Run early adoption cases to demonstrate value and identify shortcomings
Language	Concepts and terminology - Some already developed for UNFC, but additions will be required for UNRMS					
Structure and Specifications	Framework and specifications to describe, classify, compare and progress projects - Is UNFC structure sufficient? If not then either modify or develop separate structure into which UNFC categories can be mapped					
Data	Data, standards and guidelines for analysis – required by stakeholders to assess and compare options, make choices and monitor performance - different stakeholders will require different data e.g. government policy makers, investors, operators, communities					
Guidance	Guidance on how to influence and select outcomes to meet stakeholder needs and SDGs					

28. The Expert Group may wish to discuss the following initial aims:

(a) Develop a facility for linking energy management with management of other resources drawing, among other things on the UN System of National Accounts (SNA) and its System of Environmental-Economic Accounting (SEEA). This would provide data both to enable planning national energy provision and assessing the SDG impacts of existing and planned projects (or groups of projects);

(b) Strengthening analyses of the effects of policy and public framework reforms on industrial and market developments. This analysis would then provide the basis for guidance on national policy and public frameworks to achieve the desired outcomes;

(c) Develop standard processes and tools that facilitate resource management processes among member states and in public-private partnerships within member states. These standards and tools would secure development efficiency and support development of national inventories and enable them to be combined to give a holistic view.

IV. Conclusions

29. This concept note briefly explains the background for the development of UNRMS, its broad objectives, requirements and intended users. The need for integrated resource management, as called for by various international initiatives, including the 2030 Agenda, is briefly explained here. This note recognizes the fact that narrow sectoral and siloed approaches are not suited for integrated resource management.

30. The key components of UNRMS are outlined, and a provisional set of fundamental principles of resource management are enumerated. The following initial development activities have been identified:

- (a) Questionnaire to understand stakeholder needs and priorities, and to gather ideas for solutions;
- (b) Follow-up discussions with stakeholders;
- (c) Pilot studies to develop requirements and test solutions, in cooperation with interested stakeholders;
- (d) Design preliminary solutions, building on existing principles, methods and tools where appropriate;
- (e) Run early adoption cases to demonstrate value and identify shortcomings.

31. A set of aims for initial work is suggested to provide:

- (a) Data standards for planning national energy provision and assessing the SDG impacts of existing and planned projects (or groups of projects), based on UN SNA and SEEA systems;
- (b) The basis for guidance on national policy and public frameworks;
- (c) Efficient standards and tools to support the development of national inventories and enable them to be combined to give a holistic view.

Annex I

Primary users of UNRMS and requirements – provisional view

A. Governments/Regional bodies

- (a) Formulation of regional and national policies on energy and raw materials for sustainable development;
- (b) Assuring the security of supply and fulfilling demand, including assessment of the global stocks and flows and ensuring access to resources;
- (c) Achieving the SDGs, including climate objectives;
- (d) Planning, including the formulation of fiscal policies;
- (e) Framing the necessary laws and regulations;
- (f) Assessments of national risks and opportunities;
- (g) Developing international standards beyond the existing ones necessary for elevated challenges of the future;
- (h) Supporting global market development;
- (i) Increasing resource management efficiency and capturing the value of resources at the source of production;
- (j) Developing hard and soft infrastructures;
- (k) Managing social issues;
- (l) Managing land use;
- (m) Managing employment issues;
- (n) Managing nature protection issues;
- (o) Implementing health, safety and environmental protection measures;
- (p) Aiding partnership and conflict resolution;
- (q) Improving education and research;
- (r) Managing impact of climate change;
- (s) Managing the impact of natural disasters;
- (t) Developing disclosure requirements.

B. Industry

- (a) Strategic planning including managing resource portfolio, supply and product chains;
- (b) Ensuring alignment of stakeholder interests;
- (c) Supporting capital investment decision-making;
- (d) Strengthening social and environmental controls;
- (e) Building resilience;
- (f) Stress testing;
- (g) Operations management;
- (h) Serving financial obligations;

- (i) Developing and deploying capabilities;
- (j) Building partnerships;
- (k) Supporting research and development;
- (l) Assisting mergers and acquisitions;
- (m) Assessing business proposals including risks and opportunities;
- (n) Securing returns on investments;
- (o) Managing opportunities and risks at the portfolio level;
- (p) Managing projects and corporate risks and opportunities;
- (q) Managing disclosure requirements.

C. Capital investment entities including stock exchanges and banking sectors

- (a) Supporting investment analysis and decision-making;
- (b) Developing capital ownership policies and practices;
- (c) Developing disclosure requirements from invested entities;
- (d) Developing self-reporting requirements.

D. Academia, Non-profits, Indigenous Communities and the Public

- (a) Resource flow modelling at various space and time-scales;
- (b) Understanding the complexities of integrated resource management;
- (c) Assisting technology development with a systems perspective;
- (d) Cross-disciplinary capacity building;
- (e) Sustainable development support;
- (f) Managing the traditional rights of the indigenous people;
- (g) Aiding futuristic studies;
- (h) Enhancing stakeholder communications;
- (i) Building International Centres of Excellence on Sustainable Resource Management (ICE-SRM).

Annex II

Fundamental principles of sustainable resource management – provisional view

1. For sustainable resource management to be holistic, i.e., respond to the complexity of all resources, time and space scales, and life cycles, it should be principles-based, rather than rules-based. From the fundamental principles, specifications or rules could be established at a lower level. Such an approach is in alignment with the ISEAL Standard-setting Code⁸, which defines how a standard should be developed, structured and revised. It requires multi-stakeholder consultation and decision-making and ensures clear and auditable conditions in the standard itself. Moreover, the Equator Principles⁹, adopted by financial institutions, for determining, assessing and managing environmental and social risk in project finance, and industry standards such as the Global Tailings Standard¹⁰ and the draft Responsible Steel Standard¹¹ follow this approach. Also, the Certification of Raw Materials (CERA), for ensuring environmental, social and economic sustainability in production, processing, trading and manufacturing can be considered here. CERA is a neutral and independent certification standard for raw materials and international benchmark for the supply chain management¹².
2. The twelve fundamental principles of sustainable resource management are listed below. These principles are provisional at this stage and will be firmed up as UNRMS is developed through pilot studies.

A. Principle 1: Responsibility to the planet

The primary responsibility of sustainable resource management shall be the continued well-being of the earth, its inhabitants, and the environment.

3. **Explanation:** The principle of environmental limits to sustainable development is recognized in the Brundtland Commission Report (1987), and reflected in the Agenda 21 (1992), the Rio Declaration (1992), the Millennium Development Goals (2000) and the Sustainable Development Goals (2015). Brundtland Commission Report (1987) says, “the concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. At a minimum, sustainable development must not endanger the natural systems that support life on earth: the atmosphere, the waters, the soils, and the living beings.”
4. The Paris Agreement on Climate Action (2016), says “climate change is a common concern of humankind”. The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.
5. Primary responsibility to the continued well-being of the planet is also the core to the Equator Principles, a framework, adopted by financial institutions, for determining, assessing and managing environmental and social risks.

⁸ ISEAL is the global membership association for credible sustainability standards. See <https://www.isealliance.org/about-iseal/who-we-are>

⁹ See Equator Principles <https://equator-principles.com/>

¹⁰ See Global Tailings Standard: https://globaltailingsreview.org/wp-content/uploads/2019/11/EN-Global-Tailings-Standard_CONSULTATION-DRAFT.pdf

¹¹ See Responsible Steel Standard Version 1.0 https://www.responsiblesteel.org/wp-content/uploads/2019/11/ResponsibleSteel_Standard_v1-0.pdf

¹² See Certification of Raw Materials (CERA) standard: <https://www.cera-standard.org>

B. Principle 2: Integrated and indivisible management of resources

Sustainable resource management shall be undertaken within the framework of public, public-private and civil society partnerships, in an integrated and indivisible manner consistent with its social, environmental and economic viability.

6. **Explanation:** The Brundtland Commission Report (1987) highlighted the integrated nature of natural resources. The report says, “until recently, the planet was a large world in which human activities and their effects were neatly compartmentalized within nations, within sectors (energy, agriculture, trade), and within broad areas of concern (environment, economics, social). Yet in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. Yet most of the institutions facing those challenges tend to be independent, fragmented, working to relatively narrow mandates with closed decision processes. Those responsible for managing natural resources and protecting the environment are institutionally separated from those responsible for managing the economy. Many of the environment and development problems that confront us have their roots in this decoupling of responsibility. Sustainable development requires that such fragmentation be overcome. The real world of interlocked economic and ecological systems will not change; the policies and institutions concerned must. The ability to anticipate and prevent environmental damage will require that the ecological dimensions of policy be considered at the same time as the economic, trade, energy, agricultural, and other dimensions.

7. The language of the 2030 Agenda highlights the need for interconnected thinking between the natural and social sciences, and between the research community and decision-makers. The 2030 Agenda says that “the SDGs are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental”. The interlinked and integrated nature of the SDGs is of crucial importance in ensuring that the purpose of the 2030 Agenda is realized on time. The need for effective public, public-private and civil society partnerships are included in SDG 17.17. States have sovereignty over all resources located on their territory, have independent legislation and full rights to manage their resources. UNRMS provides only the principles of good governance, which are applied by States on the principle of voluntariness.

C. Principle 3: Systems view

Sustainable resource management shall integrate a systems view at all stages.

8. **Explanation:** Brundtland Commission Report (1987) says, “problems cannot be treated separately by fragmented institutions and policies. They are linked in a complex system of cause and effect”. Natural resources serve as direct or functional inputs for socio-economic systems of provision, either for the production of another input, for general production and consumption purposes, or the built environment. Systems thinking suggests that research and practitioners should start from a broader nexus understanding but may well focus on specific critical interlinkages across selected layers.

9. Focusing on resources, economic sectors, or different environmental or human impacts as individual silos will not encourage progress towards improved resource use or, more broadly, the achievement of international agreements and the SDGs. Addressing one area without consideration of the others may even have negative consequences. A systems approach is crucial to maximize benefits across sectors and mitigate trade-offs from natural resource use.

10. The systems approach to environmental policy development and implementation, can address multiple global goals and is no longer an option but is the only way forward for a societal transformation to achieve global sustainability.

D. Principle 4: Social license to operate

Sustainable resource management shall ensure obtaining and keeping the social license to operate.

11. **Explanation:** Respect human rights, and the interests, cultures, customs and values of employees and communities affected by resource production is an integral part of sustainable resource management and are stressed in the United Nations Guiding Principles on Business and Human Rights. Such an approach will need to pursue continual improvement in social performance and contribute to the social, economic and institutional development. Resource management needs to proactively engage key stakeholders on sustainable development challenges and opportunities openly and transparently, and effectively report and independently verify progress and performance.

12. Sustainable resource management can also have complex social impacts related to displacement, land rights, cultural heritage, indigenous peoples, gender equality, employment, public health, safety and security, sexual exploitation and abuse, and other issues. Rights-based social safeguards, inclusive dialogue and risk management principles should be applied to resource projects to ensure that it benefits the poor, leaves no one behind, and respects human rights. Chief among these is the need for inclusive, participatory, transparent, and ongoing stakeholder consultation to be built into infrastructure planning processes.

13. Sustainable resource management should be based on free, prior and informed consent, in line with the UN Declaration on the Rights of Indigenous Peoples. Several SDG targets reinforce the above views, such as SDG 1.4 and 16.7.

E. Principle 5: Full life cycle view

Resources shall be managed with a life cycle view encompassing resource discovery to production, final use, reuse, and recycling.

14. **Explanation:** Life cycle management of resource stems from the systems approach. Life cycle analysis is a technique to assess the environmental impacts associated with all the stages of the life of a product – from raw materials production through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling (cradle-to-grave).

F. Principle 6: Service orientation

Resources shall be produced primarily as a service to society.

15. **Explanation:** The decoupling of natural resource use and environmental impacts from economic activity and human well-being is an essential element in the transition to a sustainable future. Achieving decoupling is possible and can deliver substantial social and environmental benefits, including repair of past environmental damage, while also supporting economic growth and human well-being. Service orientation is a core principle that facilitates this decoupling.

16. Service orientation is a departure from the narrow and restricted commodity-view of resources hitherto followed by industry. There is a growing recognition that industry primarily exists to “serve” customers, employees, suppliers, and communities. It is only through that service perspective that industry can create long-term value for shareholders and society.

G. Principle 7: Comprehensive resource recovery

Sustainable resource management shall facilitate and support the knowledge-base and systems for comprehensive recovery of value at all stages of operation.

17. **Explanation:** Comprehensive resource recovery, the idea that the environment should be disturbed minimally by recovery of all possible values, with a full life cycle focus on a set of priorities shall be one of the core propositions of resource management. The principle can be expanded to all stages of the life cycle, where tangible and intangible values should be captured and utilized. Comprehensive resource recovery is also one of the core principles that can contribute to the decoupling of resource use and development.

H. Principle 8: Circularity

Sustainable resource management shall facilitate and support the knowledge-base and systems for responsible design, use, reuse and recycling.

18. **Explanation:** A circular economy is a systems approach to industrial processes and economic activity that enables the resource to maintain its highest value for as long as possible. Critical considerations in implementing circularity are reducing and rethinking resource use, the pursuit of longevity, renewability, reusability, reparability, replaceability and upgradability for resources and their value-added products.

19. Sustainable resource use requires sound management of renewable resources and should aim to recycle non-renewable resources, leading to the concept of a circular economy in which waste is minimized and the by-product of a process becomes a raw material for another process. In a circular economy, efficient use of resources across their entire life cycle is critical: from production to manufacturing, through consumption and use, to recycling and reuse. Circularity is also key to the decoupling of resource use and development.

I. Principle 9: Zero waste

Sustainable resource management shall facilitate and support the knowledge-base and systems that promote the target of eliminating all wastes as reasonably achievable.

20. **Explanation:** The Brundtland Commission Report (1987) says “all countries need to anticipate and prevent these pollution problems, by, for instance, enforcing emission standards that reflect likely long-term effects, promoting low-waste technologies, and anticipating the impact of new products, technologies, and wastes.” Sustainable resource management will need to focus on conservation of all resources employing responsible production, consumption, reuse, and recovery of all products, packaging, and materials, without burning them, and without discharges to land, water, or air that threaten the environment or human health. This requirement is also vital for the attainment of the SDGs.

J. Principle 10: Zero harm

Sustainable resource management shall facilitate and support the knowledge-base and systems that pursue continual improvement in health and safety performance with the ultimate goal of zero harm as reasonably achievable.

21. **Explanation:** Maximization of safety for workers and local populations is integral to International Labour Standards on Occupational Safety and Health¹³ and other international conventions. Resource management can be practical and implementable only if the basic concept of safety is given the highest priority in all stages of the life cycle.

K. Principle 11: Hybridization

Sustainable resource management shall facilitate and support the knowledge-base and systems that promote the uptake of hybrid technologies and diversification in production and use.

¹³ <https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang--en/index.htm>

22. **Explanation:** The coming together of diverse streams of science, technology and industry is becoming a reality. Getting out of a state of lock-in is to embrace hybrid technologies, diversifications and smart approaches. This principle is acknowledged in the 2030 Agenda, in its call to “achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value-added and labour-intensive sectors.”

L. Principle 12: Continuous strengthening of core competencies and capabilities

Sustainable resource management shall ensure continuous strengthening of core competencies and capabilities that are required for cross-disciplinary research, development, demonstration, deployment and operations.

23. **Explanation:** Integrated and indivisible resource management requires a cross-disciplinary approach to problem-solving and working in diverse teams. Such an approach goes beyond what is available in traditional education and requires continuous improvement of competencies and capabilities.
