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FOREWORD

The world is rapidly transitioning to a low-carbon society to address the urgent requirement to respond to climate change. Recently, we have seen severe floods, droughts, and heat waves in many countries around the globe. The changing climate is affecting the spread of infectious diseases, putting populations at higher risk of emerging diseases and epidemics.

Energy, transport, and digital transitions are required to mitigate the impacts of global warming. Climate change also puts enormous pressure on the availability of fresh water and food production. Massive quantities of critical raw materials will be required to deploy the low-carbon technologies. Mitigation and adaptation to climate change can be realized only through a total change in how we manage our natural resource endowments.

It has become apparent that the current siloed and linear use of the natural resources model will need to be revised to face the extraordinary challenges of the future. A new paradigm of integrated and sustainable management of natural resources that promotes resource efficiency and accelerates progress towards a more circular economy is now becoming more urgent.

The United Nations Economic Commission for Europe (ECE) has been acting on these challenges since the 2030 Agenda on Sustainable Development was launched in 2015. The United Nations Framework Classification for Resources (UNFC) has been developed into a unified system to classify and report resources based on social, environmental and economic viability, technical feasibility and confidence in the resource estimates. It is heartening to see stakeholders, including governments, industry, the financial community, academia and civil society, are widely adopting UNFC today.

In 2017, ECE member States decided to extend UNFC beyond a system of classification to a dynamic resource management system that can help countries, organizations, and companies address sustainability challenges. The Expert Group on Resource Management (EGRM) was tasked to develop the United Nations Resource Management System (UNRMS), a voluntary global standard for integrated and sustainable resource management within the framework of public, public-private and civil society partnerships.

Resource production, transformation, use and reuse can ensure beneficial social and environmental outcomes if adequately managed. Broadening the application of UNFC to a full-fledged management system – UNRMS – will offer a dynamic tool kit to align investment frameworks with sustainable development. Through the application of UNRMS, users can manage natural resources in a new way that will transform the activities into a regenerative and responsible model and assist in achieving quality of life aspirations.

This publication provides the Principles and Requirements for UNRMS, offering a transition pathway on how we use and reuse our natural resources to benefit the present and future generations. Fundamental principles and measurable requirements of sustainable resource management are at the core of UNRMS. Over time, the UNRMS tool kit will be further expanded. Several specific tools will be progressively added to address the myriad of issues in sustainable resource management, such as modernizing regulations, effective environmental management, social engagement, value addition, innovation, circularity and capacity-building. These tools will provide standardized methodologies and approaches to achieve the sustainability objectives we all aim to.

It is my pleasure to bring UNRMS: Principles and Requirements to your attention. I hope it will be well adopted by all stakeholders committed to the new paradigm of integrated and sustainable resource management for the benefit of all.

Olga ALGAYEROVA
United Nations Under-Secretary-General
Executive Secretary
United Nations Economic Commission for Europe

ACKNOWLEDGEMENTS

The United Nations Resource Management System (UNRMS): Principles and Requirements has been developed through the cooperation and collaboration of United Nations Economic Commission for Europe (ECE) member States and non-ECE member countries, other United Nations agencies and international organizations, intergovernmental bodies, professional associations and societies, the private sector, civil society and academia. The development of this document has been led by the UNRMS Sub-group of the ECE Expert Group on Resource Management (EGRM).

The members of EGRM and, in particular, its Bureau, UNRMS Sub-group, Technical Advisory Group and other Working Groups are acknowledged for their contributions to the development of UNRMS. Experts and organizations who provided valuable comments during public consultations are also acknowledged.

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I. INTRODUCTION

This document details the principles and requirements for the United Nations Resource Management System (UNRMS), based on the United Nations Framework Classification for Resources (UNFC). UNRMS is a comprehensive, sustainable resource management system that supports the attainment of the 2030 Agenda for Sustainable Development. While resources are required to support sustainable development, resources need to be produced, transformed and used sustainably.

UNRMS is a voluntary global standard for integrated resource management within the framework of public, public-private and civil society partnerships. It is uniformly applicable to all resources.

UNRMS is based on the concepts presented in the following documents:

- "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)
- "The United Nations Framework Classification for Resources Applied to Commercial Assessments – Update" (ECE/ENERGY/GE.3/2020/5), and
- "United Nations Resource Management System Concept Note: Objectives, requirements, outline and way forward" (ECE/ENERGY/GE.3/2020/4).

A synthesis of UNRMS concepts is provided in the United Nations Economic Commission for Europe (ECE) document (2020) United Nations Resource Management System: An overview of concepts, objectives and requirements.[1]

Following the request of the Committee on Sustainable Energy, the Expert Group on Resource Management, at its twelfth annual session, has requested the UNRMS Subgroup to accelerate the development of UNRMS as a system in line with the proposals outlined in the document "Draft UNRMS: Provisional structure and guidelines" (ECE/ENERGY/GE.3/2021/10).

This document provides the purpose, user and intended uses, and desired outcomes of UNRMS. The document also provides the basic definitions. The structure of UNRMS is provided as (i) the fundamental principles of sustainable resource management; (ii) the requirements; and (iii) a description of UNRMS tool kit concepts, which will have to be expanded in the further development of UNRMS. Annex I provide a list of details to be considered while analyzing or reporting on the specific requirements. Annex II provides brief summaries of the UNRMS tool kit concepts.

A. Purpose of UNRMS

The purpose of UNRMS is to ensure integrated and sustainable management of natural resources for the benefit of present and future generations. The 2030 Agenda for Sustainable Development has inaugurated a new era of global development marked by an imperative to integrate social, environmental and economic objectives. The multifaceted requirements of sustainable development depend on optimal and responsible production and use of natural resources. However, the sustainable use of resources faces a myriad of challenges today. These challenges include economic aspects like market volatility, the need to pursue responsible investments, avoid windfalls, and guarantee that no one is left behind. Social impacts need to be appropriately evaluated and explained to the satisfaction of society in line with all targets determined by the commitments from the UN Climate Change Conferences.

[1] See: ECE ENERGY SERIES No. 68 United Nations Resource Management System: An overview of concepts, objectives and requirements https://unece.org/sustainable-energy/publications/united-nations-resource-management-system-overview-concepts

This must be done in an environment of geopolitical conflicts and many uncertainties. While recognizing that some of the challenges mentioned above are widespread in the general economy and industrial sectors, the governments guide sustainable resource management, together with the industry's efforts and responsibility from the financial sector. Proper management of resource production, transformation, use and reuse will ensure beneficial social and environmental outcomes and help to induce equitable distribution, reduce poverty, and eliminate conflicts.

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 the companies involved in the respective sectors such as minerals, petroleum, renewable energy, nuclear fuel resources, anthropogenic resources, groundwater, and resources that are stored geologically, etc. This fragmented approach has come up significantly short, lacking a broad "bird's-eye" view perspective and often with a limited diversity of knowledge and viewpoints to support informed decision-making. The limitations of siloed management practices are becoming more evident. They lack integrated thinking, leading to sub-optimal solutions and the risk of severe losses of natural capital. The world needs to shift how it plans and manages resources from siloed processes toward more integrated approaches.

UNRMS embraces the critical concept of integrated resource management that considers complexity, multiple scales, and competing interests and brings these together to make informed decisions. Sustainable resource management starts with understanding the world's natural capital and natural resources, including the efforts required to refine and use them and how these resources relate to present and future societal needs. Natural capital is the world's stock of natural assets. It includes various components such as water, geology, minerals, biodiversity, soil, and the ozone layer. Natural capital has properties like ecological resilience, ecosystem health and integrity.[2]

Natural resources are parts of the natural capital used to produce goods and services in economic activities. Resources such as minerals, petroleum, nuclear fuels, injection projects,[3] anthropogenic resources,[4] and renewable energy resources such as geothermal, solar, wind, biofuels, and water could be considered natural resources. While utilizing natural resources for society's benefit, the net natural capital could be enhanced rather than depleted.[5]

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, fairly and transparently and with the protection of the health and safety of the local communities.

Sustainable resource management using UNRMS is intended for optimizing sustainable benefits to stakeholders within the people-planet-prosperity[6] triad. The approach emphasizes cross-sectoral nexus linkages and minimization of potential adverse impacts.

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[2] UNECE (2021) Natural Resource Nexuses in the ECE region https://unece.org/sites/default/files/2021-04/2016242_E_web.pdf

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

[4] 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.

[5] Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. (London: HM Treasury) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962785/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf

[6] "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

UNRMS is a/an:

(a) Global voluntary system for resource management to be used by governments, industry, investors, and civil society and contribute to sustainable development implementation;

(b) Innovative integrated resource management framework for natural resources to support the development of policies and regulations in the sustainable management and advancement of the Sustainable Development Goals (SDGs);

(c) Based on a comprehensive information framework and methodology to support resource management;

(d) Cohesive system to manage the life cycle of resources, including production, storage, transport, and consumption (use and reuse);

(e) Sustainability framework to aid the financing of resource sectors;

(f) System for local and indigenous communities for evaluating and assessing projects against stated environmental-social-economic objectives;

(g) Scheme for long-term considerations of commercial and policy aspects of projects;

(h) Design of conditions for industry to harness the integrative dynamic capabilities;

(i) Support kit for projects to help align with applicable regulations;

(j) Instrument to support sustainability and financial reporting.

B. Users of UNRMS and intended uses

The primary users of UNRMS will be governments/regional bodies, industry, capital investment entities and civil society, including academia, non-profits, indigenous communities and the public. Each stakeholder group will use UNRMS for specific purposes, as shown in Figure 1. and Table 1. UNRMS is a principles-based system; therefore, the applications listed in Table 1 may be achieved by ensuring the requirements listed in Section III B. Some of the requirements may be satisfied through the standards and guidelines already available elsewhere and referenced in detailed UNRMS guidelines to be developed in the future. UNRMS documentation will be developed for requirements that do not have proper pre-existing guidance.

Figure 1.
Primary users of UNRMS

Table 1.
Primary users of UNRMS and its intended applications

A.	**Governments/Regional bodies**
(a)	Achieving climate objectives
(b)	Formulation of regional and national policies on energy and raw materials for sustainable development
(c)	Assuring the security of supply and fulfilling demand, including assessment of the global stocks and flows and ensuring access to resources
(d)	Planning, including the formulation of fiscal policies
(e)	Framing the necessary laws and regulations
(f)	Assessments of global and national risks and opportunities
(g)	Maintain national data inventories
(h)	Revenue management
(i)	Developing international standards beyond the existing ones necessary for elevated challenges of the future
(j)	Supporting global market development
(k)	Increasing resource management efficiency and capturing the value of resources at the source of production
(l)	Developing hard and soft infrastructures
(m)	Managing social issues
(n)	Managing land use
(o)	Managing employment issues
(p)	Managing nature protection issues
(q)	Implementing health, safety and environmental protection measures
(r)	Aiding partnership and conflict resolution
(s)	Improving education and research
(t)	Mitigating and managing the impact of climate change
(u)	Managing the impact of natural disasters
(v)	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.	**Investment**
(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)	Education and training
(g)	Ensuring gender equality and diversity
(h)	Managing the traditional rights of the indigenous people
(i)	Aiding futuristic studies
(j)	Enhancing stakeholder communications
(k)	Establishing International Centres of Excellence on Sustainable Resource Management (ICE-SRM)

C. Desired outcomes

Desired outcomes are based on applications listed in Table 1. They are expected to satisfy the UNRMS requirements listed in Section III. B. UNRMS will provide references to guidance that is already available to meet the requirements or develop new documentation where a gap exists. The preliminary list of desired outcomes is as follows:

(a) Resource security, i.e., assuring resources for sustainable development;

(b) Removing negative externalities of resource recovery and use, such as pollution, wastes, tailings etc.;

(c) Addressing the moral hazard, i.e., preventing rewarding actions that aggravate the negative externalities and ensuring there are no undue profits, such as windfall gains;

(d) Securing affordable, just and sustainable services;

(e) Equitable distribution of benefits to all stakeholders and alignment of incentives that promote sustainable development.

Users are encouraged to use UNRMS for analyzing, reporting and planning resources management by treating the fundamental principles as a high-level checklist and the UNRMS requirement list as a detailed checklist. The UNRMS Requirement Template (Annex II) provides a detailed breakdown of elements to be considered under each item.

II. DEFINITIONS

The language, concepts, and terminology required to define UNRMS are briefly provided in this section. This list is only a starting point; more terms will be added in future document revisions. The definitions provided below are preliminary and may be modified to meet stakeholder needs. The definitions provided here also need to be aligned with the UNFC Glossary of Common Terms[7] issued in February 2022 and to similar uses in international initiatives:

- Resource: The cumulative quantity of products that are generated and/or consumed by a project from a defined date forward and evaluated at the reference point(s) of the project. A resource has an environmental-social-economic benefit and can be renewable (e.g. solar, wind, groundwater) or non-renewable. Resources can be for primary use (e.g., minerals, hydrocarbons, renewable energy, groundwater, pore space for CO2 storage) and can be derived from or after primary use as secondary resources (e.g. anthropogenic resources, mining residues and tailings, processing or refining residues, construction wastes).
- Management: The activity of controlling resources or of using or dealing with resources in a way that is efficient in supporting the needs of present and future generations.
- System: A set of definitions, principles, procedures, organized schemes or methods according to which resource management delivers sustainable environmental-social-economic benefits.

III. STRUCTURE

The structure of UNRMS will include the fundamental principles and requirements of resource management for sustainable development. The system will also have tools to assist in analysis and decision-making.

A. Fundamental principles of sustainable resource management

For sustainable resource management to be holistic, i.e., respond to the complexity of many variables, time and space scales, and life cycles, it should be principles-based. Principles provide general guidance on the direction sustainable resource management should proceed. From the fundamental principles, requirements are established at a lower level.

The fundamental principles of sustainable resource management are as follows:

(1) State rights and responsibilities in the management of resources;

[7] UNFC - Glossary of Common Terms https://unece.org/sed/documents/2022/02/session-documents/unfc-glossary-common-terms

(2) Responsibility to the planet;

(3) Integrated management of resources;

(4) Social engagement;

(5) Service orientation for the use and reuse of resources;

(6) Comprehensive resource recovery;

(7) Value addition;

(8) Circularity;

(9) Health and safety;

(10) Innovation;

(11) Transparency;

(12) Continuous strengthening of core competencies and capabilities.

1. Principle 1: State rights and responsibilities in the management of resources

States (governments) shall have rights and legal and regulatory responsibilities for the resources located on their territory.

Explanation: The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At the heart of the 2030 Agenda are the 17 SDGs, an urgent call for action by all countries to manage resources sustainably. A state has sovereignty over all resources located in its territory. It has independent legislation and full rights to manage and use resources sustainably. The principles of good governance provided in UNRMS should be applied by states on the principle of voluntariness.

States (governments)[8] have a dominant role in producing and consuming resources. States usually take a long-term view in weighing the costs and benefits of the various measures. They establish resource policies through different instruments, statutes and laws and reinforce resource management agencies' roles and capacities, such as ministries, regulatory entities, geological surveys and universities.

2. Principle 2: 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.

Explanation: The principle of environmental limits to sustainable development is recognized in the Brundtland Report (1987) and reflected in Agenda 21 (1992), the Rio Declaration (1992), the Millennium Development Goals (2000) and the Sustainable Development Goals (2015). The Brundtland Report (1987)[9] says that "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."

Sustainable development can be defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development also means considering the balance of costs and benefits to society and the

[8] States have different legal structures, and therefore the term ‘state’ is used in a broad sense and is accordingly interchangeable here with the term ‘government’.

[9] In 1987, the World Commission on Environment and Development (WCED) published a report entitled “Our common future”. The document came to be known as the “Brundtland Report” after the Commission's Chairwoman, Gro Harlem Brundtland. It developed guiding principles for sustainable development as it is generally understood today.

planet. Resource production and consumption could have adverse impacts. Therefore, a sustainable balance between the advantages and disadvantages must be found.

The Paris Agreement (2016) says that "climate change is a common concern of humankind". Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise below 2 degrees Celsius this century and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Primary responsibility for the continued well-being of the planet is also the core of the Equator Principles, a framework adopted by financial institutions to assess and manage environmental and social risks.

3. Principle 3: Integrated 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 and systems and a full life cycle view.

Explanation: The Brundtland Report (1987) highlighted the need for an integrated approach to natural resources management. 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 the future as well as present needs. […] Yet, most of the institutions facing those challenges tend to be independent, fragmented, and 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 environmental and development problems confronting us have their roots in this decoupling of responsibility. Sustainable development requires that such fragmentation be overcome.

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 crucial in ensuring that the purpose of the 2030 Agenda is realized on time. The need for effective public, public-private and civil society partnerships is included in SDG 17.

The Brundtland Report (1987) says that "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, for the production of another input, for general production and consumption purposes, or for the built environment. Systems thinking suggests that researchers and practitioners should start from a broader nexus understanding but may well focus on specific critical interlinkages across selected layers.

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.

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.

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

4. Principle 4: Social engagement

Sustainable resource management shall ensure an adequate level of social engagement.

Explanation: Social engagement is essential between all stakeholders involved in the sustainable development of natural resources in service to all citizens of this generation as well as future generations. The stakeholders, including Governments, Industry, Customers, Employees, Suppliers, Investors, and Civil Society, need to build trust and work together to build responsible practices in human rights, labour, the environment, and corruption. Respect for 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. It is stressed in the United Nations Guiding Principles on Business and Human Rights. Such an approach must improve social performance and contribute to economic and institutional development. Resource management needs to engage key stakeholders on sustainable development challenges proactively. It should also consider opportunities and transparently independently report and verify progress and performance.

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 they benefit the poor, leave no one behind, and respect human rights. Among these is the need for inclusive, participatory, transparent, and ongoing stakeholder consultation built into infrastructure planning processes.

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

5. Principle 5: Service orientation for the use and reuse of resources

Resources shall be produced primarily as a service to society.

Explanation: The decoupling quantities of natural resource use and its environmental impacts on economic activity and human well-being is essential to transition to a sustainable future. Decoupling can deliver substantial social and environmental benefits, including repairing past environmental damage while supporting economic growth and human well-being. Service orientation is a core principle that facilitates this decoupling.

Service orientation needs to be applied to the use and reuse of resources. The industry can create long-term value for shareholders and society through that service perspective.

6. Principle 6: Comprehensive resource recovery

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

Explanation: Comprehensive resource recovery, the idea that the environment should be disturbed minimally by the 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 life cycle stages, including tailings and other residues, where tangible and intangible values should be captured and utilized. Comprehensive resource recovery is also one of the core principles contributing to the quantities of resources used and development decoupling.

7. Principle 7: Value addition

Sustainable resource management shall facilitate and support value addition throughout the life cycle.

Explanation: Value addition refers to any economic, environmental or social benefit from further processing and manufacturing resources. The goal of value added is to increase the Gross Domestic Product (GDP) associated directly with processing and manufacturing and also to increase the employment and other benefits that accrue, including from the many

supplier industries, such as engineering, design, environmental technologies, and equipment supply. The activities must be accountable through the whole value chain, including increasing local content in the local, regional or national economy. Sustainable resource management shall require up-stream linkages into capital goods and service sectors; down-stream linkages into beneficiation, processing, refining and manufacturing, consumables and services industries; and side-stream linkages into infrastructure (power, logistics, communications, water) and skills and technology development. The potential for value addition shall be carefully assessed, and the information used while managing the resources, especially vis a vis the social, environmental and economic viability. The possible social and environmental challenges could be transformed into opportunities when the value-addition possibilities are examined over the entire life cycle.

Private sector participation and investments are crucial to the integrated and sustainable development of resources, enhancing resource efficiency and having a vital role in value addition. Mutually beneficial partnerships between the state, the private sector, civil society, local communities and other stakeholders should be thoroughly examined while managing the resources.

8. Principle 8: Circularity

Sustainable resource management shall facilitate and support the knowledge base and systems for responsible design, use, reuse, recycling and minimization of waste at all stages.

Explanation: A circular economy is a systemic 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, pursuing longevity, renewability, reusability, reparability, replaceability and upgradability for resources and value-added products. Disposing of residues as waste should be the last and least preferred option.

Sustainable resource use requires sound management of renewable resources. It should aim to recycle the non-renewable resources that lend themselves to reuse, leading to a circular economy in which waste is minimized. 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, consumption and use, and recycling and reuse. Circularity is also key to decoupling quantities of resources used and development.

The Brundtland Report (1987) says that "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 the conservation of all resources employing responsible production, consumption, reuse, and recovery of all products, packaging, and materials, without burning them to the extent possible 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.

9. Principle 9: Health and safety

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

Explanation: The maximization of safety for workers and local populations is integral to International Labour Standards on Occupational Safety and Health[10] 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 life cycle stages.

[10] https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang--en/index.htm

10. Principle 10: Innovation

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

Explanation: The coming together of diverse science streams, technology, and industry is becoming a reality. Getting out of a lock-in state and transforming science-based results into an enduring value is embracing 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 a focus on high-value-added and labour-intensive sectors."

11. Principle 11: Transparency

Sustainable resource management shall ensure a public understanding of the transfer of revenues and expenditures that will help public debate allowing for an informed choice of sustainable development options.

Explanation: Open information that can be trusted informs better policy and fuels social license to operate. The need to avoid corruption, from awarding contracts and licences to procuring goods and services, emphasizes transparency in informing public debate and realistic options for sustainable development. Many governments and public and private organizations have sought to reduce the risk of corruption and ensure revenues are adequately used by improving governance and increasing transparency within the sector. Ultimately knowing who controls and benefits from a resource has been used as the key to fighting corruption and preventing illicit financial flows in all sectors of an economy.

A public understanding of the transfer of revenues and expenditures over time will help public debate allowing for an informed choice of sustainable development options. This requires the disclosure of accurate and verifiable information along the value chain. The appropriate use of natural resource wealth should be a significant driver for sustainable economic growth that contributes to sustainable development and poverty reduction. However, if it is not managed correctly, it can create negative economic and social impacts.

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

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

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.

B. Requirements

UNRMS principles are accompanied by the following requirements to be considered. All needs may not apply to all resource sectors. UNRMS application for a specific resource sector or for integrated resource management should be adapted in a case-by-case manner.

1. State rights and responsibilities in the management of resources

(a) National policy and strategy: To support the implementation of sustainable resource management aligned to the 2030 Agenda;

(b) Compliance with regulations: Establish regulatory bodies which are responsible for sustainable resource management;

(c) Coordination: Coordination with different authorities responsible for regulating sustainable resource management;

(d) Provision of technical services: Providing technical services needed for sustainable resource management;

(e) Adherence to international obligations and arrangements for international cooperation.

2. Responsibility to the planet

(a) Long-term cost-benefit analysis concerning planet-people-prosperity;

(b) Strategic environmental assessments: A Strategic Environmental Assessment (SEA) is a systematic process for evaluating the environmental implications of a proposed policy, plan or programme and provides means for looking at cumulative effects and appropriately addressing them at the earliest stage of decision making alongside economic and social considerations;

(c) Climate change-related activities: All activities align to Nationally Determined Contributions (NDCs), investor and company vision, and climate change policies;

(d) Resource and energy use efficiency: Actions to reduce resource and energy inputs used to produce resources;

(e) Greenhouse Gas (GHG) Intensity indicator: expressed in g CO_2 eq/MJ;

(f) Water use and management: Ensure water inputs are optimized and released to the environment and managed according to country legislation;

(g) Land use and management: Actions to minimize or optimally manage the land footprint;

(h) Management of all residues and effluents in an appropriate manner;

(i) Biodiversity conservation and enhancement activities: All activities in the area to conserve and enhance biodiversity;

(j) Periodic sustainability reporting for various purposes.

3. Integrated management of resources

(a) Information platform, data interoperability, dashboard: Availability of accurate and complete information on the area or project promptly to help in decision making;

(b) Estimation of resources and assigning the degree of confidence in the estimated quantities according to UNFC;

(c) Opportunity and Risk management: identification, evaluation, and prioritization of opportunities and risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events, including resource-based conflicts, and to maximize the realization of opportunities;

(d) Productivity: Ensuring required measures to enhance production efficiency. Often, a productivity measure is expressed as the ratio of aggregate output to a single input or an aggregate input used in a production process, i.e. output per unit of input, typically over a specific period;

(e) Preventing illicit financial flows, Base Erosion and Profit Shifting (BEPS): Illegal capital flight. Domestic tax BEPS occur due to multinational enterprises exploiting gaps, and mismatches between countries' tax systems affect all countries. Developing countries' higher reliance on corporate income tax means they suffer from BEPS disproportionately;

(f) Sustainable investment framework: A set of standards for a company's operations that socially conscious investors use to screen potential investments;

(g) Artisanal and small-scale mining (ASM): If ASM is present in the area, it should be integrated with the development programmes;

(h) Competent and qualified assessments: All criteria necessary to ensure the quality of data and information provided;

(i) Monetary provision for the decommissioning of facilities, including closure and decommissioning plans from the start of the operation. The plans should be updated continually.

4. Social engagement

(a) Human rights-based protocols to prevent child and forced labour and safeguard employee rights;

(b) Indigenous populations: In alignment with the United Nations Declaration on the Rights of Indigenous Peoples;

(c) Stakeholder capitalism: Orientation to serve the interests of their stakeholders such as customers, suppliers, employees, shareholders and local communities;

(d) Communications and outreach.

5. Service orientation for the use and reuse of resources

(a) Service orientation in the use and reuse of resources model: Service orientation is a business model whereby customers pay for a value-added product or service, such as heat, light or mobility, without buying the resources. Life cycle environmental and waste management recycling etc., could be part of a long-term service contract.

6. Comprehensive resource recovery

(a) By- and co-product management: Maximizing the utility of all by- and co-products;

(b) Land value release/land value capture: Optimize land use by releasing it from inefficient use.

7. Value addition

(a) Nexus approach: Determine how activities are diversified to support various areas of the economy;

(b) Feasibility studies: Detailed studies that look into the evaluation of resource and energy efficiency, productivity and consideration of all possible outcomes;

(c) Assessment and public reporting of upstream, sidestream and downstream possibilities;

(d) Manage all upstream, sidestream and downstream linkages in resource management;

(e) Supply chain optimization: aims to ensure the optimal operation of the supply chain;

(f) Life cycle assessments: Methodology for assessing environmental impacts associated with all the resource utilization life cycle stages.

8. Circularity

(a) Waste hierarchy model: The "waste hierarchy" ranks waste management options according to what is best for the environment. It gives top priority to preventing waste in the first place;

(b) Design for circularity: Design out waste and pollution; keep products and materials in use, and regenerate natural systems;

(c) Anthropogenic resources management: Use of residues as secondary resources.

9. Health and safety

(a) Crisis management, emergency response: Emergency Response Preparedness actions to foresee emergencies that are likely to occur and pre-plan critical components of a response, including innovative monitoring and digitalized feedback systems;

(b) Safety Protocols: System for protective actions to reduce existing or unregulated risks;

(c) Worker and population health standards: Adherence to international and national standards and regulations to protect workers and the population;

(d) Tailings and residue management: Safety of tailings and residues and critical evaluation of the impacts from different use of residues, mainly the anthropogenic resources.

10. Innovation

(a) Models of innovation through combining hybrid technologies and approaches applicable to diverse technologies;

(b) Build-Measure-Learn: A method to gain quick feedback on the utility of a new product or service;

(c) Development of Minimum Viable Products (MVPs): a prototype that is evaluated solely for internal quality;

(d) Innovation accounting. A quantitative approach allows seeing whether innovations bear fruit and create learning milestones.

11. Transparency

(a) Supply chain transparency and traceability: Supply chain transparency requires companies to know what is happening upstream, sidestream and downstream in the supply chain and communicate this knowledge internally and externally;

(b) Due diligence: Investigation, audit, or review performed to confirm facts or details;

(c) Governments should assess and report company upstream, sidestream and downstream linkages, as well as their supply chain due diligence processes;

(d) Data quality: Confirming accuracy and precision; legitimacy and validity; reliability and consistency; timeliness and relevance; completeness and comprehensiveness; availability and accessibility; and granularity and uniqueness;

(e) Competent and qualified assessments.

12. Continuous strengthening of core competencies and capabilities

(a) Institutional strengthening (ICE-SRMs): Creation of institutions with a long-term mission to build sustainable value and change the world for the better;

(b) Re-Skilling: Preparing workers for the end of the project and just transitions.

48. Annex I provides a generic template for further analysis, reporting, and implementation of the UNRMS requirements.

C. UNRMS Tool kit

49. UNRMS will include several tools to promote the sustainable and integrated management of natural resources. These tools will provide standardized methodologies and approaches to achieve the objectives of UNRMS. Annex II describes the concepts of the initial set of tools.

ANNEX I

UNRMS Requirement Template

Users of UNRMS can include governments, industry, the financial sectors, civil society and academia. UNRMS users need to look at the following suggested details while analyzing, reporting and planning resource management based on the specific requirements. The details may vary depending on the specific purpose for which a UNRMS analysis, reporting or planning is done. It could be for internal government, company management, or public reporting. The list provided below is not exhaustive and could be tailored as necessary.

1. Normative references

(a) 2030 Agenda for Sustainable Development;

(b) Paris Agreement on Climate Action;

(c) Regional vision, strategies and requirements (e.g., European Green Deal, European Union Raw Materials Sustainability Principles; African Union Agenda 2063, Africa Mining Vision (AMV));

(d) National Vision, Policies and Strategies;

(e) UN Policy Brief "Transforming Extractive Industries for Sustainable Development";

(f) UN instruments and conventions relevant to the requirement;

(g) Key linkages to public health and well-being.

2. Terms and definitions

3. Integration with all UNRMS principles

(a) Transformation;

(b) Adaptability to local priorities and needs;

(c) Review, feedback and audit mechanisms.

4. Scope and context

(a) Organization and its context;

(b) Stakeholders;

(c) Justification of the requirement;

(d) Optimization:

(i) Desired outcomes;

(ii) Linkages to resources as a public good;

(e) Vision and leadership:

(i) Commitment;

(ii) Policies;

(iii) Long-term stakeholder value creation;

(iv) Role and responsibilities.

5. Sustainable Development Goals alignment

(a) Demand-side:

(i) Balanced and integrated resource management;

(ii) Value chain to the point of delivery;

(iii) Compliance and delivery metrics;

(b) Supply-side:

(i) Details on the modes of resource progression;

(ii) Relevance to supply and value chain resilience;

(c) Performance:

(i) Stakeholder satisfaction scores;

(ii) Key Performance Indicators;

(iii) Monitoring, measurement, analysis, and evaluation;

(iv) Internal audit;

(v) Management review.

6. Planning

(a) General;

(b) Short-term;

(c) Medium-term;

(d) Long-term;

(e) Critical control points/dashboard indicators.

7. Support

(a) Human/institutional resources;

(b) Competence;

(c) Awareness;

(d) Communication;

(e) Information.

8. Operation

(a) Controls;

(b) Risk assessments;

(c) Risk management.

9. Improvement

(a) Corrective actions;

(b) Continual improvement.

10. Other discussions

11. Bibliography

List the relevant references.

ANNEX II

UNRMS tool kit concepts

UNRMS will provide several tools to help attain sustainable resource management based on principles and requirements. These tools will offer standardized methodologies and approaches to achieve the objectives.

Brief descriptions of the selected tools are provided in this Annex. These tools will be developed progressively based on case studies in different countries. As needs arise, more tools of a similar nature will be added to UNRMS.

1. Clean energy index

Addressing the global climate crisis and the implications of sustainable resource management is a primary imperative today. Natural resource needs to be sustainably managed to benefit the current and future generations. Sustainable resource management will require alignment with the SDGs, including eliminating poverty, fighting climate change, and ensuring access to affordable energy for humanity.

Energy for the future needs to be low-carbon. The opportunity given by the low-carbon energy transition focuses on developing renewable and carbon-abated traditional energy sources.

Global energy markets are transitioning from hydrocarbon energy to low-carbon footprint sources. According to the US Energy Information Administration (EIA) forecast, renewable energy volumes will soon double and natural gas will stay flat in the percentage of the energy share and increase by 35 per cent in absolute terms.[11]

Fuel and energy sectors need to invest in clean energy heavily. From 2008 to 2017, only 0.5 to 4 per cent of the total oil and gas companies' investment was related to renewable energy, mainly investing in operational cost reduction and developing green, clean technologies for the traditional energy business. Renewables are a significant additional energy source that can inexpensively satisfy the increasing global energy demand. According to the EIA forecast, by 2050, onshore renewable energy production will increase by a factor of ten, offshore energy will go up by a factor of forty-three and solar power by a factor of seventeen.

Renewable development is linked to the production of critical raw minerals. These minerals are critical because of the heavy dependence on the low-carbon energy sector and supply constraints. For example, it is assumed that for further renewables development, lithium production should increase by a factor of 42. And lithium is commonly produced from brines. Similarly, cobalt, nickel and graphite consumption should increase by 20. The exploration and production of critical raw materials are associated with the release of carbon emissions. The entire life cycle needs to be considered to compare the carbon footprint of various energy types of production. There is a requirement to view energy as the whole production process from various low-carbon sources, including critical materials exploration and production and waste management.

Understanding the life cycle impacts could have a positive cost reduction in power production from various sources. Therefore, it is necessary to objectively compare different energy types' carbon footprint and efficiency through a clean energy index. Such a tool could estimate the carbon footprint of energy from various sources and throughout the production cycle, such as exploration, production, and waste management. To achieve a balance across different types of energy, it is necessary to objectively compare the carbon footprint and efficiency of different energy types by comparing the clean energy indices. Such a tool will help lay out an unbiased approach to achieving the SDGs. Various stakeholders, such as governments and businesses, will be able to use the clean energy index. This UNRMS tool will become a

[11] US Energy Information Administration (2022) Annual Energy Outlook https://www.eia.gov/outlooks/aeo/

benchmark to evaluate and compare all types of energy. The clean energy index will also contribute to a circular economy and aid the integrated management of resources.

2. Service orientation in the use and reuse of resources

If the objectives of the 2030 Agenda are to be met, there will be a need for an uninterrupted supply of resources. Current patterns of consumption of resources are highly skewed, with high-income countries consuming over 25 tonnes per person per year. In contrast, the least developed economies consume less than 2.5 tonnes per person per year. It is not enough to increase production to meet the demand for resources. A relentless increase in production will have a significant environmental and carbon footprint.

Resource use efficiencies need to be improved drastically. The current commodity models are developed for a linear economy. They are ill-suited for supporting the circular economy paradigm. An alternative to the commodity model is the service model. This model recognizes the vast number of products, tools and technologies vendors now deliver to users as a service. Currently, service model transforms every industry globally, including retail, journalism, manufacturing, media, transportation, and enterprise software. Today, many companies generate most of their revenue from services, not commodities or products. Commerce is reorganized around the subscription model, which gives the companies predictive revenue.

The focus has now shifted from products to consumers and outcomes. An industry focused on services will not produce more resources but on seeing how fewer resources are required to create a particular result. Resource efficiency will be at the core, which translates to efficient production with the least environmental or climate footprint. The industry and the users become real partners and grow together. Customer loyalty will permeate society and foster a social contract on resources.

It will not be difficult for the "commodity" industry to transform into a service industry. As with many sectors, the manufacturing industry is changing. Instead of focusing on products, inventories, and promotion, the industry is razor-focused on the audience, its customers. The service-focused transition will foster a more circular economy. Inefficiencies in resource use will be replaced with maximum resource efficiencies and decoupling of development and quantities of resources used. The industry could have the advantage of potential gain from escaping the vagaries of market volatilities, forever transitioning through "boom and bust" cycles. Even if the vagaries are not fully controllable for complex supply chains, better prediction and preparedness will be possible. The stability of the resource market will benefit governments, who can anticipate stable economies and thus plan better. The transformation will bring a more equitable distribution of benefits across all stakeholders to the society, thus firming up the social contract on natural resources.

The UNRMS Service tool will provide stakeholders with options, checklists and guidelines on what is required for the transition. Stakeholders could implement the transition in a phased manner. The tool will include aspects of comprehensive resource recovery, value-addition and circularity.

3. Resource supply system

Most of the resources required for society are supplied from thousands of individual projects (mines, oil fields, wind farms, etc.), which are usually reasonably understood on a one-to-one basis. Such an understanding is not the case for the aggregate of these projects, which forms a dynamic, complex adaptive system with hundreds of components and many links and dependencies between them. The response to a change is typically non-linear and unpredictable for a system of this nature. The resource supply system tool provides a conceptual and holistic overview of the system as a basis for further investigations, including its complexity.

The tool will support the analysis of the resource supply system. It will include activities that must be carried out for a product to be supplied and is a small part of a more extensive human world economic system. It will consist of several essential components: source, physical system (production, transport, processing), financial, economic, and background (legal,

regulatory, etc.). The tool will consist of modules on demand, agents, sources, physical systems, financing and other socio-economic issues.

The tool's architecture may be understood as a normalized snapshot of a project's drivers, resources, and workflows. Each element can include many, often hundreds, agents or activities connected by many network links that form a dynamic adaptive complex system. Blockchain technology has been developed to make managing this complexity easier and more efficient.

4. Blockchain and machine learning/artificial intelligence model for resource management

Resource management has a legacy of systemic failure to resolve one of the critical targets of the circular transition, such as illicit financial flows, including corruption and tax evasion. When aggregated together, these phenomena come at a very high and persistent annual cost to many countries that are suppliers of critical and other resources to third countries. The blockchain tool will be based on its distributed ledger technology's nature to provide a "designed in" solution, simultaneously enabling full end-to-end/continuous traceability and transparency of molecules and monies.

Suppose the blockchain procedure is carefully followed by tagging (tokenizing) all resources as recovered into use, starting with recovered and reused secondary resources as always having primacy over primary resources. In that case, the unique nature of each resource unit, whether of a single or multiple resource composition, renders every resource unit unique and hence "non-fungible".

Zero waste becomes a designed-in outcome of circularity, delivered by blockchain, and an ethical tenet of sustainability. The adoption of blockchain technology inherently solves several issues within the linear supply and value chain – loss of data integrity, lack of transparency, traceability and impenetrable or ineffectual governance, resulting in illicit funds flows – through its Distributed Ledger Technology functionality.

A significant advantage of blockchain lies in the use of "smart contracts", in which "smart" is currently meant as essentially "automated" in terms of a contract that can be embedded in the system, with the contractual terms and conditions available in a transparent and verifiable form. When the terms are met, the transaction is executed automatically. A new block is added to the chain, recording the fulfilment. Tampering with or falsifying a record is also significantly more complex and traceable. Any change in transactions resulting from such interventions generates a new block recorded as part of the chain.

The tool will be developed against (a) notional specifications for various tools included in UNRMS and (b) existing systems (such as the different food supply chain and customer service business line tools). The Structure of an inter-industry supply chain process with a Blockchain-Based Foundation to track, record, translate, and potentially communicate crucial data points and analytics to all relevant parties will be explained.

Blockchain and machine learning/artificial intelligence tool for resource management will be designed using blockchain tokenization to identify transparent and traceable molecules and monies as non-fungible items through the circular resource economy for several vital objectives, such as inhibiting or eliminating illicit flows of both resources and funds. By overlaying blockchain with machine learning and artificial intelligence to implement smart contracts in supply and value-chains supported by the UNRMS system, the capacity to eliminate avoidable losses and wastages becomes "designed in" allowing much closer mapping of resource demand to resource supply – especially of critical raw materials – in a sustainable, financially transparent and fair manner.

5. Critical raw materials dashboard

Energy transitions are heavily dependent on the supply of critical raw materials. Critical raw materials have geographical dependencies, sustainability issues in production and use, and complex supply chains. Governments, industry, financial, academic and civil society stakeholders require timely information on availability, production, use and reuse to properly manage critical raw materials. There is no shortage of data in today's digitalized environment. Making the data into useful information for decision-making is the biggest challenge.

Making critical raw material resource data available and harmonized using UNFC standards is part of the solution. UNFC-based information must be combined with other production information, primarily social and environmental aspects. Supply chain information and data related to the use and reuse of other factors need particular attention.

How data appears is often as important as data quality. Data that cannot be easily accessed or viewed is not usually used for comparative analytics. A dashboard is a visual display of the essential information needed to achieve one or more objectives, consolidated and arranged on a single screen so users can monitor the information at a glance.

Data dashboards fall under four main classifications. Informational dashboards serve an objective, unbiased information about a project or business. Strategic dashboards help users discover opportunities, create forecasts, drive strategy, and focus on high-level performance data. They are typically static dashboards updated monthly in preparation for review and lead planning for the next block of time. Analytical dashboards are detailed and allow users to drill down into the data. Analytical dashboards typically include background information, context, and data analysis. Operational dashboards give users insight into the operation's processes and other underlying functions. They often surface live (or real-time) data and provide continuous, up-to-the-minute information.

Analytical, rather than informational, dashboards will meet the needs of a multidisciplinary user group studying natural resource management. UNRMS users would benefit from the ability to drill down into data assembled by subject matter. The information generated could be used for internal resource management or public reporting. For example, dashboards for critical raw material resources should allow users to see and query the data. Users could answer questions themselves rather than being given information in predefined reports.

As can be seen from available but challengingly difficult-to-extract data from many data sources, there is a significant difference between data and information. The critical raw materials dashboard tool will provide actionable information to all stakeholders.