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Development, maintenance and implementation of the United Nations Framework Classification for Resources and the United Nations Resource Management System: Concept and design of the United Nations Resource Management System

United Nations Resource Management System: Concept and design

Prepared by the Expert Group on Resource Management

Summary

This document discusses the concept and design of the United Nations Resource Management System (UNRMS), which is related to the United Nations Framework Classification for Resources (UNFC). UNRMS builds on the strengths of UNFC. The strength of UNFC fundamentally rests in its capability to parse information at a specific point in time of three types social-economic viability, project feasibility and level of knowledge to steward a resource from discovery to final production. UNRMS is fully complementary to and a logical extension of UNFC, providing a tool kit for the systemic development of a project through time, whether comprising a single resource or combinations of different resources, to ensure its capacity to contribute to sustainable development within the "people, planet prosperity" remit of the 2030 Agenda for Sustainable Development. The document advances the initial ideas presented in an earlier document "Transforming our world's natural resources: A step change for the United Nations Framework Classification for Resources?" (ECE/ENERGY/GE.3/2018/7) showing how decision and policymakers in particular can use UNRMS for better informed, balanced and integrated resource management in the service of attaining the Sustainable Development Goals.

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I. Introduction

1. The 2030 Agenda for Sustainable Development (2030 Agenda) was adopted by 193 Heads of State in September 2015, and on 1 January 2016 the seventeen Sustainable Development Goals (SDGs) came into force[1]. The 2030 Agenda calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet resulting in increased and more equitably-shared prosperity for all. The essence of sustainable development consists in harmonizing three core elements: economic growth, social inclusion and environmental protection.

2. The people-planet-prosperity triad which lies at the heart of the 2030 Agenda is designed to ensure that: "all human beings can fulfil their potential in dignity and equality and in a healthy environment". It directly resonates the aspiration to "protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations". It links all activity to a holistic development paradigm that proclaims: "all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature".

3. The critical role of efficient management of natural resources in achieving almost all SDGs is clearly recognized in the 2030 Agenda. In this context, efficient management means a process which is both "integrated and indivisible and balance[s] the three dimensions of sustainable development: the economic, social and environmental". This observation moves the economics of resource management firmly into the domain defined by John Nash in his papers on equilibrium theory as those transaction types where parties either both win or both lose[2]. What has characterised the past century of resource management is successive boom and bust cycles, with negative externalities such as pollution and discarded wastes imposed by one generation on the next, typically at very high cost.

4. Such a systemic approach is a primary conclusion of the International Resource Panel (IRP) Report, *Assessing Global Resource Use: A systems approach to resource efficiency and pollution reduction*. This Report indicates that about 90 billion tonnes of resources such as biomass, fossil fuels and non-metallic minerals were used in 2017. This is three times the quantity used in 1970 and by 2050[3] the resource demand is likely to double to approximately 180 billion tonnes/year. "Focusing on single resources, single economic sectors, or single environmental and health impacts will not achieve the collective visions of the Sustainable Development Goals," the report says. What is needed is a "systems approach which connects the flow of resources – from extraction through to final waste disposal – with their use and impact on the environment, economies and societies at each stage of the life-cycle".

5. While SDG 12 on sustainable production and consumption is at the core of this approach, a systems approach requires that it links directly or indirectly to all the other goals, notably SDG 7 on affordable and clean energy; SDG 9 on industry, innovation and infrastructure; SDG 11 to make cities and human settlements inclusive, safe, resilient and sustainable; and SDG 13 to take urgent action to combat climate change and its impacts.

[1] Transforming our world: The 2030 Agenda for Sustainable Development, United Nations 2015, https://sustainabledevelopment.un.org/post2015/transformingourworld

[2] Osborne, M. J. and Rubinstein, A. (1994). A Course in Game Theory. Cambridge, MA: MIT.

[3] With resource use expected to double by 2050, better natural resource use essential for a pollution-free planet, UN Environment 2017, https://www.unenvironment.org/news-and-stories/press-release/resource-use-expected-double-2050-better-natural-resource-use

2. A systems approach to resource management

6. A systems approach[4] to sustainable resource management could enable tighter integration of the policies, especially the sustainable development programme of a country or a company to the project level implementation. Such an integration, if realized, will bring out an essential transformation in the resource management landscape, with emergent patterns such as:

- **Resource centering**, the life-cycle management of resources
- **Value centering**, discovery of economic resources and targeting social and environmental returns
- **Service or customer centering,** breaking away from the commodity paradigm
- **Security of supply and criticality,** examining the strategic needs.

7. Each of the above is contributory to a transition in resource management from a linear to a circular economy, where all resources whether primary or secondary are retained to the fullest extent possible within the system boundaries resulting in waste reduction to the point of eventual "zero waste".

8. While economic gains and operating profits matter, these need not be the prime drivers of a new resource management model. Profits should follow good social and environmental outcomes. This is not a radical view; many businesses have been built on similar foundations for a century or more[5].

9. Based on the first-principles thinking of identification of current assumptions, collapsing the problem into its fundamental principles and creating new knowledge-based solutions, some of the core approaches in resource management can be easily identified. This approach, which will have to be implemented at a project level include, but is not limited to:

- **Comprehensive resource recovery**, the basic premise that the project footprints should be minimized by recovering all values, including co- and by-products and eco-system benefits
- **Circularity,** to include all actions to ensure raw materials remain within the boundaries set by the requirements of "reduce, reuse, recycle."
- **Zero harm and zero waste**, the movement towards maximization of safety for the people and the environment and elimination of all wastes.

10. Although the crucial roles of resource efficiency, circularity and waste minimization are well studied and reported, a comprehensive set of tools to implement these objectives is lacking. For a discernible impact, transformative polices are necessary but not sufficient. When it comes to implementation at ground level more is required connecting policy objectives to operational realities.

[4] A system is a set of things working together as parts of a mechanism or an interconnecting network; a complex whole. A system is more than the sum of its parts. It may exhibit adaptive, dynamic, goal-seeking, self-preserving, and sometimes evolutionary behaviour. Many of the interconnections in systems operate through the flow of information. Information holds systems together and plays a great role in determining how they operate. Systems approach is derived from systems thinking, which is used to identify and understand systems, as well as predicting their behaviours and devising modifications to produce desired effects. See Meadows, D. H. (2008). *Thinking in systems: A primer*. Chelsea Green Publishing.

[5] Collins, J. C., Collins, J., and Porras, J. I. (2005). *Built to last: Successful habits of visionary companies.* Random House.

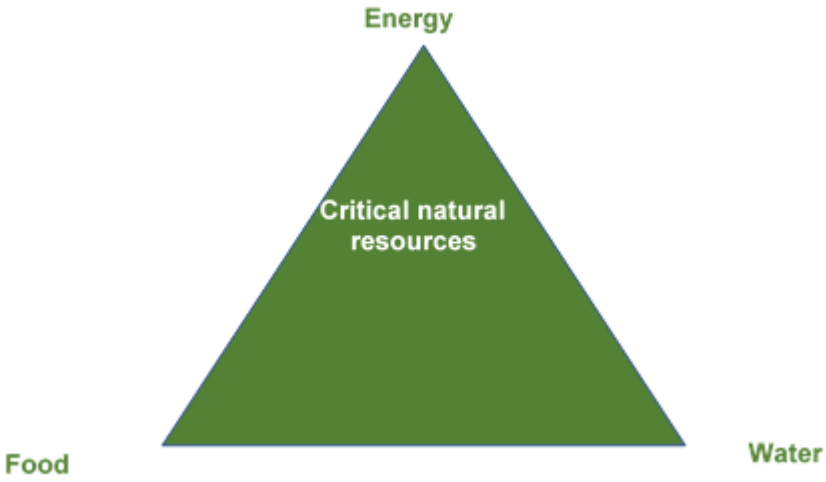
11. The objectives for sustainable development enumerated above clearly requires a systems approach, which should also be anchored at the operational levels of a project. While policy objectives are understood at the top-level, there is a need for a mechanism that drives the projects forward. To find answers to who, what, when, where, why and how the resources should be managed at an operational or project level needs a flexible systems framework.

12. In other words, a new, SDG-oriented resource management tool kit is required to implement sustainable development, which should be capable of linking the top-down policy directions and bottom-up project implementation in a coherent manner.

3. The essential linkages to resource management

13. The Food – Water – Energy (FEW) nexus integrating the security, accessibility and affordability of essential resources for each individual - in effect a summary of Maslow's essential needs hierarchy[6] - underpins the sustainable management of resources with the Agenda 2030 framework. Seen in another manner, meeting the FEW requirements comprises the sum total of delivering the critical natural resource base itself (Fig. I). Sustainable resource management not just supports the security of FEW, the raw materials are likewise embedded in the FEW triad (Figure 1). The resource management tool-kit should be capable of parsing the complex networks of the FEW space, determining gaps (unmet needs), and guiding decision and policymakers as to how to fill them.

Figure 1
Food, energy and water security as critical natural resources



14. The United Nations Resource Management System (UNRMS) is proposed as the instrument capable of linking policy objectives seamlessly to project implementation. Such a tool kit is currently not available and persistent underperformance in translating policy objectives to practical results witnessed across the planet can in significant measure be attributed to this gap.

15. UNRMS builds on the experience of applying the United Nations Framework Classification for Resources (UNFC), which classifies resource quantities into various classes depending on three primary criteria, socio-economic viability (E), technical

[6] Maslow, A.H. (1943). *A theory of human motivation*. Psychological Review. 50 (4): 370–96.

feasibility (F) and level of knowledge (G). UNFC thereby provides a uniform terminology and classifies resource into projects based on the combination of criteria as above.

16. UNRMS harnesses the unique advantages of UNFC to transition from classification to use and hence to provide standards and guidelines for resource progression (e.g. how does a project move from UNFC class E2F2 to E1F1) in a way that can aid decision-making whether for project selection and implementation or for project scoping and planning. UNRMS thus will have UNFC at its core and will have additional documentation on how sustainable development of resources could be implemented. UNRMS can also be deployed to channel feedback on policy fine-tuning and course-corrections that will be required to optimize outcomes over the longer-term, especially for projects that have an implication on inter-generational justice.

17. The benefits of UNRMS will thus accrue to policymakers in governments, decision makers in companies and the implementing experts at a project level.

4. Challenges to Sustainable Development

18. Sustainable resource development is rarely a one-person operation or one particular sector of the economy. It usually requires complex interactions with diverse sectors and often large multidisciplinary teams will have to work together. Adherence to the 2030 Agenda and the national or regional sustainable development programme will require compliance with the full gamut of relevant regulations, full integration into a company's business model and a rich understanding of the intricacies of actual project implementation.

19. Such an intricate web of activities requires ongoing and real-time access to consistent and accurate data, with an understanding of how to cope with its inherent uncertainty. When a web of actions expanding from a traditional "profit only" motive to a process that targets good social and environmental outcomes, complexity naturally increases. With this increasing complexity, there is always a danger in asynchronous availability of data between different players in the game. Often the policy makers, decision makers and the project personnel are not on the same page because not all equally possessed of the same information.

20. The players at all levels have a need to identify the options available, along with their maturity, opportunities and barriers to development. All options come with upsides and negatives, risks and challenges. At various times during the project life-cycle, reasoned choices balancing the social, environmental and economic aspects of any development need to be made.

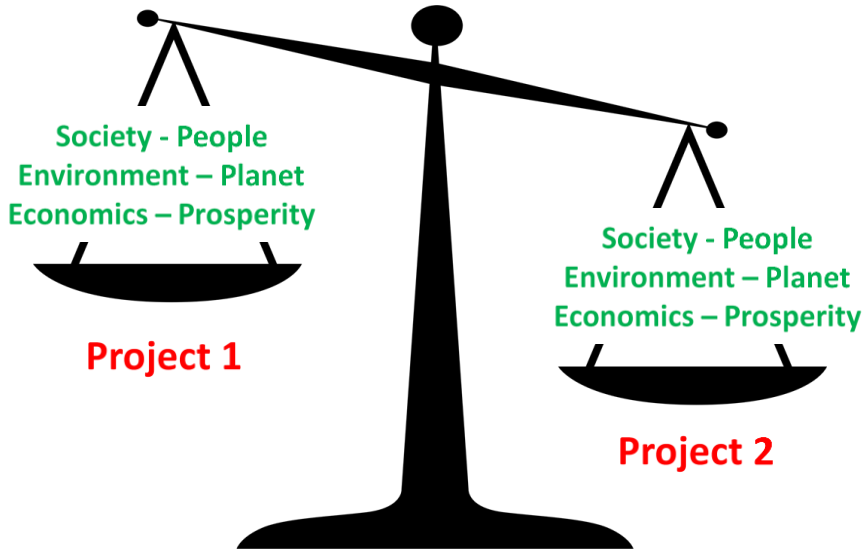
21. Progress is not a time-stamped set of activities. Performance improvements should happen all the time. For this, it is essential to analyze the outcome of a project to better guide decisions in the future. Implementation of a project today and its governance on an ongoing basis are interlinked.

22. For a resource development project, all these are not just good project management practices, but decision and actions that are coupled to resource quantities that could be available for production. Whether they are non-renewable raw materials or renewable energy, a set of criteria and filters will have to be applied and the outcomes forecasted in a system-wide manner.

23. Good decision-making depends on data, information and knowledge of the outputs, outcomes and impacts of a project. With reverse tracing (or reverse engineering) from the desired end-point of People-Planet-Prosperity back to project selection and design, projects may have to be weighted on their forecasted outcomes (Figure 2), while progress will be measured in terms of actual achievements. While the project that carries the maximum benefits requires the focused attention today, a project on the other side of the scale will also

require attention to make it more substantial on the benefit side, so ensuring equilibrium of benefit during delivery.

Figure 2
Weighing of projects based on social, environmental, and economic returns



24. The assessment of the possible outcomes is made extremely difficult not only by the "unknowns", such as market volatilities, political instabilities or natural hazards, but also the "unknown unknowns" about which we are unable to even speculate. A good decision maker's or project implementor's approach to the extreme uncertainties of the future should be to avoid the "unknowns" and minimize the negative impacts, but at the sometimes increase the exposure to the upsides of the plausible "unknown unknowns".

25. Financing a resource-development project requires an independent assessment of its investment readiness. This is also hinged to the clarity of information available. Scientific rigour is not only demanded to understand the return on investments. A growing tribe of investors today are also particularly curious about the social and environmental returns as well. Smart and flexible financing in the future will put more stringent requirements on data and information.

26. Having consistent data, information and knowledge are crucial for a project to progress.

27. However, current, consistent data, information and knowledge on a project's outcomes today can be only guessed to a large extent on an *ad hoc* basis. A tool kit that standardizes the availability of consistent data and information is sorely lacking.

5. Technology opportunities and disrupters

28. The world is on the verge of a digital transformation. This transformation is embracing all facets of the society, but more so the industry hence referred to as the fourth industrial revolution. In a nutshell, this structural transformation is also about embedding information and knowledge in all activities of society and making the activities specialized in a manner different from the past. Smart machines, robotics and artificial intelligence, are appropriating traditional specializations, while the human capability is being challenged to a special level of generalization not seen in the past.

29. In the past specialization of human activities made its implementation simpler. Today, human capabilities need a level of super-specialization than can see inter-connections, linkages and new patterns. There is a need to "unlearn and re-learn" the resource value-chain. The rise of intangibles, the drive from "extraction" to new economic resources, often characterized by capabilities, communications, seeing materials as a service, and developing a robust social license to operate are some of the examples.

30. The fourth industrial revolution or Industry 4.0, hoisted to a large extent on the wake of artificial intelligence and machine learning, will have a deeper impact on the resource development industry. This will span to broader areas of cross-sectoral linkages, hybridization of technology and processes and widespread disruptions.

31. Building resilience and robustness to business processes is going to consume a lot of attention in the future. An effective player in this scenario will have to fall back on the essential requirements mentioned in the earlier section - consistent data, information and knowledge.

6. UNFC and UNRMS: a marriage fit for sustainable development

32. UNRMS proposes to be the "swiss-army knife" to tackle the sustainability and technology challenges especially high impact technologies (mostly digital in one form or another) which allow better exploration and modelling of inplace resources and higher precision during recovery and processing that also indicates the potential for major change in the underlying economics. In this aspiration, UNRMS builds on the strengths of UNFC, which fundamentally rests in its capability in analyzing information on social-economic viability; project feasibility and level of knowledge to steward an asset from its discovery to final production.

Table
The UNFC and UNRMS convergence

UNFC	*UNRMS*
▪ Stewardship of an asset ▪ A tool for quantifying the volumes produced, recoverable and unrecoverable from all possible projects in a deposit or reservoir (note that in application to renewable energy UNFC quantifies the volumes associated with a single project) ▪ A point in time view under defined commercial conditions, opportunities and constraints	▪ Development of a project, which is an integral piece in the sustainable development programme ▪ An aid to decision makers measuring the actual progress of a project through the development stages and programme managers on how it contributes to sustainable development ▪ Project management considering all metrics to the decision makers including volume/quantities from UNFC, rate profile, economic indicators, environmental performance, social outcomes ▪ The tool kit for implementation, analysis and governance at the project level

33. UNFC is a tool for quantification of the volumes in a resource-base and assigning it a class that indicates its distance or closeness to the production gateway. UNFC-based data and information represent a snap-shot in time (synchronic time), and it is defined under the

commercial conditions and its associated opportunities and constraints. UNRMS, on the other hand, is the tool kit for the development of a project, an essential element is the sustainable development pathway through time (diachronic time) (see Table for a comparison). How a project, however small or big, performs adds to how sustainably resources are ultimately managed. UNRMS allows stripping down the project into its fundamental issues and creating new knowledge-based solutions.

34. Though an essentially reductionist approach, the UNRMS principles and rules will ensure a constant anchoring of the project to the required endpoints of good social and environmental outcomes. While UNFC aids in labelling resource classes, UNRMS comes in to advance it to higher classes.

7. Resource management system – the core concepts

35. An ideal resource management system should be able to identify all developed and undeveloped projects and their maturity towards operation and production of the desired outputs. It should be able to identify the key attributes of the social, environmental and economic viability of each project.

36. Such a system should also be able to identify how the projects connect to the sustainable development programme, be it at a facility, company, national or regional levels. The system should make the linkage of a company vision, and the project attributes visible. The same is true for national or regional policies and priorities and nodes that connect to a large number of projects. The 2030 Agenda is a good example. How a project relates to the SDGs is not just restricted to a few measures such as fuel efficiency or emissions control but needs to be firmly linked to all the 169 targets.

37. The system should be capable of quantifying or describing qualitatively the performance of the project for each of the key attributes. It should provide standards and guidance to the project implementors on key aspects of good governance, such as:

- Core Competencies and capabilities
- Implementation (including local content)
- Innovation to overcome challenges
- Zero waste
- Zero harm
- Estimation of volumes and forecasts
- Documentation
- Analysis of results.

38. UNRMS looks to aid in replotting the economics of resource management in a balanced and equitable manner, grounded in the UN System of Environmental-Economic Accounting (SEEA)[7] which is in turn firmly grounded in Nash's economic theory.

39. The SEEA Central Framework is an international statistical standard for measuring the environment and its relationship with the economy. The Central Framework covers measurement in three main areas:

[7] For SEEA see https://seea.un.org/content/seea-central-framework and for the SEEA text see https://unstats.un.org/unsd/envaccounting/seearev/seea_cf_final_en.pdf

(a) Environmental flows. The flows of natural inputs, products and residuals between the environment and the economy, and within the economy, both in physical and monetary terms.

(b) Stocks of environmental assets. The stocks of individual assets, such as water or energy assets, and how they change over an accounting period due to economic activity and natural processes, both in physical and monetary terms.

(c) Economic activity related to the environment. Monetary flows associated with economic activities related to the environment, including spending on environmental protection and resource management, and the production of 'environmental goods and services.

40. The first step in the direction of integrating SEEA principles within UNRMS has been taken by UNFC itself through it not only classifying multiple resources, but also secondary as well as primary resources. Once taken that step leads naturally to managing these resources and resource combinations in a balanced and integrated matter within UNRMS. UNRMS for example, can encompass polymetallic deposits such as those containing copper, gold, silver and uranium, but also whole energetic basins containing co-located solid, liquid and gaseous resources.

41. In summary, an ideal resource management system is all about project management, not assessment of volumes or quantities, and discerning the links to the sustainable development programme.

8. UNRMS – Designing a knowledge-based, future-proof system

42. UNRMS, in essence, has to provide a "global workspace[8]", which will aid the analysis and understanding of the non-linear impacts of several factors, clustered along the socio-economic and environmental, project feasibility and level of knowledge aspects. The system should aid use of the knowledge so gleaned for effective decision-making, including channelling of investments and capital allocations.

43. UNRMS should not only be designed to address the present challenges to resource management, i.e., supporting sustainable production and consumption, but it should also be future smart. Some of the attended uncertainties of the future has been pointed out in earlier sections, but those raising from enormous volumes of resources required in the future, its footprint and needs, to operate in a carbon-constrained world merits most attention.

44. Following the good practices established by UNFC, the system will be multi-tiered with principles, specifications (rules) and guidelines (non-mandatory guidelines). But unlike a resource classification system, where rigidity is a virtue, resource management will allow for flexibility and adaptability through time as needs and priorities evolve. The flexibility of the systems attains more meaning when viewed through the requirements of future-proofing. An adaptive (eventually Artificial Intelligence) environment where ideas can collide and be developed and applied is essential. Hence, some protocols, best practices and case studies are also needed.

45. The essential super-structure of UNRMS could be visualized as below.

- Principles
    - Linkages to the 2030 Agenda

[8] The term "global workspace" comes from Artificial Intelligence, where it refers to a memory domain that allows for cooperative problem-solving by large collections of specialized programmes.

    - Simple and straight forward; UNFC provides the common numerical, project-maturity based classification model for all resources
- Specifications
    - Improving social performance
    - Improving environmental performance
    - Improving safety performance
    - Commercial considerations
    - Treating unconventional resources
    - Exploring unconventional processes
    - Addressing the Food-Water-Energy Nexus
- Guidelines
    - Comprehensive resource recovery
    - Zero waste
    - Zero harm
    - Social License to Operate (SLO)
    - Valorization (reuse, recycling) of anthropogenic resources
    - Discovering intangibles
    - Competent Persons
    - SEEA reporting
    - Financial reporting
- Protocols
    - Treatment of specific residues
    - Treatment of data
    - Communicating to society and investors
- Best practices
    - Total resource management
    - Constructive regulations
    - Technology drivers
    - Integrated material/energy flow within a 4.0 eco-system
- Case studies
    - Reference cases

9. Who requires UNRMS?

46. As a tool kit to implement the objectives of the 2030 Agenda, the immediate beneficiaries of UNRMS are as set out below but society as a whole will have an advantage in having a UN approved RMS as the tool kit for sustainable resource development.

47. In general, a cross-section of primary stakeholders could be envisaged who stand to gain from UNRMS including:

- Governments, notably decision makers, policymakers and regulators;
- Investors, public, private, institutional and retail:
- Local communities (local content and social licence to operate);
- Operators, manufacturers and service providers;
- Educators, academia and researchers.

48. Among institutional stakeholders who are invested in UNFC are:

- Renewable Energy: The alternative energy industry does not have a consistent classification and development system like the mineral or petroleum industries. This complicates the analysis and comparison of projects by investors, governments and regulators. UNFC is already filling the need for classification; UNRMS will aid and clarify the development.
- African Union: African Union Commission has the initiative "UNFC for Africa" to develop and implement a unique continental system for the sustainable management of mineral and energy value chain in Africa as a tool to implement the Africa Mining Vision (AMV).
- European Union: European Commission for harmonizing the classification and management of raw material and energy resources in Europe. Several Horizon 2020 projects have work packages to test and implement UNFC as the resource management framework in Europe.
- EuroGeoSurveys (EGS): The community of European National Geological Surveys is committed to the development of UNFC and UNRMS. The Mineral Resource Expert Group of EGS is mapping the interoperability between national datasets and UNFC with the development of many case studies.
- Norway: Norwegian Petroleum Directorate (NPD) has been using UNFC since 2014 for classifying about 700 individual petroleum projects and reporting in annual resource accounts.
- Russian Federation: Has bridged its petroleum system to UNFC and aims to do the same with its minerals system and pilot the use of UNFC in the Commonwealth of Independent States (CIS) region.
- China: Has bridged its mineral and petroleum systems to UNFC and seeks to support stakeholder institutions involved in resource management in the Belt and Road Initiative (BRI) countries to adapt their approaches in line with the 2030 Agenda to address infrastructure gaps, based on the golden principles of extensive consultation, joint contribution and shared benefits.
- Mexico: Piloted UNFC for identifying and classifying the social and environmental aspects to project advancement in a number of their development areas (see ECE/ENERGY/GE.3/2019/5).