United Nations ECE/ENERGY/2022/7

Economic and Social Council

Distr.: General
15 September 2022

Original: English

Economic Commission for Europe

Committee on Sustainable Energy

Thirty-first session
Geneva, 21-23 September 2022
Item 5 of the provisional agenda
Modernizing resource management

Resources as a Service: A catalyst to accelerate the energy transition, safeguarding climate action targets within the circular economy – Draft for discussion

Prepared by the United Nations Resource Management System Sub-group of the Expert Group on Resource Management

Summary

Successful delivery of climate action and the Sustainable Development Goals against an emerging climate crisis combined with severe food and energy crises worldwide, more than ever, requires urgent, coordinated and simultaneous attention at government, community, and individual levels to manage and use all natural resources as efficiently and fairly as possible while eliminating all avoidable wastes. By their very nature, such measures will significantly accelerate the transition to a circular economy, a possible way the capacity of the earth's natural endowment to meet the needs of both current and future generations can be assured through the reduction of the energy, climate and environmental footprint of any human activity. The Resources as a Service (RaaS) approach offers a means of expanding to a feasible, acceptable and resilient practice of responsible resource management, using the United Nations Resource Management System (UNRMS) as a delivery platform, as recommended in the May 2021 UN Policy Brief "Transforming Extractive Industries for Sustainable Development" developed entirely in keeping with United Nations values and policies. This document presents the concepts, options, guidelines and best practices required to enhance the transition to attain the SDGs by complementing the UNRMS with the concept of RaaS. The RaaS model will not change UNFC, UNRMS principles, or its various applications. The concept proposed in this draft document must be tested in appropriate resource life cycles before verifying its actual use. It may not apply to all situations and resources.

Please recycle

Acknowledgements

The experts who have contributed to the drafting and review of this document are Julian Hilton, Aleff Group, UK; Simon Michaux, GTK, Finland; Ludwig Hermann, Proman Consulting, Austria; Frances Wall, University of Exeter, UK; Teresa Ponce de Leão, Laboratório Nacional de Energia e Geologia, Portugal; Bob Felix Ocitti, Expert, African Union; Charlotte Griffiths, ECE and Harikrishnan Tulsidas, ECE.

I. Introduction – Sustainability challenges to the circular economy

1. The United Nations Policy Brief on Transforming the Extractive Industries, 25 May 2021,[1] identifies the extractive industries as perhaps the most critical to successfully delivering the Sustainable Development Goals (SDGs),[2] notably SDGs 7, 8, 9, 12, 13, and the Paris Agreement.[3] However, current raw materials extraction and recycling are too low to accommodate the energy transition, and a broad section of society is increasingly concerned about the social and environmental impacts of the activities of the extractives industries. Concerns related to the wellbeing of indigenous peoples worldwide, and other challenges, such as low environmental standards, freshwater use and poor governance, make the energy transition and climate action goals hard to achieve. The central point identified in the Policy Brief – the need for a "shift in mindset" – is the issue of dealing with the extensive range of environmentally damaging and highly costly negative externalities, a legacy of the past. Of these, climate change is the most serious and most universally significant. This means a radical shift from past practices of extractive activities sourcing a market to the Resources as a Service (RaaS), taking one (or more) step further to encompass how resources are deployed to meet societal needs. The various business cases to achieve this must be built with the participation of the extractives sector, as underlined by the Policy Brief:

> "**Transforming extractive industries must be part of the solution. This will require giving equal weight to the management of the impact of extractives on societies and the environment, as has been given to economic considerations in the past.** A shift in mindset is also needed away from short-term economic considerations to long-term financial risks and broader-based benefits associated with the transition to net-zero economies, that include social, environmental and cultural externalities."

2. Delivering this "shift in mindset" demands nothing less than a total resource management reset, based on improved and robust information on the value of the benefits that an increase in current costs will achieve, as best crystallized in the circular economy transition,[4] combined to the development of a social circular economy model which will mainstream circular economy in the households and societal life and promote sustainable production and consumption patterns.

3. RaaS is a fundamental principle of a CE, an economy that, by definition, decouples economic activity from the consumption of finite resources. A CE is a resilient system that is good for businesses, people, and the environment.[5] Often mistakenly reduced to a single objective, recycling, the circular economy is a comprehensive, holistic, constantly developing economic concept that aims to revolutionize our production, consumption, and interaction with nature. The CE aims to reduce demand for primary materials, improve the quality of life, and create a sustainable, regenerative society while reducing any human activity's climate, energy and environmental footprint.

4. These concepts are now being turned into regulatory principles. For example, the European Union (EU) uses the concepts of "zero pollution" as well as "zero waste" to boost

[1] UNITED NATIONS, Policy Brief: Transforming Extractive Industries for Sustainable Development, New York, May 25, 2021, see https://www.un.org/sites/un2.un.org/files/sg_policy_brief_extractives.pdf

[2] UNITED NATIONS Sustainable Development Goals, New York (2015) (https://sdgs.un.org/goals)

[3] THE PARIS AGREEMENT, Paris (2015), see https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[4] See also negative externality case study, HILTON, J, "Phosphogypsum – management and opportunities for use: Resolving a conflict between negative externality and public good", Proc. No. 587, International Fertiliser Society, Leek, UK, (2006).

[5] Ellem MacArthur Foundation Circular economy introduction https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

the "Waste Hierarchy" manage waste as a resource and the "do no significant harm"[6] to promote green financing, i.e. eligible green projects in line with CE. This is to ensure the transition from the still prevailing linear economy to CE, which must also become the dominant economic model as promoted by the EU. All the above objectives are foreseen in the EU Climate Law (Regulation) and the Fit for 55 legislative packages, as well as in the strategic policy framework of the EU "Green Deal", supported by an appropriate Investment Framework of the Recovery and Resilience Plan, the Just Transition Fund and various other financial instruments. The CE model promoted by the EU is holistic; all its actions are spelt out in two consecutive Action Plans of the European Commission endorsed by the Council and the European Parliament. The implementation of the new CE Plan of 2020 will be measured against a compound of social, environmental and economic indicators. Progressively applying these indicators will largely determine significant strategic investment and capital allocation decisions by both governments and the private sector, whole life cycle operational performance monitoring and assessment procedures, monitoring and enforcement of extended producer liability responsibilities, executive remuneration packages, and financial reporting standards and obligations.

5. In the light of the growing worldwide momentum in the post-COVID-19 economic recovery phase towards this transition from a linear to a CE, it is a particularly convenient time to reassess and revalue the growing number of opportunities for the safe, beneficial valorization of these materials with a "zero waste" outcome in mind. While there is a close-to universal agreement that these issues must be dealt with urgently and systematically, the actions, including establishing framework conditions to foster positive business cases, required to implement that agreement are falling far short in terms of scale and precision, critical delivery timelines. The Food and Agriculture Organization of the United Nations (FAO) signalled in December 2017,[7] "We only have one Earth. Now is the time to take action,"; but as of June 2022, we are still further away from protecting that one Earth than four years ago. The upcoming COP27 in Sharm El Sheik should not become one more missed opportunity. It should underscore the urgency and the need to boost and coordinate further climate action and to promote CE as the economic model ensuring climate transition and leading to climate neutrality.

6. The clearest indicator of the need for this seismic paradigm shift in resource management can be found in the previously referenced Policy Brief: "As the global population increases, the demand for minerals and metals is almost certain to rise. Extractive industries are on the frontline of extracting and recycling sufficient raw materials to cover the high demand for the energy transition and the circular economy (CE). They are central to meeting climate action targets. In 2017, extraction reached 92 billion tons, compared with 27 billion in 1970. If current trends continue, the world will require 190 billion tons of material annually by 2060, including green technologies needed for a transition to a sustainable future. These trends make an increasingly urgent need for an inclusive and circular economy".[8] The issue becomes even more significant when it comes to critical raw materials. Enlightening in that respect is the "Report on Critical Raw Materials and the Circular Economy" of the European Commission of 2018 and subsequent relevant European Commission publications available on its website. The statement is, in turn, built on the 2019 appraisal by the UN Environment Programme of just how quickly the global demand for critical resources commonly associated with the naturally occurring radioactive material industries is outstripping demand and is restated in the Policy Brief as Recommendation 11 which is to:

[6] EUROPEAN COMMISSION, 'Do no significant harm' Technical Guidance by the Commission Recovery and Resilience Facility, Brussels. 16 February 2021. See also Taxonomy Regulation. https://ec.europa.eu/info/sites/default/files/2021_02_18_epc_do_not_significant_harm_-technical_guidance_by_the_commission.pdf

[7] Food and Agriculture Organization, "We have only one Earth", See https://www.youtube.com/watch?v=ejeSYO4ETPs

[8] UNITED NATIONS ENVIRONMENT PROGRAMME UN Calls for Urgent Rethink as Resource Use Skyrockets, UNEP (2019). Available at www.unep.org/news-and-stories/press-release/ un-calls-urgent-rethink-resource-use-skyrockets

> "Establish clear national visions, strategies, and industrial policies to support a just energy transition and attain a circular economy […]".

7. This document presents the context, concepts, and options required to transition to a RaaS model.

A. Total resource reset

8. The economic model which has driven the build-up of negative externalities to the point of causing actually and potentially severe damage to Earth's climate and biodiversity is the "linear" system of "extract – use – dispose of ". This has been mirrored in a business model focused on the commoditization of essential resources, notably energy, predominantly fossil fuels such as coal, oil and gas, founded on its green-house gas generating combustion. As the world is learning, extraction and use of commoditized fossil fuels have increasingly caused national, regional and global conflicts with ancillary impacts such as uncontrolled, large-scale migrations. As the pressure on land and water resources reciprocally increases, the harmful social, environmental, and economic impacts will be further exacerbated. The higher the degree of concentration on commoditizing resource use, the higher the potential negative externality burden that results in the "resource curse" phenomenon experienced in many different socio-economic and geographical contexts over the past two centuries.

9. The symptoms of that curse manifest as: "land loss, the destruction of sites of cultural heritage or spiritual significance, marginalization and systematic discrimination and the impacts from associated air, water, and social pollution have also exacerbated the loss of lives, health, livelihoods, identities and cultures, pushing many indigenous peoples into extreme poverty while prompting localized armed conflict".[9] Little wonder then that the social licence to operate between the extractives industries and the communities in which they serve or plan to invest is so hard to regain. Climate migration is also happening and is exacerbated by the above.

10. In that regard, the Policy Brief points out:

> "The challenge now is to both ensure that […] **those countries rich in the materials needed for the green transition can capitalize on these trends and achieve economic and social benefits,** in the same way, that now-advanced economies benefitted from their resources during and after the Industrial Revolution, while keeping sustainability objectives, including the goals of the Paris Agreement, front and centre."

11. So, it becomes increasingly clear that a modestly-paced "shift in mindset" is not enough. Though undoubtedly necessary, the burden of externality is well beyond the point where process optimization within existing linear production and consumption models is sufficient. Only an immediate step-change to a new, circular, service-based paradigm of balanced and integrated resource management will provide solutions. This change will be as transformative as natural resource management practices and attitudes as the market shift to "stakeholder capitalism" transform policies and procedures in managing financial resources.

B. Circularity and the end of wastes

12. The CE responds to many challenges by reducing waste and closing the material and process loops, thereby preserving the earth's natural capital. It is underpinned by a transition to renewable energy and materials. The Ellen McArthur Foundation defines CE as a system solution framework based on three principles, driven by design:

- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature.

[9] UNITED NATIONS, Policy Brief: Transforming Extractive Industries for Sustainable Development, New York, May 25, 2021, see https://www.un.org/sites/un2.un.org/files/sg_policy_brief_extractives.pdf

13. A circular economy decouples economic activity from the consumption of finite resources. The circular economy may not meet all the demands for raw materials. Still, it can contribute to a resilient system that is good for businesses, people, and the environment.[10] Often mistakenly confused with recycling, the circular economy is holistic, constantly developing an economic concept that aims to revolutionize our way of producing, consuming, and interacting with nature. The circular economy aims to reduce demand for primary materials, improve the quality of life, and create a sustainable, regenerative society while reducing any human activity's climate, energy and environmental footprint.

14. This broader perspective makes existing linear business models seem primarily inefficient and wasteful. The circular economy's challenge has been to conceptualize and integrate new business models to address these inefficiencies and create new value. The existing circular business models attempt to close, slow down, narrow, intensify and dematerialize the resource loops (Table 1).[11] In this respect, Environmental and Social Governance (ESG) patterns are developing fast to mainstream CE into the business sector and thus attract green financing for private businesses, transforming thus the concept of ESC into Circular ESG (CESG).

Table 1
Five business models of the circular economy

Closing the resource loops	*Substituting primary materials with secondary materials through reusing, repairing, remanufacturing, or recycling is essential in this context, industrial symbiosis.*
Slowing down resource loops	Reducing the environmental footprint by extending the lifecycle of products
Narrowing the resource loops	Increasing the efficiency of production, distribution, and consumption processes by implementing technological improvements, reducing waste or energy consumption
Intensifying the resource loops	Removing idle times when products are not used (renting otherwise empty apartments)
Dematerializing the resource loops	Replacing products with services (leasing the light instead of buying a lightbulb)

Source: UNECE, based on Geissdoerfer, M., Morioka, S., de Carvalho, M., & Evans (2018).[12]

15. As shown in Table 1, dematerializing resource loops means replacing products with services.

16. In modelling an accelerated transition from a "linear" to a "reuse" to a "circular" economy (see Figure I), the following key assumptions are applied:

(a) The defining principles of the circular economy are RaaS, optimized use efficiency, and primary resource conservation, leading to "Zero Waste" (See Section II);

(b) The default resource management condition is that accessing "primary" resources is necessary only when "secondary (reusable)" resources are not sufficiently available;

(c) New materials may be found from secondary or primary resources, where the attribute "new" maybe (i) previously unused, now used (or critical for) innovative purposes;

[10] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

[11] Geissdoerfer, M., Morioka, S., de Carvalho, M., & Evans, S. (2018). Business models and supply chains for the circular economy.

[12] Martin Geissdoerfer, Sandra Naomi Morioka, Marly Monteiro de Carvalho, Steve Evans (2018) Business models and supply chains for the Circular Economy. Available at: https://doi.org/10.1016/j.jclepro.2018.04.159

(ii) once used but for other purposes; (iii) reprocessed for innovative purposes using innovative technologies;

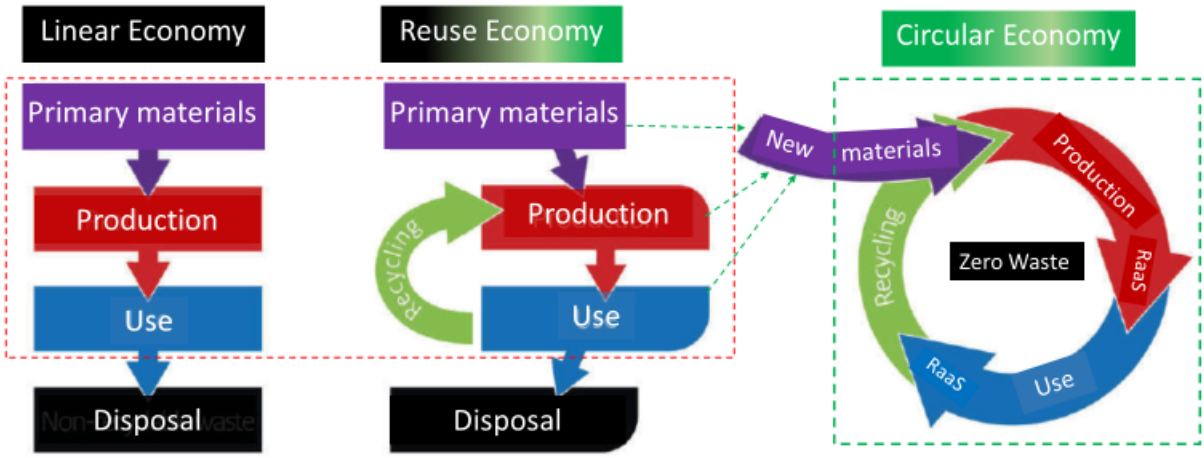
(d) The Linear economy is broken: "Extractive" requires a new, "circular" narrative based on redefined "lifecycles" for all resources. All resources stay within the system boundary, even if no foreseeable solution to their current status as "waste" is currently available;

(e) Resources are managed in "nexus" structures or clusters, such as Food: Energy: Water (the FEW nexus), based on meeting essential SDG needs and within a new Social Resource Contract;

(f) Risk/benefit models and algorithms need to be fundamentally rethought;

(g) The process needs to be supported by digital economy tools and data banks for separately collected recyclables, and industrial symbiosis resources/secondary products must be developed.

Figure I
Transitioning from Linear to Reuse and Circular Economy – Resources as a Service and Zero waste as drivers



17. Following these fundamental assumptions, and adopting the importance of the principle of "Zero Waste" in delivering a CE, is, of course, an aspirational goal. But it is to question and challenge at root the convenience of linear economic models of resource production and use that waste at scale is inevitable and a cost of doing business. Often behaviours which incentivize and reward waste are promoted. So, the Total Resource Reset is a circular economic, moral imperative, a perfect complement to "Zero Waste". And RaaS is the stewardship and governance algorithm for sustaining and sustainable circular resource flows. RaaS as a producer/ consumer concept accords with "Zero Waste" because the optimal outcome in efficient resource management is that the consumer is instinctively responsible and does not need a constant challenge to stop generating waste.

18. Early analysis of one of the unexpected benefits of blockchain systems implementation, for example, in the food production and consumption sector, is that real-time and accurate digital traceability and trackability of wastes – primarily user-generated wastes such as buying food but never eating it or cooking it for others to eat – has an immediate impact on "smart" consumer behaviours. The consumer in the circular model is fully integrated into the circular resource flow, and grounded in the objectives of SDG 12, recognizes both the need for (obligation to) responsibility on the part of the consumer not to be a net contributor to avoidable waste in the resource flow but also appreciate and quantify the tangible social and economic benefits of doing so. And as SDG 9 on industry, innovation and infrastructure is embedded in RaaS, the smart consumer is a natural and progressive innovator. Of course, the irony is that the habits of mind that underlie this smart behaviour are uncannily similar to pre-industrial revolution behaviours, mainly regarding food, renewable energy, and water sources.

C. Resources as a Service model to complement the commodity models

19. The "as a Service" model is not new, originating in the financial meltdown of 2008. It began as a modest experiment but had since rapidly gained traction, to the extent accelerated by the COVID-19 pandemic. It is transforming the industry globally, whether in retail, journalism, manufacturing, media, transportation, or enterprise software. Today, many significant companies generate most of their revenue from committed services that could be subscribed over small to large timeframes. The service model is quite different from the commodity model, which binds the extractive industries perpetually to the instabilities of daily commodity price changes. In other sectors, commerce is being reorganized around the subscription model, which gives the companies predictive revenue.

20. The Resources as a Service (RaaS) paradigm rests on achieving and maintaining a new equilibrium of social, environmental and economic benefits in our management of natural resources. Its founding principles are zero or minimal waste, zero harm and the transformation of negative externalities into positive internalities such as public good and intangible assets, new knowledge and new capabilities.

D. UNRMS and the Concept of Resources as a Service

21. The United Nations Economic Commission (ECE) Expert Group on Resource Management has developed the United Nations Framework Classification for Resources (UNFC), a tool for classifying and reporting projects based on environmental-social-economic viability, technical feasibility and degree of confidence in estimates of quantities of resources. Recently, the United Nations Resource Management System (UNRMS), in complement to UNFC, has entered the specification and development process supporting the resource delivery aspects of meeting the 2030 Agenda for Sustainable Development. UNRMS is a voluntary global standard for integrated resource management within the framework of public, public-private and civil society partnerships that is uniformly applicable to all resources.

22. For sustainable resource management to be holistic, i.e., respond to the complexity of all resources, time and space scales, and life cycles, it should be principles-based. UNRMS is based on twelve fundamental principles that provide general guidance on sustainable resource management's direction. The fundamental principles of sustainable resource management are as follows:

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

(b) Responsibility to the planet;

(c) Integrated management of resources;

(d) Social contract on natural resources;

(e) Service orientation;

(f) Comprehensive resource recovery;

(g) Value addition;

(h) Circularity;

(i) Health and safety;

(j) Innovation;

(k) Transparency;

(l) Continuous strengthening of core competencies and capabilities.

23. As seen above, UNRMS principles strongly focus on sustainable development while expanding it from the net quantities used. Value addition, circularity and innovation are the fundamental principles and are well tied to the RaaS concept. The principles point to opportunities that the industry can enrich, including the Micro, Small and Medium

Enterprises (MSMEs). Examples of such subscription-based opportunities are provided in Table 2.

24. UNRMS Principle 5 service orientation, the principle that resources are to be produced primarily as a service to society, is at the heart of the RaaS concept. Decoupling natural resource use and environmental impacts from economic activity and human well-being is essential to transition to a sustainable future. Achieving decoupling can deliver substantial social and environmental benefits, including repairing past environmental damage while supporting economic growth and human well-being. Service orientation departs from the narrow and restricted commodity view of resources hitherto followed by the resource sector. There is a growing recognition that industry, including resource-based industries, primarily exists to "serve" customers, employees, suppliers, and communities. Industry can only create long-term value for shareholders and society through that service perspective.

Table 2
Potential services based on the UNRMS model

UNRMS Principles	*Examples of services*
State rights and responsibilities in the management of resources	Information and knowledge management, Cadastral and GIS services, regulatory support services, technical and financial services
Responsibility to the planet	General environmental services, Environmental Impact Assessment services, and Strategic Environmental assessment processes under the Espoo Convention and the SEA Protocol, Climate Proofing, Environmental Liability, Environmental Criminality, Environmental Management and Audit Schemes, Ecolabel, reducing carbon footprint in operations, coast-benefit assessments, resource efficiency improvements, land use management services, biodiversity conservation and improvement services, sustainability reporting services, implementation of sustainability standards
Integrated management of resources	Multi-resource assessments, integrated supply chain management services, life cycle assessments and management services
Social contract on natural resources	Social communications, real-time information availability services, and local content development services include indigenous peoples, gender and disability sensitization, human rights monitoring, environmental information, public participation and justice under the Aarhus Convention.
Service orientation	Resources as a Service business model generation, strategic consulting services, long-term investor value creation services such as valorization of intangible assets, customer value-creation services
Comprehensive resource recovery	End-of-life mine reassessments, brownfield exploration services, residue utilization models and strategies, intangible assets management
Value addition	Up-stream linkages into resource capital goods, down-stream linkages into beneficiation, processing, refining and manufacturing, consumables and services industries, side-stream connections into infrastructure (power, logistics, communications, water) and skills and technology development

UNRMS Principles	*Examples of services*
Circularity	Residue valorization and management services; Recycling, Reuse services, conservation of water, land and soil resources
Health and Safety	Personnel protection and monitoring, risk management, emergency and disaster preparedness management services, quality assurance and control
Innovation	Research and development in new processes and materials, diversification and technological upgrading, carbon neutral process development
Transparency	Blockchain-enabled services to enable transparency and traceability
Continuous strengthening of core competencies and capabilities	Human resource development on new social, environmental and resource consciousness

25. The UNRMS requirement for service orientation promotes RaaS as a business model whereby customers pay for a value-added product or service, such as heat, light or mobility, without owning the resources themselves. The RaaS model will not change UNFC, UNRMS principles, or its various applications. The concept proposed in this document must be tested in appropriate resource life cycles before verifying its actual use. It may not apply to all resources.

II. The origins of Resources as a Service

26. Resources as a Service is applied in cloud computing, where the use of a server or software system is charged "on demand" or "as used", i.e. by the second or minute, or per transaction, like hiring a taxi rather than leasing or taking ownership of the car. The premise is that the business model which RaaS support is one "which requires economic decisions to be taken in real-time by automatic agents".[13] When the RaaS model extends into the uses of natural resources, the concept of "service" is even more pronounced, balancing the intrinsic value of the help with the service it provides to the user or beneficiary. The value proposition undergoes a fundamental pivot in the circular economy continuous lifecycle model. Away from the resource as a "fungible token," i.e., as a commodity, one unit of which the customer buys, for example, as a litre of water, a kilowatt/hour, a kilo of flour), to the resource as a unique "non-fungible token" where at the point of service delivery the benefit conveyed is special to that moment and that individual consumer or that community.

27. In the RaaS model applied to tangible resources such as food, energy and water, the blockchain or verifiable digital identifier concepts of the "automatic agent" is replaced by an "instinctively responsible consumer" whose behaviour and values as a consumer are aligned to the principles of sustainability and are fully respectful of the importance of the principle of public good in ensuring the security of access to and affordability of resources critical to life. This, in turn, shifts the emphasis from a supply-driven linear model of value to a supply-demand equilibrium where each consumer derives benefit from a given resource or resource combination but also recognizes that with that benefit comes responsibilities. These are: (i) to optimize the use of that resource, (ii) to reduce or eliminate avoidable waste, and (iii) to aid the onward progression of the resource flow to contribute to the sustainable (intergenerational) security of the supply of that resource.

28. For the objectives of the 2030 Agenda to be met, there must be a secure, ideally uninterrupted, fully trackable and traceable flow of natural resources within a circular

[13] Danielle Movsowitz, Orna Agmon, Ben-Yehuda, Assaf Schuster, Attacks in the Resource-as-a-Service (RaaS) Cloud Context, International Conference on Distributed Computing and Internet Technology 2016, pp 10–18.

economy. But rising population numbers and increased urbanization will significantly add pressure to demand per person, especially in high-income countries. Every two years, the United Nations makes projections for future population growth. Its latest medium projection estimates a population of 9.7 billion in 2050 and 10.4 billion in 2100. These numbers will exceed the Planet's carrying capacity unless the circular economy becomes the dominant economic model and is fully implemented worldwide. Current patterns of resource consumption are highly skewed. Populations in high-income countries typically consume more than 25 tonnes of resources per person per year[14]in their CESG plans.

29. In contrast, in the lowest income economies, resource consumption per head is less than 2.5 tonnes per year, i.e., some 90 per cent less. As living standards improve in medium- and lower-income countries, consumption rates will increase and may not reach the current trends. The overall quantities of resources required to meet that demand will increase drastically, to a point which will be wholly unsustainable and force efficiencies in both high- and low-income economies. Significant opportunities exist in shaping development patterns to give rise to such efficiencies.

30. A linear model which increases resource production and supply pro rata to meet demand and consumption predicates a planet of potentially infinite resources. The Earth's capacity to help, however, is finite. And the relentless increase in production, if conducted in a "business as usual" manner, will generate an even higher burden of negative externalities, starting with a potentially catastrophic environmental and carbon footprint. With grades of mineral resources becoming poorer and sourcing both mining and petroleum products reliant on increasingly difficult and expensive sources to valorize, the Energy Return on the Energy Invested (EROEI) is significantly squeezed. These factors rapidly crystallize into insurmountable problems, whether passing beyond the point when reversing the global warming temperature trend is possible or weakening the social contract between suppliers and consumers of natural resources that relations break down or end in conflict, the "weaponization" of resources. It is the imminent metastasizing of these problems that have also forced investors and financiers to extend and enrich the concept of "materiality" in terms of decision-making on investment approval or capital allocation for resource progression, to create a concept of "double materiality" where economic factors are in equilibrium with both social and environmental factors. This means "companies have to report how sustainability issues affect their business and their impact on people and the environment".[15]

31. Resource use efficiencies need to be improved drastically. Decoupling development and resource use are required, which means getting more out of fewer resources.[16] However, although some materials producers are planning for, and even approaching, 100 per cent recycling of all they produce, for example, steel and aluminium industries, in aggregate, the current volumes of materials recycled across all resources are only 8 per cent of total flows (REE recycling is less than 1 per cent).

A. Behavioural change – the rise of the instinctively responsible consumer

32. Thanks to the rise of the instinctively responsible consumer, especially in the younger generations, the focus has now shifted from producers and goods to consumers and outcomes.[17] The product is discrete and transactional but focusing on consumers and outcomes represents enduring value. Conventional product cultures are built around linear thinking, and assembly lines are organized into linear flows. Everything is in a perfectly straight line. A commodity company does not occupy a valued position in the customer's mind. The lack of visibility from both sides makes the company and customer growth unrelated. This boils down ultimately to the breaking of trust at a community level.

[14] UNEP (2019) Global Resources Outlook. https://www.resourcepanel.org/reports/global-resources-outlook

[15] See European Commission https://ec.europa.eu/commission/presscorner/detail/en/QANDA_21_1806

[16] See UNEP (2019) Global Resources Outlook https://www.resourcepanel.org/reports/global-resources-outlook

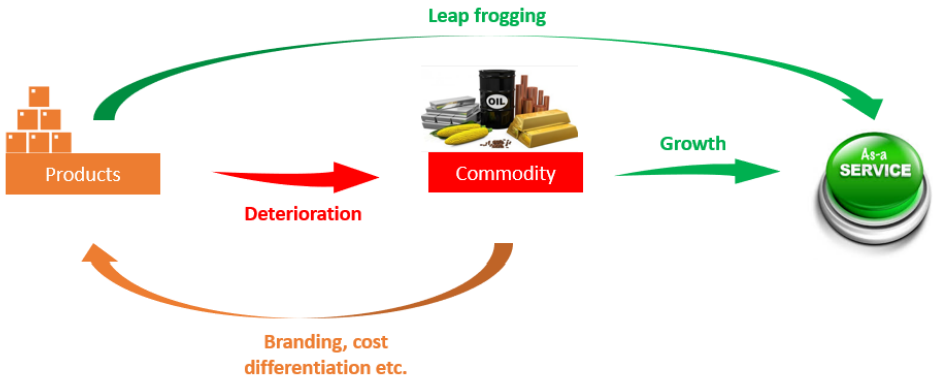
[17] Tzuo, T., & Weisert, G. (2018). Subscribed: Why the subscription model will be your company's future and what to do about it. Penguin.

B. Resource use efficiency and closing the loops

33. The success of an industry focused on services will not be judged by the extent to which productivity per worker and overall production outputs increase but by the degree of its capacity to innovate, its success in recovering and reusing secondary resources, in reducing the demand for and use of primary resources, and in lowering its levels of energy- and land-use intensity which taken together a new, sustainable point of equilibrium in the service supply/ demand equation. At its simplest, from a balance sheet perspective, this pivot moves the net present valuation of the industry from a primary or total emphasis on its tangible assets to its intangibles. The intangibles' valuation is grounded in its workforce and supply chain's capabilities and delivering enduring benefits through its value chain to its loyal and satisfied customers. A combination of resource efficiency and innovative substitution – for example, green ammonia for fossil fuel energy or new materials for construction - will be at the core of performance evaluation, which translates to efficient production with the least environmental or climate footprint. Industry and users become real partners and grow together. Customer loyalty will permeate society, and an actual social contract on natural resources will be fostered.

34. Suppose the extractives sector takes the RaaS step change. In that case, it will subsequently be much more straightforward for the "commodity" industry to evolve into a service industry (Figure II), just as accepting Environmental, Social and Governance (ESG) principles of investment will significantly facilitate the mobilization of primary financial resources to fund this. The manufacturing industry is, in many ways leading this change from within. Instead of focusing on products, inventories, and promotion, the industry is razor-focused on the audience, its customers. Transitioning to a service industry has been less painful than imagined for any industry that has walked this path. Information technology (Software as a Service, Artificial Intelligence as a Service, Blockchain as a Service, etc.), media (Content as a Service), manufacturing (Product as a Service) and transport (Transportation/Mobility as a Service) provide a few good examples of this transformation.

Figure II
Possible pathways to transforming the "commodity" industry into "a service" industry. The commodities can evolve into products and subsequently to "as a service," or commodities can be converted directly to "as a service"



35. Even if market vagaries are inherently not fully controllable for complex supply chains, better prediction and preparedness will be possible as blockchain, verifiable digital identifiers, and machine learning tools are increasingly smart. The resultant enhanced stability of the resource market will benefit governments, who can anticipate stable economies and thus plan better, especially for unforeseen crises such as COVID-19. The transformation will foster a more equitable distribution of benefits across all societal stakeholders, thus firming firm foundations for the social contract on natural resources.

III. Resources as a Service – A policy approach to reducing resource consumption

36. Over the past 50 years, a significant acceleration in resource consumption has been observed, resulting in exponential, non-sustainable growth of mineral and fuel extraction, production and use.[18] A global economy assuring the wellbeing of a maximum number of human beings while retaining resource extraction and consumption within planetary boundaries requires total resource management - producing more with less.[19] The target is simple to express, but how can it be achieved?

A. Decoupling

37. The decoupling concept is focused on performing the desired function. In contrast, the operation performed is individual, non-tangible and service-based. The primary function of food and drink is to quench hunger and thirst; the primary function of garments is to protect humans from wind and cold; and the primary function of a car is individual or group mobility, transportation of their goods, equipment and belongings. Yet, all of the above products have multiple functions going far beyond the mechanical or transactional, e.g. the social standing humans may attribute to owning a fancy car or wearing a fashionable outfit. A lesser challenge will be the transfer of more basic commodities to a service. The function of fertilizers is to make or keep soils fertile, and soils provide growing media and nutrition to crops. Economists must stop measuring the success or failure of a business by the number or volume of items sold and used but by the achievement of a specific state or quality of service and outcome.[20] Yet, this requires a new way of thinking, a total resource mindset reset, and a "circular economy culture".

38. Fertilizers are an excellent example of the potential of de-commodification of an essential but commoditized good – a "fungible token" – and their transformation into individualized and collective services – "non-fungible tokens" – not equity but a utility token required by users to interact with the network.[21] The available services are food security, infant and child development and learning at school, and public health. Currently, fertilizers are commodities sold by tonnes of products. Growing a fertilizer manufacturer's business means selling more tonnes of fertilizing products. This holds for most, if not all, commodities. Yet, soil fertility can result from tools and measures such as enhanced biodiversity, soil improvers, bio-based fertilizers, speciality mineral fertilizers and digital tools accessing, interpreting and applying big data. Instead of selling and using more commodity fertilizers, a mix of nature-based solutions, digital tools, soil improvers, controlled-release fertilizers, or high-efficiency fertigation could be applied. In short, several services replace commodity products and perform the desired function, fertile soil for food and feed production.[22]

39. The current economic landscape shows singular developments in the right direction. Spectacles are being leased instead of sold. In German-speaking countries, Samsung has offered to take back used mobile phones for a fair price in part-exchange for new phones. Yet, leasing car batteries has been abandoned by Renault, one of the pioneers of such a "shared" system. A clear trend to circularity across all types of innovative devices is not yet visible. Leasing car tires – winter to replace the other season ones – has been successfully applied by some tire producers, as well as washing machines leasing, developing thus "services good practices".

---

[18] Marina Fischer-Kowalski, 2016, Decoupling of resource use and economic growth, and the role of international trade, International Resource Panel.

[19] World Commission on Environment and Development (WCED), 1987, «Our common future» also known as . «Brundtland Report» after the Commission's chairwoman, Gro Harlem Brundtland.

[20] Ernst Ulrich von Weizsäcker, 1995, Factor Four: Doubling Wealth—Halving Resource Use: A New Report to the Club of Rome

[21] Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: how the technology behind bitcoin is changing money, business, and the world. Penguin.

[22] The Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, European Union, 2020.

B. Subscription, membership or pay-as-you-go economy

40. In line with the original cloud-based business model for managing on-demand services to clients, such as real-time, on-demand automated decision-making, the broader RaaS economic model can be understood as a subscription or membership-based service arrangement but without minimum charges or commitments to use. In that sense, it has the attributes of a pay-as-you-eat food court, an "a la carte tailored service".

41. An excellent example of a transformative RaaS approach is where ownership of a physical resource for enabling individual mobility or freedom of movement is an "as needed" subscription to a car, scooter or bicycle sharing organization where the cost of the service equates exactly to its duration and successful delivery. By becoming a member of a time-shared ownership platform, one obtains the right to use, for instance, a car from a pool which eliminates the need for any individual to take full ownership of and responsibility for a vehicle and also remedies the current highly resource-wasteful situation where 90 per cent of the individually owned cars at any time are parked on the road or in a driveway and are not used. A membership economy may save unnecessary demand for the resource stocks taken up by cars and relieve pressures on critical raw materials supply chains.

C. RaaS in practice: Energy, IT, Media, Retail, Transport, Manufacturing

42. The transition from the combustion of fossil fuels to energy conversion from the action of wind on turbine rotor blades or of sunshine on a photovoltaic panel represents a "total resource reset" within the energy transition from a linear process of extracting fuels that are converted to heat and power by oxidation and which then release CO2 into the atmosphere to a reset process extracting minerals that remain in their solid state during use and which at the end of their lifecycle are fully recoverable, recyclable. From this perspective, using renewable electricity is a prerequisite to recovery and recycling in the sense of "reusing" a material. Green energy is also produced by tides and waves, green waste and biomass from agriculture, and biowaste. Biogas and biofuels can improve the green energy mix with geothermal energy and hydropower. Last but not least green hydrogen is the green fuel of the future. Current infrastructures – gas pipelines – need to be developed as "dual" ones to be able to transfer gas and hydrogen in the mid-term and hydrogen in the long term. Finally, storage capacity is key for all renewable energy systems.

43. Some sectors have already advanced some forms of RaaS. A good example is technology companies that have adopted a service strategy in favour of product sales. Instead of pursuing deals of engineering, equipment and manufacturing facilities, "predictive maintenance" service contracts are substituted with existing manufacturing plants to increase the service life and productivity of components and technical equipment. By closely monitoring the function of features, one can more precisely predict failures, swapping out the aged component before it fails to reduce the risk of such loss and more extensive damage to the equipment or the production process. An even more recent development involves creating a "digital twin" of the system which acts as a complete virtual facsimile of the actual system by implementing machine learning to record and understand the behaviour of the actual procedure and by overlaying AI over the performance history to optimize its future performance but also to predict and mitigate future operational inefficiencies and faults, the overall service performance and operator return on investment can be significantly enhanced.

44. Although these technologies are still in their relative infancy, efficiency increases of 15 per cent have been demonstrated by processing and energy conversion plants using such techniques.[23] Automated equipment reacts faster than the fastest operator. It operates machinery closer to the ideal "best practice" regime, increasing processing facilities' performance and uptime. Also, operators can be effectively trained, and manufacturing facilities can be monitored and serviced remotely. Only the physical replacement of components needs on-site work.

[23] DPP-Forum 09.09.2021, Dr. Peter Schmittel, BASF SE, Perspektiven der Mono-Klärschlammverbrennung.

D. Models: Consumables, Network model

45. RaaS provides opportunities for the circular economy. It could be the basis of new and circular business models – a service economy built on paid labour salaries. Reuse, remanufacturing and recycling are potentially more labour-intensive than extracting and processing primary resources. This would mean reducing the current tendency of constantly lowering the workload on one specific product to increase the capital- and material intensity. Reducing the tax load on labour and increasing it on money is probably necessary to make it a success.[24]

IV. The resource ecosystem: how the innovative resource sector can deliver Resources as a Service

A. Food, Water, Energy, Raw Material Nexus

46. The need to meet the UN SDGs demands management of all resources in a nexus format, not simply as individual commodities, which has been well recognized.[25] Building on this argument, ECE reports and documents have proposed that one such critical nexus – perhaps the key nexus for the SDGs – is that of Food, Energy and Water, without which life is essentially impossible.[26]

B. Innovation

47. RaaS meets this nexus management objective most clearly in its response to delivering SDG 9 "industry, innovation and infrastructure", where the service of innovation within a sustainable resource valorization ecosystem is the fulcrum for development, whether of industry or infrastructure. And the key to valorization is the optimization of resource stocks. It flows as this process indefinitely through the circular economy (see Figure I).

C. Breaking the silos

48. Within the industrial landscape, new ecosystems for energy production grounded in RaaS principles (see Figure I) are emerging, demonstrating how innovation cannot help but break silos and disrupt long-standing business sectoral boundaries. These innovative models not only address specific energy transition challenges but make new high-growth industries in the process. Green ammonia, for example, is forging new business models and technologies to develop and promote it as an energy source for shipping. This alliance can extend to shipbuilders and energy storage and distribution service providers.[27] Green hydrogen is spawning new financial-technical fusions, for example, between offshore wind power generation and hydrogen production from seawater – through desalination, zero brine, and processes – for shipment to land for storage and use.

[24] GROWTH WITHIN: A CIRCULAR ECONOMY VISION FOR A COMPETITIVE EUROPE, Ellen MacArthur Foundation and McKinsey Center for Business and Environment, 2015.

[25] Raimund Bleischwitz, Catalina Spataru, Stacy D. VanDeveer, Michael Obersteiner, Ester van der Voet, Corey Johnson, Philip Andrews-Speed, Tim Boersma, Holger Hoff, Detlef P. van Vuuren, Resource nexus perspectives towards the United Nations Sustainable Development Goals, Nature, December 2018. https://dspace.library.uu.nl/bitstream/handle/1874/411923/s41893_018_0173_2.pdf?sequence=1

[26] Natural Resource Nexuses in the ECE region https://unece.org/info/Sustainable-Energy/UNFC-and-Sustainable-Resource-Management/pub/355180

[27] For the Maersk Yara alliance and wider eco-system partnerships for Green Ammonia see https://www.maritime-executive.com/article/maersk-keppel-and-yara-join-forces-for-ammonia-bunkering-in-singapore

D. Critical raw materials as a Service

49. Critical raw materials (CRMs) are economically essential but are also highly vulnerable to supply-chain disruption or weaponization. Lists of necessary materials may be made for international regions (e.g. EU[28]), countries (e.g. USA[29]), or at the regional or company level. Examples of CRMs such as rare earth elements (REEs), lithium, and cobalt are enablers of many clean technologies essential for the energy transition and important for digital technologies. Creating RaaS models would decrease the environmental footprint of our use of CRMs. Still, they would also significantly improve the security of supply. More intensive use of the CRMs in circulation, more reuse and recycling, as in circular economy models, would be ideal for keeping resource flows in their countries of service. For example, in the application, many CRMs are dispersed in low amounts, in complex materials and components for which there are few reverse loops involving reuse and remanufacturing and few processes for recycling. End-of-life recycling and recycling input rates are low.[30]

50. One example of RaaS involving the CRM, rhenium, is the 'power by the hour' leasing of aircraft engines.[31] This RaaS model leads to an overall recycling rate of 50 per cent for rhenium. Most of Rolls Royce's rhenium supply is now recycled material21. The company's RaaS model has helped secure a critical raw material. Another example is the use of platinum group metals, which owing to their high economic value, have higher recycling rates than most CRMs. In the chemical industry, Platinum Group Metals (PGM) catalysts can be part of the initial capital investment for the plant, purchased on a 'supply and refine basis'. They then remain the user's property and are recycled (multiple times) through a refiner to create a new active catalyst.[32] This service model results in a recycling rate of 80-90 per cent for PGMs in catalysts, compared to a rate of 60-70 per cent in automotive catalysts where the PGM are recycled without using a RaaS model, to just 5-10 per cent recycling in waste electronics, where the small amounts, dispersion and complexity of components make recycling much more difficult.

51. Lithium-ion batteries require critical raw materials such as lithium, cobalt and graphite that are likely to be undersupplied in the next ten years as the battery market multiplies.[33] They are subject to much interest in possible service models. The small lithium-ion batteries in power tanks are among the best RaaS examples. Companies at events and airports[34, 35] offer the service of electrical charging for small consumer devices. The user pays and takes a power tank, charges their device, and returns it sometime later. Thus, the power tank belongs to the service provider who has it safe to use again and ready to recycle when need be. Moving to larger batteries, Sun Mobility has a battery swap business model for e-rickshaws to provide e-mobility as a service in India.[36] Chinese EV start-up NIO offers battery-as-a-service (BaaS) in China and now in Norway. It takes just five minutes to change to a new battery at its swap stations,[37] thus saving the time to charge a large battery. NIO has 885 power swap stations in China and plans 4000 worldwide by 2025. The Chinese company CATL also now has a BaaS model. Other major car manufacturers have not chosen this route. Although various models of short- and long-term car leasing converge towards RaaS, most

[28] European Commission, 2020, Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability, https://ec.europa.eu/docsroom/documents/42849. Accessed 18.7.22.

[29] Nassar, N.T., and Fortier, S.M., 2021, Methodology and technical input for the 2021 review and revision of the U.S. Critical Minerals List: U.S. Geological Survey Open-File Report 2021–1045, 31 p., https://doi.org/10.3133/ofr20211045. Accessed 18.7.22.

[30] EU Raw Materials Scoreboard https://www.era-min.eu/sites/default/files/docs/et0320656enn.en_.pdf

[31] Rolls-Royce celebrates 50th anniversary of Power-by-the-Hour https://www.rolls-royce.com/media/press-releases-archive/yr-2012/121030-the-hour.aspx

[32] University of Birmingham Policy Commission, 2021, Securing Technology Critical Metals for Britain. 84pp. www.birmingham.ac.uk/creamcommission. Accessed 18.7.22.

[33] https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions#abstract Accessed 28.7.22.

[34] https://www.lifesaverpower.com/pages/events Accessed 18.7.22.

[35] https://www.bristolairport.co.uk/at-the-airport/passenger-information/charge-before-you-fly. Accessed 18.7.22.

[36] https://www.sunmobility.co.in/about.html. Accessed 18.7.22.

[37] https://www.nio.com/nio-power Accessed 18.7.22.

people own their cars, including batteries. Some companies have plans for battery second life as energy storage, presumably expecting a high proportion of returns at the end of life via car scrap yards that they can use for this. The regulatory control of car scrappage is key to ensuring proper materials stewardship, and second-life uses will need the same level of regulation. Car RaaS schemes thus still seem to have some way to go, especially as most tariffs are competitive for people who can afford new/nearly new cars but not for the sizeable second-hand car market.

52. RaaS models seem absent from most products that use rare earth elements (REE), except in so far as they are used in motors in EVs and thus included in car leasing (see above). In most applications until recently, the amount of REE was too small (e.g. just a few grammes) to merit much interest, and hard disk drives were the most attractive product to recycle. EV permanent magnet motors and generators in large offshore wind turbines create much larger concentrations of REEs (up to tonnes of material in wind turbines). This is undoubtedly worth recycling and maybe worth the RaaS models to ensure collection. However, wind turbine manufacturers seem to be simply selling the turbines to energy companies. It is essential for the relevant circular economy plans to be developed as systemic tools to ensure specific waste streams and separate collection and recycling targets for wind turbines and PV panels.

53. In consumer electronics, RaaS models can overcome some of the problems of the diversity of equipment that goes to general recycling, 'hibernation' of old devices in people's homes and the frequent changing and upgrading. The responsible consumer mentioned above may be interested in buying a mobile phone service, returning the device - probably frequently - for reuse, remanufacturing or recycling. A few phone leasing schemes supply both new and refurbished equipment.[38] Apple is an example of a high-profile manufacturer that seems to be taking steps toward this route.[39]

E. Resources as a Service, Financial Reporting and Intangible Assets

54. In the language of financial reporting, RaaS enabled by UNRMS may be defined as an "intangible asset" designed to manage the "tangible assets" of natural resources in a balanced, integrated and transparent way. These tangible assets are addressed as "non-fungible tokens", where each unit ("token") of each resource is understood to have a unique role and service purpose according to an individual or societal need and circumstance and is managed as such within a circular economy, not as previously in a linear economy as a "fungible token," i.e. a commodity where there is no need- or circumstance-specific service value, simply a market price. While the market price effectively determines who gets and does not get critical resources, the resources as a service premise which underpins the non-fungible resource tokens assumes there is an overriding public good argument in force which ensures that even those who cannot afford the market price nevertheless have the right of access to that resource critical to meeting local individual and societal needs.

55. The central role of resource management determines this fundamental shift in the status of resources from fungible to non-fungible plays in delivering the UN SDGs as a whole, not just in providing specific goals and their respective performance objectives. This is particularly the case in delivering those resources critical to life and well-being, whether through food security to enable zero hunger, clean water and sanitation for good health and well-being or affordable and clean energy for climate-smart, productive economic activity.

56. The enabling technology to make this possible in RaaS based on UNRMS is a combination of distributed ledger, commonly known as "blockchain", and machine learning or neural networking, widely known as artificial intelligence, because by applying these technologies together, resources can be managed in a trackable, traceable and integrated manner. That integrated process lies at the heart of blockchain. In the distributed ledger,

[38] https://www.raylo.com/ Accessed 28.7.22.

[39] Cimprich, A., Young, S.B., Schrijvers, D. *et al.* The role of industrial actors in the circular economy for critical raw materials: a framework with case studies across a range of industries. *Miner Econ* (2022). https://doi.org/10.1007/s13563-022-00304-8

monies and molecules are simply two different ways of expressing the service value of the resource itself as delivered to the consumer or user, which fuse as a single resource currency.

57. From this fusion can also be derived the transactional aspect of UNRMS as a resource management tool, whereby the obverse of the coin ("heads") is data, and the reverse ("tails") is money. The payment process for using the intangible asset, whether pay as you go or subscription, consists of two complementary parts, the uploading or "paying in" of data about the tangible assets, including the volumes and values these data represent, and the downloading or "drawing down" of that data, in the form of a range of services, functionally as processed and updated by features of the ledger (the "smart contract") but also as resource management toolbox, interpreted and refined by the artificial intelligence which increasingly optimizes the capacity to meet SDG objectives, especially the critical needs of the global population.

58. These characteristics of a RaaS based on UNRMS show how it meets the International Accounting Standards (IAS) criteria for what an intangible asset is, as defined by three key attributes:

- Identifiability
- Control (power to obtain benefits from the asset)
- Future economic benefits (such as revenues or reduced future costs).[40]

59. Identifiability is determined by assigning a unique ID (token) as the tangible asset is first registered in the system. Control is given by the distributed nature of the ledger both to the transparency of the data to the user and by smart contracts that essentially automate the management of the benefits inherent in the access to and use of those resources (the service value or outcome). Future economic benefits are secured first by the public good distribution principle, which overrides the importance of the market price when affordability criteria otherwise prevent fair access, but also because the inherent nature of UNRMS to drive the goal of zero waste throughout all management of all resources, irrespective of what phase they are in of the circular economy at any given time or place.

60. While the RaaS-UNRMS model will be available in both on-demand (pay as you go) and subscription models, the dual transactional functions of "uploading" data and "downloading" services and service instruments, are the same. The subscription model, enabling continuous and uninterrupted access to and use of UNRMS, is of significantly higher value add. In particular, it is design and operation balance the conventional retrospective "rear view mirror" tracking, tracing and recording of the distribution and use of resources and associated costs and benefits (the diachronic axis) with an increasingly smart synchronic resource management capability which both plans ahead strategically to predict and support supply chain security objectives but also to manage real-time interventions is a response to unforeseen or unpredictable critical needs.

61. The subscription model is also likely to ensure the long-term financial viability of the resource management itself, at least based on a market analysis of subscription vs more conventional businesses. In the United States, from 1 January 2012 to 30 September 2017, comprehensive studies reveal that subscription businesses grew revenues about eight times faster than S&P 500 company revenues (17.6 per cent versus 2.2 per cent) and about five times faster than US retail sales (17.6 per cent versus 3.6 per cent).[41]

62. There is also a correlation between subscription business growth and GDP growth. The subscription business growth and GDP slowed around the end of 2016 and the beginning of 2017: US GDP growth peaked in Q3 2016 at 2.8 per cent and sank to just 1.2 per cent in

[40] Formal definitions of “intangible assets” for accounting purposes have become more sophisticated and complex that as first defined by IAS, see (see https://www.iasplus.com/en-gb/standards/ias/ias38), but as core principles they remain both clear and robust and hence are referenced here.

[41] Tzuo, T., & Weisert, G. (2018). Subscribed: Why the subscription model will be your company's future and what to do about it. Penguin.

Q1 2017. At the same time, the subscription business growth rate peaked in Q3 2016 at 21.6 per cent, then cooled to an average annual growth rate of 14.3 per cent.

63. Recurring revenue-based businesses in the Subscription Economy are not guaranteed success. Still, suppose they focus relentlessly on extending average customer lifetimes by integrating UNRMS fully into governmental and private sector resource planning, management, and use while minimizing churn rates and making a complementary usage-based (on-demand) billing option available. In that case, it is likely to achieve the same or even faster growth and better retention rates than those covered in the US case study outlined above.

F. Transition from a linear model to an "as a Service" model

64. Previous experiences of several traditional companies that transitioned as a Service model are informative. When an established company starts shifting its revenue mix from an asset purchase model to a subscription model, it experiences a string of quarters where top-line revenues shrink as revenues from large, pay-up-front deals are replaced by recurring subscriptions without the big up-front payment. At the same time as revenues dip, the company must invest in many of the new capabilities and structures required for profitable "as a Service". The traditionally profitable and stable mix of more revenue than costs is replaced with a tumultuous period of costs exceeding income.

65. Some companies face this situation of falling revenues by having a transitional hybrid model of traditional commodity or product and subscription models. The hybrid model gives the company some time to build its subscription base. As subscriptions increase, revenues will be back on track, and the company can entirely shift to 100 per cent as a service model. For several industries, the successful transition time was a few quarters or about one or two years or less.

66. As many experiences accumulate, several companies learn lessons and manage the transitions less painfully. It has been observed that better planning for a smooth transition could be possible for RaaS companies.

V. Policy drivers: Regulation of Resources as a Service

67. The SDG-derived policy drivers adopted in this document to guide delivery and effective regulation of RaaS as applied to natural resources share a crucial assumption. That is, the purpose of adopting RaaS as a framing condition of resource management policy is to facilitate and enhance the efforts invested by individual nations to improve their overall management of natural resources to benefit their citizens in the face of a severe global challenge. This is to be achieved by enhancing: (a) social, environmental and economic performance in national resource management, in particular ensuring security of access for all to critical resources, such as food, energy and water; (b) equitable distribution of benefits to national citizens from valorization and use of these resources by third countries or external investors; (c) enhancing governance, accountability and stakeholder confidence in natural resource management.

68. Given the wide variations in needs and priorities between different countries and within them, there is no universal solution that is equally applicable in every country. Each country's approach should be guided and shaped by the general principles of the laws concerning natural resources, which determine how people can variously access but also maintain the services of the natural environment, irrespective of what these services are, for both economic and societal benefit. Hence for the energy sector, the general principles of good regulation must apply such that energy regulation is not solely determined and enforced by energy-specific aspects of the law but by the general principles of sustainable development as a whole.[42] Blockchain technology is a nascent technology that is evolving every day. It

[42] del Guayo I, 'The Evolution of Principles of Energy Law (a Review of the Content of the Journal of Energy & Natural Resources Law, 1982-2022)' (2022) 40 Journal of energy & natural resources law 43.

holds enormous transformative potential in many fields and "could transform how our economy works". The challenge will be to strike the right balance between ensuring the system's governance, safety and resilience while not infringing on the innovation and development of this fast-evolving capability.[43]

69. While regulating RaaS promotes good practices, which can be adopted globally, the approach should strike a balance with the need for nations to be free to produce and exchange goods and services in the natural resource sector. This is because, as Adam Smith argued, the sign of a properly functioning market system is to maximize material benefits to society's lowest members.[44] It follows then that policy drivers aimed at regulating RaaS must be perceived as fair to all stakeholders in the value chain and demonstrably fair in both practices and outcomes to remove any mercantilist tendencies by nations, or worse still, resource weaponization.

A. Good practices

70. In regulating the recovery and valorization of natural resources, practices vary widely from country to country; what is considered good or "critical" in one country may not necessarily be regarded as good or "critical" in another. To accelerate the energy transition and safeguard climate action targets within the circular economy, practices considered "good" or resources are assessed as critical by objective. Independently verifiable metrics or experts must demonstrate that they are aligned to universally acceptable ways of creating value from all resources, notably the most vital. This requirement applies regardless of whether a country is the source of the much-needed raw material or a consumer of the end product. For this to happen, fairness, equity, and mutual benefit should inform the practices under RaaS.

71. The following are general drivers of policy meant to achieve this.

(a) Locating, mapping and inventorying the resources needed for sustainable development should be promoted by all countries. This should include mapping essential raw materials required for the energy transition, without which the pace of the change to meet the climate action target will be hindered;

(b) Studying and identifying the existing resource value chain to prevent wastage of resources (closing resource loops) but also diagnosing and repairing supply chain vulnerabilities and gaps. Similar services in some circumstances can be amalgamated by region resulting in significant efficiency gains, heightened resilience, and reduced costs while still ensuring fair competition among countries producing the same raw material or offering similar services;

(c) Maximizing the value of resources at the source while optimizing local content requirements (LCRs)[45] should be promoted. Regions with existing expertise in processes and services that add value to raw materials can provide these by partnering with countries that possess these raw materials. Both partners can collectively strengthen the supply chains to the third countries with value-added service-enabling components, equipment or capabilities. This will ultimately reduce production costs globally and enhance secure supplies;

(d) Transfer of required technology to where it is needed the most in the value chain for mutual benefit should be promoted. This requires affordable access or even sharing of patent rights together with "climate-smart" efficient technology systems that maximize the lifecycle value of resources and reduce wastage within the circular economy;

[43] Kakavand, H., Kost De Sevres, N., & Chilton, B. (2017). The blockchain revolution: An analysis of regulation and technology related to distributed ledger technologies. Available at SSRN 2849251. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2849251

[44] Adam Smith. "An Inquiry into the Nature and Causes of the Wealth of Nations." OUP Oxford, 2008. https://www.google.co.uk/books/edition/An_Inquiry_into_the_Nature_and_Causes_of/SwFYIf_E1CIC?q=&gbpv=1#f=false

[45] For advice on policies concerning local content requirements (LCRs) see OECD https://www.oecd.org/trade/topics/local-content-requirements/

(e) A harmonized system of rewarding resource-rich countries to create incentives for an accelerated energy transition should be promoted. This can be promoted through a regionally coordinated tax regime for essential raw materials for the transition or carbon credit to GHG emission bans and quotas to the accelerated energy transition contributors;

(f) Enhance the dynamic integrative capabilities for meeting the goals desired in all partners to the critical public-private partnership required (Governments, industry and capital allocators).

B. Lessons learned

72. Identifying, codifying and applying lessons learned is at the heart of the harmonized RaaS system to accelerate the energy transition. In particular, case studies are required on how successfully to deploy the RaaS principles to identify bottlenecks, gaps and systemic vulnerabilities in projects and programmes designed to accelerate energy transition progress and deliver beneficial interventions in meeting the 1.5◦C climate action target within the circular economy.

73. Selected examples of such lessons learned include the following:

(a) Neglecting, ignoring or even forcible overriding local communities and stakeholders, especially those at risk of displacement from or dispossession of their land, typically leads to catastrophic failures of the social contract on natural resources and demonstrably undermines broader sustainable development, particularly in countries rich in natural resources. Communities refuse new investments, revolt against existing operators or investors, or even form local militias to enforce their demands. Working with the local communities through corporate social responsibility ESG and broader social licensing procedures and paying local stakeholders a fair share for their work should be able to secure and retain support for sustainable development or, better still, engage local stakeholders to participate directly in the development process;

(b) Lack of transparency and restricted access to data limits the actual potential value of a resource, as in-depth and collaborative analysis cannot be done. Countries must share data and work collaboratively to achieve climate action targets through sustainable development;

(c) The unregulated and not permitted mining sector reduces government benefits and increases the cost of a smooth transition. This is mainly because a poorly regulated sector promotes illicit financial flaws as resources are traded informally;

(d) Lack of enforcement of minimum labour standards and health and safety and environmental (HSE) standards for the resource sector leads to unfair treatment, particularly in developing countries with critical resources for the transition;

(e) The disparity in the economic status of nations, as identified in the Kofi Annan Report,[46] all too often leads to both selfish and wrong deals in the exploitation of resources, as there is no proper mechanism to allow for adequate bargaining power between developed and developing nations when it comes to critical resources. "[...]it is time to ask why so much growth has done so little to lift people out of poverty and why so much of Africa's resource wealth is squandered through corrupt practices and unscrupulous investment activities". As the UN Policy Brief, May 2022, makes clear, this problem remains and is far from confined to Africa.

74. The systematic application of UNRMS within the RaaS paradigm can address many of the abovementioned concerns.

[46] Kofi Annan, Africa Progress Report 2014 https://www.reuters.com/article/us-africa-inequality-annan-idUSBREA470JQ20140508

VI. Conclusions and recommendations

75. It is urgent to optimize the management of endowments of natural resources to deliver on climate change and sustainable development. The World Bank estimates that cumulatively over 3 billion tons of minerals and metals will be needed to deploy wind, solar and geothermal power and energy storage required for achieving a below 2°C future.[47] These demands are aggravated by the rapid increase and the urbanization of the world's population, which stresses grid-based power, availability of clean cooking fuels and other raw materials required to ensure energy and resource efficiency. Current patterns of resource use will not be able to meet the demand reasonably.

76. Rapid progress to a circular economy is seen as helpful. However, resource efficiency improvements are stagnating, and the amount of materials recycled remains at a dismal rate of about 8 per cent. The RaaS paradigm involves moving from current commodity and product-based business models to an outcome-focused subscription-based industry. Such a model will ensure the most efficient use of energy and resources. RaaS is a new paradigm shift that will be required to decouple the use of energy and resources and sustainable development.

77. Social resistance to resource development is rising globally. Issues of indigenous people, human rights and transparency are becoming the core of the social contract on natural resources. Responding to climate change issues is also closer to new social aspirations, which need upscaling innovative technologies. RaaS model offers several opportunities to transition to a more responsible, acceptable and resilient model, as shown in this document.

78. UNRMS is based on twelve fundamental principles that provide general guidance on sustainable resource management's direction. UNRMS Principle 5 is service orientation, the principle that resources are to be produced primarily as a service to society. UNRMS requirement for service orientation promotes RaaS as a business model. Stakeholders could implement the change to a RaaS model in a phased manner.

79. Some modest beginnings are visible in RaaS, but the concept holds a lot of promise and is still in its infancy. As in other industrial sectors, resource sectors are expected to be drastically transformed by "as a service" models. Such a change could be a welcome game-changer for an industry that is constantly plagued by "boom and bust" cycles of the commodity market. Moreover, it could integrate with new platform approaches through blockchain and attract ESG funding.

80. Governments need to be aware of the policy and regulatory support required to tap into the new opportunities opened by "as a service" models. A transition to the RaaS model should be promoted to bring wide-ranging benefits to all citizens in the face of a severe global challenge. UNRMS application can radically support resource management transformation and provides a smoother framework for the RaaS model transition.

81. Implementing the UNRMS - RaaS model includes better assessing the resource base by valorizing all intangible assets, increasing resource efficiency, optimizing local content requirements, and accessing climate and ESG-related financing easier. UNRMS application and a transition to the RaaS model will also enhance the social contract.

82. Enabling a UNRMS - RaaS model should be based on identifying, codifying and applying lessons learned. Case studies and pilot programmes with the participation of the industry should be required to have in place a RaaS economy. Policymakers, industry and financial players are recommended to adopt the UNRMS principles and requirements and use the concepts, guidelines and best practices mentioned in this document to implement a robust RaaS model. It is suggested to implement the model through national or regional working groups, which will discuss, develop and promote potential new economic paradigms.

[47] World Bank (2020) Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

83. UN Policy Brief Recommendation 11 urges to: "Establish clear national visions, strategies, and industrial policies to support a just energy transition and attain a circular economy […]". The policies, operational objectives and related fiscal and monetary levers based on the UNRMS RaaS framework include:

- Accelerate the transition from linear to circular while considering the social, environmental and economic repercussions from a short, medium and long-term perspective
- Converge short-term, profit-driven business accounting and a sustainable macroeconomic accounting by a strict "polluter pays throughout the value chain" regulatory framework
- Mandate the use of blockchain, verifiable digital identifiers and similar distributed ledger technologies to enable efficiently, climate-smart, responsible tracking and traceability of all resources, especially those critical to the delivery of the SDGs
- Track, trace and eliminate illicit flows of materials and related funds concerned with the use of natural resources, a purpose to which blockchain is technically ideally suited
- Accelerate adoption of applications such as "digital twins", machine learning and AI to complex production systems to stimulate a quantum jump in productivity, resource use efficiency and a reciprocal quantum reduction in energy intensity
- Stimulate awareness at both individual and community levels of the need for and benefits of behavioural modification for all "instinctively responsible" consumers in the circular resource flow cycle
- "Bake in" resource use efficiency by eliminating all avoidable losses and wastes, extending primary and secondary service lives and upcycling residual materials to new building blocks, and
- Base capital allocation and investment decision-making on double materiality principles, normalized ESG metrics and SDG-compliant reporting standards and practices
- Converge all these policies into a new UN-supported resource management model as the core unit of benefit to the consumer.

84. All the above should be reflected and enshrined in CE plans to be developed at the national, regional and local level – vertical circularity – and are to be also mainstreamed in all policy areas to make them circular (e.g. Circular transport, agriculture, tourism, energy etc.) as well as in the business sector through the Circular ESG – horizontal circularity. The EU is developing this good practice in the framework of the Green Deal and the updated Circular Economy Action Plan.

References

Baxter, R. K. (2015). The Membership Economy. Find your Super Users, Master the Forever.

Baxter, R. K. (2020). The forever transaction: how to build a compelling subscription model that your customers will never want to leave. McGraw-Hill Education.

Lah, T., & Wood, J. B. (2016). Technology-as-a-service playbook: How to grow a profitable subscription business. Point B, Inc.

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2016). Platform revolution: How networked markets transform the economy and how to make them work for you. WW Norton & Company.

Tzuo, T., & Weisert, G. (2018). Subscribed: Why the subscription model will be your company's future and what to do about it. Penguin.

Warrillow, J. (2015). The automatic customer: Creating a subscription business in any industry. Penguin.