re-sourcing

Renewable Energy Sector

Civil Society, Research and Academia

Roadmap for Responsible Sourcing of Raw Materials until 2050

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Abbreviations

ASM	Artisanal and small-scale mining
CdTe	Cadmium telluride
CSOs	Civil Society Organisations
D1.2, or D4.1	Deliverable of the RE-SOURCING Project (1.2 The RE-SOURCING Common Approach; 4.1 State of Play and roadmap concepts: Renewable Energy Sector)
EHS	Environment, Health and Safety
EoL	End-of-life
EU	European Union
GHG	Greenhouse gas emissions
GRI	Global Reporting Initiative
ICMM	International Council on Mining and Metals
IEA	International Energy Agency
IFC	International Finance Cooperation
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
IRMA	Initiative for Responsible Mining Assurance
LCA	Life cycle assessment
LSM	Large-scale mining
NdFeB	Neodymium iron boron
NGO	Non-governmental Organisations
OECD	Organisation for Economic Co-operation and Development
PV	Photovoltaics
REE	Rare earth elements
RS	Responsible Sourcing
SDGs	Sustainable Development Goals
S-LCA	Social life cycle assessment
SLO	Social licence to operate
SME	Small and medium-sized enterprise
TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures
US	United States (of America)
WEEE	Waste electrical and electronic equipment

Executive Summary

This publication is an **excerpt from the Renewable Energy Sector Roadmap for Responsible Sourcing of Raw Materials with a focus on recommendations for civil society, research, and academia.** The full publication with recommendations for policy makers, industry, civil society, research and academia can be found **here.**

The renewable energy sector is growing exponentially – a necessary requirement for successfully achieving the transition from fossil fuels to clean energy sources and mitigate climate change. Two of the main technologies driving this growth are wind and solar PV energy. While these two technologies are considered sustainable energy sources, the production of the raw materials and equipment that are used for them, are associated with strong environmental and social impact concerns. To ensure a just transition, the implementation of high social and environmental standards in production and sourcing along the entire supply chain is crucial.

Following the State of Play and Roadmap Concepts for the Renewable Energy Sector - a stock taking report of the current sustainability challenges in the renewable energy sector - this report by the RE-SOURCING project focuses on the road towards achieving a sustainable energy transition by 2050. The RE-SOURCING projects 'Vision 2050' for the renewable energy sector based on the concepts of planetary boundaries and strong sustainability describes the ultimate goal to be achieved with the roadmap. This roadmap addresses three raw materials (copper, rare earth elements, and silicon); two technologies (wind and solar PV energy); and three supply chain stages (mining, manufacturing, and recycling) (Fig. I); providing recommendations for industry on achieving a vision for a sustainable renewable energy sector.

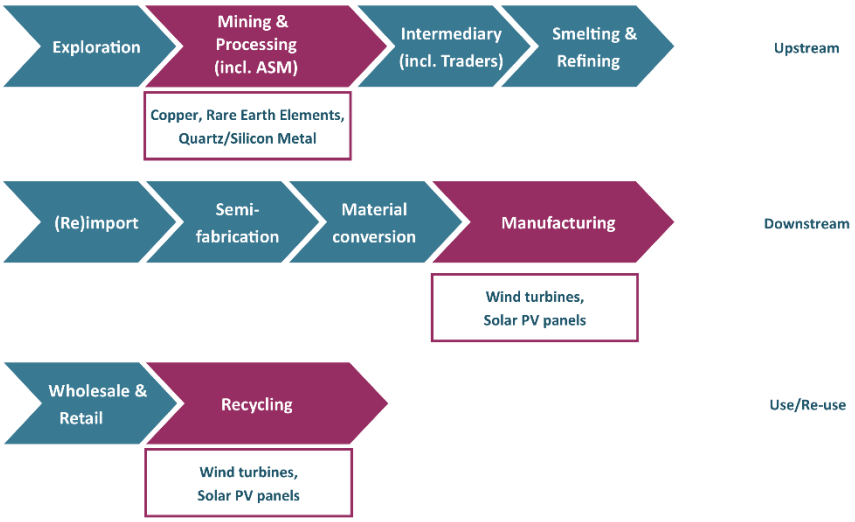

Fig. I: Supply chain stages and materials included in the roadmap

For the development of the sectoral roadmaps, the RE-SOURCING project relies primarily on bringing together existing knowledge from key stakeholder groups and regions. A series of five webinars, supplemented by additional expert consultations, were utilised to elaborate the recommendations presented in this report. Based on the State of Play Report and the consultation process, five key target areas have been identified and are addressed in this roadmap (Fig. II):

- Circular Economy & Decreased Resource Consumption;
- Paris Agreement & Environmental Sustainability;
- Social Sustainability & Responsible Production;
- Responsible Procurement; and
- Level-Playing Field & International Cooperation.

The numbering of the targets does not imply any priority. All five targets are interlinked and must be pursued simultaneously to achieve the vision for the renewable energy sector.

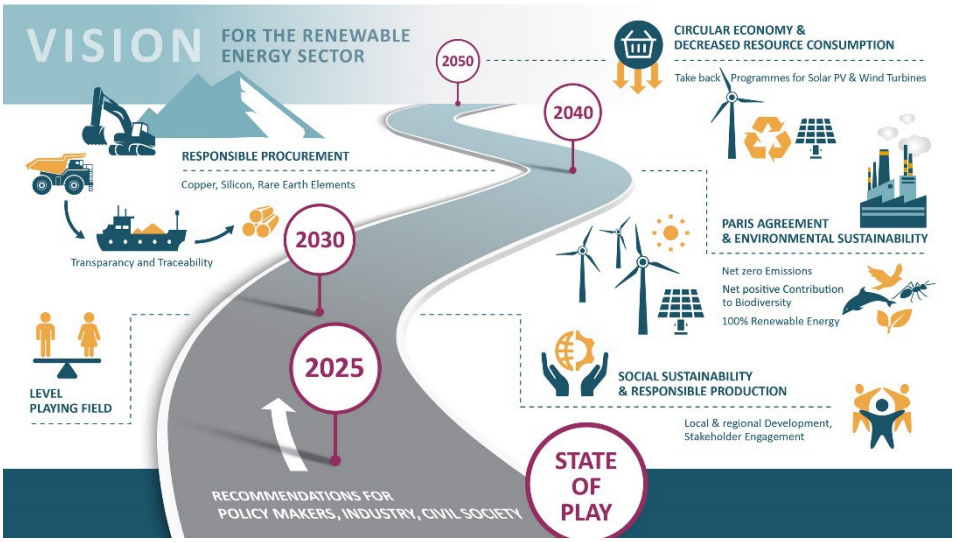

Fig. II: Roadmap for the renewable energy sector until 2050

Target 1 'Circular Economy & Decreased Resource Consumption' addresses the need for changes in behaviour and the economic system to stay within planetary boundaries. A transition to renewable energy sources without improvements in energy efficiency and decreased demand will not be possible or enough to mitigate climate change. Additionally, end-of-life wind turbines, solar PV modules, and related equipment need to be seen as strategic source of raw materials, with collection and recycling systems strengthened.

Target 2 'Paris Agreement & Environmental Sustainability' focuses on the expansion of renewable energy itself, the reduction of GHG emissions, biodiversity conservation, etc. within the supply chain stages of mining, manufacturing, and recycling. We encourage the EU to take a lead role in the transition and speed up the renewable energy expansion, while highlighting the need for improved environmental conservation.

In Target 3 'Social Sustainability & Responsible Production', the fair distribution of benefits and burdens is the main objective. This includes considerations such as occupational health and safety standards specifically for the renewable energy sector, meaningful stakeholder engagement, or the introduction of social life cycle assessments in production processes.

All issues addressed in targets 1-3 are also included in Target 4 'Responsible Procurement'. Rather than focusing on an organisation itself, this considers the entire supply chain of said organisation. Recommendations include transparency as a prerequisite for supply chain due diligence, the support for sustainable development, as well as the development of resilient and risk-proof supply chains.

Finally, Target 5 'Level Playing Field & International Cooperation' aims at harmonising requirements for companies operating and trading across the value chain, in and with the EU. Raw materials or products that are produced with lower standards should be disadvantaged in the future or no longer be imported. However, creating a level playing field also implies supporting companies, regions, and countries in improving their practices and achieving the required standards.

Keywords:

Civil Society Recommendations; Renewable Energy Sector; Wind Turbines; Solar PV; Responsible Sourcing; Sustainability; Transition Minerals

1 Introduction

1.1 The Renewable Energy Sector

The work on the renewable energy sector started with the State of Play report which was published in October 2020. The aim of this report was to investigate the current state of the renewable energy sector and the value chains of wind and solar PV energy respectively. The RE-SOURCING project focuses its efforts on the supply chains of copper, rare earth elements and silicon to produce wind turbines and solar PV modules. The supply chain stages that are assessed in more detail are mining of these minerals, manufacturing of wind turbines and solar PV panels, and their recycling. The standards and initiatives addressing sustainability challenges in these supply chain stages are discussed.

The following provides a brief overview of the main findings of the State of Play report. For details see: State of Play and roadmap concepts: Renewable Energy Sector

Copper is an essential raw material for numerous applications, including all types of wiring for electric energy supply (European Commission 2020). The majority of supply is produced by large-scale mining (LSM) companies in Chile, providing more than 28% of the world's supply in 2018. However, artisanal and small-scale mining (ASM) mainly in the 'African Copperbelt' in the DR Congo (6% of global supply in 2018) and Zambia (4% of global supply 2018) play an important role in copper production (Reichl and Schatz 2020). The existence of both LSM and ASM in the same area are often cause for conflict. LSM operations potentially deprive local communities of their livelihoods as they depend on income from ASM. Informal ASM is also exposed to risks such as child and forced labour. In regions with weak democratic institutions, corruption is also an issue (Maiotti et al. 2019; Sweetman and Ezpeleta 2017). Additionally, mining operations in the Copperbelt cause significant environmental pollution, including water pollution through effluent discharge leading to health issues, food insecurity, etc. (Kügerl and Tost 2020). The Environmental Justice Atlas also reports other issues related to copper mining projects. A major issue is the disrespect of indigenous lands, for example in Canada and Alaska (Environmental Justice Atlas 2015).

The most important supplying country of **Rare Earth Elements** (REE) is China, accounting for more than 73% of global supply in 2018 (Reichl and Schatz 2020). REE are crucial for the production of permanent magnets, which are used in certain types of wind turbines among others.

For mining and processing of REE, potential environmental pollution is one of the main challenges that need to be considered. There are numerous risks during this process that can lead to significant pollution with chemicals, heavy metals, and radioactive elements. Especially small illegal mines in China pose a threat, as they are not equipped with the necessary treatment facilities, causing serious environmental damage and health hazards (Kügerl and Tost 2020). Furthermore, an important aspect of REE production is resource efficiency, or the lack thereof. For instance, at the mining stage, the cut-off grade needs to be taken into consideration to ensure a sustainable use of the available resources. This continues at the processing stage, where Chinese floatation plants only achieve recovery rates of approximately 40-60% (Schüler et al. 2011).

Silicon for the use in solar PV modules is mined as quartz. While no major issues in mining operations were found[1], the processing of quartz to high-purity silicon (polysilicon) needs to be considered in more detail. One issue is the vast amount of energy required for the purification process. Moreover, the most important producer of polysilicon for the solar PV industry is the Chinese Xinjiang region, which is subject to allegations of human rights abuses and forced labour (Copley 2020).

For the **renewable energy technologies manufacturing** stage of the supply chain, both wind turbine and solar PV manufacturers show a lack of commitment to human rights principles, including respect for land rights, indigenous people rights and gender equality (Business & Human Rights Resource Centre 2020; Kiezebrink et al. 2018). Moreover, both production processes are very energy intensive, especially the production of materials used. **Wind turbine manufacturing** also needs to consider occupational health and safety. On the one hand, during production employees are potentially exposed to epoxy resins, fibreglass, noise, dust, etc., and on the other hand working in heights and confined spaces pose a risk. **Solar PV modules** use silicon wafers that require large amounts of energy, water, and chemicals in their production. Moreover, the resource efficiency in the production of the wafers is of concern as high material losses occur (Kügerl and Tost 2020).

The **collection and recycling** of wind turbines and solar PV modules already shows high technical recyclability. Both show a technical recyclability of approximately 90%. For wind turbine blades innovations are required to ensure the efficient reuse of the composite materials, especially considering the increasing waste streams of the coming years. In general, there currently is a gap between collection and recycling possibilities and the expected large waste streams of the future.

1.2 Vision

The horizon considered for the roadmap of the RE-SOURCING project is 2050. The vision for the renewable energy sector (Figure 1) was developed based on the underlying concepts of planetary boundaries[2] and strong sustainability[3] and will be incorporated in the definition of responsible sourcing that is developed towards the end of the project. Further information on the RE-SOURCING project's vision for the renewable energy sector can be found in the State of Play report.

The remainder of this report outlines five key target areas for achieving the RE-SOURCING Vision 2050 (Renewable Energy Sector):

- Circular Economy & Decreased Resource Consumption;
- Paris Agreement & Environmental Sustainability;
- Social Sustainability & Responsible Production;
- Responsible Procurement; and
- Level-Playing Field & International Cooperation.

The discussion of each area considers targets and milestones, followed by specific recommendations for three key stakeholder groups: Policy makers, industry, and civil society. This document only includes recommendations for civil society (for the other stakeholder groups see here).

[1] This means that during the preparation of the State of Play report, no reports on sustainability challenges in quartz mining were found. The authors do not wish to rule out the existence of such challenges in quartz mining operations in general.
[2] For further information on planetary boundaries, please refer to Rockström et al. 2009 and ; Steffen et al. 2015.
[3] An explanation of the strong sustainability concept is provided by Ekins et al. 2003; and Dedeurwaerdere 2014.

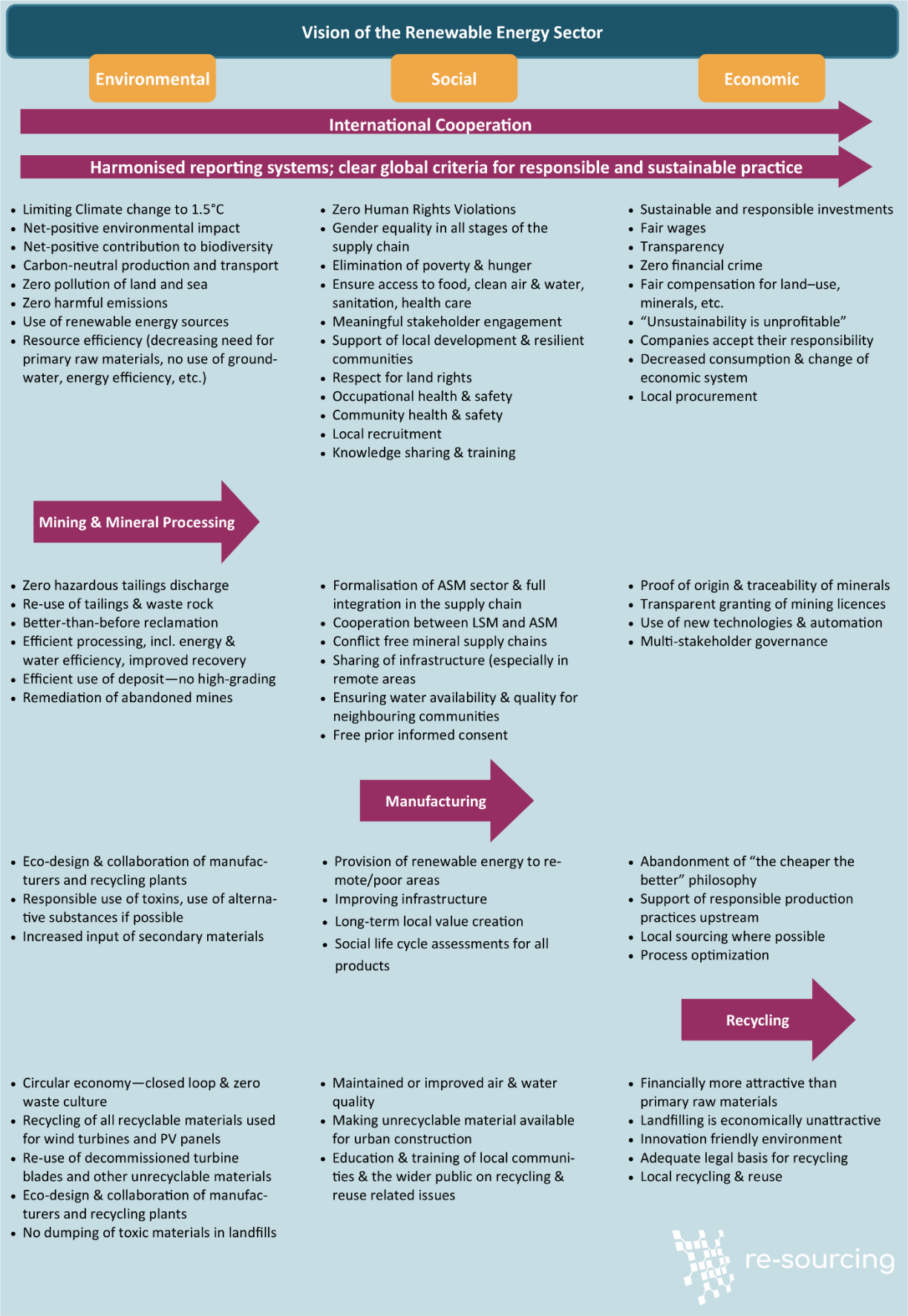

Figure 1: Vision for the renewable energy sector (based on Kügerl and Tost (2020))

2 Pathway

Scope

The RE-SOURCING project provides a roadmap, encompassing recommendations for actions. It does not propose new standards or guidelines, nor does it attempt to 'reinvent the wheel'. For many areas, appropriate standards have already been developed and the first and most important step is to successfully implement these. Implementation of these standards is part of the roadmap's recommendations - before we start thinking 'outside the box', it is important to have the foundation in place. There is ample evidence of companies that for example, are not respecting basic human rights, or governments that are failing to address the sustainability principles for protecting local communities.[4] Existing standards address these issues. However, it is also acknowledged that it is crucial to harmonise these standards, by promoting alignment and cohesion, to avoid confusion for adopters and customers in their implementation.

The State of play report is considered the baseline and the pathway provides concrete recommendations for policy makers, industry, and civil society (included in this document) for moving ahead from this baseline to the RE-SOURCING project's vision for 2050. The recommended actions for policy makers focus on the EU, whereas recommendations for industry and civil society can be considered on a global level. For the other stakeholder groups, consult the full roadmap, or policy and industry excerpts on the project's homepage. The RE-SOURCING project recognises the important role of investors, insurance, logistics providers or other business service providers. However, they are out of scope for this roadmap as they are relevant for all three sectors (Renewable Energy, Mobility, and Electric and Electronic Equipment) included in the RE-SOURCING project. Therefore, recommendations for these businesses will be provided in a separate briefing document at a later stage in the project.

As with the State of Play report, the roadmap focuses on the raw materials copper, REEs and silicon; the technologies wind and solar PV energy; and the supply chain stages mining, manufacturing, and recycling. This scope was defined as part of the consultation process for the State of Play report. There are, of course, numerous other minerals and metals that are essential for the energy transition, and many of the recommendations listed here can also be applied to other raw materials. (Information on other relevant mineral raw materials can be found in the IEA's report on The Role of Critical Minerals in the Clean Energy Transition (World Energy Outlook 2021) or the World Bank's elaborations by Hund et al. (2020)).

Assumptions and limitations

The RE-SOURCING project's renewable energy sector roadmap takes technological advancements as a given and does not specifically address this issue, apart from the continuation of these advancements and the required support by public and private sectors. Further information on the technological aspects can be found in various reports, such as SolarPower Europe and LUT University (2020) or European Climate Foundation (2010).

[4] For further information on sustainability challenges in the renewable energy sector supply chains, as well as existing standards and initiatives, please refer to the State of Play and Roadmap Concepts report for the renewable energy sector.

Conclusions from the consultation process note that it is not currently possible to set specific goals for secondary raw material input, circularity rate, etc. because the necessary research has not been undertaken fully at this time. This aspect will be highlighted in the relevant sections of the report; however, we note this as a limitation in the pathway discussion here.

Structure

The pathway differentiates between targets and milestones. **Targets** define the desired end points and are kept at a high and aggregated level. They can be medium (2030 and 2040) or long-term (2050). Targets are defined for the three pillars of sustainability: social, economic, and environmental (Figure 2), and developed during a consultation process with the project's Platform Steering Committee and Advisory Board, as well as the Roadmap Workshop with participants from all stakeholder groups of the renewable energy supply chain.

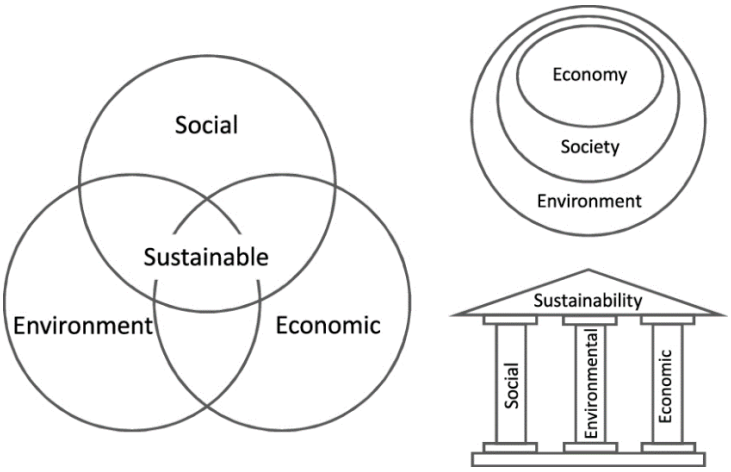

Figure 2: Depictions of the three sustainability pillars - social, environmental and economic (Purvis et al. 2019)[5]

Milestones are points along the desired trajectory from baseline to target and are supposed to help track the progress. They can be short (2025), medium (2030 and 2040) or long-term (2050). While 2025 milestones may appear as short-term considerations, they refer to the achievement of commitments already made, or set the direction for future goals. Wherever possible, milestones are specified according to desired quantity, quality and/or time (Capacity4dev Team 7/8/2016). Milestones also include already existing and agreed upon goals, such as the Sustainable Development Goals (SDGs) by the United Nations (UN) and the Paris Agreement. However, the RE-SOURCING renewable energy sector roadmap only includes targets that are relevant for this sector. Targets that are not mentioned here are therefore not considered irrelevant but go beyond the scope of this roadmap.

The classification of the milestones and actions into categories is also based on the authors' preference and should not be regarded as absolute. The timeframe for the achievement of milestones and targets shows the latest deadline, however, earlier completion is strongly encouraged.

[5] Please refer to the report The International Responsible Sourcing Agenda for more information on sustainability and responsible sourcing approaches.

The roadmap for the renewable energy sector of the RE-SOURCING project does not consider the term 'responsible sourcing' as a simple supplier - manufacturer business transaction. The term, within this project, represents the idea that responsible sourcing engages all stages of the supply chain and should be understood as a joint effort to make each stage more sustainable. Hence, the recommended actions and milestones that follow do not merely focus on procurement, but also touch upon sector specific issues.

2.1 Target 1: Circular Economy & Decreased Resource Consumption

Access to energy is a prerequisite for economic and social development and is embedded in the Sustainable Development Goals (SDGs) as Goal 7 'Ensure access to affordable, reliable, sustainable and modern energy for all' (Brand-Correa and Steinberger 2017). However, energy systems (including electricity, heat and transportation) are the largest source of manmade greenhouse gas (GHG) emissions (76% in 2018) (Climate Watch 2021; US EPA 2015). While the transition from fossil-fuel based energy generation to renewable energy sources is associated with positive effects, the negative impacts of the ever-increasing energy demand cannot be ignored. A 100% renewable energy system will certainly decrease GHG emissions and have positive environmental effects. However, continuing with business-as-usual consumption patterns can be described as a 'low-carbon destruction of planetary resources' (Swilling 2020, p. 101). New systems for both consumption and production are required to satisfy human needs and universal well-being while staying within planetary boundaries (Brand-Correa and Steinberger 2017; Raworth 2017; Swilling 2020).

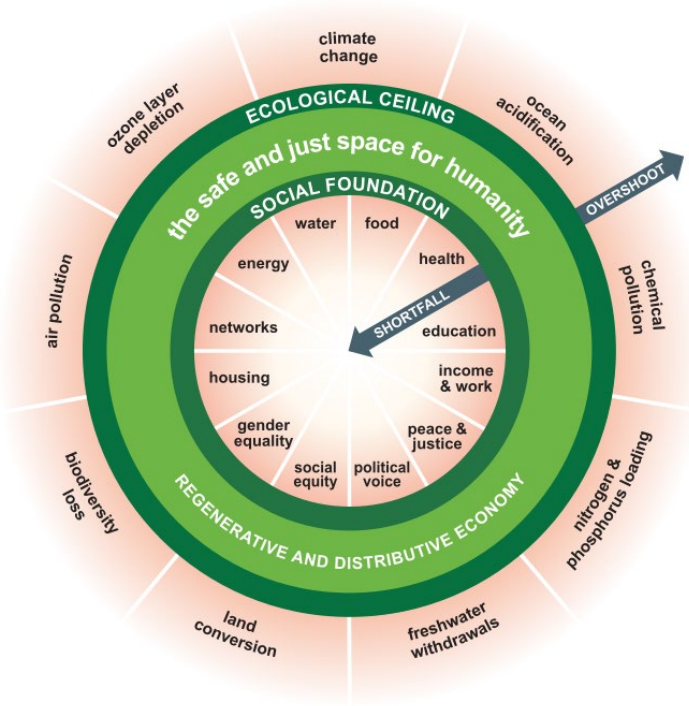

Figure 3: Doughnut Economics - combining social and planetary boundaries (DEAL 2021)

Absolute decoupling of economic growth, resource consumption and environmental impact is one of the proposed measures to tackle price shocks, resource scarcity and halt environmental degradation (UNEP 2014). Decoupling relies on decreasing resource consumption by improving resource efficiency through technological improvements, substitution of non-renewable by renewable resources, waste prevention through reuse and recycling, etc. The concept of decoupling also faces a lot of criticism and research has not agreed on whether absolute decoupling of economic growth, consumption and environmental impact is in fact possible (Parrique et al. 2019; Strand et al. 2021; Wiedmann et al. 2020). Similarly, 100% circularity of resources within an economy will not be possible, due to physical and economic constraints and in some cases not desirable due to the high negative environmental impacts of recycling processes (Moss 2019; UNEP 2013).

This roadmap follows a two-pronged approach for the renewable energy sector: on the one hand, increasing resource efficiency, recycling and reuse rates are a prerequisite for achieving the energy transition and cover the growing demand by a growing population. On the other hand, reengineering the current economic system with a focus on changing existing consumption patterns is necessary. These considerations are addressed by the Doughnut Economics Principles of Practice: 'think in systems' – aim for continuous improvements; 'be regenerative' – the 6R of sustainability (reduce, reuse, recycle, repair, rethink and refuse); 'aim to thrive rather than grow' (DEAL 2021).

Figure 4 provides an overview of the milestones for supporting the target of a circular economy and decreasing resource consumption. To achieve these milestones, a set of recommendations for actions for CSOs, academia and research are outlined further. The authors recognise the importance of inclusive green growth for both developing and advanced countries, to achieve a sustainable standard of living. Hence, the inclusion of SDG 8 for sustainable growth in milestones. It is important to rethink consumption patterns and consider material and energy needs in the development programmes of all countries.

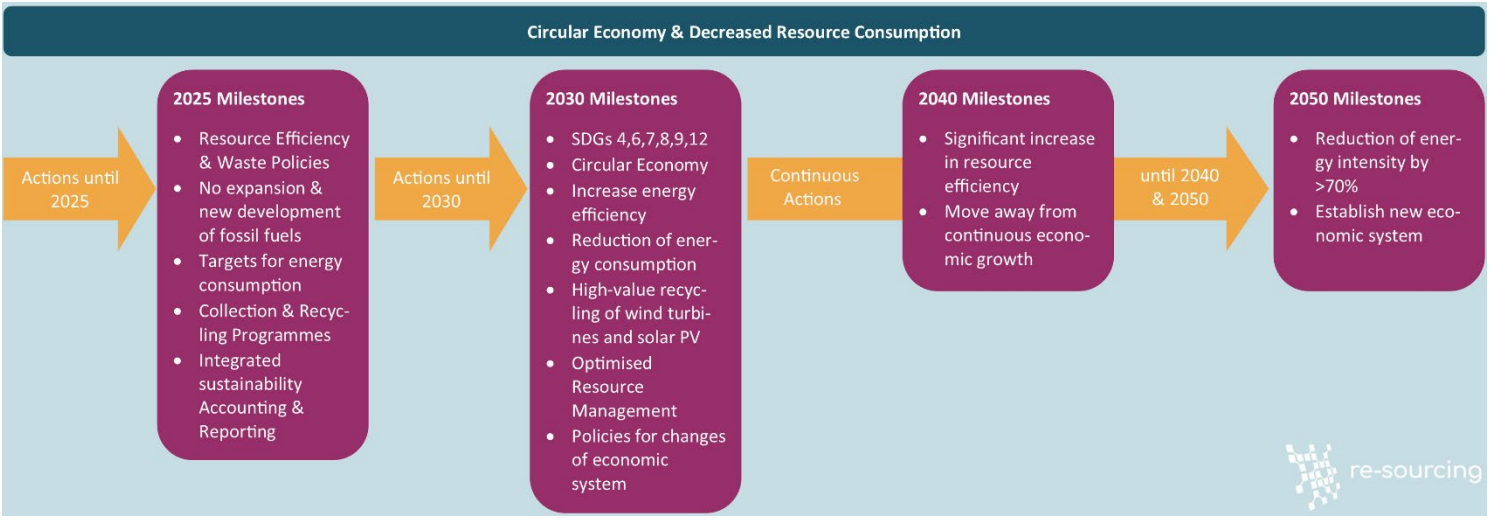

Figure 4: Milestones towards a circular economy and decreased resource consumption by 2050

The recommendations for CSOs are not subdivided and sequenced in the same way as for policy makers and industry, as we consider their role to be overarching. This means that CSOs play an important (supporting) role in the achievement of all goals and milestones and this role is not temporary.

CSOs are already important contributors to the achievement of sustainability in the supply chain of wind and solar PV power. For the target of decreased resource consumption, we especially want to highlight the role of advocacy NGOs (both local and international), industry associations and research institutions.

NGOs can make an important contribution to increasing resource efficiency and reducing energy demand. An important element of this contribution is to increase awareness and inform citizens about the impact of consumption patterns and possible alternatives. For example, increase awareness of issues such as the impact of buying a new mobile phone every year, what raw materials are needed for it, where they come from and their environmental and social impacts. Consumers need to be better informed about the consequences of continuing their current consumption patterns. In this area, the necessary and desirable cooperation with policy makers should be emphasised. On the one hand, this "educational work" is necessary at the political level, on the other hand, political measures to increase resource efficiency can be developed and communicated to the population together.

Research and academic institutions are challenged in two ways: (i) they have a primary role in developing new technologies and advancing existing ones to reduce both the resources and the energy used in their production. It is also important, in terms of recycling, for them to pay attention to the subsequent reuse and recovery of materials when designing products. When developing new technologies in the future, attention must be paid from the very beginning to the raw materials used. Interdisciplinary cooperation should be significantly strengthened and expanded for this purpose. Direct cooperation with industry needs to be intensified to effectively develop viable new products. (ii) Interdisciplinary cooperation should be strengthened not only in the technical field regarding the use of raw materials, but also interdisciplinary cooperation between engineering, social sciences, ecology, sustainability research etc. Environmental and social impacts have to be considered, for example in the form of (social and environmental) life-cycle assessments, in product development from the start of a project.

2.2 Target 2: Paris Agreement & Environmental Sustainability

The roadmap for the renewable energy sector of the RE-SOURCING project aims to assist stakeholders achieving the Paris Agreement's +1.5°C target. For this to happen, the speed required in which necessary transitions are conducted is still under debate. EU policy targets aim at net zero emissions by 2050 including a power sector 'that is based largely on renewable sources' (this is stated in the EU green deal, a revision of the targets is currently under way) (European Commission 2019). This is also reflected in the IEA Net Zero Emissions by 2050 report, which incorporates 88% renewables in electricity generation by 2050. However, this report also acknowledges a 50% probability that this path will not help achieve the 1.5°C target without overshoot (IEA 2021). In their report the IEA (2021) addresses the increased importance of electricity for the future. While the electricity demand will increase due to electrification advances, it is even more important that this sector also achieves the net zero target as soon as possible. According to the IEA, this should be achieved by 2035 in advanced economies and 2040 globally. Other studies highlight the importance of drastically increasing renewable energy supply to 100% renewable energy by 2050 (Teske et al. 2015; Jacobson et al. 2017; European Climate Foundation 2010) or 2040 respectively (SolarPower Europe and LUT University 2020). This is also reflected by many companies and countries some of which set even more ambitious targets (see RE100 (2021) and REN21 (2021)).

Based on the consultation process, this roadmap recommends the achievement of 100% renewable energy and net zero emissions by 2040. The RE-SOURCING consortium believe the EU should take a clear lead and push for a global shift to renewable energy. However, as already discussed in the previous chapter Target 1: Circular Economy & Decreased Resource Consumption this has to be accompanied by energy efficiency improvements and demand reduction (of overall energy demand, not electricity). An important aspect highlighted in many recently published reports, such as IEA (2021) or IRENA (2021).

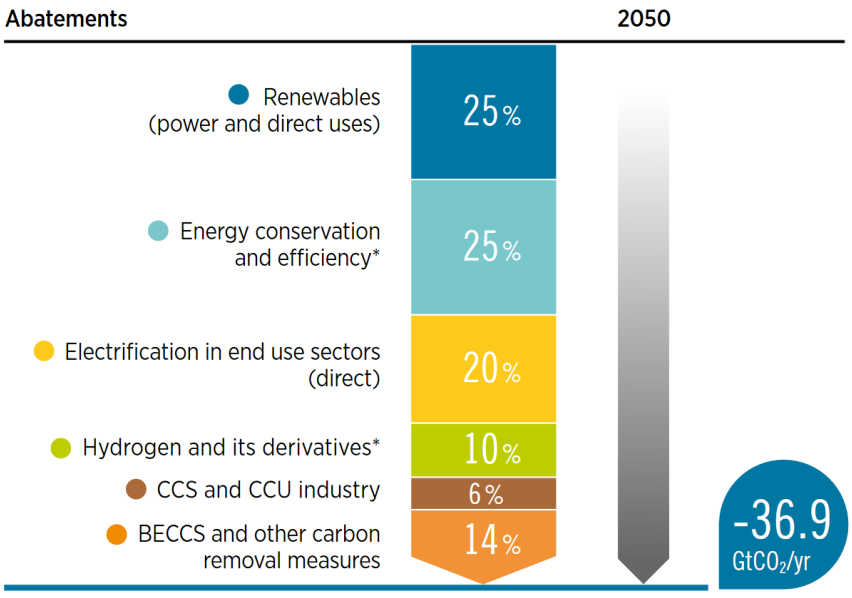

Figure 5: Carbon emissions abatements under IRENA's 1.5°C scenario by 2050 (IRENA 2021)

The recommendations in this chapter focus on the expansion of the renewable energy system. This is equivalent to phasing out thermal coal. The RE-SOURCING project recognises the importance of coal for certain industries (e.g., the production of silicon metal for solar PV, steel manufacturing or the chemical industry). Nevertheless, R&D into the substitution of coal in these industries is a crucial aspect for decarbonising the economy and reaching the target of net zero emissions (according to the ECF (2021) a 100% renewable energy system is not enough for heavy industries to be compatible with the Paris Agreement). While the authors want to highlight the importance of the phasing out of coal as a feedstock, it is out of scope to go into more detail for this report.

Apart from climate related considerations, this chapter also addresses issues such as biodiversity loss and land-use related to renewable energy supply. In their Guidelines for project developers for mitigating biodiversity impacts from wind and solar energy, the IUCN highlights the importance of biodiversity considerations in project development. Biodiversity must be taken into account from the very beginning of the planning process to successfully identify and manage risks. The choice of location plays a major role in this regard. With the correct placement, not only can risks to biodiversity be avoided, but also regulations and expectations of investors and consumers can be met more easily (Bennun et al. 2021).

Considerations on deep sea mining and legacy issues of abandoned mines will be incorporated in a separate briefing document at a later state of the RE-SOURCING project, as these issues are relevant for all three sectors included in the project.

Figure 6: Milestones to reach the Paris Agreement and Environmental Sustainability by 2040

CSOs already play an important role in identifying bad practice cases and holding industries and supply chains to account. This monitoring and reporting function of CSOs, especially local and international NGOs, will continue to be essential in achieving the RE-SOURCING projects' targets. Advocacy focused NGOs provide important data for assessing and evaluating environmental and social impacts. It is essential that this work continues, as often this data provides crucial support for policy development. NGOs need to drive policy makers towards stringent environmental regulations for mining and production, as well as for the construction of wind or solar PV farms.

As already mentioned in Target 1, advocacy focused NGOs are important transmitters of information to the population. People need to be aware of the impact their personal behaviour has on the environment and climate, and this is a function NGOs can perform as independent third parties.

Key functions relevant for climate related and environmental as well as social issues include:

- Monitoring and reporting of violations of standards to governments, companies, and the public
- Support closure and remediation of the reported incidents
- Capacity building of small businesses
- Empower CSOs to train, monitor and support small businesses
- Solution providers! – help governments to make due diligence laws feasible and impactful, suggest accompanying measures to the law that make compliance possible for businesses and make monitoring of compliance for CSOs and governments possible

(Small) community associations are required to gather and consolidate the concerns of the community and communicate them through one channel to companies and governments. Particularly, in remote areas such as Chilean copper mining regions, where the water use in copper mining can have a significant impact on communities and the environment and other organisations supporting the interests of the communities are not as present. Local NGOs can support these efforts and provide important local expertise in finding solutions between communities, companies, and governments. In the preceding chapters, companies are encouraged to seek the expertise of local CSOs when setting up or improving operations. We see this as an important role of local NGOs or community-based organisations that do not have NGO status[6]. Local knowledge is crucial for impact assessments and successful mitigation plans. This cooperation is also a prerequisite to build resilience of communities against the effects of climate change. While many NGOs are working with mining companies to increase sustainability of operations, there remains a lot of resistance from other CSOs against mining in general. While environmental impacts certainly need to be minimised, it is also important for NGOs to acknowledge the necessity of mining for the renewable energy transition as well as our everyday lives.

[6] NGO status refers to the recognition of NGOs by the UN and/or governments which creates an associated legal framework for their work; see for example NGO status by the UN: Edmund Rice International 2021, or NGO status in Austria: BMEIA 2021.

The scientific community should continue to inform governments and businesses on the state of environment and climate change. They need to develop models on the effectiveness of measures, outlining what needs to be achieved and by when, or the impact of inactivity. An important task is also to prepare scientific findings so that they can be understood by the 'common person'. A lot of scepticism about climate change and the associated effects can be remedied through clear and understandable information. Additionally, the support of industry in conducting research on and developing new technologies with smaller environmental impacts (including emissions reductions, replacement of coal in production processes, etc).

2.3 Target 3: Social Sustainability & Responsible Production

The energy transition is not only meant to mitigate the effects of climate change and address environmental issues, but also socioeconomic concerns. To achieve the often-quoted 'just transition' it is crucial to ensure the just distribution of the benefits and burdens associated with this transition. The concept of a just transition is inter-related with energy justice and both are based on the principles of distributional, procedural and recognition justice (García-García et al. 2020; Carley and Konisky 2020). For the target of social sustainability and responsible production, the roadmap aims at achieving two of the mentioned justice streams – distributional and procedural justice, recognition justice is out of the scope for this roadmap. Additionally, corrective or restorative justice is included as part of the energy justice concept. As cited in Mohai (2018, p. 23) Professor Kuehn, the former Director of the Environmental Law Clinic at Tulane University, defines distributive justice as '*the right to equal treatment, that is, to the same distribution of goods and opportunities as anyone else has or is given*' and procedural justice as *'[…] the right to treatment as an equal. That is the right, not to an equal distribution of some good or opportunity, but to equal concern and respect in the political decisions about how these goods and opportunities are to be distributed […].'* Corrective justice refers to the way in which law breaking and damages inflicted to communities or individuals are addressed and restored (Mohai 2018).

In line with these three justice movements, the main goals of this roadmap are to achieve a fair distribution of benefits and burdens across countries and populations (access to clean and affordable energy, assessment and mitigation of social impacts of production processes, support of local development, etc.); to include affected communities in decision-making processes and that 'energy procedures are fair, equitable and inclusive of all who choose to participate' (Carley and Konisky 2020, p. 570); and avoidance and correction of injustices through intervention by governments or other institutions (transparency and accountability).

Figure 7: Milestones to reach Social Sustainability & Responsible Production by 2030

Local NGOs should increasingly take on a mediating role and support a multi-stakeholder approach. This should ensure that, on the one hand, concerns of the local communities are heard, but also that sustainable developments by companies and policy makers are supported and promoted. This role is particularly important in the field of ASM. NGOs that are currently active in areas with a large ASM sector know the conditions and specifics on the ground. Both companies and policy makers need to be supported on what capacity building should look like and how it should be implemented. Capacity building, infrastructure development, etc. should always be done in consultation with the unique context of the local population and their wishes must be part of the decision-making process. Off-the-shelf solutions do not always lead to the desired results. There are various examples of NGO lead initiatives for the acceptance of ASM, however, mostly focused on gold mining. For example, the ARM's Fairmined Standard and CRAFT Code, Impact's Just Gold project, or planetGOLD. These programmes can serve as examples for copper ASM in Africa or South America and aid the transparency of supply chains.

Communities cannot be the primary monitor for practices by companies. This is the responsibility of state regulators. Nevertheless, community-based organisations are important to raise awareness of issues and to ensure that community concerns are heard. Both vis-à-vis governments and companies. International companies often do not know about local cultures and rely on information from local people (information gathering and cooperation with local organisations is included in the recommendations for companies). They can also support local development by aiding the start of cooperatives, other local businesses, or organising training opportunities and basic financial support.

Labour Unions play an important role, particularly in occupational health and safety aspects, worker rights as well as in supporting social sustainability in general. A good practice example is the framework agreement between IndustriALL Global Union and Siemens Gamesa, one of the largest wind turbine manufacturers worldwide. This agreement aims at improving social and environmental sustainability both in Siemens Gamesa's facilities and along the supply chain of the company. Commitments included are the respect for the new ILO Convention 190 on violence and harassment at work, life-long learning and training programmes for employees and supply chain due diligence based on the OECD guidance (IndustriALL 2019). This shows collaboration between labour unions and companies can lead to positive actions to support occupational health and safety of the employees, community health and safety along the supply chain and other major labour issues impacted by a company's operations.

2.4 Target 4: Responsible Procurement

ISO defines responsible or sustainable procurement as 'the process of making purchasing decisions that meet an organization's needs for goods and services in a way that benefits not only the organization but society as a whole, while minimizing its impact on the environment' (ISO 2017, p. 2). This is exactly what the authors want to achieve with their recommendations – organisations need to consider not only their own impact, but also their impact along supply chains and create value wherever possible. However, responsible procurement does not mean ending business relationships with suppliers or countries that do not adhere to required social and environmental standards, but rather engaging with and supporting them in improving their performance. Forced labour, environmental pollution, or other wilful irresponsible practices at any stage of their supply chain, cannot be accepted from companies that want to do business in the EU.

The recommendation to introduce a supply chain due diligence law is not intended to undermine current efforts by countries to introduce such a law. The timeframe proposed here, as mentioned in the introduction, is only the latest date by which these measures should be implemented. It is also intended to encourage countries that are not yet planning to implement such measures to do so and provide some recommendations on what to include. For this target no specific recommendations for CSOs, research and academia were included, as they are already covered by the other four targets, but in this case extend to the entire supply chain.

Figure 8: Milestones for Responsible Procurement by 2040

2.5 Target 5: Level Playing Field & International Cooperation

During the consultation process, it became clear that the development of a level playing field (not only) for the renewable energy sector must be one of the major targets of the RE-SOURCING roadmap. The current system rewards companies that produce the cheapest product, ignoring the way in which the products are produced and their quality or durability. This system encourages companies to move production to countries with low social and environmental standards and encourages a 'throwaway society'. One of the key takeaways from the first RE-SOURCING conference were the two main goals a level playing field needs to achieve: (i) The rules should be similar for all comparable actors. (ii) Those who need more assistance should be provided with the help to achieve implementation to reach common standards (Farooki and Korb 2021). As already mentioned in previous chapters, the RE-SOURCING project follows the idea of a joint effort to reach more sustainable supply chains. Thus, the roadmap not only encourages the introduction of requirements for social and environmental standards to do business in the EU; the recommendations also include the cooperation with and support of companies, organisations or governments that currently do not fulfil those requirements.

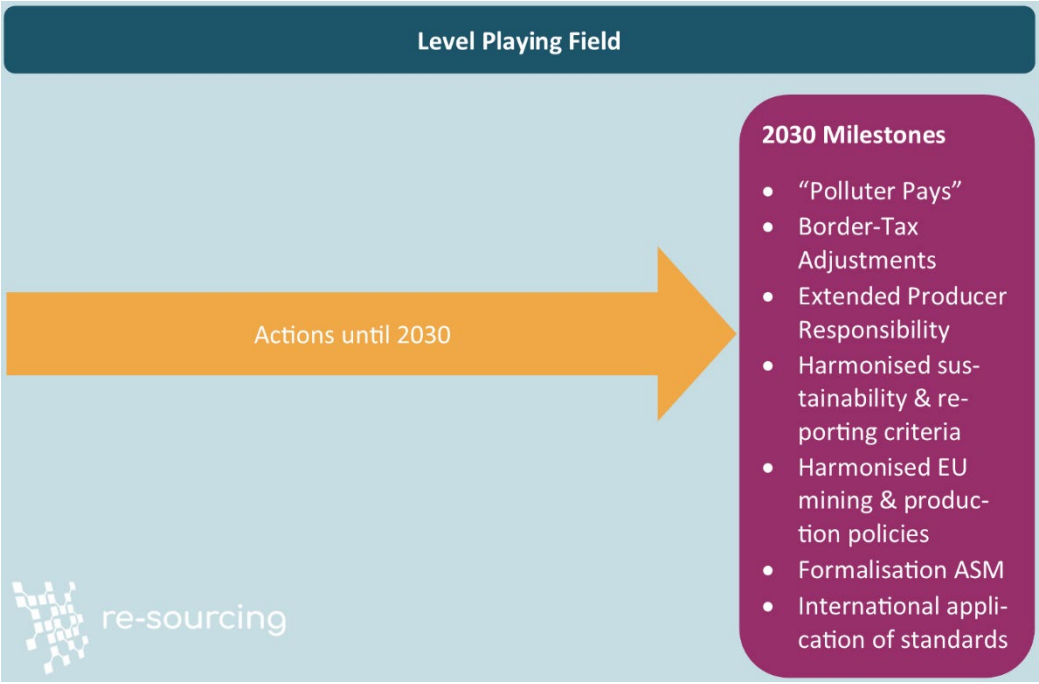

Figure 9: Milestones for a Level Playing Field by 2030

The level playing field will be a difficult goal to achieve, but one that is all the more important for achieving sustainable and responsible global supply chains.

International NGOs can support this development by playing a mediating role between different countries and stakeholders. Especially for countries with conflicting political interests, an independent advisory body is of great importance. Another important step is the harmonisation of reporting requirements and the mutual recognition of legal regulations as well as audits and certifications.

Both local and international CSOs should support information campaigns for the public, around the necessity of the development of raw material projects or the construction of wind and solar farms, etc. The NIMBY (Not In My Backyard) phenomenon is a significant challenge for the energy transition in the EU. People need to understand the necessity of these developments and be willing to compromise in order to maintain living standards. Awareness raising and educating people is an important task for NGOs.

Mining companies are often confronted with rejection and resistance from the general and local populations. Given the EU's aim to promote new projects on its own territory, it is particularly important to bring all stakeholder groups on board. As already highlighted in the industry recommendations, cooperation and involvement of local communities is crucial. In this context, the EU funded project MIREU has developed SLO guidelines and tools for all stakeholder groups. Aspects relevant for civil society are among others, what communities can expect from a mining project in Europe, help identify what SLO level the respective mining project is at, what standards are applicable, etc. A common understanding can help future stakeholder engagements and the development of joint SLO targets (Tost et al. 2021). Organisations, such as Women in Mining in the US, already do important work in educating both its members and the public about the mining and related industries.

Women in Mining also engage in educating students about career opportunities and the importance of mining in our everyday lives (Women In Mining 2021).

In general, professional and labour associations can support efforts for both responsible procurement and the development of a level playing field. Information of members and communities on legal aspects, current industry developments and supporting education and training are only few of the areas where these associations can contribute.

2.5.1 Role of International Organisations (UN/OECD/IFC)

Due to the complex and global structure of the renewable energy sector's supply chains, it is important that international organisations such as the UN and the OECD are strengthened. These organisations have an important contribution to make in shaping the level playing field and harmonising the requirements for companies. The role of the UN's international judiciary should also be extended to companies, so that internationally operating companies can be held more easily accountable for financial offences, as well as crimes against the environment and humanity.

The three organisations, the UN, OECD and IFC, already provide important templates for responsible behaviour by international companies in general. In addition, there are specific guidelines for mining, manufacturing, and responsible sourcing of raw materials, all either specific to or applicable to the commodities under consideration. These guidelines need to be implemented by member states on a mandatory basis and without delay, thereby also supporting an international level playing field.

3 Conclusion

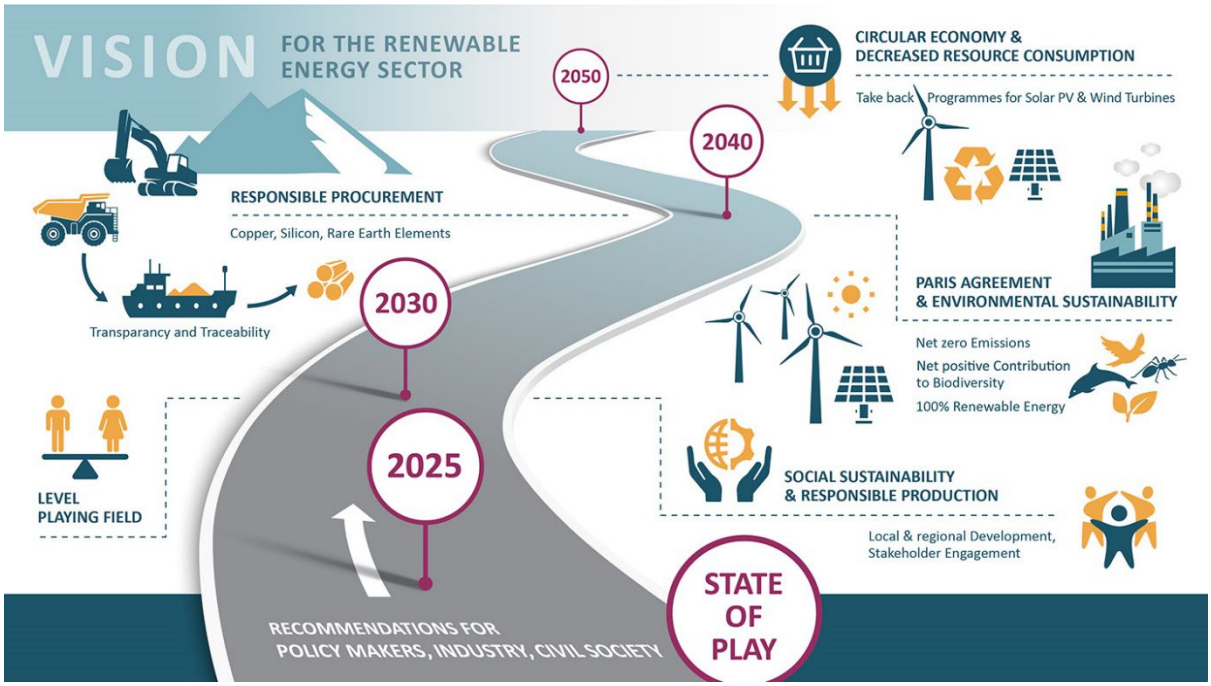

Figure 10: Roadmap for the renewable energy sector until 2050

One of the key findings of this roadmap is the importance of engaging the public in the energy transition. The population must actively support, shape and, most importantly, implement the transition. This not only requires information about the importance of the transition and all processes involved, but above all the trust of the population that this transition will be socially just and environmentally friendly is needed. Decisive and joint action by politics, industry, research, and civil society is needed to create trust and ensure the sustainability of the transition.

In the roadmap, numerous recommendations are made for CSOs, research, and academia, both specifically for renewable energies, but also very general recommendations that are valid in mineral raw material value chains of various raw materials and technologies. The rationale behind this is to recognise the systemic nature of many sustainability issues that cannot be specifically attributed to the raw materials and technologies considered in this roadmap, without ignoring their presence in other areas.

Even though the roadmap is designed until 2050, it has become clear that significant changes in procurement, production and energy consumption are needed, now and over the next two decades. This is also reflected in the time scales for the five overarching targets of the roadmap (Figure 10). Both, Targets 3 and 4 (social sustainability, responsible production and the level playing field) need to be implemented by all stakeholders as soon as possible to achieve a fair distribution of the benefits and burdens of the energy transition. The roadmap also sets very ambitious targets for the implementation and achievement of the Paris Agreement and environmental sustainability (Target 2), with 100% renewable energy and net zero emissions by 2040. Target 4 on responsible procurement combines the measures of the other goals with regard to the entire supply chain.

Human rights, environmental standards, etc. must be observed not only in a company's own production, in its own country, but in all areas in which a company or government is active and

maintains business relations. Only the goal of a circular economy and decreased resource consumption (Target 1) has a horizon until 2050, as it requires more fundamental, systemic changes to the economic system.

Nevertheless, it is essential to simultaneously address all five targets in a coordinated manner. Falling behind on only one target compromises the achievement of the others. For example, it is impossible to achieve the transition to 100% renewable energy without reducing energy consumption and increasing energy efficiency. Similarly, responsible production cannot be achieved without considering impacts along the entire supply chain.

The roadmap has not only highlighted many current problems and how to address them but has also identified gaps where crucial information is still missing. Critical research on consumption reduction, resource and energy efficiency is urgently needed to set concrete targets and implement measures.

Finally, an important finding of the roadmap is the requirement for the cooperation of all actors along the entire supply chain. Issues need to be solved together by engaging, not by ending relationships. None of the targets can be achieved by one stakeholder group alone.

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