Global Alliance for Sustainable Energy

Enabling a sustainable value chain

The Global Alliance for Sustainable Energy

Circular Design criteria Working Group Position Paper

"Reducing Raw materials' Environmental and Social impacts in Electrical Energy Technologies"

1. Executive summary

One strategic need of the industries, especially all the manufacturing industries, is to mitigate the impacts of the raw materials usage in equipment manufacturing, such as the environmental and social impact.

The energy sector is not an exception, considering that the rapid growing adoption of renewables and electric infrastructures development in the past decades has been fueled by the continuous supply of raw materials with some of them that may represent a bottleneck in the next future, as they are widely used not only in the energy sector.

According to the latest long-term decarbonization scenario for the scale-up production of the renewable generation technologies, the demand for several materials would increase from four to six times by 2040.

As a result, the annual supply of raw materials might not meet the expected demand in the long term, while increasing the prices of raw materials, may slow down the process of energy transition and eventually represent a global constraint.

Raw materials production is often highly geographically concentrated and causes high impact in terms of social and environmental dimensions, with possible consequences locally and globally, together with supply and geopolitical risks.

Circular Economy, and in particular Circular Design is a key lever, able of creating economic growth by reducing the consumption of new resources, increasing the share of recycled materials along the supply chain and by extending use and life of goods. It also facilitates the implementation of innovative models, also among different sectors, which integrate the social, economic and environmental aspects in the business.

Circular Design is a key strategy to improve the stability and the overall sustainability of supply chain, mitigating also other risks as the geopolitical and supply ones.

Sustainability and circularity integration in the entire value chain, and in particular considering the initial design phase of any equipment or powerplants, could guarantee better transparency, environmental and social performances.

The document resume and analyze all the initiative mapped by the Circular Design working group that focus on:

- Enhancing transparency and visibility of the whole supply chain, to be able to identify possible hot spots in terms of potential social and environmental impacts;
- Boosting raw material circularity, using secondary or less “critical” raw materials and facilitating materials and equipment recyclability;
- Integrating design choices that allow an extended life respect to business-as-usual equipment;
- Procuring raw materials that are certified as “sustainable”.

These activities or strategies target the possibility to mitigate or better avoid potential environmental and social impacts, guaranteeing that the raw material supply chain is compliant to the best ESG standards.

Moreover, the Working Group has worked to spread the use of common sector tools, facilitating the definition of common priorities and standards to be applied through the value chain and the definition of a common roadmap towards agreed targets.

2. *Background and context*

In September 2021 a group of global leaders from across the renewable energy value chain and the sector's innovation ecosystem (civil society, academic institutions, policy makers, sector's associations, international agencies, innovators) launched a new organization to ensure renewables are wholly sustainable for people and the planet and lead a just transition away from fossil fuels.

This organization has been growing including partners from other energy value chain, to maximize commitment toward common goal.

The partners, united in a shared vision for the sustainability of the renewables industry and the need to take concrete, collaborative action, have come together to create the Global Alliance for Sustainable Energy. The initiative, launched on 16th September in a virtual event, is unique in its scope and ambition, representing the members' joint response to the urgent need to decarbonize the global energy system while ensuring its sustainability from an environmental, social and governance (ESG) perspective.

An independent global alliance open to all actors recognizing the urgency of tackling the climate emergency according to the 'just transition' principles and the need to promote and embed sustainability and social responsibility in the renewable energy industry.

The Alliance goal is a just transition to net-zero and socially responsible energy production, achieving the ambition of The Paris Agreement to avoid the harshest impacts of climate change on people and the Planet, through:

- Defining standards and KPIs for new design, business models, and End of Life in line with United Nations' Sustainable Development Goals (SDGs);
- Disseminating and activating funding and collaboration frameworks;
- Promoting supportive regulation;
- Launching tailored initiatives such as reports or events, drawing on the wide-ranging experience and perspectives of the Alliance's founding members and stakeholder network.

3. *Energy transition context*

In the last ten years renewable energy capacity has grown by around 130%, and the growth is expected to rise by over 60% between 2020 and 2026. However, to align with the scenario in which global warming is limited to 1.5 degrees Celsius by 2050, the installed generation capacity will need to increase by 2030 and 2050, four and ten times, respectively, over the 2020 level[1].

Reaching increasingly ambitious decarbonization objectives requires a transformation of the energy system, involving Renewable electricity, flexible and digitalized grid infrastructure to enable electrification of consumption[2].
In absolute terms, the consumption of resources will be significantly reduced thanks to the progressive elimination of the large volumes of fuels currently being used, but at the same time, there will be a growing need for raw materials to manufacture Equipment and built Powerplants.

[1] World Energy Outlook, IEA 2021
[2] Critical Raw Materials for Strategic Technologies and Sectors in the EU A Foresight Study, EU 2020

The rapid growing adoption of renewables and electric infrastructures development has been fueled by the continuous supply of raw materials with some of them that may represent a bottleneck in the next future, as they are widely used not only in the energy sector.
Some of the most relevant critical materials for the renewables sector are cobalt, copper, nickel, lithium, Aluminum, and rare earth metals, such as neodymium, dysprosium and praseodymium.
According to the latest long-term decarbonization scenario for the scale-up production of the renewable generation technologies, the demand for several materials would increase from four to six times by 2040[3].
As a result, the annual supply of raw materials might not meet the expected demand in the long term, while increasing the prices of raw materials, which may slow down the process of energy transition and eventually represent a global constraint.

Raw Materials production is often highly geographically concentrated[4] and causes high impact in terms of social and environmental dimensions, with possible consequences locally and globally, together with supply and geopolitical risks.
The extractive industry is a high ESG impact sector[5], with several risks that are more frequent and common among all the raw materials, as:

- Environmental impact as water consumption and pollution and CO2 emission
- Labor risk as forced and child labor
- Local impact as economic and social destruction and indigenous people respect
- Security and safety aspect of mines and refiner.

To ensure that the energy transition is sustainable, Circular Economy, and in particular equipment Circular design is a key lever, able of creating economic growth by reducing the consumption of new resources, increasing the share of recycled or low-emission materials along the supply chain and by extending use and life of goods. It also facilitates the implementation of innovative models and methods for governance, also among different sectors that integrate the social, economic, and environmental aspects in the business.
Last but not least circular design is a key strategy to improve the stability and the overall sustainability of supply chains.

The list of raw materials impacting renewable development and energy transition is quite extensive, so to be effective the Alliance working groups on circular design decided to prioritize and select the most important to focus on. This list will be extended and re-evaluated in the next future.

Below the list of the raw material selected and the reason beneath the selection:

1. Aluminum:
    - Key Material for PV panel as it covers 5-10% of a PV panel bill of materials
    - Key material for electrical sector in general, extensively used in cable and several equipment
    - Some reserves are in fragile and/or corrupt countries

2. Copper:
    - Key material for electrical sector extensively used in cable and all the equipment
    - Some reserves are in fragile and/or corrupt countries

[3] World Energy Outlook, IEA 2021
[4] USGS - https://www.usgs.gov/
[5] Mineral demand for clean energy technologies by scenario, IEA 2021 -- The Role of Critical World Energy Outlook Special Report Minerals in Clean Energy Transitions, 2021 -- UNEP Resource efficiency and climate change, 2021

3. Iron (Steel):
    - Key material for wind turbine as it covers up to 87% of the bill of materials and Powerplant construction
4. Silicon:
    - Key material for the cells of the PV Panels

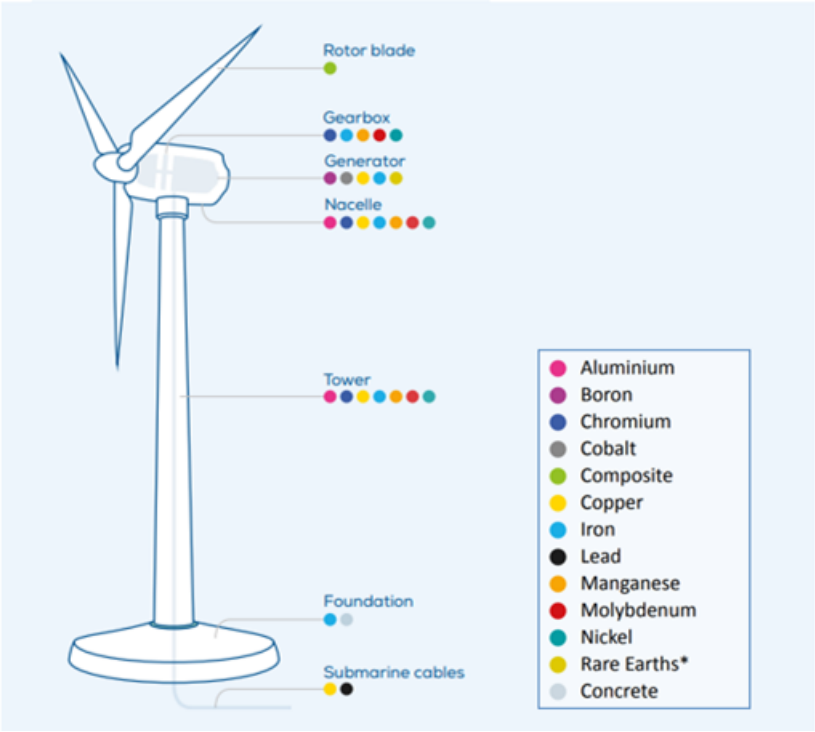


Fig. 1 – Typical materials for Wind Turbines[6]

[6] WindEurope. Decommissioning of onshore wind turbine, 2020
https://windeurope.org/intelligence-platform/product/decommissioning-of-onshore-wind-turbines/

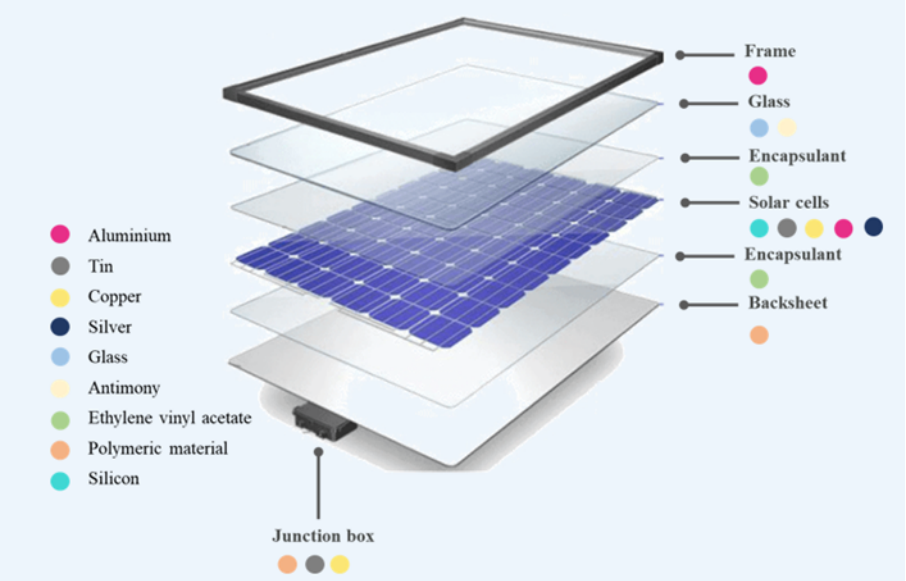


Fig. 2 – Typical materials for PV Panels[7]

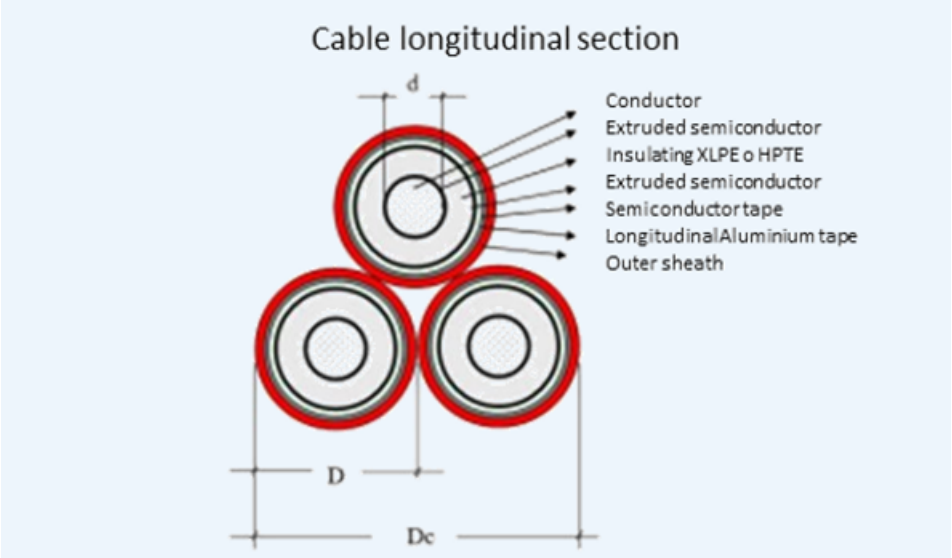


Fig. 3 – Typical materials for Cables

4. Environmental and social impacts mitigation strategies

The initial design and procurement phases are critical to the transition to equipment circular design. The approach chosen in the first phases of an equipment manufacturing and plant construction will impact the overall value chain, also influencing the future end of life management.

Several activities could be implemented during these phases to integrate more sustainability and circularity in the business choices. These activities or strategies target the possibility to mitigate or better avoid potential

[7] Clean Energy Reviews. Solar Panel Construction, 2020
https://www.cleanenergyreviews.info/blog/solar-panel-components-construction

environmental and social impact of the Value chain, guaranteeing that the raw materials supply chain is compliant to the best ESG standards.

These initiatives and strategies aim to:

- Enhance transparency and visibility of the whole supply chain so to be able to identify possible hot spots in terms of potential social and environmental impact and plan dedicated action to mitigate them;
- Boosting raw material circularity, facilitating raw material and equipment recyclability, also through design choices that implement modularity to facilitate reparability, material separation at end of life and the use of secondary or renewable or less "critical" raw material;
- Design choices that allow an extended life facilitating repairability respect to business-as-usual;
- Procure only raw materials that are certified as "sustainable".

As a Global Alliance we have been tried to map possible strategies, initiatives and practices that the sector is implementing, so to list them, analyzed them and also plan for a possible implementation roadmap for all the members. Each initiative has been analyzed considering the 4 points below:

- Description: in this paragraph the strategy has been described in details;
- Benefit: to highlight the benefit that, the implementation of this practice, could create to all possible stakeholder and environment;
- Barrier to overcome: Potential limitation that could limit a fast and general deployment of the practice;
- Possible application: a description on how the practice could be applied, by various stakeholders, in the business.

Below some examples of possible initiatives to be implemented:

I. Bill of Materials:

i. *Description*: Bill of Materials is often contained also in a detail LCA study and include all the information related to the raw materials used to manufacture the equipment.
Some of the information typically found in a Bill of Materials are: Raw materials quantity, primary or secondary raw material, recyclability, etc..

ii. *Benefit*: knowing detail information regarding material composition of an equipment could help in managing properly the end of life of an equipment, while also define a roadmap to maximize the use of secondary raw material, identify and prioritize strategic raw materials, etc..

iii. Barrier to overcome: Bill of Materials could contain confidential information that could not be shared with clients.

iv. *Possible application:* the bill of material could be requested during tenders by the clients to the suppliers and could also be used as metrics to reward suppliers aligned to specific requirement (e.g. No use of specific raw materials, minimum content of recycled raw materials, etc.).

Some examples from the members:

For Trinasolar in the product design, dual glass PV modules should take the place of single glass PV modules, which reduces the use of back sheet. For example, the production capacity of dual glass modules DEG21C.20 is much more than that of single glass modules DE21.

In addition, cutting down the use of raw materials also plays a part in reducing carbon emissions. For instance, reducing the weight of aluminum frame contributes to less carbon emissions in producing aluminum frame, meanwhile, it will not change the product performance.

For JA Solar in the product design, during the past two years, the thickness of the silicon wafer has been reduced from 175μm to 150 μm, and the cell efficiency has been enhanced from 22.8% to 23.6%, which means about 12% poly silicon materials saved per watt. Also the percentage FBR polysilicon has been increased from less than 5% to 20%, which means totally about 10% carbon emissions reduced per watt.

In addition, JA Solar also reduced the use of silver paste and soldering ribbon in cell and module manufacturing process, during the past two years, the use of silver paste has been reduced for about 18% per watt and the use of soldering ribbon has been reduced for about 3% per watt, while the product reliability performance keeps the same, which also means quiet remarkable carbon emissions.

II. EPD/LCA Certification:

i. *Description*: EPD (Environmental Product Declaration) is a Life Cycle Assessment, certified by 3rd party, that highlight the main environmental impact of an equipment considering the entire life cycle, from raw material extraction to end of life management.

ii. *Benefit*: This kind of certification can highlight the main phases of the value chain and the related environmental impact. With this information is possible to plan for action able to reduce those impacts while monitoring the overall impact of an equipment and plan for a reduction roadmap.

iii. *Barrier to overcome*: no barriers are foreseen; these kinds of studies are now quite commercial from several years. The only limit is that the lack of a unique international standard and fixed rules, could reduce the possibility to compare different studies.

iv. *Possible application*: EPD certification could be requested during tenders by the clients to the suppliers and could also be used as metrics to reward suppliers with better environmental footprint (e.g. CO2 Footprint, Water Footprint, etc.)

Some examples from the members:

Enel's circular procurement strategy is divided into the following steps:

- engaging suppliers: including rewarding mechanism or requirements on sustainability in the bidding phase to increasingly engage suppliers in their transition towards circular economy;
- setting metrics and measuring environmental impacts of what is acquired, using the Environmental Product Declaration (EPD) and developing IT systems to provide support. At global level, approximately 200 suppliers are currently involved in 13 strategic product categories, accounting for more than 50% of the expense for purchasing

materials; certification is being applied (Carbon Footprint, for example) for the remaining categories, works and services;

- co-innovation: launching projects with suppliers to jointly redesign products' technical specification

III. Material and equipment traceability

i. *Description*: Equipment are built of different components that for their manufacture has involved several suppliers, distributed along several tiers of supply chain. This ramification reflects in a difficulty in visibility of all the entity involved and their sustainability performance.

ii. *Benefit*: Traceability will enhance the complete visibility and transparency of the whole supply chain involved in the equipment manufacturing, from mining to the final user. In addition, this will help to arise awareness within all members of the value chain especially to final clients which will have more instruments to make future responsible choices.

iii. *Barrier to overcome*: the lack of a unique international standard and fixed rules, in conjunction to the huge amount of information that should be manage by the OEMs, considering the huge number of components, materials and involved entities, make it difficult to a fast and general deployment. Moreover, confidentiality of information should be managed.

iv. *Possible application*: traceability information could be requested during tender by the clients to the suppliers so to guarantee the complete visibility of all the actors involved in the supply chain.

Some examples from the members:

Enel Green Power has started to ask its OEMS more transparency and visibility of the whole supply chain involved in the production of the main equipment that will be installed in Enel power plants.

The enhanced transparency and visibility will be achieved through clauses that will ask the:

- traceability of the strategic materials involved in main equipment manufacturing;
- highest performance in terms of Human rights respect along the value chain and aligned to the best international standard;
- possibility to check the performance of each actor of the value chain through specific factory assessment that covers also ESG topic.

IV. ESG audits along the supply chain

i. *Description*: in addition to the traceability system, to perform ESG audit along all the supply chain to guarantee that the involved actors perform aligned to the best ESG standards.
These audits could be performed by the clients or a 3rd party auditor.

ii. *Benefit*: to ensure that the whole supply chain, all tiers and suppliers involved in the manufacture of the equipment perform in a sustainable way, aligned to the best ESG standards.

iii. *Barrier to overcome*: the lack of a unique international standard and fixed rules, in conjunction to the huge number of actors of the supply chain involved in the manufacturing of the equipment, make it difficult to a fast and general deployment. Moreover, confidentiality of information should be managed.

iv. *Possible application*: ESG audits could be requested during tender and then performed during contract execution by/for the clients, so to guarantee the complete transparency of all the actors involved in the supply chain.

Some examples from the members:

Iberdrola has the responsibility and the ability to motivate its suppliers to improve their environmental, ethical and social performance through actions that foster excellence in their management of sustainability. In order to do this Iberdrola has the target to ensure that 70% of key suppliers have robust sustainability or ESG policies and practices;

Supplier sustainability evaluation model

In 2021 the Purchasing Division consolidated the use of the global supplier sustainability evaluation model, which is conformed to the international reality of the Iberdrola group and organised around three core ESG pillars of sustainability.

The evaluation of a supplier measures the supplier's performance in highly significant attributes: identification of objectives linked to the Sustainable Development Goals (SDGs), management of climate change risk, circular economy strategy, human rights due diligence, etc.

The supplier must provide supporting evidence and documentation for its statements and performance.

The following information is assessed as part of the three dimensions analysed:

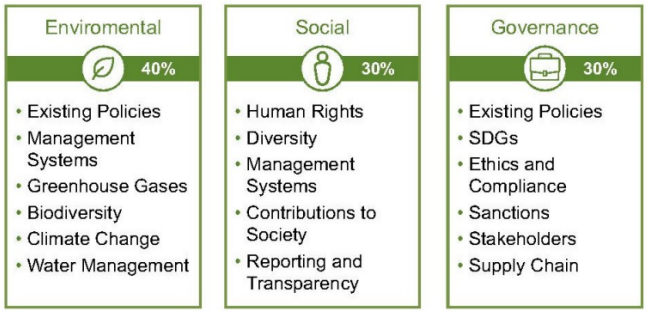


Fig. 4 – Iberdrola Supplier sustainability evaluation model

V. Action connected to output material: Boost End of life material recycling

i. *Description*: This kind of action are specific to materials, component, technologies etc. but a general approach is to integrate, in the design of the equipment and power plants, action that will allow the recyclability of the equipment itself in all its part. Some examples could be:

1. Material substitution with something more easily recyclable
2. Modularity and dismantlability, so to allow easy repairability, dismantling and material separation

ii. *Benefit*: This action will enhance the circularity of an equipment.

iii. *Barrier to overcome*: Barriers are specific to the detailed action, but one of the main barriers could be the cost of some solution, the maturity level of technologies and market readiness.

iv. *Possible application*: OEMs could integrate circular design criteria in their activities, and utilities could ask, through tender requirements a minimum threshold of recyclability, focusing on priority materials.

Some examples from the members:

Iberdrola, through its PERSEO programme, and FCC Ámbito, a subsidiary of FCC Servicios Medio Ambiente, have launched EnergyLOOP to lead the recycling of renewable installation components, one of the biggest medium- and long-term challenges in the sector. This initiative will also contribute to the energy transition and boost the circular economy in Spain.

The initial objective will be the recovery of wind turbine blade components - mostly glass and carbon fibers and resins - and their reuse in sectors such as energy, aerospace, automotive, textiles, chemicals and construction.

To this end, the new company plans to set up Spain's first blade recycling plant in Navarre. The facility will be located in the south of the region, a strategic location due to its proximity to some of the country's leading wind farms and with good connections to other regions with abundant wind farms.

VI. Action connected to input material: Boost the use of secondary raw materials

i. *Description*: the possibility to integrate the use of secondary raw materials in equipment manufacturing is specific to materials, components and technologies. While there is a desire to use secondary raw materials, performance must be evaluated in order not to compromise technical performances.

ii. *Benefit*: This action will enhance the circularity of equipment avoiding the use of raw materials mined, reducing the overall environmental and social impact of the equipment.

iii. *Barrier to overcome*: Barriers are specific to the detailed action, but one of the main barriers could be the cost and the applicability of secondary raw materials in specific applications. In some cases secondary raw materials could compromise technical performances.

Possible application: OEMs could integrate circular design criteria in their activities, while the utility could ask, through tender requirement for a minimum threshold of secondary raw materials usage, focusing on priority materials

Some examples from the members:

Enel Grids is going to utilize for its network green cables that guarantee at least 10% of recycled aluminum in input, ensuring same high quality and electrical conductor properties as primary aluminum.

VII. Raw material assurance framework

i. *Description*: In the last years, several industrial initiatives that focus on the sustainability of raw materials supply chain, in particular mining and smelting have been launched. These initiatives usually have developed an audit framework to certify the sustainability of the mines and smelters.
ii. *Benefit*: in parallel with traceability and ESG audit this kind of certification could increase the visibility of the sustainability of the first phases of the value chain. As this phase of the value chain is farther from the final clients and the one with the highest ESG risk.
iii. *Barrier to overcome*: there is limited diffusion of these initiatives with few mines taking on the process of certification. Additionally, there is a lack of a unique international standard to facilitate the spread of these initiatives.
iv. *Possible application*: Raw material assurance framework could be requested during tender by the clients to the suppliers, to drive visibility and adoption of materials that are certified by a selected initiative.

VIII. Life Extension

i. *Description*: This kind of action are specific to equipment, however limited detail description is possible. The general approach is to integrate in the design of the equipment actions that will allow the life extension of the equipment.
ii. *Benefit*: Extending the life of equipment will have a reduced environmental and social impact considering that the extended life equipment will produce and operate several more years than standard equipment
iii. *Barrier to overcome*: technology advancement and increased efficiency in the future could make it profitable to switch technology/upgrade the plant, instead of maintaining and extending the life of the current equipment.
iv. *Possible application*: OEM could develop equipment with extended life, while utility could ask, through tender requirement equipment with an extended life.

Some examples for the members:

In 2022 Enel started operating its innovative “Second Life” project, which combines 78 Nissan electric vehicle batteries, of which 48 are disused and 30 are brand new for performance comparison, at a conventional power plant in Melilla operated by Enel’s Spanish subsidiary Endesa.

The Second Life project is a pioneering initiative in Europe, based on circular economy principles, and selected as a “member initiative” by the World Economic Forum (WEF). The project uses electric vehicle batteries as a source of energy, interconnecting and storing them at Endesa’s Melilla facility. The Second Life project has a capacity of 4 MW and can produce up to 1.7 MWh. Should the power plant be disconnected from the system, the storage facility can inject energy into Melilla’s electricity grid for 15 minutes, which is enough time to reset the system and restart the power supply.

The project leverages on advanced technology based on a simple idea: once the useful life of a battery within an electric vehicle has come to an end, these batteries are recycled and assembled

in a large stationary storage system. This system is integrated with Endesa's Melilla facility in order to avoid load shedding events, improve the reliability of the grid and secure the continuity of network service to the local population.

This project also represents a breakthrough in the life extension of electric vehicle batteries. Furthermore, it has an added innovative component: when each battery pack is removed from an electric vehicle, it is then placed directly in the overall storage system exactly as it was placed in the vehicle, without the need for disassembling each pack down to the single cell level, making the whole process simpler, safer and cheaper.

5. External initiatives targeting sustainable mining and raw material production

As briefly analyzed in the previous chapter in the last few years several industrial initiatives and alliances that focus on raw materials supply chain, have been developed.

These initiatives have industry specific targets, and focus on sector relevant critical raw materials, but there is a "fil rouge" that connect them, as they want to create a unique framework and set of information that could be used globally. The overall goal is to certify that specific mineral supply chains are aligned to the best ESG standards.

As a Global Alliance we have mapped key initiatives, that have relevance or a framework instructive to our evolution as a working group. We have included them in the report as part of our analysis.

Several initiatives where found, but only 8 were chosen to be highlighted in our report out document. The selection has been made considering initiatives focusing on the 4 priority materials and with a holistic ESG approach.

- **Drive Sustainability - *(https://www.drivesustainability.org/)* – The raw material outlook - *(https://www.rawmaterialoutlook.org/)***

    - *Description*: Drive sustainability is an Automotive sector alliance, that has as mission to drive sustainability throughout the automotive industry by leveraging a common voice and by engaging with suppliers, stakeholders and related sectors on impactful activities.
      Drive Sustainability brings together global automotive companies that commit to improve both their own performance and that of their supply chain by integrating sustainability in the overall procurement process, following the common guiding principle defined by the association.
      Moreover, Drive Sustainability developed a common Self-Assessment Questionnaire (SAQ), its focus is on social and environmental sustainability, business conduct and compliance, and supplier management.

      This tool is used to assesses suppliers' adherence to international regulations and standards as well as internal guidelines and targets along the supply chain.
      It covers the areas of social, ethical and environmental standards.

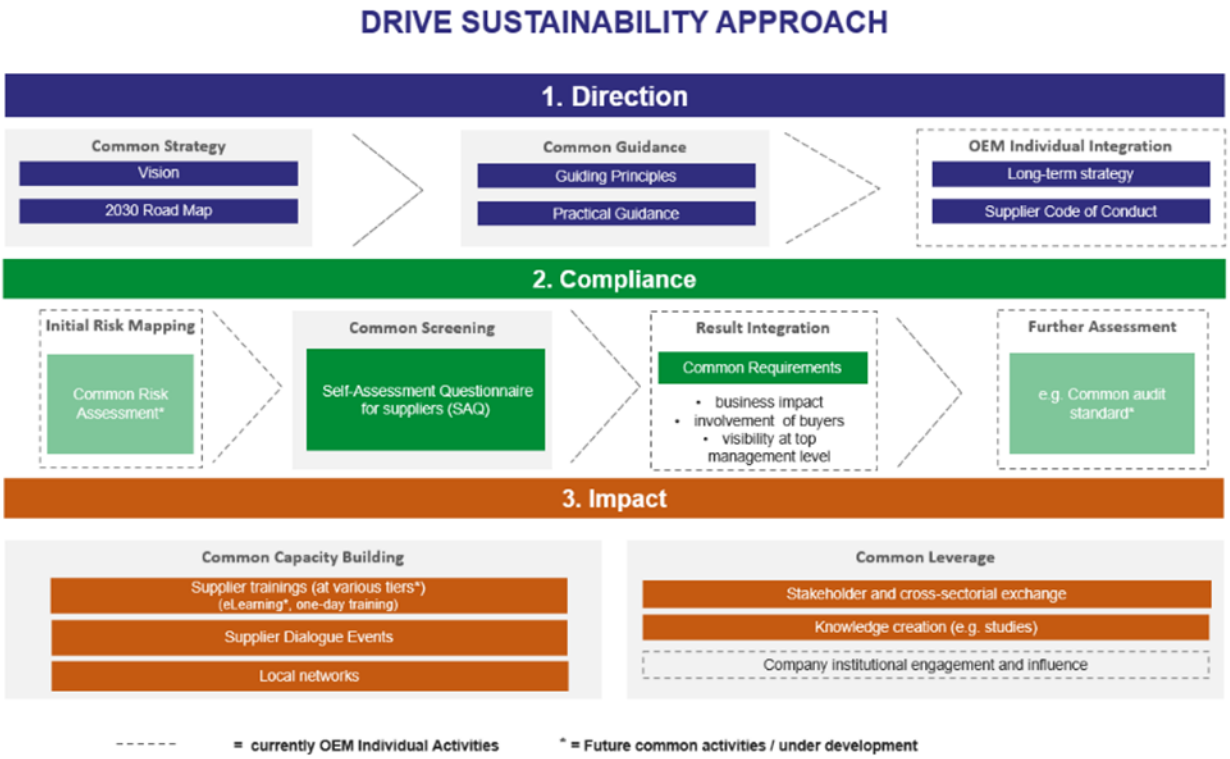


Fig. 5 – Drive sustainability Approach

The Raw Material Outlook is a Drive Sustainability initiative, launched in October 2021, and is a platform dedicated to managing and mitigating ESG impacts, including human rights violations, of materials used in the automotive value chain.

- *Target*: Focusing on The Raw Material Outlook, it aims to help partners better develop collaborations and identify leverage points to integrate sustainability throughout the global automotive supply chain. It provides a tool for individual automotive companies and the Drive Sustainability group to analyze materials value chains and advance responsible sourcing endeavors.

  Main target of the initiative:
  - Further analysis of the value chain, based on identified stages, producing companies and their locations. This provides greater due diligence and ESG risk assessment for Original Equipment Manufacturers (OEMs).
  - Identify leverage points and actions that OEMs can consider as individual companies, in the framework of the Drive Sustainability initiative or though sector and multi-stakeholder collaboration.
  - Guide Drive Sustainability engagement with different stakeholders involved in the value chain of the materials in scope.
  - Explore potential for collaborative action between Drive Sustainability partners and automotive suppliers.

- *Raw Materials:* The platform covers Aluminum/Bauxite, Graphite, Iron ore, Magnesium, Manganese, Molybdenum, Nickel, Rare Earth Elements REE, Tantalum and Zinc.

- **Responsible Minerals Initiative (RMI) - *(https://www.responsiblemineralsinitiative.org/)***
    - *Description*: Within the Responsible Business Alliance the Responsible Minerals Initiative (RMI) brings together hundreds of representatives from industry, government and civil society for updates, in-depth discussions and guidance on best practices on responsible mineral sourcing.
      The RMI has developed tools and programs to enable Raw Materials Supply chain due diligence to understand, contribute and mitigate the salient social and environmental impacts of extraction and processing of minerals in supply chains.
      The RMI has developed The Risk Readiness Assessment (RRA), a voluntary self-assessment and self-reporting tool for minerals and metals producers and processors to communicate their environmental, social and governance practices and performance.
      The Responsible Minerals Assurance Process (RMAP) uses an independent third-party assessment of smelters/refiners' management systems and sourcing practices.
      The RMAP standards are developed to meet the requirements of the OECD Due Diligence Guidance and other international standard and regulation and guide user in developing and applying a mineral supply chain Due Diligence.

    - *Target*: support responsible mineral production and sourcing globally, including but not limited to conflict-affected and high-risk areas, providing companies with tools and resources that improve regulatory compliance, align with international standards, and support industry and stakeholder expectations

    - *Raw Materials*: The RMI covers the following metals and minerals: Aluminum, Alumina, Bauxite, Cobalt, Copper, Gold, Graphite, Iron Ore, Lead, Lithium, Mica, Molybdenum, Nickel, Palladium, Platinum, Rare Earth Elements, Silver, Steel, Tantalum, Tin, Tungsten, and Zinc.

- **The initiative for Responsible Mining Assurance (IRMA) - *(https://responsiblemining.net/)***
    - *Description*: The Initiative for Responsible Mining Assurance (IRMA) is a mining standard and certification program, offering comprehensive measure of performance and incentives for best practices in social and environmental responsibility at mine sites globally.
      IRMA's approach to responsible mining is to certify social and environmental performance at mine sites globally using an internationally recognized standard that has been developed in consultation with a wide range of stakeholders.
      IRMA's Standard for Responsible Mining defines good practices for what responsible mining should look like at the industrial scale, considering Ethics social and environmental responsibility.
      It provides the list of expectations that independent auditors will use as the benchmark for responsible mines.

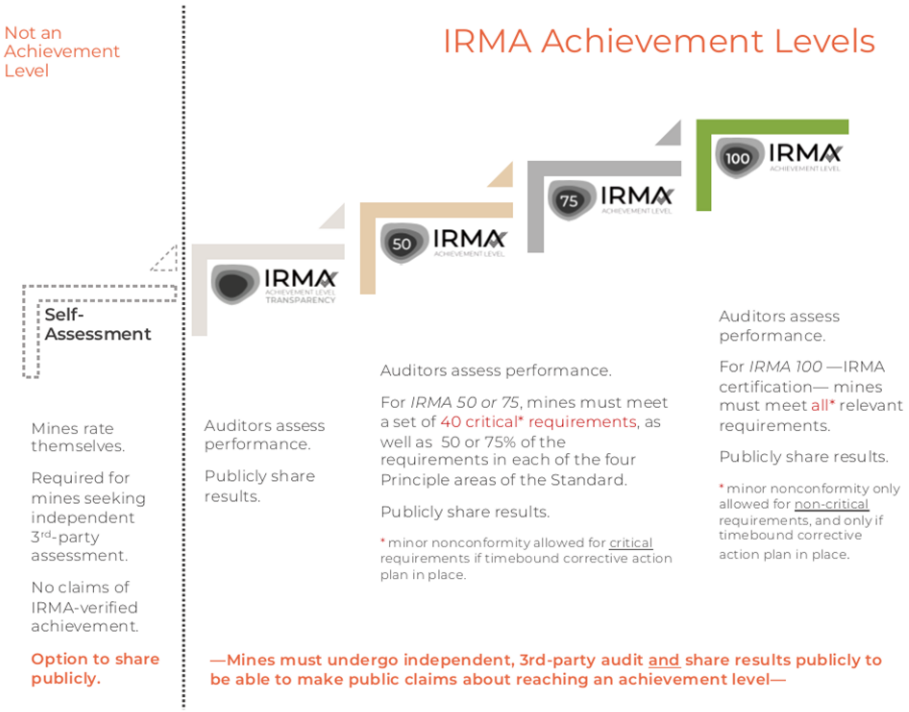


Fig. 6 – IRMA Achievement Levels

- *Target*: It offers independent third-party verification and certification against a comprehensive standard for all mined materials.

- *Raw Materials*: All mined raw materials

- **Responsible Steel – *(https://www.responsiblesteel.org/)* – Steel Zero – *(https://www.theclimategroup.org/steelzero)***
  - *Description*: ResponsibleSteel is a not-for-profit organization, multi-stakeholder standard and certification initiative for the steel sector, covering the sourcing of raw materials for steel production, as well as steelmaking itself.
    Through a global standard and certification program for the entire sector (the Standard applies to operational steel sites and to related sites that process raw materials for steelmaking, or that produce steel products. It does not apply to service providers, mine sites, or to sites producing final products made with steel components) the initiative will ensure, trough specific independent third-party certification bodies, that the steel has been sourced and produced responsibly at every stage considering all the Key ESG issue.
    ResponsibleSteel™ is working in partnership with IRMA (Initiative for Responsible Mining Assurance), TSM (Towards Sustainable Mining) and RJC (Responsible Jewelry Council) in the mining sector, to develop tools that support alignment of our various programs and to create a common platform for engaging with stakeholders.

    While SteelZero is a global initiative that brings together leading organizations to speed up the transition to a net zero steel industry.

Organizations that join SteelZero make a public commitment to procure 100% net zero steel by 2050. By harnessing their collective purchasing power and influence, Steelzero is sending a strong demand signal to shift global markets and policies towards responsible production and sourcing of steel.
To become a member of SteelZero, organizations must make a public commitment to procuring, specifying or stocking 100% net zero steel by 2050 and an interim commitment to procuring, specifying or stocking 50% of its steel requirement by 2030.

- *Target*: The objective of the ResponsibleSteel Standard is to support the responsible sourcing and production of steel, as a tool for the achievement of ResponsibleSteel's vision: to maximize steel's contribution to a sustainable society.
  While steel zero has the target to push the steel sector toward net zero emission.

- *Raw Materials*: Steel

- **The Copper Mark – *(https://coppermark.org/)***
  - *Description*: Copper Mark is an assurance framework set up to promote the responsible production of copper where Participants commit to fully meet the requirements of the Copper Mark standards.
    The Copper Mark Assurance Framework was developed to set common expectations for responsible production practices, assure that those common expectations are met at site level, and capture the changing expectations of stakeholders through regular consultation and revision.
    The Copper Mark developed two standards to set Due diligence and audit process in the copper industry:
    a) The Copper Mark Criteria for Responsible Production. The Copper Mark uses the Risk Readiness Assessment (RRA) of the Responsible Minerals Initiative (RMI) as the basis for evaluating Participants' performance;
    b) The Joint Due Diligence Standard for Copper, Lead, Nickel and Zinc of February 2021. As guidance on how to apply a value chain due diligence aligned to OECD standard and as requested by the Risk Readiness Assessment.

    Moreover, it has developed The Copper Mark Chain of Custody Standard that sets the rules to support product-level claims related to "Copper Mark copper." It seeks to increase transparency in copper supply chains and to bring responsibly sourced copper to the market.
    The Chain of Custody Standard is a voluntary add-on option to an assessment against the Copper Mark Criteria. It defines the requirements for a system of control and transparency for copper-containing products that move through a supply chain.

    This chain of custody standard is in testing between August 2022 e March 2023.

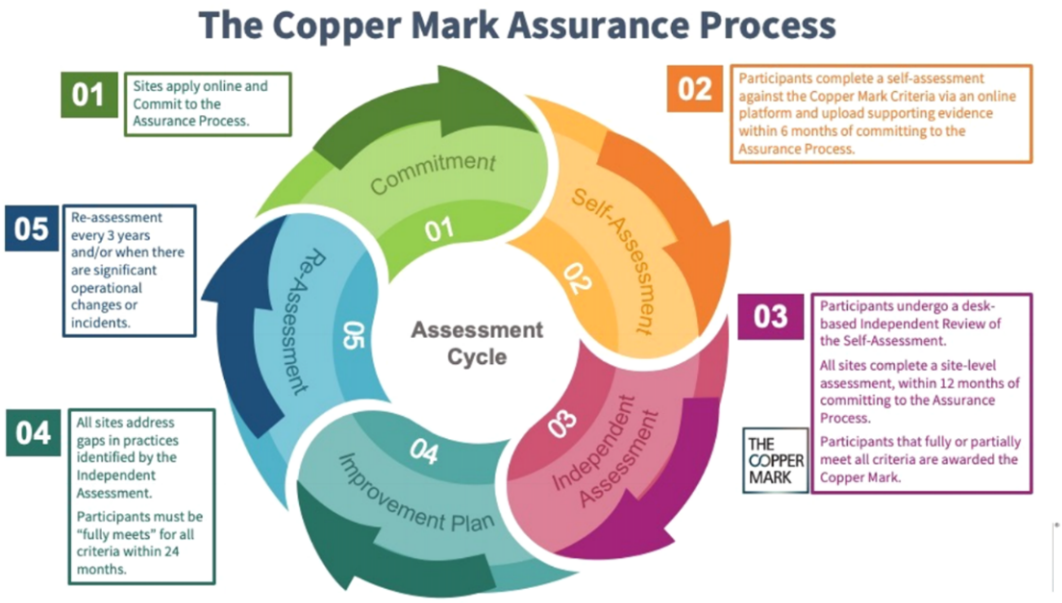


Fig. 7 – The Copper Mark Assurance Process

- *Target*: The Copper Mark is working with companies throughout the copper industry to enable them to meet the demands for responsible production practices, supporting sustainable development and mitigating environmental degradation to the benefit of local communities, customers and consumers developing tools and guidance to implement Supply chain Due Diligence and traceability process.

- *Raw Materials*: Copper

- **Aluminum Stewardship initiative – *(https://aluminium-stewardship.org/)***
  - *Description*: The ASI is a non-profit standard setting and certification organization that brings together producers, users and stakeholders in the aluminum value chain to collaboratively foster responsible production, sourcing and stewardship of aluminum.
    ASI has developed two different standards to tackle responsible production, sourcing and stewardship of aluminum, The ASI Performance and Chain of Custody Standards. These two standards form the basis of the ASI Certification program.

    The ASI Performance Standard defines environmental, social and governance principles and criteria providing a common standard for the aluminum value chain on environmental, social and governance performance. It also establishes requirements that can be audited by a 3rd party auditors to grant the ASI Certification.

    The ASI Chain of Custody Standard complements ASI Performance Standard and the sets out requirements for the flow of Chain of Custody (CoC) Material through the value chain (from mining or recycling through to final products), providing a common standard that can be audited by a 3rd party auditors to grant the ASI Certification.

    The ASI Chain of Custody (CoC) Standard is voluntary and not mandatory for ASI members that want to achieve ASI certification.

Fig. 8 – Aluminium Stewardship Initiative Strategy

- *Target*: To define globally applicable standards for sustainability performance and material chain-of-custody for the aluminum value chain, promoting measurable and continual improvements in the key environmental, social and governance impacts of aluminum production, use and recycling

- *Raw Materials*: bauxite, alumina and aluminum

- **China Green Supply Chain Alliance – *(http://www.cgsca.cn/)***
  - *Description*: The China Green Supply Chain Alliance is a non-profit national organization. The alliance consists of relative companies, universities and scientific institutes. They focus on the green supply chain management and technologic innovation, and standardization.
  - *Target*: There is a special committee of PV modules in the alliance, CHINA ECOPV Alliance. They advocate that PV enterprises should pay more attention to the green supply chain while producing green energy products. There are some aspects which should be considered, such as product designing (how to realize green design in the beginning to propel the research and use of environmentally friendly materials), manufacture technology (about how to decrease carbon emission), using green electron and developing recycling projects (to achieve a closed loop of the entire lifetime of PV modules).
  - *Raw Materials*: Aluminum, Silver, Copper, Silicon.

- **International Council on Mining and Metals (ICMM)** – ***(https://www.icmm.com/)***
    - *Description*: The International Council on Mining and Metals (ICMM) is an international organization dedicated to improving the social and environmental performance of the mining and metals industry.
      ICMM developed the ICMM Mining Principles, which define environmental, social and governance requirements through a comprehensive set of 38 Performance Expectations and eight related position statements on several critical industry challenges.
      Moreover, the ICMM issue an Assurance Procedure that establishes company member requirements for independent assurance and validation.

    - *Target*: to enhance the contribution of mining and metals to sustainable development by enabling ambitious collective action that drives performance improvement at scale, considering environmental resilience and social performances.

    - *Raw Materials*: All mined raw materials

Even if, these initiatives are all solid and well-built to help final users and buyers in implementing a responsible sourcing strategy, there needs to be standardization to facilitate their comparability.
To enhance the adoption of these instruments different industrial sectors need to ally and agree on a common strategy to increase the transparency of the overall raw material supply chain.

We believe the Global Alliance for Sustainable Energy could be a pivot across industrials sector associations that can homogenize the request from the final user of the materials to the mining sectors.

6. Industry state of the art and commitments

Implementing a responsible raw materials sourcing and Circular design criteria is a journey. From our work, not all the supply chain participants are or currently have the capacity to be at the same level. Nevertheless, it is crucial to set ambitious target and requirements to stimulate the continuous improvement of the value chain.
One of the first steps is to introduce measurable and assessable KPIs and performance levels beyond a common roadmap.

Utilities and OEMs have started to integrated initiatives that could enhance transparency, sustainability and circularity in the value chain. The goal is to integrate design criteria to enhance the circularity of the equipment and in particular focused on target materials.

As we continue to evaluate additional suppliers and supply chain tiers the situation is changing rapidly. Value chain participants and earlier phases of the value chain characteristically tend to be smaller companies with lower sustainability competency. Without additional action, these market participants can lead to lower ESG performance and lack of initiatives.

For Utilities and OEM this is one of the main barriers to overcome and it is emphasized due to the significant number of tiers and sub-suppliers involved in the manufacturing of components and materials needed for the manufacturing of the main equipment.

Moreover, the lack of standards in terms of ESG performance and regulations make it difficult for the sector to integrate a common approach that could boost concrete and measurable ESG performances. We continue to advocate for the integration of end-to-end circular design criteria and supply chain transparency.
Identifying actions and initiatives that could overcome these barriers is not easy. Some initiatives could be specific for technologies and materials, but others have been identified and implemented by some leading market participants.
The Global Alliance for Sustainable Energy will support the sector evolution by enhancing the adoption of sustainable, circular and innovative design criteria and facilitating the implementation of these approaches to lower supply chain tiers.
Moreover, the Alliance will spread the use of common sector tools, facilitating the definition of common priorities and standards to be applied through the value chain and the definition of a common roadmap towards agreed targets.

In order to define a common sectorial approach, the members of the alliance have defined and agreed on a list of KPIs, metrics and targets. This commitment will allow alliance members, within 2025, to calculate the overall circularity of a company and to plan dedicated roadmap, targets and actions aiming at maximizing the sector and companies' circularity.
This is our initial list, the working group will continue to update and refine our metrics in the future as we learn from the work that will be done by each alliance members and working groups.

KPIs		***Metrics***	***Targets & Milestones***
Overall environmental impact and resource used	• Adoption of certification as EPD	• % New main equipment produced/acquired with Certified LCA/EPD with explicit bill of materials	**Within 2024:** 100% (or for new members within 2 years after joining the alliance)
Supply chain transparency	• Traceability system for *key raw materials* in main equipment • Audit along main equipment supply chain	• Tier visibility for *key raw materials*	**Within 2024:** Traceability and audit up to mineral ore only for 2 *key raw materials* used in 1 main component; **Within 2025:** Traceability and audit up to mineral ore for all applicable *key raw materials* used in 1 main component;
Raw Materials sustainability	• Adoption of certification for sustainable raw material	• % Of certified *key raw materials* in main equipment produced/acquired	**Within 2024*:** 1 *key raw material* certified, used in 1 main component; **Within 2025*:** all applicable *key raw materials* certified used in 1 main component;

key raw material: Aluminum, Copper, Steel, Silicon
*According to availability of these certified materials in the market.

7. Final remarks

The speed of the energy transition towards a world carbon neutral could be slowed down by raw material availability and stained by the environmental and social impact of raw material extraction and refining.

Circular design, and in a broader way circular economy and sustainability are key levers to accelerate the energy transition. The power in circularity comes from reducing "fresh" raw material demand which will reduce the ESG impact and also reducing the supply risk due to high demand and geopolitical factors. Moreover, incorporating circular design will increase the sustainability of the raw materials used in the REN value chain.
Furthermore, the lack of a common approach, standards and targets makes it difficult to integrate results in a consistent way across the entire end to end energy value chain.

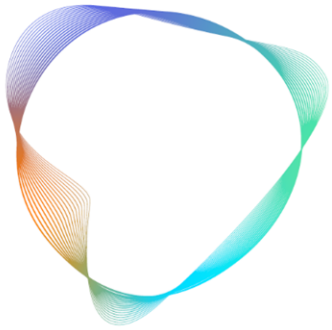
While leading market participants in the value chain have already implemented actions in their business and some initiatives are ongoing, there are many steps that we are continuing to tackle. Some of the issues are highlighted in this document, but what is missing is a holistic approach to "connect all the dots" and create a common Energy Sectorial standard, with a common target, and also leveraging sectorial cooperation and partnership.

The Global Alliance for Sustainable Energy wants to be the missing link that connect all the market participants in the energy sector to improve transparency circularity and the overall sustainability of the sector by wide spreading the adoption of best practices and the definition of sustainability standards.

8. Appendix

i. Definitions and terms

- OEM: Original Equipment Manufacturers.
- ESG (Environmental, Social and Governance): an umbrella term that refers to frameworks designed to be integrated into an organization's strategy to create enterprise value by expanding the organizations objectives to include the identification, assessment and management of sustainability-related risks and opportunities in respect to all organizational stakeholders (including but not limited to customers, suppliers and employees) and the environment.
- Bill of Materials (BOM): A bill of materials or product structure (sometimes bill of material, BOM or associated list) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts, and the quantities of each needed to manufacture an end product.
- KPIs (Key Performance Indicators): refer to a set of quantifiable measurements used to gauge a company's overall long-term performance.
- NGO (non-governmental organization): is an organization that generally is formed independent from government. They are typically nonprofit entities, and many of them are active in humanitarianism or the social sciences.
- OECD: Organization for Economic Co-operation and Development - https://www.oecd.org/.



Global Alliance for Sustainable Energy

Enabling a sustainable value chain