Roadmap to Nature Positive

→ *Foundations for the energy system*

World Business Council *for Sustainable Development*

Table *of contents*

01. Nature Action: *a business imperative*

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Nature matters for business

Nature is the backbone of the world economy: all businesses depend on nature. Societies cannot survive, let alone thrive, without the essential functions that the natural world provides: clean air, water, food and a stable earth system to exist within. And yet, humanity is using double the resources that the Earth can regenerate each year.[1]

Nature loss is already impacting business. Industry value chains that are highly and moderately dependent on nature (relying heavily on direct extraction of resources from land, freshwater and ocean realms) generate over half of global GDP; every industry has some degree of direct and indirect dependency on nature.[2]

Furthermore, addressing the climate crisis, restoring nature and protecting biodiversity are mutually supporting goals. Climate change cannot be mitigated without taking action to repair and restore natural systems, returning them to healthy and resilient states.

The solutions needed are not incremental tweaks to current business models: achieving **Vision 2050** and creating a world in which more than 9 billion people can live well, within planetary boundaries[3] requires the transformation of societies and economies.

Nature risks have shifted global policy

Nature has rapidly risen up the agenda, both within the real economy and for the financial services industry and investors. There is no escaping rising nature-related risks – driving policymakers, regulators, investors, businesses, consumers and citizens to collectively call for rapid change.

Governments have sent a particularly strong signal. The 15th **United Nations Biodiversity Conference** (CBD COP15) took place in December 2022 and culminated with the adoption of the **Kunming-Montreal Global Biodiversity Framework** (GBF) – setting a global ambition to halt and reverse biodiversity loss by 2030.

This is a key milestone for nature action, the equivalent of a "Paris Agreement" for nature, raising nature to the same level as climate on the global political agenda. The GBF's 23 targets detail the plan to address nature loss for all actors: governments, businesses and civil society.

A corporate performance and accountability system is also emerging to support and catalyze credible and impactful business action on nature, building on a similar system for climate. Organizations and governments are putting both voluntary and mandatory accountability mechanisms into place.

On the voluntary side, 2023 sees the release of the initial set of science-based targets for freshwater and land (beta) by the **Science Based Targets Network** (SBTN) and the **Taskforce on Nature-related Financial Disclosures** (TNFD) v1.0 recommendations for nature-related financial disclosures. Mandatory requirements are of immediate relevance to companies, such as the European Sustainability Reporting Standards (ESRS) under the **Corporate Sustainability Reporting Directive**[4] (CSRD) that will impact all companies operating in the European Union. Similarly, regulators in a number of jurisdictions have indicated they will adopt the still voluntary standards from the International Sustainability Standards Board (ISSB) and make them mandatory in the near future, including **General Requirements for Disclosure of Sustainability-related Financial Information** (International Financial Reporting Standards (IFRS S-1) and **Climate-related Disclosures** (IFRS S-2).[5]

→ ***See the* Roadmaps to Nature Positive: Foundations for all businesses** to learn more about the emerging voluntary and mandatory accountability mechanisms, and how key stakeholders, including regulators, investors, standard setters, consumers and employees, are all raising their expectations of business.

Nature positive and current business approaches

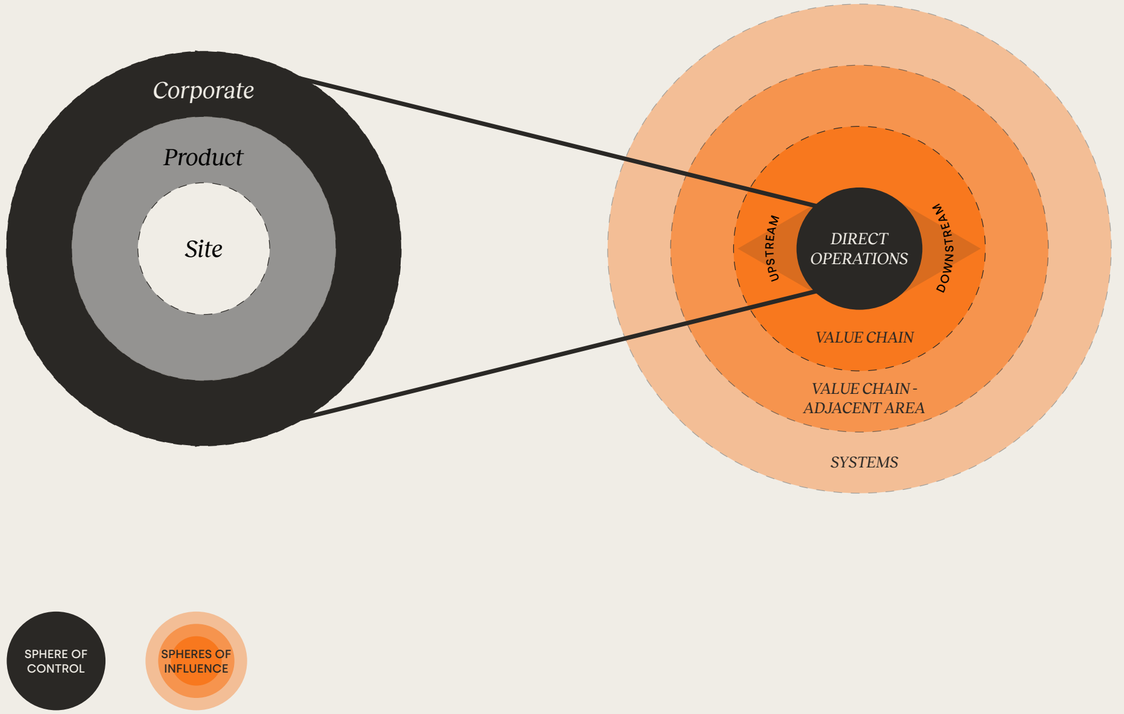
Stakeholders widely acknowledge the term "nature positive" as a global goal to halt and reverse nature loss by 2030 and achieve full recovery by 2050, as captured in the mission statement of the Kunming-Montreal Global Biodiversity Framework.[6]

Individual companies can contribute to this shared goal by adopting an approach to nature positive across their spheres of control and influence, including in their direct operations, across value chains and in priority locations for nature-related value or stress (see Figure 1).

To help guide business action on nature, WBCSD, SBTN, TNFD, the World Economic Forum and Capitals Coalition collaborated to provide business with a consistent approach: the **high-level business actions on nature to Assess, Commit, Transform and Disclose (ACT-D)**.
The key elements of the high-level actions come together as the basis for an ambitious, credible, and strategic approach to contributing to nature positive (see Figure 2).

The ACT-D framework is necessarily ambitious but there is no expectation that companies will implement it in one go. Companies enter nature journeys at different stages of readiness and maturity. To address this, WBCSD has defined maturity levels (starting, developing, advanced and leading), informed by an analysis of public corporate disclosures on nature,[7] helping companies understand where they are on their nature journey and how to advance.

Figure 1: Sphere of control and spheres of influence relevant for corporate target-setting



Source: Adapted from Science Based Targets Network (2020). **Science-Based Targets for Nature Initial Guidance for Business**

→ ***See the*** **Roadmaps to Nature Positive: Foundations for all businesses** to learn more about maturity levels.

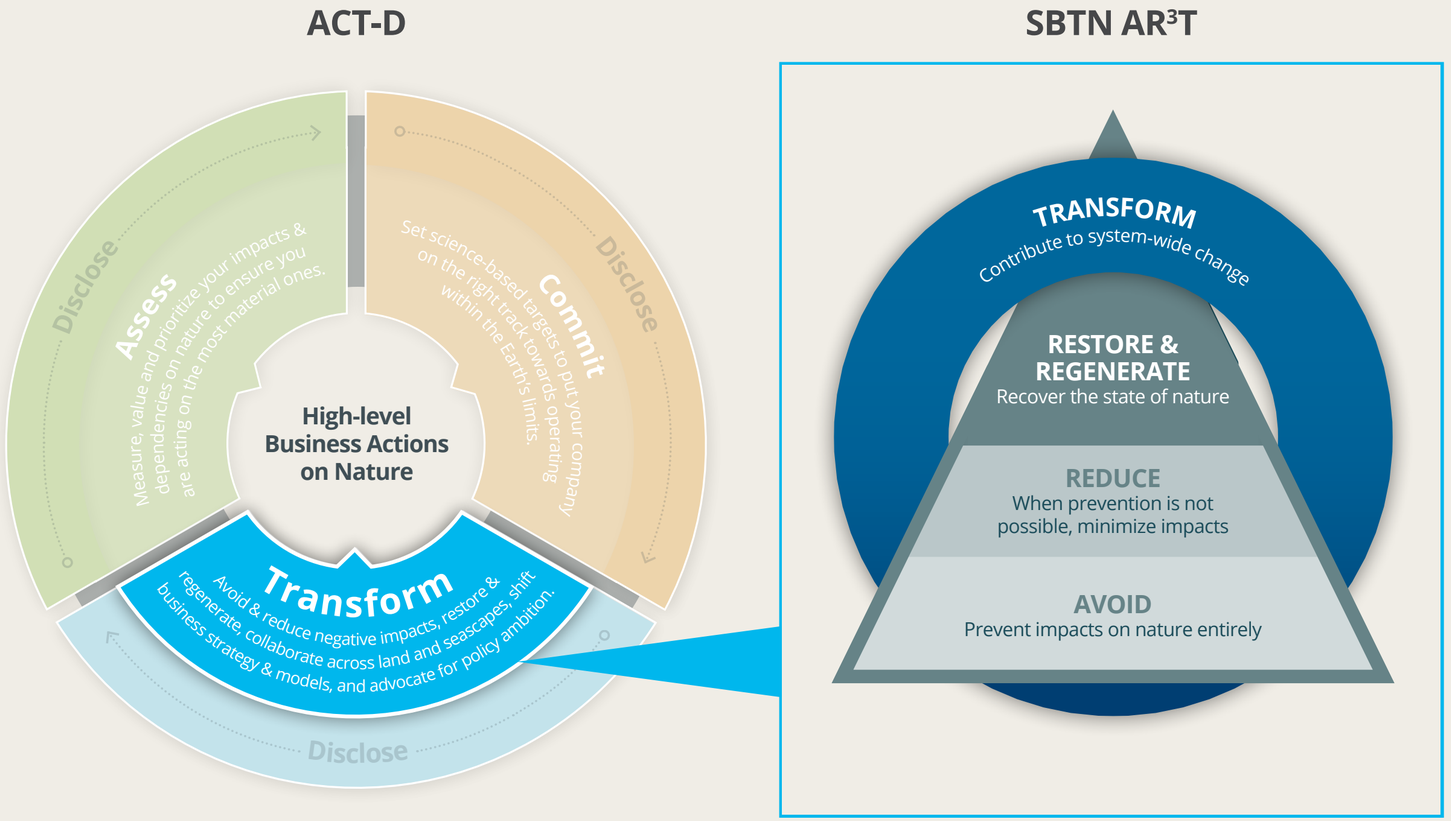
WBCSD approach to nature positive for business

Nature positive is gaining traction in the business community, yet lack of consensus around the term remains the subject of confusion. WBCSD's approach toward nature positive is based on key principles shared by leading organizations in this space, including SBTN, TNFD, Business for Nature and others.

In addition to understanding the company's relationship with nature, to set commitments that credibly contribute to nature positive, the collective impacts from regenerative and restorative business actions (doing "more good") must outweigh those from avoiding and reducing nature loss (doing "less harm") as guided by SBTN's Avoid, Reduce, Restore & Regenerate, Transform (AR3T) Action Framework (see Figure 2). This means that individual companies must urgently accelerate action to halt nature loss while simultaneously bringing back more nature. Actions that reduce harm will help to collectively reverse nature loss by 2030, while restorative, regenerative and transformative actions are critical to achieving full recovery by 2050.

In summary, companies should be holistic and transparent in the approach they take to assess, commit, transform and disclose, and in doing so highlight their contributions towards a nature positive future - rather than claiming to be nature positive themselves.[8]

Figure 2: SBTN's Action Framework (AR3T) defines the hierarchy of actions that companies can put in place as part of the "Transform" stage of ACT-D



Source: Business for Nature (2023). Priority actions towards a nature-positive future

Catalyzing critical business action in support of nature positive

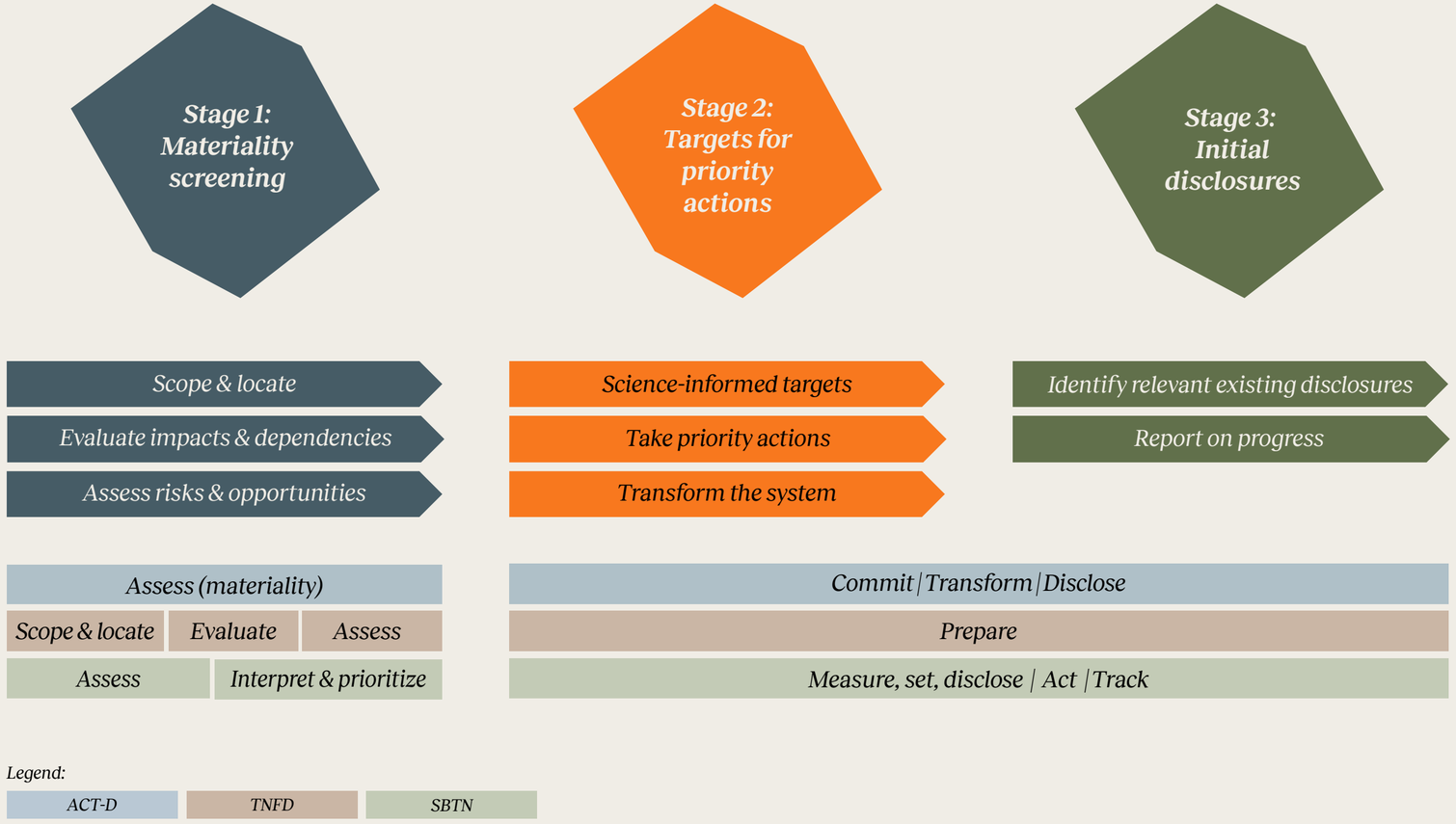
While the case for companies to contribute to nature positive is evident, this agenda can still be a blind spot. Ahead of CBD COP15, McKinsey found that while 83% of Fortune Global 500 companies have climate change targets, only 25% have freshwater consumption targets and a mere 5% have set targets related to biodiversity loss. Only 5% have assessed their impacts on nature and less than 1% understand their nature dependencies.[9]

WBCSD is working with **Business for Nature** and the **World Economic Forum** to develop **guidance to support companies** on their nature journeys: understanding their impacts, dependencies, risks and opportunities in order to prioritize actions that contribute to nature positive.

In addition, WBCSD is developing **Roadmaps to Nature Positive** that offer companies deep guidance and support on their nature journeys across maturity levels. The Roadmaps provide in-depth analysis and guidance relevant for all businesses, as well as specific guidance for four high-impact systems:[10] land use (including the agri-food and forest sectors), built environment and energy.

This initial guidance, covering the foundations of nature action, helps companies: define and improve their nature strategies based on value chain materiality screening; identify priority actions to systematically avoid and reduce negative impacts; determine the best restoration and regeneration approaches; prepare for initial voluntary and required disclosures. It provides a strong foundation to help business make progress towards achieving the shared goal of a nature-positive world by 2030.

Figure 3: Roadmaps to Nature Positive – a common approach for credible strategic action on nature



→ ***See the*** **Roadmaps to Nature Positive: Foundations for all businesses** to learn more about the approach followed for this work. Additional guidance is available for deeper support to prepare for TNFD, see **WBCSD's TNFD pilot - Lessons from TNFD piloting with 23 global companies**.

02. Introducing the Roadmap *for the energy system*

02. Introducing the Roadmap to Nature Positive *for the energy system*

Context: Importance of nature to the energy system

The energy system is dependent on nature and impacts nature in significant ways. It also has great potential to drive positive nature change within its value chain and beyond because energy is used by almost all businesses and by domestic households. Energy companies and their value chains depend on natural resources such as water for their operations and land to develop projects on. Together, these dependencies and impacts present risks to business continuity and enterprise value, as well as to society and the achievement of global nature targets.

Companies that sustainably manage natural resources have a competitive advantage compared to peers that do not. This creates an important opportunity to strengthen business performance in the eyes of investors and other stakeholders. These advantages will increase given the long time-horizons that characterize the sector: plants built today will generate and distribute energy for many years and during this time current and future nature-related risks will increase. This highlights the urgency to embed nature assessments into corporate strategies and investment decisions.

Estimates show that the share of renewables in total electricity generation globally will increase from 29% in 2020 to over 60% in 2030 and to nearly 90% in 2050.[11] Although these scenarios outline a transition to low-carbon energy, the growth in the share of renewables, if not managed sustainably, will inevitably increase pressures on the natural world, in particular global competition for land. The estimated total amount of land and sea area required to generate the world's renewable energy needs is 1 million km² – or nearly twice the size of France.[12] Developments, if not carefully managed, will result in the loss of natural habitats and undermine nature's resilience. Companies need to design and implement ambitious nature positive strategies.

Land take – the area of land "taken" by infrastructure itself and supporting facilities – isn't the only key pressure. The energy system's value chain is currently responsible for approximately 10% of biodiversity loss globally and has a particularly high impact on species and their habitat through pollution and greenhouse gas emissions.[13]

Estimates show that global energy demand will increase by nearly 50% by 2050 compared to 2020,[14] with electricity accounting for a quarter of all energy demand compared to 18% now.[15] This will exert greater pressures on the sourcing and mining of raw materials, including at the downstream value chain stages.

For these reasons, investors, governments, consumers, non-governmental organizations (NGOs) and other stakeholders are increasingly asking energy companies to be transparent about the impacts and dependencies of their business on nature and expecting action plans to address materiality and mitigate risks. They are also looking to business to realize opportunities to restore nature and the ecosystem services that others depend on.

Moreover, reporting on nature-related materiality and strategy will allow energy companies to comply with requirements such as the European Union (EU) Taxonomy and the Corporate Sustainability Reporting Directive (CSRD) – now mandatory for companies with headquarters, branches or parts of their value chains in the EU, setting the stage for mandatory disclosures in other geographies. Additionally, companies that commit to actions and targets aligned with the **Global Biodiversity Framework** will improve their ability to meet the increasing expectations and requirements of stakeholders and investors, thereby gaining better access to finance and external investments.

Scope of the roadmap

Energy exists in different forms – such as electricity, heat, and solid, liquid or gaseous fuels. The energy system includes everything involved in the production, conversion, storage, delivery and use of energy. On the energy supply side, the system includes the extraction and refining of oil and gas, coal and uranium, and thermal, nuclear and renewable generation plants. The system also includes modes of delivery including oil and gas pipelines, shipping (such as fuels and materials), and electricity transmission and distribution networks. On the demand side, key components include energy use in industry, transport and buildings.

This Roadmap covers direct operations and the supply chain of two sectors – Oil & Gas, and Utilities – as classified by the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) and Science Based Targets Network (SBTN) frameworks. As these frameworks use different classification systems – the Global Industry Classification Standards (GICS) and the International Standard Industrial Classification (ISIC), respectively – both were thoroughly considered and the value chain stages were defined with members according to the level of detail considered the most appropriate.

Direct operations were fully covered in this Roadmap: given the accelerating transition towards cleaner energy supply, and with greater investment in, and demand for, renewable and other low-carbon energy (such as from low-carbon hydrogen and biomass), the impacts and dependencies of those energy sources are emphasized. Equally, the Oil & Gas sector remains relevant as many energy companies continue to operate such business lines. While companies must phase out fossil fuels as fast as possible, they must also mitigate their current and future negative impacts, dependencies and related risks from Oil & Gas operations.

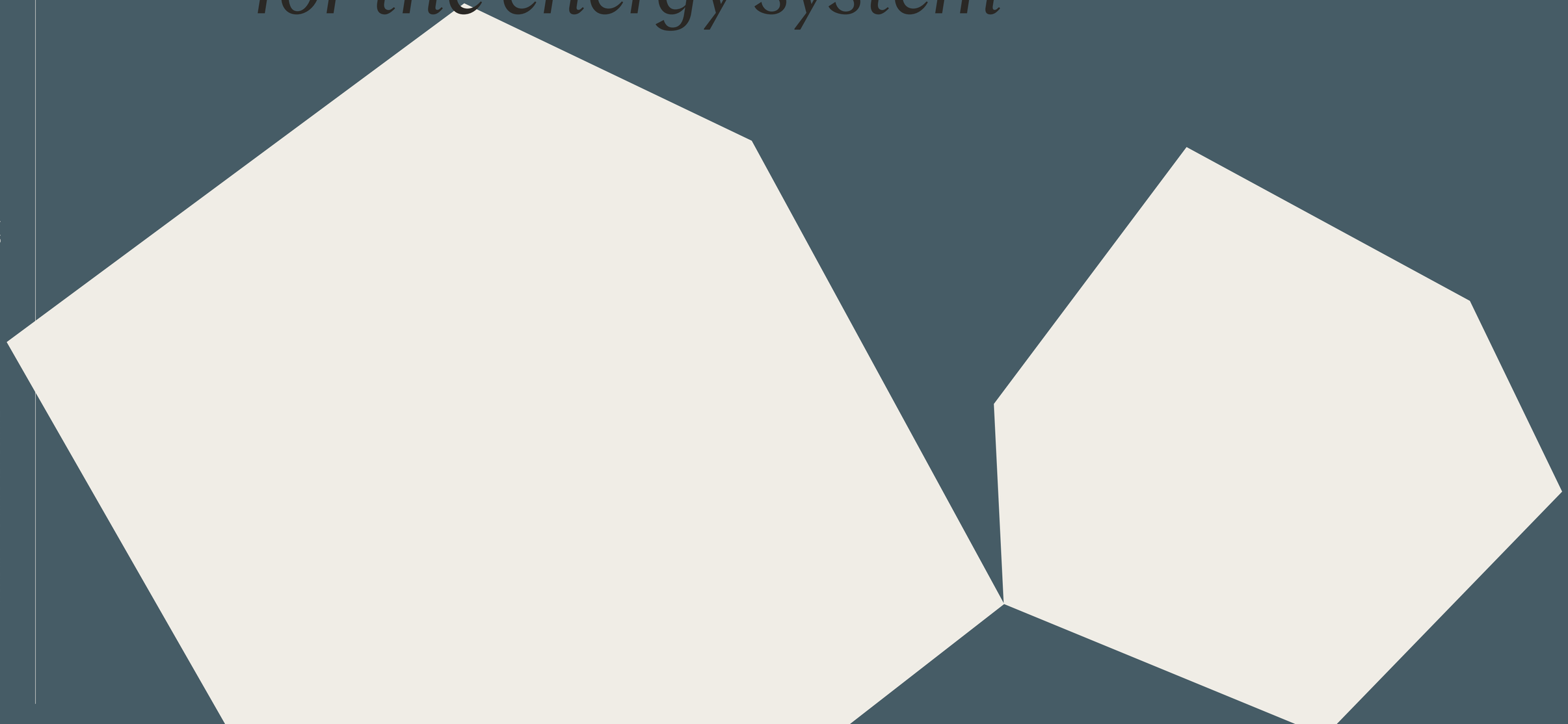
The upstream value chain was also considered, as many impacts and dependencies lie in the upstream stages of the energy system (for example, the impacts related to the sourcing of minerals and raw materials required to produce equipment, from pipelines and boilers to solar panels and batteries). However, assessments related to upstream activities linked to the energy system are still under development and improvement within the existing frameworks and tools.

Value chain stages related to marketing, retail and end-users are not yet in this Roadmap, as current frameworks and tools (such as ENCORE and SBTN) have not yet covered the relevant assessment of impacts and dependencies.

Figure 4: Scope of the roadmap for the energy system

	VALUE CHAIN STAGES		
SECTORS	UPSTREAM	DIRECT OPERATIONS	NOT COVERED IN THIS PAPER DOWNSTREAM
OIL & GAS	Mining Supply chain & sourcing Equipment & services	Exploration Production Refining Storage & transportation Gas distribution & retail	Marketing & sales End users
UTILITIES	Mining Supply chain & sourcing	Renewable energy generation Nuclear & thermal energy generation Electricity transmission & distribution	Marketing & sales End users

03. Foundations *for the energy system*



03. Foundations *for the energy system*

→ *Stage 1: Assess (materiality screening)*

Materiality screening is at the heart of an impactful nature journey as it enables a business to identify the most material nature-related issues that credible targets need to cover, including associated actions to address those issues. Companies should conduct a materiality screening as a participatory process with experts and stakeholders from within and outside the company.

Assess: Foundations – System materiality screening

A materiality screening based on typical system impacts and dependencies can help identify and prioritize the parts of the business with the highest potential risks and opportunities. By making dependencies, impacts, risks and opportunities (DIROs) more explicit, the business case for action on nature (with benefits for the business, communities and other stakeholders) becomes more straightforward.

A materiality screening should take place at the beginning of the corporate nature journey to identify priority issues for further, more detailed, assessment. More advanced companies can also use such a screening to check that they have covered their priority issues. This step is feasible regardless of system, geographic location or level of sustainability experience. Major frameworks – including CSRD, SBTN and TNFD – require it.

The foundational steps to "Assess" include:

1. **Scope and locate:** Identify the company's main sectors, sub-sectors and parts of the value chain and where they are located;
2. **Evaluate impacts and dependencies:** Prioritize potentially high impacts and dependencies on nature typical for the business and associated value chains for further assessment;
3. **Assess risks and opportunities:** Assess associated risks and opportunities for the business and for key stakeholders in order to prioritize further action.

Together, these steps can feed into a corporate materiality assessment and help prioritize those areas that require deeper analysis.

Stage 1.1 - Scope and locate

Identify the company's main sectors and sub-sectors and key parts of the value chain and their location.

Why do this:

For many companies, the main impacts and dependencies on nature will come from direct operations (sourcing of raw materials, production processes and sites) and the use of produced goods and services. The company needs to identify and address the value chain components that represent the greatest potential risks and opportunities in order to have a credible and impactful approach to nature, even if these components may not be under the company's direct control.

What to do:

→ Identify sectors and sub-sectors that represent the company's activities and key components throughout the value chain. This is necessary to extract typical impacts and dependencies from relevant tools (for example, if the company lists aluminium packaging as a key component, it should identify the aluminium mining sector as a relevant sector);

→ Identify direct operations or parts of the system where these typical impacts and dependencies are present.

Stage 1.2 - Evaluate impacts and dependencies

Prioritize potentially high impacts and dependencies on nature typical for the business and associated value chains for further assessment.

Why do this:

The starting point for materiality assessments on nature should not be subjective but informed by what data and science indicate are typical impacts and dependencies for a given sector. A company can then refine this within its risk assessment processes. In this way, it can identify and address strategically important issues and reduce exposure to accusations of greenwashing.

What to do:

→ Carry out a system materiality screening:

- Develop a list of typical nature-related impacts and dependencies based on existing materiality screening tools, in addition to expertise from the business and its partners;
- Prioritize impacts and dependencies rated as potentially "high" or "very high" risk for further analysis and action.

Common energy-system nature impacts and dependencies:

→ **Impacts**

- **Water use**
  Some direct operations of the energy system and its supply chain directly impact aquifers and water basins by reducing water flow and increasing drought severity, particularly in drought-prone areas.
- **Air pollution and emissions**
  Air pollution is a common impact of the supply chain and some direct operations, especially in the Oil & Gas sector. Emissions of greenhouse gases (GHGs), other air pollutants and particulate matter (such as dust) reduce air quality and contribute to climate change, with well-known effects on natural ecosystems and human health.
- **Pollution**
  The energy system is a major source of air pollution, water pollution, soil pollution and noise pollution. Water and soil pollution from oil spills, mining, and other activities can harm terrestrial and marine wildlife and vegetation and have long term ecological impacts. Noise pollution from power plants and other facilities can disrupt wildlife and human activities.
- **Land/sea use change**
  The construction of power plants, pipelines, and other energy infrastructure requires large areas of land, leading to habitat loss and the displacement of people, and can disturb marine ecosystems.

→ **Dependencies**

- **Water resources**
  Many value chain stages of both Oil & Gas and Utilities sectors depend on functioning water flows and water reserves. Freshwater resources from collected precipitation and water flow from natural sources are often critical and irreplaceable in production processes.
- **Climate regulation**
  Both the Oil & Gas and Utilities sectors depend on climate regulation ecosystems such as forests and grasslands that sequester carbon and mitigate the impact of extreme weather events. Such services exist at the local, regional and global scales, and alterations in these can affect companies' infrastructure and operations.
- **Flood and storm protection, erosion control**
  In addition to climate regulating services, the energy system depends on water regulating services that provide protection from flooding and storm events and control land erosion. Natural hazards can damage infrastructure and interrupt activities.

Companies can consider the materiality screening in Table 2, Table 3, Table 4 and Table 5 as foundational guidance to identify potential impacts and dependencies that each company can adapt to its specific situation. The tables provide the outcomes from an assessment of the supply chain and direct operations of the Oil & Gas and Utilities sectors. The former considers mining, supply chain and sourcing, equipment and service, and the latter all the key value chain stages in direct operations, according to GICS and ISIC.

The tables offer companies a starting point, which can be further refined according to the company's circumstances. When refining its impacts and dependencies, a company should consider frequency, timeframe and severity. This allows for a focus on regular operations – channeling efforts towards improving activities that occur regularly – with subsequent consideration of unplanned incidents that may have larger impacts but are less likely.

As companies advance on their nature action journey, they should progressively refine the assessment through additional data and granularity, which will be a specific focus of this Roadmap's next iteration. See **Annex 1** for notes on the methodology and next steps.

Data availability and how companies should conduct the "Assess" stage

Data availability and capacity are a challenge when starting the "Assess" stage. Less mature companies should first determine, through the scoping step, which priority areas (such as a specific location, geography or technology) they want to focus on, depending on their strategy and ambition level.

Then, they should identify the data already available and evaluate its quality – how old is it, how was it collected, does it align with the latest methodologies, is it science-informed, does it use recognized assessment tools such as the **Integrated Biodiversity Assessment Tool (IBAT)**, **EXIOBASE**, **ENCORE**, etc.?

Collecting and comparing available data with data needs already places companies in a good position to start a materiality assessment. More mature companies can increase granularity and scope, for example by including more or all locations, and assessing location-specific materiality of impacts and dependencies. The major frameworks and standards are developing further guidance as well as metrics.

Following the guidance of the **Natural Capital Protocol** (see page 59 in the protocol), a company should answer the following questions when planning the "Assess" stage:

- → What is the availability and quality of our data?Where time or budget do not allow for the collection of primary data, will implications of relying on secondary, potentially proprietary data and on subject-matter expert knowledge need to be considered?
- → Does the company have people with appropriate expertise and capacity to undertake the assessment?
- → Are there budget or time constraints that may affect what is achievable?

Table 1: Suitability of measurement approaches for different assessments and targets

	Primary Data	*Secondary Data*
Definition	Data collected specifically for the assessment being undertaken. Collected from site-level assessments on a specific impact driver through the use of direct measurement (e.g., volume of freshwater used to irrigate a wheat field each month).	Data that were originally collected and published for another purpose or a different assessment. Derived from modeled or proxy-level data. This could include data averaged from commodity sourcing (e.g., kg of pollutants for a given volume of leather purchased, hectares of land use per tons of timber purchased) at the national or regional level, or the use of input- output data models to provide estimates of impact drivers. Uncertainties in the quality of data used will need to be considered and discloses.
Site-level assessments and targets	**Collection of primary** data is often the most appropriate approach for site-level impacts and targets (field monitoring for biodiversity state, water flows and scarcity) and pressure measurement (internal company data). **Remote sensing** can be applied for large sites.	**Secondary data** (models of impacts, past assessments, literature values) can be applied in certain cases where primary data are unavailable or measurement is unfeasible. The appropriateness of secondary data will vary by issue area and SBT methods will provide further detail.
Company-wide assessments and targets	**Remote sensing** is a suitable approach for some issue areas-e.g., assessing deforestation.	Use of **models** linking economics activities and pressures to state are most appropriate (environmentally extended input-output (EEIO) models, life-cycle assessment (LCA) models) for estimation and may remain the best data source after refinement.

Source: Science Based Targets Network (2020). **Science-Based Targets for Nature Initial Guidance for Business**

Table 2: Impacts for Oil & Gas

Impacts of the identified value chain stages in the Oil & Gas sector									
IPBES drivers of change	*Impact drivers*	**Upstream**			**Direct Operations**				
		Mining (1)	Supply chain and Sourcing (2)	Equipment & Services	Exploration	Production	Refining	Storage & Transportation	Gas distribution & Retail
Land-/water-/sea-use change	Terrestrial ecosystem use	VH	M	ND	H	H	ND -> H (6)	H	H
	Freshwater ecosystem use	H	M	ND	H	H	ND	H	ND
	Marine ecosystem use	ND -> H/VH (4)	H	ND	M	VH	ND	H	H
Resource exploitation	Water use	VH	H	H	VH -> VH/H (5)	VH -> VH/H (5)	VH	H	ND
	Other resource use	ND	ND	ND	ND	ND	ND	ND	ND
Climate change	GHG emissions (3)	H	VH	H	H	H	H	H	H
Pollution	Non-GHG air pollutants	H	M	M	H	H	H	ND -> H (11)	ND
	Water pollutants	H	M	H	H	H	L -> M/H/VH (7)	L -> M/V/VH (12)	ND
	Soil pollutants	H	M	H	H	H	L -> M/H (8)	L	ND
	Solid waste	H	M	H	H	H	TBM (9)	ND	M
Invasive species and others	Disturbances	H	H	M	H	H	TBM (10)	M/H/VH (13)	ND
	Biological alterations/ interferences	M	ND	ND	ND	ND	L	M/H/VH (13)	ND

Full detail on component scores can be obtained from the ENCORE database. Scores that differ from ENCORE are illustrated in sand-brown. For these, WBCSD members have provided different opinions.
This table indicates potential values but detailed analysis should consider each company's value chain and specifics.

VH: Very High Impact | H: High Impact | M: Medium Impact | L: Low Impact | Modified evaluation | TBM: To be measured | ND: No data

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to mining of metal ores.
2. Other than mining: Sourcing of equipment and material used for direct operations.
3. Please consider ENCORE's evaluation as a general indication. Refer to the company-specific Scope 1, 2 and 3 GHG emissions and reduction strategies.
4. If applicable to the company's value chain, the rating should consider deep-sea mining as an emerging issue related to raw materials for the energy transition.
5. Depending on the exploration and drilling method, more or less water is used. Company specificity applies.
6. Refineries have a significant land footprint.
7. Can be VH in case of spillages or leaks.
8. Can be VH in case of spillages or leaks.
9. Oil & Gas production generates solid wastes (oil sludge, spent catalysts, etc.) too.
10. Refineries are most likely to cause greater noise/light disturbances than exploration/production facilities as they are usually much more concentrated facilities.
11. Shipping is one of the main sources of particulate emissions due to heavy oil use.
12. Water pollutants are VH especially in cases of leakage/oil spills from shipping.
13. H/VH especially from shipping.

Link to the table

Table 3: Impacts for Utilities

Impacts of the identified value chain stages in the Utilities sector												
IPBES drivers of change	*Impact drivers*	**Upstream**		**Direct operations**								
		Mining (1)	Supply chain and sourcing (2)	Nuclear and thermal power stations	Nuclear power stations	Coal power stations	Other thermal power stations	Hydropower	Wind	Solar	Geothermal	Biomass	Electric/nuclear transmission & distribution
Land-/water-/sea-use change	Terrestrial ecosystem use	VH	M	ND	ND	ND	ND	VH (4)	H-> VH/M/L (5)	VH -> H/M (5)	ND	TBM (H/VH) (6)	M
	Freshwater ecosystem use	H	M	H	H	H	H	VH	M -> L (7)	ND	ND	ND	ND
	Marine ecosystem use	H/VH (8)	M	ND	ND	ND -> TBM (9)	ND -> L (9)	ND	H -> M/L (10)	ND	ND	ND	ND
Resource exploitation	Water use	VH	H	VH	VH	VH	VH	VH	ND	VH -> M/L (11)	VH (12)	H	ND
	Other resource use	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND -> TBM (12)	ND	ND -> M (12)
Climate change	GHG emissions (3)	H	VH	H	L	VH	H	H -> M/L	ND	ND	H -> M/ (12)	H -> M/L (13)	H
Pollution	Non-GHG air pollutants	H	M	H	H -> L (14)	H -> VH (15)	H -> M/L (15)	ND	ND	ND	TBM (12)	H	ND -> L (16)
	Water pollutants	H	H	M	M	M	M -> L (17)	H (12)	L	L	H (12)	H	M
	Soil pollutants	H	H	M	M -> L (18)	M	M	H (12)	L	L	H (12)	ND	ND
	Solid waste	H	M	H	H	M	L	ND	L	L	TBM (12)	H	ND
Invasive species and others	Disturbances	H	M	H	H	H	H	ND	M	ND	H (12)	TBM -> H/VH (19)	ND -> L
	Biological alterations/ interferences	M	ND	ND	ND	ND	ND	H	ND	ND	ND	TBM -> H/VH (19)	ND

Full detail on component scores can be obtained from the ENCORE database. Scores that differ from ENCORE are illustrated in sand-brown. For these, WBCSD members have provided different opinions.
This table indicates potential values but detailed analysis should consider each company's value chain and specifics.

VH: Very High Impact | H: High Impact | M: Medium Impact | L: Low Impact | Modified evaluation | TBM: To be measured | ND: No data

Notes:

1. Mining currently includes Mining of coal and consumable fuels. Further expansion of scope (including mining of other materials, i.e., metal ores) will be conducted in future development of the roadmap.
2. Other than Mining: sourcing of equipment & material used for direct operations.
3. Please consider ENCORE's evaluation as a general indication. Reference the company-specific Scope 1, 2 and 3 GHG emissions and reduction strategies.
4. VH impacts on terrestrial/freshwater habitats and water use are mostly related to the construction and initial operating phase of the hydro PP. For 30-50 year old plants, different rankings may apply.
5. Most relevant conservation institutions (i.e. IUCN, The Biodiversity Consultancy, Fauna & Flora International) are warning about the potential high impacts of renewables on biodiversity and ecosystem services due to the land use\change. However, company specificity applies.
6. According to some companies, production of biomass has a big footprint in terms of land occupation. Deforestation risk is closely linked to biomass production.
7. Companies deemed that there are no relevant/low interactions with freshwater ecosystems during the construction and operation phases. Company specificity applies.
8. If applicable to the company's value chain, the rating should consider the upcoming deep-sea mining as an emerging issue related to raw material for the energy transition.
9. Thermal power plant with run-through cooling system using seawater - this can potentially have negative impacts on Marine ecosystem use instead of freshwater.
10. For offshore wind plants, potential impacts related to marine use for WIND are very limited. The occupied land footprint is reduced to the mast base. Footprint for the construction phase is also considered limited by many.
11. Water consumption is relevant mainly, but not limited to, the equipment manufacturing process and maintenance.
12. Rating isn't as high as other value chain stages for the same sub-system.
13. Rating isn't as high as other value chain stages for the same sub-system.
14. Non-GHG air emissions like carbon monoxide are punctual and do not have a significant impact.
15. Coal combustion emits particulate, SO2, NOx, mercury etc while gas combustion emits NOx. The impact of air pollutants from a nuclear plant should be minimal compared to fossil fuel.
16. Low imapct due to Nox, Sox, SF6 emissions based on networl losses and electricity transformation.
17. Water and soils pollutants impacts for OC/CCGT should be lower compared to coal and nuclear technologies.
18. Radioactive substances do not have a significant impact and are strongly regulated.
19. According to some companies, production of biomass has big footprint in terms of land disturbance and local biological alterations.

Link to the table

Table 4: Dependencies for Oil & Gas

Dependencies of the identified value chain stages in the Oil & Gas sector									
Ecosystem services functionality	Ecosystem services	**Upstream**		**Direct operations**					
		Mining (1)	Supply chain and sourcing (2)	Equipment & Services	Exploration	Production	Refining	Storage & transportation	Gas distribution & retail
Direct physical inputs (3)	Fibers & other materials	ND	ND	ND	ND	ND	ND	ND	ND
	Genetic materials	ND	ND	ND	ND	ND	ND	ND	ND
	Groundwater	H	ND	M	ND	L	L	ND	ND
	Surface water	H	ND	M	ND	L	L -> M/L (7)	ND	ND
Enabling production processes (4)	Pollination	ND	ND	ND	ND	ND	ND	ND	ND
	Ventilation	ND	ND	L	ND	ND	ND	ND	ND
	Soil quality	ND	ND	ND	ND	ND	ND	ND	ND
	Water flow maintenance	H	ND	M	ND	ND	ND	ND	L
	Water quality	ND	ND	L	ND	ND	L	ND	L
Mitigating direct impacts (5)	Bio-remediation	ND	ND	ND	ND	L	L	ND	ND
	Mediation of sensory impacts	ND	ND	M	ND	ND	ND	ND	ND
	Dilution by atmosphere & ecosystems	ND	ND	L	ND	ND	ND	ND	ND
	Filtration	ND	ND	L	ND	L	L	ND	L
Protecting from disruption (6)	Buffering	ND	ND	ND	ND	ND	ND	ND	ND
	Climate regulation	H	ND	L	M	L	L	M	M
	Disease control	ND	ND	ND	ND	ND	ND	ND	ND
	Flood & storm protection	ND	ND	M	L	L	M	M	M
	Mass stabilization & erosion control	M	ND	L	L	L	L	H	H
	Pest control	ND	ND	ND	ND	ND	ND	ND	ND

Full detail on component scores can be obtained from the ENCORE database. Scores that differ from ENCORE are illustrated in sand-brown. For these, WBCSD members have provided different opinions.
This table indicates potential values but detailed analysis should consider each company's value chain and specifics.

VH: Very High Impact | H: High Impact | M: Medium Impact | L: Low Impact | Modified evaluation | TBM: To be measured | ND: No data

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to mining of metal ores.
2. Other than mining: Sourcing of equipment and material used for direct operations.
3. Ecosystem services that are direct physical inputs into a production process.
4. Ecosystem services that are an enabling factor for all or part of a production process.
5. Ecosystem services that help to mitigate direct impacts associated with a production process (e.g. waste, emissions, noise).
6. Ecosystem services that protect the production process from disruption.
7. The refining process depends heavily on water.

Link to the table

Table 5: Dependencies for Utilities

Dependencies of the identified value chain stages in the Utilities sector													
Ecosystem services functionality	Ecosystem services	**Upstream**		**Direct operations**									
		Mining (1)	Supply chain and sourcing (2)	Nuclear and thermal power stations	Nuclear power stations	Coal power stations	Other thermal power stations	Hydropower	Wind	Solar	Geothermal	Biomass	Electric/nuclear power transmission and distribution
Direct physical inputs (3)	Fibers & other materials	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	VH	ND
	Genetic materials	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Groundwater	H	ND	M	M	M	M	M		L	VH (7)	M	ND
	Surface water	H	ND	VH	VH	VH	VH	VH		L	M	M	ND
Enabling production processes (4)	Pollination	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Ventilation	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Soil quality	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Water flow maintenance	H	ND	M	M	M	M	VH	ND	ND	M	M	ND
	Water quality	ND	ND	L	L	L	L	L	ND	ND	L	L	ND
Mitigating direct impacts (5)	Bio-remediation	ND	ND	L	L	L	L	L	ND	ND	L	L	ND
	Mediation of sensory impacts	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Dilution by atmosphere & ecosystems	ND	ND	ND	TBD (8)	ND	ND	ND	ND	ND	ND	ND	ND
	Filtration	ND	ND	L	L	L	L	L	ND	ND	L	L	ND
Protecting from disruption (6)	Buffering	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Climate regulation	H	ND	L	L	L	L	VH	VH	VH	L	L	M -> H (9)
	Disease control	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Flood & storm protection	ND	ND	M	M	M	M	H	M	M	M	M	VH
	Mass stabilization & erosion control	M	ND	L	L	L	L	H	M	M	L	L	H
	Pest control	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Full detail on component scores can be obtained from the ENCORE database. Scores that differ from ENCORE are illustrated in sand-brown. For these, WBCSD members have provided different opinions.
This table indicates potential values but detailed analysis should consider each company's value chain and specifics.

VH: Very High Impact | H: High Impact | M: Medium Impact | L: Low Impact | Modified evaluation | TBM: To be measured | ND: No data

Notes:

1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to mining of metal ores.
2. Other than mining: Sourcing of equipment and material used for direct operations.
3. Ecosystem services that are direct physical inputs into a production process.
4. Ecosystem services that are an enabling factor for all or part of a production process.
5. Ecosystem services that help to mitigate direct impacts associated with a production process (e.g. waste, emissions, noise).
6. Ecosystem services that protect the production process from disruption.
7. Only in the construction phase.
8. Nuclear power plants are dependent on dilution by the atmosphere and ecosystems because of their discharges.
9. Electrical power distribution depends on the processes that regulate weather patterns.

Link to the table

Stage 1.3 - Assess risks and opportunities

Prioritize further action based on risks and opportunities for the business and stakeholders.

Why do this:

Increasing numbers of businesses are making the connection between the health of ecosystems and their bottom line. Risks and opportunities originate from business impacts on nature and associated impacts on stakeholders, as well as corporate and societal dependencies on ecosystem services. Risks, as defined by the TNFD, can be physical risks (typically linked to material nature-related dependencies), transition risks (linked to nature-related impacts that an organization may face in the changing regulatory, policy or societal landscape) and systemic risks (arising from the breakdown of the entire system, rather than the failure of individual parts). Annex 1 provides more information on nature-related risks. Opportunities can result from avoided risks, and from innovation and market strategies arising from an approach that contributes to nature positive.

What to do:

→ Refine the list of prioritized impacts and dependencies by scoring for potential risks and opportunities based on likelihood versus magnitude of risks and other relevant criteria;

→ Engage with stakeholders to refine the list of issues;

→ Carry out a further qualitative assessment by considering how DIRO may evolve in the future; TNFD provides different scenarios for consideration.[16]

The following are examples of common risks and opportunities across the energy system:

→ **Water-related risks and opportunities**
Companies' negative impact on water basins and watersheds may cause direct landscape alteration, habitat disruption and local fauna displacement. Such impacts can significantly change the waterscape, resulting in decreased quality and quantity of water in the long run. Companies impacting and depending on water may incur production disruptions as well as higher costs of water management and control. Identifying such risks early on gives companies the opportunity to design and implement a sustainable water management strategy, in compliance with local, national or international regulatory requirements, with the aim to increase water efficiency and reuse and the use of alternative water resources (desalinated, wastewater, etc.).

→ **Climate change risks and opportunities**
High GHG emissions are contributing to climate change, representing one of the biggest risks for the planet. Increased frequency, severity, unpredictability and magnitude of extreme weather events might damage company infrastructure and interrupt plant activity (e.g., during storms, floods, heat waves and droughts). They might also reduce the productivity of renewable energy plants (such as solar, wind and hydro). The big opportunity for energy companies is to design and implement an ambitious decarbonization strategy, including through investments in new technologies and businesses.

Table 6 and Table 7 provide an overview of potential physical risks that companies in the energy system should consider when designing mitigation strategies. Although TNFD focuses on physical risks resulting from nature-related dependencies, and therefore mainly on risks for the company, it is important to evaluate how business negatively impact nature, creating risks for nature itself. For this reason, nature-related risks for both impacts and dependencies have been included in Table 6 and Table 7.

Starting from material impacts and dependencies identified in the previous step, a business should focus on the relevant material risks. These tables are intended to offer an illustrative assessment for companies to customize and adapt when applied to an individual company or asset.

Table 8 reports some illustrative examples of transitional risks, which are more general risks that organizations can face because of the transition to nature positive. WBCSD will address systemic risks, which produce a cascading interaction of physical and transition risks, in future iterations.

To reduce nature-related dependencies and impacts, and therefore risks, companies can identify nature-related opportunities. Table 9 and Table 10 illustrate some energy-specific examples. See **Annex 1** for notes on the methodology and next steps.

Table 6: Risks for Oil & Gas

Risks for the identified value chain stages in the Oil & Gas sector

IPBES drivers of change	*Impact drivers*	**Upstream**			**Direct operations**				
		Mining (1)	Supply chain and sourcing (2)	Equipment & services	Exploration	Production	Refining	Storage & transportation	Gas distribution & retail
Land-/water-/ sea-use change	Terrestrial ecosystem use	→ Disruption of ecosystems and ecological functions due to land clearance for site preparation, construction and surface mining, causing direct biodiversity loss and habitat fragmentation → Habitat loss and degradation due to fires from unplanned events → Disruption of mining activities if terrestrial ecosystems are degraded → Increased flood and storm risks if terrestrial ecosystems are degraded	→ Land clearance for production of packaging material, e.g. wooden pellets		→ Direct biodiversity loss and habitat fragmentation from land clearance for site preparation, construction and surface mining, disruption of ecosystems and ecological functions → Habitat loss and degradation due to fires from unplanned events → Infrastructure damages and activity interruptions due to land alterations, reduced flood defense and erosion control capacity				
	Freshwater ecosystem use	→ Reduction and/or depletion of aquifers/water basins, altering local flora and fauna and increasing fauna displacement → Hydrological & hydraulic alteration and fragmentation/removal of ecological corridors → Alteration of water quality due to intended or unintended releases of water and sediment → Disruption of mining activities in case of depletion of water supply			→ Reduction and/or depletion of aquifers/water basins, altering local flora and fauna and increasing fauna displacement → Hydrological & hydraulic alteration and fragmentation/removal of ecological corridors → Alteration of water quality due to intended or unintended release of water and sediment → Disruption in exploration, production and refining activities in case of depletion of water supply			→ Alteration of water quality due to unintended spills and leaks	
	Marine ecosystem use	→ Removal of marine benthos and reduction in water quality/increase in suspended sediments due to aggregates extraction and deep-sea mineral mining. Smothering of surrounding habitats due to deposition of suspended sediment	→ Marine habitat destruction → Increased threat to sensitive habitats and species		→ Removal of marine benthos due to drilling and footings of offshore structures → Reduction in water quality and increase in suspended sediments due to drilling. Increased sedimentation locally. → Scouring of benthic habitat due to presence of hard structures		→ Coastal and marine habitat loss due to construction → Alteration of coastal processes due to presence of infrastructure → Alteration of water quality due to unintended spills, leaks, wastewater releases → Disruption of refining activities in case of depletion of water supply	→ Alteration of water quality due to unintended spills and leaks	
Resource exploitation	Water use	→ Dewatering of aquifers required for safe extraction processes → Contribution to drought severity and/or frequency → Disruption of mining activities in case of depletion of water supply	→ Reduction and/or depletion of water sources, especially in drought-prone areas, reducing water flow and increasing drought severity and/or frequency → Disruption of water distribution process if water source is shared by other companies → Disruption in production and refining activities in case of depletion of water supply						
	Other resource use	→ Heightened pressure on nature due to high demand and limited supply of transition energy minerals							
Climate change	GHG emissions	→ Infrastructure damage and plant activity interruption due to increased frequency, severity, unpredictability and magnitude of extreme weather events such as storms, floods, heat waves and drought							
Pollution	Non-GHG air pollutants	→ Dust lift-off, more suspended particles in airshed due to heavy-vehicle movements and stockpiling of ore, waste rock and products → Fly rock, dust particles and toxic fumes due to blasting → Release of air toxins through stacks during processing and refining → Localized atmospheric release of cyanide (a toxic compound used in metal leaching and susceptible to vaporization)			→ Air pollution, negative effects on animal and vegetation growth, yield and immunity, due to emissions of volatile organic compounds (VOCs), sulphur dioxide, nitrogen oxides, particulate matter and carbon monoxide				
	Water pollutants	→ Release of water captured within industrial areas from storage dams and/or leaching of wastewater that is acidified or contains high concentrations of heavy metals and other toxic chemicals (e.g. sulphuric acid, cyanide, mercury, arsenic)	→ Leaching of toxic and persistent materials used in the manufacture of electronics and hi-tech materials into water basins and groundwater systems, affecting surrounding land and ecosystems farther away → Depositing and sedimentation of materials and substances used in manufacturing in the benthos of freshwater basins, or their transportation to other sites		→ Water pollution, negative impact on benthic and freshwater vegetation from potential pollutants such as drill cuttings, drill fluids and processed water → Groundwater pollution from brine storage dams		→ Pollutants in wastewater discharge ncreased water toxicity in localized areas due from spills and leaks from refineries → Vegetation loss resulting in habitat change across localized areas due to water-based pollution	→ Increased toxicity in aquatic habitats due to spills and leaks from storage sites, pipelines and motor transport.	
	Soil pollutants	→ Increased vulnerability of cleared land, stockpiles and rock dumps to erosion. Run-off may affect sedimentation rates in retained habitats and watercourses. → Soil rendered unsuitable for native vegetation due to dust clouds and mineral deposition from mines → Deleterious effects on soil quality and site rehabilitation due to storage or leak of hazardous materials			→ Erosion of cleared land, reduced sedimentation in retained habitats and watercourses, increased runoff from these areas → Adverse impact on soil quality and site rehabilitation due to storage or leaks of hazardous materials		→ Adverse impact on soil quality and site rehabilitation due to storage or leaks of hazardous materials		
	Solid waste	→ Negative impact on vegetation and soil conditions when exposed to accidental spillage, leakage or leaching of heavy metals from ore heaps → Local soil, surface- and groundwater pollution from improper disposal of industrial waste e.g. tires, containers and unused hazardous materials			→ Alteration of soil and water chemical balances and geomorphological environment structure affects sedimentation and groundwater flows → Drilling cuttings can accumulate and harm terrestrial and marine benthic organisms resulting in growth inhibition, mortality, and smothering → Improper disposal of industrial waste e.g. tires, containers and un-used hazardous materials can cause local soil, surface- and groundwater pollution. → Drilling cuttings affect pipe laying and maintenance operations		→ Local soil, surface- and groundwater pollution from improper disposal of industrial waste e.g. tires, containers and unused hazardous materials		
Invasive species and others	Disturbances	→ Disturbance to local species from seismic blasting, night-lighting, traffic movements, extraction and production activity			→ Seismic, blasting, night-lighting, traffic movements, extraction and production activity can result in disturbance to local species			→ Disruption or displacement of local species, affecting their migratory, feeding and breeding routes and habits in the shipping phase	
	Biological alterations/ interferences	→ Introduction of non-native and invasive species by vehicles, equipment and plant, and in some instances by reclamation programs that import "contaminated" soils → Potential change in structure and function of ecological communities due to cumulative impacts			→ Introduction of non-native and invasive species by vehicles, equipment and plant, and in some instances by reclamation programs that import "contaminated" soils → Potential change in structure and function of ecological communities due to cumulative impacts				
Social	Social/ community/ human rights	→ Displacement of communities for new asset construction or transportation routes → Worsening health of surrounding local communities due to air, soil and water pollutants → Worsening living areas and conditions of local communities, also affecting their economic and working conditions → Increase in local conflicts → Disruption and/or damage to local sacred areas → Possible violation of human rights and use of child labor							

Legend:
Text in Black: risks from impacts (tables 2 and 3)
Text in Orange: risks from dependencies (tables 4 and 5)

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to include the mining of other materials, i.e., metal ores.
2. Other than mining: Sourcing of equipment & material used for direct operations.

Link to the table

Table 7: Risks for Utilities

Risks for the identified value chain stages in the Utilities sector												
IPBES drivers of change	*Impact drivers*	**Upstream**		**Direct operations**								
		Mining (1)	Supply chain and sourcing (2)	Nuclear and thermal power stations	Nuclear power stations	Coal power stations	Other thermal power stations	Hydropower	Wind	Solar	Geothermal	Biomass	Electric/nuclear power transmission and distribution
Land-/water-/sea-use change	Terrestrial ecosystem use	→ Disruption of ecosystems and ecological functions due to land clearance for site preparation, construction and surface mining, causing direct biodiversity loss and habitat fragmentation → Habitat loss and degradation due to fires from unplanned events → Disruption of mining activities if terrestrial ecosystems are degraded → Increased flood and storm risks if terrestrial ecosystems are degraded	→ Land clearance for production of packaging material, e.g. wooden pellets	→ Biodiversity loss and habitat fragmentation from land clearance for site preparation and construction → Increase of fire risk due to presence of networks and solar infrastructures								
	Freshwater ecosystem use	→ Reduction and/or depletion of aquifers/water basins, altering local flora and fauna and increasing fauna displacement → Hydrological & hydraulic alteration and fragmentation/ removal of ecological corridors → Alteration of water quality due to intended or unintended release of water and sediment → Disruption of mining activities in case of depletion of water supply		→ Hydrological & hydraulic alteration and fragmentation/removal of ecological corridors → Entrapment of aquatic species into inflows of water for cooling thermal and nuclear power stations → Alteration of water quality due to intended or unintended releases of water, especially higher temperature water → Disruption of plant activities in case of depletion of water supply				→ Reduction of downstream water flow → Flooding of upstream terrestrial habitats and decrease in freshwater habitat downstream → Alteration of sediment transport processes, hydrology and hydraulics downstream → Disruption of plant activities in case of depletion of water supply or reduction of water flow → Infrastructure damages and plant activity interruptions due to reduced flood defense and erosion control capacity	In case of floating energy generation: → benthic habitat loss and alteration of water quality and sedimentation rates due to piling; scour and erosion of benthos by footrings. → altered hydrological and ecological processes in lakes, e.g. due to large-scale PV deployment reducing light penetration			
	Marine ecosystem use	→ Aggregates extraction and deep-sea mineral mining (for retrieving mineral deposits from the deep seabed) result in removal of marine benthos and reduction in water quality / increase in suspended sediments. Deposition of suspended sediment may smother surrounding habitats outside mining footprint.	→ Marine habitat destruction → Increased threat to sensitive habitats and species	→ Entrapment of aquatic species into inflows of water for cooling thermal and nuclear power stations → Alteration of water quality due to intended or unintended releases of water, especially higher temperature water which risks disrupting aquatic ecosystems and species → Disruption of plant activities in case of depletion of water supply					→ Benthic habitat loss and alteration of water quality and sedimentation rates due to piling; scour and erosion of benthos by footrings in case of floating energy generation				
Resource exploitation	Water use	→ Dewatering of aquifers required for safe extraction processes → Contribution to drought severity and/or frequency → Disruption of mining activities in case of depletion of water supply	→ Reduction and/or depletion of water sources, especially in drought-prone areas, reducing water flow and increasing drought severity and/or frequency	→ Reduction and/or depletion of water sources, especially in drought-prone areas, reducing water flow and increasing drought severity and/or frequency → Lack of fresh water to cool thermal generation plants and drive steam turbines → Infrastructure damages and activity interruption due to reduced flood defense capacity, erosion control capacity				→ Reduction and/or depletion of water sources, especially in drought-prone areas, reducing water flow and increasing drought severity and/or frequency → Unsustainable water abstraction → Alteration in the amount of water available within a watershed caused by large hydropower stations → Lack of fresh water to run hydroelectric dams		→ Water use for cleaning solar plants can have higher impact in water stressed regions	→ High rates of local water abstraction, particularly when water is extracted directly from nearby water bodies → Negative impacts on local freshwater species of mechanisms used to extract/return water → Local geological changes, including landslides and erosion, caused by intensive extraction or injection of fluids or steam → Disruption of plant activities in case of depletion of water supply		
	Other resource use	→ Heightened pressure on nature due to high demand and limited supply of transition energy minerals										→ Raw material loss and production disruption	→ Heightened pressure on nature due to use of raw material in construction and extention of networks
Climate change	GHG emissions	→ Infrastructure damage and plant activity interruption due to increased frequency, severity, unpredictability and magnitude of extreme weather events such as storms, floods, heat waves and drought											
Pollution	Non-GHG air pollutants	→ Dust lift-off, more suspended particles in airshed due to heavy-vehicle movements and stockpiling of ore, waste rock and products → Fly rock, dust particles and toxic fumes due to blasting → Release of air toxins through stacks during processing and refining → Localized atmospheric release of cyanide (a toxic compound used in metal leaching and susceptible to vaporization)		→ Nuclear: Emissions of gases (e.g. carbon monoxide) and radioactive substances (e.g. CH14 and H3), pollution of vegetation and decrease in soil productivity → Thermal: Poor air quality due to emissions of sulphur dioxide, nitrogen oxides, particulate matter and carbon monoxide							→ Poor air quality due to emissions from direct combustion	→ Poor air quality due to emissions from transportation and transforming
	Water pollutants	→ Release of water captured within industrial areas from storage dams and/or leaching of wastewater that is acidified or contains high concentrations of heavy metals and other toxic chemicals (e.g. sulphuric acid, cyanide, mercury, arsenic)	→ Leaching of toxic and persistent materials used in the manufacture of electronics and hi-tech materials into water basins and groundwater systems, affecting surrounding land and ecosystems farther away → Depositing and sedimentation of materials and substances used in manufacturing in the benthos of freshwater basins, or their transportation to other sites	→ Effects on marine and freshwater ecosystems due to discharge of polluted effluents				→ Alteration of temperature balances → Alteration of water chemistry → Increased sedimentation			→ Release of several types of pollutants into the environment, including minerals and heavy metals, altering water quality	→ Emissions of suspended solids and trace metals in wastewater from direct combustion (burning) reduce water quality → Raw material loss and production disruption if water for forests is polluted	
	Soil pollutants	→ Increased vulnerability of cleared land, stockpiles and rock dumps to erosion. Run-off may affect sedimentation rates in retained habitats and watercourses. → Soil rendered unsuitable for native vegetation due to dust clouds and mineral deposition from mines → Deleterious effects on saoil quality and site rehabilitation due to storage or leak of hazardous materials						→ Alteration of sediment flows within a watershed, leading to increased sedimentation or sediment starvation, as well as eutrophication			→ Release of several types of pollutants into the environment, including minerals and heavy metals, altering soil quality	→ Raw material loss and production disruption if water for forests is polluted	
	Solid waste	→ Negative impact on vegetation and soil conditions when exposed to accidental spillage, leakage or leaching of heavy metals from ore heaps → Local soil, surface- and groundwater pollution from improper disposal of industrial waste e.g. tires, containers and unused hazardous materials		→ Treatment, storage and disposal of solid wastes, most importantly hazardous nuclear waste, but also resins, sludges and filter media, among others → Large volumes of concrete and steel at end-of-life demolition, possible landfilling → Local soil, surface- and groundwater pollution at source or disposal site e.g. landfill from improper disposal of hazardous materials					→ Wind turbine blades create large volumes of blade waste made of composite materials. This waste may be sent to landfill.	→ Solar PVs generate silicon (glass) module waste and electronic waste. Untreated waste can pose a risk to human health and surrounding fauna and flora		→ Ash and other related risks related to the treatment and storage of solid waste from direct combustion	→ Risk of mortality of birds and other fauna due electrocution and collision on transmission networks → Impact on terrestrial ecosystems and species from introduction/ spread of non-native species by construction, operation and maintenance activities
Invasive species and others	Disturbances	→ Disturbance to local species from seismic blasting, night-lighting, traffic movements, extraction and production activity		→ Disruption or alteration of local species, their habits and routes due to noise and light pollution during construction phase and routine operations				→ Displacement of species from their breeding and wintering grounds → Disruption of their habits and routes due to ecosystem fragmentation and anthropogenic activites from construction and routine operations → Collisions and fatality of birds and bat species on wind power plants → Cumulative effects of concern to migratory species → Risk of entrapment of aquatic species into inflows of water on Hydropower			→ Displacement of species from their breeding and wintering grounds, disruption of their habits and routes due to ecosystem fragmentation and anthropogenic activites from construction and routine operations		
	Biological alterations/ interferences	→ Introduction of non-native and invasive species by vehicles, equipment and plant, and in some instances by reclamation programs that import "contaminated" soils → Potential change in structure and function of ecological communities due to cumulative impacts		→ Introduction of non-native and invasive species by vehicles, equipment and plant, and in some instances by reclamation programs that import "contaminated" soil → Potential change in structure and function of ecological communities due to cumulative impacts									
Social	Social/ community/ human rights	→ Displacement of communities for new asset construction or transportation routes → Worsening health of surrounding local communities due to air, soil and water pollutants → Worsening living areas and conditions of local communities, also affecting their economic and working conditions → Increase in local conflicts → Disruption and/or damage to local sacred areas → Possible violation of human rights and use of child labor											

Legend:
Text in Black: risks from impacts (tables 2 and 3)
Text in Orange: risks from dependencies (tables 4 and 5)

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to include the mining of other materials, i.e., metal ores.
2. Other than mining: Sourcing of equipment & material used for direct operations.

Link to the table

Table 8: Transitional risks

Policy & legal	→ Changes to existing regulations or new regulations aimed at achieving nature positive outcomes and energy transition targets in jurisdictions, requiring adaptations to production and operation methods. → Tighter legislation (e.g., trade restrictions, taxes) on activities, products or services that impact nature (e.g., tighter water consumption and water quality legislation for processing facilities), and rights, permits and allocations for natural resources to alleviate pressures on nature. → Enhanced reporting obligations for nature-related impacts and risks, increasing monitoring and reporting costs.
Market	→ Volatility or increased costs of materials due to increased competition or scarcity (e.g., increased prices of raw materials resulting in additional revenue or increased costs depending on where the company is in the value chain).
Reputation	→ Shift of consumer sentiment away from organizations/brands/products seen to have poor nature management leading to reduced demand for products, reduced supplier or off-take loyalty, or reduced employee attraction and retention. → Lack of transparent information/communication to affected communities or unmet expectations leading to controversies.
Technology	→ Transition to more efficient and cleaner technologies with lower nature impacts. → Lack of access to (high-quality) data that hampers nature-related assessments. Regulators demanding the use of new monitoring technologies that are costly to implement.

Table 9: Opportunities for Oil & Gas

Opportunities for the identified value chain stages in the Oil & Gas sector									
IPBES drivers of change	*Impact drivers*	**Upstream**			**Direct operations**				
		Mining (1)	Supply chain and sourcing (2)	Equipment & services	Exploration	Production	Refining	Storage & transportation	Gas distribution & Retail
Land-/water-/sea-use change	Terrestrial ecosystem use	→ Scaling up recovery, recycling, reuse of critical materials	→ Sourcing of materials and services only from ethically and environmentally certified sources and not from biodiversity sensitive areas	→ Increased circularity of materials used in construction → Sourcing of materials and services only from ethically and environmentally certified sources and not from biodiversity sensitive areas	→ Habitat restoration and reinstatement after clearance	→ Habitat restoration and reinstatement after clearance	→ Habitat restoration and reinstatement after clearance → Prevention of financial impacts and operational disruptions through implementation of risk management practices that take into account natural disasters	→ Habitat reinstatement along pipeline routes → Incorporation of Nature-based Solutions (NbS) to reduce risk along easements → Use of some of the space cleared for solar (e.g., in between tanks in tank farms) → Transformation of storage site into bird sanctuary → Creation of ecological corridors	→ Creation of ecological corridors
	Freshwater ecosystem use		→ Sourcing of materials and services only from ethically and environmentally certified sources and not from biodiversity sensitive areas		→ Onshore: recycle freshwater and reduce amount of new freshwater used → Offshore: source freshwater from less sensitive areas (if feasible)	→ Onshore: Recycling of freshwater and reduced use of new freshwater → Offshore: Sourcing of freshwater from less sensitive areas (if feasible)	→ Increased water availability for local communities → Enhanced restoration of wetland habitats and water replenishment → Increased water efficiency and reuse, use of alternative water resources (desalinated, wastewater, etc.)		
	Marine ecosystem use	→ Scaling up recovery, recycling, reuse of critical materials	→ Sustainable extraction of metals and minerals after assessment of sources		→ Supporting the establishment of marine protected areas	→ Supporting the establishment of marine protected areas Use of offshore facilities to repopulate threatened ecosystems/species (e.g., using artificial reefs) or repurposing for alternative uses (for wind power, e.g.)	→ Increased water efficiency and reuse, use of alternative water resources (desalinated, wastewater, etc.)	→ Use of offshore facilities to repopulate threatened ecosystems/species (artificial reefs) or repurposing for alternative uses (wind power)	
Resource exploitation	Water use						→ Increased water efficiency and reuse, use of alternative water resources (desalinated, wastewater, etc.)		
	Other resource use	→ Scaling up recovery, recycling, reuse of critical materials	→ Use of recycled materials → Sourcing from ethical and environmentally certified sources only						
Climate change	GHG emissions								
Pollution	Non-GHG air pollutants								
	Water pollutants								
	Soil pollutants								
	Solid waste				→ Drilling cuttings can be used as alternative aggregated, construction material or cement production (or other civil engineering works)	→ Bioremediation of wastes instead of landfill disposal → Increased reuse of materials, especially critical materials			
Invasive species and others	Disturbances	→ Restoration of disturbed areas with native species and implementation of monitoring/adaptive management plan			→ Restoration of disturbed areas with native species and implementation of monitoring/adaptive management plan				
	Biological alterations/ interferences	→ Restoration of disturbed areas with native species and implementation of monitoring/ adaptive management plan		→ Restoration of disturbed areas with native species and implementation of monitoring/adaptive management plan				→ Restoration of disturbed areas with native species and implementation of monitoring/adaptive management plan	
Social	Social/community/ human rights	→ Improved communication and relationships through hiring/engagement of local stakeholders							

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to include the mining of other materials, i.e., metal ores.
2. Other than mining: Sourcing of equipment & material used for direct operations.

Potential opportunities exist across all of the cells in the table. Some examples have been provided in the white cells, but all opportunities will depend on the specific circumstances of individual companies.

Link to the table

Table 10: Opportunities for Utilities

Opportunities for the identified value chain stages in the Utilities sector												
IPBES drivers of change	***Impact drivers***	**Upstream**		**Direct operations**								
		Mining (1)	Supply chain and sourcing (2)	Nuclear and thermal power stations	Nuclear power stations	Coal power stations	Other thermal power stations	Hydropower	Wind	Solar	Geothermal	Biomass	Electric/nuclear power transmission and distribution
Land-/water-/sea-use change	Terrestrial ecosystem use			→ Degraded areas restoration/compensation (offsetting)					→ Opportunities to create corridors for wildlife or important habitats for pollinators as part of site development → Co-construction with landowner and ecological management of sites (grazing for livestock, no use of pesticides, etc.)	→ Introduction of self-sustainable agricultural practice (agrivoltaic) → Co-construction with landowner and ecological management of sites (grazing for livestock, no use of pesticides, etc.) → Creation of ecological corridors → Planting of groves to bring back species that had deserted the area → Re-seeding the panel area with local labelled seeds		→ Creation of ecological corridors → Ensuring use of deforestation free biofeedstocks	→ Creation of ecological corridors
	Freshwater ecosystem use							→ Adoption of sustainable solution for de-silting sediment and floating biomass recovery					
	Marine ecosystem use												
Resource exploitation	Water use												
	Other resource use		→ Use of recycled materials → Sourcing of materials and services only from ethically and environmentally certified sources and not from biodiversity sensitive areas							→ Sourcing of materials and services only from ethically and environmentally certified sources and not from biodiversity sensitive areas		→ Development of sustainably managed forests	
Climate change	GHG emissions								→ Land use compatible with renewable energy				→ Enhancement of natural flood defenses (e.g., through vegetation), reduced impacts from climate change as well as costs
Pollution	Non-GHG air pollutants											→ Identification of alternative/ innovative combustion procedures to monitor and reduce pollutants	
	Water pollutants												
	Soil pollutants												
	Solid waste								→ Increased circular design of plant components				
Invasive species and others	Disturbances			→ Operation and/or consideration of appropriate equipment to respect local animal biological rhythms				→ Operate and/or consider appropriate equipment to respect local animal biological rhythms → Fauna protection due to area access restrictions	→ Operation and/or consideration of appropriate equipment to respect local animal biological rhythms → Adoption of bird/bat detection systems capable of sending acoustic signals and/or slowing down/stopping blade speeds (curtailment) to prevent collisions	→ Wildlife disturbance mitigation by installation of dedicated corridors and/ or nesting and feeding places where birds and animals can transit or rest according to their natural habits → Operate and/or consider appropriate equipment to respect local animal biological rhythms			→ Creation of ecological corridors
	Biological alterations/ interferences												
Social	Social/ community/ human rights							→ Improved water use by communities: tourism, water use for agriculture, etc.		→ Ethically framed and balanced measures in territories outside industrial sites (reduction of lighting, rehabilitation of roofs for birds and bats, etc.)			

Notes:
1. Mining currently includes mining of coal and consumable fuels. Future iterations of this roadmap will expand the scope to include the mining of other materials, i.e., metal ores.
2. Other than mining: Sourcing of equipment & material used for direct operations.

Potential opportunities exist across all of the cells in the table. Some examples have been provided in the white cells, but all opportunities will depend on the specific circumstances of individual companies.

Link to the table

→ *Stage 2: Commit and Transform (targets for priority actions)*

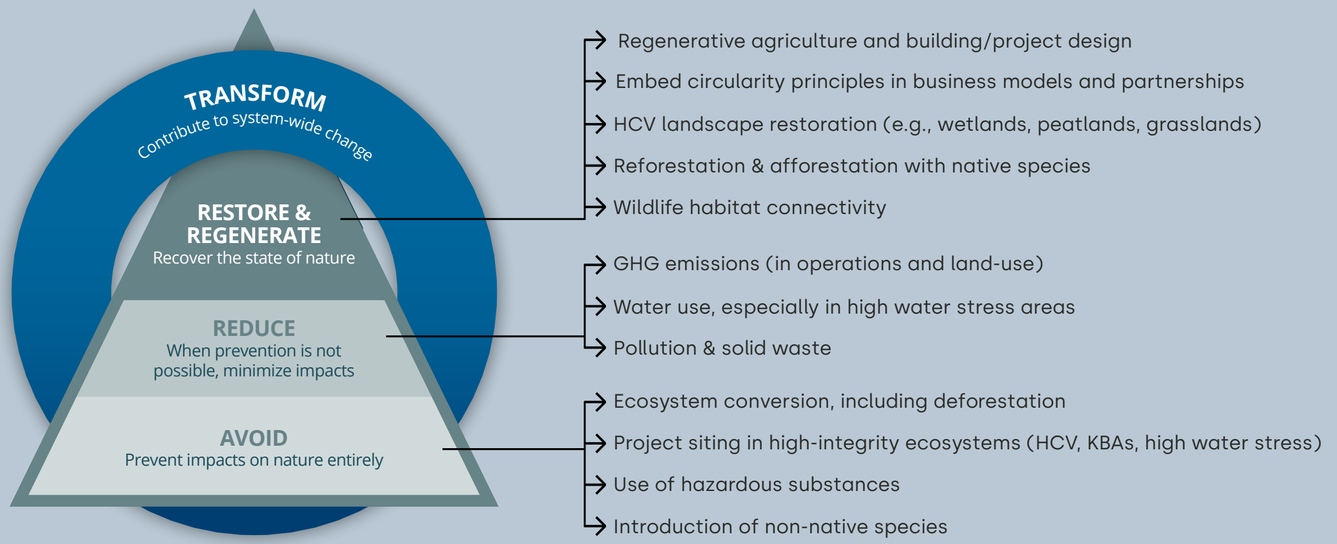
Having completed an initial materiality screening, companies should prioritize the impacts and dependencies that play a key role in informing their commitments and actions.

Credible, realistic and impactful nature commitments (including their associated targets) require a company to understand the actions it can take to address its priority impacts and dependencies on nature.

The foundational steps to "Commit and transform" include:

1. **Set science-informed targets:** Set time-bound, specific science-informed corporate-level targets and linked indicators to track progress on reducing priority impact drivers on nature;
2. **Take priority actions:** Identify existing and additional priority actions needed to avoid and reduce negative impacts, and promote opportunities to restore and regenerate;
3. **Transform the system:** Identify additional actions needed that transform business models and business activities to address barriers and improve the enabling environment (policy, financing, technology, infrastructure).

Figure 5: SBTN's Action Framework with examples of actions



Source: Adapted from WBCSD (2021). **What does nature-positive mean for business?**

Stage 2.1 – Set science-informed targets

Set time-bound, specific science-informed corporate-level targets and linked indicators to track progress on reducing priority impact drivers on nature.

Why do this:

Companies need to set targets according to a scientific assessment of where their main sectors' general impact drivers on nature are. They can then strengthen science-informed targets and add to them over time on the journey to science-based targets, which they articulate at a local level.

What to do:

→ Consider the activities throughout the value chain that typically cause the priority impact drivers and the actions the company is already taking to avoid and reduce these negative impacts (or could take in the near future);

→ Set targets, either at the impact driver level or the company response level. Identify priority land-, sea- and freshwater-scapes in direct operations to set baselines for impact drivers and eventual science-based targets;

→ Build on what the company has done so far, set targets accordingly, and always be transparent regarding methodology.

Table 11: Example of science-informed target and indicator

An illustrative science-informed target and the relevant key performance indicator (KPI).

Impact drivers	Priority actions	Global frameworks alignment	SBTN Action Framework (AR3T)					Science-informed target	Indicators (illustrative)
			Avoid	Reduce	Regenerate	Restore	Transform		
Resource exploitation	For operating sites, reduce water use in times of scarcity and implement sustainable water management which may include (but not limited to) periodic water risk assessment and minimization of freshwater withdrawals in water-stressed areas or during drought periods (accounting for company-specific available data)	GBF Target 11; Water Framework Directive (EU); Integrated Water Resources Management (UNEP); SDG 6						By 2030, reduce water withdrawals in high water impact parts of your value chain(s) by X% in line with environmental flow needs	Specific water withdrawals (m^3/kWh)

Indicates type of AR3T action

Stage 2.2 – Take priority actions

Identify existing and additional priority actions needed to avoid and reduce negative impacts and promote opportunities to restore and regenerate nature.

Why do this:

Companies need to take action to address priority impact drivers of nature loss. Companies often have actions in place that are already addressing some of the impact drivers, but which may not have been evaluated against the materiality assessment.

What to do:

→ Map existing actions against the impact drivers prioritized through the materiality assessment and course-correct: understand what actions the company is already undertaking and should continue, which ones can be deprioritized, and which ones need to be put in place;

→ These actions should align with the emerging ambition for target-setting (even if the methodology for science-based approach is not yet finalized);

→ For any action, systematically consider and apply the principles of the action framework to avoid and reduce negative impacts and have positive contributions through restoration and regeneration and wider system transformation (see Figure 5);

→ Consider these actions where the company has direct control and in areas where it has influence, including with suppliers and customers and the broader landscapes within which they operate.

Actions should be considered across three main levels:

1. Corporate
2. Operations and priority value chains
3. Broader system change (see **Stage 2.3 – Transform the system**)

This section provides energy companies with an overview of illustrative priority actions they can implement at the entity and operational levels as well as in their supply chains. They may have already partially implemented some actions in some business lines; other actions may be too advanced for companies at the beginning of their nature action journey but should be aimed for in future. Also, some of these practices are already mainstream due to regulatory and technological reasons but companies can advance, scale up and replicate them further for greater impact. All companies will need to critically assess their risks and current management plans by actively implementing or advancing some of these priority actions.

Below are some illustrative key activities that all companies can implement in the short term as part of a cohesive nature action strategy. These actions form the foundations needed to realize impactful, effective transformative changes in the organization and across value chains, sectors and multiple stakeholders at the landscape or regional level. Of course, businesses should prioritize actions where they have the most leverage and that lead to the biggest impacts.

→ Grow capacity and establish a team of experts to support the development of materiality assessment and implementation of nature strategy.

→ Start collecting data by setting up impact driver-specific databases (e.g., water use or waste produced, other resources used, land cover, pollutants used/emitted, etc.).

→ Align offset and restoration goals with the Global Biodiversity Framework to result in net gain and restoration in the wider landscape.

→ Seek to exceed statutory minimum requirements (e.g., permit conditions) and generate overall environmental improvements.

→ Take a precautionary/conservative rather than risk-based approach to biodiversity/environmental impact assessment and application of mitigation.

→ Promote natural capital account baselining and its use in decision-making.

→ Seek opportunities to achieve key business objectives using actions that protect and restore nature, such as nature-based solutions (NbS).

Stage 2.3 - Transform the system

Identify further actions to transform the system

Why do this:

Individual company actions alone will not deliver nature-positive outcomes. Therefore, companies should also consider what further actions they can take in their value chains, priority landscapes and in the broader enabling environment to encourage collaboration with other stakeholders, and transform the parts of the system that they are embedded in.

What to do:

- → Consider what the key barriers to speed and scale up action are (such as a lack of supporting government policies, financing, technology);
- → Consider trade-offs (such as balancing conservation priorities against regional food security needs) and what collaborative actions can be taken to address these;
- → Identify who needs to do what to address the systemic barriers and plan to engage with stakeholders, such as peers in the sector, suppliers, those in operational or priority sourcing landscapes;
- → Advocate for a supportive enabling environment, such as publicly demonstrating support for key policies and financing for infrastructure, institutions and technology.

The tables below contain a joint list of illustrative priority and transformative actions that energy companies may want to implement based on the material risks identified in Step 3 of the "Assess" stage.

All actions have been categorized into the corresponding impact driver and classified according to SBTN's AR3T framework: Avoid and Reduce negative impacts, Restore & Regenerate, and lead Transformation by shifting business strategy and models.

Table 12 illustrates actions specific to the energy system's direct operations, while Table 13 shows actions specific to the supply chain. Those companies just starting out can begin implementing actions specific to their direct operations, as they have more control over these. Supply chain priority actions often include suppliers and external stakeholders, where catalyzing transformation may be challenging, even for more advanced companies.

Indeed, both companies that are just starting out and those that are more advanced – as defined in the **Roadmaps to Nature Positive: Foundations for all businesses** – should focus on gathering all relevant information and taking nature-related actions that avoid generating "more harm". More advanced companies with a strong foundational assessment analysis and with clear, targeted nature-related actions already in place should also strive for more ambitious actions that restore and regenerate the environment and "do more good". Companies should then consider transformative actions that drive systems change, involving collaborations across value chains and the inclusion of multiple stakeholder groups.

Table 14 gives a brief example of how companies at different maturity stages can address the same risk.

See **Annex 1** for notes on the methodology and next steps.

"Do less harm" and "do more good" according to AR3T Framework - Avoid & Reduce, Restore & Regenerate, Transform

To achieve The Global Goal for Nature, the collective positive impacts from regenerative and restorative actions must outweigh those from avoiding and reducing nature loss. This means that individual companies must accelerate action to slow and halt nature loss while simultaneously reviving nature through regenerative and restorative actions.
By building on the mitigation and conservation hierarchy, the AR3T framework is designed to guide companies towards preventive and remedial steps to really contribute to the nature-positive agenda.
It defines actions that contribute to halting nature loss (actions to avoid or reduce loss of nature) and those that contribute to reversing loss (restorative and regenerative actions).

Table 12: Priority and transformative actions for direct operations

Impact drivers	Priority actions	Global frameworks alignment	SBTN Action Framework (AR3T)					*Direct operations*			
								Sector			
			Avoid	Reduce	Regenerate	Restore	Transform	Oil & Gas	Utilities		
								Oil & Gas	Renewable production	Nuclear & thermal	Energy transmission
Land-/water-/sea-use change	For new developments, avoid all protected areas, internationally recognized areas, and critical habitat (including but not limited to Natura 2000 sites or geography-specific equivalent network or standard)	EU Article 6(4) "Habitats" Directive 92/43/EEC; SBTN Interim Targets; GBF - Target 3									
	For new developments, avoid natural habitat and commit to net gain (not no net loss) when not practicable. Focus development in modified habitat and commit to net gain/restoration	GBF - Target 1; GBF - Target 2; GBF - Target 3; GBF - Target 4; IFC SD 6									
	For new developments and all operating sites, restore and regenerate nature by introducing innovative and nature-based solutions and implement habitat restoration and reinstatement after clearance/decommissioning	GBF - Target 2; GBF - Target 3; GBF - Target 11; GBF - Target 12; SDG 15									
	Research or fund innovative ways to reduce the negative impact of the operating process by collaborating with peers or research institutes	GBF - Target 11									
Resource exploitation	For operating sites, reduce water use in times of scarcity and implement sustainable water management that may include (but not be limited to) periodic water risk assessment, minimization of freshwater withdrawals in water-stressed areas or during drought periods (accounting for company-specific available data)	GBF Target 11; Water Framework Directive (EU); Integrated Water Resources Management (UNEP); SDG 6									
	For operating sites, implement water replenishment programs and conservation/restoration of water species affected by water withdrawals	SDG 6 Net Positive Water Impact - CEO Water Mandate									
	For all operating sites, maximize recovery of process water (e.g., water reuse/recycling, closed loops) by collecting, quantifying and mapping on-the-ground water use and mitigation policies already in place; identify potential regeneration/ restoration of areas at higher risk of depletion.	GBF Target 11; Water Framework Directive (EU); CDSB Framework on water-related disclosures; SDG 6; International Water Stewardship Standard (AWS)									
	Use innovative, habitat-enhancing, biodiversity-friendly, sustainable materials and solutions (e.g. wind turbines from fabric; turbine reefs, etc.) to replace highly negatively impactful material, through collaboration with suppliers	SDG 12									
	Establish collaboration with local conservation organizations to continue to monitor habitat restoration processes and implement larger scale conservation and restoration projects in the site area/region	GBF - Target 2									
	For raw materials used in high-volumes during production, commit to integrating recycled materials in the value chain to reduce and avoid the use of virgin materials	SDG 12									
Climate change	Invest in building and site resilience (thermal comfort with natural shading, green-roofs passive heating and cooling, etc.)	GBF - Target 8									
	Reduce operational and transport GHG emissions	TCFD; Paris Agreement									
Pollution	Recycle end-of-life and/or abandoned facilities to restore and regenerate the site, to avoid, prevent and reduce air, water and soil pollution generated by discarded facilities	GBF - Target 7; SDG 6									
	For new and operating sites, implement operational anti-pollution measures and monitoring plans, including but not limited to operational prevention and control plans (e.g., noise impact mitigation)	GBF- Target 7									
	Take effective legal, policy and administrative measures to reduce pollution and waste risks and avoid introducing any harmful levels of pollutants to biodiversity and ecosystem functions and services. This includes but is not limited to excessive nutrients, hazardous chemicals and spills	SDG 12; GBF - Target 7									
Invasive species and others	For all new and operating sites, avoid construction, maintenance and production in/during breeding, nesting, migrating, resting areas and seasons of key and threatened local species	GBF - Target 4									
	For operating sites, eliminate invasive alien species by identifying and managing pathways of introduction (i.e. ballast water management; hygiene and maintenance protocols for vehicles, vessels and equipment, and contractors) and commit to restoring genetic diversity within and between populations of native, wild and domesticated species	GBF - Target 4; GBF - Target 5; GBF - Target 6									
	For operating sites, minimize negative impacts on threatened species and aim to restore and regenerate local genetic diversity	GBF - Target 4; GBF - Target 5; GBF - Target 6									
	Use site-specific, indigenous and non-invasive species for landscaping and rehabilitation works	GBF - Target 4; GBF - Target 5									
	For all sites, reduce disturbances (e.g. light and noise), especially in already-existing, highly-sensitive operational sites	GBF - Target 4; GBF - Target 5; GBF - Target 6									
Social	Involve and employ local expertise through NGOs or other local stakeholders to better understand local ecosystems, assess onsite activities, mitigate risks and impacts for local communities, and build alliances	SDG 8, SDG 10; SDG 4									
	Implement social programs to promote local livelihoods and education	SDG 8, SDG 10; SDG 4									

Link to the table

Table 13: Priority and transformative actions for supply chain

Impact drivers	Priority actions	Global frameworks alignment	SBTN Action Framework (AR3T)					*Supply chain*			
								Sector			
			Avoid	Reduce	Regenerate	Restore	Transform	Oil & Gas	Utilities		
								Oil & Gas	Renewable production	Nuclear &thermal	Energy transmission
Land-/water-/sea-use change	Source from suppliers that regularly monitor, assess and transparently disclose their impacts, dependencies and risks on natural capital and biodiversity	GBF - Target 2; GBF - Target 3; GBF - Target 15									
	Source and engage with suppliers who commit to no negative impact on UNESCO sites, sensitive or priority habitats	GBF - Target 2; GBF - Target 3; GBF - Target 15									
	Source and engage with suppliers who implement and promote habitat restoration and reinstatement in and around the site, for new and existing sites and/or after clearance/decommissioning (including ecological corridors)	GBF - Target 2; GBF - Target 3; GBF - Target 15									
	Develop with suppliers policies and administrative measure to reduce negative impact on the surrounding natural capital	GBF - Target 2; GBF - Target 3; GBF - Target 15									
	Support and engage suppliers in understanding the risks and the opportunities of reducing and avoiding negative impacts on natural capital, ecosystem services and biodiversity	GBF - Target 2; GBF - Target 3; GBF - Target 15									
Resource exploitation	Adopt third-party certification and traceability procedures for raw materials used in production stage	GBF - Target 15									
	Prioritize suppliers that have in place sustainable water management plans, minimize freshwater withdrawals and maximize water recovery	GBF Target 11; GBF - Target 14; Water Framework Directive (EU); CDSB Framework on water-related disclosures; SDG 6									
	Source commodities only/mostly from ethical and environmentally certified suppliers	SDG 12									
	Use certified sustainable raw material, include thorough procurement and traceability process along the supply chain										
Climate change	Source and engage with suppliers with a transparent climate strategy and targets, with clear actions to reduce their GHG emissions	GBF - Target 8; Paris Agreement; TCFD									
Pollution	Prioritize suppliers who have implemented anti-pollution measures, periodically monitor their impact and have a response plan in place										
	Collaborate and engage with suppliers to develop and implement a circular business model to reduce direct operational waste	GBF - Target 14; GBF - Target 15; SDG 12									
	Source and engage with suppliers committed to sustainable production	GBF - Target 14; GBF - Target 15; SDG 12									
Invasive species and other	Source and engage with suppliers who minimize negative impacts and disturbances during critical reproductive and feeding seasons of key species										
	Prioritize suppliers who measure and monitor alien invasive species										
Social	Prioritize suppliers who ethically source and produce their products	GBF - Target 14; GBF - Target 15									
	Engage with suppliers to be transparent on local livelihood impact	GBF - Target 14; GBF - Target 15									

Link to the table

Table 14: Examples of actions deployed by maturity level

Impact drivers	Addressed risk	Maturity level	Priority actions	SBTN Action Framework (AR3T)				
				Avoid	Reduce	Regenerate	Restore	Transform
Land-/ water-/sea-use change	Land degradation disrupts ecosystems and ecosystem services, increasing biodiversity loss and habitat fragmentation	Starting	For new developments, commit to no negative impacts on UNESCO sites, sensitive or priority habitats, Key Biodiversity Areas and High Conservation Value Areas (i.e. including but not limited to Natura 2000 sites or geography-specific equivalent network or standard)					
		Developing	For new developments, avoid sites with threatened species, commit to No Net Biodiversity loss, limit reducing ecosystem services and functioning (e.g. flood control, water purification), and mitigate negative impacts by restoring and regenerating nature					
		Advanced	For new developments and all operating sites, restore and regenerate nature by introducing innovative and nature-based solutions and implement habitat restoration and reinstatement after clearance/decommissioning					
		Leading	Research or fund innovative ways to reduce the negative impact of the operating process by collaborating with peers or research institutes					

Impact drivers	Addressed risk	Maturity level	Priority actions	SBTN Action Framework (AR3T)				
				Avoid	Reduce	Regenerate	Restore	Transform
Resource exploitation	Significant water use depletes water basins and watershed increasing risks to production processes and contributing to ecosystem degradation and drought severity	Starting	Reduce water use in times of scarcity and implement sustainable water management which may include (but not be limited to) periodic water risk assessment, minimization of freshwater withdrawals in water-stressed areas or during drought periods (accounting for company-specific available data)					
		Developing	Maximize recovery of process water (e.g. water reuse/recycling, closed loops) and identify potential regeneration/restoration of areas at higher risk of depletion					
		Advanced	For operating sites, implement water replenishment programs and conservation/ restoration of water species affected by water withdrawals by using innovative technological and nature-based solutions					
		Leading	Establish collaboration with local conservation organizations to continue to monitor habitat restoration processes and implement larger scale conservation and restoration projects in the site area/region					

→ *Stage 3: Disclose (initial disclosures)*

Nature-related disclosures help companies communicate how they are acting on nature-positive outcomes. Disclosure will directly contribute to the achievement of GBF Target 15, and will increasingly be required by both voluntary and mandatory accountability mechanisms.

Why do this:

Increasingly, companies are expected to monitor their progress and be transparent on the steps taken to advance on their nature journey. When companies disclose this information systematically, for example according to the TNFD Framework, then investors and society are able to make informed decisions about the comparative sustainability performance of companies and sectors.

Investors will judge whether a company is creating additional enterprise value through its management of nature-related risks and opportunities. They will also consider the collective actions of companies to address systemic risks. Other stakeholders may focus on the total impact of a company or sector from the perspective of a social license to operate, including its alignment with societal goals for nature. Disclosures therefore provide an opportunity for a company to highlight its nature-related strategy, the progress made on its delivery and the value it creates.

What to do:

→ Monitor progress and be transparent about the nature journey, to meet increasing expectations from stakeholders.

→ Initial disclosures can include the methodologies and outputs of a company's materiality assessment, value chain mapping, interim target-setting and progress on actions. As a company's nature journey matures, disclosure ambitions and granularity will increase. The structure of the TNFD's reporting framework reflects this reality, providing both "core" and "enhanced" disclosures across the four disclosure framework pillars.

The foundational steps to "Disclose" include:

→ Leverage existing disclosures that are relevant to nature;

→ Report on the foundational "Assess" and "Commit and Transform" stages (methodologies and outputs).

→ ***For further lessons,*** see the PwC/WBCSD joint blog post "**Five things you should know about the TNFD**." For further guidance and use cases, see **WBCSD's TNFD pilot - Lessons from TNFD piloting with 23 global companies**.

Lessons from the WBCSD TNFD pilot

WBCSD ran a TNFD pilot for 23 member companies from September 2022 until June 2023, including six companies from the energy system.

WBCSD's TNFD pilot revealed that energy companies will most likely be able to initially report more information on operations than value chains. Furthermore, they will likely report impacts and risks in greater detail than dependencies and opportunities. The reason for both is that data and metrics are more readily available for operations, impacts and risks, given these have been a focus for the sector for some time.

The pilots also showed that, for the energy system, nature-related scenarios require more work before they can form part of nature-related disclosures. Nature-related scenarios sit within the strategy pillar of TNFD. As such, companies should consider different scenarios when determining strategy and resilience to nature-related risks and opportunities.

The work completed for TCFD scenarios by WBCSD and synergies with the approaches taken for climate change could be a helpful starting point for companies.

Typical areas companies identified where further work was needed to implement TNFD include:

- → Identification and management of dependencies and opportunities;
- → Testing of business strategy and resilience against scenarios;
- → Translation of risks and opportunities into business impact.

For more lessons, see the PwC/WBCSD joint blog post **"Five things you need to know about TNFD"**.

For further guidance and recommendations, see **WBCSD's TNFD pilot - Lessons from TNFD piloting with 23 global companies**.

In order to provide practical examples of how to apply the Roadmap steps described so far, WBCSD will release case studies in the fourth quarter of 2023. The aim is to translate the suggested methodology into real business-world examples, highlighting both positive takeaways and challenges encountered.

A use case by Iberdrola as part of its TNFD pilot is the first applied example, mainly highlighting TNFD recommendation alignment, structure and approach.

Summary of Iberdrola case study

Iberdrola undertook a first approach to the locate phase of the TNFD LEAP (locate, evaluate, assess, prepare) assessment process as follows:

To determine impacts:

1. It mapped the locations of facilities, assets and activities. This included projects under construction and operation.

2. It combined the above with datasets on:

   – Protected and internationally recognized areas (EU Natura 2000 sites, Key Biodiversity Areas and Ramsar wetlands);

   – Water stressed areas (WRI Aqueduct);

   – Red lists of threatened species (global, national and regional);

   – Site-specific data collected through field surveys, where available.

The results allowed for the identification of priority locations and the technologies located at them. By using a technology lens (e.g., onshore wind farms, power-lines and substations, nuclear power plants), Iberdrola was able to consider how business processes differ across locations and parts of its value chain, providing a fuller assessment.

To determine dependencies:

1. Iberdrola used the ENCORE tool to identify sector-level ecosystem services relevant to its activities.

2. It complemented this with data from the Common International Classification of Ecosystem Services (CICES) list of ecosystem services to gain more granular information on size and scale.

3. Next, it used the data to create a matrix of ecosystem services and dependencies for each of Iberdrola's technologies.

To quantify the impact of operations at the corporate level, Iberdrola used the Corporate Environmental Footprint (CEF) tool. This enabled the company to trace its impact pathways to the technologies and regions most responsible for impacts.

The outputs produced were:

→ A table showing how each asset interfaces with protected areas;

→ Maps for the main operating countries showing assets and their nature interface;

→ A list of the ecosystem services and dependencies the business relies on;

→ The main impacts associated with the business and their relative proportion by technology and region.

The outputs helped to scope and inform a risk and opportunity assessment at the global and organization levels, in consultation with local stakeholders. Having reviewed the risks and opportunities, the company considered whether any additional measures were required to deliver those in accordance with its nature strategy. Where additional measures were required, the company designed recovery and action plans to guide implementation and monitoring of nature actions.

A full copy of the Iberdrola case study can be found in **WBCSD's TNFD pilot - Lessons from TNFD piloting with 23 global companies**.

04. Next steps for the *Roadmaps to Nature Positive*

04. Next steps for the *Roadmaps to Nature Positive*

To support companies as they advance on their nature journeys, subsequent iterations of the Roadmaps to Nature Positive will build on the 2023 Foundations guidance, focusing on performance and accountability.

WBCSD will work with members to implement aligned measurement methods to support more detailed assessments.

The work will support WBCSD members in testing and using commonly agreed indicators for nature disclosures, both general and system-specific, with key pathways. Activities will include mapping core and enhanced **TNFD v1.0 indicators** against current member practices, and identifying and addressing gaps (including metrics for reporting on interim and science-based targets). This work will build on and connect to related indicator work within WBCSD, including **Regenerative Agriculture Metrics**, the **Wastewater Impact Assessment Tool (WIAT) Initiative**, and **Nature-based Solutions** and the **Circular Transition Indicators v4.0 (CTI)**. It will also build on the work of other related initiatives, including the **Align** project (recommendations for a standard on corporate biodiversity measurement and valuation) and the **Transparent project** (standardized natural capital accounting and valuation principles for business in line with the ambition of the **European Green Deal**).

In addition, other emerging work to support the Nature Positive Roadmaps includes:

- → Putting in place science-informed target-setting and supporting companies that are further along on their journey as they prepare to set science-based targets for nature;
- → Mobilizing resources needed for transformative actions;
- → Working with WBCSD's Equity Action imperative to clearly identify when and how to bring stakeholders effectively into corporate and landscape engagements (to be scoped);
- → Working with the WBCSD's Climate Action imperative to build on related work on actions to deliver resilient systems.

Annexes

Annex 1: Notes on methodology and next steps

Stage 1: Assess (materiality screening)

→ **Evaluate impacts and dependencies**

WBCSD used the ENCORE and SBTN Materiality Screening Tool (based on ENCORE for direct operations and EXIOBASE for upstream) to rate impacts and dependencies. WBCSD rated the impacts per impact driver, grouped by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) drivers of change, to align with TNFD's wording. WBCSD rated dependencies per ecosystem service (see **Roadmaps to Nature Positive: Foundations for all businesses** – Annex 1: Key definitions).

Each rating factors in the frequency, timeframe and severity of impacts. WBCSD reviewed the impact and dependency ratings with WBCSD members who are nature experts. When a member's opinions differed significantly from ENCORE's suggested rating, a grey cell was inserted and added notes to indicate why. Generally, where assessments conflicted, a conservative approach was taken to not underestimate a potentially severe impact as ratings are dependent on a company's activities.

WBCSD will enrich this step in the roadmap's further iterations and provide additional suggestions for companies on refinement and location-specific evaluation. A list of additional useful tools for assessing specific nature topics, where possible, in specific locations will also be provided.

→ **Assess risks and opportunities**

WBCSD developed Table 6 and Table 7 from the identified material nature-related impacts and dependencies (Table 2, Table 3, Table 4 and Table 5), using information provided by ENCORE, additional views provided by WBCSD's members, and desktop research. To support the reader in understanding how risks for companies fall under impact drivers, an impact driver has been assigned to each ecosystem service it provides functionality to, as shown in Table 15.

Additionally, a specific category is included for social risks, with the aim of helping companies to start considering joint assessment of nature, climate and social risks.

Finally, building on the identified risks, examples of opportunities in designing mitigation strategies are proposed.

WBCSD will enrich this joint approach, as well as the methodologies to translate nature-related risks and opportunities into financial metrics, in the roadmap's further iterations. The next guidance will go into more depth on different risk categories (e.g., demarcating physical risks as acute or chronic), providing companies with more clarity on the differences and implications of each. For companies already more mature in their nature action journey who want to go more granular, WBCSD suggests referencing the **TNFD's definitions**.

Table 15: Impact drivers and ecosystem services

Impact driver (Impacts - Risks for nature)	*Ecosystem service (Dependencies - Risks for companies)*
Terrestrial ecosystem use	Pollination, soil, groundwater, surface water, flood and storm protection, mass stabilization and erosion control, fibers and other materials
Freshwater ecosystem use	Surface water, water flow and quality, buffering, filtration, flood and storm protection, climate regulation
Marine ecosystem use	Groundwater, buffering, filtration
Water use	Groundwater, surface water, fibers and other materials
Other resource use	Fibers and other materials, genetic materials
GHG emissions	Climate regulation, pollination
Non-GHG air pollutants	Climate regulation, pollination
Water pollutants	Water quality, bio-remediation
Soil pollutants	Pollination, soil quality, bio-remediation, mass stabilization
Solid waste	Bio-remediation
Disturbances	Pollination, ventilation
Biological alterations/interferences	Bio-remediation, pest control, disease control

Stage 2: Commit and transform (targets for priority actions)

→ **Take priority actions and transform the system**

WBCSD identified physical priority actions starting from the assessed risks and proposed opportunities in Step 3 of the "Assess" stage. Supply chain and direct operations are divided into two tables to improve readability and support, giving priority to actions that companies can implement in their direct control sphere as opposed to supply chain actions, that may be more challenging.

Working with members, WBCSD identified actions for each impact driver by assessing risks applicable to multiple value chain stages in both Oil & Gas and Utilities sectors. Each action was then classified against the AR3T framework. To further clarify and support the understanding of where to implement the action in a company's business line, it is specified if an action is suggested for new operations or existing plants. This by no means limits or excludes the application of the same action to a wider extent.

Finally, as the aim of these actions is also to align with various global frameworks that companies may be familiar with or already align to, the "Global frameworks alignment" column lists alignment with the Sustainable Development Goals (SDGs), GBF and other international standards.

WBCSD will enrich the "Commit and Transform" stages in the Roadmap's future iterations, with a deeper look into collective transformative actions. Future iterations will also focus on key performance indicators (KPIs) to measure actions and impacts, and science-informed targets.

Endnotes

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Disclaimer

This publication has been developed in the name of WBCSD. Like other WBCSD publications, it is the result of collaborative efforts by representatives from member companies and external experts. A wide range of member companies reviewed drafts, thereby ensuring that the document broadly represents the perspective of WBCSD membership. Input and feedback from stakeholders listed above was incorporated in a balanced way. This does not mean, however, that every member company or stakeholder agrees with every word.

The report has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, legal or other professional advice.

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The World Business Council for Sustainable Development (WBCSD) is a global community of over 220 of the world's leading businesses, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Together, we transform the systems we work in to limit the impact of the climate crisis, restore nature and tackle inequality.

We accelerate value chain transformation across key sectors and reshape the financial system to reward sustainable leadership and action through a lower cost of capital. Through the exchange of best practices, improving performance, accessing education, forming partnerships, and shaping the policy agenda, we drive progress in businesses and sharpen the accountability of their performance.

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