



International Expert Workshop on Biodiversity Mainstreaming in the Sectors of Energy and Mining, Manufacturing and Processing and Infrastructure

Cairo, Egypt 20-22 June 2018

Background Document

This note provides background information for the upcoming workshop on mainstreaming of biodiversity in the sectors of energy and mining, infrastructure, manufacturing and processing. Additional information on these topics will be made available on the Convention on Biological Diversity website for the second meeting of the Subsidiary Body on Implementation¹ which will be discussing these topics, and will be circulated to participants.

I. Background

Biodiversity and ecosystems services are essential for human well-being, economic activities, and social priorities. Biodiversity underpins the provision of food, fibers, freshwater, and provides resilience to climate change and natural disasters. Yet biodiversity continues to decline in all regions of the world. Significant additional action is needed to achieve the objectives of the Convention on Biological Diversity, and to address the continuing loss of biodiversity.

In order to make the necessary shift, the importance of biodiversity needs to be understood and acted upon by relevant decision makers. Government policies and business practices need to adopt measures and approaches that recognize the value of biodiversity for economic and social prosperity. A central means to achieving this shift is to take actions to mainstream and integrate biodiversity in relevant economic sectors, as well as in cross-cutting national policies such as development plans and processes, budgets, and economic policies. These kinds of actions are often referred to as “biodiversity mainstreaming”, which is generally understood as ensuring that biodiversity, and the services it provides, are appropriately and adequately factored into the policies and practices that impact it.

There have been a wide variety of efforts undertaken under the Convention that have a mainstreaming component. These include: 1) as part of the elaboration of revised NBSAPs; 2) work to advance implementation of key cross-cutting Aichi Biodiversity Targets, including Target 1 on raising awareness, Target 2 on poverty and sustainable development and its Chennai Guidance, Target 3 on incentives, and Target 4 on sustainable consumption and production; and 3) work to advance implementation of sectoral policies, such as Target 7, on management of agriculture, aquaculture and forestry. Voluntary guidelines for biodiversity-inclusive environmental impact assessment were adopted at COP 8. At its thirteenth meeting, the Conference of the Parties adopted an extensive decision on mainstreaming, including actions for the sectors of agriculture, forests, fisheries and tourism; cross-sectoral policies; engagement in relevant international processes, and the role of key actors including the business sector.

¹ <https://www.cbd.int/meetings/SBI-02>

Despite the significant decisions and specific efforts, the extent to which actions are being taken to mainstream biodiversity at the national level appears to be lagging. There are likely several explanations for this. First, there continues to be a lack of understanding of the value of biodiversity for national economic and social interests, and thus, the failure to ensure that such value is considered in planning and decision making that could adversely impact biodiversity. Second, the value of biodiversity and ecosystem services is often not captured by markets, and as described by Sir Nicholas Stern with respect to climate change, damage to biodiversity can be seen as a result of market failure. Third, the value of biodiversity may flow to other beneficiaries than those whose actions could potentially harm it. And fourth, the political benefits of protecting biodiversity are likely to be less clear to political leaders than taking action on matters such as the economy and jobs.

At a more technical level, there is a lack of understanding of what actions for mainstreaming biodiversity are likely to have the largest impacts; while extensive actions and tools for mainstreaming of biodiversity have been identified under the Convention and by partners, there has not been an effort to set priorities for key actions. Indicators for actions aimed at mainstreaming biodiversity are generally lacking. In a forthcoming report, the OECD provides some approaches for possible indicators to monitor progress towards biodiversity mainstreaming. There also is a lack of information on obstacles and challenges to implementation.

The fourteenth meeting of the Conference of the Parties (COP 14), which will take place this November in Sharm el Sheik, Egypt will be considering action on the mainstreaming of biodiversity in the sectors of energy and mining, infrastructure, manufacturing and processing, as well as health. The host government of Egypt has also decided to focus the discussions of the ministerial part of the COP on these issues.

This workshop will provide an opportunity for informal discussions that will contribute to the consideration of the issues regarding mainstreaming in the sectors of energy and mining, infrastructure, and manufacturing and processing; separate discussions on health and biodiversity are taking place in other forums. The importance of mainstreaming biodiversity in these sectors cannot be overemphasized. The activities that arise from these sectors rely in direct or indirect ways on biodiversity and its ecosystem services, as well as generate significant impacts on biodiversity. Major growth is projected in all of these sectors, and all are key drivers in the 2030 Agenda for Sustainable Development.

COP 14 will also launch a process for developing a new global biodiversity framework, to be adopted at COP 15 in Beijing, China in 2020. The issue of mainstreaming biodiversity is certain to be of major significance to such new framework.

II. Overview: Mainstreaming in the sectors of Energy and Mining, Infrastructure, and Manufacturing and Processing

The energy and mining, infrastructure, and manufacturing and processing sectors comprise a wide variety of industries and activities. While they all depend, to varying degrees, on biodiversity and the ecosystem services that biodiversity underpins, all have potentially significant impacts on biodiversity. These three groups of sectors are closely interrelated. For example, new energy facilities make up a large part of projected future infrastructure. Materials and fuels may be extracted by mining, before being processed and used in manufacturing by other industries. Infrastructure requires materials and energy for its construction, and in turn, is needed for their distribution.

Most of these sectors are expected to grow significantly through 2050 and beyond, and are at the core of national economic development growth forecasts. Such growth could have significant implications for biodiversity. For example, at a global level, infrastructure development is cited as one of the major drivers of biodiversity loss. The fragmentation effect of large linear infrastructure projects (such as roads), noise, water, soil and air pollution, water extraction and indirect or induced impacts associated with opening up previously inaccessible areas to human activity (both legal, and illegal such as poaching) can result in loss of biodiversity and degradation of ecosystem services long after construction ends. Most of the new infrastructure over the next several decades will be built in or around cities, including large scale development of new cities in many regions of the world.

Given the potential impacts that the sectors of infrastructure, energy and mining and manufacturing and processing pose on biodiversity, and the dependencies (some indirect) of these and other sectors on biodiversity

and ecosystems services, the mainstreaming biodiversity considerations within these sectors is essential in ensuring the continued viability of these sectors, as well as stemming the loss of biodiversity that underpins these and other sectors, and sustainable development more broadly.

A short summary on each of the sectors is provided in the Annex.

III. Possible Actions for Mainstreaming

There are a range of opportunities and approaches for mainstreaming biodiversity in these sectors, involving a range of actors. These include actions that can be taken through international processes, at the national level, by the business sector, the financial and banking sectors, as well as by other actors to increase the mainstreaming of biodiversity in these sectors.

At the national level, actions for mainstreaming biodiversity may be usefully grouped in a number of categories, including the following: a) strategic national planning (economic, development, etc); b) policies, law and regulations; c) incentive measures; d) spatial planning across landscapes and seascapes; e) measures at the scale of the site or production plant; f) supply-chain measures.

Some of the most important areas for mainstreaming of biodiversity are summarized below:

International forums and processes

The 2030 Agenda for Sustainable Development is one of the most important global processes for the mainstreaming of biodiversity. It sets out an ambitious framework to address a range of global societal challenges and to promote policy coherence and foster integrated implementation across sectors and domains of society. The Conference of the Parties already recognized that the implementation of the 2030 Agenda for Sustainable Development provides a major opportunity for the mainstreaming of biodiversity and for the achievement of the Aichi Biodiversity Targets.

Implementation of the 2030 Agenda for Sustainable Development requires an integrated approach that achieves socio-economic goals while also achieving the goals and targets related to biodiversity. In addition to numerous goals and targets related to biodiversity and ecosystems, the Sustainable Development Goals include targets related to these sectors, aimed at ensuring that the economic aspects are balancing social and environmental considerations. For example, SDG 9, on infrastructure, makes a call in target 9.4 to upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and processes. SDG 11 target 11.3 calls for sustainable urbanization, and strengthening efforts to protect and safeguard the world's cultural and natural heritage. SDG 12 calls for the sustainable management and efficient use of natural resources.

The 10-year framework of programmes on sustainable consumption and production is another important global initiative, adopted at the UN Conference on Sustainable Development in 2012. Strengthening the focus on biodiversity within this programme would be beneficial for the achievement of the Convention. The New Urban Agenda includes numerous calls for urbanization that is consistent with safeguarding biodiversity and ecosystems. The Global Infrastructure Forum, which stemmed from the Addis Ababa Financing for Development and engages all of the multilateral development banks, amongst others, has taken up discussions on sustainable infrastructure. The Sendai Framework for Disaster Risk Reduction is also highly relevant for reducing the destruction of ecosystems that are essential for human settlements and all economic sectors. The United Nations Environment Programme has numerous programs that are also of direct relevance, including the work of the International Resource Panel. Finally, a number of other UN entities are engaged in efforts that have a bearing on these sectors, including UNIDO and UNCTAD, amongst others.

Global social and environmental safeguards

Over the past few years, the World Bank and the International Finance Corporation adopted updated environmental and social safeguards, which are likely to set the new global best practice standards. These have strengthened some aspects related to biodiversity and ecosystem services. Ensuring the widespread adoption of these standards, and their effective implementation, is a key opportunity for the mainstreaming of biodiversity in

these sectors, particularly for infrastructure, and energy and mining, due to the significant finance required. Methodologies have also improved for evaluating potential impacts on biodiversity and ecosystem services.

National Biodiversity Strategies and Action Plans

National Biodiversity Strategies and Action Plans (NBSAPs) are the main entry point for implementation of the Convention and the Strategic Plan for Biodiversity 2011-2020. However, very few include a specific focus related to these sectors. For example, a high level review of the revised National Biodiversity Strategies and Action Plans indicates that 16 have strategies or actions specifically linked to mining; 35 have strategies or actions explicitly related to energy; and 36 had strategies or actions that relate to environmental and social impact assessment / strategic environmental assessment. While few had strategies or actions specific to infrastructure, some examples exist.

National-level strategic planning

One of the most significant opportunities to mainstream biodiversity in the energy and mining, infrastructure, and manufacturing and processing sectors is at the level of strategic decision-making within national governments and subnational governments, as well as the policies and decisions of other governments and global and regional institutions that influence such decisions. One important element of Aichi Target 2, reflected in Sustainable Development Goal target 15.9, calls for the integration of biodiversity values in national and local development and poverty reduction strategies and planning processes. Another important tool, Strategic Environment Assessment (SEA), is now applied in some 90 countries either as a legal obligation or on a voluntary basis. The use of a strategic environmental assessment is key to ensuring that trade-offs and alternatives for investment pathways are considered in national and regional development and investment planning. SEA is an important tool for upstream planning, to consider whether investment in new facilities is actually needed, or if other approaches are available to achieve national goals.

National policies, laws and regulations

National-level regulations and policies are at the heart of the mainstreaming of biodiversity at the national level. These include sector-specific requirements, as well as cross-cutting measures and regulations.

Sector-specific requirements typically include direct regulation (command and control) where a standard, procedure or process is specified, such as hazardous waste, water pollution or air emissions regulations. Regulatory requirements are also common at the scale of the site of a facility.

Other measures include market-based instruments such as taxes / subsidies and trading schemes which help internalise negative environmental externalities (e.g. landfill taxes, greenhouse gas trading schemes), and the removal, phase out or reform of incentives, including subsidies, harmful to the environment, among others. Many countries have been modernising their public procurement laws, integrating sustainability into the decision-making process, which helps drive markets towards rewarding sustainable practices.

Policies may include incentives, such as those for using cleaner technology, supportive mechanisms for certain types of energy and mining activities or 'best available technology' requirements. Land use planning policies are crucial for avoiding impacts related to the location of facilities. No net loss or net gain policies that promote or require implementation of biodiversity strategies, based on the concepts of the mitigation hierarchy and biodiversity offsets, are increasingly being adopted, although there are differing views about the use of this approaches.

Legislation requiring an evaluation and mitigation of potential environmental impacts is among the most important for mainstreaming of biodiversity in these sectors. However, it also has its limitations, particularly in that such assessments are usually only required at the project level, after a decision has already been made to pursue a specific development. Legislation and policy relating to civil liability on human rights is also important, given the potential impact of these sectors on indigenous peoples and local communities.

The effective of all of these measures relies on how effectively they are implemented, and enforced. For instance, the effective use of environmental impact assessment depends on the both the use of effective methodologies, but also the availability of accurate data.

Spatial planning across landscapes and seascapes

The specific geographic location of mining operations, facility siting, and trajectories of linear infrastructure will strongly influence the resulting impacts on ecosystems and biodiversity, both in terms of the direct footprint of operations but also the induced impacts of associated developments. In order to avoid, or where this is not possible, minimize these impacts, land-use and marine spatial planning that integrate biodiversity values are key instruments that work across economic sectors to achieve the best possible outcomes for biodiversity and society. There are a growing number of tools available to support spatial planning (e.g. the Integrated Biodiversity Assessment Tool, and MapX). Spatial planning in both the terrestrial and marine realms can be extremely valuable for the integration of multiple sectors into a single space and avoiding conflicts with conservation and social considerations (often referred to as integrated land use and/or resources planning).

Urban planning and related measures

Urban planning increasingly recognizes the critical role of ecosystems and biodiversity for sustainable urban development, underpinning the provision of necessary water resources, food security, control of air pollution and temperature regulation, as well as for human health and enjoyment. The New Urban Agenda recognizes the key role of nature, biodiversity and ecosystems for sustainable cities and urban quality of life.

The nexus of biodiversity and cities was addressed in the Cities and Biodiversity Outlook whose 10 key messages include the need to integrate biodiversity and ecosystems into urban policy and planning, and the large potential of cities to generate innovation and governance tools for biodiversity and sustainable development.

Technology and innovation

Innovation and advances in technology can help reduce biodiversity impacts from these sectors. Advancements in efficiency, the increasing use of renewable energy, improved techniques in agricultural practices, techniques such as road-less development, amongst others contribute significantly to reducing the impacts of human economic activities on biodiversity and ecosystems. The development of Circular Economy approaches – including the safe and efficient recovery of mined materials (minerals and metals) from discarded technology such as mobile phones and the development of secondary markets for these materials – may slow the demand for primary production. Innovations in nature-based solutions also provide alternatives to engineered approaches. Various efforts are being undertaken globally to advance the development of innovative technologies that have fewer impacts on the environment, such as those being undertaken by UNIDO and the Global Environment Facility. Yet innovation and technology has been relatively absent from discussions under the Convention. It is important to assess the benefits and risks of technological advances for the mainstreaming of biodiversity.

Mainstreaming and Indigenous Peoples and Local Communities (IPLCs)

IPLCs are holders and owners of traditional knowledge, innovations and practices that have supported sustainable lifestyles over millennia. IPLCs as on-site, local ecosystem managers, with a knowledge of the local environment including its biodiversity, could be well placed to support efforts to mainstream biodiversity in these sectors.

While IPLCs are often marginalized and excluded, they can become victims of imposed developments (such as protected areas, mega-dams and extractive industries). However this is not always the case. Successful partnerships have been established between sectors such as mining and IPLCs where both parties contribute to a shared goal and benefit in different ways.

A fundamental principle of the Convention on Biological Diversity has been the effective participation of indigenous peoples and local communities (IPLCs) on all matters that affect them within its mandate. This is relevant for the mainstreaming efforts promoted under the Convention. In order to support Governments and IPLCs, the Conference of the Parties in its decision VII/16, endorsed the Akwé: Kon Voluntary Guidelines which provide guidance to Parties and Governments on the incorporation of cultural, environmental and social considerations of indigenous and local communities into new or existing impact-assessment procedures. They should be applied in conjunction with the guidelines for incorporating biodiversity-related issues into

environmental impact assessment legislation and/or process in strategic environmental assessment endorsed by the Conference of the Parties in decision VI/7 A and contained in the annex to that decision.

Supply-chain measures

In all of these sectors, perhaps particularly in the manufacturing sector, supply chain policies can be highly powerful means for addressing the potential biodiversity impacts from suppliers. These can be required through governmental laws and policies, and/or be adopted as voluntary measures by businesses. In the manufacturing sector, this often involves whole value chain approaches dealing with resource efficiency (e.g., reducing water use and energy consumption) and emissions reduction (e.g., minimising waste), from the retailer to the raw material producer.

Voluntary international sector specific standards

There are a number of efforts carried out at the industry level for reducing impacts by these sectors. There are good examples of work being done by large scale mining and energy companies to encourage the protection of biodiversity and ecosystem services (for example, guidance and tools developed by ICMM, IPIECA and CSBI), as well as through strengthened regulation and enforcement. These include guidance on environmental impact assessment developed by the global oil and gas industry association for environmental and social issues (IPIECA)).

The Roundtable on Sustainable Palm Oil, which manages a certification scheme to ensure the credibility of palm oil sustainability claims, has a membership of several hundred companies, including consumer goods manufacturers, processors and/or traders, retailers and producers. Industry associations such as International Council on Mining and Metals and IPIECA can help guide and inform the private sector's approach to biodiversity and ecosystem services. Accountability and transparency is one of the 10 Principles of the International Council on Mining and Metals, which has a membership of 25 mining and metals companies and over 30 mining associations. The Natural Resources Governance Institute's Charter provides a set of principles for how natural resources can be harnessed to support sustainable development, aimed at both governments and societies.

While these standards are often important in setting standards that may be more rigorous than those required at the national level, an important challenge is that they are not universally applied across the sectors. This can result in an "uneven playing field", where companies that follow less sound measures are rewarded due to their lower costs, and points to the need for globally-agreed (and enforced) best practices.

Corporate policies and measures

Individual companies or association of companies have embarked on formulating their own policies and measures to mitigate impacts on biodiversity. For example, there have been significant advancements in embedding biodiversity considerations in Environmental Management Systems (e.g., ISO 14001, EU Eco-Management and Audit Scheme - EMAS); typically with targets and key performance indicators for monitoring selected biodiversity attributes at the owned or leased sites of multinational companies. This can be correlated to a large extent with efforts made to improve the surface area and condition of habitats (as well as populations of threatened species) at the level of manufacturing plants. Moreover, various other sectoral initiatives have developed useful site level guidelines and best practices that could be adapted to various manufacturing sectors to improve biodiversity management of factory sites (e.g., the Cross-Sector Biodiversity Initiative, The Energy and Biodiversity Initiative).

Reporting by businesses on their actions related to biodiversity

Reporting by businesses on their actions related to biodiversity is another important measure that can help reduce impacts and provide incentives for positive approaches. In addition, research undertaken on these issues also points to the need to focus future work in this area on a number of strategic priorities related to factors that are pre-conditions for effective reporting, bearing in mind that disclosure and reporting is the last step of the process for identifying businesses impacts and dependencies on biodiversity. These include the need for strategic actions to improve the understanding among businesses on the role of biodiversity, and to develop and improve measure methodologies and metrics for biodiversity impacts and dependencies.

Financial sector

Biodiversity has been relatively invisible in most of the financial sector. This can be contrasted with climate change, the risks and opportunities around which have led to new and innovative financial approaches, including special funding mechanisms and insurance products. Efforts to better value biodiversity and ecosystems are key to further leveraging this sector.

Efforts to value biodiversity

A number of efforts are being undertaken to better identify the value of biodiversity. One example is the Natural Capital Protocol, developed and published in 2016 by the Natural Capital Coalition, which aims to provide a standardized, generic framework to support businesses in better identifying, measuring and assessing their impacts and dependencies on nature, with a view to improve pertinent decision-making. This will help companies to understand where biodiversity loss poses a “material risk” that could impact their bottom line, in a manner that is legible to companies. A Natural Capital Protocol Toolkit maps existing tools, methodologies and approaches for natural capital measurement against the Natural Capital Protocol framework. Additional sector guides and supplements have been launched, including for apparel as well as food and beverage. There are several projects under way which are aimed, inter alia, at further strengthening the role of biodiversity in the natural capital concept, with a “biodiversity supplement” to the Natural Capital Protocol as one possible concrete output of this work. A working group has currently been established with a view to undertaking work on the role of biodiversity in the natural capital concept.

Institutional mechanisms at the national level

One of the most important measures that can be taken by Parties to advance the mainstreaming of biodiversity is to establish effective institutional mechanisms that ensure the consideration of biodiversity in decisions that could impact it. Such mechanisms are also used for consultations with stakeholders, for development of scientific and technical data and approaches, and for other purposes.

Role of Communications for mainstreaming of biodiversity

A major obstacle to implementation of mainstreaming efforts is the fact that the value of biodiversity in general continues to be largely invisible to public and private decision makers. Biodiversity is currently not perceived by many public and private decision makers as relevant to them. There is also a lack of robust indicators for important aspects of the Strategic Plan for Biodiversity 2011-2020, in particular, some of the key mainstreaming targets such as Aichi Biodiversity Target 2, on integration of biodiversity into national and local development and poverty reduction strategies, planning processes, and national accounts. Effective communication to address this challenge can take form at different levels, from policy messages about the importance of biodiversity to poverty eradication and development, livelihoods, and health, to more technical data demonstrating the value of biodiversity.

ANNEX

Sectors Overview

Energy and Mining

Energy and mining encompass a range of activities and economic sectors involved in the exploration, extraction, processing and distribution of oil, gas, coal, materials such as sand and rock, minerals and metals; the generation, production, distribution and delivery of energy from fossil and non-fossil sources; and the disposal of waste products associated with the sector. The energy sector includes oil and gas; unconventional oil and gas; coal; geothermal energy; solar energy; wind power; hydropower; wave power, biofuels; and nuclear energy. The mining sector includes mining for minerals and metals; sand and aggregate quarrying; gemstones; seabed mining; and artisanal and small scale mining. Energy and mining also often involve a lot of associated infrastructure, such as pipelines and access routes.

With a rising population, an expanding global economy and a trend towards urbanization, the demand for materials and energy is increasing, particularly in countries outside the Organization for Economic Co-operation and Development (OECD). Mining plays a vital role in the economic development of many countries and can be an important contributor to employment and income generation, particularly in low-income countries.

Impacts within these sectors arise from the exploration and production of oil and gas, generation of renewable energy, and mining of coal, minerals and metals, as well as the transportation, processing and marketing of extracted materials. It is important to consider direct, indirect, induced and cumulative impacts on biodiversity and ecosystem services throughout the lifecycle of a project, including exploration, construction, operation, closure and post closure (legacy). The supply chain from mine to market and consumer, or well to wheel, should also be considered. Many mining and energy projects can have relatively long lifespans and impacts can occur over time periods that exceed the lifetime and geographical limits of a mine or energy project. Management of all waste products associated with the mining and energy sector is particularly important to avoid or minimize impacts on biodiversity and ecosystem services. Legacy waste issues related to closed projects remain a challenge.

Direct impacts on biodiversity from these sectors include habitat loss, damage and fragmentation, disturbance, displacement or mortality of species (including collision with wind turbines or powerlines), disruption of breeding and migration events for certain species, changes in water quality and flow, pollution of soil, air and water (including thermal pollution) and the introduction of invasive species.

Renewable energy generation also has biodiversity impacts, including significant habitat conversion, impacts associated with certain biofuels, impacts on migratory bird species from wind power as well as the supply chain impacts associated with solar technology and energy storage. Nuclear energy has large impacts in terms of mining and disposal of hazardous materials, with a number of documented catastrophes related to nuclear accidents.

Impacts can vary between the large-scale mining sector and artisanal and small scale mining. However, larger-scale mining tends to be better regulated than artisanal and small scale mining, which can lead to avoided or reduced impacts on biodiversity and ecosystem services. For example, the use of mercury in artisanal and small scale mining processes for gold is globally the largest single source of mercury pollution. This can lead to severe impacts on human health, biodiversity and ecosystem services such as water and food provision.

The physical footprint of energy and mining operations can be relatively small compared to some other sectors (such as agriculture or forestry, or urbanization). However, biodiversity impacts linked to the in-migration of people to an area as a result of energy and mining operations can be very significant, leading to further encroachment of natural habitats. It can also lead to increased exploitation of natural resources, including forests, wildlife and fish, to unsustainable levels.

These sectors also have a number of dependencies on biodiversity and ecosystem services, such as supply of water, as well as protection of infrastructure (e.g. roads, pipelines, dams, operational structures) from erosion effects, landslides, and natural disasters such as flooding and storm surges.

Infrastructure

Infrastructure is fundamental to human societies. Built infrastructure is central to economic growth and facilitates every aspect of modern life. It includes the transport infrastructure that moves people and goods across the globe, telecommunications, energy infrastructure that delivers power to homes and business, urban infrastructure, and the dams, water and wastewater treatment plants and water pipelines that manage water supplies for domestic, industrial and agricultural use.

Infrastructure is required for almost every transaction, including the transport of raw materials for, and products from, the manufacturing and processing sector, agriculture, forestry, energy and mining. The construction of infrastructure, and in some cases its operation and maintenance, relies on large quantities of materials (in particular construction minerals and timber) as well as water and energy. It is therefore important to consider biodiversity and ecosystem services throughout the entire supply chain and life-cycle of infrastructure projects.

There are many different types of infrastructure. These include: linear infrastructure (e.g. railways, roads and highways, pipelines, telecommunications cables and river and canal systems); energy infrastructure (e.g. energy distribution (also part of linear infrastructure), power plants, hydro-electric dams); urban/social infrastructure (residential buildings, non-residential buildings such as hospitals and schools, footpaths and cycleways, car parks and leisure infrastructure); transport infrastructure (including linear infrastructure such as roads and railways, plus airports, bus stops etc.); water infrastructure (waste water and water treatment plants and dams); and marine infrastructure (ports, sea defences, pipelines and platforms).

Increasingly, nature-based infrastructure, such as mangroves and forests, are being used to provide infrastructure services including water treatment or coastal protection. 'Green' infrastructure (whereby planted or other adapted systems are used to mimic natural processes) can be used for processes such as water purification or management. These approaches not only reduce the need for built (or 'grey') infrastructure but can also provide additional ecosystem services.

While estimates vary the major trend in the infrastructure sector is likely to be one of growth. One projection indicates that 25 million kilometres of new paved roads will be required by 2050, and 335,000 kilometres of rail track. Demand for both 'conventional' and 'smart' power grids are also likely to increase. With increasing urbanisation (particularly in Asia, Latin America and Africa), and growth in infrastructure-dependent sectors (for example energy and mining), there will also be increased demand for, and construction of, associated infrastructure. This includes urban infrastructure, pipelines, energy distribution infrastructure and access routes including road and rail links.

Infrastructure has both direct and indirect impacts on biodiversity and ecosystem services. The types, scale and duration of these impacts vary across infrastructure types and depend on the environment in which they occur, the biodiversity values and ecosystem service values present, the design and nature of the operation, and the impact mitigation measures adopted.

At a global level, infrastructure development is cited as one of the major drivers of biodiversity loss. The fragmentation effect of large linear infrastructure projects (such as roads), noise, water, soil and air pollution, water extraction and indirect or induced impacts associated with opening up previously inaccessible areas to human activity (both legal and illegal, such as poaching) can result in loss of biodiversity and degradation of ecosystem services long after construction ends.

The infrastructure sector also has dependencies on ecosystem services, including the provision of water for construction (e.g. water required for the preparation of mortar, cement or other materials), and protection from natural disasters. In the case of nature-based infrastructure, the role of ecosystems is central to their functioning.

Urban infrastructure

Most of the new infrastructure over the next several decades will be built in or around cities. As of 2014, 54 per cent of the world's population resided in urban areas. By 2050, this is expected to reach 66 per cent. By 2030, there are projected to be 41 cities with more than 10 million inhabitants. It has been estimated that, if

current trends continue, by 2030 urban land cover will be 1.2 million square kilometres, almost a threefold increase since 2000. The increasing rate of urbanization represents a number of challenges to biodiversity, including the growing demand for resources, such as water and energy. As a result of this growth, it has been estimated that up to 70 per cent future of infrastructure investment will be focused on urban locations. The next 15 to 20 years will see enormous growth of urban areas; it is projected that 50 to 60 per cent of the total urban area that will exist in 2030 will be built in the first three decades of the twenty-first century.

The growth of urban infrastructure will have a variety of effects on biodiversity but the main direct impact will be through habitat loss as cities grow to accommodate more people. Many expanding cities are located near biodiversity hotspots and other areas of high conservation value. There are currently 422 cities with more than 300,000 inhabitants in the world's conservation hotspots, of which 383 are evaluated as facing conflicts between urban growth and biodiversity. Further, between 2000 and 2030 the urban land area located in or near biodiversity hotspots is expected to increase fourfold. Most areas with exceptional and unique biodiversity already are at direct risk from urban expansion. At the same time, cities rely on biodiversity and healthy ecosystems for many basic services, such as supplying freshwater, improving air quality, regulating temperature, providing resilience against climate change and natural disasters. Thus, how the cities of the future evolve is highly relevant to biodiversity. If the projected urban expansion is not appropriately planned and managed, there is a risk of significant adverse impacts on biodiversity which, in turn, jeopardizes urban areas and has regional and global implications.

Manufacturing and Processing

Manufacturing is at the heart of our modern economies. Technological and organisational innovations have allowed the sector to diversify, and it now includes industries such as manufacture of food products; beverages; tobacco products; textiles; wood and products of wood and cork; paper and paper products; chemical products; pharmaceutical products; plastic products; fabricated metal products; computer, electronic and optical products; electrical equipment; machinery and equipment; motor vehicles,; furniture; among many others.

Manufacturing “includes the physical or chemical transformation of materials, substances, or components into new products”. This involves facilities (plants, factories or mills) that typically use power-driven machines and materials-handling equipment, small scale/artisanal transformation of materials or substances into new products, and businesses that sell directly to the general public their products made on the same premises from which they are sold (e.g., bakeries and custom tailors). The output of a manufacturing process may be finished, i.e. ready for utilization or consumption, or semi-finished, as an input for further manufacturing.

According to the World Bank, manufacturing accounted for approximately 15% of global Gross Domestic Product (GDP) in 2016. The growth of manufacturing industries in OECD countries lies in high-end technologies, which often directly relies on inputs of raw material from countries with major emerging national economies and developing economies. Manufacturing accounted for 23% of total employment worldwide in 2012, with projections for 2018 by the International Labour Organization (ILO) amounting to 24% of the global workforce.

The manufacturing sector relies directly and indirectly on various ecosystem services. Some industries rely primarily on renewable and non-renewable resources (provisioning ecosystem services), typically on raw material inputs into various manufacturing processes, and some regulating ecosystem services, such as water flow regulation and purification services. Some manufacturers rely on the supply of renewable, biological raw/transformed materials (e.g., fibres, foods) while others use genetic resources and associated traditional knowledge, including the pharmaceutical, agriculture, industrial biotechnology, cosmetics, botanicals, and food and beverage sectors' These dependencies on ecosystems can be diverse and complex, contingent to the type of raw material extracted or produced for manufacturing transformation by raw material extractors and producers.

The globalised nature of supply chains involved in the manufacturing of goods can create challenges in tracking which ecosystem services matter the most to specific manufacturers, especially when a company knows very little about the activities of its suppliers (e.g., material inputs purchased from wholesalers on global markets), and where dependencies on such services are indirect. Yet, dependencies on biodiversity and ecosystem services can become strategic business issues for many manufacturing industries.

Impacts on biodiversity vary across manufacturing industries, and are driven by the specifics of their production inputs (e.g., renewable and non-renewable resource use) and non-product outputs (e.g., air and water emissions, solid waste). Manufacturing companies generate both direct (e.g., factory location and its direct pollution) and indirect (e.g., through the supply chain) biodiversity impacts and dependencies, across globalised value chains from raw material extraction / production to manufactured goods consumption. Most manufacturing processes cause, to varying degrees, air, water and soil pollution, which all can have significant impacts on ecosystems and human health. Manufacturing is responsible for around 35% of global electricity use, over 20% of CO₂ emissions and up to 17% of air pollution-related health damage, with estimates of gross air pollution damage ranging from 1 to 5% of global GDP (UNEP 2011). Key indirect biodiversity impact drivers of manufacturing industries include habitat loss/degradation, overexploitation of biological resources, land conversion and deforestation, and remain a challenge in many countries.

In the foreseeable future, major risks for biodiversity linked to the activities and growth of manufacturing industries include: (a) the siting / design of factories as well as point-source pollution from manufacturing processes; (b) land use changes linked to the supply of various manufacturing inputs (e.g., foods, beverages, textiles, rubber); and (c) the over-harvesting of biological resources (e.g., fish, wood, natural and genetic materials). Biodiversity loss can occur over the whole value chains of manufactured goods, due to the activities of retailers, manufacturers and / or raw material producers. However, the most significant land use changes might occur at a specific step of the value chain, for instance at the level of raw material producers. Demand for land (leading to habitat destruction) may be correlated to the need for specific raw materials, as required by

manufacturers to produce goods in response to the needs of retailers, the ones in direct contact with consumers (e.g., expansion of palm oil plantations or agrofuel farms in response to rising global demands).