Industrial Development Board's input to the 2018 HLPF

Executive Summary

1. **Introduction:** Through the adoption of the Lima Declaration in December 2013, UNIDO's Member States underscored the role of industrialization for development and poverty reduction. The core of inclusive and sustainable industrial development (ISID) includes growth within an environmentally sustainable framework, decoupling industrial activities from negative environmental impacts and natural resource use. It also embraces the Agenda 2030 principle of "leave no one behind" by promoting equal opportunities and an equitable distribution of the benefits of industrialization to all countries, all peoples, and all parts of society. Against this backdrop, the achievement of the Sustainable Development Goals (SDGs) 7, 11, 12 and 17 are vital for the achievement of ISID which lies at the heart of SDG 9 – and vice versa. While much progress has been made in implementing the SDGs, efforts to promote inclusive industrial development, to provide clean and affordable energy for all, to reduce the environmental footprint of production and consumption, to foster clean technologies, and to develop solutions for sustainable and thriving cities still need to be intensified. Leaving no one behind is at the heart of the 2030 Agenda for Sustainable Development. The Agenda pledges that no one will be left behind and that the goals and targets are to be met "for all peoples and all segments of society" and that efforts will be made "to reach the furthest behind first".

2. **Assessment of the situation:** Global electrification has generally improved, mainly due to grid expansion, which accounts for 97 percent of new electricity connections since 2000, while fossil fuels still play an important role. Major investments are still required in order to achieve SDG 7 by 2030. In 2016, there were still 1.1 billion people globally without access to electricity, in particular in rural areas. Industry is an important stakeholder in achieving the targets of SDG 7. Energy consumption in the manufacturing sector grew at an average annual rate of 2.8 percent in 2000-2014 whilst its energy intensity decreased by an average annual rate of 1.3 percent in 1990-2014. Industries are also important drivers in the development of technical solutions and business models in the field of renewable energies and other clean technologies that support achieving SDG 7. Affordable, reliable and clean access to energy are important factors for manufacturing and production, particularly in rural areas, hence the importance of sharing the benefits of industrial development, ensuring that no one is left behind.

3. **Gaps and challenges, and ways to address**: In recent years significant improvements towards a more inclusive and sustainable industrial development have been achieved. For industrial development to meaningfully contribute to transformation towards sustainable and resilient societies, a number of challenges remain, particularly in the areas of innovative clean technologies and the robust integration of renewable energy sources into existing energy infrastructure on a global scale. These include the need: (i) to strengthen integrated energy approaches; (ii) to implement decentralized energy systems; (iii) to implement Energy Management System (EnMS); (iv) to facilitate effective and sustainable technology development, transfers and dissemination, and (v) to lower environmental impact. Options to address the gaps and challenges present for industrialization include the integration of renewable and smart energy systems into industrial policy. As major energy consumers, industries can act as change agents, particularly in the urban

settings. It would be useful to explore engagement with the private sector to scale up investments, devise a clear structure on how to enable decentralized electrification as well as recognizing the important role the public sector has in setting regulatory framework for private sector interventions. Knowledge sharing and capacity building are necessary and are key factors for the effectiveness and success of technology transfers towards sustainable energy systems. Finally, awareness raising, supported by well-designed policies will support the progress towards the state of sustainability.

4. **Valuable lessons learned:** Implementation of energy-efficiency policies in manufacturing increases competitiveness of manufactured products and economic productivity on the global market while reducing greenhouse gas emissions. For energy efficiency policies to be implemented successfully, key indicators for successful transformation towards sustainable and resilient societies using synergies of sustainable energy systems include (i) strong ownership, accompanied by appropriate enabling environment; (ii) establishing decentralized renewable business models; (iii) availability of appropriate co-financing and resources from partnerships; (iv) developing and implementing urban industrial policies and approaches, such as urban industrial symbiosis and cluster approaches to value chain and enterprise development; (v) effective means of technical assistance and technology transfer; (vi) awareness raising and coordination; (vii) Including gender perspectives in energy, and engaging youth for sustainable energy.

5. **Emerging issues:** As a result of the increment in the renewable energy targets set by countries, as well as the growth of renewable energy sources, it has become necessary to understand how energy systems with large shares of renewables and multiple energy producers could be managed in an efficient and secure manner. With the rapid growth of digital developments and trends, such as artificial intelligence, cyber-physical systems, big data, and block chain technologies – often referred to as "industry 4.0" in the industrial context, awareness is vital, given that it could have major implications for the development of sustainable societies. Governments therefore need to be agile in adopting policies fast enough to provide an enabling environment for innovation, as well as ensuring its citizens and country will be protected from potential adverse impacts. Another emerging issue is the development, diffusion and implementation of climate technologies to support the transition towards low-carbon societies worldwide. Climate change mitigation and adaptation require tailored technologies that fit economic and industrial development strategies. Urbanization and ISID is another key emerging issue. With 60 per cent of the places that will be urbanized by 2030 yet to be built, an opportunity exists for countries and cities to make choices about spatial pattern, urban form and investments that encourage the development of cities that are functional and competitive.

6. **Political Guidance by HLPF**: The HLPF may consider: (i) calling for enhanced international cooperation in achieving Goal 7; (ii) raising awareness on the need to increase international industrial cooperation on issues related to sustainable energy so as to accelerate progress towards Goal SDG 9, taking into consideration its effects on the other SDGs being reviewed, namely SDGs 6, 7, 11, 12, 15 and 17; (iii) identifying appropriate channels to encouraging member states to prioritize ISID; (iv) encouraging and advocating for stronger inclusive partnerships, particularly in an environment where developments in industry are changing the ways of doing business.

7. **Policy recommendations**: The IDB proposes the following policy recommendations to accelerate sustainable energy and ISID, towards establishing sustainable and resilient societies: (i) Policy settings in industrialized and developing countries alike need to be tailored towards

minimizing natural resource requirements, waste and emissions via industrial resource efficiency, sustainable cities and infrastructure; (ii) Policies to encourage innovative climate technologies for inclusive and sustainable industrialization, and how they could be realized should be further promoted towards achieving (Goals 7, 12 and 17); (iii) Countries should develop policies and infrastructure to allow them to exploit the benefits of digitalization for sustainable, low-carbon economic development; (iv) To foster integrated approaches to achieving SDGs 7 and 11, targeted policies and incentives should be developed to foster the integration and application of clean technologies; (v) Supporting inclusive and sustainable industrialization strategies that will achieve affordable and clean energy in developing countries would benefit from policies developed using a cross-sectoral approach; (vi) The development of integrated policies is necessary to connect urban and spatial planning with economic planning, ensuring that public contributions and investments capitalize on the opportunities urbanization and industrialization present for sustainable development.

Transformation towards sustainable and resilient societies: using synergies of sustainable energy systems and inclusive, sustainable industrial development that leaves no one behind

1. Introduction

1.1. Through the adoption of the Lima Declaration in December 2013, UNIDO's Member States underscored the role of industrialization for development and poverty reduction, which "can only be achieved through strong, inclusive, sustainable and resilient economic and industrial growth, and the effective integration of the economic, social and environmental dimensions of sustainable development."[1] The core of inclusive and sustainable industrial development (ISID) includes growth within an environmentally sustainable framework, decoupling industrial activities from negative environmental impacts and natural resource use. It also embraces the Agenda 2030 principle of "leave no one behind" by promoting equal opportunities and an equitable distribution of the benefits of industrialization to all countries, all peoples, and all parts of society. Against this backdrop, the achievement of the Sustainable Development Goals (SDGs) that are being reviewed at this year's HLPF, namely SDGs 6, 7, 11, 12, 15 and 17 are vital for the achievement of ISID which lies at the heart of SDG 9 – and vice versa.

1.2. Sustainable industrial development that promotes clean energy solutions and reduces the environmental footprint of both production and consumption contributes to the preservation of natural resources, such as water, soil and biodiversity, supporting the implementation of SDGs 6, 12 and 15. These supported by energy efficiency policies, technologies and practices together with access to affordable renewable energy for the facilitation of productive activities will provide countries with an opportunity to follow a low-carbon and low-emissions growth path, supporting implementation of SDG 7. These efforts have the propensity to enable smart industries and industrial clusters in urban industrial zones to achieve resource efficiency, and develop the required industrial competitiveness for local businesses in the global markets, thus supporting implementation of SDG 11.

1.3. Leaving no one behind is at the heart of the 2030 Agenda for Sustainable Development. The Agenda pledges that no one will be left behind and that the goals and targets are to be met "for all peoples and all segments of society" and that efforts will be made "to reach the furthest behind first".[2] Towards this end, the implementation of sustainable energy systems that support the progress towards and attainment of universal access to modern energy in addition to improved energy efficient would be important. Efforts to leave no one behind will have an impact on the objectives to build sustainable, secure and resilient[3] societies.

[1] For details on Lima Declaration, please visit:
https://isid.unido.org/files/Lima/UNIDO_GC15_Lima_Declaration.pdf

[2] United Nations System Chief Executive Board for Coordination (2017). Leaving No One Behind: Equality and Non-Discrimination at the Heart of the Sustainable Development: A Shared United Nations System Framework for Action.

[3] Representing the positive ability to manage potential negative consequences of risks.

2. Assessment of the situation

2.1. Global electrification has generally improved, mainly due to grid expansion, which accounts for 97 percent of new electricity connections since 2000, while fossil fuels still play an important role.[4] The contribution of renewable energies in providing energy access has been increasing and in particular in Sub-Sahara Africa, where 70 percent of new electricity access was provided through hydropower, geothermal and photovoltaics since 2012.[5]

2.2. However, the statistics also show that major investments are still required in order to achieve SDG 7 by 2030. In 2016, there were still 1.1 billion people globally without access to electricity, in particular in rural areas.[6] While decentralized renewable energy solutions currently play a minor role in providing electricity access, the declining costs of renewable energy technologies, such as wind turbines, biomass conversion technologies, photovoltaics and battery technologies[7] is likely to make them an attractive and affordable option for providing electricity in particular in remote rural areas where grid access is lacking.[8] With current policies and investments, this number is projected to decline to 674 million by 2030.[9]

2.3. Industry is an important stakeholder in achieving the targets of SDG 7. Energy consumption in the manufacturing sector grew at an average annual rate of 2.8 percent in 2000-2014 whilst its energy intensity[10] decreased by an average annual rate of 1.3 percent in 1990-2014[11].

2.4. Emission wise, energy-intensive sectors have made progress towards energy efficiency. In 2014, these industries, as reported in the IAE tracking clean energy progress, reached 24 percent of global Co_2 emissions.[12] In examining Co_2 emissions, and the use of materials in manufacturing, it is important to distinguish between production-and-consumption based emissions. In recognition of this, UNIDO provided a framework capturing the interactive nature of manufacturing consumption and industrial development in its Industrial Development Report 2017. For manufacturing goods, consumption-based emissions were found to be higher than production-based emissions.

2.5. In its Fifth Assessment Report, the IPCC projected emissions from industry to increase by 50 to 150 percent by 2050 (baseline scenarios), unless significant energy efficiency improvements were made (medium evidence, medium agreement).[13]

2.6. Industries are also important drivers in the development of technical solutions and business models in the field of renewable energies and other clean technologies that support achieving SDG 7. Affordable, reliable and clean access to energy are important factors for manufacturing and production, particularly in rural areas, hence the importance of sharing the benefits of industrial development, ensuring that no one is left behind.

[4] IEA (2017a): Energy Access Outlook 2017. From Poverty to Prosperity.
[5] Ibid.
[6] Ibid.
[7] List is non-exhaustive
[8] Ibid.
[9] Ibid.
[10] Energy intensity is defined as energy consumption per unit of manufacturing value added whereby less energy intensity means greater energy efficiency
[11] United Nations Industrial Development Organization, 2017. Industrial Development Report 2018. Demand for Manufacturing: Driving Inclusive and Sustainable Industrial Development. Vienna
[12] IEA (2017b): Tracking Clean Energy Progress 2017. Energy Technology Perspectives.
[13] IPCC (2014): Summary for Policymakers.

2.7. Over 50 percent of the world's population lives in cities and it is expected that this number will rise to more than two thirds by 2050, with 90 percent of urban growth expected to happen in Africa and Asia.[14] Urban areas account for approximately two thirds to three fourths of global energy use and contribute over 70 percent of the global CO_2 emissions.[15] Given these figures, there is a pressing need to transform urban transport and energy systems to reach the targets of SDG 11 (and SDG 13). By supporting the adoption of circular business practices and models[16], renewable energy, improving energy efficiency and increasing the use of low carbon transport, industry not only plays a key role in achieving SDG 7, but also in the transition to sustainable cities. The alignment of industrial and urban policies that ensure low-carbon urban industrialization, such as eco-industrial parks, should be a priority in the development of sustainable cities. Moreover, fostering productive use of renewable energies in rural and peri-urban areas could contribute to lifting populations in these areas from poverty and thereby contribute to decreasing migration pressure from rural areas to urban centers. While many initiatives have been launched (e.g. the International Council for Local Environmental Initiatives (ICLEI) or the Global Platform for Sustainable Cities (GPSC)), more innovative efforts should continue in order to reach the targets set by the UN Agenda 2030.

2.8. In order to achieve sustainable and resilient societies, transforming production and consumption patterns is vital. For industry, which is both a producer of goods and a consumer of energy and natural resources, this means addressing the three sustainability dimensions individually and synergistically by working toward the following three outcomes: a) heightened economic performance through improved productive use of resources, which include water, energy and material; b) environmental and climate protection by conserving resources and minimizing industry's impact on the natural environment; and c) social enhancement by providing jobs, protecting the wellbeing of workers and local communities and reducing health risks from industrial activities. Circular business practices and models in design, production, logistics, re-use of products and materials, and waste management are being adopted to help deployment of climate-friendly and innovative technologies and materials that will improve the wellbeing of societies. Organisations such as UNIDO have already moved towards a circular economy, and have been helping to advance circular economy models, in particular in developing countries.

3. Gaps and challenges, and ways to address

3.1. In recent years significant improvements towards a more inclusive and sustainable industrial development have been achieved. Exemplary achievements include a general rise of awareness for sustainable production and consumption, and the relative decoupling of global economic growth and energy consumption, mainly due to efficiency improvements[17]. However, overall energy and resource consumption is still rising, posing challenges to the achievement of ISID. For industrial development to meaningfully contribute to the transformation towards sustainable and resilient societies, a number of challenges and obstacles remain, particularly in the areas of innovative clean

[14] UN DESA (2015): World Urbanization Prospects: The 2014 Revision.
[15] IPCC (2014): Summary for Policymakers.
[16] Circular business practices and models is a concept that eliminate toxics from products and reduce material use by design (light-weighting); reduce energy, materials and water use in production; ensure easy reuse, repurposing and sharing; rapid and simple disassembly of end-of-life products for remanufacturing, materials extraction and recycling or regaining embedded energy so that nothing goes to waste.
[17] IEA (2017c): Energy Efficiency Indicators Highlights (2017 edition).

technologies and the robust integration of renewable energy sources into existing energy infrastructure on a global scale.

Gaps and Challenges

3.2. *Integrated energy approaches*. If industrial development is to be sustainable, the role of renewable energy in the industrial sector needs to be strengthened. . The integration of renewable energy into existing energy systems, and their development into integrated energy systems (also known as Smart Energy Systems) are central elements for a decarbonization of the energy sector. The term integrated energy approaches is an approach in which electricity, thermal and gas grids are combined with storage technologies and digitally coordinated to identify synergies between them enabling improved solutions for each individual sector and the overall energy system[18]. Technology to support integrated energy has yet to mature fully and is still being explored. However, it is anticipated that it will be increasingly applied and tested in industrialized countries, with the aim to further reduce their greenhouse gas emissions. Integrated energy solutions could also be promising for developing countries and emerging economies. The growing use of sustainable energy is necessary to reverse the present situation, albeit many countries still rely significantly on fossil fuels. Efforts should not be spared to make best available technologies aimed at greenhouse gas (GHG) emissions reduction as affordable as possible.

3.3. *Implementing decentralized energy systems*. Often off-grid or mini-grid systems[19] are regarded as the most promising approaches to enhance national grids and to bring electricity, in particular to remote, rural areas[20]. Such decentralized energy systems are also associated with the possibility to foster productive use of energy at the bottom of the pyramid. Specific challenges related to mini-grids include the capacity to develop the required feasibility studies[21], infrastructure, policy frameworks, regulatory environment and appropriate business models for mini-grids[22], the relatively high initial investments which may translate into higher tariffs; the need for tailoring to site-specific conditions; the need to minimize regulatory uncertainty, and ensure adequate maintenance.[23]

3.4. *Implementing Energy Management Systems (EnMS)*. The digitalization of manufacturing industries opens up new opportunities to monitor and evaluate energy management systems (EnMS) based on the increased availability of process-related data. Integrating these solutions into industrial environments could create more transparency for the actual ecological achievements of industry and be a fundamental step towards Goal 7 and 12. The integration of existing commercial solutions for environmental management into existing business processes is often quite complex. Major gaps that need to be addressed in order to increase the application of EnMS are the limited availability of competent professionals to guide and assist organizations in implementing EnMS and the lack of credible, local showcases that proof the feasibility and benefits of EnMS. Large market

[18] Lund, et al. (2017). Smart energy and smart energy systems. Energy (137), 556-565.
[19] Noting that mini-grids are not new applications to electrify remote communities, enable industry in isolated areas and back up the main grid in case of failure. However technological improvements and innovative business models are providing an opportunity for mini-grids to evolve. In the future, they will use increasingly more energy from renewable sources and will provide increasingly reliable power (IRENA, 2016).
[20] Africa Progress Panel (2017): Lights, Power, Action: Electrifying Africa.
[21] UNIDO is in an initial phase of developing a scoping study on digitized mini-grid and its potential role for rural electrification, and productive capacities in Africa.
[22] See http://www.euei-pdf.org/en/recp/mini-grid-policy-toolkit (accessed 5 April 2018)
[23] UNCTAD (2017): The Least Developed Countries Report 2017 (Overview), Transformational energy access.

opportunities exist if best practices and technologies to overcome these gaps are accelerated. Examples include establishing a sustainable mechanism to provide a response (i.e. training and skills development) to the existing lack of personnel qualified in implementing EnMS in line with ISO 5001, enriching the service industry of the local Industrial Energy Efficiency market and promoting certification programmes that enable the legal requirement for obligated organizations to deliver tangible benefits that improve energy/cost savings as well as enhanced overall performance[24].

3.5. *Facilitating effective and sustainable technology development, transfers and dissemination.* Climate technologies to mitigate[25] and adapt[26] to climate change help to lower emissions, increase resilience, and generally develop more sustainably. Technology development, transfer and dissemination of such climate technologies are important to help ensure that economic growth happens in a sustainably and inclusive manner. Therefore, technology development and transfer policies need to be localized and developed accordingly to domestic needs , so that developing countries will be better equipped to achieve their sustainable development goals (i.e. Goals 7, 11 and 12). However, expertise with regard to climate technologies in technology development, deployment, capacity building, finance, investment and policy are urgently needed in many regions[27] Effective and sustainable development, transfers and dissemination of climate technologies through global partnerships as well as home grown innovation can support in addressing these gaps. An illustration can be seen via the Climate Technology Centre and Network (CTCN). The CTCN, co-hosted by UN Environment and UNIDO, promotes the accelerated transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries.

3.6. *Lowering environmental impact.* Despite efficiency gains, production and consumption patterns in high-income countries lead to high and even rising per capita footprints for energy, water and other natural resources. Similarly, as industrialization gains momentum and living standards improve[28] in developing countries and emerging economies, their material footprint is also rising. The development and implementation of technologies, modes of consumption and production as well as increased material efficiency that lower the environmental impact of industry therefore requires urgent attention. Material efficiency is the ratio between the amount of material in the finished products and the amount of material used for their production. A higher material efficiency could be achieved by reducing the use of materials, such as by reducing the scrap, waste and the use of consumables or by optimizing the product design. A concept that promotes this idea is the circular economy, which calls for using resources more efficiently, thus providing large economic and environmental opportunities through materials saved, re-used or extending the lifecycle of a product. UNIDO is currently supporting efforts to develop resource efficient and cleaner manufacturing of products, in addition to developing safe, easy-to-recycle products with longer lifespan.

[24] UNIDO has experience in achieving organization-wide energy savings in first 1-2 years range from 4% to 15%, with little or no capital investments through EnMS.
[25] Climate technology to mitigate climate change includes renewable energies such as wind energy, solar power and hydropower
[26] Climate technology to adapt to the adverse effects of climate change include drought-resistant crops, early warning systems and sea walls
[27] CTCN (2017): 2017 Progress Report, Technology accelerating climate action on the ground.
[28] UNEP (2016): Global Material Flows and Resource Productivity. An Assessment Study of the UNEP IRP.

Addressing the Gaps and Challenges

3.7. *Integrating renewable and smart energy systems into industrial policy.* Emerging transition towards renewable and smart energy systems should not only be considered as a forward looking energy policy, but also as part of any industrial policy, and should be tackled in an integrated manner. Sustainable energy systems are not only an enabler, but also an important entry point for ISID. Industries are key actors and stakeholders in encouraging and implementing measures to foster a smart renewable energy transition "within" and "beyond" the fence. "Within" the fence, industries can contribute to implementing energy efficiency measures and environmental management schemes using digital technologies. By integrating smart energy management schemes, they can also actively participate in renewable energy transition "beyond" the fence and become network points in a smart renewable energy system. As major energy consumers, industries can also act as change agents in urban settings and together with municipalities discuss and develop potential pathways towards energy transition for smart sustainable cities.

3.8. *Engaging with the private sector.* To support the implementation of decentralized energy systems, particularly for developing countries, it would be useful to explore engagement with the private sector to scale up investments, devise a clear structure on how to enable decentralized electrification as well as recognizing the important role the public sector has in setting regulatory framework for private sector interventions[29].

3.9. *Knowledge sharing and capacity building*. Past experiences of technology transfer to developing countries show that explicit knowledge sharing was a key factor for the effectiveness and success of technology transfers.[30] They also highlighted the need (especially in developing countries) for greater emphasis on capacity development in energy-related projects; robust science, technology and innovation (STI) policy frameworks; and efforts to promote experience-sharing and mutual learning in energy-related research.[31]

3.10. *Awareness raising, supported by well-designed policies*. Awareness and knowledge regarding the economic and ecological potentials on the state of sustainable and consumption methods is insufficient in many developing countries and must be raised, especially through technology demonstrations in local contexts and knowledge transfer. This should be supported by well-designed national policies and regional initiatives. Since 1994, UNIDO and UN Environment have been working together to build local capacity in Resource Efficient and Cleaner Production (RECP) methodologies, in developing countries. Around the world, these national centres provide awareness raising workshops, training programmes and policy advice on cleaner production methods.

4. Valuable lessons learned

4.1. Implementation of energy-efficiency policies in manufacturing increases competitiveness of manufactured products and economic productivity on the global market while reducing greenhouse gas emissions. For energy efficiency policies to be implemented successfully, the following are the key indicators for successful transformation towards sustainable and resilient societies using synergies of sustainable energy systems:

[29] For an example of how this can be done, see UNIDO's "Promoting Renewable Energy Based Mini Grids'' project in Chad: https://open.unido.org/projects/TD/projects/100184
[30] Günsel, A. (2015): Research on Effectiveness of Technology Transfer from a Knowledge Based Perspective.
[31] UNCTAD (2017): The Least Developed Countries Report 2017 (Overview), Transformational energy access.

4.1.1. *Strong ownership, accompanied by the appropriate enabling environment*. It is vital for strong country ownership to prevail, accompanied by an enabling environment that promotes the required capacity building to ensure sustainability. Projects promoting industrial energy efficiency measures by implementing ISO-based energy management standards and system optimization approaches are currently performed in Thailand[32] and Moldova[33]. The project in Thailand benefitted from a strong engagement with the government counterpart, strengthening the sense of ownership, a large uptake of EnMS by industries, and sufficient train the trainer programmes for system optimization to ensure that these programmes can be sustainable on their own. In Moldova, having a good number of enterprises in the first phase of the project participating in train the trainers workshops resulted in the successful second phase of implementation, as the new trainers were able to replicate their expertise in the second phase. In that manner, both projects demonstrate the relevance of capacity building, strong partnerships and committed counterparts on the side of industry as well as governance in order to promote energy efficiency as one key element of ISID.

4.1.2. *Establishing decentralized renewable business models*. Taking into account the declining cost of producing and storing renewable energy, decentralized renewable business models are gaining attraction. Clear regulations, financial incentives for investors and the encouragement of new business models for mini-grid operators have been found to encourage the expansion of renewable mini-grids.[34] A project in Chad[35] established a renewable energy based mini-grid for productive uses in a rural context. Lessons learned from this project emphasize the importance of a clear communication to manage expectations and avoid misunderstandings, ensuring the availability of co-finance at the start of the project as well as the conclusion, that electricity alone will not develop productive activities if there is also a need for awareness raising and micro-finance to set up businesses. A similar project in Cote D'Ivoire[36] is making attempts to pick up these lessons learned by means of technology demonstrations and creation of awareness and technical capacities. In addition to this, knowledge transfer as well as the need for integrated approaches that consider both energy access and financing opportunities are also necessary to in order to make productive use of electricity.

4.1.3. *Availability of co-financing and resources from partnerships*. Cooperation with development partners, such as the Global Environment Facility (GEF) ensures appropriate co-financing and partnership to achieve targeted development goals. Examples of promoting clean technology innovations and entrepreneurship can be seen in Malaysia[37] and Morocco[38], where along with a large interest from start-ups have successfully implemented accelerator training and mentoring programmes. These activities ensure that entrepreneurs in developing countries are empowered to build their business models on state of the art RECP technologies, and circular practices which allow them to combine a reduction of the negative environmental impacts of their industrial activities and running a profitable business.

[32] See also UNIDO Open Data Platform: https://open.unido.org/projects/TH/projects/103071Thailand
[33] See also UNIDO Open Data Platform: https://open.unido.org/projects/MD/projects/103043
[34] UNIDO (2017): Accelerating clean energy through Industry 4.0: manufacturing the next revolution.
[35] See also UNIDO Open Data Platform: https://open.unido.org/projects/TD/projects/100184
[36] See also UNIDO Open Data Platform: https://open.unido.org/projects/CI/projects/100186
[37] See also UNIDO Open Data Platform: https://open.unido.org/projects/MY/projects/120096
[38] See also UNIDO Open Data Platform: https://open.unido.org/projects/MA/projects/160081

4.1.4. *Developing and implementing urban industrial policies and approaches*. Urban industrial policies and approaches, such as urban industrial symbiosis and cluster approaches to value chain and enterprise development, can create co-benefits between sectors, creating jobs while reducing the environmental impact of industries.[39] The concept of industrial symbiosis is attracting interest as a way to foster environmental benefits at a large scale. In this concept, companies use each other's waste streams as alternative inputs, an example of which can be seen in eco-industrial parks. Nevertheless, an analysis of eco-industrial parks indicated that 80 percent are in industry-oriented zones, with only 3 percent in urban areas. In terms of how eco-industrial parks are created, most result from retrofitting existing parks (59 percent), followed by planned development of eco-industrial parks (34 percent)[40]. Therefore identifying mutual profitable links of "synergies", between eco-industrial parks in the urban setting can tap into under-utilized and under-valued resources materials, energy, water, logistics, assets and expert knowledge).

4.1.5. *Effective means of technical assistance and technology transfer*. It is important to develop systems for knowledge transfer between pilot cities and developing countries through providing technical assistance services that include knowledge sharing, capacity building and training, which facilitates transformation towards local sustainable solutions. Best practices and lessons learned could be tapped from the on-going Sustainable Cities Integrated Approach Pilot (SC IAP) projects in Malaysia, Cote D'Ivoire, Senegal and India, which are funded by UNIDO and the Global Environment Fund (GEF). These projects, covering a range of areas including the adoption of renewable and smart grid technologies, urban e-mobility, industrial parks and waste management will provide useful insights.

4.1.6. *Awareness raising and coordination*. Countries of various levels of industrialization have different capacities to adapt to climate change, economic shockwaves and rapid urbanization. For example, developing countries, especially LDCs are highly vulnerable due to their physical terrain, infrastructure and lack of appropriate technologies to absorb and recover from a wide array of system abnormalities. Therefore, collaboration between countries and the business sector is important to effectively promote and coordinate Resource Efficient and Cleaner Production (RECP) practices and frameworks at the local level. The Global Network for RECP (RECPnet) is an asset towards the realization of the SDGs as they are the entities that have the mandate to provide technical support and advisory service to SMEs, the economic drivers in many countries.

4.1.7. *Implementing gender mainstreaming in energy*. Equal and equitable access to and control over sustainable energy services for women and men is an essential right to development.[41] It is necessary to recognize the role of women in the energy sector to ensure that services are gender sensitive, and that they are provided with opportunities, in business and entrepreneurial activities such as the delivery of reliable energy services based on renewable energy technology[42]. In energy efficiency related initiatives, it is important to ensure that gender relations are understood. The development of energy-efficient industrial technologies should be complimented by a thorough understanding of gender relations and an awareness of the different roles, experiences and opportunities men and women currently have in this field.

[39] Kechichian, Etienne; Jeong, Mi Hoon. 2016. Mainstreaming Eco-Industrial Parks. World Bank, Washington, DC.
[40] Ibid.
[41] See http://www.energia.org
[42] See UNIDO (2014): The Guide on Gender Mainstreaming UNIDO's Energy and Climate Change Portfolio

4.1.8. *Engaging youth for sustainable energy.* Youth are also seen as integral driver to achieve SDG 7, and the overall 2030 Agenda, particularly considering today's reality where the world's population is young, 42 per cent under the age of 25[43]. Actions and initiatives led by young women and men can trigger the necessary momentum for local innovation and development. In particular, businesses, including youth-led social enterprises, youth activists, scientists, practitioners and good practices play a key role in light of these endeavors, especially as these increasingly cover a wide range of industries and services. They are important in developing breakthrough technologies, particularly clean technologies, and providing innovative solutions to support mitigation and adaptation efforts. Furthermore, data generated by youth-led activities and initiatives can greatly contribute to measuring the social impact and can consequently contribute to further research and innovation to ensure sustainable energy for resilient communities.

5. Emerging Issues

5.1. The transition from fossil-fuel-oriented energy systems towards renewable-energy-oriented energy systems has gained great momentum over the past decade. In 2005, 43 countries had set renewable energy targets[44], a decade later this number has risen to 164.[45] Since 1990, renewable energy sources grew at an average annual rate of 2.0 percent, with particularly high growth rates in solar photovoltaics and wind energy.[46] Against the backdrop of this development, it has become necessary to understand how energy systems with large shares of renewables and renewable energy producers could be managed in an efficient and secure manner. The notion of smart, decentralized energy systems has gained great momentum and is one of the major emerging issues for exploiting the synergies between sustainable energy systems and ISID. Modern ICTs and digital technologies allowing the flexible management of a network of large and small renewable energy producers could be an important enabler for the transition towards smart renewable energy systems. For example, blockchain technologies could make trade of micro-quantities of electricity between a multitude of actors possible, allow to efficiently manage smart renewable energy systems and lead to the development of new business models in the energy sector.

5.2. However, besides technological challenges, there are also unresolved questions on how infrastructure, energy policies and regulations need to be designed to allow a smooth transition towards smart renewable energy systems. Furthermore, data security and resilience of such digital energy systems are areas of concern. The transition towards smart renewable energy systems is a rather complex endeavor that can best be realized through a multitude of different possible pathways that need to be adequately designed to match countries' existing infrastructure, energy security needs and technological preferences. This also includes considering the potential of less-carbon intensive fossil fuels, in particular gas, for the transformation towards climate-friendly energy systems.

5.3. Awareness of digital developments and trends, such as artificial intelligence, cyber-physical systems, big data, and blockchain technologies – often referred to as "industry 4.0" in the industrial context is vital, given that it could have major implications for the development of sustainable societies. Digital technologies could for example enhance the energy and resource-efficiency of

[43] World Bank (2017). Atlas of Sustainable Development Goals, 2017 – How is the World's Youth Population Changing? http://blogs.worldbank.org/opendata/voices/chart-how-worlds-youth-population-changing
[44] IRENA (2015): Renewable Energy Target Setting.
[45] Ibid.
[46] IEA (2017d): Renewables Information: Overview.

production and foster the enforcement of high environmental standards in manufacturing and make their application transparent. They could also enable the development of new business models and services that provide new sources of employment and income. Therefore, proactive assessments and comprehensive studies associated with digitalization needs to be undertaken to undertake and address challenges, such as disruptive technologies, rebound effects, loss of employment across all levels of skills, rapid and fundamental change of existing industries, emergence of marginalized digital labor (such as e.g. digital "sweatshops", micro tasks and employments that offer low payment and low security and rights for workers, etc.), and the disruption of existing value chains through delocalization. Against the backdrop of both opportunities and challenges, shaping the development of digital economies and industry 4.0 vis-a-vis ISID will be an important emerging field for policy-making. The vast and increasing speed of technology developments is likely to lead to a first-mover advantage for pioneering countries or companies. Governments therefore need to be agile in adopting policies fast enough to provide an enabling environment for innovation, as well as ensuring its citizens and country will be protected from potential adverse impacts.

5.4. Another emerging issue is the development, diffusion and implementation of climate technologies to support the transition towards low-carbon societies worldwide. Climate change mitigation and adaptation require tailored technologies that fit economic and industrial development strategies. Industry plays a central role in developing, manufacturing and implementing such technologies. Manufacturers and producers are well aware of local contexts, challenges and opportunities, so they can provide relevant expertise and are valuable partners, as are cities and communities, in activities targeting climate technology. Furthermore, climate and clean technologies are an industrial sector itself that has a high innovative power, high potential to create employment and offers many opportunities to positively affect adjacent industries. Developing suitable policies, regulative frameworks and funding schemes to spur innovation, development and implementation of climate technologies and to foster partnerships with industries, financing institutions, and other local stakeholders should therefore be seen as an investment into sustainable futures, that along with climate change mitigation and adaptation provide a multitude of co-benefits. In order to spur the development, diffusion and implementation of technologies for sustainable, low-carbon industries, several initiatives have been launched in the past years, such as the Global Cleantech Innovation Programme, a joint activity of UNIDO with the Global Environmental Facility (GEF), and the Climate Technology Center and Network, the operational arm of the UNFCCC Technology Mechanism, co-hosted by the UN Environment in coordination with UNIDO. These programmes aim to address the need for suitable support measures to spur innovation in, diffusion and implementation of as well as investments for clean and climate-friendly technologies by taking the national respectively local context into particular consideration.

5.5. Finally, urbanization and ISID is another key emerging issue. With 60 per cent of the places that will be urbanized by 2030 yet to be built, an opportunity exists for countries and cities to make choices about spatial pattern, urban form and investments that encourage the development of cities that are functional and competitive.[47] A recent report from the UNECA highlights the importance of connecting national, urban and industrial development policy through national planning

[47] Seto et al. (2012): Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools.

frameworks, noting national development plans in Africa often lack spatial consideration and urban plans often omit economic aspects.[48]

6. Areas where political guidance by the HLPF is required

Taking into consideration various issues, gaps and challenges, the HLPF may consider:

6.1. Calling for **enhanced international cooperation** in achieving Goal 7 to be performed within the scope of existing international agreements. Sustainable energy systems play a central role in the achievement of ISID and the SDGs alike. Towards this end, the HLPF may want to consider further encourage the involvement of industries in national and sub-national dialogue processes on identifying and developing suitable pathways for sustainable energy transitions.

6.2. **Raising awareness** on the need to increase international industrial cooperation on issues related to sustainable energy so as to accelerate progress towards Goal SDG 9, taking into consideration its effects on the other SDGs being reviewed, namely SDGs 6, 7, 11, 12, 15 and 17. Whilst energy and resource efficiency have been accelerating at a fast pace, its implementation and delivery have yet to meet its full potential and is still insufficient to achieve the Agenda 2030. As indicated earlier, it is crucial to close this gap through the creation of enabling environments, policy design and knowledge exchange through multi-stakeholder partnerships.

6.3. **Appropriate channels for encouraging member states to prioritize ISID** as a necessary aspect in future sustainable urban development strategies and planning. Industry is both an actor as well as a stakeholder in the development of sustainable cities. However, the connection between ISID and sustainable cities is not yet fully recognized and the potential synergies between sustainable industrial and urban development not yet fully explored. The development and dissemination of best practices would be useful to showcase and encourage the development of sustainable and viable solutions.

6.4. **Encouraging and advocating for stronger inclusive partnerships**, particularly in an environment where developments in industry are changing the ways of doing business. Achieving the 2030 Agenda requires the pooling of resources and expertise of various actors. An innovative business model to facilitate partnerships is required, to support the promotion of sustainable use of energy through increased resource-use efficiency, the adoption of clean and environmentally sound technologies.

7. Policy recommendations

7.1. Policy settings in industrialized and developing countries alike need to be tailored towards **minimizing natural resource requirements, waste and emissions** via industrial resource efficiency, sustainable cities and infrastructure. There is also a window of opportunity to support investment in high-quality and sustainable infrastructure to promote sustainable development.[49] A close collaboration of industry, science and politics should be fostered towards an innovative energy transition for a more sustainable industrial development that also recognizes energy security needs. This cooperation should entail: public support for research and development, facilitating the business sector's capability to develop new technologies, and creating incentives for private actors to robustly adopt innovative technologies to local requirements.

[48] UNECA (2017). Urbanization and Industrialization: For Africa's Transformation.
[49] UNEP (2016): Global Material Flows and Resource Productivity. An Assessment Study of the UNEP IRP.

7.2. Policies to encourage **innovative climate technologies** for inclusive and sustainable industrialization, and how they could be realized should be further promoted towards achieving (Goals 7, 12 and 17). Innovation and development in environment-and climate-friendly technologies should be fostered by public policy, and financing especially focusing on the development of local solutions for local challenges in particular in developing countries. Multi-stakeholder forums that incorporate views from international organizations, governments, the business sector and academia, to discuss the latest challenges and opportunities in the energy sphere, is able to offer insightful and innovative policy solutions to promote innovative climate technologies. The biennial Vienna Energy Forum[50] provides a platform for the exchange of knowledge and experiences to address the challenges of sustainable energy.

7.3. Countries should develop policies and infrastructure to allow them to exploit the **benefits of digitalization for sustainable, low-carbon economic development.** However, to keep up with the pace and speed of technological developments, and to minimize adverse social and environmental impacts, these policies need to be well designed and agile enough to react to and manage newly emerging trends and technologies in a way that leaves no one behind. Developing and least developed countries in particular should take advantage of the opportunities offered by ICT and Industry 4.0 technologies to achieve their development priorities. Their access to these technologies could be facilitated through policies at the national, regional and global levels that would help narrow global inequalities.

7.4. To foster integrated approaches to achieving SDGs 7 and 11, targeted policies and incentives should be developed to **foster the integration and application of clean technologies** (e. g. by supporting local innovation hubs and entrepreneurship for clean technologies). Sustainable cities also need strategies supporting the retrofit of existing industries and implementation of innovative digital technologies in order to reduce their ecological footprint. Funding options could be introduced to enable investment for low-carbon infrastructure and the deployment of leap-frogging technologies. Therefore, Goal 17, which necessitates partnerships between governments, the private sector and civil society, is vital to support the integration and application of clean technologies.

7.5. Supporting inclusive and sustainable industrialization strategies that will achieve affordable and clean energy in developing countries would benefit from policies developed using a **cross-sectoral approach**. This cross-sectoral approach could be done in cooperation with other entities in the United Nations system to eliminate possible silo approaches to problems which are to be solved[51]. It is necessary to cooperate with many different entities and assist Member States in achieving their development goals. Partners include, inter alia, governments, development and multilateral organizations, United Nations sister agencies, financial institutions (e.g. the World

[50] The Vienna Energy Forum is a biennial event with its first edition beginning in 2009, designed to discuss real and practical solutions for moving forward towards the world's sustainable energy future. The Federal Ministry for Europe, Integration and Foreign Affairs (BMEIA), Austrian Development Agency (ADA), the International Institute for Applied Systems Analysis (IIASA) and Sustainable Energy for All (SEforALL) have successfully cooperated with UNIDO in organizing the Vienna Energy Forum for the past five editions.

[51] UN initiatives in the energy and climate change sphere are collective efforts by the UN system through its member organizations to address issues in this area. Examples include UN-Energy, a UN mechanism for inter-agency collaboration in the field of energy aimed at promoting system-wide collaboration in the area of energy and the United Nations System Strategic Approach on Climate Change Action that aims to improve collaboration and the delivery of support on climate change to achieve the 2030 Agenda for Sustainable Development.

Bank, the International Finance Corporation), global environmental financing mechanisms (e.g. Global Environment Facility), the business sector, civil society and academia. In line with the targets set by Goal 17, such partnerships should aim at enhancing coordination and policy coherence, while respecting each country's socio-economic development policies.

7.6. The development of **integrated policies** is necessary to **connect urban and spatial planning with economic planning**, ensuring that public contributions and investments capitalize on the opportunities urbanization and industrialization present for sustainable development. National coordination of urban and industrial policies enables cities to develop industries based on their own comparative advantages, in terms of their access to labour, markets, inputs and knowledge. By doing so, countries will be able to create a system of cities that are balanced in their development. Government support and investment in industrial subsectors should be spatially targeted. This includes evaluating the benefits and costs of the placement of industries within different cities. It should also be matched accordingly to priority infrastructure investments within selected urban regions[52].

[52] UNECA (2017). Urbanization and Industrialization: For Africa's Transformation.

References

Africa Progress Panel (2017): Lights, Power, Action: Electrifying Africa. Available at: http://www.africaprogresspanel.org/policy-papers/lights-power-action-electrifying-africa/ (last checked on: 26 February 2018).

CTCN (2017): 2017 Progress Report, Technology accelerating climate action on the ground. Available at: https://www.ctc-n.org/file/19725/download?token=Di4zx0QR (last checked on: 26 February 2018).

Günsel, A. (2015): Research on Effectiveness of Technology Transfer from a Knowledge Based Perspective. Procedia - Social and Behavioral Sciences, 207, 777–785, doi:10.1016/j.sbspro.2015.10.165.

IEA (2017a): Energy Access Outlook 2017. From Poverty to Prosperity. Availabe at: http://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf (last checked on: 26 February 2018).

IEA (2017b): Tracking Clean Energy Progress 2017. Energy Technology Perspectives 2017 Excerpt. Informing Technology Sector Transformations. Available at: https://www.iea.org/publications/freepublications/publication/TrackingCleanEnergyProgress2017.pdf (last checked on: 26 February 2018).

IEA (2017c): Energy Efficiency Indicators Highlights (2017 edition). Available at: https://www.iea.org/publications/freepublications/publication/energy-efficiency-indicators-highlights-2017.html (last checked on: 26 February 2018).

IEA (2017d): Renewables Information: Overview. Available at: https://www.iea.org/publications/freepublications/publication/RenewablesInformation2017Overview.pdf (last checked on: 26 February 2018).

ILO (2016): Women at work. Trends 2016. Available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_457317.pdf (last checked on: 26 February 2018).

IPCC (2014): Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf (last checked on: 26 February 2018).

IRENA (2015): Renewable Energy Target Setting. Available at: http://www.irena.org/documentdownloads/publications/irena_re_target_setting_2015.pdf (last checked on: 26 February 2018).

IRENA (2016). Innovation Outlook: Renewable Mini-grids. International Renewable Energy Agency, Abu Dhabi.

SE4All & Power for All (2017): Why wait? Seizing the energy access dividend. Available at: http://www.se4all.org/sites/default/files/Why_Wait-Full.pdf (last checked on: 26 February 2018).

Kechichian, E.; M. Jeong. (2016). Mainstreaming eco-industrial parks. World Bank Group, Washington D.C.

Lund, H., Østergaard, P.A., Conolly, D., Mathisen, B.V. (2017) Smart energy and smart energy systems. Energy, 137, 556-565.

Seto, K. C.; Güneralp, B.; Hutyra, L. R. (2012): Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. Proceedings of the National Academy of Sciences 109, no. 40: 16083-16088.

UNCTAD (2017): The Least Developed Countries Report 2017 (Overview), Transformational energy access. Available at: unctad.org/en/PublicationsLibrary/ldcr2017_en.pdf (last checked on: 26 February 2018).

UN DESA (2015): World Urbanization Prospects: The 2014 Revision. Available at: https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Report.pdf (last checked on: 26 February 2018).

UNECA (2017). Urbanization and Industrialization: For Africa's Transformation. Available at: https://www.uneca.org/sites/default/files/uploaded-documents/ERA/ERA2017/era-2017_en_fin_jun2017.pdf (last checked on: 26 February 2018).

UNEP (2016). Global Material Flows and Resource Productivity. An Assessment Study of the UNEP International Resource Panel. H. Schandl, M. Fischer-Kowalski, J. West, S. Giljum, M. Dittrich, N. Eisenmenger, A. Geschke, M. Lieber, H. P. Wieland, A. Schaffartzik, F. Krausmann, S. Gierlinger, K. Hosking, M. Lenzen, H. Tanikawa, A. Miatto, and T. Fishman. Paris, United Nations Environment Programme.

UNIDO (2014). Guide on Gender Mainstreaming: Energy and Climate Change Projects. Available at https://www.unido.org/sites/default/files/2015-01/Guide_on_Gender_Mainstreaming_ECC_0.pdf (last checked on 22 March 2018)

UNIDO (2016). Global Assessment of Eco-Industrial Parks in Developing and Emerging Countries: Achievements, Good Practices and Lessons Learned from Thirty-three Industrial Parks in Twelve Selected Emerging and Development Countries. Available at https://www.unido.org/sites/default/files/2017-02/2016_Unido_Global_Assessment_of_Eco-Industrial_Parks_in_Developing_Countries-Global_RECP_programme_0.pdf (last checked on 22 March 2018)

UNIDO (2017). Accelerating clean energy through Industry 4.0: manufacturing the next revolution. Available at: https://www.unido.org/sites/default/files/2017-08/REPORT_Accelerating_clean_energy_through_Industry_4.0.Final_0.pdf (last checked on: 26 February 2018).

United Nations Industrial Development Organization (2017), Industrial Development Report 2018. Demand for Manufacturing: Driving Inclusive and Sustainable Industrial Development. Vienna.