

FINANCING SUSTAINABLE, RESILIENT AND INCLUSIVE SOLUTIONS TO ATTAIN SDGs 6, 7 AND 11

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EXECUTIVE SUMMARY

This background paper considers the means of delivery and intersection between cross cutting themes of finance, resilience and science, technology and innovation (STI) with the Sustainable Development Goals (SDG) 6 (clean water and sanitation for all), 7 (affordable and clean energy for all) and 11 (sustainable, inclusive and resilient cities and human settlements). These goals are notable because they have been included in the in-depth review at the High Level Conference for Financing and Development and the Means of Implementation of the 2030 Agenda in November 2017 as well as the 2018 Financing for Development (FfD) Forum and July 2018 High Level Political Forum (HLPF) under the theme “transformation towards sustainable and resilient societies”.

Funding for STI must be more effective, diversified, scaled up and aligned with the SDGs. This requires increasing the participation of the private sector through regulatory reform and building both capacity and partnerships with the private and public sectors but also with other stakeholders. In particular, enabling access to finance and funding by subnational governments and utility companies offers huge potential for transformational change. Public efforts have an irreplaceable role to play in supporting research and development (R&D), helping to manage risk as a part of blended finance and with Overseas Development Assistance (ODA) targeted to help those furthest behind (e.g. lacking access to basic energy, urban opportunities and water services).

There are also important opportunities to make significant progress which can be implemented without recourse to increased funding, but within short timescales. Implementing proven regulation to drive efficiency in buildings, transport and industry can save money and increase GDP. Removing pricing distortions by phasing out of inefficient subsidies and adopting carbon pricing can also help to reach SDG targets whilst also simultaneously making extra revenue available. Devolving decision making and budget authority can enable better and faster investments.

STI roadmaps have an important role to play by setting a clear direction and identify national priorities (e.g. for developing countries this could target leapfrogging through technology transfer) to achieve the SDGs. This in turn can help support coherence in policy and decision making across all related institutions and stakeholders. Crucially, this can also encourage private sector investment by building confidence in a stable regulatory, financial and policy environment. Fundamentally, this must be driven by strong political will.

A number of detailed recommendations are presented throughout and at the end of this paper needed to advance the financing of sustainable, resilient and solutions needed to attain SDG 6, 7 and 11.

INTRODUCTION

On 1 January 2016, the 17 SDGs of the 2030 Agenda for Sustainable Development – adopted by world leaders in September 2015 at an historic UN Summit – officially came into force. Countries, regions, cities but also sectors are now working on implementation, supported by a monitoring, reporting and verification (MRV) approach.

Funding and finance are a critical enabler for development and has been the focus of a number of important inter-governmental events, notably the Third International Conference on Financing for Development which resulted in the 2015 Addis Ababa Action Agenda (AAAA). Whilst the outcome reaffirmed commitments to ODA, it also reflected the reality that the role of ODA is diminishing whilst that of the private sector is growing. Emphasis is placed on the most vulnerable countries (LDCs, LLDCs and SIDS) which may help to ensure that nobody is left behind. Other important points include the focus on strengthening domestic resource mobilization (widening the tax base, setting revenue targets, etc.), social protection (with spending targets including water and sanitation), as well as the Technology Facilitation Mechanism (TFM), a focus on cities and commitments to support resilient and environmentally sound infrastructure in developing countries.

The important role of technology transfer in facilitating sustainable development has been discussed in many fora over the years resulting in a Rio+20 mandate to explore the idea of creating a TFM. This was later formalised in paragraph 123 of the AAAA and then incorporated into paragraph 70 of the 2030 Agenda for Sustainable Development which created; a) a UN inter-agency task team STI for the SDGs, b) an online platform to provide information on existing STI initiatives, and c) the STI forum. These priorities are also reflected in SDG 17, notably on the targets related to technology.

Resilience is an important cross cutting issue with many dimensions including climate change and natural disasters. Improving the resilience of water, energy and cities can have numerous knock-on effects that can also help increase efficiencies at the same time. Improving resilience is directly noted by a number of the SDGs - notably in SDG 11 on cities which makes specific reference to the Sendai Framework for Disaster Risk Reduction. It recognises that whilst the state has the primary role to reduce disaster risk, responsibility is shared with local government, the private sector and other stakeholders, commensurate with this, it prioritises investing in disaster risk reduction for resilience using both public and private sources.

THE CHALLENGE OF FINANCING THE SDGS

The United Nations Conference on Trade and Development (UNCTAD) has estimated that the SDGs will cost up to US\$175 trillion over 15 years. Globally, this is an incremental increase of 1.5–2.5% of world GDP invested each year by the public and private sectors to achieve the SDGs in every country. **Whilst there may be sufficient public and private savings to fill the gap on finance, the key challenge is to more effectively use and redirect these financial flows to support the achievement of business models for the SDGs.** This is because spending would be offset in other areas such as energy (-30%) and other infrastructure (-9%), meaning that overall investments would largely reflect business as usual spending. The problem is that whilst the costs are upfront, savings will accumulate overtime and felt in other sectors. The key will be to take this into account when making investment decisions so as to be more effective and holistic when it comes to current spending patterns.

Local and national actions as well as international cooperation can help change the trajectory of the global economy and support countries towards achieving the SDGs. The seven action areas of the Addis Agenda address the different sources of finance: domestic public resources; domestic and international private business and finance; international development cooperation (including ODA, South-South cooperation and development bank lending); international trade; debt sustainability; systemic issues; and STI as well as capacity building.

Public resources from national budgets have historically been a major source of funds and will remain so to support SDG implementation. Countries, like Ecuador, are aligning their national development plans and strengthening funding frameworks to support SDG implementation. National budgets are essential for the SDGs and include the use of revenues the countries raise themselves, in particular through the taxes. In developing countries and emerging economies around 65% of the costs of infrastructure investments are financed by public resources. In advanced economies, public resources contribute to around 40%.

On average, there is increasing evidence that countries with tax revenues below 15% of GDP have difficulty funding basic state functions. Yet taxes in most LDCs remain below that threshold, especially in states that are experiencing or have recently experienced social, economic or environmental difficulties.

What this points to is the need to mobilise and effectively use significant additional domestic and international public and private resources to achieve the SDGs. Additional local and domestic resources will be, first and fore-

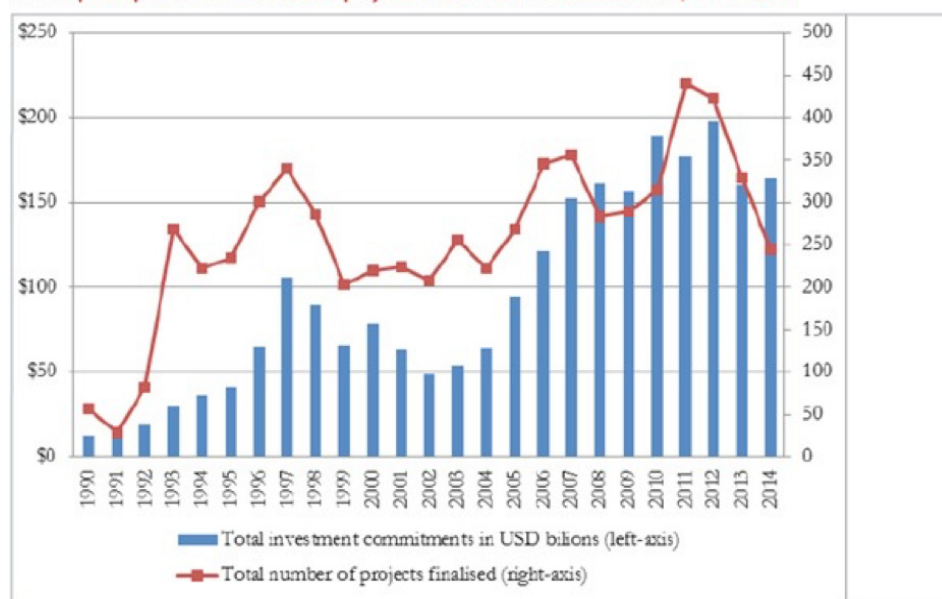
most, generated by economic growth, which STI policies can play a key role in facilitating. Improved policies and administrations will also help realize more efficient and effective resource mobilization. However, in a world of cross-border trade, investment and finance, there are limits to what can be done by domestic policy alone, necessitating strengthened local, regional, national and international cooperation.

For **sub-national and local governments**, there will be a need to diversify funding sources and raise finances on their own. As expenditures and investments in sustainable development are increasingly being devolved to the subnational level, the problem is that they often lack adequate administrative and technical capacity, financing and support. A study by the OECD showed that grants and subsidies in developed economies account for just over 50% of total subnational revenues, while tax revenue accounted for just over 30% and other sources (such as social contributions, user charges, fees for public services) for around 15%. Sub-national governments in low-income countries studied are more dependent on government transfers and subsidies, at around 65% of revenue. This shows that cities are still very much depending their on national governments, highlighting the need to diversify funding sources at the local level. At the same time, cities are increasingly finding themselves in debt, further hampering access to much needed finance.

Green and municipal bonds may prove crucial in augmenting new sources of finances in the public sector. For the private sector to increase SDG financing, in addition to an enabling environment, new business models based on payment for performance, and innovative financing facilities such as risk sharing offer great opportunities. In 2017, the World Bank launched the first-ever bonds directly linked to the SDGs. BNP Paribas arranged the bonds, which the World Bank will issue in order to raise financing (€163 million) to support projects that contribute to achieving the SDGs, including eradicating poverty, boosting efforts on energy, water, cities and tackling climate change. While SDG bonds are extremely new, green bonds are increasingly being issued in efforts linked to the SDGs.

Only some large cities, if any, have access to capital markets. As such, the majority of subnational governments have no access at all to public or private credit – often because of federal law restrictions on local borrowing – and therefore depend on capital grants from the central level for large-scale investments. Public revenues may be used to fund private concessions as infrastructure operators or other private entities, for example, using procurement mechanisms or **Public-Private-Partnerships (PPPs)**. It will be essential that private finance be aligned with the SDGs and focused not solely on financial return. Private finance can come from many sources and can be raised through a variety of mechanisms, some of which can be used to blend public and private investment for the SDGs.

Private participation in infrastructure projects and investment commitments, 1990 – 2014



Source: World Bank, Private Participation in Infrastructure Projects Database (<http://ppi.worldbank.org/>)

As outlined in the graph above, there has been a sharp rise in the private sector's participation in infrastructure development in developing countries since the 1990's. The majority of this investment was for PPPs in middle income countries. Over the period 1990-2014, only US\$61 billion was invested in low income countries, compared to US\$1.6 trillion in middle income ones. Of the sectors invested, energy, telecommunications and the road sector are by far the largest beneficiaries but the value of PPPs have not always stacked up. It has been found that the costs of tendering and monitoring can add up to 10-20% in additional costs, can encourage unsound country fiscal management and do not necessarily enhance service provision. This is not to say that all PPPs are bad, examples such as the Metro de Seville, Spain, allowed for better governance and the ability of the public authority to raise important revenue for the project via land value capture. The 2012 London Olympics created 457 apprenticeships through PPPs, of which 11% of jobs went to the previously unemployed. This is because the PPP from the outset had a higher purpose than simply the bottom line. There was a focus on legacy and future growth of the region. If all PPPs had the attainment of the SDGs at heart, then huge advances could be made.

Corporate reporting mechanisms are important tools by which to encourage companies to align their business strategies to advance the SDGs. In particular, SDG 12.6 encourages large companies to adopt sustainable business practices and to integrate sustainability information into their reporting cycle as this can help financial risk management, accountability and transparency towards the SDGs. Increasingly, countries across the globe are passing regulations requiring both public and private organisations to account sustainability information and provides an important tool going ahead to encourage companies to align their contributions on the SDGs. Voluntary reporting frameworks - such as the Global Reporting Initiative (GRI) - are also aligning themselves against the SDGs and could aid benchmarking in the future. The same is also true for city reporting frameworks.

Blended finance offers a huge, largely untapped potential for public, philanthropic and private actors to work together to dramatically improve the scale of investment in developing countries. Its potential lies in its ability to remove many bottlenecks that prevent private investors from targeting sectors and countries that urgently need additional investment. To accelerate progress towards the SDGs, blended finance needs to be scaled up, but in a systematic way that avoids certain or uncertain risks.

Trillions of dollars are held by **sovereign wealth funds (SWF), pension funds and private endowments** with an interest in long-term stability and sustainable development. SWFs are expanding quickly in all parts of the world and are becoming a major force in global capital markets. The number of funds specifically has grown five-fold since 2000 to approximately 80 and more are being created constantly. Furthermore, the SWFs have grown US\$400-500bn per year since the global financial crisis, reaching a total level of over US\$6.5 trillion currently. Theoretically, there is significant scope for SWFs to invest in sustainable development sectors and support the SDGs.

ODA is obviously critical towards meeting the SDGs in developing countries, and in particular for reaching those furthest behind. In general, it is established that the majority of ODA is allocated to central governments and not subnational governments or at the sectoral level. It is clear that ODA allocation levels will not be sufficient to bridge finance gaps or capabilities in developing countries, particularly the least developed. At the same time, ODA providers should deliver on the commitments pledged so as to catalyse wider investments.

Development finance institutions (DFIs), including multilateral development banks (MDBs) are a key source of public finance for sustainable infrastructure. They are well placed to work as a bridge between governments and private investors, and the use of public finance to catalyse private finance. MDB finance of infrastructure has more than doubled from 2004-2013 to about US\$54 billion. Ensuring that these investments are geared towards the SDGs will be essential and MDBs have also been encouraged to better leverage their existing capital by the G20, and have taken steps in this regard. Nonetheless, significant scope remains to optimize their balance sheets and take advantage of the funds available. For example, up to 50% of the World Bank's funding in some areas are not used due to a lack of capacity to develop bankable projects to invest in. It is widely agreed that the MDB system has the potential to significantly expand its contributions to financing the 2030 Agenda for Sustainable Development. Indeed, the Addis Agenda pointedly recognizes this potential and calls on MDBs to take responsive steps.

Key factors that shape views of bankability



Source: New Climate Economy, 2016

International funding mechanisms, such as climate finance, also offer new sources of funding - with the Green Climate Fund the most obvious mechanism that will be available. A number of large scale crises and emergencies are also driving a dramatic increase in humanitarian funding needs. Funding requirements for inter-agency humanitarian appeals coordinated by the United Nations have risen significantly over the last decade, from US\$5.2 billion in 2006 to US\$22.1 billion in 2016. While funding also increased over the same period, from US\$3.4 to US\$12.6 billion (as of 30 December 2016). Allocating more development funding to emergency responses should not divert resources from long-term investments in sustainable development, but should be used to stimulate wider financial sources at the same time.

Despite the range of financing options available to meet the SDGs, there remains a number of barriers. There is a need to incentivise investment in underfunded areas and overcome barriers that hamper investment flows. Ensuring that these investments are geared towards the SDGs adds another level of complexity. According to the New Climate Economy, the main barriers are:

- **Unfavourable investment regulations and policies** - subsidies and tax breaks which fail to address negative externalities can steer finance and investments away from the SDGs and favour technologies and infrastructure that support unsustainable options. Uncertainty over policies, notably tax policy which typically has a short term horizon, is a serious stumbling block.
- **Lack of transparent and bankable projects** - there is a general consensus that there is not a lack of capital for projects, rather there is a lack of bankable projects because they are likely or perceived to not deliver enough return to attract private sector. In both developed and developing countries, the capacity to develop such projects remains a significant challenge. The timescale of projects further complicates the process, with large-scale infrastructure investments taking a number of years to prepare but also construct. This highlights the urgent need to make the right investments decisions today in order to meet the 2030 Agenda.
- **Risk and inadequate returns** - in some cases, risks associated with unproven, new technologies puts off investors or the rate of return on projects is deemed too low. Better models to capture co-benefits of projects is needed because they are not properly accounted, making the case for investment further diminished.
- **Lack of viable funding and business opportunities** - many governments, cities as well as companies have not built up their creditworthiness to access affordable debt finance. Some investments for the SDGs may not generate any revenue at all, so there will be a lack of investor interest in such projects to pay for upfront costs.

- **High transaction costs** - the bureaucratic and fragmented nature of project approval and delivery can put off investors as well as governments at all levels. Scale is also an issue, as small scale projects can result in high transaction costs with limited opportunities for further development. Institutional gaps and capacity, notably in developing countries, can add additional costs which is a further barrier for investment.

All these barriers will need to be overcome in order to meet SDGs 6, 7 and 11 but STI strategies and roadmaps can play a significant role in addressing these challenges, with solutions explored in the following chapters.

TRENDS IN SCIENCE, TECHNOLOGY AND INNOVATION

Investing in sustainable infrastructure alongside STI will be key to realising the SDGs, the new Urban Agenda, Addis Agenda and the Paris Climate Agreement. All these agreements have strong STI elements attached to them in order to transform the efficiency and resilience of both traditional and new infrastructure.

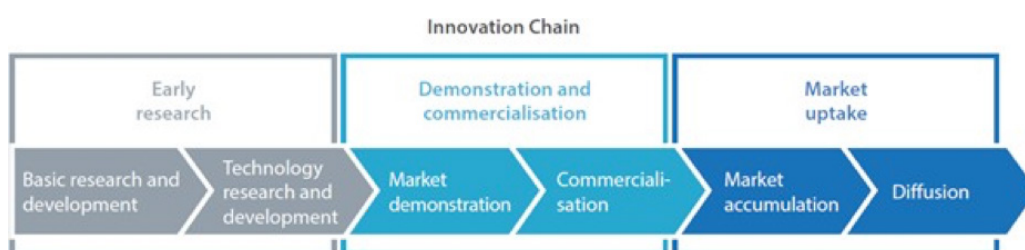
Key elements of identified successful national STI strategies (e.g. South Korea, Denmark, New Zealand, U.K.) and leading economic research all point to the fact that for them to succeed, they need to be based on strong policy, good governance, capacity development and knowledge sharing, regulatory environments, monitoring and reporting as well as partnerships.

Technology and innovation are at the heart of economic development and as economic growth will essentially determine the public budget for innovation, the two can be seen as mutually supportive. Over the past several decades, there has been progress in access to many technologies, particularly in information and communication technology (ICT). As such, STI strategies can help overcome bottlenecks and redirect the necessary finance and funding needed for the SDGs.

The innovation chain

Many technologies are initially developed in industrialized countries and then spread through different types of trade. The STI performance of a country, as well as the economic and social impact of STI, are affected by the quality and level of interactions and flows of knowledge between agents in the innovation system – such as cities, business, universities, research centres, public agencies and intermediate organizations.

It can be seen that the development and deployment of new technology have different drivers at each stage of innovation, and different policy mechanisms will be most effective depending on where the technology is in the innovation chain.



Source: UN Secretary General's High Level Advisory Group on Sustainable Transport, October 2016

As innovations are of different types, occur in many different ways, and have varying effects, they call for different policy responses. For example, policies that address the tail-end of the product innovation cycle and encourage demand for innovation are more likely to stimulate incremental innovation rather than to foster radical innovation. By contrast, experience indicates that publicly funded research has often been critical to the development of many radical innovations.

As an innovation moves down the line from research to uptake, it is critical that policy, investment frameworks and capacity also adapt to the new reality, and that decision makers work to facilitate the up taking of such innovations. Regulations and standard setting can also help advance R&D efforts, for instance, Japan's top runner

approach to regulation, where the latest innovations set the standard for development, provide an incentive for R&D. As such, national governments can provide push policies for R&D, but one of the major challenges in promoting technological innovation, notably in developing countries, is the lack of knowledge and capacity.

ICTs are specifically mentioned as a means of implementation and essential to driving future innovation under SDG17, highlighting the cross-cutting transformative potential of them. They can play a key role in achieving all of the SDGs, since ICTs are catalysts that accelerate all three pillars of sustainable development as well as providing an innovative and effective means of decision making for implementation in today's interconnected world. Paragraph 15 of the 2030 Agenda for Sustainable Development highlights that "the spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies..." We are seeing real breakthroughs in digital education, e-governance and health care, mobile money as a tool for financial inclusion and new business models to connect the unconnected. Each sector will need to leverage ICT effectively to achieve the SDGs by 2030: for technology and innovation to deliver transformational change at the pace and scale required, but three key supporting aspects need to align – an enabling policy framework, strong partnerships, and sufficient investment.

Facilitating the innovation chain through innovation strategies

National policies and strategies for STI serve several functions in government policy making. First, they articulate the government's vision regarding the contribution of STI to their country's social and economic development. Second, they set confidence in priorities for public investment in STI and identify the focus of government reforms (e.g. university research funding and evaluation systems). Third, the development of these strategies can engage stakeholders ranging from the research community, funding agencies, business, and civil society to regional and local governments in policy making and implementation. In some cases, national strategies outline the specific policy instruments to be used to meet a set of goals or objectives. In others, they serve as visionary guideposts for various stakeholders.

An example of best practice is South Korea which has committed to a technology-based economic development model and enjoys a national consensus on the importance of STI throughout its national strategies. It has high levels of R&D expenditure (circa. 4% of GDP), a highly educated labour force, good and improving innovation framework conditions, large knowledge-intensive and internationally competitive firms, and a strong ICT infrastructure. In 2012, the national STI strategy focused on accelerating development on three fronts: 1) advancement in new green innovation and technology; 2) high value industry (such as health and education) and; 3) new technologies, such as robotics and ICT. Alone, the strategy has earmarked US\$2.4 billion to invest in green technology. In 2011, the National Science and Technology Commission (NSTC) was reconstituted as a coordinating agency with considerable responsibility for national STI policies and allocation of public R&D funding. The creation of a strong governance framework and coordination system enabled a monitoring and evaluation framework to advance implementation of the national strategy. The evaluation framework follows a 'plan, do, check, act' approach against key performance indicators (KPIs) to ensure that R&D spending is directed towards national priorities for maximum impact. Key elements of success include a well-structured, integrated system, with a committed high level policy and governance framework to enable, engage and align with ministries and resources, a focus on capacity building and stakeholder engagement to drive continuous improvement and partnerships alongside clear long term prioritisation, monitoring and evaluation.

Countries should work to develop national strategies for STI that are in line with the SDGs, compromising policy, regulatory and institutional frameworks and agencies that will help to strengthen the enabling environment and enhance interactive learning, while also allocating resources for STI rollout, which in turn will attract greater private investment.

The 2016 OECD STI policy survey identified a number of countries where national STI policies specifically supported objectives linked to SDGs 6, 7, and 11. A high level review indicates that energy is included in virtually all national STI policies, water is represented but in less than 50% of the surveyed policies, whereas cities issues are more difficult to identify. However, this high level review should be interpreted with some caution, SDGs 6 (water) and 7 (energy) represent well defined fields of technology and so lend themselves to easy identification. Contributions to SDG 11 (cities) depend on the application of a broader range of disciplines and so may be supported in some way by many of the STI strategies, with ICT is becoming the cornerstone.

Global trends for R&D

Since 2000, the total spending from both the private and public sector on R&D as a proportion of GDP has grown in all country categories and doubled in the last 15 years. A group of larger countries dominate total R&D funding, with just 25 countries (both OECD and non-OECD, but not LLDCs, LDC, SIDS) accounting for 90% of expenditure. Pressure on public spending in OECD countries may pose a challenge for STI strategies since government budgets account for an average 90% of higher education and government R&D expenditure, this is particularly true for the largest performers, e.g. Japan (98%) and the United States (96%). Although, public spending on R&D in many developing countries has contracted in recent years, overall there has been an incremental increase in total spending.

Public budgets for R&D have shifted in past decades towards environmental and health-related objectives. A degree of country level specialisation can be detected, with energy being prioritised in R&D budgets for Mexico (19%), Japan (11%) and Korea (9%). Linking R&D budgets to clear long term strategies with strong long term political commitment is obviously important. Supply side driven technologies are not going to drive market diffusion alone, demand side innovation and diffusion policies will be just as important.

Incentives have a huge impact on investment decisions, and in turn R&D, which are key elements to successful STI strategies and implementation. These incentives should reflect the full costs of development (social, economic and environment) and be used to redirect financing and funding towards sustainable infrastructure and technologies. These incentives can be played at the national but increasingly at the local level, which can attract stronger private investment.

All levels of governments should introduce policies that ensure that spending and efforts on R&D remains stable and long-term and should be deployed alongside a variety of incentives that can leverage private investment.

The establishment of innovation funds can greatly advance efforts in this area and more than 35 have been established globally. For example, under the Australian National Innovation and Science Agenda the strategy includes AU\$36 million invested over four years to, amongst other things, seed funding to support global Small and Medium Enterprises (SME)-to-researcher collaborations to enable viable projects to grow and test commercialisation through the Global Connections Fund. Bulgaria's National Innovation Fund supports R&D of enterprises and fosters cooperation between science and business, focused on the technological development of new products, processes, services, or on a significant improvement in existing ones in priority sectors (maximum grant - 500,000 BGN (€255,646)). While most national funds concentrate on providing resources, some also offer technical advice. For example, the Global Innovation Fund (GIF) provides funding and advice at three stages: pilot, test and scale - and is open to ideas from any sector and any country provided that the innovation targets those living on under US\$5, or preferably, under US\$2 a day. GIF offers grants, loans (including convertible debt), and equity investments ranging from £30,000 to £10 million.

While some progress has been made in establishing innovation funds, more effort is encouraged not just at the national and global level, but also regionally and locally. Funds should be aligned with the SDGs and scaled up over time. Overall, there should be an increase in funding targeted at STI's for SDGs implementation, this should include a modest but visible floor percentage of countries' ODA, which is also made available to cities.

One notable recent initiative is the Technology Bank for Least Developed Countries, located in Gebze, Turkey, and operationalized on 22 September 2017. This will improve access and policy relating to STIs helping increase and improve utilization and partnerships in the 47 least developed countries. The new Bank will contribute to efforts to achieve the SDG target 17 on building capacity to support developing countries, including for LDCs and SIDS, to increase significantly the availability of high-quality, timely and reliable data so as to respond to the principle of "leaving no one behind".

It is critical that the Technology Bank provides the financial and knowledge base by which to help least developed countries strengthen their STI capacities and generate home grown research in order to take these to market.

Trends in scaling up capacity, education and deployment of innovations

The Addis Agenda and the 2030 Agenda recognises capacity development for innovation as an integral part of sustainable development. It calls on governments to enhance international support and establishment of multi-stakeholder partnerships for implementing effective and targeted capacity-building in developing countries, as well as to reinforce national efforts in developing countries.

Projects, including technical cooperation and capacity-building initiatives, represent around 75% of South-South cooperation. There are numerous examples of capacity building by international organizations. It is important to note that capacity development can be influenced by national policies but also in the context of financing for development. Collectively the countries subscribing to the Addis Tax Initiative declare their commitment to implement the Addis Agenda in the leading action of raising domestic public revenue, to improve fairness, transparency, efficiency, and effectiveness of their tax systems, and commit to step up their efforts that will collectively double their technical cooperation in the area of domestic revenue mobilisation and taxation by 2020.

There is a need to strengthen international cooperation for STI and develop the necessary partnerships for sustainable development which lie at the heart of SDG 17. South-South cooperation on STIs would help to significantly scale up efforts on SDG implementation, notably because 47% of total South-South foreign direct investment is geared towards ICT.

Education policy also has a major impact on university research and the availability of highly skilled labour in technology intensive firms. Education policies, the intellectual property rights (IPR) regime and a range of other policies are important contributors to an enabling environment for STI and capacity development, while the international environment needs to be supportive as well. On education, the Addis Agenda commits to enhance technical, vocational and tertiary education and training, ensuring equal access for women and girls and encouraging their participation therein, including through international cooperation. It also commits to scale up investment in science, technology, engineering and mathematics education. The commitment can also help to enhance technology transfer.

Partnership development will also be essential as technology has always advanced through partnership between public and private entities - research, through the public infrastructure needed to integrate new technologies into everyday life and through the public policy frameworks that serve as the context for progress. This can help enhance North-South, South-South and triangular regional and international cooperation and enhanced knowledge sharing on mutually agreed terms. This can include improved coordination among existing mechanisms, in particular at the United Nations level, notably through the TFM. Business can also play an important role here, not only through their practices but also through partnership with their supply chain.

Development banks should play a key role in building capacity and established dedicated mechanisms to build STI understanding and capacity alongside project implementation and partnership development in support of the TEM. This will ensure that projects are bankable and skills developed.

The final key area is the importance of high quality data for policy making and monitoring against strategic goals. Data capacities will need significant strengthening at all levels as well as the monitoring of financial flows.

Significant efforts should be made to build capacities through the UN system, notably in those countries who need it most, especially on those SDG goals and targets with no data attached to them. Particular focus should be given to cities through relevant non-state actors so that STI investment can be better targeted and tracked.

The following sections will look at some of the specific issues faced by SDG 6, 7 and 11 in the three broad categories of policy, finance and capacity needed to scale up STI for SDG implementation. From this, overall recommendations will be made to scale up STI roadmaps and financing sustainable, resilient and inclusive solutions to facilitate the necessary investments to attain SDGs 6, 7 and 11 and beyond.

SDG 6 - ENSURE ACCESS TO WATER AND SANITATION FOR ALL

SDG 6 aims at achieving universal access to drinking water, sanitation and hygiene, addressing inequalities and global challenges on water quality, efficiency resource management and ecosystem services. These issues cannot be addressed in isolation as there are strong connection with other areas, such as health, cities, agriculture, climate change, energy, poverty, economic productivity, equity and education. Agriculture accounts for 70% of global water withdrawals rising to 95% in some developing countries. Water is an important gender issue with the burden of collecting water falling on mainly women and girls (263 million people spend over 30 minutes daily to collect water).

Water covers 71% of the Earth's surface but only 4% of this is freshwater, of which only 0.5% is suitable for human consumption. Every year, nearly a million people, more than a third are children under five, die from diseases, caused by unsafe water, inadequate sanitation and poor hygiene. Around 90% of disasters are water related and in Northern and Western Asia water stress levels often exceed 60%. Water is an increasingly contentious issue between countries given the cross boundary nature, and also with cities, as highlighted recently in São Paulo, Brazil, where water shortages resulted in civil unrest. Today, over 2 billion people still lack access to safely managed drinking water and around 40% of the global population suffer from water scarcity.

Global requirements for water will double over the next 20 years, which together with further pressures resulting from climate change, mean that some observers are predicting a water crisis and unrest in the years to come. The sector needs to be more resilient and adapt to ensure that it can continue to meet the needs of people, businesses and the environment – and government frameworks needs to adapt too. There is a need to enhance national policy frameworks to secure the long-term resilience of the sector, helping to deliver a cleaner, healthier environment, benefiting people and the economy. However, significant recent progress has been made – in 2015 nearly 90% of the world's population used improved drinking water sources and around 5 billion used improved sanitation facilities, notably in rural areas.

There is a sound economic case to further advances on SDG 6 as water and sanitation interventions offer a pay-back of 3-6 fold. The costs of inaction is even more compelling; inadequate sanitation in India costs 6.4% of GDP, water related disasters wiped out 5% of Thailand's GDP in 2011 and water pollution in China costs 2% of rural GDP. South Africa needs SAR700 billion (approx. US\$50bn) in the next decade to prevent water demand from outstripping supply by 2025.

Technological solutions and patterns of innovation

There are already many technology solutions available for water supply, sanitation and hygiene that are proven to be cost effective. However, these technologies alone will not be enough – other factors will also need to be put into place, such as behaviour change, financing, capacity, policy, partnerships and so on, which will be explored later.

There are three broad types of technological solutions, all of which must be considered in order to improve efficiency and resilience needed for SDG 6. Water supply enhancement technologies can advance more drought resistant water supplies, such as reclaimed water or desalination, greywater, rainwater and stormwater capture, which also reduce energy costs. The second major area are demand management technologies that encourage and enable water efficiency or water conservation. This can help regulate water use, supply and pollution. Examples include drip irrigation and smart meters, which can encourage behaviour change as well as water use through real time information via sensors (ICT) which can allow for pollution detection, for example. The final category looks at governance improvements, which can enable water utilities to more closely match demand and supply through real time issuing and forecasting that can help tackle inefficiencies in governance but also maintenance.

Countries are starting to implement these technologies so that they will more efficiently manage energy and water consumption, for example it is planned to install 800,000 smart water meters in Kuwait. There is also an economic reason to save water, for example in the US 30% of treated water is lost due to leaks resulting in a substantial loss in revenue. Smart monitoring technologies, such as those established in Portugal, offer real time monitoring allowing utilities to better detect pipe bursts and match demand with supply to drive efficiencies, all helping to reduce operational costs.

Smart water use technologies is becoming particularly important for cities given future demands as populations grow. In Hong Kong, the use of seawater to flush toilets has reduced freshwater consumption by 20%. Given that 65% of major global cities are located alongside coasts it offers potential solutions for a huge percentage of global citizens. Smart metering solutions in buildings and households are further driving efficiencies and storm water retention tanks, collecting runoff when sensors signal heavy rain and drain when safe to do so, also provide low cost solutions when planned properly.

Despite these advances, there are a number of bottlenecks to innovation in the water sector, causing it to lag behind others. Globally, venture capital investment in the energy sector grew by a factor of fivefold compared in the water sector over 2004–2011, with billions invested in energy and only millions in water. In the US, since 2000, the clean energy sector has benefited from about US\$8 billion in public investments, while only US\$28 million in public funding in the water sector. This lack of financial resources and investment is holding back innovation by SMEs as well as R&D, demonstrations and commercialisation. There is also a tendency for risk aversion partly due to the high financial and other impacts associated with disruption to water and sanitation but also an absence of visible demonstration projects to show the capabilities of new innovation.

Coherent regulation has the ability to stimulate innovation but the water sector is highly fragmented, with utilities responsible for each of the SDG 6 targets independent from each other. Often these utilities are relatively small, lacking strategic, technological and planning competencies as well as the necessary funds to implement innovative technologies, particularly at scale. This also results in conservative and fragmented procurement practices which give preference to low cost, short term offers with proven technologies. All these factors explain a lack of innovation in the sector, but these can be addressed through innovations in improved regulations, institutions, policy, finance, capacity and management, as recommended to the UN High Level Panel on Water. The following section will outline the key elements that should be included in a STI roadmap focused on SDG 6.

A coherent policy, regulatory and institutional environment

Integrated water resource management (IWRM) plans have been developed in three quarters of countries and will, in part, address problems with institutional silos which divide the multiple agencies at the nexus of water, energy, agriculture, climate (and so on). Yet implementing IWRMs has proceeded at a slow pace, meaning that integrated responses at the national, sub-national as well as between countries are few and far between. In many countries, institutional and legal reforms are required to facilitate implementation as seen by ground breaking jurisprudence in countries such as India, South Africa and Argentina, which are addressing the rights to water and sanitation. **There is a need for institutional strengthening to transform water management practices and coordinated policies through advanced STI, this is a priority issue for developing countries.**

A successful example can be seen in the reform of water management in Pakistan supported by IDA- financed programs, notably the National Drainage Program. The water users' associations were given delegated authority by the national government to operate and maintain irrigation canals and requested changes to the mandate and structure of the Water Authority and the Irrigation Departments. This enabled measures to increase operational efficiency, accountability and financial sustainability including contracting out operation and maintenance to the private sector. Public awareness campaigns were used to build wider support for the reforms, all of which help to enhance institutional capacity.

Better coordination between agencies and sharing knowledge will help further policy coordination, institutional strengthening and integrated decision making. In Italy, the Arno River Basin Authority developed a shared information dashboard to gather all relevant data regarding river basin management planning. By gathering all this information into a single depository, it has helped to bridge information gaps hindering effective management decisions and coordination across the different agencies involved.

Regulations and standards will always play an important role in the water sector when it comes to policy coordination but they will also be fundamental to driving innovation. Regulatory regimes developed around existing technologies should be avoided as they may provide barriers to innovation. While the WHO develops international norms on water quality in the form of guidance, these need to be translated into a country's own unique circumstances. The guarantee, predictability and clarity of this translation as well as their enforcement mechanisms is fundamental in driving innovation but also policy coordination. Technology forcing mechanisms in the water sector have effectively helped to drive policy and innovation in the EU and Japan. The US Clean Water Act

requires the implementation of best available technologies (BAT). By imposing such a standard, it encourages the development of innovation and provides an incentive towards continual improvement. **It is essential that advances in water policies, regulations and practices are also reflected in STI strategies as well as funding for innovation.**

Bridging the finance gap for technology and innovation

As stated in the FfD Sustainable Development Report, finance is key to implementation but also technology development. Advances will be felt greatest by those most in need yet in 77% of countries, public finance is still insufficient to meet the SDG targets for access to drinking water and sanitation. **There is a need to use finance and funding more effectively, diversify sources and PPP development in the water sector.**

Many water systems are subsidised to support the extraction, purifying and distribution of water. Globally, only 39% of utilities set tariffs that cover total costs and many utilities in Africa do not cover even their operating and maintenance. This under-pricing of water presents a significant obstacle to innovation. As costs are low, the return on investment for innovation is also low, leaving limited options to pursue profits. The water sector's low investment levels compared to other sectors means that less than 1% of all start-ups are in the water sector. The Water Council found that in 2015, only US\$44 million in deal flow went to water technology start-ups compared to almost US\$60 billion in other areas. One area of funding which can help address this gap is 'challenge funds' as this can play an important role in start-up innovation and partnership building. For example, the Human Development Innovation Fund is a £40 million UK challenge fund providing grants to businesses, NGOs and research institutions for scaling innovations focused on the quality, value for money, and sustainability of basic services in education, health and water, sanitation and hygiene in Tanzania. The prize, worth £25,000 (US\$38,348), have been awarded to a number of low cost solutions, including a water filter which absorbs anything from copper and fluoride to bacteria, viruses and pesticides which should help the 70% of households in Tanzania that do not have clean drinking water.

Addressing the price of water can also help to address the innovation gap and can be done through using shadow water prices, where the price is set according to local availability rather than the actual price thus incentivising better water management by utilities. Better metering can also ensure that the true costs of consumption are captured. For example, metering of water consumption is mandatory in Israel and by doing so, the innovative use of recycled water has been encouraged, notably in the agricultural sector. Strategies to increase the cost of water, as recently seen in South Africa, can also help to drive behaviour and innovations towards SDG 6.

Broader implementation of pro-poor pricing is needed to overcome barriers to access and innovative solutions. Some families in developing countries spend half of their income on safe drinking water. The application of 'pro-poor' principles can overcome this problem by adjusting prices (e.g. by offering rebates to the poorer farmers) to reflect the user's circumstances, whilst at the same time discouraging waste and incentivising efficiency. New technologies - notably ICT - can play an important role in advancing efforts given the opportunities to increasing efficiency, cleanliness, access to services and introduce dynamic pricing strategies with metering and billing.

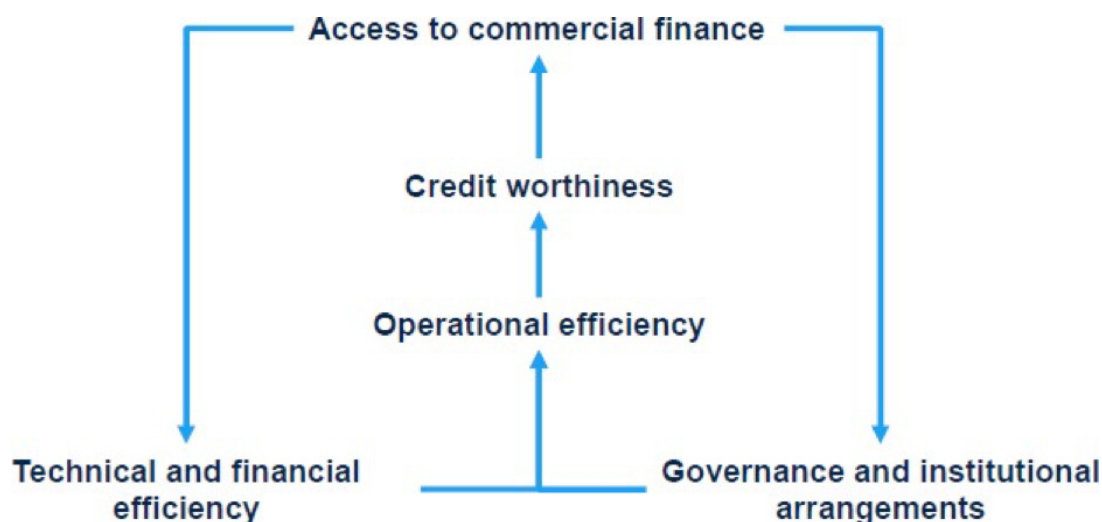
Making more effective use of current funding opportunities is essential but there is also the need to diversify funding sources. The Green Climate Fund will support countries to adopt mitigation and adaptation efforts representing as much as US\$100 billion per year. This offers potential sources of funding for the SDG and in addition, agricultural funds such as the Fund for Smart Agriculture in Latin America and the Caribbean offers alternative sources at the international level. ODA is another such source which is well suited to addressing problems of access for those furthest behind. Since 2005, ODA investments in water have remained relatively constant at about 5% of total ODA disbursements reaching US\$8.5 billion in 2015.

The strategic use of blending finance of public taxes, development grants, loans and subsidies offer a new way to finance water infrastructure, distribution, maintenance and technology development. A mix of new instruments can be used and green bonds offer an additional source. They are starting to be used in the water sector, for example the District of Columbia Water and Sewer Authority (USA) issued a US\$350m green bond for their Clean Rivers project that helps to significantly reduce pollution incidents to the areas waterways. Creditworthiness schemes can also help to repay debt and raise valuable revenue for water projects at the local level. This in turn can help to improve governance and institutional arrangements as well as enhance technical, operational

and financial efficiency. **It is recommended that greater support is provided to water utilities to enhance their creditworthiness and use of green bonds.**

The use of micro finance has advanced STI efforts notably in developing countries. Schemes in Bangladesh, Cambodia and the Philippines have helped households to invest in water and sanitation. Nearly 600,000 projects accounting for US\$120 million have benefitted 2.4 million people to date and 25% of women are able to increase incomes due to greater productivity as a result. Projects include rainwater harvesting, shallow wells, pumps, biogas toilets. Importantly, they offer small loans to individuals that do not have access to traditional credit. **Microfinance solutions should be scaled up - notably within STI strategies - with a focus on addressing gaps in access to water services.**

Private sector financing accounts for only 7% of total spending on water and sanitation in developing countries, and in Sub-Saharan Africa the figure was estimated to be less than 0.5%. Outside financial sources can help to attract more private capital by de-risking the investment. Notably, in Uganda, the Ministry of Water has facilitated growth of a domestic water market with the implementation of a number of small-scale water PPPs. The government began by introducing one-year area performance contracts that remunerated local managers based on results, bonuses and penalties (of up to 25% of basic salary) tied to targets. During the first year of the project, residents have seen a dramatic improvement in the quality and level of water services. A total of 430 connections have been installed, water production has increased from eight to 21 m³/hr and collection rates have increased from 70% to 85%. **Improvements to the technical skill set and openness to innovation should be prioritized in order to attract and enable greater levels of PPP investment.**



The virtuous cycle of financing the water sector, source: World Bank

Capacity building, knowledge and R&D

The key to implementing STIs for SDG 6 will be to upscale not only institutions but also individuals, communities and citizens which can support the uptake of smart water solutions. In 2013, the Portuguese Association of Water and Wastewater Services launched the 'Young Water Professionals' group with the aim to develop the capabilities of young professionals under the age of 35, and prepare the future generation of leaders and technicians in various fields of knowledge, helping them to meet the growing challenges in the water sectors and the technologies that can help scale up performance.

Better knowledge exchange and consultation with citizens can also help drive performance, accountability and capacity. In Scotland, UK, the establishment of a Customer Forum in 2011 enabled customers to provide their views on setting water prices in a drive to boost efficiencies. This sense of co-creation and knowledge exchange helped inform long term business planning and greater exchange of knowledge between customers and suppliers. This process of engaging customers has also proved successful in Canada, Japan and South Aus-

tralia. Online platforms, like the one established in Rijnland, Holland, can also help to address knowledge gaps of water authorities as it allows citizens to inform them of local circumstances and problems.

Knowledge exchange will clearly help R&D development and schemes, for example Israel's NEWTech programme helps to promote water technologies in both global and local markets by supporting R&D, participating in water related stakeholder events and for creating marketing tools to raise awareness of such innovations as well as knowledge exchange and capacity building. Business can also play a vital role in R&D advancement through sustainable business practices and projects but also SDG 6 delivery.

ICT tools can greatly enhance the monitoring of water availability, withdrawals and consumption which enables improved allocation as well as savings, efficiency and greater resilience. Similarly, information about drinking water quality and the sanitation situation, including wastewater discharge, supports public health intervention and the protection of water bodies. Monitoring can also inform best practices, latest technologies and innovations as well as support productive integration across sectors within the SDG framework. Monitoring costs are often marginal compared to the large investments that are typical for the water sector and can offer significant returns. For example, Philadelphia's Surveillance and Response System demonstration project integrates monitoring and data streams through ICT to promote early and rapid detection of a water-supply contamination. Information was integrated via an innovative event detection dashboard using a web GIS-spatial platform in real time and has saved significant costs due to proper asset management, quick decision making and a transition from reactive to proactive maintenance. It also increased efficiency by operating assets at peak performance, better cross-departmental communication through open information sharing as well as enhanced citizen communications regarding safety, security and compliance with environmental regulation.

Early adoption of mobile-to-web technologies in Africa provides a unique opportunity for the region to bridge the gap between the lack of data and information on existing water and sanitation assets and their current management – a barrier for the extension of the services to the poor.

Monitoring frameworks are also central to IWRMs and their implementation, which is vital in order to achieve SDG 6.5. The classical plan-do-check-act framework must be complemented by institutional reforms. Data and monitoring are central to Egypt's IWRM as they allow for continual improvement and benchmarking, aimed at creating an incentive for good performance at village levels and at Branch Canal Water Board levels. It is also a key element in creating both partnerships and incentives for sustaining agreed water quality and health goals.

This coordination of stakeholders at all levels will help scale up action as well as pool the resources and capabilities needed for effective delivery of technology for SDG 6. In September 2017, the EU and China stepped-up joint work on water protection by establishing a Water Policy Dialogue. The platform will help shared best practice and knowledge on the latest technologies and innovations needed for effective water management but also help engage the business community. **Collective agreements can help trust building and transboundary cooperation which will be especially important to achieve SDG 6.5, particularly in Africa and landlocked countries.**

Partnerships are also essential not only for the macro level but also for small scale delivery which are particularly important for developing countries. India's Urban WASH Alliance partners with public and private sectors to implement and scale innovative water and sanitation initiatives in India's largest urban centres. The Alliance is supporting five public-private partnerships that are improving water and sanitation services through technological solutions in Bangalore, Ahmedabad, Delhi, Chennai, Kolkata, and Hyderabad. These types of partnerships are an essential part of SDG 6.b which encourages the support and strengthening of local communities and in improving water and sanitation management.

Business can also help further partnership through corporate sustainability efforts. For instance, the Coca-Cola Company committed by 2020 to safely return to communities and nature an amount of water equivalent to what it used in its finished beverages and their production. Over 100 billion litres of water have now been replenished to communities and nature. In addition, with partners across government, civil society and the private sector, more than US\$300 million in replenish programs has been invested globally.

Finally, given the synergies with various SDG goals - resilient infrastructure (SDG 9), sustainable cities (SDG 11), sustainable consumption (SDG 12) and inclusive societies (SDG 10) - partnerships should go beyond just those involved in the water sector. An important dimension of IWRM is that it provides a framework for water man-

agement to encourage engagement options into broader national and international development planning in a structured way. By aligning and integrating interests and activities that are traditionally seen as unrelated or that, despite obvious interrelationships, are simply not coordinated, IWRM can foster more efficient and sustainable use of water resources to achieve the SDGs but also technological innovations. By identifying win-win solutions, costs can be shared and innovation scaled up.

SDG 7 - ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

Energy is central to social and economic well-being and inextricably interlinked too many SDGs, including poverty eradication, food security, clean water and sanitation, health, education, prosperity, job creation and the empowerment of youth and women. Yet more than 1 billion people have no access to electricity and over 3 billion people have to cook with polluting, inefficient fuels. This acute access gap epitomises those most in need and furthest behind and as such presents a strong case for ODA funding. Whilst progress has been made against the SDG 7 targets of access, efficiency and renewables, more rapid progress is needed or it will be impossible to deliver on other SDGs by 2030.

Decarbonising the global energy supply is perhaps the single most important and challenging objective required in order to deliver the Paris Agreement and SDG 13. In addition, energy production and use is by far the largest man-made source of air pollution, and linked to SDG target 11.6 and contributing factor towards the 6.5 million premature deaths each year associated with poor air quality.

The energy sector is popular for private sector investment (electricity attracted US\$744Bn investment 1990-2014, second only to telecommunications) and relatively well suited as demand is steady, quality of service can be easily assessed and better quality infrastructure can lower operational costs. However, in developing countries public funds tend to dominate with over 90% of all investment in infrastructure.

STI has a major role to play with a range of proven solutions offering huge potential to improve access, efficiency and the use of renewables. Innovation must be supported at all stages with governments taking a leading role. Allocation of resources should be informed by both long and short term opportunities for SDG 7.

Policies at the national level have great potential for impact, e.g. power generation, grid expansion, building codes, standards and labelling for equipment, road vehicles, etc. Meaningful improvements will require higher levels of financing, bolder policy commitments and embracing new technologies. **Technology transfer must be supported to enable developing countries to leapfrog. The energy transition must be a 'just' transition and not leave anyone behind.**

Energy resilience is also a key issue especially as climate change leads to increasingly severe and frequent devastation around the world, as such shoring up the resilience of energy infrastructure has become an urgent priority, especially in SIDS that often find themselves in the eye of the storm. The 2017 hurricane season was one of the most active in recent history, as severe rain and winds wreaked havoc across the Caribbean, and took out essential services - including electricity. Energy systems are vulnerable not just to hurricanes, but also to other extreme weather events such as earthquakes, wildfires, winter storms and rising sea levels. When electricity infrastructure is damaged in the wake of natural disasters, it affects all walks of life. Essential recovery services suffer. Hospitals are left unable to run life-saving equipment or preserve critical medication at the right temperatures. Markets have trouble preserving food and people live in darkness, and cannot use basic appliances stoves. The best way to be prepared to face and recover from natural disasters is for countries to have a good emergency preparedness plan, accompanied by strategic investments that can shorten restoration time and limit the impact of disasters. Therefore, resilience in the energy sector is essential and innovative solutions can help the sector to prepare for any eventuality.

Energy technology & innovation solutions

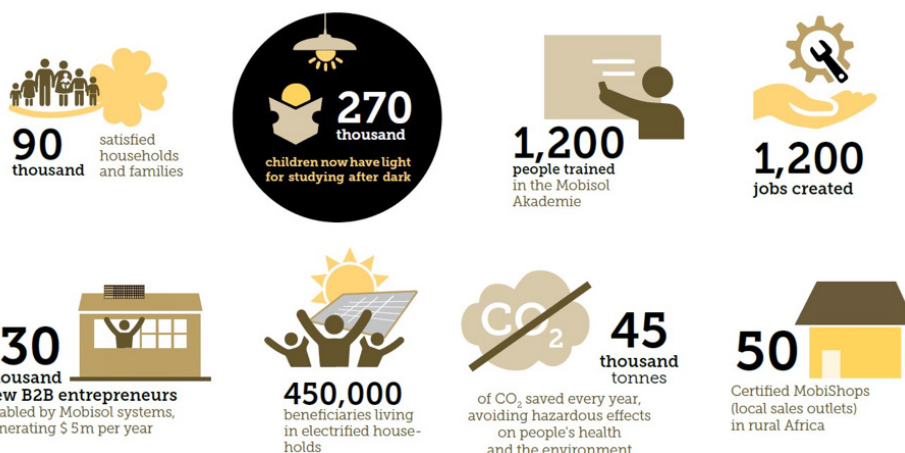
A range of technologies are available to provide access to electricity where the extension of the national grid may not be a feasible option due to remoteness and low population density. Decentralised renewable energy solutions are cost-effective over the system's lifetime, easy-to-deploy, install and maintain and their design can be tailored according to individual needs. Solar energy stands out as the most favoured generation tech-

nology, followed by batteries/storage, hydro, diesel back-up, biomass and wind. For example, Mobisol has more than 90,000 customers in rural Tanzania, Rwanda and Kenya using their decentralized solar electrification as described in the following case study.

Case study - Mobisol decentralized solar electrification in rural SubSaharan Africa

Mobisol offer decentralized solar electrification to lower-income households and small businesses in rural SubSaharan Africa financed using a PAYG (Pay-As-You-Go) model. Combining solar energy with mobile payment technology, Mobisol designs, procures, distributes and services 80 to 200 Watt solar home systems sufficient to illuminate entire households, power laptops, radios, TVs and other appliances. The company has more than 90,000 customers and installed almost 10 MW of capacity in Tanzania, Rwanda and Kenya. Mobisol's pay-as-you-go system circumvents the initial investment hurdle for customers who previously could not afford high-quality solar home systems

MOBISOL - KEY FACTS & FIGURES



The efficiency of electrical distribution offers huge scope for improving efficiency and thought this reducing total electricity production needs, for instance, presently some 70% of electricity is wasted before it reaches the end-user. Large-scale expansion of high-voltage transmission infrastructure connecting grids can help balance supply and demand, assist penetration of renewables while maintaining energy security. To date, inter-connecting grids has largely been at the national level, with some exceptions. Innovative smart metering and smart grids can shift peak load to off-peak times enabling a step-change in productivity whilst also supporting integration of renewables. For example, the German city of Munich is developing smart grids and a virtual power plant (a network of several small-scale energy plants using water, geothermal, solar and biomass, wind power) in order to meet its entire electricity demand with renewable energy by 2025. This approach offers emerging economies an opportunity to leapfrog to more sustainable energy development at the same time spurring economic growth. A range of energy storage technologies are available with others currently in development.

Improvements to building thermal insulation (e.g. double glazing) can be retrofitted to existing stock or designed in from the start for new constructions which is important because the building envelope has most influence over heating and cooling needs. Ownership of household appliances (e.g. refrigerators) is increasing energy demand in buildings, however there has been some good progress with increased use of high-efficiency LEDs lighting which is around 30% of residential sales in 2016 and television sets where improvements in efficiency is moving faster than increases in television sizes.

For road vehicles there is a range of proven technologies available to improve efficiency, including engine down-sizing, hybridisation, electrification, waste heat recovery, aerodynamics, reduced rolling resistance for tyres, weight reduction, driver training and speed governors.

Currently renewables have risen to 24% of global power output, costs continue to fall with solar PV overtaking wind power in terms of new capacity. Utility-scale solar PV has halved over just four years, and in some cases is now competitive without subsidy and cheaper than fossil fuel alternatives. Prices are coming down dramatically, for example in India, the prices of solar fell by 40% in one year in 2017, thanks to access to cheaper finance and growing investor confidence in the country's pledge to increase renewables capacity.

Policy and regulation must enable the coming energy revolution

Energy technologies interact and thus must be developed and deployed together with a whole system perspective. Whilst the economic competitiveness of some new technologies is improving, market forces alone will not deliver the needed impetus. Strong, consistent and coordinated policies as well as regulation are essential to both support the penetration of sustainable technologies and enable innovative business models.

Top performing countries generally do well for policy and regulation across all three energy supply solutions - grids, mini-grids and stand-alone systems - suggesting that all three components are complementary. The main barriers to wider deployment of this mixed approach include early stage market fragmentation and un-made linkages.

Energy efficiency is often overlooked but offers enormous untapped potential for saving both money and energy, in particular for buildings, transport and industry. For example, since 1990 IEA member countries have saved US\$5.7Tn in energy expenditure through improving efficiency. In developed countries, efficiency is the largest source of 'new' energy supply. It has been estimated that further investments in efficiency could boost global GDP by US\$18Tn by 2035 increasing growth by 1.1% per year. There are also large potential savings in developing countries, for example in India there is a difference of 40% in energy demand between the low and high efficiency scenarios for 2030. This saving is equivalent to India's entire current energy consumption. Notably, investments in efficiency create up to three times more jobs than for fossil fuels.

However, only one third of countries have mandatory requirements for building energy efficiency codes and a similar number have standards for energy-consuming equipment in buildings. As the vast majority of new buildings will be constructed in developing countries, this presents an important opportunity to leapfrog development by implementing the latest technology standards, accessing affordable renewable energy and energy efficiency policies supported by global initiatives such as the Clean Energy Ministerial Global Lighting and Energy Access Partnership (LEAP) and the Efficiency for Access Coalition.

Many countries, including 20 EU Member States, Brazil, Canada, China and South Africa, impose vehicle taxes based on fuel economy or CO₂ emissions with some of these using the revenue to subsidise cars with superior fuel economy. The Global Fuel Economy Initiative (GFEI) have had some notable success working with governments (including Indonesia, Kenya, Ethiopia and Chile) and other stakeholders to support stronger policy on minimum road vehicle fuel efficiency standards. A number of technologies can be retrofitted to existing vehicles with payback periods as low as three years. Relative poor uptake reflects a market failure that could be addressed through awareness raising and financial support. **It is recommended that broader implementation of proven, aligned policy and regulatory instruments concerning energy efficiency be considered as a priority.**

Whilst the cost of renewables continues to fall, support from coordinated policy and regulation is needed, e.g. feed in tariffs and policy on energy security, carbon pricing and air quality, etc. Renewable policies continued to shift from government-set tariffs to competitive tenders with long-term power purchase agreements. By 2016, almost 70 countries had employed auction/tender schemes to determine support levels. While the first adopters were primarily emerging economies (Brazil and South Africa), this trend has now spread to mature renewable markets (the European Union and Japan).

Carbon pricing is an important tool that should be strengthened to support penetration of renewable energy by both improving competitiveness and raising funds for investment. According to the World Bank nearly 40 countries and more than 20 cities, states and provinces use or are preparing to implement carbon pricing mechanisms such as emissions trading systems (current market value US\$30 billion) and carbon taxes. The share of greenhouse gas emissions covered by domestic carbon pricing initiatives increased significantly, led by the launch of six carbon markets in China. The impact of carbon pricing is largely affected by the strength and predictability of the price signal, but prices vary considerably from US\$1 (Mexico) to US\$168 (Sweden) per tonne.

Finance and other barriers

Universal access to modern energy services will require annual investments of US\$45 billion (targeted at grid expansion, mini-grid and off-grid solutions), raising to at least US\$1 trillion per year in order to tackle climate change. Analysis of the 20 high-impact countries (Sub-Saharan and Asia) shows that current finance flows for decentralized energy solutions are very low (US\$200 million per year, or only 1% of trackable electricity finance) which is alarming given their enormous potential to improve rural electricity access. The problem is even more acute for residential clean cooking where solutions are vastly underfunded. The needed investment for the 20 high-impact countries has been estimated at US\$4.4 billion per year, far greater than the trackable investment which averages US\$32 million a year (2013-14 data), or just US\$1 per capita per year.

By refining finance strategies to scale up action and prioritize energy access, it is possible to reach more people with sustainable energy. **Targeted strategies are needed from national governments, and the international finance community and partnerships with the private sector so that energy access gains - especially in rural areas with the biggest gaps - can be delivered faster.** One positive trend since the early 2000s is the steady increase in international development finance commitments and disbursements for electricity, although much of this is targeted towards non high-impact countries.

Fossil fuel subsidies present another important barrier to sustainable energy, as they create a burden on government budgets, reducing resources that could be put to more efficient use; undermine access to affordable energy by benefiting the rich rather than the poorest people; decrease the competitiveness of low-carbon businesses, discouraging investment in renewables energy efficiency; as well as compromise energy security (compared to subsidising alternatives such as renewables and energy efficiency). Fossil fuel subsidies also have a significant impact deterring technology transfer to developing countries. However some important progress is being made with reforms being undertaken in almost 30 countries in 2013 and 2014, some of which were spurred by falling oil prices (in line with SDG 12.C.1). In early 2017, investors and insurers with more than \$2.8 trillion in assets under management called on the group of G20 economies to phase out fossil fuel subsidies by 2020 in order to accelerate green investment in the energy sector and reduce climate risk. **It is recommended that prompt action is taken to phase out inefficient fossil fuel subsidies.**

Implicit in the target to increase the share of renewable energy, is the need to reduce consumption of fossil fuels. In particular, the phasing out of coal mines and coal fired power stations is an important step with multiple benefits including climate change (SDG 13.2) air quality (SDG 3.9.1 & 11.6) and energy security. In recognition of this, both the National Australian Bank and European Investment Bank have said that no new deals will be signed to financing new coal power plants, sending a strong signal about the future of coal.

As a first step the construction, commissioning and expansion of coal mines and fossil power stations should be halted, followed by closure of facilities approaching or past the end of their economic lifespan and then early closures should be considered. Whilst closure and decommissioning of all facilities will incur cost (e.g. in North America decommissioning of a 500-MW coal-fired power plant may cost US\$5-15 million net of scrap and take 18 to 30 months) at the same time, phasing out unprofitable coal plants could save US consumers US\$10 billion per year, but also boost the whole country's competitiveness.

The last step where plants are closed before the end of their economic lifespan poses the most difficult challenge, particularly where money has been borrowed for construction but not yet repaid. There are a number of possible sources of finance which could cover the remaining debt, including shareholders, the local or national government, climate finance or funds raised through carbon taxes. Whilst there is often no legal or other requirement to demolish an old power plant, it is important to consider and properly manage recycling, disposal and redevelopment of the site and assets within a reasonable time frame.

Many power plant sites may have significant redevelopment potential, they tend to be large consolidated properties and maybe located close to water near cities or industrial areas. Options for regeneration will depend on the individual circumstances, but typical choices include ports and terminals, petrochemical or industrial plants, commercial, or mixed-use development. Conversion from coal to natural storage gas is also a popular option (particularly North America driven by low gas prices) although this may not help to increase the share of renewables (SDG 6.3) there are other benefits including reduced carbon emissions, pollution and waste.

However, significant progress in the transition away from coal is being made. In 2016, China set a target of stop-

ping or delaying at least 150,000 megawatts of coal-fired power plant projects and followed this in 2017 with action on 150 proposed plants which together contribute 50,000 megawatts towards this target. Whereas in the USA, since 2000 over 200 coal-fired power plants (over 100 gigawatts of capacity) have been closed. More recently at the COP23 Climate Change negotiations, 19 Countries committed to a rapid phasing out of coal.

Whilst greater access to finance is critical to increase energy efficiency investments in both non-OECD and in OECD countries, numerous studies have identified various barriers including both the availability of funds and project development / transaction costs. Energy efficiency projects require an upfront investment which pays off by delivering cost savings over time (e.g. oil and gas boilers have low upfront cost whereas renewable technologies have lower whole life costs) but they do not increase business revenue and so it can be difficult to clearly perceive the benefits. Energy efficiency projects often struggle to attract lending from Local Financial Institutions (LFI) because they are small, fragmented, have high transaction costs, a high proportion of “soft costs” (project design and development) and therefore a lower proportion of securitised assets. Aggregators who could create scaled bankable opportunities are often lacking.

PPPs have been used with remarkable success to attract investment in energy efficiency. Practice shows that institutional capacity for PPPs is very important. There are many possible PPP approaches, some examples include:

- Dedicated credit lines overcome the issues related to insufficient availability of funds for energy efficiency projects by providing the needed funds to LFIs which they can then on-lend to project developers or implementers. For example the Kreditanstalt für Wiederaufbau Bankengruppe (KfW) of Germany provided a dedicated credit line of €50 million to the Small Industries Development Bank of India (SIDBI) to finance energy efficiency projects in SMEs. Investments focused on efficiency for plant and machinery and production processes and delivered a reduction of 25 tonnes of greenhouse gases for every INR1 million (about US\$22,500) invested.
- Risk-sharing facilities provide LFIs with partial risk coverage on loans for energy efficiency projects, thereby overcoming a perception of increased risk. Examples include the Commercializing Energy Efficiency Finance (CEEFF) which was designed to meet the Global Environment Facility objectives to promote and enhance commercial financing of energy efficiency projects in Hungary, Czech Republic, Slovak Republic, Latvia, Lithuania, and Estonia.
- Energy Saving Performance Contracts (ESPCs) have proven to be effective tools in overcoming financing barriers to energy efficiency implementation in countries with very mature markets (e.g. in the USA more than 500 ESPC projects have been completed to save US\$11.7 billion in energy costs). In the ESPC approach, the customer engages a commercial service provider to design and implement an energy project with remuneration connected to the performance of the project.

Access to modern energy must go beyond residential power access. It must aim to unlock new entrepreneurial opportunities and support global energy interconnection. **The technology for worldwide energy connectivity is available, the barriers are institutional, not technological. Decisive progress can only be made through partnerships that mobilize and share knowledge, expertise, technology and financial resources.**

Capacity building, knowledge & partnerships

Capacity building and knowledge have a critical role to play in ensuring that the right policy and regulatory framework is in place, but also to unlock both public and private funding by presenting bankable projects and scaling up proven solutions such as micro finance and energy efficiency. LFIs are often unfamiliar with energy efficiency technologies leading to unfounded aversion due to a perception of complexity, additional expertise, effort and cost. **Building capacity within project developers, energy services companies (ESCOs), project hosts (energy users), and LFIs can help to overcome the ‘disconnect’ between projects and current lending practices.** There is also lack of knowledge and trained professionals required to complete risk assessment and management of these projects. MRV protocols have been developed but these must be more widely disseminated and implemented particularly among bankers and lenders.

Extensive international experience and knowledge should be leveraged to expand labelling programmes and minimum energy performance standards for major buildings equipment (e.g. boilers, refrigerators, air

conditioners etc.}). Programme development, training, capacity building, and financing are especially needed in developing countries where there is strong evidence that investments can produce large energy savings.

At the global level monitoring and reporting progress towards SDG 7 is essential and is chiefly undertaken by the Sustainable Energy for All (SEforALL) initiative. Findings are published in a biennial report, the 2017 edition concluded that whilst many countries are taking action, the world is not moving fast enough.

Country level assessments regarding policy and regulatory support for sustainable energy have been completed using the World Bank Regulatory Indicators for Sustainable Energy (RISE). This provides a reference point to help policymakers benchmark their sector policy and regulatory framework against those of regional and global peers, and offers a powerful tool to help develop policies and regulations but also target investments that advance sustainable energy goals.

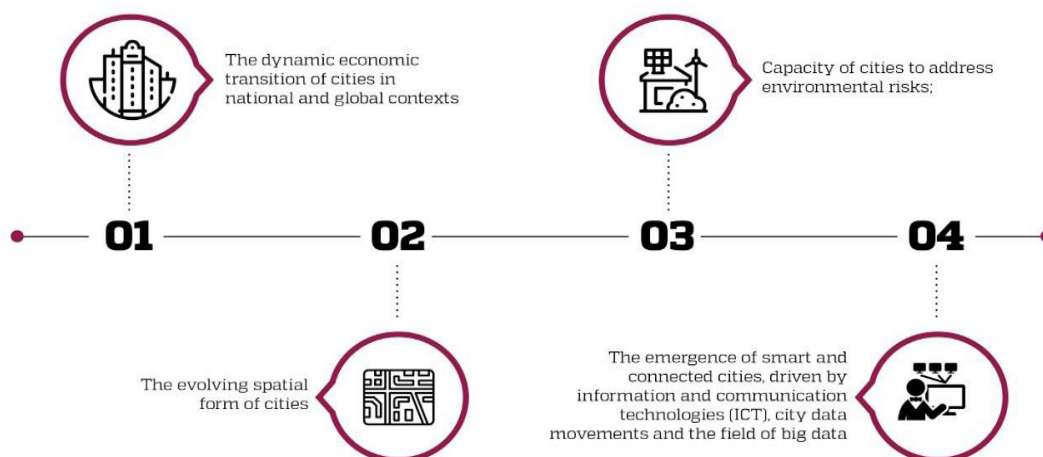
Partnerships have a direct role to play in delivering SDG target 7A (aimed at enhancing international cooperation), and more broadly for all the targets. The SEforALL supports international cooperation and partnerships including with governments, business, institutions, financiers, development banks, unions and communities, entrepreneurs and civil society in support of SDG 7. The Global Compact for Sustainable Energy provides a complementary framework dedicated to business action in support of SDG 7. The objectives are to motivate, inspire, and guide private-sector engagement in support of SEforALL and identifies where different industries can have the most significant impact. More specifically aligned with SDG target 7.3, the International Partnership for Energy Efficiency Cooperation (IPEEC) works with 17 of the Group of 20 (G20) economies (representing 80% of energy use) to accelerate energy efficiency policies. The Partnership has agreed an action plan with nine dedicated task groups focused on priority areas, best available technologies and best practices. A quick win solution to develop partnerships between state and non state actors is the Marrakesh Partnership on Global Climate Action under the UNFCCC. Cooperative climate action among Parties and non-Party stakeholders through the Marrakech Partnership aims to support implementation of more climate action now, consistent with the achievement of the national climate action but also SDG 7, and to foster greater ambition over time on mitigation, adaptation, and the delivery of finance, technology and capacity building to developing countries. The tracking of progress in the delivery of commitments by non-Party stakeholders and voluntary initiatives can build the confidence required to increase ambition over time, and will help identify gaps and where there is a need for improvement. **Countries should sign joint declarations with initiatives and countries to reinforce partnership efforts and political dialogue on SDG 7 implementation, notably via the Marrakesh Partnership.**

SDG 11: MAKE CITIES INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

By 2030, the majority of the world's population will live in urban areas, with most of the expansion set to take place in developing countries. If we are to end global poverty and inequality by 2030, it's not just countries that need to achieve the SDGs, but cities too. Yet cities face a number of challenges of their own, many of which could reverse progress. The number of people living in slums is rising, widening the gap between rich and poor. City governments frequently lack the resources to provide water, sanitation, waste management, transport and other infrastructure services that contribute both to well-being and poverty, reducing economic growth. Cities produce a high level of pollution and account for most of the world's energy consumption and high population levels make urban areas more vulnerable to human, social and economic loss caused by climate change and natural disasters. SDG 11 aims to address these challenges head-on and by endorsing a standalone goal on cities, the international community recognized urbanization and city growth as a transformative force for sustainable development.

This transformative force can be achieved with cities taking the lead to address many of the global challenges of the 21st century, including poverty, inequality, unemployment, environmental degradation, and climate change. Cities have become a positive and potent force for addressing sustainable economic growth, development and prosperity, and for driving innovation, consumption and investment in both developed and developing countries. This dramatic shift towards urban life has profound implications for energy consumption, politics, food security and human progress. Although some of this change is positive, poorly planned urbanization can potentially generate economic disorder, congestion, pollution and civil unrest.

Key issues that position cities at the fore towards enabling transformative and sustainable development.



Source: UN Habitat, 2016

Clearly, cities need to be enabled to deliver but they also need to understand their role in achieving the global policy agenda. The challenge for cities has never been greater: increasing demands on services and infrastructure, reduced budgets, increased expectations, concerns about the environment and global competition. Advances in technology, ICT, the Internet of Things (IoT), and data analytics provide cities with the tools to better understand the functioning and operation of cities, and to better plan as well as deliver services more effectively and efficiently - helping create 'smart cities'. This can enable them to make more efficient use of physical infrastructure, improve local governance, respond to city needs in real time and even predict them. This will allow for better water and waste management, traffic flows, more efficient building and energy systems as well as allowing for greater resilience, improved governance as well as more cost effective on demand services that benefit citizens.

By taking an integrated approach to strategic city planning, as targeted by the SDGs (11.3 and 11a), all the above city systems and interlinkages are considered collectively which would result in greater efficiency in terms of both carbon and cost. This highlights the need to take a holistic approach to solutions, which is in the spirit of the SDGs. Moving from sectoral interventions to strategic urban planning and more comprehensive urban policy platforms is crucial in transforming city form, notably to enhance the densification of cities. ICTs have the potential to enhance better urban planning and smart city growth, rejuvenating inner city areas and older suburbs, remediating brownfields and, where new suburbs are developed, designing them to be town centred, transit and pedestrian-oriented, with a mix of housing, commercial and retail uses, drawing on cleaner energy and green technologies.

Urban innovation is becoming a massive global market, estimated to be worth over US\$400 billion to US\$1 trillion by 2020. Meaning, many of the technologies and innovations needed for SDG 11 are already on the market and with around 50% of all urban development yet to be built - mainly in developing countries - this offers an opportunity to leapfrog traditional urban development and design in smart solutions from scratch.

Given the long-lived nature of urban infrastructure, the decisions made over the next five years by both national and local governments will determine the development pathway of the future and SDG 11. Urban infrastructure investment is expected to make up two thirds of global infrastructure to 2030, which equates to around US\$4.2 trillion. Financing urban areas are hindered by many of the same barriers faced in other areas, including market failures, short term thinking, lack of bankable projects and the capacity to develop such projects. Many cities around the world are constrained by their national governments, their inability to raise local revenue, take on debt, and engage in PPPs and so on. Successful approaches that cities have employed to overcome these bottlenecks will be explored in further detail but it is essential that there is scale when it comes to capital investments and in LDCs, development finance needs to be exploited.

Cities and resilience

Technology and innovation is helping to make cities more resilient, which is recognised as a priority for SDG 11 (targets 11b and c). Currently, every seventh person worldwide lives in an informal urban settlement, summing up to 850 million people globally. With growing numbers of disadvantaged people now concentrated in mainly urban areas, investments in urban infrastructure can help to meet the needs of poor but also offer huge resilience dividends. This includes providing access to electricity, clean water, and waste disposal as well as access to schools, hospitals and housing. Providing basic infrastructure such as sanitation and sewers helps to build resilience, for instance during floods and disease outbreaks. Public transport, energy installations and basic housing also help to enhance resilience and alleviate poverty help to increase access to urban opportunities and reduce the costs of providing basic urban services. ICT development can play a key role especially in the upgrading of city slums. For example, Kibera, the largest slum in Kenya's capital, Nairobi, is home to approximately 1 million people. Yet Kibera has been excluded from city maps, but by working with local universities and developing an interactive digital map with ICT technologies, it has help the city build resilience as well as to provide basic urban services and better information to citizens, for instance where unsafe areas are flagged.

Many large cities are concentrated in low coastal zones and are exposed to extreme coastal water level events and inland cities, like their coastal counterparts, are also at risk. Settlements located along rivers are specifically considered 'high risk locations'. ICT can play an essential role in disaster risk detection and management through improved flood management systems, as has been done in the City of São Paulo where rain gauges equipped with ICT sends information to an online management platform in real time. This provides an early warning system to the city and its citizens on the likelihood of floods, landslides and droughts. The city of Calgary uses a similar approach to predict floods and by having better information, more targeted regulations on flood prevention have been formed, saving the city millions in water damage costs and improved city resilience. Usually, this benefits those most vulnerable and getting this right will be fundamental to achieving the 2030 Agenda.

The Philippines is a case in point where ICTs have been incorporated in all stages of the disaster management lifecycle from the national to local level. This is helping to prepare and predict flood incidents and in Japan, ICT is helping to prepare urban residents for potential earthquakes. As such, ICT is becoming an increasingly important tool to help cities, countries and citizens prepare and enhance their resilience. In addition, given increasing urbanism, the more resilient a city is, the more likely it is to be able to recover and bounce back to its normal state. **It is imperative that cities take climate and social risks into account when making investment decisions because if not, then cities become increasingly vulnerable and unattractive for further investment.**

Localising the SDGs, driving change and building institutional capacity

In order to make meaningful progress against the targets, national governments and cities need to both adapt their goals towards the SDGs as well as implement, monitor and report progress against them - a process known as localising the SDGs. As much as 65% of the SDG agenda may not be fully achieved without the involvement of urban and local actors. Given their critical role, local governments cannot be mere implementers of a global or national SDG agenda, but must be partners in co-creating and defining policy and programmatic responses, and in the implementation and monitoring of progress against the goals and targets. This can be initiated as part of a national agenda, ensuring policy alignment from a vertical perspective or decentralised to the local level or indeed, driven by cities themselves. As in the case of New York, USA, the city 'OneNY' strategy has been aligned with the SDGs and in Davao, Philippines, they have done an inventory on how local initiatives align with the SDGs. This can ensure the alignment of policies at the national level but also across city departments for SDG 11.

As a priority, national and local policies should be aligned to the SDGs, which in turn will create confidence to investors. Three additional factors should be addressed: greater access to finance, strengthening devolution alongside institutional capacities and development of partnerships in order to boost innovations.

This process of localising SDGs can also be integrated with STI development, for instance Dubai, UAE, has developed a number of policies to govern the opening and sharing of data through the use of ICT developments to support implementation of SDG 11. It has also created a governance structure to oversee its implementation.

The Smart Cities Mission is an urban renewal and retrofitting program by the Government of India. It aims to develop 100 smart cities all over the country making them citizen friendly and sustainable. As of June 2017, 90 cities had been selected to be upgraded as part of the mission. Each city will create a corporate company to oversee implementation, thus enhancing institutional capacity, and in return will receive core government funding to ensure implementation.

It is clear that strong leadership is a prerequisite to “kick start” significant STI uptake within a city but organisational change and strengthening is just as important in order to overcome siloed action, which in turn will help to delivery effective city services at a lower cost for citizens. For example, in Barcelona, Spain, after a major organizational reform, the Urban Habitat Department (the ‘Smart City’ department) was created. It is a new umbrella structure to coordinate services previously provisioned by individual departments regarding infrastructure, ICT, urban services, urban planning, environment, housing, architecture, energy and water, etc. Thus, previously siloed governmental departments are called to synchronize their strategies to achieve common sustainability goals.

In the UK, there is also a growing trend to decentralise power to the local level for urban STI uptake. Manchester’s Smart City Strategy is based on this decentralised model where the national government has given greater autonomy to the city, giving them greater access to local finance (including powers to raise local taxes) so as to invest in local SMEs to advance STI projects throughout the city. This also helps to drive the local economy and further raise local taxes which the city can then re-invest. **While this trend in overcoming departmental silos and decentralisation is a growing trend in developed countries and cities, the focus in developing countries should be to first establish the necessary institutions and capabilities.**

Emerging markets, like those in Africa, have the opportunity to leapfrog now-redundant technologies in developed nations and create truly smart cities and importantly, the development of such cities are on the increase in Africa, many of which are being built from scratch. An example is a new smart city, Sèmè City, in Benin, which is aiming to foster Africa-grown innovation as a solution to the continent’s economic challenges. Sèmè City will serve as a tech hub for Benin, complete with a business incubator – with 250 start-ups to be selected to receive support by 2030. A range of incentives have been offered by the government to encourage entrepreneurship and investment, such as tax and customs incentives, special economic zones and procedural advantages. The smart city will also host a number of research facilities and higher education initiatives, and is currently looking for international universities to create new learning establishments. The Sèmè City project aims to address the economic challenges faced by Benin and Africa at large, and graduate 200,000 students and create 200,000 new jobs by 2030.

To enhance local level institutional capacity to better plan, generate revenues, direct public investment as well as attract private investment, city authorities should have more influence and impact at the local level as well as being recognised and supported by their national governments.

Integrated land-use management and city planning should be a priority at the local level to improve coordination and support local investments. National governments must scale up efforts on making their cities more sustainable and smarter but also hubs of innovation.

This is important as structural problems and a lack of coordination between levels of government and across cities often constrain the levels of public investment. Particularly in developing countries, development coordination, including through MDBs and other development institutions, can play a key role in enhancing organisational capacity. Kampala, in Uganda, has worked with development banks to strengthen institutional arrangements and processes, in order to enhance service delivery. Such an approach has helped the city’s financial management, which has enhanced its creditworthiness thereby giving greater access to finance which can be used to advance STI efforts. Institutional strengthening and reform can also mean that private companies are less likely to be hesitant to invest in new technologies and infrastructure within cities.

Access to smarter finance and new business models

Access to finance is one of the most significant barriers that city leaders face in delivering on their development plans and SDGs. Additionally, there is a shortage of not only financial resources but also expertise in

securing investment for infrastructure projects. Despite these difficulties, many cities are devising innovative ways to diversify sources of finance as well as strengthening urban access to appropriate finance so as to empower them as agents of change.

In many cases, the public sector – locally and centrally – have limited budgets. This means that new market-oriented and sustainable strategies of public-private cooperation must be developed and cities must seek greater levels of external investment. For this to happen, the investment community seeks certainty through policy, leadership and direction, but most importantly scale of investment. However, most cities, at an individual level, presently deliver neither of these.

There is a need for cities to diversify traditional funding sources, but also generate new sources of revenue. These include greater budgetary control, enhanced creditworthiness, the use of land value capture, municipal bonds, reform of multilateral funding, and the ability of cities to generate their own taxation. In Lagos State, Nigeria, land and property tax reforms helped to raise public revenues from US\$190 million to over US\$1 billion. The “Rail plus Property” model which captures the increase in property values due to new public transport routes delivered US\$940 million in profits in 2009 for the 76% government-owned MTR Corporation in Hong Kong. Land sales and leases of government owned land also offers a one-off opportunity to raise revenues, notably if land value capture opportunities are not available. For example, Mumbai, India, generated US\$1.2 billion in 2006 from the auction of 13 hectares of land, which was 10 times more than the city budget the previous year.

In addition, user charges and fees can generate much needed revenue, for example in the UK, London’s congestion charge generates over £100 million which is earmarked for enhancements in the capital’s sustainable transport network. The ability for cities to generate their own taxes is also important. In France, cities have been given the authority from their national government to charge business over a certain size a tax so that the revenues can be invested back into the public transport network which ultimately benefits the business in return. This type of ‘beneficiary pays’ approach is becoming increasingly popular, for example, in the UK around a third of the funding for a cross-London rail project will be funded by local business given the benefits that they will receive from it.

National governments can play a key role in addressing the finance gap in cities so that they can meet local level needs aligned to the SDGs. A key area will be to strengthen city authorities in terms of finance, capacity and policy frameworks. This will help to transform the financial system of cities and the effectiveness of investments needed to meet the SDGs.

A major sticking point is that only 4% of the 500 largest cities in developing countries are deemed creditworthy in international financial markets, rising to 20% in local markets. This is centrally related to the weak revenue bases that often characterise municipal budgets. Investing US\$1 in raising the creditworthiness of cities can leverage more than US\$100 in private-sector financing for smart infrastructure. The World Bank’s City Creditworthiness Initiative has proved particularly successful for cities such as Lima, Peru, which enabled it to issue bonds to invest in low-carbon public transport. **Improving urban finance for the least-developed countries is a global development imperative and improving knowledge exchange is particularly important for developing countries but also for South-South cooperation.**

Cities can also use municipal bonds to finance a group of infrastructure projects, whose collective assets underwrite the bond. Such bonds allow cities to attract large institutional investors which typically prefer not to invest in small, individual projects. Sometimes, investors will accept a lower return when there is a commitment to use funds in a socially or environmentally responsible manner. The volume of labelled green bonds has grown steadily since 2013, reaching US\$221 billion outstanding issuances in 2017, but of this less than 2% has been directed to Southern cities. Despite this, Johannesburg in South Africa has recently successfully issued green bonds, worth ZAR1.5bn (approx. US\$143m) and is funding projects across a range of sectors including 150 new dual fuel buses and converting 30 buses to biogas. The bond was 150% oversubscribed. Citizens should be also involved in innovative co-creation and “crowdfunding” mechanisms, in order enhance their sense of awareness by getting tangible outcome from smart cities initiatives. This has proved successful in New York where local citizens have invested in the city’s green bonds, which has also helped to make the city more resilient.

The bond market can help to enhance city resilience, for example, catastrophe bonds can be leveraged in the goal to provide the world with access to the \$200-\$300 billion of capital required to help countries and cities com-

but climate change and other natural disaster shocks.

As green bonds are relatively new, MDBs - which are major players in these markets - should only issue them when there is a direct link to the targets of SDG 11. International standards should be established to ensure this. Furthermore, as smaller cities are often unable to take advantage of such facilities, they should look to develop joint initiatives and partner up to raise their scope of borrowing so as to aggregate demand.

However, if bonds are to be issued, the projects themselves must be bankable. This is true for other sources of financing and funding and there are facilities available that can help to achieve this. For example, the UN Habitat Slum Upgrading Facility works with local actors to make slum upgrading projects bankable – that is, attractive to retail banks, property developers, housing finance institutions, service providers, micro-finance institutions, and utility companies. The Facility has pilot projects in Ghana, Indonesia, Sri Lanka and Tanzania, where various approaches are being tested to support the bankability of projects.

PPPs are an obvious area for city finance but tend to be top-down driven by national governments. However, they are increasingly being driven from the bottom up. In Flanders, Belgium, in 2014, the national bank launched a co-financing program of €400 million with the European Investment Bank to facilitate the realization of smart projects. Local authorities and local business joined forces and made a massive use of this program, and the success has resulted in the launch of a second program, again available for €400 million.

For PPPs to succeed, lessons must be learned from historic failures. Poorly structured deals using more expensive private finance and overly optimistic user revenue forecasts have had disastrous consequences. One example is Mexico's PPP road programme, which left local and national users with some of the most expensive road tolls in the world and ended with the government taking 23 projects back into public sector control, along with responsibility for US\$5bn of debt. In Egypt, freshwater – a vital resource already in short supply for drinking – was wastefully being used for irrigating urban green areas. The government knew something had to be done, but public funds were tight, and it had limited experience in enlisting the private sector to develop solutions. After adopting PPP legislation, the government invited companies to tender for building a wastewater treatment plant, which could both generate water for irrigation and limit the amount of polluted water being dumped in the Nile. By adopting a prosocial PPP model, costs have been brought down, indirect jobs created and the city of Cairo is now more resilient.

This experience is not unique, PPPs have been effectively deployed in cities across all continents, with PPPs accounting a sizable proportion of investments in some economies, for example the UK where it can be as such as 10%. As PPPs cover long time spans, these can complicate contractual arrangements, difficulties to cover costs through fees and political risks alongside a lack of administrative capacity can all make PPPs unattractive propositions. However, if done well, it can significantly enhance action towards the SDGs.

For PPPs to be successful, there needs to be a shared and balanced distribution of risk and reward and contracts should not try and predict every eventual outcome. By having flexibility in contracts, with the support of national governments, PPPs can scale up implementation on the SDGs.

Leveraging ODA and MDB finance for the local levels can play an important role in scaling up new partners and blending finance for the SDGs. Current ODA to LDCs is in the region of US\$41 billion but only US\$0.3 billion of ODA is allocated for urban projects in LDCs. ODA to LDCs has recently increased but is way off the UN target of 0.15-0.2%. The AAAA commits to scaling up international coordination to strengthen capacities of local authorities and a concerted effort by all stakeholders. Using ODA will help de-risk investments from the private sector and build institutional capacity as well as accountability. Ensuring the capacity of the local level to develop bankable projects as well as partnership building (including South-South cooperation) is just as important. **ODA funding needs to better target urban areas and not just at the infrastructure level but also at the human capacity level, in terms of project development but also project implementation. This is typically overlooked and technical assistance must feature more prominently in MDB finance.**

Capacity to act and knowledge sharing

Alongside new and better coordinated institutions and finance, there will be a need for new urban managers and skills to take advantage of new technologies and innovations. National government can play an important role in facilitating this. In the UK, the government worked with cities across the country to develop capacity,

best practice sharing and knowledge on scaling the uptake of technology innovations at the local level. City and sectoral networks are also sharing knowledge and best practices around new technologies ideas, which should be taken advantage of at the local and national level.

Skills in integrated planning and management capabilities must be scaled up in both developed and developing cities, which involves spatial, temporal and technical coordination of diverse policy areas and planning resources. It is particularly challenging as it involves managing long-term planning perspectives alongside short-term actions.

Living labs in cities like Singapore, and Santiago de Chile are helping to test innovative technologies, R&D and deployment. In the case of the latter, tax incentives are given to business who support R&D activities. These can act as test-beds for innovation and facilitate the transition for SDGs, which can support the scale and pace needed for their attainment. The most promising innovations right now are already on the market in the building, energy, waste, water sectors and so on. However, the greatest innovations can also come from the way we work and align ourselves to facilitate innovations. To do this, we need the capacity to make this happen. **A quick win solution for national governments would be to establish innovation zones in cities and to facilitate the sharing of best practices and capabilities between cities as soon as possible.**

The old adage, “you can’t manage what you can’t measure” is fundamental to the urban SDGs given their wide ranging focus but also for decision making. There are a multitude of indicators which are being aligned with the SDGs that incorporate ICT and geospatial information and can be used to progress smart city efforts (e.g. ISO 37120 and the International Telecommunications Union (ITU) indicators on United for Smart Sustainable Cities). By having comparable data, cities can make informed decisions through better data analysis, benchmarks, and target performance, prioritize budgets, improve operations transparency which can support the development of new business models, overcome governance silos, learning and leverage funding for infrastructure and technological investments. Mobile phone data offers a quick and relatively cheap source of information and has been used to enhance understanding of travel patterns in London, UK, Nairobi, Kenya, but also support crowd control and people’s safety during Mecca in Saudi Arabia. **Only about 20% of the world’s 150 largest cities have even the most basic analytics needed for low-carbon, SDG planning, and too few have created long-term plans and targets. This is a challenge to achieving the SDGs and makes capacity building on MRV – especially in cities – all the more important. This should be a priority for national governments and UN agencies to address.**

Data exchange can also drive the local economy through innovation and open standards, helping to avoid vendor lock in. The Copenhagen City Data Exchange, collates information from various private companies and public authorities, synthesising the information to enhance the efficiency of the city allowing it to eliminate big data silos. The exchange enables large companies, small and medium enterprises, start-up companies, as well as the academic, the public and public sectors, to come together and integrate multiple sources of information. Such levels of data integration helps business develop innovative partnerships and solutions with open standards that also helps the city of Copenhagen to largely improve its city operations and provide improved services without having the need to increase capex on infrastructure and data gathering, while also helping drive local business.

National reviews on the SDGs are starting to include complete local level data but this is the exception rather than the norm. This will need to change if national governments are to put in place the right frameworks in order to facilitate the local level action that can drive STI developments and finance in cities.

Partnerships will be essential to scale up deployment and can take several forms, from partnerships between national and local governments, partnerships between the public and private sector, to partnerships between cities and their citizens. This helps to break down hierarchies and lead to greater innovation, better targeting of resources and an increased sense of ownership of projects and initiatives. At the same time, the objectives of cities and business are sometimes (perceived to be) not aligned, resulting in a lack of partnership development. To overcome this, Amsterdam, Holland, partners with a range of local business, universities and SMEs through an online platform where innovative solutions are put forward and solutions taken up. A key success condition is that the partners involved must agree that this project is valuable, and commit resources to it accordingly (co-financing, charging for products or services at cost, or committing in-kind hours). Most projects thrive by having one partner that can clearly benefit from the project: as owner of the project, he or she feels responsible

for the process and its outcomes, takes initiative when the project struggles and is often also the project leader.

Partnership programmes that have also been set up at the national level to support cities, including in China, Brazil and Holland. By the end of 2015, after four years of numerous applications and 185 concluded projects, the Dutch government has proven with the Green Deal Programme that with a responsive and collaborative approach and by bringing in relevant stakeholders across sectors, many barriers to city investment can be overcome. Partnerships can also work between countries, such as the recent partnership agreement with the EU and India on smart urbanism as well as with cities, for instance through the World Bank's City and Regional Partnership Programmes which helps cities across Japan share best practice efforts on funding and financing STI innovation.

The scaling up of partnerships is essential. Local, national and global initiatives should take advantage of the networks and facilities available. A particular priority will be to bring state and non-state actors at the local level closer together. The city initiatives under the Marrakesh Partnership of Global Climate Action is a quick win solution and should be further facilitated, financed and championed by the UN system as well as at the national and local level.

RECOMMENDATIONS AND CONCLUSIONS

While all the SDGs face their own unique circumstances, they share similar challenges which cannot be seen in isolation. Transformational change is needed in how we run and build our cities, produce and use energy as well as how we manage and supply our water systems. There is a consensus that money will not do the job alone and that a range of barriers need to be firstly tackled to raise the quality and quantity of investment decisions. Other efforts will take time to bed-in but will result in significant progress going ahead.

The importance of strong political will cannot be understated. This can create the right vision and align incentives to support higher levels of ambition, if not, it will lead to disorganised and even conflicting efforts that have the potential to be counterproductive. This will must be enacted at all levels of the political spectrum. Concerted action in five interlinked areas can overcome these barriers and build the much needed enabling framework to advance efforts on the SDGs.

1. **Strengthen investment in STI and foster business dynamism**
2. **Invest in and shape an efficient system of knowledge creation and diffusion that will help to foster talent, skills and optimise their use**
3. **Seize the benefits of the digital economy**
4. **Improve the governance and implementation of policies for innovation**
5. **Transform the financial environment for the SDGs**

In addition to the specific recommendations outlined for the individual SDGs, these cross-cutting recommendations build on and take forward the 10 "Doha Messages" drawn from the discussions of the High Level Conference on Financing for Development and Means of Implementation of the 2030 Agenda (19/11/2017) and provide timely input and consideration to the 2018 HLPF and FfDForum.

1. Strengthen investment in STI and foster business dynamism:

Recommendation: Increase national and global financing and funding targeted at STI's for SDGs implementation, this should include a visible floor percentage of countries' ODA focused on helping those furthest behind and cities. Funding allocation should account both financial and non-financial factors in order to strengthen transparency, allow solid monitoring, increase accountability and review, and provide useful contributions to national SDG reporting.

Recommendation: Governments should tackle fundamental price distortions in order to provide incentives for investment, innovation as well as to generate revenue to support those most in need. Removal of inefficient subsidies, notably inefficient fossil fuel subsidies, should be complemented with pro-poor pricing as appropriate to remove access barriers and ensure that no-one is left behind.

Recommendation: Governments should establish a comprehensive and transparent fiscal accounting and reporting standard for “people first” PPPs and inclusive innovation. They should establish legal, regulatory and monitoring frameworks for PPPs that ensure appropriate pricing and quality of service aligned with the SDGs. It is necessary that countries also set up the public institutional capacity to create, manage, evaluate and monitor PPPs.

2. Invest in and shape an efficient system of knowledge creation and diffusion that will help to foster talent, skills and optimise their use

Recommendation: Increase public and private sector investment in R&D aligned with SDGs. To do this, it will be necessary to provide better public support and include predictability of regulatory regimes, tax credit schemes, proper pricing schemes (e.g. carbon pricing) and other investment incentives, notably in cities. These incentive policies should be time-bound, in that it can trigger rapid learning-by-doing and lower the financial risk associated for the private sector.

Recommendation: All countries, including the poorest, to invest at least 1% of their GDP on research and urge the most advanced countries to spend at least 3% of GDP on R&D. Countries should also exploit the impact of trade and aid to scale up opportunities for global, cross border, regional and local capacity building, knowledge sharing and so on, in order to advance SDG efforts. There should be a focus on the diversification of LDC economies and all national funding sources should be aligned to STI roadmaps to avoid a piecemeal approach. A particular focus should be on supporting SMEs, which can play a key role in driving local and national economies. This should include the state acting as a guarantor in the first instance for loans and then acting as an advisor or regulator if needed.

Recommendation: National R&D priorities and STI roadmaps should be developed and aligned with the SDGs. In turn, these roadmaps should influence reforms to the science and education policies, including university, secondary, tertiary and vocational education and skills in countries. This will create a skilled workforce and informed citizens of the future needed to deliver a paradigm shift to advance STIs for the SDGs. At the same time, Governments must also partner with countries (notably LDCs) and non-state actors to help cities to share experiences and best practices, supported by the UN system, notably through the TEM. A quick win solution would be to scale up efforts on the Marrakesh Partnership on Global Climate Action.

3. Seize the benefits of the digital economy

Recommendation: Both the public and private sector should promote open data and open standards in support of SDG implementation. In this context, data should be considered an “asset” whose development for universal use should be the objective of public policies, but also protecting people from the misuse of personal data. Where appropriate, the public sector players should look to “monetise” data wherever possible.

Recommendation: International collaborations on data science and technology research must be scaled up by UN bodies. The HLPF must urgently address data gaps related to the SDGs and associated targets at the local, national and international level. Where gaps are identified, roadmaps and expert groups, at both the national and international level, should be established instantly to build capacity for MRV through STI, notably including ICT.

4. Improve the governance and implementation of policies and regulation for STI

Recommendation: Establish National Science and Technology Agencies and Funds to ensure coordination at all levels. Governments should devolve decision making and budget control to an appropriate level in order to enable local level action to implement STI solutions for SDGs. For this to be effective at the local level, particularly in developing countries, institutional capacity and funding / finance need to be strengthened. Better budgetary management, enhanced creditworthiness, municipal bonds, reform of international public finance and the leverage of cities over taxation are critical for making an impact. Countries should set up excellence centres, technology incubators etc. in cities with SMEs, where in some cases national regulations are relaxed to test innovative solutions.

Recommendation: Quick action should be taken to improve effective and proven regulation, standards, labelling and trade towards the SDGs. This should account end of use issues and be mandated by public authorities as well as the private sector. The public sector should also include SDG criteria in all procurement procedures and decisions.

Recommendations: Apply relevant policy principles (e.g. polluter pays, beneficiary pays, etc.) that will help drive behaviour change. All countries should develop long term transitional plans for STIs aligned with the SDGs and related international agreements in order to accelerate efforts. These plans should be replicated in cities, prioritising long-term policies and investments aligned to the objectives of Goal 11 and beyond, to ensure a whole government and society approach, ensuring coordinated action both vertically and horizontally.

5. Transforming the financial system for the SDGs

Recommendation: Multilateral and other DFIs, alongside governments at all levels, to formally commit and detail how their future policy and investment decisions and STI roadmaps will be aligned to the SDGs. Sovereign wealth funds and financial blending should also be aligned to the SDGs and best practices on how to do this can be done must be urgently shared, notably through the UN system, in order to scale up supply and demand side innovation.

Recommendation: Governments, MDBs and investors should agree common standards for the scaling up of investments towards the SDGs, notably in relation to municipal green bonds so as to enhance liquidity in financial markets and unlock capital for investment towards. As an urgent first step, municipal and green bonds should only be issued if there is a direct link with the SDGs and international standards should be established to ensure this. Wider financing and funding conditionality should be used where necessary to ensure effective investment is targeted towards the SDGs.

Recommendation: Countries should mandate public, private organisations and investors to disclose their contribution to the SDGs by requiring accounting and transparency in their decision making and financial systems through non-financial reporting legislation. This disclosure will help undertakings to incorporate the SDGs in terms of accountability, transparency and investments. Voluntary frameworks for disclosure - such as the GRI - could provide useful mechanisms to ensure that disclosures are sufficiently detailed and transparent, enabling the benchmarking of performance.

Conclusions

The recommendations outlined above, as well as in the individual chapters, detail a number of important steps needed to finance and implement any roadmap for STI transformation for the SDGs. In doingso, with determined political will, economies will be transformed as well as efforts towards SDG 6, 7 and 11. There is also a need for patience as countries, regions and cities as well as the international community at large refocus on their attainment. The SDGs will only be taken seriously if they have a mandatory MRV element attached to them at the company, local, regional, national and international level, with clear lines of responsibility and accountability.

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