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FOREWORD BY THE TASK FORCE CHAIR MIGUEL ANGEL GUTIERREZ

Energy transitions through actionable and sustainable practices: our global, supportive and coordinated perspectives.

The way we generate and distribute energy is of paramount importance for our societies, regardless of our origin. Rational and conscious energy choices need to be made to guide the sustainable development of each nation, bridging business, politics and sciences.

At the same time, the year 2018 year has shown us the unprecedented consequences and hazards of climate change, the danger and the scale of challenges that urge our global community to swiftly take control of greenhouse gases emissions. In my role as B20 Argentina Chair of the Energy, Resource Efficiency and Sustainability Taskforce, I am very pleased by how much the B20 community has embraced in terms of low-carbon options energy choices, energy efficiency and distribution upgrades, and climate mitigation measures.

For the Paris Agreement scenarios and targets to be achieved, significant shifts and reforms in the energy systems are required, with leadership motivation, trade-offs and responses coming from our Business Community. We need to overcome climate and energy efficiency challenges while unlocking future business opportunities, guaranteeing lower carbon power generation and society´s growth, support and inclusion.

A clean and efficient energy future will entail the widespread adoption of renewable energy sources complemented by cleaner energy sources namely natural gas, cleaner liquid fuels, biofuels, hydrogen, nuclear and energy efficiency initiatives. Region-centred roadmaps will guide energy transitions according to distinct resource availability and capabilities, starting points and paths to travel.

Fostering tangible actions, the policy paper we propose to the G20 ministers, emphasizes three pillars: roadmaps to guide low-carbon and energy-efficient transitions, just transitions to include all human capital while shifting our energy matrix, and circular economic models to avoid pollution as the inevitable consequence of economic activity and growth.

We are convinced that a supranational cooperation organization, similar to the intergovernmental Resource Efficiency platform proposed by the 2017 B20 Germany, should guide and support countries, especially emerging economies, across these transitional processes.

We as the Energy, Resource Efficiency and Sustainability Taskforce, are pleased to have worked meticulously and discussed democratically in order to understand and propose actionable and grounded recommendations to accelerate such energy transitions, to deploy energy efficiency in industries and households, to reinforce new

energies regulatory frameworks and finally to shift producers and consumers habits towards climate resilient actions through integrated economic and business models. And to have placed emphasis in mainstreaming human capital and technology advancement in such endeavours.

I also want to thank Germany for the brilliant work carried out last year and for leaving us with this process in such good order. And I pledge to do everything I can to ensure an equally smooth and productive transition for our Japanese friends.

Sincerely,

Miguel Gutierrez

Chair of the Energy, Resource Efficiency and Sustainability Task force
Chairman, YPF

TRANSITIONS TOWARDS A SUSTAINABLE FUTURE

EXECUTIVE SUMMARY

The Argentina B20 Energy, Resource Efficiency and Sustainability (ERES) Taskforce, wishes to commit the global business community and the G20 leaders to pursue accelerated transitions towards a low carbon, sustainable and equitable energy future as mandated by the UN Sustainable Development Goals (SDGs). B20 leaders call for decisive action against climate change and the provision of actionable roadmaps aimed at the accelerated reduction of greenhouse gases (GHG) emissions. B20 acknowledges that for signatory Governments, the Paris Agreement provides an international legal framework capable of ensuring local and regional paths to fight climate change at global scale.

To accomplish this goal, the B20 ERES task force is determined to cooperate with the G20 leaders to overcome present challenges. In 2017, global energy-related CO_2 emissions grew by 1.4 percent, reaching a historic peak of 32.5 gigatons, while energy efficiency improvements slowed down. Resource efficiency still falls behind in the leaders' agenda, hampering necessary transformations from linear to circular economies. Over 1.1 billion people worldwide lack access to energy, 2.8 billion need clean cooking solutions, and climate adaptation policies only account for 7 percent of climate impact investments. Worldwide consistent strategies to cope with the irreversible consequences of climate change need further conscious cooperation. Argentina B20 ERES Taskforce acknowledges the opportunity to deliver consistent strategies and policies at global, regional and national levels to mitigate the actions and consequences of climate change.

Building upon the previous B20s commendable efforts, the ERES Task Force recognizes that a clean and efficient energy future will entail the widespread adoption of renewable energy sources complemented by cleaner energy sources namely: natural gas, cleaner liquid fuels, biofuels, hydrogen, nuclear and energy efficiency initiatives. Region-centered roadmaps will guide energy transitions according to distinct resource availability and capabilities.

The B20 Argentina asks the G20 to accelerate energy transitions to a low carbon future, advising on human-centered development and scaled financial support, while enabling political and regulatory environment, high commitment to Research, Development and Deployment (RD&D), and improved institutional capacity. In favor of sustainable energy transitions the B20 ERES task force encourages the G20 leaders to pursue the following five actionable recommendations:

Recommendation 1: Accelerate transitions to a low carbon future – The G20 should act decisively on mitigation strategies, favoring the substitution of high carbon fossil fuels for low carbon, renewable sustainable and cleaner energy sources.

Firstly, we advise G20 leaders on the importance of strengthening national policies that augment the capacity of countries to implement energy transitions while meeting growing energy demands. We support developing roadmaps for energy transitions, respecting national specificities; scaling financial solutions to enable

roadmap execution; promoting flexible regulatory environments and fostering just transitions. Secondly, we prompt the G20 to encourage accelerated research, development and deployment of renewable energies and cleaner sources, enhancing grid electrification, re-electrification, digitalization and storage technologies; fortifying carbon capture, usage and storage; and developing interconnections and international trade.

Recommendation 2: Increase coverage and impact of energy efficiency policies – The G20 should foster the expansion of energy efficiency policies, advancing standard-setting in energy and utility companies, businesses, households and transportation systems.

Firstly, we encourage the G20 leaders to commit to appropriate energy efficiency policies within energy and utility companies and across industries´ value chains. This includes reinforcing the global discussion towards a harmonized global carbon pricing as a policy to reduce energy waste and as an incentive to lower emissions. Secondly, we advocate for efficient policies and practices for buildings and households, implementing time-dependent pricing and smart meters; and mandating sustainable building design. Thirdly, we recommend the development of sustainable and efficient mobility systems setting standards for ground transportation.

Recommendation 3: Ensure access to affordable, reliable and sustainable energy – The G20 should support the global expansion of energy access through on-grid, off-grid and clean cooking solutions for underserved communities striving to minimize the energy access gap.

Firstly, we encourage G20 leaders to promote rapidly implementable transition solutions to reach SDG7, facing the challenges of each alternative, such as densification and expansion of on-grid solutions for urbanizations and decentralization and off-grid solutions for rural communities, while systematically prioritizing the provision of clean cooking solutions. Secondly, we encourage and support the G20 to assist countries in public policy planning and in promoting sustainable business models to reach underserved communities.

Recommendation 4: Promote resource efficiency and circular economies – The G20 should promote policies and incentives for the adoption of circular business models to finally decouple economic growth from environmental issues.

Firstly, G20 governments should promote knowledge and capacity to facilitate and regulate circular economy development, enabling public and private sector cooperation to identify practical opportunities in: resource recovery, product life extension, circular design, shared platforms. Secondly, we prompt G20 leaders to develop metrics and methods to track and efficiently promote circular activities in the private sector, enhancing reuse, recycling and upscaling, while strengthening competitiveness and innovation.

Recommendation 5: Expand climate change adaptation policies – The G20 must improve climate-resilience plans, evaluation and funding of adaptation policies.

Firstly, we recommend G20 leaders to enhance the ability to assess and predict the impacts of climate change on infrastructure, production and business operations through climate modelling and forecasting tools, emergency response and disaster recovery plans. Secondly, we call for innovative technological integration of climate models and risk assessment into development policies and plans, supported by financial mechanisms to close the investment gaps in adaptation.

Finally, we firmly believe that the achievement of a sustainable energy future requires a platform for international cooperation guiding and supporting the different transition paths that countries are implementing. Such a platform needs to facilitate and coordinate evidence-based policy making and accelerate actionable practices towards a low carbon future.

We trust that, through enhanced international cooperation and the implementation of the recommended actions, the G20 leaders hold a unique opportunity to advance in the fulfillment of the Paris Agenda and the SDGs, delivering the promise of a shared and sustainable prosperity within a low carbon and equitable global economy.

KEY POLICY RECOMMENDATIONS AND ACTION PLAN

TOPIC 1: ENERGY TRANSITIONS

RECOMMENDATION 1: Accelerate transitions to a low carbon future

Policy Action 1.1: Further Transitions Readiness

- Implement roadmaps for energy transitions through renewable and cleaner energies.
- Scale financial solutions for renewable and cleaner energies.
- Support energy regulatory reforms to unleash innovation.
- Commit to just transitions.

Policy Action 1.2: Support Innovation in Renewable and Cleaner Sources

- Enhance replacement of high carbon energy sources, promote and update electrification. re-electrification and energy systems digitalization across the power system.
- Address storage technology challenges for renewables advancement.
- Advance research and deployment of Carbon Capture, Usage and Storage.
- Develop transnational interconnections and global energy trade.

TOPIC 2: ENERGY EFFICIENCY

RECOMMENDATION 2: Increase the coverage and impact of energy efficiency policies

Policy Action 2.1: Incentivize Energy Productivity Across Utility Companies and Industrial Value Chains

- Reward energy waste reduction through reflective pricing, certifications and management standards.
- Support the global discussion on carbon pricing.
- Incentivize the entry of new technologies into the energy infrastructure.

Policy Action 2.2: Increase Support for Efficient Policies and Practices for Buildings and Households

- Develop smart building plans.
- Implement time-dependent pricing, smart meters and home-device interoperability to profit from home connected devices.

Policy Action 2.3: Promote the Development of Sustainable and Efficient Mobility Systems

- Set standards for ground transportation, especially heavy-duty trucks.
- Incentivize fuel efficient and electric vehicle purchases, and the deployment of EV charging infrastructures.

TOPIC 3: ACCESS TO ENERGY

RECOMMENDATION 3: Ensure access to affordable, reliable, sustainable and modern energy

Policy Action 3.1: Promote Appropriate Rapidly Implementable Transition Solutions to Reach SDG7.

- Promote densification and expansion of on-grid solutions and improve user paying systems.
- Focus on decentralized solutions for rural communities.
- Prioritize the provision of clean cooking solutions to address the urgent problem of Household Air Pollution.

Policy Action 3.2: Improve Policy-Planning Capacity to Meet SDG7.

- Support national planning and business plans to achieve affordable, reliable and sustainable energy demand.
- Engage MDBs in developing financing solutions for energy projects.

TOPIC 4: CIRCULAR ECONOMY

RECOMMENDATION 4: Promote resource efficiency and circular economies

Policy Action 4.1: Enhance Public and Private Sectors' Capacity to Achieve Greater Resource Efficiency and Circular Economies

- Develop integral resource efficiency and circular roadmaps.
- Promote the adoption of industry-specific parameters for resource efficiency and circular economy.

Policy Action 4.2: Promote the Adoption of Resource Efficiency Actions in all Industries

- Prioritize policies that encourage the private sector to implement resource efficiency and circular economy.
- Enhance reuse, recycling and cascading at the product's end of life to an extent that brings about the highest sustainability benefits according to full life cycle assessment.

TOPIC 5: CLIMATE CHANGE ADAPTATION

RECOMMENDATION 5: Adapt to climate change with a focus on integrating resiliency plans into public and private investment plans

Policy Action 5.1: Integrate adaptation measures into mitigation and investments plans:

- Enhance assessment and prediction capacity of climate impacts in key economic sectors.
- Integrate climate change adaptation into development policies and plans.
- Promote the collaboration of the public and private sectors to implement

effective adaptation measures.

Policy Action 5.2: **Promote financial mechanisms to overcome the investment gaps in adaptation**

- Quantify the effort needed for adaptation investments and resilient infrastructure.
- Promote financial mechanisms to close the investment gaps in adaptation.

TOPIC 1: ENERGY TRANSITIONS

In 2017, carbon emissions rose for the first time since 2014, driven by a 2.1 percent increase in global energy demand, doubling rates from the previous year. According to the latest report[1] of the International Energy Agency (IEA), although renewable energies saw impressive gains, in a renewed period of strong global economic growth, increasing energy demand was met 46 percent by oil and coal and 22 percent by natural gas.

Constrained by specific regional and national energy matrix, transitions towards a lower carbon future need to accelerate. Decarbonization of energy systems, mitigation through energy efficiency actions, expansion of renewables and cleaner energies, fuel switching, and carbon capture, usage and storage are all musts in energy business and politics. In emerging and developing countries (EMDCs), access to affordable energy and sustainable growth will require international support to be paralleled by decarbonization trends.

As we believe that the world needs low-carbon energy production and strong growth in profitable, renewable energy, we invite G20 leaders and governmental organizations to lead an international approach to energy transitions, by (a) replacing high-carbon energy sources with cleaner energy sources; (b) accelerating the resolution of regulatory challenges for worldwide renewable energy adoption; (c) improving transition readiness through increased access to funding; (d) retraining and upskilling workforce where needed.

Transition readiness implies financial and human resources availability, with the former representing a challenge in emerging economies where financial risks can be particularly high.

In a context of robust global economic growth and increasing renewable energy competitiveness, G20 leaders should seize the momentum and commit to game-changing decisions for transitioning power-system matrices and accelerating progress towards low carbon and sustainable economies in all nations. According to a UNEP report[2], in 2016, investments in renewable capacity doubled those in fossil-fuel generation for the fifth consecutive year. The global proportion of electricity coming from these renewable sources rose from 10.3 percent in 2015 to 11.3 percent in 2016, avoiding the emission of an estimated 1.7 gigatons of CO_2. The IEA expects that the installed capacity from renewable sources on a global scale will grow 43 percent by 2022. This paper addresses the challenges of ensuring a no-one-left-behind approach in these energy transitions.

The global business community has a unique opportunity to shape a low carbon future and advance the Paris Agreement, a historical global commitment to achieve shared prosperity while protecting people and climate. For this reason, B20 leaders are committed to working together with G20 leaders to expand cleaner and renewable energy, replacing high carbon technologies and increasing the flow of qualified labor and investments.

[1] The Global Energy and CO_2 Status Report. IEA, 2017
[2] REN 21 Renewables 2017 Global Status Report in Perspective

RECOMMENDATION 1: ACCELERATE TRANSITIONS TO A LOW CARBON FUTURE

POLICY ACTIONS

1.1: Further transitions readiness.

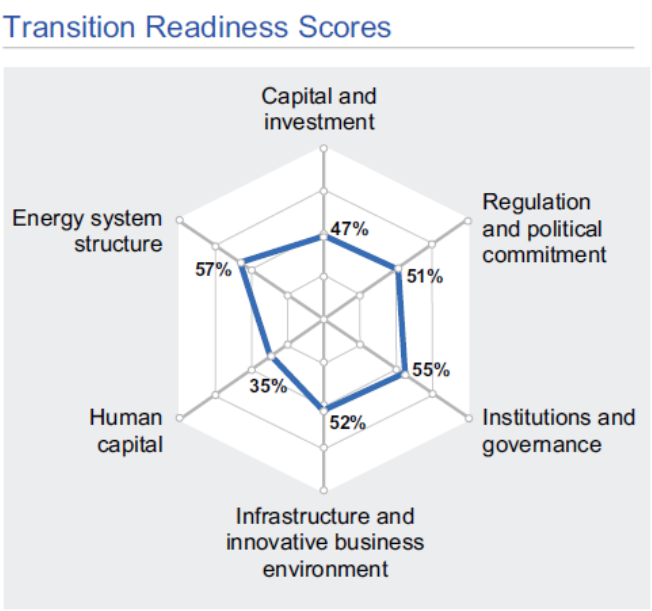
1.2: Support innovation in renewable and cleaner sources.

Policy Action 1.1: Further Transition Readiness

The G20 needs to guarantee an *ad hoc* political framework that augments the capacity of countries to implement just energy transitions through roadmaps, financial solutions and flexible and predictable regulations. Transitions towards a clean future require implementing carbon mitigation strategies feasible for, and adaptable to, specific regional energy matrices. A study by the World Economic Forum (WEF) identifies the six dimensions of energy transition readiness (Exhibit 1) that support effective and timely progress in system performance:

- Availability of investment and capital
- Effective regulation and political commitment
- Stable institutions and governance
- Supportive infrastructure and innovative business environment
- Human capital
- Ability of the current energy system to accommodate change[3].

Exhibit 1 | Transition Readiness Score



Source: World Economic Forum with McKinsey & Company's support

Aiming at obtaining good scores in regulation, capital and investment, institutional stability, infrastructure, business environment and human capital, the B20 members

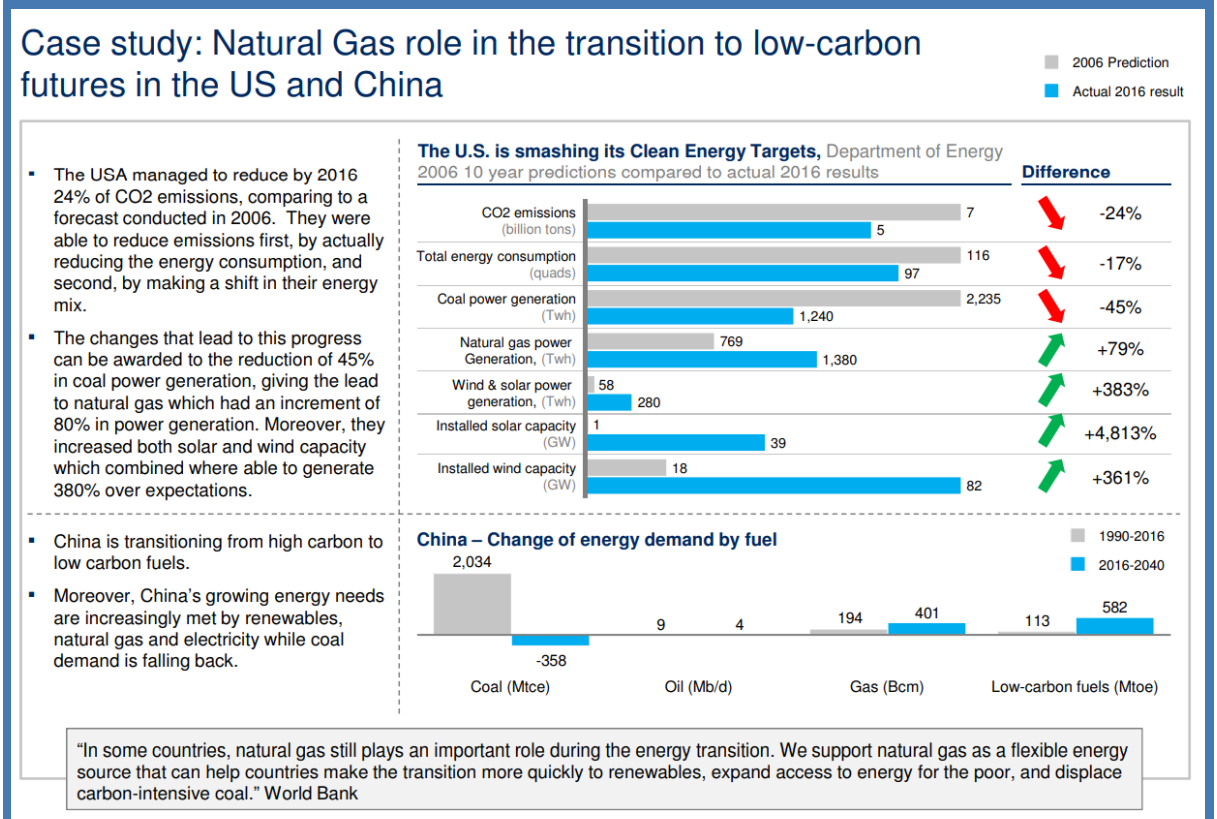
3 Fostering Effective Energy Transition. A Fact-Based Framework to Support Decision-Making. World Economic Forum. With analytical support from McKinsey & Company. March 2018.

recommend that the G20 presidencies incorporate the following actions:

- **Implement roadmaps for energy transitions through renewables and cleaner energies**

The G20 should: (a) reinforce political commitment to transform energy systems through energy planning roadmaps that align stakeholders and (b) structure clear governances to ensure continuity of energy transitions and institutional stability for accelerating decarbonization. Governments should leverage their existing energy matrix to fight climate change at the lowest society cost. Transitions should be addressed from a comprehensive and cross-cutting perspective covering all sectors, as illustrated in Exhibit 2, seeking to prioritize cost effective actions and respecting technological neutrality for decarbonization through renewables, natural gas, hydro, bio fuels, and nuclear, among others.

Exhibit 2 | Natural Gas Role in the transition to low-carbon futures in the United States and China



Source:_https://www.weforum.org/agenda/2017/10/the-us-is-smashing-its-clean-energy-forecasts, https://www.iea.org/weo/china/#section-1-4,http://www.worldbank.org/en/topic/energy/overview?cid=ECR_TT_worldbank_EN_EXT#2

Governments should also guarantee coordination of the various public-sector agencies through a national cross-agency plan, facilitating the involvement of renewable energy stakeholders in telecommunications, transportation and environment, by means of new technology pilots. Special attention should be paid to human talent recruitment for the specialized public-sector.

Under the Chinese G20 presidency, leaders announced the implementation of the

G20 Toolkit of Voluntary Options for Renewable Energy Deployment, with the goal of accelerating renewable energy growth through a joint action[4]. The toolkit, reinvigorated by the German presidency and by ERES, represents a relevant instrument that provides information on the progress of countries, and rigorous policy analyses on region-centered sustainable visions.

- **Scale financial solutions for renewable and cleaner energies**

Governments are recommended to engage the private sector in the design and implementation of Nationally Determined Contributions (NDC), aiming at the maximum contribution to achieving the Paris Agreement. Governments and businesses must partner to translate NDC plans into investment plans and bankable projects, focusing particularly on energy systems transformations and infrastructure update.

Dynamic optimization of current financing mechanisms (Feed in Tariff- FiT, Feed in Premium- FiP, auctions and corporate power purchase agreements (PPA)) is suggested in order to guarantee successful energy transitions and evolution in regulation. Experiences suggest considering FiT incentives and FiP as "transition mechanisms", acting as essential tools for the initial uptake of renewables. Last renewables auctions results have shown that the Levelized Cost of Energy (LCOE) of wind and photovoltaic (PV) is becoming competitive with fossil-fuel technologies (Exhibit 2). To further increase the ability of renewables to meet growing demand, short-term markets and long-term prices need to complement.

G20 governments should empower Multilateral Development Banks (MDBs), supporting policy preparation, guarantees and risk mitigation strategies. Access to concessional loans from MDBs is vital for investors in developing countries. Measures to increase infrastructure investment are discussed in the Financing Growth and Infrastructure policy recommendation. Exhibit 3 refers to Green Bonds, a relevant financial option for private and public entities especially in emerging economies.

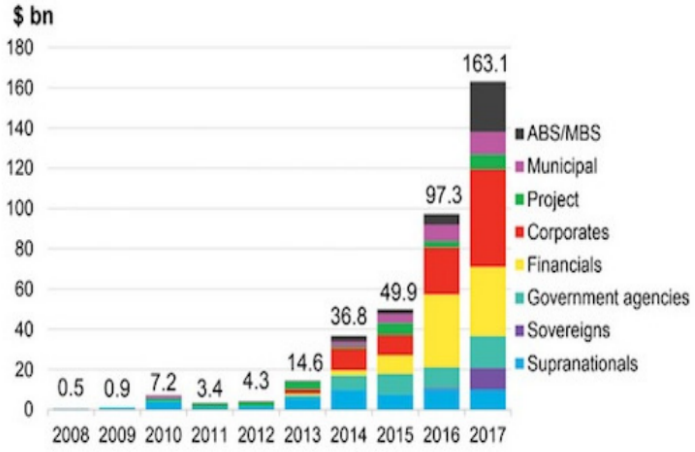
[4] The project is coordinated by the International Renewable Energy Agency (IRENA).

Exhibit 3 | Green Bonds Growth

Case study: Green bonds grow at fast pace with new initiatives to support in emerging countries

- Green bonds are financial options for both private and public entities.
- Green bonds attractiveness comes from the possibility given to firms to invest in climate conscious business and track their investment impact.
- The amount issued grew a 68% from 2016 to 2017 reaching 163.1 Billion USD with the largest share belonging to corporate issuers.
- The International Finance Corporation (IFC) is looking forward finding new ways to encourage local financial institutions to issue green bonds.
- IFC created a fund to support emerging markets and was involved in the issuance of both the first green Islamic bond and the first green bond in Fiji (emergency economy).

Figure 1 : Annual green bond issuance by bond/issuer type



NOTE: ABS stands for asset-backed securities, MBS stands for mortgage-backed securities
http://www.worldbank.org/en/results/2017/12/01/green-bonds ; http://pubdocs.worldbank.org/en/343311520466168445/report-impact-green-bond-2017.pdf

Source: Bloomberg New Energy Finance, Bloomberg LP

■ Support energy regulatory reforms to unleash innovation

G20 countries need to further stringent regulatory updates for energy systems to transform. Reforms must assure private stakeholders of consistent regulations and long-term goals, considering trade-offs, transition costs and benefits. Our key suggestion to G20 governments is to develop regulations that promote energy systems flexibility while ensuring affordable energy access. As stated by the recent UN Global Tracking Framework, "*such a reconfiguration would unleash innovation, investment, and improve energy productivity. Truly transforming the energy system will require a creative shift in policy and regulation, yet in many countries the current political, regulatory, and industrial infrastructure is not ready for such a transformation*".[5]

According to Expert Group[3], Smart Grid Task Force[6], flexible energy systems enable (a) suppliers to optimize their portfolios; (b) network operators to delay or avoid network reinforcement; and (c) system operators to manage constraints and congestions at an efficient cost. Providers of flexibility can in turn benefit from offering a service through direct payments or savings on energy purchases. The report by the UK Government Office of Gas and Electricity Markets concluded that

[5] Global Tracking Framework: UNECE Progress in Sustainable Energy. UNECE ENERGY SERIES No. 49. United Nations, 2017.
[6] Regulatory Recommendations for the Deployment of Flexibility. SGTF-EG3 Report. January 2015

"*the way to promote flexibility is through regulations, incentives and public support to enable stakeholders to participate. In the current context, this means maximizing access to the existing range of markets (capacity, wholesale, balancing and ancillary services), alongside new markets or revenue streams (e.g., for services at distribution network level, or for new services) and being able to stack value across them wherever appropriate. In the future, it could mean more fundamental changes to market structures or signals, to make it simpler for providers to combine value streams*[7]".

- **Commit to just transitions**

Acknowledging the International Labour Organization's (ILO) publication "*Guidelines for a just transition towards environmentally sustainable economies and societies for all*"[8], G20 leaders should (a) devote special care and attention to transitions roadmaps, focusing and supporting retention, redeployment and reskilling of human capital; and (b) address the gender gap in the energy sector and in Science Technology Engineering Art and Mathematics (STEAM). Gathering input from key stakeholders, including SMEs, unions, non-profit and community organizations, will provide insights into employment trends, employment opportunities and forces driving transformations. On the education front, retraining, reskilling, skilling-up in clean energies development and management, will be a necessary supplement to traditional core expertise.

International organizations should establish a council of stakeholders responsible for certifying qualifications required in new energy-sector jobs, developing updated standardized academic and training programs, on new skills and credentials. Governments should actively seek academic-industry partnered input to design updated courses that will facilitate human capital development in new energy management (at both graduate and post-graduate levels). Skill-up practices and programs should be proposed and implemented within major energy companies across the global energy system.

Former UNFCC Executive Secretary Chistiana Figueres, is unequivocal when discussing the role of the energy industry: "*the energy companies are the experts; they have the best engineering expertise; they know the market; they know the energy system. The industry producing the energy is the industry that needs to be called to the table to transition that energy. I have a hard time understanding why this is not clear to everyone*!", emphasizing the philosophy and strategy to be adopted during current energy transitions. The G20 should encourage energy companies to reskill and upskill their STEAM workforce to nurture the discipline sets that enable successful energy innovation meeting internationally recognized ILO labor standards.

In terms of the gender gap, the renewable energy sector shows a less pronounced difference than the traditional energy sector (Exhibit 4) and provides an opportunity for leaders to support gender conscious policies reverting current disequilibrium. Based on IRENA's survey on 90 renewable energy companies worldwide, women

[7] Upgrading Our Energy System. Smart Systems and Flexibility Plan. Office of Gas and Electricity Markets. UK Government. July 2017

[8] Guidelines for a just transition towards environmentally sustainable economies and societies for all. International Labour Organization, 2015

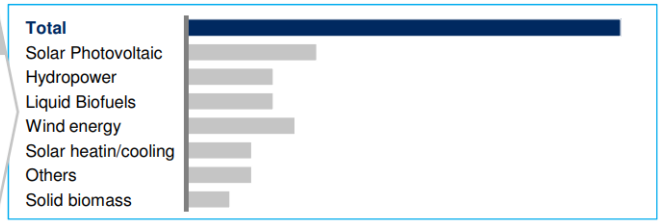
account for 35 percent of the workforce (IRENA, 2016), a share greater than in oil and gas industries. Men outnumber women in middle, upper and top management levels in the traditional energy business. This unequivocal data can be reversed by reskilling, skilling up, new science and technology education, and youth mindset, all of which represent a chance not-to-be-missed and drastically evolve.

Exhibit 4 | Renewable energy jobs

Case study: Renewable energy industry creates new jobs relaying on new skills while increasing women involvement

Labor employment growth

- Renewable energies´ growth keeps raising job employment in the industry. Employment opportunities appear throughout the value chain from manufacturing, operating, installing and maintaining to project planning.



New capabilities demand

- Countries explore the renewable energies labor capabilities aiming at developing the skills needed at a country level.

- Canada developed a training program, Canada Green Corps, a UNA-Canada youth employment program that bridges talented youths to meaningful employment in Canada´s search for green economy by:
  - Offering a 6-months full time program.
  - Providing wage subsidies to organizations who host the program attendees.
- Encouraging peer-to-peer knowledge and skill transfer.

Path to gender equality

- Women employment in renewable energy is already higher than in conventional energy.

- Women in renewable energy sector reached a share of 35%. Comparing to the conventional industry, women involvement in renewable energies is growing, depending on the country and the technology.

Source:

http://unac.org/unac-projects/canada-green-corps/
http://resourceirena.irena.org/gateway/dashboard/?topic=7&subTopic=10
https://sustainabledevelopment.un.org/content/documents/17495PB_13_Draft.pdf

Policy Action 1.2: Support Innovation in Renewables and Cleaner Sources

The G20 must support the early research, development and deployment of incremental and radical innovations to favor energy transitions.

Governments should (a) continue to support innovative research, awards, development and deployment of technologies and infrastructures that reduce cumulative emissions (b) encourage solutions for increasing energy efficiency, renewables adoption, fuel switching and carbon capture, usage and storage. Existing technologies should be maximized and optimized by policies advancing collaboration, experimentation, rewarding and local innovation to deliver effective low carbon solutions.

Cost effective renewables grow at an annual 4.6 percent rate in OECD countries and at 7.4 percent elsewhere. In the next 25 years, non-GHG generating sources will

account for an estimated 43 percent of Africa's new power plants, 48 percent of Asia´s and 63 percent of Latin America´s. More than 1,500 renewable power plants will come on-stream in these three continents, almost as many as the rest of the world combined[9]. However, decarbonization needs sustained commitment. Research and development investments in renewable energy dropped 7 percent in 2016 to US$8 billion, 14 percent below its peak in 2011. Corporate RD&D slumped by almost 40 percent last year, as wind and solar manufacturers retrenched. However, estimates suggest that government spending on renewables research increased 25 percent, to a record US$5.5 billion, breaking a 3-year losing streak.[10] According to the latest WEF report on energy innovation, "*despite the recent surge in investment in clean energy and the evolution of enabling policy instruments, investments in clean energy RD&D are too low, and significant barriers to innovation remain*"[11]. Investment levels need to sustain main technology challenges. G20 leaders should promote and facilitate public-private and industry-academia collaboration in sustainable energy RD&D at all scales, to face the challenges of Renewable Energy Sources (RES) variability mainly breakthroughs in storage technologies.

The B20 members suggest the G20 presidency execute the following actions:

- **Enhance replacement of high carbon energy sources, promote and update electrification, re-electrification and energy systems digitalization across the power system**

G20 governments must support electrification as a strategy to achieve decarbonized power systems. Gradually increasing electricity share in end use, while lowering fossil fuels, are among the driving areas to transition global energy towards low carbon economies. Renewable energy, excluding large hydroelectric facilities, accounted for 55.3 percent of new power-generating capacity added globally in 2016. This is the largest proportion in any year to date, and the second consecutive year this ratio exceeded 50 percent. In 2017, significantly more gigawatts of solar power were added than of any other generating technology. In 2017 alone, renewables prevented close to 1.7 gigatons of CO_2 emissions.

Although renewables accounted for 25 percent of the global electricity generation in 2017,[12] with increasing consumption rates, high carbon fossil energy still dominates the consumption scene, with the high carbon electricity sector contributing 40 percent of GHG emissions [13].

To address the issue of climate change and drive the energy transitions to lower-carbon and clean future, implementing replacement on the energy consumption side is an essential. Replacement of high carbon fossil energy with clean-source electricity is compelling in transportation, household heating, industrial boilers, harbor and airport energy use. Enabling policy and supporting mechanisms should pave the way for facilitating such replacements, including: a) adoption of sound regulatory frameworks; b) reduction of risks for private investors through a political and

[9] A reality check for renewable energy. McKinsey & Company
[10] Global Trends in Renewable Energy Investment 2017. Frankfurt School-UNEP Center/BNEF. 2017
[11] Accelerating Sustainable Energy Innovation. World Economic Forum White Paper. Prepared in collaboration with KPMG. January 2018
[12] Global Energy & CO_2 Status Report. The latest trends in energy and emissions in 2017. International Energy Agency
[13] Understanding CO_2 emissions from the global energy sector. The World Bank. 2014

institutional framework that supports favorable business climate; and c) incentives for replacement of projects, by providing subsidies or introducing proper pricing mechanisms, based on each country's national circumstances.

New technologies, such as storage and PV plus storage, fully electrified industrial processes and residential consumption, are available to facilitate electrification at more competitive prices. In addition to this, low cost and low carbon technologies will allow a greater deployment of decentralized electricity access solutions.

Sustainable mobility solutions like electric vehicles (EV) and intelligent transportation systems, among others, are expected to mainstream rapidly at the core of a highly connected, multimodal transportation system. The spreading of e-mobility platforms and related services will provide clean, decarbonized and efficient transportation. Cities must ready themselves through changes and investments in physical and digital infrastructure.

Existing incentives and awards, (e.g. on buildings, self-consumption etc.), led to a significant increase of renewable energy generation. Incentives should encourage end-consumers to limit the risk of adoption and industrial players to invest in promising technologies. Distribution System Operators (DSO) will have a crucial role in integrating innovative solutions for an efficient grid management (Exhibit 5). They will require long term regulatory frameworks providing the right incentives for (a) energy storage specific technologies (b) high penetration of distributed energy resources scenario and (c) new customer behavior models and evolving market needs.

Exhibit 5 | Electricity Replacement

Case study: China's Best Practices of Electricity Replacement

Electricity replacement is a key element in re-electrification. The purpose is to replace the use of fossil end-consumption with electricity, which can be generated from an increasing share of renewable energy, hence driving a clean, low-carbon energy transition

Achievements

In 2017, State Grid Corporation of China (SGCC) has:
- Replaced fossil energy with **115 TWh** of electricity in total.
- Reduced **644 million tons** of direct coal burning.
- Cut **1.100 million tons** CO_2 emissions.
- Reduced **360 million tons** of SO_2 and other emissions.

Enabling Policiy and Mechanism

- **National policy**: *"The Guidance on Promotion of Electricity Replacement"* by National Development and Reform Committee.
- **Standard System**: SGCC has established two qualification standards for electricity replacement projects and 14 standards for harbor power facilities.
- **Industrial Alliance**: SGCC initiated the establishment of *Electricity Replacement Development and Promotion Alliance.*

Public Education

- **National policy**: Widely spread the concept of electricity replacement through newspapers, radio, television, Internet and new media, etc..
- **Theme Campaigns** such as the "Energy Saving Publicity Week" to promote social participation in electricity replacement.

Policy Projects

- **"Internet of Vehicles"**: to build nationwide EV charging network and develop a cloud-based platform has connected about 170.000 charging piles and registered about 801.000 customers.

- **Harbor Power Facilities**: to build power facilities to replace the use of diesel in harbors with electricity. In 2017, SGCC has:
  - Built 24 high-voltage and 507 low-voltage harbor power systems.
  - Achieved 50% coverage of low-voltage power systems along the Beijing-Hangzhou Grand Canal.

- **Beijing Winter Olympics**: to promote electric heating in Beijing-Zhangjiakou area, significantly improving air quality in Olympic hosting cities
  - Heating is now fueled by clean energy during Winter in over 900,000 households in Beijing.
  - According to plans, over 1.5 billion m^2 in Northern China will be heated with electricity by 2021.

Source: State Grid Corporation of China (SGCC)

The G20 should favor the advancement of digitized infrastructures to accelerate grid densification and expansion, the mainstays of electrification. Leaders should promote digitization plans as drivers for cleaner and renewable systems, adopting smart grids, smart meters, and sensors while profiting from the application of the Internet of Things (IoT) in renewable energy systems. Such application facilitates network optimization and maximum use of renewable sources to balance supply and demand in real time.

New network infrastructures in transport and distribution are key to unlock renewable energy growth. The transition will require further investment in the transmission and distribution sectors of power grids. These investments will integrate new renewable capacity, mostly connected to low and medium voltage grids, manage the development of electric mobility, and support the electrification of consumption in the residential and services sectors. Network digitalization and smart grid models are key in energy spending savings, GHG emissions reduction and air quality improvement.

Investments in electricity infrastructures and related digital solutions must be supported by research funding and innovation actions to accelerate the market uptake of new solutions. Subsidized large-scale pilots will help to test the integration of digitalized energy systems. Full deployment should be supported by innovative financial instruments such as loans-grants blending mechanisms to mitigate the industrial risks.

The G20 governments are asked to focus policy frameworks on digitalized infrastructures that can accelerate grid densification and expansion as the mainstays of electrification. In addition, they should promote the use of renewables according to the specifics of their national power systems and National Determined Contributions (NDC).

- **Promote the spread of storage technology to overcome renewable energy challenges and increase overall system value**

G20 leaders should promote the spread of storage technology to incentivize renewable energy production and reduce GHG emissions. The evolution of the electricity sector is facing different challenges: (a) infrastructure development versus capacity growth; (b) progressive change in production sources and in consumption demand.

Storage technology is a key factor to promote massification of renewable sources and stabilize grids; storage capacity and dispatchability are the limits to overcome. In fact, renewables coupled with BESS (Battery Energy Storage System) can provide frequency regulation, supporting grid stability and increasing the overall power system efficiency.

Flexible energy storage, combined with power conversion and demand flexibility, can be used as products and services in future energy markets, allowing the storage, conversion and shifting of excess power from renewable generation in hydro reservoirs, batteries or thermal storage. Flexibility can be offered by active grid users being generators, consumers, prosumers or aggregators.

Even if BESS capital costs are decreasing substantially year over year, still the main challenge is to develop intelligent Energy Management Systems to maximize the economic returns of such systems, stacking different applications as a stand-alone, or in combination with distributed renewable generation. Other relevant challenges are related to (a) research on new battery chemistries to increase energy density and efficiency, and the safety of overall solutions; and (b) optimization of the overall energy storage systems.

- **Invest and implement Carbon Capture, Usage and Storage**

G20 governments should invest and foster energy companies' investments, in the implementation of carbon capture usage and storage (CCUS) to reduce the impact of climate change. The separation of carbon dioxide and its capture, utilization and storage can drastically reduce GHG emissions, representing a key technology for transforming the energy sector. In IEA´s Sustainable Development Scenario, by 2040 CCUS delivers over 11 per cent of the global annual emissions reduction[14]. Thus, large-scale deployment of CCUS is a crucial element to low-emission pathways consistent with the Paris Agreement´s goals.

Industry and academia must collaborate on developing new, reliable energy solutions that are both green and cost-efficient. Leading CCUS players are already able to remove carbon from gases and store it safely without adding to climate change.

[14] IEA WEO Model 2018, http://www.iea.org/weo/

CCUS is the leading technology for decarbonizing fossil fuels and an important long-term measure for reducing CO_2 emissions globally. Since the nineties, many energy companies have conducted significant RD&D in the removal, reuse and storage of CO_2. Sharing research and expertise among research institutions, academia, other companies and authorities will aid the development of CCUS worldwide.

As previously mentioned, energy companies have the technical expertise to rigorously characterize subsurface reservoir cases and scenarios, and propose ideal storage and disposal candidates based on stratigraphic, structural, petrophysical and reservoir engineering parameters (rocks and fluids). Geophysical surveillance and 3D mathematical simulations are required as monitoring practices. Geological sites and subsurface reservoir candidates should undergo rigorous screening to assess non-leaking/seepage characteristics and seismic stability.

To reduce the impact of climate change, G20 Governments should invest in long term CCUS research and development and should incentivize energy companies to implement CCUS by promoting funding and support programs for large-scale CO_2 storage.

- **Develop transnational interconnections and global energy trade**

G20 leaders must promote the interconnection and international trade of energy by (a) strengthening political coordination, communication and cooperation for coherent and comprehensive regional energy development plans; (b) establishing bilateral or multi-lateral cooperation mechanisms; (c) introducing business innovations to rapidly implement new projects from public-private and industry-academia partnerships.

The uneven distribution of global energy resources and consumption centers has created a demand for optimal and widespread allocation of energy resources. Interconnecting power grids and natural gas infrastructures is an effective way to deliver clean energy globally, to complement the energy resources in different countries and to optimize the allocation of their resources. Grid interconnection can also greatly enhance a grid's ability to integrate renewable energy, which will promote the transition to clean and low-carbon energy resources.

Moreover, cleaner energy sources such as natural gas need strengthened global trade circulation to enable fuel switching. An essential aspect of consolidating cleaner fuels as replacements for high carbon-emission sources is the development of policies and infrastructure, and the promotion of international trade to help seize the opportunity generated by the current high levels of seasonal variation in natural gas demand.

TOPIC 2: ENERGY EFFICIENCY

The 2017 IEA's Global Energy & CO_2 Status Report informs that policy-making on energy consumption efficiency slowed down after a great improvement in the period 2000-2016. It is mandatory to reinvigorate energy efficiency policies, being an effective way to reduce emissions. Since energy efficiency pays for itself, it is certainly the least costly way of addressing energy security and environmental challenges. Across all major energy sectors, from power generation and distribution to industry, transport and buildings, immense opportunities exist for efficiency optimization. The IEA calculates that almost half of the reduction in emissions required to reach the 2°C Paris Agreement target will come from energy efficiency measures.

Moreover, energy efficiency has additional social and economic advantages: it creates employment, reduces public deficit, improves health and wellbeing and boosts industrial productivity[15]. In emerging economies, evidence exists that efficiency policies alleviate poverty and increase energy access in disadvantaged groups, reducing reliance on imports, and increasing technology adoption to update existing infrastructures[16].

The B20 Argentina fully subscribes to its predecessors, the B20 Germany Task Force on Energy, Climate and Resource Efficiency who pointed out, "*the B20 supports energy efficiency as a critical component of the energy transitions and stands ready to collaborate with public authorities to unlock the vast potential for profitable energy-efficiency investments*"[17].

This 2018 G20 has already adopted Energy Efficiency as one of the key deliverables of the Argentine G20 Presidency, establishing the determination to build on the G20 Energy Efficiency Leading Program (EELP), developed during the Chinese Presidency and ratified by the G20 Hamburg Energy and Climate Action Plan for Growth, and the "*G20 Energy Efficiency Investment Toolkit*"[18].

RECOMMENDATION 2: INCREASE COVERAGE AND IMPACT OF ENERGY EFFICIENCY POLICIES

POLICY ACTIONS

2.1: Incentivize energy productivity across utility companies and industrial value chains.
2.2: Support efficiency policies and practices for buildings and households.
2.3: Promote the development of sustainable and efficient mobility systems.

Policy Action 2.1: Incentivize Energy Productivity across Utility Companies and Industrial Value Chains

The G20 should reward efficiency policies, mandate standards and promote

[15] Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.
[16] Ibid.
[17] World Economic Forum: 6 ways to align the energy transition with economic growth. March 2018.
[18] G20 Argentina 2018. Energy Transitions towards Cleaner, more flexible and Transparent Systems. First Sherpa Meeting, San Carlos de Bariloche, December 15, 2017.

technology adoption to reduce energy waste across all sectors and value chains

Governments and international institutions must build databases on energy efficiency to facilitate fact-based policy making. Within the business sector, special attention should be paid to SMEs and export-oriented companies, particularly in emerging economies, so that measures and regulations do not delay economic development. Moreover, governments should consider implementing and fostering incentives to reward energy waste reduction schemes, such as carbon cap and trade (pricing), including CO_2 and CH_4 emission reductions. Developing an international carbon-pricing scheme would aid energy-efficiency programs, provided they are tax neutral.

More specifically, we refer to the following actions:

- **Reward energy waste reduction through reflective pricing, certifications and management standards**

We encourage G20 leaders to streamline certifications of energy waste reduction. White certificates implemented by Italy, France and Denmark could be taken as examples. Improvements to energy-management standards would be relevant to industries and small and medium enterprises. As reported in the IEA's Efficiency Report 2017, the use of energy management systems in industry is growing. The adoption of an energy management system, whether driven by policy or by a company's strategy, can lead to savings in energy and associated costs. Data contained in 42 ISO 50001 case studies from France, Germany, the UK and other countries (Exhibit 6), show average, annual, energy savings of 26 percent[19].

It is also critical to create Key Performance Indicators (KPI) of different measures, such as (a) distributed generation; (b) level of losses; (c) quality levels; (d) CO_2 and other GHG emission intensity; (f) energy intensity; (g) system average-interruption duration. The output regulation objectives to be introduced are: a) quality regulation vs. KWh, decoupling revenues and volumes; b) possible KPIs: MW of distributed generation, level of losses SAIDI[20], and percentage of customers in dynamic pricing. Governments should inform industries about these indicators to encourage their proactive action. Especially, schemes to give advice for SMEs, should be considered.

Exhibit 6 | Energy Efficiency Case Studies - *Source: Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.*
Denmark. The Danish energy-efficiency obligation (EEO), white certificate, is a relevant model on how to design an EEO that encourages cost-effective savings, effectively includes third parties and contains a solid verification and measurement system. Whereas the French scheme is effective in improving efficiency in the residential sector, and the Italian scheme is effective in improving efficiency in the industrial sector, the Danish scheme does better in the trade and industrial sectors. This shows the adaptability of EEOs as an effective policy instrument.
Ireland. 73 companies of the 173 members of the Sustainable Energy Authority's Large Industry Energy Network have obtained, or are working towards a ISO 50001 certification and are achieving a 10 percent

[19] Energy Efficiency Report 2017, International Energy Agency, 2017.
[20] Acronym for (S)ystem (A)verage (I)nterruption (D)uration (I)ndex.

**Exhibit 6	Energy Efficiency Case Studies -** *Source: Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.*
reduction in energy demand. (IEA 2014a).
China. The Top 10,000 Energy-using Enterprise Program covers over 15,000 enterprises using more than 10,000 tons of coal equivalent per year. In the first phase of the program, (1,000 industries) an investment of CNY 50 billion in 2007 achieved an energy demand reduction of 115 Mtoe by 2010. The key to expanding the program was the newly-learned scope and methods for capturing efficiency gains (IEA 2013).

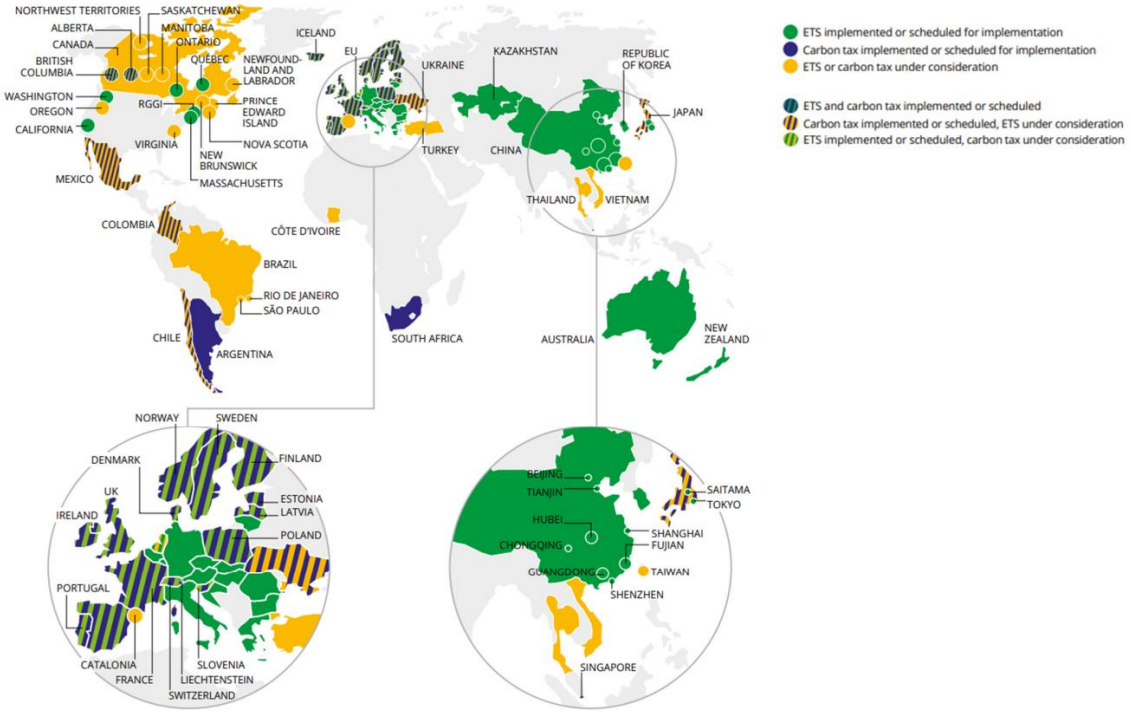
- **Support the global discussion on carbon pricing**

B20 members continue to support the intergovernmental pricing platform proposal generated by Germany's B20 Taskforce.

The platform provides a basis for global discussion on carbon-pricing mechanisms, enables members to share best practices, and uses carbon-pricing revenues to advance efficiency programs. Although it could unlock several benefits, the mechanism has not yet been regulated nor implemented, which emphasizes the compelling need to strengthen discussions across agencies and institutions (Exhibit 7), recognizing the important role of the private sector in delivering on emissions and climate action. The upcoming COP24 in Katowice will be crucial to advance carbon pricing discussions under Article 6 of the Paris Agreement.

Exhibit 7 | Carbon Pricing Development

Case study: Summary map of regional, national, and subnational carbon pricing initiatives implemented, scheduled for implementation and under consideration (EPS and carbon tax)



Source: State and Trends of Carbon Pricing 2018. The World Bank, 2018

The private sector is increasingly involved in carbon-pricing initiatives. As of November 2017, 1,300 companies had developed an internal price for their GHG emissions, using carbon pricing as a tool to align business with low-carbon economy transition. Overall, companies increased their carbon-pricing initiatives by 11 percent.

Despite continued progress on carbon-pricing last year, more stringent work is needed to meet the requirements of the Paris Agreement. Also, G20 leaders must firmly promote the improvement and deployment of technologies for reducing gas flaring, gas venting and gas leakages, to strengthen the ability to reduce carbon dioxide and methane greenhouse gas emissions.

- **Incentivize the entry of new technologies into the energy infrastructure**

G20 leaders should incentivize the entry of new technologies into the energy infrastructure to reduce energy costs and increase its availability.

Governments must promote and accelerate innovative regulations along the value chain, such as smart grid regulation, electrification and re-electrification, grid-scale storage and smart metering. Digitalized transmission and distribution infrastructures are key elements of new energy-saving models. The ongoing global discussion must stress the importance of achieving consistent energy saving at all stages of the energy value chain in all sectors (Exhibit 8).

Exhibit 8 | Alternative transaction validations for Bitcoin

Case study: Enabling alternative transaction validations for Bitcoin to reduce its energy footprint

Cryptocurrencies like Bitcoin could undermine global efforts to reduce carbon emissions and threaten grid stability

- Estimates of Bitcoin's total electricity consumption vary between roughly **1 TWh and 32 TWh** per year, depending on methodology; the former is enough to power roughly 90,000 US homes for a year, the latter is on par with the annual electricity use of Denmark. Today a single Bitcoin transaction consumes as much electricity as an average American home does each week.
- Current Bitcoin's consensus protocol is called **proof-of-work** (PoW).
- PoW sets an extremely **high bar for validating blocks** and makes it exceedingly difficult to tamper with blockchain.

Energy Web Foundation – A New Blockchain for the Energy Sector

- The Energy Web Foundation (EWF) is building a public, open source blockchain-based platform designed to **host decentralized applications** that support distributed and renewable energy-focused business models and products. Meeting this objective requires a highly scalable network with a robust governance structure that doesn't require massive computational – and hence, energy – resources.
- EWF is currently designing a proof-of-authority (PoAs rely on a trusted set of authorities to create and validate blocks) consensus mechanism for its network, with EWF affiliates – energy companies that have partnered with EWF – serving as authorities. The PoA consensus mechanism allows EWF's network to **maintain a lighter energy footprint.**

Source: Beyond Bitcoin: As Blockchain Adoption Accelerates, a Need to Manage Energy and Climate Emerges – Rocky Mountain Institute https://rmi.org/beyond-bitcoin-blockchain-adoption-accelerates-need-manage-energy-climate-emerges/

Policy Action 2.2: Support Efficiency Policies and Practices for Buildings and Households

The G20 should strive to achieve standards implementation, support behavioral change among consumers and mainstream adoption of new technologies.

Through efficiency glazing, retrofit insulation systems, PV and advanced heating systems[21], buildings can be converted into zero or near-zero emission systems. Over half of the residential sector's consumption is attributable to space heating. Improvements to space heating energy efficiency are the product of better insulation in new buildings, updated heating equipment and refurbishment. Urban renewal and design projects can be used as opportunities to support energy efficiency in households through setting stricter building codes. Higher standards for appliances and lighting could substantially increase building energy savings; the IEA Energy Efficient End-Use Equipment Technology Collaboration Program (IEA 4E-TCP) reported energy savings of 16 percent to 26 percent over the past 10 years for major household appliances[22].

[21] Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.
[22] Energy Efficiency Report 2017, International Energy Agency, 2017

Ambitious, wide-ranging goals must be coordinated by national and city governments. To succeed, they need the cooperation and engagement of stakeholders, including citizens, construction companies, and SMEs. By actively promoting efficient energy use, governments could change the way households, government agencies and businesses save energy. As per this goal, we strongly recommend the following initiatives:

- **Develop smart building plans**

Partnership between local governments and international organizations should be fostered, to rapidly upgrade appliances and approve regulations that increase building energy efficiency.

G20 leaders will have to encourage consistent smart building plans that provide enabling environments for business innovation, technology upgrade, and consumer awareness of energy efficiency as shown by examples in Exhibit 9. A lack of interoperability between technologies and protocols currently hampers the full development of smart buildings.

Exhibit 9 | Energy Efficiency Case Studies - *Source: Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.*
China Energy Efficiency Project aims to increase energy efficiency in urban residential buildings and central heating systems in China's cold-climate regions by integrating three components: 1) operational demonstrations that the greatest energy efficiency gains and cost savings in residential space heating can be achieved by simultaneously addressing the thermal integrity of buildings, the operational efficiency of heat supply systems, the provision of means for heat control by consumers, and the implementation of heat metering, cost-based heat pricing and consumption-based heat billing; 2) cooperation with central government; and 3) promotion of simultaneous development of heating sector reforms while building energy efficiency improvements in Chinese municipalities.
Bulgaria. Within a project of the Bulgarian Ministry of Regional Development and Public Works and UNDP, launched in 2007, fifty multi-family buildings were renovated to demonstrate the benefits of home energy efficiency improvements. Energy savings ranged between 40 and 60 percent, corresponding to a total annual savings of nearly 8.5 million kWh, and to a 6,700-ton reduction in CO_2 emissions. The project sponsored by national and UE programs, won the EU's 2011 Sustainable Energy Europe Awards competition.
Argentina. In 2016, the Ministry of Energy and Mines launched a behavioral program for public buildings (similar to the Guide of Good Practices for the Responsible Use of Energy). The program issued guidelines for responsible energy use, including adjusting thermostats and lighting schedules. The second phase will assign an energy manager to each public building. A Diploma in Energy Management program was also introduced (Ministry of Energy and Mines, Argentina, 2017). Source: Energy Efficiency Report 2017, International Energy Agency, 2017

- **Implement time-dependent pricing, smart meters and home-device interoperability to profit from home connected devices**

G20 leaders should favor the adoption of efficient household appliances. The need exists to create large-scale savings and address: high installation and operating costs, lack of time-variant pricing and smart-grid infrastructure, privacy and security issues,

market fragmentation, and inadequate interoperability.

Gartner estimates that 8.4 billion connected "things" were in use in 2017, up 31 percent from 2016[23]. Smart devices include lighting (LEDs), appliances (smart washing machines, refrigerators) and home automation (home security). The adoption of smart devices in homes and buildings needs careful attention from policymakers. If combined with smart regulations, such as smart meters and time-dependent pricing, these devices can capitalize efficiency.

Governments can encourage shifts in energy use (from peak-load hours to lower-demand periods) by offering cost-saving incentives for non-peak times and penalties for peak times energy use.

Policy Action 2.3.: Promote the Development of Sustainable and Efficient Mobility Systems

The G20 governments should require a raise in standards for heavy-duty vehicles, promote efficient vehicle purchases, develop public and private recharging infrastructure and ensure sustainable public transportation in favor of energy efficiency and climate action.

Because transportation accounts for 27 percent of global energy consumption, our imperative is to increase efficiency in mobility systems. Ground transportation is responsible for 76 percent of such consumption, with vehicles (cars, buses and trucks) making up 94 percent of land-based transport. The Global Fuel Economy Initiative (GFEI) announced a 2050 target for doubling the efficiency of the global vehicle fleet, from an average of 8 l/100 km (2005 levels) to 4 l/100 km. Energy demand, particularly fossil fuels, could be reduced through ride sharing, producing US$150 billion dollars in annual savings. Considering only a moderate scenario, total annual savings amount to US$750 billion[24]. The B20 supports actions that accelerate the transition to energy-efficient transportation systems, including:

- **Set standards for ground transportation, especially heavy-duty trucks**

Setting mandatory CO_2 standards for the automotive manufacturing industry proves to be a powerful and effective tool to reduce road transport emissions. When standards are applied consistently numerous benefits are generated: emission reduction, lower transportation costs, air quality improvements, reduction of associated health and environmental costs and reduced energy consumption. All of these are key elements of the substantial improvements cascading form standard formalization.

To date, policies have focused more on light-duty vehicles (LDVs); and as of 2016, only four countries had fuel-economy standards for heavy-duty vehicles (HDVs). Regulating HDVs is of relevance as they represented nearly 43 percent of road-oil consumption and one-fifth of total oil consumption in 2015[25]. Incentives are to be proposed by governments to increase the market share of efficient vehicles, and

[23] Gartner Newsroom, available at: https://www.gartner.com/newsroom/id/3598917
[24] Considering technology acceleration, the impact can increase up to US$1.360 billion of total annual savings.
[25] Energy Efficiency Report 2017, International Energy Agency, 2017

provide adequate information on vehicle emissions.

Standards also play a significant role in adopting zero and low emission technologies. Governments should accompany industries transitions through the development of alternative fuel infrastructures. According to the IEA projections, the electric car stock will range between 9 million and 20 million by 2020 and between 40 million and 70 million by 2025[26].

- **Incentivize fuel efficient and electric transportation and the deployment of EV charging infrastructures**

Electric vehicle sales grew 40 percent in 2016, down from the 70 percent growth in 2015. The total number of electric vehicles worldwide is 2 million, which is less than 0.2 percent of the 1.2 billion LDVs on the road[27]. To increase the market-share of fuel efficient and EV, governments might provide purchase incentives, vehicles' replacement policies and information on produced emissions (Exhibit 10). Certificate schemes for manufacturers promoting zero and low emission vehicles, like those adopted by California and China, also contribute in the same direction. To better accommodate the development of EV, construction and deployment of charging infrastructures should be incentivized. Information technologies can be integrated with the operation of charging networks, making it smarter and user-friendly. By 2020, about 15 percent of city buses worldwide will use alternative fuels and 5 percent will use electric engines. Currently, fully electric buses are being rolled out globally (Exhibit 11); and electric and hybrid buses are expected to make up 14 percent of the global fleet by 2020.

Exhibit 10 | Private Energy Efficiency Case Studies - *Source: Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.*
France 'Bonus–malus' scheme. By offering an incentive to purchasers of efficient vehicles and a disincentive for inefficient ones, the government is skewing purchases towards high-efficiency vehicles. Also known as 'fee bate' (fee/rebate) schemes, these policies can be designed to be fiscally neutral, balancing the discounted life cycle costs to consumers of inefficient vehicles against the benefits of efficient vehicles, with little or no costs to government.
Ireland A 2008 car taxation-scheme moved away from systems assessing vehicles based on engine size to one that is solely based on CO_2/km emissions. This measure provided a strong incentive to buy smaller and more efficient cars: between 2007 and 2011, CO_2 emissions dropped from 164 g/km to 133 g/km. (Energy Efficiency Watch 2012).
Spain. The Efficient Vehicle Incentives Program, launched in 2012, facilitates the replacement of older, fuel-intensive vehicles with high-efficiency models of lower consumption and GHG emissions. A direct government aid of EUR 1,500 per vehicle is given for efficient vehicles which before-VAT cost EUR 25,000 or for electric, plug-in hybrids which before-VAT cost EUR 30,000. The seller of the vehicle is to contribute with a discount that amounts to the same as the government subsidy. The program has led to avoided emissions of 848,486 tons of CO_2 per year.

[26] Global EV outlook 2017, International Energy Agency
[27] Energy Efficiency Report 2017, International Energy Agency, 2017

Exhibit 11 | Public Energy Efficiency Case Studies - *Source: Best Policy Practices for Promoting Energy Efficiency. A structured framework of best practices in policies to promote energy efficiency for climate change mitigation and sustainable development. UNEP DTU Partnership. United Nations 2017.*
Nigeria. The 2005 Lagos State Transport Master Plan set economic development targets for a sustainable public transport system that will double public transport mode share (PT2x) by 2025. The resulting bus rapid transit system, has decreased average transport costs by 50 percent for commuters while reducing congestion on bus rapid transit (BRT) routes by 40 percent. (IEA 2013b).
Asia Pacific Energy Research Center (APERC) Cooperative Energy Efficiency Design for Sustainability (CEEDS) Best practices in Energy Efficient Urban Passenger Transportation outlines policies that: a) avoid or reduce the need to travel or use motorized vehicles through policies that promote transit-oriented development (TOD); b) shift people to using more energy-efficient modes of travel, including non-motorized transport and carpooling, and improving and promoting the use of public transit systems; c) improve the fuel economy of new vehicles through fuel economy standards and/or emissions standards, development of efficient vehicle technologies, and monetary policies to incentivize improvements in fuel economy.
Finland implemented a comprehensive policy package for energy efficiency in the transport sector. The goal of the package is to make public transport, walking and cycling more attractive compared to driving. The measures are regulatory as well as informational. It includes vehicle tax rates that are dependent on the car's emissions, and expansion of the public transport system. It also includes energy-efficient driving in the curricula of the driver's education. Experts have identified transport and public-sector elements of Finland's NEEAP to be one of the most effective in Europe.

TOPIC 3: ACCESS TO ENERGY

Access to affordable, reliable, sustainable and modern energy for all, is the United Nations' SDG7 established in 2015. This goal was chosen as one of the priorities for the Argentine Presidency of the G20, building on the regional Voluntary Action Plans developed in 2015 and 2016 for Sub-Saharan Africa and Asia-Pacific regions. Argentina opted to promote a Voluntary Action Plan for Energy Access in Latin America and the Caribbean, with special emphasis on affordability.[28]

Achieving universal energy access cascades positive impact on other interlinked SDGs. Businesses and governments can accelerate the transition to an affordable, reliable and sustainable energy system by investing in renewable energy resources (Target 7.2), prioritizing energy efficient practices (Target 7.3), and adopting clean energy technologies and infrastructure (SDG9). Innovative technologies will be the drivers to a change in the *status quo* of the global energy system, contributing to job creation and economic growth (SDG8) and to the climate-change solutions (SDG13). Moreover, providing energy to households, benefits education (SDG 7), enabling sustainable development (SDG4).

In 2016 the number of people without access to electricity was 1.1 billion. Despite increased access to energy in recent years (Exhibit 12), 14 percent of the world's population currently has no access to energy, 84 percent of them from rural areas[29]. Eight percent of the world's population is likely to remain without access to electricity through 2030, and higher percentages will suffer from the inadequate supply of electricity.

At present, 2.8 billion people rely on traditional biomass fuels for cooking, roughly the same number as in 2000. And 2.5 million people die prematurely each year due to polluted household air. The World Bank estimates that it will cost only US$3 billion a year to deliver universal clean cooking access, one-tenth the cost of delivering universal electricity access. The benefits are significant: an estimated 1.8 million premature deaths due to household air pollution could be averted in 2030, without additional GHG emissions.

Sustainable social and economic development should guide G20 decisions and the business community's participation in the decision-making process. As stated by the B20 Task Force on Energy, Climate and Resource Efficiency in Germany, "*Modern energy is a vital catalyst for larger social and economic development. It contributes to basic needs such as clean water, food preservation, sanitation, healthcare, transportation, education, and telecommunication.*"[30] In other words, there will be no social or economic development without increased and sustained access to energy.

International leaders need to focus on low-income communities. According to the latest World Bank Regulatory Indicators for Sustainable Energy (RISE) framework assessment, Sub-Saharan Africa has a pressing need for help with access, densification and expansion of electrification-grids, off-grid solutions and financially

[28] G20 Argentina 2018. Energy Transitions towards Cleaner, more flexible and Transparent Systems. First Sherpa Meeting, San Carlos de Bariloche, December 15, 2017.
[29] Energy Access Outlook 2017 Form Poverty to Prosperity. World Energy Outlook Special Report. International Energy Agency. 2017
[30] A Climate for Change. Embracing the Transition towards Energy-Efficient, Climate and Resource-Friendly, Competitive Economies. B20 Task Force on Energy, Climate and Resource Efficiency Policy Paper 2017.

unviable utilities[31].

RECOMMENDATION 3: ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

POLICY ACTIONS

3.1: Promote appropriate rapidly implementable solutions to reach SDG7.
3.2: Improve policy-planning capacity to meet SDG7.

Policy Action 3.1: Promote Appropriate Rapidly Implementable Solutions to Reach SDG7

The G20 needs to encourage electrification in urban settings and decentralization in rural areas considering specific challenges to reach SDG7, as well as urgent solutions for clean cooking.

Several alternatives for providing power access are identified in IEA's "*Energy Access Outlook 2017 From Poverty to Prosperity*[32]", mainly referring to on-grid, mini-grid and off-grid solutions.

- **Promote densification and expansion of on-grid solutions and improve user paying systems**

On-grid solutions are delivered by a connected local network (or a grid extension) linked to a transmission network. The power needed to feed this network is normally provided by centralized power plants and increasingly by distributed energy generators such as solar PV or biogas units connected at low voltage. On-grid access to energy is preferable in high-density urban areas that are close to transmission networks since on-grid access makes it cost effective to extend existing grids.

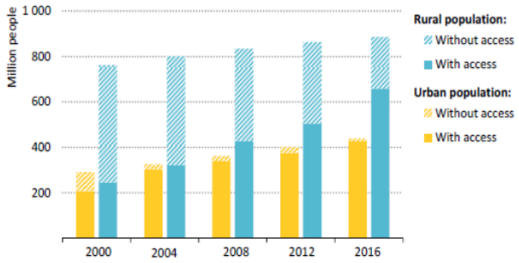
Although most countries have improved their regulatory frameworks for on-grid solutions (Exhibit 12), gaps still exist in building new infrastructure for underserved urban populations, defining performance standards and supporting end-users to pay connection charges. Thus, governments should facilitate the implementation of charging systems that support accessible and sustainable services and attract private company investments. In terms of affordability, the "*RISE affordability indicator suggests that this problem may be less common than feared, with almost half of the countries in the green zone and only 13 percent in the red zone. It appears, however, to be an issue in the 10 countries with the lowest electrification rate, where as many as 40 percent are in the red zone for affordability*"[33]. In these cases, the compelling need is financing social tariffs, targeting subsidies for in-need households and communities.

[31] Regulatory Indicators for Sustainable Energy (RISE). A Global Scorecard for Policy Makers International Bank for Reconstruction and Development. The World Bank. 2017
[32] Energy Access Outlook 2017 From Poverty to Prosperity. IEA, 2017.
[33] Regulatory Indicators for Sustainable Energy (RISE). A Global Scorecard for Policy Makers International Bank for Reconstruction and Development. The World Bank. 2017.

Exhibit 12 | Universal electricity access

Case study: India charges ahead on universal electricity access

Rural and urban populations with and without electricity access in India



Access to electricity is accelerating due to strong policy commitments in India

- An estimated 239 million people were still without electricity access in India in 2016, equivalent to almost a quarter of the number of people without access worldwide.
- Notably, India has made significant strides in improving access, with electricity now reaching 82% of the population, up for 43% in 2000.
- The pace is accelerating: the number of people gaining access has risen from 28 million per year between 2000 and 2012 to 41 million people per year in 2016. If this pace is maintained, India will achieve universal access in the early 2020s.
- To that end it has introduced the Deen Dayal Upadhyaya Gram Jyoti Yojana scheme, which is focused on strengthening distribution networks and increasing village and household connections by co-funding network upgrades and extensions by the electricity distribution companies.
- Coal has fueled about 75% of the new electricity access since 2000, with renewable sources accounting for around 20%.

Source: Energy access outlook 2017 - EA

■ Focus on decentralized solutions for unreached rural communities

Electricity access deficit is mostly a rural problem. In 2016, rural areas encompassed 86.6 percent of the global access-deficit[34]. G20 leaders must continuously support the development of decentralized solutions, namely mini-grids and off-grid solutions.

Mini-grids are localized power networks mostly suited for underserved infrastructure areas that tend to rely on modular generation technologies like solar PV, wind turbines, small-scale hydropower, diesel, LNG and LPG generators. Like other grids, mini-grids need a stable flow of power to function properly, often using either a small diesel generator or battery systems for back-up. Investments tend to be justified only when there is a certain threshold of demand. One of the benefits of mini-grids is that they are scalable and can be added to the main networks if demand expands, provided the equipment is compatible.

The second option is providing electricity from stand-alone off-grid systems that can power single households. At present, this is mostly done by diesel generators and solar home systems. From a system-cost perspective, off-grid solution may be the most cost-effective option in sparsely populated and remote areas. In fact, innovative products are coupling stand-alone generation with appliances. These products can often be scaled up as power demand grows, and they can generate power for a range

[34] Tracking SDG/7 The Energy Progress Report. 2018. World Bank and custodian agencies.

of needs, from lighting and charging mobile phones to refrigerators.

G20 leaders must work to overcome the critical barrier of the upfront cost of the off-the-grid, which is currently the highest of the available pathways to electricity access. However, solar costs are decreasing, making solar PV and batteries increasingly attractive. At present, 60 million people in Africa are served by off-grid renewable solutions. Moreover, decentralized solutions face additional challenges; project-completion rates need to increase and the time frame for completion needs to be shortened. To establish a mini-grid facility requires an average of 18 months to obtain common permits and licenses, ranging from 61 days in Madagascar to 4.3 years in Sri Lanka[35]. Bureaucracies need to streamline procedures for obtaining authorizations, submitting environmental impact assessments, and obtaining generation licenses. Other procedures that need to be streamlined and standardized include procuring land-use permits, construction and building permits, indigenous peoples' rights approval, renewable-energy incentive subsidy approvals, and PPAs, in order to facilitate this urgent energy access.

- **Prioritize the provision of clean cooking solutions to address the urgent problem of Household Air Pollution**

Population growth in Sub-Saharan Africa has outstripped the number of people gaining access to clean cooking technologies by a ratio of four to one[36]. Countries such as India, Indonesia and Vietnam, which could expand clean cooking access faster than population growth between 2014 and 2016, did so by implementing national-scale LPG or piped natural gas distribution for cooking. The IEA, the World Health Organization and other leading experts have identified the supply of clean fuels, particularly LPG, ethanol and biogas as the quickest, cheapest and most life-saving solution to Household Air Pollution. Developing countries governments representing over 30 percent of the world's population, have also announced national targets for the provision of universal or near-universal access to affordable clean cooking fuels, to improve the health of their populations and preserve their forests.

Global policymakers and providers of capital must focus on the rapid deployment of clean cooking fuels. Issues to be addressed include lack of infrastructure for fuel production and distribution, low consumer awareness about the benefits of clean cooking, as well as infrastructure and consumer financing gaps.

Policy Action 3.2: Improve Policy Planning Capacity to Meet SDG7

The G20 must support and coordinate energy access planning at all governmental levels and enable sustainable business models for broader energy access.

Experience from countries that have reached broad access shows that the last 10 to 15 percent of the un-electrified population is the slowest and most costly to connect.[37] At the current pace, experts estimate that 674 million people will lack access to electricity in 2030. A US$28-billion investment per year is required to

[35] Regulatory Indicators for Sustainable Energy (RISE). A Global Scorecard for Policy Makers International Bank for Reconstruction and Development. The World Bank. 2017
[36] Tracking SDG/7 The Energy Progress Report. 2018. World Bank and custodian agencies.
[37] Energy Access Outlook: from Poverty to Prosperity. World Energy Outlook-2017 series.

achieve universal energy access by 2030.[38]

One of the key findings of the RISE study is that "*policy frameworks for grid densification and expansion, the mainstay of electrification efforts, lag substantially behind and still need much progress. As many as 60 percent of access deficit countries score in the lowest tier for grid-based electrification. Widespread problems are lack of capital subsidies to fund high up-front costs of household connection or expansion into rural areas, as well as lack of performance standards for new connections*"[39]

Energy access constraints are a major obstacle for business development in emerging economies according to the World Bank Enterprise survey on infrastructure. Around 30 percent of businesses name problems with energy access and reliability as a major bottleneck[40]. In developing countries, industry accounts for more than one-third of energy consumption and, consequently, there is an opportunity for this economic sector to participate in infrastructure development, improvement and optimization.

- **Support national planning and business plans to achieve affordable, reliable and sustainable energy demand**

G20 leaders need to support emerging economies and developing countries in designing and implementing affordable energy plans. The first step to supporting national planning processes is setting policy targets and timelines for energy access, including affordability thresholds and quality service standards. Governments should streamline the delivery time of connections by reducing bureaucratic processes and improving procurement. In developing countries, the policymaking process needs to be collaborative, bridging private sector and civil society to develop effective, efficient and legitimate access plans.

Infrastructure and equipment deployment are main issues in these processes. Business models are hence crucial for making energy systems sustainable. G20 leaders must promote solutions and business models that, while based on industry best practices, can reach underserved populations.

- **Engage MDBs in developing financing solutions for energy projects**

G20 leaders need to implement energy financial tools to unlock energy affordability, namely, PPAs and Independent Power Projects (IPPs) where a government agency enters into an arrangement for a private power company to establish a power plant and sell on the power to the government agency.

When governments are unable to fund their countries' power needs and utilities do not have investment-grade ratings to raise sufficient debt at affordable interest rates, IPPs have an important role to play. This role needs to be supported by clear regulatory frameworks and adequate financial solutions. It is essential for financial support to be available to all sustainable projects in given specific country conditions.

[38] Power for All Research Summery. IEA World Energy Outlook Special Report. November 2017.
[39] Regulatory Indicators for Sustainable Energy (RISE). A Global Scorecard for Policy Makers International Bank for Reconstruction and Development. The World Bank. 2017.
[40] World Bank Enterprise Survey 2016.

Development Financial Institutions (DFIs) are ideal partners in IPPs development for the achievement of SDG7. Along with equity investments and debt financing, they can provide instruments such as guarantees and insurances particularly effective in attracting private investments in countries exposed to market failures. In addition, DFIs can provide the technical support and the know-how necessary to the development of market institutions and regulations of the power sector in the recipient countries.

TOPIC 4: CIRCULAR ECONOMY

Linear consumption is reaching its limits, pushing resource productivity to the breaking point. Over the last 40 years, annual extraction of materials more than tripled. By 2050, due to population growth and an emerging middle class, the total demand for resources is expected to triple again, a level that will exceed Earth's total capacity by more than 400 percent.[41] These long-term trends underpin the urgency of scaling up circular economic principles.

The goal of a circular economy is to maximize value retention from resources, products, components and materials, as well as create long-life cycle system, optimal reuse, refurbishment, virtualization, remanufacturing and recycling-upcycling of materials. This calls for minimal raw material extraction, reintroduction of existing materials and no waste, decoupling economic growth from environmental issues, while strengthening competitiveness and innovation, creating development opportunities for companies and societies.

Continuous and focalized efforts are urged to re-design the way industries produce and users behave, increasing resource efficiency to achieve the SDGs and the Paris Agreement. Circular use of materials is relevant to GHG reduction, since over half of the world's GHG emissions are associated with basic materials production[42]. Making better use of materials already present in current economies, could globally reduce 3.6 billion tons of CO_2 per year by 2050[43].

Moreover, doing so is economically attractive. A circular economy model offers operational and strategic benefits at micro and macroeconomic levels. The opportunity is valued a trillion-dollar[44], with huge potential for innovation, job creation hence economic growth[45]. Circular economy practices and business models can help achieve several of the SDGs' targets: contributing directly to 21 targets - especially SDG6 (*Ensure availability and sustainable management of water and sanitation for all*), SDG7 (*Ensure access to affordable, reliable, sustainable and modern energy for all*), SDG8 (*Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*), SDG12 (*Ensure sustainable consumption and production patterns*), and SDG15 (*Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*) - and contributing indirectly to an additional 28 targets.

B20 ERES believes it is critical that governments and businesses work together to create the conditions for circular economy models, as a key lever in transitioning to a low-carbon economy, and fulfilling the Paris Agreement and the SDGs. Last year's G20 Leaders' Declaration launched a Resource Efficiency Dialogue to "*exchange good practices and national experiences to improve the efficiency and sustainability of natural resource use across the entire life cycle, and to promote sustainable*

[41] UNEP International Resource Panel (2016): Global Material Flows and Resource Productivity Assessment Report
[42] Blok, K., Hoogzaad, J., Ramkumar, S., Srivastav, P., Tan, I., Terlouw, W., De Wit, M.: Implementing Circular Economy Globally Makes Paris Targets Achievable. (2016)
[43] Material Economics.The circular economy - a powerful force for climate mitigation. Stockholm. 2018
[44] McKinsey & Company. Circular economy toolbox – Engaging our clients on circular economy – The ReSOLVER tool. July 2015
[45] WEF. Towards the Circular Economy: Accelerating the scale-up across global supply chains. 2014.

consumption and generation patterns."[46] Following the dialogue, the B20 assumed a major role in determining how to integrate the circular economy paradigm with energy and sustainability systems.

RECOMMENDATION 4: PROMOTE RESOURCE EFFICIENCY AND CIRCULAR ECONOMIES

POLICY ACTIONS

4.1: Enhance public and private sectors capacity to adopt resource-efficiency actions and circular economies models.
4.2: Promote policies and incentives that enable systems transformation towards circular economy models.

Policy Action 4.1: Enhance Public and Private Sectors Capacity to Adopt Resource Efficiency and Circular Economy Models

Companies face increasing commodity prices, price volatility and climate change risks, all of which highlight the risks of linear economies. Circular business models have the potential to increase a business's competitive edge by creating more value from each unit of resource than the linear 'take-make-dispose' model.

By applying circular economy principles, companies can reduce waste, increase resource efficiency and productivity and decouple growth from natural resource consumption. Different circular strategies or models can be applied: (a) circular supplies: use renewable energy and bio-based or fully recyclable inputs; (b) resource recovery: recover useful resources out of materials, by-products or waste for reuse as inputs or cascading for other uses; (c) product life-extension: extend product lifecycles by repairing, upgrading and reselling, as well as through innovation and product design; (d) circular design: designing products and assets with low-carbon material selection and minimized lifecycle resource model; (e) sharing platform: connect product users to one another and encourage shared use, access or ownership to increase product use; (f) products as a service: move away from product ownership and offer customers paid access to products, allowing companies to retain the benefits of circular resource productivity or ownership to increase product use.

Moving beyond waste and recycling and the use of disruptive technologies, can leverage the full suite of circular business models, particularly through: (a) digital technologies, such as IoT, big data, blockchain, and RFID that help companies track resources and monitor utilization and waste capacity; (b) physical technologies, such as 3D printing, robotics, energy storage and harvesting, modular design technology and nanotechnology that help companies reduce production and material costs, and environmental impact; (c) biological technologies, such as bio-energy, bio-based materials, biocatalysis, hydroponics and aeroponics that help companies move away from fossil-based energy sources.

Analyzing the most advanced business cases confirms that a supply chain

[46] G20 Leaders' Declaration: Shaping an interconnected world. Hamburg, July 7-8, 2017

management approach is critical to maximizing resource productivity globally.

Typically, the supply chain of a consumer goods company has a far greater social and environmental cost than its operations alone, accounting for more than 80 percent of GHG and more than 90 percent of the impact on air, land, water, biodiversity, and geological resources. This suggests significant benefits can be captured by moving to a circular economy model, including: increased growth; innovation and competitive advantage; cost reduction; reduced energy consumption and CO_2 emissions; and increased supply chain and resource security.

Key barriers, such as legal definitions and end-of-life criteria for waste, lack of information and quality control standards, consumer perception of secondary materials, and the need to have a collaborative public-private problem-solving approach, all impact in the ability of companies to adopt circular economy model. The following recommendations should be implemented to enhance the capacity to adopt resource efficiency and circular models in all industries:

- **Develop integral resource efficiency and circular economy roadmaps**

G20 leaders should engage with the private sector to develop integral resource efficiency and circular economy roadmaps.

A circular economy presents each sector with opportunities and challenges for enhancing specific competitiveness, accelerating growth and mitigating risk. Thus, G20 governments should develop public sector knowledge and capacity to facilitate and regulate circular economy developments.

Individual companies cannot easily translate these macroeconomic opportunities into practical actions to the benefit of their value chains; hence, setting up private-public partnerships to provide information, business cases, best practices and opportunities, will facilitate companies identify, assess and implement circular initiatives relevant to each sector.

G20 governments can also support and promote innovation start-ups, pilot programs and projects leading to long-term strategies. The B20 is engaged in the design of transition roadmaps for specific sectors and value chains.

- **Promote the adoption of industry-specific parameters for resource efficiency and circular economy**

Existing metrics were not designed for the circular economy model and cannot provide national data at the level of sharing or remanufacturing.[47] Life Cycle Assessment (LCA) should be the starting-point, focusing on a product's function and does not impact the environment or the supply chain.

To enable useful comparisons, the metrics and methodologies used to measure progress towards a circular economy must be consistent across governments (Exhibit 13), companies and non-governmental agencies.[48] The B20 and G20 should

[47] Delivering the circular economy. A toolkit for policymakers. Ellen MacArthur Foundation. June 2015.
[48] WBCSD, 2017.

work together to promote the necessary coordination and consistency.

G20 governments should assess the benefits of different approaches to a circular economy and encourage all actors to share their findings on the impact circular economy has had on their natural and social capital, value chain, and sustainability accounting and reporting.

Exhibit 13 | Metrics for Circular Economies. Source: Delivering the circular economy. A toolkit for policymakers. Ellen MacArthur Foundation. June 2015
Scotland has developed a carbon metric to quantify the carbon impact of waste, assessing the emissions generated by producing and recycling materials as well as the emissions from the disposal process itself.
In **Europe**, the EU Resource Efficiency scoreboard and the Raw Material Consumption (RMC) indicator show that individual member states and the European Union as a whole are increasing their resource efficiency.
The **UK** developed Sankey diagrams to visualize and analyze the material flows and circularity of the economy.
In **Denmark**, Statistics Denmark is implementing a system of physical supply-use tables and input-output tables. The system augments the monetary supply-use and input-output tables with information on the quantities of materials (natural resources, products and residuals) flowing into, through and out of the economy.
The **Ellen MacArthur Foundation** and **Granta** with EU LIFE Funding have developed circularity indicators that help companies assess how well a product or company performs in a circular economy. The main indicator, the Material Circularity Indicator, measures how restorative the material flows of a product or company are, and complementary indicators measure additional impacts and risks.
The **German government's** goal to double raw material productivity by 2020, compared with 1994, is expressed using the ratio of GDP to direct material input in tons of abiotic raw materials. The indicator Domestic Material Consumption in raw material equivalents is also used as it considers material flows caused by the production of imports. A third indicator, Total Material Consumption, will be used in future, if data quality is sufficiently improved, to cover unused extracted resources, such as mining spoils.

Policy Action 4.2: Promote Policies and Incentives that Enable System Transformation Towards Circular Economy Models

G20 governments can promote circular economy by removing obstacles in legislations, providing information, and fostering partnerships among stakeholders.

Adopting a circular economy requires fundamental changes in economic structures and consumption patterns, through all facets of the value chain, ranging from extracting raw materials and manufacturing, to consumer use and end-of-life. This means that policies governing circular economies must consider a range of issues, including design, procurement and secondary use, recycling and waste management.

Nevertheless, most of the current policies and legal frameworks addressing resources and wastes are often based on a linear economy perspective, going from production

to disposal, and not focusing on efficiency and reuse. Moreover, regulatory obstacles to circular economy are not only due to a single policy, but also to an aggregation of rules that requires balanced policy mixes.

As the B20, we aim to partner with public authorities in developing policies that increase resource efficiency to reduce environmental impact and poverty, and we suggest the following:

- **Prioritize policies that unlock resource efficiency and circular economy potential**

The G20 should promote policy frameworks that enable resource efficiency and circular economy models, stronger incentives in favour of reusing, recycling and cascading products' life cycles to maximize sustainability through full life cycle assessment. The role of local and national governments is crucial in effectively promoting circular activities in the private sector that enhance reuse, recycling and upscaling product's end of life.

G20 government should critically review the current legislation and policy framework based on linear thinking to address specific barriers to advancing the circular economy schemes nationally and internationally. Legislations that hinder the use of recycled materials in production processes, together with the lack of unified and harmonized legislations in favour of circular concepts, undermine opportunities for these new economic models.[49] By waste delisting, (keeping materials suitable for re-use and recycling out of the waste stream) and by streamlining waste, product and chemicals legislation to promote circular value chains, several barriers can be overcome.

Additionally, G20 governments should promote resource efficiency and circular economy through integrating circular economy principles in: (a) sustainable public procurement practices; (b) formal education and training programs to address skills in circular product design and production; (c) consumer campaigns to improve consumption patterns and informed choices; (d) appropriate treatment of used products and thorough prevention of illegal dumping.

- **Drive collaborative platforms to scale up circular economy**

Circular economy unleashes technological, organizational and social innovation across and within value chains.

However, non-alignment of incentives among actors within and across value chains (e.g. among producers and recyclers) remains a critical barrier to improving cross-cycle and cross-sector performance[50] The circular transformation requires joint efforts and coordination across industry and sectors.[51]

The G20 must engage with businesses and stakeholders to promote collaborative solutions, identifying the most relevant circular economy opportunities and the

[49] Regulatory barriers for the Circular Economy: Lessons from ten case studies. Technopolis Group, Fraunhofer ISI, thinkstep, Wuppertal Institute. 2016.
[50] WEF. Towards the Circular Economy: Accelerating the scale-up across global supply chains. 2014.
[51] WBCSD, 2017

intersectoral and intrasectoral impediments. To this end, G20 governments should initiate and stimulate stakeholder dialogues and fora about circular economy, to meet governance challenges regarding responsibilities, liabilities and ownership, endorsing long-term collaboration. Finally, it is recommended to empower a champion to drive the process forward across the multiple policy domains.

TOPIC 5: CLIMATE CHANGE ADAPTATION

Climate change threatens global development, posing increasing dangers and risks for societies, economies and the ecosystems that both sustain. Uninterrupted availability of affordable energy sources is also at risk when climate-related hazards occur. All changes in energy infrastructure related to decarbonization efforts need to be evaluated in terms of potential exposure to climate change. Energy systems, new or refurbished, have to become climate-resilient.[52]

Governments are increasing their commitment and efforts to mitigate climate and avoid worse and irreversible impacts; yet, overall GHG emissions have committed us to climate warming, extreme weather events and sea level rise. In Latin American and the Caribbean, for example, climate change will directly and indirectly affect infrastructures with forecasted annual economic losses of 1.5 to 5 percent of GDP by 2050[53]. The severity of these losses will depend on each country's vulnerability or resilience to climate change.

Adaptation practices call for adjustments in natural and human systems, as these will increase countries' resilience and reduce their vulnerability to further climate change[54]. Every country needs to develop adaptation strategies that include planning, infrastructure, risk management and emergency response.

The World Bank puts the global price tag of adapting to climate change between US$70 billion to US$100 billion annually until 2050[55]. In addition to the financial challenges, climate impact strategies are not a priority in leader`s agenda, and data needed for decision-making is scarce. Experts agree that clear measures to recognize, review and compare resilience capacity are needed[56]. Common adaptation metrics within NDC, will benefit from in-depth international debates and sharing of implementation.

Previous B20 commitment supports actions that "*promote adaptation efforts and cooperation on climate resilience within the G20 and beyond*"[57]. B20 members support the UNFCCC in "*elaborating a Paris rule book with effective rules for NDC-development, assessment of adaptation methods, transparent reporting and stocktaking of GHG emissions, and accounting of public and private climate finance*"[58].

[52] International Energy Agency (2015): Making the energy sector more resilient to climate change.
[53] CEPAL, The economics of climate change in Latin America and the Caribbean, 2015.
[54] CEPAL, The economics of climate change in Latin America and the Caribbean, 2015.
[55] Economics of Adaptation to Climate Change, The World Bank. 2011
[56] More Clarity Needed on Adaptation to Effectively Implement Paris Agreement. United Nations Climate Change. 13th May 2016.
[57] G20 Leaders' Declaration: Shaping an interconnected world. Hamburg, July 7-8, 2017
[58] A Climate for Change. Embracing the Transition towards Energy-Efficient, Climate and Resource-Friendly, Competitive Economies. B20 Task Force on Energy, Climate and Resource Efficiency Policy Paper 2017

RECOMMENDATION 5: EXPAND CLIMATE CHANGE ADAPTATION POLICIES

POLICY ACTIONS

5.1: Integrate adaptation measures into mitigation and investments plans.
5.2: Promote financial mechanisms and insurance solutions to overcome the investment gaps in adaptation.

Policy Action 5.1: Integrate Adaptation Measures into Mitigation and Investments Plans

The G20 leaders should coordinate efforts in favor of mitigation metrics and guidelines providing fiscal support for these activities.

G20 governments need to facilitate capacity building, information access, stakeholder engagement and public-private partnerships on climate adaptation measures and adaptive practices. Assessment and prediction capacity of climate impacts and climate risk is key for strategic economic sectors and assets.

Climate-change adaptation strategies should include proactive actions in such areas as construction-resilient infrastructures; crop and livelihood diversification; seasonal climate forecasting; climate change impact mitigation in communities; early warning systems; insurance solutions and water management, among others. Reactive or ex-poste adaptations, such as emergency response and disaster recovery, are also to be part of these adaptation strategies. The following actions are hence recommended:

- **Enhance assessment and prediction capacity of climate impacts in key economic sectors:**

B20 encourages G20 governments to facilitate access to climate information (e.g. climate data, research results, data-sharing platforms, knowledge-sharing fora and climate services), relevant to assess and include the impact of climate changes into the business decision-making processes and operations for all size companies, especially SMEs.

- **Integrate climate-change adaptation into development policies and plans**

Integrating climate-change adaptation strategies into development policies and plans allows countries and regions to mitigate exposure to climate risks, fortifying infrastructures and emergency response systems.

The B20 encourages G20 governments to commit policymakers to ensuring that all government agencies build climate-impact agendas in a coordinated manner. These agendas should require regional and national agencies to coordinate their plans for timely response and rapid decision-making during crises in the following five systems: (a) energy (b) food chains (c) health (d) transport (e) infrastructure and communications.

The B20 further encourages G20 governments to streamline infrastructure pipelines

and include adaptation strategies into broad national plans, with an ample and integrated vision of their territory.

- **Promote public-private collaboration for the implementation of effective adaptation measures**

Civil society organizations and business community should join efforts in the identification of adaptation priorities.[59].

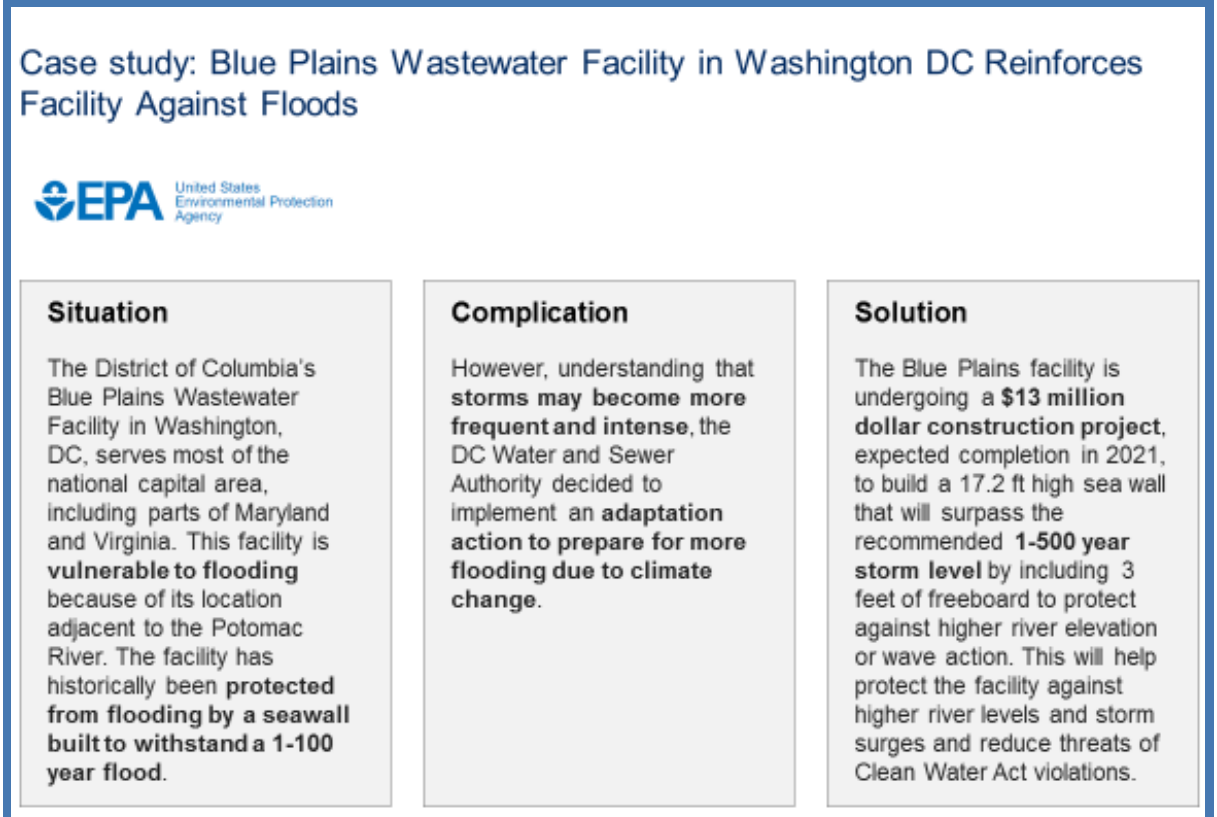
Risk assessment is crucial for businesses to operate within predictable frameworks and adjust and calibrate activities. To make assets and operations resilient to climate-change impacts and adapt them to future changes, businesses and government agencies need to assess the risks of climate-related impacts, by advanced climate numerical modelling and forecasts.

Innovative technology to model climate solutions scenarios, develop resilient materials, design resilient infrastructures and improve information systems, as well as the skills to upgrade project-management competencies, can be provided by private enterprises. Business sector and governments must coordinate and share efforts in emergency preparedness and response measures, to ensure the functioning of strategic assets.

Since populations and economic actors are directly affected by climate impact, it is key to develop inclusive and participatory mechanisms as part of the adaptation and mitigations plans. This participation increases legitimacy, makes policies sustainable and investments more productive (Exhibit 14).

[59] International Energy Agency (2015): Making the energy sector more resilient to climate change.

Exhibit 14 | Adaptation to Climate Change



Source: https://www.epa.gov/arc-x/blue-plains-wastewater-facility-washington-dc-reinforces-facility-against-floods

Policy Action 5.2: Promote financial mechanisms to overcome the investment gaps in adaptation

The G20 must quantify the effort needed for adaptation investments, and support businesses and SMEs to overcome financial gaps and access climate finance. Together with capacity-building, the access to financial and technical support to implement effective climate adaptation measures shows a gap calculated between US$700 billion to US$1.1 trillion.

In 2015, adaptation projects represented only 7 percent of the total funds available for climate adaption, with mitigation projects absorbing most of the total US$390 billion earmarked for climate change initiatives. For example, while Asia concentrates most of the funding, around 30 percent in total, other regions in the developing world capture less than 6 percent[60].

Consequently, G20 leaders should implement the following initiatives:

- **Quantify the effort needed for adaptation investments and resilient infrastructure**

The B20 encourages G20 governments to detail and quantify the investments needed to build and maintain the resilient infrastructure for regions and countries to

[60] McKinsey & Company. Climate Finance Basics. October 2016.

adapt to climate change. Firstly, governments should identify geographies and necessary infrastructure. Secondly, governments should quantify the investments required to build such infrastructures, using standardized tools that provide comparable information on funds and impact. Additionally, G20 governments should foster public-private partnerships to translate adaptation plans into bankable projects for energy systems and infrastructure. An estimated US$23 trillion in climate-smart investment opportunities exist in emerging markets[61].

- **Promote financial mechanisms to close the investment gaps in adaptation**

Realizing the access to financial support for governments and businesses is critical to implement effective adaptation measures. To improve access, governments and businesses must develop the knowhow to use the best financial instruments that fit their needs; the use of insurance tools could for example facilitate economic stability, motivating resilience-building and risk-preventive behavior.

Finally, the B20 encourages the G20 to (a) promote viable financial mechanisms to foster investment opportunities; (b) develop project pipelines to encourage private investment in climate resilience; (c) allow mechanisms to support SMEs to overcome financial gaps; (d) facilitate access to climate finance through actively engaging the participation of financial institutions; (e) promote targeted financing structures and financiers' expertise in understanding, promoting and financing technologies and practices that can improve climate resilience; (f) enhance awareness and collaboration between supply chains actors and the financial system to foster private investors' engagement in the overall climate topic.

[61] Climate Investment Opportunities in Emerging Markets. International Finance Corporation. 2016

ANNEX I: LIST OF ABBREVIATIONS

BESS	Battery Energy Storage System
CCUS	Carbon Capture and Storage
DFIs	Development Financial Institutions
DSO	Distribution System Operators
EELP	Energy Efficiency Leading Program
EMDCs	Emerging and developing countries
GFEI	Global Fuel Economy Initiative
GHG	Greenhouse Gases
HDVs	Heavy-duty vehicles
IEA	International Energy Agency
ILO	International Labor Organization
IOT	Internet of Things
IPPs	Independent Power Projects
KPI	Key Performance Indicators
LCA	Life Cycle Assessment
LCOE	Levelized Cost of Energy
LDVs	Light-duty vehicles
MDBs	Multilateral Development Banks
NDC	National Determined Contributions
PPA	Power purchase agreements
RD&D	Research, Development and Deployment
SDGs	Sustainable Development Goals

ANNEX II: SCHEDULE OF TASK FORCE EXCHANGES

#	Date	Location	Theme
1	February 26th	Teleconference	Inception Document and Participation Chanel Results
2	March 27th	Buenos Aires	1st Policy Paper Draft Discussion
3	May 3rd	Teleconference	2nd Policy Paper Draft Discussion
4	May 28th	Paris	3rd Policy Paper Draft Discussion
5	July 31st	Teleconference	4th Policy Paper Draft Discussion & Advocacy Process
6	October 4th& 5th	Buenos Aires	B20 Summit, 2nd advocacy meeting

ANNEX III: TASK FORCE MEMBERSHIP LIST

Name	Company/Organization	Country	Deputy

COORDINATION GROUP

Chair			
Miguel Angel Gutiérrez	YPF	ARGENTINA	Sebastián Mocorrea
Co-Chairs			
Kurt Bock	BASF SE	GERMANY	Beate Ehle
Hugo Eurnekian	COMPAÑÍA GENERAL DE COMBUSTIBLES	ARGENTINA	Juan Pablo Freijo
Ignacio Galán	IBERDROLA	SPAIN	José Gasset
Marcelo Mindlin	PAMPA ENERGIA S.A.	ARGENTINA	Ricardo Torres
Marcos Bulgheroni	PAN AMERICAN ENERGY GROUP	ARGENTINA	Diego Maqui
Shu Yinbiao	STATE GRID CORPORATION OF CHINA	CHINA	Guangchao Zhu
Teofilo Lacroze	SHELL	NETHERLANDS	Enrique Smiles
B20 Policy Sherpa			
Fernando Landa	BUSINESS 20	INTERNATIONAL	Paula Ini
Knowledge Partner			
Martín Maestu	MCKINSEY & COMPANY	UNITED STATES	
Ignacio Gorupicz	MCKINSEY & COMPANY	UNITED STATES	
Patricio Ruiz Yanzi	MCKINSEY & COMPANY	UNITED STATES	
Mariana Lef	MCKINSEY & COMPANY	UNITED STATES	
Concept Partner			
Sebastian Anibal Bigorito	ARGENTINEAN BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (CEADS)	ARGENTINA	Sebastian Anibal Bigorito
Maria Virginia Vilariño	ARGENTINEAN BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (CEADS)	ARGENTINA	Maria Virginia Vilariño
Network Partner			
Sebastien Louvet	Business at the OECD	INTERNATIONAL	
Members			
Andres Monroy	BASF ARGENTINA	GERMANY	Mara Schlein
Lida Wang	PAMPA ENERGIA	ARGENTINA	
Haoyuan Qu	STATE GRID CORPORATION OF CHINA	CHINA	
Magdalena Mingo	UNIÓN INDUSTRIAL ARGENTINA (UIA)	ARGENTINA	
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