

NDCs IN 2020

Advancing renewables
in the power sector and beyond



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The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that serves as the principal platform for co-operation, a centre of excellence, a repository of policy, technology, resource and financial knowledge, and a driver of action on the ground to advance the transformation of the global energy system. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. www.irena.org

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ABBREVIATIONS

AOSIS	Alliance of Small Island States	IRENA	International Renewable Energy Agency
CO₂	carbon dioxide	LDCs	least developed countries
ESG	environmental, social and governance	NDC	Nationally Determined Contribution
EU	European Union	SIDS	small island developing states
CHP	combined heat and power	TCFD	Task Force on Climate-Related Financial Disclosures
COP	Conference of the Parties to the UNFCCC	TW	Terawatt
C&I	commercial and industrial	TWh	terawatt-hours
GDP	gross domestic product	UN	United Nations
GHG	greenhouse gas	UNFCCC	United Nations Framework Convention on Climate Change
GW	Gigawatts	U.S.	United States
INDC	Intended Nationally Determined Contribution	USD	U.S. dollar
IPP	independent power producer	°C	degrees Celsius

KEY FACTS

The year 2020 represents a significant milestone in global efforts to cut energy-related carbon dioxide (CO₂) emissions.

- As countries review and update their **Nationally Determined Contributions (NDCs)**, they could simultaneously raise their ambitions to scale up renewable energy.
- The **new NDC round** offers an important chance to strengthen targets for renewables in the power sector and beyond.

Present NDC pledges are far from sufficient to meet climate goals.

For example, within the power sector:

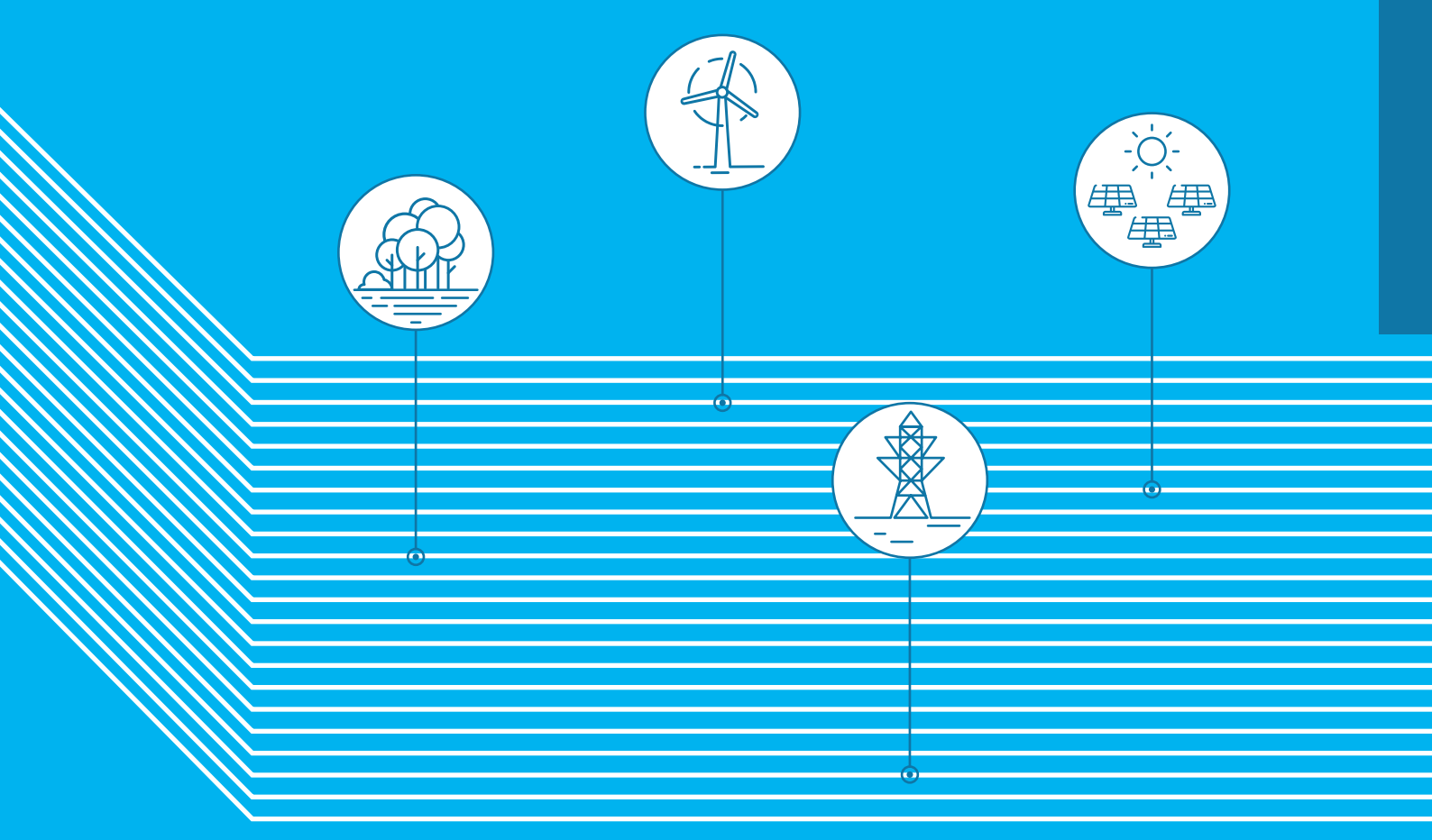
- **Current NDC power targets overlook 59% of the potential for renewable electricity deployment in line with the Paris Agreement by 2030, according to IRENA estimates.** More extensive deployment, amounting to **7.7 TW** (or **3.3 times** current global capacity), could be achieved cost-effectively and would bring considerable socio-economic benefits.

• **NDC power targets even fall short of countries' existing strategies and plans.**

Only 85 countries have included unconditional renewable power pledges in their current NDCs – compared to 135 with non-NDC domestic renewable power targets (either national or sub-national). Aligning the next round of NDCs closely to those real-world targets could increase global renewable power capacity to 5.2 TW (or 2.2 times current global capacity) by 2030.

• **NDCs do not reflect the actual growth of renewable power, with global capacity growing by an average of 8.6% per year since 2015.**

Implementing current NDCs would only translate into annual capacity growth of 4% for 2015–2030, even though annual renewable power growth already averaged 5.9% in 2010–2014. With current deployment trends, the 3.2 TW foreseen in current NDC power targets for 2030 would already be realised by 2022.



Many countries recognise the need to scale up renewable power.

To date:

- **135 countries** have renewable electricity targets in their **national and sub-national** energy plans;
- 140 NDCs mention renewables in the power sector, but only **105 NDCs** of the 140 include **quantified targets for renewable electricity**.*

To drive the changes needed for a climate-safe future, NDCs must become more ambitious in 2020, reaching for the levels necessary to meet climate goals and extending to end-uses, such as direct heat and transport.

Power sector decarbonisation alone will not suffice to meet Paris Agreement objectives.

Rather, the entire energy sector must undergo a profound transformation through the adoption of renewables and energy efficiency measures, as well as increased electrification of end uses. This requires deep changes to the socio-economic foundations of the energy system.

- **Meeting the climate challenge would require cumulative investments of USD 110 trillion in the energy sector through 2050.** Financial institutions are increasingly moving towards renewables and climate-resilient investments. Fresh investment, including institutional and other private capital, must be mobilised.
- **An integrated policy framework will be essential to address potential economic and social misalignments and ensure a just transition.** This would encompass a combination of deployment policies, enabling policies and integration policies. Such a framework needs to extend well beyond the energy sector to address impacts on society, institutions, financing, ownership structures and the wider economy.

Renewables provide a readily available climate mitigation and adaptation tool that supports multiple Sustainable Development Goals.

With these aims at the forefront, NDCs in 2020 offer an immediate opportunity to strengthen renewable energy targets in the power sector and beyond.

* The 105 include one NDC submitted by the European Union on behalf all EU member countries.

STRENGTHENING PLEDGES IN 2020



Five years on from the historic signing of the Paris Agreement, countries around the world are struggling to translate their emissions-reduction pledges into concrete actions to fight climate change.¹ However, the coming year presents a decisive opportunity.

As part of the “ratchet mechanism” of the Paris Agreement, countries are meant to progressively increase the ambitions of their Nationally Determined Contributions (NDCs) in 2020 and every five years thereafter. This includes expanding the ambitions on renewable energy deployment. By adopting targets to transform the global energy system, policy makers could finally begin to turn the tide against global warming. Given the competitiveness of technologies and the multiple benefits that they bring to the economy (e.g., job creation), renewables are a readily-available and cost-effective option to raise NDC ambitions today.

In December 2015, virtually all Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed to limit the rise in the global average temperature to well below 2 degrees Celsius (°C), and ideally 1.5°C, by the end of the present century, compared to pre-industrial levels. With 187 Parties having ratified the Paris Agreement to date, the global consensus on addressing the threat is clear.

By the end of November 2019, government pledges to reduce greenhouse gas (GHG) emissions, including NDCs under the Paris Agreement, still fell short of the global goals adopted in 2015 and would only serve to limit global warming to about 2.6°C (Climate Action Tracker, 2019). This is an alarming shortfall compared to the levels of permissible climate change agreed. Current NDC commitments miss the 2°C objective by 30% and the 1.5°C effort by over 70% (Climate Action Tracker, 2019). Recognising the need for urgent action, several governments and private sector

actors made commitments at the United Nations (UN) Climate Action Summit to further reduce GHG emissions and deliver concrete actions towards the objectives of the Paris Agreement. Specifically, 70 countries announced their intention to raise the ambitions of their national action plans by 2020, while 65 national and sub-national governments pledged to achieve net zero emissions by 2050 (UNCAS, 2019).

The year 2020 will be decisive for policy makers, in that they will need to define their responses to the climate emergency for the next decade. Meeting the agreed levels of ambition at this next NDC milestone is crucial to avoid catastrophic climate change and its related, severely negative socio-economic impacts. Recognising the fundamental contribution of renewables to achieving global climate objectives, this analysis quantifies renewable power sector targets included in current NDCs and assesses opportunities for strengthening such pledges in 2020.

¹ The term “country” is used in this report to indicate Parties to the UNFCCC and does not imply the expression of any opinion on the part of IRENA concerning the legal status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

² End of November 2019.

With the energy sector being responsible for approximately two-thirds of global GHG emissions (IEA, 2019), the transition towards a decarbonised global energy system becomes essential to meet climate mitigation targets. In fact, according to IRENA's Energy Transformation scenario, the world's energy-related carbon dioxide (CO₂) emissions in 2050 must fall by at least 70% more than what current plans and policies are set to achieve (IRENA, 2019b).

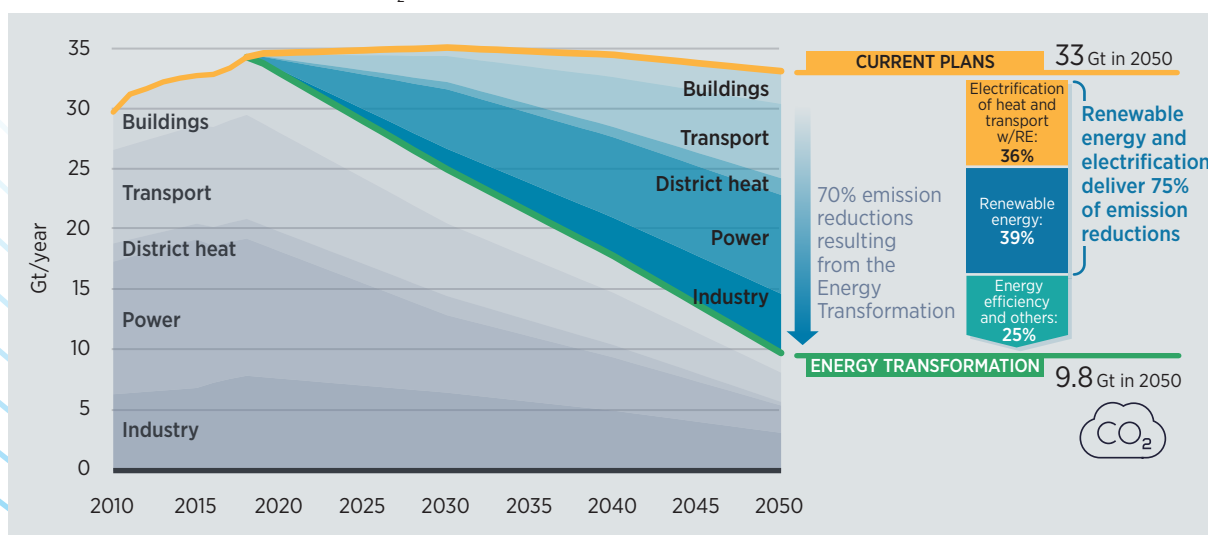
This translates into a 33% reduction in cumulative energy sector emissions during 2015-2050 compared to the current trajectory (see Figure 1 for a disaggregation of emission reductions in 2050 and the evolution of emissions during the transition).

The power sector (including combined heat and power), would need to reduce its emissions in 2050 by 78% more than under current strategies and plans, contributing to a 14% reduction in cumulative energy sector emissions over the 2015-2050 period (IRENA, 2019b).

Section 2 of this report provides an overview of renewable power targets in current NDCs and assesses the additional installed capacity that would result from their implementation in 2030. Section 3 contextualises these projections, comparing the level of renewable electricity deployment under the NDC implementation with IRENA's Current Plans and Energy Transformation scenarios, and actual deployment over the past two decades. Finally, Section 4 discusses energy sector developments needed beyond renewables and the power sector, with a focus on the investment required for the energy transformation and the policy framework necessary for a just transition.

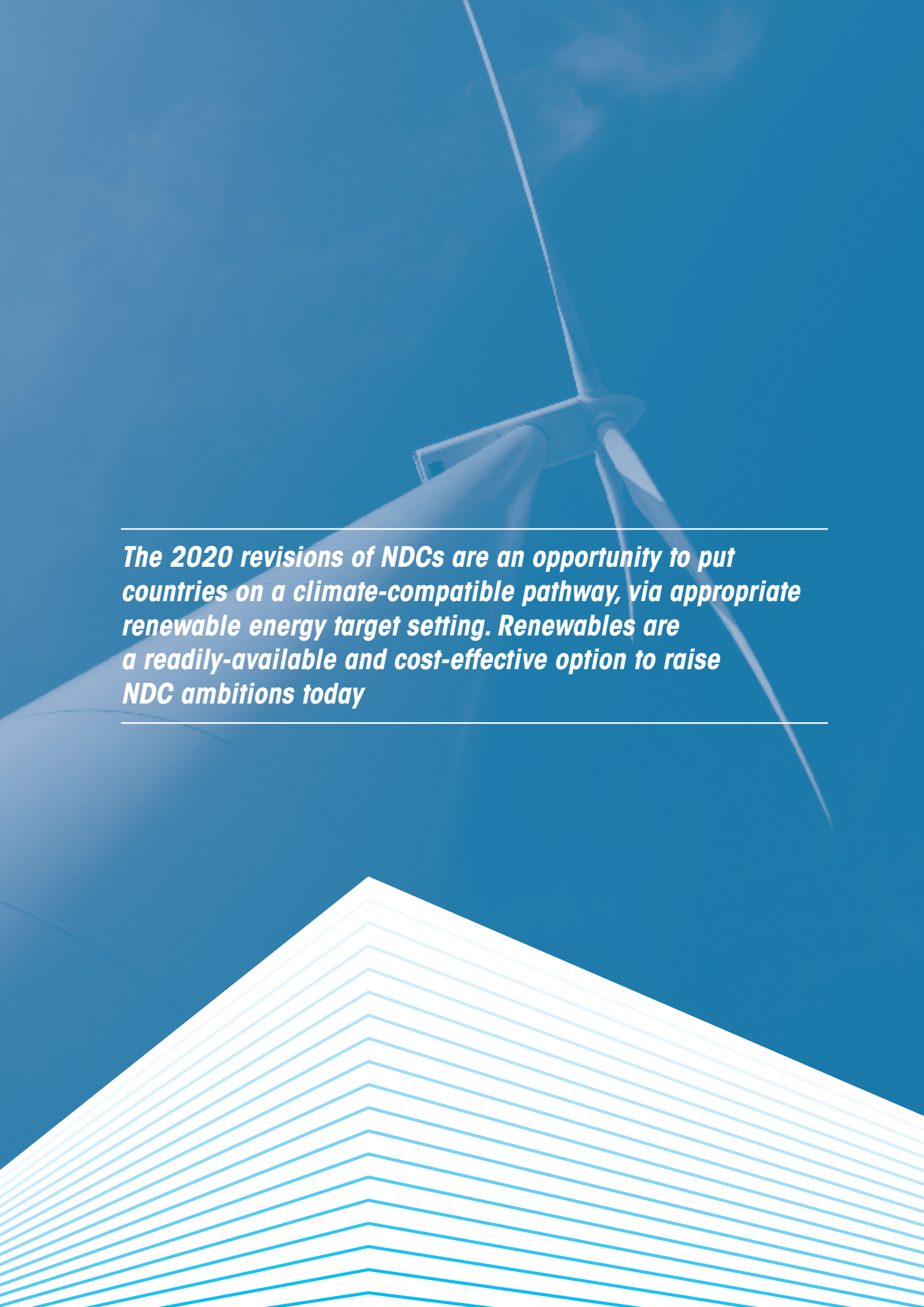
Drastic emission reductions to call for a global energy transformation. This must include renewable energy, energy efficiency measures and increased electrification of end-uses such as heating and transport. It would also require deep changes in the socio-economic structures upon which the energy system is built and a significant ramping up and re-directing of energy investments (IRENA, 2019b; forthcoming [a]).

Figure 1 Annual energy-related CO₂ emissions and reductions, 2010-2050



Note: "Renewables" in the caption denotes deployment of renewable technologies in the power sector (wind, solar photovoltaic, etc.) and in direct end-use applications (solar thermal, geothermal, biomass). "Energy efficiency" denotes efficiency measures in industry, buildings and transport (e.g., improving insulation of buildings or installing more efficient appliances and equipment). "Electrification" denotes electrification of heat and transport applications, such as heat pumps and electric vehicles. Gt = gigaton; RE = renewable energy.

Source: IRENA (2019a)



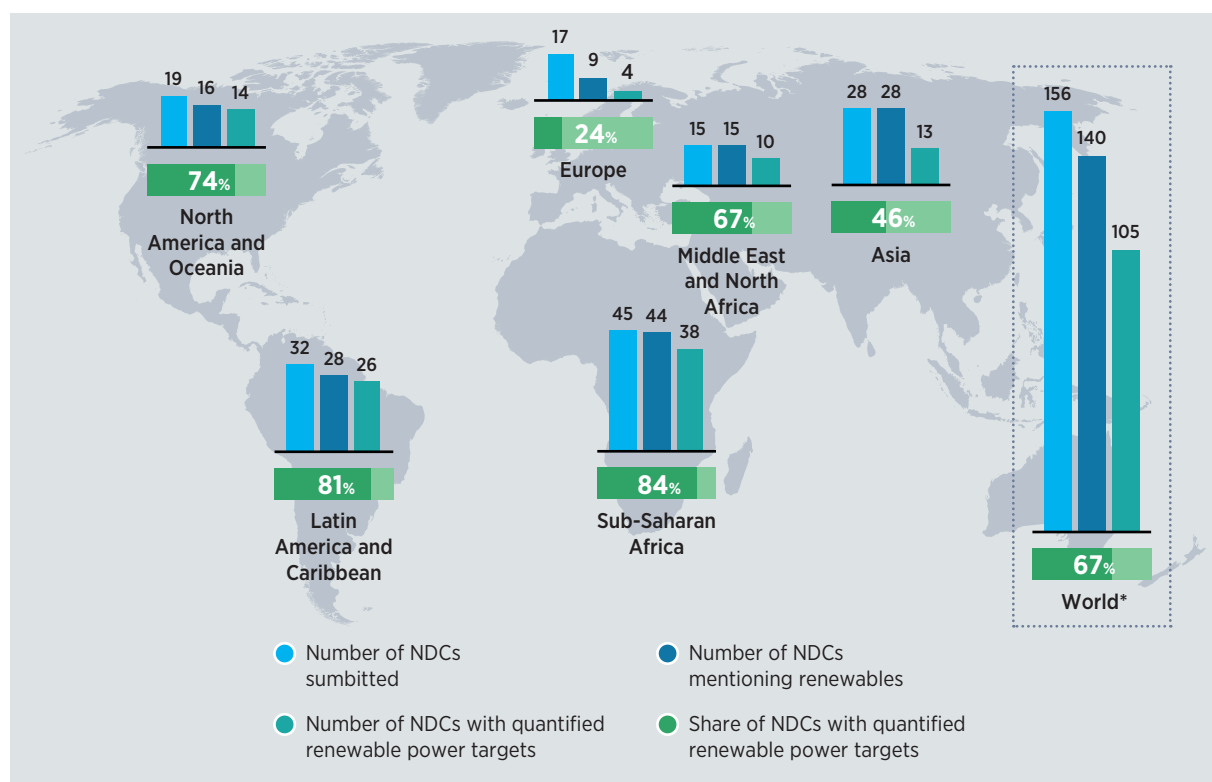
The 2020 revisions of NDCs are an opportunity to put countries on a climate-compatible pathway, via appropriate renewable energy target setting. Renewables are a readily-available and cost-effective option to raise NDC ambitions today

ASSESSING RENEWABLE POWER TARGETS IN CURRENT NDCs



Most countries have recognised the role of renewables in mitigating emissions that originate from electricity generation and have included them in their first round of NDCs. To date³, 184 Parties to the UNFCCC have formally submitted 156 NDCs.⁴ Of these, 90% (or 140 NDCs) refer to renewable energy action for the power sector, while 67% (or 105 NDCs) include quantified targets for renewable electricity generation (see Figure 2). Almost all NDCs from North Africa and the Middle East (100%), Sub-Saharan Africa (98%) and Asia (93%) specifically mention renewable electricity measures, while the proportion of NDCs referring to renewables is lower in Europe (53%) and North America and Oceania (84%).⁵

Figure 2 Renewable power components in the first round of NDCs



* All UNFCCC Parties

Source: IRENA analysis

³ End of November 2019.

⁴ As of the end of November 2019, Angola, Iran (Islamic Republic of), Iraq, Kyrgyzstan, Lebanon, South Sudan, Turkey and Yemen had signed but not ratified the Paris Agreement, hence their NDCs remain formally classified as “intended” (INDCs). In addition, Brunei Darussalam, the Philippines, the Russian Federation and Senegal had ratified the Paris Agreement but not submitted their first NDCs to the UNFCCC (based on UNFCCC, 2019b). As INDCs are not binding documents, these 12 Parties are excluded from the main analysis. A complete list of Parties and the updated status of ratification of the Paris Agreement can be found at https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=en.

⁵ Details concerning the regional groupings used in this analysis are included in the Annex.

Since the ratification of the Paris Agreement on 4 November 2016, the International Renewable Energy Agency (IRENA) has analysed the renewable power pledges included in NDCs and quantified the impact of their implementation through 2030 in terms of additional capacity and investment needs, with a focus on the power sector (see Box 1).

This analysis finds that at least 1.5 terawatts (TW) of additional renewable power installed capacity would come online globally through 2030 as a result of NDC implementation.⁶ This is roughly equivalent to the current renewable power capacity installed in Asia and the European Union. As shown in Figure 3, the majority of this would be installed in Asia (69%, or over 1 TW). This would be primarily concentrated in China, India and Japan, followed by Indonesia and Lao People's Democratic Republic.

At the global level, the majority of this capacity (79% or over 1.2 TW) would be added through unconditional contributions – *i.e.*, those to be met unilaterally and for which international support is not foreseen – with shares ranging between 40% (in the Middle East and North Africa) and close to 100% (in Europe).

As a result, global renewable energy installed capacity would reach 3.2 TW in 2030, up 87% compared to the 1.7 TW installed at the end-2014 baseline,⁷ although projected growth differs significantly by region. The highest increase would occur in Sub-Saharan Africa, which is projected to more than triple its total renewable power installed capacity by 2030. Asia, and the Middle East and North Africa follow with more than a twofold increase over the same period (see Figure 3).

Box 1 IRENA's analysis of renewable power targets in NDCs

With the ratification of the Paris Agreement in 2016, and in view of the importance of the energy sector in achieving international climate objectives, IRENA began to examine renewable energy in the context of climate change, with a focus on NDCs.

In 2017, IRENA carried out its first assessment of the renewable energy components of NDCs. The analysis quantified explicitly-stated renewable energy targets both in terms of additional renewable installed capacity and investment needed by 2030. The resulting findings, outlined in the report *Untapped potential for climate action: Renewable energy in Nationally Determined Contributions*, were released at the 23rd Conference of the Parties to the UNFCCC (COP23).

The study found that, taken together, the (I)NDCs submitted as of October 2017 did not appear to be driving an accelerated global energy transformation. The study provided policy makers with a set of recommendations to accelerate the implementation of current renewable energy targets and further strengthen such components in the next round of NDCs.

This work has been essential in progressing the global climate discourse, bringing to the attention of climate policymakers the recent progress in global renewable energy deployment, its contribution to climate mitigation and adaptation strategies, and the existing untapped potential to raise the ambitions of NDCs.

To reflect new NDC submissions and revisions on the part of UNFCCC Parties, and ensure timely and accurate information, IRENA regularly updates its NDC analysis. Updated results and figures were included in a briefing note for COP24 in 2018 and a booklet for climate discussions in mid-2019.

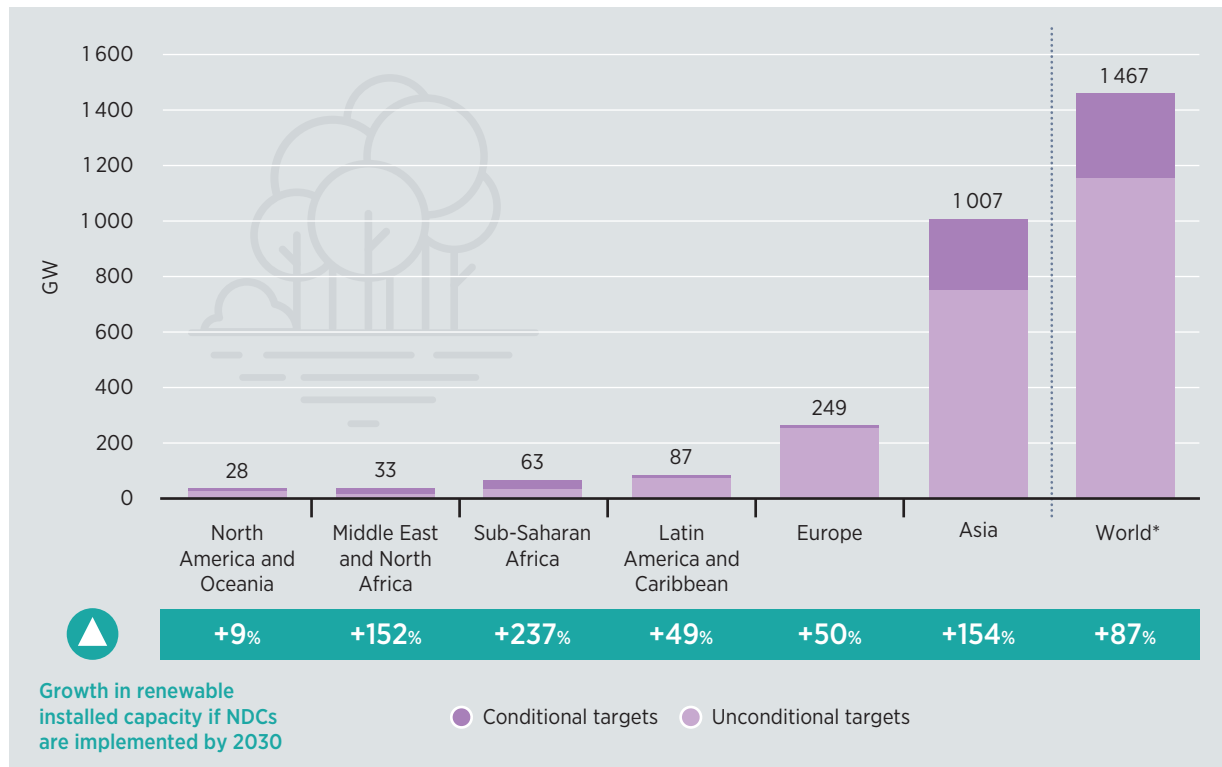
This publication, prepared for COP25, represents the second update to IRENA's work on NDCs; it aims to assess NDC renewable energy targets against the levels of ambition set in the Paris Agreement, as well as global progress towards the attainment of renewable energy targets in current NDCs.

For more on IRENA's climate-related work, see www.irena.org/climatechange.

⁶ Additional 58 GW would be added if INDCs, which are not binding, are also included in the analysis.

⁷ In this analysis, 2014 is used as a baseline as this is when countries started setting their renewable energy targets under the Paris Agreement.

Figure 3 NDC-driven increases in renewable power installed capacity up to 2030 by region and target



*All UNFCCC Parties
Source: IRENA analysis

The implementation of the first round of NDCs would bring online an additional 1.5 TW of renewables, taking global renewable energy installed capacity to 3.2 TW in 2030

Considerable growth in renewable energy capacity is expected in those countries most vulnerable to the impacts of climate change. This is projected to almost quadruple in small island developing states (SIDS), from 2.3 gigawatts (GW) in 2014 to 8.6 GW in 2030.⁸

Recognising the importance of urgent and enhanced climate action, 44 SIDS pledged collectively in September 2019 to raise the ambition of their NDCs in 2020 and to achieve net zero emissions by 2050 with support from the international community (see Box 2) (AOSIS, 2019).

At the same time, least developed countries (LDCs) would see an additional 56 GW installed, resulting in more than a threefold increase in total renewable energy installed capacity.⁹

G20 members – which are expected to deliver 80% of the global energy-related CO₂ emissions reductions projected for 2050 (IRENA, 2019b) and play a pivotal role in the achievement of the Paris Agreement objectives – are projected to double their renewable energy installed capacity, reaching 2.8 TW in 2030, up from 1.4 TW at the end of 2014 (see Box 3 for an analysis of G20 targets).¹⁰

Renewable power capacity is set to grow considerably in small island states and the world's least developed countries

Box 2 SIDS Package at the UN Climate Action Summit

Synergies between climate and development objectives are particularly evident in the small island context. SIDS are among the world's most vulnerable countries to the impacts of climate change, and ambitious climate action is fundamental to advance their economic development and other priorities, including energy security, employment growth, and advances in health and education. At the same time, measures aimed at accelerating economic and social development in SIDS can considerably boost their adaptive capacity and build their resilience (IRENA, 2017a; AOSIS, 2019).

In September 2019, the 44 Member States of the Alliance of Small Island States (AOSIS) presented the “SIDS Package” at the UN Climate Action Summit in New York. This represents a holistic and integrated approach to addressing both climate change and sustainable development challenges in SIDS across the Pacific, the Caribbean, and the Atlantic, Indian Ocean and South China Sea regions.

The SIDS Package encompasses a set of cross-cutting initiatives and partnerships that address the nine climate action areas highlighted at the Summit: energy transition; industry transition; infrastructure; cities and local action; climate finance and carbon pricing; mitigation; nature-based solutions; resilience and adaptation; social and political drivers; and youth and public mobilisation. All initiatives presented in the package are SIDS-focused, SIDS-defined and intended to be dynamic, scalable, replicable and transformative.

As part of the SIDS Package, AOSIS members made a collective commitment to update and raise the ambition of their NDCs in 2020 and to achieve net zero emissions by 2050, conditional on receiving necessary international assistance. Recognising the importance of renewables both for climate and development purposes, SIDS have also pledged to pursue 100% renewable energy targets by 2030 (AOSIS, 2019).

⁸ A list of SIDS is included in the Annex.

⁹ A list of LDCs is included in the Annex.

¹⁰ A list of G20 members is included in the Annex.

Box 3 Renewable power targets in the NDCs of G20 members

Previous IRENA analysis (2017b) shows the fundamental G20 contribution needed to achieve the objectives set by the Paris Agreement. These countries alone are responsible for 80% of the global energy-related CO₂ emissions reductions projected for 2050 and account for about 90% of the global renewable energy potential for both 2030 and 2050 (IRENA, 2019b).

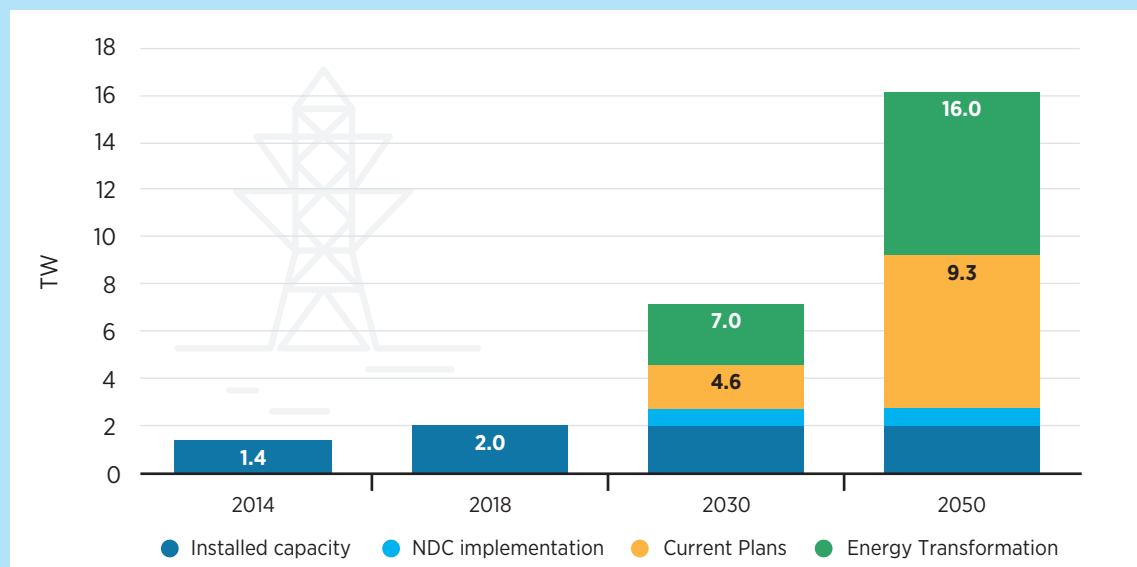
To date, 12 of the G20 countries have included quantified renewable energy targets in their NDCs – Brazil, Canada, China, the European Union (including France, Germany, Italy and the UK), Indonesia, India, Japan and South Africa. In addition, although Turkey has not ratified the Paris Agreement, it has included a conditional quantified target for hydropower in its INDC.

With the implementation of NDC targets, around 1.3 TW of additional renewable power capacity is projected to come online between 2015 and 2030 in the G20. In this scenario, 2.8 TW of renewables would be installed by the end of 2030. As shown in Figure 4, this represents a 37% increase in the next decade over current levels (2 TW in 2018). Due to the misalignment of renewable energy targets in NDCs and other national energy strategies, NDCs would also deliver only 60% of the deployment foreseen under Current Plans (about 4.6 TW in 2030) (Figure 4).

In the Energy Transformation scenario, renewable power installed capacity in the G20 reaches 7 TW in 2030 and more than doubles to 16 TW by mid-century. In other words, about 60% of the renewable energy potential for 2030 is left untapped by NDC targets. An additional 4.3 TW could be added by 2030 in a cost-effective way (Figure 4). This would not only put the G20 on track to meet the ambition of the Paris Agreement, but also lower significantly the cost of the energy transformation through fuel savings, avoided investments and reduced health and environmental damage (IRENA, 2019a).

Significant potential for increased NDC targets exists in China (with over 2 TW of renewables not captured by NDC targets), the United States (over 730 GW) and India (340 GW).

Figure 4 G20 renewable power installed capacity, 2014, 2018 and 2030
(NDC Implementation, Current Plans and Energy Transformation scenarios)



Source: IRENA (2019b, 2019c); IRENA analysis

PUTTING POWER SECTOR NDC TARGETS INTO CONTEXT

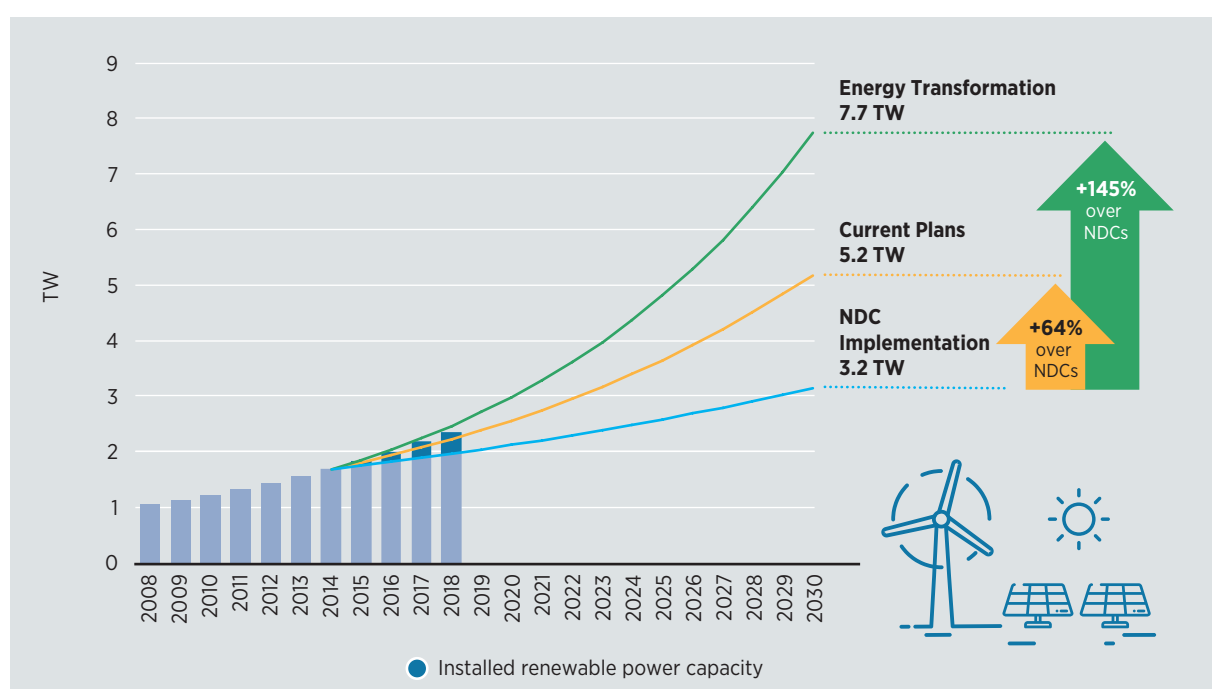


Renewable power targets in NDCs cannot be considered in isolation. This section compares these targets with recent deployment trends for renewables, as well as with the scale of deployment projected under two alternative scenarios developed by IRENA – i.e., Current Plans (or Reference Case), and Energy Transformation (or REmap Case).

Figure 5 shows the projected deployment through 2030 in the three different scenarios. While NDCs would result in 3.2 TW of global renewable installed capacity at the end of 2030, current and planned policies are expected to deliver 5.2 TW. A higher deployment level, amounting to 7.7 TW, could be achieved in 2030 in a cost-effective way and with considerable socio-economic benefits globally (IRENA, 2019b).

Noteworthy in this analysis is the fact that the pace of renewable energy deployment foreseen by current NDCs is slower than actual deployment trends. Figure 5 shows how actual growth in renewable power installed capacity during 2015–2018 has already well exceeded NDC implementation projections.

Figure 5 Projected renewable electricity deployment in different scenarios



Note: For simplicity, constant CAGR is used to project global renewable energy deployment up to 2030 in the three scenarios.
Source: IRENA (2019b; 2019c); IRENA analysis

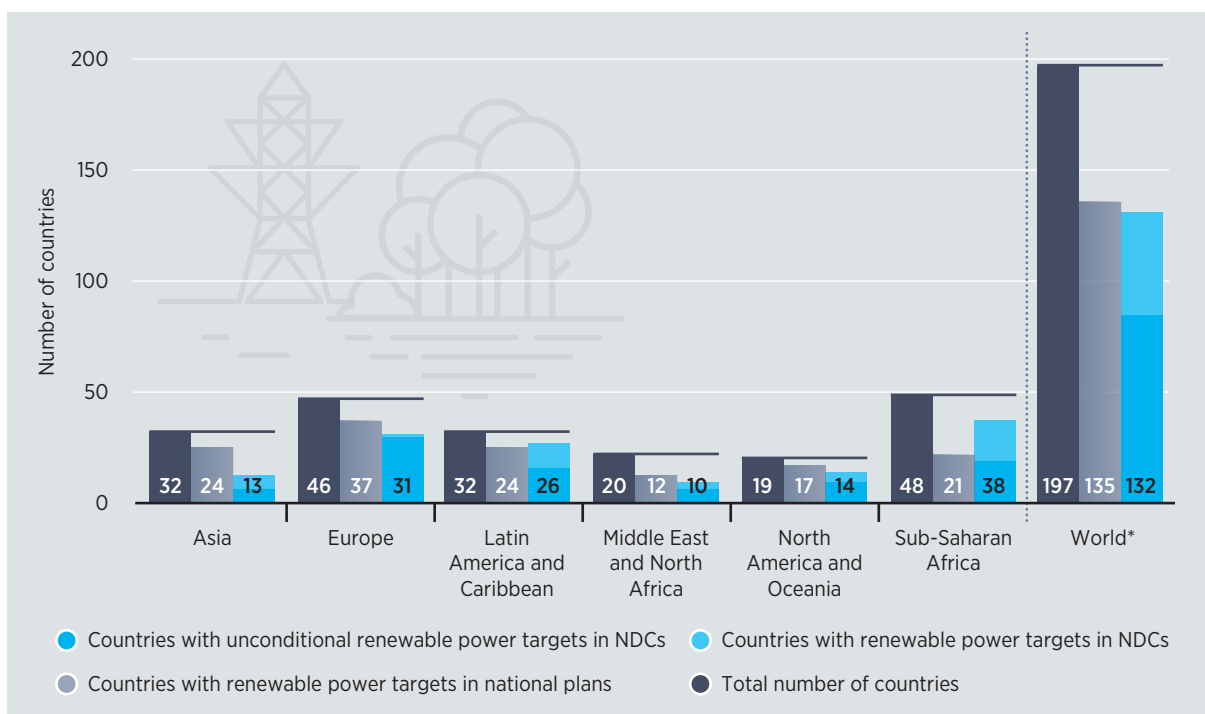
3.1. NDC power targets vs. other national energy plans and strategies

National and sub-national renewable energy targets¹¹ are now a defining feature of the global energy policy landscape; however, these targets are not always reflected in NDCs.

As shown in Figure 6, 135 countries¹² currently have national, regional and/or subnational renewable electricity targets in place, representing 69% of the total. By contrast, only 132 Parties included renewable electricity targets in their NDCs. However, the number falls to 85 if only unconditional targets are considered (*i.e.*, those to be achieved unilaterally).

To date, only 94 countries include renewable power targets in both NDCs and national plans, whereas 41 only set targets in national energy strategies, and 38 countries only include them in NDCs (see Figure 7). Interestingly, most countries in the latter group (*i.e.*, with targets only in NDCs) are in Sub-Saharan Africa, and Latin America and the Caribbean. This is because developing country Parties in these regions often include conditional renewable electricity targets, which are more ambitious pledges that countries intend to implement provided that international support is made available, and that do not imply any use of domestic resources. Even when countries include renewable power targets in both their NDCs and other energy plans, these often contradict each other, with NDC targets tending to be less ambitious.

Figure 6 Renewable electricity targets by region and type



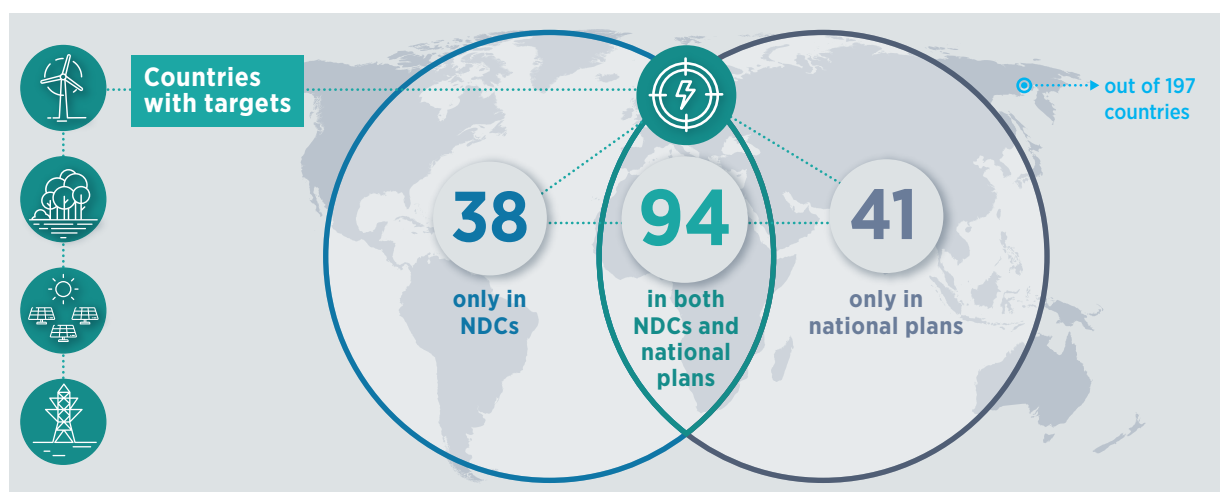
* All UNFCCC Parties
Source: IRENA analysis

¹¹ *i.e.*, targets that governments have set unilaterally in their national, regional and/or sub-national energy policies, plans and strategies. These documents differ from NDCs, which are submitted to the UNFCCC under the framework of the Paris Agreement.

¹² This only refers to UNFCCC Parties. An additional nine countries that are not UNFCCC Parties also have national renewable electricity targets, giving a total of 144 countries.

Only 85 countries have unconditional renewable power pledges in their NDCs, while 135 have targets in other national and sub-national energy plans

Figure 7 Numbers of countries with renewable electricity targets in NDCs vs. national energy plans

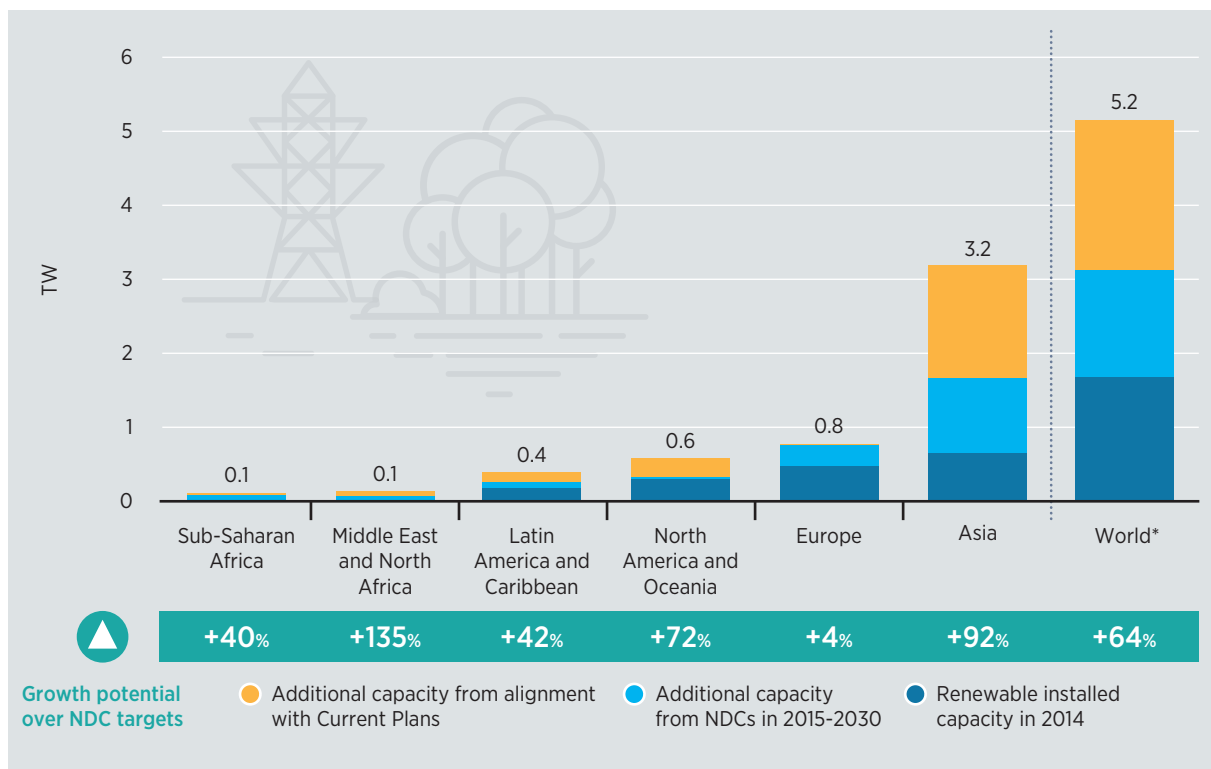


NDCs = Nationally Determined Contributions pledged under the Paris Agreement
IRENA analysis

Based on IRENA's estimates (IRENA, 2019b), current and planned national targets and policies, including the commitments made in NDCs, would deliver an estimated 5.2 TW of renewables by 2030. This is as opposed to the 3.2 TW that would result from the implementation of NDC targets alone.

In other words, governments can already increase their renewable electricity pledges by 64% in 2030, simply by aligning the next round of NDCs to other national energy plans. This is particularly true in the Middle East and North Africa (where NDC targets would more than double), Asia (+92%), and North America and Oceania (+72%), as seen in Figure 8.

Figure 8 Additional renewable power capacity reflecting alignment between national and subnational plans and NDCs in 2030



* All UNFCCC Parties

Source: IRENA (2019b, 2019c); IRENA analysis

Aligning the next round of NDCs to national and subnational energy plans already in place around the world would lead to a 64% increase in projected global renewable power installed capacity in 2030

3.2. NDC power targets vs. estimated 2030 cost-effective potential

Existing renewable electricity targets, both in NDCs and other national energy policies, do not put the world on track to attain the goals of the Paris Agreement. Much more can be achieved in a cost-effective way and with considerable socio-economic benefits.

In IRENA's Energy Transformation scenario, the share of renewables in the power sector more than doubles from 25% in 2018 to 57% in 2030, before ramping up to 86% by 2050 (IRENA, 2019b).

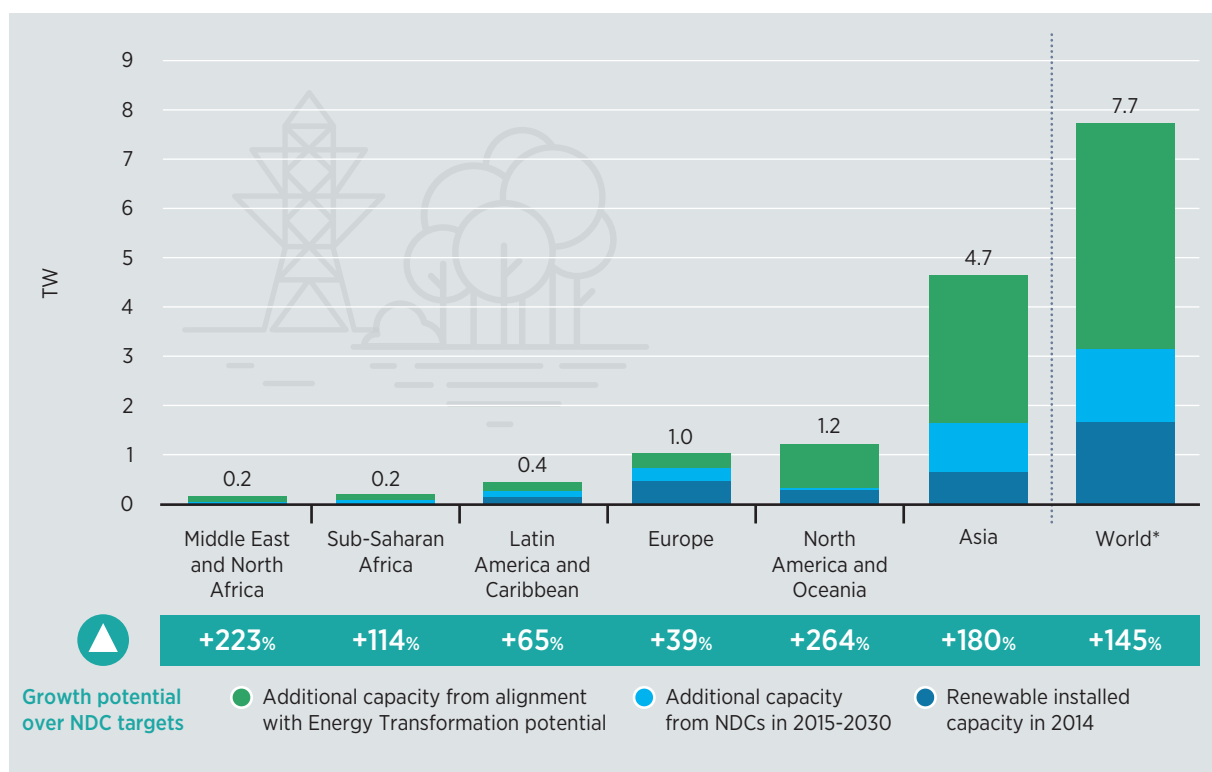
Under this scenario, global renewable energy installed capacity would reach over 7.7 TW by 2030, before growing further to 18.1TW by mid-century. By contrast, the implementation of NDC targets would only result in 3.2 TW of renewables installed in 2030. In other words, current NDC targets leave 59% of estimated renewable potential untapped.

An additional 4.6 TW could be added globally in a cost-effective way by 2030.

As shown in Figure 9, the greatest untapped potential in absolute terms exists in Asia (3 TW), North America and Oceania (896 GW), and Europe (290 GW). In relative terms, the installed capacity of renewables could almost quadruple in North America and Oceania, triple in the Middle East and North Africa, and almost triple in Asia, compared to what is foreseen in NDCs.

To exploit the full cost-effective potential for renewables in the power sector, IRENA (2019a; 2019b) estimates that USD 22.6 trillion in cumulative investment would be needed in renewable generation capacity by mid-century. This implies at least a doubling in annual investments compared to current levels, from USD 289 billion in 2018 to USD 662 billion through 2050 (Frankfurt School-UNEP Centre/BNEF, 2019; IRENA 2019a) (see Figure 10).

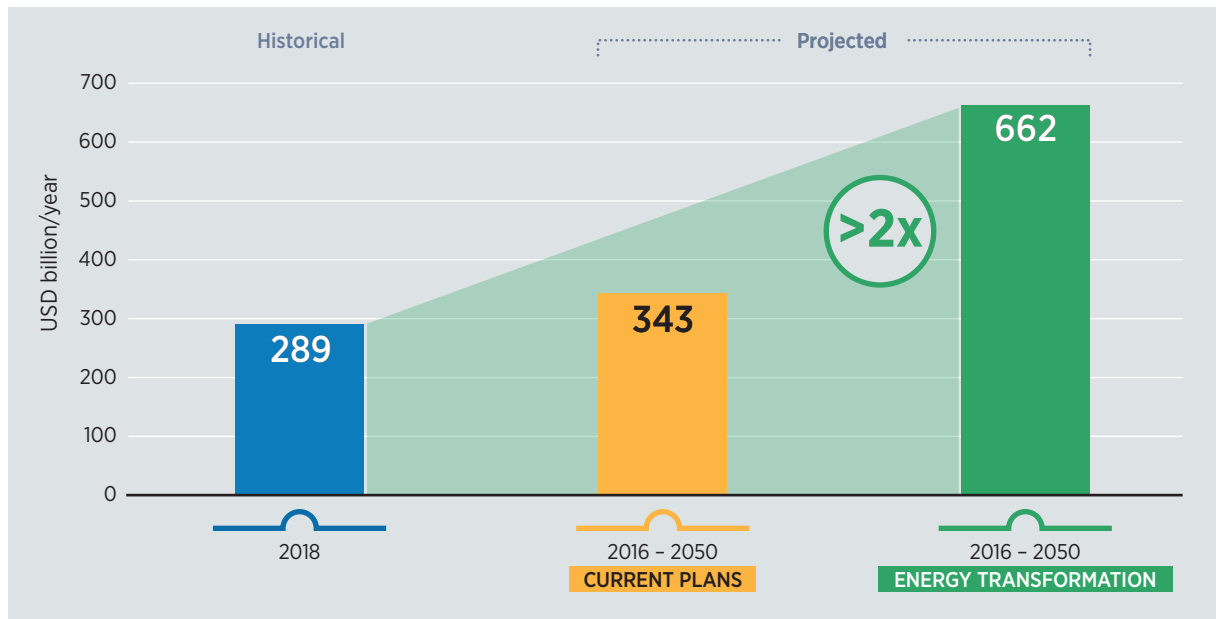
Figure 9 Additional cost-effective potential for renewable energy deployment in 2030 in the Energy Transformation scenario



* All UNFCCC Parties

Source: IRENA (2019b, 2019c); IRENA analysis

Figure 10 Average annual investments in renewable power generation capacity until 2050



Source: Frankfurt School-UNEP Centre/BNEF (2019) and IRENA (2019a)

Achieving the full cost-effective potential for renewables in the power sector requires at least a doubling of current annual investments, from USD 289 billion to USD 662 billion

If renewables were to grow at the 8.6% annual rate experienced in 2015-2018, global renewable energy targets in NDCs would already be achieved by 2022

3.3.NDC power targets vs. actual deployment progress

Global renewable energy deployment has grown remarkably over the past two decades, with cumulative capacity rising from just above 750 GW in 2000 to over 2.3 TW in 2018 (Figure 11). Annual capacity additions saw more than an eight-fold increase since 2000, with 174 GW added in 2018 alone (IRENA, 2019c).

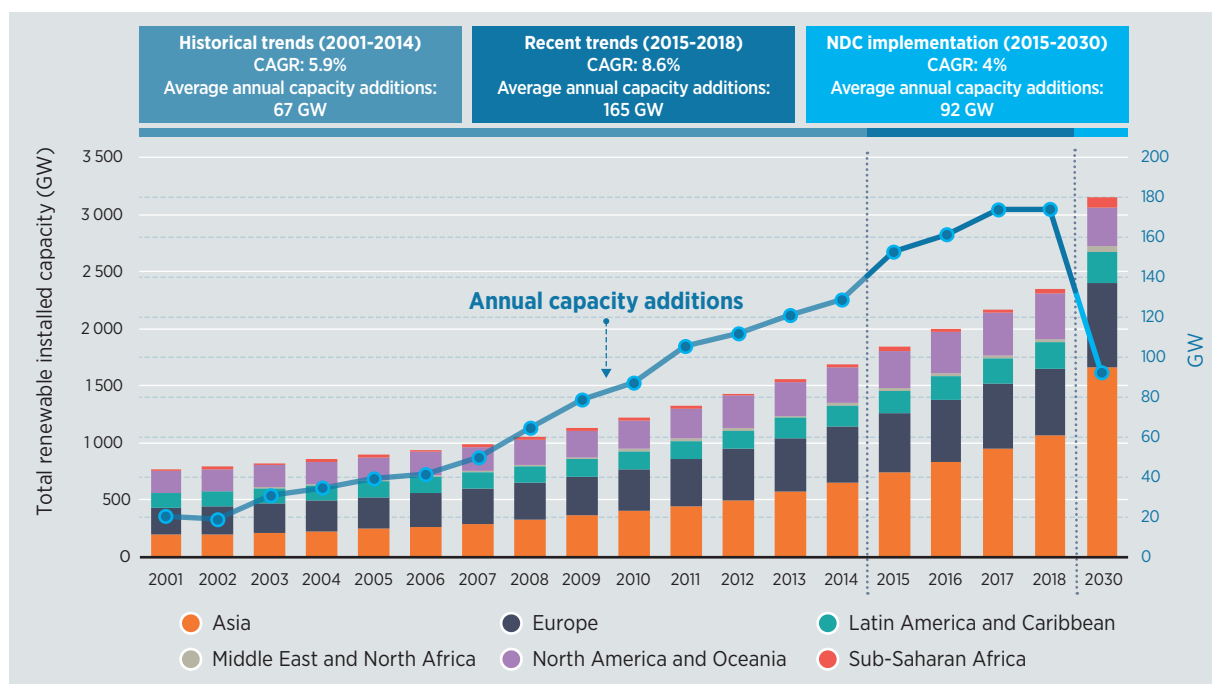
In fact, global renewable power capacity was growing at an average rate of 5.9% each year between 2001 and 2014. However, most pledges countries submitted in the form of INDCs would only translate to an average annual increase of 4% through 2030, or an average 92 GW of added capacity each year.

In reality, deployment has witnessed even more rapid growth since the signing of the Paris Agreement, rising annually by 8.6% between 2015 and 2018. This is over twice as fast as foreseen by the implementation of NDCs, adding an average 165 GW of renewable capacity each year (see Figure 11).

Hence, when put into context, renewable power targets in NDCs do not appear to be driving an accelerated global energy transformation; rather, they fail to reflect the actual pace at which renewables have grown, leaving significant room for increased targets (see Figure 11). Opportunities for more ambitious NDC targets exist particularly in Asia, and North America and Oceania, where projected growth rates are well below recent and historical rates.

If the recent pace of growth continues, global renewable energy targets in NDCs could already be met in overall terms by 2022, albeit with results varying by region. North America and Oceania had already achieved their current NDC targets by the end of 2018. Latin America and the Caribbean would reach their target renewable energy deployment in 2021, and Asia and Europe in 2022. All regions would achieve their current NDC targets by 2029, by which point global deployment would exceed current overall targets by 2.7 TW. Thus, the ambition expressed through NDC targets could already almost double just by reflecting the recent pace of renewable energy deployment.

Figure 11 Renewable power deployment and annual capacity additions: actual trends (2001–2018) and 2030 projections based on NDC implementation



Source: IRENA (2019c); IRENA analysis

MOVING BEYOND THE POWER SECTOR TO RAISE NDC AMBITIONS



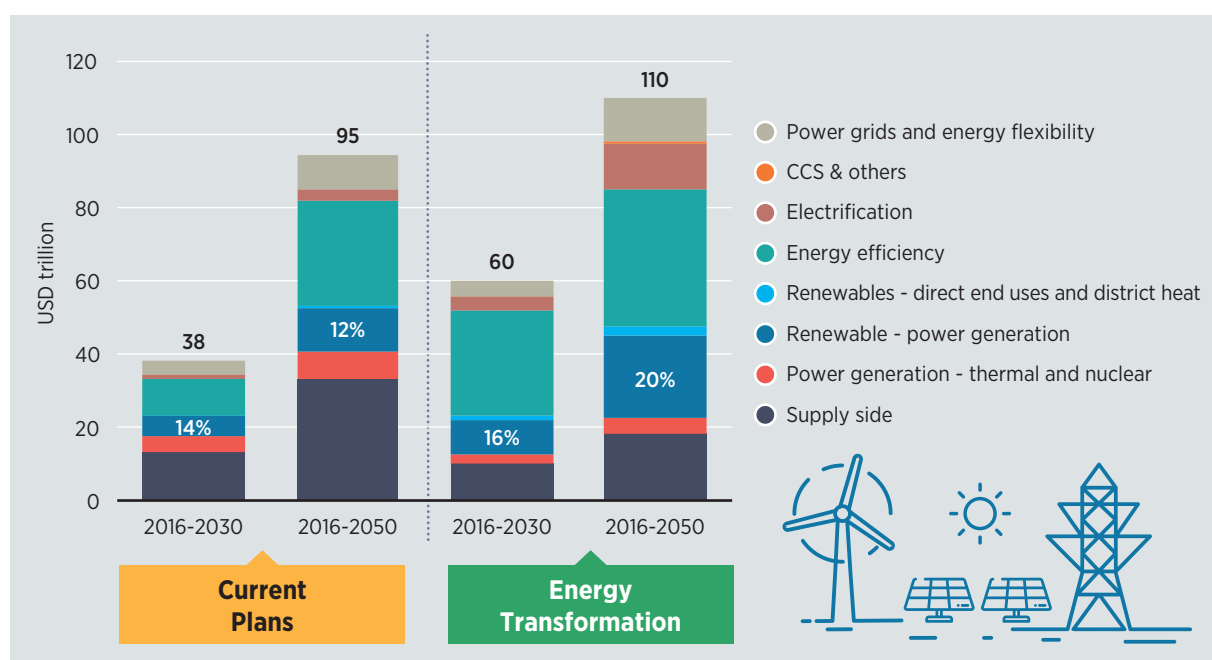
The scale of emission reductions required to achieve the objectives of the Paris Agreement implies that countries must look well beyond the power sector. This section discusses the developments needed, both in terms of investments and policy measures to accelerate the Energy Transformation scenario and maximise its benefits.

4.1. Aligning investment with Paris Agreement objectives

Advancing the global energy transformation to address climate challenge would require a massive scaling-up and re-directing of investments in the energy sector. A cumulative USD 110 trillion would be needed under an energy transformation scenario (IRENA, 2019b). Of this, only 20%

(or USD 22.6 trillion) would be for new renewable generation capacity – illustrating the fact that power is only one aspect of the solution. Over USD 37 trillion would need to be invested in energy efficiency, USD 13 trillion in electrification (including for electric vehicles and railways) and USD 12 trillion in power grid and energy flexibility measures (e.g., smart meters and energy storage) (see Figure 12).

Figure 12 Cumulative investment needed through 2030 and 2050 under Current Plans and Energy Transformation scenarios, USD trillion



Source: IRENA (2019b)

In closing the financing gap, the private sector will continue to provide the bulk of renewable energy investment, but public capital and support remain important to kick-start new markets and mobilise new capital sources. The private sector currently finances around 90% of annual direct investment in renewable energy assets, on average (IRENA and CPI, 2018). This includes non-energy producing companies, which have started sourcing electricity and heat from renewables.

Such corporate sourcing could drive additional investment in the sector (see Box 3).

Due to its limited availability, public capital is unlikely to increase above current levels. Public resources and support should, therefore, be used to systematically crowd in private capital via targeted capacity building, support for demonstration projects, blended finance initiatives and the provision of risk mitigation solutions (IRENA, 2016).

Box 4 Recognising corporates as drivers of renewable energy deployment

The world's non-energy-producing companies are increasingly turning to renewables as their preferred energy choice. According to IRENA analysis (IRENA, 2018), corporate sourcing of renewables¹³ is already taking place in more than 75 countries, driven by environmental and social benefits such as cutting emissions, but also economic benefits including cost savings, long-term price stability and security of supply. Of the more than 2 400 companies surveyed by IRENA, more than half reported that they actively source renewable electricity to supply their operations. Close to 200 companies indicated that at least half of their electricity was sourced from renewables, with 111 of these companies already procuring more than 85% of their electricity from renewables. While most are headquartered in North America, Europe and Asia, rising demand for renewable electricity has also been noted among companies in the Asia-Pacific region and Latin America, and high potential is expected in Africa and the Middle East.

By committing to procure renewables for electricity, heat and transport, private sector companies have a unique opportunity to drive significant additional investment in renewable energy and help achieve the Paris Agreement's objectives. Companies in the commercial and industrial (C&I) sector currently account for about two-thirds of the world's end-use of electricity. With increased electrification of the C&I sector's transport, heating and cooling processes, these companies are expected to continue to represent a large share of electricity consumption going forward. By volume, the materials segment – including the mining, pulp, paper and chemicals industries – is reported to be the biggest consumer of electricity within the C&I sector.

IRENA analysis (IRENA, 2018) has found that companies actively consumed about 465 terawatt-hours (TWh) of renewable electricity in 2017. This represents about 3.5% of total electricity demand and 18.5% of renewable electricity demand within the C&I sector. Electricity demand in the C&I sector is projected to grow from 13 500 TWh in 2017 to 18 100 TWh in 2030. About 57% of this projected demand would need to come from renewables to be in line with global climate objectives (IRENA, 2019b), equalling about 10 300 TWh. Based on existing company targets, commitments and ambitions, corporate sourcing is estimated to grow to only 2 150 TWh by 2030 (IRENA, based on IRENA, 2019b; 2018).

To further accelerate renewable energy investment in the C&I sector, innovative corporate sourcing financing models coupled with risk mitigation instruments and better knowledge are needed. This requires strengthening transparency on additionality to ensure that companies invest in new renewable energy projects, rather than existing renewable power installed capacity.

With the right frameworks in place to stimulate more ambitious renewable energy deployment, corporate sourcing is bound to play a significant role in the energy transformation and the achievement of the Paris Agreement's objectives. Enabling frameworks that encourage corporate sourcing while triggering additional renewable energy investment include supporting a credible and transparent system for the certification and tracking of renewable energy attribute certificates, creating energy market structures that allow for third party sales between companies and independent power producers (IPPs), and incentivising utilities to provide green corporate procurement options such as green electricity consumer labels and green tariff programmes.

¹³ (Active) corporate sourcing of renewables refers to a company actively procuring or self-generating renewable electricity to supply its own operations, as compared to a passive approach in which consumption is based on the average renewable electricity content available in the grids from which companies source their electricity.

Private capital pools that so far have been largely dormant in the energy transformation must be activated. Among these are institutional investors (*i.e.*, pension plans, insurance firms, sovereign wealth funds, foundations and endowments), which hold about USD 100 trillion of assets and currently provide only about 2% of direct financing for renewable projects (IRENA, forthcoming [b]). Renewable energy assets represent a good match for such investors, providing them with portfolio diversification as well as steady, strong and long-term cash flows matching their liabilities.

To enable their greater participation, an integrated approach is needed that combines effective regulatory and policy action (*e.g.*, review of investment restrictions, clarification of fiduciary duties, enhanced climate risk disclosure), development of capital markets and appropriate financing instruments (*e.g.*, green bonds, green funds and other green securities), co-operation between the public and private sectors to develop a pipeline of bankable renewable energy projects, as well as internal changes on the part of institutional investors (*e.g.*, capacity building, adoption of long-term sustainability mandates) so that they can manage risks while maximising the benefits from renewable energy investments (IRENA, forthcoming [b]).

The alignment of capital with climate objectives and the re-directing of investment towards climate-resilient assets such as renewable energy is already occurring around the world – albeit slowly – driven by growing awareness of climate-related risks associated with carbon-intensive investments.

Financial institutions increasingly recognise the threat posed by climate change to their assets and are starting to integrate climate-related considerations in their investment strategies and overall asset management activities.

A number of developments in the financial sector make the overall trend clear, although progress is not as rapid as it needs to be. Sustainable finance initiatives, such as the incorporation of ESG (environmental, social and governance) aspects in investment practices are increasingly in demand among investors and are slowly gaining ground (IRENA, forthcoming [b]). Due to such investor demand, the creation of new ‘green’ investment vehicles that channel capital towards sustainable sectors is growing. Green bonds issuances have more than quadrupled over the past five years, reaching USD 167.6 billion in 2018, with over half (52%) of total proceeds allocated to green energy in emerging markets, and 26% in developed countries (CBI, 2019). Green bonds have plenty of room for further growth as they still represent only a minuscule portion of the USD 1 trillion in annual global bond issuances.

Capital markets and institutional investors are also slowly but surely moving away from the status quo. The past few months alone have seen large institutional investors announcing their move away from fossil fuel assets. At the same time, oil and gas companies have been reclassified as “non-renewable energy” on the London Stock Exchange to distinguish them from greener energy producers (Kollewe, 2019).

The alignment of investments with climate objectives is already underway. New sources of private capital will need to be further mobilised to accelerate the energy transformation and achieve climate goals

Climate risk disclosure is also picking up pace but so far remains extremely low. The Task Force on Climate-Related Financial Disclosures (TCFD), which has set out guidelines for ‘decision-useful’ climate-related disclosures, reported that even though every year more companies are disclosing their climate risks, currently only one in four discloses information aligned with more than five of TCFD’s 11 recommended disclosures, and only 4% make disclosures aligned with at least 10 of the 11 recommended disclosures (CDSB and SASB, 2019). Climate risk disclosure, like other sustainable finance trends, is on the right path but must be scaled up rapidly and massively, with the active involvement of all stakeholders – policymakers, capital markets, investors and companies.

To stimulate private sector participation and investments, stable, comprehensive and transparent policy frameworks are needed that alleviate financing barriers and ensure predictable project revenue streams. While renewable energy targets – both in the NDCs and other national energy plans – provide a critical policy signal for the private sector, dedicated policies and measures in support of these targets are required for them to be effective. These include, for example, feed-in tariffs and premiums, auctions, renewable portfolio standards and regulatory mandates. However, such measures cannot be viewed in isolation and must be embedded in holistic policy frameworks that take into consideration the interlinkages with the broader socio-economic system.

With the right set of policies, both within and beyond the energy sector, governments can strongly stimulate private sector participation in the energy transformation

4.2 Establishing the policy framework for a just transition

To achieve the objectives of the Paris Agreement, drastic emission reductions are required. This calls for a global energy transformation that encompasses the entire energy system (*i.e.*, beyond just renewables and the power sector) as part of the wider economy and the planet's natural systems (see Figure 13).

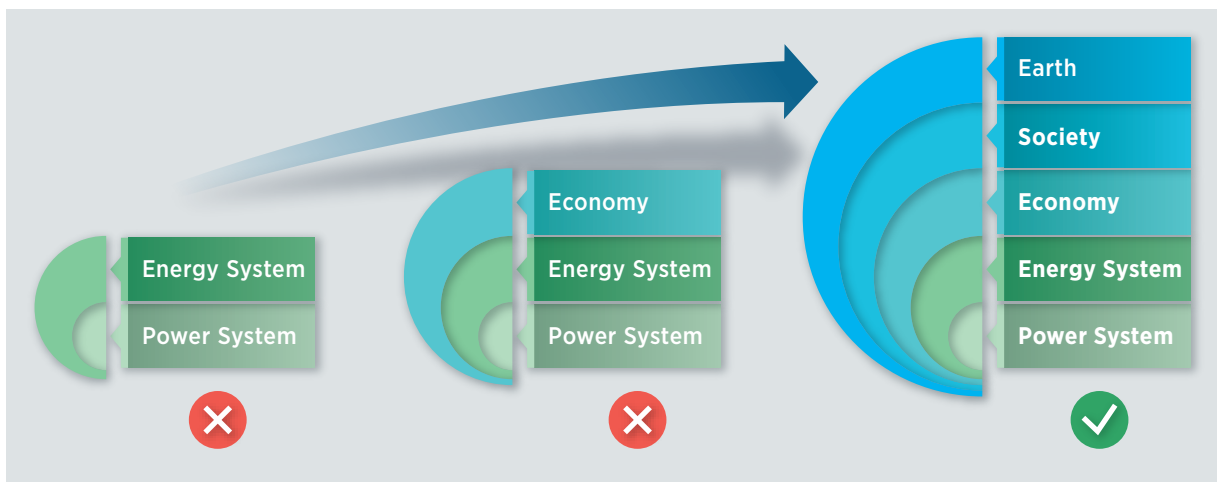
This transformation of the energy system, therefore, cannot be viewed in isolation from broader socio-economic structures. Developments in the energy sector would have impacts throughout the economy and would prompt changes in the socio-economic footprint, including in terms of gross domestic product (GDP), employment and human welfare (IRENA, 2019b) (see Figure 14).

Analysis of the socio-economic impacts of the transition can provide insights into how to maximise the benefits resulting from this process and ensure equitable outcomes.

IRENA (2019b) finds that the transformation of the energy system would not only bring the world closer to achieving global climate objectives but would also bring socio-economic benefits and be less expensive than a business-as-usual scenario. By 2050, the energy transformation could lead to additional gains in global GDP of as much as USD 98 trillion and to an increase in energy sector employment of 14%, compared to current plans (IRENA, 2019a; 2019b).

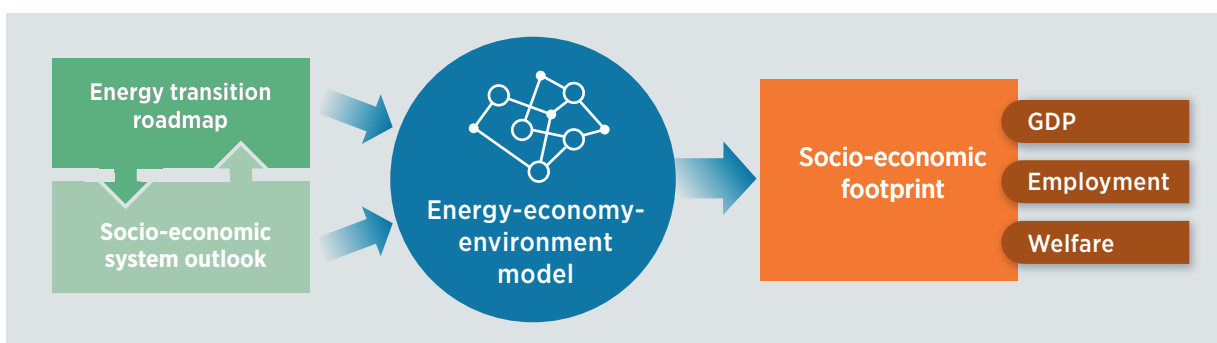
The transformation would result in cumulative net savings of between USD 45 trillion and USD 140 trillion through 2050, derived from lower net energy subsidies and reduced human and environmental health damage (IRENA, 2019a; 2019b).

Figure 13 The embedded nature of the energy system



Source: IRENA (2019b)

Figure 14 The energy transition and its socio-economic footprint



Source: IRENA (2019b)

However, different impacts (positive and negative) can be expected in different countries and regions, due to the diversity of socio-economic structures and their interactions with the energy transformation. To address these misalignments and ensure a just transition, an integrated policy framework is needed that extends well beyond the energy sector itself and pays greater attention to the transformative impacts on society, institutions, financing, ownership structures and the wider economy.

As depicted in Figure 15, the policy framework encompasses three sets of transformative policies. In addition to *deployment policies* specifically aimed at accelerating the uptake of renewables (push policies such as targets and mandates; pull policies such as administratively and competitively set tariffs; and fiscal and financial incentives), *enabling* and *integrating policies* are also needed. Enabling policies aim to strengthen co-ordination between the energy sector and the rest of the economy and focus, for example, on making

the energy sector a leading sector of the economy (industrial policies including R&D); building the necessary skills and capabilities for renewables production, use and application (education and training policies); facilitating labour mobility and job security (labour market and social protection policies); and developing adequate public investment strategies (financial policies). Integrating policies aim to promote the integration of renewables with countries' economic ambitions and social objectives; these include infrastructure policies and policies for sector coupling and storage (IRENA, 2019a).

Policies must be carefully selected and designed, taking into consideration specific national and local circumstances. As the sector matures, they must adapt to changing market conditions in order to ensure a cost-effective and sustainable energy transformation. This requires supporting effective participation and sound co-ordination between all stakeholders (IRENA, IEA and REN21, 2018).

Figure 15 Policy framework for a just transition



Source: IRENA (2019a) based on IRENA, IEA and REN21 (2018)

The integrated policy framework required to ensure a just transition rests on a combination of deployment policies, enabling policies and integrating policies

CONCLUSIONS

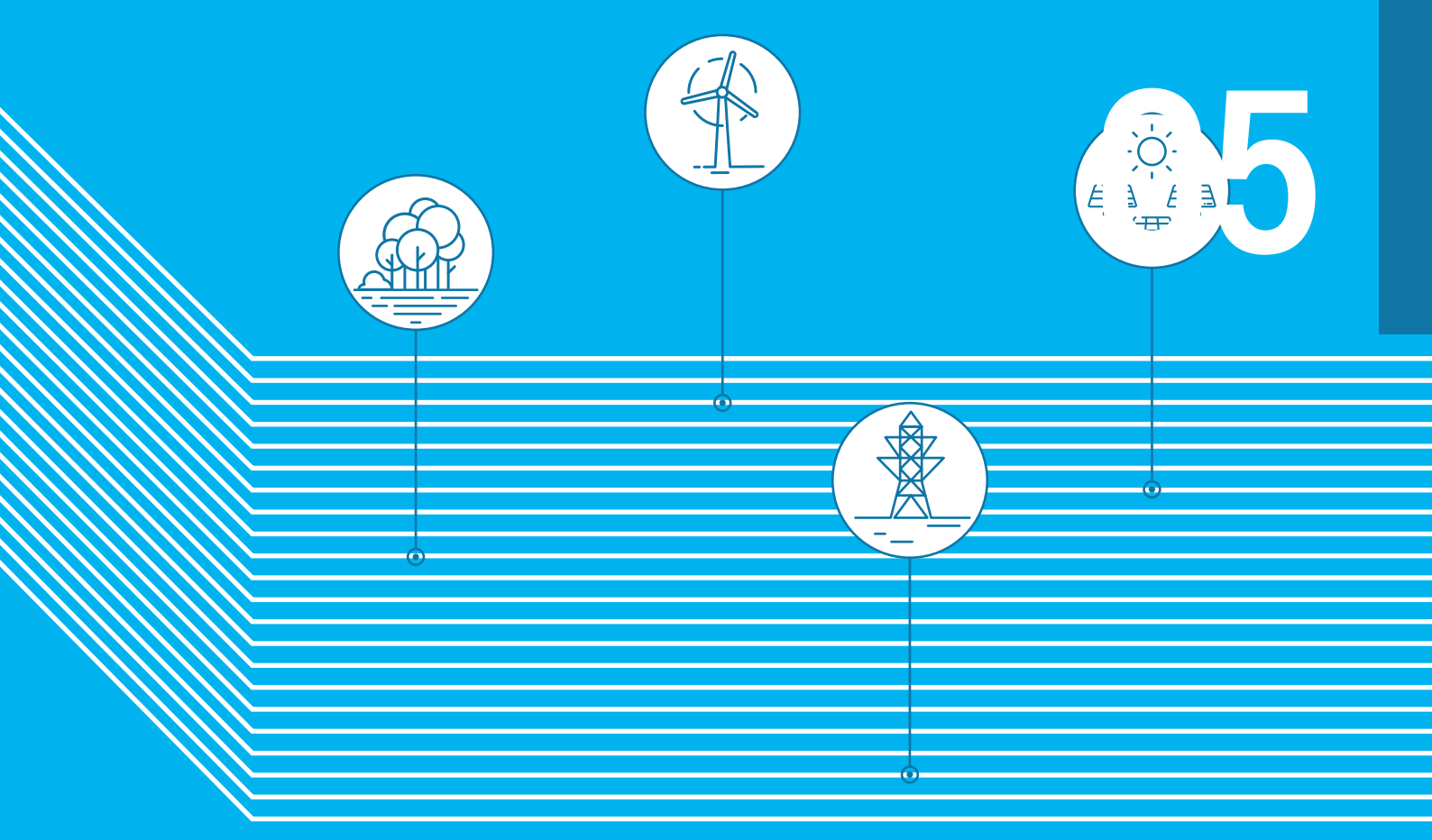
Although renewables are widely recognised as a key tool in addressing climate change, NDC pledges are not ambitious enough to meet the goals set out in the Paris Agreement. Current NDC power targets leave 59% of the potential for renewable electricity in line with the climate agreement untapped by 2030, according to IRENA estimates. NDC power targets even fall short of countries' existing strategies and plans. Moreover, NDCs do not reflect the actual, rapid growth of renewable power over the past decade.

Higher renewable electricity deployment, amounting to 7.7 TW (or 3.3 times current global capacity), could be achieved cost-effectively and would bring considerable socio-economic benefits, according to IRENA's global energy transformation scenario. Meanwhile, aligning NDCs more closely to existing national and sub-national plans could accelerate deployment and increase the world's renewable power capacity to 5.2 TW in 2030 (2.2 times current global capacity).

Considering the current growth in renewable power capacity (8.6% annually since 2015), NDCs fall short of market realities. Implementing existing NDCs for 2030 would only translate into annual capacity growth of 4% for 2015–2030, despite actual annual renewable power growth already amounting to 5.9% in 2010–2014. In fact, given current deployment trends, the 3.2 TW power capacity targeted by current NDCs for 2030 will already be realised by 2022.

Furthermore, the scale of renewable energy deployment foreseen by current NDCs is insufficient to meet the aim of the Paris Agreement, specifically to keep the rise in average global temperatures “well below 2°C” – and ideally at 1.5°C in the present century – compared to pre-industrial levels.

Current NDC renewable energy targets, moreover, focus predominantly on electricity. Only 14 NDCs set targets for liquid biofuels, 11 for non-power-sector biogas and 8 for solar water heaters.



Some countries also include energy efficiency measures in their NDCs. The decarbonisation of the power sector alone, however, would not put the world on course for a climate-safe future.

Rather, the entire energy sector must undergo a profound transformation through the adoption of renewables, energy efficiency measures and end-use electrification. Just as importantly, deep changes are needed in socio-economic structures extending well beyond the energy system.

More ambitious renewable energy targets, within and beyond the power sector, would enable the new round of NDCs submitted in 2020 to drive the necessary changes. Cost-effective options exist for most countries to raise their renewable energy NDC pledges, promising both investment opportunities and societal gains.

Creating a climate-safe energy system requires increased investments in renewables and energy efficiency, with an additional USD 15 trillion needed by 2050.

Financial institutions, recognising risks associated with carbon-intensive assets, are moving towards more climate-resilient investments, such as in renewable energy. Ultimately, scaling up renewables will cost less than a “wait and see” approach to emissions reduction.

Renewable energy provides a readily available climate mitigation and adaptation tool. It is a key enabler of sustainable development, contributing directly and indirectly to many SDGs, including poverty alleviation, education, water and sanitation. Renewables also bring broad socio-economic benefits, creating new jobs and fostering local industries.

Through ambitious renewable energy components, NDCs could help to advance multiple climate and development objectives. The NDC review in 2020 offers an immediate opportunity for countries to reassess their targets and raise their ambitions for renewables, both within the power sector and beyond.

ANNEX

REGIONAL CLASSIFICATION USED IN THIS ANALYSIS

This analysis groups UNFCCC Parties by region as described in Table 1 below. Additionally, Table 2 provides a list of UNFCCC Parties included in other groupings used in this report, namely SIDS, LDCs and G20. The designations employed in this brief and the presentation of material herein do not imply the expression of any opinion on the part of IRENA concerning the legal status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Table 1 Regional classification used in this analysis

Region	Number of UNFCCC Parties	UNFCCC Parties
Asia	32	Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Democratic People's Republic of Korea, India, Indonesia, Japan, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Republic of Korea, Singapore, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Turkey, Turkmenistan, Uzbekistan, Viet Nam.
Europe	46	Albania, Andorra, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, European Union, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Netherlands, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, North Macedonia, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Ukraine.
Latin America and Caribbean	32	Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela (Bolivarian Republic of).
Middle East and North Africa	20	Algeria, Bahrain, Djibouti, Egypt, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, State of Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, United Arab Emirates, Yemen.
North America and Oceania	19	Australia, Canada, Cook Islands, Fiji, Kiribati, Marshall Islands, Mexico, Micronesia (Federated States of), Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, United States, Vanuatu.
Sub-Saharan Africa	48	Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.

Table 2 Other regional groupings used in this analysis

Regional grouping	Number of UNFCCC Parties	UNFCCC Parties
G20	20	Argentina, Australia, Brazil, Canada, China, European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russian Federation, Saudi Arabia, South Africa, Republic of Korea, Turkey, United Kingdom, United States.
LDCs ¹⁴	43	Afghanistan, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Zambia.
SIDS	34	Antigua and Barbuda, Bahamas, Barbados, Cabo Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia (Federated States of), Nauru, Niue, Palau, Papua New Guinea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu

¹⁴ As defined by the United Nations in November 2019 (UN, 2019).

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NATIONALLY DETERMINED CONTRIBUTIONS IN 2020

Advancing renewables
in the power sector and beyond