IRENA
International Renewable Energy Agency

Renewable Energy Target Setting

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About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. 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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Acronyms

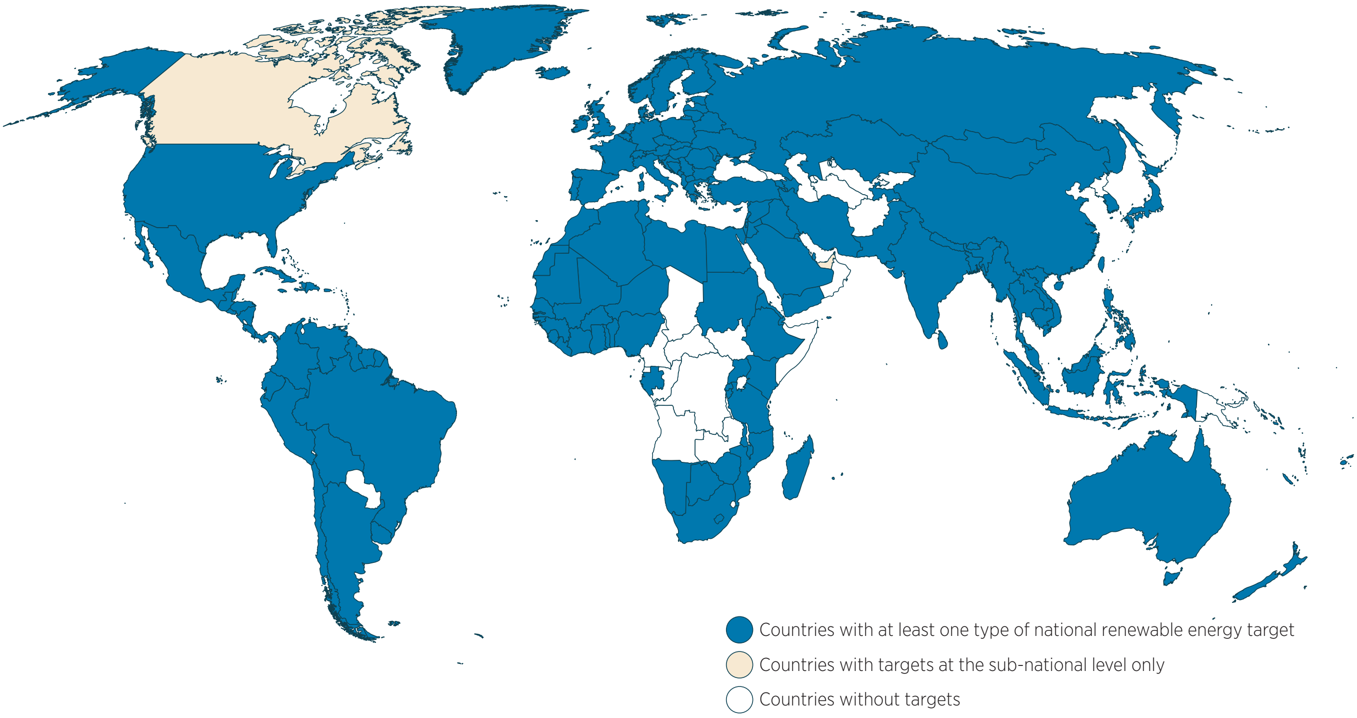
ACP	Alternative Compliance Payment
CAD	Canadian Dollar
CARICOM	Caribbean Community
CCS	Carbon capture and storage
CEER	Council of European Energy Regulators
CfD	Contract for Difference
CSP	Concentrating solar power
EC	European Council
ECOWAS	Economic Community of West African States
EJ	Exajoule
EU	European Union
EUR	Euro
FiT	Feed-in Tariff
GBP	British Pound
GDP	Gross domestic product
GSR	Global Status Report
GW	Gigawatt
GWh	Gigawatt-hour
GWth	Gigawatt-thermal
ILUC	Indirect land-use change
INR	Indian Rupee
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
IRP	Integrated resource plan
kW	kilowatt
kWh	kilowatt-hour
LSE	Load-serving entities
MASEN	Moroccan Agency for Solar Energy
MBO	Management by Objectives
MDG	Millennium Development Goal
MEMEE	Moroccan Ministry of Energy, Mines, Water and Environment
MENA	Middle East and North Africa
MMS	Mandatory market share
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
MWh	Megawatt-hour
NDRC	National Development and Reform Commission
NEA	National Energy Administration

NREAP	National Renewable Energy Action Plan
NSM	National Solar Mission
OECD	Organisation for Economic Co-operation and Development
Ofgem	Office of Gas and Electricity Markets
PPA	Power Purchase Agreement
PV	Photovoltaic
Quad	Quadrillion British thermal unit
Q1, Q2	First quarter, second quarter (of a given year)
R&D	Research and development
REC	Renewable Energy Certificate
REN21	Renewable Energy Policy Network for the 21st Century
RES	Renewable energy sources
RES-E	Renewable energy sources of electricity
RES-H&C	Renewable energy sources of heating/cooling
RET	Renewable energy technologies
RFS	Renewable Fuel Standard
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
RPS	Renewable Portfolio Standard
SASAC	State-owned Assets Supervision and Administration Commission
SHS	Solar home system
SIDS	Small island developing states
SMART	Specific, measurable, achievable, realistic and time-bound
TFEC	Total final energy consumption
TPES	Total primary energy supply
UAE	United Arab Emirates
U.K.	United Kingdom
UN	United Nations
U.S.	United States
USD	U.S. Dollar
VAT	Value-added tax
W	Watt
WHO	World Health Organization

Executive Summary

Renewable energy targets have become a defining feature of the global energy landscape. As of mid-2015, 164 countries around the world have adopted at least one type of renewable energy target, up almost four-fold from 43 countries in 2005. Two more countries have set renewable energy targets at the sub-national level only (Canada and the United Arab Emirates). While the expansion of targets in the early 2000s was driven by Organisation for Economic Co-operation and Development countries, in recent years, developing and emerging economies have taken a leading role in the growing adoption of targets and now account for 131 of the 164 countries with renewable energy targets in place.

Global Map of National Renewable Energy Targets of All Types, 2015



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Since their emergence in the 1970s, renewable energy targets have taken many different forms. They have ranged from simple government announcements to legally binding obligations with clear, quantifiable metrics and specific compliance mechanisms. In the majority of cases, renewable energy targets are not accompanied by a binding obligation. They often are either embedded within sectoral plans, such as Integrated Resource Plans or energy sector master plans (*e.g.* South Africa, Brazil), or in National Renewable Energy Action Plans (*e.g.* in the European Union and now in the Economic Community of West African States region), or they are part of national development plans (*e.g.* China, India). As a result of this considerable diversity in target types, it can be difficult to define precisely what constitutes a renewable energy target.

The great diversity of renewable energy targets calls for definition and context

This report sets out a general definition of renewable energy targets, which are defined as numerical goals established by governments to achieve a specific amount of renewable energy production or consumption. They can apply to the electricity, heating/cooling or transport sectors, or to the energy sector as a whole. They often include a specific time period or date by which the target is to be reached.

Different types of renewable energy targets can be represented along a spectrum to visualise where they stand in relation to one another, depending on how specific, measurable and binding they are. The aim of the spectrum is to more accurately describe the many forms and realities that the simple term *renewable energy target* can cover, ranging from aspirational statements, to energy strategies and action plans, up to fully articulated targets, accompanied by clear, quantifiable policy instruments and backed by legally binding obligations.

Spectrum of Renewable Energy Targets

While renewable electricity targets are the most widespread type, heating/cooling and transport sector targets have increased significantly over the last decade

The majority of countries continues to focus on the electricity sector, with 150 countries having set renewable electricity targets to date. Nevertheless, the number of countries setting targets for the heating/cooling sector saw a remarkable progression in the last 10 years, from 2 countries in 2005 to 47 by mid-2015. This can be explained in part by the adoption of the European Union Renewable Energy Directive (Directive 2009/28/EC), which mandates specific renewable energy heating/cooling targets for all Member States, as well as by the proliferation of solar thermal targets globally. The number of countries adopting renewable transport targets has also shown steady growth, having more than doubled from 27 in 2005 to 59 by mid-2015.

Renewable energy targets exist at the intersection of multiple policy drivers and priorities

Robust target design depends on the primary policy objectives pursued. Country examples show that rather than being motivated by one single overarching objective, governments are increasingly adopting renewable energy targets to meet multiple interconnected objectives such as energy security, environmental sustainability and socio-economic benefits. It is important that renewable energy targets be based on a sound knowledge base, where metrics and design features are one dimension, and where decisive contextual factors such as political, institutional and economic aspects are also considered. Clearly articulating the objectives underlying renewable energy targets can help balance the costs and benefits of different target levels and types, while also improving the monitoring of their impacts over time.

Targets can serve different functions throughout the policy-making process

Targets can have a number of positive functions at different stages of the policy-making process (*i.e.* formulation, implementation, and monitoring and evaluation). They serve an important guiding and knowledge function at the policy formulation stage, where they can bring consistency across different policy spheres and reveal data requirements and discrepancies. They can also enhance the transparency of the policy-making process by providing a common information base to all stakeholders, thereby fostering public support. At the policy implementation stage, targets signal political commitment, indicate long-term investment and innovation trends, improve coordination and motivate stakeholders to take action. At the monitoring and evaluation stage, targets can help measure the effectiveness of various policies and measures, and provide an opportunity for review, adaptation and continuous improvement.

Targets send an important signal to stakeholders

As they have spread around the world, renewable energy targets have played a significant role in informing investment decisions. When backed by supportive policy and investment frameworks, they can provide long-term visibility to industry, a critical ingredient in stimulating deployment at scale. Renewable energy targets contribute to developing a clearer vision for the development of the sector and enable stakeholders to allocate resources more effectively. They are also instrumental in indicating the envisioned trajectory of market growth, thereby helping to anchor medium and long-term expectations. By giving a sense of trajectory and growth, they can contribute to lowering deployment costs and establishing a supply chain utilising local industry. In this perspective, targets can help drive valuable knowledge and local skills development given the long time frames involved in building human capacity.

Stakeholder engagement strengthens ownership and feasibility of targets

The effectiveness of renewable energy targets does not only depend on their design and effective integration into the broader policy framework. Political commitment, support by key stakeholders and institutional capacity are all essential elements of effective targets. Although governments are generally responsible for setting targets, achieving them relies on the contribution and efforts of different actors. This makes stakeholder engagement an essential element in building momentum, as well as in identifying potential bottlenecks that may constrain renewable energy market development. Establishing online platforms to communicate renewable energy plans and provide ready access to supporting documents and resources is an efficient way to involve individuals, organisations and industries and overcome resistance to new policy initiatives. Public consultation can also help obtain valuable information related to the feasibility of targets.

Technology-specific targets are now predominant

Governments increasingly recognise the benefits of adopting a portfolio approach to renewable energy deployment. Targets that are exclusive to selected technologies can be introduced to support their specific deployment, in particular when they are most suitable in terms of resource availability matching peak demand (e.g. solar targets in Dubai). Such targets can also sustain the development of the local value chain of selected technologies. In addition, technology-specific targets can support the diversification of the energy mix to increase energy security. As a result, technology-specific targets have significantly increased in recent years. By encouraging the simultaneous development of a range of different renewable energy options, policy makers are enabling more diversified renewable energy sectors to emerge and to grow.

The metrics of renewable energy targets have implications for implementation and monitoring

Specific design issues for policy makers to consider include whether targets should be established in absolute terms (a specific quantity of energy to be supplied) or relative to a moving baseline (*i.e.*, in percentage terms), and whether electricity targets should be set in capacity (megawatt) or in output (megawatt-hour) terms. Many of the benefits of deploying renewables — improved air quality, reduction of fossil fuel imports, etc. — only materialise if actual energy is generated. Capacity-based targets may be easier to monitor for some technologies but run the risk of allowing idle or under-performing capacity to be registered as contributing towards the target, even though such capacity may add little real energy to the system. However, it is possible to combine these two approaches, and to frame targets in both output and capacity terms. This can facilitate implementation by making it easier to connect renewable energy targets to specific policies and measures, such as auctions or feed-in tariffs.

Making targets mandatory matters

Establishing targets in law is an important step in increasing their credibility and longevity. While most targets currently adopted around the world lack clear enforcement mechanisms or penalties, a number of countries are enacting their targets in law. Making targets binding in law helps reassure investors that a local market will continue to exist for their product in the future. Furthermore, legally binding targets are harder to repeal and therefore may be less vulnerable to changes in the political climate. Overall, the track record for jurisdictions with aspirational targets is varied. In contrast, the track record for jurisdictions with binding targets is considerably stronger. It should be noted, however, that binding targets not only require compliance and enforcement mechanisms but also an institutional structure to monitor and enforce them.

Who is obligated and how also matter

A key consideration whether targets are binding or aspirational remains on whom the obligation to reach the target is imposed. In some jurisdictions, governments are responsible for meeting the target. In such cases, enforcement mechanisms are unclear, unless the obligation is specifically delegated to a relevant entity. In the context of the European Union, the European Commission can initiate infringement proceedings against Member States failing to implement appropriate policies, although there are currently no standardised sanctions. In some countries, the target is embedded in the policies that obligate the relevant entities. In the U.S. electricity sector, for example, the target is generally imposed on load-serving entities (utilities, co-operatives and other electricity service providers) through policies such as Renewable Portfolio Standards. In the absence of independent regulation and enforcement, the targets themselves remain aspirational, rather than binding in any legal sense.

Penalties and enforcement mechanisms vary widely

Governments have used a wide range of penalties and enforcement mechanisms in the process of enforcing binding renewable energy targets. In some cases, the penalties for non-compliance involve simple payments, or fines. In others, governments have attempted to increase compliance flexibility by allowing obligated entities to purchase Renewable Energy Certificates rather than producing or purchasing their own renewable electricity. In still other cases, most notably in the United States, regulators allow load-serving entities even more flexibility by allowing them to pay an "Alternative Compliance Payment" instead of procuring the mandated renewable energy generation. In addition to providing obligated entities with more flexibility, alternative compliance payments simultaneously act as a cost cap, which can help lawmakers to push mandatory targets through the legislative process. However, flexibility must be balanced by clear rules and regular oversight.

Striking the right balance between ambition and realism is vital to the success of targets

Establishing a target level that is agreed upon by all stakeholders may be difficult in certain jurisdictions, particularly where there is considerable disagreement on the overall renewable energy strategy, or strong opposition from incumbents. This is another reason extensive stakeholder engagement is essential, particularly during the initial design phases as well as during subsequent revisions. In some cases, governments start by establishing modest targets, especially in early stages of market development. Once the foundations are set, more ambitious targets can help to mobilise key stakeholders towards broader, more structural changes in the electricity or energy mix of countries.

Effective renewable energy targets should be backed by clear strategies and specific policies

While underscoring the importance of establishing renewable energy targets, this report recognises that targets alone are not enough. In order to be seen as credible by investors and to provide a clear trajectory for the future evolution of the energy mix, they need to be accompanied by a clear strategy and backed by specific policies and measures. Linking renewable energy targets to specific policies is critical to make targets more meaningful and to ensure their effectiveness. This aspect could be the subject of further analysis to understand more precisely what makes renewable energy targets effective at the implementation stage.

Introduction

Renewable energy targets have emerged as a popular mechanism to set national and regional economies on the path towards a more secure and sustainable energy future. They play a crucial role in the global energy landscape, by providing an overview of renewable energy trends and indicating the envisioned trajectory of deployment, thereby helping to anchor medium and long-term expectations. As such, they can provide an important signal to the industry of where future growth opportunities may lie, and can help to align stakeholders by creating a clearer, common vision for the development of the energy sector and its various sub-sectors.

As of mid-2015, 164 countries had national renewable energy targets, along with two countries with renewable energy targets set at the sub-national level only (Canada and the United Arab Emirates (UAE)), and a myriad of targets at the municipal or local level. While acknowledging the considerable progress that has been made at the sub-national and regional levels on renewable energy targets, this report focuses primarily on national renewable energy targets.

In contrast to policy instruments, literature focusing specifically on renewable energy targets has been limited. Two main factors make the analysis of renewable energy targets complex. First, there is a wide diversity of target types with different definitions and characteristics. Second, renewable energy targets are often defined in conjunction with a wide variety of policies, so that it is often hard to distinguish between targets and the specific policies used to achieve them. In some cases, renewable energy targets are embedded within broader planning efforts (such as energy sector master plans, or five-year plans), or within a particular policy instrument (such as auctions). In other cases they are the key element of vision statements (white papers).

Setting renewable energy targets is not always a scientific, sequential process. In some countries, the process of setting targets has been very comprehensive, beginning with an assessment of resource availability and costs, balancing costs with benefits and overall objectives, informed by sound data and analysis and involving a wide range of stakeholders before deciding the level and type of target. In other cases, renewable energy targets have been set based on less rigorous processes and/or specific stakeholder interests. Because every country is shaped by different dynamics and conditions, there is no generic methodology for setting renewable energy targets.

This report on *Renewable Energy Target Setting* aims to shed light on the actual process of setting renewable energy targets. To this end, it presents a global overview of the diversity of renewable energy targets and brings together insights from a wide range of countries.

Importantly, the report draws lessons from the experience to date with renewable energy targets from a design perspective – *i.e.,* it does not assess the implementation of targets across different countries. It highlights the critical importance of definitions and specific design features suited to different objectives. The overall aim of this report is to lay out a comprehensive framework that can inform policy makers as they embark on the task of designing – or revising – their renewable energy targets.

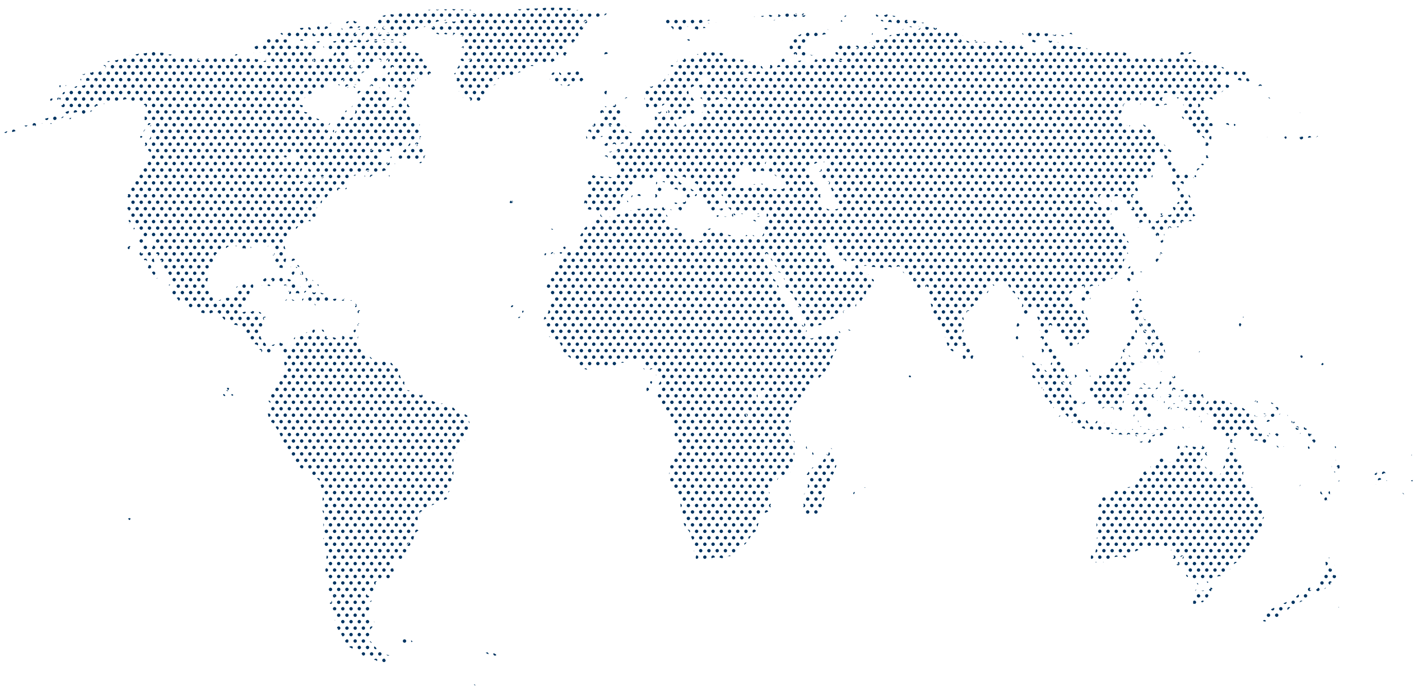
While underscoring the importance of renewable energy targets, this report recognises that they are not sufficient in and of themselves. In order to be seen as credible by investors and society and to provide a reliable trajectory for the future evolution of the energy mix, they need to be accompanied by a clear strategy and backed by specific policies and measures.

Chapter 1 of the report looks at the foundations of renewable energy targets, both historical and theoretical. The chapter provides an overview of the expansion of renewable energy targets globally and highlights some of the trends that have emerged as targets have expanded both in their scope and sophistication. It traces their use from the introduction of biofuels targets for the transport sector in the 1970s in Brazil, to the adoption of the first Renewable Portfolio Standard for the electricity sector in the U.S. state of Iowa in 1984. The chapter sets out a general definition of renewable energy targets and highlights key aspects of the diversity of target types. It concludes with a discussion on the theoretical foundations of renewable energy targets.

Chapter 2 focuses on the importance of establishing a sound basis for renewable energy targets with clear motivations and processes, informed by robust data and analysis. It examines the drivers and functions of targets at different stages of the policy-making cycle. It then provides an overview of the various steps involved in setting targets, including developing the baseline analysis, analysing potential costs, benefits and impacts, as well as considering additional tools such as long-term energy planning and resource assessments.

Chapter 3 examines a series of specific design issues for policy makers to consider, including whether targets should be established in absolute terms (a specific quantity of energy to be supplied) or relative to a moving baseline (*i.e.*, in percentage terms), and whether electricity targets should be set in capacity (MW) or in output (MWh) terms. The chapter then turns to the more detailed design choices of whether renewable energy targets are long-term or short-term, mandatory or aspirational, and technology-specific or technology-neutral. The chapter concludes by looking more closely at how renewable energy targets are translated from overarching objectives into the specific policy tools and measures that will be used to achieve them.

Chapter 4 concludes the report with a series of lessons based on the diversity of country examples examined and the various aspects discussed. The conclusions are intended as key considerations to help policy makers design and achieve renewable energy targets more effectively, based on their country conditions and priorities.



1. Foundations of Renewable Energy Targets

This chapter provides an overview of the main trends emerging from the expansion of renewable energy targets across the world, tracing their use since the introduction of the first ethanol production target in Brazil in the 1970s and the adoption of the first Renewable Energy Standard in the U.S.[1] It then addresses key aspects and definitions related to renewable energy targets. The chapter concludes with a discussion on the theoretical foundations of renewable energy targets.

1.1 OVERVIEW OF RENEWABLE ENERGY TARGETS AT THE GLOBAL LEVEL

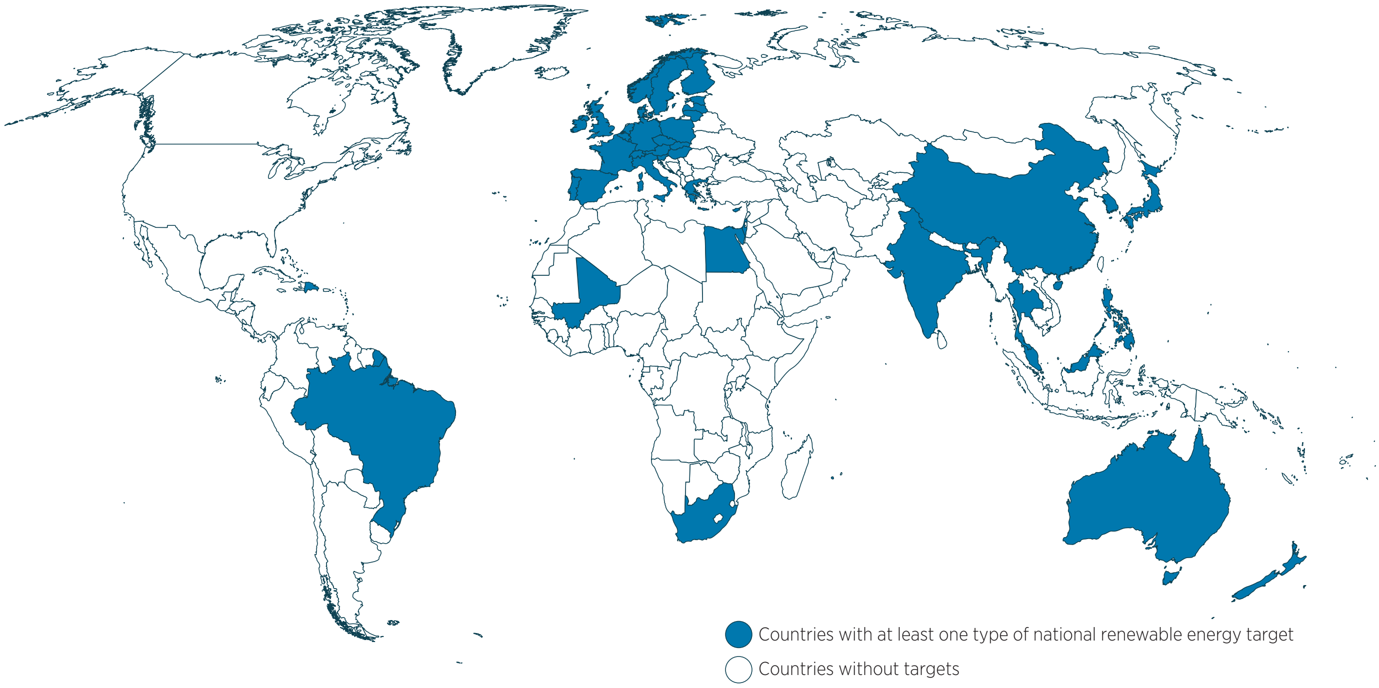
As they have spread around the world over the last two to three decades, renewable energy targets have shifted geographically and have become highly diverse, both in the scope of the energy sources/technologies they cover and in the increasing sophistication in their overall design and enforcement.

Geographical expansion

In 2005, there were 43 countries with renewable energy targets, led primarily by Organisation for Economic Co-operation and Development (OECD) countries (see Figure 1). By mid-2015, the number of countries had grown to 164 (see Figure 2). In addition, there are two countries with renewable energy targets set at the sub-national level only (Canada and the UAE).

In recent years, developing and emerging economies have taken a leading role in the growing adoption of targets. The number of non-OECD countries with targets in place went up from 12 to 131 in the last decade (see Figure 2). For a detailed list of countries with national targets by type/sector as of mid-2015, see Annex I. While renewable energy targets are also increasingly being adopted at the sub-national (*e.g.* state, municipal) and regional levels, this report focuses primarily on national renewable energy targets.

Figure 1: Global Map of National Renewable Energy Targets of All Types, 2005



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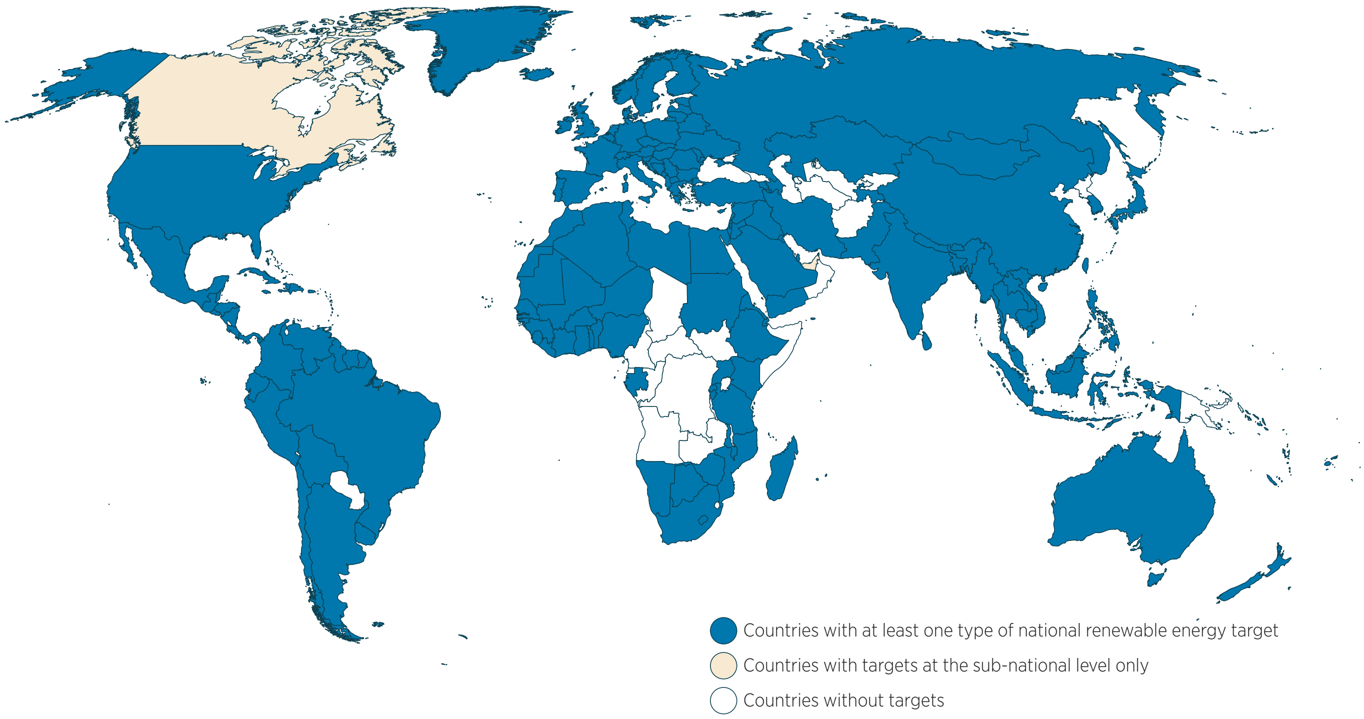
Source: IRENA based on REN21, 2005 and 2006.

[1] Renewable Energy Standard is used here as a general term to capture a wide range of similar policy frameworks, including Renewable Portfolio Standards, Renewable Electricity Standards, Alternative Energy Portfolio Standards, Renewable Portfolio Goals (which are non-binding), Clean Energy Standards, as well as the Renewables Obligations adopted in the U.K. China has recently introduced a similar policy approach, labelled the "mandatory market share" (see Box 19). For a more detailed description of Renewable Energy Standards as they are implemented in the U.S. , see Box 2. For a more detailed description of the Renewables Obligation in the U.K., see Box 3

Africa has witnessed a rapid rate of adoption of renewable energy targets over the last decade. A total of 41 of the continent's 54 countries now have at least one type of renewable energy target for specific technologies or for specific sectors, as well as to guide dedicated off-grid policies for rural electrification and sustainable cooking. Notably, the 15 Member States of the Economic Community of West African States (ECOWAS), representing one-third of the population of sub-Saharan Africa, have all adopted overall renewable energy targets at the regional level and they are in the process of developing their National Renewable Energy Action Plans (NREAPs). This rapid dissemination is remarkable considering that, in 2005, there were only three countries on the continent (Egypt, Mali and South Africa) with aspirational renewable energy targets.

Renewable energy targets also have become increasingly widespread in small island developing states (SIDS). Notably, several islands throughout the Pacific region have adopted highly ambitious renewable energy targets, including the Cook Islands (100% renewable energy sources of electricity (RES-E) by 2020) (SPREP, 2013), Tokelau (100% RES-E by 2012 - achieved) (SPREP, 2011), Tuvalu (100% RES-E by 2020) and Fiji (100% RES-E by 2020). Several SIDS have established renewable energy targets as a share of total primary energy supply (TPES), including the Federated States of Micronesia (30% of TPES by 2020), Nauru (50% of TPES by 2015), Palau (20% of TPES by 2020) and Samoa (over 10% of TPES by 2016) (IRENA, 2013a). For many SIDS, transitioning to an electricity system (and eventually an energy system) based primarily on renewable energy sources (RES) instead of imported fossil resources will result in net cost savings both for governments and for citizens. This underscores why ambitious renewable energy targets are becoming so widespread in island regions around the world.

Figure 2: Global Map of National Renewable Energy Targets of All Types, 2015



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Source: IRENA based on REN21, 2014 and REN21, 2015. For additional countries, see sources in Annex I.

Target structure

A growing number of countries have begun to move beyond a sector-specific approach that focuses predominantly on electricity, to applying their targets to the total energy mix, with the total number growing from 30 in 2005 to 79 as of mid-2015. Targets that apply to the entire energy mix and are framed in terms of TPES or TFEC, are referred to here as "overarching" renewable energy targets (see Section 1.3 on the definition of renewable energy targets). They range from 1% by 2016 for Botswana to 100% by 2050 for Denmark, with most in the range of 10-40% (REN21, 2014). While these overarching targets are often combined with technology-specific targets or sector-level targets, this trend shows that policy makers are beginning to use renewable energy targets to induce structural changes in the total energy mix, rather than simply in one sector (*e.g.* electricity or transportation).

Another important trend relating to the structure of targets is that when setting overarching targets covering the total energy mix, countries are shifting to targets defined in TFEC rather than in TPES. As discussed in Section 3.1 on the structure of renewable energy targets, targets expressed as a share of TFEC are increasingly seen to be more appropriate as they focus on the actual energy consumption, rather than on the primary energy inputs used. This approach enables different RES such as wind and solar power, whose contribution to the energy mix is only measured by calculating their GWh output, to be compared more effectively with fossil and nuclear sources, where one can calculate both their output (GWh) as well as the primary energy content of their input fuels (*e.g.* coal, uranium, etc.) Focusing on the primary energy inputs (as the TPES method does) tends to overstate the share of fossil and nuclear energy in the overall energy mix, as there is no analogous metric to evaluate the primary energy content of RES such as wind and solar power (see Section 3.1 for a more detailed discussion of the differences between TFEC and TPES).

As of mid-2015, a total of 54 countries had established targets as a share of renewable energy in their TFEC. By comparison, 29 countries had established targets as a share of TPES, while four countries had set targets for both TPES and TFEC.

A notable example illustrating this trend is China. In 2005, China's State Council and National People's Congress approved a comprehensive law for developing and promoting RES (PRC, 2005). Through this Law, the Chinese government sent a clear signal that renewable energy development was a national priority by setting a target of 15% of TPES to come from renewables by 2020. At the end of 2009, the Renewable Energy Law was updated, revising the original renewable energy target to a share of 15% of TFEC to originate from non-fossil fuel sources (*i.e.* renewables and nuclear), up from 9% of TFEC in 2008. While the new target represents a smaller absolute quantity of renewable energy compared to the original 15% target of TPES (as TFEC is generally smaller than TPES due to conversion losses), it places China's target in the same category as the 2009 European Union Directive 2009/28/EC on the *Promotion of the Use of Energy from Renewable Sources* (EU RE Directive), which likewise adopted a renewable energy target as a share of final energy.

While many renewable electricity targets continue to be framed in terms of capacity (MW), a growing number of jurisdictions are opting for renewable energy targets in terms of output (MWh) or as a percentage share of the total energy or electricity mix (see Section 3.1 on the structure of renewable energy targets). This can be seen in many U.S. Renewable Energy Standards, as well as in countries such as the Republic of Korea, Egypt and throughout ECOWAS countries.

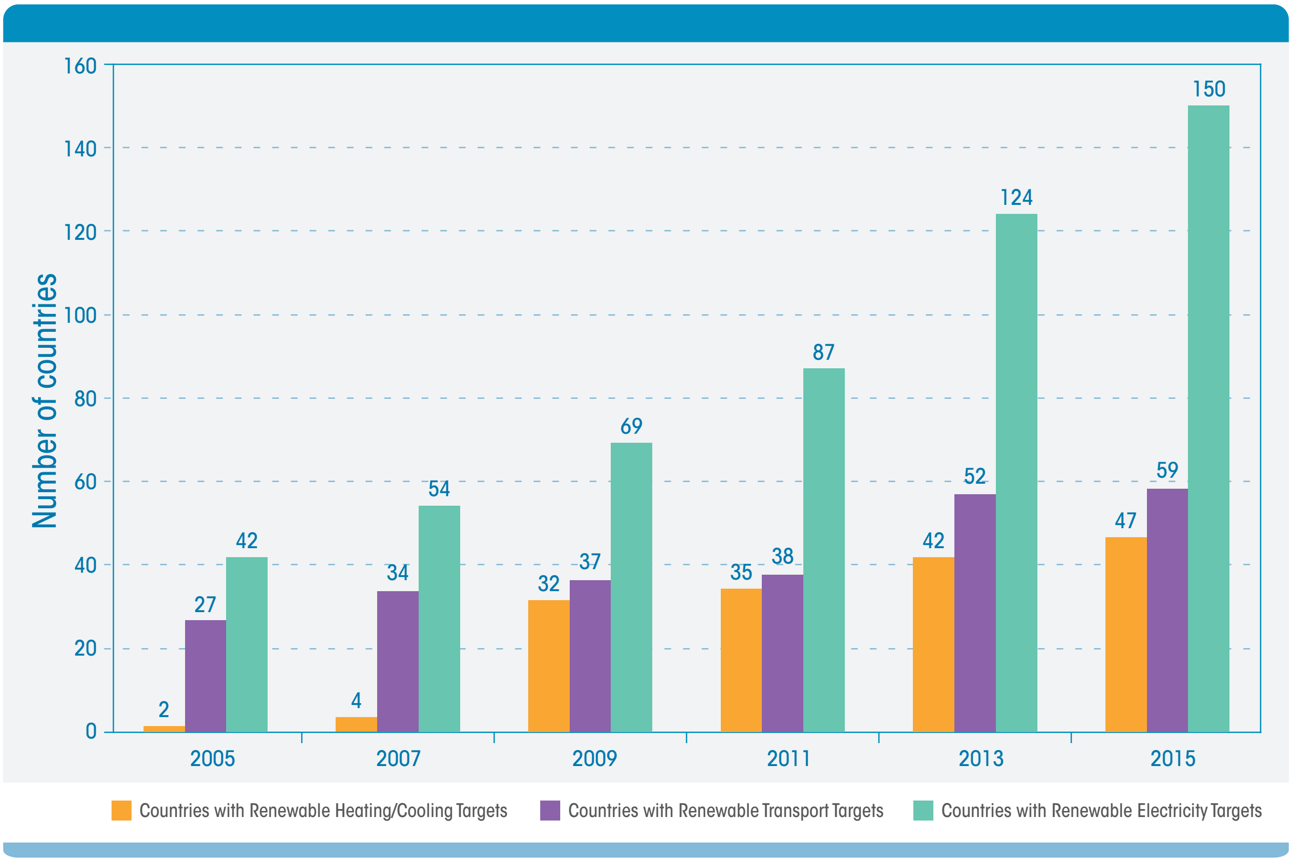
As shown in Figure 3 below, while the majority of countries continues to focus on the electricity sector, the number of countries setting renewable energy targets for the heating/cooling sector saw a remarkable progression in the last 10 years, from two countries in 2005 to 47 by mid-2015. This can be explained in part by the adoption of the EU RE Directive, which mandates specific renewable energy heating/cooling targets for all Members States as well as by the proliferation of solar thermal targets globally. The number of countries adopting renewable transport targets also showed steady growth, and more than doubled from 27 in 2005 to 59 by mid-2015. This trend reflects increasing policy attention to promote RES in the heating/cooling and transport sectors.

Strength of obligation

As of mid-2015, at least 59 jurisdictions in the world (including both national and state-level) had adopted legally binding renewable energy targets, up from 12 in 2000. These include 29 mandatory Renewable Energy Standards in the U.S.[1] and two legally binding renewable energy targets at the provincial level in Canada. The 2009 EU RE Directive established legally binding targets for its 28 Member States at the regional and national level.

With the growth of legally binding targets, there also has been a proliferation of enforcement mechanisms, including direct financial penalties, fines and Alternative Compliance Payments (ACP) (see Box 18), as well as the threat of losing the right to continue doing business in the state or jurisdiction in question for failing to comply. However, it is important to note that the majority of targets both at the national and sub-national level remain non-binding. One of the reasons could be the difficulty that governments face in implementing self-enforcement mechanisms. If the EU 2030 renewable energy targets become non-binding, this will make binding targets at the national level even rarer. This aspect is discussed further in Section 3.3. These emerging trends are elaborated further in subsequent chapters to develop a comprehensive framework facilitating the design of effective targets.

Figure 3: Global Renewable Energy Targets by Sector, 2015



Source: IRENA based on REN21, 2005, 2007, 2009, 2011, 2013, 2014.
For additional countries, see sources in Annex I.

1.2. BRIEF HISTORY OF RENEWABLE ENERGY TARGETS

The early consideration of quantifiable renewable energy objectives finds its origin in the context of the oil crisis of 1973, which triggered wide-ranging changes in many countries' energy policies and helped underscore the vital importance of energy security, and by extension, of energy policy.

In 1975, Brazil launched its ProAlcool Programme (Programa Nacional do Álcool), which set a national target to boost ethanol production for expanding the use of ethanol in the transport sector, making it the first country in the world to adopt a formal renewable energy target. The quadrupling of imported petroleum prices in 1973-74 contributed to a major foreign debt crisis, posing a significant challenge to the country's financial stability and energy security. The aims of the ethanol target were to protect Brazil against rising oil import costs, and simultaneously to support the growth of the country's domestic sugarcane industry (Bertelli, 2011; BNDES and CGEE, 2008).[2]

Established on November 14, 1975 by presidential decree, the ProAlcool Programme set a goal to produce 3.5 billion litres of ethanol by the year 1980, up from 0.625 billion litres in 1974. Although the target did not include a specific mechanism to ensure compliance, it is noteworthy that the target was achieved slightly ahead of schedule, in 1979 (Meyer *et al.*, 2012). Already with this first renewable energy target, the basic structure of renewable energy targets emerges. Brazil's ProAlcool Programme introduced a clear, binding obligation in the form of a Presidential Decree to reach a well-defined numerical goal by a certain date. Moreover, the programme made it clear on whom the obligation was imposed, namely domestic sugarcane producers (see Box 1).

BOX 1: BRAZIL'S PROALCOOL TARGETS

In 1975, Brazil set in motion its ProAlcool Programme as a strategic initiative to substitute costly petroleum imports while reviving its struggling sugar cane industry.

In the first phase of the ProAlcool Programme, the government supported the target with specific incentives for increasing both supply and end-user demand. To incentivise producers, the government offered low and negative interest loans to expand milling and distilling capacity and regulated the prices paid to producers based on the price of production. For customers, ethanol prices at the pump were capped at economically attractive levels. As ethanol production expanded, the supply was blended into gasoline in mixes up to 25% that accommodated gasoline-based automobiles. By 1979-1980, the target was met as ethanol production grew to a production volume of 3.4 billion litres annually (Goldman, 2009).

In 1979, a second oil price shock drove the next phase of the programme. The ethanol production target was tripled to 10.7 billion litres in 1985 (Barzelay, 1986). While ethanol was previously readily incorporated into gasoline in blends of up to 25% suitable for vehicle engines, a greater expansion of the program required a widespread shift in vehicle engine technology. In 1979, the Brazilian government signed a bold protocol with major vehicle manufacturers operating in Brazil aiming to produce 350,000 ethanol-only vehicles by 1982 (Cordonnier, 2009). Driven by subsidies to vehicle manufacturers and attractive ethanol prices for consumers, by 1983 the majority of vehicle sales were ethanol-only vehicles. Production of ethanol surpassed the target in 1985, scaling to 12.8 billion litres (Myer *et al.*, 2012). In 2010, ethanol production reached 28 billion litres, over 40 times the production in 1975, the first year of the ProAlcool programme (EPE, 2011).

The first formal renewable energy target in the electricity sector was adopted in the U.S. state of Iowa in 1984. Referred to as the Alternative Energy Law, it required the state's two investor-owned utilities to collectively install 105 megawatts (MW) of generation capacity from RES. Since no date was set for achieving the target at the time, the law remained as an open-ended obligation imposed on the two major utilities. While the target is now referred to as the first Renewable Portfolio Standard (RPS), or Renewable Energy Standard, neither term was widely used at the time (see Box 2). The target was mandatory as it was established in state law, and utilities were required to demonstrate their compliance through their annual regulatory filings to the Iowa Utilities Board.[3]

Iowa's Alternative Energy Law helped kick-start Iowa's wind energy industry and gave it the early momentum it needed to become one of the leading states in renewable energy deployment in the U.S.[4]

While other U.S. states started adopting renewable energy targets throughout the 1990s, Iowa remained the only one with a binding obligation until 1999 (Leon, 2013). That year, Minnesota entered into its first year of compliance (Barbose, 2014). As of 2014, 29 states and the District of Columbia had Renewable Energy Standards in place, and an additional seven states had non-binding renewable energy targets (Barbose, 2014).

[2] *The Institute for Sugar and Alcohol (IAA), the São Paulo ethanol producer co-operative, Copersucar, and the state-owned oil company, Petrobras, were the main stakeholders involved in the creation of the ProAlcool programme.*

[3] *At the time (1984), the IUB was still referred to as the Iowa State Commerce Commission; see IUB, n.d.*

[4] *As of Q2, 2014, Iowa had a total installed wind power capacity of 5 177 MW, making it one of the leading states in the country in wind power capacity.*

BOX 2: KEY FACTS AND DEFINITIONS OF U.S. RENEWABLE ENERGY STANDARDS

"Renewable Energy Standards" establish a minimum target for the share of renewable energy in a state's (or in some cases, in an individual utility's) electricity mix or final retail sales. To ensure that the target is met, Renewable Energy Standards often include a specific regulatory mandate that obligates retail electricity suppliers (often referred to as load-serving entities (LSEs)) to procure a minimum share of renewable electricity by a certain date. This is why Renewable Energy Standards are often referred to as mandates, targets or obligations.

In practice, each of these terms is accurate, as Renewable Energy Standards typically contain each of the following elements: 1) a specific, numerical target for a minimum share of renewable energy in utilities' final retail sales; 2) a compliance or tracking mechanism, which often involves the use of renewable energy certificates (RECs) representing 1 megawatt-hour (MWh) of eligible renewable energy generation; 3) an enforcement mechanism, which often takes the form of fines or penalties; and 4) a monitoring framework, which often involves an obligation to report progress toward the target on an annual basis to the government regulator or public utilities commission. Finally, Renewable Energy Standards can be referred to as a policy tool, as they are often framed (or packaged) as a bundle of related policy and regulatory measures that governments can adopt to meet their energy and environmental objectives.

A further feature of Renewable Energy Standards is that, in order to implement them in a least-cost fashion, LSEs typically are required to foster competition among different renewable energy producers and to prioritise least-cost options. The result has been that Renewable Energy Standards are often (although not always) accompanied by a procurement mechanism that emphasises competition, such as competitive tendering or auctions (Heeter *et al.*, 2014).

Key Facts:

- Over 80% of U.S. Renewable Energy Standards (29 out of 36) are legally binding; the seven remaining are generally referred to as Renewable Portfolio Goals and are considered non-binding.
- Targets range from about 1% of final retail sales in Iowa to 40% of final retail sales in Hawaii.
- A growing number of targets include carve-outs, or "set asides", for specific, often higher-cost forms of generation such as solar photovoltaic (PV). Eleven states have added special carve-outs since 2007.
- In most, but not all, cases, compliance with the targets is monitored via the use of RECs. Utilities or LSEs must demonstrate that they have procured or generated a certain number of RECs in order to comply with the mandate. Rules on whether RECs are tradable among obligated entities, and over state boundaries, vary widely.
- Instead of supplying the mandated share of renewable energy generation, or of RECs, utilities can opt to pay the ACP, which ranges from a few dollars per MWh to over USD 50 per MWh for each MWh of shortfall from the target.
- The costs of compliance with Renewable Energy Standards across the U.S. are on average quite low, featuring direct ratepayer impacts of 1% or less (Kreycik *et al.*, 2011; Wiser and Barbose, 2008; Barbose, 2014). (Note that this does not include the cost to taxpayers of the various tax incentives, such as the Production Tax Credit, the Investment Tax Credit and accelerated depreciation).
- Mandatory Renewable Energy Standards are often backed by specific fines or penalties for non-compliance. These include measures such as direct financial penalties, or revoking the operating licenses of non-compliant actors.
- After years of mixed progress, a growing number of U.S. states are now overshooting their Renewable Energy Standards obligations, as economic fundamentals of wind and solar power in particular, combined with the existence of numerous tax incentives, assume priority in investor and utility decision-making.

BOX 3: KEY FACTS ON THE U.K.'S RENEWABLES OBLIGATION

The U.K.'s Renewables Obligation (RO) scheme came into effect in 2002 in England, Wales, and Scotland, followed by Northern Ireland in 2005, and has since been the primary policy mechanism regulating the development of large-scale renewable energy projects in the U.K. It places an obligation on U.K. electricity suppliers to source an increasing proportion of the electricity they supply from RES. The RO scheme shares many important features with U.S. Renewable Energy Standards, as it sets a binding renewable energy target and is imposed on the main electricity suppliers in the market (*i.e.*, on the private sector). In recent years, the RO has come under criticism for being costly and inefficient, which has led to proposals for the adoption of an alternative support policy.

In early 2015, the U.K. began implementing a new framework based on the use of Contracts for Differences (CfDs), which offer a top-up to the compensation that renewable energy producers receive on the market. Unlike the RO, which was limited to renewable energy technologies, the CfD framework adopts the broader category of "low carbon" generation sources. While the U.K. also has implemented a FiT policy, the majority of the renewable energy capacity to date has been installed under the RO.

Key Facts:

- Applied to the major utilities operating in the U.K., with separate obligations applicable for England, Wales, Northern Ireland and Scotland.
- Target designed to increase the share of renewable energy by 1% per year from 3% in 2002-03, up to 10.4% of the electricity mix in 2010-11. The target was increased in December 2003 to 15.6% by 2015-16.
- Renewable energy producers were awarded one Renewables Obligation Certificate (ROC) per MWh procured.
- Utilities were given the option to either build their own renewable energy generation, buy ROCs from others in the market or pay the buyout penalty.
- The buyout penalty was established for each MWh of shortfall from the target (the "buyout price").
- These penalties were collected into a fund by the regulator Office of Gas and Electricity Markets (Ofgem) and recycled back to generators to reward them for their compliance, and (in theory) to reduce ratepayer impacts of the RO scheme. However, due to the low level of the buyout penalty, compliance with the RO has ranged between 60% and 70% on average, as utilities attempted to strike the optimal balance between procuring generation to meet the target, and receiving funds from the regulator.
- While the RO was originally technology-neutral, the U.K. introduced multipliers for different technologies in 2009. As of 2014, the multipliers offered for onshore wind were 0.9 times the value of the ROCs, while other technologies such as offshore wind received multipliers of 1.5 ROCs, and other technologies such as wave and tidal power received 2.0 ROCs.
- According to the U.K. regulator Ofgem, the RO has encouraged the development of over 8 500 MW of renewable energy capacity, resulting in approximately 23 TWh of accredited RES-E being supplied per year to the system. This represents approximately 64% of the anticipated target for the period.

Outside the U.S., in the early 2000s, the number of renewable energy targets started growing and their design became more sophisticated, as illustrated by the U.K.'s first Renewable Obligation (RO) in 2002 (see Box 3).

One crucial difference between Renewable Energy Standards (including the U.K.'s RO) and the EU's "20-20-20" targets (see Box 4) is that in the EU, the actual renewable energy obligation is imposed on the *governments* of individual Member States, whereas Renewable

BOX 4: OVERVIEW OF THE EUROPEAN UNION'S "20-20-20" TARGETS

The EU Climate and Energy Package is also known as the "20-20-20" targets for greenhouse gas emissions, renewable energy and energy savings. These targets are unique in the world in both their breadth and their depth.

The original legislation adopted in 2009 (Directive 2009/28/EC) established three separate targets:

1. Reducing greenhouse gas emissions by 20% from 1990 levels.
2. Increasing the share of renewable energy as a share of TFEC to 20%.
3. Improving energy efficiency by 20%.

The renewable energy targets apply to the EU-28's total final energy consumption covering electricity, heating/cooling and transportation. A specific target mandates a 10% share of renewable energy for the transportation sector (see Box 17). This distinguishes them from most other renewable energy targets around the world. The targets were informed by extensive analyses and represent objectives that were deemed ambitious, yet achievable. Each Member State was allocated a RES target expressed as the share of energy from RES in its projected gross final consumption for 2020.

Negotiations on these national targets took into account the different starting points of the Member States, their renewable energy potential (due to differences in geography and climate) and their economic performance. The objective of these specific parameters was to ensure that the effort was balanced between Member States based on their resource endowments and economic conditions. As a result, the targets range from 10% in Malta to 49% in Sweden.

Each Member State was required to develop a National Renewable Energy Action Plan (NREAP) that outlined both its current energy mix as well as the various policy measures being used or to be implemented to achieve the targets in each of the three sectors (electricity, heating/cooling and transport). The baseline year for the renewable energy targets was set as 2005, and Member States are required to produce regular reports to the European Commission demonstrating their progress towards the targets. A similar approach using NREAPs has recently been launched for the ECOWAS region of West Africa.

The share of renewables in total final energy consumption increased from 8.6% in 2005 to 15.2% in 2013 thanks to the enabling policy frameworks and renewable support schemes that have been implemented to help achieve the targets.

Sources: EC, n.d. a; EC, 2013; EC, n.d. b; Beurskens, 2013; Eurostat (n.d.)

Energy Standards obligations are imposed on electric *utilities,* or load-serving entities (LSEs). This constitutes a key policy design difference and one that has been underappreciated in the literature on renewable energy targets to date (see Section 3.3).

The more widespread adoption of targets took place in the 2000s, starting with EU countries. It should be noted that while the EU has assumed a leading position worldwide with its ambitious energy and climate targets, the actual process of establishing these targets was far from straightforward, and highlights some of the challenges in setting renewable energy targets.

While some countries like Denmark[5] had adopted targets as early as 1990, the discussion on the European Union's (EU) renewable energy targets started with the *White Paper on Renewable Energies* published in 1995. After years of political discussions and compromise, in 2001, a European Directive (Directive 2001/77/EC), was adopted to promote the development of renewable energy. The Directive set an ambitious target of 21% of total EU electricity consumption to be generated from RES by 2010. National indicative, *i.e.*, non-binding, targets for each Member State were specified in the Annex to the Directive.

[5] *The renewable energy target was initially adopted in 1990 to reach 12-14% of energy supply by the year 2000; see University of Strathclyde, n.d.*

The European Commission (EC) originally expected national consumption targets to be met in a cost-efficient manner through renewable energy trade (*i.e.*, trade of RECs not necessarily accompanied by physical trade of electricity) among Member States. The legislative process, however, resulted in confusion on both the nature (absolute or proportional) and the definition (consumption or production) of the RES-E targets (Verhaegen *et al.*, 2007). As a result, the targets were implemented in all Member States as national production targets, achievable exclusively through an increase of RES-based power generation.

Building on the EC's *Renewable Energy Roadmap* and the discussions on the EU Climate and Energy package, the legislative work on a mandatory European renewable energy target started in January 2007. The EU RE Directive (Directive 2009/28/EC) formally established, in 2009, "mandatory national targets for the overall share of energy from renewable sources in gross final consumption[6] of energy and for the share of energy from renewable sources in transport", consistent with a target of at least a 20% share of energy from RES in the Community's gross final consumption of energy in 2020 and a 10% share for renewable energy in the transport sector (EC, 2009).

The 20% EU renewable energy target is part of the Climate and Energy package (see Box 4), a piece of binding legislation that aims for a highly energy-efficient, low-carbon European economy. As the 20% renewable energy target accounts for the whole EU, it was translated into binding national targets based on a set of country parameters.

Five years later in October 2014, the European Council adopted the Climate and Energy Framework for 2030. While the Framework has increased the renewable energy target to 27% of the EU's final energy consumption and raised the target for greenhouse gas reductions to 40% below 1990 levels, a wide range of stakeholders and critics considers these renewable energy and energy savings targets of 27% as evidence of weakening ambition. Importantly, unlike the 2009 EU RE Directive, the renewable energy target, while binding on the EU, will not be legally binding on individual Member States and will not be translated into national targets via EU legislation. It is, therefore, unclear whether and how specific enforcement measures will be put in place to ensure that the targets are reached. Acknowledging this uncertainty, the Framework calls for a review of the targets in 2020 "to give the EU the means of ensuring that the 2030 EU level target is met" (EC, 2014). Table 1 shows the evolution of EU renewable energy targets.

1.3. KEY ASPECTS AND DEFINITION OF RENEWABLE ENERGY TARGETS

Since their emergence in the 1970s, renewable energy targets have taken many different forms. They have ranged from simple government announcements to full-fledged and legally binding obligations with clear, quantifiable metrics and specific enforcement, compliance and monitoring mechanisms. In some cases, renewable energy targets are simply embedded within sectoral plans, such as Integrated Resource Plans (IRPs)[7] or energy sector master plans, as is the case in South Africa, or NREAPs, as in the ECOWAS region. In other cases, such as in China and India, renewable energy targets are part of national development plans articulated in five-year plans. They can also take the form of legally binding obligations with clear, quantifiable metrics and specific compliance mechanisms as in Chile, the U.S. and the EU Member States, among others. As a result of this considerable diversity in target types, it can be difficult to define precisely what constitutes a renewable energy target.

Definition of renewable energy targets

A small number of reports discuss renewable energy targets in detail, but these have been largely jurisdiction-specific and policy-specific (see Wiser *et al.*, 2008 and Ofgem, 2015). To date, the first and most comprehensive attempt to compile and publish data on the global growth of renewable energy targets remains REN21's Global Status Report (GSR), which was first published in 2005.[7] The GSR 2014 proposes the following definition: "An official commitment, plan, or goal set by a government (at the local, state, national, or regional level) to achieve a certain amount of renewable energy by a future date. Some targets are legislated while others are set by regulatory agencies or ministries".

Therefore, the GSRs have adopted an inclusive approach that encompasses all forms of renewable

[6] Gross final consumption of energy is defined in Directive 2009/28/EC as: "the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution and transmission."
[7] See the REN21 website for a full list of Global Status Reports: http://www.ren21.net/ren21activities/globalstatusreport.aspx.

energy targets. REN21 publishes these in a series of tables featuring targets in the electricity, transport and heating/cooling sectors, as well as broader energy sector targets such as those that apply to the entire primary or final energy mix. In addition, the GSRs also count all jurisdictions within which renewable energy targets are found: this means that countries such as Canada, which have sub-national renewable energy targets but which do not yet have a national renewable energy target, also earn a place on the list. In addition, blending mandates are considered as targets.

Given the broad universe of renewable energy targets, further issues emerge when trying to differentiate among different renewable energy target types. For instance, there is no clear differentiation in the terminology to distinguish among aspirational statements of renewable energy targets and targets that are accompanied by detailed plans and include specific policy measures to achieve them, such as the EU's National Renewable Energy Action Plans or China and India's five-year plans.

In an attempt to clarify these terminology issues, this report sets out a general definition of renewable energy targets. *Renewable energy targets are defined as numerical goals established by governments or other actors (such as electric utilities) to achieve a specific amount of renewable energy production or consumption. Renewable energy targets can apply to*

Table 1: Evolution of the European Union's Renewable Energy Targets

Name of Directive	Scope and time frame	Target(s) and Units	Legal status	No. of Member States
DIRECTIVE 2001/77/EC on the promotion of electricity produced from RES in the internal electricity market	Share of electricity in 2010	• Indicative target of 12% of gross domestic energy consumption by 2010 and 22.1% of electricity from RES in total European Community electricity consumption • The 22.1% target was changed to a target of 21% with the accession of the 10 new Member States	Voluntary	• Originally EU-15 • EU-25 after 2004 enlargement
DIRECTIVE 2009/28/EC on the promotion of the use of energy from RES	Share of energy from RES consumed in transport, electricity and heating/cooling in 2020	• 20% of gross final energy consumption at EU level • 10% for transport • National shares defined in NREAP	Binding at EU level and at national level	• EU- 27 • EU-28 after accession of Croatia in 2013
2030 Climate and Energy Policy Framework as adopted by EU leaders at the European Council held on 23-24 October 2014 (EUCO 169/14)	Share of energy from renewable sources in 2030; no target for transport; heat not mentioned	• At least 27% of gross final energy consumption at EU level • Not deemed appropriate to establish new targets for renewable transport fuels	Binding at EU level but not at national level	• EU-28

the electricity, heating/cooling or transport sectors, or to the energy sector as a whole, and often include a specific time period or date by which the target is to be reached. Renewable energy targets that cover the entire primary or final energy mix are referred to as "overarching" renewable energy targets in this report. *Furthermore*, the report focuses on targets at the national level.

This definition considers that renewable energy targets set by regional organisations (*e.g.* the Caribbean Community (CARICOM), the ECOWAS) apply to all member states, since they are typically approved by relevant ministers in the form of high-level Declarations or Communiqués. This is the case of the 2012 ECOWAS Renewable Energy Plan (ECOWAS, 2012), 2013 renewable energy targets established by the Caribbean Community (CARICOM, 2013) or the first EU RE Directive of 2001, among others.

The literature tends to blur the lines between renewable energy targets (*i.e.*, the numerical goal to be reached) and the specific tools, such as compliance and enforcement mechanisms required to achieve them. This can be seen in Renewable Energy Standards, which are often referred to as both a target *and* a policy tool. In fact, Renewable Energy Standards encompass a numerical target (or targets) as well as additional procurement, monitoring and enforcement mechanisms (see Box 2).

While a range of specific policy instruments can be used to achieve a specific target, they do not in themselves represent a renewable energy target. A renewable energy target, whether mandatory or aspirational, remains a numerical goal set out for a sector as a whole (electricity, heating/cooling, or transportation), or for the primary of final energy mix of a country. Governments that have set a renewable energy target for themselves, or the utilities on whom a renewable energy obligation has been imposed, continue to have a number of different options to reach the target. Auctions are only one such policy tool. A number of jurisdictions around the world have used feed-in tariffs in a similar way in order to achieve their targets in part or in full. Likewise, blending mandates are one among a range of policy instrument to achieve renewable energy targets in the transport sector.

Spectrum of renewable energy targets

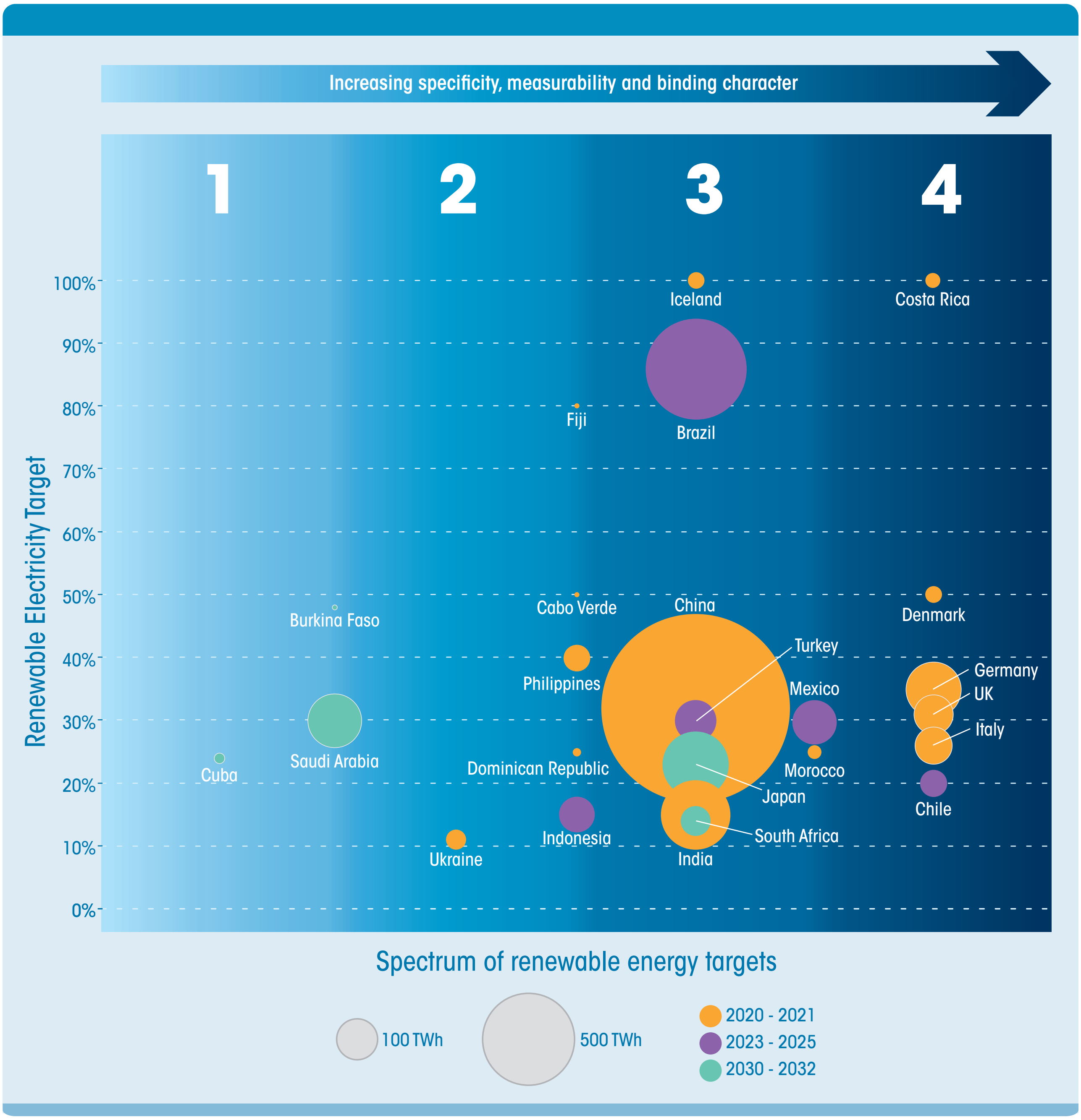
One of the most important features of effective targets is that they should be SMART (*i.e.* Specific, Measurable, Achievable, Realistic and Time-bound, as described in Section 1.4) (Edvardsson and Hansson, 2005). Based on this concept, the different types of renewable energy targets can be represented along a spectrum to visualise where they stand in relation to one another, depending on their specific, measurable and binding characteristics. The aim of the spectrum is to distinguish simple government announcements from fully articulated renewable energy targets that are accompanied by clear, quantifiable policies and measures and backed by legally binding obligations.

As shown in Figure 4, in the first band of the spectrum, renewable energy targets can take the form of political announcements, vision statements or regional-level energy declarations or plans.

Such statements are usually supported by further elaboration of the targets, which can take a variety of forms. The second category of the spectrum includes electricity expansion plans and integrated resource

Figure 4: Spectrum of Renewable Energy Targets

Figure 5: Renewable Electricity Generation Targets by Target Date for Selected Countries Along Spectrum



Notes:

Total estimated renewable electricity generation by target dates represents all RES including hydropower.

EU Member States: There is no renewable energy share for the power sector as such for 2020 (for any of the EU Member States) according to the NREAPs, but rather projections of expected paths and capacity by sector and by technology to comply with the national renewable energy targets share in gross final consumption. **Chile:** Target excludes hydropower plants over 40 MW. **China:** IRENA's analysis based on capacity targets for 2020 disaggregated as follows: 350 GW hydropower, 200 GW onshore wind, 30 GW offshore wind, 100 GW PV, 3 GW CSP and 30 GW biomass. **Denmark:** Denmark's 2012 "Energy Agreement" set a target of 50% of electricity consumption supplied by wind power by 2020. **Germany:** The 2014 amendment to the German law "Renewable Energy Sources Act" set a target for renewable energy to account for 80% share in gross electricity consumption by 2050, with intermediate targets of 40-45% by 2025 and 55-60% by 2035. **India:** Target excludes hydropower plants over 25 MW. For 2022, new capacity targets are disaggregated as follows: 100 GW solar, 60 GW wind, 5 GW small hydropower and 10 GW biomass. **Japan:** Energy strategy update to be fully approved by the government. **Mexico:** The overall target is for 35% electricity generation from "clean energy" sources (defined as renewable energy, cogeneration, nuclear energy, fossil fuels with CCS, and other low-carbon technologies) by 2024. The 2014 Special Programme for the Use of Renewable Energy set a target of 24.4 GW of renewable energy capacity by 2018 disaggregated as follows: 13 GW hydropower, 8.9 GW wind, 1 GW geothermal, 0.7 GW bioenergy and 0.6 GW solar. **Morocco:** IRENA's analysis based on target of 42% of installed capacity met by renewable energy by 2020 disaggregated as follows: 2 GW wind, 2 GW solar and 2 GW hydropower. **Saudi Arabia:** IRENA's analysis based on capacity targets for 2032 disaggregated as follows: 16 GW solar PV, 25 GW CSP, 9 GW wind, 3 GW waste-to-energy and 1 GW geothermal. **Sources:** see Annex II.

plans. Such renewable energy targets can be embedded within energy planning tools, or underpin alternative scenarios and strategies, but remain at the planning stage and aspirational or indicative in nature.

In the third category of the spectrum, renewable energy targets become more specific and measurable, and are geared towards implementation. As such, they grow more sophisticated both in terms of alignment with broader economic and energy objectives and in terms of translation into specific actions plans and policy, regulatory, fiscal and financial instruments. This category includes NREAPs, technology-specific roadmaps, renewable energy programmes, etc.

The last tier of the spectrum corresponds to renewable energy targets that are clearly measurable and translated into specific policies and measures with clear compliance mechanisms to ensure their implementation. The term "binding" depends on political regimes and legal traditions and can take the form of parliaments adopting a law, or the passing of an executive order. In some cases, a national policy or planning document can be considered binding in the sense of a high-level obligation, but without necessarily defining who is the obligated entity or specifying penalties for non-compliance (see Section 3.3 on mandatory vs. aspirational targets). When the EU RE Directive was adopted in 2009, all EU Member States moved to this band of the spectrum. Similarly, the ECOWAS Renewable Energy Plan adopted in 2012 was closer to a political announcement, and would therefore have been situated in the first band; with the adoption and validation of the NREAPs (which is scheduled to conclude in mid-2015 in most ECOWAS countries), ECOWAS Member States will move to the third band.

Figure 5 represents renewable electricity generation targets by target dates for a sample of 24 countries representing both different percentage levels as well as different types of targets according to the spectrum categories. The circles represent total estimated renewable electricity generation by the target date for respective countries. The figure illustrates three important trends.

First, among the broad universe of target types the majority of renewable energy targets have a certain degree of specificity and measurability as most national targets fall in the second and third categories of the spectrum.

Second, although renewable energy targets are often expressed as percentages of overall power generation, differences in the sizes of power systems mean that similar-looking targets can correspond to very different levels of targeted renewable energy generation. Targets differ importantly depending on varying renewable energy potentials, possibilities for integration in the power grids, local policy and regulatory frameworks and financing conditions. All of these elements must be taken into consideration when assessing renewable energy targets. Some countries have already met and exceeded their targets, for example Iceland or Italy.

Deriving from this, a third trend shows that the majority of targets fall in the 10-40% range. The few countries aiming for shares of renewable energy generation larger than 50% tend to apply to either hydro-based electricity systems or to relatively smaller electricity systems. It should be noted that Figure 5 is illustrative in nature and simply aims to show overall trends and orders of magnitude.

It is important to recognise that renewable energy targets follow a dynamic process of definition, implementation and revision. The spectrum can help policy makers to better understand where their own national targets fit as well as in visualising the absolute level of renewable generation to be reached by the target date.

Debates surrounding renewable energy targets

Renewable energy targets play a number of important roles in supporting renewable energy development. They provide an important long-term signal to manufacturers, installers, and other stakeholders; they can contribute to reducing investment risks across the value chain; they help support investment decisions regarding capital allocation and hiring; they can make it easier to plan other long-term investments such as transmission and distribution infrastructure; and finally, they provide a key signal to investors of future market opportunities and a market's anticipated growth (see Section 2.1. on the functions of targets). In these and many other ways, renewable energy targets can help accelerate countries' transition to a lower carbon and more sustainable energy system.

Although renewable energy targets are now commonplace around the world, they have faced the same criticism as renewable energy deployment policies. Some argue that renewable energy targets are costly and counter-productive, as they lock in more expensive and less efficient technologies rather than encouraging the emergence of new and more efficient technologies that will become available in the future (Helm, 2010). In this view, governments should focus instead on boosting investments in research and development (R&D) to bring about the 'next generation' of renewable energy technologies rather than focusing on encouraging deployment of today's less efficient models (Fischer, Newell and Preonas, 2011).

Second, it has been argued that, in light of the urgency of the climate crisis, the real focus of energy policy should be reducing carbon emissions, not mandating a

BOX 5: INTERACTIONS BETWEEN CLIMATE AND RENEWABLE ENERGY TARGETS

It has been argued that imposing renewable energy targets in addition to carbon pricing (in particular in markets with a cap-and-trade system such as the EU) may not only be redundant, but counter-productive, as it may increase overall policy costs (Hood, 2011). The reason for this is that in markets with a cap-and-trade system for carbon emissions, a renewable energy target will serve to displace fossil fuels from the electricity mix, thereby suppressing the price of emissions and reducing the incentive to switch from coal to natural gas, as well as the incentive to invest in new technologies or in R&D. Since the emissions price is reduced, it is argued that this paradoxically benefits the most carbon-intensive technology (namely coal) by delaying its displacement from the market. Moreover, it is argued that renewable energy targets impose additional costs on consumers, as they force more expensive abatement options (such as some renewable energy technologies (RETs)) into the energy mix rather than favouring comparatively less expensive abatement options such as fuel switching and energy efficiency (Philibert, 2011).

From the perspective of neoclassical economics, policy makers could avoid the interaction between renewable energy targets and climate targets altogether, as precedence would be given to reducing carbon emissions, and the market (rather than governments) would choose how best to achieve the desired emissions reductions. Despite the rhetorical appeal of this position (which remains widely shared), there is strong evidence (IPCC, 2011) to suggest that policies need to ensure the complementarity of instruments to achieve the scale of emissions reduction required.

This raises the question: if climate policies are to complement renewable energy targets and policies, how can this interaction be improved to avoid some of the unintended consequences highlighted above? In the case of simple carbon pricing, such as a carbon tax, there is no inherent conflict; the two can reinforce each other if designed in a robust fashion (Fankhauser, Hepburn and Park, 2011).

However, the situation is somewhat different with cap-and-trade schemes. There are broadly two ways for cap-and-trade schemes to take renewable energy targets into account: first, they can tighten the emissions caps, or allowances offered, in order to compensate for the increased presence of RES in the electricity mix. Second, policy makers can introduce emission price floors, to avoid a situation where rising RES-E generation suppresses emissions certificate prices below the level necessary to induce other forms of desirable substitution in the market, such as from coal to natural gas (Böhringer and Rosendahl, 2009; Helm, 2014).

As these examples underscore, there is no reason why renewable energy targets cannot co-exist with cap-and-trade schemes, or with carbon pricing. However, policy makers should be aware of the potential negative interaction effects and adjust their policies accordingly. Thus, the challenge is how to design these various policies and approaches to work more effectively together.

specific share of renewable energy in the energy or electricity mix. These critics argue that renewable energy targets and deployment policies are unnecessary and counter-productive, and that they result in inefficient capital allocation and higher costs to society as governments effectively 'pick winners' rather than allowing the market to find the cheapest and fastest route to decarbonisation (McIlveen, 2010). Instead, governments should pursue a technology-neutral approach, such as a well-designed carbon tax; in this way, critics argue, they could achieve their desired objective (namely, a low-carbon energy system) at the lowest cost to society (Helm, 2014) (see Box 5).

Finally, some have argued that renewable energy targets are virtually indistinguishable from central planning (Liebreich, 2014), where the government sets out rigid targets for different sectors of the economy. Such central planning has fallen into disrepute in governing other sectors of the economy, it is argued, and therefore should be abandoned in the renewable energy sector as well. Despite these various criticisms and concerns, this debate seems to have done little to slow the growth of renewable energy targets over time.

1.4. THEORETICAL FOUNDATIONS OF TARGETS

Targets have been used in the public and private spheres for many years, and an abundant literature across several academic disciplines exists on the topic. Much of this literature uses some of the same terms to mean different things. Throughout this report, the term *objective*, often used as a synonym of goal, refers to the overall purpose that a particular government is trying to achieve. It is determined by "fundamental principles" underpinned by key societal values (Rietbergen and Blok, 2010). Targets specify the level of performance that a government, organisation or firm intends to achieve through the implementation of specific policies and measures (Marsden and Bonsall, 2006; Hepburn, 2006). As such, targets typically have both a quantitative and a time dimension. In addition, at a relatively high-level, *e.g.*, at the national or international level, they can intrinsically represent and/or support overall goals and a hierarchy of objectives by providing a sense of purpose and direction for a particular sector (*e.g.* economic, environmental) and setting a framework for action. *Indicators* are the variables used to measure progress towards the achievement of targets.

Management by Objectives

A key theoretical foundation for the study of targets is the literature on performance management and Management by Objectives (MBO). The MBO conceptual framework was developed by Peter Drucker in the 1950s and originally centred on efforts to make companies more efficient. Underlying Drucker's MBO theory is the assumption that it is possible to identify common goals across distinct individuals, which, when explicitly defined as targets, can harness collective efforts and produce more efficient results. Although originally focused on the manufacturing sector, MBO later was applied as part of an extensive reform of public services across industrialised countries.

The use of targets linking public policies to quantitative indicators emerged in the 1980s and 1990s. The Thatcher government in the U.K. and the Reagan administration in the U.S. promoted a series of methods and reforms regrouped under the term New Public Management and aimed to improve and monitor the performance of public sector organisations. This school of thought is based on the general theory that the public sector can be improved by "the importation of business concepts, techniques and values" (Pollitt, 2007). One famous example is the *U.S. Government Performance and Results Act* of 1993, aimed at improving government performance management and requiring U.S. federal agencies to plan more effectively and to focus on results by setting goals and targets, measuring results and reporting progress. In this perspective, the use of targets was deemed a central tool to improve "both democratic accountability and organisational performance" (Cave, Kogan and Smith, 1990) of public agencies.

MBO principles, and in particular the central aspect of target setting, have been applied extensively to manage the performance of public organisations in the health and education sectors (Edvardsson and Hansson, 2005). There are many examples of public policy targets that are set at the national level as an indicator of performance reflecting the final or long-term outcomes of dedicated policies, *e.g.*, secondary school enrolment rates (Cust, 2008), crime rates or emergency room wait-time targets (Kelman and Friedman, 2007).

Targets also can be set at the international level, where they usually focus on global economic policy (*e.g.*, inflation objectives, public deficits) as well as on strategic outcomes capturing the multidimensional nature of human development or environmental issues (*e.g.*, reducing global poverty, eradicating communicable diseases, curbing greenhouse gas emissions). One prominent example is the United Nations (UN) Millennium Development Goals (MDGs), which define a set of overarching qualitative goals, each associated with a set of quantitative targets (see Box 6).

Some studies suggest that the expanded use of targets and performance-based measurement in recent years, both at the national and international level, can be linked to the systematic use of monitoring and evaluation systems by international organisations (Holvoet and Renard, 2007). In the context of international development, targets often are used to structure the projects and loans of international financial institutions, with the aim of assessing the performance of public administrations and monitoring the implementation of reforms (OECD, 2007).

SMART targets

One of the most important features of effective targets is that they should be SMART (*i.e.* Specific, Measurable, Achievable, Realistic and Time-bound) (Edvardsson and Hansson, 2005). The first two criteria relate to the structure and definition of targets, which should be both precise and evaluable – *i.e.*, specific and measurable. A target has to be reasonably precise in order to be measurable. Another related aspect is clarity, which is essential to ensure that the target can be understood and implemented by a wide range of stakeholders (policy makers, experts and the public at large). In addition, a target can only guide effectively if it is possible to know and measure to what extent it has been achieved; this also entails that it must be possible to monitor and check compliance.

The third and fourth criteria relate to the extent to which it is possible to reach the target – *i.e.*, well-designed targets must be both achievable and realistic. The degree of realism is linked to both the time horizon and the level of effort required to reach the target. In theory, targets should stimulate stakeholders to go beyond the business-as-usual trajectory and should be based on a clear strategic vision for the future (Van Herten and Gunning-Schepers, 2000). Conversely, targets set too high can result in non-achievement, frustration or complacency (Van Herten and Gunning-Schepers, 2000). In reality, the level of ambition of targets is often the result of political decisions or negotiations and can change over time.

BOX 6: THE MILLENNIUM DEVELOPMENT GOALS AND TARGETS

The Millennium Development Goals (MDGs) are a synthesis of the International Development Goals outlined by the OECD Development Assistance Committee in 1996 and the declaration adopted at the Millennium Summit in New York in 2000 (OECD *et al.*, 2000). The MDGs are defined as eight overarching, qualitative goals aiming to reduce extreme poverty through a multi-sectoral agenda. They set out a series of time-bound, absolute targets on a global scale, with a time period of 15 years, from conception in 2000 to completion in 2015. Policy interventions are structured around the eight goals. For example, MDG 5, "Improve maternal health", is translated into two specific quantitative targets: 1) reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio, and 2) achieve, by 2015, universal access to reproductive health (United Nations, n.d.).

These quantitative targets are measured using a set of indicators, such as the proportion of deliveries attended by skilled health personnel. The monitoring framework for MDG 5 was revised following the review of progress at the 2005 World Summit, and added one new target and four new indicators (United Nations, 2011).

With the MDGs concluding at the end of 2015, UN Member States are expected to adopt a new set of Sustainable Development Goals at the Special Summit on Sustainable Development in September 2015. The target-setting process of these new goals is the subject of intense negotiations and analysis.

The time dimension of targets is a critical aspect of their effectiveness. If the time period is not defined, there is little motivation to achieve the target and it will be difficult to measure progress. If the time frame is too short, there may be little incentive to go beyond it, and if the time frame is too long, there may be diminishing motivation (Rietbergen and Blok, 2010). Short-to medium term targets, *i.e.*, ranging between three and ten years, aim to operationalise targets by specifying time scales that fit within company-level planning cycles (Rietbergen and Blok, 2010). Short-term (*e.g.*, three-year) intervals enable more effective implementation and rapid learning from the policy process and can coincide with electoral cycles. However, they do not allow the impact of policies to fully mature.

In contrast, long-term targets, *i.e.*, beyond ten years, aim to provide a long-term trajectory and allow for more holistic policies. In the case of some renewable energy technologies (RET), a long ramp-up period and vision for the sector can allow the development of the whole supply chain and the required upgrades to grid infrastructure. However, long-term targets arguably provide less guidance in terms of concrete implementation, which is why they are often accompanied by intermediate milestones to facilitate monitoring. One solution could be to set intermediate or “staged” targets, as discussed in Section 3.2.

In addition to being SMART, renewable energy targets should be motivating, in the sense that they should support specific, high-priority policy objectives. Beyond their intrinsic rational/SMART properties, what makes targets motivating is largely their content – *i.e.*, the underlying policy objectives that they seek to achieve. For example, while some experts have questioned the feasibility of the government of India’s announcement in March 2015 of a scale-up in solar targets to 100 gigawatts (GW) from 22 GW by 2022, the aim of the target in this case is largely to galvanise the Indian industry and to urge the bureaucracy to step up its efforts. In this sense, targets have a catalysing function. They can galvanise change and motivate stakeholders to take action.

2. Main Functions and Basis for Renewable Energy Targets

Rather than being motivated by one single overarching objective, governments increasingly are adopting renewable energy targets to meet multiple interconnected objectives of energy security, sustainability and economic growth. This chapter discusses the various functions performed by targets throughout the policy cycle as well as the development of the baseline analysis. Clearly articulating the objectives underlying renewable energy targets has important implications for balancing the costs and benefits of different target levels and types, and how the impacts (costs, grid impacts, etc.) of renewable energy targets are evaluated over time.

Several renewable energy targets were first announced officially in the context of higher-level policy commitments, such as climate change targets at major international climate conferences. While climate change often is an important consideration in the origin of renewable energy targets, it is mostly envisaged as a co-benefit of renewable energy development, in particular in developing countries. However, the convening power of international climate change negotiations provides a valuable setting for countries to announce long-term renewable energy targets as they encapsulate national renewable energy strategies and express political commitment, and gives them international visibility as well as staying power.

The EU "20-20-20" targets were established at a time when the EU sought to demonstrate leadership on tackling global climate change and in the context of high fossil fuel prices. There was broad consensus that the benefits of economic diversification and green growth would help propel the EU's economy. However, with the economic crisis continuing to weigh on the region, and growing concerns around competitiveness and energy security, the drivers behind the EU's energy and climate targets have begun to shift (IEA, 2014c).

The macroeconomic benefits of renewable energy deployment are increasingly at the fore of policy makers' considerations when building the case for a greater share of renewable energy and for balancing the costs of renewable energy with the broader benefits. Increasingly, renewable energy targets are framed in the context of their contribution to economic performance, measured in terms of impact on gross domestic product (GDP) and job creation. Others have emphasised economic diversification and industrial diversification, in an attempt to reduce reliance on "brown" industries and to accelerate the development of "green" industries (Lütkenhorst *et al.*, 2014). In countries where macroeconomic benefits are an important driver of renewable energy targets, these are explicitly connected to other sectors (*e.g.*, manufacturing, employment, R&D). Specific socio-economic benefits aligned with national priorities can be targeted through the design of local content requirements.

The aspirational target in Saudi Arabia also aims to establish a renewable energy supply chain maximising local value. The White Paper released by Saudi Arabia's K.A.CARE in April 2013 (K.A.CARE, 2013a) set a target of 54 GW by 2032 of installed renewable energy capacity, with the potential for the renewable energy sector to become one of the main industrial pillars of Saudi Arabia with approximately 85,000 jobs (K.A.CARE, 2013b), and a contribution to the economy from the export of alternative energy (both renewables and nuclear) ranging between USD 40 billion and USD 60 billion (Babelli, 2012).

To benefit fully from the socio-economic impacts of renewable energy, and in particular the development of a domestic renewable energy industry requires stimulating investments, strengthening firm-level capabilities, promoting education and training, and encouraging research and innovation. In this perspective, technology-specific renewable energy targets can play an important role, as discussed in Section 3.1 on technology-specific vs. technology-neutral renewable energy targets.

For many countries in the Middle East and North Africa (MENA) region, the broader context of energy pricing reform is often cited as a key motivation for the establishment of renewable energy targets, as illustrated by Morocco, Egypt and Jordan's recently established renewable energy targets. The share of energy subsidies in Egypt is the sixth highest worldwide, representing approximately 6% of GDP (IEA, 2014a). Reducing reliance on expensive fossil fuel imports is a key concern for SIDS. Some islands have set renewable energy targets as high as 100% of the total electricity mix, in order to fully displace diesel use in the electricity sector. This is currently being pursued in the Cook Islands, Dominica, Tokelau and Tuvalu.

Rural electrification targets often include renewable energy targets. Bangladesh's solar home systems (SHS) programme started in 2003 with a target to install 50 000 SHS over a five-year project period. The programme far exceeded its goals and is currently installing over 65 000 systems per month, making it one of the fastest growing SHS programmes in the world. The programme now reaches a total of 13 million people, or 9% of Bangladesh's population (electrification rate in Bangladesh in 2011 was 60%), and has driven the development of a robust domestic industry that employs nearly 100 000 people (IRENA, 2015a). The SHS Programme is now targeting 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity (IDCOL, n.d.).

In the majority of countries renewable energy targets serve to meet multiple interconnected objective. For instance, the underlying objectives of Germany's renewable energy targets, recorded in the Renewable Energy law (EEG, 2014), include protection of resources, climate, energy security, emissions and technology cost decreases in the area of energy policy.

2.1. FUNCTIONS OF RENEWABLE ENERGY TARGETS THROUGHOUT THE POLICY-MAKING CYCLE

Drawing on a number of examples across different policy fields, the main functions performed by targets can be regrouped along the process of policy making, which can be regrouped under three main "stages" of formulation, implementation and evaluation.

Table 2 details some of the essential roles that targets play in policy development along three stages: to explore, to guide and motivate, and to regulate.

Policy formulation stage

Targets serve an important exploratory and knowledge function at the policy formulation stage. A widely discussed aspect of designing effective targets is the quality of the information that underpins them. The

Table 2: Role of Targets at Different Stages of Policy Development

Policy development stage	Role
To *explore* — policy formulation	• Develops the information base by gathering data • Complements/validates information through consultation • Reveals gaps in knowledge • Increases the transparency of policy making • Stimulates debate, raises awareness and acceptance
To *guide* and *motivate* — policy implementation	• Improves planning • Provides clear direction of policy to stakeholders • Signals political commitment • Encourages alignment of public policies • Motivates stakeholders to take action • Anchors strategic priorities and scenarios • Fosters accountability
To *regulate* — policy evaluation	• Supplies concrete milestones for evaluation and adjustments • Shows deficiencies in current operations • Provides opportunities to take action to correct deviations • Exposes data needs and discrepancies

process of defining specific target metrics can reveal data requirements and discrepancies. When the first objectives in the U.S. health prevention agenda were published (see Box 7), data sources were listed for each of the targets even when no baseline data were available. Such a systematic approach to health information greatly contributed to the improvement of data collection and standardisation in the United States as well as public dissemination (Van Herten and Gunning-Schepers, 2000).

Deriving from this data-gathering function, targets can enhance the transparency of the policy-making process. Governments may make the underlying information used to set the target publicly available, thereby fostering public support for the targets and reinforcing their political stability. In several countries, national health targets, for example, are the result of a national consultation process with the clear purpose of giving them stability through changes in government.

among others, where various stakeholders can offer valuable information related to practical feasibility (see Box 8). In some cases, participation is seen more as a process to improve ownership and accountability rather than to deliver substantial content (Guthrie, 2008). Indeed, stakeholder participation can improve the robustness and therefore the effectiveness of targets by creating a sense of co-ownership that makes them easier to implement.

However, the other side of exploration is negotiation, and, during the policy formulation stage, targets can be the subject of intense lobbying and political compromise, or can be driven by external parties (Lester and Neuhoff, 2009). This is apparent in the current discussion around the 2030 EU targets, where different industrial associations, non-governmental organisations and analysts are debating the costs and benefits of different target options, including whether they should be binding and question the numerical value of the proposed targets.

BOX 7: TARGETS IN THE HEALTH SECTOR

The application of MBO to the health sector opened the possibility of measuring health systems in terms of output – namely, healthier people. The use of health targets started in the 1970s and was pioneered in the United States by Michael McGinnis. The U.S. national prevention agenda *Healthy People*, through its use of specific, measurable health targets, was a precursor to the establishment by the European Region of the World Health Organization (WHO) of 38 targets to further define the qualitative Global Health for All Strategy in 1984*. The normative role and monitoring and evaluation activities led by the WHO at the international level gave momentum to the diffusion of health targets in several countries (Van Herten and Gunning-Schepers, 2000).

* In 1977, the World Health Assembly unanimously adopted a Global Strategy for Health for All stating that the main social target of governments and of WHO should be the attainment by all the people of the world by the year 2000 of a level of health that would permit them to lead a socially and economically productive life.

Renewable energy targets can be established through top-down or participatory processes, or a combination of both. In some cases, top-down targets established at the political level by the highest authority are essential to tackling the inertia of energy systems and opening space for new entrants in the renewable energy sector. However, renewable energy targets deriving only from political objectives tend to be fragile. On the other hand, renewable energy targets can be a motivational tool for governments to harness their country's energies behind shared goals and across a wide range of actors. Participatory renewable energy target setting at the policy formulation stage can take the form of committees, hearings, workshops and written comments,

Policy implementation stage

At the policy implementation stage, targets can signal political commitment, indicate a long-term trajectory for policy direction and investment, improve planning and motivate stakeholders to take action.

The effectiveness of renewable energy targets depends on the ability of governments and institutions to lead the process of setting targets, establishing dialogue with key stakeholders and ensuring that cross-cutting goals are achieved. Leading institutions and actors can help to resolve conflicts that can emerge in the implementation process due to different stakeholder

BOX 8: SOUTH AFRICA'S INTEGRATED RESOURCE PLAN CONSULTATION PROCESS

The South African Department of Energy undertook a broad consultation process in the further development of its integrated resource plan (IRP) by creating a web portal to disclose key documents underpinning, among others, the renewable energy targets. Following a first round of public consultation in June 2010, a second draft version of the IRP was released in October 2010 and was open for comments for 60 days. In this Plan, a target of 11.4 GW of renewable energy by 2030 was envisioned. Over 200 written comments were received on the renewable energy parameters, which led to some of the model assumptions being altered. One of the main changes was the inclusion of up-to-date learning rates of RETs, making the costs lower over time (Modise, 2013). This change was supported by a report by external consultants, who performed market analyses of solar PV to show recent changes in costs (Eberhard, Kolker and Leigland, 2014). As a result, technology-specific renewable energy targets were increased to total 17.8 GW by 2030. The greater emphasis on renewable energy in the revised IRP was due in large part to the input of stakeholders and to the transparency of the target formulation process. Therefore, the active participation of relevant actors, public and private, in the design of renewable energy targets and strategies, is crucial to refine their specific SMART characteristics.

interests and inherent trade-offs between policies. One such example is the Moroccan Agency for Solar Energy (MASEN), set up by the Moroccan government in 2010 to manage the solar auctions to install 2 GW by 2020. Its institutional set-up is that of a public-private company, independent from the Ministry of Energy, Mines, Water and Environment (MEMEE) and the national utility, and governed by a Board of Trustees and a Supervisory Board. The structure of the organisation is a good example of political commitment[8] and strong leadership in implementing renewable energy targets and policies, with recognised expertise, clear direction and inclusive stakeholder engagement.

Setting long-term targets provides a clear policy direction, thereby fostering long-term investments in renewable energy manufacturing as well as in project development, including skills development and training (IRENA, 2013b). Manufacturing plants producing renewable energy parts and components can be in place for decades, if not longer. As a result, investors often carefully consider the overall growth prospects within a specific market before committing to a particular investment. For example, the decision to build a wind assembly plant requires a minimum market size. Thus, one of the key functions of setting long-term renewable energy targets is to create a stable and predictable investment environment.

Renewable energy targets also facilitate the tracking of market development. The numerical value that targets can represent at early stages of market development can be limited due to a number of factors such as the immaturity of the market, steep learning curves linked to new renewable energy technologies, and as local supply chains may not be in place (IEA, 2011). In this phase of early market development, renewable energy targets backed by supportive policy frameworks play a critical role to generate investment confidence and stimulate deployment at scale. By giving a sense of trajectory and growth, they can help to bring down deployment costs, establish a supply chain utilising local industry and skill set, and engage different stakeholders (*e.g.* utilities, Independent Power Producers (IPPs), financing institutions and public agencies). As renewable energy markets develop, the foundations of the sector are built, which provide a stronger basis for more ambitious targets. This dynamic is well represented in the case of India's solar targets (see Box 9).

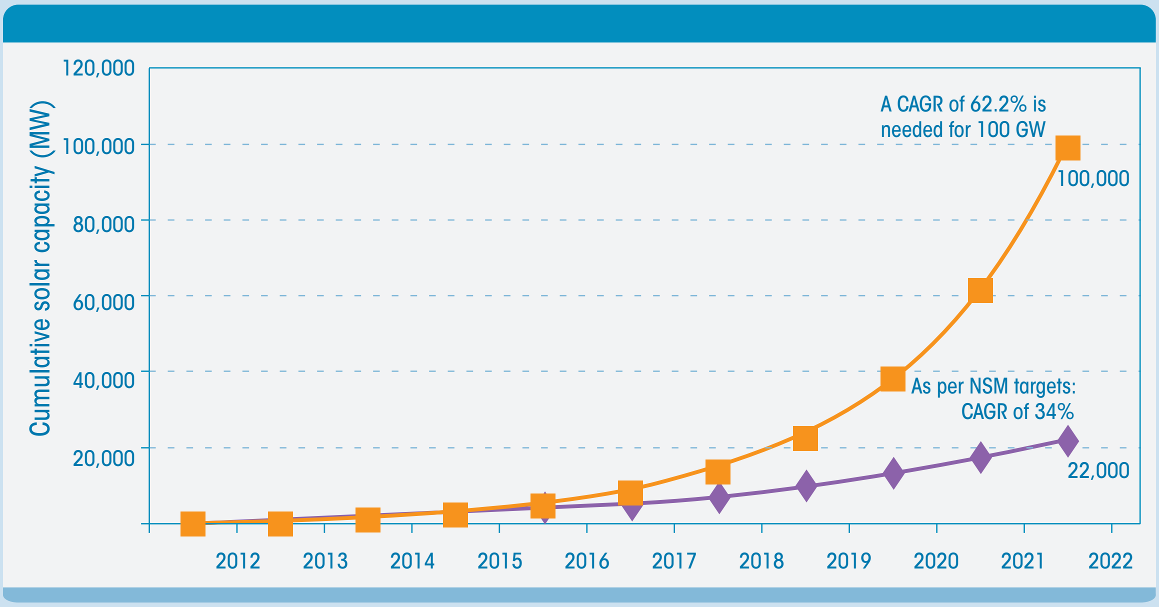
Clear and credible targets, for the long, medium and short terms, also can have positive impacts on both the availability and the cost of finance. RETs are characterised by high upfront costs and nearly zero fuel costs. The principal cost components of electricity generation from RETs are therefore closely associated with the cost of capital, both for debt and for equity. Political and policy uncertainty directly influence risk perception by investors and impact financing costs. These risks can be addressed through the establishment of long-term targets for the development of the

[8] MASEN was established by Law 57-09 adopted in 2010, in close relation with the umbrella Renewable Energy Law 13-09 of 2009.

BOX 9: INDIA QUINTUPLES SOLAR TARGETS

In India, consecutive bidding rounds since the launch of the National Solar Mission (NSM) in 2010 have seen a reduction in the average price of contracted solar power. The price has now stabilised around 6.5 to 7 INR/kWh (0.1 to 0.11 USD/kWh) after a period of four years during which deployment has gone from under 40 MW to 3 GW. With a local solar industry in place, the government has recently decided to scale-up the solar target from 22 GW by 2022 to 100 GW. While this would require a remarkable shift in the current trajectory of deployment (see Figure below), the industry has generally supported the rise in ambition with total (non-binding) commitments reaching over 160 GW of solar power capacity. The scale-up in targets has also coincided with efforts to further reduce the cost of solar generation through the development of large-scale solar parks (>500 MW capacity). Between 2014 and 2019, India aims to set up 25 solar parks with a cumulative capacity of over 20 GW.

Growth Trajectory of Solar Power in India – Current and Proposed



Source: CEEW, 2014
Note: CAGR - Compound annual growth rate

renewable energy sector and backed by a supporting policy and investment framework.

In this perspective, the EC explicitly states the need to provide "regulatory certainty for investors" as one of the primary reasons for adopting its long-term energy and climate targets. The Council of European Energy Regulators (CEER) issued a position paper stating that the EU should not only establish an overall target 27%, but also establish clear, national renewable and sectoral targets, since uncertainty about the proportion of RES-E could "lead to significant network planning and cost implications for regulators in managing uncertain system balancing and financial arrangements" (CEER, 2014). Clear and credible targets also facilitate network expansion and integration of renewable energy.

In addition, renewable energy targets can facilitate closer alignment among different policy spheres, by articulating carbon reduction objectives and renewable energy, or by linking renewable energy deployment to reduced import bills. In so doing, targets can help address a number of co-ordination failures between different policy fields, and foster closer co-operation between distinct public institutions or stakeholders. For example, heating/cooling targets can help to raise the importance of the sector for policy making across energy efficiency, buildings and energy institutions. By encouraging the mainstreaming of administrative and regulatory measures across a wide range of stakeholders and end-use sectors: industry, commerce, the public sector and private households, heating/cooling targets and policies can effectively unlock deployment.

Fostering accountability is another potential benefit of targets at the implementation stage. However, in many cases of national targets, it is unclear where the responsibility lies for delivering the targets, since the results cannot be attributed to the actions of a single stakeholder, but represent the interactions between different stakeholders and levels. National targets often attribute primary responsibility to a line ministry or institution, while in practice successful implementation depends on other ministries and organisations and requires the sharing of efforts and financial resources. In this perspective, the concept of "mutual accountability" (OECD, 2007) can be more suited to national targets which involve the shared commitment of a broad group of stakeholders across different sectors. In the case of renewable energy targets, clarity regarding accountability and who is obligated is closely linked to the specific design modalities of targets, as discussed in sections 3.3 and 3.4, and applies to the evaluation stage.

Policy evaluation stage

At the evaluation stage, targets serve as a measure of the effectiveness of various policies and measures – *i.e.*, whether or not the target is being reached. Evaluation can be conducted by periodically monitoring quantitative progress of targets along the trajectory to full completion. This assumes that the target that was set was rational/SMART, as defined in Section 1.4.

If the target was designed in a sound manner, its non-achievement will initiate the evaluation of the effectiveness of underlying policies. Defining targets makes it possible to organise feedback and to establish systematic reviews and revisions of targets, priorities and the allocation of resources. In the process of monitoring and evaluating the target lies an opportunity for review and adaptation, which may in turn lead to adjustment of the target.

Decentralised implementation is a core component of dynamic policy making, where the regional or local governments are allowed to develop their own policy targets and regulations in line with, but independent from, federal policy. In turn, state governments can feed back to the federal level the details and barriers encountered during implementation (International Partnership on Mitigation and MRV, 2014).

It is considered best practice to ensure transparency of information and decision making in this regard. In the case of U.S. Renewable Energy Standards, utilities or retail electricity companies must provide reports to the regulator documenting their progress towards the objective. In many cases, this translates into a clear, year-by-year obligation, expressed in gigawatt-hours (GWh). Any shortfall may result in a mandatory payment or financial penalties.

Monitoring can be done either internally or externally, or can even be a combination of both. Examples of internal actors that monitor renewable energy targets are usually public authorities such as ministries or municipalities. A more independent form of monitoring can be done by network operators, knowledge institutions or other independent parties, as illustrated in Box 10.

Such efforts can play an important role in improving transparency and public buy-in. In this context monitoring renewable energy targets can also be critical to detecting whether targets are on track during policy implementation and evaluation and to adopt corrective measures. Another example of the role of renewable energy targets in monitoring and evaluation is the "Keep on Track!" project[9] coordinated by the European Renewable Energy Council. The project, launched in February 2013, indicates whether member states are on trajectory to meet their 2020 targets as specified in the EU RE Directive.

BOX 10: MALMÖ MONITORS PROGRESS TOWARDS ITS RENEWABLE ENERGY TARGETS VIA WEBSITE

In Malmö, Sweden, the city has developed a website for citizens to monitor the progress towards the city's environmental goals, including the renewable energy target (Miljöbarometern, n.d.). It monitors developments for four key indicators and signals whether the city is reaching its goals, as well as outlining the reasoning behind each goal assessment. The website allows for the municipality to communicate its progress, indicate areas for improvements and increase the possibility for the public to hold politicians accountable.

[9] *http://www.erec.org/projects/ongoing-projects/keep-on-track.html*

Therefore, renewable energy targets fulfil important functions all along the policy-making process. They contribute not only to elaborating the content of renewable energy strategies by concentrating discussions on specific SMART criteria, but also lay the foundations of effective implementation when designed through robust participation and institutions, while providing an important point of reference to evaluate and monitor progress.

2.2. ESTABLISHING THE BASELINE AND BUSINESS-AS-USUAL SCENARIO

Clearly articulating the objectives underlying renewable energy targets has important implications for balancing the costs and benefits of different target levels and types, and how the impacts (costs, grid impacts, etc.) of renewable energy targets are evaluated over time. To that end, the demarcation of a clear baseline is an essential reference point to evaluate the alternative pathways.

The development of a sound basis for a renewable energy targets is a two-step process: First, a baseline year must be selected; second, a business-as-usual (BAU) forecast must be developed. Establishing the baseline year against which growth towards the targets will be measured is a critical component of effective target setting and the subsequent monitoring and reporting regime that accompanies it. The baseline year is defined as the starting point: it provides a summary of the overall energy mix at a particular point in time. Many jurisdictions already have a certain share of renewable energy in the mix because of existing hydropower projects, the use of traditional biomass or solar hot water technologies. Therefore, establishing a baseline provides a clear picture of how much remains to be done to achieve the target or mandate. As discussed in Section 2.1, a clear and stakeholder-validated baseline is instrumental to accurately measure progress towards the target that has been set.

To develop the baseline, a baseline year must be selected. For countries adopting renewable energy targets for the first time, this typically represents the most recent year for which comprehensive data are available. Then, the base year data/statistics for that year need to be gathered for each of the sectors covered (*e.g.*, heating/cooling, transport and electricity) (see Box 11). It is important to note that the consistency with which the specific baseline year and data are used and reported, as well as the overall methodology adopted, are essential to monitor and evaluate progress towards renewable energy targets over time. The initial analysis of the baseline year can serve to provide an accurate estimate of the total magnitude of energy demand at a particular point in time. In some cases, developing the baseline analysis will involve detailed studies.

For instance, in 2005-06, the EU funded a substantial research effort to analyse the structure of the heating/cooling sectors as well as the various renewable technologies available. The final reports provide a comprehensive overview of the structure of European heating/cooling demand, and adopt 2003 as the baseline year. The methodology as well as the data sources used in establishing the baseline were published and validated with stakeholders. These results laid the foundation for the inclusion of the heating/cooling sectors in the EC analysis of its energy and climate strategies (RHC-Platform, n.d.; Connolly *et al.*, 2013). Similar baseline analyses were conducted for the electricity and transport sectors, and have been updated periodically since (EC DGET, 2007; EC DGE, 2009). Taken together, they helped provide a clear reference scenario to compare alternative policy pathways, and adjust different variables like economic growth, energy demand growth, climate policy, etc.

Once the baseline year has been established, the second major step of the process is to develop a business-as-usual (BAU) scenario that indicates the anticipated total energy consumption in the target year for the sector(s) selected. This scenario makes important assumptions about the underlying rate of energy demand growth, technology costs, learning curves, etc. A sound BAU scenario requires careful consideration of these assumptions, and in particular the anticipated rate of energy (or electricity) demand growth. Indeed, assumptions about demand growth are a core aspect of BAU forecasts (see Box 12). This includes, by extension, important assumptions about the rate of energy efficiency improvement and substitution. If the target is set in percentage terms, connecting the renewable energy target to the BAU forecast enables the target to be indexed to the actual (realised) energy mix.

By enabling different alternative development pathways to be compared with one another, establishing

BOX 11: ECOWAS RENEWABLE ELECTRICITY TARGETS

The ECOWAS region's recent renewable energy policy roadmap illustrates the key steps in setting the basis for renewable energy targets. The strategy outlines a baseline year (2010), provides a detailed analysis of the region's electricity mix in that year: the total regional renewable electricity target (including medium and large hydro) for 2030 has been set at 75.6 TWh, which represents an estimated 31% of total electricity demand in the target year.

the baseline and BAU scenarios play an important role in helping decision makers better understand the various impacts (financial, economic, etc.) of achieving different levels and types of renewable energy targets.

2.3. EVALUATING THE COSTS AND IMPACTS OF RENEWABLE ENERGY TARGETS

Before adopting and implementing a renewable energy target, policy makers generally conduct a number of scenario analyses to evaluate the potential impacts of achieving the targets on a range of different variables, including energy or electricity prices, overall fossil fuel imports and local job creation, among others. In most cases, an analysis of the costs of achieving a given renewable energy target must include an evaluation of the policy tool(s) or mechanism(s) used to achieve it.

Impact analysis is an important stage in the process of setting renewable energy targets, as it can also help identify what level of renewable energy target is achievable at a cost that is considered acceptable. In some cases, this cost will be an important factor and may limit the level of the renewable energy target or its time frame.

In addition, running different scenarios of the costs and impacts can help policy makers develop a range of different potential pathways. These pathways can then be used to inform the process of agreeing upon and setting a final renewable energy target level. Developing scenarios to arrive at an agreed-upon target is therefore an important step. This notwithstanding, many countries around the world have modified their renewable energy targets as circumstances (whether technological, political or other) have changed. As such, the goal of evaluating the impacts (and costs) of achieving different renewable energy target levels is to capture what stakeholders deem to be realistic (*i.e.* achievable) at a particular moment.

BOX 12: BUSINESS-AS-USUAL FORECASTS IN THE EUROPEAN UNION

In the European Union's PRIMES analysis*, a detailed modelling effort conducted in the mid-2000s, the total energy demand in the EU would amount to 82 EJ under a BAU scenario. The EU target of reaching a 20% improvement in energy efficiency was intended to be relative to this fixed baseline projection, resulting in total cumulative energy savings, versus the BAU forecast, of approximately 16 EJ. Thus, the EU's total energy use, as envisioned in the PRIMES projections, would total 66 EJ in 2020. This, in turn, is the level of total energy consumption on which the EU's 20% RES target was originally based, making it equivalent to approximately 13 EJ of final energy consumption by 2020.

This example points to a few important insights. First, improvements in energy efficiency can work synergistically to facilitate the achievement of renewable energy targets. Second, combining both energy efficiency and renewable energy is likely to translate into direct cost savings when compared to a BAU forecast, as the cost of curbing demand growth is often lower than the cost of increasing supply.

Source: Harmsen *et al.*, 2011

*Note: PRIMES is a partial equilibrium model for the European Union energy markets, used for forecasting, scenario construction and policy impact analysis used mainly in the field of energy and environmental policy.

A clear example of this is the U.S. state of Massachusetts, which commissioned a series of analyses in 2013 to evaluate the various economic impacts (both the benefits as well as the costs) of achieving the state's initial technology-specific solar PV target of 400 MW (Commonwealth of Massachusetts, n.d. a). These economic analyses were then used to assist policy makers with the design and implementation of the state's renewable energy target, which is now in place and requires utilities operating within the state to deliver 1 600 MW of solar PV by 2020 (Commonwealth of Massachusetts, n.d. b). These economic impact analyses played a vital role in stimulating discussion around expanding the solar PV target, and provided specific insight into potential job creation benefits, as well as potential ratepayer impacts, that the 1 600 MW target could generate (La Capra Associates and Sustainable Energy Advantage, 2013). Analysing the costs and benefits of achieving different target levels can significantly enrich the policy-making process and provide decision makers with a clear justification of the level of target deemed appropriate, as illustrated in the case of Cabo Verde (see Box 13).

Other costs that are important to consider, beyond the simple costs of supply, are the associated infrastructure costs of reaching a certain renewable energy target. In the electricity sector, this may involve investments in new power lines and substations, as well as investing in new monitoring and forecasting capabilities. Understanding and identifying the technical and investment implications of integrating RETs into the existing grids permits the setting of technically and economically feasible targets. For small systems with a rapid transition towards a renewable energy-based power system, such as the 90% renewable energy power generation target for 2015 set by the Fiji government in 2011, it is particularly important that grid integration issues are considered as part of the target-setting exercise.

In the transport sector, this may involve additional investments in electric vehicle charging infrastructure or in public transit, which in turn may require upgrades to other associated infrastructure. In the heating/cooling sectors, imposing an obligation to equip buildings with renewable energy sources of heating and cooling (RES-H&C) technologies, for instance, may impose additional short-term costs on building owners and construction companies as well as on the buyers of new houses or commercial buildings. Developing ways to ensure that these costs are affordable and are factored into the overall costs of the strategy can be an important part of successfully implementing a renewable energy target.

The role of modelling tools in setting renewable energy targets

Setting renewable energy targets, whether for the electricity, transport or heating/cooling sectors, can be a highly multidisciplinary undertaking, involving a wide range of experts and skill sets. At various stages of implementing the target, it may require conducting an evaluation of the overall potential of different RES (biomass, wind, geothermal, hydro, solar, etc.), applying spatial or land-use analysis, developing network expansion strategies (in the case of electricity, district cooling/heating or even for the distribution of biofuels), as well as undertaking detailed analyses of the costs and benefits of increasing the share of renewable energy in either of the three targeted sectors. Each of these analyses can be considered the various "layers" and may support a particular aspect of the decision-making process.

BOX 13: CABO VERDE INCREASES RENEWABLE ENERGY TARGETS

In island jurisdictions such as Cabo Verde, the costs of pursuing a more aggressive renewable energy target were found to be below BAU estimates of generation costs based on a continued heavy reliance on fossil fuels. In Cabo Verde's case, it is estimated that achieving both its 50% target, as well as its now revised 100% target for the electricity sector, will result in net savings for the government, the national utility, as well as ratepayers, as domestic RES-E on the island (primarily from wind and solar) currently undercut the avoided cost of generation from the islands' existing diesel and heavy fuel oil plants. Conducting an analysis of the full costs and benefits can therefore help strengthen the case for renewable energy, and may even help identify potentials and cost savings that were not anticipated at the outset.

Moreover, energy systems analysis allows the holistic planning of various energy sub-sectors under a consistent framework, thereby identifying and addressing specific inconsistencies (for instance, between technology-specific targets, sector-specific targets and across sources of energy). Undertaking energy system planning in a holistic way also can make it easier to conduct comprehensive statistical analysis, and improve monitoring and enforcement.

However, it is important not to overstate the need for planning and modelling tools. In particular, policy makers should try to avoid what has been referred to as "paralysis through analysis" – the tendency for detailed analysis to become an end in itself, rather than a means to implementation. The process of conducting analyses and modelling exercises should support decision making, not distract from it. In the real world of political decision making, policy makers are frequently (if not invariably) required to work with imperfect information. In the process of setting long-term renewable energy targets, the aim is to take the various considerations into perspective (resource potential, energy security benefits, integration costs, environmental considerations, etc.) and to set out a plan or strategy that responds appropriately to those realities, and that is well adapted to respond to future risks and opportunities.

In practice, very little detailed modelling may be required to set renewable energy targets, particularly in the early stages. However, the need for various analytical tools and models can be expected to grow over time as the share of renewable energy in the energy mix grows. This applies particularly to higher order energy challenges, such as the integration of large shares of variable renewables into existing electric grids, or modelling of impacts of high volumes of electric vehicles in urban centres.

Resource mapping and assessments

Many jurisdictions have made extensive use of renewable energy resource assessments to assist them in their policy and planning processes. Some countries such as Denmark have developed comprehensive mapping tools to enable both the government and private sector participants to plan for the anticipated growth of large-scale wind projects in the country. Mapping tools and technical assistance are also publicly available through initiatives such as the Global Atlas initiative co-ordinated by IRENA.[10] The Global Atlas is a freely accessible platform, which enables investors and policy makers to identify areas of interest for further prospection.

The goals of renewable energy resource mapping are manifold:

- Develop an estimate of the total available resource potential in different sectors (wind, solar, micro-hydro, etc.).
- Provide developers and prospective investors with basic data and information about the scale of the renewable energy resource that is available.
- Raise public and investor awareness.
- Help inform other electricity sector priorities, such as planning transmission corridors.
- Help designate specific renewable energy development zones, among others.

In addition, a growing number of governments are making their resource maps publicly available.[11] This demonstrates that resource mapping is increasingly used as a tool to support renewable energy policy development, both in developed and in developing countries.

There is no standard methodology to estimate renewable energy potentials. While some common parameters can be found for solar and wind technical potentials, each study has its own methodology, leading to significantly different results, which are valid for a specific set of assumptions.

Therefore, it is important to note that the analysis of a country or region's renewable energy potentials is not an exact science. It provides orders of magnitude, not precise numbers. As a result, developing a resource map analysing solar or wind power potential, for instance, is not sufficient to attract investment. The majority of renewable energy resource maps are not detailed enough to meet the full information requirements of project developers, lenders and investors.

[10] *See: IRENA, Global Atlas for Renewable Energy, http://globalatlas.irena.org/*

[11] *See: Global Energy Network Institute. Renewable Energy Resource Maps. http://www.geni.org/globalenergy/library/renewable-energy-resources/; U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. California Renewable Energy Resource Maps. http://apps1.eere.energy.gov/states/maps.cfm/state=CA; PEI Energy Corporations. Prince Edward Island Wind Atlas. http://www.gov.pe.ca/envengfor/windatlas/ . U.S. National Renewable Energy Laboratory. Biomass Maps. http://www.nrel.gov/gis/biomass.html*

However, renewable energy resource maps can raise both public and investor awareness of the considerable renewable energy potential that a country has. Moreover, developing a resource map is not sufficient to set the final target level as it often relies on a range of other political, economic and technical considerations, of which resource mapping is only one, as highlighted in Box 14.

BOX 14: OVERVIEW OF THE EUROPEAN UNION'S RENEWABLE ENERGY TARGET SETTING PROCESS

Establishing the EU RE Directive (the so-called "20-20-20" targets) involved numerous steps. Besides EU internal discussion rounds with the EU Commission, Council and Parliament, the EU administration invited stakeholders to give feedback to the Green Paper, an EU consultation document that outlines a policy proposal to be discussed and debated in public. In these consultations, individuals as well as associations or industry representatives contributed their input and suggestions. The following link shows the feedback of the public consultation process of the 2030 EU Framework for Climate and Energy Policies: *http://ec.europa.eu/energy/en/consultations/consultation-climate-and-energy-policies-until-2030*

The consultation process was particularly important to discuss the impact assessment studies or scenarios used to estimate the potential impact of policies or the potential deployment targets policies. These studies were published as papers and are cited or considered as grey literature.

3. Key Design Features of Renewable Energy Targets

Having established the basis for renewable energy targets, policy makers need to consider a further set of issues as they determine the specific design features of renewable energy targets. This chapter discusses a wide range of options, including the structure of renewable energy targets and their specific units, and the differences between technology-specific and technology-neutral targets, long-term and short-term targets, and mandatory and aspirational targets. The chapter concludes by looking more closely at how renewable energy targets are translated from broad goals into the specific policies and measures that will be used to achieve them.

3.1. STRUCTURE OF RENEWABLE ENERGY TARGETS

Renewable energy targets take a wide variety of forms and structures. At the highest level, governments have adopted what are referred to here as "overarching" renewable energy targets that apply to a country's entire energy mix. At the next level, a number of jurisdictions around the world have established targets that apply to a particular sector (electricity, heating/cooling or transportation) or to a specific technology (see Box 15).

In the majority of cases, renewable energy targets have been applied to the electricity sector, although the number of targets in both the transport sector and in the heating/cooling sector is growing rapidly (see Figure 5).

The structure of renewable energy targets becomes more complex as one moves from broad, overarching renewable energy targets to technology-specific targets. In the process, targets also become more specific, which in turn makes them easier to monitor and to enforce. However, as targets become more specific, a range of structural and design-related issues emerges. The following section considers some of these structural issues in greater detail.

Technology-neutral vs. technology-specific targets

The issue of whether renewable energy targets (and renewable energy policy more broadly) should be technology-neutral has been a central part of the policy debate as early as the 1980s. Leaving aside the example of Brazil's ProAlcool Programme, most early renewable energy targets that were adopted (such as the U.K.'s Non-Fossil Fuels Obligation and most U.S. Renewable Energy Standards were originally designed to be technology-neutral: they applied to all (or most) RETs. While early renewable energy targets often excluded large hydropower from eligibility (as large hydro projects were considered "mature"), most of them did not stipulate particular shares of a certain technology, nor did they offer differentiated support, or apply different policy mechanisms, for specific technologies (Rader and Hempling, 2001).

There are two core reasons why policy makers tended to prefer the technology-neutral approach. First, it was argued that different technologies should be required to compete with one another in order to achieve the target in a least-cost fashion — policy makers lacked the information required to decide. As such, the market should be left to determine which technologies should be used, based on the least-cost criterion. Second, there was an increasingly common argument that governments should not "pick winners". Thus, instead of setting technology-specific targets, policy makers should rather set the target and allow the market to identify the best (*i.e.*, most cost-effective) way of meeting it. See section 1.3 on debates surrounding renewable energy targets.

However, despite the initial logic of this technology-neutral perspective, it arguably remains vulnerable to the same criticism that it aims to address: by setting price as the chief criterion, in many markets the technology-neutral approach implicitly ended up "choosing" onshore wind power as the technology of choice, as this has long been the cheapest renewable electricity technology.[12] In other words, while the process may

[12]Note that this is with the possible exception of large hydro, which frequently is excluded from renewable energy support mechanisms on the grounds that it is already a "mature" renewable energy technology and therefore not in need of further policy support.

BOX 15: TRADE-OFFS OF TECHNOLOGY-SPECIFIC RENEWABLE ENERGY TARGETS

There are multiple reasons why many policy makers around the world have favoured a technology-specific approach. First, the regulatory framework can be designed to ensure that different technologies are offered a cost-reflective tariff for their output. This helps avoid both underpayment, as well as over-payment, by allowing the purchase price to reflect what each technology needs in order to be profitably developed. This remains a common feature of FIT policies worldwide (Couture, 2010), as well as of successful auction policies (Kreycik, Couture and Cory, 2011).

Second, under a technology-neutral framework, it is likely that project development is overly focused in one or two technologies and fails to harness the full renewable energy potential of a region or country. As a result, limiting deployment to one or two technologies may make it harder to achieve a jurisdiction's renewable energy target. Also, limiting deployment to one technology can increase competition for the available sites (potentially causing delays, or increasing citizen opposition) and reduce the range of technologies that can contribute to the target.

Third, a technology-neutral approach is more likely to exacerbate grid integration issues in the case of electricity targets, as an over-concentration on one resource (*e.g.*, wind projects along windy coastlines) can make it harder to adequately integrate the power into the network, thereby increasing the risk of curtailment and bottlenecks. Having a diverse mix of renewable energy resources feeding into the energy or electricity supply mix can help mitigate some of these issues, and improve the resilience of the overall energy supply infrastructure, as different technologies complement each other and vary in response to different meteorological factors (solar, hydro, wind, etc.)

Finally, focusing exclusively on one or two technologies may constitute a significant opportunity cost. An in-depth research project undertaken in 2011-12 for Intelligent Energy Europe by a number of leading research institutes in Europe found that, contrary to conventional arguments, adopting a technology-specific approach to renewable energy policy would actually reduce the long-run costs of meeting the EU's "20-20-20" targets (Ragwitz *et al.*, 2012). The primary reasons for this were that a technology-specific approach would encourage so-called dynamic efficiency, enabling technological innovation, cost reduction and so-called learning by doing in a wide range of different technologies simultaneously.

In light of the dramatic decline in solar PV costs seen in recent years, it would appear that this argument has proved to be correct, and that failing to have provided technology-differentiated support would have been a significant missed opportunity. If all countries had adopted a technology-neutral approach, it is unlikely that the dramatic cost declines in solar PV would have occurred when they did, as these were supported by the presence of large markets (most notably, Germany) that drove competition, cost reduction (in both hard and soft costs) and private-sector led investments in R&D. Partly in response, policy makers increasingly recognize the benefits of adopting a portfolio approach with technology-specific targets. Evidence from the recent decline of solar PV costs suggests strongly that there is a significant opportunity cost in focusing too narrowly on one resource, as it may limit innovation in other technology areas, so called "dynamic efficiency" and even crowd out the emergence of new technologies.

However, despite these many arguments, it remains the case that encouraging less-mature technologies can increase the cost of achieving a given renewable energy target in the short-term. Policy makers should carefully consider the weighting given to different technologies, and regularly review technology costs in order to adjust their strategies accordingly.

have been technology-neutral, the outcomes often were not. By setting price as the main criterion, a technology-neutral approach can actually crowd out other emerging technologies, limiting diversification in the market and potentially even increasing the long-term costs of reaching the target by delaying innovation and cost reductions in other technology areas (so called dynamic efficiency).

Therefore there may be a significant opportunity cost of choosing a technology-neutral approach. This position appears to be supported by the recent rapid decline in solar PV costs (Bazilian *et al.*, 2013), which arguably would not have occurred without technology-specific policy support (see Box 15 on the trade-offs of adopting technology-specific renewable energy targets).

While the debate over whether renewable energy policies should be technology-neutral peaked in the 1990s and early 2000s, the argument is now more commonly heard in the context of the debate over carbon abatement options, where one of the predominant views is that governments should adopt a technology-neutral approach and allow the market to choose the cheapest abatement option (see Box 5 on the interactions between climate and renewable energy targets).

In the renewable energy sector, the majority of governments appear to have moved beyond arguments about technology-neutrality, recognising that different technologies have different costs, and that there are a number of advantages of having a diversified portfolio of generation sources. A brief survey of the various renewable energy targets and policies found around the world confirms the predominance of technology-specific targets and policies (REN21, 2014). Table 3 provides a few examples.

Indeed, targets that are exclusive to selected technologies can be introduced to support their specific deployment, in particular when they are most suitable in terms of resource availability matching peak demand (*e.g.* solar targets in Dubai). Such targets can also sustain the development of the local value chain of selected technologies. For instance, Morocco's target of 2 000 MW solar by 2020 has led to the development of a local industry. In the case of Ouarzazate, around 40% of the installation costs is spent locally, with the potential to exceed 60%.

Similarly, various U.S. states have established different categories for eligible technologies, and a growing number divide different RETs into "tiers" or "classes" of eligible resources. Many, such as Maryland and Oregon, include carve-outs for technologies such as solar PV, while some, such as New Hampshire, include special requirements for heating or allow investments in renewable forms of heating to qualify for the target (New Hampshire Government, n.d.). In this way, regulators have begun to exert more influence on the resource mix used to achieve the renewable energy target, by converting the Renewable Energy Standards into distinct technology-specific obligations, extending even into the heating sector, as seen in the case of New Hampshire. However, it is important to note that carve-outs often reflect political processes – for example, in the U.S., some solar carve-outs are the result of lobbying by the solar industry.

Table 3: Overview of Technology Specific Targets

Country	Technologies	Targets
Bangladesh	Solar PV	500 MW by 2015
	Off-grid Solar PV	2.5 million systems by 2015
	Bioenergy	2 MW by 2014
	Biogas	150 000 plants by 2016
Morocco	Wind	2 000 MW by 2020
	PV and CSP	2 000 MW by 2020
	Hydropower	2 000 MW by 2020
Rwanda	Hydropower	340 MW by 2017
	Small Hydropower	42 MW by 2015
	Geothermal	310 MW by 2017
	Biogas	300 MW by 2017
	Off-grid Renewables	5 MW by 2017
India	Solar PV	100 000 MW by 2022
	Wind	60 000 MW by 2022
	Small Hydropower	10 000 MW by 2022

In some cases, while the renewable energy targets may have remained technology-neutral (*e.g.*, 20% RES-E by 2025), policy makers have nevertheless made use of technology-specific policies in order to achieve them. This approach can be seen in Germany, Ghana and Malaysia among others (REN21, 2014).

Moreover, a number of countries that previously opted for technology-neutral policies have since modified their policy frameworks to allow for technology-specific support.

When the U.K.'s RO scheme was adopted in 2002, it was intended to be technology-neutral (see Box 3). It set out a target of reaching 10.4% of the electricity mix from eligible RES by 2010-11. The utilities were required to demonstrate compliance with the obligation either by developing their own renewable energy projects or purchasing a certain amount of ROCs. It quickly became clear that some technologies were not succeeding in getting developed under the technology-neutral framework set out in the RO.

Due to the lack of diversity in the market, regulators in the U.K. introduced technology-specific banding in 2009, with different categories applied for a range of different renewable energy technologies. Each technology was granted a multiplier value, with a value of less than 1 (0.25) for landfill gas, a value of 1 for onshore wind, a value of greater than 1 (1.5) for offshore wind and a value of 2.0 for wave power, tidal power and other less cost-competitive technologies (Woodman and Mitchell, 2011). This suggests that despite the original intention of pursuing a purely technology-neutral approach, it was found impractical to do so, as the framework failed to provide sufficient support for less-mature technologies.

By encouraging the simultaneous development of a range of different renewable energy options through technology-specific targets, policy makers are enabling more diversified renewable energy sectors to emerge and to grow.

Total primary energy consumption vs. Total final energy consumption

When determining the structure of renewable energy targets, an important distinction for policy making is whether renewable energy targets apply to TPES or to TFEC. One of the most basic metrics used by countries around the world is TPES, which refers to the total direct supply of energy in its raw, or unprocessed form. It includes the sum of all fossil fuel supply, nuclear, as well as renewable energy supply within a country in a given year. In contrast, TFEC applies to the total final energy consumption from households, government, businesses, industry as well as the transport sector. Both TPES and TFEC are measured in energy units, for example in million tonnes of oil equivalent (Mtoe), quadrillion British Thermal Units (Quads) or exajoules (EJ). As seen in Section 1.1, the total number of countries with renewable energy targets framed in terms of either TPES or TFEC more than doubled from 30 in 2005 to 79 in mid-2015.

However, using TPES as a statistical basis for setting a renewable energy target poses one key problem: the methodology used to calculate the primary energy equivalent of some fuels. In the electricity sector, the input of fuels used in thermal power plants (such as coal, oil, natural gas or biomass) is easy to measure. However, for non-thermal electricity generation happening in nuclear plants, wind or hydropower facilities, the input of fuels, or primary energy equivalent, needs to be calculated using assumptions which are often taken for granted, but result in distortions between fuels.For example, under the physical energy content method, while the efficiency in hydropower plants is assumed to be 100%, that of nuclear power plants is assumed to be 33%. Therefore, 1 GWh of electricity will be associated with a primary energy equivalent of 1 GWh for hydropower but 3 GWh for nuclear. Thus, gathering energy statistics for the electricity sector on the basis of physical energy content method would tend to overstate the share of biomass, oil, nuclear, natural gas and coal in the overall energy mix, as 60-70% of the primary energy is in fact lost in the process of conversion. Partly in order to address this issue, a growing number of jurisdictions (including the EU) are beginning to base their overarching renewable energy targets in terms of TFEC instead.[13]

Share of energy demand vs. fixed amount

When considering sector-specific or technology-specific renewable energy targets, a further distinction emerges: policy makers can establish targets as a percentage of final energy or electricity consumption (*e.g.*,

[13] In addition, at least four countries have set renewable energy targets in terms of both TPES and TFEC: Albania, Lithuania, Moldova and Poland. See REN21, 2014.

BOX 16: AUSTRALIA REVISES ITS RENEWABLE ENERGY TARGET

In 2010, policy makers in Australia established the country's renewable energy target in absolute terms, requiring utilities to supply 41 000 GWh of electricity from RES by 2020*. This obligation was intended to represent approximately 20% of electricity demand by that date and was based on load forecasts conducted at the time (Pears, 2014). Moreover, the leading business association previously supported a target framed in absolute terms on the grounds that it would improve certainty and make it easier for utilities to plan how they would meet their compliance obligations. However, as electricity demand in Australia has declined in recent years, the business association has reversed its position, arguing that the 41 000 GWh target should be changed to a percentage-based target instead (Pears, 2014). Current estimates suggest that the 41 000 GWh target will represent approximately 26% of final electricity demand in 2020 (Commonwealth of Australia, 2014). This highlights the important role that uncertainty in overall energy (or electricity) demand plays in renewable energy target design, and the importance of reflecting carefully on how the final target is structured in the law or regulatory act.

*See: Renewable Energy (Electricity) Act of Australia, (2000, amended 2010, 2011 and 2012). Available at: www.comlaw.gov.au/Details/C2012C00389; see also Commonwealth of Australia, 2014.

25% of final electricity consumption by 2020), or as a fixed amount of renewable energy to be supplied (*e.g.*, 500 GWh of RES-E by 2025).

In many regions, a combination of rapid economic growth, rising affluence and significant increases in access to energy can make underlying energy demand growth extremely high. In such cases, setting a renewable energy target in percentage terms introduces a growing obligation over time, as the target must track this rapid pace of energy demand growth. If actual, or realised, energy demand growth ends up being lower than forecasted, and this can have a direct impact on the overall magnitude of the renewable energy target (in GW or GWh terms). Conversely, if demand growth is slow, or even negative, as is planned in the EU's "20-20-20" targets, the targets will tend to be easier to achieve, all else being equal.

In contrast, the second approach of framing the target in absolute terms (*e.g.*, 500 GWh of renewable electricity generation per year by 2025) may introduce less uncertainty and be easier to monitor over time, as it stipulates a specific quantity that must be produced or consumed. However, this approach can also create challenges in countries where hydropower plays an important role as the difference in output between a wet and a dry year may be significant; as well as in countries where electricity demand unexpectedly turns negative, an issue that became a central part of Australia's debate over its renewable energy target in 2014 (Commonwealth of Australia, 2014) (see Box 16).

In conclusion, a target framed as a percentage of final electricity demand ensures that the target grows or shrinks as a function of actual energy demand. While this may introduce more uncertainty about the total actual output required to achieve the target, it also has the advantage of keeping up with potentially rapid demand growth. However, as the case of Australia demonstrates, while setting the target in absolute terms is more likely to reduce uncertainty for market participants, it also shows the shortcomings of absolute targets in the face of hard-to-predict electricity demand. One way to resolve this tension is to include a clause that establishes the renewable energy target in both absolute and percentage-based terms, and states that the requirement is based on whichever of the two is greater (or smaller, as the case may be).

When targets are structured as a fixed amount to be reached by a certain date, targets (such as those in the electricity sector, for instance), they can take the form of either capacity (in MW) or output (MWh). This distinction is examined more closely in the following section.

Metrics of renewable energy targets by sector

In the electricity sector, jurisdictions have defined their targets in capacity-based (MW) or output-based

(MWh) terms, and in some cases, they have changed from one to another. Indeed, there are a number of advantages to an output-based approach.

First, many of the benefits of increased renewable energy development (such as emissions reduction, improved air quality, etc.) are only realised if the energy produced actually displaces polluting or other non-renewable forms of energy.

Capacity-based targets may be easier to monitor for some technologies but run the risk of allowing idle or under-performing capacity to be registered as contributing towards the target, even though such capacity may add little real energy to the system. Thus, framing targets in terms of output is the only way to ensure that these benefits are realised.

Second, focusing on production rather than capacity ensures that individual project owners or operators have an incentive to keep their facilities operating at a high level of efficiency. Otherwise, an obligated entity, such as a utility, could simply count the installed capacity on its network as complying with the target, regardless of whether that capacity was actually producing electricity. Moreover, encouraging producers to maintain efficient production ultimately contributes to reducing the levelised cost of that electricity, and ensures that the total target is ultimately reached at a lower level of total capital investment.

In markets that use Power Purchase Agreements (PPAs) or feed-in tariff policies that provide long-term, output-based contracts (USD/kWh), generators are only remunerated for the electricity that they actually export to the network, so this may be less of an issue in jurisdictions where the right policy conditions are in place. This raises the important issue of who is ultimately responsible for achieving the target (see Section 3.3. on Mandatory vs. Aspirational Targets). If the target is framed in capacity (*i.e.* MW) terms and a utility is responsible for meeting it, the utility in question may be less concerned about dealing with issues like curtailment, than it would be if the target were framed in output (*i.e.* GWh) terms. Thus, output-based targets help ensure that the right incentives are in place for both generators, as well as for the entity on whom the obligation to reach the target is imposed.

Finally, as mentioned earlier, framing targets in output terms helps ensure that the magnitude of the target automatically tracks overall growth in energy demand over time.

Therefore, from the perspective of the energy system, an important factor to consider is the actual output that reaches end-use customers (*i.e.*, GWh of output, litres of biofuel blended, etc.), and thus enters into the TFEC statistics. For these and related reasons highlighted above, targets set in capacity terms (MW) are arguably not as rigorous as targets established in output (GWh) terms.

However, despite the advantages of setting targets in output terms, it remains the case that capacity-based targets may be easier to monitor for some technologies than targets set in output terms. For instance, regulators may find it easier to track the total MW installed, rather than the specific output, from highly distributed technologies such as solar hot water systems or ground-source heat pumps. As a result, in some cases and for some technologies, setting targets in capacity terms may be appropriate.

Some jurisdictions have chosen to frame their renewable energy targets in both output (GWh) and capacity (MW) terms, with one being linked to the other through the establishment of specific capacity factors. This approach is used in the U.K.'s Renewables Obligation scheme, where different load factors are assigned to each technology, resulting in estimates of how much installed capacity will be required to comply with the mandate (DECC, n.d.). This conversion should be done carefully, by paying attention to using capacity factors that are realistic given specific country conditions.

One advantage of also framing the total generation target (GWh) in terms of installed capacity (MW) is that it helps connect the target to a specific procurement process, such as a series of auctions, as in South Africa and Brazil, or a volume-limited FIT policy, as seen in Malaysia (or vice versa). In other words, translating output-based targets into capacity-based quantities can potentially help in translating the targets into the specific policies and measures (see Section 3.4).

Regardless of which approach is chosen, achieving renewable energy targets requires detailed reporting and monitoring. This means that policymakers and

BOX 17: AMENDMENTS TO THE EUROPEAN UNION'S TRANSPORT TARGET

The set-up for the transport sub-target of the EU RE Directive mandated that the share of energy from renewable sources must amount to at least 10% of final energy consumption in the sector by 2020 for each of the Member States (*i.e.*, no differentiation across Member States). While the terms of the EU RE Directive were being finalised, but after the 10% target had been agreed by Member States, an intense debate started about the life-cycle greenhouse gas balance associated with the production of biofuels, including in particular the issue of emissions from land-use change – both direct and indirect (ILUC).

Based on further evidence from the impact assessment of ILUC, in 2012, the EC proposed further measures to reduce the risk of ILUC by amending the RE Directive and the Fuel Quality Directive. The amendment seeks to limit the proportion of the 10% target which can be met by first-generation biofuels (produced from sugars, oil crops, etc.) to a maximum of 50% of the total. At the same time, the amendment to the Directive is to reward biofuels based on wastes and non-food feedstocks by allowing them to count twice towards the 10% target (EC, 2012). This proposal is currently under discussion in the European Parliament and Council.

The 2030 Climate and Energy Framework does not deem "appropriate to establish new targets for renewable energy or the greenhouse gas intensity of fuels used in the transport sector or any other sub-sector after 2020" (EC, 2014). The Commission further states that "the focus of transportation policy should be on improving efficiency, electric vehicles, and second- and third-generation biofuels and other alternative, sustainable biofuels as part of a holistic, integrated approach".

regulators need to develop appropriate monitoring processes in conjunction with their renewable energy targets.

As discussed in this section, there are various ways of structuring renewable energy targets in each sector. Table 4 provides examples of how targets can cover different sectors, with an overview of how they can be framed in a wide range of units. In the electricity sector, they typically are framed in terms of electricity generation (GWh or TWh, as in the Republic of Korea) or in terms of electricity capacity (MW, as in South Africa). Focusing on the electricity production would consist in taking the sum of the total so-called bus bar[14] generation from all eligible (or metered) RES-E assets on the network. However, in some countries, both technical and non-technical losses in the electric grid can be as high as 30-40%. This is why most jurisdictions that set targets in output terms (GWh or percentages) – including across the United States, the EU and many jurisdictions in Asia – stipulate that the target applies to final electricity consumption, which in this case means final electricity sales. Reporting for compliance purposes therefore often relies specifically on the share of generation in relation to final electricity sales.

Targets in the transport sector are often framed in terms of tonnes of oil equivalent (toe), percentage terms (%) or total litres of fuel blended, as seen in Spain's, Uganda's and Liberia's renewable fuel targets. Further specification is normally needed in mandates for biofuels in percentage terms, specifying whether the percentage is in volumetric, mass or energy terms (see Box 17).

For the heating/cooling sector, some targets (such as China's) are framed in terms of GW of thermal capacity installed (GWth), others (such as Spain's) are framed in terms of toe, and still others are framed in terms of the number of specific solar hot water systems installed (REN21, 2014) (*e.g.* Mozambique), or as a percentage of homes equipped with renewable energy heating/cooling systems (*e.g.* Jordan).

Therefore, a wide range of metrics can be used to define renewable energy targets by sector and within sectors, as illustrated in Table 4.

As this section indicates, there are no general rules about the structure of targets, nor about the units used to define them. This notwithstanding, the examples cited above also highlight the importance of particular target design choices on overall policy impacts. The

[14] The "bus bar" generation is used to describe the total generation output that is injected into the network, net of any on-site power consumption used by the generation facility.

Table 4: Selected Renewable Energy Target Metrics by Sector

Sector	Options for units of energy used to define the target	Example
Electricity	GWh or TWh (total generation in absolute terms) by a certain date	Republic of Korea: 2 046 GWh of generation from solar PV by 2030
	% of the mix (often rendered in GWh or TWh) by a certain date	Guinea: 6% of total electricity from solar PV by 2025
	MW or GW of capacity installed by a certain date	South Africa: 17.8 GW of renewable energy capacity by 2030
Transport	toe (tonnes of oil equivalent)	Spain: 2 313 ktoe of ethanol or bio-ETBE* by 2020
	# of litres of fuel by a certain date	Uganda: 2.2 billion litres of biofuels by 2017
	% of total transport fuels	Liberia: 5% of total transport fuels from biofuels by 2015
Heating/ Cooling	GWth of thermal capacity (surface area in m^2)	China: 280 GWth of solar thermal capacity (400 million m^2) by 2015
	toe	Spain: 50.8 ktoe of heat pumps by 2020; 644 ktoe of solar hot water and solar space heating by 2020
	# of individual renewable energy heating/cooling systems	Mozambique: 100 000 solar hot water systems (no date)
	% of homes equipped with renewable energy heating/cooling systems	Jordan: 30% of homes by 2020
	% of RES in total heating/cooling mix	Slovenia: 30.8% renewable energy in the total heating/cooling mix by 2020

Source: REN21, 2014
* bio-ETBE = Ethyl tert-butyl ether, or bio-ethanol

different ways of structuring targets are discussed in the remainder of this chapter.

3.2. LONG-TERM VS. SHORT-TERM TARGETS

Renewable energy targets are often set in a long-term perspective, typically 10 to 20 years. In some cases, renewable energy targets extend further into the future, with Denmark, Germany, as well as some U.S. states such as Vermont having set targets or goals that extend to 2050.

Long-term targets provide a key signal to stakeholders, in particular to developers, investors and manufacturers, about the long-term opportunities available in a given market. In particular, a number of capital-intensive investments in the renewable energy sector, such as manufacturing and large-scale project deployment, would be far less likely to occur (*i.e.*, they would be less likely to obtain financing, or to secure board-level approval) without the focus jurisdiction having demonstrated a clear long-term commitment to renewable energy deployment. Likewise, network planning and expansion are time-intensive processes, and hence also benefit from long-term visibility.

Furthermore, in order to build the human capacity required over time in the financial, logistics-related, installer, operator, supplier and related sectors, a short-term renewable energy target of three to five years is unlikely to be sufficient (DB Climate Change Advisors, 2009; CEM and IRENA, 2014). Thus, the commitment embodied by a long-term renewable energy target helps anchor stakeholder expectations and build a broader support base towards achieving the target.

The positive impacts of setting a long-term target can be seen in the cases of Germany and Denmark, which aim to meet 60% and 100%, respectively, of their total energy consumption from RES by 2050 (BMWi, 2012; Danish Government, 2011). Such targets provide an important long-term signal and can help reassure investors and manufacturers who are making decisions in the present that their investments will pay off, and that there will continue to be a market for their products and services well into the future. In this way, long-term targets can be a critical factor in helping to induce a structural shift in the energy supply system, as they help encourage the overall development of the renewable energy market, including the supporting skills and knowledge.

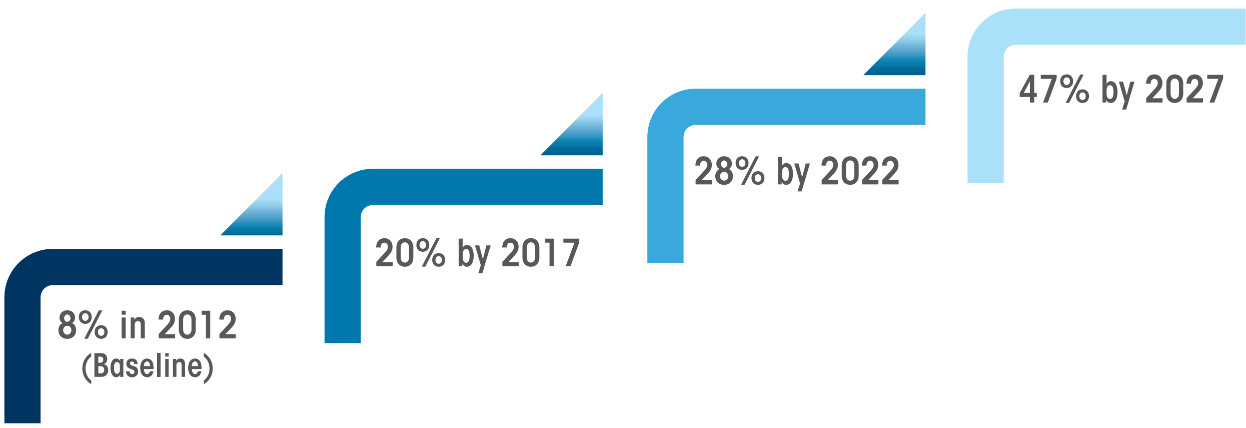
It is common for long-term targets to be modified over time as market and political circumstances change – the most important aspect is how governments navigate and communicate these changes. A key design principle of renewable energy targets and policies is to link them closely to regular monitoring of market conditions to allow for timely adaptation to changes in system costs and learning curves with a view to avoiding windfall profits and better controlling overall market growth. This is best achieved by providing a clear and predictable schedule of review.

For example, in 2010, South Africa developed a long-term IRP[15] for the electricity sector for the period 2010-2030. The IRP set out a forecast that included targets for 11 GW of wind power, 400 MW of concentrating solar power (CSP) and no allotted capacity for solar PV (Republic of South Africa Department of Energy, 2011). Following extensive consultations with stakeholders (see Box 8), and inspired largely by the unprecedented decline in solar PV costs, the 20-year IRP was revised in 2013 with a significant increase in the planned solar PV capacity. The revised long-term plan introduced a slight downwards revision to the wind power target to 8 400 MW, but a more than doubling of the solar CSP target to 1 000 MW, and a remarkable increase to the solar PV target from 0 MW to 8 400 MW by 2030 (Eberhard, Kolker and Leigland, 2014).

In this case, revising the IRP to include a substantial share for solar PV has provided a valuable foothold to the solar PV industry in a market with significant solar potential and rapid electricity demand growth. A failure to adapt the plan therefore would have represented a significant opportunity cost and a much smaller market opportunity for investors and developers.

Short- to medium-term targets (*e.g.*, three to five years) enable more effective implementation and rapid learning from the policy process and can coincide with investment and electoral cycles. China and India use five-year plans to frame the development of their energy sectors (among others). The periodic nature of five-year planning allows for a high level of flexibility and adjustment as the targets are reviewed and adjusted regularly.

Figure 6: CARICOM Renewable Electricity Targets



Source: CARICOM (2013)

[15] *IRPs are a common tool in the electricity sector for establishing long-term planning and investment priorities.*

In some cases, short-term targets may be appropriate, particularly when the additional capacity needed to reach them is relatively small. For instance, the island government of Tuvalu has set a goal of reaching 100% of its electricity from RES by 2020. Total annual electricity demand is currently 4 900 MWh, and peak demand in the country rarely surpasses 1 MW. In such cases, a relatively short-term target may be suitable, as it introduces a sense of urgency and motivates stakeholders to take action. In light of the above, policy makers should consider a balanced combination of broad, long-term targets, articulated into a series of short-to-medium term targets.

In an attempt to strike this balance, a growing number of jurisdictions are beginning to introduce "stepped" or "tiered" renewable energy targets. This generally involves setting a long-term, overarching objective (*e.g.*, 25% renewable energy by 2025) combined with a series of interim steps (*e.g.*, 2015, 2020, etc.). This can be seen in the targets recently adopted in the CARICOM region, which has established a set of interim targets to help it stay on track to reaching its broader objective of a 47% share of renewable electricity in the region's power mix by 2027 (see Figure 6).

This stepped approach can provide greater transparency and improve overall monitoring and compliance. Also, to the extent that interim targets introduce regular opportunities for corrections and adjustments to be made, they can allow such corrections to be made without unduly impacting investor or developer confidence. These stepped targets therefore represent a middle ground between the inflexibility of long-term targets and the lack of long-term visibility common to short-term targets.

As highlighted throughout this chapter, as well as in Section 2.1, one of the most important functions of renewable energy targets is the signal they provide to investors, developers, manufacturers and a range of other stakeholders. In the global marketplace, decisions to invest in capital-intensive or long lead-time sectors such as electricity generation, transportation, buildings or manufacturing often rely on the presence of an attractive set of market fundamentals. Long-term renewable energy targets represent a core part of those fundamentals for many investors. This makes it important to develop a clear strategy to deal with revisions to the target, and to communicate any planned changes. It also highlights the advantages of having a series of interim targets, which can allow for greater transparency, and make it easier for stakeholders to stay on track.

3.3. MANDATORY VS. ASPIRATIONAL TARGETS

As discussed earlier in Section 1.3 on the definition of renewable energy targets, there is a wide variety of target types, which ranges from aspirational goals or political announcements to specific, measurable and legally binding obligations. Although it is not always easy to ascertain how binding a specific target is, distinguishing between binding and non-binding targets remains an important way to help make sense of the wide variety of renewable energy targets that exist.

When evaluating whether a target is binding or not, it is important to consider the specific compliance and enforcement mechanisms that are used: Are there specific fines or penalties for failing to comply? Who is responsible for levying (*i.e.*, collecting) these fines or penalties? Who has the authority to enforce the payment of the fines or penalties? If fines are levied, is the utility allowed simply to recover the cost of the fines from ratepayers? Can exceptions for failing to comply be made (such as due to force majeure), and if so, when, and how is this determination made?

Equally important is the necessity to consider who is ultimately responsible for achieving the target: Is the government itself responsible for meeting the target, or a public-owned utility? Or is it a private entity, such as a utility, or other private stakeholders, responsible? Is the entity the sole or monopoly supplier in the market? Moreover, it is important to note that what is meant by mandatory or "legally binding" will depend to a significant degree on a jurisdiction's legal and institutional make-up, as well as its unique culture and history.

While compliance mechanisms and penalties differ markedly, the fact that renewable energy targets are legally binding is significant. First, it means that they are generally harder for any individual government, or governing party, to repeal. This gives them a legislative "staying power" that other regulations or government policies may lack. Second, establishing renewable energy targets in law means that they have been ratified by the executive or legislative body of a country, which gives them a credibility that industry targets (such as IRPs, which traditionally are developed by electric utilities) may not have. In turn, this raises their credibility in the eyes of potential investors. Finally, legally binding targets typically are accompanied by specific penalties or consequences for non-compliance. As a general rule, such penalties help foster compliance. However, the effectiveness of any legally binding renewable energy target depends critically on overall expectations of the likelihood and the severity of the penalties. As such, penalties must be high enough to encourage compliance, but not so high as to lack credibility.

To draw on perhaps the most widely recognised legally binding national renewable energy targets, it is worth considering the EU's "20-20-20" targets, established in 2009. Each EU Member State is responsible for meeting its own national targets, and the latter are framed as individual contributions towards the EU's broader energy and climate objectives. However, although the EU's renewable energy targets are legally binding in principle, the EU RE Directive also states that "[it] does not foresee a specific enforcement or penalty mechanism in case a Member State fails to reach its target". This makes the EU's RE Directive mandatory, although it arguably lacks a specific enforcement mechanism (Fouquet and Nystem, n.d.).

In fact, most legally binding renewable energy targets are currently found at the state or province level in the form of Renewable Energy Standards, and not at the national level. This means that the majority of national-level renewable energy targets are best characterised as being aspirational or non-binding, albeit to varying degrees.

However, even if the national renewable energy target remains non-binding, it is often the case that either the sub-national target (*e.g.* state, provincial, utility-led, and municipal targets) or the particular policy instruments (such as auctions or tenders) that are used to achieve these targets are binding. In particular, mechanisms like auctions (which often contain specific renewable energy targets) can be made binding in one of two ways: 1) by holding the agency or agencies that are responsible for implementing the target accountable, or 2) by penalising the project proponents (*i.e.*, the winning bidders, in the case of auctions) for not delivering on the contracted capacity. In fact, it is increasingly common for countries that use auctions to introduce a range of compliance rules to discourage underbidding and to encourage timely delivery of the contracted supply (IRENA, 2013c; IRENA, 2015b). See Section 3.4 for more discussion on the relationship between auctions and targets.

At a state or provincial level, Renewable Energy Standards provide a valuable template as a policy instrument with compliance rules, as they were the first legally binding renewable energy instruments to be adopted worldwide. Renewable Energy Standards are also a valuable example because of their high overall record of fostering in-state RES-E development (Heeter *et al.*, 2014). Although some U.S. states have adopted a voluntary approach (*e.g.*, Renewable Portfolio Goals), most states have implemented Renewable Energy Standards that are binding in law (29 out of the 36 states with Renewable Energy Standards) (Barbose, 2014).

Table 5 provides examples of the penalties applied for both Renewable Energy Standards and auctions in various jurisdictions around the world. As can be seen in the table, the penalties applied to enforce mandatory renewable energy targets or to ensure the timely delivery of renewable energy projects through specific policy instruments range widely. Most Renewable Energy Standards include some form of penalty to encourage compliance that is in addition to the alternative compliance payment (ACP) that utilities are required to make for each MWh of shortfall from the target (see Box 18). The ACPs are usually collected by the regulator, placed into a fund and re-allocated to support further renewable energy development within the state. The same principle underpins the U.K.'s buy-out price fund. In Texas, rather than introducing an ACP, the penalty is levied as a direct financial penalty, which currently stands at USD 50 per MWh for each MWh of shortfall from the target.

Some jurisdictions have introduced far more onerous consequences for non-compliance: policy makers in New Hampshire, for instance, have provided the regulator (the Public Utilities Commission) with the authority to revoke the utility's generation licence for non-compliance, and even have the power to prohibit the

Table 5: Overview of Obligations and Penalties in Binding Renewable Energy Targets Instruments in Select Jurisdictions

Jurisdiction	Target	Policy tool	Obligated entity	Applicable penalties
California (U.S.)	25% by December 31 2016; 33% renewable electricity as a share of retail sales by 2020	Renewable Energy Standards mandate	Investor-owned utilities; municipal utilities; electricity service providers; and community choice aggregators (CCAs)	Failure to comply with any order, decision, rule, regulation or other put forward by the California Public Utilities Commission is punishable by the courts, at a penalty to be determined by the courts.
Texas (U.S.)	10GW by 2020 (already achieved); plus 500 MW of non-wind renewable energy resources by 2015 (voluntary target)	RPS mandate	Investor-owned utilities; co-operative utilities; municipally owned utilities; retail electricity suppliers	USD 50/MWh of shortfall from the mandated target; framed as a financial penalty, which means that it cannot be passed on to ratepayers; it must be borne by shareholders
United Kingdom	3% in 2002/03 rising to 31% of total electricity supply by 2020 (part of U.K.'s 15% RES target as a share of final energy consumption)	RO	Licensed Suppliers of Electricity	Buyout price* set at GBP 43.30/MWh (USD 67.86/MWh) (fixed for 2014/15). Suppliers can also be fined for the late payment of the funds.
Brazil Auction 2012	289 MW installed wind capacity	Auction	Project developers	Guarantees of project completion, including a bid bond of 1% of project's estimated investment cost and a project completion bond of 5% of project's estimated investment cost. Penalties for delays implemented. Contract termination for delays greater than one year. Penalties implemented for underproduction and market price offered for overproduction
Peru Auctions 2011	681 GWh/year of small hydropower; 43 GWh/year of PV; 429 GWh/year of wind; 828 GWh/year of biomass	Auction	Project developers	Use of performance bonds deposited by the project developers in order to secure completion of projects. Compliance with volume of energy generation contracted is ensured by penalising shortages. In the case of delays, extension can be granted and/or performance bond value is increased. Contract is terminated if failure to complete.
South Africa Auctions of 2012 for different technologies	3 725 MW	Auction		Contracts terminated for bidders who fail to meet their commitment under the PPA.

* For a definition of buy-out price and the buy-out fund, see Box 3 on the U.K.'s RO.

Sources: California from State of California, n.d. and from DSIRE, 2015b; Massachusetts from Commonwealth of Massachusetts, n.d. c. and from DSIRE, 2014a; U.K. from DECC, 2015 and from U.K. Government, n.d.; Province of New Brunswick, 2013; Province of Nova Scotia, n.d.; Brazil, Peru and South Africa from IRENA 2013c.

BOX 18: WHAT ARE ALTERNATIVE COMPLIANCE PAYMENTS?

The Alternative Compliance Payment (ACP) is an alternative means of complying with the renewable energy target, or mandate set by the state or regulator. Many utilities choose to pay the ACP instead of procuring all of the renewable generation required by the Act or law. The use of ACPs remains a core feature (and according to some, a key weakness) of many U.S. RPS policies and of the U.K.'s RO, which uses a buy-out price that serves a similar function. This has allowed some U.S. states (as well as many utilities in the U.K.) to repeatedly fall short of their renewable energy obligations, as utilities have frequently opted to pay the ACP for a significant portion of their compliance obligation.

For instance, in 2013 in New Hampshire, utilities paid ACP totalling over USD 17.2 million, which, based on the applicable ACP payments, represents total avoided RES-E generation of approximately 366 GWh, or 50% of the total RPS obligation in that year. Similarly, in Massachusetts, electricity suppliers in 2011, 2012, and 2013 opted to pay over USD 30.5 million, USD 16.6 million and USD 2.4 million, respectively, in total penalties into the ACP fund for Class I resources* rather than procure the generation that would have been required. This amounts to 455 GWh of generation over this three-year period.

The primary goal behind providing utilities with an alternative means of compliance is to reduce the total policy costs. However, in practice, paying the ACP effectively reduces the total RES-E generation in the market. As a result, critics argue that ACPs (and other similar mechanisms) are not in fact designed to encourage greater investments in RES-E: they rather are designed to provide utilities with an alternative to doing so. For these and other reasons, the ACP should not be considered a fine or a penalty. If the ACP is high enough, however, it can create an incentive for utilities to develop or procure the required renewable energy generation rather than pay the ACP. When well designed, ACPs can therefore help foster compliance with the renewable energy target or mandate.

*Class I Resources in Massachusetts include solar PV; solar thermal-electric energy; wind energy; ocean thermal, wave or tidal energy; fuel cells utilising renewable fuels; landfill gas; certain hydropower projects; certain bioenergy types; marine or hydrokinetic energy; and geothermal energy. A separate carve-out was introduced within the Class I resources for solar PV.

Sources: NH PUC, 2013; RDCEP, n.d.; US EIA, 2014.

non-compliant utility from conducting business within the state. This raises the issue of the credibility of the proposed fine or penalty, and the need for penalties to be proportional and realistic. This is not only important for the actors on whom renewable energy obligations are imposed, but also for the regulators responsible for enforcing them. Indeed, a penalty that is perceived to be too large or severe may be virtually impossible to apply in practice, for fear of the potential negative consequences on investors or other market participants.

Thus far, no utility in New Hampshire has faced this penalty. In the case of Nova Scotia, the government reserves the right to levy a fine of up to a maximum of CAD 500 000 (USD 430 000) per day for each day of non-compliance, up to a maximum of CAD 10 million (USD 8.6 million) per occurrence. As in New Hampshire, this penalty has not yet been applied, as the utilities have remained in compliance with the target (Nova Scotia Power, 2013). Similarly, Texas has already exceeded its 10 GW RPS target, with current installed wind power capacity of over 12 900 MW as of Q3, 2014. This record has spared utilities within the state from paying the USD 50/ MWh financial penalty they would have had to pay for failing to comply (AWEA, 2014). While the rapid growth of the wind industry in Texas is arguably attributable to the better-than-expected economics of wind power in the state, rather than to the threat of a penalty, the role of fines and penalties in increasing compliance with renewable energy targets should not be underestimated (AWEA, 2014).

In conclusion, binding targets matter in increasing the level of certainty among stakeholders that the objectives will be reached, and in marshalling both the public and private sector resources required to achieve them. However, aspirational targets have proven to be sufficient in some cases, and have been effective at encouraging renewable energy deployment, particularly when accompanied by well-designed policies. However, particularly in contexts with significant opposition from incumbents, making renewable energy targets binding can play a vital role in creating a stable framework for change and mobilising actors.

Compliance rules in transport and heating/cooling

The remainder of this section briefly considers the use of enforcement mechanisms in both the transport sector and in the heating/cooling sectors.

For transport sector targets such as Renewable Fuel Standards (RFS), the mandate typically is imposed on different entities operating at various stages of the supply chain: refiners, distributors, importers and/or retail sellers of transportation fuels (Mosey and Kreycik, 2008). The U.S. national RFS sets a target of increasing the total volume of renewable fuels blended into the national fuel mix to 36 billion gallons (136 billion litres) by 2022 (US DOE, n.d.). The U.S. target also includes separate carve-outs for cellulosic biofuels, biomass-based diesel fuels (*i.e.*, biodiesel), as well as other forms of advanced biofuels.

In the U.S., the Environmental Protection Agency is responsible for monitoring and enforcing the target. The consequences for failing to comply with the regulation can lead to a fine of up to a maximum of USD 37 500 per day for each day of non-compliance (McIntyre, 2011). Each entity required to comply with the mandate (whether a refiner, distributor or seller of transportation fuels) has to attest that their compliance obligation has been met and have this attestation approved by a certified public accountant. If the entity is found liable for falsifying information, or for failing to comply with the RFS, they can be required by law to pay a substantial fine, as cited above.

The U.S. RFS makes a wide range of potential violators liable, including the person who is responsible for failing to meet his or her own requirements, or who causes others to fail to meet theirs; parent companies also can be liable, as can any member of a joint venture or the joint venture itself (McIntyre, 2011). Thus, both individuals and companies can be found liable for failure to comply with the rule and can be required to pay a fine for non-compliance. This strict enforcement structure, with reporting and independent auditing requirements, sets a high standard and helps to ensure substantive compliance with the mandate.

With regard to the heating/cooling sectors, there currently are very few legally binding renewable heating/cooling obligations, in the strict sense of having a binding timeline with clear penalties for non-compliance. Although many of these heating/cooling mandates are not considered renewable energy targets per se, they provide insights into how objectives to increase the use of renewable energy in the heating/cooling sectors can be made mandatory.

In 1983, Israel introduced an obligation that all new homes built be equipped with solar water heating units (Hill, 2008). A similar obligation was imposed in Barcelona in 2000 (WWF, 2012). Spain has followed suit in 2006 by introducing a mandate that certain new or recently renovated buildings have to supply a portion (30-70%) of their water heating needs with solar thermal systems (Zane, 2014). In 2010, Hawaii passed a law stating that no new single-family residential construction will be able to obtain a building permit without the inclusion of a solar water heating system (DSIRE, 2014b). Kenya has introduced a similar measure, but it is limited to buildings that have a hot water demand greater than 100 litres per day. Overall, 47 countries worldwide have targets applying to the heating/cooling sectors, while several other jurisdictions at the sub-national level have adopted similar measures (IEA-RETD, 2015).

While most renewable energy targets currently adopted around the world lack clear enforcement mechanisms or penalties, a growing number of countries have enacted their targets in law, as seen in the EU and the United States. As highlighted previously, making targets binding in law helps reassure developers, manufacturers and prospective investors that a local market will continue to exist for their product. This applies to all renewable energy sectors, including electricity generation, biofuel production and the development and installation of renewable heating systems.

3.4. TRANSLATING RENEWABLE ENERGY TARGETS INTO SPECIFIC POLICIES AND MEASURES

A core component of designing effective renewable energy targets is to connect the target to a series of specific policy or implementation-related measures. Establishing a renewable energy target is only an initial step – it is essential to outline specific policies, support measures, incentives or investment frameworks that will allow market participants (including state-owned companies, where applicable) to achieve the target according to the timeline. Due to the long time frames involved, and to the high capital costs of many aspects of energy infrastructure, it is necessary to have a certain degree of planning security, and for the right policy and regulatory frameworks to be in place at each step of the process to support the achievement of the target.

In the electricity sector, translating renewable energy targets into specific policy instruments can include a wide range of different policy mechanisms, such as a schedule of auctions to procure a specific quantity of RES-E by a certain date, developing a FIT policy to provide independent power producers with standard contracts to connect and supply power to the grid, or designing specific tax incentives to encourage growth in RES-E supply. Note that although some renewable energy policies, most notably auctions, occasionally contain specific targets within them, they should not be considered renewable energy targets, strictly speaking: auctions are best understood as a procurement mechanism that can be used to reach renewable energy deployment objectives (IRENA, 2015b; Kreycik, Couture, and Cory, 2011).

Table 6 provides an overview of some of the policy instruments used to reach renewable energy targets. In a growing number of jurisdictions, these different instruments are being combined, such as using FiTs for smaller projects and auctions for larger projects, or combining VAT or other tax exemptions with a net metering policy (note that the list of policies and measures included in Table 6 is not exhaustive).

As highlighted above, the process of linking renewable energy targets to specific policies is a critical step in making targets more specific and measurable. In the process, selecting particular policies and measures can help focus regulatory and monitoring resources more efficiently as the role or contribution of individual policies to achieving the overall renewable energy target can be assessed, and their performance can be evaluated over time.

As seen in Table 6, a number of jurisdictions around the world use periodic auctions to procure specified quantities of RES-E. For example, Morocco has conducted a series of auctions to achieve its target of procuring 2 000 MW of solar and 2 000 MW of wind power by 2020. The auctions launched thus far are directly linked to the target, with specific capacities to be procured according to a fixed schedule. An initial 150 MW of wind power was auctioned in 2011, with a subsequent auction in 2012 targeting an additional 850 MW. A similar process was undertaken with the solar auctions: the first auction was launched in 2012 to procure 500 MW, largely focused on CSP, with additional auctions planned through 2020 to procure the remaining 1 500 MW from a combination of both CSP and solar PV. Auctions have also been held to procure specific renewable energy capacities in Brazil, China, India, South Africa and a number of other countries around the world.

For projects procured via FITs or net metering, volume caps can be introduced to ensure that deployment takes place along a sustainable trajectory and periodic adjustments can be used to address under-performance (IRENA, 2014a). A similar approach can be developed for both the heating/cooling and transport sectors, as policy actions and measures are enacted to achieve specific shares of the targets.

Another instrument to translate renewable energy targets into specific policies is a renewable energy obligation, or mandate, which is commonly used in the United States (see Box 2 on the U.S. Renewable Energy Standards) but also found in the U.K. (see Box 3 on the U.K.'s RO). As discussed in Section 1.3, while Renewable Energy Standards and RPSs are often thought of as policy mechanisms, they in fact contain a number of different elements including a specific numerical target, an obligation to supply a minimum share of renewable energy by a certain date, a compliance mechanism, as well as a number of enforcement and monitoring provisions. In that sense, Renewable Energy Standards can be understood as an integrated package of policy and regulatory measures that both establishes a target (or series of targets) and includes the mechanisms required to achieve the renewable energy target(s). The 36 U.S. states and 3 Canadian Provinces (Kreycik, Couture and Cory, 2011) that have adopted a form of Renewable Energy Standards, as well as England and Wales', Northern Ireland's and Scotland's Renewables Obligations (DECC, 2015), each provide a different approach to designing and adapting Renewable Energy Standards.

Table 6: Policy Instruments for Achieving Renewable Energy Targets

Sector	Policy Instruments	Country Examples
Electricity Sector	Auctions or competitive solicitations	Brazil, Morocco, South Africa,
	Feed-in tariffs (FITs) or Standard Offer Contracts	China, Malaysia
	Feed-in premiums (FIPs) or Contracts for Differences (CfDs)	Germany, Netherlands, U.K.
	Renewables obligations or mandates*	U.K., U.S.
	Bilateral contracts (direct negotiations with IPPs)	Burkina Faso
	Tradable Renewable Energy Certificates (RECs) or Tradable Green Certificates (TGCs)	India, Sweden
	Net metering or net billing	Cook Islands, U.S., Grenada
	Low-interest loans or revolving loan programmes	U.S.
	Tax incentives (*e.g.*, investment tax credits, production tax credits, accelerated depreciation, VAT and duty exemptions)	U.S., India, Cabo Verde
Heating/cooling Sector	Heating/cooling mandates** (minimum share of RES-H&C use on public buildings, new construction, households, etc.)	Spain, Germany, Swaziland, Kenya
	Performance-based incentives (renewable heating/cooling production incentives, USD/kWhth)	U.K., Netherlands
	Grants and direct subsidies (*e.g.*, % of system cost, or fixed amounts per system type, USD/kWth)	Austria, Denmark, China, Cyprus
	Tax incentives (*e.g.* tax exemptions on RES-H&C related products)	Cabo Verde, Denmark
	Soft-cost reduction programmes (*e.g.*, training and certification, streamlining permitting for district heating/cooling, etc.)	Denmark, Germany, Australia
	Low-interest loans or revolving loan programmes for RES-H&C investments	Spain, Tunisia
Transport Sector	Biofuel production subsidies (*e.g.*, USD/litre produced)	Canada
	Competitive tendering (*e.g.*, for biofuel production facilities)	Poland
	Biofuel blending mandates** (*e.g.*, E10, B5)	Angola, Thailand, U.S.
	Tax Incentives and Exemptions	Brazil, U.S., Canada
	Grants and direct subsidies (*e.g.*, for so-called advanced biofuels)	Australia, U.S.

*Note that renewables obligations and mandates like the RO, Renewable Energy Standards and RPSs act simultaneously as a policy, a target and a tool. See Boxes 4 and 5 .

** For the purposes of this report, policies such as biofuel blending mandates and solar thermal mandates (which are included in the table above) are considered to be policy and regulatory tools rather than renewable energy targets, while acknowledging that they share important features with renewable energy targets (for a definition of renewable energy targets, see Section 1.3).

Sources: IEA-RETD 2015; REN21, 2014; REN21, 2010; Clean Energy Authority, n.d.; Energize Delaware, n.d.

The example of China's Mandatory Market Share brings together the various dimensions of the structure of targets, their translation into specific policies and the importance of enforcement and compliance mechanisms (see Box 19).

In the EU, the process of translating high-level targets into specific policies and measures is accomplished largely through National Renewable Energy Action Plans (NREAPs),[16] which each individual Member State

[16] *https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans*

BOX 19: TRANSLATING CHINA'S TARGET INTO POLICIES: THE MANDATORY MARKET SHARE

The 2007 Medium and Long-term Development Plan for Renewable Energy set out national targets for a mandatory market share of 1% of renewable energy (excluding hydropower) in the country's total electricity mix by 2010 and 3% by 2020. Furthermore, power producers with a capacity larger than 5 GW were mandated to meet a share of 3% of their total capacity from non-hydro RES by 2010 and 8% by 2020 (NPC, 2013; Zhang *et al.*, 2013).

To implement these targets, in 2007, China's National Development and Reform Commission (NDRC), which is responsible for energy and climate change policy in China introduced a mandatory market share (MMS), a policy instrument similar to U.S. Renewable Energy Standards, to achieve China's renewable energy targets.

As of 2010, none of the six largest Chinese utilities had met the 3% renewable energy target, partly due to the lack of monitoring and compliance requirements. Furthermore, the MMS mandates a share of installed capacity rather than generation. Therefore, there was no incentive for grid operators to implement the target. To address these problems, the NDRC began to develop an improvement plan in 2011, which introduced changes and additional details to improve the MMS (Lo *et al.*, 2014). These included:

- Individual targets would be assigned to utilities and grid companies, depending on their circumstances and capacities, with the aim of clarifying the companies' obligations;
- Grid operators were required to purchase a fixed amount of renewable energy. For example, the State Grid, China's largest grid operator, is expected to achieve a 4.8% non-hydro renewable energy share by 2015 (revised from the previous target of 3% by 2020),
- The National Energy Administration (NEA) was given the responsibility of monitoring compliance on a monthly basis.
- The failure to meet targets would negatively impacts on managers' performance evaluations. All generators and grid companies regulated by the RPS are state-owned enterprises, and their managers are evaluated annually by the State-owned Assets Supervision and Administration Commission (SASAC).

Several details of the MMS have yet to be finalised, according to Lo *et al.* (2014) but it is expected to be operational by the end of 2014 or in 2015.

Source: IRENA, 2014b.

is required to develop (see the example of France in Box 20). These NREAPs outline the various measures each intends to use to reach its share of the EU's overarching energy targets. In turn, they must be validated by the EC and deemed to be credible and sufficient to achieve the targets.

A similar process of transposition is under way in the ECOWAS region. ECOWAS Member States are taking the NREAP process one step further in terms of both detail and specificity by developing Investment Prospectuses (ECREEE, n.d.). These documents outline specific investment opportunities representing specific contributions to reaching the regional target. It is expected that the regional targets will be translated into national targets over time, and that the Investment Prospectuses will directly facilitate the achievement of the target by converting the numerical target into a specific set of investable projects.

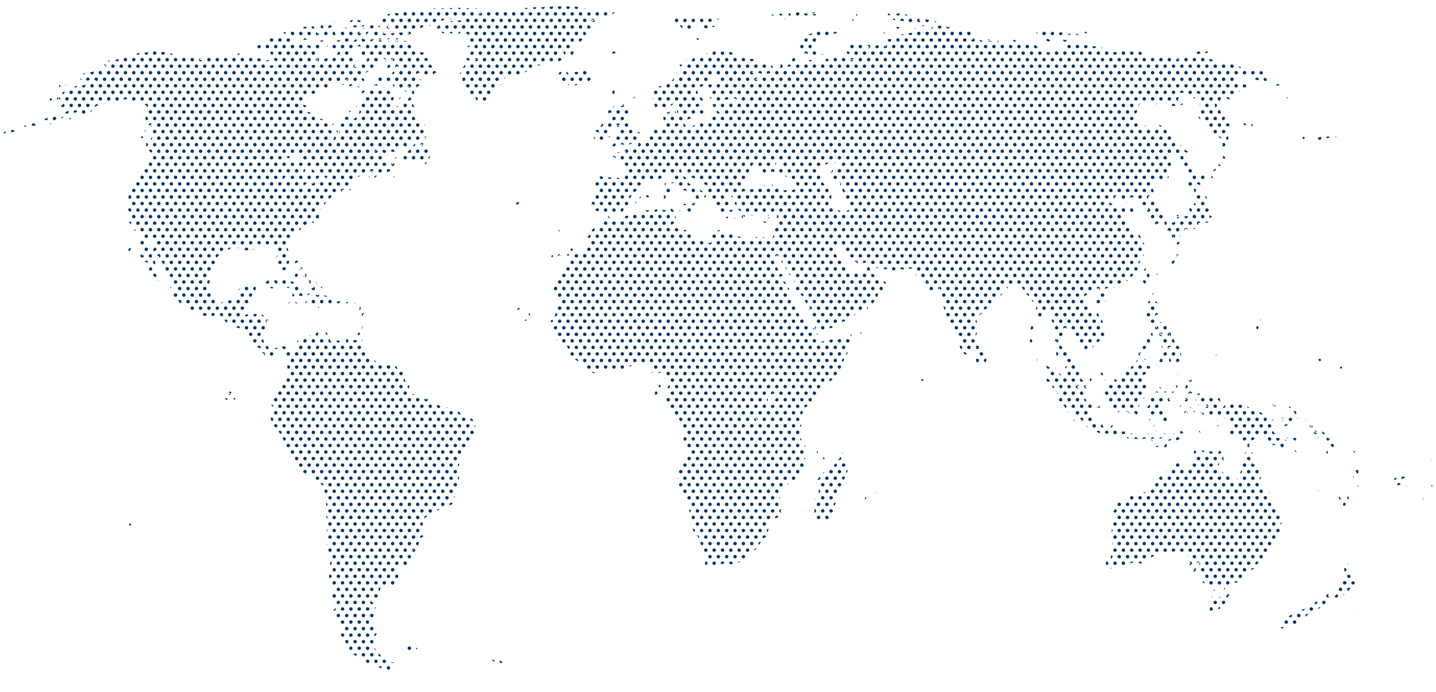
While the policy instruments outlined above are not exhaustive, translating renewable energy targets into specific policies and measures, and combining them to meet the specificities of certain sectors or technologies, is a crucial part of the effectiveness of renewable energy targets. This process enables policy makers to sharpen their overall strategy, and to develop specific policies to achieve specific objectives deriving from the definition and design features of targets. This aspect could be the subject of further analysis to understand more precisely what makes targets effective at the implementation stage.

BOX 20: TRANSLATING THE EU RE DIRECTIVE TARGETS INTO NATIONAL RENEWABLE ENERGY ACTION PLANS: FRANCE

France's NREAP includes an extensive list of policy, regulatory, and administrative measures that it will implement to achieve its targets, including:

- Simplification of administrative procedures for small-scale renewable energy projects;
- VAT reductions for renewable energy-related equipment;
- Improved accelerated depreciation provisions;
- An RE-Heat fund to finance up to 5 400 ktoe of RES-H by 2020;
- Feed-in tariff framework for small RES-E projects;
- Request for proposals (RfPs) for larger RES-E projects;
- Other measures.

Source: http://ec.europa.eu/energy/sites/ener/files/documents/dir_2009_0028_action_plan_france.zip



4. Conclusions: Key Lessons

Renewable energy targets are now an integral part of the global energy landscape, with 164 countries worldwide having adopted some type of renewable energy target to date. How they are designed and implemented will therefore play a critical role in shaping and defining the global energy mix in the decades ahead. Whether in the electricity, transport or heating/cooling sectors, targets have proved to be a clear sign of political commitment and have played an instrumental role in mobilising investment in renewable energy globally. This section highlights some of the key lessons that emerge from the global experience with renewable energy targets to date can inform policy makers as they embark on the task of designing – or revising – their renewable energy targets.

Targets send an important signal to stakeholders

As they have spread around the world, renewable energy targets have played a significant role in informing investment decisions. When backed by supportive policy and investment frameworks, they can provide long-term visibility to industry, a critical ingredient in stimulating deployment at scale. Renewable energy targets contribute to developing a clearer vision for the development of the sector and enable stakeholders to allocate resources more effectively. They are also instrumental in indicating the envisioned trajectory of market growth, thereby helping to anchor medium and long-term expectations. By giving a sense of trajectory and growth, they can contribute to lowering deployment costs and establishing a supply chain utilising local industry. In this perspective, targets can help drive valuable knowledge and local skills development given the long time frames involved in building human capacity.

Stakeholder engagement strengthens ownership and feasibility of targets

The effectiveness of renewable energy targets does not only depend on their design and effective integration into the broader policy framework. Political commitment, support by key stakeholders and institutional capacity are all essential elements of effective targets. Although governments are generally responsible for setting targets, achieving them relies on the contribution and efforts of different actors. This makes stakeholder engagement an essential element in building momentum, as well as in identifying potential bottlenecks that may constrain renewable energy market development. Establishing online platforms to communicate renewable energy plans and provide ready access to supporting documents and resources is an efficient way to involve individuals, organisations and industries and overcome resistance to new policy initiatives. Public consultation can also help obtain valuable information related to the feasibility of targets.

Technology-specific targets are now predominant

Governments increasingly recognise the benefits of adopting a portfolio approach to renewable energy deployment. Targets that are exclusive to selected technologies can be introduced to support their specific deployment, in particular when they are most suitable in terms of resource availability matching peak demand (e.g. solar targets in Dubai). Such targets can also sustain the development of the local value chain of selected technologies. In addition, technology-specific targets can support the diversification of the energy mix to increase energy security. As a result, technology-specific targets have significantly increased in recent years. By encouraging the simultaneous development of a range of different renewable energy options, policy makers are enabling more diversified renewable energy sectors to emerge and to grow.

The metrics of renewable energy targets have implications for implementation and monitoring

Specific design issues for policy makers to consider include whether targets should be established in absolute terms (a specific quantity of energy to be supplied) or relative to a moving baseline (*i.e.*, in percentage terms), and whether electricity targets should be set in capacity (MW) or in output (MWh) terms. Many of the benefits of deploying renewables only materialise if actual energy is generated. Capacity-based targets may be easier to monitor for some technologies but run the risk of allowing idle or under-performing capacity to be registered as contributing towards the target, even though such capacity may add little real energy to the system. However, it is possible to combine these two approaches, and to frame targets in both output and capacity terms. This can facilitate implementation by connecting renewable energy targets to specific policies and measures, such as auctions or feed-in tariffs.

Making targets mandatory matters

Establishing targets in law is an important step in increasing their credibility and longevity. While most targets currently adopted around the world lack clear enforcement mechanisms or penalties, a number of countries are enacting their targets in law. Making targets binding in law helps reassure investors that a local market will continue to exist for their product in the future. Furthermore, legally binding targets are harder to repeal and therefore may be less vulnerable to changes in the political climate. Overall, the track record for jurisdictions with aspirational targets is varied. In contrast, the track record for jurisdictions with binding targets is considerably stronger. It should be noted, however, that binding targets not only require compliance and enforcement mechanisms but also an institutional structure to monitor and enforce them.

Who is obligated and how also matter

A key consideration whether targets are binding or aspirational remains on whom the obligation to reach the target is imposed. In some jurisdictions, governments are responsible for meeting the target. In such cases, enforcement mechanisms are unclear, unless the obligation is specifically delegated to a relevant entity. In the context of the European Union, the European Commission can initiate infringement proceedings against Member States failing to implement appropriate policies, although there are currently no standardised sanctions. In some countries, the target is embedded in the policies that obligate the relevant entities. In the U.S. electricity sector, for example, the target is generally imposed on load-serving entities (utilities, co-operatives and other electricity service providers) through policies such as Renewable Portfolio Standards. In the absence of independent regulation and enforcement, the targets themselves remain aspirational, rather than binding in any legal sense.

Penalties and enforcement mechanisms vary widely

Governments have used a wide range of penalties and enforcement mechanisms in the process of enforcing binding renewable energy targets. In some cases, the penalties for non-compliance involve simple payments, or fines. In others, governments have attempted to increase compliance flexibility by allowing obligated entities to purchase Renewable Energy Certificates rather than producing or purchasing their own renewable electricity. In still other cases, most notably in the United States, regulators allow load-serving entities even more flexibility by allowing them to pay an "Alternative Compliance Payment" instead of procuring the mandated renewable energy generation. In addition to providing obligated entities with more flexibility, alternative compliance payments simultaneously act as a cost cap, which can help lawmakers to push mandatory targets through the legislative process. However, flexibility must be balanced by clear rules and regular oversight.

Striking the right balance between ambition and realism is vital to the success of targets

Establishing a target level that is agreed upon by all stakeholders may be difficult in certain jurisdictions, particularly where there is considerable disagreement on the overall renewable energy strategy, or strong opposition from incumbents. This is another reason extensive stakeholder engagement is essential, particularly during the initial design phases as well as during subsequent revisions. In some cases, governments start by establishing modest targets, especially in early stages of market development. Once the foundations are set, more ambitious targets can help to mobilise key stakeholders towards broader, more structural changes in the electricity or energy mix of countries.

Effective renewable energy targets should be backed by clear strategies and specific policies

While underscoring the importance of establishing renewable energy targets, this report recognises that targets alone are not enough. In order to be seen as credible by investors and to provide a clear trajectory for the future evolution of the energy mix, they need to be accompanied by a clear strategy and backed by specific policies and measures. Linking renewable energy targets to specific policies is critical to make targets more meaningful and to ensure their effectiveness. This aspect could be the subject of further analysis to understand more precisely what makes renewable energy targets effective at the implementation stage.

ANNEX I: LIST OF COUNTRIES WITH NATIONAL TARGETS BY TYPE/SECTOR AS OF MID-2015

Country	Total Primary Energy Supply	Total Final Energy Consumption	Electricity	Heating & Cooling	Transport
Afghanistan					
Albania	✓	✓			
Algeria		✓	✓	✓	
Andorra					
Angola					
Antigua and Barbuda			✓		
Argentina			✓		
Armenia			✓		
Australia			✓		✓
Austria		✓	✓	✓	✓
Azerbaijan	✓		✓		
Bahamas			✓		
Bahrain					
Bangladesh			✓		
Barbados	✓		✓		
Belarus			✓	✓	
Belgium		✓	✓	✓	✓
Belize			✓		
Benin			✓		✓
Bhutan			✓	✓	
Bolivia (Plurinational State of)			✓		
Bosnia and Herzegovina		✓			
Botswana		✓			
Brazil		✓	✓		
Brunei Darussalam			✓		
Bulgaria		✓	✓	✓	✓
Burkina Faso			✓		✓
Burundi		✓			
Cabo Verde			✓		✓
Cambodia			✓		
Cameroon					
Canada*					
Central African Republic					
Chad					
Chile			✓		
China		✓	✓	✓	✓

Country	Total Primary Energy Supply	Total Final Energy Consumption	Electricity	Heating & Cooling	Transport
Colombia			✓		
Comoros					
Congo					
Costa Rica			✓		
Côte d'Ivoire	✓		✓		✓
Croatia		✓	✓	✓	✓
Cuba			✓		
Cyprus		✓	✓	✓	✓
Czech Republic		✓	✓	✓	✓
Democratic People's Republic of Korea					
Democratic Republic of the Congo					
Denmark		✓	✓	✓	✓
Djibouti			✓		
Dominica			✓		
Dominican Republic			✓		
Ecuador			✓		
Egypt	✓		✓		
El Salvador			✓		
Equatorial Guinea					
Eritrea			✓		
Estonia		✓	✓	✓	✓
Ethiopia			✓		
Fiji		✓	✓		
Finland		✓	✓	✓	✓
France		✓	✓	✓	✓
Gabon		✓	✓		
Gambia			✓		✓
Georgia					
Germany		✓	✓	✓	✓
Ghana			✓		✓
Greece		✓	✓	✓	✓
Grenada	✓		✓		
Guatemala		✓	✓		
Guinea			✓		✓
Guinea-Bissau			✓		✓
Guyana			✓		
Haiti			✓		
Honduras			✓		
Hungary		✓	✓	✓	✓

Country	Total Primary Energy Supply	Total Final Energy Consumption	Electricity	Heating & Cooling	Transport
Iceland		✓	✓	✓	✓
India			✓	✓	
Indonesia	✓		✓		✓
Iran (Islamic Republic of)			✓		
Iraq			✓		
Ireland		✓	✓	✓	✓
Israel		✓	✓		
Italy		✓	✓	✓	✓
Jamaica		✓	✓		
Japan	✓		✓		✓
Jordan	✓		✓	✓	
Kazakhstan			✓		
Kenya			✓	✓	
Kiribati			✓		
Kuwait			✓		
Kyrgyzstan					
Lao People's Democratic Republic		✓			
Latvia		✓	✓	✓	✓
Lebanon		✓	✓	✓	
Lesotho			✓		
Liberia			✓		✓
Libya	✓		✓	✓	
Liechtenstein					
Lithuania	✓	✓	✓	✓	✓
Luxembourg		✓	✓	✓	✓
The former Yugoslav Republic of Macedonia		✓			
Madagascar		✓	✓		✓
Malawi	✓		✓		
Malaysia			✓		
Maldives			✓		
Mali	✓		✓		✓
Malta		✓	✓	✓	✓
Marshall Islands			✓		
Mauritania	✓				
Mauritius	✓		✓		
Mexico			✓		
Micronesia (Federated States of)			✓		
Monaco					
Mongolia	✓		✓		

Country	Total Primary Energy Supply	Total Final Energy Consumption	Electricity	Heating & Cooling	Transport
Montenegro		✓			
Morocco			✓	✓	
Mozambique			✓	✓	
Myanmar			✓		✓
Namibia			✓		
Nauru		✓			
Nepal			✓		
Netherlands		✓	✓	✓	✓
New Zealand		✓	✓		
Nicaragua			✓		
Niger	✓		✓		✓
Nigeria			✓		✓
Norway		✓	✓		
Oman					
Pakistan			✓		
Palau	✓				
Panama	✓		✓		
Papua New Guinea					
Paraguay					
Peru			✓		
Philippines			✓		✓
Poland	✓	✓	✓	✓	✓
Portugal		✓	✓	✓	✓
Qatar			✓		✓
Republic of Korea	✓		✓		
Republic of Moldova	✓	✓			
Romania		✓	✓	✓	✓
Russian Federation			✓		
Rwanda			✓		
Saint Kitts and Nevis			✓		
Saint Lucia	✓		✓		
Saint Vincent and the Grenadines			✓		
Samoa	✓				
San Marino					
Sao Tome and Principe					
Saudi Arabia			✓		
Senegal			✓		✓
Serbia		✓	✓		
Seychelles			✓		
Sierra Leone			✓	✓	✓

Country	Total Primary Energy Supply	Total Final Energy Consumption	Electricity	Heating & Cooling	Transport
Singapore			✓	✓	
Slovakia		✓	✓	✓	✓
Slovenia		✓	✓	✓	✓
Solomon Islands			✓		
Somalia					
South Africa			✓		✓
South Sudan					
Spain		✓	✓	✓	✓
Sri Lanka			✓		✓
Sudan			✓		
Suriname			✓		
Swaziland					
Sweden		✓	✓	✓	✓
Switzerland	✓		✓		
Syrian Arab Republic	✓		✓	✓	
Tajikistan			✓		
Thailand		✓	✓	✓	✓
Timor-Leste			✓		
Togo		✓	✓		✓
Tonga			✓		
Trinidad and Tobago			✓		
Tunisia			✓	✓	
Turkey	✓		✓		
Turkmenistan					
Tuvalu			✓		
Uganda			✓	✓	✓
Ukraine		✓	✓		
United Arab Emirates*					
United Kingdom of Great Britain and Northern Ireland		✓	✓	✓	✓
United Republic of Tanzania			✓		
United States of America					✓
Uruguay	✓		✓		
Uzbekistan					
Vanuatu			✓		
Venezuela (Bolivarian Republic of)			✓		
Viet Nam	✓		✓		✓
Yemen			✓	✓	
Zambia					
Zimbabwe					✓

Sources: IRENA, based on REN21, 2014 and REN21, 2015

* Country with renewable energy targets at the sub-national level only

Sources for additional countries and targets:

1. The 2011 targets contained in Armenia's Renewable Energy Roadmap were updated in the 2014 Armenia Scaling Up Renewable Energy Program (SREP) Investment Plan: Renewable electricity generation target of 21% by 2020, 25% by 2025 (excluding hydro); *https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Armenia%20SREP%20Investment%20Plan_final.pdf*;

2.Belarus aims to produce 28% of its electricity and heat demand from RES and local fuels by 2015, 32% by 2020: *http://www.renewableenergyworld.com/rea/news/article/2013/08/belarus-pushes-renewable-investment-but-urges-everyone-to-play-by-its-rules*.

3. Bolivia has a target to deploy 183 MW of renewable electricity by 2025, as set by the 2014 Bolivia Electric Plan 2020-25 : *http://www2.hidrocarburos.gob.bo/index.php/balance-energetico-nacional/category/47-plan-electrico-del-estado-plurinacional-de-bolivia-2025.html?download=750:plan-electrico-del-estado-plurinacional-de-bolivia-2025*

4. Brunei Darussalam's 2014 "Energy White Paper" by the Energy Department at the Prime Minister's Office lays out the target of reaching 10% of electricity from renewable energy by 2035 representing an estimated 954 GWh: *http://www.energyweek.gov.bn/Shared%20Documents/Energy%20Week%20PDF/Energy%20White%20Paper%202014.pdf*

5. Burkina Faso's NREAP is in the process of being finalised, and will be validated during the course of 2015.

6. Cambodia's 2005 Rural Electrification Plan includes a target to produce 15% new and renewable energy by 2015 (this target excludes large hydro): *https://energypedia.info/images/8/8b/Rural_Electrification_Plan_Final_Report_-_Cambodia.pdf*

7. China has a target of 2 million tonnes of biodiesel consumption, and 10 million of ethanol, by 2020: *https://openknowledge.worldbank.org/bitstream/handle/10986/12076/wps6243.txt?sequence=2*

8. Cuba has a target of 24% of renewable energy in the electricity mix by 2030: *http://www.cubadebate.cu/especiales/2014/08/14/cuba-apuesta-por-una-energia-mas-limpia-diversa-y-eficiente/#.VUItBmZfpaQ*

9. Ecuador's Electrification Master Plan 2013-2022 has a target to reach 90% of electricity generation from RES by 2017: *http://www.conelec.gob.ec/contenido.php?cd=10329&l=1.*

10. El Salvador's Master Plan for the Development of Renewable Energy includes the following capacity addition targets by 2026: windpower 60 MW, solar PV 90 MW; solar thermal 200 MW; geothermal 60-89 MW; small hydro (<20 MW) 162.7 MW; biomass 45 MW; and biogas 35 MW: *http://www.cne.gob.sv/index.php?option=com_phocadownload&view=category&download=375:plan-maestro-para-el-desarrollo-de-la-energia-renovable&id=41:pmer&Itemid=63*

11. The 2013 Fiji National Energy Policy aims to reach 81% and 99% of renewable electricity generation by 2020 and 2030 respectively, and a share of RES in TFEC of 18% and 25% by 2020 and 2030: *http://issuu.com/fijiroadsauthority/docs/final_draft_fiji_national_energy_po*

12. Haiti's 2011 National Energy Sector Development Plan includes a target of 50% renewable energy in electricity by 2020: *http://www.worldwatch.org/system/files/Haiti-Roadmap-English.pdf.* The proposed 2015 Haiti SREP Investment Plan includes a target of 42 GWh electricity generation from grid and off-grid renewables per year (excluding baseline hydro) by 2020: *http://www.mtptc.gouv.ht/E6696F7B-8EE0-47E8-8F4B-73B390867C64/FinalDownload/DownloadId-EC882C4B4E6221E424F205F780546213/E6696F7B-8EE0-47E8-8F4B-73B390867C64/media/upload/doc/publications/PlanSREP1.pdf*

13. Iceland's NREAP includes the following targets: gross final energy consumption 77% in 2020; renewable energy in electricity is already at 100%; renewable energy in final energy consumption for heating & cooling 96.1% in 2020; renewable energy in transport final energy consumption 9.9% by 2020; *http://www.atvinnuvegaraduneyti.is/media/Skyrslur/NREAP.pdf*

14. Iran aims to generate 5 000 MW of renewable energy by 2015 as stipulated in the Fifth Five-Year Economic Development Plan (2010-15): *http://www.irna.ir/en/News/2737421/*

15. Myanmar has a target for 15-18% renewable electricity capacity by 2020 and 8% of transport fuels using biofuels by 2020; *http://www.gms-sef.org/docs/workshops/Regional/REGIONAL_presentations_chiang_mai/S3.4%20MYAMAR.pdf*

16. Namibia has a target for 10% of total installed renewable energy capacity (no date); *http://www.economist.com.na/headlines/28-mining-energy/6109-nampower-guns-for-renewable-energy*

17. Nauru has a target to supply 50% of the total energy use in Nauru from renewable energy sources by 2015. IRENA, 2012: *https://www.irena.org/DocumentDownloads/Publications/Nauru.pdf*

18. The Government of Nepal has set a target to provide electricity to 25% of the population through decentralized renewable energy generation solutions by 2030: *http://aepc.gov.np/docs/workwithus/tor/20140730014639_02%20Mini-%20Micro%20Hydropower%20Expert%20(SASEC-PSEP)%20_ToR.pdf*

19. Pakistan's 2011 Medium-term Policy includes an alternative energy (hydro < 50MW) target of at least 5% of total commercial energy supplies by 2030: *http://www.aedb.org/midtermpolicy.htm*

20. Panama's National Energy Plan 2009-2023 includes a target to increase the share of total primary energy supply from 14.4% in 2007 to 18.3% in 2023: *http://www.energia.gob.pa/pdf_doc/planestrategico.pdf.* The government is in the process of developing an energy plan for the period 2015-50: *http://www.energia.gob.pa/noticia-secretaria-de-energia-numero-246.html*

21. Peru's renewable energy targets were updated in the National Energy Plan 2014-2025 which aims for 6% of renewable electricity generation (other than hydro) by 2018 and sets the goal of 60% electricity from RES (including hydro) by 2025: *http://www.minem.gob.pe/minem/archivos/file/institucional/publicaciones/InformePlanEnerg%C3%ADa2025-281114.pdf* and *http://reneweconomy.com.au/2014/peru-lifts-renewable-energy-target-60-2025-aims-100-long-term-19379*

22. Singapore established a solar power target to meet 5% of electricity demand by 2020 translating into a target of 350 MWp by 2020: *https://www.nccs.gov.sg/news/straits-times-spore-powers-towards-energy-target-new-solar-projects*

23. South Africa's Biofuels Industrial Strategy aims to achieve 2% penetration of biofuels in the national liquid fuel supply, which is equivalent to 400 million litres per annum: *http://www.energy.gov.za/files/esources/petroleum/petroleum_bio.html* and *http://www.biofuelsdigest.com/bdigest/2014/12/31/biofuels-mandates-around-the-world-2015/*

24. In 2013, the Community of Caribbean countries (CARICOM) established a target for renewable electricity generation to reach 20%, 28% and 47% for 2017, 2022 and 2027 respectively: *http://www.caricom.org/jsp/pressreleases/press_releases_2013/pres50_13.jsp*

25. Tanzania's Medium-Term Strategic Plan (2012–16) includes a renewable energy target for electricity generation of 14 % (complemented by 26% large hydro) by 2015; Tanzania's Scaling-Up Renewable Energy (SREP) Investment Plan includes a total target of 47.5 MW of off-grid renewable energy for rural electrification by 2020: *https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/SREP_Tanzania_Investment_Plan_Design.pdf*

26. Venezuela's Development Plan for the National Electric System 2013-2019 (PDSEN) sets a target of 613 MW of additional renewable electricity capacity by 2019, of which 500MW from wind power: *http://www.mppee.gob.ve/download/publicaciones_varias/PDSEN web.pdf*

ANNEX II: RENEWABLE ELECTRICITY GENERATION FORECAST REFERENCES BY COUNTRY

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