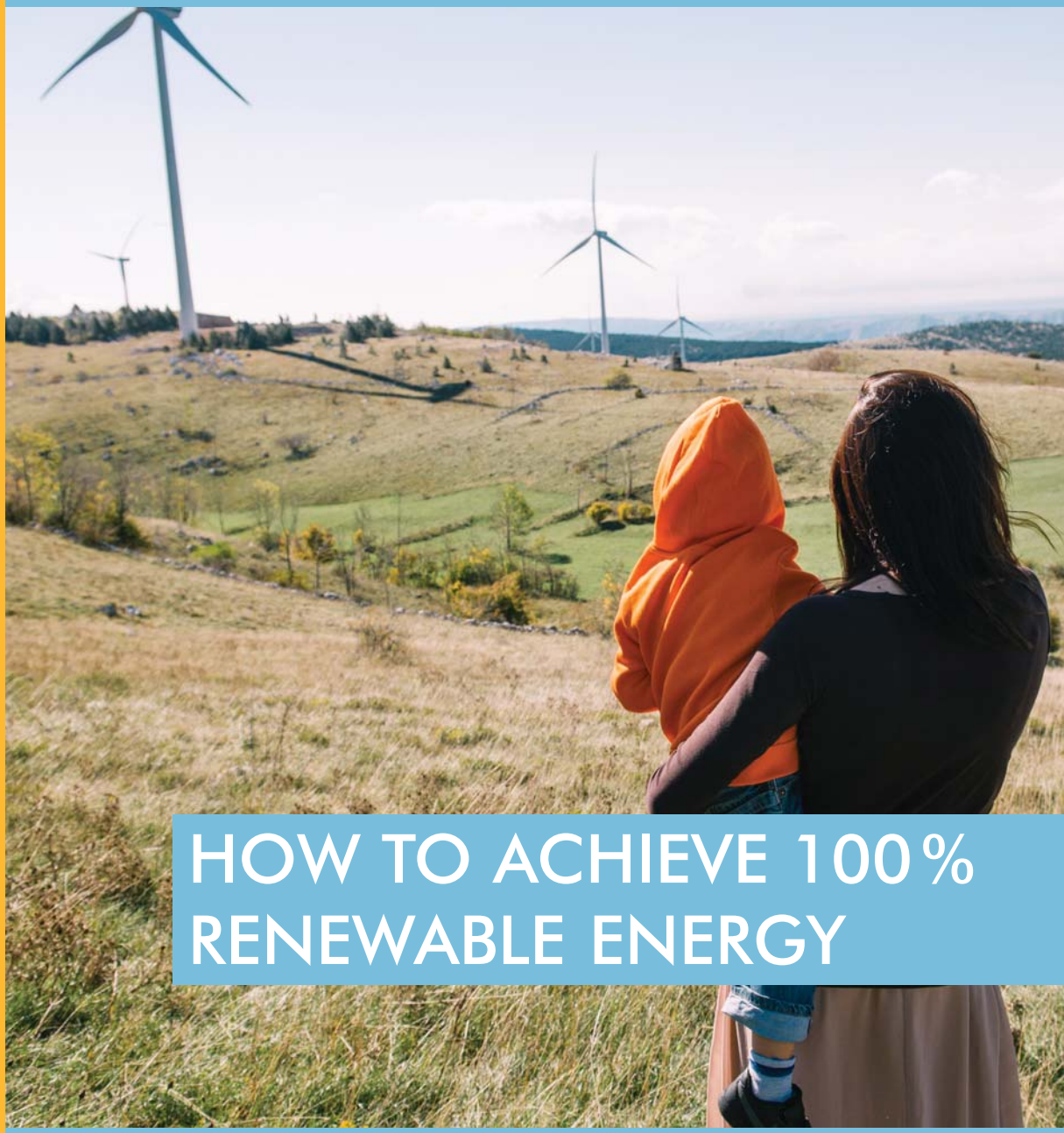
POLICY HANDBOOK

World Future Council

100% RENEWABLES

VOICE OF FUTURE GENERATIONS



HOW TO ACHIEVE 100% RENEWABLE ENERGY

IMPRINT

Authors:
Toby D. Couture, Founder & Director, E3 Analytics
Anna Leidreiter, Policy Officer Climate Energy, World Future Council

Reviewer:
Stefan Schurig, Director Climate Energy, World Future Council
Eric Martinot, Institute for Sustainable Energy Policy (ISEP)

Commissioned by:
The World Future Council
published September 2014

Photos:
Cover: viki2win / Shutterstock, p. 6: World Future Council, p. 9: (from left to right) World Future Council, Katja Zimmermann / World Future Council, Heinrich Boell Foundation Kenya, p. 10: Mykhaylo Palinchak / Shutterstock, p. 42: Cabildo de El Hierro, p. 43: Gorona del Viento, back cover: deENet

Design: Anja Rohde
Print: oeding print GmbH

ClimatePartner klimaneutral
Druck | ID: 53192-1304-1004

RECYCLED
Papier aus Recyclingmaterial
FSC® C013861

FOREWORD

100 % Renewable Energy – the only option we have

Evidence of imminent total-system change in energy markets has become clearer in recent months. Systemic risks of oil supply, climate shock and financial collapse threaten tomorrow's economies and mean businesses and policy makers face huge challenges in fuelling tomorrow's world.

We are on the verge of a profound and urgently necessary shift in the way we produce and use energy. This shift will move the world away from the consumption of fossil resources toward cleaner, renewable forms of power. Renewable Energy (RE) technologies are blowing the whistle on oil dependency and spark economic and social renaissance.

The question is: Do we make this transition from fossil resources to RE on our own terms, in ways that maximize the benefits to us today and to future generations, or do we turn our heads away and suffer the economic and social shocks that rising prices and market volatility will create – as it has done so often in the past?

Both present and future generations are relying on our actions right now to create a future less reliant on dirty energy. Our dependence upon fossil resources has built a system that lacks diversity and security, threatens the health of our citizens, jeopardizes the stability of the earth's climate, and robs future generations of clean air, clean water, and energy independence. By turning to 100 % renewable energy today, we alleviate a host of ills that beset us.

Now is the time to act

Decisions taken by politicians today will have a major influence on the world of tomorrow. Investments in fossil fuels today will lock us and future generations into a dangerous system. Especially countries in the Global South have the potential to leapfrog and build a future-just and sustainable energy system.

Taking action today – on our own terms – enables us to profit from the transition to 100 % RE in right now as well as in the future. We create the new industries and new jobs we will need in the future today. We benefit now while creating a sustainable future for our children and grandchildren.

Solutions exist

The good news is that solutions exist. The popularity of renewable energy is already skyrocketing as millions of people around the world use it to generate electricity, to heat and cool buildings and to produce a variety of cleaner vehicle fuels. From North America to Europe, Africa, Asia and Oceania, communities, islands, cities and countries demonstrate that making the transition to 100 % RE is a political decision and an ethical imperative – the technical options already exist. I champion these pioneers as incubators and catalysts of the kind of change that needs to be replicated.

While being an inspiration, the move towards 100 % renewable energy is still taking place in scattered communities and regions around the globe.

Policy makers have taken up measures nowhere near proportional to the urgency to act. Therefore this policy handbook serves as a tool to push us over the verge to a fossil free world. It is a valuable and necessary source of inspiration and knowledge for policy makers to take action.

Jeremy Leggett, Social Entrepreneur and Author

ACKNOWLEDGMENTS

The World Future Council would like to thank the many researchers and experts who assisted in providing information for the preparation of this report:

Haruhiko Dohman, Ph. D. student at Rikkyo University, and a research associate at the Institute for Sustainable Energy Policy (ISEP) in Tokyo, Japan.

Hironao Matsubara, senior research associate at the Institute for Sustainable Energy Policy (ISEP) in Tokyo, Japan.

Jansenio Delgado, Energy Expert at the Ecowas Center for Renewable Energy and Energy Efficiency (ECREEE), in Praia, Cape Verde.

Dr. M. Khaliquzzaman, Consultant at the World Bank in Dhaka, Bangladesh.

Tetsunari Iida, Executive Director of the Institute for Sustainable Energy Policy (ISEP), in Tokyo, Japan.

Pia Buschmann, Projektmanagement, deENet Kompetenz-netzwerk dezentrale Energietechnologien, Germany

All participants of the WFC Parliamentary Hearing on "Building Political Will on 100% Renewable Energy" in Brussels (March 2014): http://power-to-the-people.net/wp-content/uploads/2014/03/Participants-List.pdf

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A transition is underway around the world: Away from an energy system powered by increasingly expensive and unsustainable fossil fuel resources toward one powered fully by abundant, local, and affordable renewable energy sources. In the years ahead, this transition is poised to improve the quality of life for millions, reduce harmful greenhouse gas emissions, and help forge a world that is more just toward both current and future generations. This report provides an overview of some of the early pioneers leading the way toward such a future.

The rising economic, health-related, and environmental costs of burning fossil fuels, combined with the accelerating impacts of climate change are introducing a new urgency into global efforts to rapidly diversify away from fossil fuels. As the most recent Intergovernmental Panel on Climate Change (IPCC) reports highlight, **in order to ensure planetary habitability for today's and future generations, we urgently need to build societies powered by safe, affordable, and sustainable energy.** More than 2/3 of global GHG emissions originate from the burning of fossil resources such as oil, gas and coal. In order to remain below a 2 degrees Celsius increase compared to pre-industrial temperatures, it will be necessary to move to a fully decarbonized energy sector by 2050. **The close interconnection between our current energy system and the emerging climate crisis demonstrates that energy is not only the key problem we need to solve; it is also the solution.**

Fossil and nuclear resources are by definition non-renewable. They are a one-time endowment, one that current generations have to use prudently and intelligently in order to transition to a world powered entirely by renewable energy resources. **This will require a paradigm shift in how we think about energy,** a shift from a system based on extracting energy sources from the ground, towards one based on harnessing natural and abundant flows from the air, the water, and the sun. It is the challenge of this century to make this transition a reality.

The goal of fully transitioning the world's total energy mix toward renewable energy sources is no longer a utopian ideal: **it is being achieved in a number of places around the world today.** Hundreds of jurisdictions across the globe have set 100% renewable energy (RE) targets and are beginning the journey toward a fully fossil- and nuclear-free society.

In the process, these pioneers have been incubators of regionally appropriate best practices and policies. This policy handbook takes a closer look at these early pioneers to provide inspiration and concrete examples to other jurisdictions that are aiming to embark on the same transformation. **It analyzes case studies to identify drivers, barriers as well as facilitating factors and, from these, it derives policy recommendations to finally enable their transfer to other jurisdictions around the world.**

This policy handbook examines eight (8) case studies in detail, with a few additional examples along the way, structured in four categories:

Cities & Communities	■ Frankurt am Main, Germany ■ San Francisco, California
Regions & States	■ Fukushima Prefecture, Japan ■ Rhein-Hunsrück District, Germany
National Governments	■ Cape Verde ■ Denmark
Island Governments	■ Tuvalu ■ El Hierro, Spain

Key Findings

As many case studies covered in this report demonstrate, achieving **100% RE is both possible and affordable, and can be achieved with today's technologies,** although continued technological improvement and innovation in business models will no doubt make the transition easier, and faster. 100% RE means that all energy needed within the electricity, heat and transport sector in the particular region is coming from renewable sources.

The first step toward achieving 100% is to set a formal political target. Setting an ambitious, long-term renewable energy target demonstrates political commitment, and can provide both stakeholders and the population an understanding of the long-term vision for the jurisdiction. It catalyses change by providing an official mandate for action. Further, this report highlights the **importance of engaging with a wide range of stakeholders early and often in order to build momentum, and create the synergies and partnerships across society that will make the strategy a success.** The case studies in the report demonstrate that achieving **100% RE requires political will,** and the awareness among political decision makers that a 100% renewable energy future is both realistic, and achievable.

A further conclusion that emerges from this report is that so far, **too little emphasis has been placed on increasing the share of renewable energy in both the heating/cooling as well as the transport sectors.** With regard to heating and cooling, the potential is tremendous and technologies are readily available in many parts of the world. But most policies and official government strategies continue to underestimate the potential of harnessing these resources, whether via solar hot water, air-heating and cooling systems, heat pumps, electric heat storage, waste heat recovery, or the development of district heating and cooling systems. With the exception of a few jurisdictions such as Denmark, Germany, and Sydney, Australia, too few governments are making the increased use of renewable energy sources in the heating and cooling sectors a priority.

This applies to an even greater degree for transportation: **too few jurisdictions have begun to tackle the challenge of increasing the share of renewable energy sources in the transport sector.** With a few exceptions, most efforts to increase the share of renewable energy have left the transport sector almost untouched, focusing instead on the electricity sector.

Resulting from the analysis of the case studies this policy handbook highlights **five (5) key findings** that serve as transferable policy lessons. These key findings include both benefits and requirements that can be useful for other governments around the world in establishing and achieving a 100% renewable energy target.

#1: Achieving 100% RE can generate significant cost savings

100% RE is both financially and economically advantageous, generating a wide range of benefits for both citizens and governments. The benefits range from savings on fossil fuel imports, improved energy and economic security, as well as reduced energy and electricity costs for governments, local residents and businesses.

#2: 100% RE strategies are not just for the wealthiest countries

The goal of achieving 100% RE is not only for wealthy or industrialised countries – it is taking root in countries and jurisdictions in all four corners of the globe, including in Africa, the Asia-Pacific region, as well as Latin America. 100% RE provide a plethora of development benefits that have a high priority among governments across the world. Since almost 3 billion people suffer from both, erratic or no access to electricity and reliance on inefficient and polluting solid biomass fuels for cooking, 100% reliable, affordable and efficiently used renewables are the only realistic, long-term options for ensuring a more decent livelihood for all.

#3: Transitioning to 100% RE can mitigate risks and make countries more resilient

The report finds that **transitioning to 100% RE can also make economies more resilient,** reducing their exposure to external factors such as rising fossil fuel prices. In times of geopolitical tensions and climate change, this is one of the key drivers for governments to take action.

#4: Committing to 100% RE can generate new economic activity, create jobs, and improve quality of life

In addition to cost savings, **100% RE generates new economic activity and improves quality of life.** Case studies suggest that demonstrating a clear commitment to transitioning 100% to renewable energy can help stimulating job creation, create new business models and opportunities as well as generate new sources of domestic revenue for both citizens and businesses.

#5: Achieving a fully 100% RE system will require significantly expanding RE in the heating/cooling and transport sectors

The case study analyses suggest that **a significant expansion of RE in both the transport and heating/cooling sectors will need to become a strategic priority for governments to achieve 100% RE.** In line with this, the analyses show that achieving 100% RE on a sustainable basis will likely require storing excess energy in the form of either heat or electricity in individual homes and businesses and that this will require a higher level of integration between these different sectors than in the past. The total generation supplied by electricity systems should be greater than 100% the majority of the time to allow the transport and heating sector to be integrated.

WFC Parliamentary Hearing on "Buiding Political Will for 100% Renewable Energy" in Brussels, March 2014

Recommendations for policy makers

Based on the key findings that serve as transferrable policy lessons, the policy handbook lays out **five (5) recommendations for policy makers** to help jurisdictions around the world in achieving 100% RE targets. These include:

#1: Make energy efficiency a top priority

All case studies suggest that making energy efficiency a top priority is a critical part of achieving a 100% renewable energy future. **By developing more efficient energy infrastructure, it becomes easier to develop, finance, and integrate the remaining infrastructure required to meet a jurisdiction's energy needs with locally available renewable resources.** This can significantly reduce the total investment requirements for reaching the target and support decoupling economic growth from the growth in greenhouse gas emissions.

#2: Electrify the heating/cooling and transport sector

Achieving 100% RE will require increasing the interconnection between the electricity, the heating/cooling, as well as the transport sectors, allowing renewable electricity to be channeled to a wider range of dispatchable end-uses such as in thermal systems or in electric vehicles. Case studies suggest that **shifting the reliance of the heating as well as the transport sector to a greater reliance on electricity should be a policy priority in the decades ahead.**

#3: Maximize opportunities for citizen participation and the development of new business models

At the heart of a successful 100% RE strategy, it is fundamental to allow open participation in the development and financing of energy infrastructure. Governments must implement inclusive policy frameworks that allow new business models to emerge and foster sustained citizen engagement. **By providing market access to a wide range of stakeholders, policy makers can help build positive synergies across the region and build further momentum.**

#4: Educate and inform citizens and businesses

Implementing a 100% RE strategy requires the participation of a variety of stakeholders, which makes both the breadth and the depth of awareness crucial to long-term success. **Educating and informing the public as well as businesses facilitates building public support and acceptance.** As local opposition to energy infrastructure can be a major barrier to achieving 100% RE, educating citizens, fostering engagement, and improving public outreach must be a top priority for policy makers.

#5: Adopt an integrated approach to fiscal, economic & energy policy

A successful 100% RE strategy requires an integrated approach across policy areas such as fiscal, energy, economic, as well as infrastructure policy. Additionally, this includes an approach that reaches across different governance levels. It entails collaboration across government departments, as well as between all levels of society. Policy makers must therefore increase the coherence of their policy and planning and deepen the policy dialogue between previously distinct sectors and government departments in order to sustain the political and economic momentum required to achieve 100%.

1. INTRODUCTION

In his speech before the German Physics Society in 1995, member of the German Parliament and long-time advocate of solar energy, Hermann Scheer posed a question to the representatives, who had recently published a report demonstrating that renewable energy could potentially supply as much as 30% of the total energy mix. He asked the members of the Society: "Why not 100%?"[1]

Almost twenty years later, this question is beginning to be answered, as jurisdictions around the world begin the journey towards an energy system powered entirely by renewable energy sources (RES). This includes jurisdictions at all levels, ranging from local and municipal governments, provincial and state governments, islands, as well as national governments.

There are a number of factors fuelling these various developments toward 100% renewable energy regions. These include the rapid reduction in the cost of renewable energy technologies; a growing awareness of the finite nature of fossil fuels such as coal, natural gas, oil as well as of mineral resources such as uranium; reducing the harmful impacts of the current energy system on our air, water, and soil resources; and growing concerns over global climate change, among others. And beyond all of these various drivers and motivations, there is a growing awareness that our current energy system, dominated as it is by fossil and nuclear energy sources, is leaving an unsustainable legacy for future generations.

In response to these and many other related factors, jurisdictions around the world are beginning to launch into a fundamental restructuring of their energy systems. **By doing so, these early pioneers are demonstrating that a new energy paradigm is possible, and that the transition to a renewably powered society can be a positive one from an economic, social as well as from an environmental perspective.** This is a profound shift, and although it is relatively recent, it is rapidly gaining momentum. As this movement continues to build, there is a growing need to provide policy makers and decision makers with concrete examples to draw from, both as a source of inspiration, and as a source of insight into the kinds of technological, social, cultural, economic, as well as financial transformations involved in making such a profound transition possible.

It is in this spirit that this report has been prepared: to demonstrate that supplying 100% of a jurisdiction's electricity needs, and eventually, 100% of total energy needs, is a realistic option: it is technically and financially achievable, and can bring a wide range of benefits to citizens, businesses, local economies, governments and to the environment.

As a sign of the growing recognition of this potential, a prominent article published in Scientific American in 2009 suggested that the sun, the wind, and the rain could power the entire world's energy needs.[2] In 2012, the National Renewable Energy Laboratory (NREL) in the U.S. released a series of major reports

1 Scheer (2001), p. 181

2 Jacobsson, M. Z., Delucci, M. A. (November 2009), Scientific American. Available at: http://www.scientificamerican.com/article/a-path-to-sustainable-energy-by-2030/

demonstrating that an 80% renewable electricity future was both technically and financially achievable.[3] Similar reports have been published by PricewaterhouseCoopers (PWC)[4], Greenpeace International[5] and WWF[6] as well as in Germany,[7] and for island regions around the world.[8]

What was once seen as unachievable has now become a leading topic of technical research and applied science; and as this report demonstrate, it is also becoming a top priority for many governments around the world. Regions, communities and nations across the globe are already proving that it is possible to commit and successfully transition to 100% renewable energy. In the process, these pioneers have been incubators of best practices and policies. This handbook analyzes a number of these case studies and derives policy recommendations to finally enable policy makers to replicate the benefits of this development in other constituencies. **The guiding question of the report is therefore: How can policy makers achieve 100% RE?**

Approach of this report:

The report builds on the work that the World Future Council has conducted in the past two years. Apart from in-depth research, it reflects the insights and conclusions resulting from a variety of World Future Council's parliamentary hearings on similar subjects.

In October 2012, the WFC hosted a parliamentary hearing on "100% Renewable Energy in European Regions" in the Danish Nordic Folkecenter, which resulted in the establishment of the Global 100% RE Campaign. Particular input and expertise was taken from policy workshops Denmark, October 2012, San Francisco, USA, April 2013, Tanzania, Oct 2013 and Kenya, February 2014.

Finally, research for this report has been conducted in conjunction with a high-level Parliamentary Hearing in Brussels in March 2014.[9] The workshop brought together Members of the European Parliament and Member States, energy experts, researchers, city planners, politicians, as well as members of civil society groups.



3 Mai, T., Sandor, D., Wiser, R., Schneider, T. (2012). Renewable Electricity Futures Study: Executive Summary. NREL/TP-6A20-52409-ES. Golden, CO. Available at: http://www.nrel.gov/docs/fy13osti/52409-ES.pdf

4 PwC/PIK/IIASA/ECF (2010), 100% renewable electricity: A roadmap to 2050 for Europe and North Africa, available at: http://www.pwc.ch/user_content/editor/files/publ_energy/pwc_percent_renewable_electricity.pdf

5 Greenpeace/GWEC/EREC (2012): Energy [R]evolution, available at: http://www.greenpeace.org/international/en/campaigns/climate-change/energyrevolution/

6 WWF/Ecofys (2011): The Energy Report, available at: http://wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions22/renewable_energy/sustainable_energy_report/

7 Klaus, T., C. Vollmer, et al. (2010). Energieziel 2050 – 100% Strom aus erneuerbaren Quellen. Dessau, Umweltbundesamt. Available at: http://www.iass-potsdam.de/sites/default/files/files/study_buergerbeteiligung_und_kosteneffizienz_0.pdf

8 Marin, C., Alves, L. M., Zervos, A. (2005). 100% Renewable Energy Sources: A Challenge for Island Sustainable Development, UNESCO. Available at: http://www.unescocan.org/pdf/100RES.pdf

9 http://power-to-the-people.net/2014/03/european-politicians-across-party-lines-call-for-long-term-100-target-for-renewable-energy/

2. THE ROLE OF TARGET SETTING

Targets play a central role in global, national, and local renewable energy policy and strategy. Since the 1970s, jurisdictions around the world have adopted targets to diversity their energy mix, boost the share of renewable energy sources, and reduce their reliance on imported energy resources. Setting an ambitious, long-term renewable energy target also demonstrates political commitment, and can provide both stakeholders and the population as a whole a clearer view of the long-term vision for the region, as well as a better understanding of how they fit within it. It catalyses change by providing an official mandate for action.

Identifying and communicating a 100% renewable energy target has a number of additional advantages: it can help engage a wide range of stakeholders; it can ensure a more efficient deployment of both technical and administrative resources, and reduce the risks of duplication and competing policy goals; it can help give key stakeholders (such as utilities, or private investors) the confidence required to make large investments, such as in transmission and distribution grids. By increasing investment certainty, setting ambitious targets can also help attract domestic and international investors, ultimately making it easier to achieve the target. Experience in the European Union and in many other jurisdictions around the world demonstrates that targets can also help build awareness, both among external audiences as well as among the citizens in the local area. This awareness can be essential to building public support among local citizens and businesses to help to achieve the objective.

It is also important to highlight that there are different kinds of 100% targets, including targets for 100% renewable electricity, such as in Cape Verde; 100% strategies that are being implemented in parallel with a 100% carbon neutral strategy, such as in Frankfurt; 100% targets for renewable energy in rural electrification, such as in Bangladesh; and finally, there are more comprehensive targets that aim to supply 100% of total energy needs with renewable energy sources, such as Denmark. This variety of 100% targets provides a tremendous potential for knowledge sharing and collaboration, and for identifying transferable policy lessons that may be applicable in other contexts.

It is important to highlight that target setting alone is not sufficient to ensure effective implementation. As shown by a number of unmet targets in several jurisdictions around the world, targets need to be credible and achievable. Moreover, targets are more likely to be achieved when they are supported by a stable policy and regulatory framework as well as by a clear, step-by-step roadmap with indicators and regular progress reports.

3. CASE STUDIES

This section includes a number of case studies drawn from jurisdictions around the world that have either developed, or implemented a 100% renewable energy strategy. In some cases, such as in Tuvalu and in Cape Verde, the implementation is still underway and is at a relatively early stage of development; in other cases, such as in Rhein-Hunsrück in Germany, the 100% renewable electricity target has already been surpassed and efforts are now underway to extend this success to both the heating and transportation sectors.

Selection criteria for choosing the case studies:

1. **Applicability:** the jurisdiction must have formally adopted a clear target to supply 100% of either their electricity, heating/cooling, or transportation needs from renewable energy sources (RES), and it underscores transferrable policy elements that may be useful for policy makers in other regions;
2. **Geographic Representativeness:** the case studies should capture a broad range of jurisdictions from different parts of the world (Asia Pacific, Africa, the Americas, and Europe);
3. **Diversity in Energy Targets:** the case studies should include jurisdictions that focus not only on electricity, but also on renewable energy heating, cooling, and transportation;
4. **Levels of Government:** the case studies should include different levels of government, including city and community level initiatives, state or regional governments, national governments, as well as island regions.

The eight (8) major case studies included are:

1. **Cities and Communities**
   a. Frankfurt am Main, Germany
   b. San Francisco, United States
2. **Regions and States**
   a. Rhein-Hunsrück, Germany
   b. Fukushima Prefecture, Japan
3. **National Governments**
   a. Cape Verde
   b. Denmark
4. **Island Governments**
   a. Tuvalu
   b. El Hierro, Spain

Each case study begins with a brief snapshot of the current energy mix, the current electricity mix, or both depending on the data available for each jurisdiction. It also includes a table indicating the extent to which the three main components of energy use in each jurisdiction are covered: 1) electricity, 2) heating/cooling supply, and 3) transportation. In order to ultimately achieve a truly 100% renewable energy system, each of the three different sectors needs to be included, and integrated into the overall strategy. Currently, most of the 100% strategies being implemented around the world focus on the electricity sector, and on increasing the share of solar, wind, hydro, and bioenergy in the overall electricity mix. A few jurisdictions, such as Rhein-Hunsrück in Germany and Costa Rica, have begun to adopt a more holistic approach, accelerating the use of renewable energy in the heating and transportation sectors as well. This is recognized in a summary table at the beginning of each case study that identifies according to a simple Green-Yellow-Red framework:

Symbol	Definition
	A high priority, featuring a wide range of policies, projects, and regulations supporting the transition to 100%; clear political recognition and widespread awareness and visibility.
	Identified as part of the energy strategy, but not in a significant way; unclear policy and regulatory framework; absence of significant business, community, and political support, or momentum.
	Little or no mention in the energy strategy; lack of any meaningful policy or regulatory framework; absence of any significant recognition, public awareness, momentum.

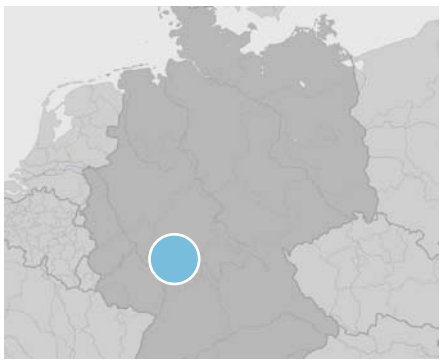
The goal of this color-coded scheme is to provide a quick overview of where additional efforts are likely to be required in the years ahead, and to provide readers with insight into which different jurisdictions are demonstrating additional leadership by including both heating/cooling needs as well as transportation in the overall energy strategy.

At the end of the case studies (island regions, city governments, regional and state-level governments, and national governments), a separate analysis discusses the commonalities and driving forces across the cluster and identifies common threads, as well as important differences.

Finally, noteworthy examples of ambitious renewable energy strategies are included in dedicated text boxes throughout the report. These provide important additional examples of 100% renewable energy strategies, and are drawn from all over the world including Sumba in Indonesia, Costa Rica, rural communities in Bangladesh, the 100% Regions Network in Germany, as well as Sydney, Australia.

3.1 Cities and Communities

3.1.1 Frankfurt am Main, Germany

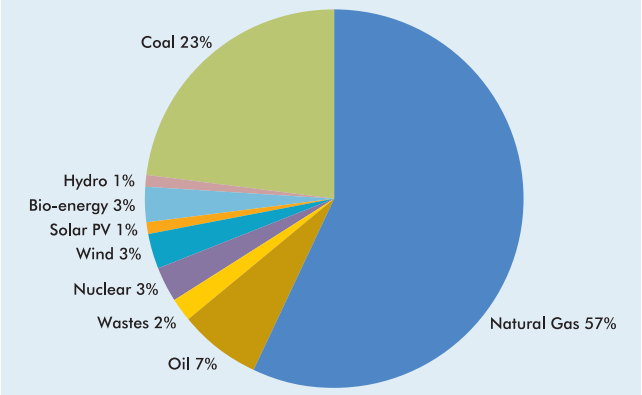


Average Temperature Range	–1 Celcius to 26 Celcius
Size (sq. km)	248.3 km^2
Population Size	687,775 (2012)
Political Status	City

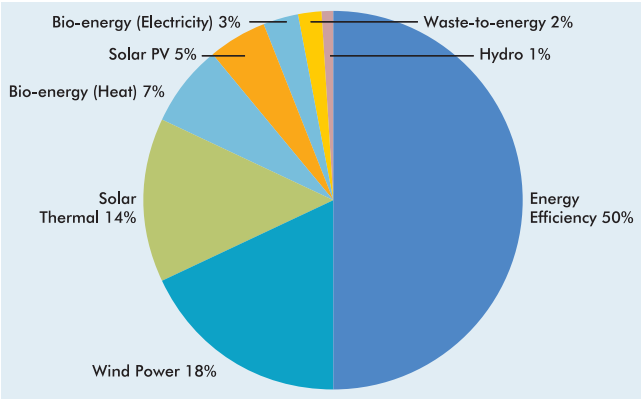
Sector	Focus
Electricity	●
Transportation	●
Heating/Cooling	●

ENERGY STRATEGY

Frankfurt's Electricity Supply Mix (2010)
Total = 5,702 GWh



Breakdown of Contributions to Frankfurt's 100% Plan: 2050



Annual Electricity Demand: 5,702 GWh (2010)
Electricity Access Rate: 100%
Peak Demand (MW): –

Sources:
http://www.100-ee-kongress.de/fileadmin/redaktion/100-ee-kongress/Praesentationen/F7_Neumann.pdf
http://www.masterplan100.de/fileadmin/user_upload/content/pdf/ER_FlyerMasterplan.pdf

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

Due to the fact that Frankfurt is a relatively dense urban area, city representatives and local experts determined that in order to supply 100% of its energy needs from renewable energy sources, Frankfurt would need to rely on neighbouring communities and the surrounding rural area in order to reach its target. Currently, the Master Plan envisions that approximately 25% of the target will be met with supply from within the City, 25% from outside the City, and total energy consumption will be decreased by 50%, thereby making it possible to supply 100% of the City's total energy needs from renewable energy sources.

There are a few key elements to Frankfurt's 100% strategy:[10]

- Increasing energy efficiency by 50%
- Expanding combined heat and power (CHP)
- Increasing the role of solar (both thermal and PV), wind, and the use of local organic wastes for both heating and power generation

In addition, there are a number of pilots underway, including the initiative to develop a Virtual Power Plant (VPP), which would be designed to integrate several small generators into a interconnected network capable of adjusting to fluctuations in RE output.[11] A core element of Frankfurt's approach is that it is approaching the 100% strategy in both a top-down as well as a bottom-up way, involving local citizens and businesses in achieving its objectives while establishing a clear vision in its city-wide Master Plan.

Political Aspects

In addition to being a global financial centre, for several decades Frankfurt has positioned itself as a leader in sustainability and climate protection. In 1985, it founded one of the first municipal energy and climate protection agencies, which has worked extensively on promoting energy efficiency in local buildings and the adoption of combined heat and power systems. As with many other case studies included in this report, Frankfurt's 100% renewable energy target is closely connected to its climate strategy; they feature mutually reinforcing components and policy objectives.[12]

The City of Frankfurt also has a strong track record to build on: between 1990 and 2012, the City managed to reduce its emissions by 15% while the economy grew by over 50%.[13] This success, combined with political leadership at the City level, have helped push Frankfurt's strategy forward, making it a leading city within Germany in terms of adopting a holistic approach to energy and climate policy.

In 2008, the Frankfurt City Council agreed to implement a list of fifty energy saving and climate protection measures. The current Master Plan includes a dynamic array of projects and initiatives designed both to reduce emissions and to increase the adoption of renewable energy and energy efficiency technologies. Together, it is these various initiatives that will help Frankfurt reach its ambitious 100% target.

Frankfurt benefits from a highly educated workforce, and a citizenry that broadly supports climate action and the continued expansion of energy efficiency and renewable energy. In addition, both the federal and

10 http://www.frankfurt.de/sixcms/media.php/738/Klimaschutzkonzept_web.pdf

11 In German: http://www.frankfurt.de/sixcms/detail.php?id=2855&_ffmpar[_id_inhalt]=9276189

12 In German: http://www.ifeu.de/energie/pdf/Masterplan_100Prozent_Klimaschutz_ifeu.pdf

13 Interview with Andrea Graf, Project Manager Masterplan 100% climate protection, City of Frankfurt on http://www.go100percent.org/cms/index.php?id=136

state-level governments have provided funds to help support Frankfurt's 100% strategy, demonstrating the important role that supportive frameworks at the national and regional levels can play. The City's Energy Agency is in the process of elaborating on its Master Plan, a strategy whose implementation foresees the involvement of architects, engineers, consultants, local businesses, public buildings such as schools and hospitals, as well as local residents. As highlighted above, Frankfurt's strategy is designed to be participatory, and to involve as many actors as possible in its realization. This is an important aspect of its success, and a valuable example to other jurisdictions seeking to implement a 100% strategy.

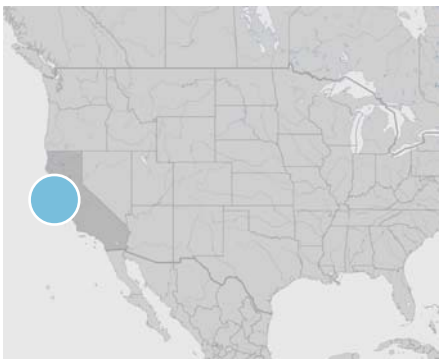
Another core aspect of Frankfurt's strategy is that it involves increasing awareness within local schools through a wide range of onsite projects in schools across the city. This helps create a wider consciousness among the city's youth, a fact that will no doubt play an important role in maintaining the momentum in the decades ahead.

Barriers and Solutions

There were many critics of the strategy at the beginning, many who argued that such a strategy was too ambitious, and would not succeed. Others were concerned that certain aspects, such as increasing energy efficiency, were incompatible with Frankfurt's building stock, which is comprised of many old heritage buildings. Frankfurt's city staff overcame many of these barriers by moving forward gradually, engaging stakeholders, and by clearly communicating the results and the impacts to the wider population. Pilot projects helped create awareness, and over time, these individual projects began to generate more than simply electricity and heat: they began to generate momentum.

As an indicator of its success, since 1990 when Frankfurt began to implement its climate and energy strategy, it has saved an estimated EUR 100 Million in energy costs, a number that is projected to continue increasing as energy efficiency and conservation efforts continue. Among the main beneficiaries of this are local residents and businesses, who now pay lower energy costs. Hereby, Frankfurt as well as many other case studies in the report, demonstrates that an ambitious energy and climate strategy can provide significant cost savings to both governments and local residents. The fact that the local government can already point to specific cost savings has been a powerful factor in maintaining momentum, and sustaining public and administrative support for the strategy.

3.1.2 San Francisco, U.S.



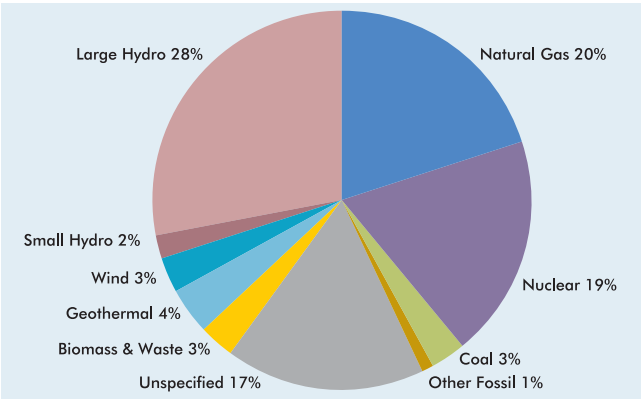
Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

Source: http://www.pge.com/myhome/edusafety/systemworks/electric/energymix/

Average Temperature Range	8 Celcius to 21 Celcius
Size (sq. km)	121 km^2
Population Size	825,863 (2012)
Political Status	City-County

ELECTRICITY MIX

San Francisco's Electricity Supply (2010)
Total = 6,094 GWh



Annual Electricity Demand: 6,094 GWh
Electricity Access Rate: 100%
Peak Demand (MW): 970 MW

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

In an attempt to leave a positive legacy for the future of San Francisco, the outgoing Mayor Gavin Newsom set out a vision in December 2010 to obtain 100% of the city's electricity from RES-E by 2020.[14] This target has been adopted and endorsed by the new Mayor Edwin Lee and has led to the creation of a Mayoral Task Force in early 2011. In an effort to bring a wide range of different stakeholders and perspectives to the table, and to ensure that the ultimate recommendations received support from both business as well as civil society groups, the Task Force included stakeholders from all sectors including direct citizen representation.[15]

San Francisco's strategy focuses on three key components:

1) improving energy efficiency,
2) increasing distributed renewable energy (RE) generation within the City, and
3) providing all San Francisco electricity customers with a 100% renewable energy power purchasing option from new or existing electricity providers.

It is important to point out that, as of mid-2014, San Francisco's 100% target remains a political target rather than a binding legal target, and that it is being layered on top of an existing series of initiatives, programs, and incentives at the City, State, and federal levels.

While the primary focus of the strategy is on electricity, San Francisco has also undertaken a range of efforts in the transportation and heating sectors: the public transportation infrastructure is powered by either electricity or biodiesel, and the City has also developed plans to support electric vehicle charging infrastructure.[16] The City now has over twenty-five (25) combined heat and power (CHP) installations totalling 60 MW of installed capacity (SFPUC 2011). These initiatives, while not yet consolidated around a coherent renewable heating or transportation strategy, indicate that policy makers and local stakeholders are making efforts to expand their efforts beyond electricity.

Overview of key projects

- Hetch Hetchy hydro reservoir (over 400 MW of installed capacity, supplying roughly 20% of load)
- 7.36 MW of Municipally-owned solar PV projects;
- 15.7 MW of distributed solar PV within the City's limits (residential and commercial);
- 3.5 MW biogas cogeneration project at the City's wastewater treatment plant

Additionally, in the last few years, a program called CleanPowerSF has been launched to establish a Community Choice Aggregator (CCA), a new business model designed to provide all residential customers in San Francisco with a 100% renewable energy supply option.[17] In many U.S. states, citizens are still unable to switch electricity service providers, either because of existing rules and regulations or because alternative providers are not available within their service area. San Francisco's CCA program is designed to enrol residential ratepayers into the 100%

14 New York Times, December 14 2010: "San Francisco Eyes Goal of 100% Green Power by 2020".
Available at: http://www.nytimes.com/gwire/2010/12/14/14greenwire-san-francisco-eyes-goal-of-100-green-power-by-39895.html
15 San Francisco Mayor's Renewable Energy Task Force: Recommendations Report, (September 2012). Prepared by the San Francisco Department of Environment.
Available at: http://www.sfenvironment.org/sites/default/files/fliers/files/sfe_re_renewableenergytaskforcerecommendationsreport.pdf
16 See: http://sfwater.org/index.aspx?page=516
17 See: http://sfwater.org/index.aspx?page=577

RE option, and provide them with the ability to opt-out if they desire to do so.

Political Aspects

While the outgoing Mayor set out the 100% objective in 2010 and the Mayoral Task Force provided recommendations for achieving a 100% target by 2020, the only objective that has been officially endorsed by San Francisco is the target to have a GHG-free electricity mix by 2030, adopted in Ordinance 81-08 (SFPUC 2011).

There are many factors behind the adoption of San Francisco's energy and climate targets:

- the strong environmental and energy consciousness of the City's residents, as well as of its political and business leaders;
- a long-standing commitment to reducing carbon and other emissions (the City achieved its Kyoto commitment of reducing GHG emissions by 7% below 1990 levels);
- the creation of "green" jobs and increased economic activity;
- enhancing the City's resilience, a consideration that has grown in prominence both in the wake of California's electricity crisis, and more recently, Hurricane Sandy;
- Reducing vulnerability to volatile fossil fuel prices

An interesting feature of San Francisco's efforts to achieve a 100% power mix centres around its emphasis on customer driven approaches rather than binding rules and mandates. This is reflected in the City's promotion of the CleanEnergySF program (see above). Given the dominance of a large electricity supplier in the market, the long-term success of San Francisco's 100% strategy will require either active participation from the leading utility, or a significant reduction of its market share as a supplier of electricity to the City.

The financing of the many programs, measures, and initiatives that will help achieve the target, come from a wide variety of sources. These include traditional rate increases, tax incentives, tapping into existing renewable energy and energy efficiency funds, as well as out of the municipal government's budget.

Barriers and Solutions

San Francisco faces a few major challenges to achieve its 100% RE target: First, the target itself has yet to be formally adopted in law or enshrined in any particular statute. This will likely need to be overcome in order to generate the broad based support required to achieve the 100% target. Second, in contrast to many of the other jurisdictions covered in this report, San Francisco has limited ability to regulate the power suppliers that currently provide the bulk of its power demand. Utilities and electricity service providers are largely regulated at the state level, while a host of legacy contracts and agreements continue to hamper any wholesale change of the electricity sector. Moreover, the establishment of the Community Choice Aggregator, a centrepiece of the city's efforts to move to a 100% renewable electricity mix, continues to face a number of hurdles.

A further challenge in San Francisco is that two thirds of residential homes are in multi-family buildings and over 60% of households rent, rather than own, their residence. This makes it challenging to overcome split incentives between residents and building owners to improve energy efficiency. A related challenge has been providing workable financing solutions for individuals and families situated in multi-family residential units. Some of the solutions that have emerged to address these challenges are green leases, virtual net metering, as well as community-based solar financing schemes that allow individuals to get together to finance larger projects in locations other than their primary residence. All of this suggests that San Francisco will have to rely more on innovative approaches, and increased citizen and business leadership in order to succeed.

Sydney, Australia

In 2013, the city of Sydney, Australia (Population: 4.6 Million) launched a Green Infrastructure Plan that included an objective to supply 100% of its electricity, heating and cooling needs from renewable energy sources by 2030. In contrast to many other jurisdictions, the Sydney Master Plan puts a strong emphasis on the integrated use of bio-energy sources such as biomass, biogas as well as waste sources from forestry and agriculture, and in particular the use of 'tri-generation' – the integrated production of heating, electricity and cooling. It is expected that tri-generation powered by local waste and bio-energy resources will represent up to 70% of Sydney's target, with the remaining 30% largely supplied by local solar PV and wind power projects.

In order to implement its 100% objective, the City identified thirteen (13) 'enabling actions,' specific measures that will ultimately drive the implementation of the strategy. City staff also commissioned detailed mapping analyses of the City according to many different layers, including electricity and gas demand, available floor space, thermal energy demand, etc. These detailed analyses helped ensure that the results of the analysis were robust, data-driven, and that the 100% strategy was both realistic, and achievable.

The example of Sydney demonstrates that in order to get to 100%, you need a detailed plan: having a clear, data-driven strategy helps identify any challenges or barriers in advance, engage specific stakeholders, adopt concrete implementation measures, and to quantify the contribution of individual measures to the success of the strategy as a whole.

Source: http://www.sydney2030.com.au/wp-content/uploads/Decentralised-Energy-Master-Plan-%E2%80%93-Trigeneration-%E2%80%93-Adopted-15MB.pdf

3.2 Regions and States

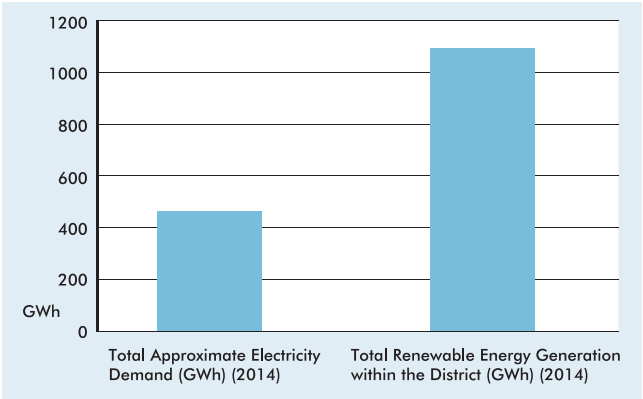
3.2.1 Rhein-Hunsrück, Germany

Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

Average Temperature Range	1 Celcius to 17 Celcius
Size (sq. km)	963 km^2
Population Size	104,000 (2012)
Political Status	Regional District

ELECTRICITY MIX

Rhein-Hunsrück RES-E supply already supplies over 200% of demand



Annual Electricity Demand: 460 GWh
Electricity Access Rate: 100%
Peak Demand (MW): 683 MW

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

As of early 2012, the District of Rhein-Hunsrück officially began producing more than 100% of its electricity needs, crossing an important milestone on the way to creating a truly 100% renewable energy system.[18] Its ambitious push into renewable energy, which dates back over two decades, has rapidly turned it into a leader in Germany, where it is engaged in a friendly competition with a growing number of other +100% regions across the country. In early 2014, it is estimated that Rhein-Hunsrück already produced over 230% of its total electricity needs, exporting the surplus to the regional and national grid, or re-directing it into local transportation, hydrogen or methane production.

The current projects are broken down into a number of different technology areas:

Overview of key projects

- Over 2.000 individual solar PV systems
- Over 100 wind turbines across the region
- 17 biomass CHP facilities

In addition, Rhein-Hunsrück has undertaken a wide range of other measures and projects to help achieve its objectives. These include:

- Replacing old oil heating units with solar, biomass, and heat-pump technologies in public buildings;
- Developing an integrated regional plan for the harvesting of woody biomass and related biomass wastes;
- Expanding and retrofitting of district heating networks across the region to use a greater share of RES in their heat supply;
- Developing new biogas projects, some of which are designed to feed their gas directly into the local natural gas network;
- Increasing the use of geothermal heat pumps in both public and private buildings;
- Demonstration projects in hydrogen fuel cells and electric vehicles

With all of these various initiatives and projects underway, and the recent addition of a major new wind farm in the region, Rhein-Hunsrück has already demonstrated that a 100% renewable electricity future is not only possible, but that it can be profitable too.

Political Aspects

Rhein-Hunsrück benefits from a unique combination of leadership at the political and administrative levels as well as a broad pool of expertise and engagement at the local citizen level. Together, these factors have helped generate the momentum required to turn its strategy into a reality. After commissioning and drafting a few reports and strategy documents, the District is now fully engaged in the implementation of the 100% vision, a vision that now extends into the education of its youth and local training programs for local residents.

As other case studies in this report have already demonstrated, policy coherence across governance level is crucial to successfully achieve 100% RE. Rhein-Hunsrück benefits from the continued presence of national policies, such as Germany's Renewable Energy Sources Act, as well as from federal incentives for renewable energy heating, and energy efficiency improvements.

In addition to supplying over 100% of its electricity needs with RES-E, Rhein-Hunsrück has adopted a

18 http://www.taipei.diplo.de/contentblob/3433492/Daten/2068218/DownloadPresentationFleck.pdf

number of parallel targets. These include a target to have a 100% carbon neutral power supply, an objective to supply 100% of its electricity and heating needs from local, decentralized sources, as well as a broader objective to reduce the amount of money that it spends on imported energy and fuels. It is estimated that as of 2011, the District as a whole spent approximately EUR 290 Million per year on fossil fuels, including oil and natural gas sources. By 2050, the District aims to localize approximately EUR 250 Million of these expenditures, keeping more money in the local economy while supporting local job creation and innovation. Indeed, the early successes of Rhein-Hunsrück demonstrate that attempting to achieve a 100% RE target can bring not only significant environmental benefits, but also substantial economic and financial benefits, helping reduce the region's reliance on imported energy while generating more jobs and revenue within the District. This makes Rhein-Hunsrück a powerful example to other jurisdictions around the world.

Barriers and Solutions

In contrast to some of the other case studies included within this report, Rhein-Hunsrück benefits from having robust grid connections with neighbouring districts. From a technical standpoint, this enables the District to generate more than 100% of its domestic electricity needs, because it does not need to invest in all the system balancing, demand response, storage, and network intelligence architecture that other, more isolated jurisdictions would.

Rhein-Hunsrück demonstrates that achieving a 100% is therefore more attractive for interconnected regions, for two primary reasons: 1) it is less costly than in isolated systems, and 2) it is less technically challenging. The example of Rhein-Hunsrück could therefore help motivate other interconnected regions to do same, and benefit from the same positive economic, financial, environmental, energy security and job creation benefits that this District in Germany has been able to harness.

Ultimately, one of the challenges that Rhein-Hunsrück faces in the years ahead is to continue to expand the ability of its local energy and electricity system to make better and more efficient use of its excess power. Over time, the region aims to use more of its electricity locally, taking up as much of its surplus renewable electricity and putting it to productive uses either in its residential, commercial, and industrials sectors, or in its heating and transportation systems. Indeed, if there is one aspect that is conspicuous by its absence in Rhein-Hunsrück is that the District has not yet developed a clear strategy to transition its transportation sector to a greater reliance on renewable energy sources, an omission found in many of the other case studies included in the report. This indicates that far greater efforts will be needed in this sector in the years ahead. By using its surplus renewable electricity, it is possible that Rhein-Hunsrück could begin allocating more of its domestically generated electricity into electric vehicles, for instance, thereby helping the District as whole to achieve a truly 100% renewable energy system.

3.2.2 Fukushima Prefecture, Japan

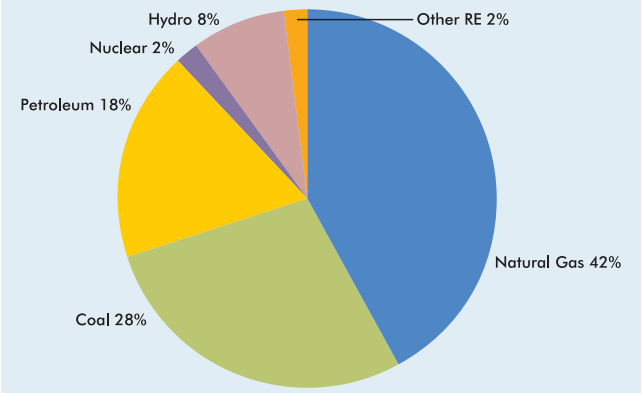
Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

Source: http://www.stat.go.jp/data/nenkan/zuhyou/y1018000.xls

Average Temperature Range	25 Celcius to 31 Celcius
Size (sq. km)	13,783 km^2
Population Size	Approx. 2 Million (2012)
Political Status	Prefecture of Japan

ELECTRICITY MIX

Electricity Mix in Japan (%) 2012
Total = 289 TWh



Annual Electricity Demand in Fukushima Prefecture (2011): 4,135 GWh[19]
Electricity Access Rate: Effectively 100%
Peak Demand in Fukushima Prefecture (MW) (2013): 2,760 MW

19 http://www.stat.go.jp/data/nenkan/zuhyou/y1018000.xls

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

In 2009, the Fukushima prefecture already procured 20% of its electricity from renewable energy sources, making it a leader within Japan well before the devastating tsunami struck the region.[20] In August 2011, five months after the meltdown at the Fukushima Dai-ichi nuclear power plant, the government of the Fukushima prefecture published a Vision for the Revitalization of the region.[21] In this vision, the report stated that the Prefecture "will seek to ensure great progress in the field of renewable energy and aim to make strong advances in resource conservation, energy saving, and recycling …" The plan lays out a broad strategy with many different components aimed at achieving energy self-sufficiency in the region.

In March 2012, Fukushima Prefecture built on this vision and formally announced its target to supply 100% of its future electricity needs from renewable energy sources by 2040. While the details of the strategy are still being articulated, the ambition of the Prefecture is clear.

Overview of key projects

- 5,920 MW of solar PV capacity
- 260 MW of solar thermal capacity
- 1,225 MW of wind power capacity
- 260 MW of hydro power capacity
- 300 MW of geothermal power capacity

Projects already underway include over 100 MW of wind power projects, a 65 MW geothermal project, a 40 MW biomass project, as well as a series of demonstration projects.[22] The strategy also envisions the development of solar hot water systems, pellet stoves for on-site heating, as well biomass and micro-hydro systems. In addition, there is also discussion of setting up model communities for the implementation and demonstration of smart grid concepts.

In addition to the focus on renewable electricity supply, the strategy also anticipates a significant contribution from energy efficiency, projecting a reduction in electricity demand of over 15% over the same period (2012–2040).

Political Aspects

In the wake of the Fukushima nuclear crisis, the government of Fukushima Prefecture quickly mobilized to establish a new, positive, and future-oriented vision for the people of the region. In the months after the crisis, this led to the adoption of a far-reaching plan to re-build infrastructure in the region, increase support for child-care, strengthen educational services, and to provide a stronger and more positive vision for the future of the Prefecture. The 100% renewable energy strategy is at the heart of these revitalization efforts.

In the strategy published in December 2012,[23] the region declared its intention to *"take action to build a safe, secure and sustainable society free from nuclear power through dramatic advances in renewable energy."* This strategy included four (4) objectives:

20 See (in Japanese only): http://www.pref.fukushima.lg.jp/download/1/plan_for_revitalization2_outline.pdf
21 See : http://www.pref.fukushima.lg.jp/download/1/plan_for_revitalization2_outline.pdf
22 See: Japan Times, November 11 2013: http://www.japantimes.co.jp/news/2013/11/11/national/floating-wind-farm-debuts-off-fukushima/#.Ut-3YIU1igQ; see also: http://www.asiabiomass.jp/english/topics/1307_06.html
23 See (in Japanese): http://wwwcms.pref.fukushima.jp/pcp_portal/contents;jsessionid=001E4A95E6F70AD350FC8D0110A1C11F?CONTENTS_ID=36894

1. Expansion of renewable energy, including solar, wind, geothermal, hydropower and biomass
2. Investment in R&D
3. Fostering the development of a cluster of renewable energy-related industries
4. Local production and use of renewable energy through smart communities and citizen investment.

Together, these policy objectives will be instrumental in guiding the on-going evolution of Fukushima's strategy as it builds a new future for itself in the years ahead.

There are many driving forces behind the adoption of Fukushima's 100% renewable energy target. These include, among others:

- Recovering from the devastation caused by tsunami and rebuilding a sustainable society
- Reviving and strengthening community bonds around a new, positive vision for the region
- Creating leading industries for a new era of energy and environmental sustainability
- Building a forward-looking and disaster-resilient community
- Harnessing breakthroughs in renewable energy to build a new society
- Building resilience against external shocks

While the actual policy mechanisms and financing strategies have yet to be fully articulated, in the near-term, the region will benefit from the continued presence of Japan's national feed-in tariff policy, which enables individual developers and investors to connect to the grid and supply renewable energy into the system. The region is also benefiting from a wide range of re-development and revitalization funds, which will contribute to different flagship projects across the Prefecture and further contribute to the achievement of the 100% target.

Barriers and Solutions

Despite having adopted an aggressive renewable energy target for the region, Fukushima continues to face a range of challenges to achieve its 100% renewable energy target.

First, due to the on-going nuclear contamination efforts, the region has had to deal with significant out-migration, a lingering stigma associated with the region and its products (particularly agricultural), and the erosion of the traditional bonds that held communities together. As a result, the revitalization strategy has to focus on a broader set of issues than simply the transformation of the energy and electricity mix – what is envisioned is a transformation of the region as a whole.

On a more technical level, achieving the target will likely require expanding transmission capacity with other regions of Japan, something that it cannot do alone. Achieving its own objectives will therefore require closer cooperation with neighbouring regions and potentially further collaboration between the regional electricity supply companies. Progress toward this objective has begun and far more is expected in the years ahead as some of the larger RE projects begin to be connected to the grid.

Another difficulty relates to financing, and particularly to the availability of cost-effective insurance options for large-scale renewable energy projects. There is currently a significant gap in risk insurance coverage for projects in the Pacific region, and in the wake of Fukushima this remains a challenge that project developers have to face.

Also, given that the bulk of the projects planned are ultimately supported by Japan's national feed-in tariff framework, it remains dependent on the continued support for the FIT at the national level. However, in light of the strong commitment of the Prefectural government to the 100% strategy, it is likely that they will continue to push forward and develop alternative mechanisms irrespective of developments at the national level.

Ultimately, building a more positive vision for the future of the region will take time, and a significant amount of effort and collaboration between the local and the national government, as well as a shared commitment to reconstruction and revitalization among citizens, stakeholders, utility representatives, and government officials.

In line with that, one of noteworthy phenomena is that community power is rising all over Fukushima since the Fukushima Dai-ichi nuclear power accident. Among them are AiPower, based in Aizu region in Fukushima that had been launched already in summer 2011 and the "9th Generation", which widely involves various local actors such as citizens, local business, farmers, engineers, financial institute, co-op, local politicians, local media, artists and designers.

Local and regional visionaries have been steadily developed their idea to become energy independent in create a 100% renewable region. Such community power initiatives in Fukushima have been fostered and strengthened through networking platforms supported by national non-profit organisations and under the community powers support program by the Ministry of Environment since 2011.

One concrete example was the "International Community Power Conference 2014 in Fukushima" hosted by the Institute for Sustainable Energy Policy (ISEP), which has resulted in the "Fukushima Community Power Declaration". On this platform, participants explored and developed synergies between various sectors from local to national level.

100% Renewable Energy Regions Network in Germany

In 2007, communities and regions across Germany gathered to establish a formal network of 100% renewable energy regions. This network now includes more than 140 different communities, cities, and regions that have established 100% renewable energy targets. Admission into the network is based on a 99-point scoring system that includes 33 different criteria. Every year, the 100% RE regions meet in Kassel in central Germany to convene all the different stakeholders and participants, including other representatives from communities around the world that make up the 100% renewable energy movement.

Since its launch, the 100% RE Regions Network has helped increase awareness of the climate, energy security, financial, as well as economic benefits of pursuing a 100% strategy both within Germany and around the world. It provides individual cities and regions with the tools and expert networks required to achieve their objectives, and acts as a central coordinating point for members of the 100% RE Regions Network. One of the key lessons learnt is that providing a common platform for communities helps to communicate experiences, activities and visions on 100%RE more effectively. Consequently, seemingly scattered local actions are powerfully bundled and given political weight as a common movement.

3.3 National Governments

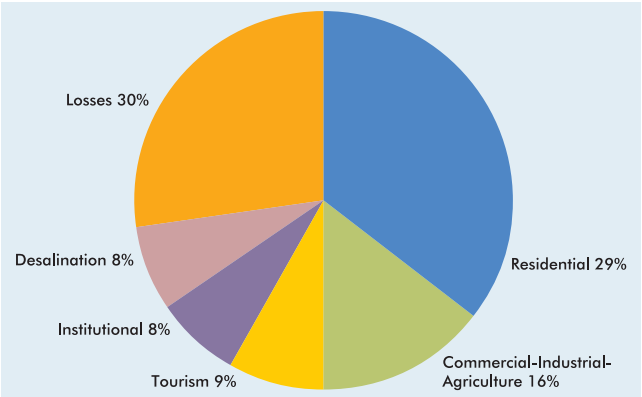
3.3.1 Cape Verde

Average Temperature Range	18 Celcius to 29 Celcius
Size (sq. km)	4,033 km² (across nine inhabited islands)
Population Size	491,875 (2010)
Political Status	Republic of Cape Verde

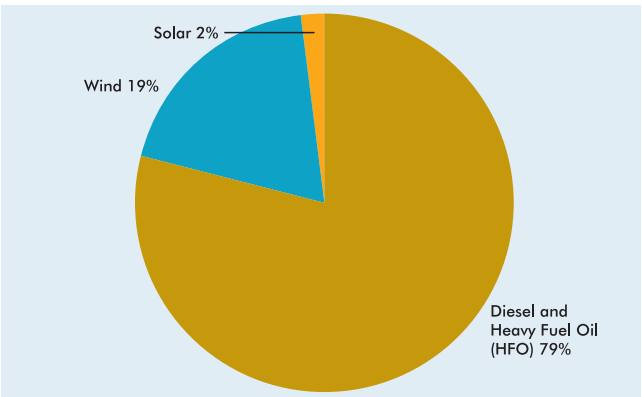
Sector	Focus
Electricity	●
Transportation	●
Heating/Cooling	●

ELECTRICITY MIX

Breakdown of Electricity Demand in 2010 (%)
Total: 318 GWh



Generation Mix in Cape Verde (GWh) 2012: Total=403 GWh



Installed Capacity: 113 MW
Electricity Access Rate: Approx. 95 %

Sources:
http://www.electra.cv/index.php/Download-document/55-Relatorio-e-Contas-2012.html
http://www.electra.cv/index.php/Download-document/55-Relatorio-e-Contas-2012.html

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

The development of Cape Verde's 100% strategy emerged in three different steps. Faced with a rapidly rising fuel import bill (for diesel and heavy fuel oil), it set out a target to supply 25% of its electricity needs from renewable energy sources by 2012.[24] A detailed analysis conducted for the Government concluded that it would be economically beneficial to set a higher target, due primarily to the rapid growth in energy demand (both electricity and fuels) and the rising costs of imports. The report proposed a target of 50% by 2020, and included a parallel target to reach 100% on one of its nine (9) islands, the island of Brava, as a demonstration project.[25] More recently, in collaboration with the IFaS[26], a leading energy storage firm based in Germany, a further and much more ambitious plan has been drafted indicating that it may be even more cost-effective to achieve a 100% RE target by 2020, instead of the original 50% target.

The initial 50% strategy launched by the Government of Cape Verde was remarkable for a number of reasons, and provides valuable guidance for other countries interested in pursuing a high-penetration renewable energy goal: first, it identified a number of specific renewable energy development zones (REDZ) in collaboration with local stakeholders where projects could be located and cost-effectively integrated into the grid; it provided specific generation (GWh) and capacity (MW) targets for each renewable energy technology, by site, for every island; and finally, it developed preliminary estimates of what the strategy as a whole would cost, based on different scenario analyses for the growth in demand, the current and future costs of RE technologies, and the future costs of imported fuels.[27]

The 100% strategy builds on these previous estimates and outlines the total supply requirements. Since Cape Verde is comprised of a collection of islands, the strategy includes a focus on both new sources of generation, as well as a combination of energy storage systems.[28]

Island	Technology			
	Solar PV	Wind	Battery Storage	Seasonal Storage (pumped hydro)
Boa Vista	35 MW	35 MW	9 MW	1,600 MWh
Brava	2 MW	1 MW	1 MW	70 MWh
Fogo	10 MW	7 MW	2 MW	550 MWh
Maio	10 MW	3 MW	1 MW	280 MWh
Sal	39 MW	17 MW	9 MW	1,200 MWh
Santiago	168 MW	112 MW	30 MW	7,700 MWh
Santo Antao	12 MW	3 MW	3 MW	250 MWh
Sao Nicolau	3 MW	2 MW	1 MW	110 MWh
Sao Vicente	64 MW	16 MW	10 MW	900 MWh
Total	343 MW	196 MW	66 MW	12,660 MWh

24 ECREEE 2011, http://www.ecowrex.org/system/files/documents/2011_summary-of-cape-verde-renewable-energy-plan_ecreee.pdf
25 Brito 2013, http://www.ecreee.org/sites/default/files/event-att/100x_apresentacao_jb_para_ecreee.pdf
26 Institut für angewandtes Stoffstrommanagement
27 ECREEE 2011, http://www.ecowrex.org/system/files/documents/2011_summary-of-cape-verde-renewable-energy-plan_ecreee.pdf
28 Brito 2013, http://www.ecreee.org/sites/default/files/event-att/100x_apresentacao_jb_para_ecreee.pdf

The total investment necessary to achieve the 100% strategy using pumped hydro storage is estimated at EUR 1.272 Million[29], with all generation and storage projects included, to replace the anticipated electricity needs of Cape Verde by 2020. This results in a levelized cost of energy (LCOE) of between EUR 0.104/kWh and 0.189/kWh depending on which island is considered, which is significantly less than both the current LCOE of electricity generation using heavy fuel oil (EUR 0.19/kWh), and diesel (EUR 0.30/kWh). The 100% strategy in Cape Verde is therefore projected to result in a net cost savings for the government.

In addition to several wind projects already built or underway, Cape Verde has already signed contracts for two utility scale solar PV projects with a total installed capacity of 7.5 MW.[30] This includes a 5 MW project near the capital Praia, as well as a 2.5 MW project on the island of Sal.

However, it is estimated that in order to achieve the 100% RE target in Cape Verde, significant investments in power storage and demand response are going to be needed. Based on the current strategy, this will involve synthetic methane production using wind power, pumped hydro, as well as the coordinated dispatching of various loads across the country (demand response) such as desalination plants and bottling factories. These projects will enable Cape Verde to make use of excess supply in the network, help stabilize the grid, and help it integrate a higher share of renewable energy into its various island systems.[31] The case of Cape Verde demonstrates that achieving 100% in isolated systems involves a far higher level of power system engineering and investment planning than achieving 100% in interconnected regions. Achieving 100% on a sustainable basis, across the electricity, transport, as well as heating/cooling sectors, will ultimately require advanced system monitoring as well as dynamic dispatching capabilities such as demand response to continuously adapt to short-term fluctuations in supply and demand. Solving these technical challenges, as Cape Verde and many other jurisdictions are beginning to do, will be at the heart of successful 100% RE strategies.

Political Aspects

In 2006, the Government of Cape Verde passed Law Decree No. 30, which set out licensing procedures for independent power producers (IPPs) and auto-producers. This was an important step, as Cape Verde realized it would need external investment to support its renewable energy development goals. After a few years of capacity building efforts, planning, and local stakeholder engagement, Cape Verde passed its 2011 law, which set out its renewable energy policy framework in greater detail. Over the course of these various legislative developments, the Government of Cape Verde worked closely with a range of consulting firms and international research institutes to refine the strategy, and identify future opportunities.

So far, the majority of renewable energy projects in Cape Verde (with the exception of two utility scale solar PV projects with a total installed capacity of 7.5 MW)[32] are owned and operated by Cabeólica, which has projects on four of the country's nine islands. Cabeólica has signed a number of 15-year power purchase agreements (PPAs) with the national utility company, Electra. The projects are project financed on a 70–30 debt-equity structure. After the 15-year contract period, projects will receive a lower tariff of between 20–30% less than the original tariff value. The contract also includes a 5-year renewable service agreement contract to ensure that maintenance is completed. The Public-Private Partnership (PPP) structure, by bringing together a strong set of

29 See slide 22: http://www.ecreee.org/sites/default/files/event-att/100x_apresentacao_jb_para_ecreee.pdf
30 See Martifer Solar: http://www.martifersolar.com/countCv.php
31 Brito 2013, http://www.ecreee.org/sites/default/files/event-att/100x_apresentacao_jb_para_ecreee.pdf
32 See Martifer Solar: http://www.martifersolar.com/countCv.php

local and international partners, was found to be an important component in obtaining the financing for the project.

The total investment in Cabeólica projects to date, which include 25.5 MW of wind power capacity spread over four islands (Santiago, Sao Vicente, Sal, and Boavista) have totalled over EUR 60 Million. The financing for Cabeólica projects came from a wide range of sources, including the European Investment Bank, the African Development Bank, the Africa Finance Corporation, Finnfund, the Government of Cape Verde, as well as a few private sector partners.[33]

Significantly, one of the key components for successfully attracting capital to the project was the establishment of a dedicated escrow account.[34] This account ensures that the payments are made on time, and that the funds are clearly allocated, and transparently managed. Additional components that have supported the success of Cape Verde's strategy is that it offers a complete tax exemption for the first five years of each RE project's operational life, with 50% reduction offered for the following five years. The fiscal framework in Cape Verde also involves waiving export duties on certain RE products and components, and some of the projects have also benefited from concessional financing from the Portuguese Government.

Notwithstanding Cape Verde's leading position in wind power, the majority of the technical renewable energy potential remains in solar power. The primary consultant report that laid out the original 50% strategy for the Government of Cape Verde identified over 2.000 MW of solar PV potential across the various REDZ, over six (6) times the estimated wind power potential.

Another important dimension of the Cabeólica projects is that public consultations were held in each of the four islands where wind projects were built and comprehensive Environmental and Social Impact Assessments (ESIAs) were conducted.[35] This included a process to engage local landowners in particular in the siting of the projects, and in the designation of the REDZ. This makes Cape Verde a leader not only in terms of its targets and the detail of its overall strategy, but also in its environmental stewardship and citizen engagement efforts.

Barriers and Solutions

Despite its current leadership position as one of the jurisdictions in the world with the highest wind power penetration, Cape Verde has had to overcome a wide range of policy-related, technical as well as operational hurdles.

In the mid-2000s, it ran a number of unsuccessful renewable energy bidding processes, failing to attract foreign investment. In response, the Government partnered with a privately managed, donor-funded infrastructure company, to finance a series of projects across the country. This led to the establishment of a Public Private Partnership for wind power development described above.[36]

Second, the relatively small size of the islands combined with limited road access made the construction and planning of the wind power projects difficult. Also, integrating the projects into each island system required individualized grid impact analyses and careful balancing of the trade-offs between turbine size, road access, grid capacity, output profiles, and a host of other factors.

Another aspect of Cape Verde's success can be traced to the awareness-raising efforts of the government,

33 Vilar 2012, http://www.ecreee.org/sites/default/files/renewable_energy_in_west_africa_0.pdf
34 Cabeolica 2013, http://www.ecreee.org/sites/default/files/event-att/cabeolica_2013_ecreee_regional_workshop_v6_final.pdf
35 Cabeolica 2013, http://www.ecreee.org/sites/default/files/event-att/cabeolica_2013_ecreee_regional_workshop_v6_final.pdf
36 Vilar 2012, http://www.ecreee.org/sites/default/files/renewable_energy_in_west_africa_0.pdf

and the reinforcement provided by local media coverage of renewable energy development in the country. This virtuous cycle has helped create stronger public support for renewable energy in Cape Verde, and a broader awareness of the issues related with its high dependency on fossil fuel imports.

Further challenges that emerged and had to be solved relate to transporting the various turbine units to each of the project construction sites – this proved challenging, not only because of the limited road access but also because of the size restrictions at the various ports and the lack of available warehousing capacity to safely store the turbine blades and tower components. This required extensive of logistical planning, and experienced project management.

Also, like many other countries around the world, Cape Verde faced a significant lack of a local trained workforce to assist with construction and development of key projects. Partly in response to these initial challenges, certain firms in the country have undertaken a number of training related initiatives in partnership with private sector partners and related research institutes to build the local capacity and train local residents to manage and operate wind parks sustainably in the long-term.

Finally, a number of challenges emerged relating to grid stability, frequency and voltage control, as well as the effective dispatching of personnel to address issues as needed. Grid integration on the smaller Santo Antao project, for instance, has seen a significant learning curve, with a steady decrease in voltage and frequency events as both project operators and the grid operator learn to better integrate variable wind power into the network.[37]

In the long term, wind power alone is anticipated to supply between 20–50% of total power needs across Cape Verde's nine (9) islands. This will require a range of technical improvements in communication and control systems, closer cooperation with the grid operator, as well as continued performance of the individual wind projects. The current grid stability and spinning reserve requirements limit wind penetration to approximately 40–50%. Dispatching and spinning reserve optimization is therefore being developed, and the wind power will need to be further complemented both by other RE technologies, such as solar PV, as well as by storage and demand response technologies.

Indeed, while the international focus is often on the wind turbines and solar panels being installed, the Government of Cape Verde recognizes that it must plan for a substantial increase in demand side management, demand response, as well as electricity storage systems to improve the integration of higher volumes of renewable energy. In order to reach the 100% target, these technical solutions will need to be a central part of the mix. This is particularly important for island regions, where achieving 100% of renewable energy in the mix on both a daily and a seasonal basis will require that it exceeds 100% of total demand during many hours of the day, and many days of the year, and that it intelligently manages this surplus power via integrated storage and demand response solutions. This will therefore require both short-term and long-term storage, as well as advanced load management solutions, to adapt to both daily as well as seasonal fluctuations in the availability of renewable energy.

Finally, in order to truly turn Cape Verde into a 100% renewable energy archipelago, it will need to significantly increase its efforts to transition both its heating/cooling sectors, as well as in its transportation sector toward a greater use of local renewable energy sources.

37 Graça 2013, http://www.ecreee.org/sites/default/files/event-att/workshop_regional_cedeao_energia_eolica_electricwind.pdf

Rural Bangladesh

Bangladesh is one of the countries in the world with the highest population densities, at approximately 1,000 inhabitants per square kilometre. Currently, only 40% of rural homes in Bangladesh have access to electricity, with approximately 15 million households still awaiting electrification. The population of the country as a whole is approximately 154 million.

With the continued decline in solar module costs, the high cost of transmission and distribution infrastructure due to the many rivers that crisscross the country, and the persistently high costs of diesel for power generation and of other fossil fuels used for lighting such as kerosene, Bangladesh has tremendous potential for the widespread deployment of onsite solar home systems (SHS). The Government has established a goal of increasing electricity access in rural Bangladesh to 100%, a goal that is being implemented almost exclusively with the use of solar home systems (SHS) due to economic advantages.

Bangladesh now features a well-established supply chain of local installers, suppliers, and lenders supporting the deployment of SHS to the country's poorest residents. There are now over 2 million solar home systems in Bangladesh, making it one of the largest markets in the world for distributed solar PV deployment. Recent estimates indicate that there are approximately 40,000 rural families receiving a new system every month, and a target has been set to achieve a total of 2,5 Million SHS by the end of 2014. Most systems installed range from 10 W to 135 W, and cost less than USD $ 1.000. Assuming an average system size of approximately 50 W, this translates into a total installed solar PV capacity in the country of over 100 MW.

This far-reaching initiative has been facilitated through a number of international partnerships, turning Bangladesh into a leading example of harnessing renewable energy sources to improve access to modern and sustainable energy services.

Costa Rica

Costa Rica (population: 4.5 Million) currently supplies approximately 93% of its total electricity needs from renewable energy sources, mostly from domestic hydro. However, despite the many advantages of hydropower, it also presents significant hydrological risk for the electricity system, exposing the country to the risk of decreasing rainfall in the years ahead and a growing reliance on fossil fuels. In response, Costa Rica has developed a strategy to help diversify its electricity mix by developing other forms of renewable energy, such as solar, biogas, geothermal, and wind power, with the aim of supplying 100% of its electricity from renewable energy sources by 2021. This is coupled to a parallel target to be 'carbon neutral' by the same date.

The country's current plan will see the state-owned monopoly, The Instituto Costarricense de Electricidad (ICE) purchase power from independent power producers in Costa Rica over 15-year contracts. This will result in a gradual decentralization of the electricity system as it moves toward its combined energy and climate objective.

In addition to its focus on achieving 100% RE in the electricity sector, Costa Rica is encouraging the broader adoption of electric vehicles in order to gradually do the same in the transportation sector. It is currently offering targeted incentives for the import and sale of EVs as well as for the development of charging infrastructure. Given that transportation represents approximately 44% of final energy consumption, efforts to diversify away from oil are a critical part of Costa Rica's long-term objectives. Combined with its abundant renewable energy resources, the shift to electric mobility in Costa Rica will help gradually transition both its electricity and its transportation system to a greater reliance on local and sustainable energy sources.

Sources: http://www.renenergyobservatory.org/uploads/media/Costa_Rica_Producto_1_y_2__Ing__01.pdf
http://news.co.cr/costa-rica-committed-to-renewable-energy/15673/

3.3.2 Denmark

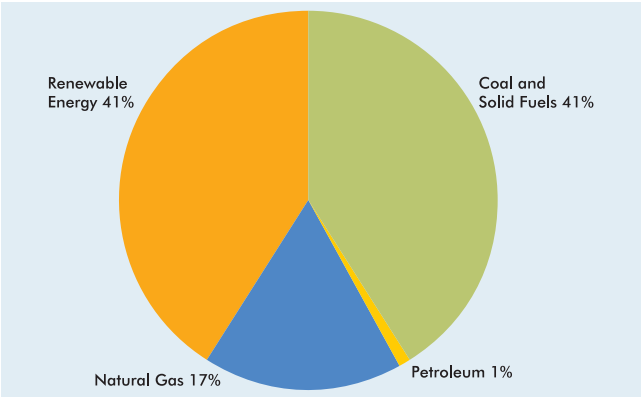
Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

Source: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf

Average Temperature Range	0 Celcius to 16.7 Celcius
Size (sq. km)	42,915 km^2
Population Size	5,627,235 (2014 est.)
Political Status	Kingdom of Denmark

ELECTRICITY MIX

Denmark's Electricity Generation Mix (2011)
Total = 34.5 TWh



Annual Electricity Demand: 38.6 TWh
Electricity Access Rate: 100%
Peak Demand (MW): 14,116 MW

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

Denmark's energy and climate strategy includes an ambitious target of meeting 100% of electricity and heating needs with renewable energy sources by 2035. In the electricity system, this will involve a significant expansion in both wind and solar power as well as the continued deployment of combined heat and power (CHP) systems. Specifically in the heating sector, Denmark plans to expand the use of both renewable sources of gas (such as biogas) as well as other renewable forms of heating such as solar thermal, ground-source heat pumps, and wood-based biomass in the country's district heating network as well as in individual homes and businesses.

Denmark's strategy is not limited to electricity and heat: it aims to phase out fossil fuel use *entirely* in all energy sectors (including transportation) by 2050. Under current projections, this will involve a massive expansion in the use of electric vehicles[38] and continued growth in the use public transit. The current share of renewable energy in the transportation mix was estimated at less than 1% in 2011,[39] compared to a share of approximately 40% in the electricity mix. Thus, by shifting more of transportation energy needs onto the electricity system, Denmark will make progress toward achieving its overall 100% renewable energy target.

Another important component of Denmark's strategy is a strong, economy-wide focus on energy efficiency. Current EU plans envision a 20% reduction in energy use by 2020, and efforts continue to be made to increase energy efficiency in existing buildings via extensive retrofitting and in new buildings by raising the standards on all new construction in the country.

In order to achieve its 100% objectives, Denmark is relying heavily on a broader electrification of its energy sectors, combining the heating and cooling, transportation and end-use sectors. This will involve, among other aspects, converting greater volumes of the country's abundant wind resources into thermal form (e.g. funnelling more wind power into the district heating system as well as into on-site water heaters) as well as into electric battery storage for the transportation system.[40] Denmark also envisions a significant increase in the use of solar thermal technologies to supply heat directly into the country's district heating systems. Due to a combination of high electricity prices and high taxes on fossil fuels, the solar thermal market has grown from approximately 19.000 m^2 of solar collector space in 2000 to over 300.000 m^2 in 2012, making it an increasingly important contributor to the country's heat supply mix.[41] Plans are also underway to expand the use of renewable energy in its island regions, such as the Faroe Islands.[42] Combined with plans to expand transmission links with neighbouring Germany and Sweden to allow greater imports and exports of renewable electricity, and a motivated industrial, commercial, and residential sector, Denmark has the human, the natural, as well as the technological capital to make its transition a success.

Political Aspects

Denmark has a long history of leadership on energy and climate change, initially as a pioneer in wind power technologies and then as a major proponent of concerted action on climate change at both the European level and on the international stage. This

38 http://www.ens.dk/en/policy/danish-climate-energy-policy
39 http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf
40 http://www.ens.dk/sites/ens.dk/files/policy/danish-climate-energy-policy/our_future_energy.pdf
41 http://solarthermalworld.org/content/long-term-experiences-solar-district-heating-denmark-2013
42 http://www.nordicenergy.org/wp-content/uploads/2013/11/Wind-Power-Based-Pumped-Storage_Pre-Feasibility-Study_Suduroy-Faroe-Islands_2013.pdf

leadership is now reflected in Denmark's domestic energy policy, which aims at a complete 100% transition of the energy system toward renewable energy technologies.

An important factor underpinning Denmark's 100% strategy is the high level of energy and environmental awareness among both its citizens and its politicians. This awareness has been cultivated over several decades since the 1973 oil crisis (and indeed before), helping create and maintain public support for a comprehensive energy strategy based on fully harnessing domestically available renewable energy resources. Denmark also benefits from a relatively small population, a highly educated workforce, and a number of world-class companies and research institutes to support the implementation of its strategy.

Like many of the other case studies included in this report, Denmark expects that the strategy will save them money over business as usual. Estimates included in the country's future energy plan indicate planned investments of approximately EUR 750 Million (5.6 Billion Danish Krone) by 2020, with expected savings in energy costs of over EUR 920 Million (6.9 Danish Krone) over the same period, making the launch of the strategy a direct saving for the government, businesses, as well as local residents.[43]

In addition to a feed-in tariff and a net metering framework, many of the policy measures rely heavily on fiscal policy, including the use of what are sometimes called 'green taxes' or environmental taxes.[44] For instance, Denmark levies a number of taxes on fossil fuels and has special taxes on environmental externalities such as carbon pollution, which increase the costs of gasoline, diesel, coal, as well as heating oil. Collectively, these taxes serve to make it more attractive to use local, renewable sources of energy instead of continuing to rely on fossil energies. Denmark also offers special tax incentives and in some cases even cash grants to encourage specific technologies, such as electric vehicles. This combined use of regulatory instruments, fiscal instruments, and an overarching national energy strategy represents the core of Denmark's 100% plan. For both its coherence, comprehensiveness and its clarity of purpose, it provides a valuable example for other countries seeking to re-orient their economies toward a more sustainable, renewably powered future.

Barriers and Solutions

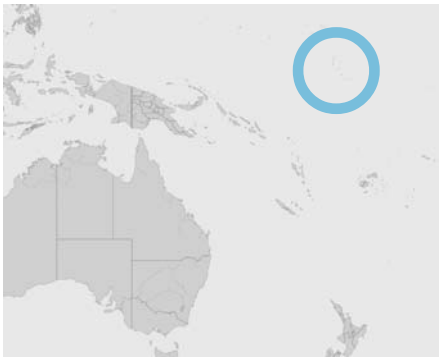
Despite the clear vision underpinning Denmark's strategy, there remain a few key challenges. Some have argued that high taxes and high energy costs in Denmark[45] will make it difficult to maintain public support for the 100% strategy, particularly for lower income residents in the country. Others are sceptical that the country will be able to phase out the use of coal in its district heating network completely by 2030, as currently planned.[46] Also, adding significant additional volumes of wind power into the network will require expansions in transmission capacity with its neighbours Germany and Sweden, and greater cooperation on cross-border electricity trade, developments that take time and resources.

However, despite these concerns, the political commitment at the local and national level in Denmark remains strong.[47] And in light of estimates conducted for the government, Denmark plans to actually save money by implementing its 100% renewable energy strategy. To keep its strategy on track, and keep the momentum behind it in the years and decades ahead, it will be important that these economic benefits are shared with citizens.

43 http://www.ens.dk/sites/ens.dk/files/policy/danish-climate-energy-policy/our_future_energy.pdf
44 http://www.docufin.fgov.be/intersalgnl/thema/publicaties/documenta/2011/BdocB_2011_Q2e_Larsen.pdf
45 http://ec.europa.eu/energy/doc/2030/20140122_swd_prices.pdf
46 http://www.ens.dk/sites/ens.dk/files/policy/danish-climate-energy-policy/our_future_energy.pdf
47 http://www.kebmin.dk/node/840

3.4 Island Governments

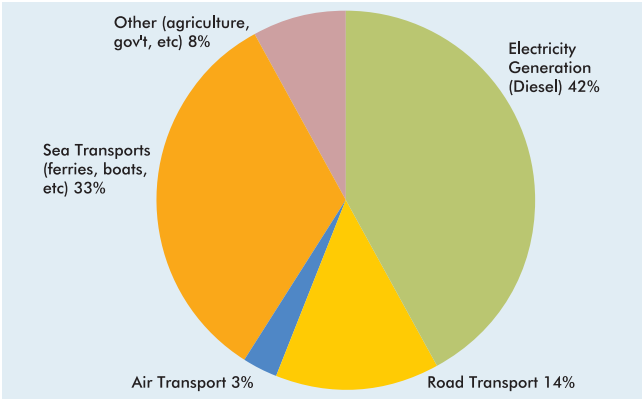
3.4.1 Tuvalu



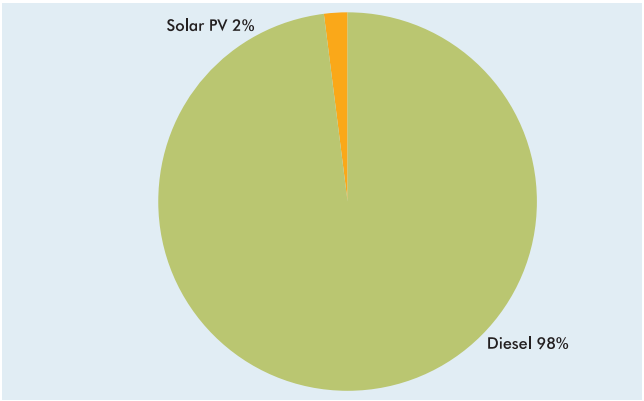
Average Temperature Range	25 Celcius to 31 Celcius
Size (sq. km)	26 km^2 (over nine coral islands)
Population Size	11,200 (2012)
Political Status	Nation State, Member of the British Commonwealth

Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

Oil Use By Sector (2012)



Electricity Mix (2012)



Annual Electricity Demand: 4,900 MWh
Electricity Access Rate:
100% on Funafuti, the main island;
estimated 94% countrywide
Peak Demand (MW): over 1000 kW

Key Elements of the 100% Renewable Energy Strategy

Technical Aspects

Currently, the electricity system in Tuvalu is fragmented due to the geography of the atoll on which Tuvalu stands. The main island has three diesel generators with a total installed capacity of approximately 1,800 kW, while each of the outer islands has diesel capacity ranging from 148–220 kW. The estimated levelised cost of generation from these diesel units in Tuvalu was USD $ 1.05/kWh in 2010–11, while the average price paid for power was approximately USD $ 0.48/kWh after subsidies.[48] This suggests that like other islands covered in this report such as Cape Verde, achieving a 100% RE target is likely to result in a net cost saving for Tuvalu.

Overview of key projects

- 66 kW grid-connected solar PV system at the desalination plant;
- 46 kW off-grid solar PV system at Motofua Secondary School on the island of Vaitupu, combined with a 533 kWh battery system, perated on a hybrid basis with diesel back up;[49]
- 42 kW grid-connected solar PV system at another desalination plant;
- 40 kW solar PV system on top of the capital city's football stadium;
- small biogas systems making use of farm wastes;
- 65 kW solar PV system in Funafuti, the capital;
- Solar hot water systems, solar streetlights, as well as solar ovens are also being promoted.

Political Aspects

In 2009, the government of Tuvalu adopted the country's National Energy Policy (NEP), setting out the objective to supply 100% of its electricity needs with renewable energy sources (RES) by 2020.[50] According to the Majuro Declaration, signed by members of the Pacific Islands Federation on September 5th 2013, Tuvalu aims to supply between 60–95% of its power needs using solar PV systems, 0–40% using wind power, and an additional 5% using imported biodiesel.[51] The Declaration also aims to reduce electricity demand by 30% on the main island of Funafuti through a range of energy efficiency improvements. While many elements of the strategy have yet to be fully articulated, several different initiatives are underway to help it achieve its objectives and it is benefiting from a wide range of different international supports.

Tuvalu has recently established the Renewable Energy and Energy Efficiency Unit (REEEU) within the Tuvalu Electricity Corporation (TEC), the national utility. The aim of this new Unit is to help Tuvalu reduce its dependence on imported diesel, improve the efficiency of the power system, reduce carbon emissions, improve the overall operational effectiveness of TEC, and develop a strategy for the increased development of solar and wind power generation on the island.[52]

There are many factors behind the adoption of Tuvalu's 100% renewable energy target:

- Reducing dependence on imported diesel fuels
- Reducing exposure to volatile fuel prices
- Increase the island nation's energy security by improving the efficiency and sustainability of the electricity system
- Promoting access to modern energy services

48 http://www.theprif.org/sites/theprif.org/files/TISIP%20Final%20Report.pdf
49 See: http://www.sma.de/fileadmin/content/global/Products/Documents/Referenzanlagen/REFTUVALU-AEN122110.pdf
50 http://www.e8.org/upload/File/tuvalu_solar_power_project_final.pdf
51 http://www.majurodeclaration.org/the_declaration
52 See: http://www.reegle.info/profiles/TV

A wide range of partners and funding agencies has supported Tuvalu's renewable energy development efforts, including the International Union for the Conservation of Nature (IUCN), the e8 Group,[53] the International Renewable Energy Agency (IRENA), UNDP-GEF, the World Bank, the United Arab Emirates, the Danish, Japanese as well as New Zealand governments. The financing of the strategy is anticipated to come from a wide variety of sources.

Tuvalu's National Energy Policy is analogous to a Renewable Portfolio Standard, requiring the national utility to supply 100% of overall electricity demand with renewable energy sources by 2020. The strategy will likely rely on external development funds, as well as on investments by the Tuvalu Electric Corporation. As such, most projects will likely remain partially or fully government owned. Although the current RE penetration remains limited to a few per cent of total supply, the projects currently under development are expected to bring the supply to 30–40% of the total mix by 2015.

Barriers and Solutions

Tuvalu faces a few major challenges to achieve its 100% RE target. Like many other small island developing states (SIDS), Tuvalu remains heavily dependent on international development assistance. It is estimated that in 2010, fully 55% of the Tuvalu Electric Corporation's total income came from development partner grants rather than from electricity tariffs.[54] And while efforts are underway to bring tariffs more closely in-line with generation costs, this remains a major challenge.

Another challenge is that according to the World Bank, between 2008 and 2011, domestic revenue was sufficient to fund only 40% of total Government expenditures.[55] This means that new infrastructure investments in the electricity sector have to be largely if not exclusively funded by donors and other international development partners. Ensuring that sufficient funding is available, particularly for long-term operation and maintenance (O&M) costs will be essential to the long-term sustainability of the renewable energy strategy. Indeed, budgeting for these "life-cycle costs" is often challenging for small islands like Tuvalu.[56] The prevalence of maintenance issues with domestic rainwater collection infrastructure on individual households suggests that even for immediate needs like water, the appropriate maintenance fails to be provided. This indicates that a significant challenge in the years ahead in Tuvalu will be to ensure sufficient resources to support the maintenance of key RE infrastructure, including both on-going and preventive maintenance.

Another important challenge in Tuvalu has been securing access to land. Due to the limited availability of land, the government is attempting to find a way to ensure that the grant-funded projects can be focused on roof-mounted solar PV systems rather than ground-mounted systems. This has raised important issues about how the individual homeowners, or building owners, will be compensated for hosting solar PV projects on their roof, and how routine maintenance will be performed.

Further challenges to achieving its 100% target include the lack of comprehensive information about the current electricity system's characteristics, such as disaggregated load data that would allow utility representatives to run simulations and modelling exercises, and other requirements for the successful integration of high shares of variable renewable energy generation.[57] These capacities and skills will

53 http://www.globalelectricity.org/upload/File/07293_brochure_energyinaction-7_0_final.pdf
54 http://www.theprif.org/sites/theprif.org/files/TISIP%20Final%20Report.pdf
55 http://www.theprif.org/sites/theprif.org/files/TISIP%20Final%20Report.pdf
56 See page 40 on http://www.theprif.org/sites/theprif.org/files/TISIP%20Final%20Report.pdf
57 http://www.ppa.org.fj/wp-content/uploads/2013/09/Tuvalu-Tariff-Review-Request-for-Proposal.pdf

need to be developed in partnership with international experts to ensure that Tuvalu is successful in meeting its ambitious targets.

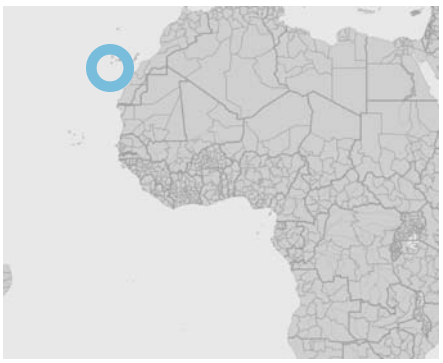
In order to overcome these challenges, Tuvalu has taken a number of different measures. Throughout this process, two key components have been the strong political will domestically, and sustained support from a wide range of donors internationally. This applies as much to the provision of financial resources as knowledge and training. Also, securing the support of key actors in Tuvalu, in particular representatives of the Tuvalu Electricity Corporation (TEC) has proved essential.

With strong international support for Tuvalu's ambition to achieve its 100% RE target and the modest sums required to reach the objective, Tuvalu is well positioned to reach its 100% target. In the process, it will have established a cleaner and more resilient electricity system, be less exposed to rising fossil fuel prices, and better equipped to continue to raise awareness about the importance of tackling global climate change.

Sumba, Indonesia

One island in Indonesia adopted an ambitious plan to supply the entire island with 100% renewable energy as part of a broader strategy to empower local residents, spur economic development and support public services such as electrification. With 700.000 inhabitants, Sumba has demonstrated what is possible with the right combination of political will, and support from local and international agencies. One agency that has been at the forefront of this initiative is Hivos, a local NGO that has led a series of stakeholder engagement initiatives to spread awareness of, and build support for, the 100% strategy. The organization has worked with the private sector, the Indonesian government as well as other civil society organizations to jointly implement the strategy. When the initiative was launched a few years ago, only 25% of the local population had access to electricity. After three years of efforts, electricity access has been increased to over 40% of the population and is continuing to grow. Most of the projects being developed are relying on solar PV, biogas, or micro-hydro systems. The Indonesian Ministry of Energy has taken responsibility for the implementation of the strategy, and efforts are now underway to increase both domestic as well as foreign investment. Both the Asian Development Bank as well as the Dutch and Norwegian governments have contributed financially to support the initiative.

3.4.2 El Hierro, Spain

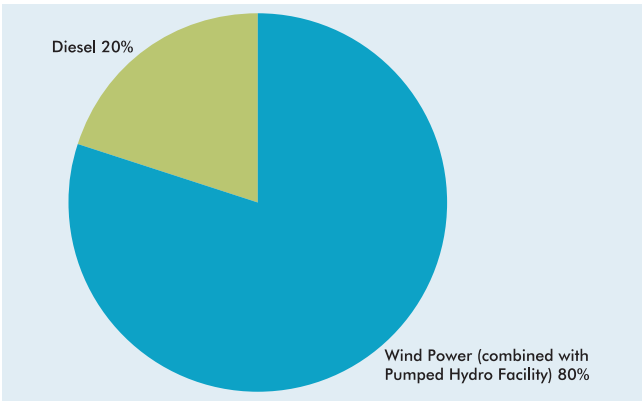


Average Temperature Range	25 Celcius to 31 Celcius
Size (sq. km)	278 km^2
Population Size	10,700 inhabitants
Political Status	Autonomous Community of Spain

Sector	Focus
Electricity	
Transportation	
Heating/Cooling	

ELECTRICITY MIX[58]

El Hierro Electricity Mix (2014):
Total=35 GWh/year



Peak Demand (MW) (2011): 7.56 MW[59]

58 Since its inauguration on June 27 2014, the wind-powered pumped hydro project is expected to produce approximately 80% of the total electricity needs on the island on an annual basis. See also (in Spanish): http://www.goronadelviento.es/index.php?accion=articulo&IdArticulo=147&IdSeccion=89

59 http://www.renewableenergyworld.com/rea/news/article/2012/10/creating-a-hybrid-hydro-wind-system-on-a-spanish-island

Key Elements of the 100 % Renewable Energy Strategy

Technical Aspects

El Hierro's 100 % renewable energy strategy is anchored in its unique climate and geology. It benefits from stable and relatively strong winds throughout the year, and has appropriate island topography for the development of a large pumped hydro storage system. As such, the majority of its 100 % target is now being met by a 11.5 MW wind farm, whose output is coupled to the functioning of a pumped hydro facility situated in a volcanic crater. When the winds are strong and the output from the farm exceeds the island's demand, the excess electricity is used to pump water into the empty crater for storage. When the winds are weak, or absent, the water stored in the reservoir is released and run through hydro turbines (four units with a combined capacity of 11 MW) to produce electricity. In this way, the pumped hydro system acts as a battery bank for the whole island. Another component of the system are the desalination plants that produce water for the island's residents – the plants will be operated in an integrated manner with the wind farm, ensuring that the water supply for the island is also generated in a clean and sustainable way.

Another component of the strategy is to replace the island's 4,500 cars with electric vehicles, in order to further reduce reliance on imported fuels and promote sustainable development on the island. Finally, a focus has also emerged on encouraging the island's agricultural industry to make greater use of bio-digesters in order to make use of local resources more efficiently.

Political Aspects

In the early 1980s, El Hierro decided to adopt a development model that placed a greater emphasis on the respect of the natural environment and the conservation of natural resources. In 1997, El Hierro was the first of the Canary Islands to adopt a sustainable development plan, a move that earned it a UNESCO biosphere designation in 2000.[60] Now, in the face of the global climate crisis and persistently high fossil fuel prices, El Hierro's ambitions have grown and it now aims to transition its entire electricity and transport system to renewable energy sources, while maintaining the ecological integrity of its island ecosystem.

The current electricity generation cost on El Hierro is estimated at USD $ 0.32/kWh, providing significant opportunity for lower cost alternatives to displace the diesel generation on the island. The island's oil use is currently approximately 40,000 barrels per year, totalling approximately USD $ 4 Million in annual fuel import costs. Estimates suggest that the project will save the island approximately $ 2.5 Million in diesel costs every year.[61] The remainder is currently used in the island's transportation system. However, once the vehicle fleet is transitioned to rely on domestically produced electricity, this will effectively eliminate the island's reliance on diesel power.[62] This will not only save the island millions of dollars per year in imported fuels: it will also reduce its exposure to fossil fuel price volatility, making it more resilient to external shocks and strengthening the local economy by keeping more of its income in the region. This positive economic impact that the transition to renewable energy is projected to have on the island is a powerful factor in maintaining the momentum at both the local and the political levels.

60 http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/europe-north-america/spain/isla-de-el-hierro/
61 http://www.greenbiz.com/blog/2014/03/03/how-small-spanish-island-became-renewable-energy-pioneer-el-hierro
62 The current diesel generators are expected to remain in place and to serve as an emergency back-up system.

There are several interconnected factors that have helped turn El Hierro into a leading example of a 100% renewable energy island. These include:

- a long tradition of environmental leadership
- a sustained political vision
- a high level of environmental awareness among the population, including about the potential consequences of climate change
- a desire for greater self-sufficiency.

The initiative on El Hierro has been a product of the close cooperation between the island government of the Canaries (which owns a 60% stake in the project), the Instituto Tecnológico de Canarias (which owns 10%), and a private Spanish energy and utility group (which owns the remaining 30%).

Inauguration, July 2014

Barriers and Solutions

The Canary Islands are relatively isolated, approximately 300 kilometers from the coast of West Africa. This remoteness makes it more costly to import power system components such as generators, turbine towers, and distribution system infrastructure; it also makes it more expensive to fly in technical experts, such as engineers and project developers. This was partly overcome by partnering with, and building on the existing capacities of, the Instituto Tecnológico de Canarias (ITC), a local institute based in the main island Gran Canaría that provided significant technical and strategic support over the course of the project. Drawing on the expertise of the ITC made it possible to develop a cluster of expertise in the Canary Islands. This cluster of experts is beginning to reach out to other islands across the Canaries to help them reduce their reliance on imported fuels and increase the share of renewable energy in the overall mix.

On the regulatory side, the Canary Islands' previous Electricity Act had a clause limiting the total share of wind power in any individual island system to 12%.[63] This was originally included in order to ensure grid stability at a time when expertise in the field of wind power integration was less advanced. This restriction was eventually overcome by coupling the wind system on El Hierro with the integrated hydro storage system.

Additionally, despite the ongoing implementation of the wind-hydro system, analysts from the Canary Islands estimate that the total share of energy provided by the system will be approximately 80%. This indicates that El Hierro will need additional generation sources such as solar PV, and will need to expand efforts to adopt electric vehicles to reduce oil use in the transportation sector.[64] El Hierro will also face challenges similar to Cape Verde in supplying 100% of electricity needs on a daily as well as on a seasonal basis, a challenge that will require a far higher level of system integration and network intelligence than for interconnected systems such as Rhein-Hunsrück in Germany. Like Cape Verde, El Hierro will have to produce more than 100% of its total

63 http://www.unescocan.org/pdf/100RES.pdf
64 http://www.renewableenergyworld.com/rea/news/article/2012/10/creating-a-hybrid-hydro-wind-system-on-a-spanish-island?page=all

electricity needs most of the time, and store the excess in either its pumped hydro system, or divert it into others forms, such as thermal storage or in the form of desalinated water, which can be readily stored and dispatched.

Finally, developing and implementing the integrated wind-hydro hybrid system that forms that core of El Hierro's renewable energy strategy required a significant investment of time and resources that would have been difficult for a small island like El Hierro, with a population of just over 10,000 inhabitants. In achieving success, the support of both local and international institutes, of business partners, as well as funding bodies such as the European Union played an important if not invaluable role. Also the role of expertise will be particularly valuable for island regions around the world that are seeking to transition their systems to 100% renewable energy, in particular in light of the integration and storage challenges highlighted above. Overcoming these challenges will require developing solutions that are carefully adapted to the local context, and to the local energy demand requirements, and load patterns. A detailed system analysis, and a high level of planning and modeling to ensure that energy demand can be met 24 hours per day, and 365 days per year will be necessary.

Wind Farm in El Hierro

4. KEY FINDINGS

Drawing on the wide range of case studies above, there are a number of transferable policy lessons that can be useful for other governments around the world in establishing and achieving a 100% renewable energy target. This section highlights **five (5) key findings.**

Key Finding #1	Achieving 100% renewable energy can generate significant cost savings

There are quite a few positive economic and financial impacts of a 100% strategy that can be seen in several examples in this report, among them Cape Verde, Frankfurt, Rhein-Hunsrück District, Denmark and Tuvalu: These jurisdictions have managed to reduce their consumption of expensive and volatile fossil energy sources such as diesel and fuel oil, substituting them with local renewable energy resources. This represents direct cost savings for governments and utilities, as many renewable energy technologies are now cheaper than imported fossil resources. Energy consumers, e.g. in Cape Verde and Tuvalu, benefit from lower energy prices and enhance access to sustainable energy specifically in island-states and isolated areas. **Contrary to many arguments that transitioning fully to a renewably powered system would be too costly, case studies in this report demonstrate that the economics can be highly positive.**

In times of rising geopolitical tensions, significant energy price volatility, and global climate change, this benefit is a strong driver for 100% RE. Case studies analyses have shown that the reduction of fossil fuel imports and related economic savings are one of the key motivations for policy makers to implement a 100% RE target.

By reducing dependency on imported energy resources, an ambitious RE strategy can improve a jurisdiction's economic and energy security, bringing a wide range of direct and indirect benefits.

In many cases, the cost savings would be even higher if the substantial savings produced by offsetting fossil fuel subsidies were included in the calculation. In many countries, every litre of gasoline or diesel used for transportation or power generation translates into a direct loss for the government and burden for the national trade balance. It is estimated that annual fossil fuel subsidies aimed at reducing end-use prices alone (so-called 'consumption subsidies') totalled USD $ 530 Billion in 2012.[65] 100% RE would therefore be a solution for many governments around the world to build economic and social resilience, save money, and meet development goals.

Key Finding #2	100% strategies are not just for the wealthiest countries

As case studies like Bangladesh and Cape Verde or the example of Sumba in Indonesia are showing, a 100% renewable energy strategy can be a cost-effective solution to meet energy needs in jurisdictions at all levels of development. While some of these jurisdictions may need to rely more on external technical and financial support, the case studies demonstrate that **a 100% target is technically achievable in any country or jurisdiction, regardless**

65 See: http://www.economist.com/news/finance-and-economics/21593484-economic-case-scrapping-fossil-fuel-subsidies-getting-stronger-fuelling

of economic strength or GDP. In fact, small islands like Tuvalu in the South Pacific are demonstrating that least developed countries can experience significant direct benefits through the reduction of diesel imports, which consume a growing share of many island governments' budgets.

In addition, achieving 100% RE can provide a wide range of benefits that have a high priority among governments across the world, including reduced air pollution and health impacts, new and sustainable jobs, reduced freshwater demand as well as reduced fossil fuel import dependence. It can also produce a number of important health-related benefits in the least developed regions: since almost 3 billion people, mainly in South Asia and Sub-Saharan Africa suffer from both, erratic or no access to electricity and reliance on inefficient and polluting biomass fuels for cooking, increasing access to reliable, affordable and efficient renewables is essential to ensuring a more decent livelihood for all. This is also evident in the example of Bangladesh, where the Government, in partnership with a number of donor agencies, is achieving most of its rural electrification objectives using stand-alone solar home systems financed jointly between the end-user and international donor funds.

Key Finding #3	Transitioning to 100% RE can mitigate risks and make countries more resilient

The analysis of almost all case studies concludes that building resilience is one of the key benefits for countries, regions, districts, cities and communities around the world. 100% renewable energy systems mitigate risks by reducing the exposure to volatile fossil fuel prices, the risk of fuel supply disruption, as well as the risk of excessive import dependency. Cities like San Francisco, regions like Rhein-Hunsrück District and Fukushima, countries like Cape Verde and Denmark as well as islands like El Hierro and Tuvalu have identified this as one of the key motivations to phase out fossil fuels.

One of the lessons from El Hierro is that a holistic approach that integrates RE also in the transport sector can lead to a more resilient local economy. By transitioning its vehicle fleet to rely on domestically produced electricity, the island will effectively eliminate its reliance on diesel power. This will not only save the island millions of dollars per year in imported fuels: it will also reduce its exposure to fossil fuel price volatility, making it more resilient to external shocks and strengthening the local economy by keeping more of its income within the local economy in the region.

In an era of rapidly accelerating climate change, the awareness among policy makers of the additional risks and impacts of climate change is growing. By significantly reducing harmful emissions, **the transition to 100% renewable energy can be a powerful solution to increase the economic, social and infrastructural resilience to global climate change.** As a result, transitioning to 100% renewable energy can be understood as both mitigation (a way of reducing carbon emissions) *and* adaptation (a way of creating a society more resilient to external disruptions).

Key Finding #4	Committing to 100% RE can generate new economic activity, create jobs and improve life quality

Beyond generating economic savings for governments and citizens (see finding 1), 100% RE can also generate new economic activity, stimulate job creation and lead to clear improvements to quality of life. New business models for scaling up RE and providing energy services can help harness locally-produced energy sources and improve reliability. Models like San Francisco`s Community Choice Aggregator can help communities take greater control of their energy future; and the opening of the electricity market to independent power producers such as citizens and cooperatives seen in countries like Germany and Denmark can generate new forms of

local wealth and a greater degree of local ownership, and engagement. In Fukushima, the 100% RE strategy has catalysed several community power initiatives, and engaged a wide range of stakeholders who had not been part of the energy sector in the past.

Furthermore, the case studies also suggest **that improving energy efficiency and increasing reliance on locally available energy resources can have a direct positive impact on local economies,** including a host of positive multiplier effects as more money circulates within the region. This can be seen in the case of Rhein-Hunsrück in Germany, where its 100% strategy has already provided a significant boost to local economic activity and generated additional income for the District.

As jurisdictions embark on the journey towards 100%, they simultaneously develop a host of skills and technical knowledge that can be highly valuable both domestically as well as internationally. This was seen in the case of Cape Verde as well as El Hierro in the Canary Islands, where the local research institute ITC has become a hub for knowledge sharing and for providing advisory services to other island governments. The local expertise developed in the process of achieving a 100% target can therefore be valuable in its own right, and lead to spin-offs in both technological as well as in technical or consulting services.

Key Finding #5	Achieving a fully 100% RE system will require significantly expanding RE in the heating/cooling and transport sectors

As highlighted throughout the report, to date, far too little emphasis has been given to increasing the share of renewable energy sources in both the heating/cooling as well as the transport sector. First attempts and valuable lessons learnt can be found in Denmark, Costa Rica, San Francisco, Sydney, El Hierro as well as in Rhein-Hunsrück District. These examples suggest that **the significant expansion of RE in both the transport and heating/cooling sectors will need to become a strategic priority to achieve 100% renewable energy.**

In line with that, the analyses specifically of El Hierro and Rhein-Hunsrück District show that achieving 100% RE on a sustainable basis will require storing excess power in the form of heat in individual homes and businesses, in both hot water and refrigeration, allocating it to electric vehicles and other forms of storage, as well as offloading it into desalination, water pumping systems, demand response networks, and a host of other flexible loads. The total generation supplied by the energy and electricity systems should therefore be greater than 100% RE the majority of the time. This suggests that in order to achieve 100% RE on a stand-alone basis, electricity will need to be managed far more dynamically than in the past, and that electricity demand will need to become increasingly dispatchable.

This is an area where policy makers around the world need to devote more resources and attention, as the potential in both areas is tremendous, and in some cases even larger than in the electricity sector alone. This may involve increasing coordination between the electricity sector and the transport sector through the deployment of electric vehicle charging infrastructure, as seen in Costa Rica and San Francisco, or between the heating and the electricity sectors, as seen in Denmark and in Sydney Australia. Also the case of El Hierro suggests, the expansion of RE in other sectors like the transport sector can also lead to a more resilient and strong local economy.

5. RECOMMENDATIONS FOR POLICY MAKERS

Based on the analyses and five key findings outlined above, there are a number of policy recommendations that can help decision-makers in their efforts to set and achieve 100% RE targets. The first step in some jurisdictions is likely to be the hardest one, which is gathering the political support required to set a binding 100% RE target. As highlighted earlier in the report (see section 2), setting the 100% RE target is essential to catalyse action, and to mobilise stakeholders. Establishing a target can help provide a clear political mandate for action, helping streamline the process, attract investment, and improve coordination across multiple different actors and sectors. This is a common aspect across all of the case studies examined.

Once this first step has been achieved, jurisdictions can then start to identify specific policies that will help them achieve their objective. This may involve adopting a feed-in tariff to encourage more citizen investment in renewable energy supply, as in Germany, or developing a specific investment plan to support electric vehicle charging infrastructure, as in Costa Rica; it could also include broader measures such as undertaking ecological tax reform, to put a price on polluting sources of energy while encouraging investment in cleaner alternatives, as seen in Denmark. Ultimately, which policies are adopted will depend on the local context, the local energy mix, as well as on the available renewable energy potential.

Note that the recommendations included here are not jurisdiction specific: they are aimed at highlighting policy guidelines for a successful transition to a 100% renewable energy system.

#1 Make energy efficiency a top priority

A 100% RE target addresses both energy efficiency and energy generation. No region will meet its 100% RE target without simultaneously improving its energy efficiency. As a number of the case studies suggest, making energy efficiency a top priority is a critical part of achieving a 100% renewable energy future. Energy efficiency makes a 100% RE strategy easier and less costly to achieve, more sustainable in the long term, and supports the broader objective of decoupling economic growth from the growth in energy use.

In many of the case studies, such as in San Francisco, and in Frankfurt, energy efficiency has been identified as the cheapest way to help achieve the 100% RE target. In addition, jurisdictions like Denmark demonstrate that maximizing efficiency is not only about reducing energy needs but can also involve developing combined heat and power (CHP) infrastructure, and district heating networks, which can increase the full-cycle efficiency of delivered heat. These system-level approaches can be particularly important in reducing energy consumption in dense urban areas, by providing a more sustainable way to supply both residential and commercial heating and cooling needs. **By developing more efficient energy infrastructure,** including appliances and other end-use devices, **it becomes easier to develop, finance, and integrate the remaining infrastructure required to meet a jurisdiction's energy needs with locally available renewable resources.**

#2 Electrify the heating/cooling & transport sectors

Achieving 100% RE will require increasing the interconnection between the electricity, the heating/cooling, as well as the transport sectors. This allows renewable electricity to be channeled to a wider range of dispatchable end-uses such as in thermal systems, alternative forms of storage, or in electric vehicles. The examples of Denmark, Sydney, El Hierro and Costa Rica suggest that **transitioning the heating as well as the transport sectors to a greater share on electricity will need to become a policy priority in the decades ahead.** Further, the analyses of the case studies show that electrifying a greater share of the transportation sector will increase not only implementation flexibility, but also technical and engineering flexibility in achieving a 100% renewable energy target. In other words, the move toward greater electrification of heating and transport is likely to make it easier for jurisdictions to achieve their 100% RE targets.

Denmark for instance integrates renewable electricity in the heating sector through combined heat and power (CHP) fuelling its district heating infrastructure. Besides being highly efficient, this approach has added the benefit of being easily turned on and off, which gives it the flexibility needed to work well with an all RE system. Further, district heating infrastructure provides a form of decentralised storage for excess renewable power.

The example of Costa Rica shows that the electrification of the transport sector is key to mitigate climate change. Given that transportation represents approximately 44% of final energy consumption, efforts to diversify away from oil are a critical part of Costa Rica's long-term objectives and a key part of its efforts to tackle climate change. Combined with its abundant renewable energy resources, the shift to electric mobility in Costa Rica will help gradually transition both its electricity and its transportation system to a greater reliance on local and sustainable energy sources.

In line with that El Hierro experienced that a holistic approach that integrates RE also in the transport sector can lead to a more resilient local economy. By transforming the transport sector toward relying on domestically produced electricity, the island will effectively eliminate its dependence on diesel power. **One of the key lessons from these case studies is that a holistic approach combining the heating, power and transport sectors provides the foundation for a more reliable and robust energy supply system.**

#3 Maximize opportunities for citizen participation and the development of new business models

As seen throughout the case studies, adopting a 100% RE target can help mobilize thousands of actors across the economy toward achieving the target. This should be supported by implementing specific open-access and inclusive policies such as feed-in tariffs, offering targeted incentives, and by creating long-term investment certainty for citizens, local businesses as well as for international investors. Governments should aim to create inclusive policy frameworks that allow new business models to emerge as well as new forms of citizen engagement. **By providing market access to a wide range of stakeholders, policy makers can help build positive synergies across the region and help sustain the momentum required to achieve 100%.**

These new synergies can be seen in Germany's 100% RE regions network, in Frankfurt, Rhein-Hunsrück District, Denmark, San Francisco as well as in Fukushima Prefecture in Japan, where citizens, utilities and local businesses are partnering with research institutes, project developers, civil society groups as well as local governments. By providing market access to new stakeholders that have not been part of the energy

sector in the past, innovative business models emerge that help facilitate the transformation of the energy system. In other words, achieving a 100% RE target can enable policy makers to deliver simultaneously on a wide range of non-climate-related priorities.

An open-access energy system enables and strengthens cooperation, and a collective awareness of both the challenges, and the solutions available to overcome them. Moreover, as local opposition to energy infrastructure (in particular transmission projects) can be a major barrier to 100% RE, local and regional involvement of citizens and businesses help policy makers to overcome this hurdle and build public support.

The analyses of the German and Danish case studies in particular demonstrate clearly that participatory policy approaches can help a great deal to attract investments and to accelerate the transformation of the energy sector. Thus, **the transition to 100% RE is not just a switch from the combustion of fossil fuels to renewables: it is also an opportunity to strengthen and diversify the energy market, stimulate new forms of socio-economic development, and enable a wider range of stakeholders and citizens to participate in the financing and ownership of energy infrastructure.**

#4 Educate and inform citizens and businesses

As the case of Germany's 100% RE Regions, including Frankfurt and Rhein-Hunsrück District as well as Cape Verde and many others demonstrate, public awareness and education is absolutely critical to long-term, sustained success of a 100% RE strategy. As highlighted in the previous section, implementing **a 100% RE strategy requires the participation of a wide variety of stakeholders; this makes both the breadth and the depth of awareness crucial to long-term success.** Thus, educating citizens, improving awareness campaigns, and deepening public outreach must become higher priorities for policy makers seeking to achieve 100%.

This underscores the importance of the local education system, the role of the media, as well as the importance of citizens having open access to data and information. As the example of Frankfurt highlights, the engagement of local schools through a wide range of onsite projects and pilots is crucial to build a wider consciousness among the city's youth. In Cape Verde, media has helped create stronger public support for renewable energy, and a broader awareness of the issues related with its high dependency on fossil fuel imports.

The role of governments can also include publishing regular reports and updates, such as those prepared by the Federal Environment Ministry in Germany, or by the Danish Energy Agency in Denmark, to ensure transparency and improve access to information. Finally, direct engagement with citizens and businesses through conferences and consultations, as well as direct stakeholder engagement and participation in projects should be a central component of any successful, long-term 100% RE strategy to debunk myths around RE and educate people about the benefits.

#5 Adopt an integrated approach to fiscal, economic, and energy policy

The case studies included in this report suggest that only integrated strategies that adopt a long-term approach and that involve a broad spectrum of different government departments and agencies will succeed. As such, in order to be successful, a fully 100% RE strategy will require an integrated approach across policy areas such as fiscal, energy, economic, as well as infrastructure policy. Case studies such as Sydney, Frankfurt, Denmark and Cape Verde demonstrate that **a greater coordination between different levels of government is required.** In the process, **policy makers should aim to increase the coherence of their policy and planning processes**

and deepen the policy dialogue between previously distinct sectors and government departments. For instance, this can involve increasing the collaboration between the electricity and transportation sectors, or between the construction industry and the heating and cooling sectors.

As the case of Sydney demonstrates, an integrated approach can involve undertaking detailed sectoral analysis, and engaging stakeholders from each sector in the development and implementation of the strategy. Also, as seen in San Francisco, achieving the target without an integrated approach may not be possible in many cases, due to the prominent role played by certain traditional actors. This makes it important to engage stakeholders from different sectors early, and often, in the development and implementation of the strategy.

Further, achieving a 100 % RE target may require the cooperation of different Ministries, or government departments, that have not had a history of collaborating together. In the case of Denmark, for example, a core element underpinning its transition is its fiscal policy, which integrates the external costs of pollution into energy prices. This makes non-renewable resources in most sectors costlier than using renewable resources, thereby accelerating the transition through a better alignment of economic and environmental incentives. Similar lessons can be learnt from Cape Verde. An important component that has supported the success of Cape Verde's strategy is that it offers a tax exemption for the first five years of each RE project's operational life, with 50 % reduction offered for the following five years. The fiscal framework in Cape Verde also involves waiving export duties on certain RE products and components; some of the projects have also benefited from concessional financing, all of which help accelerate the transition to renewable energy technologies. However, in order to be adopted, these kinds of fiscal and economic policies required coordination from a wide range of different government departments.

The principle of policy coherence must also apply to the different government levels. Examples like Frankfurt, Rhein-Hunsrück District, Denmark and Fukushima prove that national and federal policies can trigger and support action on the regional and local level. In line with that, San Francisco and Sydney face bigger challenges due to the lack of policy coherence across governance levels.

All of these different examples demonstrate that a more holistic and integrated approach to fiscal, economic, and energy policy across governance levels is going to be necessary to achieve the transformation to 100 % renewable energy.

6. CONCLUSION: BUILDING THE POLITICAL WILL

The overall goal of this report is to outline solutions and implementation strategies that enable political decision makers at the national, regional and local levels to spearhead the energy transition. The analyses show that the importance of policies and regulatory frameworks cannot be overstated. Setting clear policy targets is hereby essential to provide investment security, mobilize stakeholders as well as improve the allocation of resources.

Based on case studies analyses, the policy handbook highlights five key findings that serve as transferable policy lessons. These key findings include both benefits and requirements that can be useful for other governments around the world in establishing and achieving a 100% renewable energy target.

#1	Achieving 100% RE can generate significant cost savings
#2	100% RE strategies are not just for the wealthiest countries
#3	Transitioning to 100% RE can mitigate risks and make countries more resilient
#4	Transitioning to 100% RE can generate new economic activities, create jobs, and improve quality of life
#5	Achieving a fully 100% RE system will require significantly expanding RE in the heating/cooling and transport sectors

Key Findings of 100% RE Case Study Analyses

Political decision makers are uniquely positioned to shape, advance and implement the sustainable development agenda based on 100% RE within their constituencies, countries and beyond. They can lead the development of relevant legislation and policies, monitor implementation, ensure oversight, accountability, and transparency. As elected representatives, they can help define the fiscal and budgetary priorities in a way that directly advances the goal of achieving 100% RE, and advances the goal of intergenerational equity. Indeed, as many of the case studies included in this report suggest, the transition to 100% will be a crucial part of forging a world that is more just, both toward current as well as toward future generations.

This policy handbook identifies five policy recommendations that can help policy makers in local, regional and national governments on all continents to realize 100% RE:

#1	Make energy efficiency a top priority
#2	Electrify the heating/cooling and transport sectors
#3	Maximize opportunities for citizen participation and the development of new business models
#4	Educate and inform citizens and businesses
#5	Adopt an integrated approach to fiscal, economic & energy policy

Policy Recommendations for achieving 100% RE

This publication underscores the fact that building political will is essential to catalyzing the transformation toward 100% RE. In his book "A Solar Manifesto", Hermann Scheer anticipated the rise of 100% renewable energy regions, and the potential role that they could play in mobilizing support for renewable energy worldwide: *"A … city or region that accomplished the transformation to solar energy … could start an avalanche by such an example, and with it, could cause political changes far beyond its own borders."*[66]
As Scheer understood well, **efforts to create societies entirely powered by renewable energy sources would generate countless virtuous cycles, as jurisdictions learn from one another and begin**

66 Scheer (2001), p. 244

moving toward a more sustainable paradigm. At the heart of these efforts is a movement of growing **awareness:** awareness of the increasing risks of our existing carbon-intensive growth paradigm; awareness of global climate change; and awareness of real, affordable alternatives.

As the case studies in this report show, continuously building **this awareness, both among citizens and political decision makers, is arguably a precondition to creating the kind of political will required to sustain and intensify the implementation of 100% RE strategies in the years ahead.** Indeed, it is noteworthy that in many of the case studies examined in this report, the political momentum has been maintained by citizens and civil society. This suggests that with the right level of awareness and education, the momentum can be created and sustained through increasing collaboration between stakeholders, including local businesses, media and civil society groups.

Building on these lessons, there are a number of specific actions that stakeholders and decision makers can take to help build the political will for 100% renewable energy:

- ✔ Inform and educate citizens and business leaders about the concrete possibility of a 100% renewable energy future
- ✔ Analyse the cost savings, environmental benefits, and improved economic security of a 100% renewable energy strategy
- ✔ Clearly communicate the economic advantages of renewable energy
- ✔ Build alliances across political parties and across sectors
- ✔ Engage citizens and investors

Policy Recommendations to build political will for 100% RE

As the various case studies have demonstrated, the motivations for establishing a 100% renewable energy target are diverse. They range from a growing awareness of the need to demonstrate leadership on tackling global climate change, to a desire for greater energy independence, to a need to reduce the vulnerabilities of relying on increasingly expensive fossil energy sources. Any attempt to build political will therefore need to take into consideration these local circumstances, develop a narrative that is compatible with the context and draw on the arguments that are most likely to be successful in each jurisdiction.

The vision provided by the emergence of 100% renewable energy regions is an inspiring one: it demonstrates that supplying 100% of a jurisdiction's energy needs with renewable energy sources is both technically and financially feasible, and can be achieved with today's technologies both by industrialized countries as well as in the Global South. The critical step is for policy makers at all levels to begin developing and implementing the policy frameworks required to support this transformation. In light of the tremendous inertia present in the global energy system, achieving 100% will not happen without good policies and a clear vision: it is only by putting these in place that governments can mobilize both the financial as well as the technological resources required to make this transition a reality.

REFERENCES

Asia Biomass Office (2013). Promoting the Introduction of Renewable Energies in Fukushima Prefecture, Available at: http://www.asiabiomass.jp/english/topics/1307_06.html

Brito, J. (2013). Cabo Verde: 100% RE Project. ECOWAS Wind Energy Workshop, November 5 2013; Praia, Cape Verde. Available at: http://www.ecreee.org/sites/default/files/event-att/100x_apresentacao_jb_para_ecreee.pdf

Cabeolica (2013). First Large Scale Wind Energy PPP in Sub-Saharan Africa, ECOWAS Wind Energy Workshop, November 5 2013; Praia, Cape Verde. Available at: http://www.ecreee.org/sites/default/files/event-att/cabeolica_2013_ecreee_regional_workshop_v6_final.pdf

Costa Rica (2011). Available at: http://www.renenergyobservatory.org/uploads/media/Costa_Rica_Producto_1_y_2__Ing__01.pdf

Costa Rica (October 13 2012). Costa Rica Committed to Renewable Energy, Available at: http://news.co.cr/costa-rica-committed-to-renewable-energy/15673/

Database on State Incentives for Renewable Energy (DSIRE) (2014). City of San Francisco, Available at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA211F&re=0&ee=0

Danish Energy Agency (2014). Energy Statistics, Available at: http://www.ens.dk/sites/ens.dk/files/info/tal-kort/statistik-noegletal/aarlig-energistatistik/figures2012.xlsx

Danish Energy Agency (2014). Danish Climate and Energy Policy, Available at: http://www.ens.dk/en/policy/danish-climate-energy-policy

Denmark (2013). Energy Policy Report, Report by the Ministry of Climate, Energy and Building to the Danish Parliament on Danish Energy Policy, Available at: http://www.ens.dk/sites/ens.dk/files/policy/danish-climate-energy-policy/dkenergypolicyreport2013_final.pdf

Denmark (2011). Our Future Energy, Available at: http://www.ens.dk/sites/ens.dk/files/policy/danish-climate-energy-policy/our_future_energy.pdf

e8 Group (2007). Energy in Action, Available at: http://www.globalelectricity.org/upload/File/07293_brochure_energyinaction-7_0_final.pdf

ECREEE (2011). Summary of Cape Verde Renewable Energy Plan, Available at: http://www.ecowrex.org/system/files/documents/2011_summary-of-cape-verde-renewable-energy-plan_ecreee.pdf

Elektra (2013). Cape Verde Utility: Annual Report, Available at: http://www.electra.cv/index.php/Download-document/55-Relatorio-e-Contas-2012.html

European Commission (March 17 2014). Energy Prices and Costs Report: Commission Staff Working Document, Available at: http://ec.europa.eu/energy/doc/2030/20140122_swd_prices.pdf

European Union (2013). Energy Statistics Pocketbook, Available at: Source: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf

Frankfurt am Main (2013) Masterplan 100% Klimaschutz, Available at: http://www.masterplan100.de/fileadmin/user_upload/content/pdf/ER_FlyerMasterplan.pdf

Frankfurt am Main (2008). Energie- und Klimaschutz-konzept, Available at: http://www.frankfurt.de/sixcms/media.php/738/Klimaschutzkonzept_web.pdf

Frankfurt am Main (2012). Masterplan für 100 Prozent Klimaschutz, Available at: http://www.frankfurt.de/sixcms/detail.php?id=2855&_ffmpar[_id_inhalt]=9276189

Fukushima Prefectural Government (December 2012). Plan for Revitalization in Fukushima Prefecture: Second Version, Available at: http://www.pref.fukushima.lg.jp/download/1/plan_for_revitalization2_outline.pdf

Go 100% (2014). City of Frankfurt am Main, Available at: http://www.go100percent.org/cms/index.php?id=136

Graça, D. (2013). Wind Farm of Santo Antao: The First IPP in Cabo Verde. ECOWAS Wind Energy Workshop, November 5 2013; Praia, Cape Verde. Available at: http://www.ecreee.org/sites/default/files/event-att/workshop_regional_cedeao_energia_eolica_electricwind.pdf

Greenpeace/GWEC/EREC (2012): Energy [R]evolution, available at: http://www.greenpeace.org/international/en/campaigns/climate-change/energyrevolution/

Greenbiz (2014). How a small Spanish island became renewable energy pioneer, Available at: http://www.greenbiz.com/blog/2014/03/03/how-small-spanish-island-became-renewable-energy-pioneer-el-hierro

Henning, H.-M. and A. Palzer (2012). 100% Erneuerbare Energien für Strom und Wärme in Deutschland. Freiburg (Germany) Fraunhofer-Institut für Solare Energiesysteme ISE

Homer Energy, (2013). The Problem with 100% renewable energy, Available at: http://blog.homerenergy.com/the-problem-with-100-renewable-energy/

Ifeu et al. (2010). Masterplan 100% Klimaschutz: auf dem Weg zur Null-Emissions-Kommune, Available at: http://www.ifeu.de/energie/pdf/Masterplan_100Prozent_Klimaschutz_ifeu.pdf

IfaS Report (2013). Cape Verde 100% Renewable Energy: A Roadmap to 2020, Institut für angewandtes Stoffstrom-management (IfaS)

International Renewable Energy Agency (IRENA) (2010). Renewable Energy Country Profile – Tuvalu, International Renewable Energy Agency (IRENA). Available at: http://www.irena.org/REmaps/countryprofiles/pacific/Tuvalu.pdf#zoom=75

Jacobsson, M. Z., Delucci, M. A. (November 2009). Scientific American, Available at: http://www.scientificamerican.com/article/a-path-to-sustainable-energy-by-2030/

Japan Times (November 11 2013). Floating Wind Turbine debuts off Fukushima, Available at: http://www.japantimes.co.jp/news/2013/11/11/national/floating-wind-farm-debuts-off-fukushima/#.Ut-3YIU1igQ

Klaus, T., C. Vollmer, et al. (2010). Energieziel 2050 – 100% Strom aus erneuerbaren Quellen. Dessau, Umweltbundesamt. http://www.iass-potsdam.de/sites/default/files/files/study_buergerbeteiligung_und_kosteneffizienz_0.pdf

Larsen, T. (2011). Greening the Danish Tax System. Available at: http://www.docufin.fgov.be/intersalgnl/thema/publicaties/documenta/2011/BdocB_2011_Q2e_Larsen.pdf

Mai, T., Sandor, D., Wiser, R., Schneider, T. (2012). Renewable Electricity Futures Study: Executive Summary. NREL/TP-6A20-52409-ES. Golden, CO. Available at: http://www.nrel.gov/docs/fy13osti/52409-ES.pdf

Marin, C., Alves, L. M., Zervos, A. (2005). 100% Renewable Energy Sources: A Challenge for Island Sustainable Development, Available at: http://www.unescocan.org/pdf/100RES.pdf

McIntyre, A., Bell, B., Uota, S. (2012). Tuvalu Infrastructure Strategy and Investment Plan, Pacific Infrastructure Advisory Centre, Sydney, Australia. Available at: http://www.theprif.org/sites/theprif.org/files/TISIP%20Final%20Report.pdf

Murray, Diane (April 16 2013). "Charting the Path to 100% Renewable," 100% Renewable Energy Conference, San Francisco

Neumann, W., (2012). Frankfurt am Main: Masterplan 100%, Kassel Conference Presentation, Available at: http://www.100-ee-kongress.de/fileadmin/redaktion/100-ee-kongress/Praesentationen/F7_Neumann.pdf

New York Times, December 14 2010: "San Francisco Eyes Goal of 100% Green Power by 2020," Available at: http://www.nytimes.com/gwire/2010/12/14/14greenwire-san-francisco-eyes-goal-of-100-green-power-by-39895.html

Norden Nordic Energy Research (2013). Wind power based pumped storage: Faroe Islands, Available at: http://www.nordicenergy.org/wp-content/uploads/2013/11/Wind-Power-Based-Pumped-Storage_Pre-Feasibility-Study_Suduroy-Faroe-Islands_2013.pdf

Pacific Gas & Electric (PGE) (2013). Energy Mix, Available at: http://www.pge.com/myhome/edusafety/systemworks/electric/energymix/

Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project, (PIGGAREP) (2013). http://www.ppa.org.fj/wp-content/uploads/2013/09/Tuvalu-Tariff-Review-Request-for-Proposal.pdf

PwC/PIK/IIASA/ECF (2010), 100% renewable electricity: A roadmap to 2050 for Europe and North Africa, Available at: http://www.pwc.ch/user_content/editor/files/publ_energy/pwc_percent_renewable_electricity.pdf

REEGLE (2014). Tuvalu Profile, Available at: http://www.reegle.info/profiles/TV

Rhein-Hunsrück-Kreis (2011). Rhein-Hunsrück District: From energy importer to energy exporter, Available at: www.taipei.diplo.de/contentblob/3433492/Daten/2068218/DownloadPresentationFleck.pdf

Renewable Energy World, (2012). Creating a hybrid hydro-wind system on a Spanish island, Available at: http://www.renewableenergyworld.com/rea/news/article/2012/10/creating-a-hybrid-hydro-wind-system-on-a-spanish-island

Rickerson, W., Couture, T., Glassmire, J., Lillienthal, P., Peralta, M. S. (2012). Renewable Energies for Remote Areas and Islands, International Energy Agency – Renewable Energy Technology Deployment (IEA-RETD), Available at: http://iea-retd.org/wp-content/uploads/2012/06/IEA-RETD-REMOTE.pdf

San Francisco Mayor's Renewable Energy Task Force: Recommendations Report (September 2012). Prepared by the San Francisco Department of Environment. Available at: http://www.sfenvironment.org/sites/default/files/fliers/files/sfe_re_renewableenergytaskforce recommendationsreport.pdf

San Francisco Water (2013). GoSolar Handbook, Available at: http://sfwater.org/modules/showdocument.aspx?documentid=4586

San Francisco Water (2014). Electric Vehicle Charging Stations, Available at: http://sfwater.org/index.aspx?page=516

San Francisco Water (2014). About CleanPowerSF, Available at: http://sfwater.org/index.aspx?page=577

Scheer, Hermann, 2nd Edition (2001). "A Solar Manifesto", London: James & James Ltd.

SMA (2012). Off-grid power supply for Motufoua Secondary School, Available at: http://www.sma.de/fileadmin/content/global/Products/Documents/Referenzanlagen/REFTUVALU-AEN122110.pdf

Solar Thermal World (September 20 2013). Long-term Experiences with Solar District Heating in Denmark, Available at: http://solarthermalworld.org/content/long-term-experiences-solar-district-heating-denmark-2013

Sydney, Australia (2013). Decentralised Energy Master Plan, Available at: http://www.sydney2030.com.au/wp-content/uploads/Decentralised-Energy-Master-Plan-%E2%80%93-Trigeneration-%E2%80%93-Adopted-15MB.pdf

The Economist (January 11 2014). Fueling Controversy: The economic case for scrapping fossil fuel subsidies is getting stronger, Available at: http://www.economist.com/news/finance-and-economics/21593484-economic-case-scrapping-fossil-fuel-subsidies-getting-stronger-fuelling

The New Scientist (January 6 2014). Renewable village offers lifeline to Fukushima farmers, Available at: http://www.newscientist.com/article/dn24816-renewable-village-offers-lifeline-to-fukushima-farmers.html?cmpid=RSS|NSNS|2012-GLOBAL|online-news#.UvzF34W6CQ3

Think Progress (February 5 2014). Fukushima Pledges 100% Renewable Energy, Available at: http://thinkprogress.org/climate/2014/02/05/3247591/fukushima-pledges-100-percent-renewable/

United Nations Education, Social, and Cultural Organisation (UNESCO) (2014). Island of El Hierro, Available at: http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/europe-north-america/spain/isla-de-el-hierro/

Vilar (Ed.) (2012). Renewable Energy in West Africa: Status, Experiences and Trends. ECREEE, Instituto Tecnológico de Canarias (ITC), Casa Africa: Praia, Cape Verde. Available at: http://www.ecreee.org/sites/default/files/renewable_energy_in_west_africa_0.pdf

World Future Council (2014). European Politicians across party lines call for long-term 100% target for renewable energy. Available at: http://power-to-the-people.net/2014/03/european-politicians-across-party-lines-call-for-long-term-100-target-for-renewable-energy/

World Future Council (2013). From Vision to Action – A workshop report on 100% Renewable Energies in European Regions. Available at: http://www.worldfuturecouncil.org/fileadmin/user_upload/Climate_and_Energy/From_Vision_to_Action_Policy_ Recommendations_for_100__RE_in_European_Regions.pdf

WWF/ Ecofys (2011): The Energy Report, Available at: http://wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions22/renewable_energy/sustainable_energy_report/

ABOUT THE WORLD FUTURE COUNCIL

The World Future Council consists of 50 eminent global change-makers from governments, parliaments, civil society, academia, the arts and business. We work to pass on a healthy planet and just societies to our children and grandchildren with a focus on identifying and spreading effective, future-just policy solutions. The World Future Council was launched in 2007 by Jakob von Uexkull, Founder of the 'Alternative Nobel Prize'. It operates as an independent foundation under German law and finances its activities from donations.

World Future Council
Mexikoring 29, 22997 Hamburg, Germany
Tel: +49 40 3070914-0
Fax: +49 40 3070914-14
E-mail: info@worldfuturecouncil.org

www.worldfuturecouncil.org
www.go100re.net

HOW TO DONATE

Donate by bank transfer to:
World Future Council Foundation
Reference: Global 100% RE Campaign
Institution: GLS Bank
Acc. No.: 200 900 4000
Sort Code: 430 609 67
IBAN: DE70 4306 0967 2009 0040 00
BIC (SWIFT-Code): GENODEM1GLS

or via www.worldfuturecouncil.org/donate.html

WWW.WORLDFUTURECOUNCIL.ORG WWW.GO100RE.NET