CLIMATE SERVICE CENTER

From vision to action

A workshop report on 100% Renewable Energies in European Regions

World Future Council

CSC Climate Service Center Germany

An institution of Helmholtz-Zentrum Geesthacht

Background information

This report is a documentation of the parliamentary hearing hosted by the World Future Council, the Nordic Folkecenter and the Climate Service Center (CSC) at the Helmholtz-Zentrum Geesthacht. The workshop took place on October 4th to 7th 2012 at the Nordic Folkecenter in Hurup Thy, Denmark. It provided a platform for policy makers and experts to share knowledge, exchange ideas, develop strategies and build up networks in order to implement the 100% Renewable Energies (RE) target across European regions. The overall goal was to enable decision makers from European regions to undertake the necessary political action to realize the 100% RE goal by presenting political instruments and strategies that showed success elsewhere in Europe. In this multi-stakeholder dialogue, 40 representatives from national, regional and local governments as well as academia and civil society from 15 European countries and Canada participated. The authors would like to thank the participants for their engagement in the workshop and the valuable input for this report.

For all presentations please visit:
www.power-to-the-people.net/100-renewable-energy-european-regions.

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1. Introduction

One of the most pressing challenges humanity faces today is the conversion of our energy production and supply industry to a more sustainable, environmentally responsible, and efficient system. The world's leading scientists have issued a mandate that this transition is the pREquisite for achieving the internationally agreed upon 2-degree Celsius cap on the average global surface temperature warming. This energy shift is not a lifestyle choice, but an essential way to preserve habitability of our planet and combat climate change. There can be no human development on an uninhabitable planet.

We urgently need democracies in which policymakers show leadership while ensuring that the public debate and expectations face a "reality check." Leadership, first of all, requires the truth: We have lived at the expense of nature and future generations, and these bills are now coming due. We are not as rich as we think we are, for much of our "wealth" represents claims on planetary resources that either do not exist or cannot be used without causing irreversible damage to the natural environment on which we all depend. The value of many current "investments" is based on expectations of future capital flows that the Earth can no longer deliver. We therefore need legal frameworks that ensure that we limit the use of resources and maximize their efficiency.

The choice and design of environmental policy instruments will play a crucial role. Best policies are the basis for achieving climate protection goals, assuring social and economic development, and securing the needed energy demand.

Europe is showing that we can move into a sustainable energy future based on cost-effective, clean and stable supplies. Renewable Energies (RE) accounted for more than 71% of total electric capacity additions in 2011, bringing RE's share of total electric capacity to 31.1%.[1] A number of European cities, regions and countries have already committed to and even achieved or surpassed generating 100% RE in the electricity, heating and/or transportation sectors.

New ownership models are required

Learning from frontrunner countries like Germany, Denmark, and Austria, we know that converting our energy system is more than substituting fossil and nuclear fuel with new energy sources like sun and wind. By its nature, RE technology is decentralized – because the source of energy is dispersed – and thus requires a completely different infrastructure and market than conventional energies. Evidence suggests that a true energy transformation must ensure wide participation of a broad range of stakeholders, including local citizens, and new ownership models. Only community-driven solutions are proving to enable our society to rapidly convert our energy production and supply industries.

New sources of energy, therefore, both enable and require major transformations in regions in which they are developed. On the ground experiences confirm that RE can actually result in enormous environmental and economic benefits. Positive municipal and regional economic developments generated by the use of renewable energies include saving fossil fuel costs, creating jobs and obtaining tax and lease revenues. Already today, businesses active in resource-efficient and RE technologies form a significant part of the European economy and provide millions of jobs in Europe.

1 REN21 (2012): Renewables 2012 Global Status Report: http://www.ren21.net/Portals/0/documents/Resources/%20GSR_2012%20highres.pdf.

However, the challenges for the energy system of each country are significant. Despite the encouraging development, Europe's energy system on the whole is still characterized by increasing energy consumption, rising costs, and ever greater dependence on fossil and nuclear fuel imports. The price of fossil fuels has tripled over the last decade and become more and more volatile. The current policy environment in the Member States, moreover, does not correspond with key challenges, such as grid integration of RE, costs of implementing RE technologies, and public participation. National, regional and local political decision makers, therefore, must be empowered to spearhead the energy transformation by creating policy frameworks and instruments that meet these challenges by moving from vision to action.

To that end, knowledge transfer and exchange between policy makers are vital. Networks between trailblazing countries must be established all over the continent to successfully implement the European energy transition to 100% renewable energies. Despite numerous good practices and successful policy instruments, this information does not always get through to government leaders. We need to facilitate dialogue, so that decision makers can learn from the invaluable experiences of the most successful countries, and scarce resources can be wisely used.

To this end, the World Future Council, the Climate Service Center (CSC) at the Helmholtz-Zentrum Geesthacht and the Nordic Folkecenter Denmark organised a parliamentary hearing on the topic of "Regional Development and RE in Europe: Best Policies for 100 % RE in European Regions". The workshop provided a platform for policy makers and experts to share knowledge, exchange ideas, develop strategies and build networks, with the overall goal of implementing the 100% RE target across European regions. It equipped political decision makers from European regions with the toolkit of political instruments, strategies, and actions that have proven necessary to succeed in reaching 100% RE targets elsewhere in Europe.

This report summarizes the key issues discussed during the invitation-only seminar and outlines solutions, implementation strategies and lessons learned from presented case studies. The overall aim is to educate and inspire the range of stakeholders who must engage, if we are to advance the goal of 100% RE in European Regions.

2. 100% RE in European Regions is reality already today

It is a fact that non-renewable energies will, by definition, deplete. It is also a fact that in the meantime, dependence on these energy sources is causing multiple existential global crises. If human beings are to preserve planetary habitability, we must soon shift to 100% RE in all sectors.

Against all obstacles and hurdles, winds of change are blowing through the European energy sector, and in many regions, 100% RE is reality already today. According to the German network of competence for distributed energy technologies – deENet – the main reasons communities are moving, or ought to move, towards 100% RE are economic development and creation of local value.[2] In line with those goals is independence from fossil fuel resources.[3]

Numerous local authorities and regions, especially in rural areas, have come to see that the transition to local renewable resources for energy supply is central to economic development. One reason is that everyone can participate in the decentralized development of RE, e.g. with public or community-based wind farms or solar systems. Additionally, installation, maintenance and operation of RE plant systems cannot be outsourced overseas and are mostly carried out by local businesses, e.g. tradesmen, technicians, agriculture and forestry workers. In other words, citizens, communities, and farmers, as well as small and medium-sized enterprises, all have the opportunity to benefit from and promote regional added value.

Increased local production of RE also reduces dependence on fossil and nuclear fuel imports and their rising prices. Indeed, more than half (53.9 %) of the EU's gross inland energy consumption in 2009 came from imported sources.[4] According to the International Energy Agency, the price of fuel imports totaled an estimated € 550 billion in 2011.[5] Local authorities and municipalities, as users of RE, can effectively reduce costs, e.g. through solar heating systems for their swimming pools or through harvesting the energy of biowastes in biogas plants. Instead of paying energy bills to international natural gas corporations and oil sheikhs, the money spent on energy remains in the region.

The following case studies show how RE technologies created regional and local value for communities in Germany, Denmark and Austria. What national political tools, technologies, resources, and local driving forces paved the way for these three countries to transition to such high shares of renewables?

2 The concept of value creation is used in various ways in economics. It includes net profits of the enterprises involved, net income of the employees involved, and taxes paid to the municipality.

3 Moser, P. (2012): Value creation in European communities and regions. Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

4 European Commission (2011): Energy production and imports. Eurostat, Data from September 2011: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Energy_production_and_imports.

5 International Energy Agency – IEA (2012): Impact of high oil prices on the economy: http://www.iea.org/publications/worldenergyoutlook/pressmedia/speeches/WEO-Speech-10April2012-Birol_2nd_set_oil_slides.pdf.

2.1 RE development in Germany

Since the 1970s, mounting concerns regarding the harmful impacts of fossil and nuclear fuels have propelled Germany's commitment to shift to a more sustainable energy system based on renewable resources. Germany has made significant strides, particularly in the power sector, increasing the share of renewable electricity sources from 3.1% in 1990[6] to more than 25% today.[7] With strong public and political support frameworks in place over the past decade, several towns and regions have committed to or already achieved – even surpassed – a 100% renewable electricity target. The country as a whole reached its 12.5% renewable power target by 2010 – three years ahead of schedule – and 20% in 2011. Germany is clearly on track to reach its renewable power goals of 35% by 2020 and 80% by 2050. Germany has set an official target of reaching 60% overall RE use by 2050. The German Federal Environment Agency (UBA) has created an even more ambitious roadmap for reaching 100% overall RE by 2050.[8]

The history of the German success story on transforming the energy sector can be summarized as follows: It was envisioned in the 1980s, went through an experimental stage in the 1990's, became mature policy in the early 2000's, and has been gaining momentum since. Chancellor Merkel and her conservative party threatened to undermine it by delaying the mandated shutdown of nuclear power until the Fukushima disaster in March 2011, when public outcry forced Merkel to champion the "Energiewende" or energy transformation. Although conservatives in the federal government continue to push back against the rapid uptake of renewable energy in Germany, there is strong bipartisan support on the local and regional level, and Germany remains one of the top front runner countries on renewables worldwide.

<u>1970's – 1998: The Beginnings</u>

The oil embargo of the 1970's catalyzed the first federal effort to promote RE in Germany. But this was limited to support for research and development, and the policy response primarily continued to center around nuclear and coal power.[9] This changed with the Chernobyl disaster in 1986, which sharply turned public opinion against nuclear energy. Concurrently, the first briefings on the climate crisis took place, and acid rain caused by fossil fuel pollution was making international headlines. National RE policy evolved to include the first efforts 1) to prioritize RE's access to the grid, 2) to compensate renewable power producers that fed electricity into the grid enough fees cost recovery of the technology plus a reasonable profit (aka "feed-in tariffs" or "FITs"), and 3) to simplify the process between generators and utilities for installing renewable power technologies.

6 German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety – BMU (2011): Erneuerbare Energien in Zahlen (RE Sources in Figures). December 2011: http://www.bmu.de/files/pdfs/allgemein/application/pdf/ee_zahlen_internet-update.pdf.

7 German Federal Association of the Energy and Water Industry – BDEW (2012): Erneuerbare Energien liefern mehr als ein Viertel des Stroms: http://www.bdew.de/internet.nsf/id/20120726-pi-erneuerbare-energien-liefern-mehr-als-ein-viertel-des-stroms-de.

8 German Federal Environment Agency – UBA (2010): Energy Target 2050: 100% Renewable Electricity Supply: http://www.umweltdaten.de/publikationen/weitere_infos/3997-0.pdf.

9 Lauber, V. and Mez, L. (2004): Three Decades of Renewable Electricity Policy in Germany. In: Mez and Lutz (Ed.): Green Power Markets. History and Perspectives. Energy & Environmen (Special Issue) Vol. 15, No. 6, pp. 599-623.

Local communities also began to pursue powering their homes and businesses with local renewable electricity sources like solar, wind, and biomass waste. A remarkable trailblazer on this front was Schoenau, a Black Forest town of about 2832 people that successfully fought to buy back the grid from the major utility, which had denied public requests to end use of nuclear power in the wake of Chernobyl. Shoenau started a citizen-owned municipal utility powered by local RE sources, which originally served 1,070 customers within the town.[10] Now this pioneering utility cooperative serves over 130,000 electricity customers and approximately 8300 natural gas customers throughout Germany, using 95% RE and 5% combined heat and power.[11]

1998 – 2004: The Dawn of strong Federal RE Policy

National RE policy, however, remained relatively timid and makeshift until the Social Democrats created a coalition with the green party in 1998. This "red-green" coalition made it a cornerstone of their policy platform to combine socio-economic development and environmental protection through modernization of ecological practices. They established the 12.5% renewable by 2010 target for the power sector, along with a 50% by 2050 target. In 2004, an interim 20% by 2020 goal was added. More recently, due to the overwhelming success of renewable electricity installation in Germany, that goal was reached ahead of schedule in 2011 and was therefore expanded to 35%. The 2050 goal was also increased to 80%. In 1999, the successful 1000 solar roof program was also augmented to a new goal of 100,000 solar roofs, with low interest loans as the incentive.

The real game changer, however, that was to put Germany on a trajectory of becoming a world RE leader, was the passage of the RE Sources Act (RESA or "EEG"). The first version of the Act was passed in 2000 and built upon previously adopted mandates that had prioritized uptake of renewable electricity into the grid and that had established feed-in tariffs (FITs). Under RESA, several modifications were made to existing law, including fixing the price of the feed-in tariffs for 20 years to promote investment, setting a degression schedule of the tariffs as technologies matured to ensure tariffs would not be excessive, and, for the first time, offering tariffs that favored photovoltaic, offshore wind, onshore wind in less favorable locations, and biomass. The new law also distributed the payment of the tariff over all grid operators and allowed utilities to be beneficiaries of the FIT. This legislation would spark unprecedented investor confidence, and with it, new industries and among the most rapid adoption of renewable power technologies seen yet.[12]

2004 - Present: Mature RE Policy Adoption and Implementation in Germany

RESA was modified in 2004 to decrease incentives for onshore wind, strengthen tariffs for solar power, biomass, and offshore wind, and further streamline dealings between generators and utilities.[13]

10 Gipe, P. (2006): Strom Rebels of Schönau – The Village That Built Their Own Solar Utility: http://www.wind-works.org.

11 Elektrizitätswerke Schönau – EWS (2012): Introducing the Elektrizitätswerke Schönau (EWS): http://www.ews-schoenau.de/fileadmin/content/documents/Footer_Header/2012-03_presentation__EWS_english_.pdf.

12 Lauber, V. and Mez, L. (2004): Three Decades of Renewable Electricity Policy in Germany. In: Mez and Lutz (Ed.): Green Power Markets. History and Perspectives. Energy & Environmen (Special Issue) Vol. 15, No. 6, pp. 599-623.

13 Lauber, V. and Mez, L. (2004): Three Decades of Renewable Electricity Policy in Germany. In: Mez and Lutz (Ed.): Green Power Markets. History and Perspectives. Energy & Environmen (Special Issue) Vol. 15, No. 6, pp. 599-623.

The results by the end of 2011: more than 65 GW of renewable electricity had been installed in Germany.[14] More than half of this amount is owned by citizens and farmers.[15] The recipe to the FIT's success was that it was a clever financing instrument that inspired investor confidence and allowed virtually everyone to participate. Participation triggered acceptance. Acceptance triggered mass scale investment. Investment triggered rapid decentralised renewable electricity installations.

Substantial economic benefits have resulted, especially on the regional and local levels. According to the German RE Agency, if renewable energies expand as forecasted, the total value creation for municipalities will increase from € 6,8 billion in 2009 to € 12,3 billion in 2020. Avoided expenditures for fossil fuel imports will amount to € 33 billion by 2020.[16]

Additionally, more than 300,000 new jobs have been created in the clean energy sector, about half attributed to RESA. Whole new industries have sprung up that supply not only Germany, but also export to countries around the world. Several rural towns that were suffering from unemployment and declining population as young people moved to the cities have been revitalized now that farmers have developed new sources of revenue by becoming RE producers. The number of locally owned energy co-operatives has risen six-fold since 2007, to 586 in 2012. Unlike the typical conventional, centralized power systems that tend to put money in the pockets of large corporations and major developers, Germany's energy renewable revolution is mainly being driven by regular citizens, farmers and small businesses.[17]

Several other provisions have complimented Germany's RE law in recent years. In 2000, for instance, lawmakers negotiated the Nuclear Exit Law to phase out nuclear power in Germany by 2020. This mandate spurs RE advancement by effectively leaving a vacuum to fill where a large power source once existed. It also removes a technical barrier to mass scale renewable electricity because much renewable power – chiefly that from wind and solar – is intermittent and thus incompatible in large amounts with nuclear reactors, which are not flexible or easily dispatchable. Wind farms have, in fact, at times been forced to shut down to accommodate cumbersome nuclear power plants, lest the grid be overwhelmed with too much electricity. A renewable power mix not only requires nuclear power to end by definition, but also by technical necessity.

As previously mentioned, the Nuclear Exit Law was dealt a setback when Angela Merkel, who was elected Chancellor in 2005, and her conservative party took steps to delay its implementation. However, in the wake of massive public outcry after Fukushima, Merkel recommitted to the nuclear power ban in Germany, which is currently set to be complete by 2022. Within weeks after the disaster hit in Japan, Germany shut down 8 of its 17 nuclear power plants.

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14 German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety – BMU (2012): Erneuerbare Energien in Zahlen – Internet Update ausgewählter Daten (RE Sources in Figures), December 2012: http://www.erneuerbare-energien.de/fileadmin/Daten_EE/Dokumente__PDFs_/20130114_BMU_EEiZ_Herbst12.pdf.

15 Gipe, P. (2012): "Citizen Power" Conference to be held in Historic Chamber Where World's First Feed-in Law Was Enacted: http://www.windworks.org.

16 German Renewable Energy Agency (2010): Value Creation for Local Communities through Renewable Energies: http://www.unendlich-viel-energie.de/uploads/media/46_Renews_Special_value-creation_for_local_communities.pdf.

17 Gipe, P. (2012): "Citizen Power" Conference to be held in Historic Chamber Where World's First Feed-in Law Was Enacted: http://www.windworks.org.

Additionally spurring Germany's RE commitment has been the nation's Integrated Energy and Climate Programme and ambitious greenhouse gas reduction targets to combat climate change. Clearly, these targets cannot be met without a rapid shift to RE. The German government has declared goals of reducing GHG emissions 40% by 2020 and 80-95% by 2050. Because of Germany's robust RE and efficiency implementation, the country managed to lower GHG in 2011 by 26.5% compared to 1990 levels, even with the shutdown of the 8 nuclear power plants since Fukushima. This exceeded the Kyoto Protocol target of 21% by 2011.[18]

Other policies that have complimented Germany's direct commitment to RE implementation include:

- eco-taxes on petroleum and conventional power use
- strong building insulation standards
- labeling of efficiency performance for buildings
- development of RE storage options
- promotion of smart grid technologies
- the requirement and promotion of energy efficient technologies, such as combined heat and power (CHP), power saving light bulbs, and efficient appliances
- the German government's development bank, KfW, which provides low interest loans program that have promoted quicker adoption of RE and efficiency improvements
- automobile emission standards that encourage fuel efficiency.

18 German Federal Environment Agency – UBA (2012): Less greenhouse gases with less nuclear energy. http://www.umweltbundesamt.de/uba-info-presse-e/2012/pdf/pe12-17_less_greenhouse_gases_with_less_nuclear_energy.pdf.

2.2 RE development in Denmark

Germany has undoubtedly raised the bar on setting the pace for RE policies. But it is not the only European country to have embraced the transition and to have reaped environmental and economic benefits. Another leader has been Denmark. The birthplace of the modern wind industry and the original FIT policy concept, Denmark is also pioneer of the first mandated national target in the EU to achieve 100% RE – specifically 100% renewable power, heating, and transportation by 2050.

30 year history of local RE development

When Denmark began its exploration of renewables in the wake of the 1970's oil crisis, the country was completely dependent on petroleum for energy. Ever since, the Danes have prominently led the way on wind and Combined Heat and Power (CHP) and firmly resisted nuclear and coal power. The main objectives of Danish energy policy since the 1970s have been: secure energy supply, diversified use of energy sources, environmental and climate friendly energy use, and cost effectiveness.

The Danes developed a clear understanding that RE technology can drive local development, which has supported continued expansion of their renewable economy even in the face of opposition. In 2002, despite Liberal-Conservative government efforts to cut the RE programs, wind power per capita remained among the highest in the world, and in 2009, was responsible for close to 25,000 jobs.[19]RE had become so deeply rooted among the Danish people as the only realistic long-term solution, that in 2008, the prime minister declared the goal for Denmark to be a fossil-free society, setting a target of 100% overall RE by 2050.

Many Danish communities and regions prove that this is a realistic target. In the region of Thy, for example, farmers, industry, utilities and cooperatives have extensively invested in and used RE resources for the past 30 years.

By 2011, almost 80% of the power consumption added (340 GWh) was covered by wind energy (power production from wind energy 265 GWh). The other 20% came from biogas, CHP waste and a very small amount of PV solar.

The area is home to 226 windmills, with further investment expected. 80 to 100 MW of new wind projects are in the planning process, as part of the municipal plan for Thy city of Thisted. The annual income may reach up to € 7 million, which will be earmarked for local energy initiatives, underscoring the policy shift from supporting investors to securing local energy supply.

Experts offer three key observations on Thy's successful RE development: 1) Thy actively engages citizens in this process. 2) The region involves local companies. 3) They use mature technology that exists in the field.

Local ownership of RE is a prevailing theme throughout Denmark. Local residents have invested as much as € 16 million in RE projects. Over 100 wind energy cooperatives have a combined ownership of three-quarters of the country's turbines. The price per kWh for electricity from community-owned wind parks is not only competitive with conventional power production, but also is half the price of electricity from off-shore wind parks.[20]

19 International Renewable Energy Agency – IRENA (2011): IRENA Working Paper – Renewable Energy Jobs: Status, Prospects & Policies: http://www.irena.org/DocumentDownloads/Publications/RenewableEnergyJobs.pdf.

20 Maegaard, P. (2012): Democratization of the Energy Sector. Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

Combining Intermittent RE with CHP and District Heating for Added Value and Reliability

Denmark has also found an answer to the key challenge of integrating wind energy fluctuations. The Danes have managed to combine and integrate such intermittent renewable power technologies with district heating and cooling and units, to create truly autonomous systems. When wind power is packaged with CHP, rather than standing alone, these technologies together provide a more reliable and robust supply than either can achieve on its own.

CHP has achieved high penetration in Denmark. The country is reported to have about 60% CHP in its energy mix, compared to about 10% CHP in all of Europe.[21] Besides being highly efficient, CHP has the added benefit of being easily turned on and off, which gives it the flexibility needed to work well with an all RE system. Typically CHP uses natural gas, but plant based fuels have also been used in Denmark and will substitute natural gas, as the country phases out fossil fuels.

The CHP units in Denmark are also used to fuel a decentralised district heating infrastructure, which triples energy efficiency and provides decentralised storage.

District heating systems has a long history in Denmark dating back to the 1950s. Instead of using fossil fuel burners for space heating and domestic hot water, the new infrastructure enabled people to supply heat at reduced maintenance and cost.

The majority of district heating loops in Denmark were owned by the inhabitants of the community. This gave control to the people and ensured that energy was distributed to the communities at fair prices. In addition, the savings due to the increase in efficiency could be reinvested in the community or given back to the energy consumers in the form of lower heating costs.

In many countries, the necessary infrastructure for CHP is already in place. With modest investments, its fuel can easily be changed from fossil fuel to local RE sources. The combination of high total efficiency and two energy products from the same fuel source can help reduce costs of power and heat.

Policies to promote RE Development

Denmark's robust local RE development, like Germany's, was enabled by the political framework. Two key policies especially drove regional value creation and empowered local citizens to benefit from the energy transition: 1) Only local public companies can obtain permission and access to sites for wind turbines for collective supply. 2) Income from local wind power can only be spent by the local green foundation for common good energy purposes. These laws together prompted municipalities, regional governments and local enterprises to prioritize generating local energy supply.

An example of how these policies have translated to action and benefits at the local level is the town of Hvide Sande on the Danish west coast. In December 2011, three wind turbines at the Hvide Sande harbour were installed. In accordance with Danish law, 80% of the project is owned by the Holmsland Klit Tourist Association foundation, a local business fund which initiated and financed the installation. Hvide Sande's North Harbour Turbine Society pays an annual rent of € 644,000 to the local harbour. The other 20% of the project is owned by local residents living within a 4.5 km radius, per the national policy (Danish RE Act). This wind co-operative has a total of 400 local stakeholders, and with an annual return of 9 to 11%, the turbines are expected to pay for themselves in 7 to 10 years. The fund is used to initiate new business initiatives for the benefit of the harbour and local municipality.

21 Maegaard, P. (2013): Danish Renewable Energy Policy: http://www.wcre.de/en/images/stories/pdf/WCRE_Maegaard_Danish%20RE%20Policy.pdf.

2.3 RE development in Austria

High Penetration of RE

With renewable resources making up almost 31% of energy consumption in Austria, the nation is another leading EU Member State in RE development. Between 2008 and 2010, green industry grew in Austria by 5.8%, while the national economy grew by only 1.2% during the same period. In 2008, there were approximately 194,000 green jobs in Austria, and by 2010, this figure had grown to 210,000, an increase of 9.6 %.[22] Such statistics suggest Austria has begun to embrace the opportunities, as well as meet the challenges, of the transition to renewable energy.

Austria has also joined the movement to 100% RE. For example, the Austrian state of Burgenland recently began producing as much power as it consumes with wind.[23] Additionally, the town of Guessing is among the first in the EU to have achieved the 100% RE goal. Guessing overcame economic hardship with a plan that included supplying 100% of its energy supply with local resources, and not only did it succeed, but the town actually produces about 10 times more energy than it needs and approximately 40 times more electricity than it uses, all with renewable resources. This effort created 1,000 jobs, about 100 of which are directly in the energy sector, and made Guessing an international tourist destination. Guessing inspired its state, Upper Austria, to commit to achieving 100% RE in the power and heat sectors by 2030.[24]

Austria's Policies Supporting RE

The national policies that allowed Austria to reach such a high share of renewable energies were a combination of laws like the Green Electricity Act[25] and the Act on the Support for Environmental Measures[26], regional initiatives like Climate Protection klima:aktiv[27], and support schemes like the Climate and Energy Fund.[28]

The 2012 Green Electricity Act established a combination of feed-in tariffs and investment grants. Unlike in Germany, there is no exemption for paying the tariff for intensive energy users. There are also bonuses allowed on top of the feed-in tariff for some green technologies, such as high efficiency cogeneration units that produce both electricity and heat using renewable resources.

The Act on the Support of Environmental Measures was first established in 1993 and has been continuously updated to provide funding for a broad range of domestic and international programs that reduce air pollution and climate changing emissions.

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22 Liebel, G. (2012): What Policies Do We Need to Achieve 100% Renewable Energy. Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

23 Oekonews (2013): Burgenland is the world's first wind power autonomous province (German): http://www.oekonews.at/index.php?mdoc_id=1077187.

24 Go 100% (2013): Region of Upper Austria: http://www.go100percent.org/cms/index.php?id=70&tx_ttnews%5Btt_news%5D=41.

25 European Commission (2012): State aid: Commission approves Austrian support scheme for renewable energies „2012 Green Electricity Act". Press release: http://europa.eu/rapid/press-release_IP-12-111_en.htm.

26 Justice and Environment (2011): Climate Change Legislation Austria. Report on the Concepts and Directions of Climate Legislations: http://www.justiceandenvironment.org/_files/file/2011%20CC%20AT%281%29.pdf.

27 www.klimaaktiv.at.

28 Klima und Energiefonds Österreich (2013): Climate and Energy Model Regions. An Austrian blueprint for a successful bottom-up approach in the field of climate change and energy: http://www.klimafonds.gv.at/assets/Uploads/Downloads-Frderungen/KuE-Modellregionen/Fact-Sheet-Climate-and-Energy-Model-Regions.pdf.

Established in 2004, Climate Protection klima:aktiv is a regional program that supports training, networking, awareness raising, and guidance in the fields of green building, renewable energy, and sustainable transportation. The program receives millions in funding annually, has helped promote Austria' transition to a green economy, and prevents the equivalent of approximately 1.3 million tonnes of CO_2 emissions every year.

The Climate and Energy Fund was founded in 2007 by the Austrian Federal Government to develop new, innovative ways to combat climate change and support sustainable development. Since its inception, a total of € 730 million has been made available for the Fund's activities. The Fund bases its actions on two principal goals – sustainability and efficiency. It finances projects in the fields of climate protection and energy research, mobility and market penetration. By the end of 2011, 38,000 projects had been completed. The Climate and Energy Fund supports regions that have made "becoming independent of fossil fuels" their prime target. This target is fulfilled by drawing on the regions' own resources and by meeting energy demand with a smart mix of RE generation, enhanced energy efficiency and smart controls.

The Climate and Energy Fund, echoing Germany's and Denmark's energy policies, encourages a decentralized approach. The country already has more than 80 Climate and Energy Model Regions encompassing almost 900 municipalities and two million people, all of which are setting the course for Austria's target of becoming energy independent by 2050. Over the course of a year, the amount of RE produced in these regions must equal the annual energy consumption. These Model Regions build a large, well-established, interlinked and coordinated network to which the national Climate and Energy Fund has provided € 17 million since 2009.[29]

The Austrian government has identified three factors for successful implementation:

1. *Developing an implementation concept that describes the status quo, sets goals + benchmarks, identifies potentials, and sets out concrete actions* – Limiting the size of a model region to a maximum number of 60,000 inhabitants has proven to be ideal.

2. *A "driving force" on location (e.g. model region manager)* – The success of a model region often depends on a single person driving the implementation of projects of the action plan. This person also acts as contact person for the stakeholders of the region.

3. *Integrating the region into the development process* – Cooperation among stakeholders, including local businesses, policy makers and citizens, increases awareness about the project and anchors its development within the region. Co-financing by local communities is also a crucial factor in ensuring the transition is economically feasible and culturally accepted.

29 Klima und Energiefonds Österreich (2011): Smart Cities – Städte mit Zukunft: http://www.klimafonds.gv.at/assets/Uploads/Broschren/brosmartcitiesRZscreen-1.pdf.

A study from October 2012 by the Austrian Institute of Economic Research shows that the nation's investments and instruments for energy efficiency and the uptake of RE could have a positive long-term effect on the national and local economy. The data shows that the Austrian GDP could rise by 0.3% in the short term (with no change of capital stocks) and by 2.3% in the long term (with a change of capital stocks). The local economy in all provinces already is benefiting in the short term, due to falling demand for petroleum products. The model region Steiermark could see its GDP rising by 0.6%, and Upper Austria could see a GDP increase of 0.5%.[30] The study's scenario without the implementation of these policy measures notably shows that the national and regional GDPs will decrease.

Like Germany and Denmark, Upper Austria sees a great potential to create green jobs with its 100% RE policy framework. In addition to the before mentioned jobs created in the town of Guessing, the state is reported to employ more than 4,500 workers in a network of green energy companies with an annual turnover of over € 1.5 billion.[31]

30 Österreichisches Institut für Wirtschaftsforschung – WIFO (2012): Volkswirtschaftliche Effekte von Maßnahmen zur Steigerung der Energieeffizienz und des Anteils erneuerbarer Energien in den österreichischen Klima- und Energiemodellregionen: http://www.wifo.ac.at/wwa/downloadController/displayDbDoc.htm?item=S_2012_ENERGIEEFFIZIENZ_45538$.PDF.

31 Öhlinger, C. and Egger, C. (2009): Electricity Efficiency Policy in Upper Austria: http://www.aaee.at/2009-IAEE/uploads/fullpaper_iaee09/P_169_Egger_Christiane_29-Aug-2009,%206:57.pdf.

3. 100% Renewable Energies: Thinking together mitigation and adaptation strategies

European communities and regions are facing challenges and opportunities as they progress toward their climate change and 100% RE targets. Therefore, there is an urgent need, and as the following chapter shows also a high potential, of bringing together mitigation and adaptation strategies.

The option of climate change adaptation is becoming more and more important in climate change policy. Especially in view of the failure of international negotiations on climate protection and the improbability of a trend reversal in the climate changes that have already occurred, responding to climate change now involves both mitigation to address the cause and adaptation as a response to the changes.[32]

A decentralised energy system based on 100% renewable energies might be a promising way to combine both mitigation and adaptation, since it contributes to climate mitigation by reducing greenhouse gas emissions and helps communities adapt to climate change impacts by reducing vulnerability of the total energy system.

Overview: adaption and mitigation

Adaptation is an action that aims to reduce the vulnerability of a system and to enhance its resilience against actual or future impacts of climate change. During an adaptation process, measures and behaviours to prevent, moderate, cope with and take advantage of climate change events are planned and implemented.[33] In politics, adaptation is often seen as opposite to climate protection (aka ”mitigation”). Mitigation aims to implement policies that stabilize the concentration of greenhouse gas emissions in the atmosphere by reducing them and enhancing greenhouse gas emissions sinks.[34] Adaptation is implemented on – and benefits – a local or regional scale, whereas mitigation has global benefits. Moreover, adaptation actions have an influence in the short-term, while the impact of mitigation options is long-term. This section, however, shows that adaptation and mitigation are two sides of the same coin and that 100% RE can address the two challenges with one solution.

Currently, various countries have already initiated a process of adaptation by drafting strategies or catalogues of measures. Climate change is viewed as a complex set of risks, the impacts of which vary between regions and sectors. The aim of climate adaptation is to reduce the related negative costs and impacts of climate change and to take advantage of any new potential opportunities that may by adjusting to a changing climate.[35]

32 Heuson, C., Gawel, E., Gebhardt, O., Hansjürgens, B., Lehmann, P., Meyer, V. and Schwarze, R. (2012): Fundamental Questions on the Economics of Climate Adaptation – Outlines of a New Research Programme. UFZ-Report 05/2012.

33 World Bank (2012): Adaptation guidance notes – Keywords and definitions, http://climatechange.worldbank.org/climatechange/content/adaptation-guidance-notes-key-words-and-definitions.

34 IPCC (2007): Summary for Policymakers. In: Climate Change (2007) The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA.

35 Heuson, C., Gawel, E., Gebhardt, O., Hansjürgens, B., Lehmann, P., Meyer, V. and Schwarze, R. (2012): Fundamental Questions on the Economics of Climate Adaptation – Outlines of a New Research Programme. UFZ-Report 05/2012.

Taking a more detailed look at implications of climate change for the energy sector, the following risks can be identified:[36] Direct physical impacts and damages to the transmission and distribution grid are to be expected, due to more intense extreme weather events like storms, floods or thunderstorms. Adverse impacts of extreme weather periods like heat and drought are expected to cause problems for the cooling of thermal and nuclear power stations, along with decreased efficiency. Indirect impacts include increased demand – e.g. during heat waves – on transmission infrastructures. Furthermore, energy system vulnerability will likely be heightened with a higher amount of transmitted energy and subsequently less domestic supply in many regions.

As regions progress toward 100% RE targets, it is reasonable to expect that risks will generally decrease. Unlike centralized conventional power plants, which can take days or weeks to power up after a storm, most renewable power technologies can be turned on immediately. The problem of cooling water for thermal power plants will be reduced by modern renewable energies, many of which use little to no water and none of which pollute water with warming or contaminants. With the exception of biomass, which is affected by climate change due to effects on vegetation growth, and hydropower, which may be impacted by climate related drought, renewable energy sources also are not at risk of diminishing significantly in a changing climate. Moreover, renewable energies can be implemented successfully in every region, as Germany has shown with its rapid uptake despite relatively low renewable energy sources.

The growing relevance of adaptation is further reflected in new regulations addressing critical infrastructures. For example, in the Council Directive on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection, the European Council identifies the energy sector as one critical infrastructure in the European Union.[37] The relevant sector thereby can be split into subsectors like the electricity subsector, which includes infrastructures and facilities for generation and transmission of electricity in respect of supply electricity. For instance, the UK Climate Change Act 2008 includes new obligations for the energy sector as critical infrastructure to prepare reports on how they assess and act on the risks and opportunities from a changing climate. The reporting mainly covers an assessment of the current and predicted impacts of climate change in relation to the reporting authority's functions, as well as a statement of the reporting authority's proposals and policies for adapting to climate change in the exercise of its functions and the time-scales for introducing those proposals and policies.[38] It is to be expected that also in other European countries, actors in the energy sector will be confronted with increasing legal obligations regarding their efforts to adapt to climate change.

36 Bardt, H. (2012): Implications of climate change for the supply of energy. Presentation held at the Parliamentary Hearing on 100% RE in European Regions. McCallum, S. (2012): Adaptation of Energy Infrastructure to Climate Change – What role for Policy Makers? Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

37 EC (2008): Council Directive 2008/114/EC of 8 December 2008 on the Identification and Designation of European Critical Infrastructures and the Assessment of the Need to Improve their Protection, Brussels.

38 Hendel-Blackford, S. (2012): Legal Obligations on Adaptation – The energy sector as critical infrastructure. Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

Some main targets for adaptation are briefly outlined as follows: 1. Strengthen climate-proof transmission infrastructure by mapping vulnerable hotspots. 2. Climate-proof the design of new RE infrastructure and thereby safeguard energy production. 3. Reduce or eliminate seasonal climate-induced demand peaks threatening supply and transmission, e.g. by promoting building isolation and regulating energy demand reduction. 4. Enable storage capacities to provide crucial buffers for the European energy market and to allow for higher shares of RE. 5. Find solutions to manage the complex relationships between decentralized energy systems, land use, and adaptation.

Furthermore, it is important to underline the necessity of government intervention, as well as the role of policy makers on different governance levels in the adaptation process. Adapting to changing framework conditions is surely not a novel phenomenon, but rather an ongoing task for all societies and economic players. Governments and specifically national policy makers therefore play a key role in elaborating adaptation strategies for the energy sector and support the implementation of measures against a regional background of expected climate impacts. They need to ensure that mitigation targets and according energy mixes are climate proofed and promote energy efficiency and sufficiency by environmental policy instruments. On the European level, political decision makers must set a clear focus on the European transmission grid safety, sufficient redundancies and cross-border connections. Likewise, the EU should promote research on the energy sector vulnerability, measures to increase energy sector resilience (e.g. investment in research on alternative storage technologies) and climate-proofing RE supply. Finally, it is important to mainstream adaptation of concrete measures into mitigation policies in order to cut-off peak demands during e.g. heat waves. For all concrete adaptation measures in the energy sector, joint efforts across all governance levels are needed and also public-private-partnerships seem to be one key factor for success.[39] Additionally, since climate change impacts are local and need locally tailored responses, there will be a growing future responsibility for local actors.[40]

Another urgent challenge that presents high potential of bringing together mitigation and adaptation strategies is the problem of land scarcity. This is already being done in the Netherlands by so called "Energy Islands".[41] The Energy Island concept is to bring together on a single floating structure a variety of renewable energy conversion systems to maximise the energy production available from the diverse sources available, so that the interrelated systems can assist each other to reach greater efficiencies of conversion. Energy islands are artificial islands at sea. The energy production is therefore moved further away from settlements to solve the challenge of land scarcity and conflicting land use. This program takes into account the high potential of implementing no-regret or low-regret measures, such as smart and flexible infrastructure, increased energy efficiency, energy demand management, and building insulation. Each of these has positive implications for mitigation through reduced energy consumption for heating and cooling. Positive implications for adaptation include protection from heat and human health benefits.

39 McCallum, S. (2012): Adaptation of Energy Infrastructure to Climate Change – What role for Policy Makers? Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

40 Bardt, H. (2012): Implications of climate change for the supply of energy. Presentation held at the Parliamentary Hearing on 100% RE in European Regions. McCallum, S. (2012): Adaptation of Energy Infrastructure to Climate Change – What role for Policy Makers? Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

41 Scheele, U. (2012): Energy landscapes. Presentation held at the Parliamentary Hearing on 100% RE in European Regions.

Another positive example of a strategy that supports climate change adaptation and mitigation is passive-solar housing design. This approach uses the sun's natural light and heat to reduce electricity needs and captures natural breezes to reduce air-conditioning demand. Passive solar buildings both produce fewer greenhouse gas emissions and may be also more suitable for a warmer, sunnier climate.

On the other hand, it is important to avoid mal-adaptation – or adaptive responses that actually increase our greenhouse gas emissions and make the problem worse. A simple example of such a counterproductive strategy would be installing more air-conditioners that run on coal-fired electricity as a response to more frequent heat waves.[42]

Bottom line: If we want to be successful on the way from vision to action in implementing a real sustainable future energy system in Europe, there is an urgent need to combine mitigation and adaptation strategies. A promising first step would be to identify possibly low-regret or no-regret adaptation measures that do not necessarily depend on reliable climate impact projections.[43]

42 Moser S. C. (2012): Adaptation, mitigation, and their disharmonious discontents: an essay. In: Climatic Change (2012) 111: 165–175.

43 Heuson, C., Gawel, E., Gebhardt, O., Hansjürgens, B., Lehmann, P., Meyer, V. and Schwarze, R. (2012): Fundamental Questions on the Economics of Climate Adaptation – Outlines of a New Research Programme. UFZ-Report 05/2012.

4. Rate Limiting Factors for the transition to a 100% RE Society

The speed and scale of RE advancement in Europe will depend on the rate of progress on a number of fronts. Four key factors particularly influence the pace of RE adoption:

1. Technology availability and market maturity

2. RE resources

3. Local driving forces

4. National policy

In the following, these four rate-limiting factors will be described in order to build the basis for a development of a roadmap with concrete implementation.

4.1 Technology availability and market maturity

Clearly, accelerated RE use depends directly on appropriate technologies being developed, manufactured, and reaching the market place. Volume production is necessary to bring down costs and help make these technologies affordable and widely available to users.

Europe would not have adopted the quantities of RE it has in recent years without this type of technological readiness. It is hard to imagine how Germany, for instance, would have managed to install nearly 30 gigawatts of solar power[44] in the last decade and a half without evolution in photovoltaic technology, including improvements in durability and efficiency, growth of a skilled workforce to manufacture, sell, and install the solar equipment, and a production capacity and global market that became large enough to affect dramatic and steady price reductions.

Currently, RE technology is clearly advanced enough to have allowed several towns, even regions, in Europe to produce all their power and heating needs with renewable sources. In the transportation sector, towns like Kristianstad in Sweden are already using 50% biofuels, and several others are increasing their electric mobility and planning for higher use of walking and bicycles.

While available technologies technically exist to allow Europe to transition to 100% RE, practically, this achievement of a complete post fossil and nuclear fuel future will likely require further maturation of some technologies and markets. In particular, sustainable mobility options, like vehicles that run on electricity, advanced biofuels, or methane created from excess renewable power (solar methane), will need to achieve greater economies of scale. So, too, will charging infrastructure for electric vehicles. The same holds true for certain energy storage solutions like batteries, hydrogen, or solar methane.

Progress in these areas of emerging technology markets is clearly on its way. In recent years, for instance, there has been sharp rise of the number of automobile manufacturers selling electric vehicles in the EU and throughout the world. Substantial investment is likewise being made by prominent companies to commercialize solar methane for transportation and RE storage. Several pilot projects supporting this technology are in place throughout the EU, such as a partnership with Audi and Solar Fuel in Germany that is scheduled for completion in 2013, and a project on the Isle of Wight off the coast of England that recently received a £ 2.4 million grant from the UK innovation agency Technology Strategy Board (TSB).

A number of commercial airlines, furthermore, are successfully using advanced biofuel blends on commercial flights. Air France-KLM, for example, has completed flights using biofuel made from waste cooking oil, and British Airways also has plans to incorporate this renewable fuel into their jet operations.[45]

44 Burger, B. (2012): Electricity production from solar and wind in Germany in 2012: http://www.ise.fraunhofer.de/en/downloads-englisch/pdf-files-englisch/news/electricity-production-from-solar-and-wind-in-germany-in-2012.pdf.

45 Guangzhou Pengfa Biomass Energy Equipment Co. Ltd (2012): KLM Royal Dutch Airlines will buy 2,000 tons of waste oil for jet fuel in China: http://www.pengfamill.com/news/show_1198.html.

Further, energy efficiency is key to achieving 100% renewable energies. With an increasing energy demand we need to be sure that appliances, vehicles, lighting, and buildings use the minimum energy that is technologically feasible. One challenge cited by critics of energy efficient technologies is the “rebound effect” that describes that people tend to use these technologies more liberally, diminishing the energy savings benefits. A recent study of the issue by the American Council for an energy efficient economy, however, concludes such claims are exaggerated.[46]

Also critical to reaching a 100% renewable energy system rapidly and sustainably are conservation measures, load management and demand response programs. Key to tying all these together are “smart” technologies and systems that provide more detailed energy consumption information to consumers and allow energy use to be adjusted to help manage the heating/cooling and power grids.

46 Nadel, S. (2012): The Rebound Effect: Large or Small? http://www.aceee.org/white-paper/rebound-effect-large-or-small.

4.2 RE resources

Availability of natural resources, such as wind, sunshine, biomass, earth energy, tides and flowing water, maximizes the use of renewable technologies, making it possible to produce more energy with less investment. To illustrate, in 2011, abundantly sunny Italy produced approximately the same percentage of its electricity mix using solar power (3.1%) as consistently cloudy Germany did (3%) using about half the amount of solar panels (12.773 GW in Italy vs. 24.8 GW in Germany).[47] Today, both Italy and Germany produce about a quarter of their power with renewables, with Italy again using substantially less renewable electricity technology installations to do so because of a greater share of natural resources.

That said, limited renewable resources need not spell failure, if other supportive factors are in place. Germany may have needed more renewable technology than Italy to achieve the same power output, but along the way to installing it, the country virtually revolutionized and helped globalize the renewable power industry, achieving the local and national benefits that came with it. Thanks to groundbreaking policies, like the advanced feed-in tariff, cloudy Germany has spawned a vast number of new companies, created hundreds of thousands of good, new jobs, and become a role model for dozens of countries worldwide. Despite its resource limitations, in other words, it is a global industrial and economic leader of the global shift to renewable energy.

47 Bundesverband Solarwirtschaft e.V. – BSW (2012): Statistische Zahlen der deutschen Solarstrombranche (Photovoltaik): http://www.solarwirtschaft.de/fileadmin/media/pdf/bsw_solar_fakten_pv.pdf.

4.3 Local Driving Forces

Motivated, organized local communities can and do enable the shift to renewable energies. First of all, communities often have the agility to mobilize in the face of needed change more quickly and effectively than lumbering corporate and government institutions. As Margaret Mead famously said, "Never underestimate the power of a small group of people to change the world. In fact, it is the only way it ever has."

The pride of ownership should also not be underestimated. When local citizens have a personal financial stake in RE projects, social acceptance of these projects tends to be greater, and barriers to advancement are more easily eliminated.[48]

Local ownership is increasingly facilitated by RE cooperatives, such as those seen in Denmark and Germany. Cooperatives have a long tradition in many countries, and in the case of RE, further help tap into local investment capital and the potential of sites like rural rooftops that individuals would not be motivated to leverage on their own.[49]

Energy cooperatives are ideally based on the seven international cooperative principles: 1) voluntary, open membership, 2) democratic member control, 3) member economic participation, 4) autonomy and independence, 5) education, training and information, 6) cooperation among cooperatives and 7) concern for the community.

If the energy installations are owned and operated by the community, the benefits are also delivered to the community, rather than to large corporations, banks, and developers. When local citizens invest in and operate local green power producing infrastructure, their communities reap all the benefits, including local pollution reduction, lowered greenhouse gas emissions, job creation, business development, economic diversification and capacity building. This, in turn, leads to public acceptance and more rapid adoption of renewable energies.

National Policy

Of all factors impacting the pace of large-scale RE advancement, none has proven to be more critical than national policies. National policy frameworks can trigger action on the local level by helping to level the playing field for RE to compete fairly with conventional energy sources and by creating a favorable investment environment for RE.

The choice of support instrument is a key element in the expansion of RE sources. In the field of power generation, FITs modeled on the German Renewable Sources Act (RESA) have proven to be particularly successful at catalyzing rapid uptake. 20 out of the 27 EU countries have introduced feed-in systems. Some countries have opted for a combination of FITs and quota systems. In Italy and the UK, for example, quota commitments predominantly apply, while small systems and PV systems are eligible for FITs. The FIT's success is seen when comparing wind installation in Germany, where there has been an FIT to support development, to that of the UK, where there has been a quota system only. Germany has installed about 80% more wind power than the much windier UK, with only about a 23% higher population.[50]

48 World Wind Energy Association (2011): World Wind Energy Report 2010.

49 DRGV and Agentur für Erneuerbare Energien e.V. (2012): Energy Cooperatives – Citizens, communities and local economy in good company.

50 World Wind Energy Association (2011): World Wind Energy Report 2010.

Similarly in Italy, the rapid increase in PV installation in recent years has been enabled by an attractive FIT for solar, which has stimulated installation of 12.8 GW from 2007 when the FIT was enacted through 2011.[51]Along the same lines, the UK, after lagging behind by trying to rely on RE certificate schemes, saw a 4,100% increase in solar installation in 22 months after implementing its solar FIT.[52]

Not all FITs are made equal, however. How well the policy is designed has significant influence on its results. Much has been written and discussed about what criteria are necessary to ensure a strong FIT.[53] Failure to include these elements can, on one end of the spectrum, prevent renewable electricity growth from getting off the ground, as is the case with most of the very small and limited FITs so far enacted in the US; or on the other end of the spectrum, create booms followed by busts, as has been the case in countries like Spain where generous tariffs for solar were plagued by loopholes and inflexibility that inhibited them from adjusting to rapid changes in the market.

A well designed and implemented FIT creates steady, balanced support for renewable power. It does so by including a variety of factors, such as:[54]

- giving RE priority access to the grid
- obliging grid operators to purchase electricity from renewable sources
- setting the price for RE electricity for long, fixed periods
- removing caps – or at least raising them to high levels – to amount of RE feeding into the grid
- supporting installations of different sizes and technologies, including small, distributed projects like rooftop solar promoting innovation and technology efficiency with periodic reduction of tariffs .

Aside from the successful design of FITs, the further expansion of renewable power also depends on several other supportive actions, including streamlining permitting and interconnection processes, training skilled labor, and improving the grid through smart technologies, load management, and expansion where necessary.

National policy is not only essential to the renewable power sector, but to the heating sector as well. Underscoring this, the International Energy Administration (IEA) reports that direct renewable heat and climate related policies correlate to substantial increases in renewable commercial heat in recent decades in several European nations.[55]

51 GSE (2011): Rapporto Statistico 2011 – Solare Fotovoltaico: http://www.gse.it/it/salastampa/news/Pages/rapporto-statistico-solare-fotovoltaico-2011.aspx.

52 Vaughan, A. (2012): Feed-in tariff sees solar panel installation breakthrough, Guardian: http://www.guardian.co.uk/environment/2012/feb/23/feed-in-tariff-solar-breakthrough.

53 For several examples of writings on FIT design, please visit http://www.futurepolicy.org/renewableenergy.html.

54 World Future Council – WFC (2007): Feed-In Tariffs Boosting Energy for Our Future.

55 International Energy Agency – IEA (2011): RE, Markets and Prospects by Region.

In the transportation sector, policy has also been advancing the shift away from fossil fuels and toward renewable based solutions. Air quality, climate, and oil independence policy frameworks have supported the move to sustainable alternatives, including solar methane, biofuels, and electric mobility that can be powered by renewable sources. These frameworks have inspired government provisions that curtail use of petroleum-based fuels. Among these provisions are eco-taxes, fuel efficiency mandates, carbon reduction targets, renewable fuel quotas, and tax credits for sustainable transport solutions.

It is critical going forward to end the fossil fuel subsidies that heavily distort the market. Whereas in 2011, subsidies for fossil fuels jumped by about 30% to US $ 523 billion, renewable energies received under 17% of that figure, at US $ 88 billion.[56]

In the end, the shift to 100% RE across all major sectors in Europe will entail a multi-pronged approach that integrates technology, available natural resources, local forces, and national engagement. Ongoing cooperation and coordination will be needed between the private sector, which drives technology advancement and facilitates change, and government, which implements policies that can enable progress.

56 International Energy Agency – IEA (2012): World Energy Outlook 2012.

5. The Roadmap towards 100% RE: Key steps for implementation

Drawing on the above, the following chapter outlines key steps for implementing a 100% RE system. Recommendations are made for infrastructure and ownership schemes, best policy solutions, and supportive governance structures. As there are differences between energy sectors, each of the sections are divided into electricity, heating/cooling and transportation. Key action points and policy recommendations follow each section.

5.1 Enabling infrastructure solutions and ownership schemes for 100% renewable energies

The presented case studies suggest that high citizen participation and regional value creation from decentralized infrastructure are the key factors contributing to achieving 100% renewable energy targets. Such infrastructure solutions need to promote energy efficiency, including combining production of heat and power.

5.1.1 Power Sector

As stated previously, rapid uptake of renewable power has been significantly enabled by well-designed FITs and opportunities for local ownership that have tended to result smaller, decentralized installations. Whereas conventional fossil and nuclear power plants are typically hundreds of, if not up to a couple thousand, megawatts in size and linked by transmission lines to residential and industrial centers, renewable power projects in Europe have been predominantly small and placed closer to the end users along the distribution grid.

In Italy, for example, about 97% of its more than 400,000 installed solar systems, commonly placed on rooftops, are below 200 kilowatts in size.[57] Of the 12,773 megawatts installed in Italy by the end of 2011 as many as 74% were below 1 megawatt in size.[58] In Germany, where 24,800 megawatts of solar had been installed by the end of 2011,[59] most solar projects are below 100 kilowatts in size.[60] By contrast, sunny Spain has tended to favor large, utility scale solar arrays and only achieved 4,214 megawatts of installed solar by the end of 2011.[61]

This trend toward multiple small, distributed renewable power generators is not just the case with solar technology. By the beginning of 2011, projects smaller than 20 megawatts comprised almost 90% of Germany's 27,000 megawatts of wind power capacity, with the majority being only 1-5 megawatts in size.[62] In 2011, Germany's approximately 2,500 megawatts of biogas power was being produced by an estimated 6,800 biogas plants, which would make the average size of each plant about 270 kilowatts.[63]

Small, distributed renewable power projects carry many advantages over large, centralized installations. These include reduction of transmission losses, lowered wear and tear on the grid by decreasing chances for overload during peak demand, greater flexibility in load management, avoidance of expensive and time-consuming new transmission line construction, and elimination or reduction of the environmental risks of larger projects. One disadvantage of smaller renewable electricity projects that typically tends to impact wind power is that because they are often situated in closer proximity to population centers, communities sometimes resist them as a perceived nuisance. This challenge is often mitigated by providing opportunities for local citizens to benefit financially from the projects. One study showed that in Germany, for instance, local ownership options boosted community acceptance of new wind projects from 16% to 45%.[64]

57 Gipe, P. (2012): Italian Solar Generation Surpasses Wind for First Time: http://www.wind-works.org.

58 Gipe, P. (2012): Italian Solar Generation Surpasses Wind for First Time: http://www.wind-works.org.

59 German Solar Industry Association – BSW (2012): Statistic data on the German Solar power (photovoltaic) industry: http://www.solarwirtschaft.de/fileadmin/media/pdf/BSW_facts_solarpower_en.pdf.

60 Farrell, J. (2011): Over 80 Percent of German PV Installed on Rooftops: http://www.ilsr.org/over-80-percent-german-pv-installed-rooftops.

61 EurObserv'ER (2012): Photovoltaic Barometer: http://www.eurobserv-er.org/pdf/photovoltaic_2012.pdf.

62 Farrell, J. (2011): Distributed Wind Power Scales, Too: http://www.ilsr.org/distributed-wind-power-scales-too.

63 Linke, B. (2011): Country Report Germany: http://www.iea-biogas.net/_download/publications/country-reports/april2011/Germany_Country_Report.pdf.

64 Farrell, J. (2011): The Political and Technical Advantages of Distributed Generation: http://www.ilsr.org/political-and-technical-advantages-distributed-generation.

As 100% renewable power use expands throughout Europe, further infrastructural support will likely be needed. An example of such support is increased power storage capacity. Storage solutions include a wide range of technologies, including batteries, flywheels, molten salt, pumped hydro, fuel cells, solar methane, inverters and condensers placed strategically to help stabilize the distribution grid.

Increased use of load management applications will also allow for the needed controlled, quick adjustments in power supply and demand that are especially needed for efficient, reliable handling of intermittent renewable power. For instance, several regions are planning or implementing "smart grid" technologies, along with "smart appliances" that can communicate with the grid to know when it is most appropriate to increase or decrease power use. "Smart meters," which are becoming increasingly prevalent, can help manage electricity loads by measuring time of use of electricity and informing customers in greater detail about their energy use. It is also possible that the European regional grid infrastructure will need to expand to increase efficiency of 100% renewable power use.[65]

5.1.2 Heating and Cooling Sector

One of the most important infrastructural models supporting the shift to 100% RE in this sector, especially in densely populated areas, is district heating and cooling, which offer improved efficiency and greater environmental benefits over exclusively individual units. District systems can be fed by renewable energies, including biomass, geothermal, solar thermal, and in the case of cooling, cold water from lakes and rivers. By using the otherwise wasted heat by product and residual cooling of the electricity and industrial sectors, district systems can further help reduce pollution, fuel imports, and long term costs. According to industry research, as much as 20 EJ heat out of 63 EJ are lost annually in power plants, oil refineries, and industrial processes – heat which district systems can make useful.[66] In 2005-2006, it was estimated that if the EU transitioned to 25% district cooling by 2020 (i.e. 125 TWh/year out of 660 TWh/year total), 30 billion euros would be saved in electricity capacity investments.[67]

The town of Frederikshavn in Denmark aims to reach 100% renewable heating by converting 70% of industrial and residential heating to a district system fueled by a combination of waste heat from a local wastewater treatment plant, combined heat and power, and geothermal energy.[68] The remaining industry heat demand will be supplied using biomass boilers, and the remaining homes not on the district heating grid will be retrofitted with a mix of solar thermal panels and electric heat pumps.

Brunico, Italy manages to actually produce more heat than the town needs, in large part with a 120 km district heating network fed by a 9 MW biomass plant and a 1.5 MW biogas plant near a landfill site that supplies heat for more than 2000 buildings.[69] And the entire region of Aller-Leine-Tal in Germany has committed to achieving 100% renewable heat with a district heating grid, along with geothermal, biomass to heat, and improved efficiency.[70]

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65 German Federal Environment Agency – UBA (2010): Energy Target 2050: 100% RE Supply: http://www.umweltdaten.de/publikationen/weitere_infos/3997-0.pdf.

66 Vernon, P. (2006): Euro Heat and Power: http://www.euroheat.org/ecoheatcool.

67 Euroheat and Power (2006): Possibilities With More District Cooling In Europe: http://www.euroheat.org/files/filer/ecoheatcool/documents/Ecoheatcool_WP5_Web.pdf.

68 Energy City (2013): http://www.energycity.dk.

69 RES Champions League (2013): Brunico (IT) – 100% renewable town: http://www.res-league.eu/european-league/european-best-practices/brunico-it-100-renewable-town?Itemid=1.

70 Renewables 100 Policy Institute (2013): Aller-Leine-Tal - 100+% Region: http://www.go100percent.org/cms/index.php?id=19&id=69&tx_ttnews%5Btt_news%5D=225&tx_locator_pi1%5BstartLat%5D=45.93583305&tx_locator_pi1%5BstartLon%5D=-4.86260045&cHash=444defee04161ed4a16ad7900f0cf7b6.

5.1.3 Transportation Sector

Because one of the most prominent emerging solutions is electric mobility, renewable power infrastructure is also translating into advancements in renewable transportation. The benefits have the potential to go in the other direction as well, when charging of electric vehicle batteries provide storage for intermittent renewable power being fed into the grid.

Charging infrastructure for electric vehicles is being advanced by a wide range of entities. These include electric vehicle companies and owners, clean tech entrepreneurs, financial institutions, government bodies, and retail businesses that see opportunities for attracting customers by placing electric charging stations near their locations.

To help overcome "sticker shock" of plug-in vehicles, which are still relatively new to consumers and tend to have higher up-front costs, alternatives to standard vehicle ownership are being created. For instance, in addition to long-term leasing programs, short-term leasing through electric car sharing memberships have been emerging throughout Europe. Paris launched an electric car sharing program in 2011,[71] and Oxford launched one in 2012,[72] just to cite a couple of examples.

Another alternative ownership scheme that has been on the rise is decoupling the ownership of the battery from that of the vehicle. The aim is to encourage customer security by reducing upfront purchase costs and eliminating the risk to vehicle owners of having to pay to replace the battery, which is by far the most expensive component of electric vehicles. Under this type of set up, owners pay a monthly fee to lease the battery and, in turn, save typically thousands of euros on out-the door purchase costs. When they need a new battery, they can simply get an exchange from the automobile company. French vehicle manufacturer Renault requires battery leasing on sales of their electric vehicles. Mia also provides this option, and Volkswagen and others reported to be considering this model as well.[73]

Liquid biofuels have benefited from being able to use existing infrastructure used for petroleum based fuels – i.e. the well-known gas pump. Similarly, as the solar methane industry advances, it will be able to take advantage of existing natural gas distribution infrastructure to power vehicles that are equipped to run on various forms of natural gas (methane, compressed natural gas, etc.).

71 BBC News Europe (2011): Paris Launches Electric Car Sharing Scheme: http://www.bbc.co.uk/news/world-europe-15134136.

72 Creeney, P. (2012): Oxford Charges Up New Electric Car Sharing Scheme, The Ecologist: http://www.theecologist.org/News/news_analysis/1479273/oxford_charges_up_new_electronic_car_sharing_scheme.html.

73 Masson, L. J. (2012): EV Battery Leasing Could Become Norm in Europe: http://www.plugincars.com/leasing-battery-ev-may-become-norm-europe-120223.html.

5.1.4 Infrastructure and Ownership Scheme Recommendations

Infrastructure and ownership scheme recommendations can be summarized as following:

- Emphasize decentralized, distributed energy
- Encourage local RE cooperatives
- Increase storage capacity, load management, and smart grid technologies to maximize RE resources and stabilize the grid
- Incorporate district heating and cooling solutions to help improve efficiency
- Support electric mobility with ample charging infrastructure and creative alternatives to standard vehicle ownership
- Encourage development of solar methane to use excess renewable power and take advantage of existing natural gas grid and vehicle technologies.

5.2 Best political frameworks and policies for achieving 100% renewable energies

To arrive at 100% RE, the most basic political framework that supports the effort is to commit to getting there. After all, it is much harder to achieve a goal without setting one. Throughout Europe, there are more than a hundred towns and regions that have set a 100% renewable goal in at least one sector, and many have already achieved, even surpassed their goal.[74]

Other helpful frameworks include targets for 1) increasing efficiencies, e.g. for buildings, appliances, light fixtures, goods movement, and vehicles, 2) greenhouse gas and other fossil fuel related pollution reduction, 3) phasing out of non-renewable energies, 4) developing and implementing electricity storage technologies and 5) supporting and integrating upgrades to the energy distribution network, including the power grid, heating networks, and moving forward, electric vehicle charging infrastructure.

Additionally, it is important that energy lifecycle costs, including external costs like environmental and public health economic impacts, be reported transparently and monetized, in order to help repair distortions in the marketplace that tend to favor long established conventional energies over RE technologies, which are comparatively new industries. These costs can be reflected in a number of policy mechanisms, the more successful or promising of which are discussed below.

Finally, the best policy frameworks ad here to fundamental principles of transparency, consistency and predictability. Schemes that are shrouded in excessive complexity, that stop and start, or are that are tied to short term, erratic government policies inhibit investor confidence and slow progress.

74 For various examples please visit http://www.go100percent.org.

5.2.1 Power Sector

As already highlighted the policy widely recognized as most effectively enabling the shift toward – indeed, beyond in some cases – 100% renewable power is a well-designed FIT. Numerous analyses have concluded that a good FIT law that follows best practices previously described in this document is far more effective than any other policy in advancing renewable electricity, including quota systems and the Emissions Trading Scheme.[75]

Complimentary policies to strongly constructed FITs include efficiency mandates for electricity related technologies. After all, the less power needed the faster and least expensively it is possible to shift to 100% renewable electricity.

Also strongly supporting 100% renewable electricity advancement is elimination of cumbersome permitting requirements that slow or stymie the process of installing renewable electricity technologies. For example, it is helpful to exempt rooftop solar installations from building permits, as is done in Germany and France.

Going forward, policies directed at development of and investment in grid upgrades will also be important. The European Commission has already made Smart Energy Networks a priority of the current EU Framework Programme, which focuses on the efficiency, safety, reliability and quality of the European electricity and gas grids in the context of a European energy market.[76] The Commission estimates that the public and private sectors will need to invest about 2 billion euros over the next 10 years in research and development for the deployment of future electricity networks in Europe.[77] Considering the Commission's forecast that Europe will likely reach about 37% renewable electricity by 2020, clearly additional investment will likely be needed to achieve a 100% target.[78]

Expanded support for large-scale demonstration and integration of power storage technologies will also play an important role in the shift to 100% renewable electricity. European Commission analysts, for example, assert that policy should aim to achieve more flexible operations of the EU's regionally diverse hydropower system and to enhance it with grid connections that allow for additional storage capacity to the European system. They also advocate for a comment assessment of the market potential for power storage, in order to facilitate public and private investment decisions.[79]

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75 DB Climate Change Advisors (2009): Paying for RE: TLC at the Right Price.

76 European Commission (2013): Smartgrids: http://ec.europa.eu/research/energy/eu/research/smartgrid/support/index_en.htm.

77 European Commission (2013): Smartgrids: http://ec.europa.eu/research/energy/eu/research/smartgrid/index_en.htm.

78 European Commission (2011): Communication „RE: Progressing towards the 2020 target“ [COM/2011/31]: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0031:EN:HTML:NOT.

79 European Commission (2013): Electricity storage in the power sector: http://setis.ec.europa.eu/technologies/Electricity-storage-in-the-power-sector/info.

5.2.2 Heating and Cooling Sector

In the heating and cooling sector, the legislative landscape for renewables is not yet as mature as in the power sector. Even in a country as committed to RE as Germany, the goal for renewable heating and cooling is only 14% by 2020, whereas the target is 35% for electricity. That said, some towns have nonetheless succeeded at achieving or even exceeding 100% renewable heat with the support of 100% RE targets and limited available incentives. In Germany, for instance, several locations have benefited from grants available for small installations or low interest loans for larger installations that supplement the Renewable Heat Act. This law has obligated new buildings to use renewable heat and cooling technology starting in 2009 and was expanded to public building retrofits in 2011.[80]

However, for 100% RE heating and cooling to be adopted on a wider scale, greater focus will likely need to occur at the regional, national, and European policy levels. Greater understanding must be developed, for example, regarding how to best maximize the large potential for mass-scale district heating and cooling in high population areas throughout Europe. In locations where a district heating system is already in place, progress is clearly more readily achievable. When Stockholm launched its district cooling program in 1994, no government incentives were needed to eventually reach 50% penetration in large part because the region had a long history of buying district heating.[81] However, in areas where district systems are not widely used – and therefore, installation costs and cultural acceptance barriers are highest – policies would be needed that support long term commitment, despite the short-term capital costs that tend to be the focus of our economic system. For instance, the UK does not have the benefit of such a history with district heating, and analysts conclude that regulatory changes are thus needed to affect any significant uptake.[82]

FIT schemes that allow generators of various types and sizes of renewable heating and cooling to be adequately compensated for the energy they produce can additionally assist in advancing 100% RE in this sector. Denmark was a pioneer of this model, when it introduced a triple tariff in 1990 for peak, medium and low load CHP production, in which heat went to existing district networks and power was fed into the national grid.[83] In the UK, the Renewable Heat Incentive (RHI) was launched in 2011 for the business, public, and industrial sectors and offers tariffs for large, medium, and small biomass, regular and small heat pumps, solar thermal, biogas, and biomethane.[84] Expansion to the domestic sector has been slower to start and is expected to be underway in 2013. In France, tariffs have been offered for small biogas plants that can be combined with a modest bonus for heat production and a further bonus for methane produced on-farm.[85] France, along with several other countries, including Germany and Switzerland, also offers an FIT bonus for CHP that compensates for the heat produced.[86] How to optimize FITs and other incentives for renewable heat is a policy topic that merits further examination going forward.

80 German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety – BMU (2011): http://www.erneuerbare-energien.de.

81 Euroheat and Power (2006): Possibilities With More District Cooling In Europe: http://www.euroheat.org/files/filer/ecoheatcool/documents/Ecoheatcool_WP5_Web.pdf.

82 Poyry Energy Consulting (2009): The Potential and Costs of District Heating Networks: http://www.ilexenergy.com/pages/documents/reports/electricity/District_heating_exec_summary.pdf.

83 Maergaard, P. (2009): Danish Renewable Energy Policy: http://www.wcre.de/en/images/stories/pdf/WCRE_Maegaard_Danish%20RE%20Policy.pdf.

84 UK Department of Energy and Climate Change (2011): Renewable Heat Incentive: https://www.gov.uk/government/publications/renewable-heat-incentive.

85 Gipe, P. (2010): The Next Wave: Feed-in Tariffs for Green or Renewable Heat: http://www.wind-works.org.

86 Gipe, P. (2010): The Next Wave: Feed-in Tariffs for Green or Renewable Heat: http://www.wind-works.org.

5.2.3 Transportation Sector

In the transport sector, with the exception of the railways, of which 80% runs on electricity with very little of that mix being oil, the vast majority of transportation in Europe – and the rest of the world – relies on petroleum. Arriving at policies that effectively accelerate the shift to 100% renewable transportation energy shows promise with recent progress in development of electric vehicles and advanced biofuels.

In 2009, the European Union set the first mandated target for RE for transport. Voluntary targets prior to this – 2% by 2005 and 5.75% by 2010 – produced very limited success, with only a few countries reaching the goals on time. Therefore, framework was elevated to law, and currently, under the RE Directive, Member States are required to reach 10% RE for transportation by 2020. The target may be achieved with either liquid or gaseous biofuels or renewable electricity. Since 2010, strict sustainability guidelines have been enacted to ensure greenhouse gas reductions, biodiversity protection, conservation of high carbon areas like peatland, and agro-environmental practices. European policy has been supported by Member State policies such as direct subsidies, fuel efficiency mandates, and tax policies, which favor biofuels and add fees to the production and sales of fossil fuels.

Modest progress has been made toward biofuel adoption in the transportation sector, although unintended negative consequences have been a challenge. In addition to the problems addressed in the 2010 sustainability criteria, as described above, data from 2011 showed that nearly all EU biofuel – which comprised approximately 4.5 percent of EU transport fuel – was made up of food-crop based feedstock. This has contributed to sharp rises in global grain prices. This problem led the European Commission to recently recommend that food-crop biofuels be limited to 5% of the 10% mandated target, with non-food feedstocks like agricultural waste, grasses, and algae making up the remainder of the mix going forward. A proposal of this recommendation was published in October 2012, after which EU governments and the European Parliament will need to vote on it, in order for it to become law.

Because commercial production of non-food crop biofuels has yet to reach mass scale, some raise questions about whether the biofuel industry can withstand the shift and whether the 10% target can be met by 2020. Not surprisingly, the most vocally concerned are food-crop biofuel industry representatives, while environmental advocates have tended to argue that the proposed 5% limit is the least the EU can do to arrest the damage. In the meantime some non-food biofuel industry achievements that signify hope. Airlines are completing commercial flights using up to 50% oils from waste, and just recently Lufthansa signed an agreement with an algae aviation fuel producer to create a large scale production plant. Meanwhile, several pilot and demonstration projects for ground transportation using advanced biofuels are in progress throughout Europe and around the world.

Another hopeful development has been the significant upswing in development of electric vehicles in recent years. Whereas only a few years ago, EVs were largely relegated to auto expos and pilot projects, today several automakers are selling them in the commercial market. Because of the ability of EVs to integrate so smoothly and symbiotically into the renewable power system, they are widely forecast to play a major role in the transition to 100% RE. As previously discussed, market barriers still must be overcome in order to see broad deployment of EVs, but momentum is occurring now like never before. Notably, several towns with 100% RE goals have been early adopters of electric vehicles as part of their energy plan. For example, the community of Dardesheim in Germany's Harz Mountains already produces 40 times more electricity with renewables than it needs and 10 times more energy than it needs for heating, cooling, and mobility, and has begun integrating electric cars into its energy plan.

5.2.4 Policy Recommendations

In summary, national policies like feed-in tariffs have kick started an impressive development in Europe. Our task now is to adopt policy frameworks on all governance levels to accelerate the transition to 100% renewable energy and to implement best policies to encourage uptake of RE, like advanced FITs, as well as integration of RE.

In order to set the scene for a 100% renewables future, the following policy principles are needed:

- Require that all new energy investments are 100% toward renewable energies
- Provide market access for all, including citizens
- Provide investment security to enable people to put their money into the most appropriate technologies
- Ensure direct benefits to communities
- Increase efficiency of the energy system by combining heat and power
- Create a level playing field between the renewable energies sector and fossil fuel industry.

Concrete policy recommendations include:

- Eliminate permitting barriers for RE installation
- Adopt long-view planning that encourages development of most efficient heating and cooling solutions that can use 100% renewable sources like district heating and cooling in high density areas, along with heat pumps
- Implement advanced FITs – or strenghten existing FITs where needed – to accelerate the shift to 100% RE
- Expand FITs to include renewable heating and cooling technologies
- Stop direct and indirect subsidies (e.g. favorable tax breaks) for fossil fuels, while providing support schemes for alternative transportation fuels that can be part of a 100% ERE system
- In the case of biofuels, ensure that production does not interfere with food and water supplies, carbon rich forests and peatland, or other critical land uses, for example, by utilizing agricultural waste and other advanced biofuels as feedstock
- Set 100% RE targets for all sectors, along with complimentary bold targets for local and global pollution reduction, and efficiency of buildings, industry, and transportation
- Promote research, development, and implementation of power storage and grid upgrades, in order to support advancement of renewable power
- Monetize external costs of fossil and nuclear fuels, such as impacts on public health, the environment, and security
- Make sure policies adhere to principles of transparency, consistency, and predictability, in order to stabilize promoted investment.

5.3 Enabling governance models to achieve 100% renewable energies

The transformation to 100% RE across all major sectors in Europe requires a multi-pronged approach that integrates technology, available natural resources, local forces, and national engagement. Political frameworks can only be effective if there is a stable political climate and policy coherence across governance levels. Ongoing cooperation and coordination is a prerequisite between three tiers of society: 1. Private sector, which drives technology advancement and facilitates change. 2. Governments that implement policies and can enable progress. 3. Civil society that can accelerate the transition by active participation.

An important tool is target setting. By identifying and communicating the goal one may get two significant effects: a) mobilizing and activating other stakeholders, b) more efficient channeling of resources. Target setting enables different stakeholders to coordinate and agree their agendas, programs, initiatives and efforts more effectively.

In every transformation process, there is the tension of whether to pursue a top-down or bottom-up approach. As national budgets increasingly face constraints, the top-down approaches in which national governments provide funds and political strategies are becoming less popular. However, policies like the German model of FIT, which are national law but do not depend on national budgets, show that top-down approaches can still be highly appropriate and effective, even during economically challenging times. This does not mean, however, that case studies from Europe have not shown that communities, cities and regions are more than equipped to also play a leading role in the transformation. We can, therefore, conclude that in order to reach the needed scale and speed, we need coordination and integration among the different governance levels and therefore a combination of top down and bottom up.

In Europe, there are four main possible starting points to initiate change: European Union, member states, cities/municipalities/regions or citizens. As constituencies and administrative structures differ among member state, the choice for where to kick start the transformation process depends on national structure. As shown in previous sections, Germany, Denmark, and Austria provide numerous examples of how local and regional decision makers implement and achieve much more ambitious and visionary RE targets than the federal government. This shows that subnational level targets and policies can influence national policies. National governments observe actions on the subnational level as experiments or test cases, and if they prove successful, are more willing to use them as a blueprint on the national level. However, transformational development has primarily been enabled by the appropriate national framework.

Further, international negotiations like the UNFCCC must reflect the urgency and set the scene for all other actions. The EU plays an important role in not only driving national policies in frontrunner countries, but also in supporting regions that lack political security from their national government. The Romanian city Bistrita, for example, has ambitious targets to enhance energy efficiency standards and increase the use of renewable energies. For this, they rely on the support of the European Union on the supranational level, as the Romania policy framework on the national level does not provide any long-term security for investors.

Integrated governance systems that enable a 100% RE system also need a cross-sectoral approach. The council of the Scottish city Aberdeen has understood, for instance, that to develop their climate action plan, the government ought to work with stakeholders from the whole supply chain. In their case, this has includes partners from Scottish fossil fuel industry, as Aberdeen`s city council sees that the valuable expertise of the oil and gas sector can be applied to a fossil free future.

Additionally, communication is a crucial element of an integrated governance system. By using the right language and wording, consensus may be easier to reach. Some Dutch communities experienced how wording can make a difference in integrating different stakeholders, when they changed the language from “Climate Action Plan” to “Energy Transition Plan” and gained the acceptance of many more people.

The same goes for communicating about renewable energies. Whereas the climate change debate tends to have negative connotations, renewable energies are generally regarded as a solution. Yet the broader public may also view renewable energies as a technical and complicated topic that only experts can understand. In order to involve all impacted stakeholders there is a strong need for a more appealing communication strategy. To this end, telling success stories and spreading the word about solutions and opportunities are important tools.

The narrative also must be relevant to people. For instance, during the current economic crisis, people may not respond to renewable energy as an answer to the climate crisis, as much as they will understand that it is a way of creating jobs, independence from expensive energy imports and greater resource efficiency.

Concrete governance model recommendations:

- Target setting is a first step for developing a roadmap towards 100% renewable energies
- Combination of top-down and bottom-up approach
- Adapt the language and wording to integrate difference stakeholders
- Develop political solutions in a way that it works across party lines and political ideologies in order to make implementation feasible
- Enhance constructive and positive communication about the topic by making use of success storytelling and by being relevant
- Implement legal frameworks for space planning rather than for certain technologies or sectors – Austria’s efforts on developing a partnership agreement on an “Energieraum” provide a first example
- Energy Agencies can be an actor to connect different levels and sectors
- There are several models for cooperation like the Clean Tech Alliance bringing several municipalities together and enhancing knowledge exchange and the opportunity for coordinated action
- Cooperative models provide the opportunity for people to organize themselves and get started without strong political commitment – This can initiate a push from the public.

6. Conclusion

The overall goal of this report was to outline solutions and implementation strategies that enable political decision makers on national, regional and local level to spearhead the energy transition towards a fossil free society.

The analysis shows that the importance of national policy framework cannot be overstated. Whereas the private sector is the enabler providing appropriate technologies, policies determine when and how energy investments make a profitable business case. Policies are therefore the facilitators that moderate the transformation towards a future-just energy system. There are best policy solutions implemented across Europe that kick started remarkable development, especially in countries like Germany, Denmark and Austria. The key that boosted this transformation on a meaningful scale in a short time was the fact that the high share of renewable energies resulted in economic development and local value creation from which the broader public benefited. While several policies were helpful, feed-in tariffs (FiTs) especially have played a key role by acting as a connecting policy, linking people, policy, energy and economy.

Europe proves that participatory decentralized policy approaches achieve the necessary energy transition faster. This is what we need because we are running out of time. The transition to renewable energy is not just a switch from fossil fuel to renewables, but also an opportunity to decentralize the energy market, bring socio-economic development, and enable all stakeholders and citizens to participate.

The rapid development of renewable energies requires constant policy adaptation. The challenge in many places in Europe is no longer to accelerate the deployment but to integrate RE technologies in existing infrastructure. Here, countries with a high share of renewables like Denmark can provide expertise. Knowledge transfer and exchange, as well as the establishment of networks are vital in order to implement best policies for 100% RE and adapt existing frameworks accordingly.

From a climate change discourse perspective, a 100% RE based system combines adaptation and mitigation strategies and is, therefore, a win-win situation for communities. Decentralised fossil free energy systems contribute to climate mitigation by reducing greenhouse gas emissions and help to adapt to potential climate change impacts by reducing the vulnerability of the total energy system.

In order to design the energy system of the future, we need the following shift in understanding of the nature of energy: The world's climate and energy security issues are not connected to energy but rather to the fuel we are using. The new energy system is also about energy services rather than consumption. The new system is also about initial investment, not long-term production costs. That is, the transition to 100% RE requires that we build infrastructure that is paid for by upfront capital, but after that, with the exception of some bioenergies, the fuel is free and has almost no running costs.

Drawing on lessons learned from case studies and debates at the parliamentary hearing at the Nordic Folkecenter in October 2012, this report aims to enhance the debate and reach out to other stakeholders to achieve the overall goal of 100% RE in European Regions. Policy dialogue goes hand in hand with policy learning and is a prerequisite for a successful future. There is only one certainty in this biggest transformation process that humanity has ever faced: The future is not the continuation of the past.

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