100% RE Building Blocks

A practical toolkit for
a sustainable transition to
100% Renewable Energy

100% RENEWABLES

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DESIGN

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THE GLOBAL 100% RENEWABLE ENERGY PLATFORM

The Global 100% Renewable Energy campaign (Global 100%RE) is among the first of global initiatives that advocates for 100% renewable energy. Global 100%RE was founded at the beginning of 2013 in San Francisco by 10 international organisations: deENet, Fraunhofer ISE, International Geothermal Association (IGA), International Solar Energy Society (ISES), Institute for Sustainable Energy Policy (ISEP), World Bioenergy Association (WBA), World Council for Renewable Energy (WCRE), World Future Council (WFC), World Wind Energy Association (WWEA), Renewables 100 Policy Institute. It emerged from a parliamentary workshop hosted by the World Future Council in the Danish Nordic Folkecenter in October 2012, and following a side-event at COP18 in Doha, Qatar, which was hosted by the REN Alliance. In additional to founding partners, members of the campaign include stakeholders from different sectors and world regions: Sierra Club, Climate Action Network International (CAN), ICLEI, the world´s largest city network and the Australian-based organisation Beyond Zero Emissions (BZE). In May 2017, Global 100% RE is established as a legal entity: The first multistakeholder platform for 100% RE.

Global 100% RE connects the dispersed dots of renewable energy advocates and builds a global alliance to confirm that being powered by 100% sustainable renewable energy is both urgent and achievable. This unique campaign builds on initiatives already taking place on national, regional and local levels, and sets the global discourse on renewable energy towards 100% RE as the new normal. Since its establishment, the goal of Global 100%RE has been to initiate dialogue, build capacity, and educate policy makers on the benefits of 100% RE based on the ever increasing number of case studies from around the world.

In 2015, several members and supporting organizations launched the Global 100%RE Cities & Regions Network, which brings together leading cities, towns and regions that are driving the transition towards 100% Renewable Energy, in a global community of practice to facilitate peer-learning and accelerate progress. The 100%RE Cities & Regions Network is part of the Global 100% Renewable Energy Campaign. The Network is inclusive and open to all ambitious cities, towns, and regions setting their course towards 100% Renewable Energy and demonstrating that it is possible to realize this vision. It is coordinated by all partners of the Global 100% RE campaign that work directly with cities and regions and is comprised of local and subnational governments (e.g., cities, towns, regions, provinces, states) that have approved a 100% Renewable Energy (RE) target or that are committed to setting up such a target for their jurisdiction in the foreseeable future. ICLEI is the first chair of the network.

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EXECUTIVE SUMMARY

As the 100% renewable energy (RE) movement gains momentum, policy guidance on implementing the political target as well as assess progress is crucial. Political decision makers and local champions need tools to realize the transformation within the sustainable development framework. Therefore, it is essential to provide a comprehensive definition of the meaning of 100% RE and to develop the necessary steps, guiding principles and tools to implement a 100% RE plan. At the same time, communities and local governments must be assisted in how to measure the success of their efforts via effective monitoring and benchmarking. Neighbourhoods, cities and regions need to be assured that a 100% RE future will address income inequality and contribute to the creation of social wellbeing and the long-term protection of our ecosystems. In order to address these key issues, members and supporters of the Global 100% RE campaign embarked on a multi-stakeholder consultation process, analysing available experiences and sharing lessons learned.

This report lays out the results of this process, proposing a comprehensive collection of building blocks, which help realize and evaluate a sustainable transition towards 100% renewable energy. These building blocks are applicable across jurisdictions with various geographical, political, social, cultural and economic conditions and provide guidance for policy makers, governments and community champions to develop their own 100% RE roadmap. The ultimate ambition of this paper is to create a living document that can serve as an interactive tool box for stakeholders worldwide. This means creating a set of workable building blocks that can be adapted and modified as appropriate to fit particular local contexts. These building blocks serve as guidance when developing 100% RE roadmaps and strategies as well as a monitoring and benchmarking tool for mapping progress towards the achievement of the 100% RE goal.

A VIABLE PATH

+300

cities, regions and municipalities across the world have demonstrated that transitioning to 100% RE is a viable political decision.

CLEAR TARGETS

1000

mayors and councillors pledged to reach the 100% Renewable Energy target within their municipalities.

BEYOND LOCAL

16

countries are planning to fully decarbonize their electricity system and achieve 100% renewable electricity within the next decades.

This encouraging movement would not be as successful as it is without civil society, practitioners and businesses pioneering it. Indeed, all major non-state actor groups have joined forces to build the political will for 100% RE in the Global 100% Renewable Energy Campaign.

100% RE: a global movement

A substantially increasing number of municipalities, cities, regions and countries have committed to a 100% renewable energy future. As of late 2016, more than 300 cities, municipalities and regions including Frankfurt, Vancouver, Sydney, San Francisco, Copenhagen, Oslo, Scotland, Kasese in Uganda, Indionesia's Sumba island and the Spanish Island of El Hierro have demonstrated that transitioning to 100% RE is a viable political decision[1]. Many of these municipalities and regions are setting the 100% RE target as they consider it not only a technically and economically feasible option but an ethical imperative in the face of global climate change. During COP 21 in Paris in December 2015, nearly 1000 Mayors and councillors pledged to reach the 100% Renewable Energy target within their municipalities[2]. Given that the majority of people are living in cities today, and urban areas are accountable for 70% of energy related CO2 emissions[3], this commitment to a renewable energy transition is an encouraging trend. But this movement goes far beyond the local level. Sixteen countries with small-island states in the lead are planning to fully decarbonize their electricity system and achieve 100% renewable electricity within the next decades (Aruba, Cape Verde, Cook Island, Costa Rica, Denmark, Fiji, Tokelau, Niue, Saint Lucia, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu[4]). At the COP22 in Marrakesh, 48 developing countries pledged to "strive to meet 100% domestic renewable energy production as rapidly as possible while working to end energy poverty, protect water and food security"[5].

This encouraging movement would not be as successful as it is without civil society, practitioners and businesses pioneering it. Indeed, all major non-state actor groups have joined forces to build the political will for 100% RE in the Global 100% Renewable Energy Campaign[6]. Further, more than 80 corporations committed to 100% Renewable Electricity under the RE100 campaign[7].

And thousands of small and medium-sized companies, entrepreneurs and citizens are making the transition away from fossil fuels towards 100% RE, creating innovative business models to help accelerate the transition. For example, in Bangladesh, since 2003 more than 3.9 million rural households and shops have electricity from solar home systems, providing sustainable electricity for millions of people in rural areas[8]. In Africa, M-Kopa's business innovation is using the mobile payment systems to deliver solar energy in off-grid regions[9]. Also in industrialised countries like in Germany, the energy system is undergoing fundamental changes with more than 800 community energy cooperatives forming the backbone of the pioneering Energiewende[10].

While this is an encouraging development, crucial questions arise: What does 100% RE actually mean? What are the implementation steps to achieve the target? How do we measure success? And, how do we ensure that the transition to 100% RE is an instrument towards wealth redistribution, creation of social wellbeing and the protection of our ecosystems? In fact, urban

energy planning and climate mitigation and adaption are not new fields and several methods and instruments exist[11]. However, a survey unveiled[12] that they do not sufficiently address the transformation to 100% RE, the action's impact on local sustainable development or are not applicable in an international context. Meanwhile, legislators, policy makers and community champions often find themselves in the position in which converting the energy system to 100% RE is about more than replacing fossil resources with renewable sources. Planning urban growth around 100% renewable energy targets calls for coordinated implementation strategies that can integrate with the myriad other priorities municipal staff are charged with addressing. This sharply contrasts stepwise implementation of one-off renewable energy projects that can be developed in relative isolation from other social, economic, environmental planning goals.

Finding the tools to guide these formative actions can be problematic and structuring long-term implementation plans may seem prohibitively complicated. To fill this gap, members and supporters of the Global 100% RE campaign embarked on a multi-stakeholder process, analysing available practices, policies and learnings. The Global 100% Renewable Energy Campaign was founded in 2013 and has become a unique multi-stakeholder platform that gathers experiences and successes, amplifying the feasibility of 100% RE to inspire more communities to set this target and to encourage an international policy dialogue supporting 100% RE.

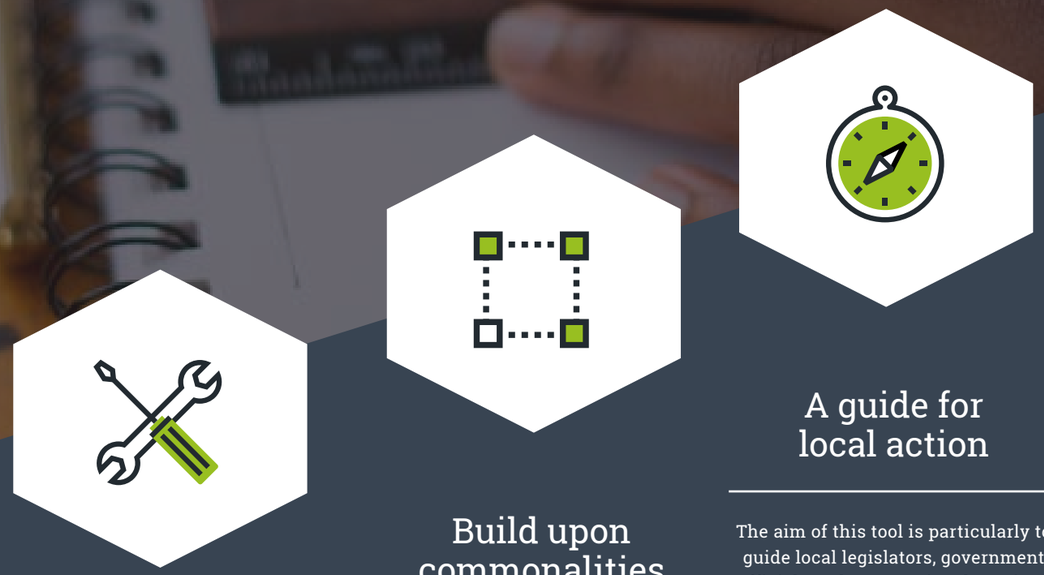
To navigate the complexity inherent in policy planning, frameworks and guidelines which are built on available practices and experiences can help decision-makers and community champions orient themselves to confront the challenges of achieving 100% RE. The building blocks offer one such framework for re-orienting policy planning around a 100% renewable energy goal. The focus is therefore placed on local and regional governments as this is where practical experiences are most accessible and sharable.

While acknowledging that every jurisdiction faces unique challenges and is situated in a distinctive context, this tool aspires to create a common and comprehensive set of recommendations to facilitate the building of bridges, overcoming political, cultural and social differences in places around the world.

These building blocks are addressed to legislators, government officials, and community champions who are motivated to bring the 100% RE vision forward within their communities.

FROM VISION TO ACTION

REALIZING 100% RE



Modify and adjust to the context

It is not a mandatory list of activities but a set of recommended actions that communities and local authorities should consider, adjust and modify to fit their particular local context.

Build upon commonalities

While every jurisdiction surely faces unique challenges, they also share many commonalities. By building on available experiences and multi-stakeholder consultations with practitioners, policy makers and experts, the proposed building blocks can help communities shape and evaluate their own 100% RE plan.

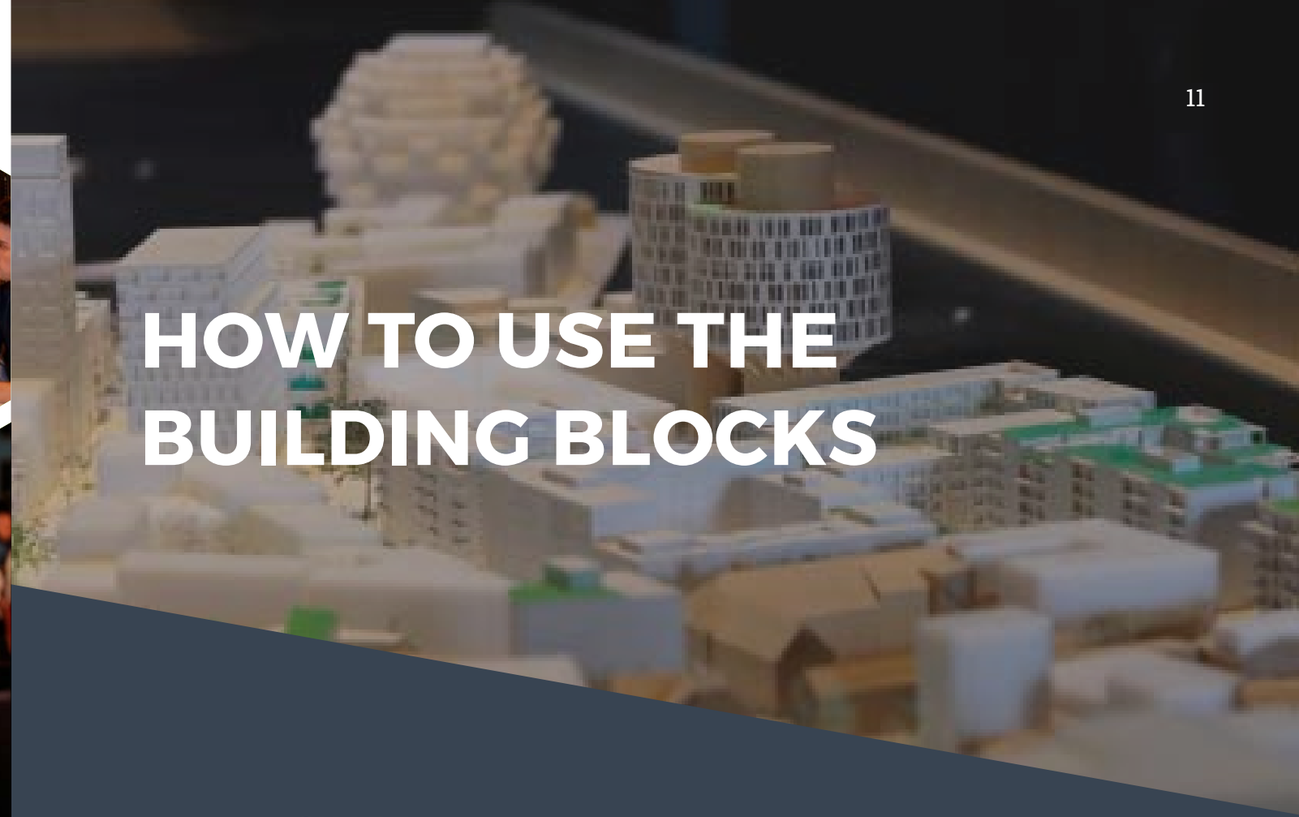
A guide for local action

The aim of this tool is particularly to guide local legislators, government officials and community champions in developing and enacting 100% Renewable Energy (RE) plans.

The process

The Global 100% RE Campaign was founded in April 2013 in San Francisco by 10 international organisations from different sectors[6]. The first two years were focused on expanding the advocacy network and proving that 100% RE is already a reality. Soon, it became obvious that there is the urgent need to go beyond that and support policy makers in defining possible pathways and means to measure success. This is why since 2014, several consultations and dialogues were hosted by a diverse group of members and supporters from the Global 100% RE campaign[13], feeding in the development of a first proposal, which was published as a discussion paper in 2015. This report was titled "Criteria for a Sustainable Transformation towards 100% Renewable Energy: Starting an International Dialogue"[12], outlining twelve criteria that were put forward to assist policy makers in the construction of their 100% RE roadmap. This Discussion Paper has fed several consultations (e.g. the Kassel International Dialogue[14] and a workshop with 12 local governments at COP21[15]) and has nurtured interest across jurisdictions in Canada as well as several districts in Northern Hessen[16], Germany. For example, Oxford County in Ontario, Canada used the criteria to help guide the development of its 100% RE strategy[17] as well as its Zero Waste Plan[18]. This on-going multi-stakeholder dialogue has accrued a considerable amount of knowledge and generated a substantial amount of feedback related to the twelve criteria put forth in the Discussion Paper. Primarily, practitioners suggested flexible building blocks instead of static criteria which may be regarded as a fixed list of standards that must be applicable to meet the norm.

All feedback accumulated through the past three years of the Global 100% RE campaign has been refined and incorporated in this report. Comments and feedback have been consolidated by the authors in consultation with other experts and stakeholders leading to the creation of the building blocks proposed in this report. This is an attempt to create a more intuitive yet comprehensive and adaptable document to summarize the key action areas for an effective transition towards 100% RE.



HOW TO USE THE BUILDING BLOCKS

SHAPE

Users of the building blocks are invited to adapt the tool to their local context and identity as it is meant to provide flexibility for distinctive features and potential of different juristictions.

CUSTOMIZE

There are several overlaps between different actions and so the most effective implementation of one building block might arise only when also considering the recommendations of other blocks in a non-linear way.

ENGAGE

The building blocks can support the identification of relevant stakeholders from different sectors as well as government levels and stimulate their engagement.

MONITOR

The building blocks are both a guideline for action and a tool to evaluate the performance and achievements of a community's efforts.

LEVERAGE

The building blocks can leverage collaboration between governments' representatives from the municipal to national level, by supporting the alignment of purposes and streamlining of efforts across jurisdictions and constituencies.

OXFORD COUNTY

ONTARIO, CANADA

Oxford County is a motivated municipality; a region with visionary leaders and staffed by people determined to bring positive change by building a robust economy and social network, but doing so with protection of a limited environment in mind. Creating an energy plan from scratch can be a challenging experience; creating an energy plan from scratch with a vision to transform a fossil fuel based system to one based largely on renewable energy is daunting.

When considering our options and trying to determine the best place to start, we consulted both World Future Council and Renewable Cities (Canada). These two organizations along with their own network of visionaries provided a critical starting point for us through the Kassel Criterion model. Over a period of several months and in consultation with a variety of local and international stakeholders, these 12 Criterion were to become the 'backbone' of the Oxford County 100% draft plan.

One of the guiding principles of the Kassel Criterion is that of consistent approach among many jurisdictions around the world. What was developed in Kassel, can be molded in Oxford County, only to be further refined in Victoria BC, and around the world it goes. The brilliance of this approach lies in the continuous improvement of a common theme; assembling and shaping and refining the plan, one block at a time.

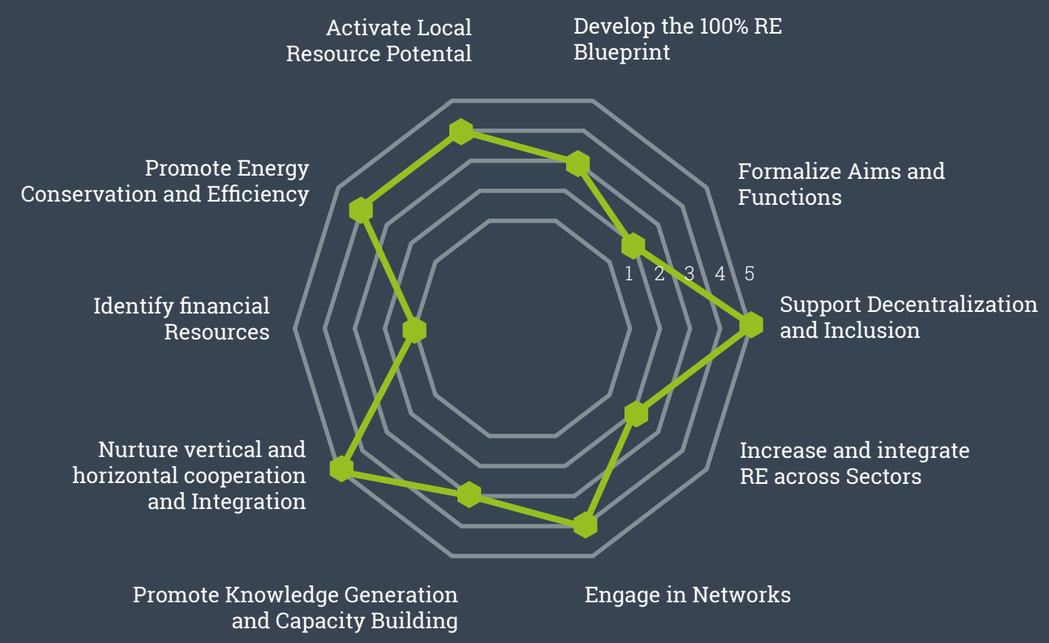
The Criterion approach is now evolving in 2017 to be identified directly as the Building Block approach – again, continuous improvement of a model evermore repeatable by others. We are committed to this vision and intend to reshape our plan to follow the 10 Building Block theme. In the spirit of this collaborative approach, we welcome any questions or ideas that will keep this international dialogue and common theme expanding and improving over time.

- Jay Heaman
Manager of Strategic Initiatives

VISUALIZING PROGRESS USING THE BUILDING BLOCKS

(on a scale 1 to 5)

The building blocks can be used to guide monitoring and evaluation of performance. The graph below is an example on how to visualize the level of progress achieved by a city or community, applying the different building blocks. For instance, if a city has strongly engaged in networks, their score is let´s say 4. Some progress may yet to be made but efforts are made and meaningful action can be observed. On the other hand, this city or community may done little with regards to identifying finance resources, so their score here is low. Progress on individual blocks is essential, but there must always be a holistic analysis considering all parts of the puzzle. The criteria for a 1 or a 5 may be defined by local stakeholders, depending on the context. Standardization applied to a whole country or a region would be valuable and requires a coordinated policy dialogue across levels of governance and sectors. In any case, a comprehensive and constant monitoring is encouraged of the progress made using the 100%RE building blocks.



12 FIELDS OF ACTION
GERMANY

In Germany, the twelve criteria (which were retitled as "fields of action" due to the differing connotation of the term "criteria" in the German language) have been applied and tested in the region of North Hesse, Germany. This most Northern region in the federal state of Hesse is striving to create a 100% RE roadmap, involving five districts and its municipalities as well as the city of Kassel in the development process. To assess the status quo of the municipalities' transition to 100% RE, the twelve fields of action were applied in the context of the regional project "process design of North Hesse's energy transition" at the Institute of Decentralized Energy Technologies (IdE) in Kassel, Germany. The project employed the twelve fields of action in order to structure discussions with policy makers and local stakeholders in personal talks as well as workshop about local activities. Further, they formed the base for a municipal benchmarking system, which has been developed by the IdE project. By assigning qualitative and quantitative indicators to each one of the twelve fields of action, a comprehensive system to assess and monitor the development of North Hesse's energy transition evolved. Understanding and communicating the twelve fields of action on the road to 100%RE, local stakeholders learned to recognize the scope of the energy transition and necessitated commitment.

Shape them to fit local context

The motivation for creating building blocks is to provide a flexible and adaptable planning tool for the many contingencies that local conditions may present. This report is intended to be a living document and to act as an interactive and adaptable tool, as opposed to a static list of standardized recommendations typical of traditional certification systems. The building blocks are designed to be adapted by local actors who should relate their design to their specific local context and identity. This stems from the belief that the transition to 100% RE needs to begin with the understanding that each place is unique; actors must build on the distinctive features and potential that are engrained in a particular place. The proposed building blocks are a set of actions that are meant to be scalable to support all levels of governance, as well as civil society groups aiming to harness local potential. It is expected that the building blocks will evolve with time, adapting to changes in society and technology. The building blocks are not intended to remain a fixed set of actions but be dynamic, continuously promoting progressive actions and behaviours. At the same time, these building blocks are meant to provide a solid base from which to structure a comprehensive 100% RE plan. The premise is to ensure that any issues raised within a particular jurisdiction can be sensibly addressed by considering them.

In addition, it is important that the constituencies participating in the creation of a 100% RE future based upon these building blocks take ownership by reworking and enriching them as they deem necessary. Oxford County, for example, developed its own Microsoft Excel spreadsheet in order to facilitate an "at a glance" look at what the municipality is already doing that would support a 100% RE goal, as well as specific areas that would need attention, and how the impact of the action might be evaluated. As another example of local ownership, Renewable Cities, an NGO based in Vancouver, has been working with the District of Saanich and Cities of Surrey and North Vancouver to assess their readiness for setting a 100% renewable energy target.

Customize their order of implementation

The order of implementation of building blocks does not necessarily follow the order or structure suggested in this report; another key aspect is the flexibility of implementation - the order of steps can vary considerably according to specific contexts. While it is logical to begin with considering the foundational building blocks first, many of the building blocks are interlocking and may therefore be implemented simultaneously. There are several overlaps between different actions and so the most effective implementation of one building block might arise only when also considering the recommendations of other blocks. The visualization and tools in this report should support the user in this exercise.

Use them to monitor and benchmark progress

It is important to point out that these building blocks become useful as both a guideline for action as well as a tool to evaluate the performance and achievements of a community's efforts in each building block. Benchmarking is used to provide feedback to guide improvement in specific areas as shown and tested in districts in Northern Hesse, Germany.

It is of the utmost importance to note that adopting an objective method to evaluate progress in each area is not an easy task. Both qualitative and quantitative measures should be used, but accuracy and objectivity thereof may not be easy to achieve. It is beyond the scope of this tool to propose a specific set of objective and scientific indicators to be adopted for the assessment of a community's progress within each building block. It is strongly recommended that each particular constituency develop context specific indicators

The building blocks become useful as both a guideline for action as well as a tool to evaluate the performance and achievements of a community's efforts in each building block.

to monitor progress and benchmark their level of implementation considering all building blocks. The visualization, examples and tools in this report should support the user in this exercise.

Use them to stimulate synergies

The building blocks are not only applicable to guide an energy transition, but can apply to other sectors—waste, water, transport, food, etc.—as shown by Oxford County, Canada. This can be beneficial in facilitating cross-sectorial dialogue, as it creates a common language and a shared understanding that can ease communication and collaboration across departments, perspectives and interests.

Furthermore, it is important to point out that the guiding intent of these building blocks is to support communities around the world in achieving not only a renewable energy transition, but a comprehensive and regenerative transformation leading to a more just, equitable and sustainable society that can safeguard the well-being and prosperity of current and future generations. The implementation of the building blocks suggested in this report represents a strong foundation for a more inclusive and systemic change in society, working towards a long-term sustainable future.

The 100% RE transition requires the mobilization of existing partnerships and the formation of further multi-lateral alliances. A wide range of actors are needed to understand how the transition will affect them and what their role within it might be. The number of sectors involved in the transition towards 100% RE goes well beyond the energy sector and will therefore require all parts of society to participate and contribute to direct a cohesive effort towards a common 100% RE vision. Beyond simply framing the issue in terms of energy and the environment, we must strive to understand and convey the extensive added value of a transition towards 100% RE. These building blocks represent the development of a new method, attempting to incorporate essential local participants and their efforts into the local processes, which will in turn facilitate the progression of diverse social and governmental supports necessary for the realization of a shared renewable future.

Use them across levels of government

While the main target group of these recommendations are local governments and communities, it is important to note that local authorities might not have the legislative power nor the capacity to carry out many of the recommendations presented in the building blocks as their implementation may fall on the jurisdiction of regional and national governments. It is therefore essential to point out that these recommendations are not only valid for local and municipal governments but should be applied across different levels of government. Local communities should not work in isolation but collaborate as much as possible with other levels of government (regional, national and international) to be able to move towards the 100% RE target effectively. All governments' representatives from municipal to national level should find pathways to work together and to set up the necessary policy frameworks and institutional bodies able to align purposes and streamline efforts across jurisdictions and constituencies.

The Building Blocks

Activate local resource potential

PERFORM PRELIMINARY ASSESSMENTS

Local communities should carry out preliminary assessments to establish their community energy consumption baselines. These provide greater understanding of the current state of energy use and start to prepare the data needed for formulating a 100% RE scenario and its specific pathways.

MOBILIZE LOCAL RESOURCES

It is important that local actors are not left to work in isolation. From the outset, local governments must gather and engage interested parties, forming broad coalitions of concerned local actors, organize workshops and roundtables or engage with local utilities and regulators from the very start.

IDENTIFY PROGRAMS FOR SUPPORT AND ASSISTANCE

It is important that local governments start exploring existing options available at different scales (meaning for example at different levels of government) with the potential to support a successful 100% RE transition. These might range from capacity building programs to funding schemes that can be tailored to focus on renewable energy implementation and energy efficiency investments. This is an opportunity for the development of new and creative forms of funding and financing a 100% RE future.

Any local actor or community that wishes to bring the 100% RE vision forward should understand the particularities of their place, the potential of their unique region and distinguishing features of their unique community. This includes, but is not limited to, its geographic, climatic, environmental, cultural, social and economic features, as well as its educational structures or human resources. The local resource potential (meaning not only local natural resources but also social, economic, educational, etc.) should be mobilized and gathered from the very beginning of any action plan. The 100% RE target and its related policy framework needs to be tailored to this particularity as this will ensure effective and rapid policy and project implementation.

Mobilize Local Resources

It is important that local actors are not left to work in isolation. From the outset, local governments must gather and engage interested parties, which they can do by:

- Taking stalk of existing community groups and stakeholders.
- Forming broad coalitions of concerned local actors, including the Mayor, City Councillors, active residents, community leaders, businesses, etc.
- Recruit engaged citizenry; inspire them and give them purpose.
- Organize workshops and roundtables that bring people together and start to identify interests, roles, level of engagement, etc.
- Promote alignment across groups: speaking to those who might be opposed to such initiatives and plans to learn and understand what their objections are so that they may be addressed in some manner.
- Engage with local utilities and regulators from the very start.
- Ensure pro-active outreach to people in the community who are not necessarily active in municipal/civic policy matters. This could include people from low-income communities, minorities, immigrants, etc.

In 2009 the City of Vancouver set out to develop the Greenest City Action Plan. The consultation and participation process that was developed, with contributions from over 60 City staff, more than 120 organizations, and thousands of individuals, sets an example of best practices in citizen engagement and partnership building.

In 2011, Vancouver implemented its Greenest City Action Plan with the goal of becoming the greenest city in the world by 2020 and defining ten sectoral targets. The success of the plan and partnerships built to achieve the targets led the city to build on it and create further targets, including community-wide 100% renewable energy by 2050.

ASPEN
UNITED STATES[21]

In 2000, the City of Aspen in partnership with Pitkin County launched the Renewable Energy Mitigation Program (REMP), designed to promote renewable energy and energy efficiency. How does REMP work? The County's and City's building codes require buildings to follow a strict "energy budget". Homeowners and commercial property owners who wish to consume additional energy for snowmelt, outdoor pools, spas or excess floor area have the option of installing a renewable energy system onsite to provide the extra energy necessary or paying a mitigation fee instead. This mitigation fee feeds into the REMP fund. The REMP funds are distributed in the form of rebates and grants for renewable energy and energy efficiency projects, with oversight from the City and County. REMP has raised over $12 million for energy efficiency and renewable energy projects, and it is estimated that for each dollar REMP invests, further 6 dollars are leveraged.

Preliminary assessments provide greater understanding of the current state of energy use and start to prepare the data needed for formulating a 100% RE scenario.

Identify Programs for Support and Assistance

It is important that local governments start exploring existing options available at different scales (meaning for example at different levels of government) with the potential to support a successful 100% RE transition. These might range from capacity building programs to funding schemes that can be tailored to focus on renewable energy implementation and energy efficiency investments. This is an opportunity for the development of new and creative forms of funding and financing a 100% RE future.

Perform Preliminary Assessments

Local communities should carry out preliminary assessments to establish their community energy consumption baselines. These provide greater understanding of the current state of energy use and start to prepare the data needed for formulating a 100% RE scenario and its specific pathways.

Assess the local RE potential

Assess the renewable energy potential of the particular region and ensure regional natural strengths are fully captured. The design of a renewable energy system strongly depends on the natural resources available for a neighbourhood's, community's or municipality's consumption needs; which renewable energy sources—solar (PV and solar thermal), wind, hydro, biomass or geothermal energy—should be used; and the extent to which the solution goes beyond being technological. It is important to remember that while a technology might be acceptable to one

All members of society must gather and discuss what sort of RE development is most desirable for their setting, taking into equal account the area's distinctive economic, social and environmental values and objectives.

CHEMNITZ
GERMANY[22]

In 2008, the city council developed the Integrated Climate Protection Programme (*Integriertes Klimaschutzprogramm*). The first focus area in the programme, Climate Protection, gave rise to a comprehensive analysis of RE potentials in Chemnitz, including photovoltaic (PV) systems, biomass energy, wind energy, landfill gas, geothermal energy, and hydropower. The analysis resulted in a holistic overview of the current state of climate change, future trends, and potentials of energy efficiency (EE) and RE. The analysis has been instrumental in informing on-going policy plans, identifying priority measures and key action areas needed to achieve the RE targets and starting consultation processes with relevant stakeholders.

community it might not be to another. Therefore all members of society including local community champions, elected officials, members of local businesses, civil society organizations, private citizens, academics, and so on must gather and discuss what sort of RE development is most desirable for their setting, taking into equal account the area's distinctive economic, social and environmental values and objectives.

Define Boundaries

Define the geographic boundaries of the area transitioning to 100% RE. This is important for establishing clarity about which areas will be affected, how and when. All of the various building blocks and related actions—from the early stages of gathering data to policy and system implementation—will be relevant for the geographic areas defined at this stage. Identifying a specific area of action allows for clear boundaries for the application of sustainable Building Blocks.

Analyse Energy Consumption Data

Collect monthly, quarterly, or yearly energy consumption data for all measurable sectors, namely electricity, heating/cooling and transport for the selected area. Map producers and methods of production, to evaluate the status quo and to assess the availability of data that will be required at later stages, for example to feed data into a particular energy modelling tool used.

Identify Energy Shares by Source

Evaluate current energy performance (e.g. for buildings this could be kilograms of CO_2 emissions per square meter) and calculate the local energy mix (the share each type of energy source—renewable or fossil-based—contributes to the total energy consumed); assess the potential that has been realized and whether there are areas

In 1996 the City of Växjö approved the target to become a fossil fuel-free city in order to eliminate climate impact and fossil fuel dependency. The city had already accumulated good experience on the use of renewable energy since 1980 and plans to reach 100% renewable energy by 2030. The City of Växjö methodically monitors and reports performance in the carbonn Climate Registry global platform, including energy matrix and greenhouse gas emissions. The reported data demonstrates that the city has already made significant progress with the renewable energy share at 64% as of 2015. In parallel, the emissions of GHG have also dropped dramatically – per capita emissions are just over 2 tons in 2015, a decrease by 54% compared to 1993 levels. Progress is most notorious in the heating sector thanks to the use local biomass and geothermal energy and the district heating network.

Externalities are important yet difficult aspects account for when pricing energy. Yet incorporating them allows to appreciate how competitive renewable energy sources actually can be.

for additional benefit. Evaluate the resilience and flexibility of the current energy system and map the system's dependence on particular sources (for example from imported oil and gas). When fossil fuel resources are local, for example, this phase will enable communities to imagine their local economy thriving without these assets, thereby overcoming carbon lock-in and optimizing use of more sustainable local resources.

Identify GHG Emissions by Sector

Estimate total GHG emissions produced by sector and calculate relative shares of those sectors and sources. This is essential to understanding which sectors contribute the most to GHG emissions and how to strategically prioritize interventions in ways that will have the greatest impact on reduction and mitigation.

Measure Current Energy Costs

Estimate average annual per capita costs for electricity, heating/cooling and transport. In other words, determine how much each resident spends per year. It is important to compare the current costs with the costs projected for the 100% RE scenario to confirm whether costs are realistic and competitive.

Measure and Quantify Externalities

Assess externalities associated with the current energy system. These are the costs that are not accounted for, such as health and climate change costs, among others. A long-term cost analysis of proposed energy technologies should also be considered. Externalities are important yet difficult aspects account for when pricing energy. Yet incorporating them allows to appreciate how competitive renewable energy sources actually can be[23].

2 Activate local resource potential

Preliminary assessments

- Measure current Energy Costs.
- Measure and quantify Externalities.
- Analyse energy consumption data and identify energy shares by source.
- Identify GHG emissions by section.
- Identify the RE potential of your region.
- Define geographical boundaries of the 100%RE area in transition.

Mobilise local resources

- Map stakeholders and their interests and identify existing engagement platforms and potential gaps for different stakeholders.
- Organize workshops and roundtables to identify interests, roles, level of engagement, form coalitions, set up taskforces, engage different actors, start planning etc.

Identify programs for support and assistance

- Identify programs, funds and supporting schemes (from local to international from across departments (energy, environment, economic development, social welfare, etc.) that might support your 100%RE transition.

Develop the 100% RE Blueprint

DEFINE THE 100% RE TARGET

Formulating a target that is time-bound and measurable, and whose scope and political obligations are well-defined, is essential to developing and implementing a comprehensive and coherent 100% RE strategy.

MODEL A 100% RENEWABLE ENERGY SCENARIO

In parallel with defining the 100% Renewable Energy target, local authorities should engage local research centres to develop a credible energy scenario using computational modelling tools and other means of analysis such economic cost-benefit analysis.

ESTIMATE THE POTENTIAL ECONOMIC, ENVIRONMENTAL AND SOCIAL BENEFITS

The results of the energy scenario can also help develop an estimation of the potential economic, environmental and social benefits that such an energy transition would entail. These should include specific estimates in terms of job creation, energy savings, local revenue production, opportunities for local industries, positive effect on human health, local air pollution, climate change mitigation potential and resilience.

All the actors in a community should participate in shaping a shared and inclusive 100% RE blueprint and in doing so they can better understand how best to direct their own efforts. The 100% RE blueprint should be based on local potential and should be as inclusive as possible to ensure that all parts of society are involved and engaged. It is also important to create synergies between the 100% RE goals and other community objectives, for example how an energy transition can also contribute to increase community resilience against natural disasters or boost local economic development. Identifying such synergies can help in mobilizing a greater number of people to support the transformation.

Define the 100% RE Target

Formulating a target that is time-bound and measurable, and whose scope and political obligations are well-defined, is essential to developing and implementing a comprehensive and coherent 100% RE strategy. As a general guideline, a 100% RE goal is fully achieved when the amount of renewable energy generated within or imported into the defined area equals or exceeds the annual energy consumed. Yet, this definition is left intentionally vague, as it does not specify which energy-use sector is included (electricity, transport, heating/cooling, etc.) nor does it set the scope of the target (whether community-wide or municipal). It also does not specify where the energy is to be produced or by whom, or still more ambitious, whether the technology will be sustainable in the broadest sense, for example: whether the solar panels are to be manufactured per strict environmental standards or whether the community accepts hydropower as environmentally or socially sustainable, etc.

Therefore, the specifics about a community's 100% RE target must be clearly and comprehensively defined each time a 100% RE target is set. The details of the particular 100% RE target depend on the specific case and they should be defined by local authorities in a transparent, open, accessible and comprehensible manner. The geographic area to which the target applies should also be clearly defined to avoid confusion.

Each 100% RE target is unique and they should be defined by localauthorities in a transparent, open, accessible and comprehensible manner.

Interim targets should also accompany the longer-term targets. Furthermore, other community targets should also be explored for how they could complement the 100% RE target. Among others, energy conservation and efficiency, GHG emissions and air pollution reduction targets would complement the 100% RE goal.

Lastly, it is important to highlight that setting the 100% RE target does not necessarily equate to energy independence or self-sufficiency. Regions should understand that a 100% RE Future can be a target best achieved through an interconnected system where energy is shared across territories and where nations and regions cooperate and integrate their local grids.

The City of Malmö is committed to reaching 100% RE in local government operations by 2020 and 100% RE at community-scale by 2030. The city has set targets significantly more ambitious than both the European Union's target for Sweden (49% by 2020) and the national plan (50% by 2020). Malmö benefited from committed local politicians, private investment, strong co-operation with regional stakeholders and a thorough knowledge of the locally available RE sources. The target setting exercise has allowed the local government to integrate and mainstream the targets across the City of Malmö's plans.

Model 100% Renewable Energy Scenario

In parallel with defining the 100% Renewable Energy target, local authorities should engage local research centres to develop a credible energy scenario using computational modelling tools and other means of analysis such economic cost-benefit analysis. The results of the energy scenario should be summarized in a structured and easily communicated way that guides policy makers in developing specific policy interventions. The energy scenario creates a credible base that will help build support and understanding of how the 100% RE scenario would look like in practice, especially in terms of technologies and infrastructural changes involved. This energy scenario should be regularly reviewed and modified according to how implementation evolves and to updated market data, energy prices and other factors that could change the model projections.

FRANKFURT'S 100% RE ROADMAP[26]

Besides being a global financial hub, the German city of Frankfurt has been positioning itself as a leader in sustainability and climate protection for several decades. Its 100% RE roadmap is based on a technical scenario, conducted by Fraunhofer ISE. Frankfurt's approach is that it aims to combine a top-down and bottom-up strategy, involving local citizens and businesses in achieving its objectives while establishing a clear vision in its city-wide Master Plan. This Master Plan includes a dynamic array of projects and initiatives designed both to reduce emissions and to increase the adoption of renewable energy and energy efficiency technologies. Together, it is these various initiatives that will help Frankfurt reach its ambitious 100% RE target.

Estimate the Potential Economic, Environmental and Social Benefits

The results of the energy scenario can also help develop an estimation of the potential economic, environmental and social benefits that such an energy transition would entail. These should include specific estimates in terms of job creation, energy savings, local revenue production, opportunities for local industries, positive effect on human health, local air pollution, climate change mitigation potential and resilience. These are essential also to creating the necessary momentum and political will across different sectors, departments and jurisdictions.

In terms of economic impact, it is important to understand that the transition may strand assets. These include local resources, which cannot be used because of their carbon intensity (such as oil, coal or natural gas), as well as related infrastructure like coal or natural gas plants. The labour sector will also transform from traditional energy expertise and professions to renewable energy skills and careers. It is therefore warranted to have economic analyses and conversion strategies that also consider the impact the transition has on current social structures, including on employment.

Güssing, Austria adopted a target to reach 100% RE in 1990 when the town was experiencing economic decline. The target was reached in just over one decade with very positive outcomes: the use of local biomass as an energy source created more than 1,000 jobs and produced a regional value added of around 14 million Euros per year. The transition to 100% RE increased municipal tax revenue from 400,000 (1990) to 1.4 million (2008).

It is warranted to have economic analyses and conversion strategies that also consider the impact the transition has on current social structures, including on employment.

100% RE TRANSITION

SOCIO-ECONOMIC BENEFITS

There are many examples of a comprehensive economic impact assessment for a 100% RE scenario already in place. Further references are available on the e-library page of the Global 100%RE campaign website[1].

In a study published in 2010 titled "100% Renewable energy systems, climate mitigation and economic growth"[28], researchers from Aalborg University in Denmark proposed a 100% RE scenario for Denmark analysing also the socio-economic benefits of such a transition. As part of this study, the authors carried out a long-term economic analysis of how the transition from a fossil fuel-based system to one that is 100% renewable energy-based are expected to affect the current Danish economy. In this 100% RE scenario, parts of the existing infrastructure and of the natural resources (namely oil and gas in the North Sea) are to be decommissioned. However, they are to be replaced with local renewable energy production and by modernized infrastructure, both of which were projected to benefit the long-term prosperity of the country. The study showed the major economic benefits of this 100% RE scenario compared to the business- as-usual scenario (still mostly based on fossil fuels).

Assuming mid-range fuel prices and low carbon prices, Figure 1 shows the decrease in socio-economic costs in the IDA (Danish Society of Engineers) Climate Plan (100% RE) compared to the reference scenario (business-as-usual scenario). There will be economic gains even with prices of oil at half those estimated by the IDA. As shown in Figure 2, for different estimates of fuel and CO2 prices, the IDA scenario is still favourable given the overall decrease in costs and increase in investments predicted for year 2050. It was estimated that Denmark in the reference scenario would have to spend between 50 and 90 billion DKK/year on fuels. In contrast, In the IDA scenario expenditures would be reduced to between 29 and 51 billion DKK annually.

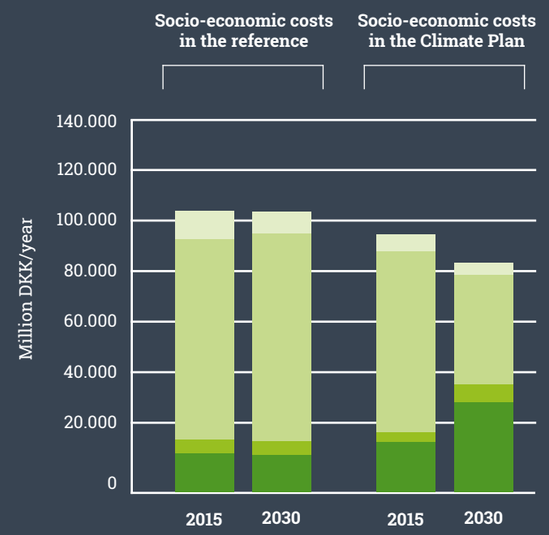


Figure 1: Cost to the economy for the two different scenarios. Visible decrease in total costs is expected if the Climate Plan, i.e. IDA scenario, is implemented. Greater investments are considered beneficial to the economy (Mathiesen, Lund & Karlsson, 2010)

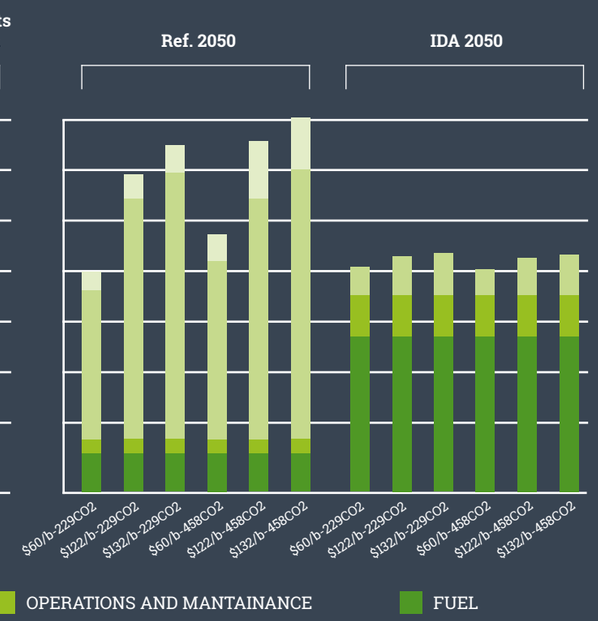


Figure 2: Costs to the economy in 2050 at different fuel and CO2 prices. Again the greater investment share is a positive aspect of the transition as it will lead to considerable local economic growth (Mathiesen, Lund & Karlsson, 2010)

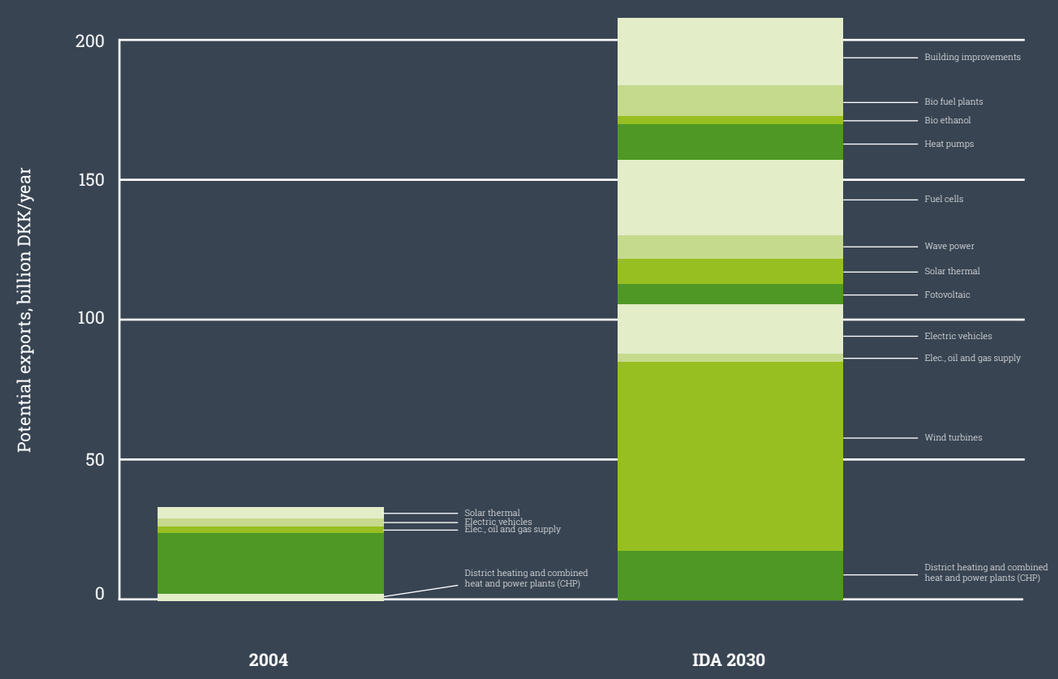
100% RE TRANSITION

BUSINESS POTENTIAL

Shifting expenditures devoted to fossil fuel costs towards RE investment will create new jobs and boost local economies. The increase in overall operations and maintenance costs coupled with energy efficiency projects will also provide opportunities for employment and market diversification. Approximately 30,000 to 40,000 jobs have been created thanks to the implementations of the IDA plan. It is expected that by 2050, the reference scenario will net an additional 15,000 jobs. Jobs will be lost in the oil and gas industry but can be shifted to the RE technology sector. The number mentioned above regarding new jobs created does not include the opportunities for employment coming from the increase in export of renewable technologies which can replace the oil and natural gas export jobs expected to disappear entirely in the course of 10–20 years.

As shown in Figure 3 below, there is immense possibility for exporting the technologies developed for the IDA plan. Innovation, research, market diversification, new business and job development, investments, technological advancement will advance because of implementing the IDA plan and will be the key drivers of this transition.

Business Potential



Develop the 100% RE blueprint

Define the 100% RE target

- Define what sectors are included in the target.
- Explain how you calculate your RE shares.
- Define your mid-term target / by 20__
- Define your long-term target / by 20__
- Define the scope of the target (e.g. community-wide, municipal operations etc.).
- Define the role of public institutions, private entities, citizens, utilities and energy companies.

Model 100% renewable energy scenario

- Identify potential partners in the region such as universities/research institutions to conduct the modelling.
- Evaluate the infrastructural changes the scenario entails.
- Explore opportunities to fund a 100% RE scenario.
- Explore how the 100% RE scenario meet sustainability criteria.

Estimate potential socio-economic benefits

- Calculate potential savings such as import of conventional energy and additional local revenues.
- Explore short-term, mid-term and long term economic savings.
- Define externalised costs of current energy system.

Formalize aims and functions

FIX BINDING TARGETS

After declarations that signal strong and widespread political commitment for the goal, it is essential that the 100% Renewable Energy target is legislated as binding and enforceable. Setting an ambitious, long-term renewable energy target demonstrates political commitment and provides investors, businesses, and residents with a clear long-term vision for the region, along with better understanding of how their roles within it.

DEFINE COMPREHENSIVE LEGAL AND REGULATORY FRAMEWORKS

Specific laws will need to come into force to ensure that all the other recommendations listed in the building blocks are indeed implemented. Any such law should support a decentralized, people-centred, participatory transition maximizing distributed, community-owned renewable energy systems.

ESTABLISH RELEVANT INSTITUTIONALIZED BODIES

Institutionalization also means establishing formal bodies or organizations to be responsible for designing, implementing and monitoring the transition towards achieving the target. These bodies should promote and facilitate multi-level governance, cross-sectoral collaboration and peer-to-peer cooperation between regions, cities and local governments. As an energy transition is a long-term endeavour, it needs to be well-rooted within a combination of institutional practices that are formal and informal.

Formalization of the transition means official, binding targets need to be set, policies and legislation need to be written into law, and specific institutions to supervise and drive the transition forward must be established.

Fix Binding Targets

After declarations that signal strong and widespread political commitment for the goal, it is essential that the 100% Renewable Energy target is legislated as binding and enforceable. Setting an ambitious, long-term renewable energy target demonstrates political commitment and provides investors, businesses, and residents with a clear long-term vision for the region, along with better understanding of how their roles within it. Providing an official mandate for action catalyses change and helps streamline efforts. Depending on the national context, local authorities might not have the legislative power or the capacity for this and implementation may fall to the jurisdiction of regional and national governments. Therefore local communities should not work in isolation but collaborate as much as possible with other levels of government (regional, national and international) in order to be able to formalize declarations. Governments' representatives from municipal to national level should find pathways to work together and to set up the necessary policy frameworks and institutional bodies able to align purposes and streamline efforts across jurisdictions and constituencies.

Setting and communicating a 100% renewable energy target has a number of additional advantages: it can stimulate engagement with a wide range of stakeholders; it can ensure more efficient deployment of both technical and administrative resources and reduce duplication and the risk of developing competing policy goals; and it can give key stakeholders (such as utilities, or private investors) the confidence required to make large investments, such as upgrading transmission and distribution grids. By improving investment certainty, ambitious targets can also attract domestic and international investors, in turn making it easier to achieve the target. Experiences from around the world demonstrated that targets can also build awareness among external audiences as well as among the region's citizens. This awareness can be essential to building the public support needed to support and eventually reach the target.

Setting an ambitious, long-term renewable energy target demonstrates political commitment and provides investors, businesses, and residents with a clear long-term vision for the region, along with better understanding of how their roles within it.

Define Comprehensive Legal and Regulatory Frameworks

Institutionalization refers to establishing stable, formal legal and regulatory frameworks that support the 100% RE targets. Specific laws will need to come into force to ensure that all the other recommendations listed in the building blocks are indeed implemented. Any such law should support a decentralized, people-centred, participatory transition maximizing distributed, community-owned renewable energy systems. While large scale projects should not be necessarily excluded especially when it comes to certain types of necessary interventions (e.g. enlarging and upgrading the power grid), governments at all levels should consistently support small-scale, household-level renewable energy systems that can enable a transition to a decentralized energy future where all citizens can benefit from this energy transformation (for example by becoming prosumers, i.e. consumers as well as producers of energy). Regulatory frameworks should establish clear and effective rules for financing and for inter-regional and cross-border energy trading. Policies must: be supportive of renewable energy investments; favour clean technologies over carbon-intensive alternatives; and level the playing field through appropriate taxation of fossil fuels, internalization of fossil fuel and nuclear externalities, and stimulation of energy cooperatives and other participatory and decentralized processes of renewable energy development. Finally, considering the variability associated with renewables, markets and infrastructure need to facilitate flexible resources, demand response needs to be enhanced, cross-border trade needs to be fluid and free of excessive regulatory burdens. Trade mechanisms need to facilitate and promote exchange of energy across regions and countries.

Legal frameworks that support the 100% RE targets should support a decentralized, people-centred, participatory transition maximizing distributed, community-owned renewable energy systems.

Establish Relevant Institutionalized Bodies

Institutionalization also means establishing formal bodies or organizations to be responsible for designing, implementing and monitoring the transition towards achieving the target. These bodies should promote and facilitate multi-level governance, cross-sectoral collaboration and peer-to-peer cooperation between regions, cities and local governments. As an energy transition is a long-term endeavour, it needs to be well-rooted within a combination of institutional practices that are formal (e.g. regulations, laws and acts) and informal (e.g. round tables, task forces, energy days). A platform for permanent, efficient organization and allocation of the necessary resources can enable generational continuity of the transformation and coordination of local actors and projects. A local authority, an energy agency, or a third-party could provide such a platform, but to foster trust, it should be independent of corporate interests, influence of private investors and short-term political trends.

It is very important that these commissions and the policy framework that are established to support the 100% RE target can moderate potential swings in political trends related to changes in political leadership and mandates.

Instituting mechanisms to monitor the pace of progress is also needed. The appointed commissions or taskforces should be charged with evaluating progress and reporting on best practices and what has not performed to expectations.

Carbon lock-in is also a potential risk that should be confronted early on. To tackle the inertia of fossil fuel-based energy systems that tend to repeat in perpetuity, it is essential to support strong policies and specific regulatory frameworks that can effectively and systematically support innovative renewable energy infrastructure, rather than new fossil fuel infrastructure.

Byron Shire has a target to reach 100% RE at community-scale by 2025. Byron Shire demonstrates how institutional arrangements can support 100% RE strategy development and implementation.

The Zero Emissions Byron (ZEB) project is championed by the Mayor, steered with the help of Byron Shire Council and driven by the community. Five working groups were created to address the sectors of energy, waste, buildings, land use and transport. This work will be used to develop 10-year strategic plans for the transition to zero emissions for all sectors.

The region has been making efforts to cut emissions since 2014, through the launch of a community-owned clean energy generator focusing on solar photovoltaic (COREM - Citizens Own Renewable Energy Mullumbimby), a strong take-up of rooftop solar and the energy retailer ENOVA, through which Byron will buy and distribute renewable energy from a range of sources.

Promote energy conservation and efficiency

CHANGE HUMAN BEHAVIOUR

A large decrease in energy consumption can come from non-technological measures that support a cultural focus on energy savings that lead to behaviour change. This can be done by promoting a culture of sustainability within the community, which is based not only on raising the level of awareness among citizens (e.g. through education and awareness campaigns) but also on increasing their level of engagement within their community.

RETROFIT EXISTING BUILT-ENVIRONMENTS

Considerable amounts of energy and carbon emissions can be saved by aggressively retrofitting existing buildings. Policies must establish strict standards for all new buildings and local governments should invest in retrofits of existing public building stock.

UPGRADE INFRASTRUCTURES AND SUPPORT EFFICIENT TECHNOLOGIES

By upgrading infrastructure, energy conservation can be achieved. Technologies that enhance energy efficiency and save energy through improvements in infrastructure and efficient technologies include cogeneration systems, district heating and cooling systems, decentralised electricity generation, smart grids and micro-grids, and recapturing industrial waste heat and other secondary heat sources.

Energy efficiency and energy conservation represent core components of a sustainable 100% RE strategy. Prior to considering how much energy can be generated from renewable energy sources available on site, ways to significantly reduce current energy demand should be assessed. Generally speaking there are three key approaches to decreasing energy consumption, which are briefly summarized in the sub-sections below.

Change Human Behaviour

A large decrease in energy consumption can come from non-technological measures that support a cultural focus on energy savings that lead to behaviour change. This can be done by promoting a culture of sustainability within the community, which is based not only on raising the level of awareness among citizens (e.g. through education and awareness campaigns) but also on increasing their level of engagement within their community[30].

To promote sustainable behaviour, a much more systematic approach to the problem is needed[31]. Behavioural psychology has shown that a sense of belonging to one´s own community and territory, fostered by engagement in decision-making processes, helps to nurture a feeling of empowerment and responsibility leading to more sustainable behaviours[32]. However, people can often feel disconnected from their community and environment, especially in cities[33]. This can foster feelings of political apathy and increasingly individualistic behaviours that lead to indifference to the impact of personal action on the community and environment[34]. City and community councils behave as neighbourhood representatives closest to the community and therefore play a crucial role in enabling change.

For example, improved community engagement can be achieved by supporting or creating platforms for people to interact and undertake community activities (gardening, tree planting, energy saving initiatives, community energy projects). By providing a space for individual and collective participation and learning in a social context, community engagement platforms catalyse sustainable behaviour in three ways. Firstly, participatory decision-making processes help create a sense of identity, ownership and belonging to a community which impacts behaviour. Notably, if rules and regulations guiding behaviour are decided through a participatory process, people are more likely to act by these rules and model their behaviour to follow them. Secondly, community activities and active democratic participation create more conscientious and better-informed citizens who are aware of how dependent everyone is on one another. They should also be more inclined to consider their individual behaviours in the context of their community. Lastly, participation also means investing in public and shared spaces and promoting activities that fulfil our most human needs, diverting people from merely material or consumption-based actions.

Community engagement in decision-making processes helps to nurture a feeling of empowerment and responsibility leading to more sustainable behaviours.

Several studies demonstrate that significant improvements in energy efficiency coupled with renewable energy sources can actually reduce building emissions to zero.

Another way to promote sustainable behaviour can be achieved by inviting people to prioritize certain choices. This means that governments will need to consider how their particular laws and policies are affecting behaviour[35]. For example, holistic and cross-sectoral considerations such as human-scale and integrated urban planning, dense mixed-use development, pedestrian and bicycle-friendly development are all solutions that can lead people to make energy-wise choices[36]. Similarly, providing attractive routes and planning for pedestrians and cyclists can lead to considerable savings in the amount of energy used for transportation. Creating a dense, multi-modal, affordable, accessible and well-functioning public transport network can also encourage car-free mobility and, overall, a more sustainable transport system. Similarly, mixed-use development can create denser urban areas where people work and live in the same area of the city, allowing them to walk or ride to work. All of these interventions impact behaviour and can significantly reduce the overall demand for energy.

Retrofit Existing Built-Environments

Buildings contribute a substantial amount of greenhouse gas emissions. For example, UK buildings contributed 37% of the total UK greenhouse gas emissions in 2012[37]. Considerable amounts of energy and carbon emissions can be saved by aggressively retrofitting existing buildings[38]. Policies must establish strict standards for all new buildings and local governments should invest in retrofits of existing public building stock. The energy associated with the built environment include numerous factors including[39]: embodied energy (energy required to extract, manufacture, transport, install and dispose of construction materials); operational energy required by the mechanical and electrical systems (amount and types of lighting, heating and cooling); passive energy conservation provided by the building envelope (the interface between the interiors and the outdoor environment); on-site energy generation (ideally by integrating renewable energy technologies into the building design); and other energy end-uses in buildings

(these can decrease with state-of-the-art technologies substituting older and less efficient technologies).

Costs for retrofitting buildings can be substantial and lead to savings only in the long-term. The technologies and material involved are often more expensive than conventional solutions, and construction can be interruptive and result in lost earnings for the owner[40]. District energy fuelled by renewable energy sources can reduce the need for costly refurbishments.

Several studies demonstrate that significant improvements in energy efficiency coupled with renewable energy sources can actually reduce building emissions to zero[41]. Regardless of the amount of initial financial outlay, efficient buildings have been shown to yield energy and cost savings over the lifetime of the building, reducing utility bills by more than 50%, and also increasing property values[41].

Concern over "split incentives" commonly deters investment in energy efficiency retrofits. A split-incentive indicates the disconnect between the interests of the people who own, manage or operate a building and those who pay the utility bills, for example. Landlords may not have incentives to retrofit their properties because it is their tenants who may be responsible for paying the utility bills, they are often not motivated to retrofit their properties[41]. Implementation of progressive sustainable building policies are essential to promoting climate-friendly buildings. They can include a range of strict standards and codes, financial incentives, information and education programmes, lead-by-example programs, and investment in further research and development[42].

UNEP reports that district energy can result in a 30%-50% reduction in primary energy consumption.

Upgrade Infrastructures and Support Efficient Technologies

By upgrading infrastructure, energy conservation can be achieved[43]. Technologies that enhance energy efficiency and save energy through improvements in infrastructure and efficient technologies include cogeneration systems (Combined Heat and Power), district heating and cooling systems (especially those designed to shift from using fossil fuels to biomass, geothermal energy or other renewable source as the primary fuel), decentralised electricity generation, smart grids and micro-grids, and recapturing industrial waste heat and other secondary heat sources.

For example, UNEP reports that district energy can result in a 30–50 per cent reduction in primary energy consumption[44]. Denmark has seen a 20 per cent reduction in national CO2 emissions since 1990 thanks to district heating. The district heating and cooling systems of Tokyo use 44 per cent less primary energy and emit 50 per cent less CO2 compared to individual building heating and cooling systems[44].

Promote energy conservation and efficiency

Retrofit existing built-environments

- Identify percentage of your GHG emissions coming from buildings.
- Define energy efficiency improvements to be implemented in buildings and its potential economic savings.
- Define the kind of energy that is used in the built environment (e.g. embodied energy, operational energy, on-site generation, passive energy conservation etc.).
- Identify winners and loosers of efficiency measures.

Upgrade infrastructures and support efficient technologies

- Identify inefficient infrastructures in your community.
- Identify efficiency potential of sector integration and infrastructural changes.
- Identify winners and loosers of measures.

Change behaviour

- Engage your community in local decision making processes related to energy consumption and production.
- Define projects and platforms to foster community engagement and education particularily on energy.
- Map existing policy initiatives that target change of behaviour with in a community or society.

Increase and integrate RE across sectors

INCREASE RENEWABLE ELECTRICITY GENERATION

To develop a sustainable energy system that is meeting (or reducing) local energy demand, which itself varies hourly, daily, and seasonally, a smart, integrated use of RE, energy efficiency, demand management and energy storage technologies is necessary. Variable RE resources such as solar and wind play key roles for energy generation, as well as dispatchable renewables like bioenergy and hydropower.

TACKLE THE BUILT ENVIRONMENT CHALLENGE

The built environment improvements are key to achieving energy efficiency and savings in heating and cooling and electricity, and participation by private homeowners and business owners and employees is essential.

MODERNIZE THE GRID AND OTHER INFRASTRUCTURE

Policies must support the integration of the technical and infrastructural changes needed to support an energy system fully powered by renewable energy sources. A policy framework will need to delineate clear actions to overcome the major technical hurdles specifically related to the flexible nature of RE and the necessary modernization of the energy grid.

TACKLE MOBILITY AND TRANSPORT CHALLENGES

Policies should focus on the electrification of private transport and on the phasing out of diesel and petrol cars by a certain date, for example as it is being explored in the Netherlands and in Germany , which are planning to ban sales of combustion engines cars by 2025 and 2030 respectively.

For a jurisdiction to pursue 100% RE, there is the need to increase RE penetration across sectors (e.g. electricity, heating and cooling, and transportation) and to ensure that these are developed in an interconnected and integrated manner, as this rises the likelihood of achieving 100% renewable energy[45]. The following sections include key considerations for developing a strategy to increase the share of RE.

Increase Renewable Electricity Generation

To develop a sustainable energy system that is meeting (or reducing) local energy demand, which itself varies hourly, daily, and seasonally, a smart, integrated use of RE, energy efficiency, demand management and energy storage technologies is necessary. Variable RE resources such as solar and wind play key roles for energy generation, as well as dispatchable renewables like bioenergy and hydropower. Coupling RE technologies with district heating and cooling can complement a 100% RE strategy and help regulate variable loads. New system technologies such as power-to-heat or power-to-gas are showing potential as useful means to convert renewable electricity generated into heat or gas for non-electric application uses, or to use excess electricity directly for heating or transport (EVs)[45].

A smart, integrated use of RE, energy efficiency, demand management and energy storage technologies is necessary to develop a sustainable energy system that meets a local energy demand thatis variable.

Tackle the Built Environment Challenge (Heating/Cooling)

The built environment improvements are key to achieving energy efficiency and savings in heating and cooling and electricity, and participation by private homeowners and business owners and employees is essential. Working towards energy efficiency and saving energy in buildings is known as demand side management (DSM) and it can include smart metering, providing incentives for energy efficient appliances, lighting and energy systems (e.g. ventilation, heating, cooling, local district energy), as well as offering energy consultation and training. New investment and financing models that de-risk initial capital outlay as well as innovative loan and other supporting programs also augment DSM activities. Local government staff together with policy makers from the regional and national government can mandate and enforce high energy efficiency standards, particularly for new buildings. It can also help increase the rate of retrofitting existing buildings using existing jurisdictional levers[46].

Lastly, considering relatively low natural gas prices, especially in certain regions of the world (e.g. North America), transitioning away from natural gas for heating purposes in building remains an economic challenge[47]. Stronger financial incentives for cleaner technologies and adequate taxation of carbon emissions will be essential tools to favour renewable energy technologies over fossil fuel-based options[48].

Tackle Mobility and Transport Challenges

Transitioning the transport sector towards 100% RE is one of the most challenging aspects of an energy transition, from policy, user behaviour and technological perspectives. To date, the share of renewable energy in transportation plays only a minor role in this sector, as many appropriate technologies to replace fossil resources still need to be tested and further developed[48]. Such technologies range from electric to hydrogen to biofuel-based solutions. With respect to biofuels, an unsolved challenge is to ensure regional and sustainable fuel sources[49]. Additionally, very often efforts to make transport sustainable with biofuels challenges the need to promote a fundamental change in the underlying transport technology or drive train. Whether ethanol, biodiesel, or traditional gasoline, the fact remains that internal combustion engines are staggeringly inefficient. Biofuels have been a distraction for urban and other policy makers which should focus on driving the transition to truly sustainable transport and mobility technologies such as light rail powered by renewables, cycling and electric vehicles.

With respect to hydrogen cars, costs and efficient hydrogen production remain two key techno-economic challenges. With respect to biofuels, ensuring regional and sustainable fuel sources remains a significant challenge. The most accessible option as of 2017 remains electric cars[50]. Policies should focus on the electrification of private transport and on the phasing out of diesel and petrol cars by a certain date, for example as it is being explored in the Netherlands[51] and in Germany[52], which are planning to ban sales of combustion engines cars by 2025 and 2030 respectively.

In parallel to the technological challenges, it is equally important to address infrastructure and cultural barriers. One way is to reduce the need for private cars all together by developing, improving, and spreading concepts and strategies that improve planning and reduce traffic (e.g. by inviting car sharing or by investing in a dense, smart public transport system that is integrated with dense cycling and pedestrian infrastructure). Other key challenges include developing feasible renewable energy-powered alternatives for interregional and international transport. This extends to the need to decarbonize shipping and air travel, which remain considerable global issues that must be addressed systematically by any 100% Renewable energy scenario.

While these issues fall beyond the sphere of influence of local governments, they should be debated at all levels and local plans should consider their roles within regional, national and international dynamics and how they can contribute in changing them (e.g. engaging in international networks, lobbying national and international negotiations, evaluating their community´s dependency on international resources, improving the use of local resources as opposed to imported ones, etc.)

Developing and improving strategies that improve planning and reduce traffic is as important as addressing technological challenges in the mobility and transport sector.

Increase Renewable Electricity Generation

Policies must support the integration of the technical and infrastructural changes needed to support an energy system fully powered by renewable energy sources. A policy framework will need to delineate clear actions to overcome the major technical hurdles specifically related to the flexible nature of RE and the necessary modernization of the energy grid.

In particular, to increase the penetration of renewable energy into the total energy supply, it is fundamental to increase the connectedness of the power, heating/cooling, and transport sector and to identify how these different sectors can be optimally integrated[53]. Electric grids across borders should also be integrated to mitigate variability issues related to most renewable energy sources[54].

There are five major infrastructural and technical challenges that will need to be supported by any 100% RE policy framework. Some of them may again require cooperation with upper level governments.

Enlarge & improve the network infrastructure

A key technical challenge for achieving 100% RE is the intermittency of RE sources. One way to mitigate it consists of connecting a large number of variable sources across a wide geographic area smooth out the variability of output from the renewable sources[54]. In simple terms, an example may be, when the wind is not blowing on a wind farm in one region, it might be blowing very strongly in another part. If the grid is connected to both sources, electrical reliability is enhanced and requirements for storage and back up energy are minimized. A policy that facilitates the construction and management of a large electrical network is therefore recommended. It is important to point out that network infrastructure enlargement should be assessed against the possibility of creating off-grid, mini-grid and smaller scale smart grid solutions which are able to tackle the variability

To increase the penetration of renewable energy into the total energy supply, it is fundamental to increase the connectedness of the power, heating/cooling, and transport sector and to identify how these different sectors can be optimally integrated.

issues through autonomous storage systems. The decision of upgrading and enlarging the power grid as opposed to creating smaller scale off-grid systems should be based on a careful economic feasibility analysis and comparison between on-grid and off-grid options[55]. For example, for areas with low on-grid connectivity such as in several developing countries, it is often more efficient and economically viable to establish off-grid solutions rather than to extend the grid to remote rural places[56].

Increase generation flexibility and mix of resources

Greater power reliability is provided by diversifying portfolio of RE technologies, such as wind, tidal, solar, geothermal and hydroelectric. For example, combining wind power with tidal power in certain regions can reduce by as much as 37% the cost of extra reserve to balance for variability as compared to a wind-only scenario[57]. Furthermore, small and flexible plants such as biomass thermal plants or combined heat and power plants, are ideal for the integration of variable renewable energy (VRE) and for reducing balancing costs. In contrast, much less flexible generating plants, such as coal or nuclear plants, are incompatible and unable to adapt rapidly to changes in output from renewable sources[58].

Demand-side management and efficiency improvements

Flexibility can come not only from diversifying the supply side mix, but also from improved interaction with the demand side and bi-directional power and information flow (producer to consumer and consumer to producer). Implementation of a smart grid and smart metering systems for demand-response management to help variable sources better match variable loads will be very important[59]. The development of advanced communication technology with smart electricity meters linked to control centres will offer greater flexibility which will require consumer engagements in terms of changes in behavioural patterns, social acceptance and privacy/security issues. Schemes and incentives will be needed to encourage consumer participation with power system operator schemes that require demand-supply smart interaction[60]. This may include distributed intelligent community grids or prosumer networks. Lastly, reaching the 100% RE target will also require major increase in energy efficiency and energy savings which will involve demand side interventions such as more energy efficiency lighting systems, more efficient building insulation, more efficient cooling and heating technologies and so forth.

Improved operational, market and planning methods

Current operational, planning and electricity market procedures, mostly designed around dispatchable and predictable energy load patterns, will need to change to facilitate integration of variable sources[61]. The nature of regulatory

Technology with smart electricity meters linked to control centres will offer greater flexibility but will require changes in the consumers' behavioural patterns, social acceptance and privacy/security issues.

practices greatly affects balancing costs: If system balancing actions are determined close to real time, system balancing costs are minimised since variable output can be forecast with a high degree of accuracy within such timescales. In countries where balancing decisions are made a long period ahead, forecasts of VRE supply is much less accurate and therefore balancing costs are higher. Forecasting for improved predictability of variable output, such as improved wind forecasting and accurate prediction models, will also be essential.

Storage

Storage is also core to the discussion around the transition towards 100% renewable energy. While it is true that energy storage will be necessary to achieve 100% renewable energy, it is also important to note that with a relatively well-interconnected grid (e.g. Germany), storage would only become necessary with penetration of variable RE greater than 60% or 70%[62]. Furthermore, with a well-integrated energy sector where electricity, heating/cooling and transport are increasingly interconnected (e.g. vehicle-to-grid options for grid balancing or smart district energy systems that integrated electricity and heating) the problems associated with RE variability and storage are reduced[45]. Storage can become extremely valuable assets when there are great fluctuations in demand (e.g. in high tourism areas where demands changes periodically[63] or in rapidly urbanizing areas) as storage can provide a prompt and stable supply of energy during peak demand while storing energy during low demand, which increases the overall efficiency of the energy supply system.

Many storage options available can be extremely useful in balancing variable loads with fluctuating sources[64]. For example, pumped hydro storage allows water to be pumped up into a reservoir when demand is low but then can produce electricity when the water is released to drive generating turbines. While commercial options like small-scale electric batteries (e.g. Tesla domestic batteries Powerwall[65]) are becoming increasingly accessible and cost competitive, support from the government to research and develop improved and ever more efficient storage technologies is needed. It is also extremely important to ensure that the benefits of storage options are carefully compared with those of other balancing technologies, such as increased interconnections, flexible spinning reserves, demand side management measures, among others[66]. It is crucial that local communities understand the extent to which variable RE can be used (sometimes up to 70%[67]) before storage becomes the most economic option for further integration.

While commercial options like small-scale electric batteries are becoming increasingly accessible and cost competitive, support from the government to research and develop improved and ever more efficient storage technologies is needed.

Increase and integrate RE across sectors

Increase renewable electricity generation

- List ways to support the creation of new RE generation capacity.

Tackle the Built Environment Challenge

- Support the creation of new RE generation capacity.
- Support Demand-Side Management and smart infrastructure developments.
- Improve energy efficiency (see overlaps with other building blocks).
- Identify the role of different stakeholders in the current and future energy infrastructure.
- Identify opportunities to integrate different sectors such as electrification of heating/cooling system to balance variabilities and enhance storage capacity.
- Identify beneficials of a smart energy system and adapt finance mechanisms/ energy pricing.

Tackle mobility and transport challenges

- Evaluate and assess your community's public transport system.
- Encourage active mobility (walking and sycling), public transport and mix-use developments.
- Evaluate the community's public transport system and analyse citizen´s mobility behaviour incl. connection to surrounding regions/suburbs.

Modernize the grid and other infrastructure

- Assess the implications of larger RE penetration in terms of storage capacity, demand side management and overall infrastructural upgrade.
- Improve and enlarge power network infrastructure, storage options and demand side management solutions to accommodate larger RE shares.

Identify financial resources

INTRODUCE INNOVATIVE AND ALTERNATIVE FINANCING MECHANISMS

Although major investments in renewable energy infrastructure and technologies require consistent and reliable financial support from governments, local authorities also need to raise capital to support local projects. This is especially true for urban jurisdictions where little capital is available and there is strong dependence on central governments for financial support.

IMPLEMENT NEW MECHANISMS TO INTERNALIZE EXTERNALITIES

Promote adoption of innovative, locally-based fee systems, such as a carbon tax, waste tax or pollution tax, and other financial mechanisms to favour low-polluting in the marketplace alternatives over carbon and resource intensive processes.

ESTABLISH STABLE, LONG-TERM SUPPORT SCHEMES

Create financial incentives that stimulate private investments and that encourage private individuals to opt for renewable energy options rather than conventional fossil fuels. Consistent financial support from national, regional and local governments is essential to develop the renewable energy market and to stimulate the necessary participation of companies and private individuals in moving this transition forward.

Local actors need effective and innovative financial mechanisms to carry out a successful energy transition. Although major investments in renewable energy infrastructure and technologies require consistent and reliable financial support from governments, local authorities also need to raise capital to support local projects. This is especially true for urban jurisdictions where little capital is available and there is strong dependence on central governments for financial support. In fact, cities and regional governments are frequently mandated to solve complex problems without being allocated the financial resources to tackle them effectively[68]. Furthermore, financial resources should not only be directed to renewable energy projects but also to energy efficiency given that a considerable decrease in energy consumption will be the essential condition to achieve a 100% RE future.

Introduce Innovative and Alternative Financing Mechanisms

These include options such as public private partnerships (PPP), private financing initiatives (PFI), civic crowdfunding, cooperative funding models and local share-based cooperative models[69]. Open and accessible online tools to monitor public expenditures (e.g. participatory budgeting schemes) are also recommended[70]. Local governments should work cohesively with national governments towards decentralized fiscal policies that ensure access to the tax revenues and financial instruments needed to make the necessary local investments[68].

Financial resources should also be directed to energy efficiency given that a considerable decrease in energy consumption will be the essential condition to achieve a 100% RE future.

The Australian Capital Territory (ACT) has a legislated target of 100% renewable energy by 2020. ACT will achieve its targets through a series of innovative large-scale reverse auctions that will deliver renewable energy to the territory at the lowest possible cost. By providing a fixed price for the energy for the next 20 years to renewable energy project developers, ACT was able to unlock private sector investment in renewable energy. The ACT Government has contracts in place for the construction of wind farms and solar plants within the next 4 years that will allow it to supply 100% renewable electricity by 2020 to ACT's 400,000 inhabitants. ACT's policies have generated 500 million dollars in investment in energy efficiency and renewable energy projects, plus new job opportunities.

Implement New Mechanisms to Internalize Externalities

Promote adoption of innovative, locally-based fee systems, such as a carbon tax, waste tax or pollution tax, and other financial mechanisms[70] to favour low-polluting in the marketplace alternatives over carbon and resource intensive processes—especially in certain sectors, such as in the building sector where natural gas heating, for example, remains cost competitive[72]). This can help ensure that personal short-term interest (i.e. saving money) is closely aligned with society's longer-term self-interest (reducing waste, minimizing pollution, etc.).

Establish Stable, Long-Term Support Schemes

Create financial incentives that stimulate private investments and that encourage private individuals to opt for renewable energy options rather than conventional fossil fuels[73]. Feed-in Tariffs are an example of a tool that helps de-risk investments and provide price certainty. Consistent financial support from national, regional and local governments is essential to develop the renewable energy market and to stimulate the necessary participation of companies and private individuals in moving this transition forward. Financial support schemes should not only target renewable energy technologies but also energy efficiency and solution to reduce consumption.

Feed-in Tariffs are an example of a tool that helps de-risk investments and provide price certainty. Consistent financial support from national, regional and local governments is essential to develop the renewable energy market and to stimulate the necessary participation of companies and private individuals in moving this transition forward.

BENEFITS OF A FEED-IN TARIFF

Gives renewable energy priority access to the grid.

Increases demand for RE, which makes RE cheaper.

Obliges grid operators to purchase electricity from renewable sources.

Sets the price for RE electricity for long, fixed periods

Feed-in tariffs put a legal obligation on utility companies to buy electricity from renewable energy producers at a premium rate, usually over a guaranteed period, making the installation of renewable energy systems a worthwhile and secure investment for the producer. The extra cost is shared among all energy users, thereby reducing it to a barely noticeable level.

Identify financial resources

Introduce innovative and alternative financing mechanisms

- Map existing financing mechanisms for building renewable energy infrastructure and implementing energy efficiency measures.
- Identify finance gaps to achieve 100% RE target.
- Map role of stakeholders (incl. citizens) in existing finance mechanisms and identify potential innovation.
- Explore finance mechnisms implemented by other pioneering institutions with similar conditions.
- Map political mandate of juristiction to develop new finance mechanisms.
- Develop or identify decentralized fiscal policies.
- Implement new mechanisms to internalize externalities.
- Introduce innovative and alternative financing mechanisms.
- Establish stable, long-term support scheme.
- Define long-term and stable support systems that encourage investments in RE and categorize them by "Energy Production", "Energy Efficiency" and "Consumption Reduction".

Support decentralization and inclusion

ENSURE ACCOUNTABILITY AND TRANSPARENCY

Holding politicians responsible and ensuring an environment of trust among community members and political authorities are essential to raising and maintaining public engagement. Accountability and transparency are fundamental aspects of an effective, inclusive and "future just" transition that ensures citizens are motivated to take ownership of the 100% RE system.

PROMOTE INCLUSIVE COMMUNICATION AND OUTREACH

Without a shift in awareness by the broader population, far-reaching energy transition processes cannot be launched. Citizens need to be involved in decision-making processes that lead to a shared 100% RE goal. Information and consultation raise citizen awareness to motivate energy conservation.

EMPOWER A DECENTRALIZED AND DIVERSIFIED ENERGY TRANSITION

The shift from a centralized energy system based on fossil fuels to one that is decentralized and run entirely on renewable energy sources requires citizens and communities to evolve into "Prosumers"—not just consumers but also producers of energy.

SAFEGUARD A SOCIALLY JUST TRANSITION

To guard against impacts of potential fall-off in traditional manufacturing and construction jobs, policies to enable families and businesses to alter their professions, business models and their consumption choices in responsive and effective ways must be in place.

A transition to 100% renewable energy will inevitably require a structural shift in how energy is produced, distributed and used. This paradigm shift entails a switch from a vertical to a horizontal structure. Most existing energy markets are characterized by complex centralized infrastructures and vertical supply chains and dominated by few big utilities; on the contrary, most future energy markets will be characterized by decentralized, horizontal supply chains with benefits that are widely distributed among new actors and stakeholders, including individual citizens and small businesses. The transformation towards a renewable energy-powered future is not the simple substitution of one fuel for another. It is more than that. It is a transition driven by the desire for more inclusive, democratic processes that enable all citizens to become champions and beneficiaries of their energy systems. A more equal, inclusive and fair society is an essential and necessary outcome of the transition towards 100% RE.

The transition to 100% RE entails a wide range of interventions that will inevitably affect all citizens. Whether it relates to household consumption, nutrition or mobility, almost all areas of life are touched by energy systems. Therefore, it is essential to mobilize and activate as many citizens as possible so they adopt this process as their own.

RENEWABLE ENERGY COOPERATIVES

IN EUROPE[74]

In Europe there are about 3000 renewable energy cooperatives (REScoops), of which half are organized in an association REScoop.eu. Most REScoops can be found in West and Northern Europe as there is supportive legal framework for RES generation. Between 2008 and 2015, only in Germany, the number of renewable energy cooperatives increased from 67 to 812. More than half of Germany's renewables investments are in the hands of citizens, farmers and cooperatives, although growth has decelerated, due largely to recent changes in energy policy. The Netherlands has experienced a similar trend, with the number of energy cooperatives increasing from 19 in 2008 to more than 310 in 2016. In Scotland, an estimated 508 megawatts (MW) of community and locally owned capacity is operational since 2015, which exceeds the 500MW target of the national government by 2020 five years early.

Mechanisms to ensure accountability and transparency legitimize government commitments and, in turn harness the citizen support, trust and consensus needed to govern effectively.

Ensure Accountability and Transparency

Holding politicians responsible and ensuring an environment of trust among community members and political authorities are essential to raising and maintaining public engagement. Accountability and transparency are fundamental aspects of an effective, inclusive and "future just" transition that ensures citizens are motivated to take ownership of the 100% RE system.

Mechanisms to ensure accountability and transparency legitimize government commitments and, in turn harness the citizen support, trust and consensus needed to govern effectively. Greater accountability and transparency also ensure politicians legislate with the best interest of the community in mind and align their political commitments with a decentralised, participatory approach such that they promote energy democracy and equitable access to clean renewable energy. There are several resources available to support local governments in accountability and transparency efforts, such as carbonn® Climate Registry (cCR).

Promote inclusive communication and outreach

Communication and outreach are also necessary—without a shift in awareness by the broader population, far-reaching energy transition processes cannot be launched. Citizens need to be involved in decision-making processes that lead to a shared 100% RE goal. Furthermore, information and consultation raise citizen awareness to motivate energy conservation.

Mechanisms to ensure accountability and transparency legitimize government commitments and, in turn harness the citizen support, trust and consensus needed to govern effectively.

A thorough communications network (e.g. via social media, newsletters, online networking, etc.) is necessary to inform citizens about how they can participate throughout planning and development processes. Local community groups and local governments should work to ensure citizens receive regular information about the objectives, strategies and interim achievements regarding the overall 100% RE strategy, as well as the actions and opportunities to participate. This can help initiate further projects and activities, as citizens and other local stakeholders might develop new methods, greater capacity and innovate ways to engage with the overall energy strategy.

Since not all citizens can be reached through electronic communications other materials need to complement the public engagement strategy including brochures, press articles and conferences. Friendly competitions between regions or groups and celebrations to award prizes are additional ways to motivate citizens to champion the 100% RE strategy. Targeted group activities, such as in education and training also can help promote participation by children, students, adults and practitioners (e.g. craftspeople, architects and engineers). Where significant portions of the community communicate in another language, it is important to provide outreach material in those languages.

Empower a decentralized and diversified energy transition

The shift from a centralized energy system based on fossil fuels to one that is decentralized and run entirely on renewable energy sources requires citizens and communities to evolve into "Prosumers"—not just consumers but also producers of energy. Citizens must gain access to the local electric grid, and ownership of renewable energy technologies at the household level needs to be simplified and rewarded financially. There is arguably no better way to ensure the long-term success of the energy transition than through broad-based ownership of the infrastructure and assets that underpin it.

Local community groups and local governments should work to ensure citizens receive regular information about the objectives, strategies and interim achievements regarding the overall 100% RE strategy, as well as the actions and opportunities to participate.

Therefore, empowering new actors to enter the market and safeguard their right to produce energy and sell it to the grid operator becomes an extremely important aspect of the transition.
In practice, this can be achieved by implementing specific open-access and inclusive policies such as feed-in tariffs, offering targeted incentives, and by creating long-term investment certainty for citizens, local businesses as well as for international investors. Governments should aim to create inclusive policy frameworks that allow new business models to emerge as well as new forms of citizen engagement. By providing market access to a wide range of stakeholders, policy makers can help build positive synergies across the region and help sustain the momentum required to achieve 100%.

By providing market access to new stakeholders that have not been part of the energy sector in the past, innovative business models emerge that help facilitate the transformation of the energy system. In other words, achieving a 100% RE target can enable policy makers to deliver simultaneously on a wide range of non-climate-related priorities.
An inclusive energy system enables and strengthens cooperation, and a collective awareness of both the challenges, and the solutions available to overcome them. Moreover, as local opposition to energy infrastructure (in particular transmission projects) can be a major barrier to 100% RE, local and regional involvement of citizens and businesses help policy makers to overcome this hurdle and build public support.

Thus, the transition to 100% RE is not just a switch from the combustion of fossil fuels to renewables: it is also an opportunity to strengthen and diversify the energy market, stimulate new forms of socio-economic development, and enable a wider range of stakeholders and citizens to participate in the financing and ownership of energy infrastructure.

AN INCLUSIVE ENERGY MARKET

The benefits of an inclusive energy market can be seen in Germany's 100% RE regions network, in Frankfurt and Rhein-Hunsrück District in Germany, across Denmark, San Francisco, US as well as in Fukushima Prefecture in Japan, where citizens, utilities and local businesses are partnering with research institutes, project developers, civil society groups as well as local governments[73]. Analyses of the German and Danish case studies[73] in particular demonstrate clearly that participatory policy approaches can help a great deal to attract investments and to accelerate the transformation of the energy sector.

Safeguard a Socially Just Transition

The energy transition will not come without some level of socio-economic disruption. To guard against impacts of potential fall-off in traditional manufacturing and construction jobs, policies to enable families and businesses to alter their professions, business models and their consumption choices in responsive and effective ways must be in place.

Communities must be empowered to innovate and transform in a manner that ensures that all, including the most vulnerable members of the community, participate and benefit in an equitable way from this transition. For this reason, policy makers need to ensure that a transition to 100% RE really serves and benefits the greatest number of people and that is centred on community participation, engagement, accountability, and transparency of decision-making processes[75].

Therefore, safeguarding equity needs to gain a fundamental role within any 100% RE plan. Governments need to work together to ensure an equitable transition for businesses, workers, and communities, one where RE targets can be met without sending jobs and emissions out of state and where workers and communities are not disproportionately penalized by the transition off of fossil fuels. Policies should also protect vulnerable communities, such as low-income, which tend to be the most impacted by system changes as well as most directly affected by climate change[76].

Safeguarding equity needs to gain a fundamental role within any 100% RE plan. Governments need to work together to ensure an equitable transition for businesses, workers, and communities, one where RE targets can be met without sending jobs and emissions out of state and where workers and communities are not disproportionately penalized by the transition off of fossil fuels.

Support decentralization and inclusion

Ensure accountability and transparency

- Evaluate how transparent the systems in place are and how this affects citizen's participation.
- Develop mechanisms to ensure accountability and transparency.

Promote inclusive communication and outreach

- Develop inclusive citizen consultation processes.
- Define a communication strategy and identify channels to reach a diverse range of actors.
- Assess beneficiaries and loosers of the transition to 100% RE and align the communication message based on this analysis.

Empower a decentralized and diversified energy transition

- Explore opportunities for new actors such as citizens to become active stakeholder (investor, owner, member etc.) in the energy system.
- Support community-based cooperative models as part of the energy market.
- Assess socio-economic benefits of a decentralised, diversified energy system (see overlaps with other building blocks).
- Map existing models for decentralised investment or decision making in other sectors and explore transferrability to energy sector.

Safeguard a socially just transition

- Assess number and the kind of jobs in the conventional energy sector (direct and indirect) and define steps to facilitate a smooth transformation of traditional work forces.
- Engage universities, vocational schools, education centers to assess potential of training measures for workers from the conventional energy system.

Nurture vertical and horizontal cooperation and integration

FURTHER VERTICAL COOPERATION

Cities, regions and sub-national governments cannot work in isolation and cannot achieve the 100% RE target without engaging the support across all levels of government. Building partnerships and intensifying coordination and collaboration throughout international, national, regional and local levels are critical actions to ensure policy coherence and integration.

CULTIVATE HORIZONTAL COOPERATION

It is important to make sure that the broadest possible coalition of actors is included in the process. Key actors within a local government's territory usually represent the administration, political parties, city managers, indigenous populations, business associations, citizen initiatives, research bodies, and so on. The more diverse the community participants in the 100% RE strategy are, the further reaching and reliable are the results.

The structural shift required to achieve 100% RE cannot be tackled by a single stakeholder or particular sector. Rather, it must be a collaborative effort built upon an alliance of stakeholders permeating all departments and different levels of local government. Cooperation and synergies across parties and across different levels of government will therefore be crucial. These collaborations should be institutionalized to ensure effectiveness and appropriate implementation. The two main types of collaboration are summarized in the sub-sections below.

INJE COUNTY

REPUBLIC OF KOREA[19]

In 2015, Inje County developed the strategy 'Inje 2045 Zero Energy Independence Plan' to transition to 100% RE by 2045 as part of the County's vision of becoming an energy-safe city. Five main policy fields have been defined: expansion of new renewable energy production, 2) energy efficiency, 3) energy conservation & creation of a civic culture 4) expansion of carbon sinks, as well as 5) Building & strengthening the cooperative foundation. Seventeen projects or assignments have been defined for the implementation of these policies. Some of the actions already implemented include 6MW of wind power and 1.7MW of mini-hydropower generation capacity.

Further Vertical Cooperation

Cities, regions and sub-national governments cannot work in isolation and cannot achieve the 100% RE target without engaging the support across all levels of government. Building partnerships and intensifying coordination and collaboration throughout international, national, regional and local levels are critical actions to ensure policy coherence and integration[77]. Establishing multi-level governance approaches to policy-making, strengthening alliances and supporting a constructive dialogue among the different levels government are therefore recommended for any successful 100% RE roadmap.

As suggested in "formalize aims and functions" (see 2.3), vertical collaboration should be institutionalized in formal ways to support the coordination across levels of government and to establish a supervisory body that has a specific mandate and official executive and monitoring role. Examples of a supervisory body for multi-level governance include, a National Commission for Sustainable Development in Finland, which coordinates the sustainability agenda across various levels of government[78]. The World Future Council has also proposed creating National Urban Policy Commissions (NUPCs) to coordinate governance up through all levels[79].

OSNABRÜCK

GERMANY

The City of Osnabrück, Germany is a good example of a comprehensive, large-scale cooperation between the city and its surrounding regions[80]. Osnabrück joined the City of Rheine and the Counties of Osnabrück and Steinfurt to form Germany´s largest "Masterplan 100% Climate Protection" region. Through offsets and shared accounting of electricity generation and consumption, these partners have set an ambitious target of meeting 95% of the region's energy demand with renewable energy. In shaping its renewable energy strategy, Osnabrück integrated the various projects and activities in a roadmap that envisaged strong cross-border cooperation (especially in transportation) between urban centres and hinterlands. Specifically, the City of Osnabrück offsets its RE production deficit with its hinterland's RE production surplus. Yet, the cooperation goes beyond a simple exchange of energy between rural and urban areas. Partnership between the Osnabrück and the surrounding regions involves a continuous process of cooperation: each particular local authority assumes tasks and activities that consider the interest of the entire region and all political and administrative bodies coordinate to align strategies across regions. In fact, to ensure on-going coordination of activities, various partners and stakeholders meet regularly and co-host public events, such as their annual regional climate summit. And cooperation goes beyond knowledge exchange and communication. Some of the projects that are underway include (sharing) combined heat and power (CHP) systems, a joint energy conservation campaign in schools and day-cares, building infrastructure for electric mobility and cycling "superhighways", undertaking skills training programs, and many more.

It is therefore important that local communities consider ways either to contribute to the creation of new platforms or that tap into existing local, subnational, national or international groups that can already support multi-level governance and vertical cooperation.

Cultivate Horizontal Cooperation

When initializing and developing a 100% RE roadmap it is important to make sure that the broadest possible coalition of actors is included in the process. Key actors within a local government's territory usually represent the administration, political parties, city managers, indigenous populations, business associations, citizen initiatives, research bodies, actors from the local economy, local energy suppliers, agriculture and forestry representatives, freight and trade agents, technical experts, banks, and so on. The more diverse the community participants in the 100% RE strategy are, the further reaching and reliable are the results. The actors can fulfil multiple functions ranging from supporting the strategy, organizing and steering the process, to contributing, spreading and implementing ideas. Each of these actors will add complexity but also strength to the process, bringing in their particular interests and needs, as well as their expertise and skills. The earlier the different actors are engaged in the process, the easier it will be to address and discuss potential conflicts and reservations.

Moreover, achieving 100% RE often requires the cooperation of different Ministries, or Departments that can have few opportunities to collaborate or might even have opposing or

conflicting interests. Also, a coherent and robust policy framework must build on the integration of different sectors, departments and policy areas. These processes of cooperation should also be institutionalized (legislated and facilitated through supervisory bodies) to ensure the realisation of interdepartmental coordination is realized.

Horizontal collaboration is also about cooperation between regions, especially between urban and rural areas, which face different challenges and opportunities during an energy transition and in addressing climate change issues. That said, a closer look reveals that their challenges and opportunities are complementary in many ways, which leads to great potential in the relationship between cities and regions. Cooperation between a city and its surrounding area, for example, holds advantages for both sides in terms of sustainable energy development and climate protection. Large cities (characterized by dense infrastructure and a high population numbers) would not be able to fully meet their energy demands—even if reduced—by producing their own renewable energy. The available surface area, strictly within city limits (on roofs, for example) is relatively limited. Yet, cities are richly equipped with know-how, investment capital and pools of varied competencies (especially in the services sector), all of which are important in promoting energy efficiency, energy savings, climate-friendly mobility, and decentralized energy production.

By comparison, rural areas may have at their disposal relatively large areas to produce RE. Sustainable development of this resource offers investment opportunities for cities and revenue opportunities for regions to generate and sell the surplus energy they produce. Apart from this, there are many other ways in which cities and surrounding areas could cooperate to achieve a sustainable transition to 100% RE (e.g. city-hinterland mobility, and climate change mitigation and adaptation efforts). Cooperation is not only favourable for city-hinterland partnerships, but also for villages that are too small to produce sufficient or balanced mix of RE.

Horizontal collaboration is also about cooperation between regions, especially between urban and rural areas, which face different challenges and opportunities during an energy transition and in addressing climate change issues.

Nurture vertical and horizontal cooperation and integration

Further vertical cooperation

- Map existing partnerships with other governments and institutions on local, national, regional and international level.
- Assess benefits of existing partnerships and potential gaps.
- Establish formal structures (if not yet existent) to facilitate vertical cooperation.
- Map needs for cooperation with other governments on national, regional and international level to achieve the envisioned goal.

Cultivate horizontal cooperation

- Map existing partnerships with neighbouring juristictions as well as with stakeholders within the juristiction.
- Assess benefits of existing partnerships and potential gaps.
- Establish formal structures (if not yet existent) to facilitate horizontal cooperation.
- Map needs for cooperation with neighbouring juristictions as well as with stakeholders within the juristiction to achieve the envisioned goal by defining different roles and functions.
- Map political mandate of different public institutions within the juristiction and assess potential overlaps and gaps.

Promote knowledge generation and capacity building

GENERATE AND DISSEMINATE SPECIFIC KNOWLEDGE

A number of activities can accelerate shared learning between actors from both research and practice. For example, hosting demonstration and pilot projects to test an idea, becoming part of a research alliance, building a training centre, hosting educational programs, or ensuring a continuous process of evaluation and monitoring will all provide increased opportunities to share knowledge.

MAKE KNOWLEDGE AND DATA ACCESSIBLE

Policy makers and political leaders at the local level globally all stand to gain from a free and open exchange of lessons learned, best management practices and promotion of a further exchange of knowledge across jurisdictions, regions and countries around the world.

PROMOTE CAPACITY BUILDING AND TRAINING

This major restructuring cannot be achieved simply by swapping human capital and technologies, but by making sure that jurisdictions develop and reinforce their own local capacities and expertise that take advantage of their local human capital and fit their local contexts. Skills and training must be present or developed to support a structural transition of this scale and scope.

Transitioning towards a sustainable 100% RE system is uncharted territory. Therefore, it is crucial for jurisdictions to continuously promote knowledge generation and capacity building in the fields of RE and social innovation.

Generate and Disseminate Specific Knowledge

A number of activities can accelerate shared learning between actors from both research and practice. For example, hosting demonstration and pilot projects to test an idea, becoming part of a research alliance, building a training centre, hosting educational programs, or ensuring a continuous process of evaluation and monitoring will all provide increased opportunities to share knowledge.

Make Knowledge and Data Accessible

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Private companies and utilities also stand to gain from locally produced energy transition projects. By providing open data and allowing local governmental access to pertinent data and information, a more circular knowledge loop will accelerate RE uptake. For these purposes, clear information sharing policies must be in place to ensure access to data, good communication and constructive exchange of information across sectors, especially between the private and public sectors.

The knowledge generated should also become easily accessible by the public and presented in a way that invites exploration and understanding of the transition process. Efforts to connect and promote sharing of policies and legislative efforts should also be developed between multiple municipalities and regions that share similar local characteristics. Tools to visualize, display, and exchange information in a user-friendly and accessible manner are crucial.

Promote Capacity Building and Training

The transition towards 100% RE involves major structural transformation from centralized, dispatchable, fossil fuel-based systems to decentralized, variable, renewable energy based-systems. This major restructuring cannot be achieved simply by swapping human capital and technologies, but by making sure that jurisdictions develop and reinforce their own local capacities and expertise that take advantage of their local human capital and fit their local contexts. Skills and training must be present or developed to support a structural transition of this scale and scope. To support this, capacity building projects should be developed to support both administrative and technical staff, allowing them to be well-prepared and able to create the necessary tools and mechanisms of their new energy system. Capacity building projects could include further technical training for local politicians or policy crafting workshops for local engineers, for example.

ENGAGE IN NETWORKS

FORM AND ENGAGE IN LOCAL AND REGIONAL NETWORKS

At local or regional levels, interesting opportunities can often only be seized through common effort. Exchanging experiences and know-how with other local governments and civil society groups can enable leapfrogging and can even manifest in a joint wind or solar farm, for example.

PARTICIPATE IN INTERNATIONAL NETWORKS

Becoming part of an international networking platform not only supports constructive knowledge exchange and cooperation but can also enhance a local government's visibility and branding. Membership provides opportunities to promote a city's or community's efforts, emboldening political leaders to partake in a common 100% RE planning process.

Whereas sustainability and transition projects at the community and local level often provide a sense of providing a mere "drop in the ocean," connecting local actions with others can provide strong, comprehensive results. Linking motivated local actors and their efforts with accompanying regional, national, and international networks helps community and local leaders extend their pool of understanding as well as their reach and impact. The overarching idea is to incorporate as many effective solutions focused on a successful and sustainable 100% RE transition. By widening and accelerating the learning capacity of a community, they allow for a more rapid transition to the community's desired energy system. To support jurisdictions, particularly on their transition to 100% RE by facilitation of peer-learning and knowledge exchange, members of the Global 100% RE campaign have initiated the Global 100% RE Regions and Cities Network[81] which includes cities and regions such as Australia Capital Territory (Australia), Jeju Province (South Korea), Vancouver (Canada), and Växjö (Sweden).

Form and Engage in Local and Regional Networks

At local or regional levels, interesting opportunities can often only be seized through common effort. Examples might include directing waste heat from a local industry to a local district heating system or developing a wind park where benefits are spread widely throughout the community: Local farmers earn income from leasing their lands, energy cooperatives grow their capital, local banks support investments and profit from their interest payments, and local authorities demonstrate successful interventions to their constituents. Beyond the local or regional level, other opportunities for networking and cooperation exist and must be expanded.

Exchanging experiences and know-how with other local governments and civil society groups can enable leapfrogging and can even manifest in a joint wind or solar farm, for example.

Participate in International Networks

Becoming part of an international networking platform not only supports constructive knowledge exchange and cooperation but can also enhance a local government's visibility and branding. Membership provides opportunities to promote a city's or community's efforts, emboldening political leaders to partake in a common 100% RE planning process.

International networks can provide support to even the smallest jurisdictions around the world by initiating cooperation with like-minded partners to achieve 100% RE targets. Local communities and governments should look to engage international networks for insights beyond what is available in a local community, thereby accelerating, legitimizing and substantiating their local efforts within a larger, worldwide movement.

We need to change the narrative.
Instead of a call-to-arms, we need a doctrine
of “mutually assured survival” — a doctrine in which all
commit to the goal of 100% renewable energy.”

Andrea Reimer, Director on the Metro Vancouver Board of Directors, Vice Chair of Metro Vancouver Climate Action Committee, Councilor with the City of Vancouver.

100% RENEWABLES

CONCLUDING REMARKS AND MOVING FORWARD

As many more communities and governments across the world commit to moving towards a 100% RE future, they need to be equipped with a solid understanding of what 100% RE actually means and how to implement the political target within the framework of sustainable development. They also need a comprehensive and methodical framework to structure a 100% RE plan that can tackle the diversity of issues that arise along the path effectively. The building blocks outlined in this report offer such a guiding framework. The intention is to provide a comprehensive yet adaptable tool to ensure effective and successful implementation of a 100% RE target.

The overall aim of these building blocks is not simply to support communities and governments structure their 100% RE action plan but also to define the actual meaning of 100% RE. As the 100% RE movement grows continuously across the world, a multitude of definitions emerge which create confusion and uncertainty on its actual meaning. With these building blocks, the Global 100% RE Campaign and its partners are finally providing a shared definition of 100% RE. In essence, setting a 100% RE target is not only about transitioning from one form of energy to another, but about a much broader and inclusive socio-economic transformation towards a cleaner, fairer, more equitable and sustainable future. By adopting these building blocks and by fully understanding the meaning of 100% RE, communities can guarantee that all benefits of such a transition are reaped by all, in an equitable and democratic manner.

While there is no one-size-fits-all 100% RE plan, it is important to have a common set of building blocks to ensure a certain level of cohesion and mutual understanding is established among all members of an ever expanding 100% RE network. While trying to define a set of common and sharable recommendations applicable across jurisdictions, these building blocks should not be misconstrued as a fixed and mandatory list of actions. On the contrary, they are a flexible set of recommended actions that should be adapted and customized to fit the local context. For successful implementation of these building blocks, communities need to own them, work with them and adjust them according to their conditions.

This iteration of the building blocks is by no means final. A continuous effort to modify and improve them as conditions change and new factors come into play is extremely important. The authors are committed to making this a living document and ensuring that all voices are heard and all relevant issues included. Any learning or constructive feedback on how these building blocks can be enhanced are welcome and needed. The development of these building blocks was based on a joint effort, gathering experiences and reflections from a variety of experts and practitioners and it is intended to remain so. All communities and governments committed to driving a transition towards a 100% RE future are welcome to participate, join the discussion and raise their voices.

The ultimate wish of the authors is to ensure that these building blocks are actually useful, adoptable by jurisdictions around the world and effective in supporting a practicable, democratic and sustainable transition towards a 100% RE future. More local governments and communities are expected to apply these building blocks to their own contexts. The authors wish to support communities and governments in this effort and provide a valuable tool for the necessary and urgent realization of a 100% RE future.

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