World Future Council

Brot für die Welt

100% RENEWABLE ENERGY FOR SUSTAINABLE DEVELOPMENT

HOW 100% RE SUPPORTS THE

SUSTAINABLE DEVELOPMENT GOALS

AUTHORS

Filippo Boselli, World Future Council
Anna Leidreiter, World Future Council
Dr. Joachim Fünfgelt, Brot für die Welt

CONTRIBUTORS (ALPHABETICAL ORDER)

Bernhard Walter, Brot für die Welt
Carsta Neuenroth, Brot für die Welt
Catherine Pearce, World Future Council
Daniel Jüttner, Brot für die Welt
Eike Zaumseil, Brot für die Welt
Ina Neuberger-Wilkie, World Future Council
Lennart Huhn, World Future Council
Mareike Haase, Brot für die Welt
Samia Kassid, World Future Council

PUBLISHED JUNE 2017

World Future Council
Lilienstrasse 5-9
20095 Hamburg
Germany
www.worldfuturecouncil.org

Brot für die Welt
Caroline-Michaelis-Str.1
10115 Berlin
Germany
www.brot-fuer-die-welt.de

PHOTO CREDITS

P. 13: Africa Solar Designs.
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EXECUTIVE SUMMARY

Sustainable development can only be reached by transitioning to 100% Renewable Energy (RE). In fact, 100% RE is more than just replacing fossil with renewable sources in today's energy system. It can serve as a means for socio-economic development and help create an equitable society for today's and future generations. Hereby, it supports the implementation of each sustainable development goal (SDG). The wide-range of co-benefits linked to RE development reveal once again the strong interdependency among all aspects of sustainable development and therefore the need for a comprehensive, cross-silo and integrated policy approach for the attainment of any SDG.

In light of the vast benefits related to RE development and its instrumental role in supporting sustainable development, it becomes essential that policy makers and development organizations embrace the 100% RE message and integrate a 100% strategy into their development plans. The key policy recommendations to achieve this goal are:

- SET A 100% RE TARGET AND EMBED IT ACROSS POLICY AREAS AND IN SDG PROCESSES
- SET A "LEAVE NO ONE BEHIND" APPROACH TO ENERGY POLICY
- ENSURE ADEQUATE CIVIL SOCIETY PARTICIPATION AND CAPACITY BUILDING
- ENHANCE RENEWABLE ENERGY IN THE COOKING SECTOR
- PRIORITIZE ENERGY EFFICIENCY
- RE-DIRECT FOSSIL FUEL SUBSIDIES
- STRENGTHEN CHANGE AGENTS AND PIONEERS

INTRODUCTION

WHAT IS THE OBJECTIVE OF THIS PAPER?

This paper describes the vital relationship between renewable energy (RE) and sustainable development. In particular, it demonstrates how supporting the transition to 100% RE is both a necessary condition and a driver for sustainable development that leaves no one behind. Hereby, it unveils how transitioning to 100% RE is a prerequisite for ensuring a life of dignity, unlocking access to many substantive rights as well as procedural rights.

This report is addressed to civil society organizations, policy makers, development agencies and community leaders involved in sustainable development especially in countries in the Global South. It aims at supporting them in understanding the role of renewable energy in driving sustainable development and at determining pathways to include renewable energy into their development strategies.

In particular, this paper examines how a transition to 100% RE can contribute to the achievement of the 17 Sustainable Development Goals and can be directly relevant to many of the 169 targets. While the need to transition to 100%RE, and in so doing, harvesting the benefits in meeting many of the SDGs equally applies to the industrialized world, this paper focuses on the social, economic and political context of the Global South. Based on this analysis, this report presents the most significant policy recommendations to incorporate 100% RE into sustainable development strategies of developing and emerging economies.

WHY IS THIS ANALYSIS RELEVANT AND TIMELY?

Energy is a prerequisite of development and for a life of dignity. Access to energy is essential to overall human progress, social welfare, technological advancement and unlocks access to many human rights. Without reliable access to energy, societies would have never reached the standards of living that many countries across the world enjoy today. While it would be naïve to understate the vital role that fossil fuel energy played in improving livelihoods, it would be irresponsible, short-sighted and dangerous to ignore the threats of climate change, environmental degradation and concentration of political and economic power that this type of fossil-fuel-dependent development produced. To ensure that energy can continue to play its fundamental role in driving development, supporting human progress and improving livelihoods across the world, a fundamental shift is needed. The link between energy and development now necessarily becomes the link between "renewable" energy and development. In the light of this shift, understanding the relationship between a fully renewable-energy-based future and sustainable development becomes paramount.

Fortunately, signs of this shift are increasingly evident today. In 2013, for the first time the world added more capacity for renewable power (143 GW) than coal, natural gas, and oil combined (141GW)[1]. Only two years later, in 2015, for the first time in history, total investment in renewable power and fuels in the Global South in 2015 exceeded that in the Global North. The Global South, including China, India and Brazil, committed a total of USD 156 billion (up 19% compared to 2014). By contrast, RE investment in the Global North as a group declined by 8% in 2015, to USD 130 billion[2]. As the world undergoes an inevitable transformation towards a renewable future, an analysis of the relationship between 100% RE and sustainable development in Global South countries becomes extremely relevant and timely, especially as other major international provisions such as the SDGs and the Paris Agreement start to get implemented.

The Sustainable Development Goals, ratified in 2015, included two goals of utmost relevance: SDG7 Affordable and Clean Energy and SDG13 Climate Action[3]. These goals lay emphasis on the urgency to transform the energy sector as an essential and necessary element for both climate change mitigation and sustainable development. In the same year, the Paris Climate Agreement was stipulated. As of February 2017, a record of 131 countries already ratified the agreement and therefore officially pledged to make their contribution to limit the global temperature increase to 1.5 °C above pre-industrial levels[4]. Commitment to renewable energy also reached an unprecedented level when more than 1000 mayors from across the world committed to a 100% RE future at COP21 in Paris[5]. At the same time, the Africa Renewable Energy Initiative (AREI) was launched in Paris to "accelerate, scale-up and harness the continent's huge potential of renewable energy sources" by "widening

RENEWABLE ENERGY IS NOT ONLY THE BEST OPTION FROM AN ENVIRONMENTAL POINT OF VIEW BUT, ESPECIALLY TODAY, ALSO FROM AN ECONOMIC, SOCIAL AND GEOPOLITICAL PERSPECTIVE

access to clean energy services, improving human well-being and putting African countries on a climate-friendly and sustainable development pathway"[6].

More recently a revolutionary achievement was reached when the Climate Vulnerable Forum (CVF) vision was launched at the COP22 in Marrakech, which saw 48 countries from Asia, Africa, Caribbean, the pacific and South America declaring that they "strive to meet 100% domestic renewable energy production as rapidly as possible while working to end energy poverty, protect water and food security, taking into consideration national circumstances"[7 8].

The large commitment to RE from around the world does not come unexpectedly. A wide range of drivers are making a transition to a renewable energy world necessary and the best option not only from an environmental point of view but, especially today, also from an economic, social and geopolitical perspective[9].

Beyond mitigating climate change, air pollution and the violation of planetary boundaries, a transition to a 100% RE future makes sense from a cost perspective. For example in the US, the wholesale price of one solar panel in 2016 was about $0.65 per watt, compared with $0.74 per watt in 2015 and $4 per watt in 2008[10]. This means that in only eight years the price of solar technology has become 6 times cheaper. A recent article by Bloomberg showed how in 2016 solar power became the cheapest form of new electricity in Global South countries for the first time[11]. While this has happened in isolated projects in the past, only now unsubsidized solar is beginning to outcompete coal and natural gas on a larger scale, especially in emerging markets where new solar projects are cheaper than coal[11].In 2016, solar electricity production established "record after record", for example by producing electricity for $64 per megawatt-hour in India or $29.10 per megawatt hour in Chile, being roughly half the price of competing coal power[11].

These developments are very encouraging. With capital costs declining and essentially no fuel costs occurring as sun and wind is available for free (with the exemption of

BEYOND MITIGATING CLIMATE CHANGE, AIR POLLUTION AND THE VIOLATION OF PLANETARY BOUNDARIES, A TRANSITION TO A 100% RE FUTURE MAKES SENSE FROM A COST PERSPECTIVE

IN THE US, THE WHOLESALE PRICE OF ONE SOLAR PANEL IN 2016 WAS ABOUT $0.65 PER WATT, COMPARED WITH $0.74 PER WATT IN 2015 AND $4 PER WATT IN 2008[10]. THIS MEANS THAT IN ONLY EIGHT YEARS SOLAR TECHNOLOGY HAS BECOME 6 TIMES CHEAPER

biomass), 100% RE comes within reach also for indebted or weak economies. For countries – often landlocked regions – that depend on importing fossil resources to produce energy, a transition to 100% RE can improve the nation´s balance sheet, harnessing local energy sources. This in turn can also have a significant role in mitigating the geo-political tensions which are often driven by economic interest and power contests over areas rich in fossil fuels. The most notable example is the Middle East where many tensions and wars are strongly linked to economic interests often also related to oil and gas, including the recent devastating war in Syria[12 13].

Further, the 100% RE transition is about building a new positive narrative: a viable alternative exists and everyone can benefit from it. It is an alternative which leaves no one behind. Its implementation mostly depends on the political will and the commitment of communities around the world. While historically economic development has been strongly correlated with increasing fossil fuel deployment and GHG emissions, a 100% RE future decouples that correlation and offers a real chance to sustainable development. At the core of the 100% RE campaign lays the strong belief that leaders around the world need to build on this positive message rather than remaining trapped in trying to patch old and broken patterns of development that proved harmful and unsustainable. 100% RE is the only viable option for a sustainable future that leaves no one behind.

Setting a 100% RE goal goes well beyond simply promoting renewables. In fact, identifying and communicating a 100% RE target can help engage a wider range of stakeholders as it provides a common vision; it can help streamlining efforts and ensure a more efficient deployment of both technical and administrative resources. It can also reduce the risks of duplication and competing policy goals and can help give key stakeholders (such as utility providers, or private investors) the confidence required to make large investments, such as in transmission and distribution grids. By increasing investment certainty, setting ambitious targets can also help attract domestic and international investors, ultimately making it easier to achieve the target and in fact, phase out of fossil fuels. Furthermore, experience from many jurisdictions around the world demonstrates that clear targets can also help build awareness, both among external audiences as well as among the actors in the local area. This awareness can be essential to building public support among local citizens and businesses to help to achieve the objective[14 15].

100% RENEWABLE ENERGY

BUILDING A NEW POSITIVE NARRATIVE

A viable alternative exists, everyone can benefit from it and no one is left behind

Its implementation mostly depends on the political will and the commitment of communities around the world

It decouples the traditional correlation between increasing fossil fuel deployment and development and offers a real chance for sustainable development

SDGs & 100% RENEWABLE ENERGY

100% RE DEVELOPMENT REQUIRES STRONG CROSS-SECTORAL, TRANSREGIONAL AND TRANSNATIONAL PARTNERSHIPS

17 PARTNERSHIPS FOR THE GOALS

100% RENEWABLE ENERGY PROMOTES JUST, PEACEFUL AND INCLUSIVE SOCIETIES

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

100% RENEWABLE ENERGY IS ESSENTIAL TO MANAGE FORESTS SUSTAINABLY, COMBAT DESERTIFICATION AND HALT AND RESERVE LAND DEGRADATION AND BIODIVERSITY LOSS

15 LIFE ON LAND

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ANY MEANINGFUL ACTION AGAINST CLIMATE CHANGE WLL BE DRIVEN BY A MAJOR RESTRUCTURING OF THE CARBON INTENSIVE ENERGY SECTOR TOWARDS 100%RE.

13 CLIMATE ACTION

100% RENEWABLE ENERGY ALLOWS SUSTAINABLE AND EFFICIENT NATURAL RESOURCE MANAGEMENT

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

CITIES ARE THE PIONEERS AND THE MOST PROMISING CHANGE AGENTS OF THE 100% RE MOVEMENT

11 SUSTAINABLE CITIES AND COMMUNITIES

THE DECENTRALISED NATURE OF 100% RENEWABLE ENERGY HELPS REDUCING INQUALITIES WITHIN AND AMONG COUNTRIES

10 REDUCED INEQUALITIES

SUPPORTING THE TRANSITION TO 100% RE IS BOTH A NECESSARY CONDITION AND A DRIVER FOR SUSTAINABLE DEVELOPMENT THAT LEAVES NO ONE BEHIND

1 NO POVERTY

100% RENEWABLE ENERGY CAN PROVIDE RELIABLE ACCESS TO ENERGY AT THE LOWEST POSSIBLE COSTS.

2 ZERO HUNGER

RE CAN PROVIDE ENERGY FOR ALL SEGMENTS OF THE FOOD CHAIN AND PROVES TO BE BENEFICIAL ESPECIALLY FOR REMOTE AND RURAL AREAS.

3 GOOD HEALTH AND WELL-BEING

RE IS ONE OF THE MOST VIABLE OPTIONS TO PROVIDE ENERGY TO HOSPITALS, HEALTH FACILITIES AND HEALTH POSTS, WHICH HAS A DIRECT IMPACT ON MANY PEOPLE'S HEALTH.

4 QUALITY EDUCATION

RE IS FUNDAMENTAL IN SUPPORTING STUDENTS BY PROVIDING ELECTRICITY DURING DARK HOURS OR FREEING UP TIME FROM CHARCOAL COLLECTION.

5 GENDER EQUALITY

100% RE CAN ENHANCE SUBSTANTIVE AND PROCEDURAL RIGHTS FOR WOMEN AND GIRLS AND ACHIEVE GENDER EQUALITY

6 CLEAN WATER AND SANITATION

BUILDING A 100% RE INFRASTRUCTURE IS A MEAN AND A PREREQUISITE TO ENSURE ACCESS TO CLEAN WATER AND SANITATION FOR ALL

7 AFFORDABLE AND CLEAN ENERGY

ACCESS TO 100% RENEWABLE ENERGY IS A PREREQUISITE FOR DEVELOPMENT AND A LIFE OF DIGNITY

8 DECENT WORK AND ECONOMIC GROWTH

100% RE BOOSTS INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, CREATES EMPLOYMENT AND DECENT WORK FOR ALL

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

PROMOTING INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION ENTAILS EXPANDING RENEWABLE ENERGY INFRASTRUCTURE

100% RE AND THE SDGs: FINDING KEY LINKS

The following chapter examines how 100% RE can contribute to the achievement of the SDGs and is of direct relevance for meeting most of the 169 targets. The SDGs were adopted by the UN General Assembly in September 2015 in the Agenda 2030. Unlike the previous Millennium Development Goals, the SDGs recognize explicitly (with SDG 7- Ensure access to affordable, reliable, sustainable, and modern energy for all) the key role of renewable energy in upholding sustainable development[16]. While only SDG 7 explicitly refers to energy, there are numerous interlinkages between all SDGs: none of them can succeed in isolation. Given the integrated and organic nature of sustainable development, these linkages and synergies are extremely important and should not be overlooked[17].

While this analysis aims at demonstrating how renewable energy can support each of the 17 goals and therefore be instrumental for sustainable development that leaves no one behind, it is worth mentioning that there are also trade-offs and dangers. Expanding biomass as a source of energy for instance may lead to major cultivations of energy crops which in turn endanger particular biodiversity and therefore SDG 15. Or in order to reduce inequalities (SDG10) globally and foster innovation and sustainable industrialization (SDG9) particularly in the Global South, the priority must be to build renewable energy industries in those countries. So far, many African, Southern American or South East Asian countries depend on importing all equipment, the necessary investment capital as well as the expertise to build a renewable energy infrastructure. Instead of achieving sustainable development, this may create and foster dependencies and inequalities.

While these concerns need to be taken into account and tackled to leave no one behind, the following analysis demonstrates how all aspects of development are in fact strongly interlinked and how a comprehensive, cross-silo approach is necessary to reach any sustainable development goal.

END POVERTY IN ALL ITS FORMS

1 NO POVERTY

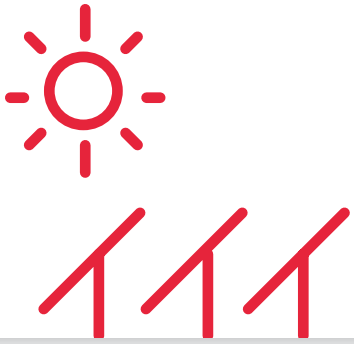
Renewable Energy is proved to provide reliable energy access at the lowest possible cost. Thereby it can benefit the most impoverished and isolated communities.

ACCESS TO RENEWABLE ENERGY IS A PREREQUISITE FOR ENDING POVERTY

100% RE HELPS ADVANCING HUMAN RIGHTS AND PROVIDE SERVICES AT THE LOWEST POSSIBLE COSTS. TAPPING ITS POTENTIAL CAN BENEFIT THE MOST IMPOVERISHED AND ISOLATED COMMUNITIES

LIFTING MILLIONS **OUT OF POVERTY**

89 million people in Africa and Asia are getting acces to energy through off-grid solar power. This provides enough power to lift 21 million individuals to the first rung of the energy ladder.



INCLUSIVE MARKET

The booming market of off-grid solar systems in Africa demonstrated how fast renewable energy could grow and reach even the remotest rural communities.

PRODUCTIVE ENERGY

RE can become a tool to generate income for rural households and enterprises.

RENEWABLE ENERGY ENABLES

ENTERPRISE DEVELOPMENT IN RURAL COMMUNITIES

PROVIDING THEM WITH THE RESOURCES TO ESCAPE EXTREME POVERTY AND HUNGER

SDG 1
END POVERTY IN ALL ITS FORMS EVERYWHERE

Access to modern energy services must be regarded as a prerequisite for ending poverty and achieving a life of dignity. This applies to substantive human rights such as access to water, good nutrition, health, shelter, education. RE plays a crucial role in providing this at the lowest possible costs. Gaining access to energy through RE can enormously benefit the most impoverished and isolated communities. Rural communities are often left without reliable access to energy as it is either too expensive to connect to the main power grid often several kilometres away or it is very expensive to purchase fuels that need to be transported to remote locations.

Thousands of examples demonstrate how communities across various Global South countries have benefited from gaining access to the RE resources available within their own region[18] and the role RE played in alleviating poverty and improving livelihoods[17 19 20]. Across several case studies, RE development proved to be extremely effective in reducing poverty and hunger in three key ways.

ACCESSIBLE, LEAST COST AND INCLUSIVE SOURCE OF ENERGY

Accessibility. RE is accessible across regions and countries. Unlike fossil fuel energy which is concentrated and available only in some regions and often monopolized by large corporations and private interests, RE is a resource that communities, even the most isolated rural ones, can seize and benefit from. The modular and decentralized nature of RE allows for great flexibility. Even the smallest communities can have a small solar system installed or an off-grid mini-grid and gain control over their own energy supply, without the need to abide to large corporations in charge of large, centralized energy distribution[18].

Least Cost. Today, RE is often the least cost option for electricity production in many regions across the world[11 21], and it is definitely the cheapest option for off-grid rural electrification[14]. According to a recent Bloomberg report, off-grid solar power is providing accessible and low cost energy access to about 89 Million people in Africa and Asia and provides enough power to "lift 21 million individuals to the first rung of the energy ladder"[22]. It is estimated that consumers save about $3.15 for every dollar spent on small solar PV (smaller than 10W) in Africa[22]. This economic advantage is thanks to the impressive fall in the cost of solar PV: 80% reduction since 2009 and continuing another 60% by 2025[23] even without considering externalities. Several Global South countries, ranging from Costa Rica to India and China, are progressively moving away from fossil fuels as they recognize the unprecedented cost competitiveness of renewable energy[24].

SOLAR POWER IS OFTEN THE CHEAPEST OPTION FOR OFF-GRID, RURAL ELECTRIFICATION[19]. THIS IS ALSO THANKS TO THE IMPRESSIVE FALL IN THE COST OF SOLAR PV: 80% REDUCTION SINCE 2009 AND CONTINUING ANOTHER 60% BY 2025. HERE IS AN EXAMPLE OF A SMALL SOLAR PANEL INSTALLATION IN THE TIRAS MOUNTAINS IN NAMIBIA

Recent cost reductions have made renewable energy the least cost option for off-grid electrification in many rural areas in countries of the Global South[17]. Several studies already demonstrate the economic advantages of 100% RE scenarios[14], including a recent study which demonstrates how a 100% Renewable Electricity future for Central and South America based on a combination of hydro, solar and wind is actually the least cost option[14]. Based on a levelised cost of electricity perspective, which takes into account life-cycle costs, costs values for electricity in the 100% RE scenario range from 56 €/MWh to 62 €/MWh, which according to this study are more cost competitive than other existing alternatives.

Inclusivity. RE can provide fast an inclusive access to basic energy needs. The booming market of off-grid solar systems in Africa demonstrated how fast renewable energy could grow and reach even the remotest rural communities. This is an extremely important factor to consider when judging the effectiveness of an energy technology compared to another in reducing poverty. For example, the Pay as you go (PAYG) modality allows off-grid customers in African countries to obtain a solar home system for a marginal initial down payment[26]. The rest of the payments are made in daily, weekly or monthly instalments and in many cases through mobile banking. Thanks to this innovative business model implemented across Africa by companies like M-Kopa, Mobisol or Azure millions of families in Africa have now access to electricity. While major investments in large projects, hence in centralised systems, are driven mainly by multilateral agencies and large developers who rely on long-term power purchase agreements, decentralized renewable energy systems such as solar home system can be extremely rapid in allowing rural communities to access electricity, especially if supported by local enterprises and favouring policies[26]. For example, from its launch in 2012 until 2015, M-KOPA Solar has brought energy to over 150,000 households in Kenya, Uganda and Tanzania[27]. This is vital to follow the principle of leaving no one behind.

ENERGY FOR PRODUCTIVE USES

Several experiences demonstrate how RE used for productive uses can actually benefit the development of communities and provide them with the resources to escape extreme poverty and hunger[29 30]. RE can in fact support several productive activities and as such become an effective tool for generating income for rural households and enterprises. RE demonstrated to be one the most effective instruments to enable enterprise development in rural communities, and in so doing to be highly effective in leveraging people out of poverty[30].

A recent report by the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) explores in a comprehensive manner the benefits of productive of renewable energy use (PURE) in supporting agricultural, commercial and industrial activities that generate income[30]. Table 1 below shows some of the examples of various energy services and their income generating value. For example, electric-powered farm equipment can considerably benefit rural farm incomes. Farm machinery such as water pumps, fodder choppers, threshers, grinders, and dryers, increases average yields per acre, improves cropping intensities, increases cost efficiency and productivity, decreases labour time consumed, increases areas for cultivation, and results in higher crop growth.

FARM EQUIPMENT POWERED BY RENEWABLES CAN CONSIDERABLY BENEFIT RURAL INCOMES, **INCREASE AVERAGE YIELDS PER ACRE, COST EFFICIENCY AND PRODUCTIVITY**

ENERGY SERVICES	INCOME GENERATING VALUE	RENEWABLE ENERGY SOURCES
IRRIGATION	Better yields, higher value crops, greater reliability, growing when the market prices are higher.	Wind, PV solar, biomass, micro-hydro.
ILLUMINATION	Reading, extending operating hours.	Wind, PV solar, biomass, micro-hydro, geothermal.
GRINDING, MILLING, HUSKING	Create value-added product from raw agricultural commodity.	Wind, PV solar, biomass, micro-hydro.
DRYING, SMOKING (PRESERVING WITH PROCESS HEAT)	Create value-added, preserve product to enable selling in higher-value markets.	Biomass, solar heat, geothermal.
EXPELLING	Produce refined oil from seeds.	Biomass, solar heat.
TRANSPORT	Reaching markets.	Biomass (biodiesel).
TV, RADIO, COMPUTER, TELEPHONE	Entertainment businesses, education, access to market news, coordination with suppliers and distributors.	Wind, PV solar, biomass, micro-hydro, geothermal.
BATTERY CHARGING	Wide range of services for end-users (phone charging business).	Wind, PV solar, biomass, micro-hydro, geothermal.
REFRIGERATION	Selling cooled products, increasing the durability of the products.	Wind, PV solar, biomass, micro-hydro.

TABLE 1: EXAMPLES OF VARIOUS ENERGY SERVICES AND THEIR INCOME GENERATING VALUE AS SUMMARIZED BY EUEI PDF 2015 REPORT[30]

POWERING BANGLADESH WITH SOLAR PV

Bangladesh is one of the most densely populated countries in the world, with 162 million inhabitants on a territory of 147,570 km2. At the beginning of the century, Bangladesh was one of the most impoverished countries of the world, with 42% of the population considered extremely poor. Moreover, the country was standing at a crossroads in terms of energy access, which further constrained the socio-economic development of the population. Only 30% of the people of Bangladesh had access to electricity. Therefore, for the area not connected to the gird, life came to a standstill after sunset. Even for those connected to the grid supply was hardly reliable due to the lack of power generation capacity (3115 MW in 2002). Furthermore, overall demand for electricity was rising by about 10 per cent annually. Infrastructure was deficient, poorly managed and could not reach many rural areas (where 75% of the population lives) due to inaccessibility and remoteness. To revert the situation, in the year 2000 the government of Bangladesh set the target to provide 100% energy access through cheap and reliable electricity by 2020. This target was seen as a strategic articulation of the government's aspiration to fight against chronic poverty and attain middle-income country status. Not surprisingly, renewable energy played a critical role in the energy transformation of Bangladesh. Because of its cost-competitive nature, renewables off-grid solutions became the most suitable energy resource other than conventional fossil fuels to provide energy access to the rural population. Today, more than 4 million Solar Home Systems (SHS) have been installed in the country, benefitting over 24 million rural people. Bangladesh today presents a much brighter energy scenario to the one it had two decades ago, when the energy sector was one of the largest bottlenecks for the socio-economic development of the country. Most of the urban population has now access to electricity (nearly 99%). In rural areas, 62% of the population has access to electricity. The country has 13,265 MW capacities. An electricity generation of 7,787 MW, of which 4,049 MW comes from the public sector, 3270 MW from the private sector, and 468 MW is imported. If current trends persist, SHS alone are expected to generate 1000 MW by 2020. Meanwhile, Bangladesh has maintained an impressive track record on growth and development, too. In the past decade, the economy has grown at nearly 6 percent per year, and extreme poverty has dropped by nearly a third[28].

END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

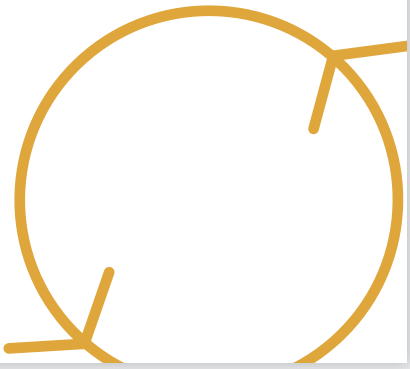
RE technologies can help communities provide energy for primary production, food processing and preservation and finally cooking. As such, integrating RE into all segments of the food chain can be extremely beneficial especially for remote and rural areas.

100% RE TECHNOLOGIES ARE ENHANCING FOOD SECURITY AROUND THE WORLD

100% RE CAN HAVE A DIRECT IMPACT ON FOOD SECURITY BY PROVIDING ENERGY TO SUPPORT ALL SECTIONS OF THE FOOD CHAIN, INCREASING CROP YIELDS IN THE MOST IMPOVERISHED REGIONS OF THE WORLD

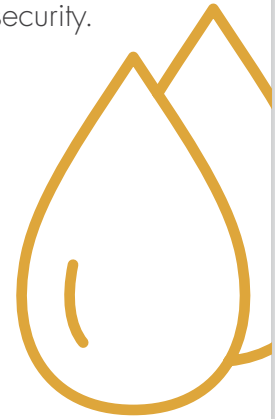
EVERY STEP
OF THE FOOD CHAIN

100% RE technologies help communities provide energy for primary production, food processing and preservation as well as cooking.



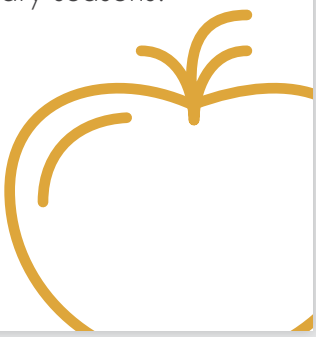
WATER PUMPING
STRESS

Water pumping for agriculture often puts stress on the electricity demand, especially during peak times and hence dangers food security.



RESILIENT
FOOD SYSTEMS

Decentralized RE-based pumping options can create much more resilient communities and avoid blackouts due to excessive electricity demand, especially during extreme dry seasons.



OFTEN SEEN AS HAVING NEGATIVE IMPACTS,
BIOENERGY, WHEN MANAGED SUSTAINABLY, LOCALLY AND EFFICIENTLY
CAN PROVIDE A LOCALISED SOLUTION TO ENHANCING ENERGY AND FOOD SECURITY

SDG 2
END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

RE can have a direct impact on food security by providing energy to support all sections of the food chain. For example, pumping technologies can help support agricultural activities in the most impoverished regions of the world and increase crop yields. Further, RE technologies can help communities provide energy for primary production such as solar or wind-based water pumping for irrigation, biofuels, solar-based desalination, harvest storage (solar or geothermal based food drying, solar cooling and refrigeration), food processing and preservation (mechanical processing driven by RE, RE-driven refrigeration, heating which can help to improve productivity and reduce food waste) and finally cooking (RE based cooking). As such, integrating RE into all segments of the food chain can be extremely beneficial especially for remote and rural areas.

For example in East Africa, especially in Kenya, the use of wind pumps significantly improved food security and family incomes. In Colombia, small hydropower for rice crop irrigation instead of diesel generators allowed farmers considerable savings[30]. In many countries, water pumping for agriculture often puts stress on the electricity demand, especially during peak times and hence dangers food security. Substituting centralized on-grid systems with decentralized RE-based pumping options can actually create much more resilient communities and avoid blackouts due to excessive electricity demand, especially during the more frequent climate anomalies such as extremely dry seasons[31].

While bioenergy can actually provide a localised solution to transform rural economies while enhancing energy and food security, it is often seen negatively because it can also threaten the latter. Additionally in a lot of countries, crops produced for bioenergy use are exported and thus not available for local markets[32]. However, when managed sustainably, locally and efficiently, bioenergy development can create new markets and generate employment opportunities that could positively affect incomes and poverty reduction, while also contributing to environmental objectives. In general, several examples show that energy produced from biomass can contribute to food security as long as it is sustainably produced and managed. For example, the production of bioenergy in integrated food–energy systems is one such approach. Intercropping Gliricidia (a fast-growing, nitrogen-fixing leguminous tree) with maize in Malawi or with coconut in Sri Lanka is substantially improving yields of agricultural products while also providing sustainable bioenergy feedstock. As opposed to what might appear counterintuitive, such an integrated food-energy industry can enhance food production and nutrition security, improve livelihoods, conserve the environment and advance economic growth[31].

IN EAST AFRICA, ESPECIALLY IN **KENYA**, THE USE OF WIND PUMPS SIGNIFICANTLY IMPROVED FOOD SECURITY AND FAMILY INCOMES

IN **COLOMBIA**, SMALL HYDROPOWER FOR RICE CROP IRRIGATION INSTEAD OF DIESEL GENERATORS ALLOWED FARMERS CONSIDERABLE SAVINGS

CLIMATE CHANGE IMPACT ON FOOD SECURITY

THE LINK BETWEEN ENERGY AND FOOD SECURITY IS ALSO FOUND IN HOW THE ENERGY SECTOR, THE LARGEST CONTRIBUTOR OF CO2 EMISSIONS, IS AFFECTING THE WORLD'S CLIMATE[19 31]

EXTREME WEATHER CONDITIONS IMPACT AGRICULTURE

Climate change increases the frequency and intensity of natural disasters such as droughts, floods and storms. These extreme events can destroy large crops, disrupt ecosystems and make it increasingly difficult to grow crops. Extreme weather events can also negatively affect the infrastructure required for collection and storage purposes, which can put further stress onto farmers and local communities.

VOLATILE FOOD PRICES AND UNRELIABLE FOOD PRODUCTION

The food production affected by a changing climate leads to an increase in the food market prices, as well as to volatile and unreliable food production. Therefore, the world´s population is at risk of a lack of access to good quality and healthy food. The poorest parts of the world are often the most exposed and most vulnerable ones. Climate change will affect first and above all those who are least equipped, exacerbating poverty and mining the socio-economic stability of those countries often already suffering from arduous economic and climatic conditions.

OCEAN ACIDIFICATION AND IMPACT ON FISHERIES

Many fisheries already face multiple stresses, including overfishing and water pollution. Climate change may add new stresses. In particular, temperature changes could lead to significant impacts, one in particular being ocean acidification. Carbon dioxide is absorbed by oceans, resulting in ocean acidification, which reduces the size and abundance of shellfish, which in turn leads to decreased fisheries output and eventually to changes in prices and availability for consumers.

ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

3 GOOD HEALTH AND WELL-BEING

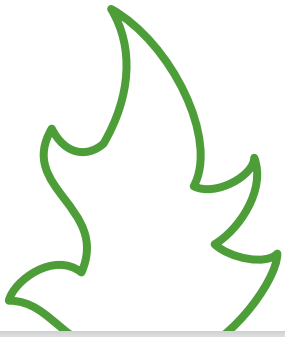
RE not only reduces significantly outdoor and indoor pollutions, but it also proved to be one of the most viable options to provide energy to hospitals, health facilities and health posts, especially in remote rural areas in the Global South. This has a direct impact on the health of thousands of people who access hospitals in the Global South every day.

100% RENEWABLES ARE CRITICAL IN DECREASING AIR POLLUTION AND PROVIDING ENERGY TO HEALTH CENTERS

BY TRANSITIONING TO 100% RENEWABLE ENERGY COUNTRIES CAN REDUCE DISEASES RELATED TO OUTDOOR AND INDOOR POLLUTION AND SIGNIFICANTLY SUPPORT THE FUNCTIONING OF HEALTH FACILITIES IN RURAL AREAS

OUTDOOR AIR POLLUTION

Outdoor air pollution, a health challenge that was estimated to cause 3 million premature deaths worldwide in 2012, can be addressed by transitioning from fossil fuel combustion to RE.

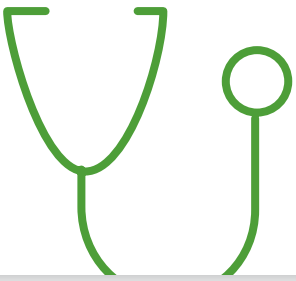


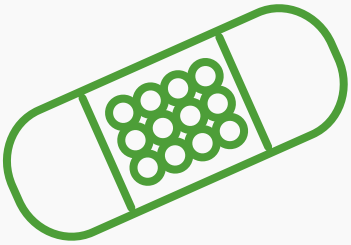
INDOOR AIR POLLUTION

Indoor air pollution results in 4 million premature deaths. Transitioning to more efficient cookstoves and RE based cooking methods can play a crucial role in mitigating this health impact.

ENERGY FOR HEALTH CENTERS

Health workers in electrified clinics have reported results such as fewer infections, fewer delays in providing life-saving care, more timely blood transfusions, and more successful child deliveries.





ON-SITE RE GENERATION FOR HEALTH CENTERS PLAYS A KEY ROLE

IN ENSURING ECONOMICALLY VIABLE AND RELIABLE ELECTRICITY TO PROVIDE HEALTH SERVICES FOR ALL

SDG 3
ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

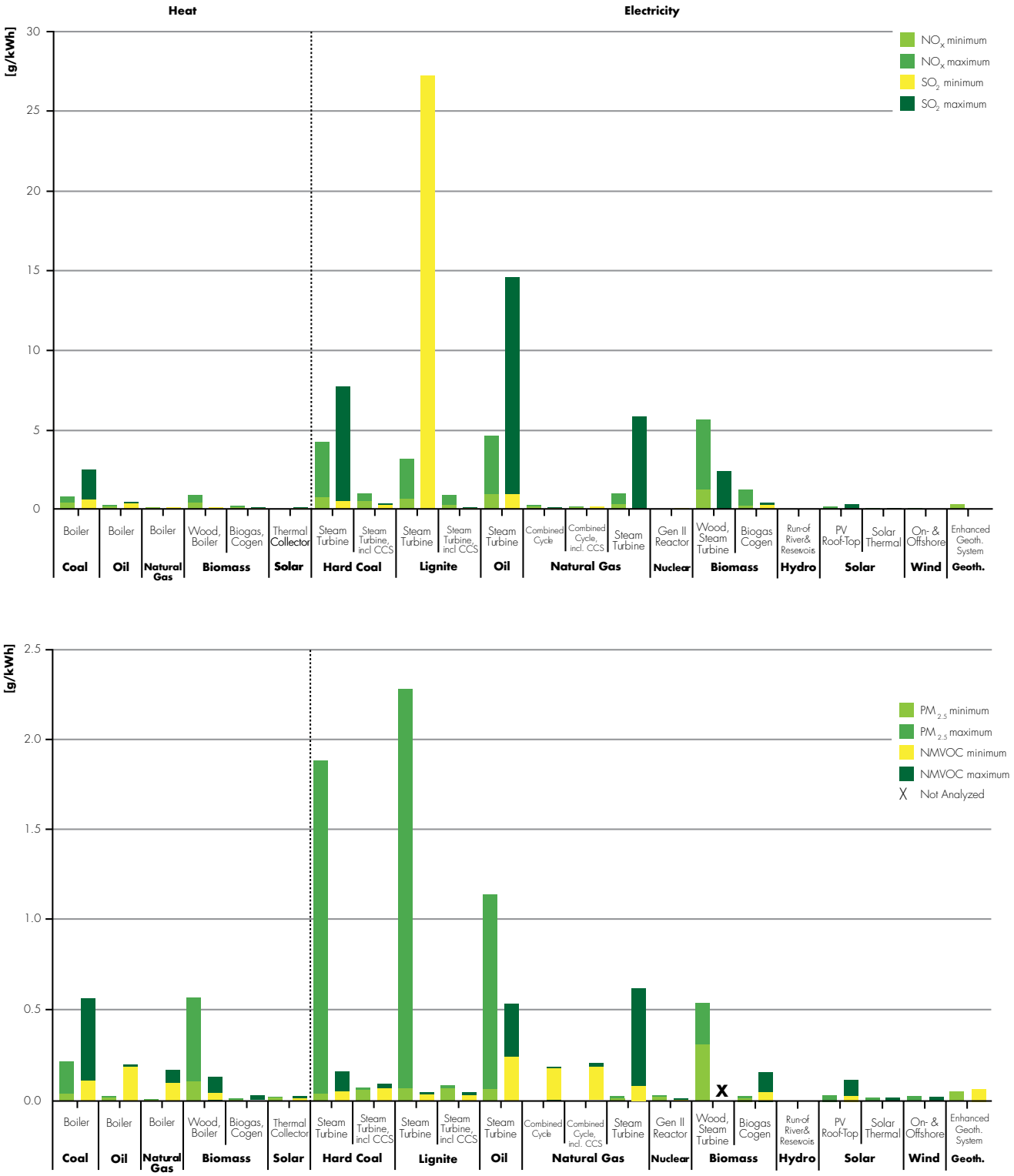
Renewables can positively impact health and well-being mostly in three ways.

DECREASE OUTDOOR AIR POLLUTION

Fossil fuel combustion is one of the major causes of outdoor air pollution[33]. According to the World Health Organization, air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, both chronic and acute respiratory diseases, including asthma and several allergies. The lower the levels of air pollution, the better the cardiovascular and respiratory health of the population will be, both long- and short-term. Outdoor air pollution in both cities and rural areas was estimated to cause 3 million premature deaths worldwide in 2012. Most importantly, 88% of those premature deaths occurred in low- and middle-income countries. Reducing outdoor emissions from household coal and biomass energy systems, agricultural waste incineration, forest fires and certain agro-forestry activities (e.g. charcoal production) would reduce key rural and peri-urban air pollution sources in developing regions[34]. As shown in the following figure the emission of NOx, SO2, PM and NMVOC (non-methane volatile organic compounds) tend to be much higher for Coal, Oil, Lignite and Natural gas than for non-combustive renewable energies in terms of grams emitted per kWh energy produced. Biomass is the only renewable option, which may have a higher level of pollution. However, drastic increase in RE deployment such as hydro, wind, and solar would significantly lower these emissions and therefore have major health benefits[35].

88% OF PREMATURE DEATHS CAUSED BY OUTDOOR POLLUTION OCCURRED IN LOW- AND MIDDLE-INCOME COUNTRIES

REDUCING OUTDOOR EMISSIONS FROM HOUSEHOLD COAL AND BIOMASS ENERGY SYSTEMS, AGRICULTURAL WASTE INCINERATION, FOREST FIRES AND CERTAIN AGRO-FORESTRY ACTIVITIES (E.G. CHARCOAL PRODUCTION) WOULD REDUCE KEY RURAL AND PERI-URBAN AIR POLLUTION SOURCES IN DEVELOPING REGIONS



CUMULATIVE LIFECYCLE EMISSIONS PER UNIT OF ENERGY GENERATED OF (A) NOX AND SO2 AND (B) NMVOC AND PM2.5 FOR CURRENT ELECTRICITY SUPPLY TECHNOLOGIES[35]

REDUCE INDOOR AIR POLLUTION

According to the World Health Organization (WHO), around 3 billion people heat their homes and cook using solid fuels (i.e. wood, charcoal, coal, dung, crop wastes) on open fires or traditional stoves[36]. Most are impoverished, and live in low- and middle-income countries. These inefficient cooking and heating practices produce high levels of indoor air pollution which includes a range of health damaging pollutants such as fine particles and carbon monoxide[37 36]. The WHO estimates that every year over 4 million people die prematurely from illness attributable to the household air pollution from cooking with solid fuels. In poorly ventilated dwellings, smoke in and around the home can exceed by 100 times the acceptable levels for fine particles. Exposure is particularly high among women and young children, who spend the most time near or inside their domestic dwellings[36]. More than 50% of premature deaths due to pneumonia among children under five are caused by the particulate matter (soot) inhaled from household air pollution[38].

Therefore promoting a transition to much more efficient cookstoves and to cooking methods based on clean and modern RE can play a crucial role in mitigating the impact on health, especially to children and women. The narrative on cooking needs to move beyond more efficient and modern cookstoves. While these are definitely better than traditional cook stoves or open fire, they can solve the issue only partially and temporarily. Concrete results also in terms of indoor air pollution reduction can only be achieved with a shift from simply improved cook stoves and LPG (liquefied petroleum gas (LPG) to truly alternative cooking solutions such as renewable electricity (e.g. solar home systems), biogas, and Power-to-Gas (P2G). A recent WFC report provides further details on this critical issue[39].

RENEWABLE BASED
COOKING METHODS

Exposure to indoor air pollution is particularly high among women and young children, who spend the most time near or inside their domestic dwellings

The narrative on cooking needs to move beyond more efficient and modern cookstoves

Results can only be achieved with a shift from simply improved cook stoves and LPG (liquefied petroleum gas (LPG) to truly alternative cooking solutions such as renewable electricity

PROVIDE ENERGY TO HOSPITALS AND HEALTH CARE CENTRES

RE proved to be one of the most viable options to provide energy to hospitals, health facilities and health posts, especially in remote rural areas in the Global South. This has a direct impact on the health of thousands of people who access hospitals in the Global South every day[40]. According to a recent report by the WHO, on average, one in four sub-Saharan health facilities had no access to electricity. Only 8% of health facilities and 34% of hospitals had what could be called "reliable" access to electricity (without prolonged interruptions in the past week)[40]. Yet, access to modern renewable energy demonstrated to significantly support the functioning of health facilities in rural areas, by generating electricity for medical devices, appliances and facility support functions (e.g. cooling, lighting and water pumping) and by providing energy for sterilisation and for space and water heating[17 41]. It was actually reported that health workers in electrified clinics – even with very small PV systems – have reported results such as fewer infections, fewer delays in providing life-saving care, more timely blood transfusions, and more successful child deliveries[41].

Successful examples of on-site RE generation for hospitals and its key role in ensuring economically viable and reliable electricity exist. An example is the university hospital of Mirebalais in Haiti, which has 1,800 solar panels on its rooftop[42]. The WHO recently highlighted the increasing role of solar power in health facilities[43]. In fact, a recent review of sub-Saharan African health facilities found a trend towards increasing use of onsite PV solar either as a primary or backup electricity source. In Uganda, some 15% of hospitals used PV solar to complement grid electricity access, and in Sierra Leone, 36% of all health facilities and 43% of hospitals used solar systems in combination with other electricity sources. In Liberia, a country with little grid coverage beyond the capital city, the pace of solar electrification has exceeded that of other power sources; in 2012, more first-line public health clinics used PV solar than generators as their primary energy source. While PV systems are limited in capacity, they appeared to offer somewhat greater reliability: more solar-equipped clinics reported having electricity available on the day they were surveyed compared with those using diesel generators as their primary source. The interest in solar has been stimulated by the increasing range of direct current (DC) medical devices and appliances that can be charged from PV solar panels, such as solar refrigerators for vaccine refrigeration. A number of inexpensive portable solar systems options exist that were specifically designed for off-grid health clinics' basic lighting and communications needs, particularly to support childbirth and emergency services[43].

A RECENT REVIEW OF SUB-SAHARAN AFRICAN HEALTH FACILITIES FOUND A TREND TOWARDS INCREASING USE OF ONSITE PV SOLAR

IN LIBERIA, A COUNTRY WITH LITTLE GRID COVERAGE BEYOND THE CAPITAL CITY, THE PACE OF SOLAR ELECTRIFICATION HAS EXCEEDED THAT OF OTHER POWER SOURCES; IN 2012, MORE FIRST-LINE PUBLIC HEALTH CLINICS USED PV SOLAR THAN GENERATORS AS THEIR PRIMARY ENERGY SOURCE

ENSURE INCLUSIVE AND QUALITY EDUCATION FOR ALL AND PROMOTE LIFELONG LEARNING

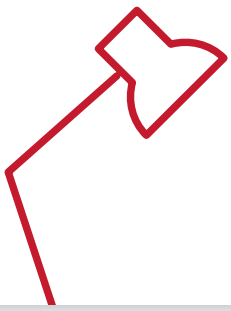
Renewable Energy can be installed where schools and educational centres are located and it is fundamental in supporting students learning in a variety of ways, from electricity for lighting during dark hours to freeing up time from charcoal or firewood collection.

IMPROVED ACCESS TO ENERGY HAS A DIRECT CORRELATION WITH EDUCATIONAL ACHIEVEMENTS

AND 100% RENEWABLE ENERGY IS THE FASTEST AND MOST INCLUSIVE APPROACH FOR REACHING THAT

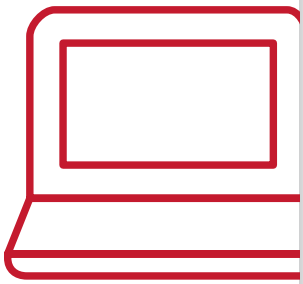
IT'S ALL ABOUT **ACCESS**

Renewable energy can provide access to millions of students in a fast and affordable way, without having to wait for the national infrastructure to be expanded or upgraded.



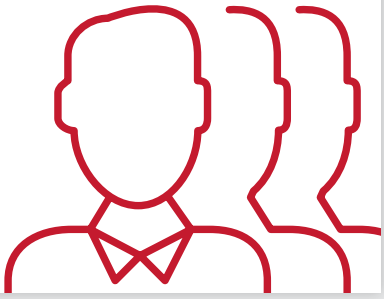
INFORMATION AND POWER

RE provides low cost electricity production to power computers and other devices to access information and facilitate communication.



ENERGY TO **RECRUIT TEACHERS**

The reliable and affordable source of electricity provided by RE can motivate teachers and qualified professionals to consider moving to these communities.



ACCESS TO RE OPTIONS FOR COOKING AND ELECTRICITY CAN **FREE UP TIME FOR STUDYING AND ENSURE SAFETY** FOR MANY CHILDREN WHO DEDICATE THEIR TIME TO WOOD AND CHARCOAL COLLECTION

4 QUALITY EDUCATION

SDG 4
ENSURE INCLUSIVE AND QUALITY EDUCATION FOR ALL AND PROMOTE LIFELONG LEARNING

SOLAR PV SYSTEM IN CIPTAGELAR, AN INDIGENOUS COMMUNITY IN THE RAIN FOREST OF WEST JAVA, INDONESIA, INSTALLED BY GREENPEACE IN 2015

Several experiences demonstrate the positive correlation between improved access to energy and educational achievements. Yet, about 300 million pupils attend schools that do not have access to electricity[17]. Using renewable energy technologies is the fastest and cheapest way to provide energy access. They can be installed where schools and educational centres are located without waiting for the national infrastructure to be expanded or upgraded. Hereby, it is fundamental in supporting students learning in a variety of ways[17]. First of all, renewable-based electricity for lighting which allow students to study during dark hours has proven to be extremely important to improve their performance. It is estimated that the deployment of about 600,000 solar lights in Africa provided 765 million pupils extra study hours in 2014, which resulted in improved performance and greater motivation and attendance[17]. A number of practical examples exist. For instance in the village of Littoral in Cameroon, solar kits were installed in all 50 houses of the village as well as the dispensary. Each house had an independent solar kit with one solar panel, 6 to 10 LED bulbs, a battery, one charge controller, one protection kit against power surges, one scaffolding and other required material for electric installation. As children could now study in the evening, their school performance improved significantly, with a recorded rise in scores (from E to C)[30].

RE can also provide a low cost option for electricity production to power computers and other devices to access information and facilitate communication, which have demonstrated to benefi students considerably[17 30]. For example in the Surkhet District in Nepal, a project completed in 2013 demonstrated how the use of energy from photovoltaic systems for lighting and for powering computers is the cheapest option for rural areas and allows students to improve their performance while the measures also helped to significantly reduce the emission of toxic gases from the current use of kerosene lamps[44].

IN LITTORAL, CAMEROON, SOLAR KITS INSTALLED IN ALL HOUSES ALLOWED CHILDREN TO STUDY IN THE EVENING, WHICH **IMPROVED THEIR SCHOOL PERFORMANCE SIGNIFICANTLY**

The lack of electricity in schools especially in rural areas also leads to difficulties for finding enough and qualified teachers. Many African countries for example report that teachers express a strong preference for urban postings, mainly due to concerns about teaching conditions and quality of accommodation[45]. Governments therefore find it more difficult to supply quality education services in rural areas. As teachers prefer to teach in urban areas, rural schools

are often left with empty posts, or have longer delays in filling posts. Even if posts are filled, rural schools may have fewer qualified teachers, if the better qualified teachers have a greater choice of jobs. Sometimes the rural schools have less experienced teachers, as the more experienced teachers find ways to move to the more desired schools. In Tanzania, experiences also proved that the quality of teaching may be lower, if teachers have limited access to electricity. Rural teachers often have less access to support services than their urban counterparts, and fewer opportunities to attend in-service course[45 46].

Further, it is important to remember that many children especially in Africa dedicate their time to wood and charcoal collection, which often leaves them less time for education and can be dangerous particularly for girls and young women being exposed to violence (rape, sexual harassment, and abduction). Access to RE options for cooking and electricity can be an alternative that would free up time for studying and ensure safety[17 39].

GOVERNMENTS FIND IT MORE DIFFICULT TO SUPPLY

QUALITY EDUCATION SERVICES IN RURAL AREAS DUE TO LACK OF ENERGY SERVICES

Many African countries report that teachers prefer urban postings, due to teaching conditions and quality of accommodation.

As teachers prefer to teach in urban areas, rural schools are often left with empty posts, or have longer delays in filling posts.

Often, rural schools have less experienced teachers, as the more experienced teachers can choose more desired schools.

ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

RE projects are often an opportunity to involve women and allow them to be the drivers of change. As the energy sector transitions from fossil-fuel dominated systems toward more efficient, sustainable renewable-based systems, new opportunities for a more inclusive energy job market are emerging which increases the role and participation of women.

100% RE CAN ENHANCE SUBSTANTIVE AND PROCEDURAL RIGHTS FOR WOMEN AND GIRLS AND ACHIEVE GENDER EQUALITY

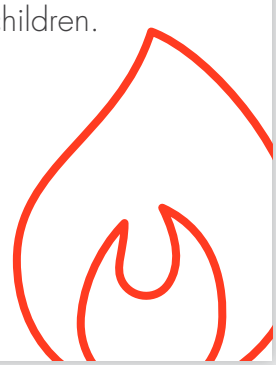
RE FEATURES MORE GENDER EQUALITY THAN THE BROADER ENERGY SECTOR. ACCORDING TO A SURVEY, WOMEN REPRESENT AN AVERAGE 35% OF THE WORKFORCE, COMPARED TO ONLY 20-25% OF THE OVERALL ENERGY INDUSTRY'S WORKFORCE

TIME OF **COLLECTION**

A reliable access to energy through RE would greatly decrease the amount of time women and girls spend providing energy for the household, which would increase the amount of time they spend on their education.

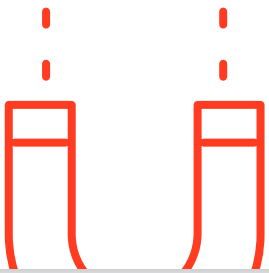
EXPOSURE TO **SMOKE**

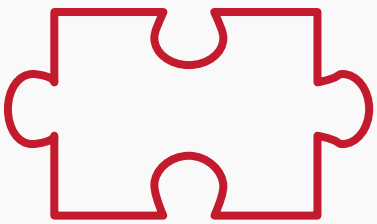
The adoption of clean cook stoves using clean and renewable fuel can prevent the majority of deaths and diseases attributable to indoor air pollution, which mainly affect women and children.



INCLUSIVE ENERGY

As the energy sector transitions from fossil-fuel dominated systems toward more efficient, sustainable renewable-based systems, new opportunities for a more inclusive energy job market are emerging.





AS A SECTOR THAT REQUIRES A VARIETY OF SKILLS ALONG THE ENTIRE VALUE CHAIN, **RENEWABLES CAN GIVE WOMEN A GREATER ROLE** TO PLAY COMPARED TO TRADITIONAL ENERGY SCENARIOS

5 GENDER EQUALITY

SDG 5
GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

SUBSTITUTING TRADITIONAL BIOMASS FUELS WITH RE OPTIONS ALLOWS WOMEN TO SPEND LESS TIME COLLECTING WOOD. RE-BASED COOKING CAN ALSO REDUCE THE DANGEROUS LEVELS OF INDOOR AIR POLLUTION TO WHICH THEY ARE EXPOSED DAILY WHILE COOKING. FURTHERMORE, SEVERAL RE PROJECTS ARE OPPORTUNITIES FOR WOMEN TO ENGAGE AND BECOME THE DRIVERS OF CHANGE

Providing energy access through 100% RE is an opportunity to enhance substantive as well as procedural rights, particularly for women and girls and achieve gender equality.

First, women in the Global South, for example in sub-Saharan Africa, are often in charge of collecting fuels for cooking, mostly wood and cow dung. In rural areas, women often spend several hours a day collecting fuelwood loads of 20 kg or more. Also in cities, women living on an often very tight household income have to buy charcoal or kerosene and have to spend a considerable amount of energy and time on the demanding task of proving energy for the household. Collection time has a significant impact on the livelihoods, limiting the opportunity for women and children to improve their education and engage in income-generating activities. Many children, especially girls, are withdrawn from school to attend to domestic tasks related to biomass use among other things, having to neglect their education and thus restricting their economic opportunities[36]. Therefore, fuel collection reduces the time women have available for rest or contributing to other aspects of livelihood strategies. Furthermore, women are also in charge of other time and energy consuming activities, such a water collection and food processing[47 41].

Secondly, women are also responsible for cooking for their families and therefore they are the ones that are most exposed to the polluting smokes from traditional cook stoves or open fire which disproportionately affect women's health compared to men's. it has been shown that higher levels of lung and eye diseases are suffered by women compared to men[47]. These are attributed to the longer hours of exposure to smoke in kitchens. The adoption of clean cook stoves using clean and renewable fuel is expected to prevent the majority of deaths and diseases attributable to indoor air pollution, which mainly affect women and children[41]. Therefore, access to RE for lighting, cooking, and productive activities can actually help them to save time and can have a significant positive effect on women's education, well-being, literacy, nutrition, health, economic opportunities, and involvement in community affairs which can, in return, benefit all family members[47].

Thirdly, RE projects are often an opportunity to involve women and allow them to be the drivers of change. In fact, as the energy sector transitions from fossil-fuel dominated systems toward more efficient, sustainable renewable-based systems, new opportunities for a more inclusive energy job market are emerging. This may include an increasing role and participation of women[48]. For example, a pilot project in West Bengal has helped women to become solar entrepreneurs by providing them with training to manage and operate solar lantern charging stations. Women can

charge lanterns, for example, and then rent them out to customers such as fishermen needing light on their boats at night. The project began in response to surveys about the impact of solar photovoltaic systems (PV) in West Bengal that showed a huge demand for service facilities, but a gap in their provision because the technically skilled male youth often migrated to the cities. At the same time, the survey revealed that women were interested in understanding the technical aspects of PV systems. The project therefore trained women on technical aspects of PVs and troubleshooting; entrepreneurial issues such as need assessment, market research, and managing micro-enterprises; and institutional issues like networking, among others. Because of the training, women have reported feeling empowered to become skilled solar entrepreneurs who can contribute to household income and wellbeing. As a result of the project many of the women have engaged in self-driven initiatives involving further training and formation of self-help groups. This has brought them in contact with other potential women entrepreneurs and helped them to tap a wider range of resources, including government schemes for women entrepreneurship development[41].

Lastly, a recent IRENA research indicates that RE features more gender equality than the broader energy sector. In fact, among the 90 companies from more than 40 countries that participated in a survey, representing the entire value chain of the sector (including, manufacturing, installation, operations and maintenance, consulting and policy making), women represent an average 35% of the workforce. In the overall energy industry, women only account for 20-25% of the workforce, which might reflect more opportunities for and a greater interest in women in the sustainability field. As a new and fast-growing sector that requires a variety of skills along the entire value chain, renewables could give women opportunities to gain a greater role compared to traditional energy scenarios[49].

WOMEN PLAY A CRUCIAL ROLE IN THIS TRANSITION AND

WOMEN-LED INITIATIVES HAVE EVIDENCED THEIR KEY ROLE AS DRIVERS OF RE DEVELOPMENT WITHIN THEIR COMMUNITIES

In summary, the transition to a 100% RE can create a wide range of benefits and opportunities for women, recognizing and respecting their rights, including green job generation, opportunities for community and entrepreneurial participation, and increasingly better health conditions. Women play a crucial role in this transition and women-led initiatives and projects related to RE access have demonstrated success and evidenced the key role of women as drivers of this transition within their communities[41].

A PILOT PROJECT IN WEST BENGAL HAS HELPED WOMEN TO BECOME SOLAR ENTREPRENEURS

BY PROVIDING THEM WITH TRAINING TO MANAGE AND OPERATE SOLAR LANTERN CHARGING STATIONS. WOMEN CAN CHARGE LANTERNS, FOR EXAMPLE, AND THEN RENT THEM OUT TO CUSTOMERS SUCH AS FISHERMEN NEEDING LIGHT ON THEIR BOATS AT NIGHT

ENSURE ACCESS TO WATER AND SANITATION FOR ALL

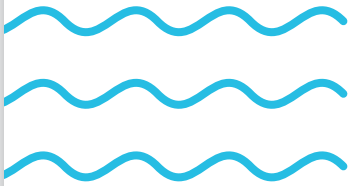
Renewable Energy can be vital in overcoming water related challenges. By shifting away from fossil fuels not only water quality and aquatic life can be improved, but RE can be used to pump water for irrigation and drinking purposes, even in the most remote and driest regions.

BUILDING A 100% RE INFRASTRUCTURE IS A MEAN AND A PREREQUISITE TO ENSURE ACCESS TO CLEAN WATER AND SANITATION FOR ALL

IN COUNTRIES WHERE WATER SCARCITY IS ALREADY AN ISSUE, THE REAL SOLUTION TO THEIR WATER AND ELECTRICITY CHALLENGES IS A SHIFT FROM COAL AND NUCLEAR ENERGY TOWARDS RENEWABLE ENERGY AND ENERGY EFFICIENCY

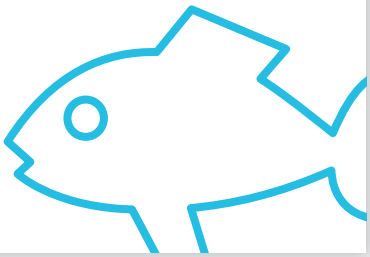
WATER PUMPING
WITH RENEWABLES

Renewable energy-based technologies can be an economic and resilient option to access, treat and pump water for multiple purposes from drinking to agricultural irrigation, even in the most remote and driest regions.



AQUATIC LIFE
AND WATER QUALITY

Coal mining can have detrimental impacts on aquatic life and the livelihoods of local populations. Locally produced Renewable energy can significantly improve the quality of water.



MINE TAILINGS
POLLUTANTS

Surface-mined coal produces large volumes of mine tailings containing pollutants that can leach into groundwater.

FROM A LIFE-CYCLE PERSPECTIVE POWER GENERATION AND PROCESSING THROUGH **RENEWABLE SOURCES ARE UP TO 200 TIMES LESS WATER-INTENSIVE** THAN FROM FOSSIL-FUELS

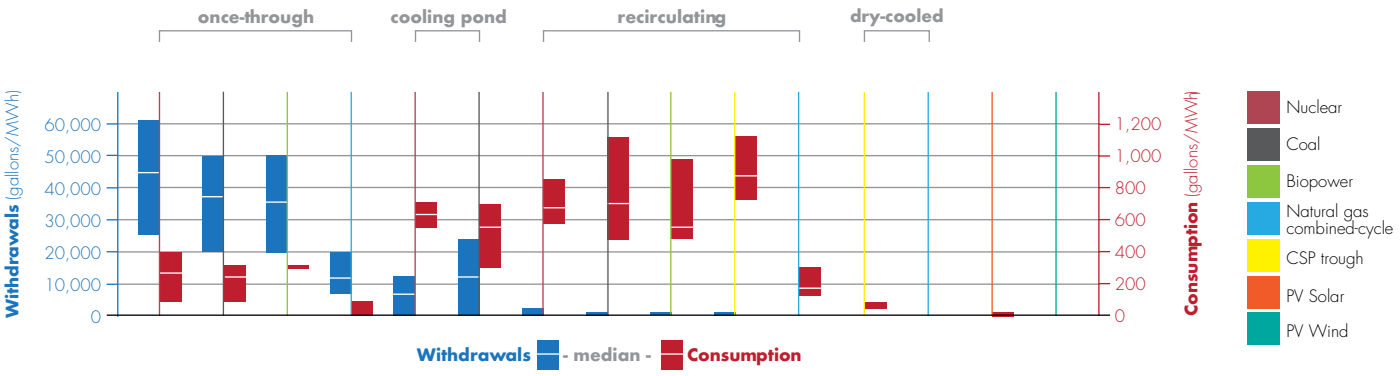
6 CLEAN WATER AND SANITATION

SDG 6
ENSURE ACCESS TO WATER AND SANITATION FOR ALL

Building a 100% RE infrastructure is a mean and in fact a prerequisite to ensure access to clean water and sanitation for all[31 50].

First, renewables are often much less water-intensive from a life-cycle perspective[51]. Currently energy supply accounts for nearly 15% of global freshwater withdrawals per year mostly because of water intensive processes for fuel extraction, processing and power generation, such as coal power generation[31]. For producing a MWh of electricity, RE technologies such as wind and solar require much less water than conventional thermoelectric generation where substantial quantities of water are needed for cooling. Solar PV or wind could withdraw up to 200 times less water than a coal power plant to produce the same amount of electricity[31]. Desalination is often seen as a solution for the water crises and from all available energy sources, solar energy is the one that correlates best with the demand for water. Geothermal and concentrating solar power (CSP) have higher water needs for operation as they also need cooling, yet recent advancement in dry cooling have shown that water use for CSP plants can be reduced significantly. Compared to other RE sources, bioenergy does necessitate substantial water inputs depending on feedstock production[31].

In many Global South countries water scarcity is already an issue[52]; therefore, a careful assessment on the impact on water resources is essential when addressing the sustainability of energy options. For example, in India, 79% of new energy capacity is expected to be built in areas that already face water scarcity or water stress. The problem is that water-intensive coal power production is planned to remain a key energy source to meet rapidly expanding power needs in spite of the evident water scarcity issues. For example, the country plans to build a cluster of 71 coal plants in the Vidarbha region of Central Maharashtra, a highly water-stressed area where lack of water for irrigation has been documented in the last decade[31]. Another example is coal power in South Africa. Despite its continuous struggle with water scarcity, in 2012 coal-fired electricity generation contributed to over 90% of South Africa's electricity. The main coal electricity producer of the country called Eskom in one-second uses the same amount of water as a single person would use within one year (based on access to the minimum 25 litres of water per day[53]. Yet a Greenpeace report clearly demonstrates how "the real solution to South Africa's water and electricity crisis is not incremental improvements in coal technology, it is an Energy [R]evolution: a shift away from coal and nuclear energy, and towards renewable energy and energy efficiency"[53]. As renewable energy technology may also



WATER USE (WITHDRAWALS AND CONSUMPTION) IN ELECTRICITY GENERATION BY FUEL AND COOLING TECHNOLOGY[137]

require water at some stage along the supply chain, they have to be used in highly efficient ways. The selection of RE technology must be water sensitive.

Secondly, renewable energy-based technologies can be an economic and resilient option to access, treat and pump water for multiple purposes from drinking to agricultural irrigation, even in the most remote and driest regions[31]. For example, in Africa's Sahel region, the lack of energy means that many of the region's 68 million inhabitants have to find ways to transport water from as far as 10 kilometres every day. Although the region receives limited annual rainfall, the water table is at distance from the surface that allow water pumping (about 100 metres). However, for the pumping they need energy, which is often unavailable in many remote areas far from the grid. After a programme was launched to deploy solar-based water pumping solutions, it is estimated that today nearly 3 million people in the region benefit from the use of these pumps[31].

Further examples include powering desalination plants in dry regions with RE technologies such as in the Middle East and North Africa (MENA) region and the installation of solar PV over canals and reservoirs to minimise allocation of new land resources and to reducing evaporative losses of water. For example, in India, a 1 MW solar plant was developed over a 750 metre stretch of a canal system, producing 1.53 GWh of electricity annually and saving 9 million litres of water from evaporation every day. Covering 10% of the 19 000 kilometre canal network with solar panels could potentially conserve 4 400 hectares and save about 20 billion litres of water every year[31].

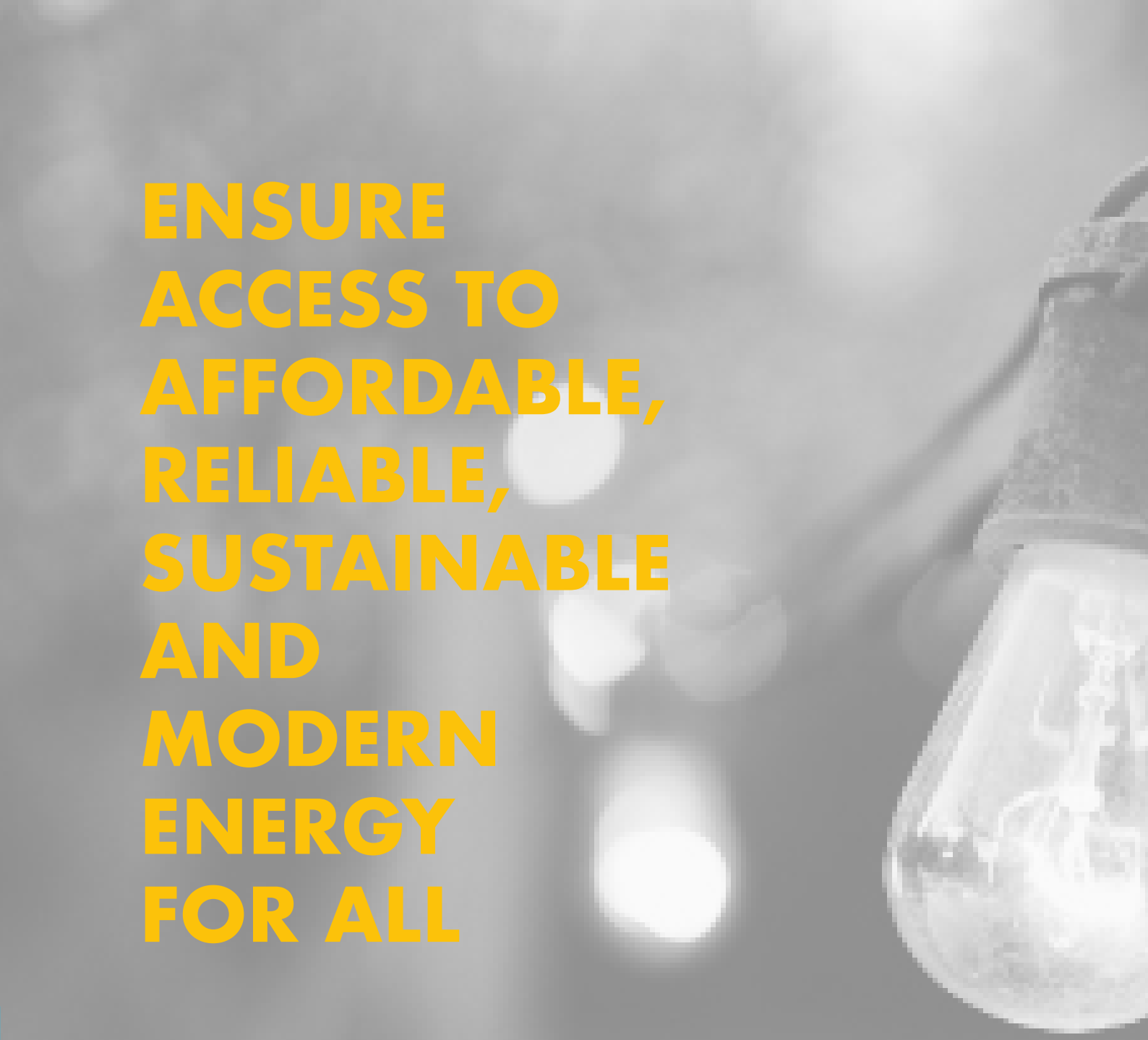
Lastly, the extraction and transportation of fossil fuels pose risks to the quality of water resources and the health of aquatic ecosystems[54]. For instance surface-mined coal produces large volumes of mine tailings containing pollutants that can leach into groundwater. An example can be found in Borneo, where water acidity has increased substantially due to intensive coal mining, with detrimental impacts on aquatic life and the livelihoods of local populations. Similarly, in South Africa the Olifants River catchment area has experienced more than 100 years of coal mining[53]. The river is showing signs of serious water pollution, soil erosion and reduced agricultural production. Very similar effects are recorded in the Vaal River catchment also in South Africa due to coal mining[53]. Similar water contamination issues are common also during oil and natural gas drilling, when seepage and major spills of retention ponds pose threats of polluting water with heavy metals and high-salinity water[55, 56].

IMPACT OF CLIMATE CHANGE

CLIMATE CHANGE, WHICH IS MOSTLY DRIVEN BY FOSSIL FUEL EMISSIONS, WILL ENORMOUSLY IMPACT FRESH WATER RESOURCES[58]. A TRANSITION TO 100% RE IS THE ONLY VIABLE SOLUTION TO MITIGATE GLOBAL WARMING AND ITS IMPACT ON WATER RESOURCES. IN PARTICULAR, CLIMATE CHANGE WILL AFFECT FRESHWATER SECURITY IN THREE KEY WAYS:

- Global warming increases the amount of water that the atmosphere can hold, which in turn can lead to more and heavier rainfall when the air cools. Although more rainfall can add to fresh water resources, heavier rainfall leads to more rapid movement of water from the atmosphere back to the oceans, reducing our ability to store and use it.
- Higher temperatures leads to the melting of inland glaciers. This will increase water supply to rivers and lakes in the short to medium term. However, this will cease once these glaciers have melted.
- In the sub-tropics, climate change is likely to lead to reduced rainfall in what are already dry regions. The overall effect is an intensification of the water cycle that causes more extreme floods and droughts globally.

ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL



7 AFFORDABLE AND CLEAN ENERGY

More than one billion people do not have access to these services but it is essential to overall human progress, social welfare, technological advancement and unlocks access to many human rights. Without reliable access to energy, societies would have never reached the standards of living that many people across the world enjoy today.

ACCESS TO 100% RENEWABLE ENERGY IS A PREREQUISITE FOR DEVELOPMENT AND A LIFE OF DIGNITY

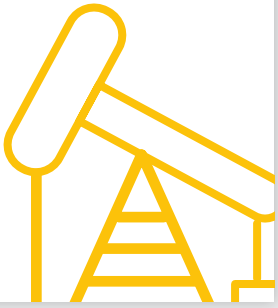
TO ENSURE THAT ENERGY CAN CONTINUE TO PLAY ITS FUNDAMENTAL ROLE IN DRIVING DEVELOPMENT AND IMPROVING LIVELIHOODS ACROSS THE WORLD, WE NEED TO SHIFT TO 100% RENEWABLE ENERGY

SUSTAINABLE IS **RENEWABLE**

Sustainable energy must be defined as renewable energy, which safeguards human rights, respects planetary boundaries, supports local communities, and ensures a just distribution of benefits.

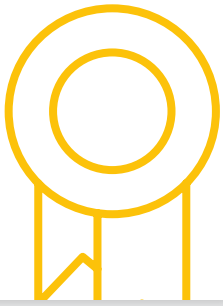
ONLY WAY **FORWARD**

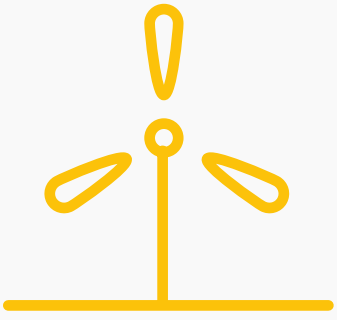
It is short-sighted and dangerous to ignore the threats of climate change, environmental degradation and concentration of political and economic power linked to fossil-fuel-dependent development.



DRIVERS OF CHANGE

Governments across the developing world are pioneering this paradigm shift and are leading the charge with strong committments and decisive action towards 100% renewable energy.





MORE THAN ONE BILLION PEOPLE DO NOT HAVE ACCESS TO ENERGY SERVICES. OVERCOMING THIS IS

ESSENTIAL TO OVERALL HUMAN PROGRESS, SOCIAL WELFARE, TECHNOLOGICAL ADVANCEMENT AND HUMAN RIGHTS

7 AFFORDABLE AND CLEAN ENERGY

SDG 7
ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

WITHOUT RELIABLE ACCESS TO ENERGY, SOCIETIES WOULD HAVE NEVER REACHED THE STANDARDS OF LIVING THAT MANY PEOPLE ACROSS THE WORLD ENJOY TODAY

Access to energy is a prerequisite of development and for a life of dignity. Energy services include lighting and electricity, cooking, heating and cooling, mechanical energy and mobility. More than one billion people do not have access to these services. However, as this report underlines, they are essential to overall human progress, social welfare, technological advancement and unlock access to many human rights. Without reliable access to energy, societies would have never reached the standards of living that many people across the world enjoy today. While it would be naïve to understate the vital role that fossil fuel energy played in improving livelihoods, it would be irresponsible, short-sighted and dangerous to ignore the threats of climate change, environmental degradation and concentration of political and economic power that this type of fossil-fuel-dependent development produced. To ensure that energy can continue to play its fundamental role in driving development and improving livelihoods across the world, a fundamental paradigm shift is needed. The link between energy and development now inevitably becomes the link between "renewable" energy and development. And sustainable energy must be defined as renewable energy, which safeguards human rights, respects planetary boundaries, supports local communities and marginalized groups, and ensures a just distribution of benefits today and in the future. In the light of this shift, understanding the relationship between a fully renewable-energy-based future and sustainable development becomes paramount. The targets of SDG Seven also recognize this. While international cooperation should be enhanced to facilitate access to renewable energy, infrastructure and technologies should be expanded and upgraded to supply modern and sustainable energy[59].

AFRICAN HEADS OF STATES LAUNCHED THE AFRICA RENEWABLE ENERGY INITIATIVE (AREI) TO **"ACCELERATE, SCALE-UP AND HARNESS THE CONTINENT'S HUGE POTENTIAL OF RENEWABLE ENERGY SOURCES"**

Governments across the developing world are in fact pioneering this paradigm shift. In Paris during COP21, African Heads of States launched the Africa Renewable Energy Initiative (AREI) to "accelerate, scale-up and harness the continent's huge potential of renewable energy sources" by "widening access to clean energy services, improving human well-being and putting African countries on a climate-friendly and sustainable development pathway"[6]. One year later, in November 2016 at COP22 in Marrakech,

further achievements were reached when 48 Climate Vulnerable Forum (CVF) countries declared that they "strive to meet 100% domestic renewable energy production as rapidly as possible while working to end energy poverty, protect water and food security, taking into consideration national circumstances"[7 8].

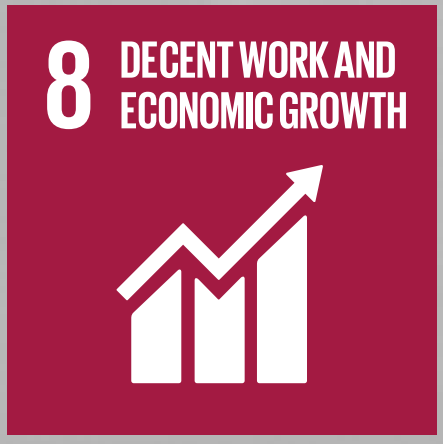
As also shown by this report, various expected benefits of a transition to 100% RE are presumed to be closely aligned with the drivers that motivates it[9]. A driver and ultimately a benefit may be the imperative of reducing the incidence of respiratory illness, which can be realized through reduced air pollution, and which is achieved in part by substituting fossil-fired power generation with renewable energy. There are different ways to categorise these drivers and benefits:[60 61 62 63]

- macro-economic effects, including macro-economic impulses such as investment and industry turnover; gross effects such as employment in the renewables industry; impact on current accounts from reduced fossil fuel imports; and net effects such as overall net change in GDP and employment from renewable energy technology deployment;
- system-related benefits such as avoided environmental damages;
- and distributional effects.

ENERGY CONTINUES TO PLAY ITS FUNDAMENTAL ROLE IN IMPROVING LIVELIHOODS ACROSS THE WORLD AND **THE LINK BETWEEN ENERGY AND DEVELOPMENT NOW INEVITABLY BECOMES THE LINK BETWEEN "RENEWABLE" ENERGY AND DEVELOPMENT**

48 CLIMATE VULNERABLE FORUM (CVF) COUNTRIES DECLARED THAT THEY **"STRIVE TO MEET 100% DOMESTIC RENEWABLE ENERGY PRODUCTION AS RAPIDLY AS POSSIBLE WHILE WORKING TO END ENERGY POVERTY, PROTECT WATER AND FOOD SECURITY**, TAKING INTO CONSIDERATION NATIONAL CIRCUMSTANCES"

PROMOTE INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, EMPLOYMENT AND DECENT WORK FOR ALL



Several comprehensive studies and experiences demonstrate the huge employment potential related to RE development and reveal how the employment potential for each MW of installed capacity for renewable energy technology is consistently higher than for fossil fuels. For every job lost due to a phase out of fossil fuels, even more jobs emerge in the RE sector.

RE DEVELOPMENT HAS AN IMPRESSIVE EMPLOYMENT POTENTIAL THAT STEADILY INCREASES YEAR AFTER YEAR

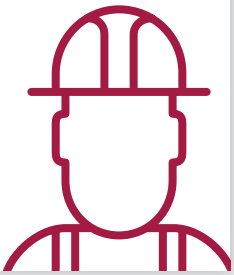
STUDIES ESTIMATED THAT DOUBLING THE SHARE OF RENEWABLES BY 2030 COULD INCREASE EMPLOYMENT IN THE SECTOR TO BEYOND 24 MILLION PEOPLE COMPARED TO A BUSINESS AS USUAL SCENARIO (13.5 MIO.)

A TRANSITION TO **MORE JOBS**

The employment potential for each MW of installed capacity for renewable energy technology is consistently higher than for fossil fuels. For every job lost due to a phase out of fossil fuels, more jobs emerge in the RE sector.

GOOD **LOCAL JOBS**

Each section of the RE value chain requires skills and workforce capabilities, which stimulates local business and employment. In India, solar PV creates more jobs per unit of energy produced than any other energy source.



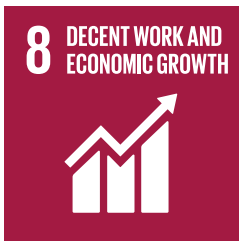
ENHANCING HUMAN **WELL-BEING**

RE also increases human well-being, taking into account environmental, social and economic dimensions. Doubling the share of renewables would increase this indicator by 3.7%.

UNLIKE TRADITIONAL CENTRALIZED FOSSIL FUEL DEVELOPMENT RE CREATES HUGE

OPPORTUNITIES FOR EMPLOYMENT IN REMOTE RURAL AREAS

REACHING IN AN INCLUSIVE MANNER THE MOST MARGINALIZED COMMUNITIES



SDG 8
PROMOTE INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, EMPLOYMENT AND DECENT WORK FOR ALL

Several comprehensive studies and experiences demonstrate the huge employment potential related to RE development[64 49 65 66 67]. According to a recent IRENA study, the RE sector accounted for 8.1 million jobs worldwide in 2015 (without including large-scale hydropower, which alone accounted for 1.3 million jobs)[49]. Solar PV was the RE technology that created the largest number of jobs in 2015, followed by liquid biofuel and wind energy. The IRENA study also estimated that doubling the share of renewables by 2030 could increase employment in the sector to beyond 24 million people compared to a business as usual scenario which would see an increase in RE jobs to only 13.5 million by 2030[17]. In fact, several studies reveal how the employment potential for each MW of installed capacity for renewable energy technology is consistently higher than for fossil fuels. For example, average employment (jobs per megawatt of average capacity) over life of facility for solar PV ranges from about 7 to 11 jobs per MW of capacity, for biomass and wind up to 3 jobs per MW and for coal and gas only a maximum of 1 job per MW[68]. Hence, for every job lost due to a phase out of fossil fuels, even more jobs emerge in the RE sector.

Especially in Global South countries, which often have high level of unemployment especially among youth and considerable potential for economic growth, RE can be instrumental in providing opportunities for local job creation and economic development. For example, a report prepared by the Indian Council on Energy, Environment and Water (CEEW) showed how also in India solar photovoltaic (PV) creates more jobs per unit of energy produced than any other energy source[69]. Considering the huge issue of unemployment in a country with a growing population and labour force, renewable energy development is in fact a desirable solution. Furthermore, the study also found that smaller projects up to 5 MW in size provide the most employment opportunities per MW of installed capacity. This means that a decentralized, small-scale approach to RE development can actually be the most beneficial for India's labor market. In fact, employment in India is expected to increase substantially as it is scaling up its ambition for solar PV and wind deployment. Meeting its 2022 target of 100 GW of solar alone is expected to create 1.1 million jobs[65].

While it was estimated that doubling the share of renewables in the global energy mix by 2030 would increase global GDP by up to 1.1% or USD 1.3 trillion[65], RE development is not only about economic growth measured merely in terms of GDP growth. As explained comprehensively in a recent IRENA report, RE development increases "overall welfare" defined as a composite indicator of human well-being which takes into account environmental (GHG emissions and resource consumption), social (employment and health and education) and economic (consumption and investments) dimensions. Doubling the share of renewables would create an increase of this welfare indicator by 3.7% (compared to 1.1% GDP improvement)[65]. The effect of doubling the share of renewables on GDP growth is thus already remarkable. The effect on overall welfare, however, is even much stronger.

Additionally, RE development creates economic growth and opportunities to leverage local industries and create value that is localized and benefits local communities[66]. As described previously for SDG 1 and 2, the use of RE for productive uses (e.g. small-scale manufacturing, agro-food chain processes, refrigeration, and communication devices) is one of the best instruments to boost local business and create opportunities for employing and economic development even in the most marginalized and remote rural areas. It is important to note the ILO and human rights standards, specifically rights of indigenous people must be followed as in every other sector. Furthermore, RE allows creating value and jobs along all segment of the value chain, including project planning, procurement, manufacturing, transport, installation, grid connection, operation and maintenance, support services and decommissioning. All these different sections of the value chain require wide range of skills and workforce capabilities, which stimulate local business and employment[66]. This aspect of renewable energy is essential when considering the goal of creating decent jobs and inclusive growth that creates a diverse work force, giving opportunities to all to contribute along the different sections of the value chain.

The unique strength about RE development is that, unlike traditional fossil fuel development based on a centralized approach to development, it can create huge opportunities for employment also in remote rural areas, therefore leaving no one behind and reaching and benefiting in a decentralized and inclusive manner the most marginalized communities. A recent study by IRENA estimates that reaching the objective of universal access to modern energy services by 2030 could create 4.5 million jobs in the off-grid renewables-based electricity sector alone[64]. However, it is important to note that following the concept of a just transition that aims at protecting those whose jobs, income, and livelihoods are at risk as a consequence of the phase out of fossil fuel based energy production, must be adequately addressed. Social dialogue as an institutional process of discussion between trade unions, employers, and governments, as well as communities and all other relevant community groups can help to achieve this goal. Building an institutional setting where those affected by the transition can discuss, decide on, and be provided with resources to design responses to the challenges of the transition is a fundamental tool for achieving decent work, economic growth and finally strengthen democracies and social support for change.

Several examples demonstrate how developing off-grid solutions can create opportunities for employment and development. For example, stand-alone solar PV expansion in Bangladesh, India and Kenya proved very effective in creating local jobs. In 2015 only, Bangladesh, added an estimated 700,000 solar home systems (SHS), raising the total cumulative installations in the country to 4.5 million. The workforce in this sector has increased by 13% to reach 127,000 jobs, a quarter of which are in manufacturing, with the remaining spread across distribution, installation and after-sales services. Similarly, India created 73,000 jobs along the off-grid solar PV value chain, according to the last available estimates. In India, several companies that build, install and maintain stand-alone systems are rapidly growing and creating jobs. For example in Africa MKOPA has sold over 300,000 SHSs in Kenya, Uganda, and the United Republic of Tanzania and created more than 700 full-time jobs along with 1,500 sales representatives[49].

Another example is biogas, often used for cooking and heating applications in rural settings[49]. The SNV Biogas programme in Vietnam, for instance, has installed over 150,000 digesters since 2003, creating around 4 jobs per installation during the construction phase. Another examples, is an improved watermills programme in Nepal, which created an estimated 8,500 jobs in operation and maintenance alone, feeding electricity into mini-grids to supply almost 900 households while also providing motive power for agro-processing. In India, some 4.68 million family-size dung-based biogas plants were installed in 2013 giving jobs to 85,000 people, while in China 42.8 million household biogas plants systems were installed by the end of 2011 creating close to 90 000 direct and indirect jobs along the biogas value chain[49].

REACHING UNIVERSAL ACCESS TO MODERN ENERGY BY 2030 COULD CREATE

4.5 MILLION JOBS IN THE OFF-GRID RENEWABLES-BASED ELECTRICITY SECTOR

Finally, solar and onshore wind technologies offer opportunities for mixed, multipurpose land use. Increasingly, solar PV and onshore wind projects are being developed on land that supports other industries. In Japan, the concept of co-production of food and energy (known as “solar sharing”) was first developed in 2004. Special structures are being deployed involving rows of PV panels mounted above ground and arranged at certain intervals to allow enough sunlight for photosynthesis and space for agricultural machinery. Similarly, the areas around solar PV and onshore wind plants are being used for farming and grazing activities, allowing farmers to diversify their income sources[31].

BUILD RESILIENT INFRASTRUCTURE, PROMOTE SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

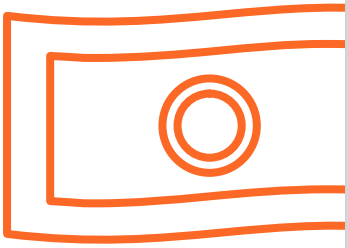
Industry is a major market for energy and industrial energy demand has a big impact on the energy sector. Countries in the Global South could pioneer low-carbon development, decoupling carbon emissions from industrialization.

PROMOTING INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION ENTAILS EXPANDING RENEWABLE ENERGY INFRASTRUCTURE

DEVELOPING AN INDUSTRY REQUIRES RELIABLE ELECTRICITY. RENEWABLE ENERGY CAN PROVIDE THAT THE CHEAPEST, FASTEST AND IN THE MOST EFFICIENT WAY

ATTRACTIVE **INVESTMENT**

RE attracts considerable amounts of investment especially in Global South countries which in return inevitably thrusts innovation, industry and infrastructure development.

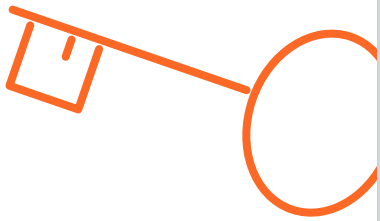


LEAPFROGGING IN THE **GLOBAL SOUTH**

In 2015, investments in renewables in Global South countries outweighed those in industrialized economies. China, India and Brazil committed a total of $156 billion, up 19% in 2014, while industrialized countries invested $130 billion, down 8%.

INNOVATIVE **BUSINESS MODELS**

Decentralised RE solutions can create value locally and boost local enterprises, which can progressively play an important role in extending access through the adoption of innovative business models.



A 100% RE FUTURE WILL REQUIRE DECENTRALISED DEVELOPMENT DRIVEN BY SMALL SCALE INVESTMENTS THAT **ALLOW COMMUNITIES TO CREATE THEIR OWN ENERGY, USE IT AND SHARE IT**.

SDG 9
BUILD RESILIENT INFRASTRUCTURE, PROMOTE SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

Many governments in developing and emerging economies prioritize industrialization, primarily to create employment. Industry is a major market for energy and developing an industry determines the demand for the energy sector. Tanzania for instance titles its national five year development plan "Nurturing Industrialization for Economic Transformation and Human Development"[69]. Such plans require reliable electricity. Renewable energy can provide that the cheapest, fastest and in the most efficient way. Hereby, countries in the Global South could pioneer low-carbon developments, decoupling carbon emissions from industrialization. Further, as already highlighted in SDG 8, the renewable energy industry provides major employment opportunities along the value chain. Promoting inclusive and sustainable industrialization therefore entails expanding renewable energy infrastructure.

In fact, RE already attracts considerable amounts of investment especially in Global South countries which in return inevitably thrusts innovation, industry and infrastructure development. In 2015, investments in renewables excluding large hydro in Global South countries outweighed that in industrialized economies[70]. The Global South including China, India and Brazil committed a total of $156 billion, up 19% in 2014, while industrialized countries invested $130 billion, down 8%. India saw its commitments rise 22% to $10.2 billion, while Brazil ($7.1 billion, down 10%), South Africa ($4.5 billion, up 329%), Mexico ($4 billion, up 105%) and Chile ($3.4 billion, up 151%) all joined it in the list of the top 10 investing countries in 2015[70]. Considering investments made in new renewable power and fuels relative to annual GDP, the top five countries included Mauritania, Honduras, Uruguay, Morocco and Jamaica[71].

The transition to a 100% RE future will require massive infrastructure transformations. The advantage of many Global South countries is that they are not locked-in fossil-fuel infrastructure and they can leapfrog industrialized countries by developing the infrastructure compatible with a long-term 100% RE vision[72]. This is particularly true for the so-called Least Developed Countries. Infrastructure that will need to be developed is very different from the prevalent type of infrastructure existing today mainly in industrialized and emerging economies, which is large-scale centralized, fossil fuel dominant type of infrastructure, driven by corporate investors. A 100% RE future will require infrastructural development based on decentralized, distributed and smart energy production systems driven by locally-based, small scale investments that allow communities to create their own energy, use it and share it locally. In places like Africa this often means off-grid, decentralized, bottom-up developments. This structural shift is fundamental to create sustainable and inclusive infrastructure for everyone, one that can benefit even the most marginalized communities

Secondly, the transition to a 100% RE future means innovation, especially regarding new, innovative business models that can drive the expansion of off-grid renewable energy market. Africa for example is already seeing the development of innovative business model to provide communities with access to renewable energy (see Box below). There is growing evidence that decentralised RE solutions can create value locally and boost local enterprises, which can progressively play an increasingly important role in extending access through the adoption of innovative business models. Furthermore, many of the technical and commercial skills required can be developed locally, thereby enhancing the sustainability of local economic activities and overall economic independence and resilience[64].

MANY GLOBAL SOUTH COUNTRIES ARE NOT LOCKED-IN FOSSIL-FUEL INFRASTRUCTURE AND THEY CAN **LEAPFROG INDUSTRIALIZED COUNTRIES WITH A LONG-TERM 100% RE VISION**

BUSINESS INNOVATION IN AFRICA FOR OFF-GRID DEVELOPMENT

IN AFRICA, SEVERAL NEW BUSINESSES ARE DRIVING INNOVATION BY PROVIDING ALTERNATIVE SOLUTIONS TO ALLOW COMMUNITIES TO ACCESS RENEWABLE ENERGY [73] [74]

SOLINC EAST AFRICA

Solinc is the East Africa's first solar-panel manufacturing plant. Established in 2011, Solinc makes solar panels from 20W to 300W. Beyond being the first one of its kind in the region, the company's innovative thinking resides in how it started to also assemble complete home solar kits that include batteries, phone chargers and LED lights. The plant's current manufacturing capacity is 140,000 solar panels per year, and it plans to double its capacity by 2018. The products are sold in Kenya, Uganda and Tanzania through a network of independent dealers. Solinc also supplies solar companies such as M-KOPA and Mobisol, which sell to customers using pay-as-you-go models.

UGESI GOLD

With a keen focus on poor or rural communities, the South African company introduces a unique solar battery charging station. Instead of households connecting to the grid, off-grid stations or SolarTurtles are used to charge battery packs, which are then carried home. Ugesi Gold gives an apt description on its website, using the analogy of a water well: "The SolarTurtle serves as the source of electricity (well), which the local community visits with batteries (buckets) for recharging"[73]. The company's energy distribution packs are designed to be owned and operated by women from off-grid communities. This way it also helps create entrepreneurs. In 2014, the SolarTurtle won the Climate Solver award from the WWF.

M-KOPA SOLAR

This pay-as-you-go solar energy company connects 550 new households across Kenya, Tanzania and Uganda to solar power each day, and up to autumn 2016 it has connected more than 375,000. The company provides M-KOPA's entry-level packages, which include home solar system featuring a battery, phone-charging facility, lightbulb, and a chargeable radio. In order to obtain the system, customers make a $34 deposit, and pay off the balance over a 12-month period in daily usage credits of about $0.50, paid to the company via mobile money, very much like a pay-as-you-go SIM card.

In 2015, M-KOPA began selling other products to encourage customers to continue their subscription once the solar-system is paid off. The products include a 16-inch solar-powered TV, bicycle, smartphone, water tank and a cooking stove. M-KOPA also offers loans to pay school fees. Households who have paid off their solar-system then essentially use that system as collateral to acquire these additional products, most of which contribute to sustainable energy usage.

AFRICAN RENEWABLE ENERGY DISTRIBUTOR

African Renewable Energy Distributor's (ARED) Mobile Solar Kiosk consists of off-grid kiosks offering a range of mobile phone services including charging, mobile money transfers, airtime sales and plans including Wi-Fi distribution. ARED is planning to have around 400 of these Mobile Solar Kiosks offering a license fee deal to partners that would like to expand on its franchise model, therefore maximising its outreach potential.

REDUCE INEQUALITY WITHIN AND AMONG COUNTRIES

The decentralized nature of RE can help remote communities access energy by establishing low cost off-grid renewable energy solutions such as mini-grids or stand-alone solutions that allow them to be independent from the centralized grid. This can play a major part in decreasing the inequality between urban and rural areas and inevitably lead to a much fairer and equitable distribution of resources across regions.

100% RENEWABLE ENERGY REDUCES INQUALITIES WITHIN AND AMONG COUNTRIES

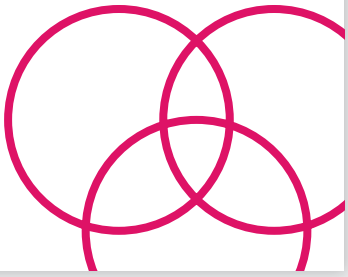
100% RE IS MODULAR AND FLEXIBLE. IT ALLOWS ALL COUNTRIES TO HARVEST ABUNDANT AND CLEAN RENEWABLE ENERGY, DISTRIBUTED WITHIN THEIR OWN BORDERS, CLOSE TO THEIR COMMUNITIES AND ACCESSIBLE BY EVERYONE

ENERGY **PROSUMERS**

With RE technologies anyone can become a *prosumer*, which enables citizens to become independent from other energy providers and provide access to energy at the necessary speed and scale as well as location

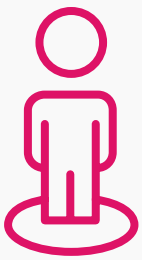
A FAIRER **DISTRIBUTION**

The decentralised nature of RE can play a major part in decreasing the inequality between urban and rural areas and inevitably lead to a much fairer and equitable distribution of resources across regions.



INTERGENERATIONAL **JUSTICE**

With 100% RE, current generations invest in the future providing cheap and sustainable energy for decades to come and it allows intergenerational justice by ensuring equal access to common resources.



THE TRANSFORMATION TOWARDS A 100% RE FUTURE MUST FOLLOW A UNIVERSALLY COHESIVE **PEOPLE-CENTERED, COMMUNITY-DRIVEN AND FUTURE-JUST APPROACH**

10 REDUCED INEQUALITIES

SDG 10
REDUCE INEQUALITY WITHIN AND AMONG COUNTRIES

IN ORDER TO OVERCOME INEQUALITIES, IT IS CRUCIAL TO MAKE TECHNOLOGIES AND HENCE THE CAPITAL TO ACCESS THE TECHNOLOGIES AVAILABLE FOR ALL.

THIS IS ONLY POSSIBLE WITH RE TECHNOLOGIES DUE TO THEIR MODULAR AND FLEXIBLE NATURE

The current fossil fuel based system leaves billions of people without any energy access and even more with very unreliable conditions. This causes severe inequalities within and among countries. In order to overcome this, it is crucial to make technologies and hence the capital to access the technologies available for all. This is only possible with RE technologies due to their modular and flexible nature. Fossil fuels are highly monopolized as it is cheaper per unit of output to exploit them at large scale than small scale. Transitioning to 100% RE is therefore the fastest and most effective way to provide universal equal access, which leaves no one behind.

It also holds opportunities to create competition, innovation and hence new business models that allow equal sharing of benefits. As RE technologies are decentralized, any individual or community can become a "prosumer", i.e. not only a consumer but also producer of energy. This can enable citizens to become independent from other energy providers and can provide access to the needed energy at the necessary speed and scale as well as location. In many countries, rural communities are left without reliable energy access as on-grid connectivity to the centralized distribution system is missing or too expensive. The decentralized nature of RE can help these remote communities access energy by establishing low cost off-grid renewable energy solutions such as mini-grids or stand-alone solutions that allow them to be independent from the centralized grid. This can play a major part in decreasing the inequality between urban and rural areas and inevitably lead to a much fairer and equitable distribution of resources across regions[75]. In fact, large fossil-fuel-based infrastructure projects often prioritize the demands of industrial consumers and urban centres over the basic needs of the poor[54]. As described by a report from the American NGO International Rivers, the large centralized investment approach to help Global South countries can "overwhelm the absorptive capacity of the governments and civil societies of poor countries" and "can entrench the power of vested interests, and encourage corruption rather than democratic control"[76].

As a contrast, the International Energy Agency has highlighted the importance of decentralized RE solutions and found that 70% of rural areas are best electrified "either with mini-grids (65% of this share) or with small, stand-alone off-grid solutions (the remaining 35%)." IEA estimated that globally $32billion per year would need to be invested from 2010-2030 to achieve universal access to electricity, and the majority of this amount, about two-thirds, would need to be invested in mini-grid and off-grid solutions.

Several examples demonstrate how decentralized, community-based renewable energy projects can help marginalized communities generate income and therefore help reduce inequalities and create the enabling conditions for fairer economic growth[76].

The district of Kasese in Uganda for instance with approximately 130,000 households is radically transforming. By 2020, Kasese will supply the energy needs of its population by only renewable sources. This ambitious target will be achieved by adopting a people-centered approach, with a wide variety of renewable sources such as biomass, solar, geothermal and mini-hydroelectric technologies. This will help the region overcome health issues strongly connected to the uncontrolled use of charcoal, firewood and kerosene, the main energy sources used for cooking and domestic electricity production. By implementing a decentralised RE system in the region, several clean energy businesses have been started since 2012, creating jobs for locals. They sell solar equipment, construct solar hubs, build biogas systems, improve cook stoves and deliver mini-hydro projects. The number of businesses in the local green economy has increased from five to 55 since 2012, and at least 1,650 people have been trained in the process[77].

Another example is the Solar Electric Light Fund (SELF), a non-profit organization that is working in more than 20 countries to install solar energy systems in rural and poor areas. One of their projects is an innovative drip-irrigation system in Benin that is powered by photovoltaics. Farmers are able to grow crops throughout the long dry season, greatly improving their food security, which has helped to improve their standard of living of these rural communities enormously[78]. The international organization Practical Action has also been helping to provide many forms of RE to poor residents of Asia and Africa. For example, they have helped villages in Sri Lanka install a wind turbine that provides electricity for the entire community. This has had benefits beyond simple access to power[78]. Villagers pooled their resources to install and manage the turbine, they received technical education and, as a result, a number of steady jobs were created. Installing a local turbine also means people no longer have to travel long distances and pay large amounts to recharge batteries that they regularly use. This is creating opportunities to fight inequality between rural and more urbanized regions, as well as gender inequalities.

Further, a transition to 100% RE is a matter of intra- and intergenerational justice. While the fossil fuel based energy system primarily benefitted some people living today, future generations have to bear the costs. 100% RE turns this around as current generations invest in the future providing cheap and sustainable energy for decades to come. It allows intergenerational justice by ensuring equal access to common resources which we have enjoyed and inherited from our ancestors. Meanwhile, impacts of climate change are already being acutely experienced by people around the world today. The effects of climate change are making it extremely difficult to ensure "development that meets the

BY 2020, KASESE, IN UGANDA, WILL SUPPLY THE ENERGY NEEDS OF ITS POPULATION BY ONLY RENEWABLE SOURCES BY ADOPTING A PEOPLE-CENTERED APPROACH, WITH A WIDE VARIETY OF RENEWABLE SOURCES SUCH AS BIOMASS, SOLAR, GEOTHERMAL AND MINI-HYDROELECTRIC TECHNOLOGIES

needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987). The effects of climate change threaten people's subsistence rights such as right to food, water, shelter. It is not a coincidence that it is primarily the most climate vulnerable countries taking the leadership to transition to 100% RE[7]. The transformation must consequently equally follow a universally cohesive people-centered, community-driven and future-just approach. Rather than fuelling the same system with different resources, governments must follow the concept of leaving no one behind and provide sustainable access to energy services for all.

In addition to that, particular countries or specific corporations that control the monopolized fossil fuel resources take over oil and gas reserves or coal mines and concentrate the benefits in the hands of a few[76], often without accounting for the social and environmental damage on local communities[53 79]. As the political power is usually with those monopolists, externalities are not regulated, which leads to enormous inequalities between those that dominate well-confined fossil fuel reserves and those who depend on them[12 80]. Many communities end up depending on large, distant energy companies to access the power they need within a regulatory framework that only poorly protects consumer rights. On a global scale, entire regions and countries find themselves being at the mercy of oil and gas exporting countries, often in the hands of authoritarian regimes. All of this inevitably creates imbalances, geopolitical tensions and unfair relationships of dependence among countries. As explained later in this report, this also threatens security and peace in many countries which has also a huge effect on inequality, as the poorest people are often the most vulnerable and most affected by political instability and wars[12].

While 100% RE can break up these dependencies due to their modular and decentralised nature, there is also the danger of creating new dependencies. Renewable resources are available everywhere but the technologies and related capital to harvest them is not yet equally distributed. As currently observed in many Global South countries, skills, capital and technologies are imported from industrialized countries to build up the RE infrastructure. Therefore, robust regulation especially of financial markets, investments and political support for technology transfer, access to finance as well as education and capacity building is necessary to overcome inequalities with the transition to 100% RE.

100% RENEWABLE ENERGY

A MATTER OF INTRA- AND INTERGENERATIONAL JUSTICE

With 100% RE current generations invest in the future providing cheap and sustainable energy for decades to come

It allows intergenerational justice by ensuring equal access to common resources which we have enjoyed and inherited from our ancestors

100% RE requires a paradigm shift that builds an energy system that leaves no one behind

THE INEQUALITY OF CLIMATE CHANGE

There is strong link between inequality and climate change[81] [82]. The carbon-intensive, fossil fuel based western world is the number one contributor to global warming. Yet, they will be the one least affected by it. In fact, poorer nations remain the most vulnerable[55]. First, because they are not equipped with the economic and technological means to adapt and respond to climate change. Second, because they are often situated in areas most affected by climate change such as tropical or arid regions. This is creating an unfair situation were the perpetrators, the rich western countries, suffer the least, and the victims, who contributed the least to GHG emissions, have to bear the largest and most dangerous consequences of climate change such extreme weather events, stronger cyclones, larger and longer heatwaves, droughts, unpredictable storms, and unbearable temperatures increase.

All of these will affect food security, political stability and the overall socio-economic welfare of a large number of developing nations. Entire regions risk becoming inhabitable, generating unprecedented migrations, stripping people apart from their homeland in the search for a habitable place to live. This is what can unquestionably be called the inequality of climate change. Countries around the world, developed countries above all, have the moral duty to take immediate action and decarbonize their economies as soon as possible: a 100% RE future is the only viable and responsible option ahead.

MAKE CITIES INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

95% of urban expansion in the next decades is forecast to take place in the developing world and, during the next two decades, the urban population of the world's two most impoverished regions (South Asia and Sub-Saharan Africa) is expected to double. CO2 will proportionally follow these growth rates and any meaningful action to decrease emissions will need to happen in cities.

CITIES ARE THE PIONEERS AND THE MOST PROMISING CHANGE AGENTS OF THE 100% RE MOVEMENT

SHIFTING TOWARDS A 100% RE FUTURE WILL IMPACT THE RELATIONSHIP BETWEEN CITIES AND THEIR SURROUNDING RURAL AREAS, ENABLING THE CREATION OF UNIQUE SYNERGIES THAT CAN BENEFIT BOTH

REDUCING **POLLUTION**

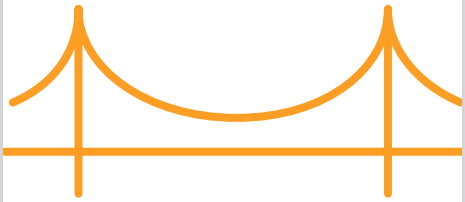
Renewable energy can significanty reduce pollution in cities. 98% of cities in low- and middle income countries with more than 100'000 inhabitants do not meet WHO air quality guidelines.

SUSTAINABLE **TRANSPORT**

A shift to 100% RE transport can have a hugely beneficial impact on cities. Traffic congestion, which affects Global South countries the most, has a wide ringe of negative effects on economic growth, productivity, health and well-being.

RURAL-URBAN **SYNERGIES**

Large cities have the know-how while rural areas count on large areas to produce RE. Cooperation between a city and its surrounding area helps both in terms of sustainable energy development and climate protection.



RENEWABLE ENERGY CAN
INCREASE THE RESILIENCE OF CITIES AND MAKE THEM LESS DEPENDENT FROM EXTERNAL RESOURCES

SDG 11
MAKE CITIES INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

Cities and urban areas around the world account for about 65% of global energy demand and 70% of energy-related carbon dioxide (CO2) emissions[83]. Cities in emerging economies will account for 70% of global growth in energy use up to 2030[83]. According to UN Habitat, approximately 95 % of urban expansion in the next decades is forecasted to take place in the developing world. In the meantime, during the next two decades, the urban population of the world's two most impoverished regions (South Asia and Sub-Saharan Africa) is expected to double[84]. Any meaningful action to decrease CO2 emissions and mitigate climate change will therefore need to happen in cities.

RE options can actually offer a wide range of benefits to urban development, primarily pollution reduction. Cities are often the most affected by the polluting use of fossil fuels to run their industries, to heat and cool their homes and to fuel their cars, especially in Global South countries. According to a WHO estimate, 98% of cities in low- and middle income countries with more than 100'000 inhabitants do not meet WHO air quality guidelines. Most of the 3 million premature deaths worldwide every year caused by outdoor air pollution, made of high concentrations of small and fine particulate matter, occur in cities and urban areas[85].

Furthermore, cities in Global South countries are also the ones who are the most affected by traffic congestion. The increase in population coupled with rapid urbanization, increase in motorization, urban sprawling, poor public transport, lack of resources and of adequate urban planning have led to the creation of increasingly congested cities especially in the developing world[86]. Traffic congestion has a wide-range of negative effects both on local economic growth and productivity as well as on health, safety and well-being. As further summarized in the next page, a shift to 100% RE transport can have a hugely beneficial impact on cities.

Shifting towards a 100% RE future will impact the relationship between cities and their surrounding rural areas, enabling the creation of unique synergies that can benefit both. In fact, urban and rural areas face different challenges and opportunities during an energy transition and in addressing climate change issues. Yet, 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 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 too 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 such as city-hinterland mobility, 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.

Further, due to their decentralized character, renewable energy may reverse or at least slow down urbanisation processes, reducing the pressure on cities. Currently, especially in the Global South, people leave rural areas mainly because there is a lack of infrastructure for basic services and related to that, limited job opportunities. Due to the above mentioned dynamics, rural areas may benefit from a 100% RE system which may lead to less people migrating to cities.

Lastly, RE can also increase the resilience of cities and make them less dependent from external resources. A 100% RE future can help communities develop the autonomy they need and to create space for more leadership in cities. As stressed recently by the New Urban Agenda, cities often know best. While they are often given the responsibility to solve the problems closer to people, they often neither have the financial means nor the power to solve the issues they face. Taking a lead in terms of RE targets can be a catalyst of change and a leverage force to move cities forward in their struggle to gain greater control over their jurisdictions and to become the leaders of change[87].

THE BENEFITS OF A 100% RE TRANSPORT IN CITIES

THERE ARE SEVERAL POSITIVE BENEFITS RELATED TO RENEWABLE-ENERGY-BASED TRANSPORT

First of all, its direct impact on health: by substituting combustion engine vehicles with electric vehicles, cities can reduce enormously their levels of air pollution and exposure to dangerous exhaustion smokes. The positive impact on health goes beyond air pollution. Renewable urban transport is also about prioritizing active mobility[88] such as cycling and walking, which has considerable benefits to health and overall physical and mental well-being. Lastly, it is also about noise pollution. According to the World Health Organization[89], noise is second only to air pollution in the impact it has on health. It has a significant negative impact in terms of hearing loss and disorders, heart disease, learning problems in children and sleep disturbance. A major uptake of electric vehicles, combined with more cycling, more walking, more public transport and less motor vehicles per capita (e.g. via adoption of car sharing systems), can reduce noise pollution enormously.

Beyond the direct positive effects on health and well-being, supporting and stimulating sustainable mobility and renewable transport solutions is also about innovation, technological development and business development. It means promoting innovation in industry and policy for the commercialization of electric and hydrogen vehicles. It also means incentivizing new business models. Currently car companies focus their efforts on selling cars. In the future, it will be less about ownership and more about the service of mobility. This means that future business models of car companies will need to be built on selling quality mobility and not cars. With the advent of self-driving cars and expanded car-sharing systems less people will be interested in owning a car. Rather they will want to buy a service, a way to move from point A to point B, not simply a car. Consequently, cars will cease to be seen as a status symbol but rather as a simple, safe and effective means of transport. Furthermore, with electric self-driving cars and electric car sharing systems, cities can be not only less polluted but also considerably less congested as car sharing and self-driving systems allow for a much more effective distribution of vehicles across the city and a much lower number of vehicles per capita[90].

Lastly, Global South countries have suffered a lot from urban sprawling[86]. This is a great problem in the Global South, damaging peri-urban areas and ecosystems, creating car-dependent patterns of mobility and an extremely inefficient and wasteful use of space. Strategies to improve transport and mobility towards a 100% RE future are also about creating denser and compact cities, which would help solve the issues related to sprawling.

ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

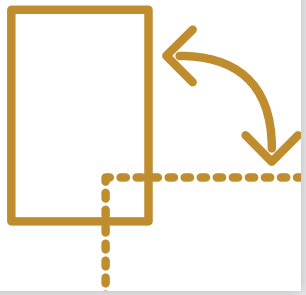
Continuing to rely on wood-based products (whether it is firewood, pellets, charcoal, or others) will become less and less sustainable. A rapid transition towards 100% RE is ever more urgent to create sustainable, long-term patterns of consumption and production.

100% RENEWABLE ENERGY ALLOWS SUSTAINABLE AND EFFICIENT NATURAL RESOURCE MANAGEMENT

LIMITING GLOBAL WARMING TO 1.5°C REQUIRES 85% OF FOSSIL FUEL RESERVES TO REMAIN IN THE GROUND. TRANSITIONING TO 100% RE IS THEREFORE INEVITABLE TO MEET THIS TARGET

TURNING WASTE **INTO RESOURCES**

In low-income countries 65% of the waste is organic. There is a lot of potential for these countries to create renewable energy from waste, which can be treated to produce biogas and be used as a source of energy.



DOMESTIC **BIOGAS SYSTEMS**

Domestic biogas production systems have demonstrated a wide range of positive impacts: they decrease GHG and pollutant emissions, they are cost-effective, and, when used for cooking, reduce firewood usage significantly.

ENHANCING **FOOD SECURITY**

With additional logistical and operational efforts to support domestic biogas systems, the daily feeding rate in some countries could gradually be increased from 2 to 5 kg, to produce 150 minutes of cooking time.

WITH HIGH RATES OF POPULATION GROWTH,
WOOD-BASED PRODUCTS WILL BECOME LESS AND LESS SUSTAINABLE
REGARDLESS OF HOW EFFICIENTLY IT IS HARVESTED, PRODUCED, OR CONSUMED

SDG 12
ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

In order to limit global warming to 1.5°C and ensure sustainable development that leaves no one behind, natural resources must be managed and used much more efficiently and in fact conserved. At current levels of CO2 emissions, the world would use up the carbon budget for a good chance – a 66% probability – of keeping global temperature rise below 1.5°C before 2021[91]. The known fossil fuel reserves significantly exceed these budgets. Limiting global warming to 2°C requires 68% and to 1.5°C 85% of reserves must remain in the ground[92]. Transitioning to 100% RE is therefore inevitable. Further, it supports the goal to reduce waste, especially food waste as it becomes a resource, whose value can always be recovered. In low-income countries most of the waste is organic (about 65%)[93]. This means that there is a lot of potential for countries in the Global South to actually create renewable energy from this organic component of waste, and often at low cost. This organic waste can be treated to produce biogas through anaerobic digestion which can be used as a source of energy. domestic biogas production systems are widely available and have demonstrated a wide range of positive impacts, such as less GHG and pollutant emissions which benefits the health especially of women and children most exposed to indoor smokes from cooking[94]. They also offer a cost-effective solution, especially for rural areas which have large quantities for organic waste that would otherwise be left unused. women and children also have more time available as they would not have to spend time collecting firewood and charcoal for cooking. plus, the digestate, i.e. the solid component remaining from the process, can be used as a fertilizer for agricultural purposes[95].

Several examples exist. Nepal has installed approximately 250,000 domestic biogas plants installed between 1993 and 2013. A national program in Kenya has targeted the installation of 8,000 domestic plants in a period of 4.5 years, and a similar programme in Tanzania has targeted the construction of 12,000 new domestic biogas plants for the 2008-2013 period (200/month)[94]. Another example is a project run by the International Fund for Agricultural Development that has been changing farmer's lives in rural china. Farmers in Fada, a village in China's Guangxi province, each built their own plants to channel waste from household toilets and nearby shelters for animals into a sealed tank. As the waste ferments, gas is captured and used in cooking. Forests are being protected because demand for firewood has been reduced, saving 56,000 tons of firewood per year. Over five years, area farmers increased tea production from 400 to 2,500 kilograms a day and average income in the village quadrupled to more than $1 per day[78]. The city of Dar es Salaam serves as another example[95] where kitchen waste amounts to about 42% of the household waste and is a potentially valuable source for the production of biogas. In only two years, from 2006 to 2008, 31 Compact Biogas Systems (CBS) have been installed in Tanzania and Uganda, which produce gas from food waste. Assuming that in Tanzania a household produces 1 kg of food leftovers and 1 kg of fruit and vegetable peelings per day, this 2 kg of kitchen waste should be able to generate roughly 170 L of biogas per day, equivalent to a 45-minutes burning period. This burning period represents about a third of the average cooking time of 2.5 h per day for a household with five members. This solution was also extremely cost effective. In fact, although the price of 850000 TZS (420 US$) for each household biogas system is the main barrier to wide distribution of this technology in Tanzania, the payback period is low; estimated to be roughly three years based on an average household saving of around 336 kg charcoal per year-equivalent to 276000 TZS (136 US$). With additional logistical and operational efforts, the daily feeding rate could gradually be increased from 2 to 5 kg, to produce 0.67 m3/d of gas or 150 minutes of cooking time. Consequently, all cooking fuel could be replaced by biogas and the payback period would drop to only one year.

Lastly, the largest source of energy in the Global South is currently biomass, such as fuelwood, charcoal, agricultural waste and animal dung. In some countries, up to 90% of the household energy consumption comes from biomass[36]. Yet, much of the biomass for use in cook stoves (whether efficient or not) is not sustainably harvested. Moreover, it is often not "renewable" due to unsustainable rates of deforestation, soil loss, and desertification. Most critically, continued reliance on wood-based fuels as the primary cooking fuel is unsustainable in the medium to long-term simply due to demographics: the population of Sub-Saharan Africa (SSA) alone is projected to almost triple by 2060, reaching as high as 2.7 billion, up from 1 billion in 2015. At such a high rate of population growth, continuing to rely primarily on wood-based products (whether firewood, pellets, charcoal, or others) will become less and less sustainable, regardless of how efficiently the biomass is harvested, produced, or consumed[39]. Therefore a rapid transition towards 100% RE, also in the cooking sector, is ever more urgent to create sustainable, long-term patterns of consumption and production.

RECYCLING AND RESOURCE MANAGEMENT FOR A 100% RE FUTURE

WHILE THE SOURCES OF RE ARE BY DEFINITION INEXHAUSTIBLE SUCH AS THE SUNLIGHT AND THE WIND, THE MATERIALS THAT ARE NEEDED TO MANUFACTURE SOLAR PANELS AND WIND TURBINES ARE NOT

Therefore, a careful management of the material resources needed to manufacture these RE technologies become extremely important, especially for a 100% RE future, which will require a considerable increase in material consumption for the production of solar panels, wind turbines, batteries and all related technologies and equipment. A circular economy approach to the production and distribution of RE technologies will be fundamental to ensure their long-term viability. A study by the WWF published in 2014[96] examined carefully the most critical supply bottlenecks of non-energy raw materials related to the transition to a 100% RE future. Some critical supply restrictions were identified for material such as lithium and cobalt, used abundantly for batteries. Other materials such as indium, gallium and tellurium used in solar PV or copper used for transition grids and electric motors were also found to be relatively critical and, although alternatives exist, these should be carefully managed to avoid future shortages. Rare earth metals, including neodymium and yttrium, which are needed for wind turbines, are expected to exceed the demand. Yet their availability is considered critical for geopolitical reasons, as they are mostly concentrated in certain geographical areas such as for example in China.

Most importantly, this report concludes that overall resource scarcity in a 100% RE future will be substantially smaller than in a scenario with much lower RE penetration. However, policy action that prioritizes recycling of RE technologies and improvements in material efficiencies are extremely important and necessary in light of the increase in precious materials needed for RE technology manufacturing. Furthermore, improvements in the recycling of RE technologies will be fundamental and will need to be complemented by the exploration of alternative, less supply-restrictive materials.

TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

The global energy system accounts for approximately three-fifths of all anthropogenic GHG emissions and the electricity sector accounts for over 40% of man-made (combustion related) CO2 emissions. It is evident that if any meaningful reduction in GHG emissions is to be achieved, a major restructuring of the carbon intensive energy sector is necessary.

A TRANSITION TO 100% RE TO MITIGATE THE MOST DEVASTATING EFFECTS OF CLIMATE CHANGE IS EVER MORE URGENT

IMPLEMENTING THE PARIS AGREEMENT REQUIRES A RAPID SHIFT TO 100% RENEWABLE ENERGY IN ALL COUNTRIES

EMISSIONS MUST FALL **STARTING NOW**

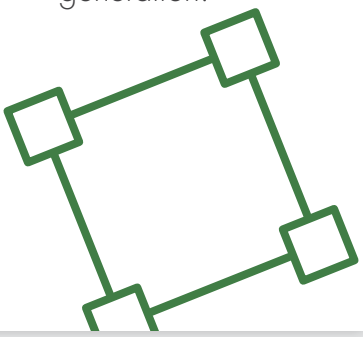
To keep global warming below 2 degrees Celsius, emissions need to reach net zero by 2070 and they must fall steeply, starting immediately. This can be done only through a complete shift from fossil fuels to RE sources.

EMISSIONS FROM THE **ENERGY SYSTEM**

CO2 emissions from fossil fuel use are the main contributor to total GHG emissions and, the global energy system accounts for approximately three-fifths of all anthropogenic GHG emissions.

BUILDING RESILIENCE BY **DIVERSIFICATION**

100% RE increases resilience in the face of climate change, by decreasing the dependence from remote energy resources or increasing energy diversity through a distributed and decentralized generation.



A MAJOR RESTRUCTURING OF THE CARBON INTENSIVE ENERGY SECTOR IS NEEDED AND **RE OFFERS AN IMMEDIATE SOLUTION TO REDUCE GHG EMISSIONS CONSIDERABLY**

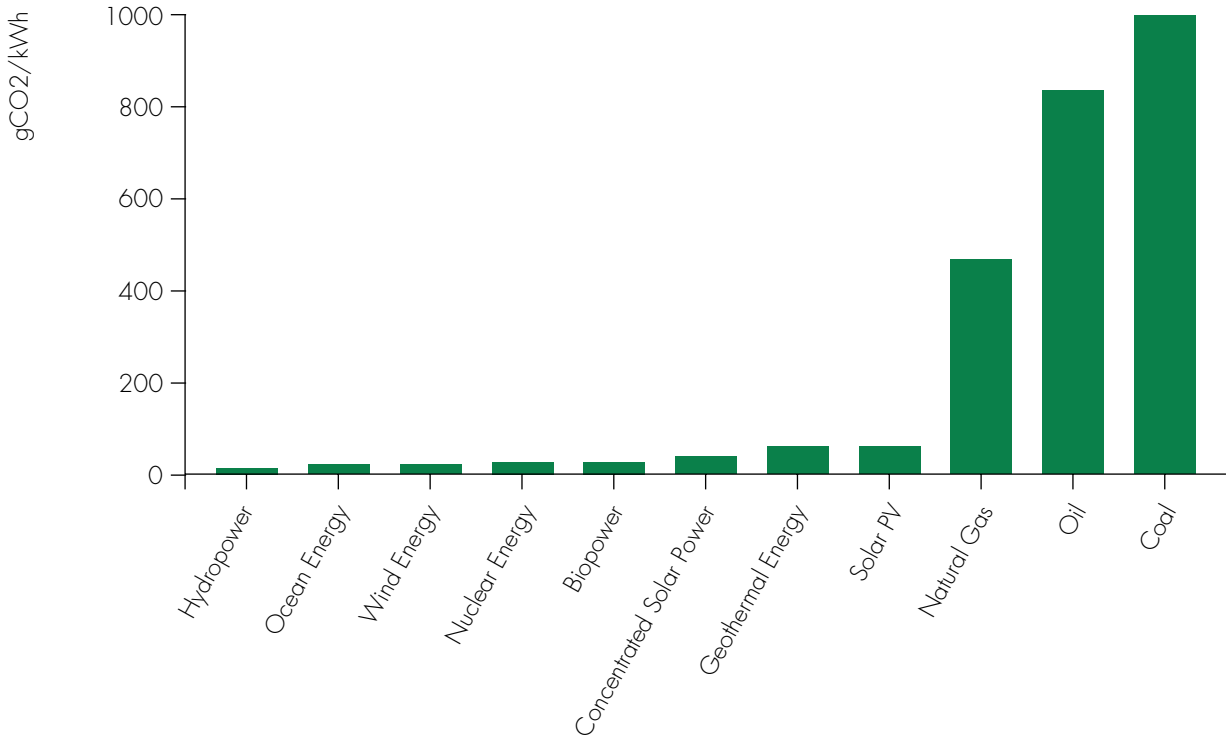
13 CLIMATE ACTION

SDG 13
TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

A transition to 100% RE to mitigate the most devastating effects of climate change is ever more urgent, especially as Global South countries will be the ones to be hit the hardest. As reported by the Guardian: "Low-income countries will remain on the frontline of human-induced climate change over the next century, experiencing gradual sea-level rises, stronger cyclones, warmer days and nights, more unpredictable rains, and larger and longer heatwaves"[55].

GHG emissions from industrialized countries are the major cause of climate change. Major emitters thus have the responsibility to take action mitigating climate change. Meanwhile, Global South countries can transition to a 100% RE future contributing to mitigate climate change, avoiding the mistakes committed in the past by industrialized countries and realizing development co-benefits.

According to recent reports, for staying below 2°C, emissions need to reach net zero by around 2070, and for 1.5°C they must do so by 2050. In both cases emissions must fall steeply, starting immediately[92]. This can be done only through a complete shift to RE sources and a stop of fossil fuel investments. Research from WWF points to a minimum of 42% RE by 2030[97] and the 2015 Energy [R] evolution scenario from Greenpeace suggests 100% RE by 2050 to stay below the 1.5° C target[98]. In fact, CO2 emissions from fossil fuel use are the main contributor to total GHG emissions and the energy sector is the main contributor to global GHG emissions. The global energy system accounts for approximately three-fifths of all anthropogenic GHG emissions and the electricity sector accounts for over 40% of man-made (combustion related) CO2 emissions[17]. It is evident that if any meaningful reduction in GHG emissions



MEDIAN GHG EMISSION IN G CO2/KWH FOR ELECTRICITY GENERATION TECHNOLOGIES[35]

A 36% RE SHARE CAN REDUCE CO2 EMISSIONS BY UP TO 12GT WORLDWIDE, REDUCING GHG EMISSIONS CONSIDERABLY COMPARED TO BUSINESS-AS USUAL SCENARIOS.

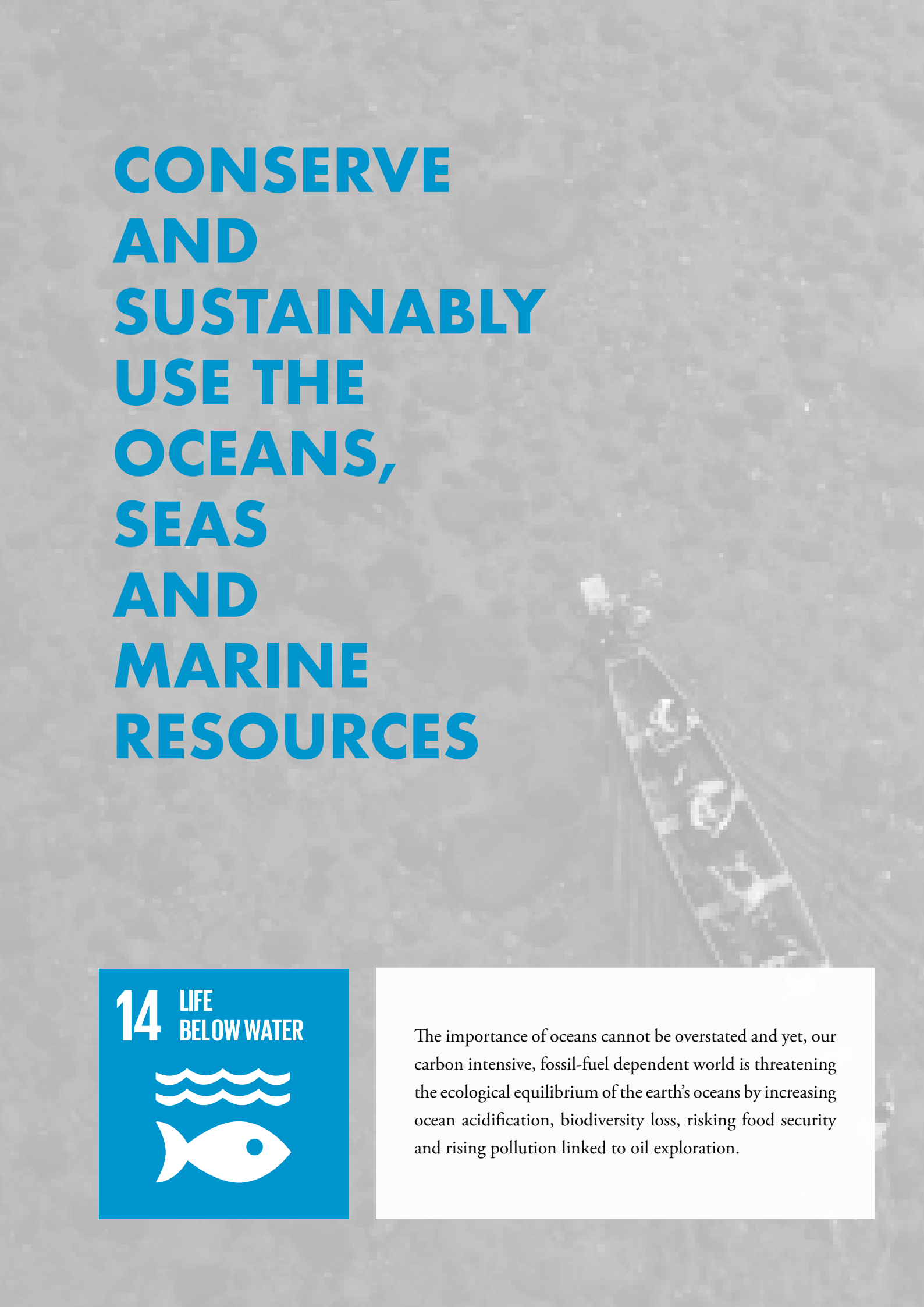
is to be achieved, a major restructuring of the carbon intensive energy sector is necessary. RE offers an immediate solution to reduce GHG emissions considerably. A recent IRENA study that a 36% RE share can reduce CO2 emission by up to 12Gt worldwide compared to business-as usual scenarios. This would already represent more than half of the required reduction to limit global warming to below 2° C.

Life cycle assessment (LCA) studies provide a well-established framework to compare different energy technologies in terms of their environmental impacts throughout the supply chain, from manufacturing through to operation and decommissioning. A useful outcome of LCA studies is a comparison of lifecycle GHG emissions in terms of kg CO2e/kWh for different electricity generation technologies. A very comprehensive report published by the World Nuclear Association (WNA, 2011) compared life cycle GHG emissions for different electricity generation sources based on 21 highly reliable studies. The life cycle analyses accounted for emissions from all phases, i.e. from construction to decommissioning. The results are summarized in Figure 7. It can be observed how RE technologies, in particular hydro and wind are significantly better performing than fossil fuel options.

A 100% RE future also increases local resilience in the face of the growing risks related to climate change. First, by enabling communities to use local RE sources and decrease the risks related to being strongly dependent from remote resources and those related to extreme weather events interrupting power supply. Second, deployment of RE increases the diversity of the energy sources. Through a distributed and decentralized generation, RE contributes to the flexibility of the system and its resistance to central shocks, which are expected to become more frequent with climate change such as unexpected storms, floods and droughts. The larger variety of energy sources used (e.g. wind, solar, geothermal, hydro), the distribution of sources over a considerably larger geographical area, the higher number of supply corridors, and a largest share of energy coming from domestic RE are indeed all major advantages for future energy security and resilience, especially considering the variable of climate change. In general, risks appear to increase if a supply chain is reliant on a limited number of companies, technologies and markets, while resilience increases if the number of companies, networks and connections is greater since this creates alternative options[99]. As such, RE has an important benefit in terms of energy resilience and autonomy, particularly in the face of increasing risks related to climate change.

THROUGH DISTRIBUTED AND DECENTRALIZED GENERATION **RE INCREASES RESISTANCE TO CENTRAL SHOCKS, WHICH ARE EXPECTED TO BECOME MORE FREQUENT WITH CLIMATE CHANGE**

CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES



14 LIFE BELOW WATER

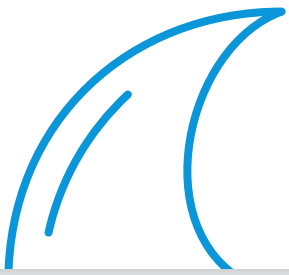
The importance of oceans cannot be overstated and yet, our carbon intensive, fossil-fuel dependent world is threatening the ecological equilibrium of the earth's oceans by increasing ocean acidification, biodiversity loss, risking food security and rising pollution linked to oil exploration.

100% RENEWABLE ENERGY IS INEVITABLE FOR CONSERVING AND SUSTAINABLY USING OCEANS, SEAS AND MARINE RESOURCES

ENERGY PRODUCTION CAN DIRECTLY AND INDIRECTLY IMPACT THE SEAS AND OCEANS ON WHICH MUCH OF LIFE DEPENDS

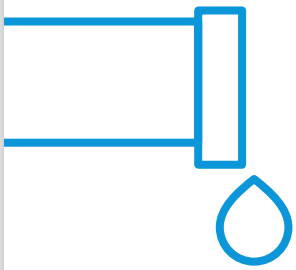
OCEAN **ACIDIFICATION**

100% RE has a considerable beneficial effect on limiting ocean acidification and therefore in preserving marine ecosystems.



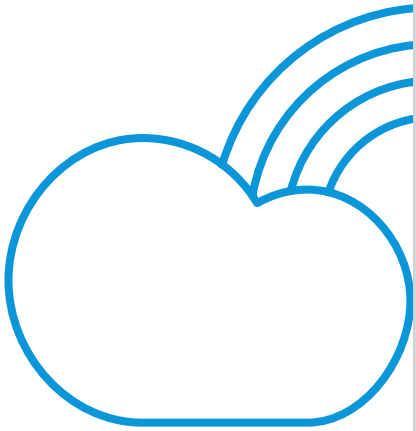
EXPLORATORY **OIL POLLUTION**

100% RE helps reducing oil pollution. Currently, oil exploration contaminates streams and rivers, destroys forests and leads to biodiversity loss.



A MUCH NEEDED **TRANSITION**

100% Renewable Energy protects communities whose employment and livelihoods depend on marine resources.



TRANSITIONING TO 100% RE
IS FUNDAMENTAL TO
CONSERVE AND USE OCEANS, SEAS AND MARINE RESOURCES SUSTAINABLY

14 LIFE BELOW WATER

SDG 14
CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES

OCEAN ACIDIFICATION LIMITS THE CAPACITY OF THE OCEAN TO ABSORB CO2 FROM HUMAN EMISSIONS, THEREFORE **AGGRAVATING EVEN MORE THE ISSUE OF GLOBAL WARMING**

The way energy is produced can directly and indirectly impact the seas and oceans on which much of life depends. In fact, the importance of oceans cannot be overstated: they cover over 70% of the planet, represent over 99% of the earth's living space and provide food security for billions. They also produce half the world's oxygen and are the major regulator of the earth's climate through their absorption and release of heat energy, absorbing some 87% of the extra energy that greenhouse gases create in the atmosphere and 30% of the anthropogenic co2 emissions[100]. Yet, a carbon-intensive, fossil-fuel dependent world is threatening the ecological equilibrium of the earth's oceans primarily in the following ways:

First, a major source of concern is ocean acidification, i.e. the ongoing decrease in the pH of the oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere rising as a result of human activities, such as burning of fossil fuels. A report published in 2013 by the International Geosphere-Biosphere Programme[101] examined the impacts of ocean acidification such as disruption of ecosystems and marine biodiversity, including tropical coral reef loss, which will affect biodiversity, tourism, food security and shoreline protection especially for many of the world's most vulnerable countries. The unprecedented rate of acidification has deleterious consequences on shellfish, molluscs, warm water corals and fisheries. These can affect food security (especially as large part of the world's population depends on fishing) and lead to revenue declines, loss of employment and livelihoods, and indirect economic costs. Furthermore, ocean acidification limits the capacity of the ocean to absorb CO2 from human emissions therefore aggravating even more the issue of global warming. The report also acknowledges that reducing CO2 emissions is the only way to minimise long-term, large-scale risks. Again, a transition to 100% RE, with RE having a much lower CO2 emission per energy output, could therefore have a considerable beneficial effect on limiting ocean acidification and therefore in preserving marine ecosystems.

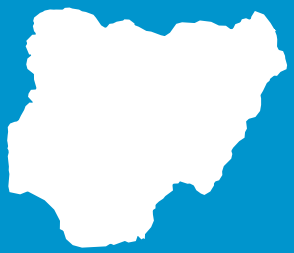
Second, both onshore and offshore oil exploration has had a series of extremely negative impacts on marine ecosystems throughout the past decades[102]. An example from Africa is the oil explorations in the Niger Delta, the biggest oil-producing region in Africa[103] [104]. It has had disastrous impacts on the environment in the region and has adversely affected people inhabiting that region. The Niger Delta is in fact an incredibly well-endowed ecosystem which contains one of the highest concentrations of biodiversity on the planet. It consists of diverse ecosystems of mangrove swamps, fresh water swamps, rain forest and is the largest wetland in Africa and among the ten most important wetland and marine ecosystems in the world. Yet, due to oil pollution, the area is now characterized by contaminated streams and rivers, forest destruction and biodiversity loss, which all contributed to make the area an ecological wasteland. This has affected and still affects

the livelihood of the indigenous people who depend on the ecosystem services for survival and has led to increased poverty and displacement of these people. The Niger Delta region is today one of the five most severely petroleum damaged ecosystems in the world. Studies have shown that the quantity of oil spilled over 50 years is up to 13 million barrels, which is about three times more than the record Deep Water Horizon spill (4.1-4.9 million barrels)[56]. Immense tracts of the mangrove forests, which are especially susceptible to oil have been destroyed. An estimated 5 to 10% of Nigerian mangrove ecosystems have been wiped out either by settlement or oil. The rainforest, which previously occupied some 7,400 km² of land, has disappeared as well. Spills in populated areas often spread out widely, destroying crops and aquacultures through contamination of the groundwater and soil. The consumption of dissolved oxygen by bacteria feeding on the spilled hydrocarbons also contributes to the death of fish. In agricultural communities, often a year's supply of food can be destroyed instantaneously. People in the affected areas complain about health issues including breathing problems and skin lesions; many have lost basic human rights such as health, access to food, clean water, and an ability to work[105].

This shows that transitioning to 100% RE is inevitable to conserve and use oceans, seas and marine resources sustainably. Renewable technologies significantly reduce and even avoid negative impacts on this ecosystem. However, it is necessary for any 100% RE strategy to assess its potential impacts on oceans, seas and marine resources. This is particularly the case when offshore wind or CSP technologies are included.

OIL SPILLS IN POPULATED AREAS OFTEN SPREAD OUT WIDELY, DESTROYING CROPS AND AQUACULTURES THROUGH CONTAMINATION OF THE GROUNDWATER AND SOILS.

IN AGRICULTURAL COMMUNITIES, OFTEN A YEAR'S SUPPLY OF FOOD CAN BE DESTROYED INSTANTANEOUSLY



THE **NIGER DELTA REGION** IS ONE OF THE MOST PETROLEUM DAMAGED ECOSYSTEMS IN THE WORLD. THE QUANTITY OF OIL SPILLED OVER 50 YEARS IS UP TO 13 MILLION BARRELS, (THREE TIMES MORE THAN THE RECORD DEEP WATER HORIZON SPILL)

SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, HALT AND REVERSE LAND DEGRADATION, HALT BIODIVERSITY LOSS

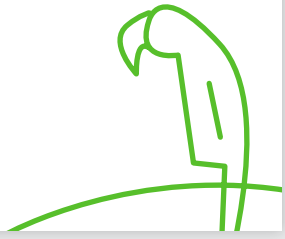
A major and rapid uptake of RE is the only sustainable solution to limit the increasing effects of climate change on the ecosystems and biodiversity, whose delicate equilibrium is greatly disrupted even by the smallest changes in average temperature. Climate change is predicted to be the greatest long-term threat to biodiversity.

100% RENEWABLE ENERGY ARE ESSENTIAL TO MANAGE FORESTS SUSTAINABLY, COMBAT DESERTIFICATION AND HALT AND RESERVE LAND DEGRADATION AND BIODIVERSITY LOSS

AS CLIMATE CHANGE IS THE GREATEST LONG-TERM THREAT TO LIFE ON LAND, THE TRANSITION TO 100% RE IS A PREREQUISITE TO PROTECT IT

MITIGATING **CLIMATE CHANGE**

100% RE is essential reduce global warming. Climate change can shift between 5 to 20% of the Earth's terrestrial ecosystems, in particular cool conifer forests, tundra, scrubland, savannahs, and boreal forest.

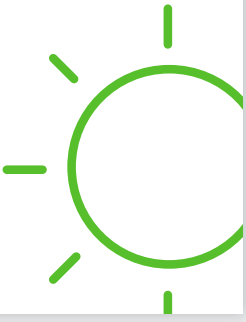


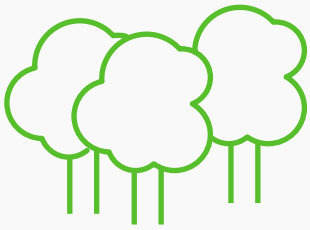
MITIGATE **DESERTIFICATION**

100% RE helps mitigating climate change induced desertification, which has huge impacts on biodiversity.

ENHANCE SUSTAINABLE **COOKING**

Renewable based solutions for cooking are already available and can provide a better option for communities to alleviate the stress that the use of wood, crop residues and untreated coal puts on their ecosystems.





IT HAS BEEN PROVEN THAT
RENEWABLE ENERGY TECHNOLOGIES HELP CONSERVING BOTH WATER AND LAND ECOSYSTEMS

SDG 15
SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, HALT AND REVERSE LAND DEGRADATION, HALT BIODIVERSITY LOSS

First of all, a major and rapid uptake of RE is the only sustainable solution to limit the increasing effects of climate change on the ecosystems and biodiversity, whose delicate equilibrium is greatly disrupted even by the smallest changes in average temperature. In fact, climate change is predicted to be the greatest long-term threat to biodiversity. Increased global temperatures and changes in rainfall patterns will result in more frequent and severe floods and droughts especially in countries, geographically situated in areas that are more vulnerable such as tropical or arid areas[106].

A recent study[107] reports that, among many other effects, climate can induce changes in vegetation communities that are predicted to be large enough to affect biome integrity (a biome is a distinct biological community that has formed in response to a shared physical climate). A shift of 5 to 20% of Earth's terrestrial ecosystems is estimated, in particular cool conifer forests, tundra, scrubland, savannahs, and boreal forest. According to this study, large portions of Amazonian rainforest could be replaced by tropical savannahs. Further, at higher altitudes and latitudes, alpine and boreal forests are expected to expand northwards and shift their tree lines upwards at the expense of low stature tundra and alpine communities. Increased temperature and decreased rainfall mean that some lakes, especially in Africa, might dry out. As explained previously, oceans are predicted to warm and become more acidic, resulting in widespread degradation of tropical coral reefs.

Climate change induced desertification will also have huge impacts on biodiversity, which will inevitably affect precious ecosystem services and therefore societies across the globe. Communities in the Global South will be the most affected also considering that populations in drylands often live under the worst economic conditions. Soil degradation in drylands exacerbates the problem even more and leads to a decline in the fertility of land, reduces crop production and can trigger a cycle of environmental degradation, impoverishment, migration and conflicts, often also putting the political stability of affected countries and regions at risk[108].

Beyond climate change and its related impacts, how communities produce and consume energy has other considerable effects on land biodiversity and ecosystems. For example, in Global South countries, especially in rural areas, 2.5 billion people rely on biomass, such as fuelwood, charcoal, agricultural waste and animal dung, to meet their energy needs for cooking. In many countries, these resources account for over 90% of household energy consumption[39]. This increased dependence on the use of wood, crop residues and untreated coal in Global South countries has a lot of negative implications also on the environment. For example, the reliance on biomass fuels results in reduced agricultural productivity by depriving the soil of recycled nutrients that would have been available from tree, crop and animal residues and could be a cause of deforestation and desertification in some areas[109]. Further, Sub-Saharan Africa continues to have the highest average per-capita wood consumption in the world, with an estimated 0.69m3/year. Estimates for highly forested countries like the Democratic Republic of the Congo (DRC) are closer to 1 m3/year. This compares to a global estimated average of 0.27m3/ year. According to surveys undertaken in Tanzania, which is currently believed to be the largest charcoal producer in sub-Saharan Africa, it is estimated that on current trends and in the absence of direct government intervention, virtually all of Tanzania's publicly-owned forests will be depleted by 2028. The sheer rate of cooking related wood consumption, when combined with anticipated population growth, makes the concerns over deforestation real, and increasingly urgent[39]. Reliance on wood and charcoal for cooking has a number of well-recorded negative effects, including deforestation, soil erosion, loss of many critical ecosystem services, loss of biodiversity, loss of food sources from indigenous plants and animals, etc. Compound to these various impacts is the fact that most areas deforested for either firewood or charcoal production are rarely replanted, resulting in further negative impacts while undermining the local ecosystems' capacity to recover[39].

Yet, several solutions based on more sustainable renewable energy options for cooking exist and could provide a much better option for communities and their ecosystems.

For example, bio-digesters in Nepal can reduce firewood consumption by 57%. On average individual households that have switched to biogas have reduced about 3 tonnes of fuelwood per year, avoiding 4.5 tonnes of CO2 emissions per year[17]. A recent WFC reports provides more details on the topic of renewable-based cooking and its benefits[39].

Furthermore, fossil fuel extraction has vast effects on biodiversity and ecosystems. Unless the transformation towards a 100% RE future gains further momentum, by 2035, oil demand is projected to increase by over 30%, natural gas by 53%, and coal by 50%. This will have increasingly negative impact on biodiversity and on ecosystems around the world. While it is often assumed that restoration after extraction (including drilling and all forms of mining) can return an area close to its predisturbance state, ecosystem disturbance and degradation resulting from direct or indirect effects of extraction can have "profound and enduring impacts on systems at wider spatial scales"[54]. Among the direct effects are local habitat destruction and fragmentation, visual and noise disturbance, pollution. Indirect effects can extend several kilometres from the extraction source and include human expansion into previously wild areas, introduction of invasive species and pathogens, soil erosion, water pollution, and illegal hunting. Gas and oil transportation can also be environmentally damaging, particularly in countries with weak governance, and can lead to deforestation, water contamination, and soil erosion. Spills in marine environments can have severe environmental impacts over wide areas. Deforestation driven by road construction is also a major source of impact on land, ecosystems and wildlife, especially considering that in the future, fossil fuels will be increasingly extracted from more remote and previously undisturbed areas. Unconventional sources, such as coal seam gas and tar sands, threaten currently undeveloped regions that are extremely biodiverse. Furthermore, the corporations of the fossil fuel extraction industry are economically and politically powerful, while many countries in areas of high biodiversity risk under fossil fuel exploration are characterized by weak governance and poor implementation of environmental regulations[54]. The Niger Delta example mentioned previously exemplifies this point.

In summary, RE options have a considerably less damaging impact both on water and land ecosystems. To demonstrate this scientifically and comprehensibly, a recent study[110] developed an Eco-indicator which calculates life cycle impact based on 11 categories that incorporate carcinogens (C), respiratory organics (RO), respiratory inorganics (RI), climate change (CC), radiation (R), ozone layer depletion (OL), ecotoxicity (E), acidification/eutrophication (A/E), land use (LU), minerals (M) and fossil fuels (FF). The overall eco-impact comparison is shown in Figure 8 where every technology is arranged with highest value indicating that much times of the lowest values. As an example, an oil power plant contributes almost 154 times the eco-impact of the hydrokinetic plant to generate every 1 kWh of electricity.

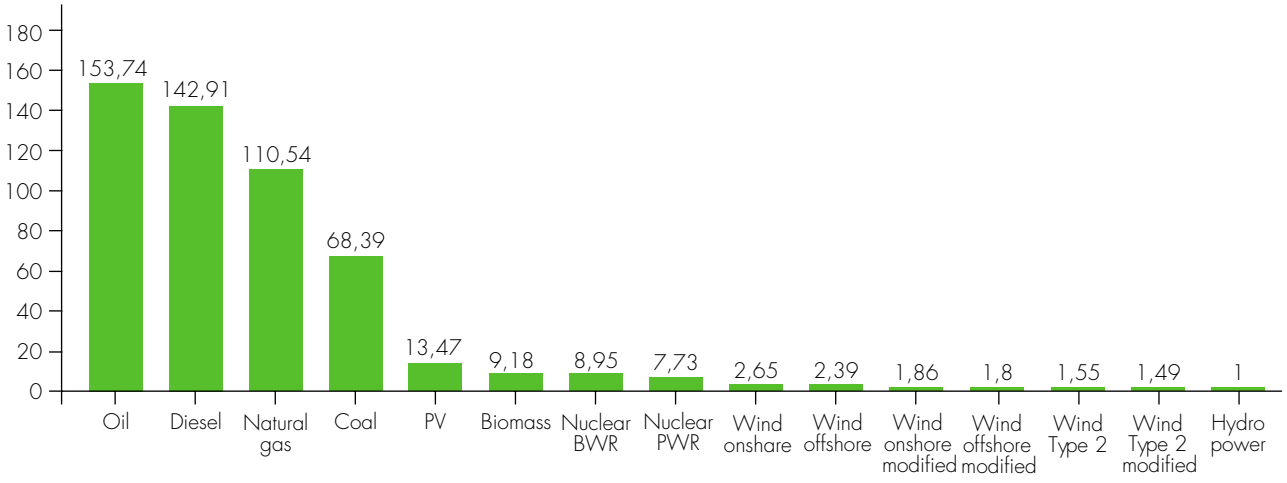


FIGURE 8: TOTAL ECO-IMPACT VALUES DERIVED FROM LIFE CYCLE IMPACT ASSESSMENT OF MAJOR POWER GENERATION TECHNOLOGIES[110]

PROMOTE JUST, PEACEFUL AND INCLUSIVE SOCIETIES

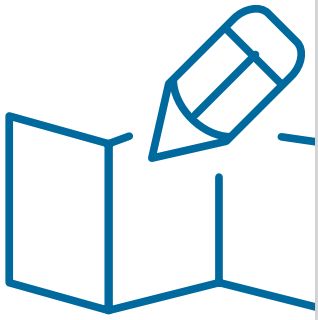
The close link between justice, peace, sustainable development and energy can be proven and oil is, in many cases, the main trigger-factor for conflicts: when oil revenues are not legally overseen, corruption is incentivized, oil is in many cases the main financing vehicle of warfare and the high dependence on rents generated by fossil fuels leads to a stagnation of socioeconomic development.

100% RENEWABLE ENERGY PROMOTES JUST, PEACEFUL AND INCLUSIVE SOCIETIES

BY REDUCING OUR DEPENDENCY ON FOSSIL FUELS AND INSTEAD DECENTRALIZING THE ENERGY SYSTEM, A TRANSITION TOWARDS 100% RE CAN IMPROVE ENERGY AUTONOMY OF COUNTRIES, REDUCE CURRENT CONFLICTS AND PREVENT THE EMERGENCE OF NEW ONES

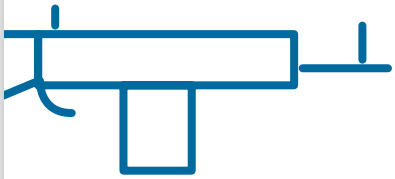
SUPPORTING ENERGY **INDEPENDENCIES**

100% RE Renewable Energy change the static concept of energy exporter vs. energy importer and transition countries. Countries can be producers of their own energy demand.



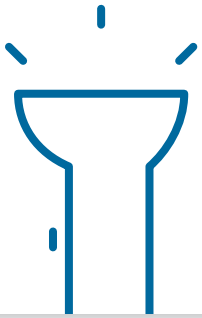
REDUCING **DOMESTIC CONFLICTS**

100% Renewable energy promote local development, self-determination and identity, while ensuring communities' control over local environmental impact mitigation and management.



BUILDING ENERGY **DEMOCRACIES**

The flexible and modular nature of RE allows going beyond national security of energy supply and rather bringing energy resources and infrastructure under public or community ownership or control.



ENERGY SYSTEMS SHOULD SERVE THE NEEDS OF THE WORLD'S PEOPLE,

AN ENERGY TRANSITION TO 100% RE WILL BE ADVANCED BY A SHIFT TO PUBLIC AND COMMUNITY CONTROL

SDG 16
PROMOTE JUST, PEACEFUL AND INCLUSIVE SOCIETIES

IN THE FUTURE MORE CONFLICTS MAY ARISE, ESPECIALLY BECAUSE THE GLOBAL CONVENTIONAL OIL PRODUCTION PEAKED IN 2006 AND SINCE THEN PRODUCTION HAS BEEN IN DECLINE

There is actually a close link between justice, peace, sustainable development and energy. While there are certainly diverse causes for the existence of conflicts, many of them are connected with access to oil and gas fields[111]. In fact, oil is often considered the main trigger-factor for conflicts following three mechanisms[111]. First, when oil revenues are not legally overseen, corruption is incentivized, which weakens political institutions and subtracts effectiveness to public bureaucracy. Second, oil is in many cases the main financing vehicle of warfare. Third, the high dependence on rents generated by fossil fuels leads to a stagnation of socioeconomic development due to highly volatile market prices of fossil fuels.

Furthermore, tensions and conflicts over the possession and exploitation of oil and gas resources have considerably influenced international geopolitical dynamics. For powerful countries such as the US, China, the EU and Russia, the high dependence on oil constantly frames their foreign policies, which has dramatic consequences for the international community. The necessity of covering the energy requirements of their large populations and military forces has exceeded their domestic exploitation capability, forcing them to look abroad. In some cases, this justified acts of intervention or even war declarations to countries with vast oil and gas reserves: the war in Iraq is one example[112]. In other cases, this meant the establishment of commercial relations with countries, whose governments turned over time into authoritarian regimes and with concentration of vast amounts of fossil fuels; that is the case in Venezuela[113] and some Asian and Arabic countries[114], which were benefited by the necessities of international powers. On the other side, this dependency led states to engage in conflicts with their own population. For example, indigenous peoples from Central American states, including Colombia and Bolivia in the South, experienced tensions with their governments[115]. Many of the planet´s remaining natural resources are on indigenous lands, which thereby become targets for global corporations seeking to exploit these natural resources[116]. Conflicts emerged due to either a lack of intention to consult the indigenous peoples over the extraction activities in their lands or because the extractive activities have a considerable environmental impact on their livelihoods[116 114].

The concern is that in the future more conflicts may arise, especially because the global conventional oil production peaked in 2006 and since then production has been in decline[114]. The risk of new armed-conflicts over this valuable natural resource is likely to grow within the next years[114], especially in specific areas such as the Gulf Region where oil is highly concentrated. Additionally, there is a growing threat parallel to the related-oil- issues, which is the new reliance on nuclear energy, and possibly on nuclear weapons. As an example, Iran is turning its attention to nuclear power to cover its population´s energy requirements, which are originally covered by crude oil and natural gas[114]. This shift allows Iran to remain a major crude oil exporter, and gives the government an element of security – and of power- before the international community.

In light of this situation, there is one truth: the most impoverished people, often from the rich-in-natural-resources yet poorest countries, will be mostly affected by new conflicts and the environmental impact derived from the dependency on oil and nuclear power[117]. Moreover, the systematic violation of liberties and constitutional guarantees typical of authoritarian governments is ironically fuelled or sustained by the oil revenues. The inhabitants of countries affected by external war action have to face broken institutions and weakened democracies and remain often abandoned by their own state and increasingly dependent on humanitarian action[118].

While the path to peace and justice relies upon different measures, peace and security can be improved considerably across the world simply by decreasing the over-reliance of countries on oil and gas[111]. Unlike fossil fuels, which are characterized by the uneven geographical distribution of natural reserves, RE is abundant across regions and countries. By reducing the over dependence on fossil fuels reserves and instead decentralizing the energy structure, a transition towards 100% RE can improve the energy autonomy of countries and reduce current conflicts and prevent the emergence of new ones. In order to ensure this for the long-term however, any 100% RE strategy must build on the principle of efficiency and recycling regarding the necessary resources used in the RE technology.

Lastly, a transition to 100% RE can also support better institutions and governance structures through what is known as energy democracy[9]. Energy democracy goes beyond national security of energy supply to bringing energy resources and infrastructure under public or community ownership or control. The term is grounded on the basic understanding that "the decisions that shape our lives should be established jointly and without regard to the principle of profit"[9]. A growing number of experts and communities believe that de-carbonization of the energy economy is critical not only for mitigating climate change but also for achieving a more just, sustainable and resilient economy. In addition, some experts note that an equitable, ecologically sound energy system should serve the needs of the world's peoples, and that an energy transition will be advanced by a shift to public and community control. The distributed nature of RE – which theoretically are public goods accessible to all – helps to facilitate this process[9].

CONFLICT DRIVES
ON FOSSIL FUELS

Oil is often considered the main trigger-factor for conflicts

Oil is in many cases the main financing vehicle of warfare

Dependence on rents from fossil fuels leads to a stagnation of socioeconomic development

REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

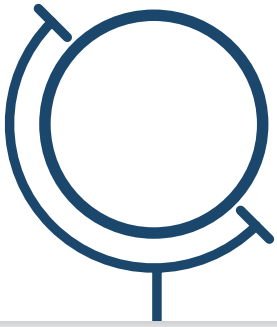
RE development requires strong cross-sectoral, transregional and transnational partnerships as well as a continuous exchange of solutions, best practises and lessons learnt. Therefore, strengthening renewable energy partnerships goes hand in hand with improving the partnerships necessary for the implementation of the SDGs.

100% RE DEVELOPMENT REQUIRES STRONG CROSS-SECTORAL, TRANSREGIONAL AND TRANSNATIONAL PARTNERSHIPS

STRENGTHENING RENEWABLE ENERGY PARTNERSHIPS GOES HAND IN HAND WITH IMPROVING THE PARTNERSHIPS NECESSARY FOR THE IMPLEMENTATION OF THE SDGS AND IT DEPENDS ON COLLABORATIONS BETWEEN LOCAL ACTORS AND OTHER REGIONAL, NATIONAL AND INTERNATIONAL STAKEHOLDERS AND GOVERNMENTS

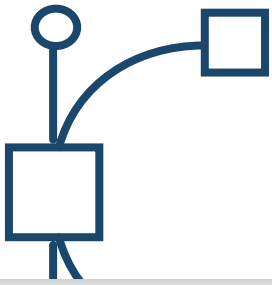
CONNECTING GLOBAL **FRAMEWORKS**

RE development and all related initiatives and projects can serve as a connector between the climate targets such as the ones of the Paris Agreement and all the SDGs.



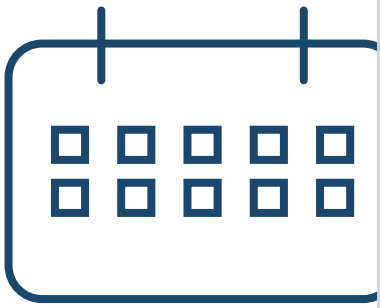
IMPLEMENTING **POINTS OF CONTACT**

Finance, information and communication technology, capacity building, data, monitoring and accountability are essential to both the formation of partnership for the goals and RE development targets.



TRACKING AND **MONITORING**

Several RE projects need specific monitoring strategies to ensure energy targets are met on time, which can also benefit the establishment of tracking processes for SDGs monitoring.



THE CAPACITY BUILDING OPPORTUNITIES NEEDED TO BRING RE TARGETS FORWARD

CAN BE BENEFICIAL FOR SDGS IMPLEMENTATION AND VICE VERSA

17 PARTNERSHIPS FOR THE GOALS

SDG 17
REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

THE POINTS OF INTERSECTION BETWEEN RE DEVELOPMENT AND THE IMPLEMENTATION OF SDGS CAN BE USED PARTICULARLY TO

SPUR THE WIDE-RANGE OF COMMITMENTS NEEDED FOR THE EFFECTIVE IMPLEMENTATION OF THE SDGS

RE development requires strong cross-sectoral, transregional and transnational partnerships as well as a continuous exchange of solutions, best practises and lessons learnt[119]. In fact, the effective and rapid implementation of a 100% RE target depends on a strong collaboration between local actors and other regional, national and international stakeholders and governments[119 15]. Therefore, strengthening renewable energy partnerships goes hand in hand with improving the partnerships necessary for the implementation of the SDGs.

Furthermore, RE development and all related initiatives and projects can be the connector between the climate targets such as the ones of the Paris Agreement and all the SDGs. As demonstrated so far in this report, there are several points of intersection between RE development and the implementation of SDGs. This can be particularly effective to spur the wide-range of commitments needed for the effective implementation of the SDGs. In fact, the implementation of 100% RE targets can be a unique catalyser, bringing together the interests of different groups ranging from gender equality to children rights, from food security to biodiversity, from labour organizations to peace and security groups.

Finance, information and communication technology, capacity building, data, monitoring and accountability are all listed as essential to the formation of partnership for the goals[16]. These are actually also fundamental aspects of any RE development target and several examples show the importance of these for the energy transition[14 15]. For example, supporting RE projects and targets is incredibly beneficial for mobilizing finance especially at the local and community level, for example through community-based energy projects[15]. It is also important for communication and information technology as demonstrated earlier in this report because RE can provide access to electricity to power communication devices also in the most remote and isolated regions[30]. Further, capacity building is often a key requirement to achieve a 100% RE target[15], which is for example necessary to train local actors to use new technology or to support local policy makers in providing new legislative frameworks to advance RE and relevant targets. The capacity building opportunities needed to bring RE targets forward can therefore be beneficial for SDGs implementation and vice versa. Data, monitoring and accountability are also important for RE development. Several RE projects need specific monitoring strategies to ensure energy targets are met on time. Again, a mutually beneficial relationship could be established between tracking progress of RE targets and SDGs monitoring.

POLICY RECOMMENDATIONS

TO ACHIEVE 100% RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT AT THE SAME TIME

- SET A 100% RE TARGET AND EMBED IT ACROSS POLICY AREAS AND IN SDG PROCESSES
- SET A "LEAVE NO ONE BEHIND" APPROACH TO ENERGY POLICY
- ENSURE ADEQUATE CIVIL SOCIETY PARTICIPATION AND CAPACITY BUILDING
- ENHANCE RENEWABLE ENERGY IN THE COOKING SECTOR
- PRIORITIZE ENERGY EFFICIENCY
- RE-DIRECT FOSSIL FUEL SUBSIDIES
- STRENGTHEN CHANGE AGENTS AND PIONEERS

POLICY RECOMMENDATIONS

Taking into account the many interlinkages between RE and sustainable development described so far, it becomes clear that integrating a 100% RE vision into development plans is in fact instrumental for the achievement of the SDGs. If any meaningful and long-term impact is to be achieved, the path towards sustainable development cannot be separated from the one towards 100% RE.

In light of this, leaders and communities across the world are urged to bring forward two key messages. Firstly, given the unprecedented threats of climate change and environmental degradation, they cannot delay to fully embrace a 100% RE for all message. Leaders from around the globe need to set a visionary, long-term 100% RE target, one that can once and for all set society on the right path towards sustainable development. By setting a 100% RE goal, as opposed to indeterminately promoting RE, they can support cohesion across parties and a much broader engagement across different stakeholders' groups; they can streamline efforts and resources by creating a unified vision for which different parties can finally synergize and work together. Furthermore, a 100% RE goal can create the necessary supporting environment to stimulate investments in renewables and widespread commitment to leave fossil fuels behind.

Secondly, leaders and communities across the world need to make clear that moving towards a 100% RE future is not only about transitioning from one form of energy to another, but about a much broader and inclusive socio-economic transformation towards a sustainable future.

1. SET A 100% RE TARGET AND EMBED IT ACROSS POLICY AREAS AND IN SDG PROCESSES

TARGET GROUP

Organizations and local communities engaged in the implementation of the SDGs / Policy makers / Development organizations.

As demonstrated throughout this report, RE development is fundamental to many other areas well beyond the energy sector. It can boost local productivity, improve livelihoods, stimulate local enterprises and industry, support gender equality, support agricultural process and stimulate innovation and technological development. It can be a tool to ensure substantive rights as well as procedural rights. Therefore, RE policies should not be separated and considered as an isolated, stand-alone area but on the contrary, any energy policy framework should be embedded in a national economic development plan and integrated in other policy areas. A transition to 100% RE should be regarded as a mean to achieve other policy priorities. Hence, policy makers must ensure that all RE benefits are taken into account and measured carefully when supporting a particular policy over another one. A silo approach to policy making would be restrictive and short-sighted, given that energy development overlaps largely with many other policy areas. Active efforts should be made to integrate 100% RE policies in other areas such as social and economic welfare, industry, employment, research and education, innovation and health. In order to do this, it is recommended to map the co-benefits of 100% RE to unveil the links among different development priorities and support the creation of cross-sectoral approach to policy making. Further, countries must in this effort review their development priorities and make sure they integrate 100% RE into all policy areas where it remained neglected or unexplored.

In particular, the countries that already demonstrated commitment to the 100% RE target such as the 48 countries of the Climate Vulnerable Forum are the ones that should first embed a 100% RE target into their national policymaking plans. These countries can pioneer this approach, ensuring that the 100% RE target is integrated across å agendas and that its implementation plan spans across departments, ministries, offices and covers different policy areas.

Further, priorities and programs relevant to the implementation of the SDGs and its targets should incorporate and in fact build on the 100% RE target. This includes mainstreaming 100% RE in the national plans, which countries are invited to develop and submit for a review progress in reaching the SDGs. The High-Level Political Forum in 2018 provides an ideal platform for this as it particularly follows up and reviews progress regarding the transformation towards sustainable and resilient societies with a special focus on energy. As confirmed in this report, supporting the uptake of RE across communities is an extremely effective instrument to stimulate the achievement of many other SDGs. Only a cross-sectoral, wide-ranging approach can help the rapid and effective achievement of the SDGs.

2. SET A "LEAVE NO ONE BEHIND" APPROACH TO ENERGY POLICY

TARGET GROUP
Policy makers.

Energy is essential to improve people's livelihoods, standards of living and overall comfort. Energy policies should focus on setting a human rights based "leave no one behind" approach, i.e. one that prioritizes that all parts of societies, including the most marginalized, can access energy and can equitably and fairly reap the multiple benefits that come with it. Access to modern energy services must be regarded as a prerequisite for a life of dignity. The only low cost, democratic and effective solution is decentralized, community-based RE development. In Global South countries, this means prioritizing off-grid development via stand-alone RE solutions (such as solar home systems) or micro-grid systems for small villages. Providing access to finance for everyone to enhance renewable energy must therefore be a core policy approach.

3. ENSURE ADEQUATE CIVIL SOCIETY PARTICIPATION AND CAPACITY BUILDING

TARGET GROUP
Organizations and local communities engaged in the implementation of the SDGs / Policy makers / Development organizations.

For the achievement of the SDGs and for a transition towards 100%RE, participation of the whole spectrum of civil society, including stakeholders from the environment, climate, development, faith and justice movement is indispensable. A participatory approach is needed to ensure participatory justice but also to manage the transition effectively. Unlike fossil-fuel-based societies, whose development and functioning mostly depends on large corporation investments and large centralized distribution systems, the decentralized structure of RE requires a much more distributed and participatory system of operation. All citizens and communities become part of a much flatter system of production and exchange of energy, made up of many small-scale initiatives and projects rather than few large ones. Within this context, civil society engagement is essential to ensure communities are supported in this transformational process. Inclusive mobilization and engagement of local actors as well as capacity building are all crucial elements of a fair and effective transition. In particular, capacity building must target legislators, government officials and civil society. All stakeholders need to become familiar with the policy changes needed to ensure a successful transition towards 100% RE. This is essential to ensure that local stakeholders build the capacity themselves to drive the transition forward as they are the only ones that can truly understand the local context and enable internal forces to support the transformation needed.

While the exchange of best practises and policy solutions is warranted, these cannot be simply imposed from above but need to be tailored to the specific local conditions and gain legitimacy from the buy-in and commitments of all local communities. Civil society organizations (CSOs) and churches can be instrumental in this process and governments must commit to support an inclusive multi-stakeholder process that continuously includes and informs all relevant CSOs. For this purpose, specific taskforces and formalized channels to involve all local actors and CSOs should be established to ensure an inclusive and fair process of engagement. Additionally the transformations needed to move towards 100% RE cannot be achieved by importing human capital and technologies, but by making sure that countries build their own domestic capacity and expertise to support such a transition within their own means. This should be perceived as a unique opportunity to mobilize local actors and further strengthen local CSOs and small enterprises, which can lead to spin-offs in innovation and local industry development.

4. ENHANCE RENEWABLE ENERGY IN THE COOKING SECTOR

TARGET GROUP
Organizations and local communities engaged in the implementation of the SDGs / Policy makers / development organizations.

Considering the multiple issues related to cooking in Global South countries, especially health concerns, impacts on local ecosystems and women's and children's rights, energy policies need to move beyond the narrative of clean cooking stoves and explore truly sustainable RE-based options for cooking. While the promotion of more efficient cook stoves remains an important interim solution and deslivers considerable results in certain Global South countries, focusing on improved cook stoves is neither a truly long-term nor a truly sustainable solution to the challenge of cooking. Much of the biomass for use in cook stoves (whether efficient or not) is not sustainably harvested; moreover, it is often not "renewable" due to unsustainable rates of deforestation, soil loss, and desertification. Further, they continue to contribute to a host of other social and economic problems, including gender inequality, low child literacy rates, as well as low labour market participation rates, all of which hinder economic diversification, entrench social injustices, and undermine long-term economic prosperity. Policies and local projects should start to recognize the tremendous potential

of alternative cooking solutions such as renewable electricity (e.g. solar home systems), biogas, and Power-to-Gas (P2G). In particular, biogas can offer a notable advantage also over the electric cooking pathways since in contrast to solar systems, which have a displacement rate of between 10% and 40%, the displacement rate for households equipped with biogas is higher, ranging between 66% and 80%. This means that in practical terms, biogas systems have proved to be more effective at actually reducing reliance on firewood, charcoal and other fuels than electric pathways. Another technology that deserves further investigation is P2G. While P2G may not be competitive with conventional natural gas delivered by pipeline, the preliminary results of a recent WFC report[39] found that it is broadly cost-competitive with current LPG prices and that it could provide a more cost-effective option to meet cooking needs than either mini-grid based electricity supply or SHS.

5. PRIORITIZE ENERGY EFFICIENCY

TARGET GROUP

Policy makers / Development organizations.

A 100% RE target addresses both energy efficiency and energy generation. No jurisdiction will meet its 100% RE target without simultaneously improving its energy efficiency. Or putting it in other words: increasing energy productivity, meaning the output achieved from energy consumed, is essential to achieve 100% RE and meet the ambition of the SDG framework. System-level approaches can be particularly important in reducing energy consumption. By developing more efficient energy infrastructure, including different sectors, appliances and other end-use devices, it becomes easier to develop, finance, and integrate the remaining infrastructure required to meet a jurisdiction's energy needs with locally available renewable resources. Studies have found that prioritizing energy efficiency in the Global South could slow the growth of their energy demand by more than half by 2020 to 1.4% a year, from 3.4%. This would leave demand about 25% lower in 2020 than it would otherwise have been[120]. Just by using existing technologies that would pay for themselves in future energy savings, consumers and businesses could save about $600 billion a year by 2020[121].

6. RE-DIRECT FOSSIL FUEL SUBSIDIES TO FUND SUSTAINABLE DEVELOPMENT

TARGET GROUP

Policy makers.

Fossil-fuel consumption subsidies worldwide amounted to about $325 billion in 2015, dropping from $493 billion in 2014. Despite this drop, the amount incentivizing fossil fuels is still more than double the $150 billion spent on support to renewable energy[122]. While research suggests that removing all consumer fossil fuel subsidies would decrease global carbon emissions anywhere between 6–8% by 2050 already, this can be even increased by using this money to build renewable energy[123]. Fossil fuel subsidies represent just under half of the budget needed to fund universal energy access, doubling the share of renewable energy in the global energy mix, and doubling the rate of improvement in energy efficiency by 2030[124]. This shows that using money that is currently used to subsidize fossil fuels, which in fact undermine sustainable development, could fill the SDG financing gap.

7. STRENGTHEN CHANGE AGENTS AND PIONEERS

TARGET GROUP

Organizations and local communities engaged in the implementation of the SDGs / Policy makers / Development organizations.

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, Indonesia's Sumba island and the Spanish Island of El Hierro have demonstrated that transitioning to 100% RE is a viable political decision[125]. 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[126]. 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)[125]. 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"[7]. These pioneers are needed to exemplify that the transformation is possible and beneficial. Change agents that are the driving force behind these success stories must be strengthened and supported. While organizations and local communities engaged in the implementation of the SDGs need to create bundles of lighthouse projects, governments and development agencies must build on these learnings and successes. For this, inclusive policy dialogues and consultations between strategic partners must be established and facilitated.

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