Regional Initiative to Promote Small-Scale Renewable Energy Applications in Rural Areas of the Arab Region (REGEND)

Policy toolkit

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Economic and Social Commission for Western Asia

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Preface

This policy toolkit was developed by the Energy Section in the Climate Change and Natural Resource Sustainability Cluster of the United Nations Economic and Social Commission for Western Asia (ESCWA) within the framework of the Regional Initiative to Promote Small-Scale Renewable Energy Applications in Rural Areas of the Arab Region (REGEND), implemented by ESCWA in partnership with the Swedish International Development Cooperation Agency.

Under the supervision of Radia Sedaoui, Chief of the Energy Section, Climate Change and Natural Resource Sustainability Cluster, ESCWA, the toolkit was developed by Laura El-Katiri, Energy Policy Expert .

ESCWA coordinated the public consultation and peer review process, including by organizing an online regional workshop entitled **"Policy Toolkit as Guidelines for Policymakers to Integrate Small-Scale Renewable Energy in Rural Development"** in December 2021. Valuable comments and substantive contributions were provided by the following experts:

Jamila Matar, Director of the Energy Department, League of Arab States; Jauad El Kharraz, Executive Director of the Regional Center for Renewable Energy and Energy Efficiency; Fida'a Rawabdeh, Chairman of the Regional Office of the Eastern Arab Area, Arab Organization for Agricultural Development; Zeyad Alsaaydeh, Director of the Rural Electrification Department, Ministry of Energy and Mineral Resources, Jordan; Yacoub Marar, Director of the Renewable Energy and Energy Efficiency Department, Ministry of Energy and Mineral Resources, Jordan; Helene Ben Khamis, Chief of Section, Solar Energy Department, National Agency for Energy Conservation, Tunisia; Jessica Obeid, Consultant for ESCWA; Maged Mahmoud, Technical Director of the Regional Center for Renewable Energy and Energy Efficiency; Nadjib Drouiche, Head of the Environmental Team, Semiconductor Technology Research Center for Energetics; Olfa Bouazizi, Chief of Service, National Institute of Statistics, Tunisia; Fatima El Aamili, Ministry of Energy Transition and Sustainable Development, Morocco; Muhieddin Tawalbeh, National Energy Research Center, Jordan; Hazir Farouk Abdelraheem Elhaj, Associate Professor at Sudan University of Science and Technology, Sudan; Fadi Jabr, Secretary General of the Arab Federation for Food Industries; Suhaib Aladaileh, Arab Organization for Agricultural Development; and Seif Hussein Alrimah, Public Authority for Rural Electricity, Yemen. Input was provided by the ESCWA Energy Team, namely Mustafa Ansari, Jil Amine and Omar Kaaki.

The REGEND initiative aims to improve livelihoods and economic benefits in rural communities, particularly among marginalized groups, and to promote social inclusion and gender equality. It seeks to satisfy energy needs and showcase the effectiveness of the bottom-up approach in achieving results by addressing energy poverty, water scarcity, vulnerability to climate change and other natural resource challenges. Pro-poor investments will be promoted using appropriate small-scale renewable energy technologies to facilitate productive activities and stimulate entrepreneurial development.

This toolkit tackles the challenges and opportunities of the creation of markets for electricity using small-scale renewable energy technologies (RETs) in rural communities across Arab countries. The toolkit also discusses policy options, guidelines for financing, innovative incentive mechanisms, best practices for facilitating the dissemination and use of small-scale RETs to improve livelihoods and gender equality in rural areas through entrepreneurial activities, respect for human rights and gender mainstreaming within an integrated approach. It also explains the way in which rural women can benefit significantly from the introduction of small-scale RETs through improved access to education and health, modern digital communication and new market opportunities related to improved access to technology and machinery.

Key messages

Policies should be designed by integrating sustainable energy access through renewable energy technologies (RETs) into rural development planning, at the local, the national and the regional levels to address the following aspects:

- Create new and innovative financing models to help overcome rural communities' traditional constraints with a special focus on the separate needs of rural women who often face additional obstacles to those faced by men in accessing finance.
- Raise quality standards by increasing the regulatory and technical capacity of governments, both at national and local levels, to spread expertise in renewable energy technologies and their specific technical requirements, and in the effective regulation of their products and services.
- Improve data availability and accessibility for policymakers, to build institutional capacity within governments to transparently collect, analyze and publish data for the ultimate objective of transitioning into data-driven policymaking.

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CFTs	cooking fuels and technologies
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
LDCs	least developed countries
LRGs	local and regional governments
NGOs	non-governmental organizations
REGEND	Regional Initiative to Promote Small-Scale Renewable Energy Applications in Rural Areas of the Arab Region
RET	renewable energy technology
SDGs	Sustainable Development Goals
SPIS	solar-powered irrigation system
STEM	science, technology, engineering and mathematics
UCLG	United Cities and Local Governments
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UN-Habitat	United Nations Human Settlements Programme

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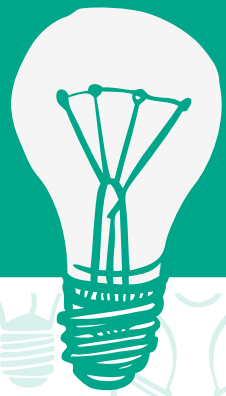
1 Background



A. Why does rural energy use matter?

B. What does the rural energy access gap look like?

C. What can small-scale renewable energy technologies offer rural communities?

D. About this report

Energy plays a fundamental role in the implementation of the 2030 Agenda for Sustainable Development. Universal access to sustainable energy—that is, energy services that are adequate, affordable, reliable, high quality, safe and clean—is a key enabler to achieve the Sustainable Development Goals (SDGs), which include eliminating poverty and hunger (Goals 1 and 2); providing universal health services and education (Goals 3 and 4); achieving gender equality and women's empowerment (Goal 5); creating decent jobs and innovative, productive economies (Goals 8 and 9); reducing inequalities (Goal 10); protecting the environment (Goals 14 and 15); and taking action to combat climate change (Goal 13).

Despite significant progress over the past decade on the global target of ensuring universal access to sustainable energy, approximately 759 million people in the world still lacked access to electricity in 2019, including 45 million in the Arab region.[1] Furthermore, over 71 million Arabs lack access to clean cooking fuels and technologies (CFTs).[2] Most of the electricity access gap remains concentrated in Arab least developed countries (LDCs): the Comoros, Djibouti, Mauritania, Somalia, the Sudan and Yemen, which together account for approximately 85 per cent of the Arab region's electricity access gap and over 70 per cent of the gap in access to CFTs.

As in other parts of the world, lack of access to modern energy in the Arab region is primarily a rural problem; around 84 per cent of those lacking access to electricity (approximately 38 million people) and approximately 60 per cent of those lacking access to CFTs live in rural areas. The gap in rural energy access compared to urban energy services is particularly acute in Arab LDCs. Rural electricity access rates are less than 40 per cent in the Sudan, 25 per cent in Djibouti, 11 per cent in Somalia and less than 1 per cent in Mauritania, compared to urban access rates of over 60 per cent in all four countries.[3] Access to CFTs is virtually non-existent in Somalia and extremely limited in the Comoros and Djibouti. The Sudan is one of the world's largest CFT-deficit countries, in which approximately 20 million people lack access (table 1).[4]

Significant progress has been made in other parts of the Arab region, particularly in the high-income Gulf Cooperation Council economies; however, most other Arab countries achieved complete access to electricity and CFTs decades ago. Since most of the smaller gaps were closed during the 1990s and early 2000s, the Arab region offers a number of lessons for the systematic expansion of modern energy infrastructure over a relatively short period of time.[5] Nevertheless, this success has not been without pitfalls; the quality and affordability of modern energy and related technologies differs significantly across Arab countries, as well as between rural and urban areas. Conflict and instability have crippled progress and hampered better energy supply in conflict-affected countries, particularly for rural populations. Affordability remains a major hurdle to the more widespread use of energy to power modern technologies and machinery, particularly in rural areas in Arab middle-income countries. Many rural communities continue to use polluting fuels since they lack access to sustainable energy sources to power modern machinery and agricultural value chains.

Table 1. Deficits in access to electricity in the Arab region, 2018

	Country	Population		Access to electricity (percentage of the population)			Access to cooking fuels and technologies (percentage of the population)		
		Total (millions)	Percentage living in rural areas	Total	Urban	Rural	Total	Urban	Rural
Maghreb	Algeria	43.1	27	100	100	99	99	100	99
	Libya	6.8	20	69	100		N/A	N/A	N/A
	Morocco	36.5	37	100	100	99	98	100	96
	Tunisia	11.7	31	100	100	100	100	100	100
Mashreq	Egypt	100.4	57	100	100	100	100	100	100
	Iraq	39.3	29	100	100	100	99	99	98
	Jordan	10.1	9	100	100	100	100	100	100
	Lebanon	6.9	11	100	100	100	N/A	N/A	N/A
	State of Palestine	4.7	24	100	100	100	N/A	N/A	N/A
	Syrian Arab Republic	17.1	45	89	100	76	97	100	96
Arab LDCs	Comoros	0.9	71	84	98	78	8	16	2
	Djibouti	1.0	22	61	72	25	10	12	0
	Mauritania	4.5	45	46	86		43	65	18
	Somalia	15.4	54	36	66	11	3	5	0
	Sudan	42.8	65	54	81	39	53	67	45
	Yemen	29.2	63	73	93	61	61	93	42

Source: International Energy Agency and others, 2021. Tracking SDG 7: The Energy Progress Report. Washington, D.C.: World Bank.

A. Why does rural energy use matter?

Lack of access to sustainable, modern energy is an outcome, a cause and a form of poverty.[6] It constrains human capabilities, productivity and access to basic services, such as health and education, and reinforces the lack of income-generating capacity and economic opportunities. Poverty itself reinforces the lack of access to sustainable energy, since modern energy is unaffordable. It also hinders progress along the entire chain of socioeconomic development, including food production and storage, health care, education and training, as well as access to modern machinery, technology and know-how.[7] The Arab region has made significant inroads in universalizing access to modern energy, including electricity and CFTs, although the type, quality, safety, affordability and, ultimately, sustainability of the energy available differ substantially across the region. In particular, in Arab LDCs, large disparities exist in the quality and level of access to modern energy.

Rural access to modern, clean and sustainable energy should not be a luxury of wealthier nations; rural smallholders manage over 80 per cent of the world's estimated 500 million small farms and provide over 80 per cent of the food consumed in a large part of the developing world, contributing significantly to poverty reduction and food security.[8] Access to electricity and, therefore, modern agricultural techniques, machinery and know-how is critical to supporting the sustainability of small-scale farming and, by extension, the entire food production chain across various Arab countries.[9]

On a social level, an imbalanced distribution of infrastructure and basic services between rural and urban areas in Arab countries also deepens territorial inequalities.[10] Some of the ramifications of this significant sociopolitical problem can be found in the historical expression of discontent by urban youth, some of whom have parents who are—or are themselves—migrants from the countryside. Rural communities are particularly affected by political conflict, often being cut off from many essential services, including modern energy services. Such a situation reinforces extreme poverty and increases the socioeconomic rift between regions and between rural and urban areas, in turn harming any efforts for national reconciliation and lasting peace.[11] In the Arab region, extreme poverty rates nearly doubled between 2015 and 2018, spurred by conflicts in the Syrian Arab Republic and Yemen.[12] Rural populations are the most likely to be affected by extreme poverty in those countries, not to mention the vast, negative effects of the COVID-19 pandemic from 2020 onwards.[13] Poor living conditions and the lack of economic prospects in rural areas throughout the Arab region reinforce existing trends in rural-urban labour migration, contributing to the brain drain in rural areas throughout the Arab region and intensifying social, economic and political pressures in urban areas. The ongoing COVID-19 crisis has further highlighted the vulnerabilities of remote communities and the need to ensure that no one is left behind.[14]

Access to poor quality energy in rural areas is also problematic from an environmental and climatic point of view. Emissions from burning traditional solid fuels in open areas and using traditional stoves have significant global warming effects, owing to incomplete combustion and non-renewable sources of biomass.[15] The rural energy mix often includes a combination of fuels other than biomass, including general household waste, kerosene as a starter fuel and diesel for agricultural machinery, which is widespread and often subsidized. This energy mix is highly polluting and ultimately unsustainable, as rural communities increase their energy consumption for household and agricultural use.[16]

Livelihoods and prospects in rural communities are shaped by central policies, even if those policies are negligent and misdirected. As the recent Dasgupta Review highlights, agricultural systems can be net providers of ecosystem services beyond food production, which can include regulating and maintaining services for their surrounding ecosystems.[17] This biosphere has intrinsic value beyond the degree to which it can produce goods.[18] Nevertheless, this role has eroded over time as a result of developmental neglect in rural areas, including through a lack of education and communication, of which energy is a critical enabler. Perverse incentives, such as the provision of subsidized liquid fuel and fertilizer, coupled with the lack of regulations in areas such as waste and water management, have led many rural communities to misuse the natural resources on which their survival depends, while remaining trapped in poverty in most cases.

B. What does the rural energy access gap look like?

Grid electricity is the prevailing mode of electricity generation and supply in developed countries. As a result, electrification as the basis for access to modern energy has been considered synonymous with grid extension for many decades.[19] In Arab LDCs, however, the expansion of the national grid to some rural areas is not always economically viable. Centralized electricity generation is not sufficient to systematically extend grid access at the rates needed. Underfinanced utilities struggle to invest in new infrastructure, while political deadlock and damage from past conflicts hamper the existing energy infrastructure, which cannot be expanded at sufficient rates in the near future.[20] Beyond LDCs, rural communities in a number of Arab countries are exposed more frequently than urban areas to service disruptions and often rely on a combination of household fuels, not all of which allow for an effective use of modern machinery and technologies. Rural communities are often among those most affected by gaps in energy services. The next sections provide an in-depth exploration of some of the facets of the lack of access to sustainable energy in rural communities in Arab countries.

1. Statistically captured deficits in access: electricity and cooking fuels and technologies

Rural communities face many different forms of energy access deficits, only some of which are quantified by

current statistics. The standard statistical approach to measuring access to energy considers access to electricity and CFTs, as presented in table 1. "Access to electricity" includes any kind of access.[21] For example, enough electricity to use a light bulb would qualify a household as having access to electricity. A complete lack of access to electricity and CFTs, as seen among substantial portions of rural populations in Arab LDCs, implies that rural households and farms rely on traditional fuels such as animal dung, crop residues and wood, as well as traditional farming and irrigation methods, and have no ability to generate electricity or use modern mechanical devices, including modern equipment to improve agricultural irrigation.

Traditional fuels are highly inefficient and polluting, owing to the low-quality equipment typically used, such as inferior cooking stoves. They reduce the likelihood that a household will to be able to consume a varied diet and require time and effort to collect—time that is therefore not available for other, more productive tasks or education.[22] A high degree of reliance on traditional fuels can also lead to the gradual depletion of local resource stocks that must then be sourced increasingly from further afield, thereby contributing to environmental degradation and fuelling intercommunal conflict.[23]

2. Partial steps up the energy ladder

Millions of people in rural populations in the Arab region have climbed the energy ladder for a portion of their energy use. Access may be through improved cookstoves and liquefied petroleum gas cylinders for cooking, electricity from the national grid for lighting and refrigeration, or the use of diesel for mechanical water pumps in agriculture. These households and farms are not accounted for in national statistics, but their energy access is rarely gained across all areas of daily life, particularly in rural areas and for communities at the bottom of the energy ladder. This includes remote communities in many parts of the Maghreb and Mashreq States, as well as Arab LDCs. Rural households may use electricity and liquefied petroleum gas in the home but traditional farming and irrigation methods on the farm. They may also be able to power a refrigerator but perhaps not a computer. Their literacy in the area of information technology may also be low, further limited by a lack of education that restricts their access to better knowledge.

3. Interruptible energy services

Even where modern energy is available, supply is not always guaranteed to be safe and secure. When access to electricity is provided via a grid, rural communities in countries with significant disruptions to service often suffer more from blackouts than urban communities, a situation that is particularly precarious in conflict-affected countries such as Iraq, Jordan, Lebanon, Libya and the Syrian Arab Republic. Lebanon offers a prime example of the difference in energy quality and supply between cities and rural areas. The latter are typically allocated significantly fewer hours of electricity supply than cities such as Beirut, often receiving less than 12 hours per day in comparison to 20 hours for cities. Service quality can be even lower in peripheral areas, owing to the country's ailing electricity sector.[24]

Liquid fuels, such as kerosene and diesel, can also experience interruptions in supply, as they are sourced from outside rural areas and from outside the country. The possibility for disruptions and delays increases the further villages are from an urban area.[25] Conflict can lead to additional supply disruptions and shortages, resulting in rising costs for liquid fuel. Affordability and income fluctuations also play a significant role in service disruptions, as conventional energy typically involves continuous fuel costs. Renewable energy, by contrast, provides mitigating features against external shocks beyond the control of end users and therefore offers a more resilient and sustainable supply.

4. Affordability

In addition, for many more rural communities across the Arab region, connecting to the national grid does not equate to affordable access. The same is true for the presence of diesel fuel or irrigation technology within a village. The 2010 Poor People's Energy Outlook summarized this problem, which continues to be acute:

> The energy provided by rural electrification programmes is rarely sufficient or affordable for cooking, the most energy-consuming household activity. This leaves millions of families who have been lucky enough to benefit from such a programme preparing their evening meal under the glow of an electric light—in a smoke-filled kitchen over an unimproved wood or dung-burning stove. Meanwhile, national planning for improved access to mechanical

> power, which is so necessary for small enterprises and the development of local economies, remains almost entirely forgotten.[26]

In countries such as Jordan and Tunisia, electricity costs are high compared to average incomes levels, implying that the income-generating potential of modern energy access in rural areas is often largely untapped.[27] Furthermore, rural communities often pay a substantial premium for inferior fuel technologies as a result of inefficient energy generation, such as from kerosene lamps and diesel generators.[28] That is the case despite often substantial subsidies on these inferior liquid fuels, which highlights the highly inefficient nature of fuel subsidies. Meanwhile, national subsidies for electricity, despite their significant value in fiscal terms, often do not reach the rural communities that would benefit from them, since they are not connected to the grid.[29]

5. Inferior fuels

Many rural energy solutions that are based on liquid fuels, such as diesel used in generators and agricultural pumps, also come at a high environmental cost. Their use cannot be scaled up indefinitely to match growth in rural communities and the increasing complexity of their daily needs. Heat sources are not only required for cooking, they are needed for sterilizing and heating water for drinking, washing and personal hygiene. Depending on the local climate and geography, they are also needed for space heating in winter, including in schools, hospitals and workplaces.[30] Stoves are also used by many women with agricultural home-based businesses to cook food to be sold later, often as their main source of income.[31]

The many uses of inefficiently fuelled heat sources extend the amount of time for which a stove or fire must be lit, with implications for fuel use and smoke in the kitchen.[32] Black carbon, commonly referred to as soot, results from the incomplete combustion of biomass and adheres to pots, clothing, walls and ceilings. It also evaporates into the air as an aerosol, absorbing and scattering solar radiation and thus contributing to climate change.[33] Liquid fuels create both indoor and outdoor pollution, contributing significantly to climate change and the spread of respiratory and obstructive pulmonary diseases in low-income and rural households.[34] In some Arab countries, the continued practice of burning household waste and plastic also has highly negative implications for human health and the environment.

C. What can small-scale renewable energy technologies offer rural communities?

In this report, the following definitions are adopted:

Renewable energy is the energy generated from renewable, theoretically inexhaustible and non-fossil-based energy sources that are replenished in a human lifetime. Renewable energy sources include solar, wind, marine (ocean), hydropower, geothermal and bioenergy.

Small-scale renewable energy technology converts renewable energy sources into electrical or thermal energy with an output power capacity of up to approximately 100 kW.

Source: Economic and Social Commission for Western Asia, 2021. Small-Scale Renewable Energy Technological Solutions in the Arab Region: Operational Toolkit. E/ESCWA/CL1.CCS/2020/TP.8.

In recent years, significant inroads have been made around the world with decentralized or off-grid technologies to support rural communities and other hard-to-reach areas using centralized grid extensions.[35] Small-scale renewable energy technologies (RETs) are increasingly cost-competitive on a long-term scale with other available off-grid technologies; they are also flexible and environmentally friendly.[36] Most Arab countries are part of the Sun Belt—the area in the world that receives the most sun per day, month

and year—providing them with significant and largely underutilized solar resources.[37] Others also have good wind resources, including Algeria (the Mediterranean coast and some interior locations), Egypt (the Gulf of Suez), Jordan (the Gulf of Aqaba), Mauritania (the Atlantic coast), Morocco, Oman (the Indian Ocean coast), the Sudan (the Red Sea coast), Tunisia, Yemen and some sites in the Arabian Gulf.[38] RETs can feed on these resources and have significant potential to fill the gap in centralized energy provision for communities that have been left behind in the past.

Small-scale RETs can be used to improve education, health and various aspects of rural life, including household cooking and daily chores. Household lighting, heating, refrigeration, power for appliances and water treatment are also made possible by small-scale RETs.[39] In addition, a higher tier of access to RETs provides critical tools that facilitate rural communities' access to additional productive uses of modern energy to generate income.[40] Such uses extend to agricultural, commercial and industrial activities, including pumping for irrigation, dryers, hydroponics, grain milling and food refrigeration, as well as information technology support for businesses.[41] Table 2 summarizes some of the productive uses of RETs. Given their versatility, small-scale RETs could supply a significant portion, if not all, of the power requirements for rural communities and help them to improve health and safety and create small businesses to enjoy a better lifestyle and economic independence.

Table 2. Examples of renewable energy services and income-generating opportunities

Renewable energy type and technologies	Application														
	Power	Agriculture					Domestic				Lighting		Water		
	Electricity generation	Pumping for irrigation	Dryers	Hydroponics	Grain milling	Industrial refrigeration	Heating	Cooling and refrigeration	Cooking	Powering appliances	Domestic	Street or farm	Heating	Disinfection	Desalination
Solar															
Concentrated solar power (CSP)	a								a						
Photovoltaic (PV) panels	a	a		a		a		a		a	a	a			a
Solar dryers			a												
Solar disinfection (SODIS)														a	
Flat plate collectors (FTC)													a		
Evacuated tube collectors (ETC)													a		
Solar thermal cooling systems						a		a							
Solar electrical cooling systems								a							
Solar (thermal) collector for heating							a						a		
Wind power															
Wind turbine/generators	a						a	a		a					a
Windmill (wind mechanical pump)		a			a										
Solar and wind hybrid															
Windmill and photovoltaic panels	a	a			a										
Wind turbine and photovoltaic panels	a				a					a	a	a			a
Solar and biomass hybrid															
Power and heat coupled system							a								

Renewable energy type and technologies	Application														
	Power	Agriculture					Domestic				Lighting		Water		
	Electricity generation	Pumping for irrigation	Dryers	Hydroponics	Grain milling	Industrial refrigeration	Heating	Cooling and refrigeration	Cooking	Powering appliances	Domestic	Street or farm	Heating	Disinfection	Desalination
Biomass															
Biofueled power generator	a														
Power and heat coupled systems							a						a		
Biofuel (ethanol/biodiesel) stoves									a						
Biodigester to produce biogas						a	a		a		a			a	
Fuel wood and green residue							a		a					a	
Biomass fuel briquettes	a						a		a					a	
Improved cooking stoves							a		a					a	
Geothermal															
Geothermal generator	a												a		a
Hydro															
Hydropower plant/turbine	a									a					
Marine (ocean)															
Marine turbine	a														

Source: Economic and Social Commission for Western Asia, 2021. Small-Scale Renewable Energy Technological Solutions in the Arab Region: Operational Toolkit. E/ESCWA/CL1.CCS/2020/TP.8, p. 33.

1. Water and food security

Energy is fundamentally interlinked with the production and management of water and food and is therefore key to agricultural productivity and food and water security.[42] More efficient agricultural machinery and irrigation techniques result in higher crop yields, but they also draw on more groundwater resources. RETs improve the efficiency of otherwise time-consuming manual house chores (i.e. transporting, harvesting, grinding and processing food), improving product output and quality and freeing up time for other activities. They also improve the quality of the collection, preparation and storage of food and agrifood products, which in turn increases their durability and reduces waste.

Small-scale RETs can support the extraction, treatment, distribution and disposal of various types of water, such as drinking water, irrigation water and wastewater. They can also power modern irrigation systems, including through solar photovoltaic water pumps. Irrigation reduces poverty, as it can critically enhance the productivity of labour and land and lead to higher incomes and lower food prices.[43] Cooking with more efficient technologies can improve the affordability of dietary choices and the boiling of water, thereby improving water and food security.[44]

2. Health and education

RETs have a fundamental role to play in facilitating rural communities' access to health services and education. Health centres with secure supplies of electricity can provide a wide range of life-improving services to communities, including vaccinations, which can be safely stored in electric refrigerators; safe childbirth; and access to family planning, such as contraceptive information, services and supplies. In communities that rely overwhelmingly on biomass, RETs can prove revolutionary in reducing the time spent on traditional fuel collection, allowing time for other purposes such

as child-rearing, education, training and paid work. In terms of education, rural communities fundamentally benefit from the presence of electricity for lighting and space heating, as well as access to computers and smart phones.

3. Increased economic activity

While better access to education and health are important benefits in their own right, small-scale RETs also have significant potential to improve economic activity in rural areas, thus helping to improve livelihoods sustainably. A key element is the way modern energy frees up time to engage in non-energy-related activities. The combination of additional time and access to modern energy services is essential to helping local populations to engage in income-generating activities and increase their productivity.[45] Examples include weather forecasts and crop prices via the radio and the Internet for farmers and fishers.[46] Local markets for RET products and maintenance can create additional economic activities based around new, local skill sets. Lighting, heating and refrigeration can also improve the productivity, time and efficiency of those activities.

4. More stable electricity supply

Small-scale RETs can help to stabilize electricity supply in areas underserved by the national electrical grid. Technologies based on solar and wind power, possibly in combination with battery storage, or a hybrid system can be implemented at the individual level or in the form of a mini- or microgrid that serves the village community during cuts in grid supply.[47] Rolling out net metering and possibly allowing users to feed surplus electricity back into the grid could further strengthen the case for businesses to provide such decentralized, clean energy options.[48]

5. Entrepreneurship and business development

The introduction of small-scale RETs in rural areas has significant potential to create local jobs in construction, distribution, sales and maintenance directly from RET installation, operation and maintenance, in addition to jobs generated in agriculture. All these activities have the potential to reduce poverty, helping to address the increasing gap between urban and rural development.[49] Specialty training to install and run RETs self-sufficiently within the community can encourage both the uptake of RETs and their diffusion in local markets. Demand for services associated with RETs can also help to generate local economic activity and facilitate innovation to create new niche markets and services. It can also help to improve entrepreneurial activity and product specialization in and around agriculture. The savings in both time and costs can be used to prop up other industries such as small trades (e.g. hairdressers, tailors), skilled workshops (e.g. carpentry, welding) and agricultural processing facilities (e.g. drying, milling, poultry, dairy).[50] Access to utilities and applications can also boost growth in secondary economic activities such as ecotourism.

6. The gender gap

Women are essential beneficiaries in the introduction of modern energy, along with their children and entire communities. Access to modern energy has significant potential to improve women's health by reducing exposure to indoor air pollution as a result of cleaner cooking, lighting and heating solutions, as well as increasing safety through improved lighting, mobile phone access and online communication.[51] It also facilitates access to the outside world through access to digital devices, for the purpose of both education and business that extends beyond the home. Reduced time spent on housekeeping activities and fuel collection due to access to electric appliances can result in better health and allow time for education, leisure activities and business development, thereby improving living standards and reducing the migration of women for work.[52] ESCWA REGEND in Jordan, Lebanon and Tunisia has demonstrated these effects on local communities.[53] Small-scale RETs can significantly reduce operation costs for businesses typically operated by women in rural areas, most of which are food- and home-based, given that these costs include the cost of energy for cooking and cold storage.[54] Empowering women to own and use small-scale RETs and related technical equipment can in turn result in significant benefits to their families' income and their communities as a whole.[55]

7. Reduced pollution and local environmental destruction

Reducing air pollution from toxic and harmful compounds by replacing fossil fuel combustion from cooking, lighting and heating applications has substantial health benefits for rural populations,

leading to safer and cleaner living and working environments. Reduced reliance on traditional fuels such as fuelwood also reduces localized environmental degradation from deforestation. In the case of biofuels, when produced on a small scale using native species, its production could have positive environmental impacts, such as land restoration and regeneration and forest conservation.

8. Biodiversity conservation

The aforementioned discussion of the environmental issues associated with the unsustainable use of traditional biomass and liquid fossil fuels in the absence of more sustainable energy sources has highlighted that rural energy use is not environmentally neutral. While the emissions profile of rural areas may be negligible compared to urban and industrial areas in Arab countries today, the 2021 Dasgupta Review recalls that climate change is but one of many environmental problems facing societies. In addition to the more immediate benefits linked to improved rural livelihoods and the productive uses of energy, small-scale RETs also have significant potential to benefit important long-term objectives to protect local biodiversity and the environment. Conditioned by forward-looking government policies, small-scale RETs can be incorporated into the fundamentals of sustainable management for rural land and water resources in the future. Table 3 provides some examples, based on policies in support of biodiversity conservation from the Dasgupta Review.[56]

Table 3. Examples of long-term benefits to natural capital and inclusive wealth

Policy targets for biodiversity protection	Potential role of small-scale renewable energy technologies
More efficient extraction and reduced waste	Access to faster transport and better storage, including electric cooling, helps to reduce food waste.
Fair and sustainable consumption, production and supply chains	Better access to local markets can help rural communities to improve their living conditions while improving the integration of regional food markets with a reduced need for imports.
Improved access to education	Well-managed education plays a critical role in providing young people not only with skills to earn a living but also with knowledge and awareness about their environment and the sustainable management of the natural resources on which rural communities base their living.
Improved land management	Education and better access to communication technologies can also help to improve the quality of land management, including through information about biodiversity conservation using sustainable agriculture.
Improved access to family planning and reproductive health	Family planning is critical to allowing women to have greater control over their lives, shifting behaviour and improving the health of mothers and babies. Family planning also plays a pivotal role in demographic management in rural areas and thus inclusive wealth creation in the future.
Conservation of natural assets	Sustainable energy in rural communities is also important for government efforts to increase conservation in rural areas. Protecting and restoring ecosystems addresses not only biodiversity loss but also climate change and can deliver wider economic benefits. Informed, educated and empowered rural communities are more likely to participate actively in conservation efforts and help to reduce habitat loss from deforestation and the overuse of chemicals.

Source: Author, based on Dasgupta, Partha., 2021 The Economics of Biodiversity: The Dasgupta Review. London: HM Treasury.

D. About this report

The REGEND initiative aims to improve the livelihood, economic benefit, gender equality and social inclusion of Arab rural communities, particularly marginalized groups, by addressing energy poverty, water scarcity and vulnerability to climate change and other natural resource challenges.[57] This will be achieved by using appropriate small-scale RETs for productive activities and entrepreneurial development; women's empowerment, with an emphasis on job creation; and the development of robust value chains in a nexus approach to promote a sustainable economy.

The initiative has produced a series of studies and publications, including country-level reports, an operational toolkit, factsheets and business models on using and implementing small-scale RETs to support productive activities in a rural context in the Arab region.[58] This final report provides a toolkit for policymakers aiming to increase the use of small-scale RETs. It offers good practices and business models, including regulatory and institutional frameworks to create an environment conducive to the use of small-scale RETs. The toolkit also includes policy options, guidelines for financing and innovative incentive mechanisms, best practices and indicators for facilitating the dissemination and use of small-scale RETs, with a view to enhancing livelihoods in rural areas through entrepreneurial activities, respect for human rights and gender mainstreaming within an integrated approach. Furthermore, the toolkit includes additional incentives for women entrepreneurs to formulate and implement real gender-affirmative actions.

The REGEND initiative is funded by the Swedish International Development Cooperation Agency with implementing partners, which include the League of Arab States, line ministries, various regional organizations, local authorities, Arab women associations, United Nations organizations, local and regional non-governmental organizations (NGOs), research institutions and academia.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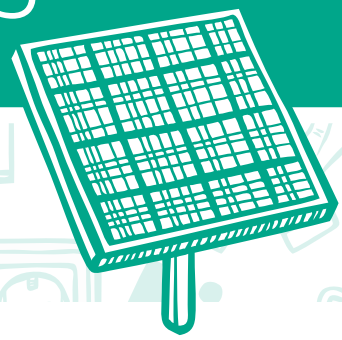
2 Creating a market for small-scale renewable energy technologies



A. What are the obstacles to the adoption of small-scale renewable energy technologies in rural areas?

B. What policies are needed to support the adoption of small-scale renewable energy technologies in rural areas?

Conventional government policy in many Arab countries has focused on universalizing access to national grid infrastructure for electricity. Small-scale energy options, particularly those based on renewable energy, have long been neglected by many Governments, which have considered large-scale centralized solutions as the most desirable option for electricity access. As outlined in chapter 1, however, the many potential benefits of small-scale RETs highlight their considerable ability to promote sustainable energy access in rural areas and for communities that are not served by a central electrical grid or have unreliable service. RETs also offer a sustainable and more environmentally friendly alternative to liquid fossil fuels for use in agriculture, particularly for irrigation and other mechanical uses.

Despite the potential of small-scale RETs to play an important role in rural development, few Arab countries have thus far made systematic use of available technologies. They should seize the opportunity to update this policy and adopt a proactive policy approach to support small-scale RETs as a systematic energy solution for rural communities. Changes in technology and behaviour require political and institutional support and aligned policies, alongside the development of local technological capabilities. These goals align well with Arab States' wider policy objectives to provide inclusive economic opportunities to all, ensure food security and protect the rural environment and its natural assets. The key rationale behind this necessary policy support is to facilitate the development of rural markets for RETs and other modern technologies, empowering communities to attain new standards of living that were previously inaccessible.

A. What are the obstacles to the adoption of small-scale renewable energy technologies in rural areas?

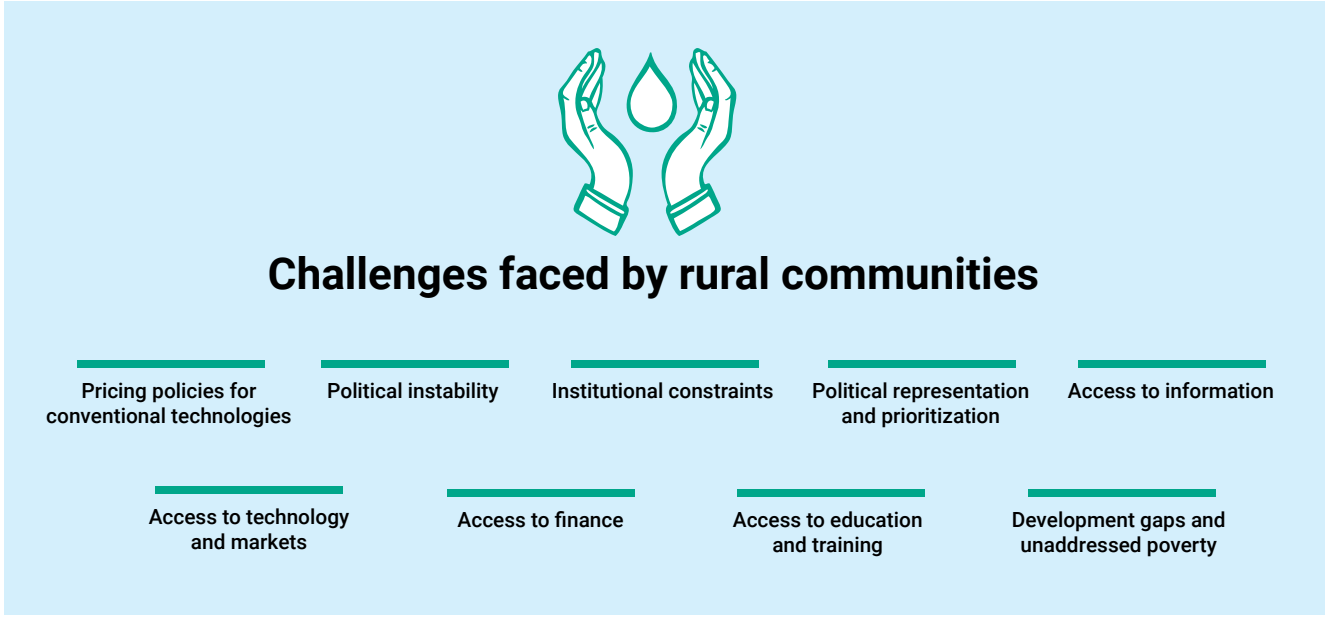
Despite the wide-ranging benefits of small-scale RETs for rural areas, their use in the Arab region remains extremely limited. Extending the use of RETs, and thus maximizing their benefits for rural communities, depends on addressing the very obstacles that have hindered their widespread adoption in the past. This section provides a better understanding of the challenges facing the use of small-scale RETs in rural areas (figure 1).

1. Development gaps and unaddressed poverty

To varying degrees across the Arab region, rural communities experience food, work and income insecurity; illiteracy; and a dependence on low-income, small-scale agriculture.[59] Poverty is often most widespread in remote communities, where there is a high concentration of socially and economically disadvantaged populations.[60] Rural areas experience higher poverty rates than urban areas in all countries participating in the ESCWA REGEND initiative.[61] Extreme poverty is particularly prevalent among agricultural wage workers, pastoralists and small-scale producers, with a wide variance of experiences across the Arab region.[62] Globally, approximately three quarters of people living in extreme poverty live in rural areas.[63] Access to energy, drinking water, sanitation and hygiene services, and transport infrastructure are often severely limited, creating a highly inequitable distribution of access between urban and rural areas and among rural communities in different regions.[64]

The lack of access to sustainable energy is one of a combination of development issues in rural areas that are often mutually reinforcing. Income poverty and a lack of public infrastructure such as roads, transport options, education and health facilities are in turn reinforced by a lack of modern, affordable and sustainable energy services. In many cases, the agricultural sector, which is the primary source of income for many rural communities, faces its own challenges, including difficulty in accessing financial services and relatively weak rural organizations that lack the training and support to spearhead their own development.[65] Rural poverty is typically coupled with higher exposure to risks, including limited access to inputs, technical assistance, key productive assets such as modern machinery (which would also require energy inputs), credit, insurance and social protection.[66]

Figure 1. Challenges to the adoption of small-scale renewable energy technologies in rural areas



Source: Authors, based on International Labour Organization, 2014. Learning from Catalyst of Rural Transformation.

Climate change, felt most directly in the agricultural sector through increased occurrences of drought and extreme weather, creates further difficulties for many rural communities in the Arab region.[67] Water scarcity, already a pressing problem, is most likely to constrain future agricultural expansion in the absence of a dedicated policy framework to manage existing water resources more sustainably.[68] This fundamental challenge is often coupled with the progressive depletion of local natural resources on which many of these communities rely, such as agricultural land and fishing grounds, ground water resources and forestry, thereby increasing pressures on rural communities.[69] An example from Tunisia illustrates this dilemma:

> In Tunisia, structural constraints limit farming productivity. These include scarcity of natural resources, such as water, particularly during drought periods, inadequate access to new technologies and financial resources, and uneven land distribution. Agricultural activity remains mainly pluvial, extensive and highly dependent on climate change, with subsequent consequences for food security.[70]

Conflicts, water scarcity and climate change pose significant constraints to agricultural production and rural livelihoods in the Arab region.[71] Climate problems, unsustainable natural resource management practices and agricultural land fragmentation add to what is often a catalogue of rural development pressures that lead many rural young people to migrate to cities.

2. Access to education and training

Many isolated rural areas are marked by limited infrastructure and access to basic services, including options for education and training. The nearest school may be too far away for regular visits, which constrains girls in particular. A lack of radio, television and modern information technology due to a lack of electricity compounds the inaccessibility of even basic knowledge and education for many remote, rural communities. Lack of education and training reinforces the limited degree of diversification for local economies and market access, creating a vicious circle of poverty for many. It also reinforces poverty-induced migration to urban centres, especially among youth.[72]

The lack of a local value chain, including local capacity to maintain and repair technology, is a major obstacle to the widespread adoption of small-scale RETs. It also contributes to distrust of those technologies by local communities in areas where pilot projects were conducted. A lack of local capacity-building and training, as well as investment in non-energy sectors in rural areas, has also limited the potential of RETs in the past,

which suggests that capacity must be built in more than one area in order to unbundle the full potential of small-scale RETs in rural communities.

3. Access to technology and markets

Many rural communities are isolated in terms of geography, infrastructure, training, technology and, by extension, markets. Deficits in access to modern energy, particularly electricity, cause local communities to pay a high price in terms of labour and bear a proportionately higher financial cost for inferior energy solutions. Modern small-scale RET solutions, even if desired, may be out of reach owing to a lack of access to the expertise and knowledge necessary for maintenance, if required.

4. Access to information

As is the case with access to technology, a lack of access to information constrains the deployment of technology in rural areas. As a result, many do not know or understand the benefits that RETs could offer, including the financial benefits. This situation can be worsened by distrust in new technologies and a lack of local experience and access to trusted sources of knowledge. In Arab LDCs, the reach of rural technology is further complicated by illiteracy, including digital illiteracy stemming from a limited use of digital technologies due to the absence of electricity.

5. Pricing policies for conventional technologies

Prices for small-scale RETs have fallen significantly in recent years, making various technologies increasingly competitive with conventional technologies when competing on equal footing.[73] This is in addition to the environmental and climate benefits of such technologies, which are not considered in the pricing of RETs. In contrast, many Arab countries continue to subsidize liquid fuels, particularly those used by low-income households and the agricultural sector, such as kerosene and diesel. The often-substantial difference between actual and subsidized prices for these fuels provides significant disincentives—some would argue perverse incentives—to continue the use of inferior, less efficient and more polluting fuels and technologies. Electricity subsidies can also provide fundamental disincentives for RETs, including in agriculture. Arab countries are among the largest subsidizers of energy, and agricultural sectors remain large beneficiaries of fuel subsidies, even where previously untargeted subsidies have been reformed in the past.[74]

This problem is illustrated by the example of solar-powered irrigation systems (SPISs), which can be cost-effective compared to conventional fuel technologies. In Morocco, fuel subsidies were largely eliminated in 2015, with the exception of butane gas, which is primarily used by households and for agricultural tasks. ESCWA identifies butane subsidies as a substantial constraint to the large-scale deployment of solar pumping systems in Morocco, as they render alternative technologies cost-ineffective.[75] In Tunisia as well, even with direct subsidies for SPISs in place, these systems are not profitable because of the heavy subsidies for electricity for pumping and irrigation.[76] While conventional fuels and electricity continue to enjoy substantial price support from many Governments in the Arab region, RETs rarely benefit from subsidies. The conventional practice is to call for market-based approaches that deliver these technologies to rural markets.[77]

6. Access to finance

Access to finance remains a significant issue for rural communities, both for end users and municipalities. Small-scale RETs may save communities money in the long term and increase productivity (and, by extension, incomes), but the initial investment cost is often too high for households, farmers and communities. Appropriate financial products targeting this particular market segment (i.e. dedicated microfinance tools and institutions) are lacking in many contexts, often leaving financing to individual pilot projects that depend on third-party funding. Even when financing options are available, such as through central government schemes, borrowers in rural areas can face significant hurdles as a result of disbursement procedures, political instability, a lack of communication, complicated paperwork or the absence of collateral.[78] These challenges are compounded by a lack of capacity to identify worthwhile projects and sources of funding and develop project proposals within municipalities serving rural areas.

7. Political representation and prioritization

Rural development gaps and a lack of access to a variety of basic services, infrastructure, technology and information have resulted in missing markets

for small-scale RETs in rural communities. The ability of rural communities to represent their needs and concerns in Government are, in turn, severely constrained in many parts of the Arab region. National development plans often pursue ambitious yet vague objectives, with limited policies specifically targeting rural development beyond indicator box-ticking, practical institutional reform or topics such as decentralized energy provision. Some past initiatives have treated small-scale RET programmes in rural areas throughout the Arab region as individual development aid initiatives run as pilot schemes, often in combination with free technology "handouts".

While some of these initiatives have benefited local communities, they have often failed to translate into scalable initiatives for market creation that can be replicated elsewhere. In fact, it is argued that some of these projects have done more harm than good.[79] For example, an ESCWA study from Lebanon finds:

> Similar to donor fatigue, the local community is suffering from assessment and survey fatigue. There is an overwhelming sense that a significant number of development and aid agencies and civil society organizations undertake thorough assessments, collect data and then either disappear or implement small-scale projects "mostly for the refugees", as reported by large numbers of citizens. This has resulted in a lack of motivation among the majority of citizens speaking to donors and organizations.[80]

While organizations such as the International Renewable Energy Agency have reported calls from within the development work community to "stop giving away things",[81] decentralized energy remains vastly underprioritized, and hence underfinanced, by Governments. This often compares with massive subsidies on fossil fuels, as discussed previously. Research by Sustainable Energy for All from 2018 reveals that, in the 20 countries with the largest electricity access deficits in the world, only 1 per cent of investments committed to the electricity sector went to decentralized energy solutions.[82] In order to create a viable rural market for decentralized small-scale RET solutions, rural development in basic services, energy, infrastructure and technology must become a focus of proactive policymaking, moving beyond bland statements of intent. This will require substantial policy and institutional reform.

8. Institutional constraints

With no existing markets for small-scale RETs, institutions from national, regional and local governments play a critical role in promoting adequate technology solutions to disadvantaged communities. The challenges faced in the Arab region, as elsewhere, include a lack of relevant and integrated regulations, laws and overall policy support for sustainable small-scale solutions to rural energy supply, as well as unclear institutional arrangements and competencies within and between different levels of government. Since rural energy is often considered primarily a poverty-related issue, local solutions may miss out on the potential of wider economic policies to catalyse localized technology development. Weak local governments often struggle to coordinate their work with national policies and with local rural organizations. As a result, remote rural populations often have little representation or ability to organize and participate in two-way communication with regulatory and legislative bodies or the private sector. The latter faces numerous challenges as well, including legal and regulatory uncertainty, red tape and corruption, none of which help to bolster credibility with people devoid of large incomes who are meant to invest in new technologies.

9. Political instability

Conflict and political instability contribute significantly to development gaps in rural areas. The Government's inability to focus on small-scale solutions to local problems in the face of overarching national security challenges contributes to this problem as much as red tape and a lack of capacity, mandates and control by national and local governments. In countries with acute political instability, rural areas and (in some cases) entire regions may be outside any clear political jurisdiction or deliberately kept isolated and underdeveloped. The social, economic and political costs of such situations are eventually borne by the entire population in these countries. Both conflict and post-conflict countries also lack financial resources and the necessary business environment to facilitate local technology and capital market creation, which could help rural communities to acquire better technologies.

B. What policies are needed to support the adoption of small-scale renewable energy technologies in rural areas?

The aforementioned obstacles create a challenging context for mainstreaming small-scale RETs in remote rural areas at sufficient levels to power productive activities to reach people who often lack access to basic necessities. The national solutions required must undoubtedly identify local needs, including the potential for demand and the willingness and ability to pay for modern energy services.

The World Bank multi-tier matrix for measuring access to household electricity supply outlines six levels of energy access, from tiers 0 to 5 (tables 4 and 5). Tiers 3 and above are usually associated with new opportunities that reduce poverty and inequality; however, any tier provides improvements to rural livelihoods when the alternative is the absence of energy services.[83]

Table 4. Multi-tier measuring access to household electricity supply

Attributes		Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
1. Peak capacity	Power capacity ratings (in watts or daily watt-hours)		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
			Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
	Or services		Lighting of 1,000 lmhr/ day	Electrical lighting, air circulation, television and phone charging are possible			
2. Availability (duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
	Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
4. Quality						Voltage problems do not affect the use of desired appliances	
5. Affordability					Cost of a standard consumption package of 365 kWh/year <5 per cent of household income		
6. Legality						Bill is paid to the utility, pre-paid card seller or authorized representative	
7. Health and safety						Absence of past accidents and perception of high risk in the future	

Source: World Bank, 2015. Beyond Connections. Energy Access Redefined. Washington, D.C. p. 6.

Table 5. Multi-tier matrix for measuring access to household electricity services

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Tier criteria		Task lighting and phone charging	General lighting, phone charging, television and fan (if needed)	Tier 2 and any medium-power appliances	Tier 3 and any high-power appliances	Tier 2 and any very high-power appliances

Source: World Bank, 2015. Beyond Connections. Energy Access Redefined. Washington, D.C. p. 6.

RETs with productive uses may result in a greater willingness and ability to pay for electricity and thus have the potential to create what the United Nations calls "a virtuous cycle of increasing energy consumption resulting in enhanced welfare and higher levels of human development".[84] They also require more sophisticated policies than those merely targeting tier 1 access, as well as a greater variety of financial products, regulatory frameworks and technical training for local communities. In this section, key policy interventions to move to tier 3 access and beyond are explored in more detail.

1. Integrating renewable energy technologies with rural development policy

Rural development policy plays a pivotal role in offering more opportunities to people in remote locations. Sustainable energy access through RETs must become an integral part of rural development planning at the local, national and regional levels. Alongside Arab countries' nationally determined contributions under the United Nations Framework Convention on Climate Change, Goal 7 on sustainable energy within the SDG framework can provide a background to promote sustainable energy access as a critical goal in and of itself in both urban and rural areas. By emphasizing the crucial need to move from merely providing people with the bare minimum (tiers 1–2) under poverty-alleviating policies towards making sustainable modern energy available for productive purposes, stakeholders can focus on policy responses that move beyond individual aid projects and hand-outs to provide technology, education and training that enables communities to address their own needs effectively through a know-how approach.

Consideration of past experiences can be helpful in designing effective policies and programmes to assist rural populations. This includes the need to strengthen municipalities' and local governments' mandates and capacities, both human and financial, in order to support rural communities more effectively. Specific capacity-building needs identified by the ESCWA REGEND initiative include areas such as identifying projects, sourcing funding, developing project proposals and conducting feasibility studies.[85] A bottom-up approach that facilitates effective communication and consultation with rural communities about their wider development needs, such as through town hall meetings, is a critical tool to develop solutions for which there will be real demand. The United Nations Conference on Trade and Development highlights this aspect, arguing:

> RETs have predominately been a result of an energy policy agenda, which was very much a market-push agenda: modern energy services and electrification are required for rural development; grid extension is too costly and time consuming; and RETs represent a low-cost and environmentally friendly alternative. But this fails to reflect market demand: what are the energy needs of that particular rural society that will enable it to develop? In order to take advantage of the opportunities afforded by increased access to modern energy services, parallel investments in other sectors are required … Energy investments should be integrated into rural development strategies so they can provide the modern energy services required by other sectors.[86]
>
> Similarly, programmes that aim only to provide access to electricity for basic needs or income-generating activities can succeed in contributing towards viable economic progress only if other

sectors in the rural economy receive equal attention. Pueyo and Maestre highlight that electricity is "a necessary but not sufficient condition for income generation and poverty reduction" that must be combined with other development efforts, such as access to financing for electric appliances, access to markets for additional production and skills for entrepreneurs to identify opportunities created by electricity.[87] The quality of electricity plays a major role as well, reinforcing the message to policymakers that rural access to sustainable energy requires more than simply providing an energy connection that checks a statistical box.

Energy sector development that mainstreams decentralized energy solutions for rural constituencies must therefore go hand in hand with investments in local training and capacity-building, as well as investment and financing solutions, including for non-energy sectors. Past studies advocating for SDG localization have repeatedly highlighted some key areas for public policy support:[88]

- Social and collaborative economic initiatives.
- Urban-rural partnerships.
- Sustainable tourism.
- Local food systems initiatives and circular economy models.

Countries such as Jordan, Lebanon and Tunisia have energy policies with national medium- and long-term objectives for the use of renewable energy, based primarily on large-scale utility projects; however, none of these countries have policies in place that specifically target the promotion of small-scale RETs for use in income-generating activities.[89] The key to scaling up such technologies is to give them space in national and localized planning and to follow up through dedicated policies with the institutional capacity to pursue them.

The work of ESCWA through its REGEND initiative in Tunisia highlights the importance of increasing the role of local governance and bottom-up approaches in sustainable rural development. In light of the significant steps made by Tunisia to increase political decentralization, ESCWA argues:

"Today, Tunisia faces the crucial task of shifting power from the national to the local level. This decentralization of power has the potential to address long-standing issues of dramatic regional disparity in the health-care, employment and education sectors, as well as in poverty and infrastructure.

While not all creative solutions are successful, local officials may be more willing to try new ideas, which, if successful, could be replicated elsewhere. This could introduce a new political class, outside the country's traditionally dominant political parties, one that could provide more opportunities for women and youth to enter politics."[90]

2. Facilitating access to finance

The lack of financing facilities for rural populations is a widespread problem across the Arab region and beyond that affects communities' ability to secure access to a wide range of technologies (in addition to RETs) with the potential to improve their economic productivity, income-earning opportunities and quality of life. Policymakers must therefore identify and support the creation of new, innovative financing models that help to overcome the traditional constraints facing rural communities. Special focus must also be placed on the separate needs of rural women, who often face additional obstacles in accessing finance (chapter 4).

In that regard, microfinance plays a key role, facilitating financing for projects that would be unbankable under normal considerations. The Food and Agriculture Organization of the United Nations (FAO) has summarized the following key options to improve the provision and accessibility of microfinance for rural communities:[91]

- **Support (micro) financing institutions that are already familiar to farmers.** Institutions can use social group guarantees and collateralize financed assets where possible and practical, providing additional insurance and technical assistance. Interest buydown subsidies can help reduce monthly payments for farmers, which was tested in Tunisia under the Solar Programme (PROSOL) of the United Nations Environment Programme.[92] Intermediaries such as social capital organizations can be used to buy equipment from vendors in bulk and resell it to farmers. Using local organizations can also help to overcome some of the barriers rural communities face in accessing finance, such as

remote locations that are far from bank branches and problems encountered by farmers in dealing with the bureaucracy associated with traditional banks and loan schemes.[93]

- **Encourage local banks to augment lines of credit to farmers.** Lebanon had a national financing mechanism initiated by the Central Bank of Lebanon (Banque du Liban) dedicated to the financing of green energy projects in Lebanon called "National Energy Efficiency and Renewable Energy Action". Green loans were offered at an interest rate of 0.6 per cent for a period of up to 14 years, including a grace period of between six months and four years; however, small farmers without the necessary capital faced barriers.[94] Traditional finance and microfinance products could be designed to help farmers to invest in new machinery and technical equipment such as RETs, including SPISs. Credit frames that correspond to farmers' needs, taking into account their seasonal and unstable incomes, are an important factor in improving the accessibility of credit facilities to farmers. A related option is microleasing, whereby solar-powered irrigation equipment is rented to the small farmer by a financial institution, such as a credit and savings cooperative, a microfinance institution or a commercial bank.[95]

- **Boost access to credit, not only for farmers but also for local entrepreneurs.** FAO laments the lack of local and regional small and medium-sized enterprises in developing countries internationally, a trend that can also be observed in many Arab countries. Strengthening the missing middle has significant potential to drive local innovation, poverty reduction and employment generation, rather than leave the market to a few large operating companies. The Tunisian Solidarity Bank, for example, was established as the main public financial institution dedicated to small and medium-sized companies. It facilitates access to financing, particularly for young entrepreneurs, by simplifying the conditions for granting loans, subsidizing interest rates, reducing self-financing requirements and offering favourable repayment terms.[96] Under the REGEND initiative in Jordan, community-based organizations manage revolving funds that are offered to local entrepreneurs to improve their income-generating activities. The loans are made possible owing to a grant provided by the Global Environmental Facility. Rural site assessment visits conducted as part of the REGEND initiative have documented the encouraging success and significance of rural women entrepreneurs taking advantage of the revolving loan programme to boost the productivity of home-based businesses, with a substantial uptake of loans to purchase and install solar water heaters.[97]

- **Promote contractor models.** Payments are made to the contractor depending on the amount of water or electricity delivered. Variants include pay-as-you-go schemes, in which repayments are matched with the cash flow of the farmer, and rent-to-own schemes, for which informal credit is provided by relatives, employers or the informal sector.

- **Provide fiscal incentives.** Governments can also further support the affordability of small-scale RETs through fiscal tools such as duty waivers, value-added tax exemptions for RET products and, in some cases, strategically designed subsidies on RET products.[98] For example, Lebanon approved an application decree that provides tax credits for expenditures related to sustainable environmental protection. These include "equipment for the production of electricity/energy from solar power, wind power, hydropower, geothermal power or power from waste-based fuels, when installed to reduce the use of fossil fuel-based power by the investor".[99]
- **Reform subsidies for competing technologies, in particular fossil fuels.** This could have a significant impact on the cost-effectiveness of RETs while actually providing savings for States that could be used to support low-income households directly.[100]

Internationally, many different financing schemes have evolved for small-scale RETs in rural areas, allowing countries to study and chose models that suit their own context. Morocco, for example, has gained experience with different financing schemes for SPISs, the costs of which compare favourably to conventional technologies

in the country, including butane, diesel and electricity pumps. Agricultural associations and banks offer special loans to farms fulfilling certain criteria, in most cases including hard collateral. There are also a few examples of a local contractor model through energy service companies that provide an alternative business model for solar-powered irrigation. Under this financing model, the company signs a performance contract with the farmer, taking over engineering, supply, financing, installation and maintenance of the solar-powered irrigation equipment, while the farmer pays for the energy or irrigation water delivered.[101]

Community energy has become increasingly popular internationally. Different models exist and usually include a utility company that acts as a contractor.[102] Under one scheme that has gained popularity in the United States of America, agricultural operations lease a portion of their property for renewable energy development, usually solar photovoltaic, for the life of the project, which can be up to 30 years. The solar company pays the landowner for use of the property on which the solar array is located, while farmers subscribe to the solar project. Users can also receive an additional benefit in the form of savings on their electric bill.[103] Community energy schemes are beneficial for rural communities, as they allow equal access to the economic and environmental benefits of solar energy generation regardless of ownership of a home, land or business and are a viable option in many Arab countries.[104]

A modified approach to community renewables might be a feasible option to support rural communities, including those unable to access the technology otherwise; however, further government policy would be required to support such schemes. In many cases, the decentralization of utility markets is fundamental to enabling community energy, supporting private energy companies in filling a gap in supply to rural communities. This often involves reforming utility markets themselves, allowing for competition but also regulating private companies and the services they offer to local communities. To support bottom-up schemes such as community renewables, stakeholders must strengthen the capacity of local governments and municipalities to consult with rural communities, map their needs and provide support to private companies in accessing communities. Lastly, international experience demonstrates that community renewables flourish where local energy production goes to local farmers and back to a grid.

While community renewables may be an adaptable model for communities that are otherwise disconnected from grid-based energy, they also have significant potential to promote the uptake of renewables in communities that have grid-based access but require structural investment in, and reform of, utility pricing and net metering. Lebanon has gained some experience with solar photovoltaic community net-metering initiatives. A number of communities have implemented community energy schemes with the aim of pooling community investment in generating electricity from clean renewable energy sources for their collective financial and environmental benefit. Based on a microgrid, solar photovoltaics or hybrid solar photovoltaics combined with diesel generators function as a backup system when the national grid does not deliver electricity.[105] This extension of community renewables and its market implications are a potent concept to consider for a variety of contexts in the Arab region and warrant further research at the national level.

3. Facilitating private sector investment in mini-grids

Mini-grids will likely form an important part of the future of decentralized energy for rural areas that cannot be connected to or receive a stable supply from a national electrical grid for the foreseeable future.[106] Mini-grids are suitable for productive uses of renewable energy in areas such as agriculture and small, rural-based industries, such as those requiring tier 3 access. Those energy services will require more power and a more reliable supply of electricity than can typically be supplied by individual home-based systems, such as those based on solar photovoltaic energy.[107] In turn, those productive uses can support local job creation and increase end users' ability to pay for the electricity they consume.[108]

The private sector plays a pivotal role in scaling up the use of mini-grids, providing technologies, individualized advice and finance. Governments, in turn, play a fundamental role in facilitating private sector investment in mini-grids by creating a business environment conducive to private sector development in the field of small-scale RETs for rural development. This includes removing or reducing hurdles specific to the development of mini-grids, particularly the political risk (i.e. the risk of eventual national grid expansion with potential subsidized tariffs), payment risks, demand, technology and operational risks.[109]

Governments can help to encourage private sector investment with additional benefits for individual small-scale applications of RETs beyond mini-grids by including rural access to RETs as an essential item in their policy agenda for rural development and by actively partnering with the private sector to this end. Key policies, in line with the national and local contexts of each country, could include:

- **Mapping off-grid areas with significant development potential.** Governments play a crucial role in de-risking high initial capital expenditure on mini-grid infrastructure by providing private companies and the public with a clear picture of local development needs, combined with security planning for private companies that includes government plans to extend the national grid.[110]
- **Providing risk mitigating measures to de-risk lending made by commercial banks,** for instance, through government guarantees. Where national Governments cannot provide these guarantees, multilateral development banks can step in and provide commercial banks with equity guarantees that can increase their reserve ratios allocated to lending for RET projects. This can also reduce the need to require collateral from borrowers. Multilateral development banks can also play a role in providing concessional loans as part of their mandate, kick-starting projects and then allowing private sector finance to flow over time as their track record builds and confidence increases.
- **Encouraging links between electricity generation and productive uses.** Governments can support the private sector by actively promoting the use of mini-grid systems that support agricultural machinery, local shops, welding machines and other income-generating activities.[111] Key tools include support for end-user finance, consumer-friendly regulation and active communication.
- **Supporting community-private partnerships.** When local governments facilitate communication between developers and local communities, businesses can explore and respond to local business potential and industry demand, thereby reducing a mismatch in supply and demand. Some developers also opt for anchor-business-community models to lower payment risks.[112] Local job creation is another potential benefit in this context.

4. Integrating rural energy and environmental management

Progress in energy access in rural communities offers a unique opportunity to couple sustainable energy programmes with environmental policy and is a necessity in some cases. Integrating sustainable (rural) energy with planning for natural resource management and climate change is a critical tool in government policy toolboxes. One such example is water management, where expanded access to modern irrigation technologies must be coupled with sustainable water use. Small-scale RETs can power agricultural irrigation via solar and hybrid pumping systems. By improving yields and reducing vulnerability to changing rainfall patterns, SPISs can play a critical role in food security, income generation and rural development.[113] Where the locality allows, excess electricity generated by SPISs could also be used for other appliances on the farm or could feed into a local mini-grid.

On the other hand, SPIS use could risk accelerating indiscriminate use of local water resources. The Arab region is one of the most water-stressed regions in the world, and the unmanaged withdrawal of groundwater resources is a non-option for Arab countries.[114] Particular risks of SPISs include implicit incentives to (i) apply more water in the field, (ii) expand the area of land under irrigation, (iii) grow higher-value crops that are more water-intensive or (iv) sell water to neighbouring farmers and communities.[115] SPISs increase these risks because, unlike in the case of irrigation systems powered by diesel or grid-connected electricity, farmers face no marginal cost per unit of water produced using an existing SPIS. In fact, SPISs may increase farmers' incentives to employ at least one of the above risks in order to speed up repayment of the technology's initial investment cost.

Unrestricted pumping and pollution can severely threaten the sustainability of aquifers, a significant problem in areas in which groundwater resources are already being overexploited. One of the most water-stressed geographies in the world, the Arab region is already suffering from a combination of dwindling groundwater resources and a lack of water governance. The

United Nations Development Programme (UNDP) has repeatedly observed that water and energy often remain mismanaged as interrelated resources. Specifically, in the Arab context:

> Water and energy are run by separate utilities that do not always share the same interests or priorities; combining them could improve coordination. The energy sector in many Arab countries is dominated by State-owned monopolies of low efficiency, and mismanagement is common. Awareness of water and energy perspectives and their interdependence are essential for effective water governance and management.[116]

Exploring and supporting the use of SPISs in policies aimed at scaling up the use of RETs in rural areas will require a focus on streamlined, effective water-energy governance that ensures groundwater resources are sustainably managed with the advent of modern irrigation technology, such as drip irrigation and flow meters that can control and limit the quantity of pumped water per day. FAO provides detailed suggestions for policies that can help manage water resources while supporting SPIS development.[117]

Water accounting. Using local groundwater water resources sustainably requires the systematic study of the current status of and trends in water supply, demand, accessibility and use. FAO explains the use of water accounting in the following way:

> By evaluating return flows, measuring both basin and field efficiencies, and distinguishing between consumptive and non-consumptive savings, water accounting helps to address such questions as: what are the underlying causes of imbalance in water supply (quantity and quality) and demand of different water users and uses? Is the current level of consumptive water use sustainable? What opportunities exist for making water use more equitable or sustainable?[118]

Water planning and regulation. Water accounting must be followed up with systematic water planning and effective regulations for water use. Similar to the way in which renewable energy and energy efficiency are frequently tied together in policymaking, policies aimed at scaling up the use of water pump systems in rural areas throughout the Arab region must be coupled with regulations on water use. Investment support may tie financial incentives to a set of specific criteria, which could include making them available only in areas where groundwater is not overexploited.[119] Incentives could also be tied to technology choices, such as the mandatory use of drip irrigation systems in combination with financially supported SPISs, which has been implemented by the ESCWA REGEND initiative to support the use of SPISs in Jordan.[120] Regulation can also be used to restrict SPISs at certain times. Communication, information and training provided to local farmers also play an important role in complementing regulations.

Separate regulatory measures may be taken to address parallel problems in certain regions, such as seawater intrusion, land subsidence, pollution by inadequate sanitation and wastewater treatment, pollution by industry and agriculture, and an inequitable allocation of water resources among farmers.[121] This highlights the vast potential for integrated water planning and policymaking that goes beyond a mere focus on SPIS technology. Despite some variance throughout the Arab region, the need for such integrated policymaking in water management is universal across Arab countries. Furthermore, the issue of inequitable allocation of water resources is also important from a social equity point of view, as traditional financing and subsidy schemes may benefit mid-sized farmers at the expense of small farming units. Small-plot farmers may face considerably longer payback times for SPISs than those with larger plots, highlighting an aspect of SPIS finance with the potential to reinforce existing inequalities within rural areas.[122] The proliferation of informal loans, used by farmers who cannot secure formal financing schemes, may then lead to more illegal wells, as seen in Tunisia, for example.[123] In such situations, local governments and other institutions may play an essential role in supporting well-designed policy solutions and regulations that truly benefit all members of local communities (chapter 3).

5. Raising quality standards

The success of small-scale RETs and their sustainable use in rural areas depends on well-designed products and the quality of their installation and maintenance. Low-quality products, poor installation and a lack of maintenance, which lead to suboptimal performance or failure, can undermine the credibility of RETs significantly and further harm trust in modern technologies and government promises. Dealing with bureaucratic processes and technical configurations can be a

challenge for many rural communities. In its global work on SPISs, FAO observed:

> The lack of quality standards for equipment was mentioned several times in interviews and the online survey. Poor tender design is repeatedly reported … Farmers feel insecure about what manufacturer, what configuration and what specifications are needed and where compromises between cost and quality considerations can be made, if any. If systems fail, farmers quickly lose trust in the technology and abandon it. Another challenge is the bureaucracy, arbitrariness and sometimes corruption at customs clearance in many countries. Arbitrary application of tax exemptions for solar equipment, for example—despite official guarantees—can significantly increase costs of solar pumping systems. Uncertainty about long-term policies, such as feed-in tariffs, negatively affects investment climates.[124]

In many cases, this means significant efforts must be made to increase the regulatory and technical capacity of governments both at national and local levels to spread expertise in RETs, in their specific technical requirements and in their effective product and servicing regulations.[125] Observations from Arab countries suggest the same presence of obstacles as observed by FAO. In the presence of an already weak regulatory environment for RETs and other technologies in Lebanon, an ESCWA study that interviewed a number of people from rural communities in Lebanon found significant related problems, including the absence of quality control supervision and inspections and numerous, uncontrolled imports from markets mass-producing cheap products across all sectors. This encouraged a downward spiral in price and quality for renewable energy products.[126]

Specific attention to this issue and institutional capacity-building must therefore be included in any plans to support the development of RETs, not only in rural areas. These include:[127]

- Quality control of RET equipment through consistent reviews and updates to technical specifications and equipment standards, in line with international standards. These standards should also be integrated into application decrees, which can then be applied to all imports and enforced at ports of entries.
- Certification of suppliers/installers in-country, to help guide end users in working with reputable, quality companies.
- Standardization of products and services, including guaranteed after-sale services, technical product design to allow interoperability of system components and common rules and quality standards.

6. Providing local training

The risk of improperly installed and poorly maintained technology that breaks down easily or provides suboptimal energy is a substantive obstacle to the wider adoption of small-scale RETs. International experience provides ample background as to the type of problems that hinder the effective use of RETs and offers a valuable context for proactive policymaking that takes into account lessons learned (box 1). In parallel to nationally enforced technology quality standards and adequate maintenance packages, local training programmes on installing, operating, maintaining and repairing small-scale RETs are therefore critical to their successful deployment. The United Nations Conference on Trade and Development highlights this point by arguing:

> The provision or sale of technology "hardware" must be complemented by development of local know-how related to that technology: the technology "software" … In general, sustained rural development can only be possible if the existing political, economic and technical basis of rural society can adapt to new ways of living. If RETs are to be a feature of this new situation, then the capacity of local populations to manage them is imperative.[128]

In line with the Conference's emphasis on the need to develop a more holistic knowledge base in rural communities, proper use of small-scale RETs must undoubtedly include the development of markets that benefit from access to improved energy, including rural agricultural techniques and business models. Local training must include entrepreneurial skills in starting, operating and growing businesses, as well as business-related skills.[129]

This, in turn, raises the question of who should provide such training. Technological knowledge related to small-scale RETs can be transferred through a range of agents and methods, including national and local

government programmes, the private sector and RET companies. Since local technology training has thus far not been a component of technology packages in Arab countries, there is a need for policy intervention, whether through direct government programmes or incentive schemes to encourage businesses. Business skills and complementary development work can be promoted through government programmes and through strengthened rural platforms such as cooperatives (chapter 3). A logical step could be to dedicate space within government policy to explore the best avenues to strengthen the rural small-scale RET sector by prioritizing the sector in national and local development policy.

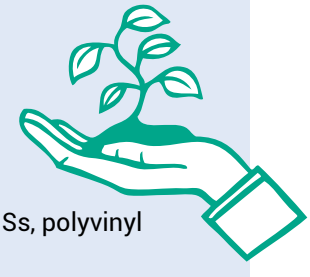
The UNESCWA REGEND initiative has taken this approach in its three base countries: Jordan, Lebanon and Tunisia. In Jordan, for example, local vocational training specifically targeted the installation of RET systems and solar water heaters, along with topical training on climate change, environmental challenges, health and safety and the cross-cutting role of gender in addressing these issues. Assistance packages to local communities consisted of donated production inputs, such as livestock, and the technical training needed to utilize them in productive activities.[130]

Box 1. Typical operation and maintenance problems with small-scale renewable energy technologies: solar-powered irrigation systems

FAO has engaged for many years in the promotion of SPISs in rural areas around the world. While there are many benefits associated with the technology (chapter 2), its uptake has faced many challenges, especially among small farmers. SPISs are relatively complex systems; therefore, their design requires not only a fit-for-purpose photovoltaic pump system and irrigation infrastructure but also an assessment of water requirements and the irrigation calendar, as well as end-user skills and knowledge.

Among the typical problems faced, FAO identifies a catalogue of issues that are representative of problems encountered by a range of small-scale RETs, including in Arab countries:

- Lack of awareness regarding the technology's potentials, risks and options.
- Lack of advisory services for farmers and other end users.
- Lack of technical skills related to planning, installation, operation and maintenance for both suppliers and farmers.
- Initial teething issues during the first months of operation.
- Lack of tailored solutions for farmers.
- Unavailability of spare parts.
- Service deficiencies, since services are often concentrated in large cities.
- Sand and dirt.
- Termites and/or rodents destroying the plastic of electrical cables and, in the case of SPISs, polyvinyl chloride (PVC) pipes.
- Poor siting, in which photovoltaic panels are shaded for part of the day or orientated incorrectly.
- Theft and/or vandalism of panels and other exposed technical equipment.



Resolving these challenges clearly involves a combination of measures, including government support for the development of supplier and service infrastructure, quality standards and rules for service provision, and collaboration with the private sector to ensure that high-quality products are expertly installed and support services are provided after installation. Local training and capacity-building are critical to complement such policies and ensure that rural populations can maintain and repair small-scale RETs, while increasing local knowledge of RETs, their potential, quality issues and correct siting and operation.

Source: Hartung, Hans and Lucie Pluschke, 2018. The Benefits and Risks of Solar-powered Irrigation: A Global Overview. Food and Agriculture Organization of the United Nations and Deutsche Gesellschaft fuŕ Internationale Zusammenarbeit.

At the government level, training can also be provided by international organizations, similar to the solutions employed by the ESCWA REGEND initiative.[131] This can include technical and regulatory support or support for identifying financing solutions and specific themes, such as regulation in areas ranging from quality standards and control to water management. Organizations such as FAO and the German Agency for International Cooperation (GIZ), for example, have also implemented a series of international courses and workshops, providing training for technical experts and guidance for government officials in areas such as financial modalities for technologies like SPISs.[132]

7. Raising awareness and improving communication

The adoption of new technologies always entails changes in consumption and behaviour. In comparison to urban areas, there is a greater leap to be made in rural areas from the status quo to investing in an unknown technology, as there are far fewer incentives for individuals to become frontrunners and thus create success stories and model cases for others. This is particularly evident in the case of rural communities, in which households are expected to pay a significant price for RETs competing with traditional fuels and energy supply practices that involve no financial transaction.[133] The introduction of improved energy technologies to rural areas can also face fundamental challenges in the switch from liquid fuel to solar or wind electric power; and many will wonder why there is a need for change when the old way had worked for so long.[134] Part of this dilemma is the often intrinsic asymmetry of information and power that leaves rural communities at the receiving end of government plans and policies, with limited market mechanisms and no support rooted in local populations for particular technologies.

Effective communication with rural communities is therefore a critical component of government policies aimed at promoting improved technology choices such as RETs. The promotion of sustainable energy technologies must consider two aspects: thematic communication, or the choice of message to convince people to adopt new technologies, and communication channels, or the way information is provided.

Thematic communication may involve all messages considered necessary to allow households and businesses to make informed decisions about their investment in energy technology. Typical messages that are used to promote the use of RETs include:

- **Social impact arguments:** Small-scale RETs present an opportunity to rectify an uneven distribution of access to electricity. They help to improve the delivery of essential services such as health and education to all members of society and foster entrepreneurship and business development.
- **Economic impact arguments:** Small-scale RETs help to increase economic productivity and development through the improved use of available resources, both human and natural. Productive uses of renewable energy offer significant potential for growth in rural business activity, allowing communities to be self-sustaining while also creating jobs around new and existing industry branches. Since RET deployment can also result in new business activities and better education for women (chapter 4), rural communities can also benefit from new business development and an increase in the number of income-generating community members.
- **Environmental arguments:** RETs can support a healthier nexus relationship between energy, water and food production; reduce environmental pollution; and contribute to the mitigation of climate change.[135] They present a sustainable energy solution to rural communities who live off of the natural resources surrounding them, helping them to protect those resources while offering them a better standard of living. Immediate, tangible benefits to local communities can include reduced indoor air and noise pollution from diesel generators, reduced deforestation and better community access to groundwater resources in areas in which solar water pumping and irrigation systems are combined with improved water management practices.

While all of these messages are important, many of these considerations are not fully understood by a number of communities (not only in rural areas) and therefore do not offer enough incentives to adopt new technologies. First and foremost, valuable information may consist of the

practical benefits that appeal to individual user groups, such as small farmers, households or public buildings like schools, health clinics and places of worship. It can focus on payback periods and cost savings for end users in the short and medium term, available financing options and the benefits to agricultural production of specific technologies such as SPISs. It can also focus on the real improvements to living standards provided by stable electricity supply: the ability to run electric appliances (e.g. refrigerators, televisions, mobile phones), space heating and hot water without the need to wait for the delivery of and frequently reinstall heavy liquefied petroleum gas cylinders.[136] Such information can be supplemented by increased information campaigning around indoor air quality and the associated health benefits for communities.

Communication channels can be diverse and are most effective if responding to the specific local context. In addition to the method of delivery, consideration must be given to who should be communicating the message. Communication methods can include media campaigns, organized workshops, hands-on training, community demonstrations, house visits, study tours and fairs and exhibitions.[137] Agents of information can and likely should involve a number of actors, including national and local governments; local community organizations, such as cooperatives and social funds; and social network institutions, including places of worship, schools and health facilities. The sharing of best practices, testimonials and success stories from neighboring communities and/or countries that demonstrate the real-life benefits of RET systems can play an important role in helping rural communities to approach new technologies, as demonstrated by the ESCWA REGEND initiative.[138]

8. Collecting data

The Arab region continues to face many constraints in the collection of qualitative and quantitative data across its economies, including with regard to energy. The international initiative "Tracking SDG7" has highlighted this repeatedly.[139] According to ESCWA:

> A key problem in many parts of the Arab region is the politicization of data and knowledge—even in benign areas such as basic population and energy consumption indicators—which provides an exceptionally difficult context for any effective policy progress.[140]

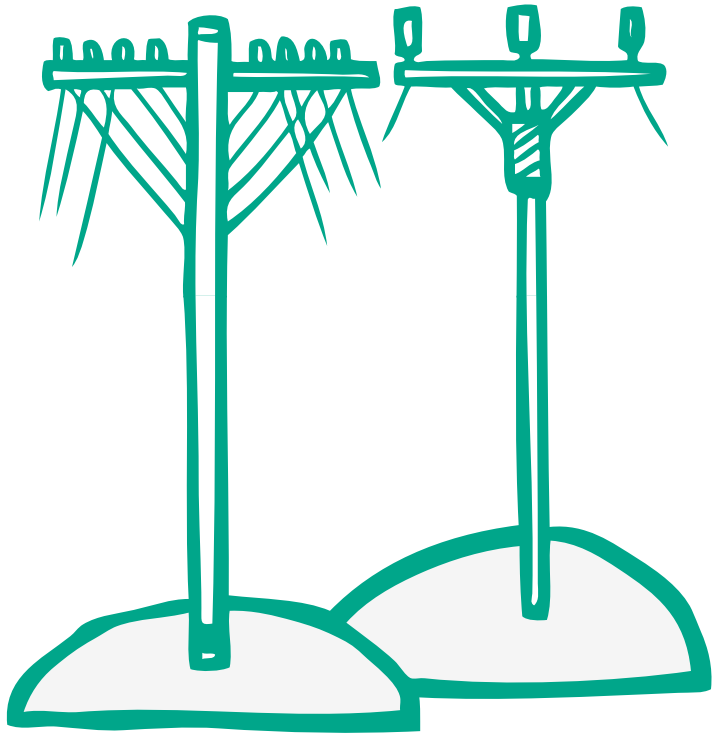
Improving the availability of and access to data for policymakers, industries, businesses, research institutions and civil society alike requires significant, active efforts by Arab Governments, which must:

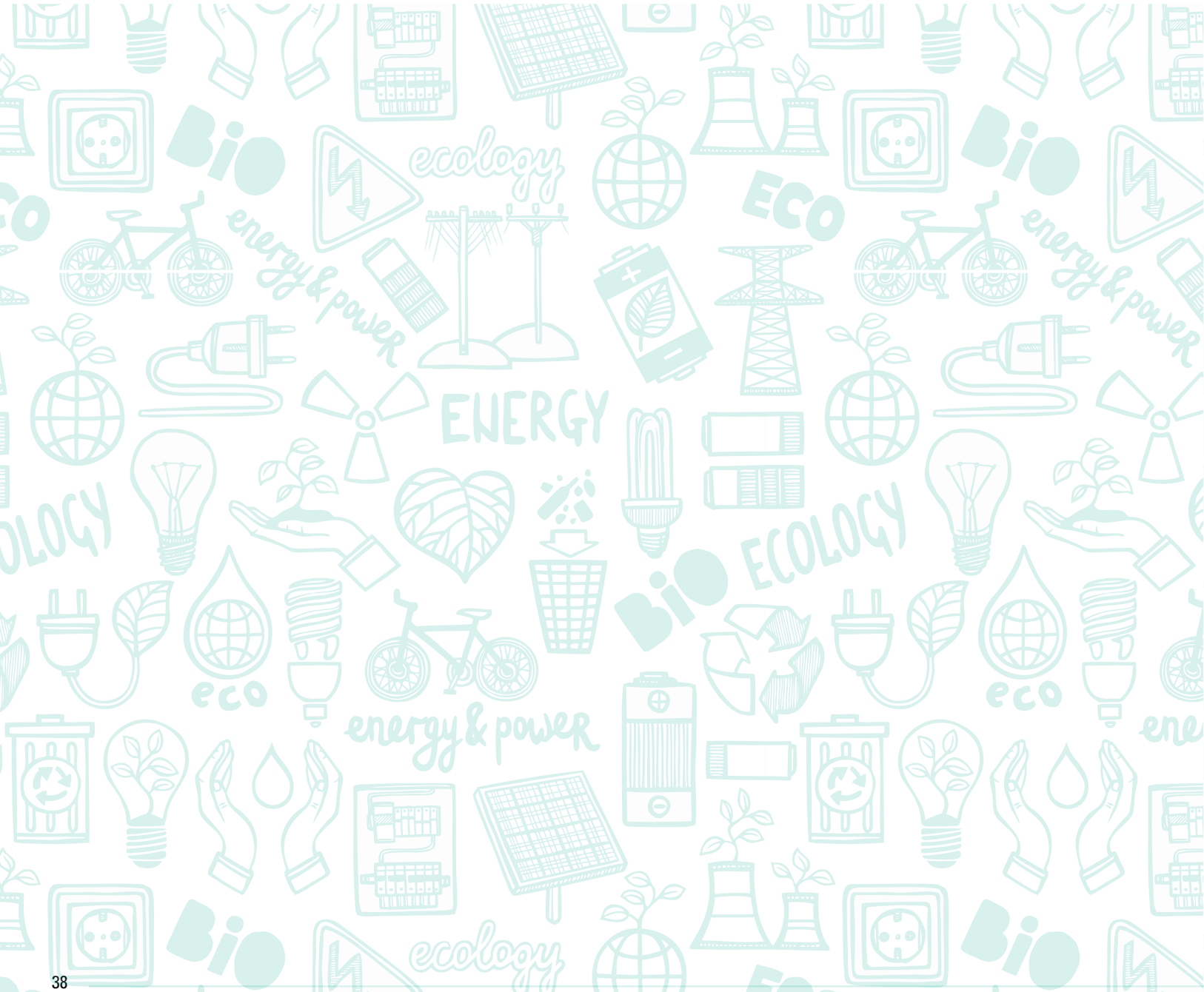
- **Build institutional capacity within Governments to collect, analyse and publish data transparently**, irrespective of political considerations.
- **Develop strong mechanisms to facilitate data-sharing between institutions**, both within the Government and between the public and private sectors, as well as with the general public.
- **Broaden the range of indicators to be measured, particularly in terms of energy, water and the environment,** including consumer surveys, and disaggregate data by geography, gender and other relevant factors. Ensure that Governments produce measurements on a regular and timely basis to track national energy trends. They should also adopt international methodologies to ensure data comparability. The ESCWA REGEND initiative has highlighted the need for more open-source, gender-disaggregated data in the context of its work in rural communities in Jordan, Lebanon and Tunisia.[141] These data should be integrated with existing data collection frameworks, such as the wide range of indicators to measure progress on the SDGs.

Data on who consumes what, with what background, in what parts of the country and with which additional needs are the basis not only for establishing a market for RETs but also for good governance and support for sustainable development as a whole. Data gaps in Arab countries are present in detailed population dynamic statistics, overconsumption habits and behaviour, regional-and gender-disaggregated data and many other aspects. These gaps complicate informed policymaking, scholarly examination and business development in many fields of development work. In order to move beyond a few headline indicators and provide detailed data on the environment and biodiversity, which remains a niche area in many Arab countries, policies must focus more on collecting data and integrating them with developmental goals.[142]

Prioritizing capacity-building for data collection, analysis and dissemination is a key component of good governance

in the Arab region and a prerequisite for economic growth. Media and academic institutions can play an important complementary role if given the freedom to explore, discuss and, where needed, criticize. They can also provide genuine credibility to data as the basis for sustainable business creation and local development initiatives.

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3 Strengthening institutions

A. Why do institutions matter for rural energy provision?

B. Why strengthen local governments?

C. What policies help to strengthen local governance?

D. What role should local development initiatives play?

A. Why do institutions matter for rural energy provision?

Institutions drive the decisions that shape people's lives, market development and the technology options available to communities, including in rural areas. Introducing new technologies such as RETs to rural markets requires a multitude of actors (including NGOs and, critically, the private sector) who depend on public institutions to provide legislative frameworks, regulations, investment codes, local and regional planning, and information to carry out their work effectively (table 6 for an overview of actors for energy provision). To strengthen the development of a local market for small-scale RETs and other sustainable technologies, targets and intentions must be accompanied by the right incentives, driven by political and institutional support and aligned policies. Institutions that can help to promote a stable framework for innovative and effective policymaking extend beyond government to include civil society associations, consumer groups and local business cooperatives. Strengthening all these institutions will provide the basis for true social dialogue, economic and social cohesion and sustainable development for rural economies.

Table 6. Roles and responsibilities of various actors for energy provision

Actors / Roles	International agreements	National policy formulation	Regulation, tax and incentives	Resource assessments	Project/initiative design	Grant funding	Commercial financing	R&D/technology development	Technical assistance	Loan guarantees	Construction	Product/service distribution	Microfinance provision	Provision of feedstocks/fuel	Marketing	Operation	Services purchase/lease	Maintenance
International bodies	■					□	□			□								
National government	■	■	■	■	□	■	□	□		■								
Local government			□	□	□	□	□											
National utilities				□	□			□		□	□	■			□	■		□
Banks/financial institutions							■											
International donors				□	□	■	■		□	■								
Technical experts				■	□			□	■		□							
Large private sector					■			□	□		■	■		■	■	■		□
Small-scale entrepreneurs					■			□			■	■		■	■	■		■
Agriculture and forest sector					□									■				
Microfinance institutions					□		■						■					
Universities/R&D								■	□									
Non-governmental organizations					■	□		□	□	□	□		□		■	□	□	□
Cooperatives					□						□		□		■	■	□	■
Community-based organizations					□						□		□		■	□	□	□
Consumers/households											□					□	■	□

■ Often undertake □ Potentially undertake

Source: Practical Action, 2010. Poor People's Energy Outlook 2010. Rugby, United Kingdom. p. 61.

B. Why strengthen local governments?

It is sometimes claimed that rural populations have limited influence in political decision-making, resulting in a national policy focus on capital cities and other urban and economic centres.[143] Strengthening local and regional governments (LRGs) can improve social dialogue and better integrate rural viewpoints and perspectives in national policymaking. LRGs have some fundamental advantages that complement central governance. They operate closer to citizens and are able to oversee their own specific social, economic and geographical contexts. In addition, if given the necessary power and capacity, they can devise policy solutions that address local and national concerns. Consulting local communities and including their needs and perspectives in national policymaking is critical to allow for a more effective development policy that helps to reduce the widening disparities between urban and rural spaces and between regions, thereby creating social and territorial cohesion.[144]

In the best cases, decentralization and the strengthening of LRGs can lead to better and more transparent service provision and improved accountability. It also creates space for local governments to experiment with alternative policies that may be less popular at the national level. This could be particularly valuable in terms of energy and technology diffusion in rural areas, in which effective solutions to local market creation may be highly dependent on the local context. As public employers, LRGs are also responsible for the employment conditions of government workers at the subnational level in charge of local policy implementation and public service provision, a critical task that can be fundamental to the effectiveness of national policy.[145]

Participants in the ESCWA REGEND initiative in rural areas in Lebanon lament longstanding structural problems in policymaking in the country, which include a large share of low-skilled employment in the public sector and a lack of sustainable and equal development across regions, with no defined strategy to drive growth in underdeveloped areas. The REGEND report on the baseline study for Lebanon finds that:

> Rural development is … constrained by the legal mandates of the municipalities. Even when funds are available and a needs assessment has been conducted, there are limited actions local governance/ municipalities can implement, especially in terms of infrastructure. The bulk of projects revolve around solid waste and water infrastructure, with the energy regulatory framework hindering investment in large-scale electricity generation projects.[146]

Similarly, weak local governments hinder the development of innovative technology solutions for local energy supply shortages.

> Another solution pertaining to Lebanon's rationing of electricity and constant shortages in supply was discussed and it consists of utilizing forestry management in a sustainable way to produce a bioenergy heating substitute to electricity. This will require the involvement of municipalities who control large forest lands and will further highlight the importance of integrated approaches towards successful implementation of similar initiatives.[147]

If provided with the right capacity, LRGs can become frontrunners and advance initiatives that benefit rural development based on local needs.[148] United Cities and Local Governments lists some of the themes that can be particularly relevant for RLGs, including:

> - Aligning urban and local plans with the SDGs.
> - Improving access to basic and social services.
> - Supporting local alternative economic models (green and circular economies, sharing and social economies, the inclusion of the informal sector in the urban fabric).
> - Boosting local food supply systems.
> - Making resilience an integral part of urban planning.
> - Fostering gender equality and respecting human rights in order to protect women, youth, minorities and immigrants.
> - Preventing discrimination.
> - Promoting cultural diversity, creativity and civic participation.
> - Increasing accountability to co-create cities and strengthen urban-rural linkages.

Stronger local governments that are better equipped to provide services, consult with and be accountable to local populations have the potential to play a catalytic role in Arab countries and their rural communities.

C. What policies help to strengthen local governance?

1. Reviewing existing government structures

Central Governments can assess whether a greater role for LRGs could help to provide better services to rural and urban populations by reviewing existing political structures. Tasks, mandates and responsibilities may be distributed not only between national and local levels of government but also among central government institutions. In Jordan, for example, there has been an increase in the number of women appointed to leadership positions in the energy and renewable energy sectors since 2018. In the Ministry of Energy and Mineral Resources, both the Minister and the Secretary General are women with proven track records in women's empowerment. EDAMA, a Jordanian business association that promotes the interests of renewable energy companies, has recently appointed two women to its board of directors. A woman has also been appointed to head the country's first and only green business incubator.[149]

Rural policy may benefit from reinforced linkages around existing institutional synergies supporting stronger coherence and coordination and from sustainable financing mechanisms and shared budgets for specific cross-cutting initiatives in rural development, sustainable energy and climate policy.[150] Some of these reviews may find that previous centralized planning and development models should be changes, for example, moving away from plans to connect rural areas to the national grid in favour or more systematic support for decentralized energy solutions in areas far from economic centres.

2. Strengthening mandates

Local governments can only implement policies that fall within their political mandate and lie within their human, technical and financial capacity. In order to strengthen the capacity of LRGs to become more effective agents of positive change in rural areas, they must be given the necessary resources: clear mandates, skilled human resources, technical expertise and a stable flow of financial resources. This implies a need for more streamlining, institutional restructuring and clear messaging and communication within and between government bodies. There must also be a systematic review of what mandates and other resources can and should be allocated to local governments, as well as what checks and balances are available to increase transparency and accountability in their operations. This is no easy or fast task for governments, but it is undoubtedly critical to empowering local communities, driving rural development and improving social and economic cohesion. Small-scale RETs can also be promoted at the national level, but local authorities must be able to assist in public consultation processes and information-sharing.

Algeria adopted a new law on local government in 2018, which seeks to strengthen local achievement of the SDGs. The project is part of the CapDel programme, which is led by the Ministry of the Interior, local Governments and land planning and receives support from UNDP and the European Union. As part of the initiative, 10 pilot municipalities have been working on the adoption of a participatory approach to local development planning, integrating the SDG framework into the planning, implementation and monitoring of local strategies.[151]

3. Building capacity

Building institutional capacity to develop integrated, effective and inclusive policies at both the national and local levels is the most important prerequisite for functioning government institutions. Municipalities and local governments in particular are critical to improving rural livelihoods and translating wider national development goals into effective local policy. Skill-based recruitment, with sufficient funding allocated for high-quality employment at all government levels, is as important as transparency and accountability across government. Training and capacity-building at multiple levels include planning, implementing, monitoring, reporting and communicating with other government institutions and the private sector. Capacity-building

to support rural development and sustainable energy initiatives at the local and regional levels can include:

- Building an understanding in government institutions of local socioeconomic challenges, including for different segments of society such as youth and women.
- Identifying barriers to development in local communities.
- Preparing lists of activities to strengthen local economic development.
- Identifying the type of assistance to be offered to local communities and, where feasible, providing access to finance for such assistance.
- Assessing capacity needs, including inside government administrations and among local agents such as business sectors, women's organizations and others.

This approach has also been adopted by ESCWA as part of its REGEND initiative to help support rural community development.[152]

A number of international organizations have been active in promoting and building government capacity at different levels of governance. To that aim, ESCWA has been conducting in-depth work in Arab countries through peer-to-peer work with governments, workshops and research, focusing on governance, natural resource management and local development.[153] As part of its REGEND initiative, the Commission has been organizing capacity-building workshops for municipalities to identify projects and sources of funding and develop project proposals and feasibility studies. It has also hosted workshops on specific thematic areas such as RETs and the water-energy-food nexus, as well as on planning, managing, implementing and monitoring nexus projects.[154] Separately, the United Cities and Local Governments Middle East and West Asia Section has designed and organized many activities and initiatives to raise awareness and involve local governments in the process of achieving the SDGs. It has organized capacity-building workshops for municipal staff based on four strategic priorities: migration and social cohesion, local development and governance, climate change and adaptation, and urban resilience.[155]

In recent years, a few Arab countries have made inroads with regard to greater involvement of LRGs, particularly in the context of national efforts to accelerate action towards the 2030 Agenda and the pursuit of the SDGs. In many cases, the primary focus of these decentralization initiatives in the context of the SDGs remains on cities; however, strengthened municipalities and a mandate for rural development (in addition to urban management) could help to extend these initiatives to promote localized rural programmes for small-scale RETs.

In Tunisia, the Government has been following a decentralization process, strengthening the role of the country's regions to leave no territory behind. Based on what the International Labour Organization calls "positive discrimination", the process is intended to provide for equitable, rather than equal, resource distribution—from State budget support to administrative and human resources. In other words, it is intended to eventually level the playing field for all Tunisians, regardless of where they live.[156] To strengthen LRGs, the National Federation of Tunisian Municipalities, together with international cooperation organizations such as International Cooperation Agency of the Association of Netherlands Municipalities, Cities Alliance and UNDP, have helped municipalities to promote strategic participatory planning and include SDGs in their plans as part of an initiative to localize the SDGs. The Tunisian cities of Béja, Gabès, Jendouba, Kairouan, La Soukra, Medenine, Monastir, Sidi Bouzid and Tataouine have aligned their development strategies for 2030 with global agendas.[157]

4. Localizing targets

Localized development targets, such as access to sustainable energy and water, can play a major role in activating local action, both for governments and citizens. This can occur in connection to a country's goals for sustainable development, as advocated by organizations such as United Cities and Local Governments, or it can be focused specifically on energy.[158] Measuring and monitoring progress locally provides an opportunity for governments to understand which regions and communities need what kind of support. This concept has already been implemented in Tunisia through the positive discrimination principle, which aims to provide more rural communities with access to sustainable energy.[159] Localizing targets goes hand in hand with improved data collection and therefore provides a more solid base for policymaking, a key goal in its own right (chapter 2).

Local targets also provide an important framework within which to empower LRGs and hold them accountable for making progress in the Government's overall plans for national development. In this context, localized development targets can include a mandate for LRGs to engage with local communities to help to identify a policy and regulatory environment to facilitate the transition from the informal to the formal economy. Approaches include opening channels for dialogue and proving technical assistance and access to credit.

5. Improving intragovernmental collaboration

National policy plans and development strategies in the majority of Arab countries are being decided by central Governments, with no involvement by LRGs. This implies that central policymaking lacks local and regional perspectives on central policies, and LRGs are left to implement policies, regardless of whether they have the capacity to do so or even believe that they are helpful for their local context. In many cases, the lack of clarity surrounding agency and political mandates also means that LRGs may not be in a position to act. They can also be a constrained by poor inter-institutional communication, such as between central, regional and local governments. The 2017 Arab Region Progress in Sustainable Energy: Global Tracking Framework Regional Report highlighted these factors, summarizing:

> Many existing policies and regulations in Arab countries, in areas such as rural development … suffer from lacking implementation and compliance. Missing communication between public institutions, such as ministries of energy, electricity, environment, electricity companies and regulatory agencies imply the scope for non-compliance with existing legislation can in some cases be large, while lack of clarity between institutions over mandates can add to confusion and deadlock in precisely those institutions that should be guiding production and consumption patterns in the energy sector.[160]

Improving intra-government collaboration is as much about communication as it is about consultation and the establishment of effective channels for regular dialogue between different levels of government and the participation of stakeholders from a variety of government levels in relevant meetings. Central Governments' key role is not only to consult and involve LRGs in relevant policy areas but also to follow up with them and guarantee transparency and accountability in these agencies. Empowering LRGs with the necessary tools to be effective also requires an adequate, predictable stream of financing and resources to support policies conducive to promoting inclusive local economic growth and generating skills-based employment at all levels of government.[161] As evidenced by the work of ESCWA through its REGEND initiative, the local and regional exchange of information, within the same country or across the region, plays a crucial role in allowing empowered municipalities to network and learn from each other's experiences and success stories.[162]

6. Fostering urban-rural links

While the administrative structure of LRGs differs significantly across the Arab region, a common feature is that local governments often find themselves overseeing both urban and rural land. Regional governments in particular habitually find themselves in this context. In many cases, urban development is seen as a separate policy space, with surrounding rural areas at the periphery in terms of both geography and policy. In reality, seemingly unrelated issues such as food security and rural water supply are closely tied to the economic growth and prosperity of cities. In addition, rural hinterlands experience positive spillover effects from urban areas.[163] The United Nations Human Settlements Programme (UN-Habitat) highlights that:

> A variety of urban-rural linkages in production, consumption and financial relationships have profound impact across the urban-rural continuum. Given the magnitude of these linkages, sustainable urban growth has large economic benefits for nearby rural areas. Strengthening these reciprocal flows is also vital for achieving sustainable urbanization.[164]

Integrating and coordinating regional and subregional development policy holds significant potential to improve the economic and social well-being of populations in both cities and the countryside, supporting market creation for technological and agricultural products. Key areas that could be the focus of future policies in this space could include local food system initiatives, sustainable tourism and environmental policy.[165]

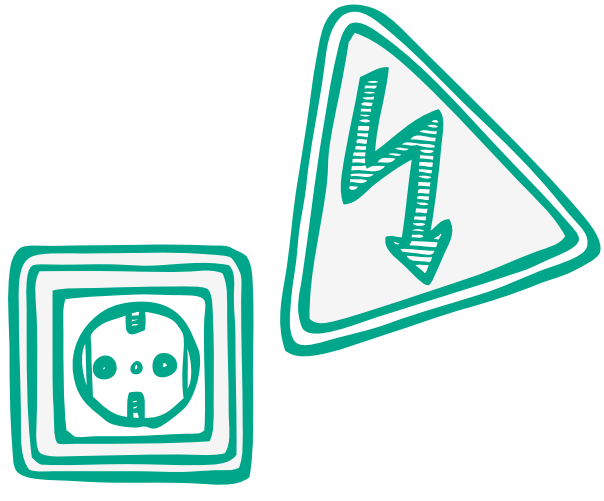
D. What role should local development initiatives play?

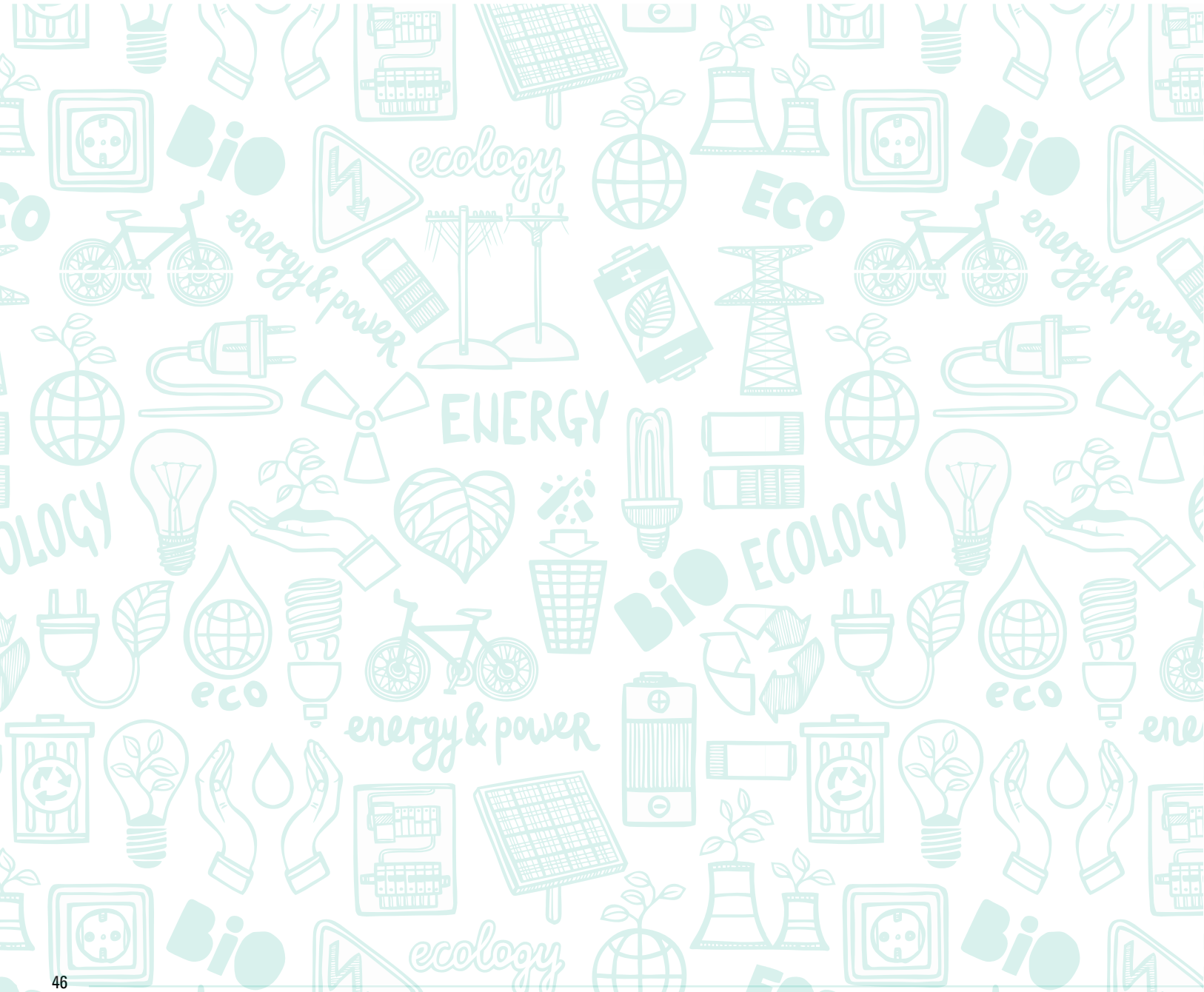
The support and participation of local communities are powerful levies for the establishment and development of catalysts. Securing such participation usually requires special efforts.[166] Local development initiatives should be supported, and spaces should be created for innovation in order to nurture and scale up local capacities and innovation. It is also important to promote synergies among local initiatives; maximize the job creation potential of urban-rural links and connectivity; and support small and medium-sized enterprises that contribute to sustainable growth, create employment in their local environments and give impulse to productive clusters and cooperative strategies both within and between sectors and territories.[167]

Community-based organizations, trade unions, farmer organizations and other local forums can enhance the role and negotiation position of rural communities.[168] Such forums can also be used to link rural communities to the renewable energy business sector and facilitate training and financing. Cooperatives are a major contributor to the economy in many countries. Through their value and governance system, they can help to overcome many of the challenges facing small-scale economic actors in both rural and urban settings.[169] Community-based organizations and cooperatives can also serve as a pilot host and/or location for RETs to help demonstrate to the community the reliability and benefits of operating RETs in terms of income generation and productive activity. This will mitigate the risk for individual community members investing in RETs for the first time, promote encouragement and trust in RETs among communities and lead to higher adoption rates of RETs for households and home-based small businesses.

In Lebanon, for example, weak and inconsistent municipalities are typical of local governance in rural areas, and there is no national development policy. As a result, growth across productive sectors has been achieved and maintained where cooperatives are strong.[170] Under Lebanese law, cooperatives are exempt from finance fees on contracts and certain taxes, such as taxes on owned real estate, the profit tax, the municipal rent tax and the municipal construction tax. These tax incentives have encouraged the growth of cooperatives, although their level of activity and their capabilities vary significantly across organizations.[171]

Governments have a role to play in providing attractive frameworks for cooperatives to flourish, including fiscal incentives (as is the case in Lebanon), a strengthened business environment and awareness-raising, particularly in the case of empowering women cooperatives.

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4 Addressing the gender gap

A. Why does women's access to energy matter?

B. What obstacles do rural women face in accessing sustainable energy?

C. What gender-affirmative policies are available to bring about change?

A. Why does women's access to energy matter?

Women's empowerment and gender equality has been deemed "the unfinished business of our time" by the United Nations Secretary-General.[172] Women and girls represent half of the population in the world—and the Arab region—and, therefore, half of its potential. Besides being a fundamental human right, gender equality in terms of rights, access and opportunities is also essential to promote full human potential, community resilience, demographic and resource management, and sustainable development.[173]

UNDP also finds a growing body of evidence in international development which establishes that gender equality at the household and community levels leads to superior agricultural and development outcomes, including in farm productivity and family nutrition.[174] FAO estimates that if women farmers had access to the same resources (such as capital and technologies) as men on the land they farm, they would increase agricultural output in developing countries by between 2.5 and 4 per cent.[175] Moreover, a 2015 report by McKinsey Global Institute calculated the economic impact of closing the gender gap in labour markets in 95 countries and concluded that the national GDP of each country would increase by at least 9 per cent and global GDP would increase by as much as $28 trillion, or 26 per cent, within ten years.[176]

The promotion of small-scale RETs presents an important opportunity to tap into the transformative potential of women in rural areas, as daughters, wives and mothers; as farmers, entrepreneurs and educators; and as tomorrow's technicians and engineers, to the benefit of their entire community. This chapter first explores the particular obstacles faced by women, followed by an overview of policy measures that should be incorporated into the agenda of those promoting small-scale RETs.

B. What obstacles do rural women face in accessing sustainable energy?

While women can and do make crucial contributions in agriculture and rural enterprises, they continue to face more obstacles than men in accessing modern energy technologies and are often entirely absent from the business value chain afforded by technologies such as small-scale RETs. As per the Global Gender Gap Report 2020 of the World Economic Forum, the Arab region has a 40 per cent gender gap, the highest in the world.[177] There are also concerns that the ongoing COVID-19 crisis will exacerbate the gender gap and reverse past progress.[178] According to the report, 10 of the 13 Arab countries included in the report were among the 20 lowest-ranking countries.[179] Furthermore, female-headed households typically face higher levels of food insecurity and lower resilience to economic hardship.[180]

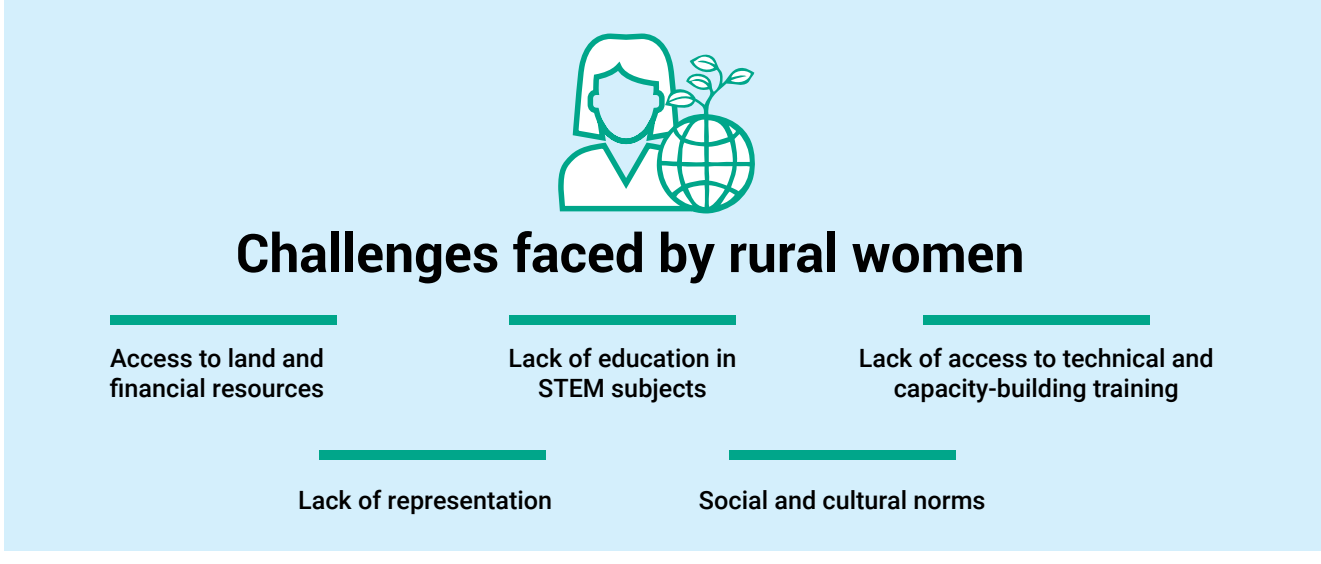
Women are affected differently and more profoundly by poor access to energy. The lack of education and economic opportunities often leaves them dependent on men and thus unable to determine their own fate. Women suffer most directly from the lack of access to modern health services, through frequent childbirth without medical assistance and a lack of access to family planning and contraception. Many rural women's time is spent on rudimentary tasks such as food preparation and fuel collection, for which simple improvements to energy access and technologies often having far-reaching positive impacts. Women and their children are most directly affected by the negative health consequences of spending more time indoors next to polluting stoves. They also have the least amount of time to dedicate to educating themselves or undertaking paid work.[181] In many Arab countries, women also own less land and are systematically disadvantaged in personal status law, such as in cases of inheritance and divorce. This significantly affects their access to capital resources and assets that could potentially be used as collateral and, by extension, their access to credit facilities.

FAO summarizes the many obstacles women face in agricultural communities, concluding:

> Women face a serious gender gap in access to productive resources. Women control less land than men, and the land they control is often of poorer quality and their tenure is insecure. Women own fewer of the working animals needed in farming. They also frequently do not control the income from the typically small animals they manage. Women farmers are less likely than men to use modern inputs such as improved seeds, fertilizers, pest control measures and mechanical tools. They also use less credit and often do not control the credit they obtain. Finally, women have less education and less access to extension services, which make it more difficult to gain access to and use some of the other resources, such as land, credit and fertilizer. These factors also prevent women from adopting new technologies as readily as men do.[182]

Much of rural women's labour remains invisible and unpaid, while their workloads become increasingly heavy as more and more young men migrate from the countryside to urban areas.[183] Their social context also constrains their access to technologies and their ability to play active roles in the promotion of sustainable energy, which would potentially improve living conditions for themselves, their families and their communities. Chief among these obstacles are: (i) a lack of access to finance; (ii) a lack of education, in particular in science, technology, engineering and mathematics (STEM) subjects; (iii) a lack of access to technical and capacity-building training; (iv) a lack of representation; and (v) social and cultural norms (figure 2).

Figure 2. Challenges rural women face in accessing small-scale renewable energy technologies



Source: Authors, based on Economic and Social Commission for Western Asia, 2020. Regional Initiative to Promote Small-Scale Renewable Energy Applications in Rural Areas of the Arab Region: Study on Gender Mainstreaming, Social Inclusion, Human Rights Processes and Outcomes of Access to Energy in Targeted Local Communities in Lebanon. Beirut, Lebanon. E/ESCWA/CL1.CCS/2020/TP.3.

1. Access to land and financial resources

Women are often highly disadvantaged compared to men in rural areas in the Arab region in terms of owning land and accessing finance, whether for better energy technologies or for their own businesses. Access to personal financial resources and physical assets is severely constrained by their routine labour in the informal sector, either as informal migrant workers in agriculture or as unpaid family members working on the family farm or for the family business. Personal status laws in many Arab countries disadvantage women further in areas such as inheritance and divorce, affecting access to financial and physical assets (including land ownership) and, by extension, the hard collateral necessary to be eligible for formal credit lines, including under available microfinance schemes.[184] In the context of its REGEND initiative in Jordan, for instance, ESCWA observed:

> Although the Ministry of Energy and Mineral Resources currently provides a 30 per cent financial subsidy for renewable energy projects through commercial banks, most women farmers cannot apply for that assistance due to their inability to offer collateral. Women in rural communities are subject to social and legal barriers that prevent them from owning land or other assets or even opening bank accounts.[185]

The United Nations Entity for Gender Equality and the Empowerment of Women (UN-Women) highlights that lack of access to land lies at the heart of women's poverty in most developing contexts.[186] Many rural women therefore lack the required formal income and capital to apply for a loan to support the purchase of better-quality crops and time- and resource-saving technology, including modern energy solutions.[187]

2. Lack of education, including in science, technology, engineering and mathematics

Despite regional differences, rural women remain disadvantaged in their education relative to men. Remote rural communities often lack access to quality education, as local schools may be improvised or non-existent. Long distances to schools, which may be located in the next village, may limit the number of girls who can even attend, and many leave school earlier than boys.[188] Illiteracy remains a major obstacle to women's ability to receive training and acquire the skills needed to make informed choices about technologies and to run their own businesses. In many parts of the Maghreb, the Mashreq and in Arab LDCs, adult female literacy rates continue to lag significantly behind those of men, a problem that can be largely attributed to rural areas.[189] Illiteracy effectively deprives women of the ability to educate themselves and read and sign contracts, thus ultimately constraining them to informal work.[190] With school education being particularly precarious in rural areas, rural populations account for a large share of illiterate men and women, highlighting the difficulty of escaping the rural poverty trap.

Fewer years of schooling also reduces the chances for girls, particularly in rural communities, to benefit from advanced education in STEM subjects, which could later help them to utilize, adapt and partner in the dissemination of modern energy technologies. Social and cultural norms may also impact the degree to which girls are encouraged to excel in these subjects or to explore them in their own backyards. Subsequent options for women may be significantly constrained; marriage and informal farm work or migration to other parts of the country for work are the most likely life choices. Lastly, women are less likely than men to be literate in information and communication technologies, with social and cultural barriers often discouraging them from undertaking digital training and education, particularly in rural areas.[191] As a result, women may be the least likely members of rural communities to be able to invest in and disseminate modern energy technologies, become entrepreneurs in the field of RETs or work within the energy sector as engineers or technicians.

3. Lack of access to technical and capacity-building training

ESCWA studies from Jordan, Lebanon and Tunisia all highlight the fact that rural women need more training and capacity-building programmes, development interventions and opportunities to contribute to their economic empowerment.[192] ESCWA findings from Lebanon, for example, suggest that most women operate in traditional and agrifood processing and struggle with market exploration, promotion, negotiation and sectoral growth, compared to their male counterparts.[193]

Case studies from rural villages in all three countries exemplify the many constraints that prevent rural women from becoming active users of and investors in small-scale RETs for productive uses through own businesses. These include limited access to marketing, capital, credit and technical knowledge networks. The work of ESCWA in Tunisia, for example, finds that barriers to female entrepreneurship in rural areas include the low mobility of women; social barriers curtailing their work in general; a lack of technical skills, diplomas and training required for value chains; and underdeveloped female entrepreneurial thinking in rural areas.[194] Case work from Jordan illustrated social barriers, such as "the widespread misconception that some jobs within the renewable energy sector can only be done by men"; some responsibilities, such as for the installation of renewable energy equipment like solar panels, was perceived as being "too arduous" for women employees.[195]

Obstacles faced by women also include their lack of access to modern digital technology. Approximately 84 million women in the Arab region are not connected to the Internet and do not have access to mobile phones.[196]

The majority of women without digital access are likely to live in rural areas.

4. Lack of representation

Rural women in many Arab countries lack social, economic and political representation. Despite progress in recent decades and differences across the region, women remain scarce in political positions, decision-making bodies and committees at the national and local levels.[197] The Arab region scored below 10 per cent on the political empowerment subindex in the Global Gender Gap Report 2020 and was the worst among all regions.[198] Female self-organization through grass-roots groups such as women's unions, rural business councils and female agricultural cooperatives remains weak. Existing organizations are often characterized by a lack of links to higher-level policymaking and financial institutions, which limits the work they can realistically accomplish for rural women. A concept note from the International Labour Organization highlights the difficulty facing rural women in Lebanon in terms of representation within the context of overwhelming rural poverty:

"Lebanon's rural workers in agriculture live in poverty as a result of the major problems facing agricultural production, which are mainly the small size of agricultural holdings, lack of agriculture policies, high production costs and lack of specialized agricultural credit. Women, who make up one third of the agricultural labour force, are particularly disadvantaged by the lack of programmes and interventions targeting them. This leads to their poor representation in all aspects of agricultural production, with negative repercussions on the socio-economic status of their households."[199]

In many business networks, including along the renewable energy value chain, women do not serve as decision makers, business counsellors, engineers, technicians or salespeople. Unsurprisingly, the specific obstacles faced by rural women are rarely taken into consideration in local policymaking and enterprise.

5. Social and cultural norms

Social norms play a critical role in shaping women's opportunities throughout their lives, their upbringing, education and the roles they are expected to play in their families and society. A 2018 international survey highlighting the perception of gender roles concluded that cultural and social norms are globally perceived to be the greatest barrier to increasing women's involvement along the renewable energy value chain.[200] This is also reflected in evidence from the Arab region. In remote rural areas, these norms are often more rigid than in urban areas and sometimes constitute considerable obstacles to allowing women to play a greater role in their communities' development beyond their homes or family business. An ESCWA study from Lebanon observes:

> The prevailing traditions and stereotypes consider women inferior to men in society and perceive them as possessing fewer of the skills required for employment. Furthermore, in rural areas, women are not expected to generate income for their families. It is the man who is the main decision maker and the one responsible for taking care of the family. These cultural norms limit women's mobility and their ability to allocate time for work.[201]

The report suggests that this result may also stem from a lack of awareness of opportunities for women in the renewable energy sector:

> There is a prevailing perception that the energy sector is not appropriate for women, which can be traced back to social and cultural norms that suggest that such a sector only involves jobs for men and may require physical strength which women are perceived as lacking.[202]

A report from Jordan concludes:

> Although many Jordanian women are educated in science, technology, engineering and mathematics (STEM), few take up employment in those areas once they have completed their studies. This is due to a number of factors, including, first and foremost, the fact that they are often required to look after their families. Rural women are often doubly disadvantaged. Firstly, because few female teachers in rural schools teach maths or science, those schools rarely offer high quality STEM education to girls or encourage them to pursue STEM education at university. Secondly, many women chose to stop working in order to look after their families, and their re-entry into the labour market at a later date can be a daunting task. Vocational training in renewable energy could enable many women to learn employable skills.[203]

Similarly, the work of ESCWA in Tunisia showed:

> Discriminatory practices [are present] in the decision-making process, particularly with the management of family financial resources, economic and commercial transactions (sale and rental of movable and immovable property) and investment decisions, which are often made exclusively by men. The trade of cattle is organized in markets frequented by men. Agricultural equipment is registered in the man's name. Few women are involved in the acquisition, leasing or operation and maintenance of machines, which remain men's responsibilities.[204]

Rural women are less likely to work in technical jobs or other jobs throughout the renewable energy value chain, as they are typically end users of small-scale RETs rather than partners in their design and installation.[205] Given the context of many remote rural settlements across various Arab countries, social and safety reasons alone can prevent women from being able to commit to the longer working hours over the day and can limit their mobility, such as for jobs that require regular travel across village borders. Consequently, role models and mentoring options are often non-existent or severely limited. This is compounded by the lack of women cooperatives and other forms of organized women's groups that could foster female entrepreneurship within the small-scale RET sector in rural communities. In Lebanon, for example, the International Labour Organization suggests that only 10 per cent of cooperatives are led by women, or 125 out of 1,238, according to figures from 2017.[206]

C. What gender-affirmative policies are available to bring about change?

1. Promoting access to education, training and technology for women

Illiteracy and the lack of education and vocational training are a core root of poverty and the lack of options for men and women. They must be tackled aggressively to empower rural communities. Under its REGEND initiative with rural communities in Jordan, Lebanon and Tunisia, ESCWA finds that rural women would benefit substantially from:[207]

> - Technical training.
> - Capacity-building and training in business management, marketing and branding, including on-the-job training.
> - Facilitated access to credit for small and micro-businesses.

Maximizing the use of small-scale RETs for access to digital communication. Evidence shows that women-led business activities in rural areas can be significantly improved with modern digital solutions, which help women entrepreneurs gain financial and commercial data on their customers, receive remote market linkage support and build a bankable profile over time to unlock further financing for their businesses.[208] Smart phones and computers are highly potent tools to improve women's access to remote education and training and to allow women to manage and increase the reach of their business from the safety of their homes. For many rural women and girls, this would also help to address prevailing constraints to mobility given the lack of transport, as well as the availability of schools and training centres.

The work of ESCWA with rural communities in Jordan highlights the significant potential of online vocational training, particularly for women in rural areas who face constraints in mobility that prevent them from travelling to urban training centres. With increasing demand for technically trained women in the small-scale RET segment, the sustainability and inclusivity of RET projects in rural communities could be improved by establishing databases and contact lists of women who have completed vocational training courses by governorate.[209]

Innovative products such as small-scale RET products that combine electricity generation with a simple smartphone and pre-installed apps could also help to market certain locally produced goods. Such products could appeal to both men and women in rural areas willing to engage in their own business. The Government could develop or encourage the development of relevant

apps as a highly cost-effective way to support rural small businesses and education for both women and men. In addition, rural development projects could target digital literacy for women and girls in the context of expanding information technology access, alongside better energy access, for all members of rural communities.

Training and building-capacity among rural women. Both internationally and within Arab countries, experience shows that rural development projects in sustainable energy benefit from initiatives that build capacity specifically among rural women. As part of its REGEND initiative, ESCWA has provided training to local women in a number of Arab countries on a range of subjects, from food packaging to marketing techniques and organizational leadership.[210] The initiative aims to promote the use of small-scale RETs in rural communities in Lebanon, Jordan and Tunisia and includes targeted interventions to address women's obstacles to accessing modern energy technologies. The focus on women in some project elements has helped to broaden community reach and tailor interventions to the needs of local women.

> Some projects in the early stages aim to map the women in productive sectors, target women cooperatives by assisting their start-up or their growth, or build digital applications to promote products outside their geographic areas. Being selected is considered a main enabler of implementation. Successful projects have resulted in more autonomy, expanding the capacity and financial independence of women participants, although follow-up, especially in the early stages, has often been crucial.[211]

Governments and the private sector can help to design and deliver integrated capacity-building programmes that equip rural communities with needed skills by focusing on aspects such as technical training; financial literacy, including pricing, cost calculation and investment; health and safety; business management; packaging, marketing and branding; the use of social media and information technology; waste and waste water management; and the water-food-energy nexus, with a view to complementing local renewable energy initiatives in rural areas. For social and cultural reasons, women are often less able than men to access digital education and training, highlighting the need for governments, businesses and NGOs to focus on this area.[212] The most promising solution is training that corresponds to the various education levels of rural women and is provided in a safe environment. Collaborative efforts can include government institutions such as relevant ministries, international development partners, local organizations (including women's associations), private companies and other NGOs.[213] Local and national authorities and international partners would likely be necessary agents of funding for such training; however, there is also potential for private business and social enterprise to find a sustainable market for their products.

2. Strengthening women's access to finance

Governments should work closely with financial and microfinance institutions to address the intrinsic disadvantages women face in accessing finance, particularly in rural areas, in order to provide them with equal access to finance to support their businesses, education and the acquisition of small-scale RETs. Microfinance solutions that help women invest in themselves and their businesses, including through access to modern renewable energy technologies, have a higher chance of successfully lifting people out of poverty, as opposed to the many microfinance initiatives that primarily target consumption. Banks and the private sector may need to design special finance products for women, which take into consideration the typical barriers they face, including their lack of formal salaries, capital and land ownership. A government subsidy on technology for women applicants may be a route to consider.

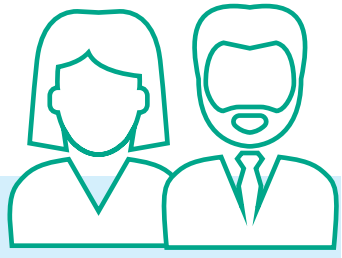
Targeting government support. Governments could consider special fiscal policies or other financial support specifically for rural women. In Nepal, for example, government financial support for SPISs was linked to the gender of the beneficiary. Women farmers were given an additional 10 per cent discount, on the condition that the land on which the SPIS was installed was transferred to the woman beneficiary. This experiment generated encouraging results; 77 per cent of requests (of the total of 65 SPISs requested) came from women farmers. In all these cases, the land was transferred to them.[214]

Similarly, government-sponsored schemes, and those supported elsewhere, could offer special initiatives to rural women, providing them with specially formatted microfinance to support investment in equipment such as mobile phones, productive machinery or commercial goods.[215] Government loan guarantees for microcredits

to rural women are an example of a relatively simple policy that helps women to overcome their lack of collateral and financial capital.

Governments should also work with cooperatives, supermarkets and grocery stores to encourage, facilitate and promote agreements to include rural women's products in their regular inventory, especially in urban areas. This could help to increase their market access, thereby increasing income and access to finance. In addition, such agreements will positively address the rural-urban divide.

Supporting women's associations and savings groups. Governments, international partner organizations and the private sector could also partner with local associations to build women's networks for female entrepreneurs or savings groups. These have proven successful in some countries as an effective way to support women in developing their own business models, sharing project risks, accessing credit, building confidence and sharing success stories.[216]



3. Guaranteeing representation

Gender mainstreaming

"The practice of assessing in any planned law, policy, or programme, its differential implications for women and men with the ultimate goal of achieving gender equality and the empowerment of women."

Source: International Renewable Energy Agency, 2019. Renewable Energy: A Gender Perspective. Abu Dhabi.

Deploying small-scale RETs in rural areas offers a significant opportunity for Arab countries to allow women not only to benefit passively from more sustainable energy access afforded to men but to become active partners in and promoters of its adoption. Women can and should guide policy development to benefit their communities and should be given equal access to small-scale RET technologies. In many rural and urban contexts in the Arab region and beyond, women continue to be highly disadvantaged in terms of education, health, access to modern technology and decent work conditions, among other areas.

Making rural audits participatory. A key starting point to establish what women need within rural communities, as farmers, businesswomen, mothers and daughters, is to enhance the ability of local and national governments to engage directly with rural communities in a way that facilitates women's participation. Government policies directed at rural development, including those related to small-scale RETs, should strive to engage with local communities by employing a participatory approach that gives them a greater say in planning. Providing women with an opportunity to discuss their impacts and needs can significantly increase the likelihood that later policies are gender-affirmative and inclusive. In some cases, women's participation may be facilitated in gender-segregated groups; in other cases, mixed groups may be more effective in mainstreaming female perspectives in policy. The aim should not be to simply check the box for public consultation but rather to create meaningful dialogue that includes ordinary citizens, not simply businesswomen and politicians.[217]

Increasing representation in governments and NGOs. Increasing the representation of women at the subnational, national and regional levels in NGOs, research institutions, development agencies, boards of businesses and business associations, and local committees is a key prerequisite to more gender-affirmative action throughout the Arab region. Such policies depend on a wide range of experiences and perspectives that include women. They offer policies and financial products that respond to the special needs of women in these communities. All-male environments are unlikely to address the long-existing gender gap in local development policies and initiatives.

One important means to increase women's participation in decision-making bodies at all levels is the establishment of quotas, which can also help to overcome resistance in appointing bodies.[218] Such a policy will often need to confront embedded sociocultural barriers to women's

participation as well.[219] In addition to raising the share of female staff, Governments must also ensure that policies are gender-affirmative. Positive international examples include the Economic Community of West African States Programme on Gender Mainstreaming in Energy Access, which aims to mainstream gender in the formulation of policy and the design and implementation of energy projects and programmes across West Africa.[220]

Increasing the share of women in the renewable energy value chain and private business. Energy businesses and other relevant institutions can also contribute significantly by committing to gender objectives within their management. Establishing a market for small-scale RETs among women promises to be most successful if some of the people aiming to sell and potentially maintain the technology are women themselves. Businesses can do a great deal to increase the number of women working in the renewable energy industry that serves both urban and rural areas.

Key policies include targeted recruitment in collaboration with schools and universities, providing girls with mentoring programmes and work insights and encouraging them to apply; an analysis of internal recruitment and promotion processes to identify strategies to strengthen the female workforce at every level; and efforts to establish an open and respectful working culture and working conditions to retain women in the workforce. A 2019 technical cooperation initiative co-funded by the European Bank for Reconstruction and Development and the Green Climate Fund to support green energy in Egypt has taken up this objective, placing women at the centre of its commitment to transition to green energy.[221] Similar initiatives could be taken up across the Arab region, including by national Governments themselves.

Supporting women so that they can help themselves. Supporting linkages and networks among women, such as for researchers, policymakers and grass-roots organizations, can be an important means of generating self-confidence and increasing visibility.[222] In rural areas specifically, women cooperatives can provide a good entry point for female-led business projects related to renewable energy and energy efficiency, capacity-building, mentorship and the sharing of success stories for other businesses.[223] Beyond the Arab region, women cooperatives have been successful in a number of countries as catalysts of female economic empowerment in urban and rural areas, providing access to special loans and financial products, education, training and childcare for their members. Box 2 includes two international case studies. While examples from elsewhere may not be replicable in the same format in Arab countries, they may serve as examples of what can be achieved through the social self-organization of women in rural areas.

In Arab countries, developments through women cooperatives could be encouraged by establishing conducive legal frameworks for the creation of cooperatives and associations, supporting projects through Ministries of Agriculture or the Interior for education and training, and facilitating access to banking products that could be tailored to women's needs. In Jordan, the community-based organization Al-Jawhara provides women and girls with safe spaces on their premises for training and education. Running its own business to generate income, Al-Jawhara offers a revolving loan programme, which has kick-started numerous women-led entrepreneurial activities related to handicrafts, woven goods, agriculture and agrifood, including dairy, fruit and vegetable production.[224]

Improving the quality of gender-related data. Governments across Arab countries must invest systematically in better data, both qualitative and quantitative, including data disaggregated by gender and region and/or locality. The gender development gap in many Arab countries is poorly documented and understood; there is a focus on headline indicators and a lack of understanding regarding socioeconomic dynamics, including at the intersection of energy and gender. The lack of both quantitative and qualitative gender-disaggregated data further complicates and hinders energy policy planning and the implementation of projects that succeed in reaching the "other half" of rural populations.

Investments should be made to expand data collection by statistical departments, relevant ministries (such as those dedicated to energy and agriculture) and other related institutions in order to document energy use, energy sector employment, agricultural employment and the impacts of energy development, alongside a broader range of social, economic and environmental indicators.[225] For certain policies, budgetary allocations could be linked to the improvement of relevant indicators on gender. Governments must therefore begin collecting additional, better-quality data that are gender disaggregated, establishing a baseline for future improvements in gender-specific indicators.[226]

Box 2. Renewable energy social enterprises and women's associations: case studies from Bangladesh and India

1. Grameen Shakti, Bangladesh

Grameen Shakti is a renewable energy social enterprise that promotes and finances renewable energy solutions through microfinancing in unelectrified villages in Bangladesh. Founded in 1996 by Muhammad Yunus, who later won the Nobel Peace Prize, Grameen Shakti introduced systematic microcredit financing for renewable energy solutions to rural Bangladesh, first for solar photovoltaic panels and then for improved cooking stoves and biogas.

Grameen Shakti's engineers are trained as "social engineers"; they go from door to door demonstrating the technologies that they finance and associated benefits. Microcredits are extended over a period of two to three years, which allows for slow repayment times. They also include an option for households to stop payments and return the equipment. In order to ensure that the purchased equipment can also be maintained over the years, Grameen Shakti has been systematically training local youth, focusing on young village girls. This focus on women continues throughout the company's business model, with over 80 per cent of borrowers being women.

In the past decade, the company has been extending its products, including relatively larger loans for dynamic members, savings instruments, financial support schemes for extremely low-income households for purposes such as building modest houses, and scholarship and loan programmes to support the children of the company's borrowers. It has been collaborating with the Bangladeshi Government, including through the Government's Infrastructure Development Company Limited.

2. Self-Employed Women's Association, India

The Self-Employed Women's Association (SEWA) was created in 1972 in India to organize self-employed women in the informal economy. Originally active in urban areas, the Association has increasingly moved towards supporting rural women as well since the 1980s, through schemes such as self-help groups, producers' groups and village resource centres, as well as its own rural distribution network that processes, packages and markets the agricultural goods produced by the Association's rural members. SEWA also provides training to its members and has created a number of technical and management schools in rural India to help overcome obstacles faced by many of its rural members owing to a lack of formal education. By the mid-2010s, approximately two thirds of SEWA members were based in rural areas.

SEWA initially faced significant challenges in supporting self-employed women, particularly in terms of access to finance. Many rural women with businesses were considered unbankable, owing to a lack of ownership over assets, illiteracy and a lack of formal education, as well as the relatively small amount of finance required. As a result, SEWA established its own corporate bank, for which the starting capital was raised entirely by its members. In addition, the Association has facilitated rural savings and credit self-help groups for women. It has also expanded its activities beyond access to finance, offering social-protection organizations for insurance, housing, childcare and education.

Sources: International Labour Organization, 2014. Learning from Catalyst of Rural Transformation; SEWA Cooperative Federation, 2019. Our services. Available at https://www.sewafederation.org/our-services/; Lescuyer, Thibault, 2011. Grameen Shakti, the green microcredit success. MicroWorld.org, 12 February.

Note: For more information on Grameen Bank, see http://www.grameen.com/.

4. Addressing social norms

Transforming women from passive beneficiaries to active agents of change is a challenge throughout the Arab region that is highly worth addressing; however, it will require concerted efforts to address the particular social and cultural contexts in which women can control their lives. The key to the successful mobilization of half of the human potential in rural areas is to acknowledge and work within the local social context.

Understanding local gender dynamics. Local community consultations and workshops in partnership with local women's associations, as conducted by ESCWA under its REGEND initiative, can help to inform companies and governments seeking to implement renewable energy solutions of the specific local gender dynamics, as well as interest in and the potential for gender-affirmative programmes and policies. It is important to seek women's perspectives in order to understand their needs and priorities. It is also important to collect gender-disaggregated data on topics such as energy consumption patterns, the financial situation and decision-making powers by women, the educational and occupational background of the population, and the number of formal and informal micro-, small and medium-sized enterprises owned by women in a community.

Informing and consulting women. Within a sociocultural context where information-sharing events and meetings are often predominantly carried out among men, greater efforts must be made by governments and private companies to address women directly, not simply their spouses.[227] In many cases, dedicated women's meetings can encourage more women to attend and provide valuable opportunities to demonstrate examples of women in business. At the broader social level, the private sector and governments could also increase the use of new communication channels to reach a wider female audience, including local, regional and national women's networks, schools and universities.[228] By increasing the number of women in renewable energy enterprises and the wider business sector, rural communities as whole stands to benefit, allowing for a more gender-balanced expertise and labour force.

Reducing prevailing social barriers. Beyond women themselves, governments and private companies must address local communities as a whole in order to build consensus on what the community believes could be sustainable advances in gender equality and development at the local level. The involvement of both men and women in local awareness-raising and information campaigns on gender and technology is critical, not only to mainstream support for new energy technologies but also to persuade women and men of the greater role to be played by women within their village's development, thereby reducing the prevailing social barriers to change. Sharing and communicating examples of women role models is essential to encouraging women to engage in the sector and girls to persist in studying relevant subjects at school and university. National, regional and local governments and the renewable energy business sector should also work towards this objective by recruiting, retaining and promoting women who are able to strengthen gender-affirmative policies and business models to better serve rural communities.

Using digital technology and education as a catalyst for change. The advent of stable and affordable electricity through small-scale RETs in rural areas presents a significant opportunity to further employ digital technology for social change. Digital communication technologies and media have significant potential to sustainably shape and promote social perspectives on the value of women as contributors to household income and necessary agents of change. Digital media can support awareness-raising about climate change, environmental pollution and management, the renewable energy value chain and the potential for women and girls to contribute to their community's development. Similarly, encouraging girls to excel in STEM subjects and women to become active in the energy sector can also support local communities in their endeavour to grow sustainably and enjoy a higher quality of life. Barriers for women and girls must be discussed at the national level as well, since the prevailing gender inequalities are rarely confined to rural areas.

Building gender competence in political institutions and businesses. The key to overcoming social barriers to women's empowerment is to address underlying cultural biases and views, not only in the general population but also among political and business elites. Gender competence is defined by Gender CC as "the knowledge and the ability to recognise the

social construction and reproduction of gender roles and to effectively deal with changing discriminatory structures and processes. It includes knowing gender policies, strategies, and tools as well as understanding gender as an analytical category".[229] Gaps in knowledge and awareness, as well as prevalent biases by political and business elites themselves, can be addressed by obligatory gender training for staff in government positions. Governments can also invest in incentivizing private companies to do the same. Some international projects in Arab countries have already begun to include gender training in local development initiatives. Examples include projects implemented by ESCWA and FAO.[230]

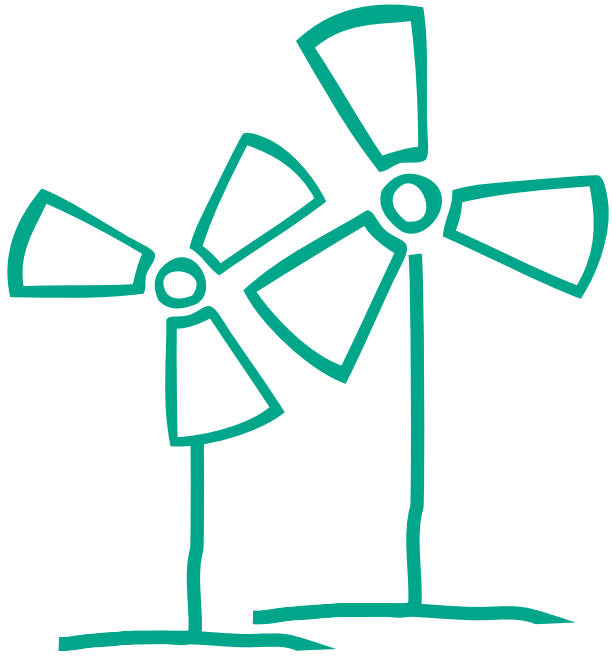
5 Conclusion

Sustainable energy is fundamental to rural development and resilience. Despite the significant progress made by many Arab countries to provide large portions of their citizens with energy, progress has not been even across countries and geographies. In addition, energy access has not necessarily translated into sustainable energy services capable of powering inclusive development. Rural communities remain the largest single group of people in the Arab region struggling to access sustainable energy, with particularly precarious situations in Arab LDCs and significant challenges in some rural areas in the Maghreb and Mashreq countries. Energy can play a fundamental role in ensuring that rural areas are not left behind as the Arab region faces multiple challenges around the issues of food and water security, climate change and economic opportunities for youth.

The creation of markets for electricity using small-scale RETs can significantly benefit rural communities across the Arab region that currently face a gap in sustainable energy supply. Small-scale RETs can provide critical and entirely realistic benefits, such as helping to power an array of socioeconomic opportunities, including better access to education and health services, modern technology and machinery (including in agriculture). They can also allow a wider range of business services to be provided in rural spaces. The region's highly favourable climatic environment, with plentiful solar resources, supports RET deployment as an increasingly cost-effective technology that can also help to manage rural pollution and emissions as rural demand for energy rises in the coming decades.

Women and girls will benefit significantly from the introduction of small-scale RETs, through improved access to education and health, modern digital communication and new market opportunities related to improved access to technology and machinery. Access to electrical appliances can reduce physical labour for women, who, in turn, will have more time for more productive activities such as work, education or childcare. The same applies to Arab LDCs, where women and children in particular spend a significant amount of time collecting traditional fuels, which can be spent in more productive ways with access to modern energy.

Small-scale RETs can be promoted through the creation of private markets, making them a low-cost option for governments, while their socioeconomic impact on rural communities can be vast. This report details the requirements for such markets to function effectively, which are based on effective policymaking and institutions capable of driving localized policies that suit the needs of individual countries and communities. The result is a potential win-win situation, as sustainable socioeconomic development opportunities in rural areas are critical to social peace and, by extension, the prosperity of the nation as a whole. Rural-urban migration, primarily by young men and their families, was a driving force behind many countries' urban protests in the early 2010s. Given the significant benefits derived by rural communities from small-scale RETs, prioritizing sustainable rural energy access in political policy should be a clear choice.



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Endnotes

1. International Energy Agency and others, 2021. For the purposes of this report, the Arab region comprises the following countries: Algeria, Bahrain, the Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, the State of Palestine, Qatar, Saudi Arabia, Somalia, the Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen.
2. Authors' calculations, based on International Energy Agency and others, 2021.
3. Ibid.
4. International Energy Agency and others, 2021.
5. United Nations Economic and Social Commission for Western Asia (ESCWA), 2019a.
6. Practical Action, 2010. See also United Nations, 2019.
7. See Practical Action, 2010; United Nations, 2019 and 2020.
8. Charles and others, 2019.
9. For information at the global level, see Dasgupta, 2021, p. 410.
10. United Nations Human Settlements Programme (UN-Habitat), 2020a.
11. World Bank, 2020b.
12. Ibid.
13. Ibid.
14. United Nations, 2020; World Bank, 2020a.
15. Practical Action, 2010.
16. Practical Action, 2010.
17. Dasgupta, 2021, p. 410. See also Agarwal and Narain, 1992; Baland and Platteau, 1996.
18. Dasgupta, 2021.
19. Glania, 2010.
20. For general background, see Glania, 2010.
21. This is the standard measure used in statistics provided by the World Bank and Sustainable Energy for All, including in their database "Tracking SDG7". Some notes on the methodology can be found here: https://trackingsdg7.esmap.org/methodology.
22. United Nations Conference on Trade and Development (UNCTAD), 2010. See also World Bank, 1996; Barnes and Floor, 1996.
23. UNCTAD, 2010.
24. ESCWA, 2020c.
25. As observed by the World Bank in Yemen. World Bank, 2005.
26. Practical Action, 2010, p. v.
27. ESCWA, 2020b, 2020e.
28. Practical Action, 2010; United Nations, 2019.
29. Fattouh and El-Katiri, 2012.
30. Practical Action, 2010.
31. Ibid.
32. Ibid.
33. Ibid.
34. See World Health Organization, 2021, for a collection of resources on household energy and indoor air pollution.
35. International Renewable Energy Agency (IRENA), 2016a and 2019b.
36. Ibid.

37. IRENA, 2020a.
38. ESCWA, 2021a.
39. Ibid.
40. See chapter 2 for a more detailed exploration of the different tiers of electricity access.
41. ESCWA, 2021a. See also Lecoque and Wiemann, 2015.
42. ESCWA, 2016 and 2017f.
43. United Nations Educational, Scientific and Cultural Organization, 2019.
44. Murphy, 2001; UNCTAD, 2010.
45. UNCTAD, 2010.
46. Ibid.
47. Harajli, 2020.
48. Franz and others, 2014.
49. As shown for instance in Jordan, as part of the ESCWA REGEND initiative. See ESCWA, 2020e.
50. Wuppertal Institute for Climate, Environment and Energy, 2010.
51. Habtezion, 2016.
52. For example, a 2018 report of the Food and Agriculture Organization of the United Nations (FAO) provides evidence for “the significant feminization of migration" in Tunisia, particularly regarding internal migration by young women from rural areas to work in other regions, often on a seasonal basis (ESCWA, 2020b).
53. ESCWA, 2020d, 2020e and 2020l.
54. ESCWA, 2020c.
55. Soler and others, 2020; Wuppertal Institute for Climate, Environment and Energy, 2010.
56. Dasgupta, 2021. Table 3 presents selected policies from the Review's policy options.
57. ESCWA, 2020f.
58. ESCWA, 2020b, 2020c, 2020d, 2020e and 2021a.
59. International Labour Organization (ILO), 2014.
60. ILO, 2014. For the case of Tunisia, see Selmi, 2020.
61. ESCWA, 2020b, 2020c and 2020e.
62. FAO, 2019.
63. United Nations Educational, Scientific and Cultural Organization, 2019.
64. ESCWA, 2020b.
65. Ibid.
66. FAO, 2019.
67. ESCWA, 2017c, 2017d and 2017e.
68. ESCWA, 2017f and 2020i. See also ESCWA, 2019a; United Nations Educational, Scientific and Cultural Organization, 2019.
69. ILO, 2014.
70. ESCWA, 2020b, p. 25.
71. FAO and others, 2020; ESCWA, 2017c, 2017d and 2019a; Charles and others, 2019.
72. For Tunisia, see Selmi, 2020.
73. IRENA, 2019b.
74. ESCWA, 2020c.
75. ESCWA, 2020t. See also Organization for Economic Cooperation and Development and International Energy Agency, 2019, p. 21.
76. ESCWA, 2020b.
77. This position is also taken in this report. For examples of market-based policies to promote mini-grids, see IRENA, 2016b, 2018 and 2020b.

78. IRENA, 2015.
79. Ibid.
80. ESCWA, 2020c, p. 51.
81. IRENA, 2015.
82. Sustainable Energy for All, 2018.
83. United Nations, 2019.
84. United Nations, 2019, p. 72.
85. See ESCWA, 2020b, 2020c and 2020e.
86. UNCTAD, 2010, p. 7.
87. Pueyo and Maestre, 2019, p. 170.
88. United Cities and Local Governments (UCLG), 2019.
89. ESCWA, 2020t.
90. ESCWA, 2020b, p. 40, 42.
91. Hartung and Pluschke, 2018.
92. A brief summary of PROSOL can be found at United Nations, n.d.-a.
93. ESCWA, 2020t.
94. Ibid.
95. Hartung and Pluschke, 2018, p. 21.
96. ESCWA, 2020l.
97. ESCWA, 2020e, p. 63.
98. Subsidies can be a highly distortive market instrument and must be carefully designed in order to achieve desired goals. Special caution should be employed in the case of SPISs, as discussed further in this chapter. For an example from Tunisia, see ESCWA, 2020t.
99. Decree No. 167, based on article 20 of Law No. 444 of 2002. 17 February 2017, Lebanon.
100. See ESCWA, 2019c.
101. Hartung and Pluschke, 2018, p. 47, 48.
102. IRENA Coalition for Action, 2018; IRENA, forthcoming.
103. Gahl, 2020.
104. Ibid.
105. Harajli, 2020.
106. This paper adopts the definition of mini-grids used by the Alliance for Rural Electrification, which defines mini-grids as involving small-scale electricity generation (from 10 kW to 10 MW) and the distribution of electricity to a limited number of customers via a distribution grid that can operate in isolation from national electricity transmission networks and supply relatively concentrated settlements with electricity at grid-quality level. "Microgrids" are similar to mini-grids but operate at a smaller size and generation capacity (1–10 kW). Franz and others, 2014.
107. IRENA, 2015.
108. Mohapatra and others, 2019.
109. Ibid.
110. IRENA, 2015.
111. Mohapatra and others, 2019.
112. Ibid.
113. FAO, 2020a.
114. ESCWA, 2019c.
115. FAO, 2020a.
116. UNDP, 2013, p. 55.

117. FAO, 2020a.
118. Hartung and Pluschke, 2018, p. 27.
119. Hartung and Pluschke, 2018.
120. ESCWA, 2020e.
121. Hartung and Pluschke, 2018.
122. For an example from Morocco and Tunisia, see ESCWA, 2020t.
123. ESCWA, 2020t.
124. Hartung and Pluschke, 2018, p. 25.
125. Hartung and Pluschke, 2018.
126. ESCWA, 2020c.
127. Hartung and Pluschke, 2018. See also IRENA, 2016a.
128. UNCTAD, 2010, p. 8.
129. ESCWA had partnered with the Arab Organization for Agricultural Development and the Arab Federation for Food Industries through its REGEND initiative to offer training workshops on such themes as food packaging, labelling and marketing in Jordan (ESCWA, 2020p) and Tunisia (ESCWA, 2020q). It also provides broader exercises such as workshops focusing on the development of small-scale RET for local development (ESCWA, 2020r).
130. ESCWA, 2020e, pp. 61–63. See also ESCWA, 2020b.
131. For an overview of the ESCWA REGEND initiative, see ESCWA, 2020f.
132. FAO, 2020a.
133. UNCTAD, 2010.
134. El-Katiri, 2014.
135. ESCWA, 2016.
136. The author's own observations in the field in Morocco and Jordan confirm these points.
137. ESCWA, 2021a.
138. For example, see ESCWA, 2020b, 2020c, 2020d and 2020e.
139. ESCWA, 2017a and 2019a.
140. ESCWA, 2017a, p. 156.
141. ESCWA, 2020d and 2020e.
142. For a thorough discussion, see Dasgupta, 2021.
143. Alliance for Rural Electrification, 2009; UNCTAD, 2010.
144. World Forum of Local Economic Development, 2017.
145. UCLG, 2019.
146. ESCWA, 2020c, p. 24.
147. SCWA, 2020g, p. 5.
148. UCLG, 2019.
149. ESCWA, 2020e, p. 52.
150. Charles and others, 2019.
151. UCLG, 2019.
152. For example, see ESCWA, 2020b, p. 45.
153. For some of the localized energy-related projects of ESCWA, see ESCWA, 2019b, 2020h and 2020i.
154. Training materials are freely accessible on the ESCWA website. For example, see ESCWA, 2020g, 2020h and 2020r.
155. UCLG, 2019.
156. ESCWA, 2020b.
157. UCLG, 2019.

158. UCLG, 2019 and 2020.
159. ESCWA, 2020b.
160. ESCWA, 2017a, p. 142.
161. UCLG, 2019.
162. ESCWA, 2020a. See also ESCWA, 2020g.
163. UN-Habitat, 2020b.
164. UN-Habitat, 2020b, p. 92.
165. UCLG, 2019.
166. ILO, 2014.
167. UCLG, 2019.
168. ESCWA, 2020e.
169. ILO, 2018.
170. ESCWA, 2020c.
171. ILO, 2018.
172. United Nations, n.d.-b.
173. World Economic Forum, 2020; FAO, 2020b.
174. Habtezion, 2016, p. 2.
175. FAO, 2011, p. vi.
176. McKinsey Global Institute, 2015.
177. The Global Gender Gap Report 2020 divides the gap into four objective dimensions: health and survival; educational attainment; economic participation and opportunity; and political empowerment (World Economic Forum, 2020).
178. ESCWA, 2020j.
179. No rankings are available for Libya, the State of Palestine or the Sudan.
180. FAO, 2020b.
181. World Health Organization, 2021; Habtezion, 2016; United Nations Entity for Gender Equality and the Empowerment of Women and United Nations Industrial Development Organization, 2013.
182. FAO, 2011, p. vi.
183. FAO, 2011.
184. ESCWA, 2020d.
185. ESCWA, 2020e, p. 51.
186. United Nations Environment Programme and others, 2013.
187. ESCWA, 2020d.
188. Girls lag behind boys in all Arab countries that submit data about progression to secondary schools, with no data disaggregation between urban and rural areas. The discrepancies between boys and girls obtaining secondary education or higher is thus expected to be significantly more distinct in rural areas. This is based on World Development Indicators data; no data are available for Iraq, Libya, Qatar, the Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen.
189. Available comparative adult literacy data do not include disaggregation between urban and rural areas; however, considering the availability of schools, it is highly likely that a large proportion of adult illiteracy in Arab countries for both men and women is concentrated in rural areas (World Bank, 2021). No data available for Egypt, Iraq, Libya, Mauritania, Tunisia, Yemen and the Gulf Cooperation Council countries.
190. World Bank, 2021. Data for 2018. No data reported by Egypt, Iraq, Libya, Mauritania, Qatar, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates or Yemen.
191. FAO, 2018.
192. ESCWA, 2020b, 2020c, 2020d and 2020e.

193. ESCWA, 2020c.
194. ESCWA, 2020b.
195. ESCWA, 2020e, p. 28.
196. ESCWA, 2020j.
197. ESCWA, 2017b.
198. World Economic Forum, 2020. See also ESCWA, 2020j.
199. ILO, n.d., p. 4.
200. IRENA, 2019, p. 32.
201. ESCWA, 2020d, p. 6.
202. Ibid.
203. ESCWA, 2020e, p. 6.
204. ESCWA, 2020l, p. 26.
205. ESCWA, 2020d.
206. ILO, 2018, p. 9.
207. See the REGEND reports on Tunisia and Lebanon.
208. Soler and others, 2020.]
209. ESCWA, 2020e, p. 46.
210. For a full overview of local training activities conducted by ESCWA in 2019/20, see ESCWA, 2020f.
211. ESCWA, 2020c, p. 47.
212. FAO, 2018.
213. Soler and others, 2020; ESCWA, 2017b.
214. Hartung and Pluschke, 2018; Mukherji and others, 2017.
215. Soler and others, 2020.
216. Ibid.
217. Gender CC, 2009.
218. United Nations Environment Programme and others, 2013. See also ESCWA, 2017b and n.d.
219. United Nations Environment Programme and others, 2013.
220. IRENA, 2019a, p. 67.
221. Zgheib, 2019.
222. United Nations Entity for Gender Equality and the Empowerment of Women and United Nations Industrial Development Organization, 2013.
223. ESCWA, 2020c.
224. ESCWA, 2020e.
225. United Nations Entity for Gender Equality and the Empowerment of Women and United Nations Industrial Development Organization, 2013.
226. ESCWA, 2020e.
227. Hartung and Pluschke, 2018.
228. Soler and others, 2020.
229. Gender CC, 2009, p. 35.
230. ESCWA, 2020k and 2020m. FAO, 2020a.

This policy toolkit was developed within the framework of the Regional Initiative to Promote Small-Scale Renewable Energy Applications in Rural Areas of the Arab Region (REGEND). It aims at providing guidelines for policymakers to integrate small-scale renewable energy in rural development in the Arab region.

The policy toolkit tackles the challenges and opportunities of the creation of markets for electricity using small-scale renewable energy technologies in rural communities across Arab countries. It also discusses policy options, guidelines for financing, innovative incentive mechanisms, best practices for facilitating the dissemination and use of small-scale renewable energy technologies for enhanced livelihood and gender equality in rural areas through entrepreneurial activities, respect of human rights and gender mainstreaming within an integrated approach. The toolkit also explains how rural women can benefit significantly from the introduction of small-scale renewable energy technologies, through improved access to education and health, modern digital communication, and new market opportunities related to improved access to technology and machinery.

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