Economic and Social Commission for Western Asia

REGEND – Small Scale Renewable Energy Technologies With Income Generating Activities in Rural Areas Within a Nexus Framework

Addressing The WEF Nexus in the Context of Climate Change and Sustainable Development – 22 October 2020

UNITED NATIONS
ESCWA

Shared Prosperity Dignified Life

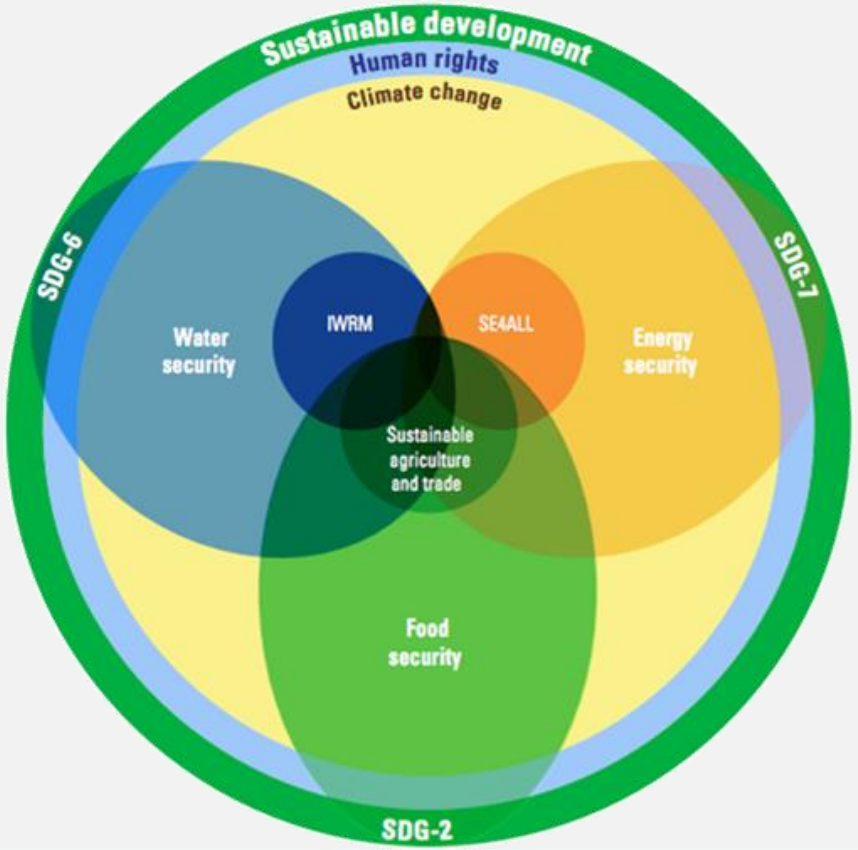
Sida

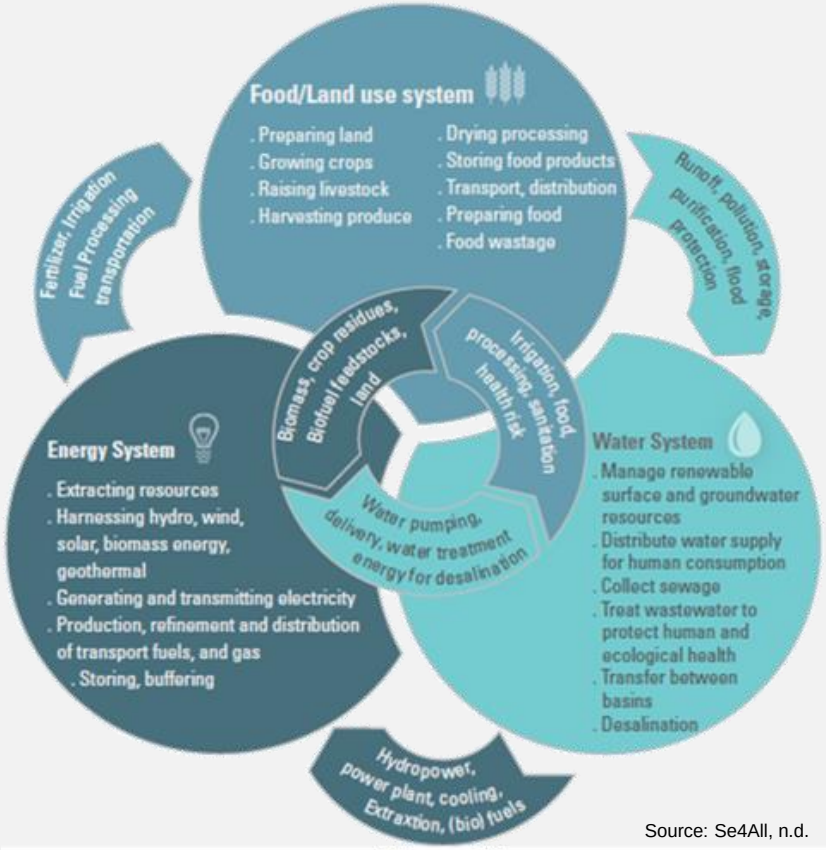
Dr. Syham Bentouati
Managing Director
NAFAS International, OMAN
ESCWA Consultant

NAFAS

Table of Contents

The Nexus Approach within the Sustainable Development Goals and Climate Change & The WEF Nexus Framework



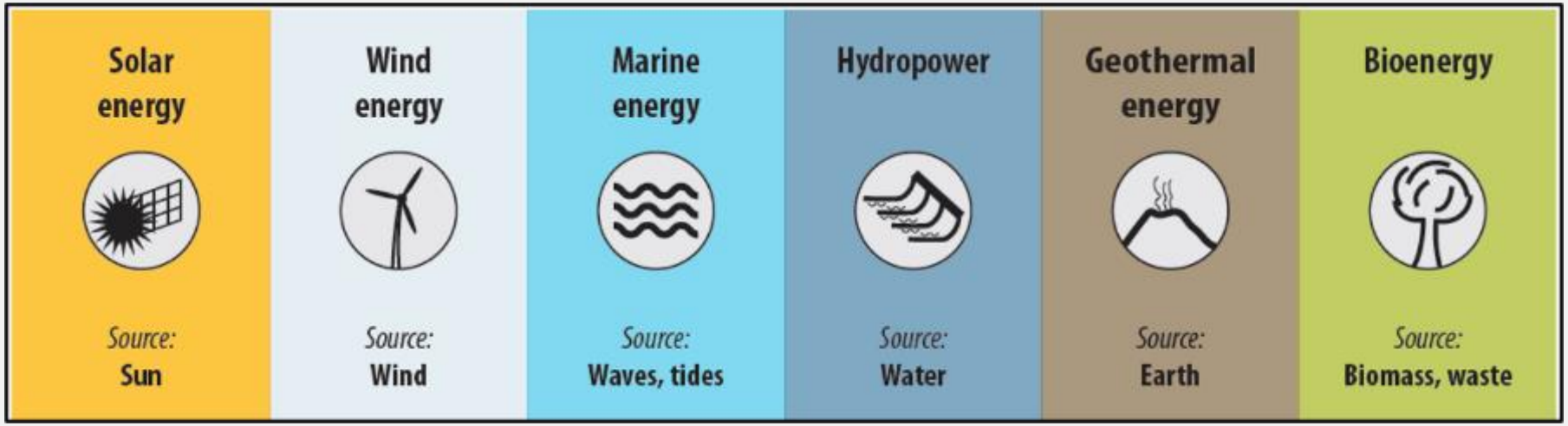


Source: Se4All, n.d.

Definitions

- **Renewable Energy:** The energy generated from renewable, theoretically inexhaustible and non-fossil-based, energy sources which are replenished in a human lifetime. Renewable energy sources include solar, wind, marine (ocean), hydropower, geothermal and bioenergy.

- **Small-Scale RE Technology:** The technology which converts RE sources into electrical or thermal energy with an output power capacity up to around 100 kW.



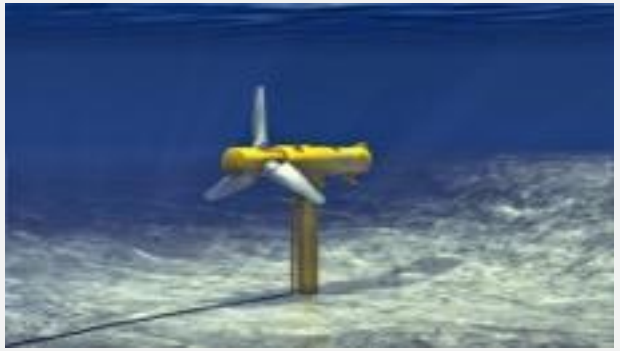
Renewable energy categories (ECA, 2018)

Main Small-Scale RE Technologies (RETs)

1. Solar Energy

2. Wind Energy

3. Marine (Ocean) Energy



4. Hydropower Energy

5. Geothermal Energy

6. Bioenergy

Assessment of Small-Scale RETs for Rural Areas Applications

Technical Suitability

- Fit-for-purposeness
- Usability
- Compliance

Economics

- Capital expenditure
- Operating expenditure
- Overall Life Cycle Cost
- Economic productivity
- Benchmarking
- Economies of scale

Environmental

- Benefits to the environment
- Adverse effects
- Water-energy-food nexus

Social Impact

- Local resourcing
- Politics
- Culture
- Individual and community health and other factors

Methodology for Mapping RE Types and RETs

Identify and select RE sources

- Identify main RE types available
- Quantify availability of each RE type and screen out unviable sources
- Select RE type options, e.g. single source or hybrid

Identify project needs

- Understand the applications required at the rural site
- Determine the energy requirements of the applications

Map RE types & technologies

- Map each RE type source option identified in Step 1 against the applications required
- List suitable RETs based on previous steps

Evaluate mapped options

- Technical feasibility
- Costs / economics
- Environmental and social impact
- Compare evaluated mapped options and select overall optimum

Potential Benefits of Small-Scale RETs

Technical Considerations	• Technical maturity
Economics	• Increased economic productivity • Growth potential
Environmental Considerations	• Water – Food – Energy nexus • Climate change • Preventing / reducing pollution
Social Impact	• Improving health and education • Entrepreneurship & business development • Women empowerment

RE Types and RET Options for Various Applications (1/3)

Renewable Energy Type & Technologies	Applications														
	Power	Agriculture					Domestic				Lighting		Water		
	Electricity Generation	Pumping for Irrigation	Dryers	Hydroponics	Grain Milling	Industrial Refrigeration	Heating	Cooling & Refrigeration	Cooking	Powering Appliances	Domestic	Street or Farm	Heating	Disinfection	Desalination
SOLAR															
Concentrated Solar Power (CSP)	√								√						
Photo Voltaic (PV) Panels	√	√		√		√		√		√	√	√			√
Solar Dryer			√												
Solar Disinfection (SODIS)														√	
Flat Plate Collector (FPC)													√		
Evacuated Tube Collector (ETC)													√		
Solar Thermal Cooling System						√		√							
Solar Electrical Cooling System								√							
Solar (Thermal) Collector for Heating							√						√		

RE Types and RET Options for Various Applications (2/3)

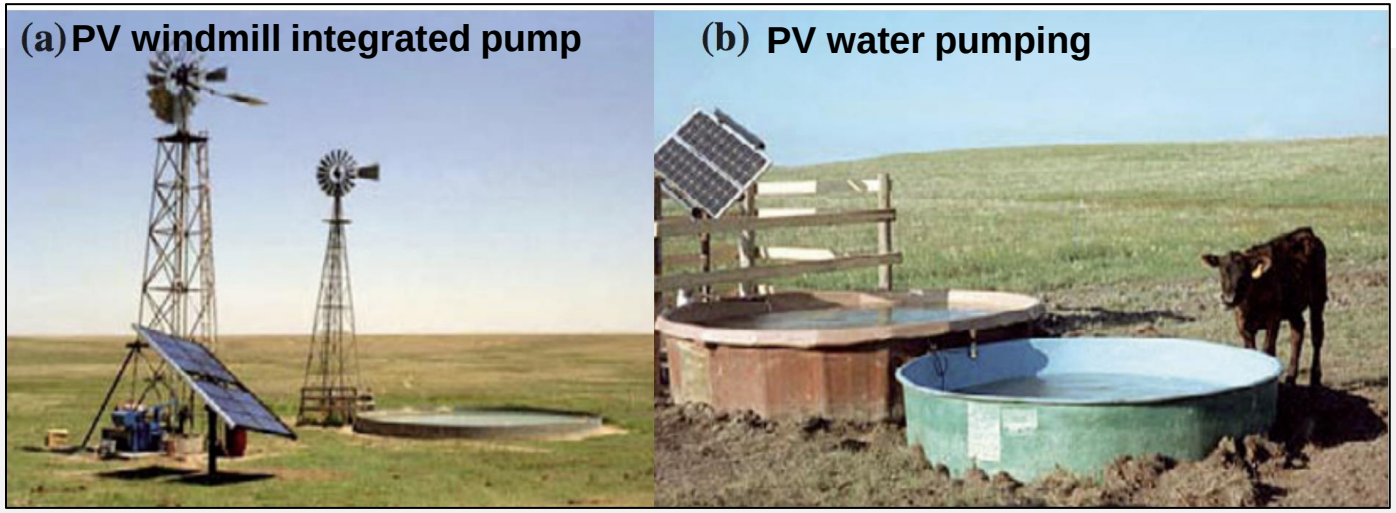
Renewable Energy Type & Technologies	Applications															
	Power	Agriculture					Domestic				Lighting		Water			
	Electricity Generation	Pumping for Irrigation	Dryers	Hydroponics	Grain Milling	Industrial Refrigeration	Heating	Cooling & Refrigeration	Cooking	Powering Appliances	Domestic	Street or Farm	Heating	Disinfection	Desalination
WIND POWER															
Wind Turbine / Generator	√						√	√		√					√
Windmill (Wind Mechanical Pump)		√			√										
SOLAR & WIND HYBRID															
Windmill & Photovoltaic Panel	√	√			√										
Wind Turbine & Photovoltaic Panel	√				√					√	√	√			√
SOLAR & BIOMASS HYBRID															
Power & Heat Coupled Systems							√								
HYDRO															
Hydropower Plant / Turbine	√									√					

RE Types and RET Options for Various Applications (3/3)

Renewable Energy Type & Technologies	Applications														
	Power	Agriculture					Domestic				Lighting		Water		
	Electricity Generation	Pumping for Irrigation	Dryers	Hydroponics	Grain Milling	Industrial Refrigeration	Heating	Cooling & Refrigeration	Cooking	Powering Appliances	Domestic	Street or Farm	Heating	Disinfection	Desalination
BIOMASS															
Biofueled Power Generator	√														
Power & Heat Coupled Systems							√						√		
Biofuel (Ethanol / Biodiesel) Stove									√						
Biodigester for Biogas Production						√	√		√		√			√	
Fuel Wood & Green Residue							√		√					√	
Biomass Fuel Briquette	√						√		√					√	
Improved Cooking Stove							√		√					√	
GEOTHERMAL															
Geothermal Generator	√												√		√
MARINE (OCEAN)															
Marine Turbine	√														

Matching Small-Scale RETs and Applications for Rural Areas

1. Agriculture



Matching Small-Scale RETs and Applications for Rural Areas

2. Domestic Use

Solar air heating system

Biofuel stove

Solar evaporation cooling

Solar PV-based cooling

Parabolic solar cooker

Matching Small-Scale RETs and Applications for Rural Areas

3. Lighting

Solar, wind solar hybrid and wind streetlamps

4. water

Women Empowerment & Entrepreneurship

Shaimaa Omar - Young entrepreneur creating energy from agri-waste

- Better **health** condition and **education** as well as small **business opportunities** can help improve the living conditions for the community.
- Street lighting can also improve the **safety** of the community, allowing them to go out or work after sunset.
- **Entrepreneurial activities** related to RETs can specifically be **geared towards women**.
- **Incentives and tailor-made policies** are key to maximizing women empowerment and entrepreneurship.

Case Study of Small-Scale RET (Irian Jaya, Indonesia)

Case Study of Small-Scale RET (Irian Jaya, Indonesia)

1. Background

- Irian Jaya village community relies primarily on subsistence farming and fishing.
- It is fairly remote, any purchased material would first need to be trucked over 100 km from the city of Jayapura, Irian Jaya to the nearest dock and then requires a 3-hour boat trip to the village.
- YUSI designed and installed a **micro-hydropower system** in the village.
- YUSI also provided training and direct support of the installed micro-hydropower system with spare parts and repairs.

2. Cost

- The government provided financial assistance towards the capital costs after receiving the request from the village leaders.
- No costs were associated with the poles as they were provided by the village. Local ironwood trees that grew in abundance near the village and naturally preserved were utilised.
- The cost of the mini-grid and house wiring averaged $60 US per household and the power plant averaged an additional $130 US per household.

Case Study of Small-Scale RET (Irian Jaya, Indonesia)

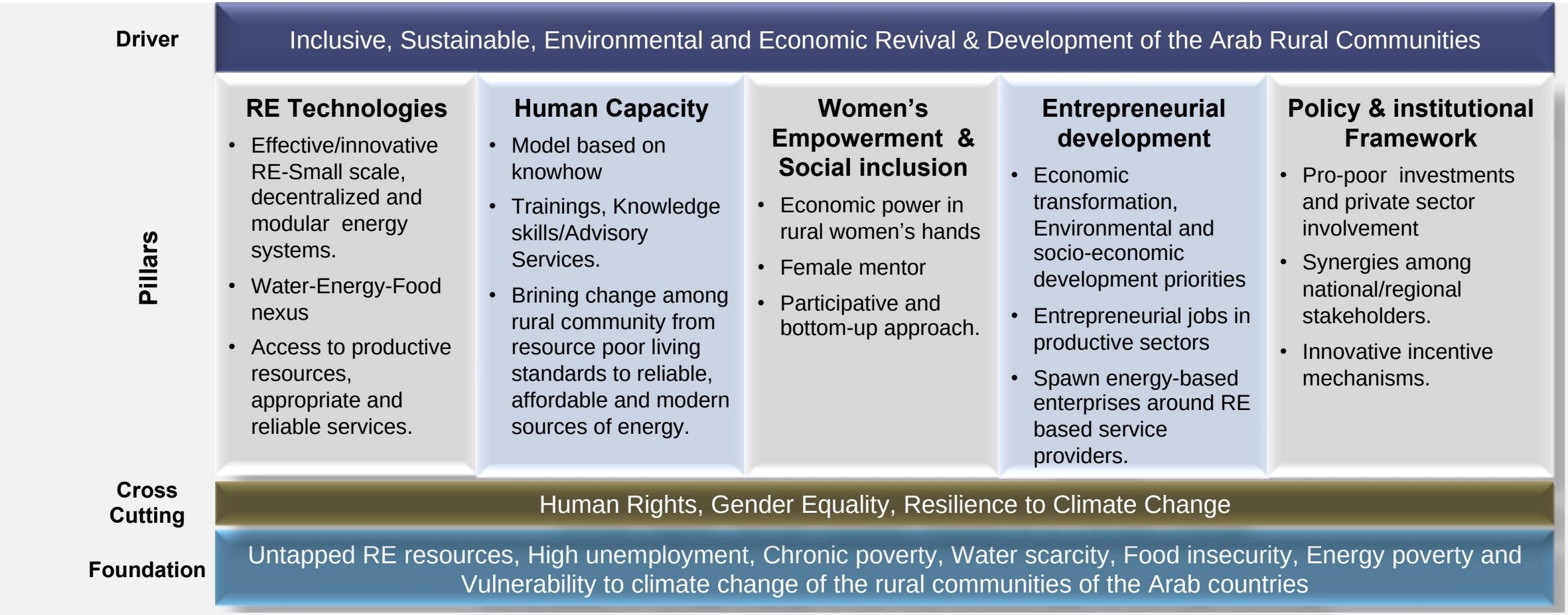
3. Benefits

- A few innovative villagers created additional income by powering a few incandescent lamps to provide warmth for raising chicks in an otherwise damp environment to support small poultry businesses.
- The government clinic installed a small refrigerator to preserve medical supplies. As a result, this improved the health condition of the community through access to vaccinations and medications.
- Retention of government staff for clinics and schools improved. Quality lighting at home improved the ability of students to study adequately at home thus supporting better educational outcomes.

4. Lessons Learnt

- The village government authority was responsible for collecting the monthly tariffs. However, this type of accounting is not transparent and often resulted in funds disappearing or being used for other things.
- An honor system was expected to stop individual households from drawing more than 40W of power from the mini-grid.
- However, in reality, many homes exceeded this limit and eventually the cumulative result was the turbine shutting down whenever its limit was exceeded.

Regional Initiative to Promote Small–Scale Renewable Energy Applications in Rural Areas of the Arab Region "REGEND"



Conclusions & Recommendations

Conclusions

- There is a great RE potential globally, including in the Arab region where it is quite under-utilised.
- Many RETs are already affordable.
- RETs selection depends on specific locations and projects.
- Many good examples of using small-scale RETs in rural areas to improve the livelihood of the communities exist, some of which in the Arab region.

Recommendations

- Post-pilot sustainability of RET-based projects
- Fit-for-purpose policy (including access to Finance and training) to facilitate development of small-scale RET-based projects in rural areas, especially for women.
- Awareness campaigns, some specifically targeting women.
- Sharing experiences and opportunities at local, regional and intra-regional levels.

Dr. Syham Bentouati
Managing Director
NAFAS International, OMAN
ESCWA Consultant
syham@nafasinternational.com

Thank you