Final Report

Introducing renewable energy solutions to enhance energy security and build climate resilience in Karachi, Sindh, Pakistan

Grantee: WWF-Sweden

Local Partner(s): WWF-Pakistan

Other Partner(s): Karachi Metropolitan Corporation and the K-Electric

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Date

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1. EXECUTIVE SUMMARY

The project has been very successful in meeting an ambitious and multifaceted objective to enhance energy security and climate resilience, through provision of the renewable and alternate energy solutions for the selected communities of Karachi to contribute to improved energy access, better health, enhanced climate adaptation capacity, and women empowerment, while facilitating the city's transition to renewable energy-focused, low-carbon development. The project was focused on three selected sites of Karachi including Rehri, Gadap and Maripur, which suffer due to poverty, lack of opportunities and access to energy and basic amenities. Thanks to a successful partnership between WWF Pakistan, Karachi Metropolitan Corporation (KMC) and the K-Electric (KE) and the project's deep on the ground commitment to support local communities in these areas, the project has been able to successfully pilot innovative alternate and renewable energy solutions for over 2,000 households residing in these peri-urban areas. These on the ground achievements have provided the KMC and KE with inspiring blueprints on which to scale up their commitments to provide clean, resilient energy to their most vulnerable communities and place Karachi on the path to a climate resilient, renewable energy-based future.

One of the important deliverables of the project was provision of solar energy for the 1639 households covering 25 villages in the off-grid areas of Gadap Town and Maripur in collaboration with the K-Electric. Deep engagement through community trainings has ensured that the take up and use of renewable energy is sustainable, where there has been a focus on community cooperation to maintain the solar units, while 41 local technicians trained to install and repair these units. The Project has supported the adoption of clean energy in the form of Fuel Efficient Stoves (FES) and innovative solar gasifiers to 960 household's from the project sites, supporting these communities in moving away from a high dependence on mangroves and other important trees species for fuel-wood while mitigating the damaging health impacts from smoke induced diseases, targeting in particular female community members. Here, K-Electric played an important role in raising awareness of the importance of mangroves and trees for local climate resilience when it carried out a massive plantation campaign, planting 153,555 saplings of local trees species in total including mangroves.

Another innovative clean energy technology implemented was biogas, leveraged to use dung produced from the local cattle colony and thereby mitigating run off into the Arabian Sea / North Indian ocean. Twelve communal biogas plants were installed and are in operation, where community training and cooperation to implement a local development business model, generating income through manure supply and plant repair operations, has again been key.

Finally, the project successfully linked its tackling of local challenges with national and even global issues as Karachi secured participation in the One Planet City Challenge (OPCC) – a global initiative which incentivizes cities towards planning, reporting, and then receiving feedback on their climate friendly actions and strategies. Karachi is the first city from Pakistan to participate in the OPCC, not only inspiring the city to develop an ambitious renewable energy action plan but also having a ripple effect nationally, with other Pakistani cities now also wanting to participate in the OPCC and follow Karachi's lead.

2. ASSESSMENT OF IMPLEMENTATION OF THE PROJECT

Achievement of Outputs and Objectives

Planned Objectives and Outputs	Indicator(s):	Achievement of the objectives and outputs:
Overall Objective: Enhanced energy security and climate resilience, through technology transfer from the Nordic region to Karachi which shall contribute to improved energy access, livelihoods, health, adaptation capacity, and women empowerment and facilitate the city's transition to renewable energy focused low carbon development	-MWs of RE from installed solutions in Karachi's energy mix -Change (%) in carbon emissions -Change (%) in socio-economic statistics (e.g. income, empowerment) against the baseline	-0.02 Mega-watts RE from installed solutions in solar energy -total avoided CO2 emission 2043.8 metric tonnes -An average 48% user of clean and alternate energy options reported a reduction in monthly health care/treatment related cost in comparison to baseline figure - Average 88% reduction in wood consumption as an outcome to adoption of biogas (contributed to HHs' monthly savings of up to 500 PKR per month); Average 48% reduction in wood consumption in Gadap Town due to adoption of fuel efficient stoves (contributed to HHs' monthly savings of up to 50-100 PKR per month)
Objective 1. 1. Improve energy security by providing access to renewable energy for 1,850 households (HHs)	**- Change in renewable energy (MWs) that target HHs' has an access**	**- 0.02 Mega watts RE Change in renewable energy (MWs) that target HHs**
output 1.1 Improved access to energy through the installation and functioning of two types of tested RE Units at project sites	- No. of HHs' using energy from installed RE solutions	- 1639 HHs using energy from installed RE solutions, signed agreements with beneficiaries
output 1.2 An enabling environment for the propagation of RE generation and reduction of carbon emissions	- No. of agreements with stakeholders to work on RE - No. of case studies	-Two MoUs with stakeholders to work on RE (KE and KMC) -OPCC registration of Karachi city one agreement with GLP for procurement of solar units -organization of three Earth Hour events at the city and provincial level showcasing RE and carbon emissions reductions potential of project - three case studies generated for biogas, solar and fuel-efficient stove adoption

Objective 2. Establish and empower community groups through transfer of practical skills to own and operate (at least 60% of) energy units installed	**- % of installed RE units owned and operated by /community groups**	**- 100% of installed RE units owned and operated by women/community groups and community**
2.1 Community groups established and functional for effective management and promotion of RE	- No. of women cooperatives/community groups and members enrolled	- A total of 33 community groups were established at Maripur, Rehri and Gadap Town comprising of 921 members wherein >50% are women -over 500 individuals participated in various training conducted for the effective usage and adoption of RE and clean energy intervention of which 63% were women participants
2.2 Women/community trained to operate and manage RE units	- No. of community members trained to operate and maintain owned RE units	-Three training modules developed on solar, biogas, fuel efficient stoves adoption and making -> 500 trained community members; all beneficiaries also got trained through master trainers and technicians in the usage of adoption of RE and clean energy units
Objective 3. Contribute towards alleviating poverty through increased capacity for potential income generating opportunities and improved health, as a result of consistent and clean energy supply	**- No. of new home-based businesses or cottage enterprises established owing to improved energy supply**	**- 41 local community members are trained to support improved energy supply**
3.1 Diversified livelihood options promoted through building capacity and awareness of target communities	- No. of trainees exploring alternate livelihood options	-Employment opportunities-biogas dung delivery model – 01 job (full time) Man, 4 men trained repair and maintenance, (part-time) -Solar technicians – 41 men (part time), 25 women; Fuel Efficient Stoves - 18 women master trainers (part-time) -Three training modules developed on solar, biogas, fuel efficient stoves adoption and construction
3.2 Improved quality of life and reduced pressure on natural resources, particularly mangrove wood, through increased use of biogas mud stoves (clean stoves)	- Incidence of indoor air pollution related respiratory diseases - Amount of fuelwood used	- Monitoring reports - List of beneficiary HH - Interviews/ field pictures - In Gadap Town, 53% individuals (n=122) reported 100% reduction in respiratory diseases, 51% reported 100% reduction ins eye related problems, 52% reported a 100%

		reduction in skin related problem due to adoption of FES/clean energy **-Rehri** (n=12):- 42% individuals reported 100% reduction in respiratory diseases, 75% reported 100% reduction ins eye related problems , 50% reported a 100% reduction in skin related problem due to adoption of clean energy Communities were 100% dependent on the mangroves wood for fuel with an average daily 15.58 Kg/day prior to the installation of the biogas units with average daily cumulative wood consumption of 638 Kg and an average 230,010 Kg/year (253 tonne/year). Provision of biogas energy has helped to reduce mangroves wood usage to 1.88 Kg/day/HHs' and hence has contributed to reduce 88% wood consumption in 41 HHs. Provision of clean energy in the form of the fuel-efficient stoves and solar powered gasifiers: Average daily baseline wood consumption by individual HH was estimated 17.5 Kg/day and a cumulative 16.8 tonnes of wood for 960 HHs (cumulative estimated annual average consumption 6,530 tonnes). Provision of clean energy in form fuel efficient stoves has supported to reduce daily wood consumption to 48% (9.11 Kg/day) for an individual HH and overall 8.05 tonnes for 960 HHs.
Objective 4. Develop results-based business models to scale up development of renewable energy, exchange of information through EHCC	**- proposed RE Action Plan and business models**	**A city-level proposed RE Action Plan and two site-based business models one focused on RE and the other on biogas**
4.1 Low carbon RE business model established for project areas	- Business model	Two business models for site-based implementation of solar and biogas adoption and sustainability developed
4.2 City Renewable energy promotion action plan developed, and interregional cooperation and information exchange	- Draft of action plan	- one Stakeholder consultation to draft an action plan for RE promotion -draft RE promotion action-plan developed and shared with key city stakeholders -three workshops one for the OPCC training, the others for the RE action plan

Deviations from the planned Outputs and Activities

The project was able to conduct all outputs and activities, with a few minor adjustments in the project delivery and design on consultation with the donor. These included:

- **Additional Off-grid sites** the off-grid sites of Kemari Town (Maripur) and Gadap Town were added for RE provision on the basis of updated feasibility studies and consultations with K-Electric at the start of the project. The additional sites also meant that the original pay-as-you-go model chosen for solar energy did not prove feasible owing to the economic conditions of the beneficiaries. This model was thus replaced with Sun King's home solar units which were purchased and given to communities with ownership agreements.

- **Activity 1.8 'Install 325 solar units for 1625 HHs and 12 integrated bio-methane plants for 120 HHS** The project originally planned to install 12 communal bio-methane plants to serve 120 households. However, this was assessed as not being sustainable owing to the limited availability of organic waste and livestock at the project sites. Instead, it was decided that 12 cluster biogas units targeting 41 households would be established and these would be supplemented with the installation of 560 solar gasifiers serving communities in Rehri and Maripur. Similarly, the project initially planned to provide communal solar units to the communities in the selected off-grid areas but that was not a feasible solution due to remote locations of the project sites and requirement of communities. Therefore, individual household based IFC certified Sun king Home 120 systems were provided to 1639 families/households, each unit comprised of a photovoltaic system with three 200 lumen high-power fixed room lights, 12,000 mAh battery, Power hub, Solar plate of 12V power output and standard 5.5V USB port with associated cables.

- **Output 2.1 Women cooperatives established and functional for effective management and promotion of RE (Target: 4 COS with 30% women representation and 10 women cooperatives formed and functioning)** Owing to wide geographic spread in the distribution of the project sites, cultural restrictions and limited capacity of the communities, it was not possible to establish 10 women cooperative across all sites. Community groups led by women were established where possible, while most other groups consisted of mixed gender representation. A total of 33 community groups were established at Maripur, Rehri and Gadap Town comprising of 921 members wherein >50% are women.

Achievement of NCF indicators

<table>
<tr><th>NCF indicators</th><th>Results</th></tr>
<tr><td>1. Number of beneficiaries reached (women/men)</td><td>
<table>
<tr><th colspan="6">Project beneficiary households [Intervention wise]</th></tr>
<tr><th>Site</th><th>Fuel Efficient Stoves</th><th>Gasifiers</th><th>Solar</th><th>Biogas plants</th><th>Total beneficiaries HHs</th></tr>
<tr><td>Gadap Town</td><td>400</td><td>0</td><td>1062</td><td>-</td><td>1431</td></tr>
<tr><td>Maripur</td><td>0</td><td>358</td><td>572</td><td>0</td><td>930</td></tr>
<tr><td>Rehri</td><td>0</td><td>200</td><td>0</td><td>41</td><td>241</td></tr>
<tr><td colspan="5">Grand total</td><td>2602</td></tr>
</table>
<table>
<tr><th colspan="3">Project beneficiaries [Gender-wise]</th></tr>
<tr><th>Site</th><th>Men</th><th>Women</th></tr>
<tr><td>Gadap Town</td><td>755</td><td>676</td></tr>
<tr><td>Rehri</td><td>41</td><td>200</td></tr>
<tr><td>Maripur (Kemari)</td><td>447</td><td>483</td></tr>
<tr><td>Total</td><td>1243</td><td>1359</td></tr>
<tr><td></td><td>48%</td><td>52%</td></tr>
</table>
</td></tr>
<tr><td>2. Number of people with increased resilience to climate change (women/men)</td><td>
<table>
<tr><th colspan="3">Total number of individuals (based on household census data of the beneficiaries)</th></tr>
<tr><th></th><th>Men</th><th>Women</th></tr>
<tr><td>Total number of individual beneficiaries</td><td>3880</td><td>3627</td></tr>
<tr><td></td><td>52%</td><td>48%</td></tr>
</table>
</td></tr>
<tr><td>3. CO2e emissions reductions (actual at project completion and expected during the lifetime of the project's mitigation investments)</td><td>Solar units
Cumulative solar energy generation from 1639 solar units 0.02 megawatts with avoided CO2 emission 68.92 tCO2e per year
Fuel efficient stoves and gasifiers: 8.05 tonnes of overall daily wood saving for 960 HHs with avoided CO2 emissions are 1799.2 tCO2e per year.</td></tr>
</table>

	● **Biogas plants -** Quantity of wood- 0.55 tonnes of wood saving for 41 HHs as an outcome to adoption of biogas energy with avoided CO2 175.6 tCO2e per year ● **Plantation -** plantation of 45,000 mangroves indirect CO2 emission reduction 17.96 TCO2e planted at the beginning of the project, whereas 45,000 more were planted at the end of the project and hence were not added to age of new plantation.
4. Number of green business concepts tested	**Alternate energy–** biogas dung delivery model and skilled local technicians in Rehri **Renewable energy** – 41 skilled local technicians trained and equipped for Maripur and Gadap Town **Fuel Efficient Stoves** – 18 skilled women Master trainers in Gadap Town
5. Number of new decent jobs created (disaggregated by number of permanent (women/men) and seasonal (women and men)	**Biogas dung delivery model –** 1 FTE man for dung delivery, 4 men trained in repair and maintenance, (part-time) **Solar technicians –** 41 men (part time), 25 women **Fuel Efficient Stoves -** 18 women master trainers (Part-time)
6. Number of people with improved livelihoods/income-generating possibilities (women/men)	Total 89 - 43 women, 46 men ● A total of 41 local community representatives were identified carrying basic skills of electricians to facilitate installation of solar units at village level and to gain important skills of solar units repair and maintenance. Technicians involved in installation of solar units in beneficiary HHs' were paid a nominal stipend of Pak Rupees 150 (US$ 1.5) for each solar unit. A total of PKR 133,800 (> 950 US$s) were paid to the local technicians to facilitate installation of solar units. 25 women were also trained to help maintain solar units and facilitate other women. ● The dung delivery vehicle has so far supplied over 307,370 Kg (~307 tons) of dung for the recharge of the biogas plant in about 300 trips. The community member operating the vehicle has earned over PKR 75,000 (550 US$). Four community members have been trained as skilled workers to fix technical issues and repairs of the biogas units, in collaboration with the company that constructed the biogas units at the project sites. ● About 18 women have been trained in making and usage of fuel-efficient stoves. These women helped to train 313 women beneficiaries from

	communities in FES making and their proper usage.
7. Number of multi-stakeholder partnerships developed	● Two formal Memorandum of Understanding (MoUs) were signed between WWF Pakistan and the Karachi Metropolitan Corporation (KMC) and K-Electric, respectively. The KMC is the city management authority and the purpose of signing MoU would ensure their involvement in OPCC, Earth Hour, carbon emission estimation inventory development, and drafting a renewable energy policy for Karachi. ● The MoU with K-Electric, Karachi's main electricity supply company, helped in the selection of off-grid communities and solar technology. K-Electric was also involved in the organisation of Earth Day consecutively for three years, planted 153,555 mangroves and other local tree species in total. ● Green Light Pakistan (GLP) was responsible to provide solar units and their field installation. GLP also facilitated trainings of electricians/skilled workers covering key aspects of solar units installation, their repair and maintenance – a post project service providers. ● Rural Development Foundation (RDF), helped to train women master trainers from local communities in making fuel efficient stoves, facilitated to develop a training manual and provided support in installation of stoves. ● Saiban Welfare Organization (SWO) facilitated construction of 12 communal biogas plants. They also facilitated capacity building of beneficiaries of biogas for maintenance and safety as well as training of skilled workers in the repair and maintenance of the units. ● Undergraduate students from the Institute of Environmental Sciences, University of Karachi (IES-UoK) were engaged in baseline and endline surveys for data collection from the project beneficiary households. ● Various other institutions and government line-departments have been involved in the project and helped in providing input and GHGs emissions data from their respective sectors for the OPCC registration and RE promotion action-plan. These included but not limited to the National Electric Power Regulatory Authority (NEPRA), Govt. of Pakistan, Sindh Transport

	Department (STD), Sindh Mass Transit Authority (SMTA), Sindh Energy Department, Planning and Development Department, Sindh Environmental Protection Agency (SEPA), Sindh Solid Waste Management Board, Civil Aviation Authority (CAA), and the National Institute of Oceanography (NIO-UoK).

3. CLIMATE CHANGE

Communities were 100% dependent on the mangroves wood for fuel with an average daily firewood consumption of about 15.58 Kg prior to the installation of the biogas units with average daily cumulative wood consumption of 638 Kg/day and an average 230,010 Kg/year (253 tonne/year). Provision of biogas energy has helped to reduce mangroves wood usage to 1.88 Kg/day/HHs' and hence has contributed to reduce 88% wood consumption in 41 HHs.

Similarly with the provision of clean energy in the form of fuel efficient stoves and solar powered gasifiers for 960 households has helped to reduced consumption of wood substantially for fuel. Communities in the areas were accustomed to use open fire system for cooking with an average daily wood consumption of 17.5 Kg/day/household (including mangroves and other trees species) prior to the provision of fuel-efficient stoves and gasifiers and a cumulative 16.8 tonnes of wood for 960 HHs. Provision of clean energy has supported to reduce daily wood consumption by almost 48% (9.11 Kg/day) for an individual HH and overall 8.05 tonnes of wood for all 960 HHs.

The project has also solar electrified off-grid communities of Gadap Town and Maripur, benefiting 1639 HHs. Each of the solar units carries three LED lights and phone chargers with associated solar plate and battery is able to generate 12.12 watts of solar energy. Provision of solar energy will contribute to mitigate/avoid 68.92 tCO_2e per year. K-Electric, one of the key project partners, planted90,000 mangroves and plantation of 63,555 other local terrestrial tree species.

4. DEVELOPMENT IMPACTS AND CROSS-CUTTING ISSUES

The project interventions included several development and cross-cutting impacts, contributing to the delivery of a number of the SDGs. One of the important deliverables was provision of solar energy for 1639 households covering 25 villages inm off-grid areas of Karachi including Gadap Town and Maripur in collaboration with K-Electric. This supported a number of SDGs, above all goal 7 but also contributed across other goals such as 1, 3, 5, 13 and 17.

The project has also helped in economic uplift of the communities through their engagement in the livelihood opportunities as an outcome to the provision of renewable energy generation, contributing to SDG 1. This has been achieved through offering diversified livelihood options promoted through building capacity and awareness of target communities by engaging over 50 local community members in various livelihood options as part of the renewable and alternative energy opportunities mainly in the maintenance and management operations.

The biogas based business model for example carries mechanism to effectively engage communities in the management of the biogas units and their sustainability together with providing income generation sources linked to manure supply and biogas plants repair operations. The business includes a community group lead entity to supervise all aforementioned operations and functioning, which will follow a mechanism to monitor biogas unit performance. The biogas model will also contribute to convert substantial quantities of dung into energy, which would be otherwise making its way to the Arabian Sea as polluting waste that harms marine life and ecosystem, thus also contributing to SDG 14.

Other cross-cutting impacts from the use of biogas units include positive health impacts through reduced exposure of communities, especially women and children to indoor pollutants and improved waste management – all contributing to an improved quality of life for project beneficiaries, thereby supporting SDG 3. The fuel efficient stoves (FES) provision to 402 HHs, and 560 solar gasifiers have also helped to reduce exposure to indoor pollutants, especially female community members so contributing to SDG 5, while also supporting to minimize pressure on the forest resources, thereby also supporting SDG 15. FES has also generating livelihoods for women cooperatives in stoves making and their subsequent maintenance, with crosscutting positive impacts for SDG 3 and 5, respectively.

The project supported to promote restoration of natural habitats, as promoted under SDG 14, through protection of mangroves and tree plantations carried out in collaboration with K-Electric to contribute towards the enhancement of carbon sequestration and mitigate carbon emissions and footprint reduction. The project has also helped to get Karachi city registered for the One Planet City Challenge (OPCC), the primary focus of the OPCC is on city actions that help move investment flows from fossil fuels to renewable and sustainable energy solutions hence has facilitated in securing commitments from the city to work towards developing a renewable energy focused policy, thus having multiple positive impacts across SDGs 7, 11 and 13. Project implementation was a result of working through enhanced collaborations and partnerships, including the private sector, governments, civil society and research organisations thus contributing to SDG 17.

A brief reflection of target community members on the support extended by the project include for example:

1. *Ms. Khadija Bibi one of biogas users mentions that before the biogas adoption, we use to buy tons of mangroves wood every month which costs us 4000-6000 PKR. Now we have access to the clean gas supply.*

2. *We have never had access to the light in our house before and we would usually have a small torch or a candle to lighten-up the nights. We now feel safe as there is no more fear of snake bites at night. My children could study at night and I have extra time for embroidery and patch-work and hence a supplementary income source to support my family - says Husna - a resident of Mubarak Village.*

3. *Ms. Nabila Bibi a resident of Gadap Town is one of the beneficiaries refers shifting to fuel efficient stoves a comfort added to her life, which is saving a significant amount of wood and cooking time in almost a smoke free background. We are burning less wood now from 45 Kg per day to 18 Kg per day, which will help to save us money as well. According to her their health issues especially eye irritations, skin rash and cough have been reduced ever since we have started using these stoves.*

5. ASSESSMENT OF THE RESULTS AND IMPACTS OF THE PROJECT

5.1 Relevance

The project target communities are located along the coastal belt of Sindh in Karachi, which are important ecological sites and critical habitat of biodiversity. Gadap Town, falls within the buffer zone of the only coastal national park of Sindh Province and faces higher pressure of deforestation on its forest resources for fuelwood. The communities are deprived of access to basic amenities including access to clean energy, drinking water, and electricity. These communities had a higher dependency on mangroves for fuelwood and are susceptible to smoke induced diseases in particular the female community members and are more susceptible to climate change induced disasters. The project hence has helped to ensure energy security and associated benefits to the communities targeting over 7000 individuals across three sites. Capacity building of community groups and mobilization of the targeted communities helped to enhance their awareness on these issues, developed a better understanding on the effectiveness of adoption of RE and clean energy technology and their future sustainability. The project also complements targets and commitments of the Government of Pakistan set out to mitigate and adapt to climate change and minimize GHGs emissions.

5.2 Effectiveness

The project was able to meet all its targets in close coordination with the main stakeholder groups and beneficiaries. The overall impact assessment of the project suggests that it has profound impacts in improving the lives of the local communities. A summarised version of the key deliverables of the project with achievements is mentioned below;

Sr#	Important achievement
1	Socio-Economic Assessments (Pre and post Installation) and feasibility studies – 2 studies
2	Registration of Karachi city for Earth Hour City Challenge (OPCC)
3	Arranged 10 webinars to enhance capacity on reporting and data collection of RE indicators as well as in-country workshop
4	Over 70 follow-up two target areas to Form Representative Women Cooperatives
5	Plantation of over 119,800 mangrove other local tree species

6	Developed two business models for biogas and solar energy provision and livelihood generation for communities
7	Provision of Fuel Efficient Stoves/Clean Stoves for 400 HHs
8	Provision of solar energy for 1639 HHs
9	Provision of 12 communal plants supporting 41 HHs biogas plants as an alternate energy source
10	Provision of 560 solar powered energy efficient gasifiers for the mangroves dependent HHs

There was a significant time lapse between the project approval and implementation during which dynamics of the proposed sites changed substantially and some of the initially suggested interventions were not feasible. The proposed renewable, clean and alternate energy solutions models were therefore, also subject to change based on the communities' feedback, their socioeconomic dynamics and the ground situation. For example, the initially proposed pay to go model of solar units was not found to be a useful option knowing the socioeconomic dynamics of communities and hence were shifted to another model which were given to communities free of cost. The number of communal biogas plants were also reduced due to limited space, water and dung availability. A significant proportion of efforts were spent in social mobilization and educating communities about the effectiveness of adoption of clean energy solutions including biogas plants gasifiers and fuel-efficient stoves as the communities were accustomed to cooking in open fire primarily using mangroves wood and facing smoke induced health issues.

5.3 Efficiency

The project was able to meet all its targets while ensuring reliable and cost effective means to achieve both technical and financial efficiency. All purchases for the project were made following WWF's standard procurement procedures which helped to find suitable and economical material and hence has helped to save 8% of the total budget. See the table below for details of savings made.

Amounts are in euro

	NCF	WWF SE	Local co-financing	WWF PAK	KE	SFI	GRAND TOTAL	%
Partner Budget	469,177	79,691	-	69,884	80,920	13,020	712,692	**100%**
Actual Total Spending	435,486	58,350	-	69,621	82,126	11,240	656,813	**92%**
Saving/(Over Spending)	33,691	21,341	-	263	(1,206)	1,780	55,869	**8%**

5.4 Impact

The project aims directly complement objectives set-out under for WWF including oceans, climate & energy, and forests practices, while the project also complements and supports in meeting a number of SDGs and targets including goals 1, 3, 5, 7, 11, 13, 14, 15 and 17.

One of the important deliverables of the project was provision of solar energy for the 1639 Households covering 25 villages in the off-grid areas of Karachi including Gadap Town and Maripur in collaboration with the K-Electric. This was the first such initiative in these peri-urban areas to provide off-grid renewable energy solutions and had multiple beneficial impacts on the lives of the local communities while also introducing innovative renewable and clean energy solutions. The Project helped to enhance the quality of their lives as well as brought substantial savings to individual HHs' daily expenses incurred on wood purchase, healthcare for the treatment of ailments as an outcome to exposure to indoor air pollutants. The average daily saving reported due to reduction in wood consumption worth 50-100 PKR (1 USD/day) in Gadap Town after the provision of fuel efficient stoves. An average 200-500 (up to 5 USD) saving in Rehri was recorded from the biogas plants users. This amount is an additional saving which is now being spent to improve the quality of food and healthcare, etc. Women have reported to have increase in the earning generated from embroidery and clothes sewing due to having more time and electricity- % as they have more time to work during the evening.

The Project interventions has helped to enhance the economic uplift of the communities through their engagement in the livelihood opportunities as an outcome to the provision of renewable energy generation. This has been achieved through offering diversified livelihood options promoted through building capacity and awareness of target communities by engaging over 50 local community members in various livelihood options as part of the renewable and alternative energy opportunities mainly in the maintenance and management operations.

Pakistan hosts seventh largest arid mangrove cover in Asia which faces serious pressure due to their extraction including fuelwood. The project has provided access to alternate energy in the form of biogas plants, which reduced over 88% pressure of mangroves for wood. The Project has helped to reduce loads of pollution being disposed off in the Arabian sea in particular the livestock dung which will be utilized to feed bio-methane plants while reducing inflow of dung to Arabian sea protecting marine habitats**.**

Adoption of fuel efficient stoves supported to minimize pressure on the forest resources and hence would contribute to protect the forest resources, associated biodiversity and ecosystem services. The target communities also have a high rate of smoke induced diseases in particular amongst the female community members. Over 50% women now experience a significant reduction in indoor air pollutants borne disease as an outcome to the adoption of the fuel-efficient stoves (n=122 respondents) and simultaneous reduction in the cost incurred on the payment of the health care expenses.

The Project supported to promote restoration of natural forest habitat through promotion of plantation of trees in particular mangroves in collaboration with K-Electric to contribute towards the enhancement of carbon sequestration and mitigate carbon emissions and footprint reduction. A total of 153,555 saplings of different tree species including 90,000 mangroves and 63,555 species of other local tree species such as Azadirachta indica (Neem) and *Phycus* were planted in different parts of the city exceeding target of 100,000 saplings to support the efforts of mangroves habitat restoration.

Karachi was the first city of Pakistan to register to the One Planet City Challenge and became the national winner in 2018. This was a commendable step of any city of Pakistan to drive a local level initiative led by a city-led authority to foster more localized actions. The project has been able to bring key stakeholders together to discuss and highlight key issues associated towards the promotion of renewable energy promotion in the city as part of the consultations and discussions organized as part of registering Karachi city to the One Planet City Challenge and development of an action-plan that can help the government to promote renewable energy. Baseline CO2 emission data collected as part of the OPCC registration process will further benefit the development of a GHG inventory of the city critical to determine the current carbon emissions and offset initiatives.

5.5 Sustainability

Key interventions of the project were undertaken at community level including provision of biogas plants, home based solar energy units, fuel efficient stoves, gasifiers, etc. The project has therefore, developed village level community groups and made them responsible to facilitate future monitoring and mobilisation for the continuous usage of these interventions. A total of 33 community groups were established at Maripur, Rehri and Gadap Town comprising of 921 members wherein > 50 % are women.

Careful selection of individual HHs' based RE model and beneficiaries, which had higher dependence on natural resources, deprived of access to basic amenities and willing to adopt renewable and clean energy interventions and their extensive capacity building will also ensure effective adoption and long-term sustainability of the project intervention. Furthermore, to ensure proper ownership and sustainability of the solar units after the project completion, tripartite agreements between each beneficiary HHs, respective Community Group and WWF-Pakistan, were signed for handing over the solar units, their proper usage, care and maintenance. The agreement also restricts beneficiary from selling the unit and carries clause for handing it over to the respective community organisation/cooperative in case of discontinuation of its use due to any unforeseen circumstances.

Training of local technicians was also made an important component of the process to ensure the availability of local skilled workers who could facilitate communities in minor repair and maintenance issues of the solar unit technologies introduced. It is also expected that these technicians will play an important role in spreading and promoting the usage of renewable energy in other off-grid areas through small enterprises in future. Furthermore, K-Electric will also be responsible for future monitoring of the solar based interventions and will continue its awareness and engagement initiatives related to RE proper usage and posy installation care.

Similarly, the biogas plants are being monitored on a regular basis by WWF-Pakistan and the Community groups, which are responsible to manage these biogas units at the project sites. To sustain the smooth supply of dung to the biogas plants from nearby cattle colony to the biogas user, one community member has been equipped with a mini loader dung delivery vehicle. This initiative carried twofold objectives, one is to ensure uninterrupted supply of dung from nearby cattle colony while ensuring livelihood support for the community member which is involved in the dung supply and collection procedure.

Through the One Planet City Challenge, Karachi Municipality’s management authority and other important departmental stakeholders have developed capacity in reporting GHGs emission data necessary for providing a baseline to then set targets, action plans and align city actions which will support the city in carrying out a transition to a renewable energy based, climate safe future. The data will be further leveraged through Karachi’s membership of the C40 Cities Group to ensure the city’s climate and renewable energy action plan aligns with the city’s fair share contribution to meeting the Paris Agreement’s goal of keeping global warming under 1.5 degrees.

POTENTIAL FOR SCALING UP AND FOLLOW-UP INVESTMENTS

The Karachi Metropolitan Corporation plans to set-up a working group recommended as part of the renewable energy action-plan drafted during the consultative event with the key stakeholders. This working group would comprise of representatives of important government line departments, which will act as a focal point to collect and report City's GHGs emission, which would ultimately offer the basis to set targets to promote more localised actions for promoting initiatives to minimise carbon footprint and enhance green living. WWF as part of its sustainable cities initiatives plans to engage Karachi and other cities of Pakistan in initiatives like OPCC in future.

The dung delivery based biogas plant system is the first of its kind in the area and is expected to contribute to convert substantial quantities of dung into energy, which would otherwise make its way to the Arabian Sea as a waste. This system has a good scale-up potential in other peri-urban areas of Karachi as well as in rural Sindh. Findings of this initiatives have been shared with the Senior Official of Government of Sindh in a meeting hosted by the Chief Secretary. A policy brief carrying details of biogas dung delivery system and its outcome is being prepared to share with the Sindh Alternate

Energy Board, Government of Sindh to support their efforts of biogas in Karachi and other parts of Sindh.

WWF-Pakistan together with its partners plans to further scale-up the solar energy supply to remaining off-grid energy deprived communities of Karachi for which the organisation plans to develop and submit proposals to relevant funding opportunities. Options to convert existing project sites into model demonstration sites to make their energy, water and livelihood secure are also being explored.

LESSONS LEARNED

Working with dynamic group of stakeholder was a beneficial experience but it also associated with a few challenges the most important of which was a change in the government, transfers of staff, shift in the strategic interest of partners like K-Electric to other sites, weak inter and intra agencies cooperation. Negotiations and discussions with new teams takes substantial amount of time and energy and affect smooth implementation of the project.

The project sites were remote mostly devoid of proper road and access to communication and the communities were scattered in small villages (goths) often apart from each other with limited connectivity. This all made working in the areas difficult and coordinate effectively. To overcome this issue, the project team was sub-divided between various villages clusters and community groups led by women or having mixed gender representation were formulated to facilitate the effective implementation and adoption of the project interventions. This also has helped in the data collection and post installation monitoring of the project interventions at all sites. Cultural restrictions also made it difficult to reach out to women community members who in most of the cases are not allowed to leave their houses, this was overcome by engaging female social mobilisers and volunteers together with the representative of their respective community or women groups which helped to ensure effective engagement of women and ownership of interventions including solar units and fuel efficient stoves at the household level.

The project used a number of ways to disseminate its work scope and results. A project conclusion and knowledge-sharing workshop was organised in collaboration with KMC and K-Electric. The event was aimed to share key achievements and experiences of the project to a wider stakeholder group and to seek their inputs and suggestions to further scale-up and replicate RE solutions in urban and peri-urban areas. Additionally, several presentations covering key aspects of the project were made for various stakeholders on different occasions. For example, a knowledge sharing webinar was arranged for the WWF network, including the team promoting WWF's energy access programme mainly in Africa and Asia. In January, a presentation and abstract carrying experiences of Karachi city's journey to participate in the One Planet City Challenge was also presented at the International Conference on Environmental Horizon held at the University of Karachi.

6. FINANCIAL SUMMARY

Table 1. Project financing per partner

	Financing, EUR					
Expenditures, EUR	NCF	WWF Pakistan	WWF Sweden	KE	SFI	**Total**
WWF Pakistan	432 380	69 621	3096			505 097
WWF Sweden			58 350			58 350
KE				82 136		82 136
SFI		7413			3827	11 240
Total	432 380	77 034	61 446	82 136	3827	656 813

7. CONCLUSIONS AND RECOMMENDATIONS

The project was a unique and successful experiment to implement a mix of clean and renewable energy solutions across poor and energy deprived peri-urban communities of a megacity, Karachi, which has been struggling with providing reliable energy access to these impoverished communities. By meeting its targets of benefiting over 2,000 households with an innovative mix of clean and renewable energy solutions, ranging from solar and biogas units, solar gasifies and fuel efficient stoves, the project has demonstrated a model that has strong potential to support Karachi in meeting the energy needs of its poor communities with significant positive impacts on the health, livelihoods, and climate resilience of its substantial population.

The project's strengths lay in its well coordinated teamwork and strong partnerships, especially with Karachi Metropolitan Corporation and K-Electric. The partnership was unique in its ability to scale up the impacts of on-the-ground activities through, for example, raising awareness of the importance of Karachi's mangroves through a massive tree planting campaign and feeding into WWF's flagship Earth Hour and One Planet City Challenge global initiatives. These really helped to incentivize climate change and renewable energy action at the city scale and even beyond, inspiring other cities across Pakistan to act.

In terms of recommendations, timeliness was key to the project, for which a delayed start led to the challenge of having to change project sites and communities targeted with knock on impacts on the selection of appropriate technologies that matched communities' circumstances. Well-coordinated

and intensive community mobilization, to develop an understanding of long-term benefits and ownership of project activities, was also key to project success. Having flexibility in choice of technology, for example where biogas units needed to be supplemented with solar gasifiers was also important to match different community contexts and environments.

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Annex 1 **Project completion fact sheet**

Project Name:	**Introducing renewable energy solutions to enhance energy security and build climate resilience in Karachi, Sindh, Pakistan**		
Country/ Region:	Pakistan, Asia	**Financing:**	
		EUR	**%**
Nordic Partner:	WWF-Sweden	61 446	9,36
Local Partner:	WWF-Pakistan	69621	10.60
Other Partner:	K-Electric	82126	12.50
	Smart Fishing Initiative (SFI)	11240	1.71
	NCF grant disbursed	432 380	65,83
	Total	**656813**	**100.00**
Classification:	Mitigation/ adaptation/ **Combination**		
Project cycle:	Contracted: 12/07/2016 Original Closing Date: 30/08/18 Actual Closing Date: 30/06/2019		
Project description:	The project focused on the generation of renewable energy for selected communities that face poverty and power outages. It engaged stakeholders at multiple levels through (1) Karachi Metropolitan Corporation's (KMC's) participation in WWF's One Planet City Challenge programme, which, through developing modalities to measure and look at reducing carbon emissions, placed the city on the journey towards developing its first renewable energy based climate change plan; (2) working together with Karachi-Electric in selecting and supporting off-grid local communities in the peri-urban areas of Rehri, Gadap and Maripur, in rolling out renewable energy solutions for sustained access to energy and decision-making through cooperatives for opportunities to start home-based businesses, and (3) facilitating dialogue among relevant private , public and other relevant stakeholders for development of a renewable energy action plan for the whole city. The project also addresses cross-cutting themes of women empowerment, reduced exposure of communities to indoor pollutants, improved waste management and providing alternate means of livelihoods for communities (e.g. through biogas manure supply and maintenance as well as solar unit installation, maintenance and repair) – all contributing to an improved quality of life for project beneficiaries. Underprivileged communities in the selected areas were targeted to enhance their climate resilience and improve their quality of life through pilot testing of biogas and solar power based renewable energy solutions. Women-led and inclusive cooperatives and citizen organisations were trained to endure the long-term management of the RE technologies, and to ensure community awareness about the benefits of RE use, reducing dependence on fuel wood and about sustainable waste management. In addition, thanks to the partnership with K-Electric, the project involved city-wide tree planting campaigns, where around 160,000 mangrove saplings and other trees were planted, involving local communities to empower them to raise awareness about the benefits from the trees and mangroves and feel ownership over the plantations.		
Key results:	**NCF indicators**	**Results**	

	1. Number of beneficiaries reached (women/men)	Men: 1243, Women: 1359
	2. Number of people with increased resilience to climate change (women/men)	Men: 3880, Women: 3627
	3. CO_2e emissions reductions (actual at project completion and expected during the lifetime of the project's mitigation investments)	**Solar units** ● Cumulative solar energy generation from 1639 solar units 0.02 megawatts with avoided CO2 emission 68.92 tCO2e per year ● Fuel efficient stoves and gasifiers: 8.05 tonnes of overall daily wood saving for 960 HHs with avoided CO2 emissions are i799.2 tCO2e per year. ● **Biogas plants -** Quantity of wood- 0.55 tonnes of wood saving for 41 HHs as an outcome to adoption of biogas energy with avoided CO2 175.6 tCO2e per year for 41 households per year **Plantation -** plantation of 45,000 mangroves indirect CO2 emission reduction 17.96 Tco2e planted at the beginning of the project, whereas 45,000 more were planted at the end of the project and hence were not added to age of new plantation .
	4. Number of green business concepts tested	**Alternative energy–** biogas dung delivery model and skilled local technicians in Rehri **Renewable energy** – 41 skilled local technicians and Maripur and Gadap Town **Fuel Efficient Stoves** – skilled women Master trainers in Gadap Town
	5. Number of new decent jobs created (disaggregated by number of permanent (women/men) and seasonal (women and men))	**Biogas dung delivery model** – 01 job (full time) Man, 4 (partial) **Solar technicians** – 41 (part time), 25 women (partial) **Fuel Efficient Stoves** - 18 women master trainers (Partial)
	6. Number of people with improved livelihoods/income-generating possibilities (women/men)	Total 89 with 43 Women , 46 men
	7. Number of multi-stakeholder partnerships developed	Three, WWF with KMC and K-Electric respectively and KMC's multi-stakeholder group for development of an RE Action Plan
	8. Amount of funds leveraged (actual project co-financing and secured future investments for scaling-up/replication)	224,433EUR

Project performance:	Main Expected Outputs	Achieved	End-of-project status
	Socio-Economic Assessments (Pre and post Installation) and feasibility studies	2 studies	Completed
	Registration of Karachi city for Earth Hour City Challenge (OPCC)	1	
	Arranged webinars to enhance capacity on reporting and data collection of RE indicators as well as in-country workshop	10	
	Over follow-up two target areas to Form Representative Women Cooperatives	70	
	Plantation of over mangrove other local tree species	119,800	
	Developed business models for biogas and solar energy provision and livelihood generation for communities	2	
	Provision of Fuel Efficient Stoves/Clean Stoves	400 HHs	
	Provision of solar energy	1639 HHs	
	Provision of biogas plants as an alternate energy source	12 communal plants supporting 41 HHs	
	Provision of solar powered energy efficient gasifiers for the mangroves dependent HHs	650	
Final beneficiaries:	2602 HHs - 7507 Beneficiaries		
Climate change impacts:	To contribute towards the enhancement of carbon sequestration and mitigate carbon emissions and footprint reduction. A total of 153,555 saplings of different tree species including 90,000 mangroves and 63,555 species of other local tree species such as *Azadirachta indica* (Neem) and *Phycus* were planted in different parts of the city exceeding target of 100,000 saplings to support the efforts of mangroves habitat restoration. Karachi was the first city of Pakistan to register to the One Planet City Challenge and became the national winner in 2018.The project has been able to bring key stakeholders together to discuss and highlight key issues associated towards the promotion of renewable energy promotion in the city as part of the consultations and discussions organized as part of registering Karachi city to the One Planet City Challenge and development an action-plan that can help the government to promote renewable energy. Baseline CO2 emission data collected as part of the OPCC registration process will further benefit the developing a GHG inventory of the city critical to determine the current carbon emissions and offset initiatives.		

Development impacts:	The average daily saving reported due to reduction in wood consumption 50-100 PKR (1 USD/day) in Gadap Town after the provision of fuel efficient stoves. An average 200-500 (up to 5 USD) saving in Rehri was recorded from the biogas plants users. This amount is an additional saving which is now being spent to improve the quality of food and spent of healthcare, etc. Women have reported to have increase in the earning generated from embroidery and clothes sewing due to having more time and electricity as they have more time to work during the evening. in Gadap 33% save20-30min and 31% save 10-20 min just from efficient cooking while in Rehri 75% save upto an hour. not only this by the commission of solar units in Gadap 48% save upto 500PKR and in Kemari town 69% save upto 500PKR. Engagement of community in the livelihood opportunities as an outcome to the provision of renewable energy generation, engaging over 50 local community members in various livelihood options as part of the renewable and alternate energy opportunities mainly in the maintenance and management operations.
Innovation, technology and learning:	Provision of solar energy for the 1639 Households covering 25 villages in the off-grid areas of Karachi including Gadap Town and Maripur. 4 Training sessions on solar units installation, safety and maintenance two in Maripur and two in Gadap. 12 communal Biogas plants constructed and 4 persons trained on safety and maintenance. Biogas dung delivery model – 01 job (full time) Man, which has so far supplied over 307,370 Kg (~400 tons) of dung for the recharge of the biogas plant in about 300 trips. The community member operating the vehicle has earned over PKR 75,000 (550 US$).
Partnership:	● Two formal Memorandum of Understanding (MoUs) were signed between WWF Pakistan and the Karachi Metropolitan Corporation (KMC) and K-Electric respectively. The KMC is the city management authority and the purpose of signing MoU would ensure their involvement in OPCC, Earth Hour, carbon emission estimation inventory development, and drafting a renewable energy policy. ● The MoU with K-Electric, Karachi's main electricity supply company, helped in the selection of off-grid communities and solar technology[1] [2] . the K-Electric was also involved in the organisation of Earth Day for three years, planted 153,555 mangroves and other local tree species ● Green Light Pakistan (GLP) was responsible to provide solar units and their field installation. GLP also facilitated trainings of electricians/skilled workers covering key aspects of solar units installation, their repair and maintenance ● Rural Development Foundation (RDF), helped to train women master trainers from local communities in making of fuel efficient stoves, facilitated to develop a training manual as well as extended support in the installation of stoves ● Saiban Welfare Organization facilitated in the construction of 12 communal biogas plants. They also facilitated capacity building of beneficiaries of biogas for maintenance and safety as well as training of skilled workers in the repair and maintenance of the units. ● Undergraduate students from the Institute of Environmental Sciences, University of Karachi were engaged in baseline data collection from the project. ● Various other institutions and government line-departments have been involved in the project and haloed in providing input and GHGs emission data from their respective sectors for the OPCC registration and RE promotion action-plan. These included but not limited to the National Electric Power Regulatory Authority (NEPRA), Govt. of Pakistan, Sindh Transport Department (STD), Sindh Mass Transit Authority (SMTA), Sindh Energy Department, Planning and Development Department, Sindh Environmental Protection Agency (SEPA), Sindh Solid Waste

	Management Board, Civil Aviation Authority (CAA), National Institute of Oceanography (NIO-UoK), civil society and academia, etc.
Sustainability and replicability:	Key interventions of the project were undertaken at community level including provision of biogas plants, home based solar energy units, fuel efficient stoves, gasifiers, etc. The project has therefore, developed village level community groups and made them responsible to facilitate future monitoring and mobilisation for the continuous usage of these interventions. A total of 33 community groups were established at Maripur, Rehri and Gadap Town comprising of 921 members wherein > 50 % are women. Careful selection of individual HHs' based RE model and beneficiaries which had higher dependence on natural resources, deprived of access to basic amenities and willing to adopt renewable and clean energy interventions and their extensive capacity building will also ensure will also ensure effective adoption and long-term sustainability of the project intervention. Furthermore, to ensure proper ownership and sustainability of the solar units after the project completion, tripartite agreements between each beneficiary HHs, respective Community Group and WWF-Pakistan was signed for handing over the solar units, their proper usage, care and maintenance. The agreement also restricts beneficiary from selling the unit and carries clause for handing it over to the respective Community organisation/cooperative in case of discontinuation of its use due to any unforeseen circumstances. Training of local technicians was also made an important component of the process to ensure the availability of local skilled workers who could facilitate communities in minor repair and maintenance issues of solar units, biogas units, etc. at a later stage. It is also expected that these technicians will play an important role in spreading and promoting the usage of renewable energy in other off-grid areas through small enterprises in future. Similarly, biogas plants are operational since November 2018 and are being monitored on a regular basis by WWF-Pakistan and the Community groups, which are responsible to manage these biogas units at the project sites. To sustain the smooth supply of dung to the biogas plants from nearby cattle colony to the biogas user, one community member has been equipped with a mini loader dung delivery vehicle. This initiative carried twofold objectives, one is to ensure uninterrupted supply of dung from nearby cattle colony while ensuring livelihood support for the community member which is be involved in the dung supply and collection procedure. Furthermore, the K-Electric will also be responsible for future monitoring of the solar based interventions and will continue its awareness and engagement initiatives related to RE proper usage and posy installation care. For the further continuation of initiatives like One Planet City Challenge, the city management authority and important stakeholders has developed its capacity in reporting GHGs emission data necessary for registering and later reporting for the challenge. This will be further used by the city for data reporting and promotion of city's work at C40. Karachi is the only city of Pakistan which in represented at C40. WWF as part of its sustainable cities initiatives plans to engage Karachi and other cities of Pakistan in initiatives like OPCC in future.
Lessons learned:	Working with dynamic group of stakeholder was a beneficial experience but it also associated with a few challenges the most important of which was a change in the government, transfers of staff, shift in the strategic interest of partners like K-Electric to other sites, weak inter and intra agencies cooperation. Negotiations and discussions with new teams takes substantial amount of time and energy and affect smooth implementation of the project. The project sites such were remote mostly devoid of proper road and access to communication and the communities were scattered in small villages (goths) often apart from each other with limited connectivity. This all made working in the areas difficult and coordinate effectively. To

	overcome this issue, the project team was sub-divided between various villages clusters and a community groups led by women or having mixed gender representation were formulated to facilitate the effective implementation and adoption of the project interventions. This also has helped in the data collection and post installation monitoring of the project interventions at all sites. Cultural restrictions also made it difficult to reach out to women community members who in most of the cases are not allowed to leave their houses, this was overcome by engaging female social mobilisers and volunteers together with the representative of their respective community or women groups which helped to ensure effective engagement of women and ownership of interventions including solar units and fuel efficient stoves at the household level. The project used a number of ways to disseminate its work scope and for results dissemination. A project conclusion and knowledge-sharing workshop was organised in collaboration with KMC and K-Electric. The event was aimed to share key achievements and experiences of the project to a wider stakeholder group and to seek their inputs and suggestions to further scale-up and replicate RE solution in urban and peri-urban areas. Additionally, several presentations covering key aspects of the project were made for various stakeholders on different occasions. For example, a knowledge sharing webinar for sharing key findings of the project and its approaches was arranged for the WWF network, including the team promoting WWF's energy access programme mainly in Africa and Asia. In January, a presentation and abstract carrying experiences of Karachi city's journey to participate in the One Planet City Challenge was also presented at the International Conference on Environmental Horizon held at the Department of Chemistry, University of Karachi.

Annex 2 **Logical Framework Matrix**

To be attached and updated (if applicable) - the revised LFA is added below

Narrative Summary	Objectively Verifiable Indicators (OVIs)	Means of Verification (MOVs)
Overall Objective: Enhanced energy security and climate resilience, through technology transfer from the Nordic region to Karachi which shall contribute to improved energy access, livelihoods, health, adaptation capacity, and women empowerment and facilitate the city's transition to renewable energy focused low carbon development	-MWs of RE from installed solutions in Karachi's energy mix -Change (%) in carbon emissions -Change (%) in socio-economic statistics (e.g. income, empowerment) against the baseline	-OPCC monitoring and data collection reports - Findings from the pre and post socio-economic assessments
Purpose - By 2018:		

1. Improve energy security by providing access to renewable energy for 1,850 households (HHs) 2. Establish and empower women Cooperatives/community groups through transfer of practical skills to own and operate (at least 60% of) energy units installed 3. Contribute towards alleviating poverty through increased capacity for potential income generating opportunities and improved health, as a result of consistent and clean energy supply 4. Develop results-based business models to scale up development of renewable energy, exchange of information through EHCC	- Change in renewable energy (MWs) that target HHs can access - % of installed RE units owned and operated by /community groups - No. of new home-based businesses or cottage enterprises established owing to improved energy supply - proposed RE Action Plan and business models	- Beneficiary statements, pictures, reports and records - Monitoring reports - Findings from the pre and post socio-economic assessments - Registration documents / meeting records/ attendance sheets of women cooperatives - Participation documentation of investors in meetings - Agreements signed with investors - Business plan/s
Outputs (Results)		
1.1 Improved access to energy through the installation and functioning of two types of tested RE Units at project sites	- No. of HHs using energy from installed RE solutions	- Signed agreements - Field pictures - Monitoring reports
1.2 An enabling environment for the propagation of RE generation and reduction of carbon emissions	- No. of agreements with stakeholders to work on RE - No. of case studies	- Minutes of consultation meetings/attendance sheets - Case studies - Publications/newsletters
2.1 Community groups/women cooperatives established and functional for effective	- No. of women cooperatives/community	- Registration documents - Meeting minutes and membership records

management and promotion of RE	groups and members enrolled	
2.2 Women/community trained to operate and manage RE units	- No. of community members trained to operate and maintain owned RE units	- RE unit ownership agreements - Attendance lists - Training reports/manuals
3.1 Diversified livelihood options promoted through building capacity and awareness of target communities	- No. of trainees exploring alternate livelihood options	- Training manual - Trainees' feedback -Monitoring reports
3.2 Improved quality of life and reduced pressure on natural resources, particularly mangrove wood, through increased use of biogas mud stoves (clean stoves)	- Incidence of indoor air pollution related respiratory diseases - Amount of fuelwood used	- Monitoring reports - List of beneficiary HH - Interviews/ field pictures
4.1 Low carbon RE business model established for project areas	- No. of agreements with potential investors Business model	- Minutes and participant lists of meetings - Agreements signed
4.2 City Renewable energy promotion action plan developed, and interregional cooperation and information exchange	- Draft draft of action plan - No. of interregional session	- Action plan
Activities:	Objectively Verifiable Indicators (OVIs)	Means of Verification (MOVs)
1.1 Conduct a desk review of transferable best practices from the Nordic region	- No. of feasible best practices reviewed	- Literature review for feasibility study
1.2 Conduct a feasibility study on the potential of RE generation	- Feasibility study findings	- Final manuscript of feasibility Study

1.3 Convene consultative sessions for enhanced cooperation between stakeholders	- No. of consultative sessions and participants	- Session reports/records - Attendance records
1.4 Select sites for integrated biogas plants and solar mobile stations	-Finalised designs for installation - % compliance to applicable standards	- Drafted designs for RE Solutions
1.5 Design integrated biogas plants and solar units		
1.6 Conduct training workshops to build capacity of waste collectors to segregate waste	- No. of trainings and waste collectors trained to segregate waste	- Training reports - Participant records - Completion report
1.7 Install 1620 solar mobile stations, and 12 integrated bio-methane plants for 41 HHs and 560 gasifiers	- No. of solar units and biogas plants successfully installed	- Monitoring reports - Pictures of installations - Beneficiary statements - Completion report
1.8 Mobilize communities in the target areas to form representative community groups as platforms for capacity building and consultations	- No. of Community' members trained regarding operation of RE solutions (men : women) - No. of mobilization sessions, trainings, and RE consultations	- Participant lists - Mobilization sessions' reports
2.1 Mobilize women from target communities	- No. of participants in mobilization meetings	- Participant lists
2.2 Train and facilitate community from target communities to form community groups (informal)	- No. of participants in women trainings	- Participant lists - Trainings' reports and photos

3.1 Conduct an awareness campaign to promote best practices related to energy efficiency, cottage industries, health, natural resource management	- No. of awareness raising events and stakeholder groups engaged	- Campaign workshop reports - Training plans - Attendance records
3.2 Provide mud stoves (clean stoves) to 400 HHs to supplement bio-methane plants	- No. of mud stoves (clean stoves) installed	- Monitoring reports - Beneficiary agreement - Completion report
3.3 Mobilise community and plant 20,000 trees every year for improved ecosystem services and climate change mitigation	- No. of participants in mobilization meetings - No. of saplings planted	- -Plantation reports shared by the K-Electric
3.4 Conduct pre and post socio-economic assessments in Maripur, Rehri and Gadap Town	- No. of HHs surveyed - List of indicators assessed	- Baseline and impact data - Field study reports
4.1 Enrol in WWF's OPCC through a formal commitment from KE and KMC	- Commitments from KE and KMC for mitigation - No. of Earth Hour pledges	- OPCC registration report - Signed agreements and commitment documents
4.2 Arrange webinars to enhance KE and KMC's capacity to collect and report carbon emissions and energy consumption data	- No. of webinars - No. of participants	- Content/agenda of webinars - Attendance records
4.3 Consultative sessions with private and public sector to develop revised policy instruments and a city action plan	- No. of sessions and stakeholders engaged - Policy documents reviewed and disseminated	- Consultative session reports/ minutes - Attendance records - policy recommendations
4.4 Draft a RE focused low-carbon development action plan	- No. of stakeholder consultation sessions to draft action plan and revisions	- Minutes/feedback from consultation sessions - Draft/final manuscripts

4.5 Disseminate results across networks and enhance interregional cooperation	- No. of progress updates and reports circulated	- Copies of reports - Audience/network lists