



**Asia-Pacific
Economic Cooperation**

Advancing Free Trade
for Asia-Pacific **Prosperity**

Lessons Learned from Promotion Mechanisms Focused on Boosting Energy Solutions in Remote Areas

Castro, Chile | 9-11 October 2019

APEC Energy Working Group

March 2020

APEC Project: EWG 17 2018A

Produced by
Ministry of Energy, Chile

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

© 2020 APEC Secretariat

APEC#220-RE-04.1

Table of Contents

| | |
|---|-----------|
| Session A: International experiences and global framework in energy access..... | 7 |
| Opening remarks..... | 7 |
| Applications of Modern Microgrids for Off Grid Electrification | 8 |
| Obstacles and Challenges to the Energy Access in Remote Areas: Chilean Experience in Rural Electrification. | 15 |
| Session B: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Collaboration, Funding and Related Issues | 19 |
| Lessons Learned and Challenges for Energy Access in Isolated Rural Areas . | 19 |
| Delivering Energy Services in Remote Areas: Project Experiences and Lessons Learned..... | 22 |
| Energy Access Project: Lessons from Nepal and Next Steps to Fill Knowledge Gaps | 27 |
| Wrap-Up Session B..... | 33 |
| Session C: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Social, Cultural and Community Issues | 36 |
| Cultural and Community Issues, Topics and Examples | 36 |
| Rural Village Electrification to Improve the Quality of Life Based on Sufficiency Economy in Thailand..... | 42 |
| Stand-alone PV in Huapi Island: Where the Community Spoke Out | 46 |
| Wrap-Up Session C..... | 50 |
| Workshop Conclusions Session | 54 |
| Technical Site-Visit Summary – Tac Island, Chiloé..... | 55 |
| ANNEX 1: Wrap-up Groups Session 2 | 57 |
| ANNEX 2: Wrap-up Groups Session 3 | 70 |
| ANNEX 3: Final conclusions | 82 |
| ANNEX 4: Workshop Agenda | 83 |
| ANNEX 5: Site-Visit Tac Island Agenda | 85 |
| ANNEX 6: List of speakers and participants | 87 |

Executive Summary

On 9 – 11 October 2019, the APEC EWG Workshop on “Lessons learned from promotion mechanisms focused on boosting energy solutions in remote areas”, initiated by Chile and co-sponsored by Japan, Chinese Taipei, Singapore, the United States, Viet Nam, and Mexico was held in Castro, Chile. Speakers and participants came from Viet Nam, Spain, the United States, Australia, Thailand, Malaysia, Mexico, Ecuador and Chile. Most of the Workshop participants were from the public sector, consulting and academia related to the economic and/or energy sector.

The APEC Energy Ministers in the Cebu Declaration (2015) recognized that providing energy access is a priority goal in developing a resilient APEC community. This is also reflected in the activities of the Energy Working Group and in the energy sector there are several approaches on how to increase the access to energy in remote areas, therefore, different public policies have been developed in order to enhance the penetration of energy access among the population in remote areas, and this project seeks to identify and share best practices from those experiences in order to apply that knowledge to local communities.

This project seeks to be consistent with APEC capacity building goals, objectives and principles. It will build the capacity of APEC members through knowledge transfer from experts that have designed or implemented promotion mechanisms for increasing rural or remote-area electrification to policy makers and other representatives of economies that are looking for new ways and abilities to increase the energy access for the population.

Through this workshop and summary document, the project will seek:

1. To develop recommendations based on international experience and best practices that support the improvement of promotion mechanisms for increasing rural energy access.
2. To increase knowledge of international experiences on how to increase energy access of populations.

With this project, the following outputs are expected:

1. The main outcome expected with this project is to provide participants with knowledge that can support the adjustment or even creation of new promotion mechanisms in interested economies. Therefore, in the coming years new projects can be implemented based on this information. It is

also desirable that participants play an active role in each economy and have already worked with promotion instruments.

2. Another expected outcome is that any economies that may not currently have promotion mechanisms can learn from those that have already carried out some actions and contribute to the creation or improvement of mechanisms, using information that they learned during the workshop.

In order to achieve these outcomes, the main objective is to exchange experiences and lessons learned from the participating economies regarding the obstacles and challenges for sustainable energy access solutions in remote locations. To fulfil this goal, there were three work sessions:

A. Introduction and international experience (October 9th, First session, PM)

Focus: Role of energy in APEC and relevance of energy access as promoter of social and economic development in Chile and The United States experiences on off-grid solutions and rural electrification initiatives.

B. Obstacles and challenges for sustainable solutions in remote locations: collaboration, funding and related issues (October 10th, Second session, AM).

Focus: Obstacles and challenges related to the stakeholders involved in energy access initiatives. Analysis of collaboration and partnership strategies focused on ensuring sustainable solutions and reflection of funding management strategies in energy access.

- Lessons learned from different experiences where collaboration and funding were critical factors for energy access projects.
- Experiences of public-private-academy partnership for energy solutions.

C. Obstacles and challenges for sustainable energy solutions in remote locations: social, cultural and community challenges (October 10th, Third session, PM).

Focus: Impact of community engagement in energy projects, importance of local needs for design and implementation of solutions, and maintenance of energy access projects with community collaboration.

- Lessons learned from community engagement and participation in electrification projects.
- Management models for operation of remote or insolate energy systems, electricity billing and payment experiences.
- Relevance of local needs and conditions for solutions design.

To finalize the workshop program, on the third day a site visit took place in the most distant island of the Chiloé Archipelago, Tac Island. Tac is inhabited by about 80 families and its electricity is provided via microgrid. This grid is powered by a hybrid system with a high penetration of renewable energy composed of diesel, wind and solar.

Session A: International experiences and global framework in energy access

Opening remarks

In his opening remarks, Mr Pablo Tello, Chief of Energization Unit in the Access and Social Development Division of the Chilean Ministry of Energy, introduced the workshop highlighting that energy is a key element in the daily activities of people and having access to it, is a factor which can open an endless number of possibilities, therefore it is essential to work in the reduction of access gaps in order to achieve energy equity for everyone. Thus, it is also extremely important to look at the past and identify what we have done and what are the lessons learned, always thinking about the project's long term sustainability from different points of view, which is the goal of the workshop.

Then, Rodrigo Barahona, Regional Representative of the Chilean Ministry of Energy in the Region of Los Lagos, emphasized the commitment of Chile in the goals of championing free and open trade and investment, promoting and accelerating regional economic integration, encouraging economic and technical cooperation. Also he spoke of the role of Chile as APEC 2019 host with the goals of sustainable growth, especially in relation to renewable energy, and the priority of the President of Chile Sebastian Piñera in international energy modernization. To conclude, he highlighted the importance of APEC technical cooperation through workshops, seminars and experts investigation, both those that are open to the citizen or those only available to specialized experts meetings.

Following, Julio Cuadra, Chief of Access and Social Development Division of the Chilean Ministry of Energy expressed his thanks to present authorities, participants and speakers for their attendance and to APEC for its funding and logistics support in order to fulfil this workshop. Then, he reviewed the agenda explaining the focus of each session presentation and encouraging the expert's discussion, experience and knowledge sharing and promotion of sustainable and equitable electricity access projects.

Applications of Modern Microgrids for Off Grid Electrification

Presenter: Cary Bloyd

Mr Cary Bloyd is Senior Staff Scientist at the Electricity Infrastructure and Buildings Division of the Pacific Northwest National Laboratory of The United States. He has managed and participated in a wide range of projects associated with the development and implementation clean energy technologies for the US Department of Energy. Project areas have included the development of analytical models of energy systems, international smart grid infrastructure analysis, alternative fuels infrastructure development, energy efficiency building infrastructure development, and economy-level energy decision making under uncertainty.

Mr Cary Bloyd presentation was divided in two main topics:

- APEC Forum Introduction: Why are we here?
- U.S Department of Energy Modernization Program
 - Alaska Microgrid Partnership
 - Experience from Hawaii

In order to give an institutional framework to the workshop Mr Bloyd introduced his presentation highlighting APEC international value, importance and explaining that APEC forum was established in 1989 to leverage the growing interdependence of the Asia-Pacific economies with the general objective of:

- Promoting trade liberalization;
- Trade facilitation and;
- Technical assistance.

In addition, he said that the impact of APEC economies around the world account for more than one third of the world's population, 54% of the world's GNP and 44% of world trade. Between 1989 and 1998, APEC member economies spanned most of Asia-Pacific region reaching 21 participants. In addition, he spoke about the reasons why APEC members are called economies, focusing in how trade benefits the region and when you have free trade, it makes the development of the economies even, that is the reason why APEC is the only international institution that includes the participation of China, "Hong Kong, China" and Chinese Taipei as individual members, because they are important actors in the regional and global economy.

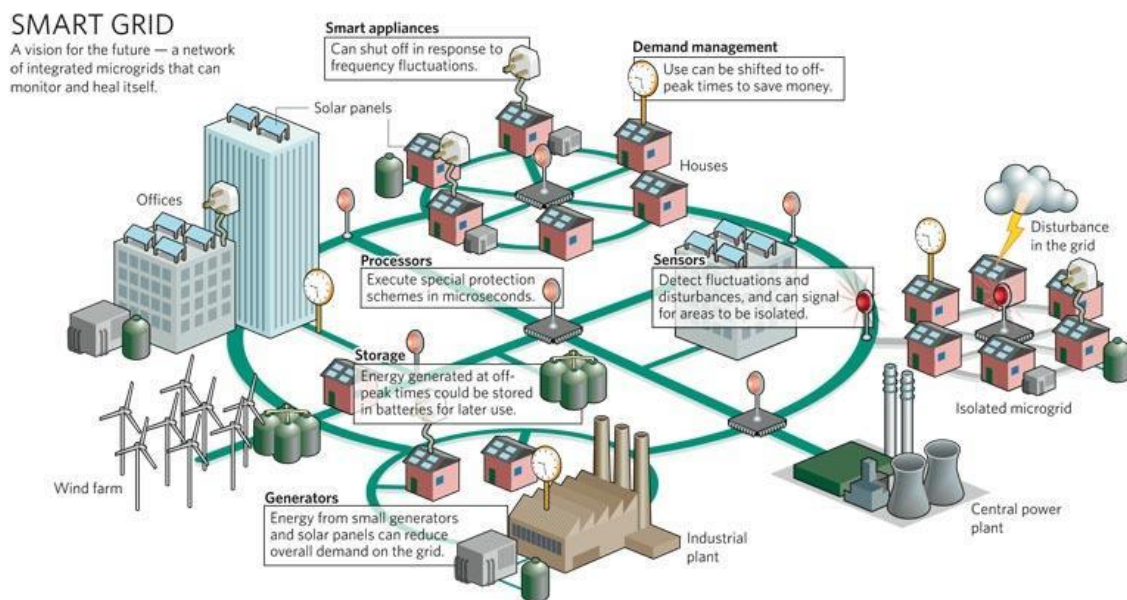
Inside APEC, there are fifteen working groups that operate under the SOM Steering Committee on Economic and Technical Cooperation (ECOTECH) and the present workshop is part of the Energy Working Group (EWG). It is also in line with the clean energy goals provided by APEC leaders and energy ministers, which are to reduce the aggregated energy intensity by 45 percent, by 2035 and

to double the renewable energy in the regional energy mix by 2030 to achieve sustainable and resilient energy development within the Asia-Pacific.

Mr Bloyd also mentioned that projects are conducted by writing proposals to the APEC Secretariat in Singapore and APEC funds 100-150 projects each year with up to \$16 million being committed per year, this workshop is one of them.

In the second part of his presentation, Mr Bloyd introduced the U.S Grid Modernization Multi-Year Program Plan which introduced the concept of Smart Grids: a network of integrated microgrids that can monitor and heal itself, thus in case of any fluctuations or disturbances can shut off or be isolated from the rest of the grid.

Figure 1
Smart Grid example



Source: Cary Bloyd presentation, 2019 (courtesy of Smart Grid 2030)

Mr Bloyd emphasized his investigation program and its goal of developing the Modern Grid Initiative, which aims to:

- Provide greater resilience to hazards of all type
- Improve reliability for everyday operations
- Enhance security from an increasing and evolving number of threats
- Provide additional affordability to maintain our economic prosperity
- Deliver superior flexibility to respond to the variability and uncertainty of conditions at one or more timescales, including a range of energy futures
- Increase sustainability through additional clean energy and energy-efficient resources

At the core of Grid Modernization Initiative are six specific technical areas that represent the key developments needed to advance the nation towards a modernized grid:

1. **Devices and Integrated Systems Testing:** New distributed devices and systems will help deliver the flexibility required by the future grid for managing variable generation, engaging consumer, and enhancing reliability and resiliency while keeping electricity affordable.
2. **Sensing and Measurements:** Measuring and monitoring vital parameters throughout the electric power network is necessary to assess the health of the grid in real time, predict its behavior, and respond to events effectively.
3. **System Operations, Power Flow, and Control:** This technical area focuses on new control technologies to support new generation, load, and storage technologies. This effort develops power flow controllers that will permit fine adjustment and multi-directional power flow as well as flow control devices that can optimize transmission flows.
4. **Design and Planning Tools:** Sound long-term planning and design yields smart capital investment. Electric power grid modeling and simulation applications are fundamental to the successful design, planning, and secure operation of power systems with billions of dollars in capital investments and operations costs.
5. **Security and Resilience:** This technical area aims to meet physical and cybersecurity challenges, analyze asset criticality, assess ways to minimize risk, address supply chain risks (specifically for transformers), and provide situational awareness and incident support during energy-related emergencies.
6. **Institutional Support:** Technical assistance to key decision-makers is important so that they can address the high-priority grid modernization challenges and needs identified by electric power industry stakeholders. It gives particular emphasis to working with state policymakers and regional planning organizations, with support for both analysis of issues and creation of information for stakeholders.

In relation to the Grid Modernization Initiative, one of its activities is the Alaska Microgrid Partnership (AMP) and Hawaii Islands program.

Alaska has 200 isolated microgrid systems where diesel is very expensive and inhabitants of these cities range from 60 up to 6,000. This project will create a development pathway for islanded microgrids which will reduce imported energy by at least 50%. For this presentation, three cases were mentioned:

- Chefnak Mini-grid Business Case
- Kokhanok Mini-grid Business Case
- Shungnak Mini-grid Business Case

Chefornak Mini-grid Business Case

Chefornak is a small community located in the Lower Yukon-Kuskokwim Region of southwest Alaska with a total population of approximately 440 people occupying about 90 residences. In addition, Chefornak has roughly a dozen community and commercial buildings. The current electric generation system and the proposed system are:

Table 1

Summary of Chefornak energy situation

| Item | Value |
|--|---|
| Diesel plant | 2x 371 kW generators 1x 179 kW generator |
| Annual electricity generation (kWh) | 1,597,000 (Avg. load: 180 kW) |
| Annual thermal consumption (kWh) | 7,905,000 (Avg. load: 900 kW) |
| Annual diesel fuel consumption [FY 2016] (gallons) | 117,500 |
| Annual diesel oil consumption [FY 2016] (gallons) | 248,200 |
| Diesel fuel cost) (for electricity production [FY 2016] (\$/gallon) | \$4.14 (2012 – 2016 range: \$4.14 – \$6.65) |
| Heating oil cost [FY 2016] (\$/gallon) | \$4.55 |

Source: GRID Modernization Laboratory Consortium, DEO, 2018

Table 2

Proposed Chefornak system configuration

| Component | Value |
|---|---------|
| Large diesel size (kW) | 371 kW |
| Small diesel size (kW) | 179 kW |
| # wind turbines (Frontier 24) | 8 |
| PV capacity (kWDC) | 0 |
| Converter size (kW) | 200 kW |
| Battery bank size (kWh) | 300 kWh |
| Electric thermal stove capacity (kW) | 650 kW |

Source: GRID Modernization Laboratory Consortium, DEO, 2018

Doing this, the results of the new proposed systems declined the cost of electricity from \$0.407/kWh to \$0.308/kWh and the fuel consumption was reduced by 80% (103,00 gal). These results are most generalizable to wind-diesel systems in communities with a good wind resource and a large thermal load.

Kokhanok Mini-grid Business Case

Kokhanok is a small community located on the south shore of Iliamna Lake, 37 km south of Iliamna with a total population of approximately 152 people. The current and proposed electric generation system is:

Table 3
Summary of Kokhanok energy situation

| Item | Value |
|-----------------------|--|
| Diesel plant | 1x 60-kW generator 1x 115-kW generator 1x 117-kW generator 1x 160- kW generator |
| Total capacity | 426,248 kWh/yr |
| Average load | 180 kW |

Source: National Renewable Energy Laboratory, DEO, 2017

Table 4
Proposed Kokhanok system configuration

| Component | Value |
|---|--------------|
| 2 Vestas 17 wind turbines | 90 kW |
| Electric thermal stoves for energy storage | 125 kW |
| Battery storage | 120 kW |

Source: National Renewable Energy Laboratory, DEO, 2017

Doing this, the results of the new proposed systems decreased the cost of electricity from \$0.69/kWh to \$0.39/kWh and the fuel consumption was reduced by 69% (22,000 gal). These results retrofit Kokhanok's energy infrastructure in order to save money and reduce reliance on imported fuel.

Shungnak Mini-grid Business Case

In the village of Shungnak, Alaska with a population of 299 individuals a large quantity of diesel fuel is used by four generators that supply electric power to the village. The current and proposed electric generation system is:

Table 5
Summary of Shungnak energy situation

| Item | Value |
|---------------------|------------------|
| Diesel plant | 202 kW generator |

| | |
|--|--|
| | 350 kW generator 365 kW generator 400 kW generator |
| Annual electricity generation (kWh) | 1,747,196 (Avg. load: 181 kW) |
| Annual thermal consumption (kWh) | 2,813,163 (Avg. load: 291 kW) |
| Annual diesel fuel consumption [FY 2016] (gallons) | 129,385 |
| Annual diesel oil consumption [FY 2016] (gallons) | 56,690 |
| Average diesel fuel cost) (for electricity production [FY 2016] (\$/gallon) | \$7.99 |
| Average heating oil cost [FY 2016] (\$/gallon) | \$7.16 |

Source: GRID Modernization Laboratory Consortium, DEO, 2017

Table 6
Proposed Shungnak system configuration

| Component | Value |
|---|--------------|
| Electric thermal stoves for energy storage | 371 kW |
| Solar photovoltaics | 179 kW |
| Wind turbines | 500 kW |

Source: GRID Modernization Laboratory Consortium, DEO, 2017

Doing this, the results of the new proposed systems reduced the cost of electricity from \$0.632/kWh to \$0.548/kWh and the fuel consumption was reduced by 74% (96,000 gal). The right combination of enough wind and solar, effective energy efficiency measures, and high fuel prices enabled positive returns on investment while achieving a greater than 50% reduction in imported fuel.

The Hawaiian Islands

To finalize, Mr Bloyd explained the Hawaiian Islands case as a good example of the real cost of providing reliable remote power. The islands have 4 electric services territories:

Table 7
Summary of Hawaii energy situation:

| Island | Grid size (MW) Firm Capacity (MW) | Residential rate (2018 average, US\$/kWh) | Peak Renewable Energy (%) |
|---|--|--|----------------------------------|
| KUIC (Kaua'i Island Utility Cooperative) | | | |

| | | | |
|--|-------|------|----|
| Kauai | 126 | 0.37 | 90 |
| HECO (Hawaiian Electric Company) | | | |
| Oahu | 1,794 | 0.31 | 22 |
| MECO (Maui Electric Company) | | | |
| Molokai | 12 | 0.40 | |
| Lanai | 10 | 0.40 | |
| Maui | 252 | 0.34 | 80 |
| HELCO (Hawaii Electric Light Company) | | | |
| Hawaii | 213 | 0.37 | 44 |

Source: Cary Bloyd presentation, 2019

Opposed to MECO y HELCO, subsidiaries of Hawaiian Electric Company (HECO), KUIC is a cooperative created after the Hurricane Iniki. The Hurricane knocked down every power tower, destroying it electric system. In response, the community brought and administrates the local energy grid themselves, deciding to interconnect a high amount of renewable and reliable energy. They designed a way to maximize the optimal penetration of renewable energy, reaching a peak of 90%. Maui Island incentive investment of RE achieved a peak of 80% RE penetration in its energy matrix.

Obstacles and Challenges to the Energy Access in Remote Areas: Chilean Experience in Rural Electrification.

Presenter: Julio Cuadra

Mr Julio Cuadra is the Chief of the Access and Social Development Division in the Ministry of Energy. The main task of the division is to reduce the energy access gap among other dimensions of energy as access to potable hot water, heating, and others.

Mr Cuadra introduced his presentation highlighting the energy as a key element for the life quality of the population, and as a global and local priority. In the international framework of energy challenges, the Sustainable Development Goals (SDGs), in particular Goal 7, “affordable and clean energy” aims to “ensure universal access to affordable, reliable and modern energy services” remarking the efforts of SE4ALL since 2011, as Ban Ki Moon said, “Energy is the golden thread that connects economic growth, increased social equity, and an environment that allows the world to thrive”. Nowadays, 14% of the global population does not have access to this basic service and the main energy gap is in the Sub-Saharan region and Asian economies.

In 2019, electricity access in Chile is close to 100%, but the efforts began in 1994 when the electricity access gap was around 50%. With the support of local government and international organizations such as Inter-American Development Bank (IADB), United Nations Development Programme (UNDP) and Global Environment Facility (GEF) in several projects, the coverage increased to 75% in 2000 and 90% in 2006, adding renewable energy gradually.

In 2015, the Chilean Ministry of Energy defined a long-term public policy jointly with citizens, proposing as a goal for 2050 to deliver universal and equal access of modern, reliable and affordable energy services to the population. The Ministry of Energy has proposed a short agenda for the 2018-2022 period called the “Energy Roadmap”, that has the goal to reduce the energy access gap and to improve electricity supply, with a goal of 2500 solutions per year.

The first challenge was to measure the existing electricity access gap in Chile, identifying where houses without electricity or with poor energy supply (less than 6 hours/day) are. The result of this work was the “Energy Vulnerability Map”. It showed that there are about 25,000 families without electricity and around 5,000 families without a continuous electricity supply.

Rural electrification funding

Mr Cuadra explained that in order to achieve the rural electrification challenge; local governments and communities have a key role in designing and planning

their rural electrification projects. In these projects, the state has a subsidiary role, however, in grid extension cases, electrical distribution companies contribute with a percentage of the costs. There are three kinds of different solutions depending on how isolated the beneficiaries are:

1. Rural electrification via grid extension:

- Permanent supply
- High quality and security regulations
- Tariff regulation

2. Rural electrification via self-generation/microgrid

- Permanent or partial supply
- Service quality depends on the operator
- High operating costs, subsidies dependency

3. Rural electrification via self-generation/individual solutions

- Permanent but restricted supply (low capacity appliance)
- Continuing training for users
- High reinvestment costs due to low tariffs , subsidy dependency

Electrification in isolated areas

Mr Cuadra stressed that deliver permanent and high quality electric solutions to remote areas are not an easy task. The main challenges are:

- Geographical and climatic conditions
- Access and logistic difficulties
- Low energy demand
- Limited generation capacity
- Required technical skills for management and operation

To continue, he presented 4 Chilean cases of electrification in remote areas and the respective challenges:

Coquimbo (2005)

Located in the north of Chile, 3,000 photovoltaic individual solutions were installed along the region with a capacity of 125 Wp, 12 VDC and 230 Ah of battery storage. This project is operated and maintained by a private company for a monthly fee of \$18 USD per dwelling. The local government subsidizes \$14 USD, therefore the final cost per house is \$4 USD monthly. The main challenges were:

- High dispersion of dwellings complicated the maintenance and fee collection.
- Despite of the user's training, the equipment was damaged due to misuse.
- The PV solution becomes quickly obsolete, in terms of basic energy solutions for the families.

Chiloé (2009)

Located in the south of Chile, 11 diesel micro-grids were installed in different islands of the archipelago. The local government ran a tender process for the construction and operation of the distribution grid and power plants that were managed by local electricity committees. The high logistics costs caused a monthly fee between \$0.5 and \$7 USD, which needs to be subsidized. In addition, the supply is available for only 12 hours/day. The main challenges were:

- Low infrastructure standard
- Difficult accessibility to the islands for maintenance companies
- Low technical and management capabilities for the operation
- Low service quality and continuity
- Low transparency and accountability due to remote location
- Low security standards in fuel use and transportation

Huapi Island (2017)

Located in the south of Chile, this project was developed jointly with the local community and consists of 151 photovoltaic individual systems, where each of them generates more than 100 kWh monthly. Even they are not interconnected, all the systems are operated by a local committee and the cost of operation is around \$4.5 USD monthly per house. The main challenges were:

- To satisfy local community expectations (community asked for sustainable solutions).
- Users rejected certain brands of PV systems.
- Permanent work with the community in order to choose the proper management model.

Easter Island

Located in the middle of the Pacific Ocean, Easter Island has approximately 5,000 inhabitants. The energy matrix has a high dependence of diesel (99%) for the electric generation (6,160 kW); however, currently there is one PV plant operating with a total capacity of 128 kWp and there is another that will be soon

in construction, both are managed by the state-owned company SASIPA. The main challenges were:

- High dependence of state funds for grid operation and investment.
- Local inhabitants request for participation in projects
- Internal conflict between local community and SASIPA

Lessons learned

In order to reach a sustainable and 100% renewable electricity access under the leadership of the Ministry of Energy, the development of energy access public policies, plans, programs and projects must be coordinate jointly with initiatives from local governments, privates, academy, among others. However, we learned after several years, that a successful sustainable project needs the participation of the community as a key stakeholder. Either as users, operators or managers of the project, the community is the key for a quality and sustainable electrification project.

Session B: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Collaboration, Funding and Related Issues

Lessons Learned and Challenges for Energy Access in Isolated Rural Areas

Presenter: Renato Oña

Mr Renato Oña Polit is an electronic, automatization and control engineer with renewable energy Master Executive Degree, sustainable environmental management Master's Degree and project management specialization. He has worked for 10 years in Ecuador, Andes Region and Latin-American and Caribbean economies, designing and implementing renewable energy projects to improve quality of life for their inhabitants. He has experience in app development based on renewable energy use in rural areas, and in energy regulatory and management model project aspects.

Mr Oña started his presentation sharing his experiences in “Mechanisms and technology transference networks related to climate change in Latin America and Caribbean” project as member of Bariloche Foundation. In 2015, with funding support of GEF and IADB, this project considered the global framework mechanisms delivered by the United Nations Framework Convention on Climate Change of cooperation for development and technology transfer. This project aims at different areas of cooperation, and Bariloche Foundation is responsible for the energy area. Therefore, the objective is the promotion of technical assistance of renewable energy and energy efficiency technologies for local and regional governments, supporting energy public policies and roadmaps for the region. Under this umbrella, the foundation worked in several projects focused on energy access. This presentation focused on 3 cases: two in Colombia and one in Ecuador.

Photovoltaic systems in Sanquianga Region, Colombia educative institutions

Mr Oña presented the case of Colombia in “Photovoltaic systems in Sanquianga Region Colombia educative institutions” that took place between 2017 and 2018, supported by local government and academy. This project aimed to design and fund technological solutions based on solar power in order to supply energy and potable water demands in 123 educational buildings. During planning and implementation phases, the following challenges were identified:

- In some rural areas, was not possible to connect the PV installation to the national grid.
- Schools with computers and tablets did not have sustainable electricity access.
- There were some problems in water treatment in schools and challenges depended on each particular site.

Energy Access Technical Assistance Studies PV, Colombia

After the first case, Mr Oña explained the second Colombian project. This was a study required by the national Colombian government where that institution wanted to check the current conditions of the PV installations in different places. For that, during the project, interviews and surveys were applied to different key actors and authorities in order to determine if it was a positive experience or not to work with PV technology, and use these lessons learned to inform new public policies. The main objectives were:

- Evaluate the technical operation of isolated solar projects and their sustainability diagrams.
- Analyze gaps and strengths of the sustainability diagrams.
- Identify lessons learned in these interventions.
- Identify improvement opportunities in these projects.
- Propose a set of recommendations for the expansion energy coverage policy.

Sustainable behavior standards proposal for the Galapagos Archipelago, Ecuador, buildings

The last case presented by Mr Oña was the Galapagos Archipelago project in Ecuador. Like most of the isolated islands in Latin America, Galapagos has a high fossil fuels dependence, which is strongly subsidized by the government due to the high cost for the families. However, it is still expensive for buildings such as governmental, schools, hotels and commerce. In order to reduce these costs, the government required a study to incentivize standards for energy efficiency in these buildings. The EE recommendations were classified in three different categories:

1. Basic Intervention: Cross ventilation, light color paint and corbels
2. Medium Intervention: Isolation of roofs and façade, solar control glass, roof ventilation and LED illumination
3. Advanced intervention: Window substitution, air flow regulation, efficient refrigerator and electrical appliances, solar collectors and photovoltaic solar panels.

Lessons learned

To finalize, and according to the previously presented cases, Mr Oña shared important questions learned through his experience, related to the project sustainability:

- ¿What will happen with the rural electrification projects without management models?
- ¿What do we really know about energy consumption in rural isolated areas? Especially in low income communities that have several electrical goods.
- ¿Do the project developers consider key indicators to measure social, economic and environment impacts of rural electrification projects in householders?
- In these projects ¿Is there any local technical capacity available to operate and maintain the equipment?

Therefore, in order to elaborate a sustainable project, there are 3 main lessons learned:

1. **We must think about the sustainability:** Achieving a sustainable energy access for isolated areas inhabitants requires a well-planned management model which considers objectives, indicators and key results in a realistic and reachable pathway.
2. **We must adapt the management model to the reality:** Off-grid projects must consider aspects such as:
 - Technical quality equipment
 - Technical quality installation
 - Geographic information system
 - Maintenance standards
 - Supervision (Local / Remote)
 - Monitoring (On-site)
3. **We must create a social sustainable business model**

The challenges of future energy access projects in isolated Latin-American and Caribbean areas are:

- A. Energy policy institutional framework which considers energy access in its agenda.
- B. Funding: Social benefits projects and productive benefits projects.
- C. Strengthening of local technical capabilities.

Delivering Energy Services in Remote Areas: Project Experiences and Lessons Learned

Presenter: Paul Rodden, Australia

Paul Rodden is a renewable energy engineer with extensive experience in the design and delivery of renewable energy project developments in regional and remote areas of Australia, South-Asia, the Pacific and in Africa. As one of Ekistica's Senior Project Managers, Paul provides a range of government, community-sector, commercial and regional development agencies with advisory, design engineering and project delivery services for projects in the energy sector. These include renewable and hybrid power systems for remote communities, large commercial-scale solar PV systems at airports and tourism ventures, technical assistance for the design of economy-level solar PV tariff policy; and technical due-diligence work for private equity firms looking to invest in utility-scale renewable generation facilities.

Mr Rodden started his presentation introducing Ekistica, engineering consultancy company, based in Australia, owned by Centre for Appropriate Technology (CAT) jointly with an indigenous NGO. Ekistica specializes in remote areas service delivery, renewable energy, power systems and water sanitation treatment.

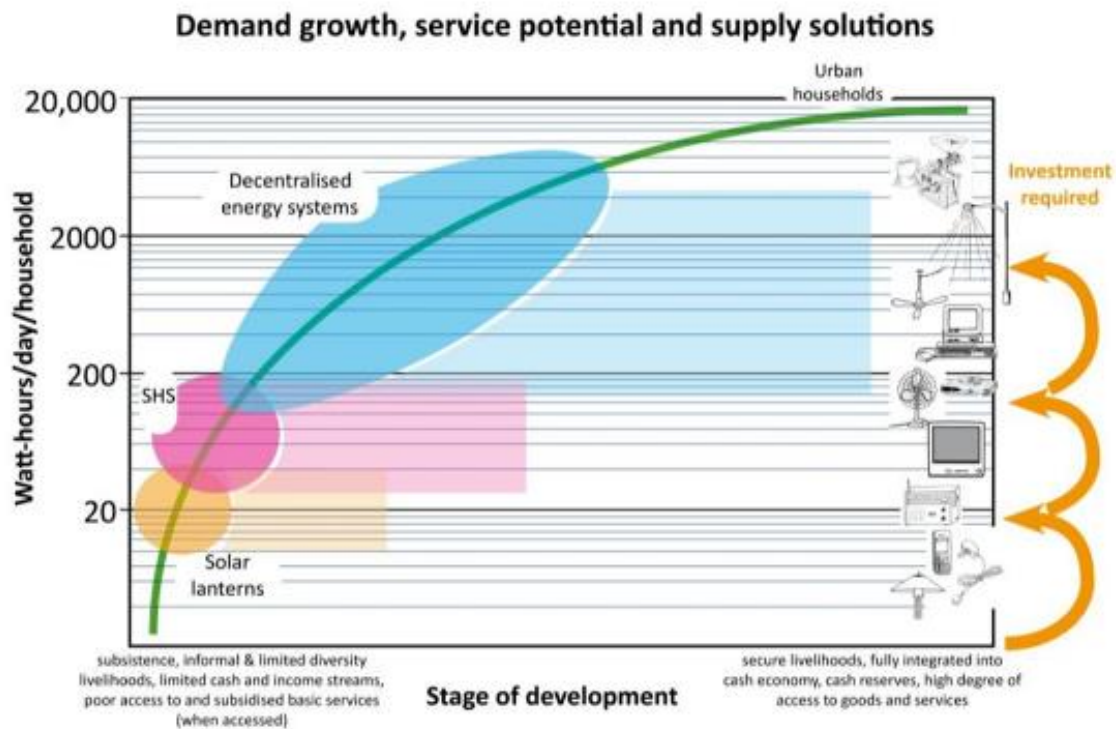
Service delivery in remote areas

Mr Rodden highlighted that communities in remote areas requires access to the same basic service as those in urban areas, especially because energy is the most critical factor for the development of a remote community, underpinning the effectiveness of all other basic services like, water, sanitation, health, education or communications. However, is important to differentiate electricity connection with access connection – access to services requires a higher standard, which means: Affordable, reliable and sufficient quantity of electricity connection to families.

In addition, Mr Rodden explained the importance of defining up front the electricity service level that the program or project aims to deliver, some points to consider are: to set appropriate tariffs, inform both, the required scale of the power system(s) and the most suitable technology, among others. This, underpins the engagement with the end user manage expectations, and allow effective understanding of project financing over the full project life cycle.

Electricity services are delivered across a broad spectrum of service levels, as this:

Figure 2
Demand growth, service potential and supply solutions



Source: Paul Rodden presentation (2019)

Barriers to Delivering Energy Services in Remote Areas

In remote areas there are several barriers to deliver energy services. Mr Rodden resumed 3 types and focused his explanation in the last category:

- **Physical barriers** (Distance, geography, transport access, weather/climate)
- **Technology** (Engagement, Training and System design)
- **Structural barriers:**
 - Governance:
 - Stakeholder capacity to understand, engage, manage, support and oversee the deployment of energy service delivery might be low.
 - Lack of policy and regulatory support
 - Lack of long term vision and/or commitment
 - Finance
 - High cost of remote deployment
 - Perceived risk leads to financing constraints
 - Finance/funding often restricted to initial capital cost of deployment. Lack of commitment to life cycle cost and long term vision
 - Supply chain

- Lack of experienced/skilled designers/installers in remote areas
- Low access to technology suppliers

Projects and Programs – Lessons learned

Mr Rodden described briefly the Australian energy context in order to explain the 3 local projects and programs. Australia is a large economy with many remote towns, communities, outstations, mines, cattle stations, tourist facilities, among other infrastructure. The grid coverage is large but limited to areas of higher population density, because of that, there is a long history with Off-Grid electrification, traditionally powered by diesel or/and gas in less populated areas of central and northern Australia. Due to the high irradiance, most the PV solar systems are concentrated in the center and north areas, and wind power is in the south.

Bushlight Program

Bushlight is a federally funded program aimed for reducing reliance on diesel generation in remote indigenous communities in Central and Northern Australia. In 10 years, 155 hybrid generation solutions of photovoltaic/battery energy storage systems (BESS) or photovoltaic/BESS/diesel were inaugurated, replacing the old diesel generation. In terms project's experience, there was a strong focus on:

- Meaningful community engagement: The emphasis in community engagement and energy planning was reflected in the different reunions with the communities, talking to them about energy, what it means and how to use it.
- Capacity building (industry, government and community): Training the users and local resources on how to use the system and training the staff on how to maintain the system.
- Quality, reliability and service availability: We guarantee a quality service, because when you do a job in a remote area, the cost of doing a bad job is highly expensive for everyone, saving money in the long term.

The main lessons learned of this project were:

- Critical elements of success delivery of energy services include
 - Effective community engagement and capacity building
 - Deployment of quality components, design and installation
 - Effective demand side management integration
 - Effective operation and maintenance
 - Committed long term funding allows for long decision making
- Mandatory long view, to plan and implement for system life cycle

- Community involvement and contributions important for system longevity

The Solar Energy Transformation Program (SETuP)

SETuP is a program funded by the Australian Government; the project delivered a wide-scale rollout of 10MW of solar systems across 25 remote indigenous communities where they operated diesel power plants. The program aims to reduce diesel consumption through low penetration PV (15-20%), typically 300kW to 500kW photovoltaic per site. However, Daly River was selected to host the large photovoltaic/BESS plant which includes 1MW photovoltaic array and 2MWh Lithium Ion BESS.

The main project outcomes were:

- Photovoltaic/BESS/Diesel system has reduced diesel consumption by over 60%
- Photovoltaic/Diesel systems have reduced diesel consumption by 15% approximately.
- Payback period approximately 5-6 years
- Potential for future rollout (another 50 similar sites available)
- Expansion of PV/Diesel system to PV/BESS/Diesel
- Lightning protection systems important in these northern areas

The Cook Islands – Outer Islands Project

The last project was funded by the New Zealand Ministry of Foreign Affairs and Trade; the program objective was the reliance reduction on diesel generation in island consumption. In order to achieve this goal, eight photovoltaic/BESS/diesel hybrid systems were installed in different communities. The following key factors were considered in the project's designing were: Reliability, portability (of components), modularity, climate conditions (cyclones and storm surges) and remote monitoring.

The main lessons learned from this project were:

- Well designed, installed and maintained power system can deliver reliable energy services for the remotest communities
- High renewable energy fraction in remote power systems is often achievable and desirable
- Risk has cost. Requirement to work through cyclone season increased costs
- Land access in some communities can be a major problem.
- Governance issues remain a concern and need constant attention
 - Recommended tariff structures not adhered to
 - Long term maintenance program slow to lock in
 - Lack of capacity building impacts local ability to manage

Promotion mechanisms to boost energy solutions in remote areas

In order to comprehend mechanisms to boost energy solutions in remote areas, Mr Rodden reflected about what we should aim when we discuss about boosting energy solutions in remote areas and what does success look like. He proposed 3 main objectives in energy solutions projects:

1. Greater volume of delivered energy services (more systems and at a higher level)
2. Better quality energy services (as reliability or power quality)
3. Better outcomes for community (as improved livelihoods, better access to other services, more income)

In addition, he stressed that the **3 structural barriers** presented before are the main obstacles to achieve well project outcomes, which is why in order to surpass it, he proposes in every barrier the next solutions:

- **Governance** (low capacity/understanding, bad policy, short-termism)
 - Build capacity and understanding of key stakeholders through education to understand the how and why of service delivery in remote areas
 - For support agencies, NGOs and government
 - Site visits and tours of successful sites
 - Publications: guidebooks, articles, media releases
 - Conferences, workshops
 - Lobby for policy and regulatory change
- **Finance** (high costs, high risk, lack of finance)
 - Education of funders and financiers
 - Reduce perception of risk
 - Life cycle cost benefits vs Capex
 - Cost reductions through improved supply chains
- **Supply Chain** (lack of capacity, support and supply)
 - Industry training for local resources (installers/maintainers)
 - General training programs/certification
 - Project specific - Bushlight
 - Installer accreditation: registered practitioners list
 - Hardware accreditation: approved component lists
 - Clustering energy service delivery improves regional capacity

To finalize, Mr Rodden concluded that successful projects promote themselves and quality is much more important than quantity.

Energy Access Project: Lessons from Nepal and Next Steps to Fill Knowledge Gaps

Presenter: Dalia Patiño, EE.UU

Dr. Patiño-Echeverri's research focuses on public policy design for energy systems, with a particular emphasis on managing the risks arising from the uncertainties influencing the outcomes of government actions. Much of her current work focuses on the policies that affect capital investment decisions within the electricity industry, and the corresponding costs to society of electricity and air-emissions levels. Her models explore the effects of different government policies by representing the industry's decisions under uncertainty on future technological advancements, fuel prices, and emissions regulations.

Ms Patiño started her presentation introducing her team at Duke University – Energy Access Project (EAP), which has 3 missions:

1. Research (Interdisciplinary and problem based)
2. Education (Multilevel, multidisciplinary and project based)
3. Engagement (Private companies, local governments, NGOs and Duke University Sustainable Energy Transition institute)

Then, she introduced the lessons learned from an ongoing research project in Nepal, presenting the context of the economy, where Nepal population has 94% electricity access, but the electricity access is narrowly defined, having a low electricity potency (for 4 lightbulbs approximately). The Nepal's energy mix is:

- 77% Traditional
 - Fire-wood and cows-dung imported from India
- 20 % Commercial
 - Petroleum
 - LPG (cooking gas)
 - Electricity grid (45% hydro, 5% fossil, 50% imported from India)
- 3% Renewables
 - Biogas
 - Micro Hydro Powerplants (MHP)
 - Solar
 - Wind

One of the most important renewable energy source in Nepal is MHP; it is the only electricity source of many rural communities in Nepal and most of them are isolated from the main power grid. MHP are of 10 up to 100 kW of power capacity and there are more than 3,000 installed, but approximately 1,000 of them are abandoned or barely operational. The total installed capacity in MHP is around 30 MW, which intended to cover 5% of the population. These MHPs are mostly

community owned/operated. Further, 40 to 50% of the project cost is covered with a subsidy from central government and the rest is covered by local government, loans or labor contribution.

90% of electricity generated by MHP is used for domestic lighting, mobile phone charging and TV. The remaining 10% is for enterprises or social institutions. However, MHP electricity is a challenge with several problems for the communities, because of:

- Poor reliability: MHP have long and frequent scheduled and unscheduled outages.
- Short lifetime: Many are closed or non-operational after 10-20 years.
- Limited: The ones that still work and provide somewhat reliable service cannot meet all energy needs.

Therefore, Ms Patiño-Echeverri discussed the origins of the problems and which interventions can fix them. In order to answer those questions, this project was oriented to: Understanding technical, financial and institutional determinants of MHP success. The project determined the following key factors for MHP performance:

1. Infrastructure: Wear and tear conditions of MHP and street wooden poles, which are poorly maintained, in addition to low standard equipment.
2. Hydro-climatic conditions: Harsh climatic conditions with hard monsoons and water flows.
3. Governance & Management: There are socio-economic structures that are not suitable for good maintenance, complemented by governance, ownership and business model problems.
4. Mismatch between Power Supply and Power Demand: There is a high load and low supply in peak hours and very low load during other periods, resulting in low revenues.

The methodology of this project is data collection based in focus groups and pilot surveys to stakeholders of 122 MHPs, which 25 were MHPs that have received an intervention, 25 that are similar size and place but have not been intervened and the rest is control group. The data analysis was divided in:

- Econometrics
 - Explore association/causality of MHP characteristics with overall success
- Power Systems Modeling
 - Montecarlo simulation of electrical load
 - Hourly demand from commercial and residential costumers
 - Montecarlo simulation of hydro-climatic conditions

- Montecarlo simulation of power system operations and estimation of reliability
- Financial Modeling
 - Cash flows and financing structure
 - Leveled cost of electricity (LCOE)

In order to solve the aforementioned problems, interventions funded by Alternative Energy Promotion Centre (AEPC) and Renewable Energy for Rural Livelihoods (RERL) focused on 1,000 MHPs with satisfactory conditions, that operate at least 8 hours a day, creating conditions such that they were regarded and managed as enterprises.

The main objective was to create a paradigm shift in the way that people see MHP as a profit-oriented enterprise, efficient and prepared to face risks, changing their role from beneficiaries to costumers and from recipients to prosumer.

Ms Patiño explained that being an enterprise has a very important component which is to promote productive use and entrepreneurship, increasing income from new economic activity. A study in 2017 of 70 MHPs showed that MHP with enterprises model have a higher cash flow per installed kW.

She also described the different phases of intervention used. Firstly, **preliminary assessment** of MPHs conditions (Technical, socio-economic and financial, among others) to intervene. Secondly, **social mobilization** to discuss what are the best MHP management models (Cooperative, private or CPP) with the community and facilitate public hearings and auditing. Then, a process of **capacity building of new management committee & staff** with organized visits to the best MHPs projects; exchanges experiences and best practices with other communities; providing training in management & accounting; setting up computerized billing systems; defining clear roles and responsibility of staff and developing incentive packages. After this, help them to set up a **new institutional framework and management practice**, as an appropriate business model; follow government policies, rules and regulations; establish formal offices; setup digital financial management system; installation of energy meters; setup repair and maintenance fund; define operational guidelines of MHP; and develop business plans. And finally, **incentivize productive energy use and market linkage**, which means identify and select who in the community can be an entrepreneur and helping them with a business plan; develop entrepreneur skills; provide financial support; help with marketing product/services; and setup women groups to manage savings/credit system.

Study cases: Darna and Simli

After this, Ms Patiño showed 2 examples of successful interventions: Darna and Simli communities:

Table 8

Darna MHP after-before intervention

| Darna MHP (83kW): Before-after intervention | |
|---|---|
| Before | After |
| Informal user's group | Registered as Cooperative (rules & regulations, regular AGM, financial governance, transparency: regular public audit & financial reports) |
| No clear rules & regulations | Rule and regulation of cooperative; regular savings and credit by women's groups; operation and management Guidelines |
| Low frequency of Executive Committee (EC)/Mass meeting | EC meeting every month and mass meeting every year |
| Unmanaged tariff structure and irregular revenue collection | Increased tariff, minimum charge + kWh charge; regular revenue collection; and discount for timely payment and penalty for defaulters |
| No energy meters | Energy meters in all HHs and end uses |
| No financial management system | Computerized billing and account keeping |
| No incentives for staff | Provision of incentives (Basic monthly salary + allowance based on revenue generation, insurance, bonus on profit, communication cost, overtime allowances, office uniform, etc.) |
| No maintenance fund | Maintenance fund established (Poles/transformer repaired or replaced 3 days with own fund) |
| Rest time of 16 hours per day | Rest time of 2 hours per day |
| No business plan | Business plan prepared |
| Low utilization of electricity | PEUs + 25kW exported to adjacent HHs and revenues from \$500 to \$1,200 per month |

Source: Ms Dalia Patiño presentation (2019)

Table 9

Simli MHP after-before intervention

| Simli MHP (29kW) Community Private Partnership Model | | |
|--|--------------------|--|
| Item | Before | After |
| Operation hours per day | 14 | 20 |
| Office | No | Yes |
| Average revenue collection per month in USD | \$2 | \$750 |
| Bill payment on time | 50% | 98% |
| Tariff rates | Flat | Upgraded (at least NPR 100 per HH/month) |
| Incentive packages | No | Yes (Life insurance, pension, dress, communication and other allowances) |
| Demand side management | Incandescent bulbs | CFL or LED bulbs (Schedule for PEUs) |
| Electricity consumption | <20% | Increased (Extension works to nearby HHs, electric cookers, PEUs) |
| Computer billing system | No | Yes |

Source: Ms Dalia Patiño presentation (2019)

Lessons learned

To finalize, Ms Patiño shared the lessons learned of previous cases and projects. Further, economic sustainability of grids is fundamental, mini- and micro-grid electric systems require efficient capacity sizing and load management. Long term survival of power systems requires two conditions: adequate power generation capacity to meet energy needs and peak load requirements; and adequate electrical load management in order to avoid sub utilization during off-peak hours and outages during peak hours. In addition, there is a strong relationship between these two points and electricity's productive use, because it is needed to increase electricity used during off-peak hours and reliability is needed to have productive use. She emphasized that we need **pre- and post-installation assistance** to ensure conditions for its existence through supportive programs. The creation of productive uses is essential to MHP sustainability, but designing and implementing these programs is challenging due to:

- Low demand for the services and products of these productive uses
- Lack of supportive services and products (phone, bank, technical support, inputs for production, or roads to market)
- Lack of enabling services (phone, bank, technical support, inputs for production, or roads to market)

- Concerns about fairness and equity in the selection of entrepreneurs
- Large growth in energy and peak power needs will create conflict among businesses and within the community
 - Time of use restrictions for businesses in peak-power limited MHPs harm some businesses
 - “Load management” approaches to deal with excess peak demand damage equipment (for example 2 minutes outages to disconnect rice cookers)
 - Large demand for productive use limits load growth in households
- High cost of program implementation
- Risk of intervention becoming irrelevant

In addition, Ms Patiño concluded with knowledge gaps as:

- If the creation of commercial and “industrial” electricity costumers is essential to power system sustainability, what kind of supportive programs are required to ensure continued energy access?
- How can we incentive productive use, like human related productive use?
- How do we design effective interventions to improve load management?
- Are some forms of governance (cooperatives, leases, private) better than others? Under what conditions?
- What are effective ways to evaluate the impact of these interventions?

Wrap-Up Session B

In order to exchange ideas and experiences from the session’s presentations, after every session four working groups composed by speakers and participants were formed. Guided and supported by a facilitator each group worked to identify and discuss key aspects of sessions during two main activities.

1. The first activity, under the session scope “Obstacles and Challenges for Sustainable Solutions in Remote Locations: Collaboration, Funding and Related Issues” the groups analyzed key actors involved in energy access projects. The main objective was promoting discussion among experts in order to exchange several scopes and learnings.

Firstly, each group identified important actors in the session topic, discussing and choosing the most relevant ones, to subsequently determine how they can contribute or obstruct in energy access projects. Then, every group briefly presented its choice.

The most relevant actors identified were the community and its local leaders, the local and national government, the academy, financing entities and technical teams and suppliers.

The next table summarizes how these actors can collaborate or block up the development of the projects.

Table 10

Relevant actors identified an how they can contribute or obstruct energy access projects

| Relevant actors | Contribution | Obstruction |
|------------------------|---|--|
| Community | It can contribute by defining specific energy needs and engaging and cooperating throughout the project. This includes their participation in the decision making on the solution and tariff, among other issues. Also, the community can provide local support, land, labor and capital. Finally, the local leaders are very important because they can motivate and support the community throughout the project. | On the other hand, the community can be against the defined solution and the construction of the project, rejecting the technology and denying access to land for example. Also, they could ask for free services and refuse to pay the tariff and there could be internal conflicts that obstruct the projects. Finally, the local leaders could be an issue when they put their own interests before the community ones. |

| | | |
|--------------------------------------|---|--|
| Local and national government | The local government can approve the project and facilitate the work through technical and management support. Also the local regulation and policies can support the project, which is also important at a national level. | Local government can delay the project implementation because of bureaucracy. The lack of regulation could be a barrier for new technologies or solutions. |
| Academia | Can provide new solutions, tools and be a bridge in knowledge regarding this kind of projects. | In opposition, too academic knowledge with not enough practical experience could be a barrier for projects and distort expectations from the theory to the practice. |
| Financing entity | Can promote the development of programs instead of projects, proposing long term efforts, and also giving technical support and assistance. | Lack of sensibility to prices and up-front costs can be a barrier when these institutions finance only in short terms. |
| Technical teams and suppliers | Their training, specific skills and experience are important factors both, the installation and the maintenance of the equipment. | Lack of local capabilities and incompetence of technical teams could obstruct the project, reflected in poor quality installations. |

2. In the second activity, working groups determined the advantages and obstacles for funding and collaboration in four critical variables in energy access projects in remote locations: Relevant context, project characteristics, strategies and needs for innovation and learning. After this, groups discussed and selected which advantages and obstacles were key topics in each central concept, presenting brief conclusions among participants.

In relation to funding and collaboration, the next table resumes the main advantages and obstacles identified by the participants, regarding relevant context, project characteristics, strategies and needs for innovation and learning.

Table 11

Advantages y obstacles regarding critical variables in energy access projects, in relation to funding and collaboration issues

| Variable | Advantages | Obstacles |
|---|---|---|
| Context | Natural and local resources available, including local skills for the project. Also, an organized community and their cultural beliefs and history can be an advantage. In addition, the funds availability can facilitate the project. | Lack of local skills or knowledge can be an obstacle as well as conflictive relationships within the community. Also, the remoteness, low income level of people and poor local development level. Finally, in the context of climate change, energy access solutions as diesel generators could be considered as an obstacle because of CO2 emissions. |
| Project characteristics | The inclusion of local community and bottom-up approach is an advantage for management and collaboration. Also, the presence of a local champion could help in this direction. A basic aspect is a good engineering design, operation and a long-term and result based funding. | Community opposition to Diesel, hydro or wind farms could be an obstacle. Also, the peak load of the system and technology risk was described as obstacles. |
| Strategies | Good understanding of the community, effective communication and engagement were indicated as advantages. Also, improving skills of local people was highlighted. Another advantage was to develop programs and not just projects, defining clearly roles and responsibilities and promoting cross-subsidies that lower cost of mini and micro grids. | Predefined or standard solutions can be an obstacle along with the impossibility to extend electric lines in some territories. Also, focusing only on CAPEX is an obstacle to consider. |
| Needs for innovation and learning. | Promote remote education in local languages were identified as advantages. Also, the design of an optimal tariff considering the willingness to pay is an important issue. Finally, a particular proposal was to create an academy of rural electrification. | The only obstacle that was pointed out by the groups was the lack of technical Information. |

Session C: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Social, Cultural and Community Issues

Cultural and Community Issues, Topics and Examples

Presenter: Xavier Vallvé, Spain

Mr Vallvé holds an Engineering and Master degrees from the University of Waterloo (Canada) and is co-founder (1986) and director of the consultancy firm Trama TecnoAmbiental (TTA) in Barcelona, Spain. He has large experience in renewable energy rural electrification projects for distributed generation both grid-tied to the national grids and autonomous RE hybrid technology for islands and isolated villages. This involves complementary and interdisciplinary skills in economic, social and management aspects as well as engineering experience.

Mr Vallvé started his presentation introducing Trama TecnoAmbiental, pioneer firm in rural access to electricity and focused on engineering and consultancy. His vision is that instead of taking either standalone individual plants or micro-grids, rural electrification should be based in providing services for a community at different levels. It means that project developers must understand very properly the demand characterization involving the comprehension of the clients and their needs. From the point of view of the client, she or he should have a certain level of service and pay a certain level of tariff for that electricity (or energy) service, instead of offering a particular technology. For instance, some dwellings can be satisfied with basic necessities as light bulbs or telephone charge and it may not need a big PV power plant to solve the needs (Figure 3).

Therefore, sharing a limited resource, like a PV plant, will mean managing the community from the outset and apply rules for the energy sharing.

Through a cost study of 10 micro-grids in operation for at least 2 years, from Asia and Africa with World Bank data, Mr Vallvé determined that some of the most important issues related to the soft costs were:

- Policy and project planning
- Market regulation
- Customs and taxes
- Local capacity building
- Community engagement

In another example of 5 micro-grids in Ghana demonstrated the importance of community engagement to the sustainability of the project. In that case, there was joint work with the community in order to determine topics like sustainability or

fees. It was very important to the understanding of the community about the impact of its payment.

By this point, Mr Vallvé stressed that critical success factors depends on the business model, local needs and community engagement.

Figure 3
Service levels: ESMAP

Portable, affordable solar lamps

| | Tier 0 | Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|------------------|----------------|---------------------|----------|---|---|-----------|
| Capacity | No electricity | > 3 W | > 50 W | > 200 W | > 800 W | > 2 kW |
| Daily energy | | > 12 Wh | > 200 Wh | > 1 kWh | > 3.4 kWh | > 8.2 kWh |
| Duration (h/day) | | > 4 | > 4 | > 8 | > 16 | > 23 |
| Reliability | | Unscheduled outages | | | No unscheduled outages | |
| Quality | | Low | | Good | | |
| Affordability | | | | Cost is less than 5% of household income per year | | |
| Legality | | | | | Bill to utility, prepaid card seller or authorised representative | |
| Health & safety | | Not convenient | | | Convenient | |

Source: Xavier Vallvé presentation (2019)

1. Quality solution (engineering & components)
2. Metering concept
3. Procurement & logistics
4. Operation and Maintenance

In addition, economy regulatory framework and policies are fundamental factors in the project success, due to the institutional difference between economies.

Furthermore, Mr Vallvé described different business models of rural electrification such as: traditional Local Model (community based) with a government ownership and operated by the community; Private Model with entrepreneurs, encouraged by grant mechanisms or long term exploitation of service; and Utility Companies with a diversified electrical distribution companies.

However the most important legal framework is the acceptance of the rules by the community. Regulatory and legal framework is commonly not adequate for rural areas, for this reason it is necessary to define a local service within the

communities in-line with in-domestic policies and laws with flexibility from government authorities.

Examples of some insular access to energy projects: PV individual solar kits in Kiribati, Pacific Ocean

This project has a road map of 7 key issues:

1. Design the programme according to local needs. With local input determining overall objectives, user energy needs and user willingness/ability to pay.
2. Adequate institutional and delivery model, which assures long term sustainability and reliable service, understanding institutional and legal framework.
3. PV kit design. It was necessary to do a robust and simple design, without user access to components or open wires. In addition, PV charge controller and battery in one single closed box, adapted to community needs and willingness to pay.
Reliable PV charge controllers are a crucial element to protect the most expensive element: the battery. In this project, the charge controllers were manufactured and repaired on the island, which was the first industry that the Island ever had.
4. Avoiding overuse of the equipment.
5. Intensive training programmes, with users trained towards a PV culture, through training of community field technicians and local trainers.
6. Regular monitoring of operations.
7. Battery recycling.

Island RE-based access to electricity project in Galapagos Island, Ecuador

In this project the community was engaged in the civil works building their own infrastructure. A more comprehensive program approach focused on more than electricity services such as, solar cookers or egg hatchers. The technical note of this project is:

Table 12

Galapagos Island project Technical Note

| | MGS3 | GFI-ca | MGS1 | MGS2 |
|-------------------------|----------------|-----------------|----------------|----------------|
| N° of clients | 55 | 2 | 2 | 2 |
| Available energy | 150 kWh/day | 1,65 kWh/day | 8,8 kWh/day | 8,8 kWh/day |

| | | | | |
|---|---------------------|--------------------|---------------------|---------------------|
| Renewable percentage | 70% | 100% | 100% | 100% |
| Photovoltaic generator | | | | |
| PV Capacity | 18,000 Wp | 400 Wp | 1,800 Wp | 2,100 Wp |
| Wind turbine | | | | |
| Nominal capacity | | | 500 Wp | |
| Battery | | | | |
| Accumulator type | Tubular Pb-Acid | Tubular Pb-Acid | Tubular Pb-Acid | Tubular Pb-Acid |
| Capacity (C100) | 288 kWh | 5,8 kWh | 43 kWh | 43 kWh |
| Voltage | 48 V | 48 V | 48 V | 48 V |
| Autonomy | 4 days | 4 days | 4 days | 4 days |
| Inverter | | | | |
| Output voltage | 120 CA sinusoidal | 120 CA sinusoidal | 120 CA sinusoidal | 120 CA sinusoidal |
| Nominal potency | 21,6 W single-phase | 240 W single-phase | 3,6 kW single-phase | 3,6 kW single-phase |
| Demand and efficient energy use management | | | | |
| Single-phase distribution | | | | |
| Service quality | 120 V C.A 60 Hz | 120 V C.A 60 Hz | 120 V C.A 60 Hz | 120 V C.A 60 Hz |
| Power meter-dispenser | 1 per connection | 1 per connection | 1 per connection | 1 per connection |
| Peak current | 15 A | 4 A | 15 A | 15 A |
| Counting capacity | 100 MWh | 100 MWh | 100 MWh | 100 MWh |
| Public lighting (32 street lights) | | | | |
| Type | s.a.p. 70 W / 46 W | | | |
| Auxiliary generator set | | | | |
| Nominal potency | 60 kVa | | | |
| Efficient appliance | | | | |
| CFLs OSRAM 20 W | 370 | 7 | 11 | 12 |
| CFLs OSRAM 15 W | 76 | 5 | 7 | 12 |
| Electrolux freezer | 14 | | 1 | 1 |
| Electrolux refrigerator R32 | 6 | 1 | | |
| Electrolux freezer | 14 | | 1 | 1 |

Source: Xavier Vallvé presentation (2019)

Island village MSG in Monte Trigo, Cape Verde.

This project benefits 56 families in the community. Mr Vallvé highlighted that the PV modules were installed over the school roof in order to provide shadow to the students. These modules electrified the local school, health centre, street lighting and one ice making machine which added value to the local fisherman’s work. Other important aspects were the added value created with the engagement of the community in the construction and maintenance of the equipment. In order to have a low tariff in relation to the community salary, local members were trained to do the maintenance of the infrastructure. The technical aspects of this project are:

Table 13
Monte Trigo project Technical Note

| Category | Energy Daily Allowance (Wh) | Power limit (kW) | Max. “Store” capacity (EDA) | Recommended Monthly Fee (€) |
|----------|-----------------------------|------------------|-----------------------------|-----------------------------|
| T0301 | 825 | 0.55 | 6 | 11.52 |
| T0401 | 1,100 | 0.55 | 6 | 14.58 |
| T0602 | 1,650 | 1.1 | 6 | 21.12 |
| T0802 | 2,200 | 1.1 | 6 | 27.64 |
| T1203 | 3,300 | 1.65 | 6 | 40.30 |

Source: Xavier Vallvé presentation (2019)

Lessons learned

Mr Vallvé presented the classic problem of energy access question:

How can we ensure the longevity of the project?

There are robust technologies to supply energy to all communities; however, are there social mandates to support these technologies and their management?

One of the problems is that most of projects are under the local Ministry of Energy, and this can be good as well as bad, because they often have an energy policy and vision which is not comprehensive enough to understand local context.

For Mr Vallvé we must firstly aim to ensure energy access and after that, we should develop the service of energy access and energy efficient utilization. Therefore, is essential to understand how people use energy, comprehend their welfare/livelihood and use of high energy efficiency solutions to those realities. Also, most of projects are obsessed with the concept of kWhs, but for Mr Vallvé this it a concept that we must forget and we should focus on adding value,

understanding topics as water-energy, culture-energy or gender-energy nexus to reach development. In remote areas, energy services operator can be the catalyst for development, because its services can be bundling with other services, such as, water or communication.

To finalize, a sustainable service requires addressing not only technical but also political, environmental, legal, economic, social, and organizational aspects.

Rural Village Electrification to Improve the Quality of Life Based on Sufficiency Economy in Thailand

Presenter: Worajit Setthapun, Thailand

Dr. Worajit Setthapun currently holds a Director position at the Asian Development Institute for Community Economy and Technology (adiCET), Chiang Mai Rajabhat University. Her role is to manage the institute's 3 missions which are Academic Programs, R&D and Training in Renewable Energy and Green Technology, and Green Business Incubation. She also develops and manages the Chiang Mai World Green City (CWGC) which is the model city for renewable energy application and sustainable development. The CWGC aims to be the center for appropriate technology research, testing and deployment. In addition, she guides research direction for adiCET's graduate students and research staff. Dr. Setthapun research interests focused on Renewable Energy, DC Microgrid, Green Technology/Product, and Community Technology Transfer & Application.

Ms Setthapun started indicating that the “Rural Village Electrification to Improve the Quality of Life Based on Sufficiency Economy in Thailand” is a project executed by the Renewable Energy for Sustainability Association (RESA) and supported by the Energy Conservation Fund at Ministry of Energy of Thailand. Its main goal is to improve the quality of life for 3 rural remote villages' through microgrid electrification in Lamphun Province, Thailand. In addition, these communities were selected due to their restricted regulations on land area and its strong relationship with the local government in other collaborative projects related to sufficiency economy initiative.

Ms Setthapun explained the steps of this project. In first place, they worked on the community engagement and participation via public hearing with local agencies, local leaders and local beneficiaries in order to determine factors such as: the willingness of the community to participate, how they would help in the project and how much they were willing to pay. After this, there was a collaborative work to propose the area for installing the energy system in order to do the proposal submission for the ministerial funding. The technical notes of this project are:

Table 14
Galapagos Island project Technical Note

| Site | Community Context | | System | | | |
|------|-------------------|-----------|--------|---------|-----------|-----------|
| | Population | Household | PV | Battery | Generator | Microgrid |
| | | | | | | |

| | | | | | | |
|--------------------|-----|-----|------|------------------------|--------|--|
| Pha Dan | 542 | 184 | 102 | Lion 307.2 kW-hr | 50 kVA | 1,900 m with street lighting |
| | | | 19.8 | Flow Battery 100 kW-hr | | |
| Mae Sa Ngae | 329 | 90 | 102 | Lion 307.2 kW-hr | 50 kVA | 1,400 m with street lighting |
| Pong Pang | 328 | 92 | 102 | Lion 307.2 kW-hr | 50 kVA | 1,400 m with street lighting. Solar Pumping System |

Source: Ms Setthapun presentation (2019)

The PV panels were installed on the roof of public buildings like kindergarten, elementary and primary schools, cafeteria, activity building and restroom building. Most of these communities have isolated conditions such as, geographic difficulties in travel, transport and logistic, which complicated equipment and panel transport and installation. However, the community and its leaders volunteered for the transport and installation of the equipment, moreover they helped building the generator and battery housing.

Then, to connect houses, Ms Setthapun explained that the community families had a voluntary connection to the microgrid of 65 USD (approximately). In addition, the technicians from local colleges connected the systems and trained local government officers, teachers, electricians, leaders and citizens for the maintenance support and operation.

The system operation is limited by 500W to 2-3 unit per day for each household, with a payment of 0.20 – 0.33 USD/kWh. In order to maintain system sustainability, the community has different fee options, which allows maintaining the system, battery replacement and PV module replacement. In addition, through a Memorandum of Understanding (MOU) signed by local municipalities, the technical college and the community, the project tries to ensure and establish a capacity building action applying “train the trainers” concept and training key actors for the operation and maintenance of the microgrid systems.

Ms Setthapun stressed the importance of monitoring via researches to observe different kind of microgrid system effects on rural communities that could be: job creation, production cost, increase yield or income, live in harmony with the forest according to sufficiency economy concept, and improvement of life quality. This project build up the capacity of community’s education and technology transfer

via capacity building; training in technology and project development; awareness creation and community participation.

Smart Community: Sustainable Community via Integration of Renewable Energy & Green Technology

In the second part of her presentation, Ms Setthapun presented her workplace at the Asian Development College for Community Economy and Technology campus of Chiang Mai Rajabhat University, as an example of 100% renewable energy (during daytime) and smart grid building with PV and Biofuel. The campus project aims to be a real living learning park of different energy sources, with installations such as: a 700kW PV training center and community of solar farms for students; Energy efficiency building; Smart water system; Bio mass gasifier; Biodiesel generator; AC and DC microgrid; among others.

The goal of AdiCET Smart Community is linking renewable energy generation and distribution with different microgrid system projects, delivering smart load (home, farm office), smart operation center (universal monitoring system) and smart control (demand response based on machine learning). All energy items must be related with community linkage such as smart consumers and smart community integration (training in operation and maintenance of the system). This community has 2 flagship projects: Smart Community Microgrid and Zero Waste – BioEnergyCycle.

Lessons learned

To conclude, Ms Setthapun shared the lessons learned in these projects, which are:

- Appropriation of technology based on community needs and resources
- People's participation in all steps of project development & implementation
- Shared ownership
- Integration with social and economic development
- Create awareness
- Share best practices
- Realize demonstrations sites
- Business and market driven model

In addition, the lessons learned in her 2 project of smart community development through renewable energy & green technology & management are:

- Smart Community Microgrid: Importance of renewable energy, energy production & consumption management in microgrids with different energy sources.
- Zero Waste - Bioenergy Cycle: Waste is an underrated and important source of energy that is available to explore.

Stand-alone PV in Huapi Island: Where the Community Spoke Out

Presenter: Javiera Inostroza, Chile

Javiera Inostroza is a natural resources engineer specialized in public policy and management, poverty and territory. She has worked in rural energy projects for almost all her professional career, both in academic and public sector. At the Ministry of Energy she has been working on public policy analysis and geographic information system analysis of energy access.

Ms Inostroza introduced her presentation highlighting the importance of this project as a successful collaborative work experience between the community and the Ministry of Energy. This project had several difficulties in its planning and implementation phases; however, this presentation show how it succeeded and which were the lessons learned.

Huapi Island is the first “solar island” without diesel generation backup of Chile, where more than 150 families receive permanent electricity supply for the first time. Back in 2004 the local government worked on a rural electrification project which concluded in 2007 with diesel microgrid electrification in the island; nevertheless, at 2014 the island’s community was against diesel microgrid, asking for a sustainable solution. The same year, the local government asked to the Ministry of Energy for a new project based on PV technology and due to this requirement a lot of experience and lessons learned appeared. Following are some of the outcomes identified:

Lesson 1: Working effectively with a rural community needs continuity

The Ministry of Energy went to the island and discussed with the community that the most suitable solution was the installation of stand-alone PV and batteries system for each family. Afterwards, in order to build trust with the community, Ministry’s staff visited every house in the island, collecting data and explaining the project, its significance and difficulties. The three main institutional players were:

- Ministry of Energy: Focused in the technical design of the project and advising in the most suitable solutions. It considered a minimum generation of 65 kWh per month with a 2.7 kW of installed capacity of the system. In addition, it was proposed the business and management model.
- Local Government (Municipality): It started the relation with the community, initiated set-up of the management model and managed permissions.

- Ministry of Social Development: Check if the project was developed under current methodology, prepare socio-economic evaluation and managed land's permissions.

Lesson 2: People deserve information even if it seems that is beyond the level of knowledge we think they have

Ms Inostroza explained that the next step was the tender process, managed by the local government and supported by the Ministry of Energy in technical issues and bidding rules. However, even if the process was successful, the community felt mistrust about the decision made and asked what company was chosen, how the decision was made, why they wasn't inform about the decision before, why they weren't part of the decision Moreover, the community asked more technical questions such as, why were batteries and PV panels Chinese, why was chosen an inverter of only 2 kW of capacity , why couldn't they use tools as drillers, why the project developer were saving money (MMUS\$ 2.6 approved v/s MMUS\$ 2.3 contracted).

After this, the priority was to work on with the community all the misconceptions and mistrusts through several meetings between it and the contractor. For this reason, the main lesson learned is that the community needs clear, accurate and well-timed information, which is a main key for a successful and sustainable project.

Lesson 3: Conflicts among people are unavoidable, the key is how we manage them.

The next step was the construction, which was challenging because the contractor had to set up a good logistic plan to build more than 140 systems at the same time in order to avoid struggles among the community. Although the tender process didn't evaluate the time limit for the project, the contractor offered a construction period of 156 days. During construction, new problems begun when new families, which were not considered in the project's design, requested to be part of the project. Local government also asked for new systems. This caused a delay and an extension of 100 days of the due date for the project and dissatisfaction of the community.

In this scenario, Ministry of Energy, Contractor; Resident Engineer; Municipality; On-field Advisor and Local Community receive different information and requirements from beneficiaries. New families that wanted to be part of the project spoke to the on-field advisor, others went directly to the mayor's office and a few of them talked to the workers at the head of the community. This was a source of disagreement among the community. Several families were discontent because not everyone was included in the project due to budget restrictions.

In order to solve this, Ministry of Energy coordinated all stakeholders and calm down the environment. This impartial role enables to understand the interests of all stakeholders and helped them to clarify differences and came out to a solution.

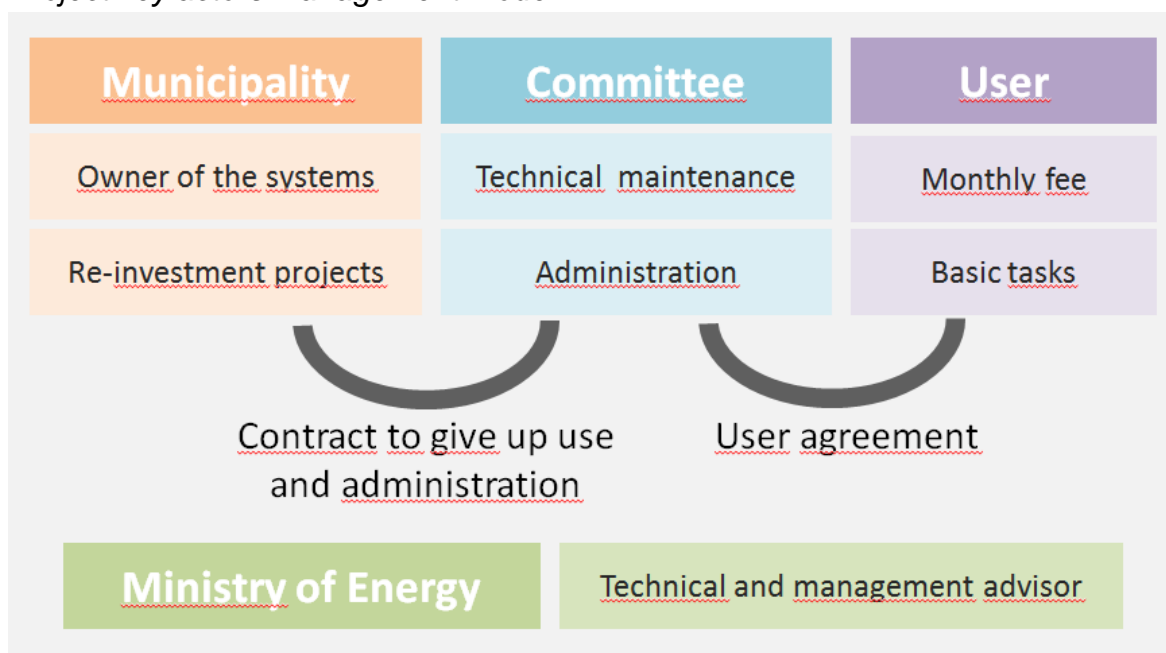
Lesson 4: The organization of a rural community is neither easy nor automatic just because they share a need

In order to stablish correctly a management model, meetings with the community to explain and solve questions were needed. Moreover, with the community’s participation it was decided that the tariff would be a fixed monthly fee. Due to that, people who always live in the island should not pay more than people who goes to the island only on weekends or in some seasons.

Ms Inostroza described that with the participation of the community, in meetings with government and facilitators, it was well informed about the responsibilities, duties and rights of the committee of users.

Giving them the opportunity to share opinions and experiences, helped the adoption of management model proposed and their acceptance of \$4.5 USD monthly tariff. The management model implemented in this project is:

Figure 4
Project key actors management model



Source: Javiera Inostroza presentation (2019)

In order to support local needs, the Ministry of Energy supported the committee with:

- Open bank account
- Set up payment receipts

- Taxes payment
- Contact with external technicians

As a result of this model, the payment rent of the community is **98%**.

The lines of improvement for this project are: work in contractual conditions with the operators and improve their technical capacities; fund payment to the head of the committee; and modernization of the administration and accountability of finances.

To finalize, Ms Inostroza highlighted that community organization is not easy, especially in a project which provides an important service for the community. It involves money transfer and responsibilities for everyone and also managing new technologies, which always can be hard for isolated communities. Even if people know that there is a need of a holistic approach for his project, the community is not a passive player and it is needed to work and look it like that. The whole process taught us that if you want a sustainable project, the community is the main character of it.

Wrap-Up Session C

Wrap-up groups: Session C

In order to exchange ideas and experiences from the session's presentations as the same as session B, four working groups composed by speakers and participants were formed. Guided and supported by a facilitator each group worked identifying and discussing key aspects of sessions during two main activities.

1. In the first activity, under the session scope "Obstacles and Challenges for Sustainable Solutions in Remote Locations: Social, Cultural and Community Issues" the groups analyzed key actors involved in energy access projects. The main objective was promoting discussion among experts in order to exchange several scopes, learning and points of view.

Firstly, each group identified relevant actors and its interests in the session topic, to subsequently determine how they can contribute or block up energy access projects. After, every group presented briefly their discussion and most relevant conversations.

The most relevant actors identified in relation to social, cultural and community issues were local leaders, both formal and natural, religious leaders or organizations, teachers, beneficiaries of the solution, local operator or technician, local organizations and small business.

The follow table summarizes how these actors can collaborate or block up the development of the projects.

Table 15

Key actors identified and their contribution or blockage to the projects

| Key actors | Contribute | Block up |
|----------------------|---|---|
| Local leaders | The local leaders can influence the project in all the stages both positively and negatively. In the first case, the natural leaders can lead by example and help in coordination tasks and formal leaders have the power to influence with short time results. | On the other hand, leader's influence can be in opposition to the project, harming it from the design until implementation. In addition, the fear of local leaders of losing control and reputation mobilize them in favor or against the project. Religious leaders in particular could cause divisions among the community, for example, putting against the preservation of traditions and the new solutions |

| | | |
|---------------------------------------|--|---|
| Teachers | Teachers can be a positive influence for the acceptance of the project and can collaborate training and managing funds, for example. | |
| Beneficiaries | Can create awareness of the solution and facilitate engagement | On the other hand, Their concerns about payment can be an obstacle. Also, if electricity is not a priority for them, they could oppose the project. |
| Local operators or technicians | | These actors could have conflicts with external experts and with the community that can affect the success of the project. |
| Local organizations | Can provide the framework for the project and support the development of the community. Small business were indicated as an important actor because can share benefit or profit with the community and provide employment. | |

2. In the second activity, working groups determined the advantages and obstacles for social, cultural and community issues in four critical variables in energy access projects in remote locations: relevant context, project characteristics, strategies and needs for innovation and learning. After this, groups discussed and selected which advantages and obstacles were key topics in each central concept, presenting brief conclusions among all participants.

In relation to social, cultural and community issues, the next table resumes the main advantages and obstacles identified by the participants, regarding relevant context, project characteristics, strategies and needs for innovation and learning.

Table 16

Advantages y obstacles regarding critical variables in energy access projects, in relation to social, cultural and community issues.

| Variable | Advantages | Obstacles |
|-----------------|-------------------|------------------|
|-----------------|-------------------|------------------|

| | | |
|---------------------------------------|--|--|
| <p>Relevant context</p> | <p>Community cohesion and the existence of a supportive culture are highlighted elements, along with the ethnicity of the population. Also, the education level is a main factor and how much they support (or not) the technology.</p> | <p>Misinformation or misunderstanding can be an important barrier and the diversity of languages can improve those barriers. Also, the property of land can be an obstacle because is a base requirement for energy access projects in some economies. There could be political pressure or people could have their own agenda that influence negatively projects.</p> |
| <p>Project characteristics</p> | <p>The first element is the matching between project and community needs and energy demands. Also an appropriate or user friendly technology can be an advantage for the success of the solution, along with the participation of the community throughout the project, which includes knowledge transfer.</p> <p>Another characteristic than can be an advantage is to consider the economic and environmental impact along the life cycle of the project.</p> <p>Finally, projects that are inter-ministerial can develop more integral solutions.</p> | <p>In contrast, uncontrolled increase of consumption can become an obstacle. Also the payment for electricity service can be an issue depending on people's willingness to pay. Finally, legal responsibilities regarding the projects and the lack of consultation to the community during the process can become obstacles to consider.</p> |
| <p>Strategies</p> | <p>As it had been said before, including the community from the beginning of the project is the main strategy for success. This should include participation on decision making process, access to transparent and clear information, regular meetings.</p> <p>Also, a pilot demonstration can be a good strategy for community engagement. In relation to the project itself, clear roles and</p> | <p>Imposed solutions and overestimate local capabilities were described as main obstacles for community involvement.</p> |

| | | |
|---|--|--|
| | <p>responsibilities was pointed out again, along with clear budget and follow up of project results.</p> | |
| <p>Needs for innovation and learning</p> | <p>It was point out the need of sharing international experiences in rural areas and create, for example, a book of lessons learned that could be useful for future projects. Also, this could lead to user training material or user guides. Moreover, a proposal was to create some sort of bank of materials for community's education and information.</p> <p>Finally, it was proposed the need to think beyond electricity innovation and to integrate cultural values in energy access projects.</p> | |

Workshop Conclusions Session

Considering the experiences and lessons learned described by the expositors and the key actors and variables identified in the work groups, there are presented below the main conclusions and proposals discussed.

Conclusions Session B

In the first place, in relation to the actors involved in the development of electrification projects in isolated areas, the most relevant that were identified are: the communities, the national and local governments, financing institutions, academy and technical teams. Specific roles and functions were defined for each one of them as part of the necessary chain of work and collaboration for projects success.

The role of governments regarding regulations and management issues was highlighted, which is also a main factor for economic viability of the projects. It was pointed out the need for long term policies and a changing focus to program formulation instead of individual projects, addressing technical and financing aspects in order to ensure the continuity and sustainability of the projects and contemplating their whole life cycle including operation and closure. In this way, there could be a constant monitoring, report and verification of the short and long term results.

In addition, work within programs could facilitate the provision of technical assistance and permanent support for the communities.

In relation to financing resources for systems operation, it was proposed the creation of cross subsidies with the other, bigger, electrical systems existing in the economies, which could reduce significantly the costs for mini and microgrids.

A final and relevant conclusion is that the academy sector has a very important role for reducing the energy access gap, promoting and transferring knowledge, developing new technical solutions and methodologies than can effectively incorporate social and cultural components.

Conclusions Session C

One of the main conclusions regarding this session is that it is indispensable for rural electrification projects to consider with due anticipation all of the social and cultural factors of the communities and their territories.

According to the participant's experiences, it is necessary to know and adapt the projects to the different religious contexts, worldviews, beliefs and mores of the communities, along with their particular bond with nature and all of the preconceived ideas they have about the technologies. In many occasions, the myths or prejudices about the energy projects have been great obstacles for their development, which is why knowing the local culture will always be of great help for project success.

Besides, it is also fundamental to consider the political and economic context of the communities because they could deepen the isolation conditions in which

they live and or could jeopardize the projects sustainability. In this sense, expositions situated in communities with high poverty levels, low schooling rates and lack of basic services, were key to analyze risk factors for the projects.

Also in relation with the local context, it was highlighted that developing projects with organized communities and strong and representative leaderships can be a great advantage because the communication is much more fluid and agreements easier to establish. Regarding this many participants shared successful experiences involving community participation in management models, their involvement throughout all stages of the projects and defining fees according the willingness to pay of the beneficiaries. In order to achieve this, technical training and education, along with clear rules and roles throughout the process are fundamental.

On the other hand, it was stand out in several times the relevance of take advantage of local competences and abilities for the construction and operation stages of the projects, which can also provide work and training opportunities for the community.

Another reiterated issue among the work groups was the importance to consider domestic, self-supply and productive energy needs of the communities in order to design energetic solutions really appropriate that can satisfy all the energy demand. This was described and highlighted as a critical factor to consider in the design stage.

Finally, there came up some specific and innovative proposals to contribute to energy access goals:

- Create an academy for rural electrification opened to the stakeholders interested in the project development and problematics in this kind of initiatives.
- Compile and systematize experiences and lessons learned about rural electrification in isolated areas which could be in a book, web page or other format.
- Develop and share more training material and guide for users that can facilitate projects implementation and community appropriation.
- Create an open repository of educational and informative material for rural communities about renewables energies, technologies used to provide electricity, costs and tariffs and sustainability among other issues.

Technical Site-Visit Summary – Tac Island, Chiloé

On 11 October 2019, a technical site visit was organized to a small hybrid plant (Diesel, Wind and PV) in Tac Island owned by SAESA. About 17 participants participated in this visit.

In order to reintroduce renewable energy to the Island, the Regional Government of Los Lagos, the Chilean Ministry of Energy and the company SAESA agreed in 2016 to improve the power plant, introducing renewables as the primary energy source and minimizing the use of diesel.

The project jointly funded between the company and the Regional Government had an investment of USD 500,000 for the installation of three wind generators with a total of 25kW nominal power, a 40kWp photovoltaic plant, storage capacity of 450kWh in batteries, and a modern control system that minimizes diesel consumption.

The new power plant has been generating electricity since June of 2018, achieving high rates of renewable energy penetration. More than 100 households of Tac Island benefit from this cleaner and reliable energy source.



ANNEX 1: Wrap-up Groups Session 2

In order to discuss presentations content after every session, speakers and participants formed four wrap-up groups to exchange ideas and experiences from the session's discussion. Wrap-up groups were formed and guided by a facilitator in order to work in different tasks, helping groups to identify and discuss key aspects of sessions. The following part will resume the elements identified by every group in keywords via flowcharts and mind maps:

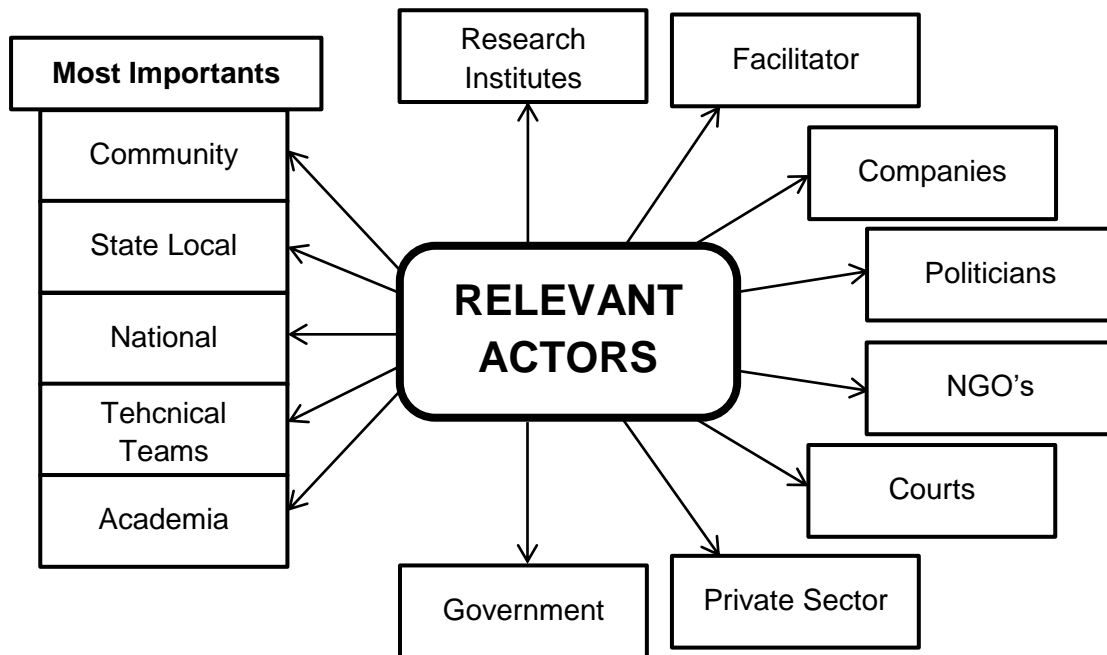


Groups:

| Group | Participants |
|-------|--|
| A | Cary Bloyd; Mareena Mahpudz; Pablo Tello; Fernando Lanas |
| B | Dalia Patiño; Julio Cuadra; Đinh Thanh Son; Roberto Dunsmore |
| C | Paul Rodden; Jacqueline Sanchez; Renato Oña; Sebastián Arroyo |
| D | Worajit Setthapun; Xavier Vallvé; Alejandro Contreras; Javiera Inostroza |

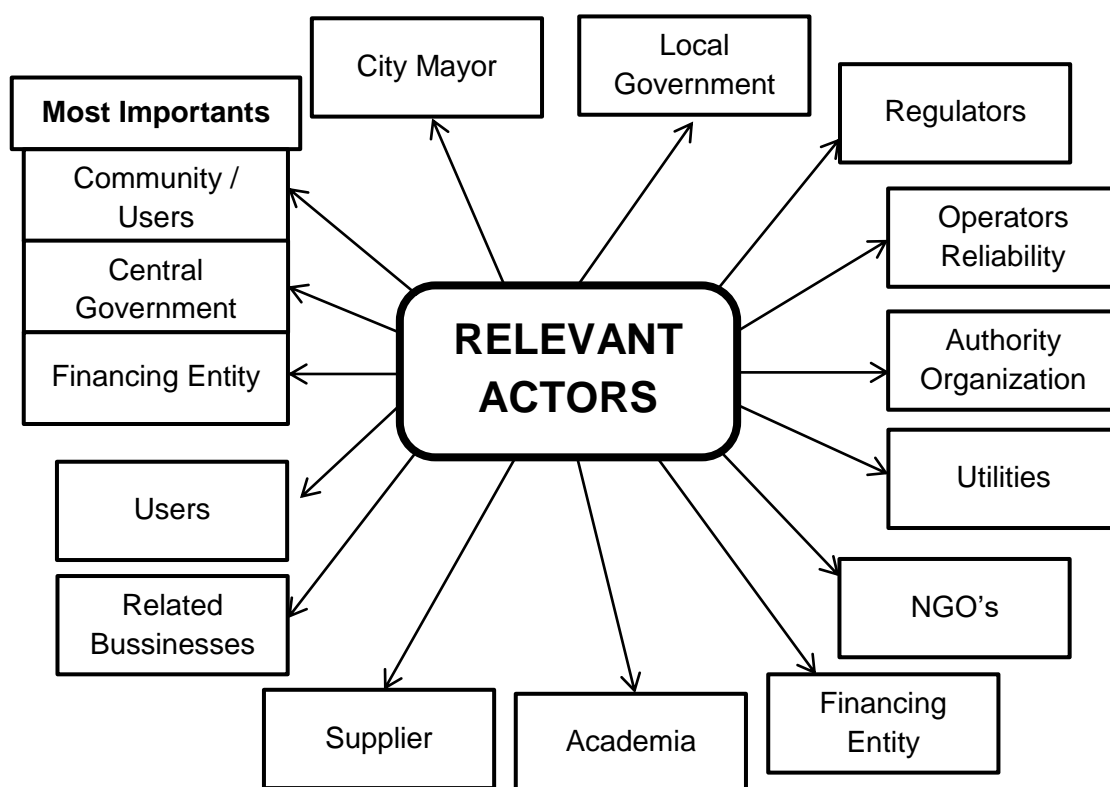
Relevant actors, how do they collaborate and how do they obstruct energy access projects:

Group A



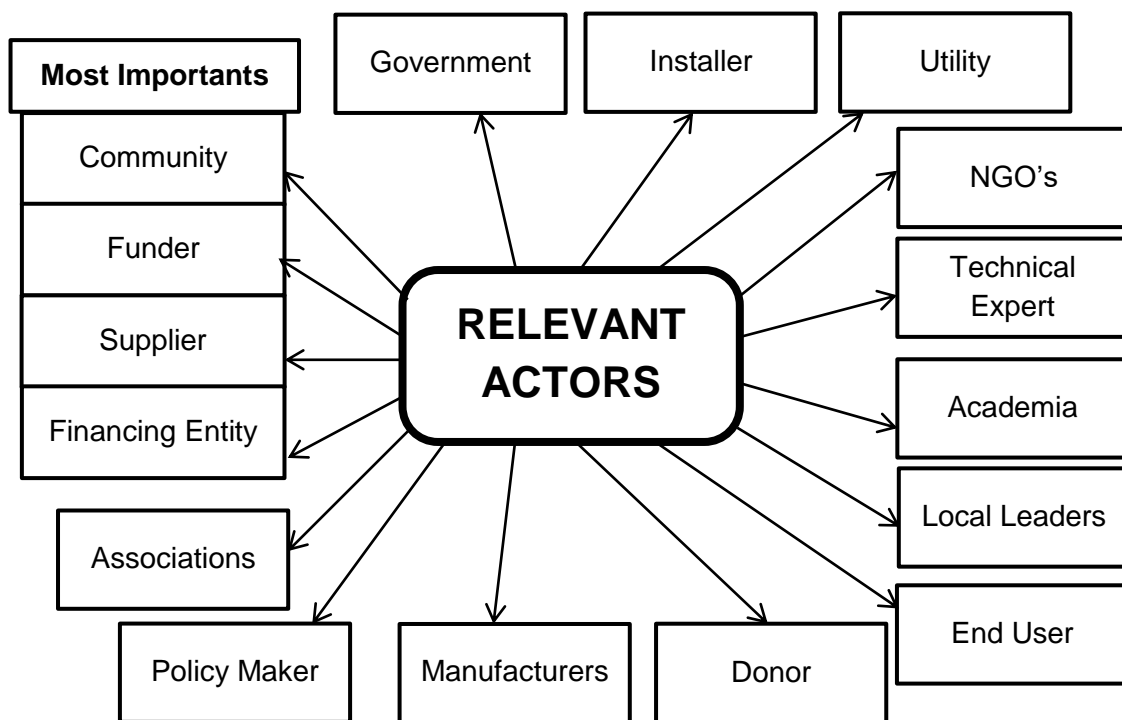
| Relevant actors | Collaboration | Obstruction |
|------------------------|---|---|
| Community | Define needs and provide local support | Oppose project and construction |
| State Local | Facilitate work and authorise project | Project delaying |
| National Government | Fund and regulate | Longer time for paper work; limited resources and they do not see what is happening on the local ground |
| Technical teams | Quality and maintenance | Lack of local capabilities and incompetence of technical teams |
| Academia | Bridge in knowledge with a multidisciplinary team | Too academic with not enough practical experience. |

Group B



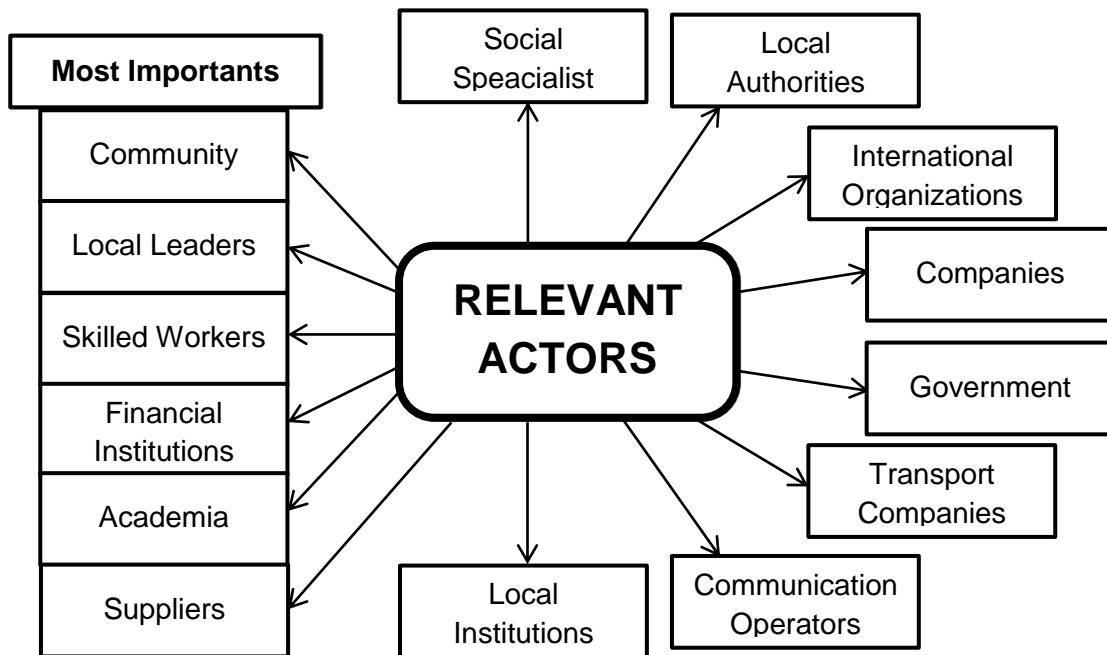
| Relevant actors | Collaboration | Obstruction |
|-------------------|--|--|
| Community / Users | <ul style="list-style-type: none"> • Provide land, labour, oversight, capital and vision (short, long term) • Decision making criteria about technology and tariff | <ul style="list-style-type: none"> • Deny access to land • Oppose to a technology • Rise the significance of risks and mobilize resistance against solutions • Ask for free services and refuse to pay |
| Local Government | <ul style="list-style-type: none"> • Local regulation • Technical/management support • Community engagement • Policies and regulatory framework | <ul style="list-style-type: none"> • Lack of regulation used as a barrier for permitting a new solution/technology |
| Financing entity | <ul style="list-style-type: none"> • Program design • Tech support/assistance • Funding | <ul style="list-style-type: none"> • Lack of sensibility to prices and up-front costs |

Group C



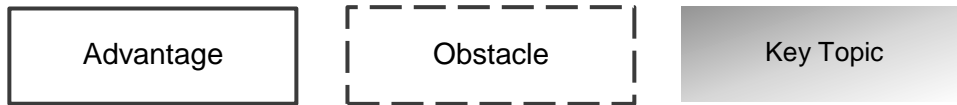
| Relevant actors | Collaboration | Obstruction |
|-----------------|---|--|
| Community | <ul style="list-style-type: none"> • Engaging and cooperation • Funding • Training, skill and experience • Regulation | <ul style="list-style-type: none"> • Opposition and high expectations • Cost of installation and short-termism • Poor quality • Bad policies |
| Funder | | |
| Supplier | | |
| Administrator | | |

Group D

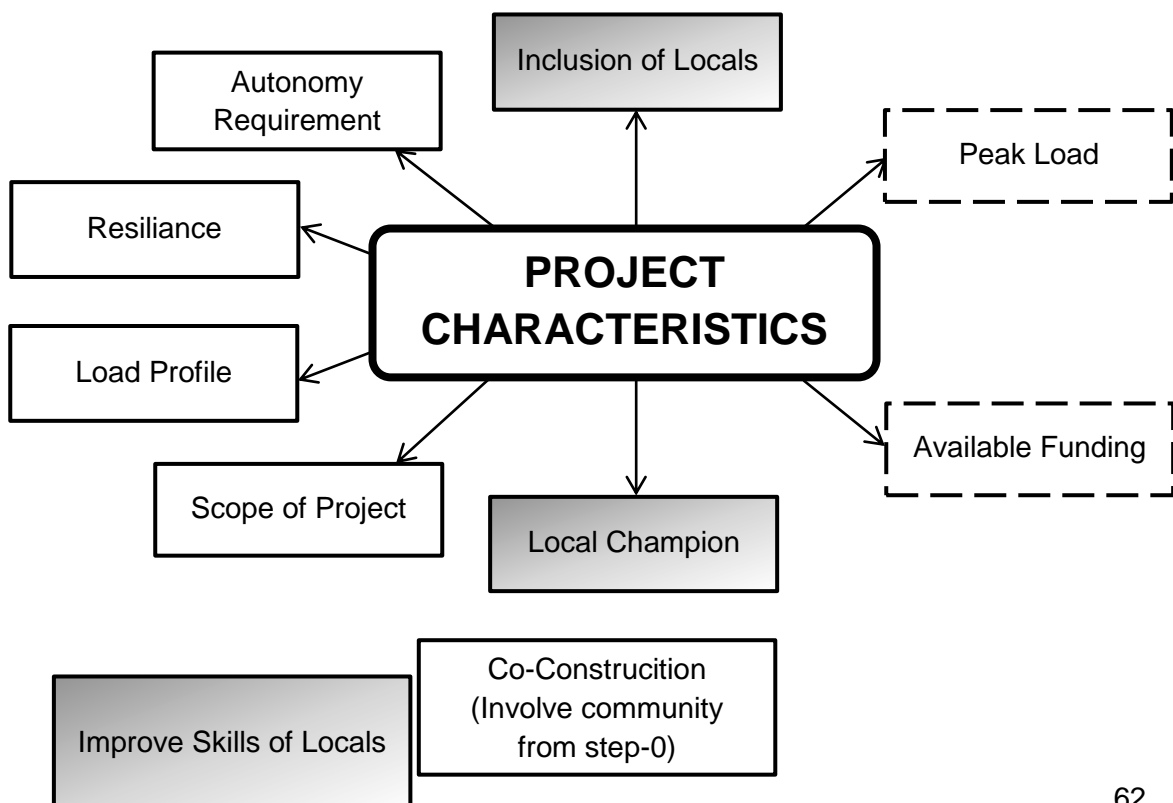
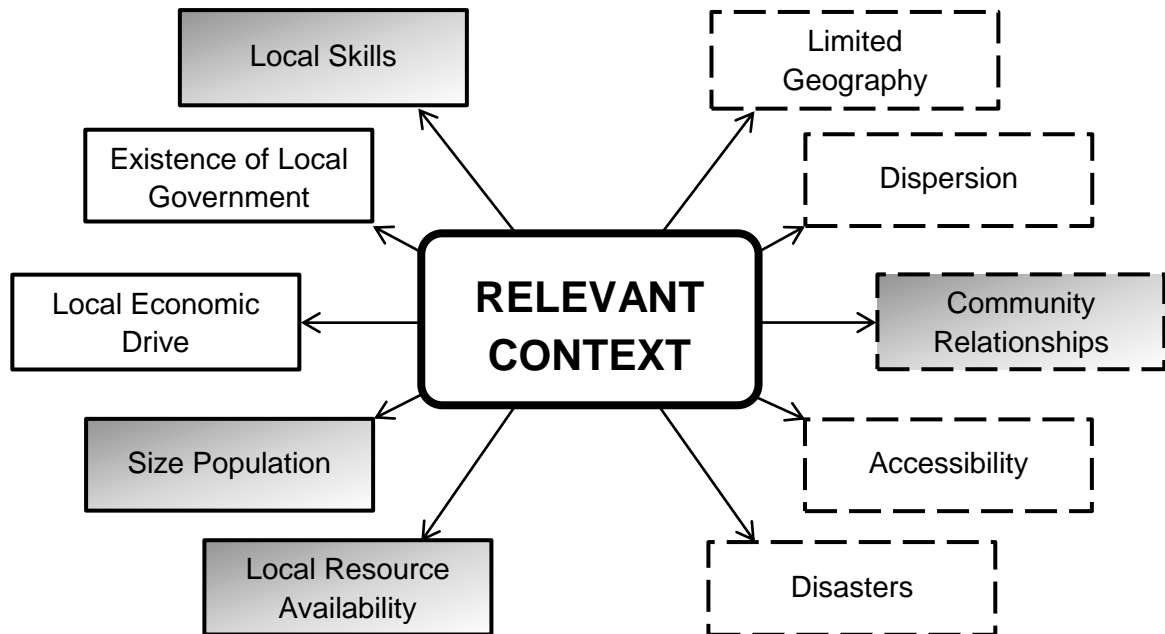


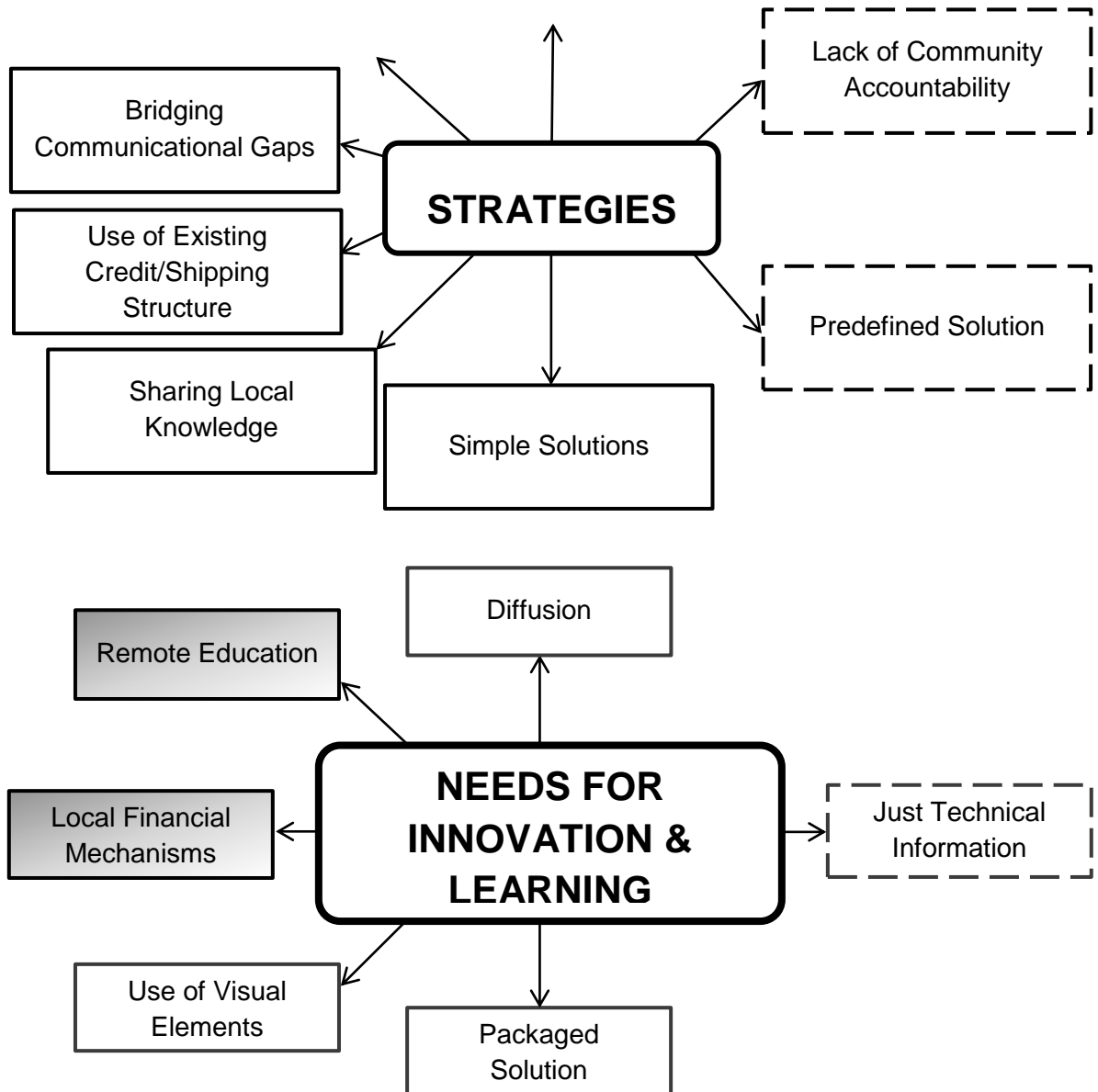
| Relevant actors | Collaboration | Obstruction |
|------------------------|--|---|
| Academia | <ul style="list-style-type: none"> • Provide new solutions and mediate tools • Give something • Support community motivate (natural leadership) • Funding • Feasibility • Experience implement | <ul style="list-style-type: none"> • Distort expectations • Internal conflict • Personal interests before community • Lack of understanding • Difficult requirements • Narrow minded • Mismatch between skills-tasks |
| Community | | |
| Local Leaders | | |
| Financial Institutions | | |
| Skilled Workers | | |
| Suppliers | | |

Advantages and obstacles: Relevant context, project characteristics, strategies and needs for innovation and learning:

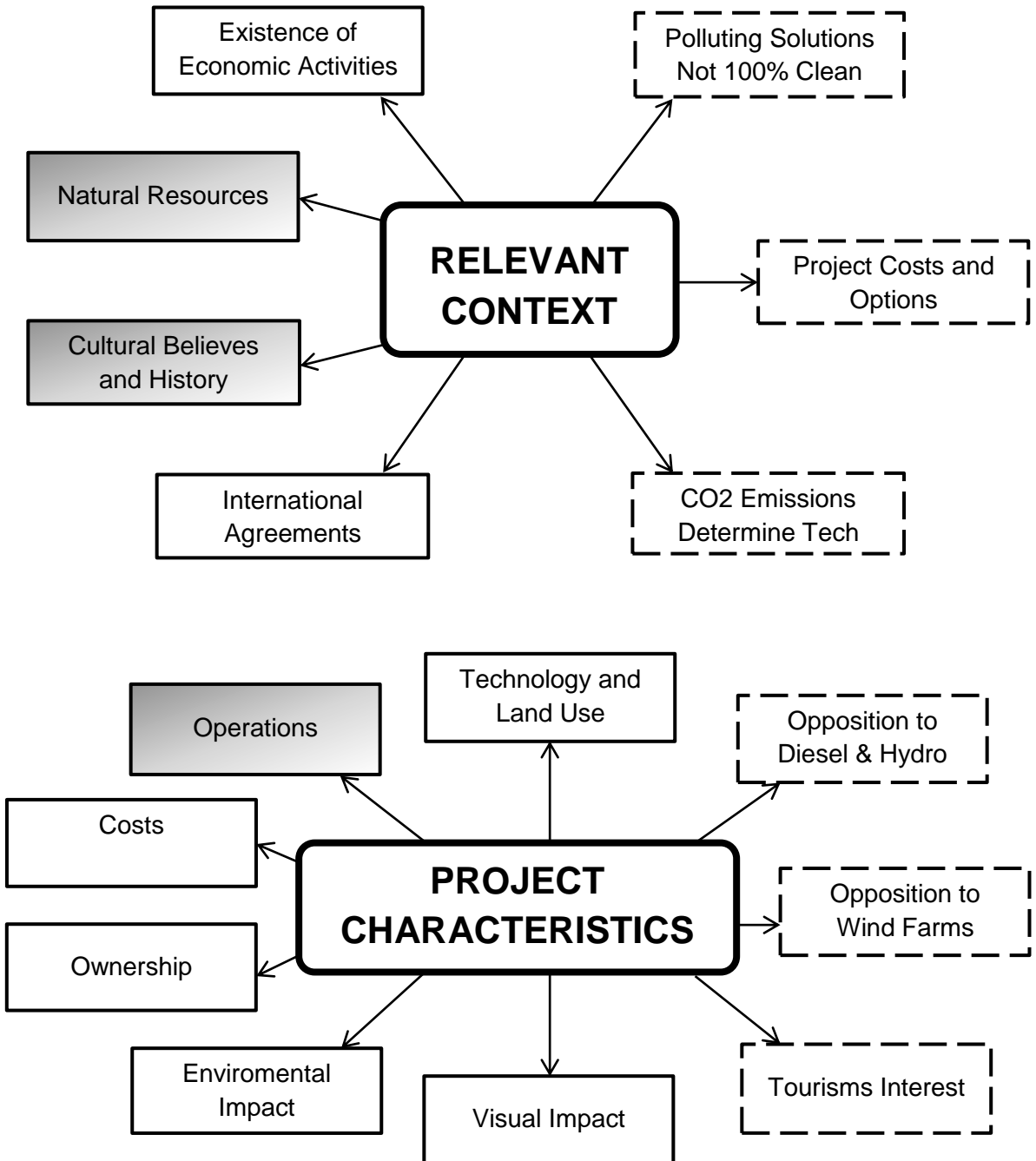


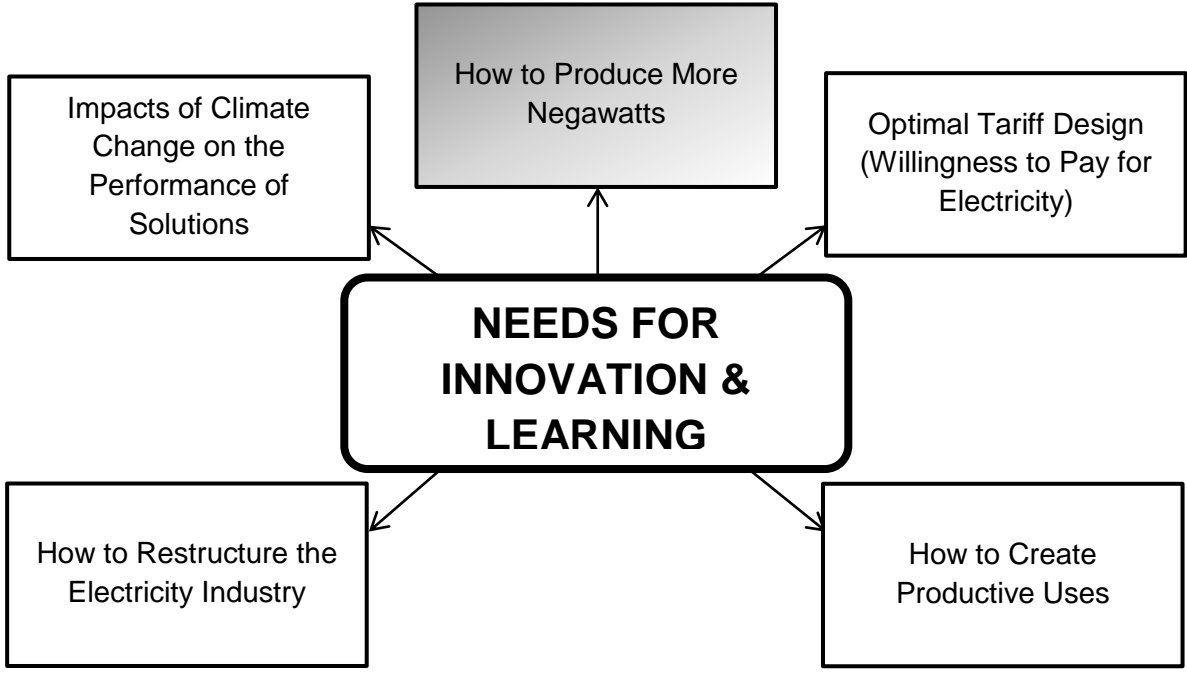
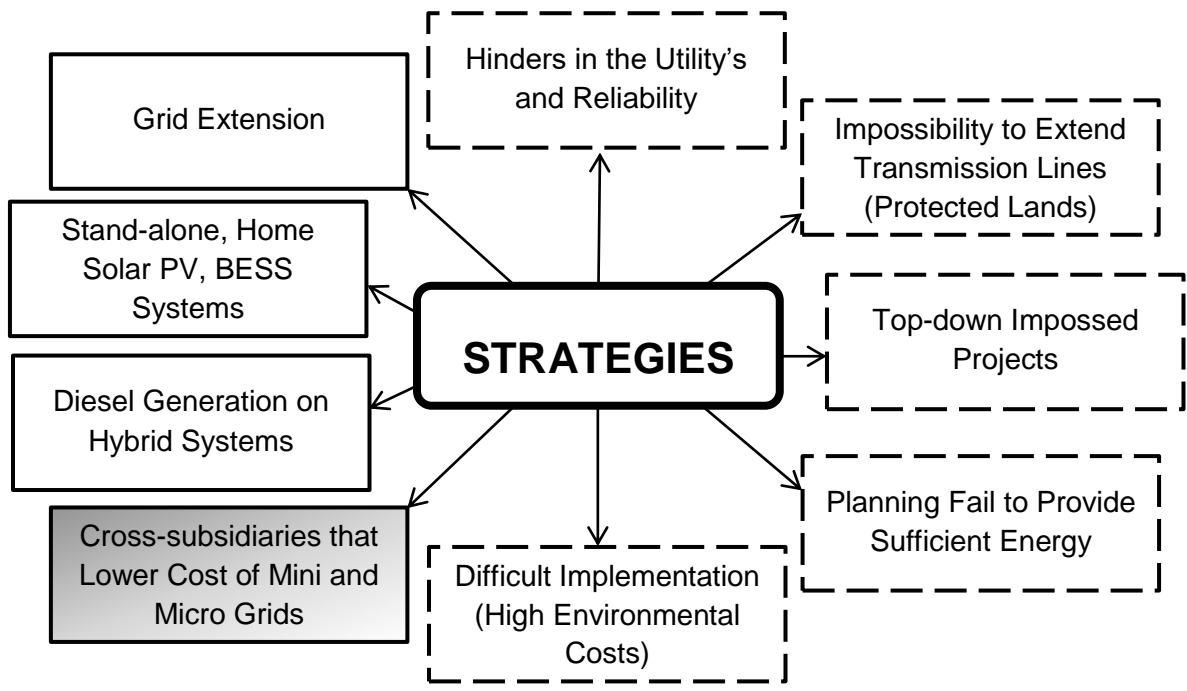
Group A



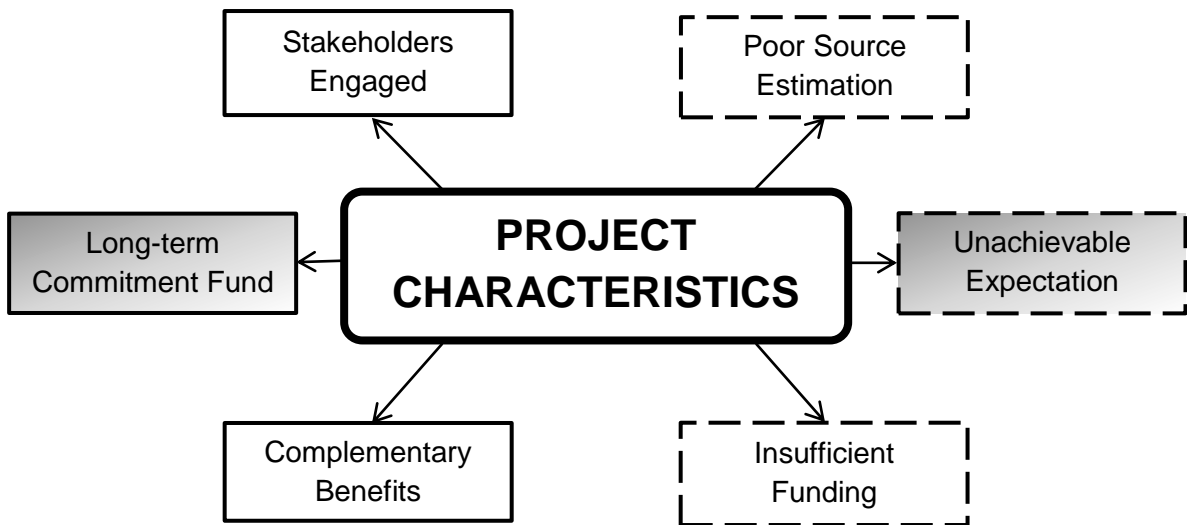
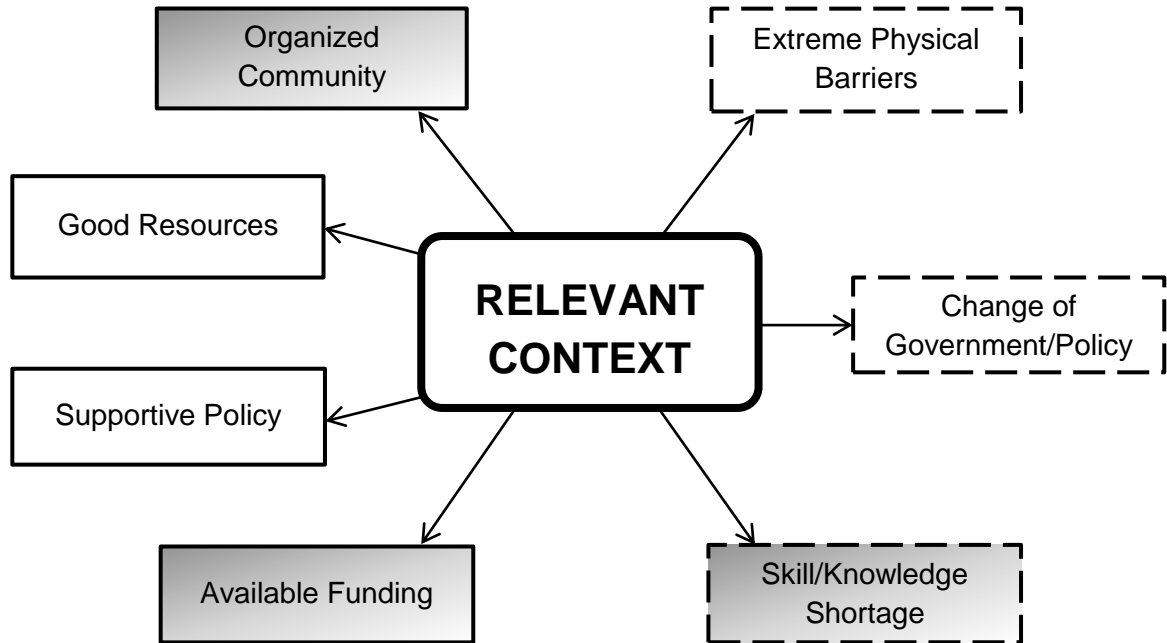


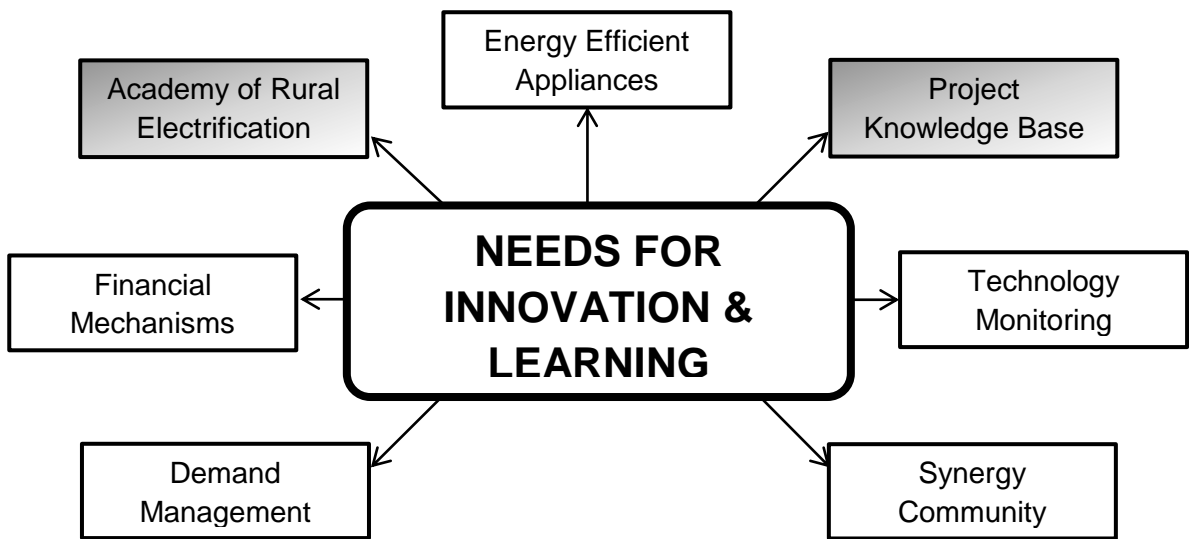
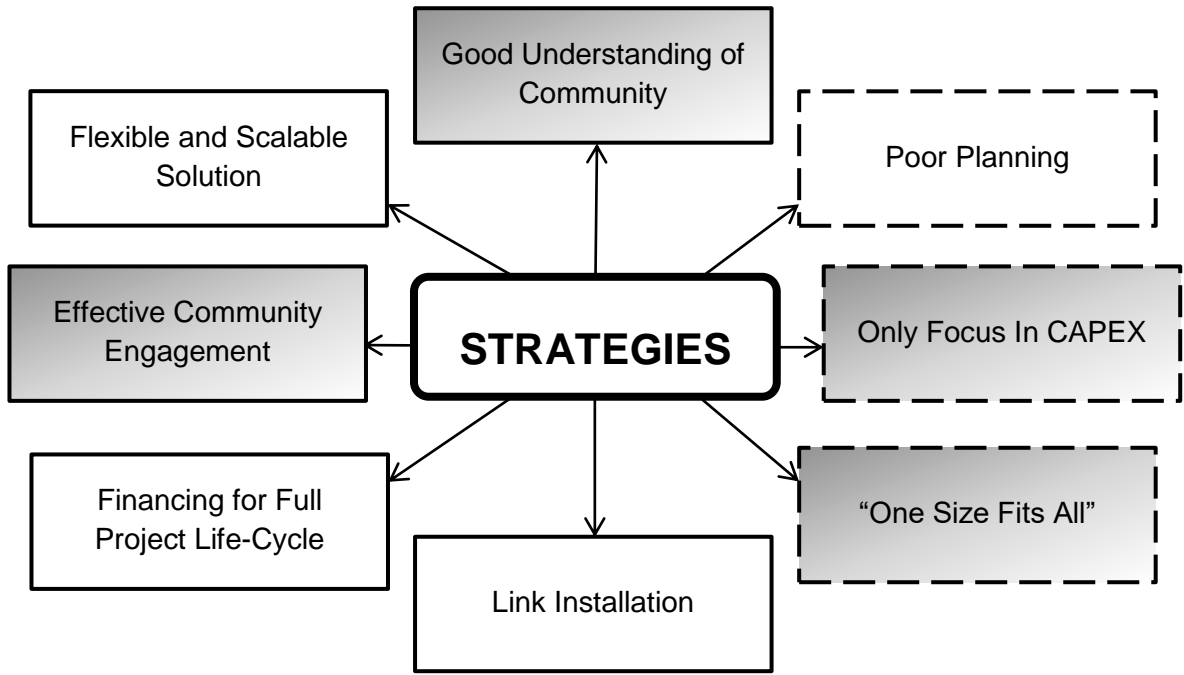
Group B

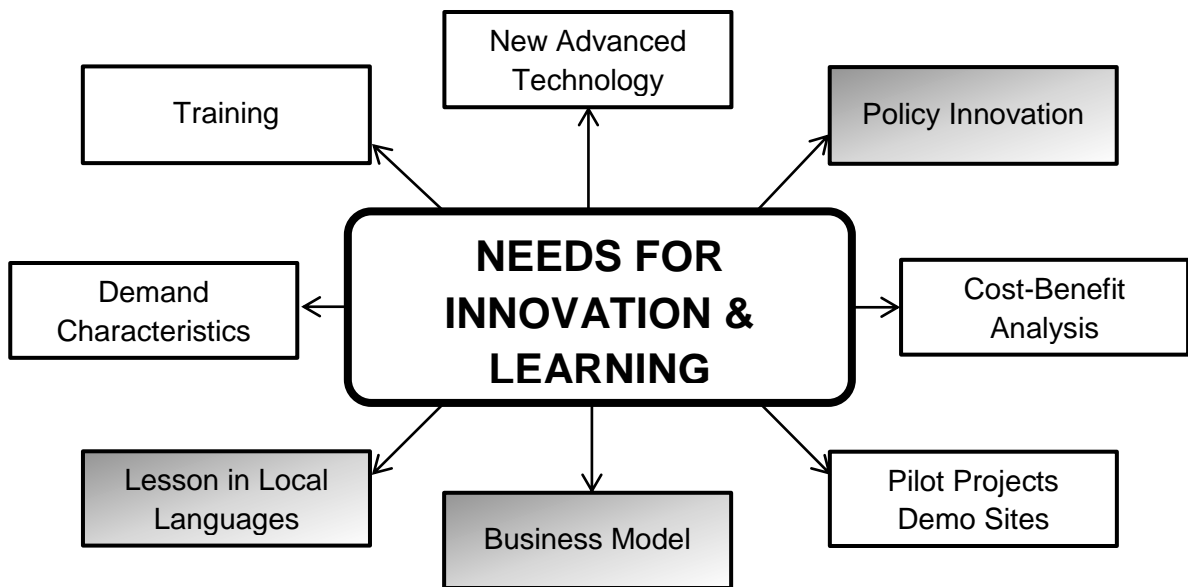




Group C







ANNEX 2: Wrap-up Groups Session 3

In order to discuss presentations content after every session, speakers and participants formed four wrap-up groups to exchange ideas and experiences of the session topic. Wrap-up groups were formed by a facilitator to work in different tasks, helping groups to identify and discuss key aspects of sessions. The following part will resume the conclusions of every group in key discussions via flowcharts and concept maps:



Groups:

| Group | Participants |
|-------|--|
| A | Cary Bloyd; Mareena Mahpudz; Pablo Tello; Fernando Lanas |
| B | Dalia Patiño; Julio Cuadra; Đinh Thanh Son; Roberto Dunsmore |
| C | Paul Rodden; Jacqueline Sanchez; Renato Oña; Sebastián Arroyo |
| D | Worajit Setthapun; Xavier Vallvé; Alejandro Contreras; Javiera Inostroza |

Relevant community actors, how do they work in favor, how do they interference and their interests:

Group A

| Community actors | Work in favor | Interference | Interests |
|---------------------------|--------------------------------------|--|-----------------------|
| Local leaders | Influential | Afraid of losing control and reputation at stake | |
| Transportation | | Possibility to increase the cost | |
| Public safety | | Wrong perception at the beginning | |
| Religion leader | Influential | Giving negative influence to local people | |
| Beneficiaries | | Worries about payment | Pay less, 24/7 energy |
| Local operator | | Conflict with the community | |
| Healthcare provider | | | 24/7 energy |
| School's principal | Children can influence their parents | | 24/7 energy |
| Local technical assistant | Conflict with external experts | | |

Group B

| Community actors | Work in favor | Interference | Interests |
|---------------------------|----------------------------------|-----------------------|--------------------------|
| Neighborhood Associations | | | Development of community |
| Ethnic leaders | | Preserve traditions | |
| Religious leaders | | Preserve traditions | |
| Teachers | | | More opportunities |
| Local-unofficial leaders | Can lead by example | Can oppose by example | |
| Political leaders | Short time results | | |
| NGO's & Funding agencies | Can create? community engagement | | |

| | | | |
|-------------------------|-------------------------------------|-------------------------------------|--------------------------|
| Small business owners | | | Profit |
| Government institutions | | | Development of community |
| Environmental groups | Own agenda | | |
| People | Can create awareness and engagement | Are not in rush to have electricity | |

Group C

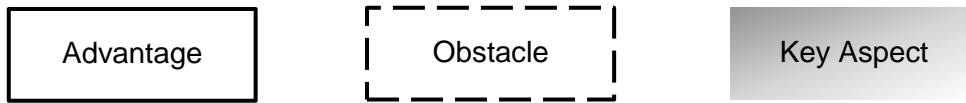
| Community actors | Work in favor | Interference | Interests |
|-------------------------|-------------------------|---------------------|----------------------|
| Natural leader | Power influence | Power influence | Influence |
| Political leader | Power influence | Power influence | Influence |
| Productive associations | Business shared benefit | | |
| Entrepreneur | | | Economic development |
| Technicians | | | |
| Exporters | | | |
| Teachers | Power influence | | |
| Religious leaders | | | |
| Gender leader | Empowerment | | |
| Shy ones | | | |
| Unions | Support livelihoods | | |

Group D

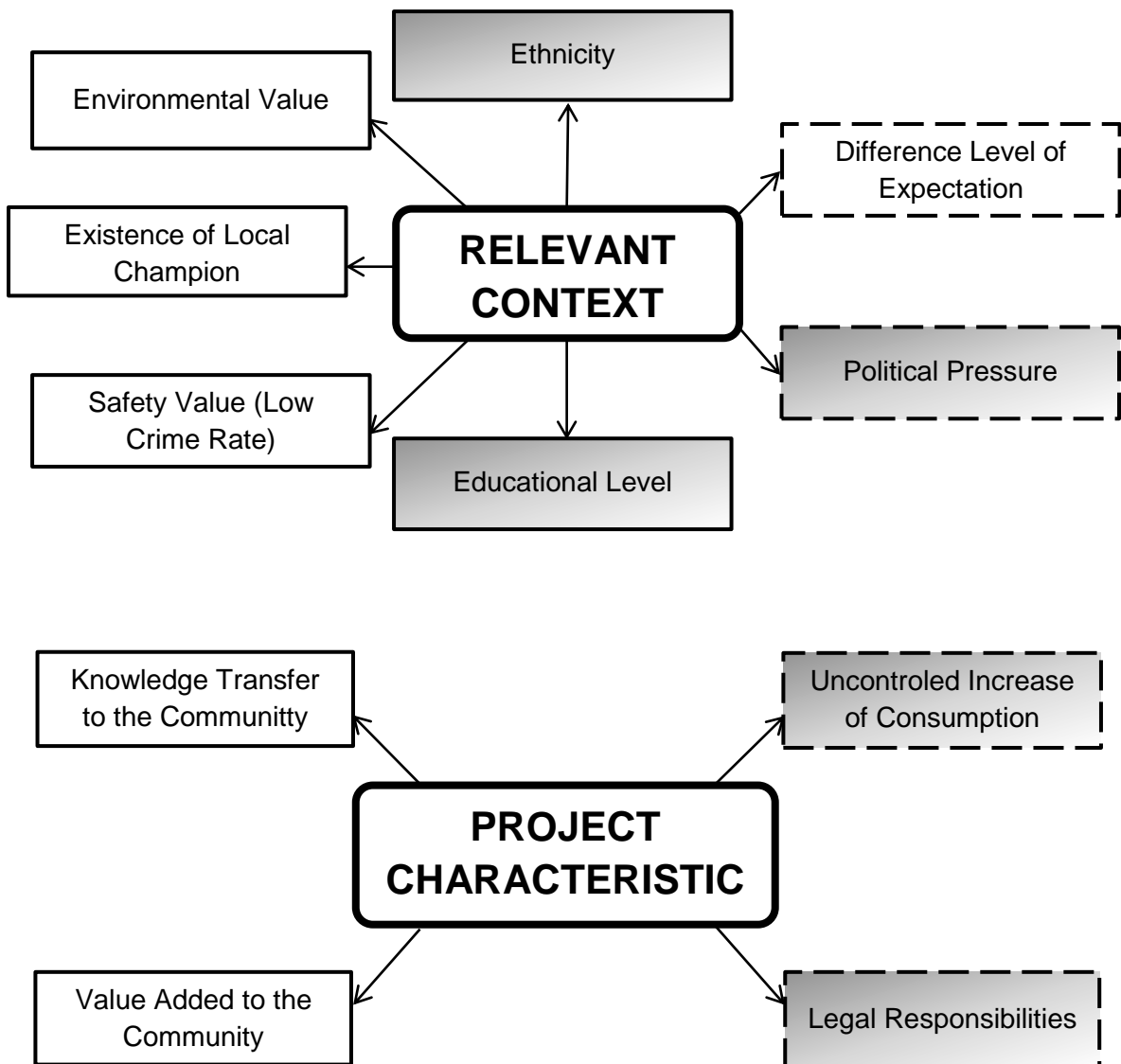
| Community actors | Work in favor | Interference | Interests |
|--------------------------------|----------------------|---------------------|---|
| School teachers | Manage fund trainer | | Customer, educate and training students |
| Formal leaders | Coordination | Oppose project | Be significant, engage and development of community |
| Natural leaders | Coordination | Oppose project | |
| Relative supporting | | | Help family |
| Community from outside economy | Funding | | |
| Religious temples/churches | | Divide community | |

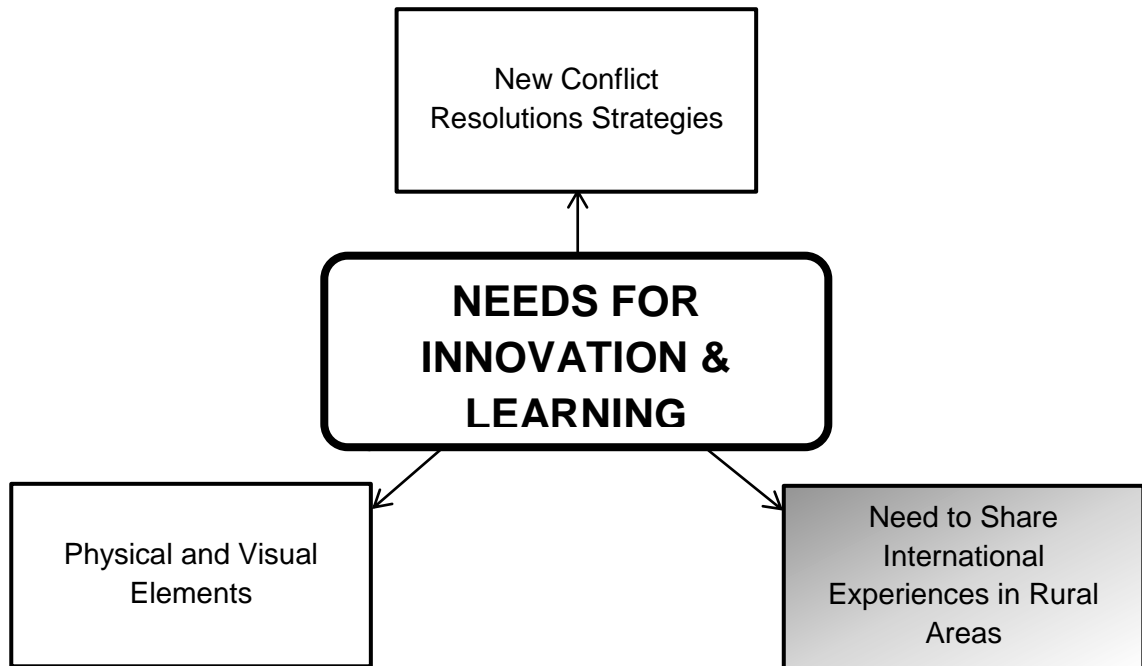
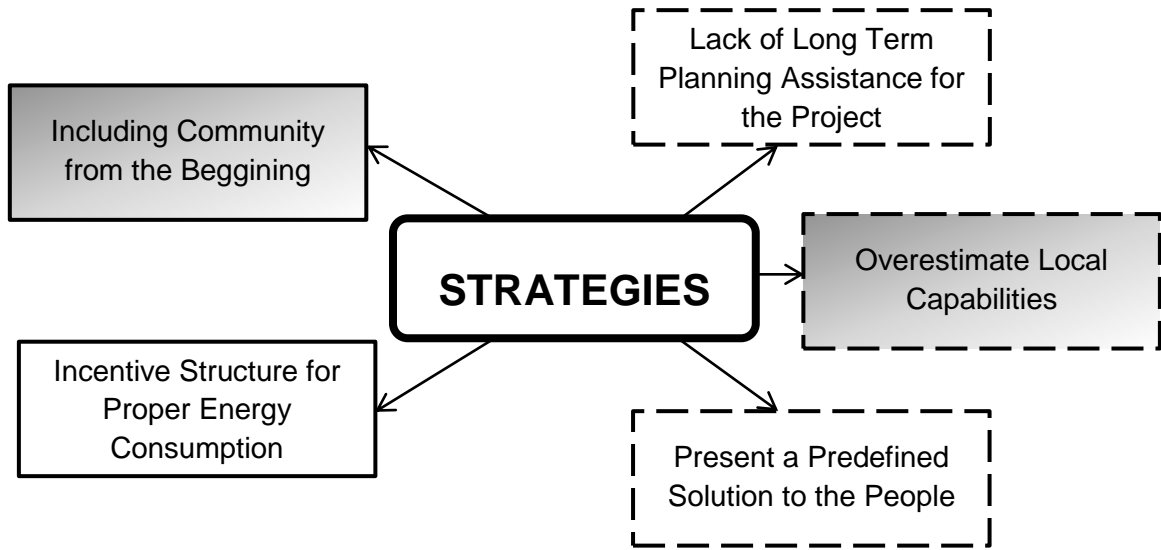
| | | | |
|--------------------|--------------------------------------|----------------|--|
| Municipality | | Top down model | Key Performance indicator (KPI) |
| Local Organization | Provide framework | | Improve quality of life and activity diversification |
| Funeral fund/group | Investing fund and provide framework | | |

Advantages and obstacles: Relevant context, project characteristics, strategies and needs for innovation and learning:

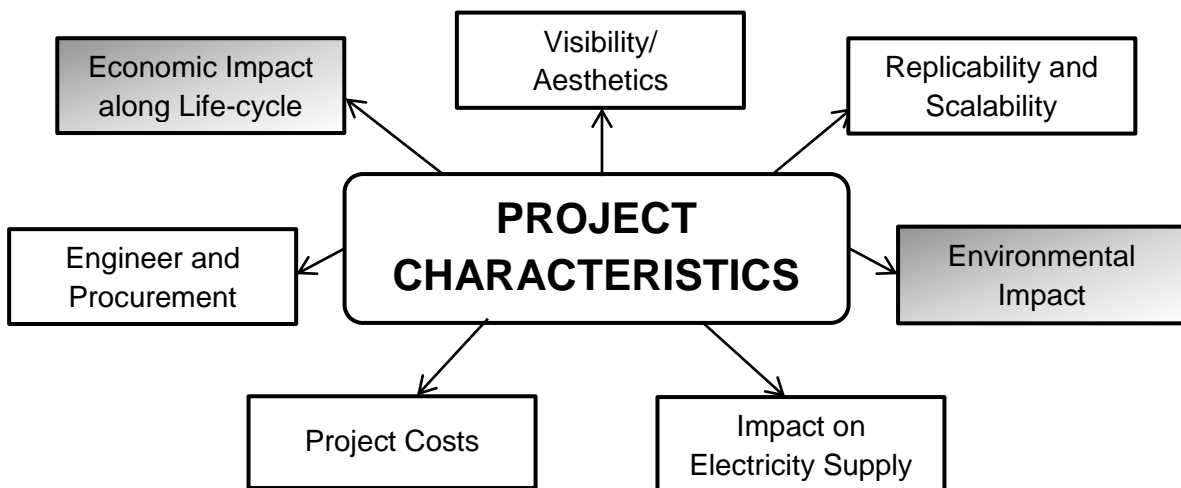
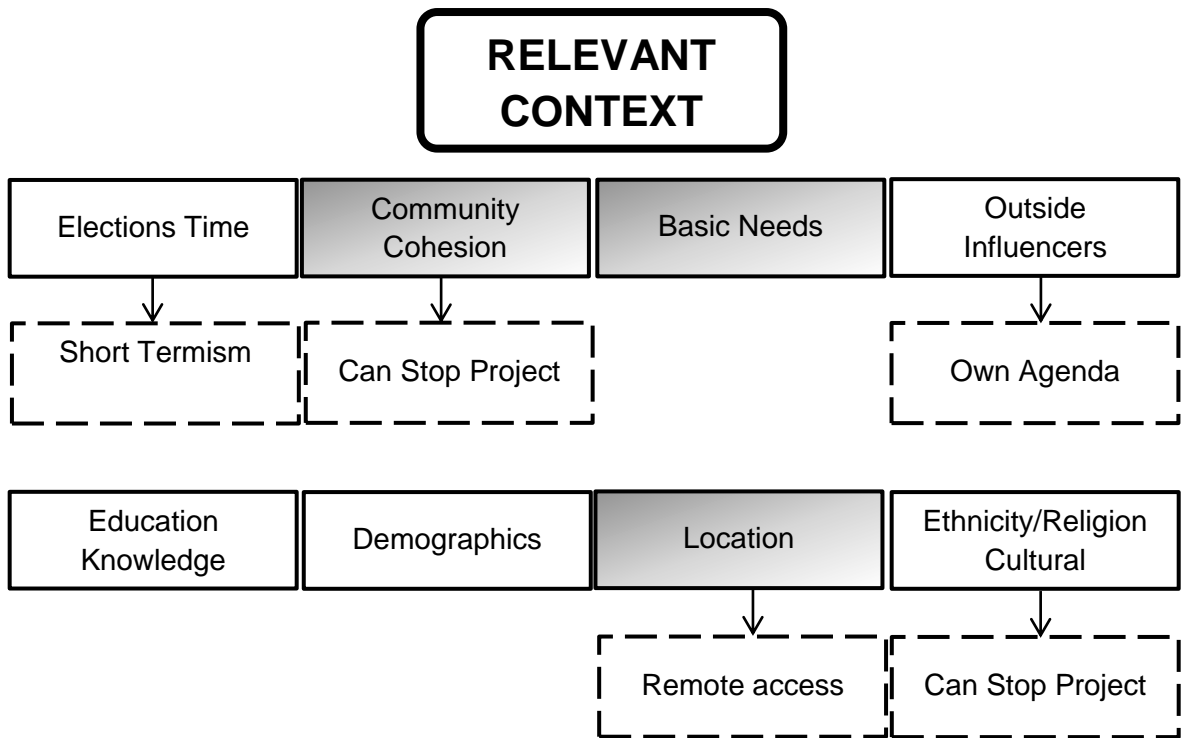


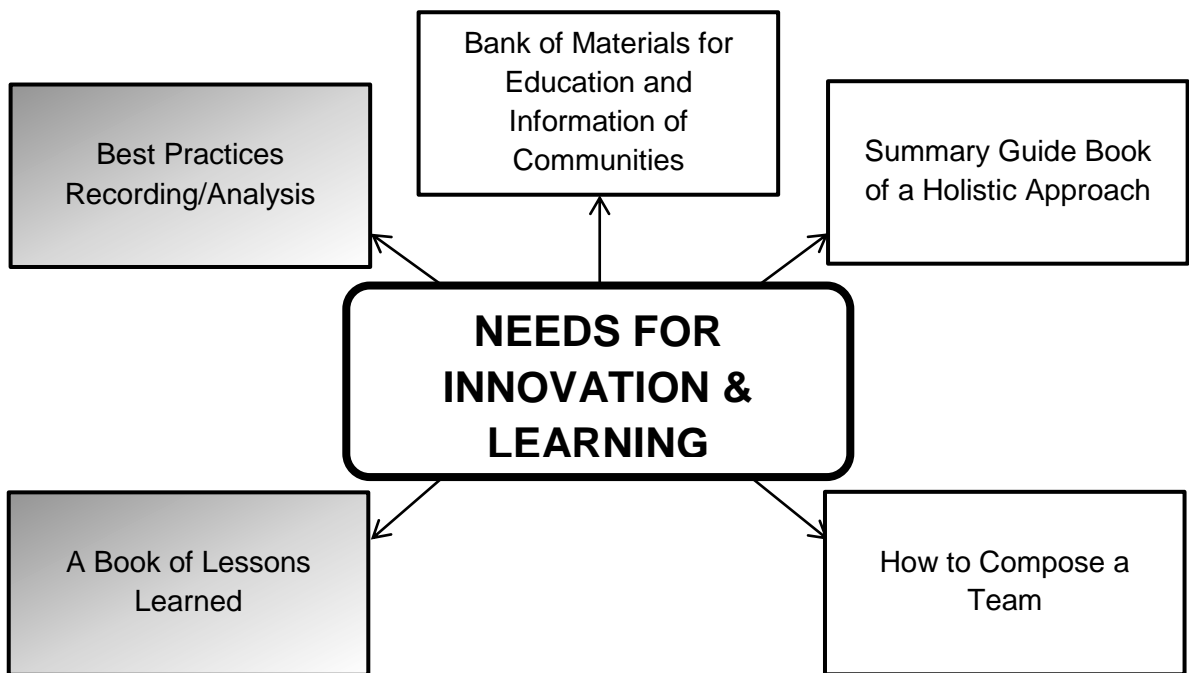
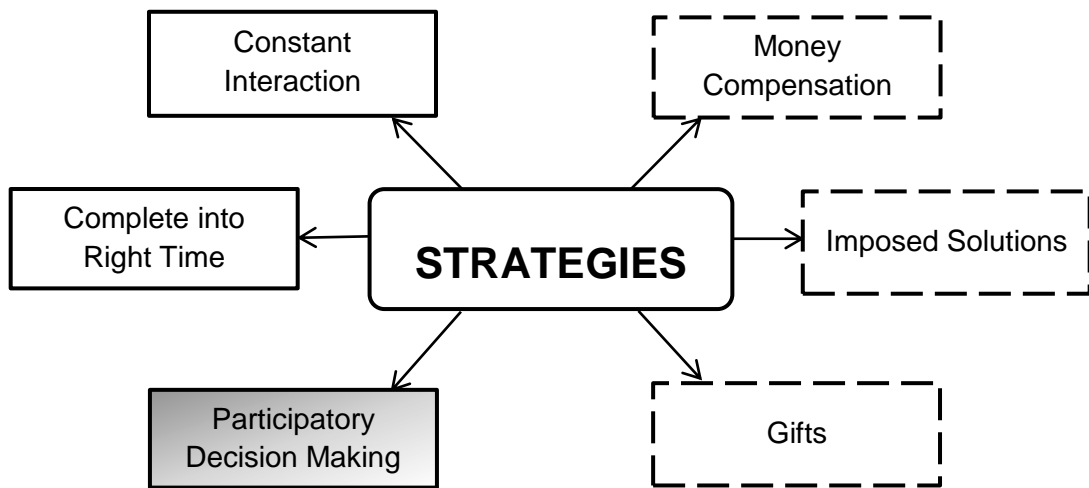
Group A:



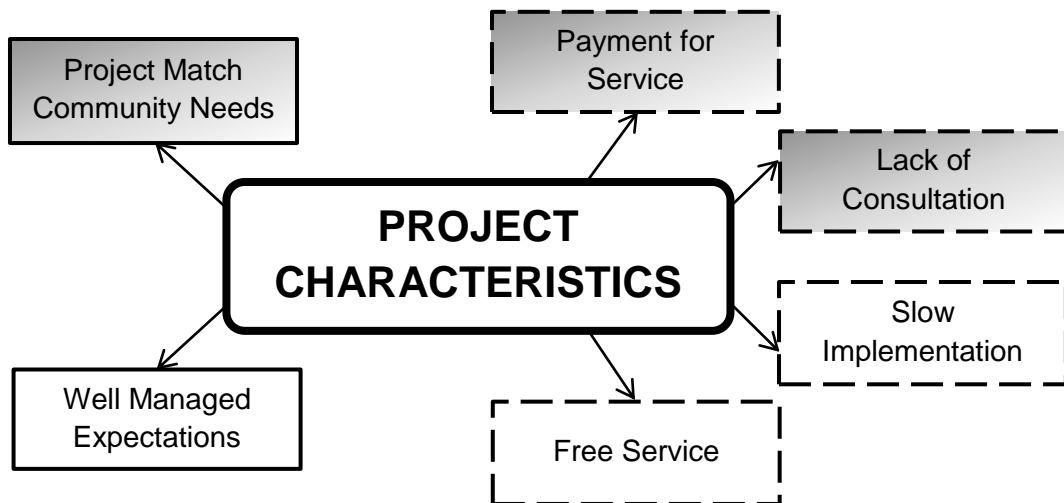
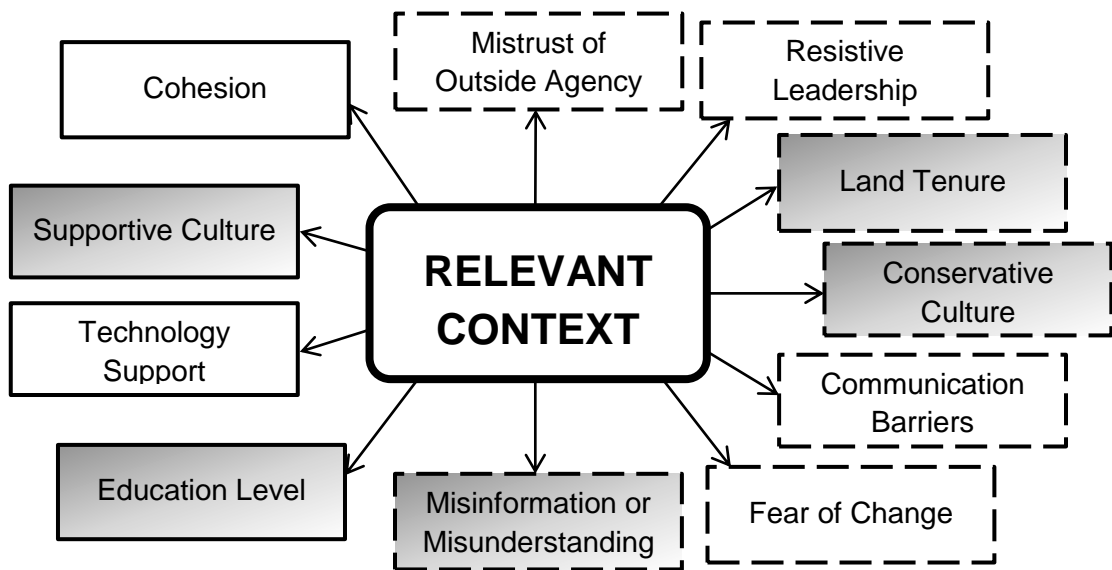


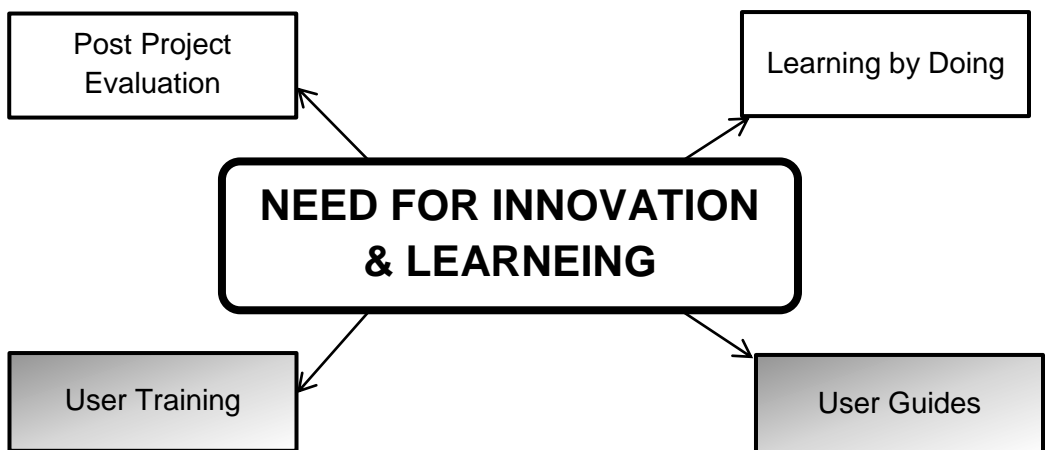
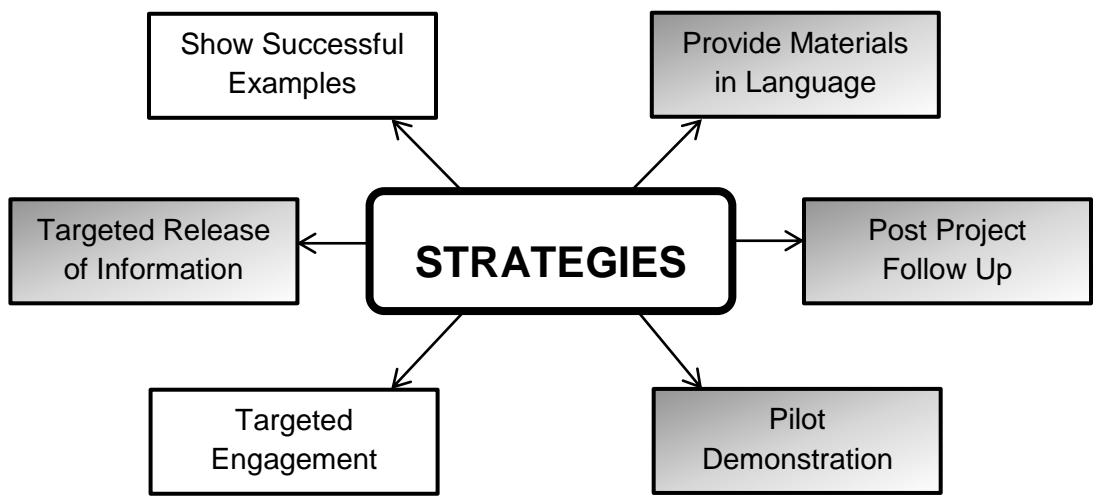
Group B



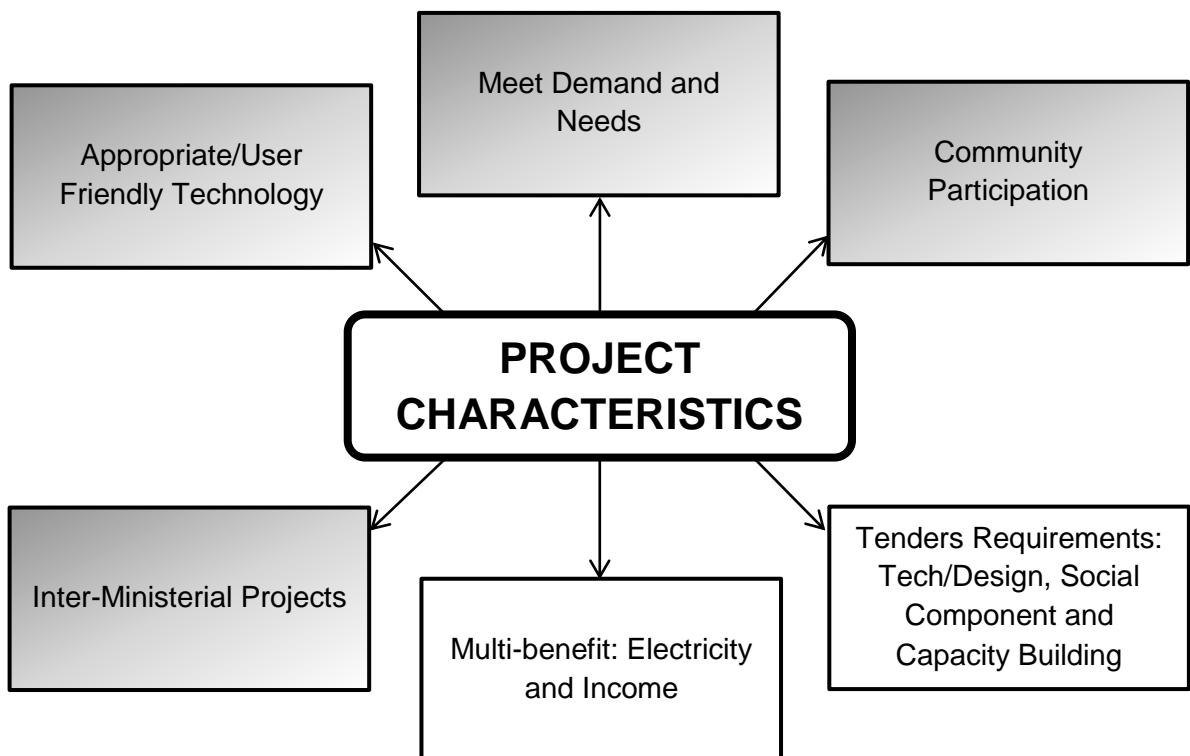
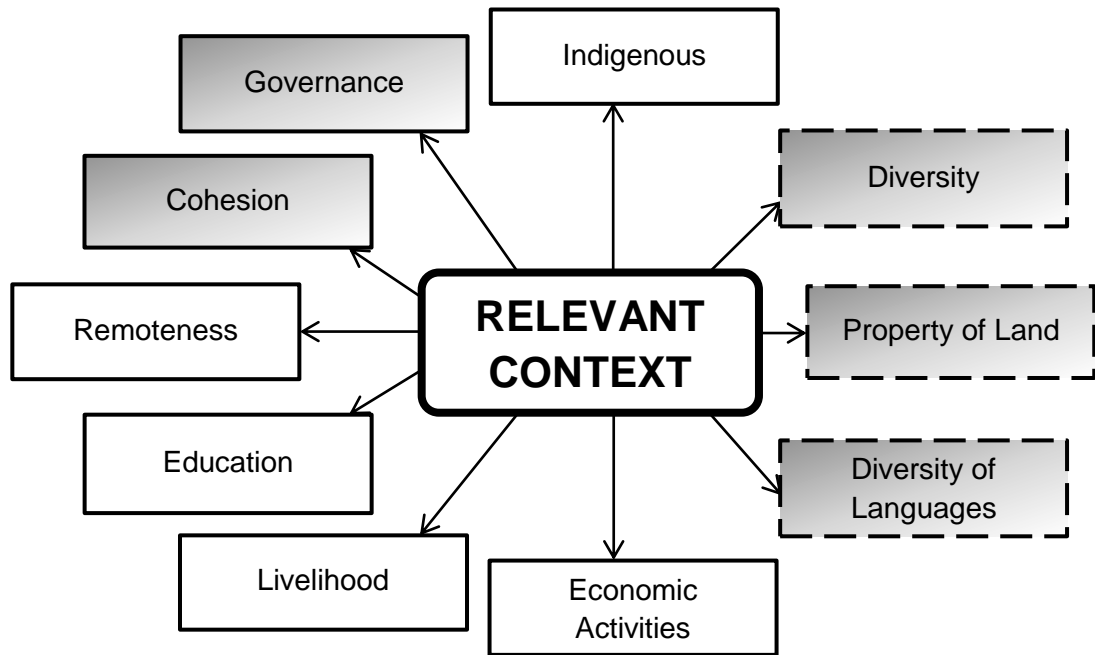


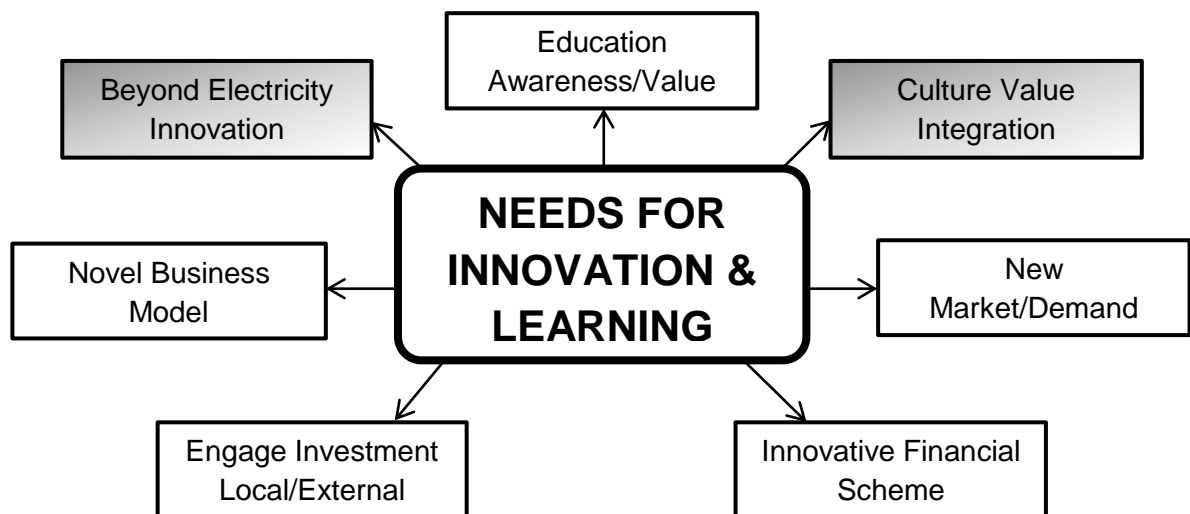
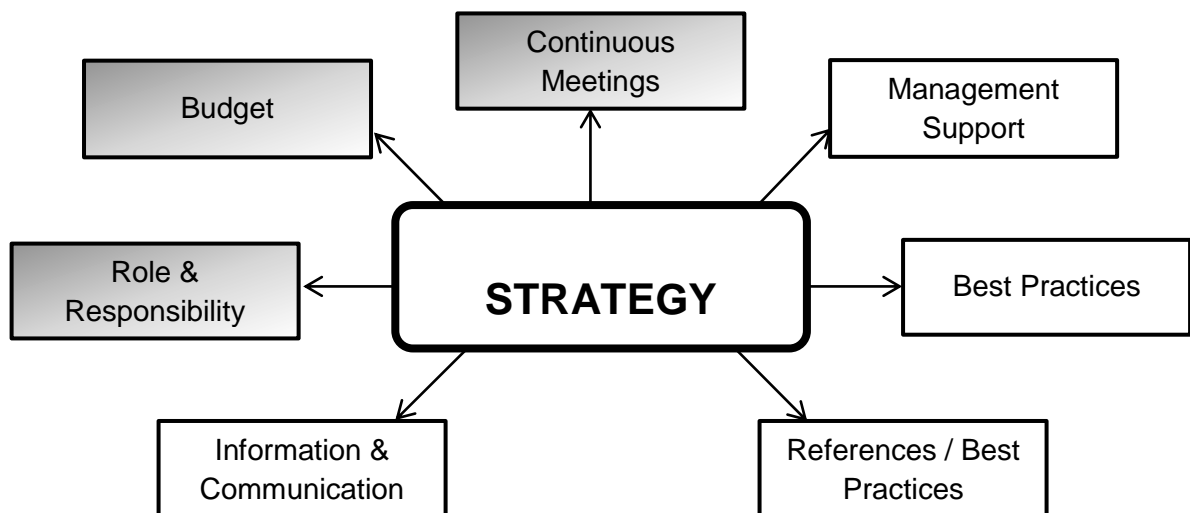
Group C:





Group D:





ANNEX 3: Final conclusions

| Group | Participants |
|-------|--|
| A | Cary Bloyd; Mareena Mahpudz; Pablo Tello; Fernando Lanas; Worajit Setthapun; Xavier Vallvé; Alejandro Contreras; Javiera Inostroza |
| B | Dalia Patiño; Julio Cuadra; Đinh Thanh Son; Roberto Dunsmore; Paul Rodden; Jacqueline Sanchez; Renato Oña; Sebastián Arroyo |

Group A:

1. Full life cycle planning, financing, execution and community engagement
2. Deploy new technology across project life cycle
3. Target/Understand to local context “One size does not fit all”
4. Ensure project meets community needs through continuous community engagement
5. Small energy access agency to summarize and share best practice for key stakeholders
6. Book of case studies of energy access projects
7. Energy service delivery requires multidisciplinary approach

Next step: Working group on how to establish an International Energy Access Agency

Group B:

1. Beyond electricity – Bundle services
2. Policy & strategy must acknowledge and apply local rules, norms & customs
3. Community Engagement all along the process of project development, implement & sustainability

Next step: Promote a joint work between EWG + SMEWG + Other sub-fora

ANNEX 4: Workshop Agenda

Day 1. Wednesday, October 9th, 2019

Session 1: Introduction and International Experience

| | |
|-------------|---|
| 15:30—16:00 | Reception coffee and Accreditation |
| 16:00—16:15 | Opening <i>Rodrigo Barahona, Regional Representative of the Ministry of Energy, Chile.</i> |
| 16:15—16:45 | International experiences and global framework in energy access Cary Bloyd. Senior Staff Scientist, Electricity Infrastructure & Buildings Division, Pacific Northwest National Laboratory, The USA. |
| 16:45—17:15 | Chilean experience on Energy Access Julio Cuadra. Head of Energy Access and Social Development Division of the Ministry of Energy, Chile. |
| 17:15—18:00 | Personal introduction of speakers and participants |

Day 2. Thursday, October 10th, 2019

Session 2: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Collaboration, Funding and Related Issues

| | |
|---|--|
| 09:00—10:00 | <p>Experts experiences</p> <p>Renato Oña, Renewable energy coordinator, Fundación Bariloche.</p> <p>Paul Rodden. Senior project manager, Ekistica, Australia.</p> <p>Dalia Patiño-Echeverri. Academic of Duke University.</p> |
| 10:00—10:30 | Coffee Break |
| 10:30—12:30 | Working groups and discussion |
| <i>Lunch break</i> | |
| Session 3: Obstacles and Challenges for Sustainable Solutions in Remote Locations: Social, Cultural and Community Issues | |
| 14:00—15:00 | <p>Experts experiences</p> <p>Xavier Vallvé. Director of Trama Tecnoambiental.</p> <p>Worajit Setthapun. Dean Asian Development College for Community Economy and Technology , Chiang Mai Rajabhat University, Thailand.</p> <p>Javiera Inostroza. Professional of Energy Access and Social Development Division of the Ministry of Energy, Chile.</p> |
| 15:00—15:30 | Coffee Break |
| 15:30—17:30 | Working groups and discussion |

ANNEX 5: Site-Visit Tac Island Agenda

Site-visit Tac Island, Chiloé, Friday, 11 October, 2019

| Time | Topic |
|-------|---|
| 07:30 | Departure from Hotel Enjoy Castro to Tenaún |
| 08:30 | Ferry boarding in Tenaún and sail to Tac Island |
| 09:50 | Arrive to Tac Island |
| 10:15 | Meeting with local community |
| 10:20 | Welcome speech from Mayor |
| 10:30 | Welcome words from Ms Irene Millalonco, President of Local Community in Tac Island |
| 10:40 | Artistic performance of the School of Tac Island students |
| 10:50 | Visit to “ Curanto ” (local meal based on steamed shellfish, fish, chicken, pork, wiener, potato, cabbage, onion, garlic, tomato and pepper) preparation |
| 11:10 | Walk to Tac Island power plant |
| 11:30 | Arrive to Tac Island power plant |

| | |
|--------------|---|
| 11:40 | Prevention risks talk |
| 12:00 | Trip around Tac Island power plant |
| 13:00 | Curanto lunch |
| 15:00 | Church and local craftwork visit |
| 17:00 | Ferry departure From Tac Island to Tenaún |
| 18:20 | Arrive to Tenaún and departure to Castro |
| 19:30 | Arrive to Enjoy Hotel in Castro. |

ANNEX 6: List of speakers and participants

**APEC Workshop Lesson learned from promotion mechanisms focused on
boosting energy solutions in remote areas
Castro, Chile, 9-11 October, 2019**

| # | First Name | Last Name | Economy | Organization |
|----|------------|-----------|------------------------------|--|
| 1 | Thanh Son | Dinh | Viet Nam | Ministry of Industry and Trade |
| 2 | Roberto | Dunsmore | Chile | Sociedad Austral de Electricidad S.A. |
| 3 | Xavier | Vallvé | Spain | TramaTecnoAmbiental |
| 4 | Cary | Bloyd | The United States of America | Pacific Northwest National Laboratory |
| 5 | Paul | Rodden | Australia | Ekistica |
| 6 | Worajit | Setthapun | Thailand | Asian Development College for Community Economy and Technology |
| 7 | Fernando | Lanas | Chile | University of Chile |
| 8 | Mareena | Mahpudz | Malaysia | Ministry of Energy |
| 9 | Jacqueline | Sanchez | México | Instituto de las Américas |
| 10 | Renato | Oña | Ecuador | Bariloche Foundation |
| 11 | Sebastián | Arroyo | Chile | University of Los Lagos |
| 12 | Dalia | Patiño | The United States of America | Duke University |
| 13 | Pablo | Tello | Chile | Ministry of Energy |
| 14 | Julio | Cuadra | Chile | Ministry of Energy |
| 15 | Javiera | Inostroza | Chile | Ministry of Energy |
| 16 | Alejandro | Contreras | Chile | Ministry of Energy |
| 17 | Valentina | Gómez | Chile | Ministry of Energy |
| 18 | Cristobal | Eastman | Chile | Ministry of Energy |