SIDA/LIFE ITP 277 PROGRAM REPORT

GLOBAL

STORIES OF CHANGE: ITP 277

Wind Power Development & Use 2009–2015

LIFE Academy

Sida

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Preface

Number 7 of the 17 Sustainable Development Goals for transforming our world is about energy; ensure access to affordable, reliable, sustainable and modern energy for all by 2030. In the world today, one in five, mainly vulnerable people living in poverty, lack access to modern electricity and three billion people still rely on wood, coal, charcoal or animal waste for cooking and heating. Successful improved living standards must include access to energy and access to electricity in particular.

The energy sector accounts for around two-thirds of global greenhouse gas emission. Renewables, mainly hydropower, contributed to almost half of the world's generated power capacity by 2014. The potential for achieving 100% renewables is achievable in the long run according to a number of studies. As the investment costs for wind and solar power have dramatically been reduced during the last years, it is possible to provide at least about 25% of annual electricity sector emissions reductions by 2050 both by decarbonising electricity supply and by increasing electricity end-use efficiency.

The International Training Programs, ITP, are capacity building programs aimed at raising capacity on the individuals within key organisations in Sida's cooperation countries. A fundamental element in the training programs is the change project carried out by each participant. Through this, the participants will become change agents in their organisations in order to achieve desired results that contribute to poverty reduction, securing of human rights and to sustainable development.

This report presents the outcome of the Sida/LIFE ITP program on Wind Power Development & Use 2009–2015 covering 22 countries and 200 participants. The report mainly focuses on stories told by 30 frontrunners who participated in a final follow-up workshop in Arusha, Tanzania in December 2015. All of these Change Agents have either contributed to policy changes, defining country based goals for renewables, setting up agencies working with renewables or in the establishment of new companies working in the wind power sector both large and small scale projects. Many projects have been performed by country teams, with many participants from each country and thus reaching a broad platform on the country level.

Through the ITP program, all participants have been empowered as Change Agents, with the ability to make valuable contributions to meeting their countries' energy needs.

Christian Lien
Head of Capacity Development Unit

Foreword

The answer is Wind Power, but what is the question? For me the main question is how to make *Change* towards a Sustainable Energy System globally. We need *Change* in many ways; we need *Change* in attitudes and policies which are not always driving in favor of renewable energy resources. We need *Change* in how investments are mainly focused on centralized energy systems and leave rural decentralized people with no access to power.

In the Sida/LIFE ITP program on Wind Power Development & Use we have contributed towards *Change* by training about 200 energy experts from 22 countries to become *Change Agents*. These *Change Agents* are now making *Change* in their home organizations and countries and some of their stories are told in this report. The training program has focused on how to make *Change* and how to sustain *Change* by learning from good practices around the globe. The program has not primarily been focused on wind power as the only solution but wind power is seen as one among many renewable energy alternatives and from that barriers and drivers for *Change* are discussed.

> ***"The answer my friend is blowin' in the wind, the answer is blowin' in the wind"***
>
> *Bob Dylan*

In December 2015 Sida and LIFE arranged a five day workshop in Arusha, Tanzania where we met with 30 former participants from our training program as well as some key experts. The aim was to share experiences and draw conclusions on how future training and capacity building in the energy sector should be focused. This report summarizes the presentations and discussions at the workshop.

As the leader of the Sida/LIFE ITP program on Wind Power Development & Use, I have had the privilege to follow all the participants and their *Change Projects* from their very first idea discussed at the starting workshop to the outcome in form of a multitude of actions taken by them. I would like to thank all our *Change Agents* for their hard work and engagement and I wish them all the very best for the future. I am convinced that our *Change Agents* will continue working for *Change* towards a sustainable future.

Stockholm March 2016

Tommy Månsson
Senior Advisor
LIFE Academy

Content

Introduction

The global wind power capacity installed over the last ten years has more than quadrupled since 2005 (see Figure 1). In terms of annual installations China has taken a lead by adding just over 23 GW of new capacity in 2014, the highest annual number for any country ever. China aims to nearly double its wind capacity to 200 GW by the end of 2020. At present, wind-generated electricity in China amounts to about 160 000 GWh, accounting for 3% of the country's total electricity output. In Africa, South Africa wind power has taken off since the introduction of the Renewable Energy Independent Power Producer Procurement, REIPPP.[1]

The last two years have been great years for the wind industry; setting new records of more than 50 GW installed each year, bringing the global total close to 370 GW. The two big stories continue to be the precipitous drop in the price of oil, and growing concerns about climate change, leading up to the COP 21 summit in Paris at the end of 2015. It is often assumed that lower oil prices will have impact upon the wind sector in a negative manner, but there is no evidence to support such assumption – by and large, wind power does not compete with oil, and the price of gas is no longer tied to the price of oil as closely as it once was.

1 Reference: African Sustainable Energy Association, AFSEA

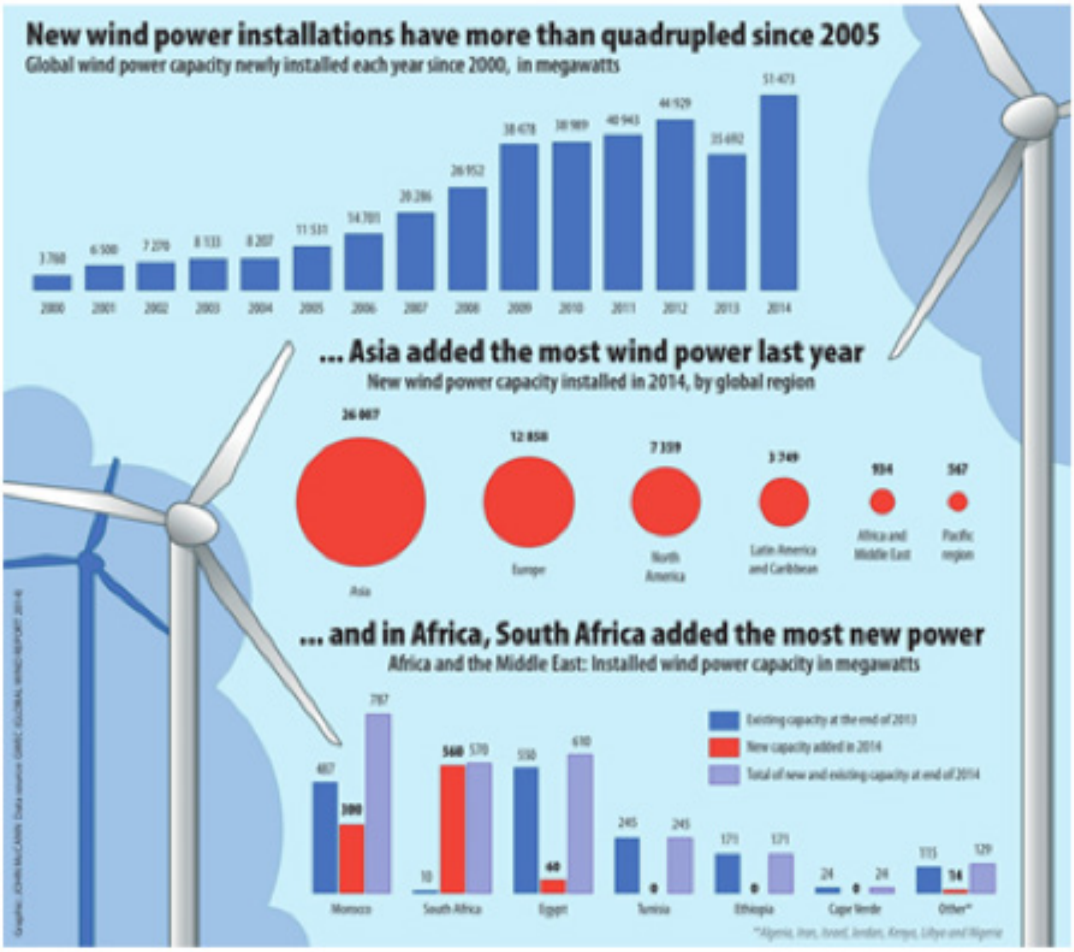


Figure 1: New wind power installations have more than quadrupled since 2005, Asia added the most wind power and in Africa, South Africa added the most power (Reference: African Sustainable Energy Association, AFSEA).

It is safe to say that the main drivers for wind energy in most of the growth markets of late have been on the one hand wind's increasingly competitiveness – the number of markets where wind competes successfully on price against heavily subsidized incumbents continues to grow; and the need to combat the choking smog that is making an increasing number of the developing world's major cities (not only in China) unlivable. Energy security, cost stability, insulation of national economies from the price shocks in the international fossil markets, job creation and local industrial development as well as environmental considerations are all still present, but price, speed of deployment and fighting local air pollution have been the main drivers in most of the major growth markets during the last years.

The sun and the wind continue to defy gravity. Renewables just finished another record-breaking year in 2015, with more money invested ($329 billion) and more capacity added (121 gigawatts) than ever before, according to data released by Bloomberg New Energy Finance. This was unexpected. Oil, coal and natural gas bottomed out over the last 18 months, with bargain prices not seen in a decade. That is just one of a handful of reasons 2015 should have been a rough year for clean energy. But the opposite was true. Perhaps the biggest surprise last year came from smaller countries that often do not register on global statistics. For the first time, half of the world's annual investment in clean energy came from emerging markets. Even more telling is that the world has reached a turning point, and is now adding more power capacity from renewables every year than from coal, natural gas, and oil combined. That trend continued in 2015 despite crashing fossil fuel prices.

Since clean energy is also getting cheaper, the world got more bang for each buck. Investment rose 4 percent in 2015, while the new capacity added for wind and solar jumped 30 percent. Globally over the past 5 years, the levelized cost of energy (LCOE) has dropped by over 75% for solar and 50–60% for wind, driven largely by a decline in capital costs and technology improvements.[2]

2 Reference: The International Renewable Agency, IRENA

This is also verified by our Change Agents from South Africa where as a result of the successful bidding system (REIPPP) prices for wind power have dropped by 50% to US$ 0.06 and solar power by 75% to US$ 0.07.

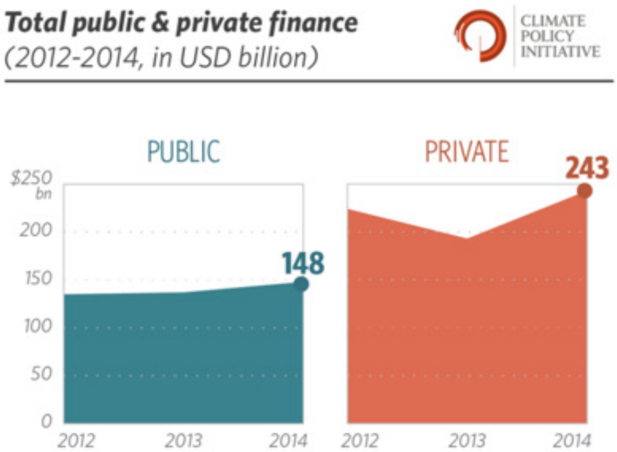


Figure 2: The total global funding in climate mitigation is now almost reaching $400 billion and the private sector is taking a lead over public spendings (Ref: Global Landscape of Climate Finance 2015, Climate Policy Initiative).

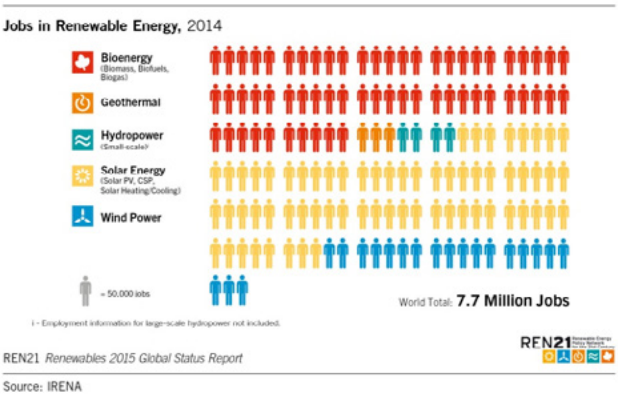


Figure 3: Number of jobs in the renewable energy sector presently is estimated over 7.7 million globally and much more people will work in the sector in coming years (IRENA 2015).

Following the trend of decreasing investment costs for wind power and other renewable energy the interest among investors and financing institutes have seen a dramatic change during the last few years. Especially, the investments from the private sector have grown substantially. For example the total global climate finance increased by 18% in 2014 and as can be seen in Figure 2, the private investment now take a lead over public funding.[3]

According to estimates by the International Renewable Agency, IRENA about 7.7 million people globally are currently working in the renewable energy sector (Figure 3). For example, the wind power sector grew last year by about 25% which created employment for over one million people.

As the renewable energy sector is expected to grow even more rapidly in future, the need for more experts in the sector is to be foreseen. For example, for the wind power sector it is estimated that 15 new jobs are created for each new MW installed. So the need of education and training in the field of wind power and other renewables is growing rapidly and especially in developing countries.

3 Reference: Global Landscape of Climate Finance 2015, Climate Policy Initiative

Training for Change

THE MODEL

The Swedish International Development Cooperation Agency, Sida, offers as part of its bilateral development assistance, International Training Programs (ITP) of strategic importance to the social and economic development in the participants' countries. Sida has commissioned LIFE Academy to carry out an advanced training program on Wind Power Development and Use. The International Training Programs are specially designed for persons qualified to participate in reform processes of strategic importance on different levels and holding a position in home organization with mandate to run processes of change. This methodology is based on the assumption that the participating country wishes to carry out changes and is willing to invest its own resources to achieve these changes. In the long-term perspective the program will contribute to institutional strengthening and capacity development in the participants' countries. The training is focused on support to individual or team projects for change. These *Change Projects* shall be well established in the participant's organization.

The overall objective of the program is to contribute to capacity building and increased understanding of the importance of wind power and other renewable energy sources among strategic organizations in a selected number of priority countries. The program aims at poverty reduction and sustainable development through increased availability of electricity from renewable sources for poor men, women and children. The program provides knowledge and introduces relevant tools and methods for designing, planning and implementing a Change Project in the energy sector including aspects of gender and public participation. The specific objectives of the program are to provide the participants with:

- An understanding of the impact of energy supply on global climate change and its importance for planning and development as well as its impact on the environment, poverty reduction and gender issues.
- Knowledge of the role of wind power in the energy supply as a whole, and its advantages and disadvantages from environmental, economic and technical perspectives.
- Knowledge and understanding of the entire process of planning, financing, installation, management, maintenance and demounting of a wind power plant.
- Exchange of knowledge and experience between the participants themselves and between the participants and Swedish actors.

Figure 4: The LIFE training model is stimulating active learning by meeting experts and technology in Sweden as well as in India.

Figure 5: The LIFE training model offers group learning with hands-on discussions with local practitioners.

A central component of the program is the participant´s own Change Project addressing a relevant problem within the scope of the program. Thus, as a part of the application process the applicant should submit a proposed Change Project, called a *Change Project Idea*. The Change Project is an important and integrated component in the training and the goal is that the participant within the scope of the program and afterwards will contribute to change towards a society based on wind power and other renewable energy sources.

The program is divided into five interlinked modules:

1. Sustainable Energy Systems
The module covers central issues for the establishment of a smart and sustainable electric system and introduces various renewable energy sources and their environmental impact, costs etc.

2. Wind Power – Basic Knowledge
The module presents detailed methods of central importance in developing wind power plants such as wind measurement, localization and design, demands on the infrastructure and the electric grid etc.

3. Planning and Decision Making Processes for Establishing Wind Power Plants
The module covers areas as environmental impact analysis, stakeholder participation and other key areas for efficient planning and decision making.

4. Management, Organization and Economy of Wind Power Plants
The module includes issues as taxes and tariffs, regulations, various organization models for managing a wind power plant, etc.

5. Change Project and Processes of Change
The Change Project plays a central role in the program and in this module methods such as project management and networking to support a process of change are introduced.

The training program includes a diversity of pedagogical methods such as lectures, case studies, study visits, mentor support and extensive use of ICT. Planning, implementation and evaluation of the Change Project has provided continuity to the program over a period of 18 months and follows a model as presented in Table 1.

The training phase in Sweden was carried out in cooperation with KTH and included a number of study visits to project developers and wind turbine manufacturers

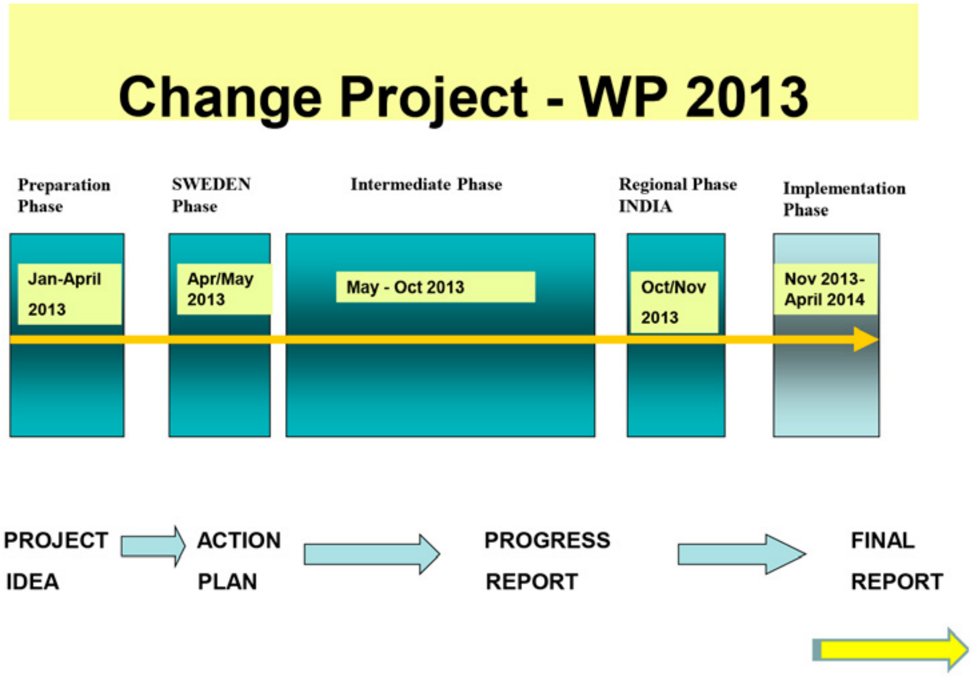
The training package included a regional phase which took place in India for all the programs. The cooperation partner in India was the Centre for Wind Energy Technology, C-WET (now called NIWE). The India phase included study visits to a number of wind turbine manufacturers in Chennai as well as visits to wind farms and wind project developers in Kanyakumari. The program also included visits to the C-WET centers in Chennai and Kayatar.

Figure 6: An important part of the training is study visits to manufactures of wind turbines in Sweden as well as in India.

Figure 7: The program included hands on discussions with Swedish project developers of wind power thereby giving an opportunity for exchanging experiences.

Figure 8: The regional phase took place in India in cooperation with C-WET and included visits to turbine manufactures, project developers and workshops in Chennai, Kanyakumari and Kayatar.

Figure 9: The training program was ended in December 2015 by arranging a Follow-up Workshop in Arusha, Tanzania for a selected group of Change Agents.



PHASE 1 – PREPARATION AND A TWO-DAY SCHEDULED WORKSHOP IN THE REGION
Two regional workshops were held, one for participants from Africa and one for participants from Asia/Europe. The workshops were held in Windhoek, Namibia, Dar es Salaam, Tanzania and Beijing and Shanghai, China. At the workshops the participants got support in defining and developing their Change Project. The workshop aimed at stimulating cooperation between participants, their respective organizations and the regional networks.

PHASE 2 – SCHEDULED PROGRAM IN SWEDEN (3.5 WEEKS)
During the training period in Sweden participants were exposed to Swedish knowledge and experience within renewable energy in general and wind power in particular. Interactive lectures and professional exchange dialogues are combined with presentations, excursions and study visits.

PHASE 3 – INTERMEDIATE CONSOLIDATION PHASE
Back in their organizations, participants continued anchoring and developing their Change Projects in dialogue with colleagues and other stakeholders. Web-based tools for communication are to be used for networking, peer review and for interactions with and support from the mentors.

PHASE 4 – REGIONAL PHASE, SCHEDULED PROGRAM (1.5 WEEKS)
The regional phase, took place in India. During this session the participants report on the progress of their Change Project with feedback from the mentors as well as other participants. Study visits provide opportunities to learn from local and regional experiences.

PHASE 5 – CONTINUED SUPPORT PHASE
Through the web there was ongoing interaction between participants, their institutions and the mentors. During this phase the Change Projects were implemented, evaluated and reported on.

Table 1: The LIFE training model included 5 training phases carried out during a period of 18 months.

Outcome

As a result of the training program, about 200 energy experts from 22 countries (Table 2) representing government organizations, private companies and NGOs at national and local level have been trained as Change Agents. Through their training and coaching by LIFE Academy and their experts, the Change Agents have implemented a large number of Change Projects of which some of them are presented in more detail in this report. These Change Projects have contributed to *Change* by setting good models for others to follow. Many of the projects have also been carried out by country teams thereby providing an opportunity to implement a broader platform for substantial policy changes in their countries.

When the training started in 2009, LIFE Academy carried out a baseline with a number of indicators for the participating countries. For each of the training batches, this has then been followed up by doing situation analysis based on the participants' knowledge. As indicated in Figure 10, there has been a substantial change in country policies as well as in organizational set-ups in the participating countries. There are of course a number of reasons for these changes, but it is quite clear that the training of a number of key staff at some of the main energy organizations have contributed to these improvements.

An important goal with the training was to support and establish better dialogues and communication between wind power experts on national and global scale. Thus, when selecting participants to the training, a broad representation of participants from a large number of countries was given priority. Through the training model, an open dialogue among the participants thereby giving broad possibilities for communication and exchange of ideas and experiences between them. As an outcome, a number of formal and informal networks were created on national as well as on international level. For example, as described later on, national wind power associations have been started in countries without such previous networks as Mongolia and Thailand.

AFRICA	ASIA	EASTERN EUROPE	LATIN AMERICA
Ethiopia	China	Georgia	Guatemala
Egypt	India	Moldova	
Kenya	Indonesia	Ukraine	
Mozambique	Mongolia		
Namibia	P.R. Korea		
South Africa	Nepal		
Tanzania	Myanmar		
Zambia	Sri Lanka		
	Thailand		
	Vietnam		

Table 2: During the period 2009-2015 LIFE Academy has trained about 200 people from 22 countries to become Change Agents.

INDICATORS 2009 – 2014 FOR 10 PRIORITY COUNTRIES	
BASELINE 2009	SITUATION ANALYSIS 2014
• 20 % of the countries have set goals for renewables • 30 % of the countries have policies for renewables • 30 % of the countries have government agency for renewables • 20 % of the countries have NGO for renewables • 30 % of the countries have local companies for large-scale wind projects • 30 % of the countries have local companies for small-scale wind projects	• 90 % of the countries have set goals for renewables • 80 % of the countries have policies for renewables • 100 % of the countries have government agency for renewables • 70 % of the countries have NGO for renewables • 70 % of the countries have local companies for large-scale wind projects • 90 % of the countries have local companies for small-scale wind projects

Figure 10: Examples of changes measured in the participating countries.

Figure 11: An important outcome of the training has been to create informal as well as formal expert networks on national and global level.

Figure 12: Examples of change projects implemented as part of the Sida/LIFE training

Previously mentioned, the Change Projects have been a central and integrated part of all the training. These projects have been born by actual problems and needs in the participants own organizations. The outcome of these Change Projects also have had an impact and contributed to better decisions on a number of areas of interest for promoting the use of wind power and other renewable sources. As the participants have represented a wide area of skills and backgrounds, the Change Projects and the outcome of these projects include a broad range of topics including e.g. energy policies, wind data monitoring, environmental assessments, software analysis (Figure 12) (Appendix 2 provides a list of all Change Projects).

> ***"LIFE Academy helped me to get contact with a national network. I did not know Matthew Matimbwi before but after being advised by LIFE to contact him, he helped me a lot with data logger for wind measurement and a lot of other things!"***
>
> *Arthur Karomba, Tanzania*

Openness as a way to succeed with wind energy[1]

There is a pressing need to speed up the development of renewable energy, including wind energy. For cooperation in this and other areas between so called developed and developing countries, openness can provide new opportunities. For development to take place in an inclusive way so the benefits can be shared (not only by those who are already privileged), knowledge is of course a key factor.

OPEN KNOWLEDGE

”Open knowledge” is a broad term to describe sharing of information at no cost, including e.g. open data. For development of wind energy, this can be of importance especially for wind data. Such data, often in the form of wind maps or time series of measured data, is crucial for determining if the wind conditions are suitable for developing wind projects. If that data is not available, it usually takes much longer and costs more to develop a project (because perhaps new measurements must be done) or there will be a higher uncertainty in the project (e.g. regarding the expected energy yield).

Often, significant resources have been used to collect wind data in many areas, for example by authorities or by private wind developers. However, such data is often held secret and is sometimes even lost. Although it is understandable that say a private wind developer often wants to keep their data secret during a certain phase of the development of their project(s), there will often come a time when also they should be able to consider making their data public. Perhaps a project could not be realized as intended. There are many potential advantages if the data is made public, including that the resources spent are not wasted but can benefit society as a whole and can create goodwill for the entity that publishes the data.

Some of the challenges related to this are determining where open data should be published, so it can easily be found, and in which format. As far as we know, there is not one standard format for wind data. In addition to the data itself, it is also important that information is preserved about the measurement setup and other relevant conditions.

For a few years, SMHI in Sweden has made meteorological data public. Although this data was not collected specifically for wind energy applications, such data can be useful also for wind energy, not least for small wind turbines where professional wind measurements on site cannot be afforded. Small wind turbines are often used off-grid and simulations of the planned energy system can be done with software such as HOMER. For this, it is essential to have a time-series of at least one year of wind data, which is representative of the wind pattern in the area (diurnal variation etc.).

When Sweden had an investment subsidy for wind turbines, there was also a requirement for wind turbine owners that received subsidies to provide operational statistics for the turbines, such as real monthly production data. These statistics were made public, and have been valuable in the development of wind energy. The Swedish system with collection and publication of operational statistics now continues on a voluntary basis.

In the USA, there have been federal policies on open data in place for a long time. There is a commitment that citizens deserve easy access to the results of research from their tax dollars which has paid for such research.

There is also a database on wind characteristics, available on www.winddata.com, intended mainly for wind energy applications. It contains data from many countries and is operated by DTU, the Technical University of Denmark. Access to the database is free of charge for Danish users, while all others need to pay a small fee.

OPEN SOURCE

The term “open source” means a development model that promotes universal access via a free license to a product’s design or blueprint, and universal redistribution of that design or blueprint, including subsequent improvements to it by anyone. It has become a huge success in software, but can also be used e.g. for open source hardware.

Open source can be important to build one’s own

1 The text is based on a lecture by Mr. Sven Ruin, TEROC at the Sida/LIFE Wind Power Final Review Workshop in Arusha, December 2015.

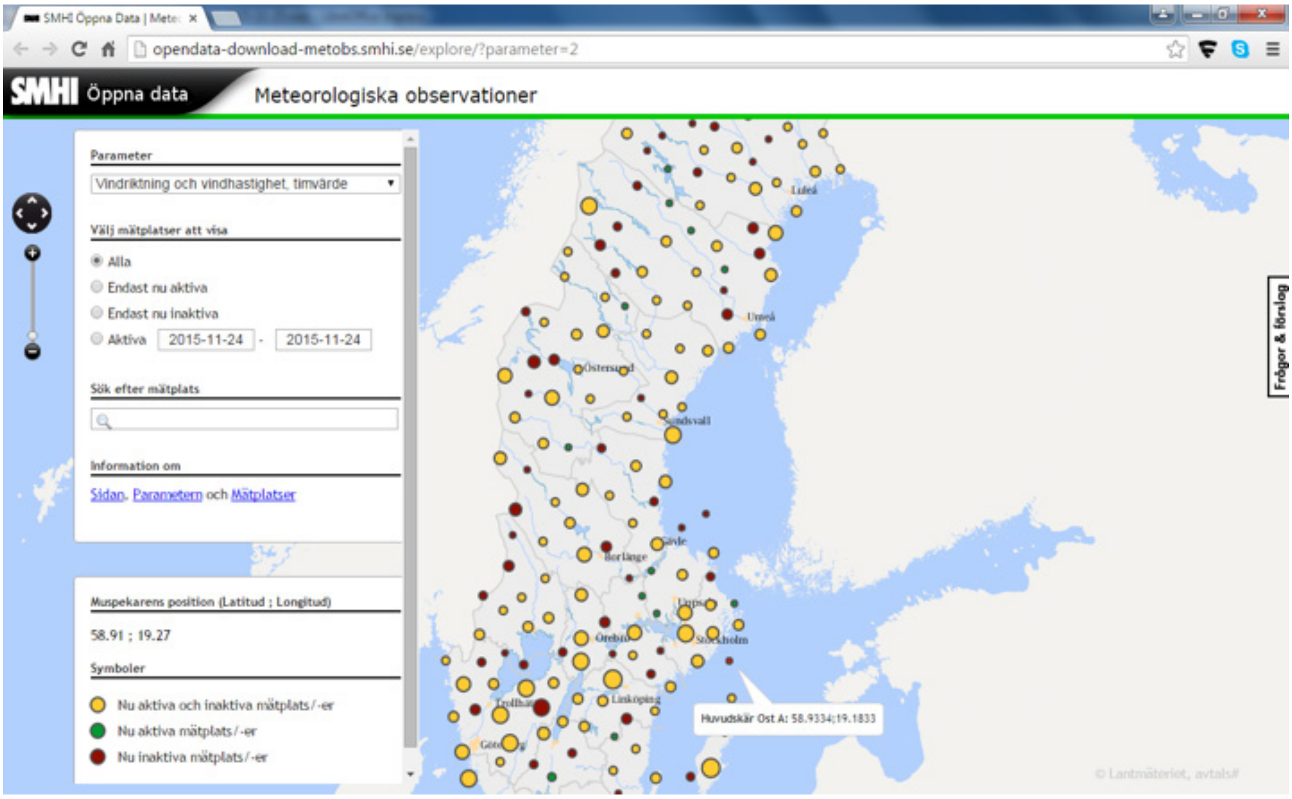


Figure 13: An example of the Swedish SMHI open meteorological data.

knowledge and enabling spare parts to be manufactured, to mention a few examples.

RetScreen is an example of software partially based on open source that helps decision makers determines the technical and financial viability of a potential wind power or any other renewable energy project. RetScreen has been introduced to all participants in the Sida/LIFE training and has been regarded as easy to run and use and thus been used in many of the participants´ change projects.

A pioneer in open source hardware is Hugh Piggott, a Scottish designer of small wind turbines, who publishes drawings on how to build your own small wind turbine. Hugh's designs are known for working quite well, and many people around the world (not least in developing countries) are now following his plans and building these turbines, which are up to 4 meters in diameter. This has led to the formation of Wind Empowerment, see http://windempowerment.org. Some of the participants in Sida/LIFE training program e.g. Mr. Arthur Karomba in Tanzania (see below) are now teaching villagers on remote locations how to build their own Piggott-type turbines. This way, the villagers also get good knowledge on how to maintain the turbines, e.g. to manufacture spare parts if needed.

Also the Swedish Wind Power Association has a project for open source small wind turbines. The background is that some manufacturers of small wind turbines in Sweden stopped their activities in this area (low prices lately on electricity and green certificates has contributed to this). The situation has left many owners of such small wind turbines in a bad position, because they have often relied on the turbine manufacturers for maintenance. Now some owners have a problem to keep the turbines running. Many manufacturers have a traditional business model of keeping almost all information secret, so in practice the turbine owners can hardly turn to anyone else for qualified maintenance. The Swedish Wind Power Association contacted a number of these (former) manufacturers and suggested that they release the design information as open source, in order to keep the turbines running in a safe way and protect the investment of the owners.

It is hoped that open source could also breathe new life into the turbine designs, so they could be further developed instead of being abandoned. JBA Vind AB is one of the companies that participates and has started making information about their small wind turbines public.

If someone wants to start making open source hardware or software, there are already good practices that can be followed. Examples of suitable open source licenses are:

- GNU GPL (General Public License) version 3, often used for software such as GNU/Linux
- CC-BY-SA (Creative Commons Attribution-ShareAlike) version 4.0, frequently used for other content such as drawings

In addition to the many general advantages often attributed to open source, there could be some special advantages for small wind turbines. One is that the development time of wind turbines is usually long and turbines are normally expected to operate for about 20 years or more. The players in small wind turbines are usually small, and can be especially sensitive to changing economic conditions during this period. Open source is a way to avoid that information is lost, e.g. in connection to a bankruptcy.

It should be noticed that the term "open systems" usually refers to control systems using an open communication protocol, which avoids vendor lock-in. See e.g. LonMark International, www.lonmark.org. Thus, open systems is not the same as open source, but they can go hand in hand. TEROC is a Swedish company working with wind energy and hybrid systems that has worked for a long time with open systems, and is now about to publish software as open source.

For more information contact:
Sven Ruin, TEROC, sven.ruin@teroc.se

Figure 14: In the Sida/LIFE training the participants learn about the various components of a small wind turbine at the TEROC facilities.

OPEN SOURCE APPLICATION IN TANZANIA

When the LIFE Academy Wind Power Training Program started in 2009 there was almost no small wind turbines installed in Tanzania and no knowledge about the potential for this technology. After training Mr. Arthur Karomba was starting wind monitoring and other preparations for setting up a small wind turbine in a rural village. He found a proper open source technology, a 1 kW Hugh Piggott wind turbine, which he started to construct by using local materials. This wind turbine now serves the village with cheap, locally produced electricity. He also established close cooperation with Vocational Education Training Authority, VETA, who also sent a person to participate in the Sida/ LIFE training program. As a result a number of practical training sessions took place which included setting up these small wind turbines at schools and dispensaries around the country. Local production and further development of the technology was also started at a workshop in Dar es Salaam.

At present, more than 10 such small wind turbines are now in operation around the country. Mr. Karomba has also translated into Kiswahili and distributed a practical handbook in how to build your own wind turbine.

For more information contact:
Arthur Karomba, Serengeti Windpower,
arthur.karomba@energioverda.com

YouTube video:
Rural electrification by wind technology in Kemgesi village, Serengeti Tanzania, 2015

Figure 15: The Hugh Piggott wind turbine can be built locally and handled without machines.

Wind resources assessment – a base for project development

The most important precondition for a good wind power project is of course that there are good wind conditions at the site. When this training started most of the participating countries had already made some inventories of the wind resources and some of them had also made a country-wide wind atlas. However, for most participating countries available wind data was of limited quality and the information could only give general information about potential sites for wind power projects. Therefore, it was in most cases necessary to carry out more detailed wind monitoring as part of a feasibility study of a project. This required setting up met-masts at the potential site for the project which measured wind data for at least one year. For a poor country with no experiences of wind power and limited meteorological data the process of getting proper wind data can be a long and cumbersome process. The examples given below, exemplify how the training has helped Change Agents in countries with limited knowledge about wind power to convince their organizations to invest in some wind resources assessment thereby getting better information and thus better energy policies.

ZAMBIA CASE

In 2009 when *Mr. Lufunda Muzeya* from *Ministry of Energy & Water Development* participated in the first LIFE Academy wind power training program, the general belief in Zambia was that wind power had no potential at all in the country. However, through Lufunda's Change Project which was focused on starting wind measurements in Western Zambia an increased awareness was growing that small wind power projects could be suitable in some areas with good wind speed. This hope was growing even stronger in 2011 when four new participants participated in the wind power training program. Their

Figure 16: Wind monitoring by hand-held equipment can give a first indication of possible sites for wind projects but in order to get reliable data for designing a wind farm, wind measurements at higher altitudes and over a longer time period is needed.

Figure 17: Monitoring wind data by remote control devices

change project was a joint project between three key institutions in the country; the utility *ZESCO Ltd.*, *University of Zambia (UNZA)* and *Kafue Gorge Regional Training Centre (KGRTC)*. Their impressive work resulted in setting up a wind power secretariat and creating a national network with various stakeholders and the general community. Besides working with various national bodies on the importance of starting wind monitoring, they also started negotiations with Sida and other donors about assisting the country in getting better wind data by installing more wind resource assessment equipment and provide technical support. Finally, Sida provided funding support for supplying and installing wind resource assessment equipment and providing technical support for actual wind measurement at KGRTC. Through this assistance, as well as efforts by the government of the Republic of Zambia with Support from the World Bank, wind monitoring has started aiming at producing a wind atlas and give input for more feasibility studies for concrete wind power projects.

Through their work, the Change Agents have contributed to a policy change in the country so that the wind power potential has been given full credit and the official plan is now to reach at least 1 MW wind power in small decentralized projects.

For more information contact:
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MOCAMBIQUE CASE

In Mozambique there are many rural areas without access to electricity and where drinking water remains a major problem as well and only 8% of the population has access to electricity. Since 2010, Ministry of Energy (lately Ministry of Natural Recourses and Energy) through *FUNAE – Fundo de Energia*, have installed masts in different sites to collect wind data in order to identify opportunities for the application of wind energy to reduce the effects of these problems. The change project managed by *Mr. Lutigardo Ernesto* as part of his training by LIFE Academy consisted of installing wind masts for data collection aiming to evaluate feasibility to install off-grid hybrid systems (solar and wind).

The project started by identifying 5 districts with rural communities in need of improved energy systems where the wind potential was regarded as promising. Through support from the Belgian government, a Portuguese company, GESTO Energy Consulting, carried out a survey of the wind potential in the country which resulted in a National Wind Atlas. By this initial work, 5 sites were identified for more detailed studies and at these sites installation of met masts were done. The wind data of 6 months was collected from these sites which indicated a wind speed at average about 4-5 m/s and this was regarded as satisfactory for carrying out more feasibility studies for the selected five sites. The sites are Namanla (Zambézia Província), Gelo and Lúrio (Nampula Província), Chissaua (Niassa

Figure 18: Wind metering at Chissaua Site - Niassa Province

Província) and (Quiterajo Cabo Delgado Província. After analyzing the wind data by using WindPro software, decisions were taken to finalize the design work and prepare for installation of off-grid hybrid systems of about 10 kWp in 5 sites selected. The plan is that the construction work and start-up of the 5 projects should have been completed by the end of year 2016.

The main problems and bottlenecks reported by the Change Agent have been the following ones:

- To get approval from the local authorities for the provision of space for the installation of masts;
- Delay in carrying out the activities because of the administrative process (cancelation of the concourse); and
- Inaccessibility of roads due to heavy rains destroying roads and bridges.

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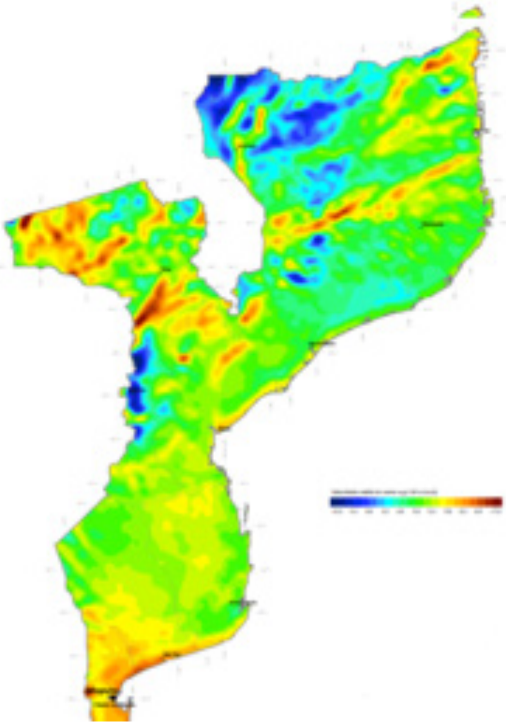

Figure 19: Wind Atlas of Mozambique done by GESTO ENERGY CONSULTING

A holistic view on grid integration of renewable energy generation in South Africa

By 2013–2014 the market for wind power took off in South Africa by installing 560 MW, with much more to come. By June 2015, 1.9 GW of the procured renewable energy capacity had already started operations (i.e. 37 projects). This is 27% towards the 2020 target of 7 GW renewable energy capacities to be commissioned by 2020. The reason for this quick take-off was a market response to the introduction of the Renewable Energy Independent Power Producer Procurement Program, REIPPPP. Since then more than 4 000 GWh clean energy has been generated.

Such a massive distributed generation of new renewable energy required a new thinking at ESKOM, the national utility. Mr. Riaan Smit, Chief Engineer at ESKOM was the person who took this as a mission for his Change work. When participating in the LIFE Academy training in 2010 he set an objective of his change project as to enable the successful grid integration of potential renewable energy projects in South Africa (expected 400–700 MW in wind power by 2013), by enabling and supporting the developments and decision making with required grid information. And then the wind industry and projects really took off in South Africa. A total of 37 projects with 3 454 MW capacity received preferred bidder status till July 2015, as well as the successful completion of Eskom's own 105 MW Sere wind farm. By end 2015, 15 wind projects with capacity of 1 207 MW were fully operational. A second goal was determining the developer potential and areas of interest to develop the required grid scenarios. This was used to prepare for grid capacity constraints, high level costing, risk analysis, support development nodes and support evaluation and approval processes.

The objective of Riaan's Change project was to enable the successful grid integration of wind power and other renewable energy projects by supporting the developments and decision making with required grid information. It included determining the developer potential and areas of interest and to develop the required grid scenarios. This has been done in order to prepare for grid capacity constraints, high level costing, risk analysis, support development nodes and support evaluation and approval processes. Activities carried out included communication and negotiations with project developers and other stakeholders, compiling a database and geographic information system and creation of scenarios for alternative localization of wind farms.

Riaan also supported the development of the internal process to facilitate the renewable energy projects to be processed technically and supported the development of the Transmission Grid Connection Capacity Assessment (GCCA)

Figure 20: The Sere wind farm (46x2.3 MW) was built by Eskom and with active involvement of Riaan Smit in the motivation and planning of the grid connection as well as some evaluation aspects.

document. The end results were improved for Bid Window applications evaluation and decision making. He also processed and prepared Geographic Information System (GIS) data for internal and external use and made network data and application data available in shape file as well as Google Earth formats to industry, Department of Energy (DoE) IPP office as well as Eskom users.

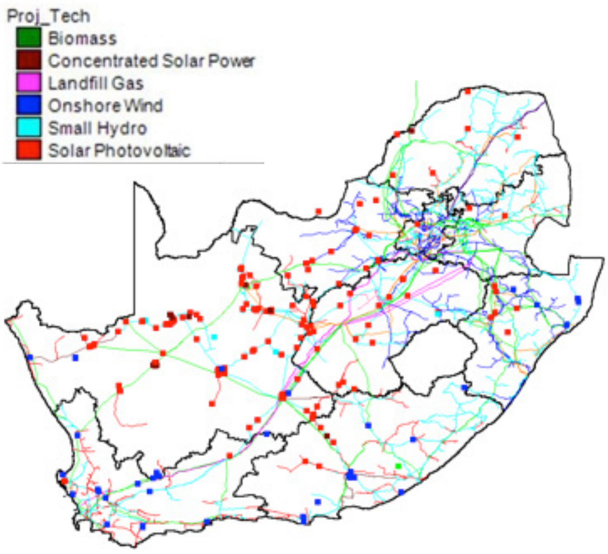

Figure 21: Eskom GAU database reflecting potential identified renewable energy projects in relation to the national grid.

Further, Riaan proposed the development of Renewable Energy Development Areas (REDA). This is now known as Renewable Energy Development Zones (REDZ, as prepared by the Department of Environmental Affairs = DEA). The REDZ were mainly developed by the Department of Environmental Affairs, with input from Eskom. It took into account the Grid Access Unit database, as well as formal application to the department for Environmental Impact Assessment approvals. This data is then also utilized in Eskom's development of Network Development Plans and the Transmission Development Plan. It can also be noted that persons from Department of Environmental Affairs and Council for Scientific & Industrial Research (CSIR) also participated in the wind power training programs arranged by LIFE Academy.

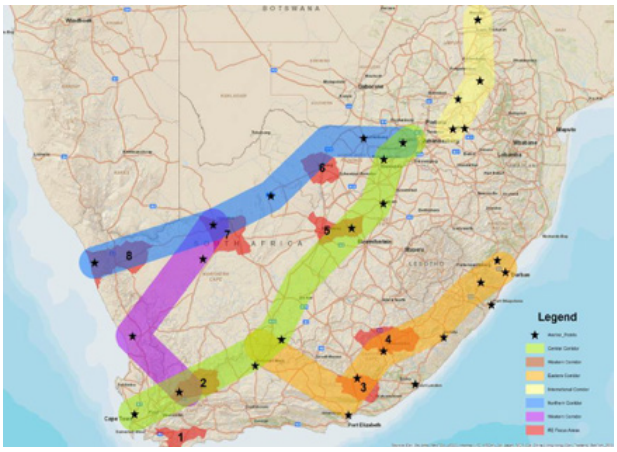

Figure 22: Proposed Strategic Environmental Assessment (SEA) corridors.

The change activities performed by Riaan have resulted in an interesting model for how the interaction between project developers and the grid owner can be more efficient and reliable. The model has been actively communicated to all stakeholders by the Change Agent and has facilitated the integration of the many new wind farms which are now in implementation across the country.

Some difficulties reported by Riaan included data quality from developers on locations and potential size. These were overcome by specifying minimum data requirements and handling it persistently. The large volume of projects led to Eskom charging an application process fee which was proposed and designed by Riaan. He also reported on how the many discussions with developers from South Africa as well as from overseas led to improved data and cooperation.

References:

- A holistic view on grid integration of renewable energy generation by Eskom. Final report for LIFE Academy Change Project, 2015.
- Process for Eskom IPP renewable energy grid integration. Published in Energize RE: Renewable Supplement, May 2013

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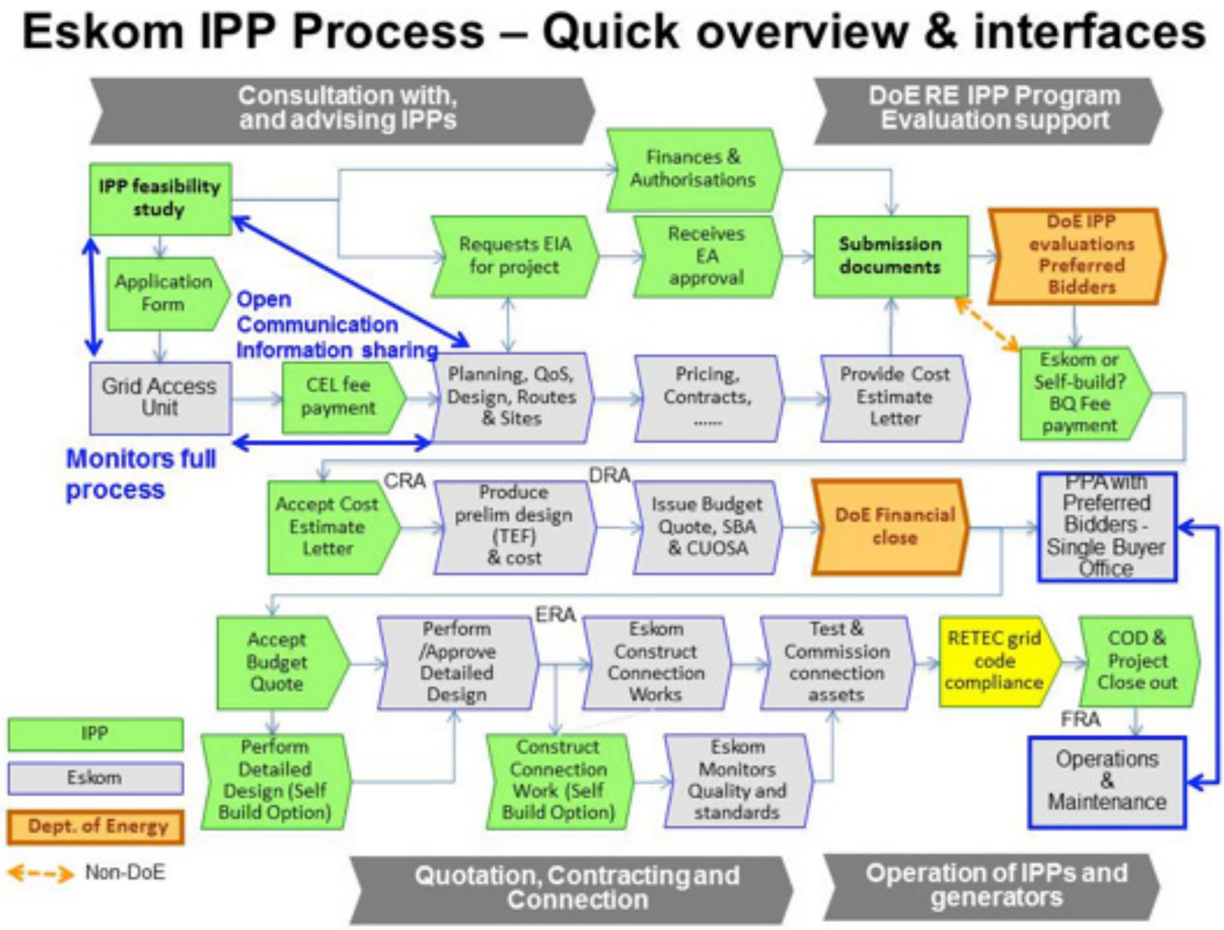

Figure 23: Eskom high level RE grid integration process.

"The developers who contacted me in an early stage were very thankful for our support, quite often noted they got more support from me than with their own local utility. Well, as a leader locally, that is a feather in my cap and well accepted to further improve on liaison with developers."

Riaan Smit

Putting policies in place

KENYA CASE

The Lake Turkana Wind Power (LTWP) project, Kenya Shillings 70 billion (€623 million), is the largest single wind power project to be constructed in Africa and is, to date, the largest private investment in the history of Kenya. It is arguably one of the most complex and challenging project financing undertaken in the renewable energy space in sub-Saharan Africa. The project is a key deliverable under the Kenyan Government's commitment to scaling up electricity generation to 5,000 MW and is a flagship project within the Kenya Vision 2030 program.[1] LWTP has signed up a 20 year Power Purchase Agreement (PPA) at a fixed price with the government through Kenya Power.

The LTWP project will provide cost effective renewable power to the Kenyan consumer and will comprise approximately 20% of Kenya's currently installed generating capacity. The LTWP consortium is comprised of KP&P Africa B.V. and Aldwych International as co-developers and investors, and Finnish Fund for Industrial Cooperation Ltd (Finn Fund), Industrial Fund for Developing Countries (IFU), KLP Norfund Investments, Vestas Eastern Africa (VEAL) and Sandpiper as investors. Aldwych Turkana Ltd, an affiliate of Aldwych International, will oversee construction and operations of the project on behalf of LTWP.

This giant wind farm could not have taking off unless a number of critical energy policies and supporting mechanisms such as a standardized Power Purchase Agreement (PPA), a national grid code and a Feed-in-Tariff (FiT) system, had been developed and introduced by a number of Change Agents from the LIFE Academy training program on wind power.

The foundation for the newly adopted national grid code and the breakthrough for new power contracts and purchase agreements were laid in 2012 by *Mr. John Keru Mwangi* from Kenya Power whose change project identified and selected key tests and procedures for grid integration of wind projects.

1 The Government of Kenya developed the Vision 2030 in 2005, in which it projected to achieve a 10% economic growth by 2030. This has implications on the overall structure of the economy, which translates into changes in energy demand.

His change activities were followed in the years to come by other participants in the LIFE Academy training. These change agents who all have a stake in putting policies in place are *Ms. Rose Murage, Kenya Power, Mr. Joseph Oketch* and *Peter Watoro* from *Energy Regulatory Commission (ERC)*.

The Kenya Electricity Grid Code is a consolidation of existing standards and practices intended to provide a transparent regulatory framework in line with the principle of non-discriminatory access to the transmission and distribution systems, and are designed to provide technical specifications and procedures. In order to maintain reliable grid performance with integration of wind power projects, the grid code required to be updated with specific requirements regarding the operation of wind farms. Commonly, wind farms are expected to support the grid as well as provide ancillary services just like conventional power plants. Some of these ancillary services included are active power, frequency regulation, low voltage and dynamic voltage control. The connection of wind power to the transmission system of Kenya will add new challenges to the real time operation and planning of the system. For this reason it was necessary to revise and update the old grid code taking into account some of the issues described earlier.

In addition to introducing the new grid code, a number of other favorable policies have also been put in place such as the FiT for the development of Renewable Energy Sources (RES) which has led to considerable interest among developers to invest in Kenya's renewable energy sector. The policy provides a fixed tariff of around 11 US Cents for electricity generated by wind-farms in grid connected mode. On wind technology, the Government has by end of 2015 received 236 applications, with a combined capacity of 1 118 MW which constitutes 74% of the total renewable energy sources. To further support the development, the Government, by a Public Private Partnership (PPP) Act and by encouraging Individual Power Producers (IPP) to carry out feasibility studies on wind energy has provided a basis for PPA negotiations with KPLC.

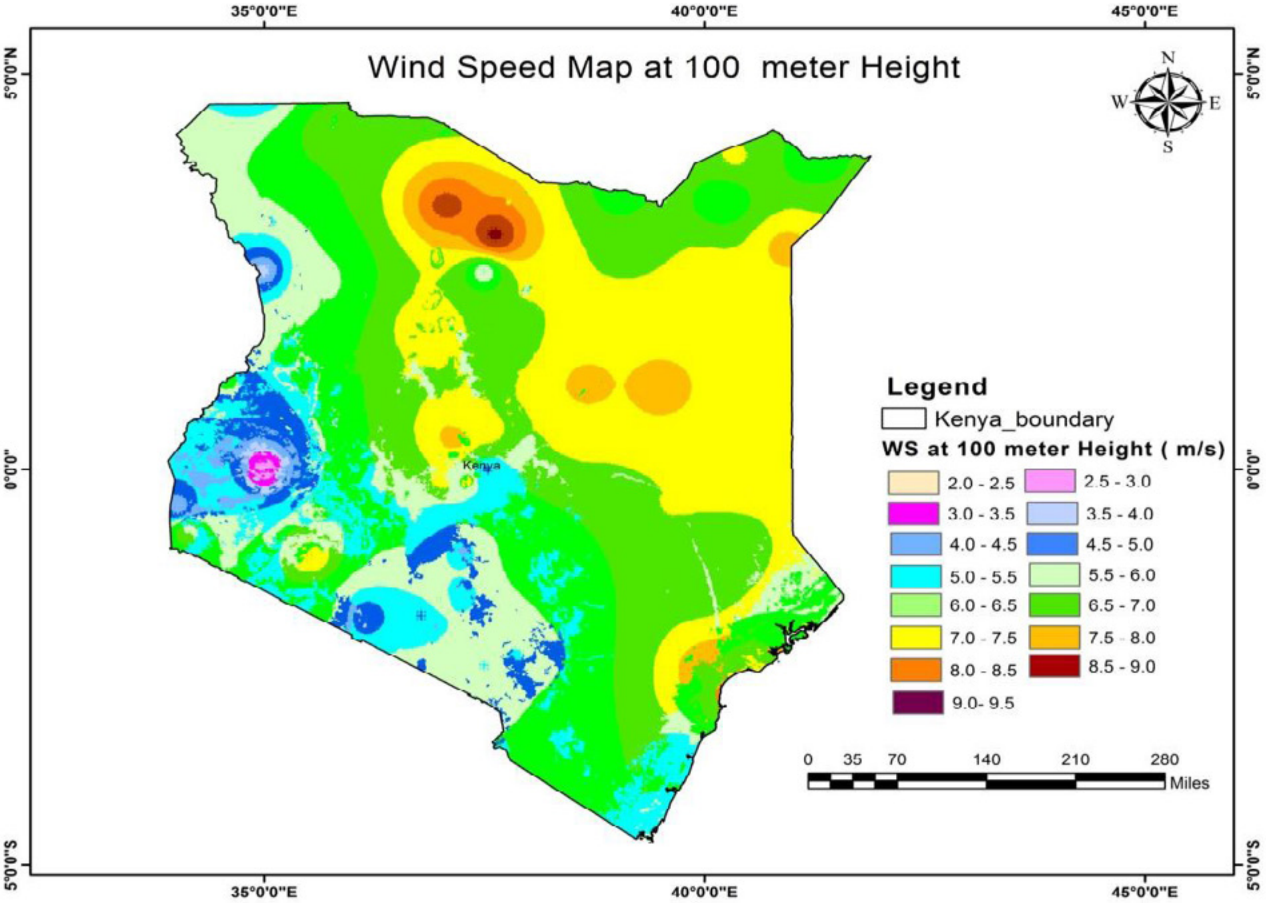

Figure 24: Wind Speed Map of Kenya at 100 m height.

An important pre-requisite for developing wind power on a larger scale is that the environmental impacts are also considered. This is a duty for the Energy Regulatory Commission, ERC as a regulator who, among other things, have to formulate, enforce and review environment, health and safety regulations in the energy sector. An important Change Project by Mr. Peter Watoro, ERC, has dealt with these issues. As a result new guidelines for Environmental Impact Analysis (EIA) have been introduced.

Figure 25: The Ngong II wind farm, with an installed capacity of 13.6 MW, is located 30 km west of Nairobi.

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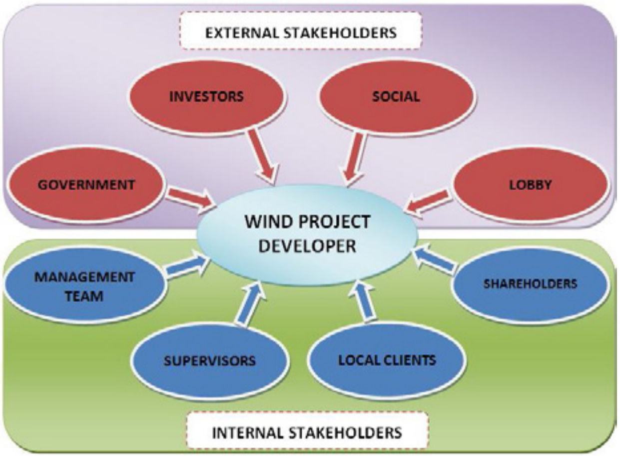
MONGOLIA CASE

The wind resources in Mongolia are first class and are estimated to be very huge but wind power development in the country is still only at the beginning stage. Ms. Bayarmaa Lkhagvadorj, NREC and Mr. Myagmardorjj Enkhmene, Qleantech LLC are two pioneering wind experts who have become Change Agents through the LIFE Academy training. In addition to these two Change Agents who have taken a leading role to explore the wind resources in the country by developing the first large wind farm in Mongolia and started the Mongolian Wind Energy Association, MWEA, also a number of other wind experts from various organizations have participated in the LIFE Academy training programs.

The main goals of their Change Projects were to carry out bankable feasibility studies for a 50 MW and a 250 MW Wind Farm in Southern part of Mongolia. These large scale wind energy projects are designed for future regional electricity markets in Northeast Asia, however, the main intention to start with is to utilize renewable energy for mining electricity consumption. Currently, the developers of both projects are obtaining the licenses for electricity generation & transmission, and construction of energy building. Also, the Power Purchase Agreement (PPA) is approved by the Energy Regulatory Committee of Mongolia. Today, the 250 MW wind farm project developed by Qleantech is in an early stage of the construction phase.

Until now, several obstacles have occurred in different cases during the implementation period. In an earlier stage, the main bottlenecks were lack of simulation of modeling, knowledge transparency and qualified specialists. Another challenge in implementing wind farm projects was obtaining the license and permission. This process has been in discussion for two years and negotiations for 1.5 years. It is a very time-consuming and costly process. Regulatory difficulties are often based on lack of experience to coordinate Public Private Partnership which is needed to support these large scale projects. But, the new Energy Framework approved by the Parliament of Mongolia is significant in supporting and encouraging private sector participation in energy sector. The Energy Framework includes "A National Renewable Energy Program" which aims to a total installed capacity generated by renewable energy power sources of 3-5% by 2010 and 20-25% by 2020 of the total energy production. "A Renewable Energy Law" sets forth feed-in tariff (FiT) ranges for renewable energy, categorized by type. The FiT for on-grid wind power is set to 8-9.5 cent/kWh and for off-grid is 10-15 cent/kWh. Two projects succeeded with contribution of these



MWEA
MONGOLIAN WIND ENERGY ASSOCIATION

Figure 26: By creating a national wind energy association, the Change Agents of Mongolia managed to get all stakeholders in the wind sector to work together for common goals.

opportunities as well as bankable feasibility studies using world standard modeling (WindPro). In addition to this successful method, being the first to enter a creating new market gave a kind of "Pioneer Advantage" for project developers. As pioneers the Change Agents have taken advantage as unique positioning, talking about their project without any competitor noise and creating loyal partners. Moreover, they have been collaborating in drafting

Figure 27: The first grid connected wind farm in Mongolia established by Public Private Partnership which has broken up the national monopoly. The project was undertaken in international cooperation with GE providing new technology. Due to the new feed-in-tariff policy the long term viability was secured.

the Energy Efficiency Law, the State Energy Policy, the Law on Investment and the Law on Concession, thereby pushing for encouraging public private partnership and domestic & foreign investments.

References: Salkhit Wind Farm Documentary, 2014. YouTube video documentary of the whole process of establishing the first wind farm in Mongolia.

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Getting wind projects bankable

SIDA EXPERIENCES OF LOANS AND GUARANTEES[1]

Sida has a very long tradition of supporting the energy sector by using various kinds of grants, loans and guarantees. An overarching goal which governs this is the same as for all Swedish development co-operation, namely to help create conditions that will enable poor people to improve their lives.

The capital flows have changed dramatically over the past decades. Direct investments are rising while ODA is kept on almost the same level. This makes it highly relevant for Sida and all other donors to work closely in conjunction with the private capital. This is probably crucial if we should be able to fund the new SDGs (Sustainable Development Goals). Traditional financing of infrastructure from donors, DFI's and development Banks continue to recede and we are witnessing an accelerating financing gap between what needs to be invested in infrastructure and the funding available. As we all know, needs for Infrastructure financing is enormous in the developing world and financing is often the most limiting factor. McKinsey have estimated that if every country builds what is needed in sub-Sahara Africa it would require about $490 billion of capital for new generating capacity, plus another $345 billion for transmission and distribution.

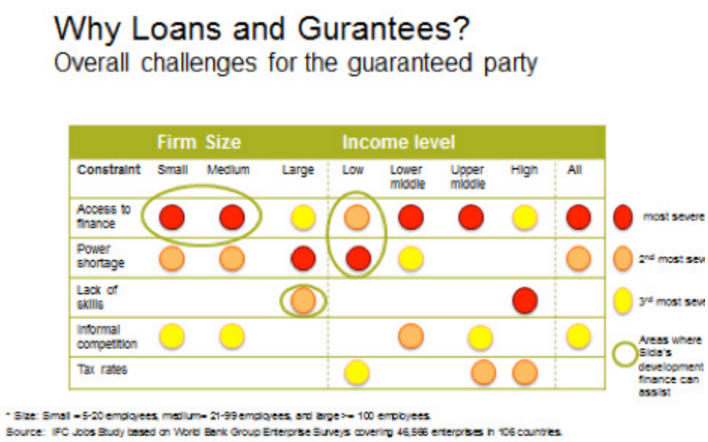

Figure 28: The figure illustrate that access to financing is the number one problem and access to power is the second runner up.

Loans and Guarantees focus on collaboration that will create commercial sustainability. Commercial sustainability is crucial because we want the investments to be vital in the longer run, not only with support from Sida which would only be "artificial respiration" for a limited time. According to Sida experiences we create make a big difference for relatively small amounts of money through better leverage of skills and capital in the private sector. Donor support can work as a catalyst to bring about more change at a faster rate. Sida and others can push the private sector to make investments, develop or introduce new products for the poorest which would not happen without a guarantee. Basically, for the same country appropriation we will gain more development results. Overall, the private sector drives economic growth in several different ways.

There are a number of reasons why guarantees are needed. The main reason is that generally banks are risk-averse and that makes it impossible for more risky companies/projects to access financing. The associated risks which are often credit risks are perceived as to high by the bank. Credit risks mean the potential loss due to a borrower's failure to pay back its loan. There could also be market related risks that can be covered with so called advanced market commitment which is a guarantee to ensure a viable market for a service or product and guarantee a certain volume. The last risk worth mentioning here is political risk which is related to actions of a state or a government and the investors do not have any influence at all over it. Another obstacle for investors is too short tenors which are a problem for companies since they need longer tenors to manage their cash-flows, plan its business, make the investment and get the needed payback of the investment, which usually takes a long time for energy investments. Often banks also receive short funding and since they can't miss-match its funds they can only lend short term. Short tenors can also be explained by the perceived risk, if that is high you don't want to lend long term.

1 The text is based on a lecture on Loans & Guarantees given by Ms. Lena Berglöw Elm, Sida/Swedish Embassy Nairobi at the Sida/LIFE Wind Power Final Review Workshop in Arusha, December 2015.

High collateral is another obstacle which comes from the banks need to cover its risks and especially when cash flows are unpredictable and can't be relied upon. This is a huge problem for companies who often don't have enough assets to put up as collateral.

The last general obstacle is high interest rates which makes borrowing very expensive. High interest rates can be derived from banks themselves borrowing at high rates since they are active in high risk markets with very high inflation, inflation which puts further upwards pressure on interests rates. Depending on what type of lending, the administration of a single loan can also be very expensive which add to the costs. Finally, the bank is dependent on interest margin to make profits and to be able to lend new money.

Sida's loans & guarantees are very flexible and can cover most risks and events. So, how can Sida then eliminate financing obstacles? Figure 29 show typical project finance where Sida co-guaranteed 50% of the debt financing of the project which included the construction of two wind turbines 50 MW each. Like many countries, Pakistan has a large energy deficit and they are dependent on foreign supply. Also, existing energy systems often use oil and diesel which is expensive so they also have a target for renewable energy. However, this kind of projects has limited access to financing and especially long term financing which project finance require. The solution was 25/75% equity to debt financing and the majority of the debt was provided by the Islamic Development bank and where Sida and ADB (Asian Development Bank) guaranteed 50% of the loan for 12 years.

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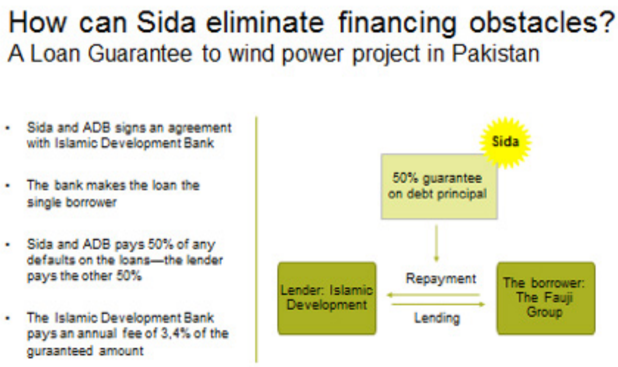

Figure 29: The figure show a typical project finance where Sida co-guaranteed 50% of the debt financing of a wind power project in Pakistan.

Training the banking sector in Sri Lanka

A key problem today reported by most Change Agents participating in LIFE Academy training is that banks often lack knowledge about wind power and renewable energy in general. And because of this they cannot really evaluate the risks and then they take that as a very good reason for not giving a loan. A solution for this is to raise the knowledge among banking staff on how to asses such projects. National Development Bank, NDB in Sri Lanka is an outstanding example on how by training a number of key staff becoming Change Agents through training at LIFE Academy; the bank now takes an active role in financing a rapid wind power development in the country. All in all, LIFE Academy has provided such training for four persons at NDB and one person from another bank, People's Bank of Sri Lanka. Two of these Change Agents are now working for International Financing Cooperation, IFC, in the region thereby providing even more possibilities for changing attitudes in the financial sector.

Figure 30: Mr. Nishanta Jayasooriya networking with some of his batch-mates during training phase in Sweden.

The participant's change projects have focused on developing guidelines and models for the banking sector in order to meet the quick growing demands. In order to facilitate the new banking requirement, a financial model to evaluate the financial viability of wind power projects was developed and introduced at the bank. Also other banks have started to use this model to analyze the commercial viability of a number of new large wind farms in the country and this instrument has made better decisions with regard to financing such projects. Their efforts have also resulted in less dependence on foreign experts.

"The wind power training offered by LIFE came timely and was of fundamental importance for raising capacity in our bank and made us less dependent on expensive foreign consultants"

Mr. Nishanta Jayasooriya, NDB/IFC

When NDB funded their first wind power project in 2009 the bank had to rely on foreign experts for their formulation of financing criteria and decision analysis. Since then, a number of wind power projects have followed including the current preparation for the next project, a 375 MW wind farm on Mannar Island. The good record from the bank has also resulted in an increased interest and willingness from international donors and banks to participate in investing with new wind projects in the country. For example, recently Asian Development Bank, ADB, has allocated a $200 million loan to support the wind power sector in Sri Lanka. ADB will provide financial support by buying debt instruments issued in the national and international market.

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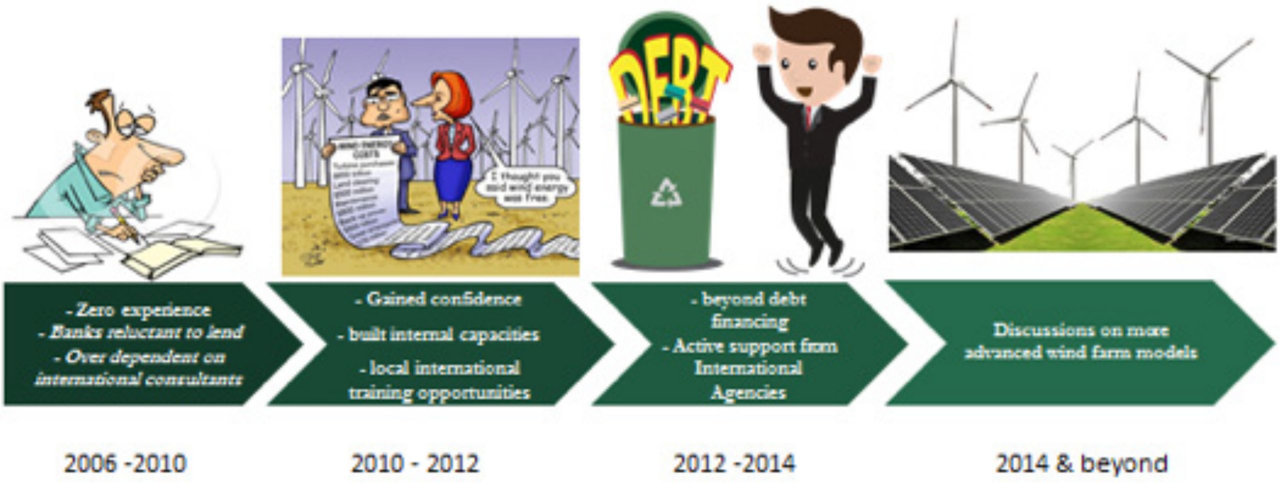

Figure 31: Financing of wind projects – the Sri Lanka story.

Figure 32: Sunset view of turbines from wind farm on the shores of Puttalam Lagoon in Sri Lanka.

South African private sector experiences

FROM FEED-IN TARIFF TO BIDDING PROGRAM

South Africa has seen a rapid development of wind farms and other renewable energy generation as a response to the introduction of the Renewable Energy Independent Power Producer Procurement Program, REIPPPP. It is important to note that the South Africa Government procurement program only allows an open tender process or known as the bidder program. It makes the initial feed-in tariff concept unacceptable. The IPP-Project Office of Department of Energy calls for bidders to submit their project proposals by responding to the Request for Proposal (RFP). This RFP is updated and released before each bid window. The Department of Energy has processed 5 procurement bid windows to date. The bid window 1 was launched in November 2011. The DoE has subsequently granted preferred bidders status for Bid Windows 1, 2, 3, 3.5 and 4.

Bids totaling 17.5 GW, from 305 bid submissions, have been received in the REIPPPP bidding process across Bid windows 1–4. The REIPPPP has successfully procured 6.3 GW from 92 IPPs in BW 1 to BW 4. By June 2015, 1.9 GW of the procured capacity had already started operations (i.e. 37 projects). This is 27% towards the 2020 target of 7 GW renewable energy capacities to be commissioned by 2020. The total foreign equity and financing invested in REIPPs (BW1 – BW 4) reached US$ 4.3 billion. This is equivalent to 53% of the total FDI attracted into South Africa in 2013. This overwhelming response not only confirms the significant potential for renewable energy in the country but also the significant market interest in establishing renewable energy supply capacity.

The main reason why the renewable energy program has been so successful in South Africa is due to government involvement and creditworthiness of the off-taker that has attracted low-cost, long-term debt.

The terms of project funding have become increasingly beneficial to projects sponsors as more projects are delivered and lenders become more comfortable with the risk. These factors have led to

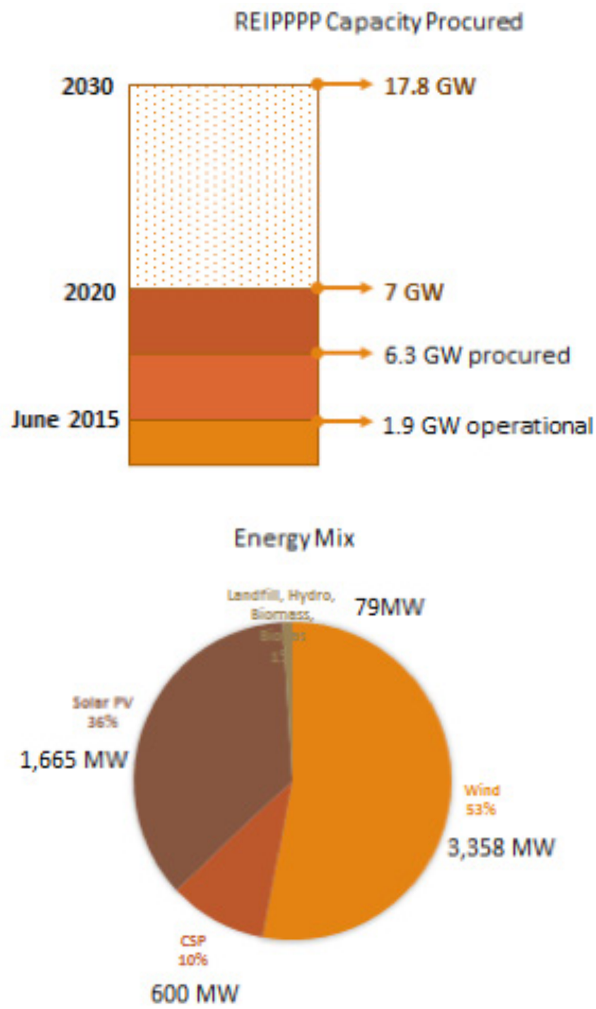

Figure 33: Procured portfolio of Renewable Energy capacity.

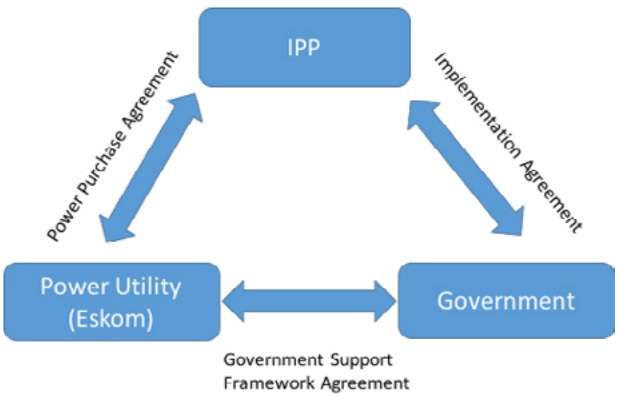

Figure 34: Framework of the REIPPPP Program.

the reduction in the required equity returns from investors in these projects (20% Bid Window 1 to 15% Bid Window 4 – 7% above South African government benchmark bond yields). This together with technology improvements and increasing competition has led to reduction in tariffs for wind projects by 50% from R1.14 per kWh in Bid Window 1 to R0.71 per kWh in Bid Window 4.

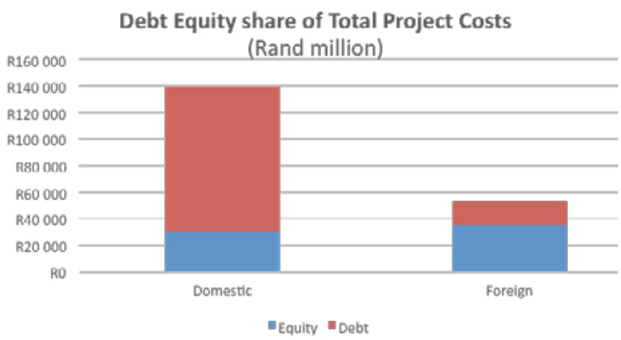

Figure 35: South African private financial institutions have financed $7.34 billion or 47.1% of total equity investment and South African DFIs (Development Financial Institutions) and SOEs (State Owned Enterprise) have financed $2.55 billion (includes direct debt, equity, community trust funding and BEE funding).

For the future bidding windows there are some anticipated changes in the financing structure. Debt: Equity ratios are expected to change from 70:30 to 80:20. As the SA Commercial Banks are highly exposed to the Renewable Energy industry, and there is a limit to what they can fund. There will thus definitely be new entrants in the debt space. Debt Funds and other foreign banks will probably enter the market to take up what the local banks cannot and because of the downward pressure on the pricing, traditional private equity is becoming too expensive and the opportunity for pension funds to invest is increasing. On the equity side, more and more pension funds will participate as the secure long term returns suit their profile for investments. Also, it is expected to see more vendors financing.

CHANGE AGENTS STORIES

When Sida/LIFE started the Wind Power training in 2009, the feed-in-tariff structure was still the policy in South Africa. Hence, a number of private company representatives participated in the training and developed interesting change projects including promising feasibility studies for wind farms. However, when the new policy REIPPPP replaced the feed-in tariff system the pre-conditions for their projects were dramatically changed. Still though, a number of private companies found interest in the new policy and developed their business models and showed interest for the training. One of these Change Agents from the private sector who participated in the training in 2011 was Ms. Carla Strydom who worked for a mining company.

Her Change Project was the development of a 40 MW wind farm project which was submitted in the 2nd window of the REIPPPP. However, the bidding was not successful due to a low wind speed at the site and hence not providing a competitive price. Her conclusion drawn from this failure was that the company, a mining company, which had no previous experience from the energy sector, had focused too much attention on building a wind project on the land owned by the company. The company has now introduced a new strategy focusing instead on sites with good wind conditions and acquiring projects developed by others.

The Copperton Wind Farm project that was developed by Mr. Zuben Jessa, another Change Agent trained by Life Academy in 2011 was successful in the 4th window of the REIPPPP.

The mining company together with Tata Power established a cleaner energy company in March 2012 and is currently commissioning the 2 wind projects that were successful in the 2nd Bid.

Figure 36: Cennergi Tsitsikamma Community wind farm project – 95 MW Wind farm built on community land in the Eastern Cape.

Carla Strydom is now working as an independent consultant assisting the private sector developing renewable energy projects.

Based on her experinces as a Change Agent, Carla Strydom gives the following recommendations when submitting a bankable project:

- Assure that the project can provide an affordable solution to its customers (lower marginal costs vs. other generation sources). Selection of a suitable project site, the installation of resource monitoring equipment to confirm wind resource and project energy yield and choosing the right technology for the site is critical for success in a competitive market. Easy access to the grid is becoming more and more important as well and the developer must be able to "self-build" and grid access infrastructure if they want to commission their projects on time.
- The country must have a clear and transparent regulatory framework, a detailed Power Purchase agreements (PPA) and Government support agreements (E.g. an Implementation Agreement) in place.
- There must be strong local and national support for the project. The local community and business as well as Government must be aligned. Local business and skills development must be strongly promoted by government.
- The project must be able to obtain a long term US or Euro denomination PPA, or is priced in a country with a liquid and relatively stable currency.
- The project must be able to secure a bankable turnkey fixed price EPC solution with a reputable EPC contractor. Reliability is more important than price, especially in remote areas and countries with a poorly developed infrastructure.
- The project returns must be attractive enough to attract non-recourse project finance dept.
- Proper counterparty credit risk mitigation, such as World Bank guarantees and where appropriate, political risk insurance is important to attract affordable project finance.

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Small off-grid wind/ solar/diesel hybrid systems

Despite a market trend that leans towards a grid-tied system with larger capacity, off-grid applications continue to play an important role in remote areas of developing countries. Off-grid applications include rural residential electrification, telecommunication stations, off-shore generation, and hybrid systems with batteries and other sources like solar or diesel. Over 80% of the manufacturers produce stand alone applications. In China, off-grid units comprised 97% of the market in 2009, and 2.4 million households still lack electricity. In the USA, off-grid small wind turbines account for most of the units deployed in distributed wind applications. For these reasons off-grid systems will continue to play a significant role, in China and in many other countries with non-electrified areas. In the future, significant growth of off-grid applications is expected in particular in India and African countries.

TANZANIA CASE

Health centers in rural areas of Tanzania are facing serious challenges. Besides a lack of qualified medical staff, equipment and medicine, bad road infrastructure and inappropriate energy supply becomes major obstacles in providing crucial basic health services for the rural population. This change project aims to solve the challenge of providing energy by finding a cheap and reliable model which can be replicated by others.

This change project has been implemented in six health centers in Babati and Hanang districts in Manyara region, Tanzania. The energy system is a hybrid system combining wind energy and solar energy into an integrated off-grid system. This system offers a maximum power throughout the day because at the absence of solar, wind energy charges batteries and vice versa.

The Change Agent, Samwel Kessy, started developing his action plan for implementing this change project in 2011 during his participation in the LIFE training program. On returning to his employer TANESCO (the national utility) he continued collecting baseline data and started the technical preparation of the project. However, he had difficulties with financing as TANESCO could not finance the project as it is an off-grid project. But the Renewable Energy Agency, REA, found the project of interest and promised funding but under a condition that the implementing body should be a private company. Thus, Samwel had to set up his own private company, Lucas-EMS, who successfully implemented the project.

As wind power is new in the country, there was no domestic provider of the technology. But Samwel was lucky getting to know a fellow wind expert in China during his training at LIFE. Through this contact he got information about a suitable type of wind turbine and formed contacts with Chinese company who could provide the equipment. As a result he got a very good turbine which has performed very well since start in August 2014.

Since commissioning of the project to the district authorities all systems have been working proper without any serious operation problems. Through training of local staff during the construction phase all staff know about the daily operation of the system which now supplies the health center with proper lighting. Previously, the health center has been using poor sources of lights e.g. kerosene lights and torches. The new system makes job easier and safer especially during night hours. Also, refrigerators which have been using gas are now using power from wind and solar. Previously, gas might run out and often took more than a month to be refilled, but now they are sure to have medicine in freezers at all time.

The system also provides more electricity than is used today at the health center and this surplus is used to charge mobile phones and in the future provide an opportunity to have TV.

CHALLENGES	WAY FORWARD
20 % Gov. t goals for RETs	90 % Gov.t goals for RETs
Lack of knowledge about wind power	Access to global network of experts through LIFE training
Lack of funding	A well prepared Change Project Action Plan
Lack of support through employer	Start your own company
Construction in remote areas with bad roads	Involve local people and provide training in O&M

Figure 37: Villagers' participation in erection of the mast and assembly of the wind turbine assisted by the Change Agent.

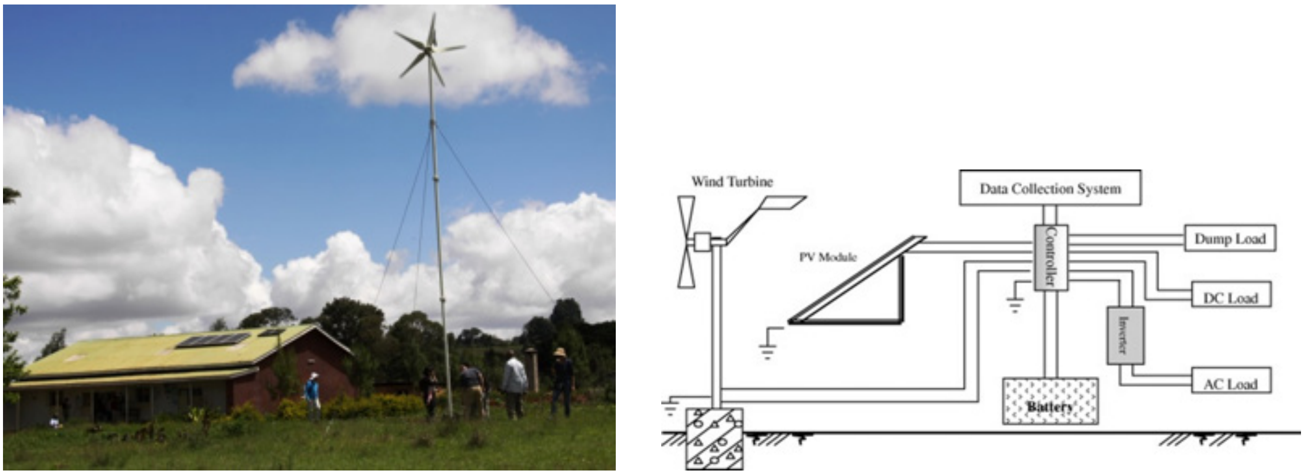

Figure 38: Quameyu Health Centre, 1 kW Wind power and 1 kW solar hybrid system with an integrated battery back-up.

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NEPAL CASE

The first Change Agent from Nepal who participated in the LIFE Academy training in 2009 was Ms. Aruna Awale, Alternative Energy Promotion Centre, AEPC. Her pioneering work resulted in a first wind energy policy document in Nepal and an increased interest among various stakeholders to explore the wind power potential. Other Change Agents to follow in 2011 was Mr. Ram Poudel, AEPC and Mr. Pralhad Sapkota, Ministry of Energy. Together, they laid the foundation for a national strategy and as a result of their ambitious work, the Asian Development Bank (ADB) became interested in their plans and decided to support implementation of a number of small wind/solar hybrid projects in villages around the country.

The AEPC and Asian Development Bank (ADB) entrusted Mr. Poudel to lead implementation of the first pilot wind power projects in Nepal. This project demonstrated the first successful application of wind energy resources in Nepal and helped to educate policy makers that such an endeavor is scalable. A scalable model based on Rural Renewable Service Company (RuRESCo) concept was also introduced.

In 2013, the responsibility for further implementation of AEPCs small scale wind projects were taken over by the Mr. Prakash Aryal, AEPC, another Change Agent, who also undertook training at LIFE Academy.

> ***"I have a dream to build at least 500 MW wind farm at the bank of Chisapani, Karnali (high wind zone) and connect it into the main grid."***
>
> *Prakash Aryal*

References:

Quantitative decision parameters of rural electrification planning: A review based on a pilot project in rural Nepal. Article published in Renewable & Sustainable Energy Reviews, Elsevier, 2013.

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Figure 39: Nepal's largest wind solar hybrid project on 25 kW inaugurated in early 2016 by support from AEPC and the Change Agent Mr. Prakash Aryal (in Phaparbari, Makawanpur).

MYANMAR CASE

Myanmar has very intermittent wind nature and hence it has not been regarded as a viable energy source. Nevertheless, it would be useful for potential hybrid solutions for remote areas. Breakthrough work in this direction has been taken by Ms. Thi Thi Soe, DRI/MOST, a Change Agent from LIFE Academy training program. Her Change Project was a feasibility study for using wind power for rural electrification. As a pilot area, Wetkaik village along the coastal area of Yangon region was chosen. As there was little or no monitored wind data, the data for the region was collected from NEDO and NASA data base. The project included a number of modeling work using HOMER software. These studies have implied a good potential for using wind power in the pilot area as well as in other remote regions of the country.

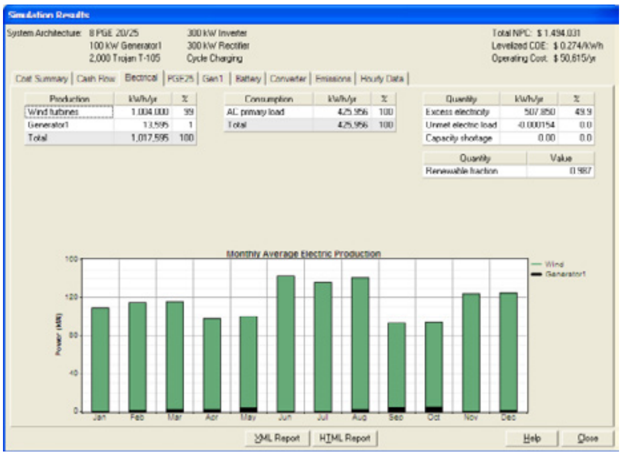

Figure 40: Power generation by source in Myanmar with 6 m/s wind regime.

The power produced by 8 wind turbines (2.5 kW) and one diesel generator set over the course of the year is displayed in Figure 40. The reason for choosing diesel generators is that there are already diesel generators installed in most remote villages and these could be used also in future but only to a limited extent. The total yearly energy production from its component of wind sources are of 99%, and 1% from the diesel generator. The optimal design can perform the lowest levelized cost of energy to 0.274 $/kWh.

In Myanmar, most of the remote areas still do not have access to electricity. There is diesel-based grid systems set up by the private sector. There exists little or no reliable access to communication systems, television, and health facilities, all of which require electricity. It is felt that application of renewable energy might be appropriate in the form of distributed electricity supply system to the rural area. The supply of adequate and reliable energy is quickly incorporated into everyday life. Rural areas that can be influenced are health, education, entertainment, income generation, social status, gender issues, migration, and the environment among others.

For this purpose, wind diesel hybrid system optimization model built in HOMER software tool is found out the expected outcomes, technical and economic, from different types of system architectures for the actual load demands in Wetkaik village. However, while Myanmar has abundant renewable energy resources, harnessing them is hampered by several factors as;

- Lack of fully transparent institutional and legal framework to support exploration, development and deployment;
- Limited financial capital to support research & development, market-based investment programs and development of physical infrastructure;
- Lack of human resource capacity; and
- Subsidized power and petroleum prices.
- Establishment of a more supportive environment for development of Myanmar´s renewable energy sources should include the following:
- More information on the resource potential;
- Improved inter-ministerial cooperation and coordination;
- Promotion of private sector participation;
- Clarification of government policy regarding renewable energy; and
- Technology dissemination regarding suitable pilot projects.

References:

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- Book: Wind power project development for Rural Electrification in Myanmar, Project-ID (130849),ISBN (978-3-659-81241-5), LAP LAMBERT Academic Publishing

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"For the future, I'll try my best to work for wind power project development in Myanmar under Renewable Energy Research Department, DRI, and MOST not only as a researcher, trainer and committee member of Renewable Energy Development for Myanmar but also a Change Agent of Life Academy for the Green World."

Thi Thi Soe

Figure 41: The Change Agent has been actively involved in developing locally manufactured small wind turbines and a 3 kW turbine prototype has been tested at a number of sites.

Building capacity by networking

In order to achieve real Change in a society you need to get all stakeholders onboard embracing a common vision. From Thailand, a number of wind experts from the utility EGAT had participated in the LIFE Academy training but it was not until a representative from the private sector took part in 2012, that a real breakthrough took place. The Change Agent, Ms. Nuanlaong Srichumpon developed an important wind farm project but she also initiated a national wind power network, ThaiWEA with an ambition to establish a network for all actors in the wind power sector. ThaiWEA was established in year 2013 as a non-profit membership-based trade association embracing the wind sector, with Thai and international members from related organizations. ThaiWEA aims to be a center of wind industry in Thailand which will provide information exchange, matchmaking, technology transfer and professional experts. The organization will also play a role as industry representative to Thai government by providing recommendations to government policy, regulations and arrange public hearings.

The following pictures (Figure 42) illustrate the steps taken to set up ThaiWEA; it can be regarded as a step-by-step guide for others who would like to start a national wind power association.

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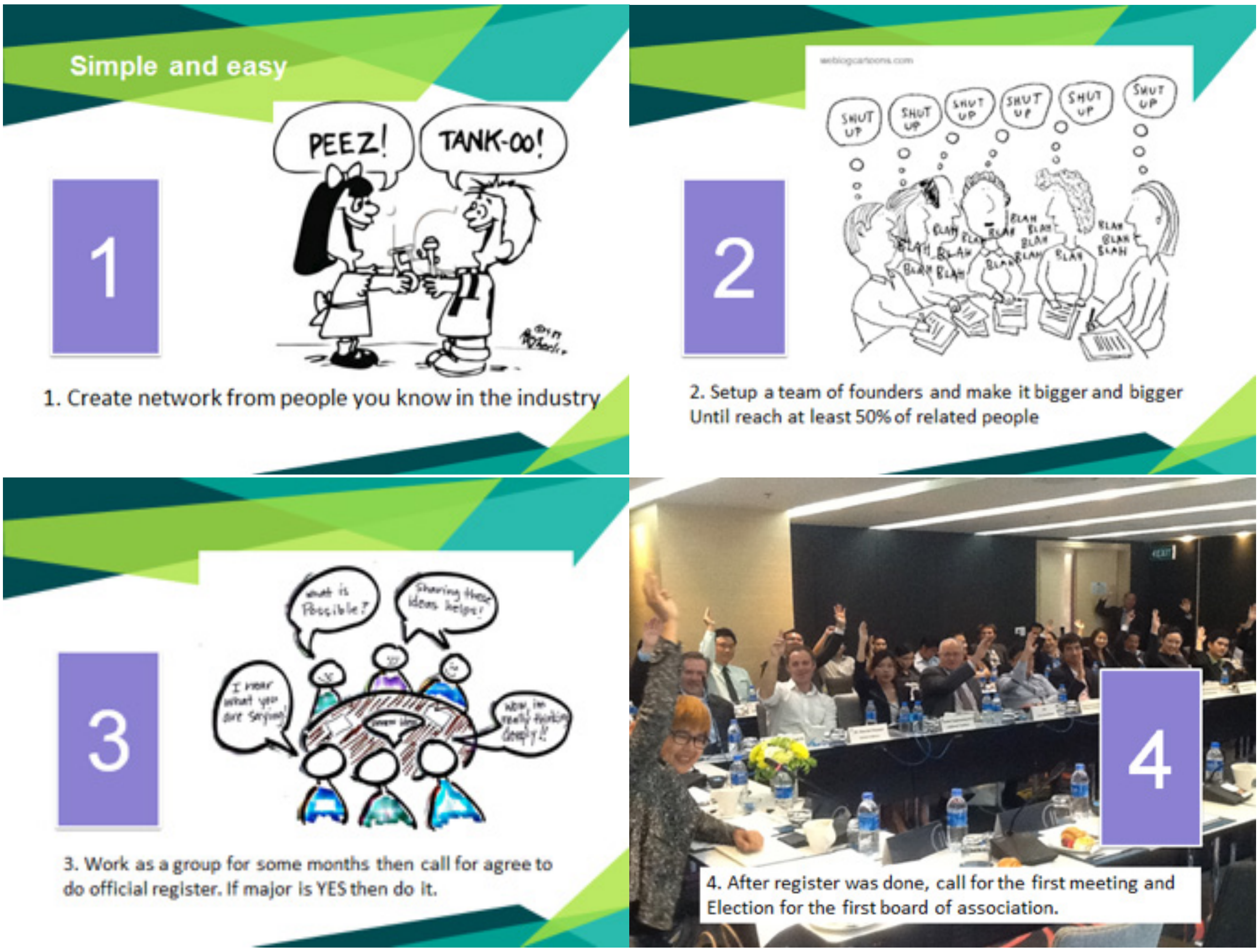

Figure 42: A Step-by-step guide for starting a national wind energy association.

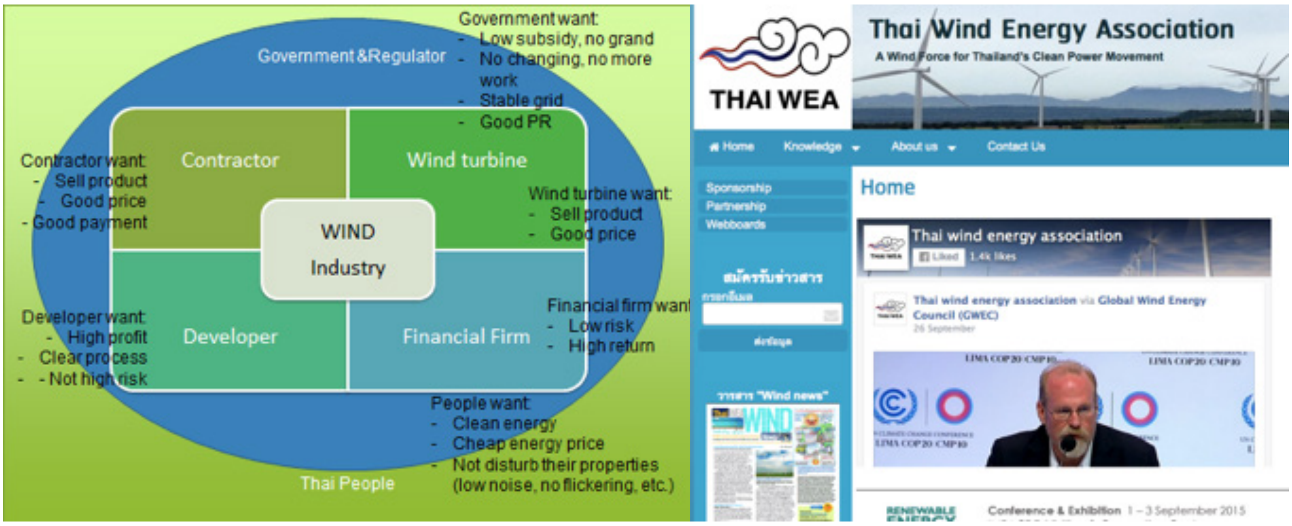

Figure 43: ThaiWEA is a platform for getting all stakeholders together.

What I learnt from my Change Project:

- Believe is thinking, but doing is fact – just do it!
- Association starting is a one-time chance – if you do it you will not get a second chance!
- When working for many people you cannot make everybody happy – the loser will be angry and the winner happy – so just do what you have to do!
- Wind power really needs strong support from government so wind industries association is needed for every country to be a "speaker" and coordinator between public and private

Ms. Nuanlaong Srichumpon founder of ThaiWEA and a Change Agent from LIFE Academy

Way forward

During the past decade we have seen dramatic shifts on the energy scene with respect to a number of issues. For example, according to newly released statistics from The International Renewable Agency, IRENA, effective deployment policies have supported the growth of renewables globally. More than 145 countries (as of early 2015) have introduced regulations (e.g. feed-in tariff, net metering, bidding systems), and fiscal incentives and public financing (e.g. capital subsidy, investment or production tax credit). This number has increased nearly ten times over the past decade. Renewables now make up a distinct share of the energy mix in several countries, with substantial growth anticipated in the coming decades. Similar trends were also confirmed at the Arusha workshop. These changes coupled with rapidly declining costs for wind power and other renewables have led to a situation where wind and solar power now are compatible with coal based power production and other conventional energy sources.

The great energy challenge of the future is to meet the demand rising of a growing world at the same time as the energy system has to be changed in order to be more sustainable. Recent global agreements on climate and sustainable development confirm the emerging consensus on the role of renewables, which is further attested by the adoption of renewable energy targets in at least 164 countries to date (Intended Nationally Determined Contributions, INDCs). The decisions taken at the COP 21 meeting in Paris, December 2015 further underpins this direction towards a great leap forward for wind power and renewables.

However, change does not happen by itself; change needs development of human resources and a re-thinking among all stakeholders who have an influence on key energy decisions. A lot of old technology and knowledge have become obsolete and the knowledge about the new energy sources like wind, solar and other renewables are still not commonly spread among many key stakeholders in the energy sector. Hence, the need of education and training in new skills and at all levels is huge. The participants at the Arusha workshop also emphasized the need of bringing knowledge to politicians and key decision makers.

In order to meet such a growth in demand of training on global scale, so called Massive Open Online Course, MOCC, has been discussed as a solution. This was also one of the discussion themes at the Arusha workshop. The conclusion from that discussion was that MOCC might have a possibility to contribute but only to a limited extent. Instead, the participants stressed the need of physical meetings where you can discuss with experts and colleagues from other countries. They also pointed out the importance of study visits where you can see with your own eyes how things can be done. Communicating and learning from others successes and experiences is also important to correct for misperceptions and myths which are common in the energy sector. Many participants verified this and recommended shorter and more focused training also targeting politicians and senior managers at utilities and ministries.

Based on the Indian experiences from NIWE (former C-WET), who has a very long tradition of international wind power training similar to the program provided by LIFE Academy, such training in future should be more towards shorter courses and e-learning as people have greater difficulties to stay away from home office for longer periods. An alternative and complement will also be webinars, videoconferences, chat-rooms etc.

When discussing capacity building and human resources development at the Arusha workshop, a number of ideas and proposals were brought up. It was quite clear that the need of training is still there in most of the participants' organizations and countries but it should be more focused and targeting key areas as wind measurement, data analysis and software tools, technology development, grid integration, environmental issues etc. However, it was stressed that the training should not only be focused on wind power alone but be integrated with solar energy and other renewables as well as energy efficiency.

There is also a need of better system thinking in the energy sector and that has to be mirrored also in how donors and training organizations develop their training packages. For example, by applying a demand side management perspective (DSM) where you start by making the energy use more efficient and then you design your energy supply system accordingly your total system cost would be lower compared with traditional thinking only focusing on the supply side based on historical data on energy demand. Especially when you are dealing with small off-grid or mini-grid system such an approach makes renewable energy projects even more economically viable.

When LIFE Academy started the wind power training program most focus on the training was on large scale wind farms. However, quite soon more and more of the participants showed interest also for smaller off-grid wind turbines and hybrid solutions where wind and solar are combined into one system. Hence, the program was gradually adapted into including this kind of technology as well. During the discussions in Arusha, it was quite clear that this is an area where there is a lot of need for training and capacity building. As it becomes more obvious that it will be impossible to reach the UN Millennium Development Goal for Energy just by extending the big centralized national power grids, more and more focus now is towards building mini-grids and supporting off-grid solutions. Thus, the need for capacity building for small scale hybrid solutions and establishing mini-grids must be recognized and more support given to this area. As this area does not have many strong actors in business and is often not seen as an option by the traditional actors (e.g. the utilities) there should be much more attention given by the donor community to the need of capacity building in this area.

APPENDIX 1

Short summaries of energy situation in participating countries

WIND POWER STATUS FOR CHINA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	2565.67
Wind Power Production (GWh)	141197
Share of Energy Supply in Fossil Energy (%)	89
Share of Energy Supply in Renewable Energy (%)	11
Total Electricity Consumption (TWh):	5121.93
Electricity Consumption/Population (MWh/ capita)	3.77
Total CO2 emissions (million metric tons)	8977.10
CO2 Emissions/Population (t CO2 /capita)	6.60
CO2 Emissions/GDP (kg CO2/2005US$)	1.85

(Source: IEA 2013 data)

Status for Wind Power Development:

- China is No 1 in the world in wind power installations and more than 30 provinces have wind farms. The first off-shore wind farms have recently been installed.
- The Chinese wind turbine manufacturers are among top 3 in the world and their export is rapidly growing

Major policies and actions for promotion of Wind & Renewable Energy:

- Notice of the State Development and Reform Commission on Offshore Wind Power electricity price policy (2014) and Notice on issues concerning State Grid Corporation of China to buy distributed Solar PV generation projects' electricity products invoice etc. (2014)
- Interim measures for the new power access network supervision (2014)
- Renewable electricity generation bonus (2013)
- Notice on integrating and accommodating wind power into the grid (2013)
- China Energy White Paper (2012)Wind Power Technology Development 12th Five Year Special Plan (2012)
- Renewable Energy Electricity feed-in tariff (2012)
- Market entry standards for wind equipment manufacturing industry (2010)
- Onshore wind power feed-in tariff (2009)
- Renewable Energy Law (2006, revised 2009)

Key organizations for promotion of Wind & Renewable Energy:

- National Development & Reform Commission, NDRC
- Chinese Wind Energy Association, CWEA

WIND POWER STATUS FOR ETHIOPIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	45.32
Wind Power Production (GWh)	356
Share of Energy Supply in Fossil Energy (%)	6
Share of Energy Supply in Renewable Energy (%)	94
Total Electricity Consumption (TWh)	6.11
Electricity Consumption/Population (MWh/capita)	0.06
Total CO2 emissions (million metric tons)	8.50
CO2 Emissions/Population (t CO2 /capita)	0.09
CO2 Emissions/GDP (kg CO2/2005US$)	0.31

(Source: IEA 2013 data)

Status for Wind Power Development:

- Ethiopia has two wind farms in operation, the 51 MW Adama 1 wind farm and the 120 MW Ashegoda wind farm. The second phase of Adama wind farm (150 MW) is under construction.
- The Ethiopian government has an ambitious plan for wind energy and has developed a master plan for solar and wind energy.Major policies and actions for promotion of Wind & Renewable Energy:
- Growth and transformation plan (GTP) 2011–2015 (2011)
- Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Energy

WIND POWER STATUS FOR EGYPT

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	82.82
Wind Power Production (GWh)	1286
Share of Energy Supply in Fossil Energy (%)	96
Share of Energy Supply in Renewable Energy (%)	4
Total Electricity Consumption (TWh)	148.72
Electricity Consumption/Population (MWh/capita)	1.81
Total CO2 emissions (million metric tons)	184.32
CO2 Emissions/Population (t CO2 /capita)	2.25
CO2 Emissions/GDP (kg CO2/2005US$)	1.43

(Source: IEA 2013 data)

Status for Wind Power Development:

- Wind Atlas available indicate very good wind potential especially in the Suez area
- A number of installed large wind farms and many in the pipeline

Major policies and actions for promotion of Wind & Renewable Energy:

- Renewable energy tax incentive (2014)
- Feed-in tariff for wind and solar projects (2014)
- National Renewable Energy Strategy (2008)

Key organizations for promotion of Wind &Renewable Energy:

- New and Renewable Energy Authority , NREA
- National Research Center, NRC

WIND POWER STATUS FOR INDIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	523.34
Wind Power Production (GWh)	33583
Share of Energy Supply in Fossil Energy (%)	74
Share of Energy Supply in Renewable Energy (%)	26
Total Electricity Consumption (TWh)	978.82
Electricity Consumption/Population (MWh/ capita)	0.78
Total CO2 emissions (million metric tons)	1868.62
CO2 Emissions/Population (t CO2 /capita)	1.49
CO2 Emissions/GDP (kg CO2/2005US$)	1.25

(Source: IEA 2013 data)

Status for Wind Power Development:
- India is the second world largest country in wind power installations.
- Due to the new government initiatives on renewables they have a de facto target of 5 GW per annum for the rest of the decade.

Major policies and actions for promotion of Wind & Renewable Energy:
- National Renewable Energy Law (2015)
- Accelerated depreciation tax benefit (2014)
- Rural Electrification Programme (2014)
- 12th Five Year Plan 2012-2017 (2013)
- Renewable Energy Certificates System (2011)
- Renewable Energy Tariff Regulations (2009, revised 2010)
- Generation based incentives for wind power (2008)
- Electricity Act (2003)

Key organizations for promotion of Wind & Renewable Energy:
- National Institute for Wind Energy, NIWE (formerly C-WET)
- National Renewable Energy Agency, NREA
- Agency for Non-conventional Energy & Rural Technology, ANERT

WIND POWER STATUS FOR KENYA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	17.59
Wind Power Production (GWh)	18
Share of Energy Supply in Fossil Energy (%)	19
Share of Energy Supply in Renewable Energy (%)	81
Total Electricity Consumption (TWh)	7.33
Electricity Consumption/Population (MWh/ capita)	0.17
Total CO2 emissions (million metric tons)	11.70
CO2 Emissions/Population (t CO2 /capita)	0.26
CO2 Emissions/GDP (kg CO2/2005US$)	0.42

(Source: IEA 2013 data)

Status for Wind Power Development:
- Wind Atlas available indicating a large potential for wind power
- A number of large wind farms installed and under construction a s well as small-scale and hybrid systems

Major policies and actions for promotion of Wind & Renewable Energy:
- Feed-in Tariff for renewable energy (2008, revised 2010 and 2012)
- Least cost power development plan 2011–2031 (2011)
- Energy Act (2006)

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Energy
- Energy Regulatory Commission (ERC)
- Kenya Power
- KenGen

WIND POWER STATUS FOR MOCAMBIQUE

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	16.63
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	10
Share of Energy Supply in Renewable Energy (%)	90
Total Electricity Consumption (TWh)	11.53
Electricity Consumption/Population (MWh/capita)	0.45
Total CO2 emissions (million metric tons)	2.95
CO2 Emissions/Population (t CO2 /capita)	0.11
CO2 Emissions/GDP (kg CO2/2005US$)	0.26

(Source: IEA 2013 data)

Status for Wind Power Development:
- Wind Atlas and wind data for 5 priority sites
- Feasibility studies for 5 wind/solar hybrid projects (10 kW each) – planned to be constructed during 2016

Major policies and actions for promotion of Wind & Renewable Energy:
- Renewable Energy Development Strategy 2011–2025 (2011)
- Energy Policy (1998)

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Energy
- Electricidade de Mocambique, EdM
- Fundo de Energia, FUNAE

WIND POWER STATUS FOR MONGOLIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	16.34
Wind Power Production (GWh)	85
Share of Energy Supply in Fossil Energy (%)	95
Share of Energy Supply in Renewable Energy (%)	5
Total Electricity Consumption (TWh)	5.46
Electricity Consumption/Population (MWh/capita)	1.92
Total CO2 emissions (million metric tons)	18.66
CO2 Emissions/Population (t CO2 /capita)	6.57
CO2 Emissions/GDP (kg CO2/2005US$)	3.66

(Source: IEA 2013 data)

Status for Wind Power Development:
- Good wind potential and the first wind farms established

Major policies and actions for promotion of Wind & Renewable Energy:
- Renewable Energy Law (2007)
- National Renewable Energy Program 2005–2020 (2005)

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Energy
- NREC
- National Dispatch Centre
- Mongolian Wind Energy Association

WIND POWER STATUS FOR MOLDOVA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	0.31
Wind Power Production (GWh)	1
Share of Energy Supply in Fossil Energy (%)	86
Share of Energy Supply in Renewable Energy (%)	14
Total Electricity Consumption (TWh)	4.81
Electricity Consumption/Population (MWh/capita)	1.35
Total CO2 emissions (million metric tons)	6.70
CO2 Emissions/Population (t CO2 /capita)	1.88
CO2 Emissions/GDP (kg CO2/2005US$)	1.66

(Source: IEA 2013 data)

Status for Wind Power Development:
- Some wind energy potential in the country and a number of feasibility studies carried out

Major policies and actions for promotion of Wind & Renewable Energy:
- National Action Plan for Renewables
- Feed-in-tariff in pipeline to be decided upon

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Economy

WIND POWER STATUS FOR MYANMAR

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	23.19
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	30
Share of Energy Supply in Renewable Energy (%)	70
Total Electricity Consumption (TWh)	8.71
Electricity Consumption/Population (MWh/capita)	0.16
Total CO2 emissions (million metric tons)	13.34
CO2 Emissions/Population (t CO2 /capita)	0.25
CO2 Emissions/GDP (kg CO2/2005US$)	0.64

(Source: IEA 2013 data)

Status for Wind Power Development:
- Limited wind data available
- Some pilot projects for small-scale wind power

Major policies and actions for promotion of Wind & Renewable Energy:
- Research programs

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Science & Technology

WIND POWER STATUS FOR NAMIBIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	0.44
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	67
Share of Energy Supply in Renewable Energy (%)	33
Total Electricity Consumption (TWh)	3.78
Electricity Consumption/Population (MWh/capita)	1.64
Total CO2 emissions (million metric tons)	3.43
CO2 Emissions/Population (t CO2 /capita)	1.49
CO2 Emissions/GDP (kg CO2/2005US$)	0.33

(Source: IEA 2013 data)

Status for Wind Power Development:
- Wind resource assessment (2014)
- Some minor wind turbines installed

Major policies and actions for promotion of Wind & Renewable Energy:
- Namibia Feed-in-tariff (2014)
- Solar Revolving Fund (2011)
- Off-grid energization Master Plan (2007)
- Petroleum Products & Energy Act establishing National Energy Fund & Electricity Levy, 2003
- Energy Policy White Paper (1998)

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Mines & Energy
- NamPower
- Renewable Energy & Energy Efficiency Institute at the Polytechnic of Namibia
- Electricity Control Board

WIND POWER STATUS FOR NEPAL

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	8.62
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	15
Share of Energy Supply in Renewable Energy (%)	85
Total Electricity Consumption (TWh)	3.57
Electricity Consumption/Population (MWh/capita)	0.13
Total CO2 emissions (million metric tons)	5.14
CO2 Emissions/Population (t CO2 /capita)	0.18
CO2 Emissions/GDP (kg CO2/2005US$)	0.45

(Source: IEA 2013 data)

Status for Wind Power Development:
- A number of small scale solar-wind hybrid projects completed as part of a larger program. Total capacity by 2015 in the range of some MW but the plan to build 200MW in coming 15 years.

Major policies and actions for promotion of Wind & Renewable Energy:
- Rural Energy Policy 2006
- Wind energy power policy and a national strategy
- Tax and VAT exemption for imported renewable energy technology

Key organizations for promotion of Wind & Renewable Energy:
- Ministry of Energy
- AEPC

WIND POWER STATUS FOR SOUTH AFRICA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	165.72
Wind Power Production (GWh)	37
Share of Energy Supply in Fossil Energy (%)	89
Share of Energy Supply in Renewable Energy (%)	11
Total Electricity Consumption (TWh)	230.08
Electricity Consumption/Population (MWh/ capita)	4.33
Total CO2 emissions (million metric tons)	420.40
CO2 Emissions/Population (t CO2 /capita)	7.91
CO2 Emissions/GDP (kg CO2/2005US$)	1.30

(Source: IEA 2013 data)

Status for Wind Power Development:

- South Africa took off in wind power installation by 2014 due to the REIPPP and has about 600 MW installed but this is just a beginning.

Major policies and actions for promotion of Wind & Renewable Energy:

- Renewable Energy Independent Power Producer Programme (REIPPP) (2011)
- Integrated Resource Electricity Plan 2010–2030 (2011)
- Renewable Energy Feed-in Tariff (REFIT) (introduced 2009 and replaced by REIPPP 2011)
- National Energy Act (2008)

Key organizations for promotion of Wind & Renewable Energy:

- Department of Energy
- ESKOM

WIND POWER STATUS FOR SRI LANKA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	5.43
Wind Power Production (GWh)	235
Share of Energy Supply in Fossil Energy (%)	46
Share of Energy Supply in Renewable Energy (%)	54
Total Electricity Consumption (TWh)	10.82
Electricity Consumption/Population (MWh/ capita)	0.53
Total CO2 emissions (million metric tons)	13.74
CO2 Emissions/Population (t CO2 /capita)	0.67
CO2 Emissions/GDP (kg CO2/2005US$)	0.33

(Source: IEA 2013 data)

Status for Wind Power Development:

- Good wind power potential which has started to be developed through a number of recently completed wind farms

Major policies and actions for promotion of Wind & Renewable Energy:

- A National Energy Policy and Strategy aiming at about 4% energy from wind power

Key organizations for promotion of Wind & Renewable Energy:

- Ministry of Power & Energy
- NDB Bank

WIND POWER STATUS FOR TANZANIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	21.06
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	14
Share of Energy Supply in Renewable Energy (%)	86
Total Electricity Consumption (TWh)	4.49
Electricity Consumption/Population (MWh/ capita)	0.09
Total CO2 emissions (million metric tons)	9.70
CO2 Emissions/Population (t CO2 /capita)	0.2
CO2 Emissions/GDP (kg CO2/2005US$)	0.42

(Source: IEA 2013 data)

Status for Wind Power Development:

- Wind Atlas available indicating a multi-gigawatt wind power potential
- There is not yet any large-scale wind farm but two large wind farms are in the pipeline.
- There are a number of installed small-scale wind turbines and hybrid solar-wind systems

Major policies and actions for promotion of Wind & Renewable Energy:

- Scaling up Renewable Energy Program for Tanzania (SREP) (2013)
- Feed-in Tariff (2010)
- Tanzanian Energy Development Access Program (TEDAP) (2008)

Key organizations for promotion of Wind & Renewable Energy:

- Ministry of Energy & Minerals
- Rural Energy Agency, REA
- Tanzania Electricity Supply Co., TANESCO
- Energy & Water Utility Regulatory Agency, EWURA
- Tanzania Renewable Energy Association, TAREA
- TaTEDO

WIND POWER STATUS FOR THAILAND

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	78.07
Wind Power Production (GWh)	305
Share of Energy Supply in Fossil Energy (%)	80
Share of Energy Supply in Renewable Energy (%)	20
Total Electricity Consumption (TWh)	166.66
Electricity Consumption/Population (MWh/ capita)	2.49
Total CO2 emissions (million metric tons)	247.45
CO2 Emissions/Population (t CO2 /capita)	3.69
CO2 Emissions/GDP (kg CO2/2005US$)	1.07

(Source: IEA 2013 data)

Status for Wind Power Development:

- There are a number of wind turbines installed and the plan is to have 888 MW of wind power by year 2030

Major policies and actions for promotion of Wind & Renewable Energy:

- Thailand Alternative Energy Development Plan (AEDP) 2015–2036 (2015)
- Feed-in Tariff for Very Small Power Producers (VSPP) (2014)
- Renewable Energy Development Plan (REDP) 2008–2022 (2009)
- Feed-in premium for renewable power (2007. Modified 2009)

Key organizations for promotion of Wind & Renewable Energy:

- Ministry of Energy
- EGAT
- Thai Wind Energy Association

WIND POWER STATUS FOR UKRAINE

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	85.93
Wind Power Production (GWh)	639
Share of Energy Supply in Fossil Energy (%)	97
Share of Energy Supply in Renewable Energy (%)	3
Total Electricity Consumption (TWh)	163.77
Electricity Consumption/Population (MWh/capita)	3.60
Total CO2 emissions (million metric tons)	265.05
CO2 Emissions/Population (t CO2 /capita)	5.83
CO2 Emissions/GDP (kg CO2/2005US$)	2.72

(Source: IEA 2013 data)

Status for Wind Power Development:

- Good wind energy potential and a number of older wind farms in need of rehabilitation and upgrading

Major policies and actions for promotion of Wind & Renewable Energy:

- National Renewable Energy Action Plan (NREAP) (2014)
- Corporate income tax exemptions for renewable energy sector (2011)
- Green Feed-in tariff (2009, amended 2015)

Key organizations for promotion of Wind & Renewable Energy:

- Ministry of Energy
- Institute for Enery Saving & Energy
- Energoatom

WIND POWER STATUS FOR VIETNAM

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	69.28
Wind Power Production (GWh)	87
Share of Energy Supply in Fossil Energy (%)	66
Share of Energy Supply in Renewable Energy (%)	34
Total Electricity Consumption (TWh)	117.19
Electricity Consumption/Population (MWh/capita)	1.31
Total CO2 emissions (million metric tons)	130.05
CO2 Emissions/Population (t CO2 /capita)	1.45
CO2 Emissions/GDP (kg CO2/2005US$)	1.41

(Source: IEA 2013 data)

Status for Wind Power Development:

- A number of larg-scale wind farms as well as small-scale wind projects on islands

Major policies and actions for promotion of Wind & Renewable Energy:

- National Power Development Plan 2011
- Feed-in tariff for wind power

Key organizations for promotion of Wind & Renewable Energy:

- EVN
- Ministry of Industry & Trade
- Centre for New & Renewable Energy

WIND POWER STATUS FOR ZAMBIA

KEY ENERGY INDICATORS:	
Total Energy Production (Mtoe)	8.78
Wind Power Production (GWh)	0
Share of Energy Supply in Fossil Energy (%)	10
Share of Energy Supply in Renewable Energy (%)	90
Total Electricity Consumption (TWh)	11.15
Electricity Consumption/Population (MWh/capita)	0.77
Total CO2 emissions (million metric tons)	3.44
CO2 Emissions/Population (t CO2 /capita)	0.24
CO2 Emissions/GDP (kg CO2/2005US$)	0.22

(Source: IEA 2013 data)

Status for Wind Power Development:

- Wind measurements done
- at a number of sites indicated potential for small-scale off-grid wind-solar projects

Major policies and actions for promotion of Wind & Renewable Energy:

- National Policy for the Environment (2007)
- Zambia Vision 2030 (2006)
- Energy Regulation Act (1995)

Key organizations for promotion of Wind & Renewable Energy:

- Ministry of Energy
- ZESCO
- Kafue Gorge Training Centre
- University of Zambia

APPENDIX 2

Titles of Change Projects

CHINA

- The impact of typhoons on offshore wind energy. Ms. Jiang Ying, Center for Wind and Solar Energy Resources Assessment, National Climate Center, CMA.
- Human resources capacity building for Chinese wind power CDM project owners on pilot scale. Ms. Wang Yi, Inner Mongolia CDM Technical Service Centre & Mr. Miao Yu, Ecochain Science & Technology Co.
- To compile a handbook of wind power plant construction standards. Mr. Xianlin Jin, Guohua Energy Investment Co. Ltd.
- Energy losses of wind farm with complex conditions. Ms. Ailing Zheng, Renewable Energy Centre, China Water Resources Pearl River Planning Ltd.
- Development of an information platform on wind power industry in China. Ms. Yan Wang, Chinese Wind Energy Association.
- Environmental impacts of introducing wind power in Shanghai. Ms. Xiaoyan Wang, Shanghai Environmental Protection Bureau.
- Monitoring and evaluation system of wind energy. Mr. Hong Yuan Yang, China General Certification Center.
- Post evaluation of Dongtai wind farm in Jiangsu province. Mr. Zhihong Luo, China Renewable Energy Scale-up Program.
- Pricing for wind – evaluation of wind power development policies. Mr. Xuxuan Xie, Energuy Research Institute, NDRC.
- A multi-source micro-grid power system for Cuoqin county. Mr. Hao Bo, Beijing Jike New Energy Technology Development Co.
- Operating wind turbine evaluation and maintenance cost prediction. Mr. Leijie Chen, China General Certification Center.
- Promoting public involvement of wind power and other renewable project development in Shanghai. Ms. Min Yan, Shanghai Environmental Protection Bureau.

ETHIOPIA

- Building a wind hybrid demonstration setup for educational purpose. Mr. Getashew Bekele Beyene, Addis Abeba Institute of Technology.

EGYPT

- Making extension in Hurghada wind farm. Mr. Wael Taher, New and Renewable Energy Authority.
- Development of a 200 MW wind farm in gulf of Zyat. Mr. Shaaban Moussa, New and Renewable Energy Authority.
- Development of a pitch controlled horizontal axis wind turbine model. Mr. Mohammed Ibrahim Haggan, New and Renewable Energy Authority.
- Feed-in tariff policy. Mr. Mohammed Ahmed Ibrahim Abd El-Rahman, New and Renewable Energy Authority.
- 250 MW Boo wind farm at the Gulf of Suez. Ms. Noha Mohamed, Egyptian Electricity Transmission Company.
- Development of indigenous low-cost technology for residential scale wind turbine. Ms. Aya Diab, Faculty of Engineering, Ain Shams University.
- Optimization of small-scale wind turbine systems considering externalities. Ms. Marwa Ibrahim, National Research Centre.
- Wind farm optimization. Ms. Mohamed Nada, New and Renewable Energy Authority.
- Design and manufacture of small-scale wind generator for remote sites. Ms. Mai Ayoub, National Research Center.

GEORGIA

- Investigations of wind potential and assessment of technical parameters for future wind farms location in Georgia. Ms. Manana Gelovani, Georgian Wind Energy Scientific Centre, KARENERGO.

GUATEMALA

- Creation of a hub to promote the development of wind power. Mr. Raul Salguero, Centre of High Studies in Energy & Mines.
- Large-scale wind power opportunities in Guatemala. Ms. Nancy Chacon Calderon, National Institute of Electrification.

INDIA

- Establishment of ANERT's 5 MW wind farm in Idukki District. Mr. Valsaraj Perumpalot, ANERT.
- Turning wind energy into a viable energy resource. Ms. Anagha Mohan, India Wind Energy Association, InWEA.
- Small wind turbines and small wind-solar hybrid systems for decentralized power generation in Gujarat. Ms. Alpana Mitra, Rajkot Municipal Corporation.
- Wind farm site selection technique by using historical meteorological data. Mr. Keyur Vora, Septett Advisory Services Pvt. Ltd.
- Supporting the use of small wind turbines in India based on lessons from the rest of the world. Mr. Ketan Gandhi, KgGuruji Consulting & Services.
- Small wind turbines and small wind-solar hybrid systems for decentralized electricity generation for the state of Kerala. Mr. Ajith Gopi, Agency for Non-Conventional Energy and Rural Technology, ANERT.
- Quality of life improvement through wind power projects in Indian villages. Mr. Ajay Kumar Jain, National Institute of Technical Teachers Training & Research, NITTTR, Bhopal.
- Strategic human resources development for Indian wind energy sector. Mr. Kanaagvel Pitchai, Centre for Wind Energy Technology, C-WET.
- Extracting maximum power generation in an existing wind farm. Mr. Hasan Ali Abdul Razack, Centre for Wind Energy Technology, C-WET.
- Green collar jobs in India by development of wind industry. Mr. Francis Jayasurya Thangaraj, Indian Wind Turbine Manufacturers Association/WindSim.
- Study on types, characteristics and trends of electrical generators used in wind turbines in India. Mr. Aruselvan Srirangarayan, Centre for Wind Energy Technology, C-WET.

INDONESIA

- Study of development of hybrid system (wind-solar) in remote Island of Madura. Mr. Ashari Sutrisno, Surabaya – Madura Regional Development Board.

KENYA

- Solar-wind hybrid systems application in pilot industries. Ms. Meena Melde, Altec Consultants, Nairobi.
- Testing and commissioning requirements of wind turbine generators for grid connection. Mr. John Keru Mwangi, Kenya Power.
- Habaswein Wind/solar/diesel hybrid system. Mr. Amos Nabaala, Kenya Power.
- Joseph Oketch & Peter Watoro, Energy Regulatory Commission (ERC).
- Grid code requirements for wind power integration. Ms. Rose Murage, Kenya Power.
- An assessment of the grid ability to accommodate planned wind projects. Ms. Grace Nyaguthi Njeru, Kenya Electricity Transmission Company Ltd. (KETRACO).
- Simulation of a wind-diesel hybrid power system. Mr. Albert Ogetto Mogire, Kenya Power.
- Grid connected wind energy development planning. Mr. Willis Ochieng, Kenya Electricity Generating Company, KenGen. Wind power pilot project in Rari village, Kisumu county. Mr. Ames Odongo, Kenya Power.
- Hybridization of off-grid power by retrofitting diesel by wind and solar. Mr. Henry Kapsowe, Kenya Power.

MOCAMBIQUE

- Wind resources mapping for Southern Mozambique. Mr. Guilherme Ten Jua, Mozambique Electrical Company.
- Installations of wind masts for wind data collection as a base for producing a wind atlas. Mr. Lutigardo Ernesto & Abel Boane, FUNAE.

MOLDOVA

- Improving the role of renewable energy sources in the development of power generation system. Ms. Galina Parsian, Ministry of Economy & Mr. Sergiu Robu, Power Engineering of Academy of Sciences.
- Feasibility study of a 30 MW wind farm in Cahul district. Ms. Olga Ene, Ministry of Economy & Mr. Ruslan Bumbu, Servinform Ltd.
- Embracing renewable energy at local and regional levels with focus on wind power. Mr. Igor Turcanu, Project Willpower/Alper SA.
- Wind power development in Moldova – challenges and perspectives. Ms. Natalia Timofte, Power Engineering of Academy of Sciences.
- Wind farm Sielv. Mr. Pavel Gore, SA Sielv Solarus.
- Small wind turbines changing the thinking. Mr. Iurii Duradiji, JSC Mahavishnu Solar.
- EU Harmonization of national legislation on renewable energy. Mr.Serghei Jomiru, Ministry of Economy.

MONGOLIA

- 50 MW wind farm project in Choir. Ms. Bayarmaa Lkhagvadorj, National Renewable Energy Centre.
- Wind farm development in Govisumber province. Mr. Enkhamgalan Dawaa Ochir, National Renewable Energy Centre.
- Providing customers in remote regions with electricity by constructing a 50 MW wind farm. Mr. Altantuya Dorjsuren & Mr. Bolor-Erdene Basbayar, Energy Regulatory Commission, & Mr. Bold-Erdene Khukhuu, National Dispatching Centre.
- Installing of the largest wind farm in Mongolia. Mr. Myagmadorj Enkhmend, Qleantech LLC.
- Wind resources assessment of Gobi region. Mr. Tumenjargal Makhbal, Ministry of Energy.
- Mandakh wind farm feasibility study. Mr. Chinbat Lkhagvajav, Mon-Energy Consult Co.
- Feasibility study for a 100 MW wind farm. Mr. Amartuvshin Oyunchuluun, ZM Engineering LLC.

MYANMAR

- Planning of wind power usage for rural electrification systems. Ms. Thi Thi Soe, Ministry of Science & Technology.

NAMIBIA

- Impact of the Namibian Electricity act (2007) on wind power development. Mr. David Jarrett, NamPower.
- CDM as a finance model for wind farm projects. Mr. Kuyaraa Katjepunda, NamPower.
- Luderitz Wind Power demonstration project. Mr. Zenas Iileka, University of Namibia.
- Refurbishment of wind turbines. Ms. Sesilia Iileka, Solaer Age Namibia.
- Development of the Energy Framework for Namibia, Technical component. Ms. Charity Nsofu, Electricity Control Board.
- National wind resources assessment. Ms. Helvi Ileka, Renewable Energy & Energy Efficiency Institute, Polytechnic.

NEPAL

- Formulation of a wind energy policy in Nepal. Ms. Aruna Awale, Alternative Energy Promotion Centre, AEPC.
- Wind power development strategy. Mr. Pralhad Sapkota, Ministry of Energy & Mr. Ram Poudel, Tribhuvan University.
- Detailed feasibility study for a wind-Solar hybrid project. Mr. Prakash Aryal, Alternative Energy Promotion Centre, AEPC.

SOUTH AFRICA

- Mitigation risks in the wind energy industry by utilizing specific insurance products in developing countries. Mr. Sudashon Naidoo, Solar Projects pty Ltd.
- Concept proposal for the funding of a 45 MW wind farm in Western Cape. Mr. Derric van Zyl, Windpowersa Ltd.
- Grid integration of wind power in Western Cape. Mr. Riian Smit, Electricity Supply Commission, ESKOM.

- Development of training modules in web-based (e-learning) platform on renewable generation grid integration. Mr. Mobolaji Bello, Electricity Supply Commission, ESKOM.
- Turbine selection for the Tiqua wind farm project. Ms. Carla Strydom, Exxaro Resources.
- Developing a community-based wind farm. Mr. Zuben Jessa, Plan 8 (Pty) Ltd.Educating the communities in which Mainstream´s wind farms are located about wind farm development. Ms. Nicoleen Swarts, Mainstream Renewable Power.
- Feasibility study for an off-grid wind power project in Eastern Cape. Ms. Monique Le Roux, Electricity Supply Commission, ESKOM.
- Strategic Environmental Framework for the development of wind power in South Africa. Mr. Trevor Mark Gordon, Department of Environmental Affairs.
- Renewable Energy Development Zones (REDZs). Ms. Lydia Cape-Ducluzeau & Mr. Cornelius van der Westhuizen, Council for Scientific & Industrial Research (CSIR).
- Design of a wind and solar hybrid system for low wind regime. Mr. Ian Lazarus, Durban University of Technology.
- Wind power education. Mr. Andrew Balepile, Electricity Supply Commission, ESKOM.

SRI LANKA

- Development and testing of a checklist for evaluation of wind power projects to be used by the National Development Bank. Ms. Deveshta Tatnanayagam, National Development Bank, NDB Bank.
- Capacity building for business line managers & guideline document on technical aspects on wind power development. Mr. Nishanta Jayasooriya, National Development Bank, NDB Bank.
- Developing a financial model for wind farm development. Ms. Dulani Rodrigo, National Development Bank, NDB Bank.
- Development of a 100 MW wind farm. Ms. Imalka Perera , Ministry of Power & Energy.
- Development of new analyzing models for banking assessment. Ms. Werapitya Chandani, People's Bank.

TANZANIA

- Wind farm potential in Makambako wind tunnel area,. Mr. Ephata J. Ole-Lolubu, TANESCO.
- Business plan for a 200 kW wind power project for electrification of Makawa village, Mr. Boniface Gissima Nyamo-Hanga, Rural Energy Agency (REA) & Mr. Julius Kilimo, Renewable Energy Development Company Ltd. (RedCot).
- Measurement and data analysis at the proposed wind farm at Kemgesi village, Serengeti district. Mr. ArthurKaromba, Better Life Tanzania/ Serengeti Windpower.
- Design of wind turbine metal blade and setting up small-scale production workshop. Mr. Matthew Matimbwi, RedCot/TAREA.
- Development of guidelines for small wind power development and use in Tanzania. Mr. Michael John, University of Dar es Salaam.
- Feasibility study for the Singida Wind Energy Project. Mr. Fokas Daniel, Tanzania Electric Supply Company Ltd. TANESCO.
- Feasibility study for the Karatu wind project. Mr. Samwel Kessy, Tanzania Electric Supply Company Ltd. TANESCO.
- Feasibility study for the Mgago wind project. Mr. Patrice Tsakhara, Tanzania Electric Supply Company Ltd. TANESCO.
- Development of curriculum for vocational education and training on wind power at VETA. Ms. Eunice Urio, Vocational Education and Training Authority, VETA.
- A feasibility study for a small scale hybrid wind project in Liwale district. Mr. Cosmas Masawe, Tanzania Electric Supply Company Ltd. TANESCO & Mr. Esebi Alois, Dar es Salaam Institute of Technology.
- Design of wind power backup system for the electrical department at the university. Mr. Albano Mahimbo, Mbeya University and Technology.
- Potential of wind power for a rural secondary school. Mr. Thomas Mkunda, TaTEDO.
- Wind power hybrid system development at Marambu. Mr. Abdallah Masingija, Tanzania Telecommunication Company Ltd.

- Wind-Solar hybrid system for Mtumbutu health center and secondary school. Mr. Robert Matiku, Tanzania Wind Energy Association, TAWEA.
- Liwale wind – diesel-gas hybrid power project. Ms. Anna Sharishoy, Dar es Salaam Institute of Technology.
- Creation of energy regulatory tools. Mr. Godfrey Chibulunje, Energy & Water Regulatory Authority (EWURA).
- The best way for implementation of wind power – case study: Wind power project Singida. Mr. Dismas Mbote & Mr. James Kivugo, TANESCO & Mr. Mkoma Masanyiwa, Ministry of Energy and Minerals.
- Replacing 2 diesel generators with wind-solar hybrid system in Loksale. Mr. Deus Lwabukuna, Tanzania Telecommunication Company Ltd.
- Human capacity building on small wind power systems for rural areas. Ms. Brenda Kazimili, University of Dar es Salaam.
- Electrification of Fundo Island Clinic. Mr. Issa Mohamed, Zanzibar Electricity Corporation, ZECO.
- Wind turbine installation at Iambi health care center. Mr. Jeremiah Kalebi, Wind Power Serengeti.

THAILAND

- Feasibility study for a wind farm in Rawai, Phuket. Mr. Worawat Oottayota, Electricity Generation Authority of Thailand, EGAT.
- Development of a guideline to prevent the obstacles and how to enhance the method of improvement for wind turbine construction project. Mr. Eakarat Samintarapanya, Electricity Generation Authority of Thailand, EGAT.
- Haad Gunghan wind farm. Ms. Nuanlaong Srichumpon, Energy Maintenance Service Co. Ltd.
- Assessment of the potential of small-scale vertical wind turbine. Mr. Sombat Somsak, Ministry of Science & Technology.

UKRAINE

- Methodology for wind energy implementation at water supply & waste water enterprises in Ukraine. Ms. Olga Rudenko, Energy Efficiency Centre, Association of Water Supply & Waste Water Enterprises of Ukraine.
- Improve the capabilities of renewable energy institute in the full scale development and implementation of wind energy projects. Mr. Mykola Kuznietsov, Institute of Renewable Energy of National Academy of Science.
- Development of training courses in power supply and wind power. Ms. Olga Lysenko, Tavria State Agrotechnical University.
- Reconstruction of Donuzlavskij site of "Donuslavska WPP". Mr. Petro Khymchenko, National Nuclear Energy Generation Company, Energoatom.
- Wind Power: Introducing European Experiences in Eastern Ukraine. Mr. Sergiy Krasnokutskyy, DCPO EcoDonbas, Donetsk.
- The concept of simulation and implementation of small-scale wind energy. Ms. Anastasia Savchenko, Institute of Energy Saving and Energy Management.
- Development of indigenous low-cost technology for residential scale wind turbine. Mr. Maksym Tykhomyrov, Lugansk Energy Interconnection Ltd.
- Mapping priority wind technologies. Ms. Mariia Kokorina, Institute of Energy Saving and Energy Management.
- Distributed windfarms in Crimea. Mr. Eduard Shyshonkov, Crimean Academy of Science.
- Wind farm in Lazurnoe. Ms. Iryna Kalinchyk, R&D Energia.
- Improving the quality of education in wind power and other alternative energy sources. Ms. Oksana Olkhovska, National Technical University.

VIETNAM

- Ly Son Island Wind farm. Mr. Minh Phuong Tran, Power Company No.3.
- Study of the Hai Ninh wind power station in Quang Binh Province. Mr. Ke Nguyen Khac, Power Company 4.
- Establishment of legal framework for grid connected wind power development in Vietnam, Ms. Thuy Dung, Ministry of Industry & Trade.
- Wind power application for electricity generation in Vietnam using CDM funding. Mr. Xuan Thao Mai, Power Company No 3.
- Making textbook and experimental model forming renewable energy. Mr. Hoang Tuan Ngo, Ho Chi Minh Electrical Power College.
- Organizing training course "Wind Power System and Application". Mr. Ma Thi Thuong Huyen, Electric Power University.
- Development of Phu Lac Wind farm (50MW) at Binh Thuan Province. Mr. Le Van Thanh, Power Company No. 3.
- Design process of a wind farm project. Mr. Kha Ngo Xuan & Mr. Phong Nguyen, Centre for New and Renewable Energy, Institute of Energy Science Academy.
- Wind data monitoring and analysis. Mr. Viet Duc Ngo, Power Company No. 3.
- Assessing the economic efficiency of wind energy projects in Vietnam. Mr. Sang Quang Le, Institute of Energy Science, Vietnam Academy of Science & Technology.
- Thai Phong wind farm. Mr. Doan Trung Tin, Power Engineering Consulting JSC (PECC2).
- An Phong wind farm feasibility study. Mr. Lam Hoai Vuong, Power Engineering Consulting JSC (PECC4).
- Binh Thuan wind farm. Mr. Thang Ngoc Quoc Dang, Power Engineering Consulting JSC (PECC3).
- Opportunities and difficulties for development of wind power in Vietnam. Mr. Tin Van Pham, Thuan Binh Wind Power Joint Stock Company.
- Design of hybrid energy system (wind/solar) for islands in Vietnam. Mr. Phap Minh Vu, Institute of Energy Science, Vietnam Academy of Science & Technology.

ZAMBIA

- Wind resources assessment for power generation potential in Western Province. Mr. Lufunda Muzeya, Ministry of Energy & Water Development, Department of Energy.
- Wind Power in Zambia – Site characterization, Resource Assessment, Technology Demonstration and Transfer. Mr. Brian Makungo, Kafue Gorge Regional Training Centre & Leonard Simukoko, University of Zambia & Mr. Alexander Kampengele and Mr. Percy Mushambi. ZESCO.
- Site characterization and wind resource assessment. Mr. Amos Banda, University of Zambia.