EXPLORING SUSTAINABLE LOW CARBON DEVELOPMENT PATHWAYS

PIONEERS OF CHANGE
21 GOOD PRACTICES FOR SUSTAINABLE LOW CARBON DEVELOPMENT IN DEVELOPING COUNTRIES

Thomas Hirsch, Christine Lottje & Nina Netzer

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Providing sustainable development for all and fighting climate change – these are two major challenges the world faces today. The project "Exploring Sustainable Low Carbon Development Pathways" aims to point out ways how to combine both: climate protection and sustainable development. As a joint initiative by Friedrich-Ebert-Stiftung (FES), Bread for the World (BftW), World Wide Fund for Nature (WWF), Climate Action Network International (CAN-I) and ACT Alliance of Churches, the project is led by the common understanding that any future development model has to be:

LOW CARBON. That means with a minimal output of greenhouse gas emissions.

ECOLOGICALLY SUSTAINABLE. That means fully respecting planetary boundaries.

HUMAN RIGHTS-BASED. That means with a strong focus on poverty reduction and participation.

SOCIALLY INCLUSIVE. That means creating wealth and employment while absorbing negative social impacts.

JUST. That means equally sharing burdens and opportunities between different stakeholders.

NATIONALLY APPROPRIATE. That means respecting countries different backgrounds and challenges towards sustainable development.

The project was started in 2013 in four pilot countries: Kazakhstan, Peru, Tanzania and Vietnam. In close co-operation and ownership with different national partners from civil society, politics and science we aim to

- Explore Sustainable Low Carbon Development Pathways in these countries which could serve as regional and international examples.
- Show that Low Carbon Development is not only possible but economically and socially beneficial.
- Create platforms for dialogue at the national level for a range of different stakeholders.
- Support and intensify networks between civil society actors in the respective countries and regions.

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Bärbel Kofler & Nina Netzer

SUSTAINABLE ECONOMIES AND DEVELOPMENT COOPERATION: CHANGE MUST COME FROM BELOW

It is becoming increasingly clear that the long-prevailing development model has had its day. This model is based on the exploitation of finite and emissions-intensive resources, on a unilateral growth fixation with excessive consumption patterns, and on unacceptable distributive injustice. It has led to ever-increasing greenhouse gas emissions, severe damage to the environment and climate, and a dramatic overuse of both finite and freely available resources, such as the atmosphere or the increasingly scarce water resources in some regions. While this is primarily a problem of an outdated economic model, solutions cannot ensue solely from an economic policy perspective. Particularly in the countries of the Global South, development cooperation can play a key role as an engine of change. On the basis of concrete projects, they show that it is possible to combat poverty and to create prosperity and good work, within ecological and social limits.

Hence, this is primarily a development policy task, because the negative consequences of this development model occur most severely – currently, at least – in the developing world. Hence, in developed countries, they are still having less severe effects, because local scarcities are offset by access to resources, labour power, and emission budgets from the Global South. Nevertheless, development successes in the form of growth in the gross domestic product (GDP) worldwide have not also led, as hoped, to a more equitable distribution of wealth or jobs. In addition, the western way of living and doing business has become increasingly copied in recent decades by growing middle and upper classes in emerging and developing countries, which makes a reversal even more difficult.

Thus, the question is not whether there will be a transformation of economies and societies. The fact that a structural change will occur is certain. Rather, the question is whether and by whom it is designed. A departure from the current economic system and the related growth paradigm will not proceed without friction – it involves redistribution, ownership, and power structures. Therefore, the transformation to a low carbon, sustainable, and equitable economic system must be designed in a democratic process involving all stakeholders. In addition to a climate policy function, governments and parliaments bear the responsibility for the creation of enabling framework conditions to foster good growth in particular in countries, regions, and sectors of society, where a minimum level of development has not yet been reached. In order to strengthen the focus on social issues – such as poverty reduction, wealth, and good work – and to ensure that a transformation actually benefits the population, this has to happen in close cooperation with other actors from civil society and the private sector.

Development cooperation – be it bilateral or multilateral – should indeed create the necessary framework, without however specifying development paths. Accordingly, civil society occupies a central role in partner countries: without their involvement, it is even more likely that the transformation is controlled solely by private sector interests. Thus, a main concern of any development policy cooperation must be to strengthen civil society networks or to support their development. The change has to come from below – and its success will depend on whether it is supported by a broad alliance of civil society, politics, science, and industry.

This publication has been created within the framework of the project »Exploring Sustainable Low Carbon Development Pathways«. Based on 21 studies from different developing countries and economic sectors, it shows that climate protection and poverty reduction are not necessarily in competition, but that they can be combined. At the same time, the authors illustrate the challenges that exist on the path to sustainable development models and those on the agenda at the UN climate summit in Paris, and they outline sustainable policy approaches for an equitable socio-ecological transformation.

21 years of climate negotiations – 21 examples of good practice that encourage and show that a just, socio-ecological transformation is possible, despite significant opposition.

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EXECUTIVE SUMMARY

In view of COP 21—which is expected to become a milestone of low carbon, climate resilient development—21 good practice examples demonstrate that low carbon, sustainable development has started, and that it is possible to combine climate and development ambitions.

While a relative small number of developed countries and China are usually the focus when it comes to energy transition, this publication covers a broader spectrum of developing countries. The examples here were chosen from submissions following a call for proposals launched in May 2015, and disseminated by the organizations and networks serving as editors of this publication.

Apart from the energy sector—which accounts for the largest portion of greenhouse gas emissions—this publication covers a range of good practice from the urban sector, including transport, industries, waste management, and urban planning.

In view of the fact that the majority of poor people still live in rural areas and that their development aspirations also deserve to be fulfilled using a low carbon approach, another section provides respective good practice examples, ranging from sustainable energy clusters for remote areas to cleaner cook stoves and more sustainable forms of land management.

The need for capacity development, knowledge and technology transfer, as well as targeted financial support programmes is also addressed by presenting good practice examples. The publication closes with two good practices in terms of national policy approaches, showing that even countries in post-conflict situations—or facing other extreme vulnerabilities—have a policy choice and can mobilize climate and development co-benefits.

Innovation and change depend on pioneering solutions (be it new technologies, economic approaches, or policies) and social change agents (be it bottom up or top down). To initiate a massive transformational process, broad support and acceptance are usually needed. To generate broad societal support, low carbon and greenhouse gas mitigation strategies must mobilize development co-benefits. This is particularly true for poor countries where poverty is the most burning issue.

The examples chosen aim to address this issue. Most of them have the potential to be expanded and replicated. Information provided on the cases is brief, but each article incudes a small toolbox that includes further links and contact details. Readers are encouraged to get in direct contact with our pioneers of change.

The publication is part of the »Exploring Low Carbon Sustainable Development Project«, initiated by an international consortium of civil society organizations and networks, composed by members as diverse as Friedrich-Ebert-Stiftung, Bread for the World, WWF Germany, ACT Alliance (Action by Churches Together), and Climate Action Network International (CAN). The project formally ends in December 2015, having initiated and strengthened national platforms for low carbon, sustainable development in various pilot countries, including Peru, Kazakhstan, and Tanzania, and Vietnam, which will continue the work.

INTRODUCTION

Thomas Hirsch

According to scientists, the long-term goal of international climate policy is clear—to decarbonize the global economy within a few decades. They warn that without a global transformation of the energy system, the world will exceed 2°C global warming and suffer from increasingly severe devastation, which will undermine development.

To keep global warming below 2°C, CO2 concentration in the atmosphere must not exceed 450 ppm, according to the Intergovernmental Panel on Climate Change (IPCC). The 5th Assessment Report (AR) calculates the global carbon budget in a 2°C world with 2,900 Gt (billion tons) CO2, of which 1,900 Gt have already been emitted. The remaining atmospheric space to store CO2 is hence limited to 1,000 GT CO2.

To remain within these limits, global greenhouse gas emissions must be reduced by 40–70 per cent by 2050 compared with 2010, and almost completely phased out by 2100, according to the 5th AR. Global CO2 emissions from the energy supply sector must be reduced even more quickly: emission cuts by 90 per cent or more between 2040 and 2070 compared with 2010 are necessary. This means completely phasing out fossil fuels by mid century.

The vast majority of developing countries is even calling for reducing global warming below 1.5°C. The 5th AR also includes respective emissions reduction scenarios. To maintain a 50 per cent or better to keep global warming below 1.5°C, 70–95 per cent of all emissions—and not just those from the energy sector—have to be eliminated by 2050. Such an emissions trajectory is only feasible with a much quicker phaseout of fossil fuels.

Apart from their warnings, scientists also deliver good news, namely that ambitious low carbon development pathways are technically possible and economically feasible. According to IPCC, this is mainly due to the fast progress and respective price decline of renewable energies. To turn from fossil to renewable energies (RE), USD 30 billion per year are to be shifted from fossil energy investments into RE investments, ramping up annual RE investments to USD 147 billion; in addition, energy efficiency investments of about USD 100 billion annually are necessary.

The transformation is achievable without frictions in the fight against poverty; moreover, ambitious climate action would not end global growth. Annual consumption growth would be reduced by just 0.06–2.94 per cent global growth (instead of 3 per cent under business-as-usual), according to the 5th AR.

Climate resilient, low carbon development has to become the new vision, backed by massive change everywhere. Taking the 1.5/2°C defence line seriously means accepting that the world has to decarbonize by 5 per cent each year until 2050, which is an unprecedented speed of innovation—e.g., ten times faster than during the Industrial Revolution. Renewable energies, as well as energy and resource efficiency, can achieve this and at the same time lift all people in the human development index rankings to at least upper middle income—if the political will is there.

There are strong indications that decarbonization has already started globally: after decades of the continuous and steep increase of emissions, this trend seems to have come to a halt since 2012. It is likely that 2014 will be the first year with slightly lower emissions from the energy sector. All OECD countries have started to decarbonize, and China—as the biggest transition state—seems to be following. The global peak year of emissions is within reach.

But what does that mean for resource-poor developing countries? Can and will they also become part of this trend? Will an energy transformation come as an extra burden for the poor, or are there development co-benefits opportunities?

Without doubt, the challenge is enormous, and there is still a long way to go for all countries to be able to realize human development, while at the same keeping per capita emissions low. But the challenge can be mastered and some countries are already on the right path, as this publication illustrates.

The transition to low carbon sustainable development has started. It is taking place around the world, with different groups of countries benefiting. It is not only limited to the energy sector, but also covers urban transport, waste management, industrial production, and city development. Rural populations have started to enjoy improved access to electricity, higher incomes, and less polluting cook stoves. They become more resilient and maintain a better environment for future generations, if part of respective programmes.

There are valuable initiatives providing knowledge, technologies, financial support, and capacity development, targeting developing countries and in particular those most in need. Finally, there are good political initiatives, providing positive incentives for transformational processes.

COP 21 is expected to deliver a global climate agreement preparing the path for climate resilient, low carbon development and accelerating change. By presenting the symbolic number of 21good practice examples from the Global South, we would like to indicate that this change has already begun. Secondly, we honour those who are pioneering change and encourage others to follow.

The examples presented have potential to be deepened, extended, and duplicated. They have been selected from a number of proposals, which were sent to us, following a call for proposals published in May 2015. Once again, we express our gratitude to all those who took up the call and responded.

In the selection process, we have tried to be representative and balanced in terms of regions and sectors. In fact, the examples differ in many regards—including scale, sectors, methodologies, and actors involved. What they have in common, however, is the underlying intention to combine climate and development ambitions with a bias to favour the poor.

To keep global warming below 1.5/2°C, bold and long-term action is needed. In view of today's huge development challenges—of prevailing inequity and massive conflicts—sustained action requires a balanced approach, which gains broad support of the people by directing mitigation efforts in a form leading to development co-benefits. We hope that you will be inspired by the selection and that it will give you the confidence and hope to join the effort.

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THE PROJECT »EXPLORING SUSTAINABLE LOW CARBON DEVELOPMENT PATHWAYS«

Juliette de Grandpre, Joachim Fünfgelt, Wael Hmaidan, John Nduna & Nina Netzer

BACKGROUND

Fighting climate change and guaranteeing sustainable development for all – these are two of the biggest challenges facing the world today. The project »Exploring Sustainable Low Carbon Development Pathways« shows what sustainable and at the same time low carbon development can look like.[1] As a joint initiative of the Friedrich-Ebert-Stiftung (FES), Bread for the World (BfdW), World Wide Fund for Nature (WWF), Climate Action Network International (CAN), and the ACT Alliance (Action by Churches Together), the project is sustained by the common understanding that any development model for the future should have the following characteristics:

- **Low emissions:** This means with a minimum of greenhouse gas emissions.
- **Environmentally sustainable:** This means fully respecting the planetary boundaries.
- **Human rights-based:** This means with a strong focus on poverty reduction and participation.
- **Socially inclusive:** This means creating prosperity and jobs, and at the same time absorbing negative social consequences.
- **Fair:** This means equally dividing burdens and opportunities between different actors.
- **Country-specific:** This means considering the specific backgrounds and challenges of various countries.

The project was launched in 2013 in four pilot countries—Kazakhstan, Peru, Tanzania, and Vietnam[2]—and experience and cooperation gradually accrued from other countries, such as Egypt, Bolivia, India, and Peru. In close cooperation with various national partners from civil society, politics, and science, the project aimed to:

- Outline key points for sustainable, low carbon development paths that can serve as regional and international examples.
- Show that low carbon development is not only possible, but also beneficial to the economy and society.
- Point out examples showing that low carbon development and poverty eradication are not mutually exclusive but can create sustainable development paths, particularly for rural populations.
- Provide national dialogue platforms for a range of different actors.
- Support and strengthen civil society networks in their respective countries and regions.

As response to the question of how sustainable development and climate protection can be compatible, the possibility of a »low emission development strategy« (Draft Decision / CP.15, Para. 2) was secured at the UN climate negotiations in the Copenhagen Accord. In the climate change negotiations in Cancun in 2010, the concept of Low Carbon Development Strategies (LCDS) emerged as a joint but differentiated approach to achieve comprehensive emissions reduction targets. The implementation of such a strategy was held as binding for developed countries, while developing countries were encouraged to submit low carbon development approaches. The project »Exploring Sustainable Low Carbon Development« shows how this international approach can be implemented at the national level.

[1] For further information about the project, please visit http://www.fes-sustainability.org/de/exploring-sustainable-low-carbon-development-pathways

[2] A detailed explanation for the selection of pilot countries can be found in the project concept at http://www.fes-sustainability.org/sites/default/files/Artikeldokumente/exploring_sustainable_low_carbon_development_pathways_overall_concept.pdf.

PROCESS AND RESULTS OF THE PROJECT

The project was carried out in each pilot country based on four ideal-typical project phases:

1. Potentials, challenges, and open questions for LCDS were analysed together with local partners in a **kick-off workshop**, and an exchange platform for different experts was created.
2. Based on the workshop results, work was initially carried out in a **reflection phase**, to close the identified gaps and obtain an overview of which other actors are already active in this area and which preparations there are in the area of low carbon development. This phase served to compile materials (studies, analyses, examples); to develop policy papers where necessary; to establish together with local partners an alliance/dialogue platform in the pilot country; and to plan follow-up activities with various stakeholders.
3. In a **major workshop or a number of national follow-up workshops**, elements of a national LCDS were presented and discussed, gaps and good practice examples were identified, a wider public debate was opened, and governments were called upon to act.
4. In a **follow-up phase**, the project was officially concluded; activities should be continued at the national level in each of the countries through the platforms that emerged from the project.

	ACTIVITY	GOAL	TIME FRAME	IMPLEMENTATION PROJECT COUNTRY
1)	**KICK-OFF WORKSHOP**	Analysing potentials, challenges, and open questions for LCDS; creating an exchange platform for different experts.	September 2013 – April 2014	Kazakhstan: 10 + 11 September 2013.
				Vietnam: 24–26 October 2013.
				Tanzania: 22 + 23 January 2013.
				Peru: 01 + 02 April 2014.
2)	**REFLECTION PHASE**	• Compiling materials to close the identified gaps (studies, analyses, examples); preparation of policy papers. • Establishment of alliance/dialogue platforms in pilot country. • Other follow-up activities with different actors.	October 2013 – October 2014 (depending on the schedule of each country, however not longer than 6 months per country).	**Kazakhstan:** • Six background papers (Russian/English): 1) Low Carbon Development in Kazakhstan, 2) Low Carbon Development in the Energy Sector, 3) Low Carbon Development in Electricity Production, 4) Low Carbon Development in Agriculture, 5) Low Carbon Development in Waste Management, 6) Low Carbon Development in Water. • Support and strengthening of the Kazakh environmental NGO »EcoForum« platform.
				Vietnam: • Development of recommendations for the Green Growth Strategy (GGS). • Support and strengthening of the civil society "Vietnam Climate Change Working Group (CCWG)", including through several workshops and trainings on NGO capacity building and campaigning. • Background paper: »Comparing and combining relevant strategies in the • fields of poverty reduction, climate change mitigation, and overall development strategies.« • Call for applications and selection of two provinces, which are supported in the creation of »Provincial Action Plans« on national GGS.
				Tanzania: • Mapping »Mapping and Assessment of existing Low Carbon Development Initiatives in Tanzania«: http://library.fes.de/pdf-files/iez/11242.pdf. • Establishment of a six-member, regularly meeting group of experts on low carbon development with local and national workshops and trainings.
				Peru: • Mapping »Overall Situation of Low Carbon Development Studies (LCDS) in Peru«: http://library.fes.de/pdf-files/iez/10907.pdf. • Support and strengthening of civil society NGO »COP 20« group with regular workshops.

	ACTIVITY	GOAL	TIME FRAME	IMPLEMENTATION PROJECT COUNTRY
3)	**MAIN WORKSHOP**	Elements of a national LCDS are presented and discussed; gaps and best practices are identified; a broad, public debate is opened; governments are called upon to act.	February 2014 – April 2015 (depending on the schedule of each country)	**Kazakhstan: 24–25 July 2015.** In the workshop, two priority sectors are identified – energy and transport – and a roadmap for further action developed.
				Vietnam: April 2015. Concluding panel of experts to discuss the policy papers.
				Tanzania: 27 + 28 February 2015. Final workshop and discussion of the mappings created.
				Peru: February 2015. Closing ceremony. By April: Development of a final policy paper with recommendations to the Peruvian government.
4)	**FOLLOW-UP**	Official closing of the project; activities should be continued at the national level in the respective countries through the platforms resulting from the project.	From April 2015.	In addition to the national FES offices, the work can be continued in Peru by the »COP 20« NGO group, in Vietnam by the »Vietnam Climate Change Working Group (CCWG)«, in Kazakhstan by the NGO Platform »EcoForum«, and in Tanzania by the group of experts on »Low Carbon Development«. Moreover, this study presents good practice examples from the various countries showing how low carbon development and poverty reduction are agreed upon in individual countries.

Table 1: Overview of the Activities in the Individual Project Countries

ASSESSMENT

The implementation of the project proceeded in the different project countries very differently because, as expected, the conditions with respect to the status quo of LCDS, the role of civil society in general, and of the presence of civil society networks on sustainable development were very different. Nevertheless, some general conclusions can be drawn.

An important goal of the project was to bring together, as much as possible, broad-based actors from different spectrums—from civil society, through media, to government officials, trade unionists, and academics. The alliance of the various project partners proved to be very helpful, because the organizations involved were able to bring together different actors from their respective range of partners, which, for example, in Kazakhstan and Vietnam resulted in an initial exchange between government officials and environmental and development organizations on low carbon development. The aim to involve trade unions as a major actor in socio-ecological transformation was more difficult in some project countries than in others, mainly due to the generally weak position of trade unions in these countries. Under these circumstances, there was often little capacity to take up issues of sustainable development beyond the key issues of trade union organization. The cooperation with national partners in the project countries proved to be indispensable, because they possessed local expertise and contacts, acted as multipliers, and now continue to pursue activities at the national level and are able to sustain networks. The evaluation of existing low carbon approaches and projects during the reflection phase in some pilot countries also made it clear that without the involvement of local expertise and civil society, they have little focus on the poverty-reducing effects of sustainable development strategies, and instead primarily pursue emissions reductions. However, a transformation to a sustainable and socially equitable low carbon economy is only possible if all stakeholders are involved.

The focus of the project on the social dimension of sustainable development proved to be helpful, because the ostensible priority of many national partners and local organizations is not in the field of climate protection, but in eradicating poverty, creating jobs, or ensuring energy access for all. Thus, a development-oriented and equitable low carbon development strategy has to place development and poverty reduction, labour market and employment – for example, how job losses in traditional sectors such as the coal industry can be cushioned, or how good jobs with decent working conditions and wages can be created in new green sectors—in the foreground to meet local needs.

The transformation of economic systems and development paths is without question a long-range and, to some extent, conflict-prone task. Thus, it is all the more important to create long-term networks and alliances, as well as broad alliances of different actors in different countries who support change, implement it even against resistance, and set their own positive examples. With this publication, we want to show that in many countries there are encouraging examples supported by various pioneers of change, and that a transformation is possible.

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PIONEERING SOLUTIONS IN THE ENERGY SECTOR

Thomas Hirsch

The burning of fossil fuels is the main source of CO2 emissions. Coal, lignite, oil, and gas contribute with 57 per cent to anthropogenic climate change, according to the 4th IPCC Assessment Report from 2007. The production of electricity and heat—including households—accounts for 48 per cent of carbon dioxide emissions worldwide, making the energy sector the biggest emitter.[3]

Energy demand is on the rise and is likely to increase for further decades, given that 1.2 billion people still lack access to electricity and that the electricity supply for billions of consumers with grid connectivity in entire world regions—such as South Asia and Sub-Saharan Africa—is rather unstable.

However, alternatives to fossil energy have become much more viable in recent years. Due to technical progress, more enabling political framework conditions (e.g., feed-in laws), and massively increasing demand, renewable energies (RE) have experienced a rapid price decline: photovoltaics (PV) is 80 per cent cheaper and 40 per cent more efficient than in 2009.

Having become a business case, RE attract investments: in 2014, investments in renewable energies grew by 16 per cent to more than USD 300 billion. According to the International Energy Agency, renewables will become the major energy source within decades.

Yet, the transformational shift towards renewables is mainly located in a few industrialized countries and China; meanwhile, the rest of the world—the Global South in particular—has a long way to go to reach its maximum potential. There are tremendous opportunities given that many developing countries have important locational advantages. Considering PV, for example, Dubai has double the amount of sunshine hours per year than Berlin (1,800 compared with 900); and cities like Bangkok (1,600), Buenos Aires (1,400), and Hong Kong (1,300) are also much better placed. Accordingly, PV generation costs for rooftop systems are comparatively cheaper: in 2010, Dubai produced at half the price of Berlin (0.17 € compared with 0.35 € per kWh) and the price is expected to decline even more significantly. By 2030, PV generation costs for rooftop systems are calculated with 0.07 to 0.09 € for Bangkok, Buenos Aires, Dubai, Hong Kong, Mumbai, and many other places in the Global South.

Progress requires pioneers. This chapter introduces pioneers of change from the energy sector. Renewables work, including in the Global South and in very different contexts, as our examples from countries as diverse as Morocco, Madagascar, and Sri Lanka demonstrate. Furthermore, renewable energy is not restricted to solar energy—there are, depending on the local context, also huge potentials for as different energy sources, such as wind, small hydro, geothermal, biomass, or waste to energy.

However, making the power shift to renewables cannot be taken for granted: among other success factors, it depends on visionaries, political will, economic investment, and broad public support. The latter is key and closely related to the question of how the energy transformation goes hand in hand with social and developmental co-benefits. The good practice examples presented here illustrate in different ways how co-benefits can be mobilized—and which challenges have to be overcome in this regard.

[3] See: http://de.statista.com/statistik/daten/studie/167957/umfrage/verteilung-der-co-emissionen-weltweit-nach-bereich/

CONCENTRATED SOLAR POWER AND ITS COMMUNITY DIMENSION IN MOROCCO

Boris Schinke & Jens Klawitter

To date, the relationship between electricity and poverty alleviation in developing countries has been discussed primarily in the context of decentralized small-scale renewable energy (RE) projects. Due to missing grid infrastructures in poor and sparsely populated areas, off-grid and community-based RE is widely understood to be an important catalyst to overcome energy poverty. However, utility-scale RE projects are also generally located in rural areas endowed with abundant land resources to cover the spatial requirements of installations. Yet, they feed into the grid with the electricity generated being routed to urban and industrial consumption centres, rather than remaining in the host communities to cover local needs. Because access to electricity in many developing countries is almost exclusively enjoyed by the non-poor in urban areas, this simple difference between decentralized and centralized RE raises questions of distributional justice and whether the poor will benefit from utility-scale RE projects—particularly when combined with options of export.

However, set within the right framework conditions, the development of centralized RE could also contribute to improvements of existing livelihood baseline conditions and affect the income and non-income aspects of poverty in adjacent communities. In this regard, the experience from the Noor I Concentrated Solar Power (CSP) in the Kingdom of Morocco provides many valuable lessons learned and best practice elements on how to take into account the needs of the poorest citizens, through an integrated approach that combines centralized modes of electrification with broader development objectives.

MOROCCO'S ENERGY CONTEXT

The energy sector in Morocco is experiencing a phase of rapid changes and will probably witness important transformations in the near future. Faced with a sustained growing demand for electricity (7 per cent in 2013), the Kingdom will need to install large amounts of additional power generation capacity and continuously expand the power grid in the short to mid term. While the country's electricity consumption was about 27.5 TWh/y in 2012, estimates project that it will increase up to 40 TWh/y by 2020 and to 80 TWh/y by 2050.[4] However, in contrast to other North African countries, Morocco does not have noteworthy fossil fuel resources and thus has to supply over 95 per cent of its primary energy needs via imports.

THREE STEPS TOWARDS A SUSTAINABLE ENERGY TRANSITION IN MOROCCO

With the goal to increase energy security and free the country from its energy import dependency—while at the same time preserving the environment and fostering development—Morocco has taken three crucial steps. On the one hand, the country is one of the global success stories in terms of improving rural electrification. Since 1996, the universal rural electrification programme—Programme d'Electrification Rurale Global (PERG)—has increased the national electrification rate from 18 per cent to levels close to full electrification in both rural (98.2 per cent) and urban (99.6 per cent) areas. Within less than two decades, more than 12 million Moroccans living in rural areas have been connected to the grid or offered off-grid solutions of decentralized electrification systems—especially in the country's most isolated and vulnerable communities.

On the other hand, Morocco can be considered a forerunner in terms of removing fossil fuel subsidies and liberalizing fuel prices—not primarily because of climate concerns, but simply because the country could no longer

[4] IEA International Energy Agency (2015): Morocco: Indicators for 2012; available at: http://www.iea.org/statistics/statisticssearch/report/?year=2012&country=MOROCCO&product=Indicators (last accessed on 25.05.2015).

afford the economic burden and trade deficits stemming from subsidizing its energy imports. Steps span from removing subsidies on gasoline and fuel oil, to the elimination of the subsidies for fuel used for electricity generation.

Lastly, Morocco ranks among the global forerunners in centralized RE policymaking. While the country's electricity sector today is strongly dominated by fossil fuels—along with hydroelectric and wind production, and imports from Algeria and Spain, totalling an installed electricity generation capacity of 6,723 MW in 2012—the share of RE is envisioned to increase significantly. Already today, Morocco generates the largest share of electricity from renewables and has the greatest number of RE projects under construction of all Arab countries.[5] With ambitious targets, strong governmental policies, and the patronage of King Mohammed VI, the country's national Solar Plan in particular represents a game-changing shift towards a low carbon and energy secure future.

RENEWABLE ENERGIES AND MOROCCO'S SOLAR PLAN

Three pillars were adopted to support the implementation of RE in Morocco:

1. Regulations and laws favouring RE expansion for electricity, such as, Law 13-09 promulgated in 2010 and designed to secure energy supply, achieve universal access to electricity, and promote the rational use of clean energy;
2. Establishment of institutions to manage, supervise, and promote RE projects, such as the National Agency for the Development of Renewable Energies and Energy Efficiency (ADEREE), the Moroccan Agency for Solar Energy (MASEN), and the Société D'Investissement Energétique (SIE);
3. Implementation of projects and major financial investments to build the required RE facilities, such as utility-scale solar and wind projects.

The overall national RE target is to build six gigawatt (GW) projects—utility-scale solar (2 GW), wind (2 GW), and hydro (2 GW)—totalling 42 per cent of installed capacity by 2020 (up from 24 per cent in 2010)—which equals around 30 per cent of electricity (up from around 10 per cent in 2010) or 10–12 per cent of the final primary energy production by 2020 (see Figure 1).

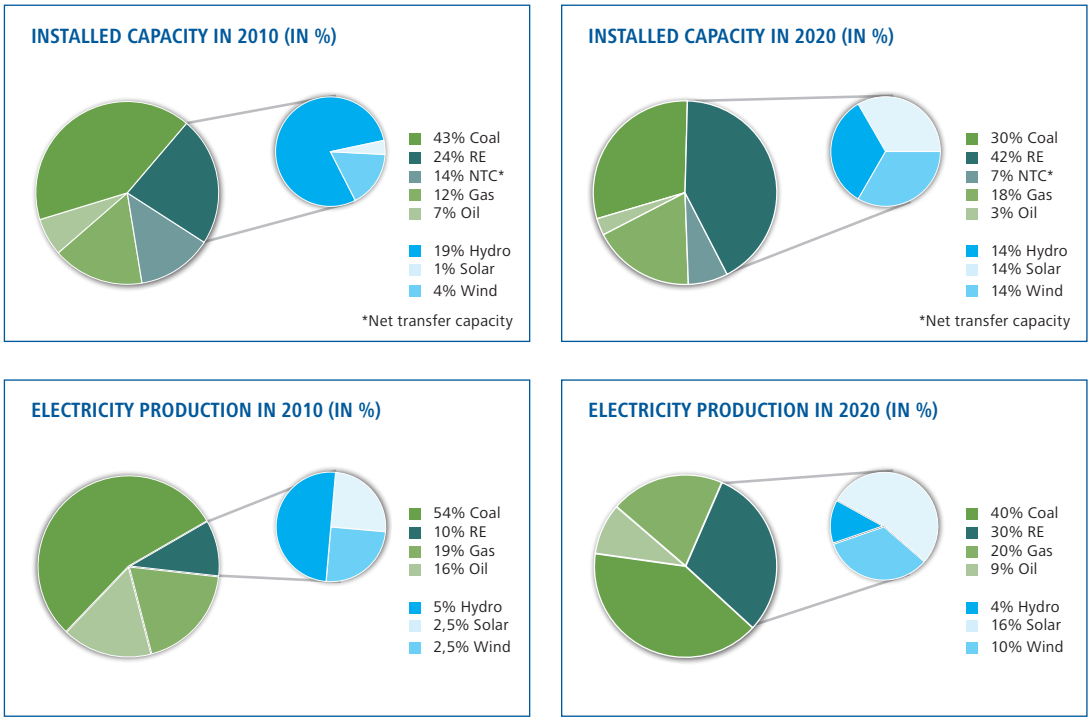

Figure 1: Installed capacity and electricity production in Morocco for 2010 and 2020 (own calculations, based on BETTER, 2015).[6]

[5] RCREEE Regional Center for Renewable Energy and Energy Efficiency (2014): Arab Future Energy Index (AFEX). Cairo

[6] BETTER Project (2015): WP3 North Africa case study: Final Report. Madrid

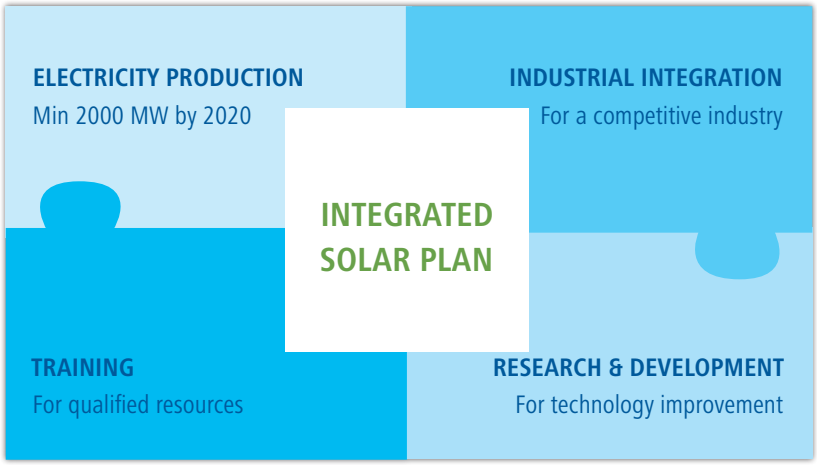

Figure 2: The MASEN approach of integrated solar projects (MASEN, Personal Interview, 2014).

While wind and hydro projects are nothing new in the Morocco's energy portfolio, MASEN was created in 2010 to support the Moroccan Solar Plan, and to put utility-scale solar power on a level playing field with other RE technologies. Five sites in the south have been slated for the development of five mega solar parks, totalling two GW on approximately 10,000 ha of land. By 2020, utility-scale solar will constitute 14 per cent of Morocco's total installed capacity and 16 per cent of electricity production (see also Fig 1).

However, the Kingdom has not simply prioritized its solar ambition out of concern for the climate, but as means to achieve multiple development objectives. Embedded within national development plans—such as the National Strategy for Environmental Protection and Sustainable Development, the Green Investment Plan or the National Action Plan against Global Warming—the production of green electrons is envisioned to yield long-lasting dividends in terms of energy security, self-reliance, and balance of payments, as well as to address local socio-economic factors through *integrated solar development projects* along the renewables value chain (Figure 2).

THE 160 MW NOOR I CSP PROJECT IN OUARZAZATE

A research project conducted by Germanwatch and Wuppertal Institute to explore the community dimension of Morocco's first solar project under the national Solar Plan—the 500 MW Noor complex next to the city of Ouarzazate—proved that efforts to align utility-scale RE deployment in order to meet broader human development objectives and integrate the project within the productive structure of the local economy were both real and substantial.

Coordinated by MASEN, the first phase of the Noor solar complex (Noor I) is a 160 MW concentrated solar power (CSP) plant with a parabolic mirror field, a salt-based thermal storage system with three hours capacity, and a water-cooled steam cycle. Noor I is currently under construction by the Saudi energy and water company ACWA Power and expected to become operational by the end of 2015. The second phase of the Noor complex involves a 200 MW parabolic trough, the third phase plans a 150 MW CSP tower (both with dry cooling and a minimum of seven hours storage), and the fourth phase aims towards 50–70 MW of photovoltaics (PV). When the third phase is completed, the Noor complex will be among the largest CSP plants in the world preventing the release of 762,000 tons of CO2 per year or 19 million tons of CO2 over a period of 25 years.

As the electricity generated at Noor I will generally be routed to the country's southern cities in order to meet Morocco's growing electricity demand, rather than remaining only in the local communities, MASEN has put great emphasis on aligning CSP deployment to the region's vulnerability context. These efforts included skill development and training, research and development, industrial integration and voluntary local content targets, direct and indirect employment, as well as social development and socio-cultural enhancement in adjacent communities financed by the land transfer required for the project site (3,000 ha.). Because the Ouarzazate region lacks a strong industrial base and is characterized by high youth unemployment rates,

local procurement policies to prioritize local workers and small-medium enterprises as well as measures to foster the competiveness and ability of the local economy to benefit from technology and knowledge transfer throughout the entire value chain of CSP technology were particularly significant ways of demonstrating shared value. While community outcomes of large-scale investments are rarely the focus of governments or investors, MASEN's foresight and planning, which sought to generate positive impacts from the country's first standalone CSP plant, were found to be commendable.

Although no infringement of human rights could be determined, the Noor I project also bears social and environmental risks. Yet, unlike the potential harm associated with fossil fuel power plants, the negative footprint of Noor I was found to be generally low and was outweighed by its positive socio-economic contributions to local communities. Nevertheless, uncertainties about the project's operational water withdrawal from the region's biggest water reservoir for cooling and mirror cleaning are a potential threat to the right to water. In the same way, a perceived lack of community engagement to give affected communities a stake in Noor I have blurred community perceptions. In response and with a clear objective to foster trusting relationships with local communities throughout the different project stages, these two issues have been addressed by applying dry-cooling technology for the next project phases of Noor II and III, and by revising the community engagement strategy to make it culturally more appropriate and allow for genuine measures of transparent dialogue, participation, and expectation management.

By recognizing the importance of local communities in successful CSP development, the high level of support found in the Province of Ouarzazate underlines the substantial efforts taken by MASEN to counteract the local conflict potential of CSP, by converting renewable energy assets into assets of improved socio-economic development, capacity, and infrastructure. Thus, we conclude that the MASEN approach taken to foster local socio-economic factors through *integrated solar development projects* in the context of the Noor solar complex provides many best practice elements on how to address poverty alleviation and socio-economic development, by setting community-oriented conditions for the deployment of utility-scale RE projects. As an international forerunner in RE policymaking, the lessons learned in Morocco could illustrate the international sustainability debate—currently negotiating the convergence of climate mitigation under the UNFCCC, the Sustainable Energy for All (SE4ALL) initiative, and the Sustainable Development Goals (SDG) within the Post-2015 development agenda—how utility-scale CSP projects could be designed to allow for triple wins with regard to climate protection, energy security, and sustainable development.

TOOLBOX:	
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Further material:	https://germanwatch.org/en/10566 http://www.masen.org.ma/

About the authors: Boris Schinke works on climate and security issues at the German NGO Germanwatch. Jens Klawitter works at Germanwatch on international energy policy. In their work, both authors focus on renewable energy, low carbon development, social sustainability, and participation in the MENA (Middle East and North Africa) region.

UNLEASHING GEOTHERMAL POWER IN SOUTH EAST ASIA

Rafael Senga

The economic potential of geothermal energy is high in South East Asia. According to a 2009 study jointly conducted by the Japan International Cooperation Agency (JICA) and the Ministry of Finance of Indonesia, a proactive geothermal development strategy will generate 2.5 times more jobs compared to a business-as-usual (BAU) scenario dominated by coal (i.e., 400,000 jobs versus 160,000 jobs)—and they are green. Furthermore, there is potential—especially for the Philippines—to market knowledge and experience in the field. Embarking on large geothermal development will also lead to spin-offs into the surrounding communities. Lastly, the nature of energy will enable access to innovative financing.

THE RING OF FIRE FLAGSHIP INITIATIVE

Figure 3: The 106 MW Mount Apo geothermal facility in North Cotabato, Southern Philippines, Source: Energy Development Corporation (EDC)

It is in this light that the so-called Ring of Fire" (RoF) initiative was developed by WWF's Global Climate and Energy Initiative (GCEI), in collaboration with WWF offices in Indonesia and the Philippines. Aimed at achieving a significant shift towards the use of geothermal energy in the Philippines and Indonesia well before 2020, the initiative provides innovative solutions for low carbon growth, energy security, and sustainable development through multistakeholder cooperation within and across countries. RoF refers to the large amounts of volcanic activities in South East Asia, which foster near-surface heat sources. In support of global efforts in response to rising carbon emissions and environmentally destructive economic practices, policymakers, the private sector, and communities are working together to rethink growth and development in a carbon constrained world. The RoF project was designed to build synergies among stakeholders, among geothermal-rich nations, and within the forest-energy nexus toward large-scale geothermal energy expansion. This will be done by creating enabling frameworks, building stakeholder capacity, and establishing industry-wide sustainability standards for geothermal energy, which will be pilot tested in showcase projects. They should mitigate the environmental and socio-cultural impacts of geothermal energy, enhance its social acceptability, and transform it into a partner in biodiversity conservation.

One key RoF strategy is building cooperation platforms between and among geothermal-rich countries in the developing world—starting with Indonesia and the Philippines—before expanding to other RoF countries and geothermal-rich regions in East Africa or Mexico. The Philippines is the largest producer of geothermal power in the developing world, with a good track record in renewable energy (RE) policy and development. Indonesia is a large, emerging economy with ambitious GHG reduction goals (26–41 per cent reduction below BAU by 2020) and where an estimated 40 per cent of the world's natural geothermal reserves are found, largely untapped. Both countries face significant threats of new coal power being planned for growing electricity demand.

By building synergies between the two countries, the RoF pursues an energy model that will help change how governments ensure energy security, how the private sector makes energy investment decisions, and how communities actively play a role in ensuring energy supply sustainability, realizing WWF's vision of living in harmony with nature and a 100 per cent RE future. So far, the initiative has achieved:

1. Policy, capacity-building, and technology cooperation between Indonesia and the Philippines on various governmental and geothermal industry levels
2. Legislation of the New Geothermal Law for Indonesia (WWF collaboration with geothermal industry and Indonesian government)
3. Publication of the Geothermal Roadmap for Indonesia
4. Development of sustainability guidelines for geothermal power development
5. Partnership with the Indonesian Geothermal Association (INAGA) and Energy Development Corporation (EDC)—the largest vertically-integrated geothermal company in the world—on adoption and pilot testing of the geothermal sustainability guidelines
6. Government of Indonesia recently upgraded its renewable power target to 25 per cent by 2025 from the current 5 per cent RE production
7. Geothermal power is fundamental part of the RE target of up to 50 per cent renewable power by 2030 in the Philippines
8. Participation in the development of the IEA Geothermal Roadmap

SUSTAINABILITY STANDARDS FOR GEOTHERMAL ENERGY

The project's initial years were devoted to establishing partnerships with governments, major geothermal companies, and industry associations; building stakeholder capacity, particularly at the local level; developing projects to pilot test the WWF's Sustainability Standards for Geothermal Energy and spotlight the multiple benefits of geothermal energy; and creating cooperation platforms within and between countries. The sustainability standards should establish geothermal energy's role as an environmentally, economically, and socio-culturally beneficial industry through best practice benchmarks, which in turn should enhance its social acceptability and role in forest and biodiversity conservation.

TARGETED PROJECT OUTCOMES

The RoF initiative aims to facilitate the creation of an enabling environment conducive to geothermal energy in Indonesia and the Philippines well before 2020. Furthermore, both countries are expected to agree on ambitious national RE targets for 2030, in line with WWF's 100 per cent renewable vision, including a target for ending energy poverty by 2030. By the end of 2015, WWF's sustainability standards should be accepted and implemented by the geothermal industry as a best practice benchmark. By achieving these goals, the RoF initiative anticipates the following outcomes:

1. Achievement of government-set targets in both countries to cumulatively increase installed capacity from ~ 3,000 MW in 2009 to 7,500 MW by 2015 (+150 per cent) and 12,000 by 2020 (+300 per cent);
2. Increase in geothermal electricity generation by 321 per cent by 2020, representing 20 per cent of the combined electricity supply by 2020 in Indonesia and the Philippines;
3. An annual reduction of 70.9 million tons of CO2 by 2020 compared to coal expansion;
4. A total green investment in the range of 18–40 billion Euros by 2020, and hundreds of thousands of new jobs.

SOUTH-SOUTH COOPERATION

The RoF programme was conceptualized as part of the WWF vision of a global 100 per cent RE future by the year 2050. In pursuit of this vision, RoF promotes the sustainable production and use of geothermal energy through the sharing of skills, knowledge and experiences between developing countries endowed with this RE resource, usually found in geologically active regions, such as the Ring of Fire, the East African Rift Valley, and the MENA Region.

Indonesia has the biggest geothermal potential in the world, with over 28,000 MW of estimated cost-effective reserves that can be used to produce electricity. This potential remains largely untapped due to the country's historical dependence on domestic oil for its energy needs. Indonesia's oil production has significantly declined since the country's exit from OPEC in 2008. With this development, the country will have to choose between two indigenous energy sources—high carbon coal or low carbon geothermal energy. Thus, there is an urgency to help Indonesia accelerate the development of geothermal energy for it to achieve its GHG reduction goal and avoid long-term carbon lock-in.

The Philippines is the world's second largest geothermal energy producer, next to the US. Currently, 17 per cent of the power produced in the Philippines is sourced from geothermal energy. The country started developing its geothermal power capacities in the 1970s, as a strategic response to the first oil shock caused by the OPEC oil embargo. Aside from its long track record in geothermal energy, which has enabled it to develop a deep pool of geothermal experts, the country is also in the forefront of renewable energy policy development, having passed a landmark Renewable Energy Law in 2008 aimed at accelerating RE development to achieve energy security and low carbon growth.

During the Mindanao Renewable Energy Forum in Southern Philippines, the RoF initiative organized a workshop and site visits with high-level guests from Indonesia. This gave the Indonesian counterparts an idea of how the industry was developed and became a vital component of the Philippines power sector, the policy framework that made it happen, and what was required to make the geothermal industry sustainable. This initiative served as foundation for cooperation between Indonesia and the Philippines, with policy exchanges continuing to date. Exchange visits between industry and government officials from Indonesia and the Philippines now occur on a more frequent basis, a sign of growing cooperation between the two geothermal giants in the region. The development of the Sustainability Standards should be another opportunity for cooperation. The RoF remains a vital cog in the quest for a clean energy future for both Indonesia and the Philippines.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available project information	http://wwf.org.ph/what-we-do/energy/ring-of-fire

About the author: Rafael Senga is based in Manila, where he works with WWF's Global Climate and Energy Initiative and co-manages the project.

PICO HYDRO AS AN INTEGRAL PART OF SRI LANKA'S GREEN ENERGY PLAN

Ranga Pallawala

Greenhouse gas (GHG) emissions, predominantly CO2, pose a huge threat to human civilization by changing climate patterns around the globe. Mitigating emissions requires enhanced actions by all countries, in line with scientific pathways—which is currently a politically challenging issue. However, several countries—including poor developing countries—have undertaken domestic efforts and developed plans to curb the GHG emissions in a given period of time. Sri Lanka belongs to this group and expects international recognition and support for future actions.

SRI LANKA'S ENERGY PLAN 2015–2025

In Sri Lanka, fossil fuel imports constitute 25 per cent of the total import bill, which in turn is equivalent to 50 per cent of total export earnings. The »Sri Lanka Energy Sector Development Plan for a Knowledge-based Economy 2015–2025« (Energy Plan) proposes reducing the traditional energy dependence of 41 per cent in 2013, to 7 per cent by 2025. This is highly ambitious. The Energy Plan states that generation capacity should increase from 4,050 MW to 6,400 MW by 2025. The renewable energy (RE) share is planned to rise from 3 per cent to 43 per cent from 2013 to 2025—excluding biomass, which is expected to remain at a constant level. As a small island country, Sri Lanka achieved over 95 per cent of grid electricity access, but recognized that there are isolated spots where it is impossible to extend the grid. The rising demand for energy is going to be met through RE initiatives, both grid and off-grid, which include mini hydro, small solar, and small wind projects for the remote areas where there is no grid connection. Accordingly, fossil fuel dependence will be drastically reduced and hydropower generation will form the new backbone of this eco-friendly transformation of the energy system in Sri Lanka.

Apart from electricity generation based on RE, the increase in energy efficiency is a strategy to achieve the targets of The Energy Plan: firstly, transmission and distribution losses should be reduced to 8 per cent by 2025. Secondly, the economy's energy efficiency should be increased by 2 per cent per year.

PICO HYDRO: SMALL HYDRO AS AN INTEGRAL PART OF THE ENERGY PLAN

The Energy Plan proposes reaching out to 50,000 remotely located customers through RE solutions, and another 126,000 rural homes through grid-based RE by 2025. Thus, smaller versions of hydropower generation technologies and approaches have been developed and tested to ensure greater benefits for poor and marginalized segments of the society. Pico hydro is the smallest hydropower generation technology—the energy production capacity is less than five kilowatts (kW). There are pico hydro plants that generate even less than 1,000 watts. A single unit of pico hydro can provide electricity for a single household, or a few houses in the close vicinity. This is sufficient to comply with the basic electricity demand—i.e., for a few energy-efficient light bulbs, television, radio, and charging of mobile devices.

A pilot pico hydro project in Sri Lanka has been undertaken by Janathakshan in Sri Lanka and the Wuppertal Institute in Germany. Beneficiaries are poor rural families, living in isolated central mountain regions. Results have been monitored in three provinces, namely the Central Province, Sabaragamuwa Province, and the Southern Province. The families were able to shift from kerosene-based lighting sources to electricity based on sustainable pico hydro.

The project has covered 135 households, by establishing 35 pico hydro units, amounting to 27.5 kW. This has resulted in avoiding the use of 32,400 litres of kerosene, which is equivalent to 83.50 tons of CO2 per year.[7]

The project has also achieved various socio-economic benefits for the families:

1. Extended study time for children: Parents state that now children are studying with more enthusiasm with the electrification of the house.
2. Extended work time in the agricultural lands: People are not required to go home early, because they can use the evening hours for housework.
3. Improved safety around the house: The quality of light from electric bulbs is far superior to kerosene lamps, therefore the feeling of safety around the house is much higher. Culturally, the toilets are located outside the main house in these villages, 10 to 15 metres away from the house. Since the surrounding area is mostly forested, snakes and other wild animals pose a threat; therefore good lighting conditions improve safety at night.
4. Access to information: Being able to use TV and radio has improved the access to knowledge and information. This makes the population more aware and empowered. In some cases, the information obtained is important for bargaining at the market places as well.

Within the Energy Plan, mini hydro is a strategic area for intervention to meet the rural electrification goal for remote villages and households. The government aims to generate 873 MW of electricity through this source alone. In this regard, the current project is an example of successful deployment of technology, which improves the standard of living and also limits future GHG emissions. It also meets the aim of creating green jobs for skilled labourers who are involved in maintenance. The scalability is high as it can be replicated in other areas with potential.

Apart from Janathakshan and the Wuppertal Institute, the provincial and national governments supported the initiative. Thus it involved a range of state and non-state actors who contributed to the project's successful implementation. In the future, such collaborative arrangements could also be attempted for other potential areas to meet the goals of the Energy Plan.

THE FUTURE POTENTIAL OF THE ENERGY PLAN

Sri Lanka is one of the fastest growing economies in the South Asian region after India. In the next decade, the projected emissions due to economic activities will increase substantially. Furthermore, economic activities will deepen the dependence on imported fossil fuels. In such a context, the Sri Lankan government's Energy Plan serves as a basis for decarbonizing the economy. It has already stimulated—and will continue to do so—the development of decentralized energy technologies and thus foster a transformational economic development process that benefits the climate, the economy, the country, and the people. However, effective implementation of the programme components of the Energy Plan and the participation of stakeholders are key. With regard to the latter, the role of civil society will be critical when it comes to the further expansion of decentralized energy systems in remote areas of the country.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
Contact person	Ranga Pallawala, CEO, Janathakshan, ranga@janathakshan.lk Website: www.janathakshan.lk
Available project information	http://www.janathakshan.net/index.php?option=com_content&view=article&id=7&catid=11&Itemid=139&lang=en

About the Author: Ranga Pallawala is Chief Executive Officer of Janathakshan Gte Limited, an organization based in Sri Lanka working on green and sustainable development. He has 15 years of experience in the development sector, with special focus on climate change and governance.

[7] The emissions factor of kerosene is calculated with 0.00258 tCO2 per litre.

WASTE TO ENERGY IN BANGLADESH

Md Shamsuddoha & Taif Ul Islam

Bangladesh is among the most vulnerable countries of the world, due to the adverse impacts of climate change. Despite an emphasis on climate resilience, the shift towards low carbon and resilient development has been the underlying focus of recent policies to address the vulnerability issues.[8] Over the years, Bangladesh has undertaken many low carbon initiatives, but they were not meant to contribute to the global mitigation goal to address climate change: rather the focus was on attaining energy security. The emissions avoided due to such activities can be considered a co-benefit to the country's development actions. The current study espouses how waste management in poultry farms contributed to emissions reduction, while ensuring clean energy to the farms as well as social and environmental benefits for the poor.

POULTRY FARMS IN BANGLADESH

Poultry farming has emerged as one of the most flourishing and promising agribusinesses. It contributes significantly to both the national and rural economies by creating job opportunities for unemployed people and alleviating poverty in the shortest period of time.[9] Overall, the annual average growth in poultry production from 2005 to 2011 was 3.7 per cent (BER 2011).

Bangladesh has 120,000–130,000 poultry farms of all sizes, which employ five million people with a total investment of around USD 2 billion.[10] Poultry farmers face two key problems: the large amount of animal waste on their farms—about 4,500 million tons generated daily by poultry farms—and the high cost of using diesel-based backup power whenever their unreliable grid electricity failed.[11] These farms rely heavily on captive diesel captive generators to meet their electricity needs, with generation costs in the range of BDT 25.2/kWh, while biogas electricity costs between BDT 7 to 10/kWh. Hence, the traditional poultry farm management practices cause emissions in two ways: emission of generated waste, which is 2 million tons of greenhouse gases (GHG) from 4,500 million tons of waste, and emission of diesel-based captive generators. However, the waste could offer multiple social and economic benefits to farms along with potential mitigation benefits, if it were converted into energy. This offers a strong business case for the poultry farms that have readily available inputs for biogas-based electricity generation and promotion of green growth in this sector.

THE PROJECT

The current initiative is undertaken by the South Asia Enterprise Development Facility (SEDF) of IFC to improve productivity and to promote clean energy in the poultry sector in Bangladesh. In partnership with the Norwegian Agency for Development Cooperation (NORAD) and the Department for International Development (DFID), this pilot programme takes two approaches: firstly, improving farm productivity through training and capacity building on farm management, disease, and biosecurity management; secondly, promoting clean energy technology and substituting clean biogas electricity on the farms operating with captive diesel fuel generators.

[8] IIED (2014): Low-carbon and resilience agendas: Bangladesh, Ethiopia, Rwanda. IIED Working Paper. IIED, London. http://pubs.iied.org/10099IIED

[9] M.T. Uddin, M.M. Islam, S. Salam , S. Yasmin (2013): Economics of native poultry rearing in the coastal regions of Bangladesh, Bangladesh Journal of Animal Science, 42 (1): 49–56.

[10] http://www.thepoultrysite.com/poultrynews/24658/poultry-litter-can-ease-energy-crisis/

[11] IFC (2014): Stories of Impact in Agribusiness: Improving Productivity in the Poultry Sector in Bangladesh, ifc.org/agribusiness

The initiative utilizes poultry waste and establishes clean biogas energy technology in 52 poultry farms. Using biogas-based electricity generation is a cheaper mode of clean energy from poultry waste, compared with the existing diesel-based models. The poultry owners were trained in developing their technical expertise in building, operating and maintaining small-scale biogas energy plants. The project also helped farmers and SMEs expand farm capacities, while meeting the required financial needs. It has helped to build new models of cooperation between SMEs, farmers, and financial institutions, which facilitated an investment of USD 1.75 million in 16 poultry farms. The overall design of the »waste to energy« project underlies the shift towards a broader concept of development based on green growth and human rights—especially in the context of poverty reduction and gender equality.

MITIGATED GREENHOUSE GAS EMISSIONS AND DEVELOPMENT BENEFITS

The current initiative includes 52 poultry farms, which would produce 1,600MWh/year of electricity from poultry waste. It is estimated that the avoided GHG emissions would be 10650 MtCO2 eq/yr—the equivalent of taking 2,100 cars off the road.

The project not only contributed to the reduction of green house gases emission but also resulted in multiple economic and social benefits:

1. Direct economic benefits for the poultry farms by replacing fossil fuels with cheaper and clean energy from biogas sources.
2. Enhanced knowledge base and motivation of the private sector to invest in sustainable and efficient energy use.
3. Reduced pressure on the over-stretched electricity grid.
4. Released funds for workforce development in a very competitive low-margin industry.
5. Provision of income to farmers—especially for women smallholder farmers—through the sale of previously highly polluting waste products, which were turned into fuel and fertilizer.

FUTURE EXPANSION OF PROJECT ACTIVITIES

Based on the experience of the pilot programme and considering the tremendous potential to expand, the IFC secured funding from the Danish International Development Agency (DANIDA) Mission in Bangladesh to extend the coverage further to other large poultry farms. The target is to produce 11GW/year of electricity and avoid 7,4000 tons of GHG per year by 2017. This second project phase will be carried out in partnership with 15 to 20 companies (poultry/dairy businesses and organic fertilizer companies), with targeted advisory services. An immediate benefit of the project is the creation of investment and technology support services across the country—from waste to energy technology. Expansion would be carried out through a mix of processes that would include a) creating access to technology/technical know-how; b) creating access to financing; c) building awareness on farm waste management, while meeting electricity needs; and d) creating market linkages for maximizing the revenue potential, particularly through sales of slurry, a by-product of the biodigestion process.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available project documents, photos, or films	A project documentary is available on YouTube at: https://www.youtube.com/watch?v=t2QnMGeGW_I

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CLEAN ENERGY INTERVENTIONS IN MADAGASCAR

Voahirana Randriambola

Madagascar, a nation off the south-eastern coast of Africa and the world's fourth largest island, is both blessed and troubled. The nation boasts a unique wealth of biodiversity—about 80 per cent of the plants and animals in Madagascar are only found on the island—yet it is also one of the poorest countries in the world. Only about 15 per cent of the Malagasy people have access to electricity, and the inhabitants have one of the lowest levels of annual energy consumption in the world. Nevertheless, a booming population and the resulting search for fuel—mainly sourced in the form of wood and charcoal from local forests—means that continued economic development and poverty are enhancing the pressure on the country's rich natural resources and threatening the future of already depleted forests.

WWF and its partners are working closely with local and national stakeholders in Madagascar to improve the livelihoods of local people, and implementing solutions that provide access to safe and reliable energy while protecting the natural resources. Here, we provide a few examples of our project work on the ground in Madagascar.

SOLAR ENERGY ILLUMINATES LAVOMANITRA AND TSARATÀNANA

In south-east Madagascar, 224 homes in Iavomanitra, Amoron'Imania and 150 homes in Tsaratànana, Atsimo Atsinana are lighting up thanks to solar panels installed by seven local grandmothers from the two villages. In collaboration with Barefoot College in India, the women were trained as solar energy technicians.

The women returned from their training in India in September 2013. The equipment supplied by Barefoot College was shipped to the port of Toamasina, arriving early May 2014. The supplies included hundreds of cartons containing batteries, panels, bulbs, lights, lamps, and spare parts. These supplies were meticulously checked by the women charged with building and maintaining the solar electric systems in their villages. They were then transported by truck, canoes, and on foot by porters on an epic journey to the remote rural locations.

In the villages, the women worked in a special purpose-made shop where they assembled, connected, and installed the equipment. The first systems went into operation in June 2014, and have since provided an important environmental advantage for the communities. They furnish Iavomanitra and Tsaratànana with a supply of clean, renewable energy that is available to all residents.

The solar power is already having an impact. Families are experiencing savings, due to a decreased reliance on expensive kerosene. The monthly cost of 3,000 Ariary for solar electricity represents about half of what families would spend on kerosene. The fees paid by each participating family is used to pay the women for their work and create a fund for the maintenance and purchase of replacement parts in the coming years.

Initiatives proposed by the villagers are also extending the benefits of the solar energy systems beyond just an energy source. Those benefitting from solar power are also requested to pay a kind of »solidarity fee«. In exchange for gaining access to the solar energy, the families in turn contribute to reforestation and village sanitation efforts.

120,000 HOMES SWITCH TO ENERGY-EFFICIENT LIGHT BULBS

An estimated 120,000 households in Antananarivo, the capital of Madagascar, are benefiting from 518,000 energy-saving light bulbs called »Lumitsits«. This initiative—run in collaboration with the Ministry of Energy,

the national electricity company JIRAMA, and the telecommunications company Telma—provides energy-efficient light bulbs that reduce energy use and bring significant economic advantages. Old, incandescent bulbs were exchanged for the energy-efficient Lumitsits bulbs.

The project is providing number of benefits. Users report an average reduction of 10 per cent in their monthly electricity bills. Three ordinary incandescent bulbs—the average number of bulbs found in an electrified city home—use an estimated 20 KWh per month and cost a family about 8,100 Ariary. Yet the same monthly consumption by three energy-saving bulbs is valued at 4 KWh per month and 1,512 Ariary.

The average lifespan of the energy-saving lights is about seven years, versus one year or less for the incandescent bulbs typically used in Madagascar. The reduced energy use and longer useful duration are projected to lead to significant financial savings down the road for families that typically struggle with poverty.

»Projected to have an average life of seven years, a good quality, energy-saving bulb will save each family an average of 600,000 Ariary over seven years«, explains Samuel Ratsimisetra, expert technician for the Lumitsits project at WWF Madagascar.

DESALINATION IN BEHELOKE

WWF works in south-west Madagascar on a number of conservation projects to protect marine, coral, and coastal environments. Our most important partners are the villagers who live in these habitats close to the sea. However, the local people face many challenges due to the hostile environment—one of the biggest being the lack of access to clean, safe drinking water.

The dry, harsh, sandy climate of the Mahafaly Plateau contains an incredible range of wildlife and landscape beauty, but sadly, not much potable water. For people in developed countries, getting drinking water is as simple as opening their taps; but in rural Beheloke fresh water is a precious and scarce resource. Therefore, a solution was developed that exploits the abundant natural resources—wind and solar—to produce fresh, clean drinking water with clean renewables.

On Sundays, hundreds of yellow cans are lined up next to the desalination plant WWF build here in 2012. As early as 5 a.m., the villagers started arriving to claim their spot in the can-line. Most of the time they drop off the cans and come back later in the morning to fill them. Normally, the water starts flowing around 9 a.m. At maximum capacity, the unit provides 600 litres of water per hour, enough for half of Beheloke's 450 homes in one day, meaning each household gets water every other day.

Prior to the desalination units, all of the residents of Beheloke relied on polluted sources for their water—either walking long distances to unclean wells further inland or digging deep pits (vovos) in the sand to reach to the brackish water below the village, which was both dangerous and unhealthy. The villagers notice a big difference between the water from the desalination plant and the other sources. They are experiencing fewer health problems including fewer cases of diarrhoea and other waterborne diseases, child mortality is down, and the water from the station simply tastes better.

The project faced some technical challenges, but it has proven successful enough that two new desalination plants were recently built in the nearby coastal towns of Tariboly and Besambay. These plants opened in June 2014. The local communities took a very active part in the construction. The land for the desalination units was donated and after a day of fishing, members of the village would pitch in and help with the construction project. With all three stations operational, almost 4,000 people in the area now have regular access to safe drinking water.

CONCLUSION: CLEAN ENERGY SOLUTIONS REDUCE POVERTY

The examples from WWF's experiences with solar energy and energy efficiency projects in Madagascar highlight energy's central role in poverty reduction. Renewable energy can serve multiple purposes that correspond to the needs of poor populations in rural and urban regions. It can be a solution for remote areas that need small-scale and off-grid technical solutions. It offers emissions reductions and can also provide direct improvements to income and living conditions. Smart energy solutions can provide a two-pronged contribution of low carbon development and poverty reduction.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
More information	https://www.youtube.com/watch?v=-JN5je7rdpE

About the Author: Voahirana Randriambola coordinates »Energy Access« work at WWF Madagascar.

PIONEERING SOLUTIONS IN URBAN AREAS

Thomas Hirsch

Today, the majority of the world's population lives in cities; this includes many developing countries, particularly Latin America and the Caribbean. The urbanization trend is expected to accelerate in the next decades, and UN experts expect 66 per cent of the world's population to be urban by 2050.[12] Africa and Asia, which still remain rural with 40 and 46 per cent of urban populations today, are urbanizing faster than the other region and are projected to become predominantly urban with 56 and 60 per cent by 2050. Just three countries—India, China, and Nigeria—are expected to account for more than one-third of the urbanization of the decades to come, and medium-sized cities with a population of less than one million are growing fastest.

Because the world is becoming urban, sustainable development challenges are increasingly focused on cities, in particular in lower- to middle-income countries where urbanization takes place fastest and where huge populations live in slum areas. Ending poverty, fulfilling basic needs, adapting the infrastructure—in particular traffic, energy, and water supply—to sharply rising demand, making industries cleaner and safer, ensuring climate resilience, and improving disaster risk preparedness in case of climate and other natural hazards are among the burning issues atop the list of governments, specialized organizations, and city developers. The issue of decarbonization is also urgent, in view of the fact that wrong infrastructural decision of today will lead to lock-in effects for decades due to the long-term nature of infrastructure investments. Accordingly, it is critical to plan for a low or even zero carbon future and, similarly, to meet today's urban challenges in a more carbon-friendly way. But are these issues on the agendas of decision-makers and investors facing enormous challenges in places like Dhaka (the fastest growing mega city in the world) or Delhi (the second largest after Tokyo)? And if not, how can a low carbon way approach become an integral part of urban planning, industrial development, and governance?

The challenge is huge indeed, but there are inspiring approaches and pioneering solutions. This chapter provides good practices from a number of different countries and sectors:

The first article from India discusses PAT, a mechanism that aims to enhance the cost effectiveness of energy efficiency measures in large industries.

The next contribution is about Masdar City, one of the world's most sustainable, low carbon cities, which is located in Abu Dhabi. Masdar is more than an urban settlement, it is a large renewable energy cluster and gives an idea of how to transform an oil-exporting country into a renewable energy hub.

Zero waste, the third appealing example from Brazil, shows the huge potential of waste recycling as a sound mitigation strategy towards decarbonization, with important co-benefits to create livelihood opportunities for impoverished and unemployed urban sectors.

The last two articles on Bolivia and India focus on the huge issue of more efficient and less carbon intensive urban transport. While the Indian case illustrates how to systematically improve the efficiency of urban bus transport, the Bolivian case rightly argues with the groundbreaking potential of ropeways to reform urban transport, in particular in hilly cities.

[12] UN (2014): World Urbanization Prospects. The 2014 Revision. New York (http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf)

IMPROVING ENERGY EFFICIENCY IN INDIA'S INDUSTRY WITH THE PERFORM, ACHIEVE, AND TRADE (PAT) SCHEME

Manish Kumar Shrivastava & Prabhat Upadhyaya

Energy efficiency has long been a priority for India, and was initially driven by energy security concerns. The fact that energy efficiency also helps to mitigate carbon emissions is an added value. To achieve this objective, the government launched in 2012 a national market-based initiative, Perform, Achieve and Trade (PAT), as part of the National Action Plan on Climate Change (NAPCC).

The NAPCC defines the overarching national climate policy of India and was approved by the Prime Minister's Council on Climate Change in 2008. So far it covers eight national missions addressing different aspects of climate change. One of them is the National Mission on Enhanced Energy Efficiency (NMEEE), which aims to increase energy efficiency by creating a regulatory policy framework. The PAT scheme is the flagship project of the NMEEE. As a market-based mechanism, it aims to enhance the cost effectiveness of energy efficiency measures in large industries.

BACKGROUND

India's transition to a low carbon and sustainable development trajectory will largely depend on its ability to decouple economic growth from fossil fuel consumption. Reducing the specific energy consumption (SEC) from economic activities holds the key for achieving this decoupling. The PAT scheme aims to mobilize this potential by improving the SEC of individual industrial units. The PAT scheme is implemented by the Bureau of Energy Efficiency (BEE). In its first phase of operation (2012–15), it has covered 478 designated industrial consumers of energy (DCs)—i.e., individual plants in eight sectors. In the subsequent phases, the scheme will cover more plants and sectors. Each DC has been individually assigned mandatory and time-bound targets to reduce its SEC, against which it will be issued Energy Savings Certificates (ESCert). The Bureau of Energy Efficiency or the Ministry of Power will issue ESCerts, upon verification by Designated Energy Auditors (DEA). ESCerts can be traded amongst DCs, thus facilitating cost efficiency in meeting the overall target. In addition, provisions for technical assistance and facilitating financing have also been made. Beyond improving energy efficiency, the PAT scheme holds strong promise for India's sustainable future as explained in the following paragraphs.

HOW IS PROGRESS MEASURED?

The SEC of an individual plant is measured on a gate-to-gate basis, which means that net energy input into the plant boundary is divided by the total quantity of output leaving the plant's boundary. The baseline SEC for each of these plants—referred to as DC under PAT scheme—has been determined on the basis of its average production and energy consumption in the period 2007 to 2010. The DCs are required to appoint an energy manager to record energy consumption and report it annually in a prescribed format to the online portal, the E-Filing energy return web portal. The reported data is verified by the DEAs, who are trained and certified by the BEE ((see figure 4). Upon verification, ESCerts are issued which can be traded in two exchanges: the Indian Energy Exchange (IEX) and the Power Exchange India Limited (PXIL). The first issuance of ESCerts is supposed to take place in August 2015.

Transparency and accountability are ensured during the process by holding the DEAs responsible for the verification. In instances of wrong verification, DEAs are not only liable to pay the penalty instead of the DC, but their license will also be revoked. The penalty has been set at INR 1 million (close to USD 15,500), plus the value of shortfall regarding the energy saving target at market prices in oil equivalent terms.

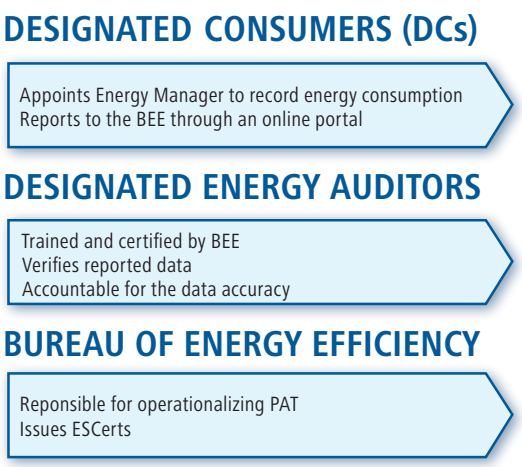

Figure 4: Roles of Key Actors Involved in PAT Scheme

PROMOTION OF ENERGY EFFICIENCY TO ACHIEVE DECARBONIZATION

The PAT scheme is likely to contribute to reductions of 26 MtCO2e of GHG emissions in its first cycle. With the extension of the scheme to other sectors and plants, its mitigation contribution will grow further. For reference, the initial draft of the PAT scheme—which proposed covering 768 DCs in nine sectors, including railways—estimated that after five years of implementation, the PAT scheme would reduce the need to install 19 GW of capacity addition and result in approximately 98 MtCO2e of annual emission reductions.

While the impact of the first cycle of PAT in terms of GHG mitigation is modest, its key contribution has been to build up the necessary institutional capacities for assessing the energy saving potential within each economic sector in India. It has set benchmarks and targets; conducted meaningful stakeholder consultations; introduced data management, auditing, and verification; identified technical and financial barriers, and ways to remove them; and has issued ESCerts to facilitate cost efficiency. The fact that the final governance architecture, including the targets, was decided together with the industry through six consultations has been critical from a long-term attitudinal change perspective. It has generated greater awareness and willingness among the private sector to take energy efficiency seriously. In addition, increased use of renewable energy is allowed as an option for DCs to improve their SECs, which contributes to the promotion of renewable energy in India. Thus, the PAT scheme's first phase has prepared India to launch a highly ambitious energy efficiency program, which in turn will contribute to lower emission intensity of the gross domestic product (GDP).

POTENTIAL FOR REPLICATION

The first phase of the PAT scheme has served as a good demonstration of how to implement multisector programmes. It has generated important lessons learnt from both within and across the eight sectors that are currently covered. The scheme is scheduled to include more plants and sectors over time. The government is already considering the inclusion of railways, oil refineries, and power plants. Having created a resource pool of energy auditors and energy managers from a very limited base, the scheme can aim at replicating itself over time and across sectors. Another potential of the scheme lies in replicating similar programmes in other developing countries, with the possibility of further extending it bilaterally or even regionally.

CONTRIBUTION TO WELFARE

PAT is not a welfare scheme as such. Its objectives do not include poverty alleviation, improved health, or access to education or water. In the long run, however, the scheme may be assessed for its contribution to the welfare of society at large. The creation of jobs for energy auditors and managers can be directly attributed to the PAT scheme. With more plants under its coverage, more such jobs will be created. In addition, the scheme increases the demand for renewable energy as an option to meet the PAT target, which may help in

lowering the cost of renewable energy technologies, thus further enabling decentralized electricity provision in far-flung areas of the country. In any case, the reduced demand for fossil fuel consumption is likely to have positive impacts on air quality, which in turn reduces health risks.

THE PATH AHEAD

The PAT scheme has a lot of potential to stimulate India's transition to a low carbon, sustainable economy. However, the scheme currently relies on marginal improvements and does not aim at promoting a radical breakthrough. In theory, DCs can achieve their SEC improvement targets by adjustments in their technological systems, scale of operation, managerial practices, or a combination thereof. But the current durations of implementation phases, three years each, is not long enough for making big adjustments in technological systems and scale of operations. A long-term stringent target may help to bring about technological innovation. The institutional capacities built so far should allow the BEE to explore this possibility of inducing a long-term paradigm change through technological innovation.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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MASDAR: A PIONEERING COMPANY FOR SUSTAINABLE LOW CARBON DEVELOPMENT IN THE ARAB WORLD

Dr Ahmed Kandil

Although Abu Dhabi—the capital of the United Arab Emirates (UAE)—is home to the world's fifth largest proven oil reserves and sixth largest natural gas reserves, it has committed billions of dollars to developing Masdar as a commercially driven renewable energy cluster. With an initial commitment of USD 15 billion from the Abu Dhabi government, today Masdar is a university, a renewable energy developer, an investor, and a clean-tech cluster in one of the world's most sustainable urban developments. Masdar's mission is to invest, incubate, and establish a new energy industry in Abu Dhabi and around the world. It has adopted an integrated, holistic business model—merging higher education, research and development, investment, and sustainable urban development—to achieve sustainable low carbon development. As a result, Masdar is contributing to the global efforts to combat climate change and to undertake transformative steps towards a more sustainable low carbon future for both the UAE and the global community.

Furthermore, the Masdar case shows what a responsible oil producer and exporter, like the UAE, can do to incrementally change its business model by phasing in renewable energies. Knowledge-based industries, such as renewable energies and low carbon technologies, could play a significant role in economic diversification of oil producing and exporting countries. By transforming its economy—which was entirely dependent on fossil fuels as the only industrial sector—to one led by knowledge, innovation, and the export of cutting-edge technologies, the UAE will win tremendously. Masdar is making a significant contribution to this process of economic diversification by:

- Investing in human capital development
- Conducting research and stimulating innovation
- Expanding the energy and technology export base
- Diversifying domestic supply of energy
- Attracting inward investment
- Encouraging private-sector entrepreneurship

MASDAR'S ORGANISATIONAL STRUCTURE

The Masdar company, which was founded in 2006, is composed of four integrated business units:

1. Masdar Institute of Science and Technology is an independent, graduate-level research university dedicated to advancing renewable energy and sustainable technologies. It was established in 2009 as an ongoing collaboration with the Massachusetts Institute of Technology (MIT). It is committed to finding solutions to the challenges of clean energy and climate change through education and research. Its enrolment is expected to grow to 600 to 800 students over the next few years.

2. Masdar City is one of the world's most sustainable, low-carbon cities. Situated 17 kilometres from downtown Abu Dhabi, Masdar City is a special economic zone and pedestrian-friendly urban development, where current and future renewable energy and clean technologies are showcased, marketed, researched, developed, tested, and implemented. Powered entirely by renewable energy, Masdar City combines passive and intelligent design to push the boundaries of sustainability. To date, its buildings reduce energy demand by 56 per cent and potable water demand by 54 per cent. Masdar City also has a low carbon public transportation systems. As a result of these and other interventions, the average temperature of this unique urban environment is almost 10° Celsius below anywhere else in Abu Dhabi.

Furthermore, Masdar City is home to:

- Siemens regional headquarters, the first LEED Platinum certified office in Abu Dhabi,
- the headquarters of the International Renewable Energy Agency (IRENA),
- UAE's first four pearl structure under the Estidama Pearl Building Rating System, and
- over 260 companies as part of Masdar City's special economic zone.

3. Masdar Clean Energy is a renewable energy developer and investor, building some of the world's large-scale renewable energy and carbon abatement projects. With a focus on mature technologies in solar and wind power, Masdar Clean Energy has invested over USD 1.7 billion of equity across projects with a total value over USD 6.4 billion, delivering nearly 1 GW of renewable energy (see Figure 5). It also aims to increase its investments to 1.5 GW by 2020.

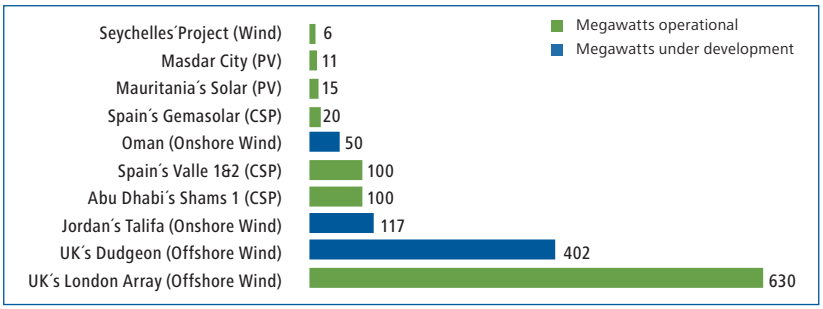

Figure 5: Selected Masdar Clean Energy Projects

4. Masdar Capital pursues investments across the full spectrum of low carbon technology companies. It helps its portfolio companies to grow and expand by providing capital and management expertise. Investments are made via two funds: the Masdar Clean Technology Fund (MCTF/Fund 1), launched in 2006 in conjunction with Credit Suisse and Siemens AG as partners, and the DB Masdar Clean Tech Fund (Fund 2), launched in 2009 in partnership with Deutsche Bank. These two funds are particularly focused on the following sectors:

- Clean energy, including power generation and storage technologies, transportation technologies, clean technology/clean energy innovation, and sustainable biofuels.
- Environmental resources, including water and waste management, and sustainable agriculture technologies
- Energy and material efficiency, including developments in advanced materials, building and power-grid efficiency, and enabling technologies
- Environmental services, including environmental protection and business services.

With each of Masdar's four units focusing on a key component of the value chain, the company operates with the broad scope necessary to meeting the most pressing challenges for sustainable low carbon development in the Arab World. This keeps Masdar at the Arab forefront of clean energy industries as it pursues pioneering and commercially viable technologies and systems. It also makes Masdar an excellent model for other oil-exporting countries, because it shows how to reduce dependence and overcome the fossil age step by step.

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ZERO WASTE: CLIMATE MITIGATION AND POVERTY REDUCTION WITH COOPERATIVE RECYCLING

Jutta Gutberlet & Magdalena Donoso

The scale of what we trash and how fast we trash is creating a worldwide crisis, with major consequences for the climate, public health, and developing economies. While waste management is not always seen as a critical issue for climate change mitigation, the growing movement for zero waste in fact offers particularly cost-effective and ready-to-implement ways to significantly reduce GHG emissions and create relevant jobs that diminish poverty.

One of the most important aspects of zero waste is recycling. Studies have shown that increased recycling has the potential to reduce GHG emissions at levels comparable to the energy and transportation sectors.[13] According to the Intergovernmental Panel on Climate Change, municipal solid waste management is a major contributor to climate change. Landfilling biodegradable waste generates methane emissions (CH4), and solid waste incineration produces fossil derived CO2 as well as nitrous oxide (N2O), among other gases; recycling reduces GHG emissions in both upstream and downstream stages of municipal solid waste management systems. Upstream emissions are avoided when recycled resources replace virgin materials in the fabrication of metal, glass, plastics, and paper products. They are also avoided as recycling decreases the need for deforestation and energy use during collection and transportation of materials, processing, and remanufacturing. Downstream, both CH4 and CO2 emissions are avoided through the diversion of resources from landfills and incinerators—both of which emit high levels of pollution, affecting the global climate. However, recycling depends on the workers that collect, sort, and sell the recyclable materials. When these workers are unionized and have good working conditions, recycling has reached its full potential as a climate and sustainable development solution.

RECYCLING IN DEVELOPING ECONOMIES

Recycling holds particular opportunities for the Global South, which has a huge informal recycling sector. It is estimated that in Latin America alone approximately 3.8 million people are engaged in informal collection, separation, and commercialization of solid waste. In many Latin American countries, recycling workers have formed unions that advance safe conditions and fair pay for workers. When recycling workers are organized in cooperatives, associations, or unions, they play a central role in developing citywide and national zero waste strategies, generating significant, cross-cutting benefits: their work helps improve the urban environment, reduces city spending on municipal solid waste management, helps educate the public to separate recyclables, builds social inclusion, and creates work.[14]

CASE STUDY: CLIMATE WORKERS AT COOPERPIRES, IN BRAZIL

Since its formation in 1999, the Brazil-based National Movement of Recycling Workers (MNCR) has achieved major victories for the sector. The vast majority of the recyclers *(catadores)* in Brazil are women, and together they make an enormous environmental contribution. What's particularly inspiring about the recycling workers' movement in Brazil is that the recyclers understand climate change mitigation as a key part of their work.

[13] Tellus Institute with Sound Resource Management (2011): More Jobs, Less Pollution: Growing the Recycling Economy in the US; available at: http://www.no-burn.org/downloads/MoreJobsLessPollutionFinal.pdf (last accessed on20.05.2015)

[14] J. Gutberlet (2008): Recycling Citizenship, Recovering Resources: Urban poverty Reduction in Latin America. Aldershot: Ashgate.

Organized as national and global social movement, the catadores work in cooperatives or associations, where they receive, sort, and sell recyclable materials. One such cooperative is Cooperpires, which began in 2006 in Ribeirao Pires, Brazil. An input-output analysis was conducted in this cooperative in order to quantify the emissions reductions being achieved with separate collection and recycling of municipal solid waste.[15] The analysis took into consideration the material and energy flows involved in the recovery of paper/cardboard, glass, metals, and plastics. It also looked at energy spending and GHG emissions during the recycling process (collection, separation, transportation, and commercialization) compared to emissions generated during extraction of virgin resources and new material production. To determine the avoidance of GHG emissions through resource recovery (recycling), a specific GHG and energy accounting method was developed using a composition of the following four tools:

1. the Clean Development Mechanism (CDM) methodology (AMS III-AJ)
2. the method to calculate avoided landfill methane emissions
3. the method to calculate the emissions factor for an electricity system
4. the tool to calculate baseline, project and/or leakage emissions from electricity consumption.

A standard calculation model was set up allowing recycling cooperatives to calculate their contribution to GHG emissions reduction and energy savings, based on their operations (see Figure 1). The results show that a considerable reduction in GHG emissions is achieved through cooperative recycling, in addition to a large array of social and other environmental benefits generated through cooperative recycling.

Figure 6: Workers at a recycling cooperative in Brazil

LESSONS LEARNT

This is a practical and replicable tool for recycling cooperatives to measure and quantify the reduction of GHG emissions and environmental benefits of their work. The tool highlights the need for recyclers—frequently a vulnerable and stigmatized population—to be included as a central component of any waste management plan in Latin America. At the same time, this tool can help inform public policies for source separation and recycling, as well as the application of climate funds related to climate change mitigation through organized recycling.

The methodology developed in this research is highly relevant for the context of the Global South and can be adapted to different geographic and operational contexts, and therefore bears a realistic potential to be replicated and multiplied by local practitioners, such as the catadores.

Life cycle assessment studies show the enormous potential of recycling to meet social, economic, and environmental objectives. Material recycling is an ecologically sound mitigation strategy for decarbonization, and thus a cornerstone for moving towards a circular economy. There is immense potential to create more livelihood opportunities through selective solid waste collection and recycling for impoverished and unemployed sectors in society. Compensating these workers' environmental service—energy and GHG emissions reduction—is a realistic poverty reduction strategy. It is time for recyclers to be fairly rewarded for their societal contribution.

[15] M. King and J. Gutberlet (2013): Contribution of cooperative sector recycling to greenhouse gas emissions reduction: A case study of Ribeirão Pires, Brazil. Waste Management 33 (12): 2771–80.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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LA PAZ AND ITS TWIN CITY EL ALTO: A TRANSPORT METAMORPHOSIS

Matthias Nuessgen

Since 2004, several Latin American cities have started to use urban ropeways as an additional mode of public transport. The first projects aimed at making small informal and isolated areas accessible and offer their populations better connections to the cities. Huge improvements in travel time were achieved for the passengers, who sometimes had needed hours to travel from their neighbourhoods to the city centres, and can now make the same trip in minutes. Medellin (2004) and Caracas (2010) are the most obvious examples of this groundbreaking strategy.

Detachable ropeways consist of many cabins that are sustained and propelled by a revolving cable pulling continuously in one direction. This form of common movement of many vehicles simultaneously is far more effective than the constant acceleration and deceleration of independent vehicles on a rail or road network, and it does not need a schedule because the cabins leave the stations every 10 to 20 seconds, depending on the characteristics of the system.

Compared to other transport modes with similar capacities, gondolas have low maintenance and construction costs. Apart from that, the vehicles themselves do not carry engines, fuel, wheels, chassis, or suspensions, thus they lightweight, which makes them a very energy-efficient and hence clean mode of transport.

With a maximum capacity of up to 6000 passengers per hour per direction (pphpd), cabins do not have the same capacity as underground metros, regional trains, or large Bus Rapid Transit (BRT) systems, but they are far easier to integrate into an urban environment than a BRT system or an over-ground rail system, and far easier to implement than an underground metro.

With a comparable capacity to tramways or small to medium-sized BRTs, they are very compatible as feeder systems for mass transit corridors or to fill gaps in existing networks. They help the mass transit modes enlarge the corridor of city fabric they are able to cover, and make them use their capacity more effectively. This increases the attractiveness of public transport, for the user as well as for the operator.

ROPEWAYS AS THE BACKBONE OF TRANSPORTATION IN LA PAZ AND EL ALTO

With the implementation of the world's largest network of urban cable cars in La Paz, the transport mode is about to complete its next development step. Here, cable transit is developing to become the backbone of metropolitan transit between La Paz and its twin city El Alto. The basic idea has been to connect two almost equally populated cities of a metropolitan area with ropeways as a main mode of transport. The geographic conditions in La Paz make cable cars the logical choice for this connection. El Alto lies on a plateau of the Altiplano, about 400 metres above the historical city of La Paz.

El Alto is by far the poorer of the two cities and suffers from severe social problems caused by its incredibly fast urban growth and the resulting housing shortage and unemployment. The *Human Development Report*—published in 2004 by UN-Habitat—reported that only 7.3 per cent of the Alteños were able to satisfy their basic necessities. According to the report, 25 per cent lived on the threshold of poverty, 48 per cent in moderate poverty and 17 per cent of the population lived in severe poverty. Nevertheless, the city is still growing faster than any other Bolivian city. What was only a village with a few houses in the 1950s has overtaken La Paz as the biggest city of the country and has over a million inhabitants today, with no end in sight.

In the 60 years of its existence, El Alto has attracted big parts of the original population from the Bolivian highlands to the metropolitan area, because they had lost their source of livelihood due to extreme climate change—i.e., droughts, torrential rainfall, and a temperature rise that allowed insects and diseases to affect their crops. For this reason, El Alto is the largest city in Latin America with a primarily indigenous population. About 85 per cent of its inhabitants belong to one of the many indigenous groups of the country, 15 per cent are Mestizos (decedents of indigenous and white Europeans), and less than 1 per cent belong to other races.

Both cities were united within the same metropolitan area, yet separated by a huge income difference, and a clear racial segregation. Public transport was developed separately in La Paz and El Alto, and discussions to develop a metropolitan transport system started only in 2010. This new system allows regular interchange between both cities and opens up an entirely new world of economic opportunities to the citizens of El Alto.

MI TELEFERICO

Apart from municipal efforts to improve the mobility in the twin cities, the national government of president Evo Morales began to plan and implement the ropeway system Mi Teleferico. Although there are obviously conflicts with the metropolitan administration, the systems will be integrated into one coherent transport system.

On 30 May 2014, the president inaugurated the first of three cable lines; he underscored that the project was meant to improve mobility options for the poorer segment of the population. By the end of the 2014, all the three lines had been completed, thanks to an investment of USD 234 million. Just after the last line was completed, the implementation of a bigger second phase was announced in early 2015. Over the next four years, another six lines with a total length of about 20 kilometres will be installed. The investment for this second phase will be USD 450 million.

Until the implementation of the first phase of Mi Teleferico, mobility options connecting the two cities of La Paz and El Alto were scarce. The trip by car or minibus normally took over one hour, due to the poor road infrastructure. The cable car system now provides state-of-the-art transport infrastructure, offering quick, affordable, and safe connections between the two cities. The fare for a single trip is 3 Bolivars (Bs), the equivalent of USD 0.40. Compared to the fare prices for the bus services in La Paz, these trips are more expensive, but for the population they seem to establish an improvement big enough to justify the price. In its first year of existence, the system carried over 23 million passengers, which is roughly about 25 per cent of the full capacity for three lines in one year. Taking into account that the service started with only one line and that the other two have only been completed in September and November 2014, this is a very reasonable result.
The Ropeway's Impact on Carbon Emissions Reduction.

To realistically calculate the potential CO2 savings of the La Paz ropeway systems, a detailed study would be necessary. Other examples prove, however, that the mitigation potential is huge: six ropeways in Medellin (Columbia) have mitigated 157,000 tons of CO2 in seven years of operation. According to a study by Climate-partner, ropeways are thus the cleanest mass transport mode available at the moment.

From a social point of view, it is obvious that only affordable transport modes can be socially sustainable. Current prices still are too high for the poorest segments of the population.

Every transport mode creates jobs, but it may also make others obsolete. The downside of the improvements in the metropolitan area of La Paz is the fear of competition amongst the private minibus and taxi operators. Though the plan is to integrate them into the system as feeders for the mass transit modes, they form a fierce opposition—especially against the implementation of the bus services.

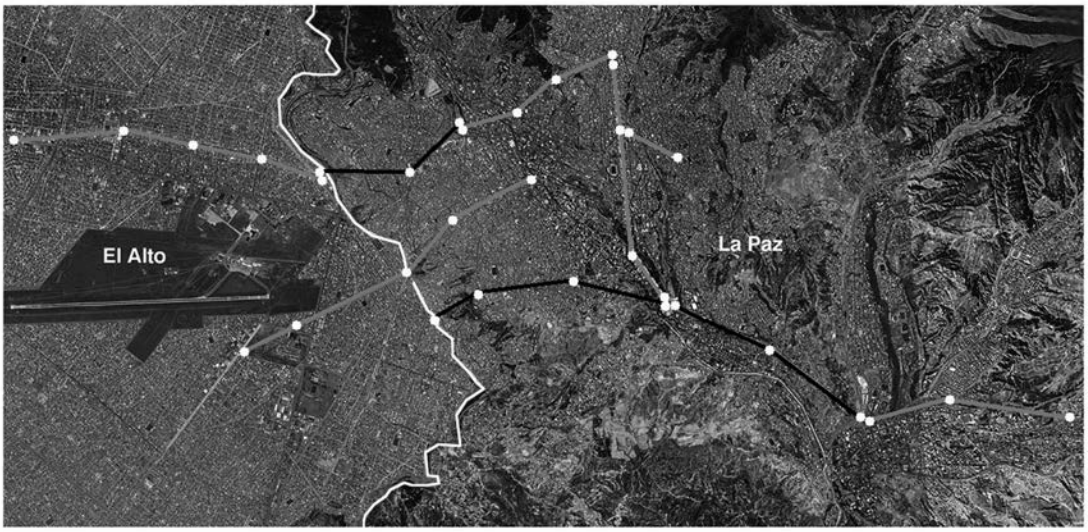

Figure 7: The ropeway system connecting El Alto and La Paz. Source: Doppelmayr

Another risk of the development is related to the clash of cultures, which has occurred in La Paz since the opening of the ropeway system. Many citizens from the wealthier parts of La Paz have even started complaining about the omnipresence of indigenous beggars and vendors in the city's streets. The government was very quick in its reaction, accusing them of racism; nevertheless, due to the huge cultural and economic differences, the real integration of the societies of both cities will probably take a lot more time than it takes to build a cable car.

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BUS RAPID TRANSIT SYSTEMS: DECONGESTING THE INDIAN CITIES

Tirthankar Mandal

The rapid urbanization process in India has generated exponential growth in demand for public transport. The government has responded to this demand by planning to spend USD12 billion for implementing the development of rapid transport systems in India's cities. This support will have a multiplier effect, by triggering private investments in this sector. During 2005, Bus Rapid Transit (BRT) systems were introduced in India with private partnerships to meet the growing demand of efficient public infrastructure. In the last ten years, BRT systems have been implemented in 24 cities and have become an integral component of the »100 Smart Cities« government project. The initiative is designed to increase efficiency in the public transport system, through small but well-defined structural changes (see Table 2).

Key Features of Bus Rapid Transit Systems in India:

ACTIVITY	LEVEL OF INTERVENTION	EFFECT
Safety measures in city bus stops	Infrastructure	Increased safety for commuters.
On-street interchanges	Infrastructure	Reduced commuting time
Terminal improvements	Infrastructure	Increased efficiency of resource usage
Driver training	Human resource management	Increased driving capacity
Smart signals	Infrastructure	Increased efficiency and reduced commuting time
Incentive schemes	Management	Increase efficiency
GPS application	IT infrastructure	Reduced commuting time

Table 2. Source: Compiled from different sources on BRT by author

With a projected urban population of 590 million by 2030 (as per UN estimates of 2014), India is facing an unprecedented challenge in terms of infrastructure requirements. The lack of efficient public transport is resulting in an increasing number of private vehicles on Indian roads every day: the average annual growth rate of cars is estimated to be 12 per cent for Indian metropolitan cities. This leads to a further squeezing of road space and thereby slow public transport speed (average of 20 kilometres per hour) during peak hours. Thus, commuting time has effectively increased, which in turn has resulted in increased emissions and lower air quality in the cities. The goal of the BRT systems is to give priority to buses and increase their average speed from the current level to at least 40 kilometres per hour in metropolitan cities.

As a growing economy, India's future demand for better facilities of mass rapid transport will increase dramatically due to rapid urbanization. To provide improved public transport facilities, transport systems have to be better integrated. In this regard, plans to expand BRT systems have been prioritized because of their cost effectiveness and because they require the least modification of the existing urban infrastructures. Furthermore, the success of such initiatives in other developing countries has given policymakers the confidence to apply it in India as well.

SOCIAL BENEFITS OF BRT SYSTEMS

BRT systems were initiated to provide cheap and fast transport options between two points. According to the EMBARQ India project on BRT systems, buses account for almost 43 per cent of the total share of city transports. During the last decade, the growth of BRT systems has been remarkable. The number of cities using them has grown from one to 24—carrying about 308,000 travellers per day. The Jawaharlal Nehru

National Urban Renewal Mission (JnNURM) plans to increase the coverage of BRT corridors from 180 to 440 kilometres. It is interesting to note that the demographic division of people accessing BRT systems is biased towards the age group of 15 to 40 years. According to a study undertaken by United Nations Environment Programme (UNEP) in 2013, female travellers outnumber their male counterparts; and according to another survey, the majority of commuters using BRT systems belong to the poorest 20 per cent of the population.

At the same time, it can be observed that higher income groups don't want to travel by public transport: the share of individual transport has increased by 43 per cent over the last decade. In North Indian cities, using public transport has become a social status issue. According to the primary survey conducted by EMABRQ in 2011, the number of people from higher income groups using BRT systems is lower than in West, South, and Central India. However, the share of higher income people travelling by Delhi Metro is quite large. That example shows that BRT has the potential to attract more people, if the system is improved considerably.

In terms of social benefits, BRT systems in Indian cities have actually reduced the commuting time. On the other hand, the net employment effect is negligible because the initiative is seen as a (mere) modification of the existing transport system in the cities. However, working conditions for bus drivers have improved as a result of BRT initiatives: bus personnel now have improved access to social and medical services, and they benefit from fairer working hours.

EMISSIONS REDUCTIONS

The transport sector accounts for around 22 to 24 per cent of India's CO2 emissions. Most buses still run on diesel, but the JnNURM initiative has begun important structural changes in the public transport system. First, there has been a fuel shift from diesel to compressed natural gas (CNG), which has already reduced the emissions. Secondly, route rationalization and dedicated corridors have increased the average speed of BRT systems to 40 kilometres per hour, thereby increasing the efficiency of the system. Third, the introduction of fuel standards is expected to further reduce the level of various fuel emissions. Due to huge variations in the characteristics of the BRTs in the different cities, it is hard to obtain consolidated data on emissions reduction benefits. However, for some of the cities, the EMBARQ assessment undertaken in 2009 suggests an indicative picture. According to the analysis, the estimated amount of avoided emissions for Mumbai would be 5.36 million tons of CO2 in 2021, Ahmedabad would avoid 0.93 million tons, and Surat would avoid 0.6 million tons. Thus, the JnNURM initiative has a substantial role to play in developing a low carbon transport sector, and the future expansion of the BRT initiative in other Indian cities will potentially increase the overall decarbonization rate of the Indian economy.

FURTHER EXPANSION OF BUS RAPID TRANSPORTATION SYSTEMS

The current government has widely propagated the concept of »Make in India«, which essentially aims at transforming India into a manufacturing hub. Developing efficient transport systems will ensure faster movement of the labour force and efficient resource use. It suits the current government's political agenda and creates socially inclusive solutions to the regular commuting challenges. Furthermore, BRT systems are now considered part of the planning and development process of all metropolitan cities due to their effectiveness and the proven benefits for the economically weaker sections of the urban population.

The government has also discussed including BRT systems in a planned Nationally Appropriate Mitigation Action (NAMA), covering the transport sector. At a bilateral level, the German corporation Gesellschaft für Internationale Zusammenarbeit (GIZ) is collaborating with the Ministry of Environment, Forest and Climate Change to develop such a NAMA. If this initiative is successful, the expansion of BRT systems could trigger important changes. The Indian government is also considering the introduction of congestion taxes for private motorized vehicles during certain times of the day, to create incentives for using public transport. This would have a number of additional benefits. First, this would increase revenues for public transport due to the likely increase in passengers. Second, it would reduce emissions and individual traffic. Finally, it would reduce commuting time due to less heavy traffic.

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PIONEERING LOW CARBON DEVELOPMENT IN RURAL AREAS

Thomas Hirsch

Many developing countries—in particular in Asia and Africa—are still predominantly rural, with large populations living below the poverty line. These people are affected the most by climate change impacts, and they contribute the least to anthropogenic climate change.

But even when per capita greenhouse gas (GHG) emissions are very low, these affected populations might still benefit from development co-benefits of low carbon solutions, compared to traditional development pathways: access to sustainable renewable energy can be faster and cheaper, if building on local energy resources as hydro, biomass, wind, or the sun. This is particularly true for remote off-grid areas, or for those suffering from unstable and expensive electricity supplies. Cooking is another example: 2.7 billion people prepare their meals on open fires or inefficient and smoky cook stoves, which leads to serious health problems and deforestation.

Deforestation matters, and so does agriculture. Carbon dioxide emissions and methane related to agriculture and deforestation account for at least 20 per cent of the GHG effect. Methane is the second most important GHG (14 per cent). It is emitted from agriculture (paddy rice cultivation, cow farming), thawing permafrost, wetlands, and peat soils. Nitrous oxide, the third most important GHG (8 per cent), is also mainly emitted from intensively cultivated agricultural soils with high fertilizer inputs.

The first article of this chapter is on the Chinese »Low Carbon Adaptation and Poverty Alleviation Program«. It aims to explore a feasible approach to integrate climate change adaptation, low carbon development, and poverty alleviation for sustainable development in rural communities. The pilot scheme has been successfully implemented in Yujiashan Village.

The second contribution shares the good experience of decentralized renewable energy option clusters, combined with a climate resilience approach. It focuses on the Indian Adivasi tribal population, with an encouraging pilot project in the Paderu region of Visakhapatnam District.

The third example discusses a very valuable approach for introducing clean cooking stoves, replacing black carbon intense and very unhealthy traditional stoves across Africa.

The fourth contribution presents a successful example of paddy straw gasification to produce electricity and run rice mills in rural Myanmar. Apart from presenting the case, the potential and unsolved problems of biomass gasification are also discussed.

Afforestation of degraded land around the Aral Sea and the successful introduction of agricultural practices in Uzbekistan are in the focus of another inspiring article.

Last but not least, Project 90by2030 is introduced as a new methodology to successfully introduce renewable energy technologies in poor rural communities in South Africa.
Happy reading!

THE LOW CARBON ADAPTATION AND POVERTY ALLEVIATION PILOT PROGRAMME IN YUJIASHAN VILLAGE, CHINA

Jing Huang & BinBin Wang

Climate change has become one of the major factors hindering global sustainable development, and one of the main reasons developing countries tend to fall into and remain in poverty. To cope with climate change and tackle poverty, climate risk management or emissions reduction is only part of the solution. A more effective approach is to integrate climate change adaptation and mitigation measures into traditional sustainable development programmes in the community, in order to enhance people's resilience and their ability to adapt to climate change. With enhanced capacity, people will be able to improve their own livelihoods and escape poverty.

In light of this, Oxfam Hong Kong has initiated the »Low-Carbon Adaptation and Poverty Alleviation Programme« (LAPA). It aims to explore a feasible approach that combines climate change adaptation, low carbon development, and poverty alleviation for sustainable development in rural communities, through interaction and cooperation with the government at all levels, research institutes, non-governmental organizations (NGOs), the private sector and the media. A gender-sensitive participatory approach has also been incorporated into the programme. The pilot scheme has been implemented in Yujiashan Village, Tingkou Town, Xianyang City, Shaanxi Province in China.

SELECTION AND BACKGROUND OF THE COMMUNITY

After in-depth research and analysis on potential communities, Yujiashan Village was selected for the programme. Tingkou Town—where Yujiashan Village is located—is a coal town where local people use coal as a main source of energy. Because coal has a high carbon content, it has resulted in serious indoor pollution, which has severely affected the quality of life and health of people in the village—especially that of the elderly, women, and children. In addition, Yujiashan Village is located within one of the most impoverished counties in China, where poverty reduction is a primary task.

Apart from the issue of unsustainable energy sources, local meteorological data have shown that the annual mean temperature has been rising year by year, and droughts and natural disasters caused by extreme weather have been occurring more frequently. Under such conditions, finding a low carbon and sustainable way to live and adapt to climate change, while reducing poverty, has become a pressing issue in Yujiashan Village.

The LAPA programme thus explores ways to increase villagers' incomes by introducing a series of low carbon solutions and sustainable development practices in agricultural production and rural life, and increasing the capacity of peasants.

THE LOW CARBON ADAPTATION AND POVERTY ALLEVIATION PROGRAMME (LAPA)

Together with Shaanxi Scientific Technology Service Centre (STSC) for Rural Women, we developed and implemented a series of poverty reduction projects suitable for the local situation:

1. New varieties of drought-resistant corn and wheat were introduced based on traditional crop farming and taking into consideration the available local natural resources, climate type, and impacts of climate change.
2. Multispecies cash crop farming was introduced. This diversified farmers' livelihoods and increased their income.
3. It was identified that persimmons had the potential to become the local speciality crop. The programme therefore assisted villagers in establishing a dried persimmon professional cooperative, developed

supportive measures and introduced product development. This included package design, agricultural product marketing, and training in e-business. Through such efforts, a secondary industry was established.

4. It is expected that the programme will bring in various projects in the future, including agricultural greenhouses and ecological agriculture, and become an agricultural attraction. It will also promote the development of a tertiary industry, such as tourism or service industries.
5. Institutions and organizations have been invited to provide training to the villagers, in order to build up their knowledge and awareness of sustainable development, as well as their capacity in implementing these measures so that they will be sustainable and independent in the long run.

The programme also adopted low carbon agricultural production methods to cope with the effects of climate change:

1. Traditional chemical fertilizers were replaced with bio-fertilizer. A straw pulverizer was introduced in each village group, so that local straw could be processed into fertilizer. Research was conducted, which indicates that under the premise that crop yields remain unchanged, the current amount of fertilizer can be reduced by 20 per cent.
2. Chemical pesticides were replaced with more environmentally friendly pest control methods, such as solar insecticidal lamps and biological pest control.

Through the programme, annual income for locals increased from 2,100 to 3,500 Yuan within less than two years, between 2013 and 2015. As the programme continues, it is expected that annual incomes will continue to gradually increase.

LOW CARBON AND CLIMATE-RESILIENT RURAL CONSTRUCTION AND LIVING

The concept of low-carbon sustainable development also played an integral part in the design process, construction, and operation of Yujiashan New Village.

1. Living and Residence: Houses in the village were designed to have narrow courtyards to block out daylight and form a shadowed area in the yard, so that villagers could avoid the heat in the summer.
2. Energy-efficient Construction: Energy-saving hollow bricks have been used to replace traditional solid ones. Thermal insulation materials have also been added to the houses' external walls, while insulated glass has been installed to make the new village more energy efficient.
3. Living Environment: The programme looked into community household water consumption, public facilities, afforestation, waste disposal, and sewage treatment to enable the villagers to better utilize resources and create an ecological rural environment for sustainable living.
4. Disaster Prevention and Warning Systems: A series of disaster prevention and warning systems have been established to enhance the community's climate resilience. For example, coal mine goafs and tunnels were avoided to ensure the safety of the residential area; mountain slopes around the new village have also been paved with stone. An anti-seismic structure system was adopted along with a reinforced drainage and fire extinguishing system. In addition, two evacuation shelters have been designed, built, and equipped with the necessary equipment and early warning and monitoring meteorological systems.

By introducing low carbon technology for both agricultural production and community life, the programme could greatly reduce greenhouse gas emissions. More specifically, it would be reduced by a total of 2,249 tCO2, or 14 tCO2e a year per household.

CONCLUSION

This LAPA programme is a pilot scheme that aims to explore the feasibility of combining poverty reduction with low carbon adaptation measures in impoverished rural areas in Midwest China. The programme focuses on strengthening the agricultural industry, helping rural communities to flourish, and farmers to improve their

quality of life. It also promotes a low carbon transformation in agricultural production and rural residents' lifestyles.

After nearly two years of implementation, the target group has gradually come to better understand the programme. They now know that low carbon development is not an economic burden, but a concept and lifestyle that enhances agricultural production and rural life. They also learnt that poverty reduction and low carbon adaptation are complementary.

Through this pilot scheme, we have gained valuable insight and experience. We hope to implement this programme in other rural areas, in order to tackle both poverty and climate change and promote the sustainable development of these areas.

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ENVIRONMENT- AND CLIMATE-FRIENDLY INITIATIVES IN THE CONTEXT OF AN INDIAN INDIGENOUS COMMUNITY

Nafisa Goga D'Souza & Siddharth D'Souza

Since 1989, LAYA Resource Centre has been involved in addressing the issues of indigenous communities—i.e., Indian Adivasi groups. The term LAYA means »rhythm« and the hallmark of LAYA's involvement with indigenous communities has been to facilitate development initiatives without affecting the rhythmic value of indigenous societies. LAYA Resource Centre's engagement on climate change was initiated in 1996, and since then efforts at the grassroots level have been centred on decentralized and renewable energy options and on promoting resilient communities with adaptation and mitigation interventions.

INITIAL FAILURES

In 2009, the Indian state of Andhra Pradesh declared that its constituents had 100 per cent access to electricity. Although the electricity infrastructure in the state has been developed considerably, the Andhra Pradesh government has found it difficult to maintain sustained access to electricity. Power outages and electricity voltage fluctuations are the norm; for remote villages it is even worse, and power cuts remain for months on end. Finally, the cost of electricity has also become increasingly unaffordable for these cash-poor yet resource-rich Adivasi communities.

LAYA Resource Centre's first initiative in 2003 was to demonstrate compact fluorescent lamp (CFL) solar lanterns in one village. At that time, there were several villages without any electricity infrastructure. These villages, which were locked in by the hills, remained in absolute darkness once the sun set. For a relatively small non-governmental organization (NGO) with no prior experience on working with energy, the initiative was soon fraught with issues. Within months, most of the solar lanterns needed repair. The community did not fully understand how to use them. Some households had even tried to charge the large 12 Volt batteries with their tiny solar panels.

The next project was the construction of a very small hydro project (1 kW) that would benefit about 20 households. Yet the lack of technical expertise coupled with a natural disaster resulted in washing away the rudimentary construction, and the system collapsed. The painful decision to withdraw further work was taken once the government installed electricity in the same village.

DECENTRALIZED RENEWABLE ENERGY OPTION (DREO) CLUSTERS

The disappointment only strengthened the resolve to work harder to overcome the technical barriers. In 2007, a feasibility study of Decentralized Renewable Energy Options (DREOs) in the Adivasi regions of four states—Andhra Pradesh, Orissa, Chhattisgarh, and Jharkhand—made it clear that DREOs work best when they complement each other. With the experience gained from setting up renewable energy technologies in a cluster of villages, LAYA saw the potential to cover technology units over a broader geographical region.

As a result, three DREO clusters emerged in two regions. Each cluster has one nodal micro hydro with the surrounding villages deployed with solar lanterns and energy-efficient woodstoves (EEWs). Typically, a hydro unit would produce about 3-10 kW of electricity supplying electricity to about 25 to 100 households (one or two settlements). Approximately 250 to 500 solar lanterns with as many EEWs were distributed in the surrounding villages.

NEW TECHNOLOGY INITIATIVES AND EXPANDING DREOS

More recently, bio-sand filters, hydrams, and solar pumps were introduced to respond to drinking water and irrigation needs. The bio-sand filter is a zero energy water filter that eliminates sediments, bacteria, viruses, compounds, cysts, worms, and other impurities. It is an adaptation of the traditional slow sand filter for intermittent use, making it suitable for household use. It is durable, robust, and fabricated from local materials, which makes it suitable for remote indigenous communities. The technology provides safe drinking water, without the necessity for boiling water on traditional cook stoves. Hydrams are renewable energy pumps that work on the basis of the gravity flow of water. Water flowing down a gradient (usually a small stream) channelled into the pump can be pushed up to three times as high to the nearby village or stream through pipes. A solar-powered pump runs on electricity generated by photovoltaic panels or the thermal energy available from collected sunlight, as and alternative to grid electricity or diesel-run water pumps.

These technologies have helped in attempting the large-scale deployment of DREO technology units. This is being achieved by the registration of these initiatives under Gold Standard Voluntary Emission Reduction (GS VER) projects. These projects use the same methodology as Clean Development Mechanism (CDM) projects. The idea is to reduce CO2 emissions with the intervention of clean technology, and sell the resulting (measured and verifiable) emissions reduced in the market to pay for the capital costs.

Consequently, LAYA Resource Centre has successfully implemented the first microscale GS VER project for energy-efficient wood stoves in Paderu region of Visakhapatnam District. A total of 4,000 wood stoves have been built and will be maintained for a period of ten years. Eventually another project was also registered for 12,000 households for energy-efficient wood stoves and bio-sand filters.

These climate- and environment-friendly initiatives have emerged as a response to the needs of the community at the household level: electricity from hydro energy, light from solar lanterns, energy-efficient wood stoves for cooking, and potable drinking water from bio-sand filters.

THE CLUSTER APPROACH REDEFINED TO FOSTER CLIMATE RESILIENCE

In the initial stages, the cluster approach was limited to decentralized technologies to meet needs such as electricity, drinking water, and irrigation. In time, we realized the importance of responding more holistically to the need of communities to become more climate resilient. This led us to undertake a vulnerability assessment study of two interior Panchayats (administrative units comprising a cluster of villages), followed by an engagement related to sustainable agriculture in promoting drought resistant grain, mixed cropping, system of rice intensification (SRI), gardens, homestead lands, horticulture, and moisture conservation through watershed initiatives. A Package of Practices (PoP) of technologies to facilitate more effective farming practices is being developed as an alternative to high inputs of chemicals. These beginnings have led us to collaborate with like-minded NGOs on low carbon farming (LCF). This is still an experiment that needs to be cemented as a methodology, which can then be widely accepted.

Responding to health and education needs of the indigenous communities, in line with their cultural ethos, is another component. LAYA's long-term experience in promoting herbal based and alternative health care processes, as complementary to the existing mainstream service structures, adds immense value to the community's long-term resilience building processes.

COMMUNITY PARTICIPATION AND FEEDBACK

From the very beginning, community participation and feedback in assessing the feasibility, functionality, and efficacy of the technologies has been critical. Micro hydros remain the most challenging and expensive systems to build and manage. Solar lanterns have a limited accessibility, particularly in areas that have already received grid electricity. Energy-efficient stoves have received a very positive response and the women naturally

take to their maintenance and upkeep, as they are quite similar to the traditional stoves. However, there is no natural demand to purchase these stoves. The perceived reduction in wood usage does not directly mean a savings of money, because wood is collected from broken, dried branches for free. Thus, each of these technologies has their own story in terms of acceptance and utility.

The path to developing resilient indigenous communities is a challenge in a context where the pressure of commercialization draws these communities into unsustainable farming practices due to the lure of instant cash incentives. What is needed are community-based alternatives that contribute to the »well-being« of such communities, while challenging the mainstream paradigm of development.

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SMOKE-FREE COOKING PROTECTS HUMAN LIVES AND REDUCES EMISSIONS

Marlis Kees

The kitchen of the elementary school Mungoye, north-west of Kisumu in north-west Kenya, lies hidden behind a school tract. The wind whistles through the walls of wood and mud. Five open fires burn in the kitchen, and over each of them, lunch for 770 schoolchildren simmers in large pots. Cook Jane Ambuka bustles from one to another, puts more branches on the fires, and stirs. It is a miracle that she can tolerate the dense smoke; the eyes burn, every breath is irritating. One immediately senses that this environment makes people sick.

Jane Ambuka is one of 2.7 billion people worldwide who cook over open fires and inefficient stoves. According to the World Health Organization (WHO), 4.3 million people die every year from toxic smoke generated by cooking fires—which is more than from malaria and HIV combined. The reason for this is the many millions of particles and airborne particles that make up the soot—especially carbon, sulphur dioxide (SO2), and nitrogen oxides (NOx). Soot not only damages the eyes and respiratory system: after CO2, it is regarded as one of the major causes of global warming.

CLIMATE KILLER SOOT

It is no accident that climate experts are just gradually becoming interested in soot and its climate impact. The matter is complex and many processes have not yet been researched. The dark particles absorb heat, reduce the reflectivity of snow and ice, and can form clouds. Some of the processes in which soot plays a role warm the climate, and others cool it down. »Soot affects the climate in various ways, both directly and indirectly. All of these effects must be considered in their interaction«, according to Sarah Doherty from the Joint Institute for the Study of the Atmosphere and Ocean at Washington University. The fact is that the effect of soot seems stronger than previously thought. The good news is that soot lingers in the atmosphere for a much shorter period than CO2. If it is possible to scale back soot emissions—for example, through higher standards for diesel vehicles and mobile pumps or the distribution of solar lamps and efficient cooking stoves—this reduces the harmful climate impact much faster than the case of long-lasting carbon dioxide. It is important to note that soot is closely linked to poverty: Africa, Asia, and Latin America currently cause about 75 per cent of global soot emissions. In India, for example, millions of cooking fires emit more soot than transport and industry.

THE ALTERNATIVE: LOW-SOOT TECHNOLOGIES

The technologies to reduce soot emissions significantly are available. Hence, there are many hundreds of stove models for different cooking cultures around the world, and dozens of types of solar-powered lamps that can be used to replace kerosene lamps. While health experts plead for soot-free cooking areas—for example, gas stove or electric-powered cookers—there are many rural regions without electricity, and gas cylinders are often very expensive due to the transport routes. Here, improved wood stoves are a very good alternative, because they save firewood and cause up to 90 per cent fewer emissions.

However, distributing efficient stoves sounds easier than it often is in reality, as many experiences from the last 35 years show. Between 1984 and 2002, for example, the Indian government distributed around 30 million cook stoves for free, of which only ten million had been used shortly thereafter. This was because the distribution of the stoves did not take into account the needs of the cooks, and the maintenance had not been planned.

Not infrequently, men from industrialized countries develop technical solutions for women from developing and emerging countries. This only works if the inventors also take into account the needs of users and know their living conditions. The Rocket Stove is a good example of this. The combustion chamber was developed by a former NASA engineer, the handling and design of the herd was refined by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with women in Latin America and Africa.

THE PATH: ESTABLISHING MARKETS FOR ENERGY-SAVING STOVES AND SOLAR-POWERED LAMPS

Figure 8: Smoke-free cooking in a fish restaurant, Kenya, Photo GIZ

Developing good-quality cooking stoves, however, is not enough: the stoves also have to be distributed. Based on the experiences in the past, development initiatives today focus on initiating markets for cooking stoves, training stove producers, and launching information and marketing campaigns. The stove producers then sell them based on their own economic self-interest and earn money from maintenance.

This approach is followed, for example, by Energising Development (EnDev)—a programme that the GIZ realizes on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ), as well as five other international donors in some two dozen countries. The target groups are rural areas without access to modern energy. In Kenya alone, EnDev has trained more than 4,000 stove producers in recent years. In total, EnDev has distributed more than 2.1 million stoves in partner countries, reaching almost 10.5 million people. And two million people benefit from clean light, because they have replaced their sooty kerosene lamps with solar-powered lanterns.

In addition, a total of nearly 1.38 million tons of CO2 per year was saved. This corresponds to 7.9 million newly planted trees or the emissions of 400,000 return flights from Frankfurt to New York.

CDM PROJECTS PROMOTE THE DEVELOPMENT OF FUNCTIONING MARKETS ONLY TO A LIMITED EXTENT

While EnDev and other initiatives today rely on market mechanisms, projects are increasingly emerging that are financed by the CDM mechanism or voluntary declarations of commitment, in order to offset their own emissions climate-neutrally. In principle, such projects are sensible. But studies from India and Kenya show that most of these projects give away the stoves or partially subsidize the price. The consideration that with cheap or free stoves, many stoves can be distributed in a small region is economically sensible. However, they counteract plans to market the stoves as high-quality products. Where cooking stoves are given away, the willingness of consumers to pay for them sinks.

REDUCE POVERTY WITH CUSTOMIZED AND COST-EFFECTIVE TECHNOLOGIES

Since soot has come more strongly into the focus of climate policy, the discussion has turned to meaningful strategies to reduce soot emissions. Thereby, in rural areas—in addition to diesel generators and kerosene lamps—the subject is primarily cooking stoves. The GIZ is pursuing a strategy that promotes local structures

and relies on simple but efficient and affordable technologies, and that the population can afford. Given mass distribution, this approach saves substantial amounts of emissions.

One of the newer developments in cooking stoves are gasifier stoves, where wood chips or pellets are burned. They guarantee clean burning, but only if they are handled properly. In addition, the stoves are more expensive and the fuel must be purchased or the wood has to be chopped, which is time consuming. Wood for open fires, however, is often freely available and only has to be collected. The acceptance of these technologies is currently still marginal in rural areas, but demand—as shown by past experience—is likely to continue to rise sharply.

Many companies, government agencies, hospitals, and even schools consume a lot of firewood for their canteens, for which they often have to spend a considerable proportion of their budget. Institutional stoves save money and protect employees from the toxic smoke—for example, in the Nyamninia primary school with their 875 children. This school is just a 30-minute drive from the Mungoye primary school, yet the two schools are worlds apart—at least in the kitchens. In Nyamninia, there are three new institutional stoves. One stove alone costs around 1,600 euros, which is a lot of money in north-west Kenya. However, the stoves will reduce firewood consumption by 70 per cent and pay for itself in just seven months. Cook Roseline Gabiambo is pleased with her smoke-free kitchen, with the soot-free walls, and by the fact that her eyes no longer burn every day. The 35-year-old woman explains: »In the meantime, I am very happy to cook again, because I do no longer have to breathe smoke«.

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TURNING WASTE INTO ELECTRICITY: BIOMASS GASIFICATION IN MYANMAR

Peter Rottach

In Myanmar, land use is the main perpetrator of and the biggest sufferer from climate change, because it is affected by changes in the monsoons, rise in sea levels, increasing storms, and heavy precipitation. Yet, in spite of rather bleak perspectives, climate change has not become a major political issue in the land of the golden pagodas. Accordingly, there has so far been little incentive for the people of Myanmar to change land-use patterns or switch from fossil fuels to renewable energy.

RICE HUSK GASIFICATION

Given the general attitude against renewable energy, what Mr. Swe Aye has achieved in his village Htaw Paing is even more remarkable. The village is located at one of the vast numbers of tributaries to the Irrawaddy, not far from the mouth of this river. This region is considered the rice belt of Myanmar. It is unthinkable, what a sea level rise of one metre would mean to this low-lying flat land, its agricultural production, and food security in the entire country. Even modest sea level increases would increase the salinity of soils in an area that is already short of drinking water due to the high salt content of ground water resources. Since rice is highly susceptible to salt, it may just be a matter of time until paddy yields in this coastal zone decline significantly.

Running a rice mill profitably under such circumstances requires a forward-looking perspective, both in environmental and economic terms. This is exactly what Mr. Swe Aye is doing. He cannot prevent climate change and sea level rise, nor can he mitigate the increasing effects of salinity; but he can make his mill more climate-friendly and more economically resilient. Eight years ago, he took some of the money he inherited from his father and bought a biomass gasification plant in China. With this plant, he is able to convert rice husks into electricity to run the rice mill. Rice husk is separated from the rice when the rice is milled. It is a waste product and is usually dumped into the rivers. Particularly in low-flowing parts of the rivers, the husks often cause eutrophication to the detriment of aquatic life. Huge heaps of rotten rice husks are a common sight at almost every rice mill in the region. But not at Mr. Aye's mill: the husks are kept inside the building where they are protected from rain, humidity, and from soil-borne moisture.

Figure 9: Biomass gasification in Myanmar

Generally, rice mills in Myanmar use diesel fuel to grind the rice. About 20 per cent of the weight of rice is made up of husks. Gasification allows the replacement of approximately 1 litre of diesel, by consuming just five to six kilograms of husks. Mr. Aye has calculated that he saves approximately 400 litres of diesel every month. This is equivalent to 1060 kilograms of CO2. His rice mill is small and only can process up to one ton of rice per hour. The 250 kW gasifier substitutes more than 70 per cent of diesel that average rice mills of this size would consume. In addition to reducing 13 tons of CO2 emissions every year, Mr. Aye said that he is saving a considerable amount of money he would have to spend for diesel oil otherwise.

GASIFICATION TECHNOLOGY

Rice husk or biomass gasification is derived from wood gasification. In principle, the technology is quite simple. Biomass not only consists of pure carbon, but many other chemical substances that are converted into gas when temperatures increase beyond 500 to 700° Celsius. Most of these gases are combustible and can be fed into a gas engine that runs a generator for electricity production. To begin the conversion from solid components of the biomass to combustible gas, heat has to be added from external sources or it can be produced by the gasification process. In this case, the biomass is burnt until temperatures have reached the triggering stage for gas production. In short, the process of producing electricity by using rice husks can be divided into five different stages:

1. Burning of wood and husks in order to get temperatures above 500° Celsius
2. Production of combustible gases from husks only
3. Cleaning and cooling of combustible gases by using filters
4. Running a gas engine with filtered gas
5. Producing electricity through a generator

Any biomass being used for gasification has to be dry. Rice husks have to be dried to less than 20 per cent humidity. This may sound challenging under humid tropical conditions, but is often not too difficult to achieve. Since rice is usually harvested when there is no rain, the husks just have to be kept well protected from rain and humidity. Preferably, they are stored next to the gasification plant or the rice mill, so that exhaustion heat can keep humidity out of the husks. For food quality reasons, farmers are highly interested in drying their rice after harvesting and delivering only well-dried rice for grinding. Thus, when running a husk gasification plant, one does not have to worry too much about the quality of the husks.

BIOMASS GASIFICATION SUPPORTS POVERTY REDUCTION

Mr. Aye invested around 10,000 Euro in his gasification plant. Such an investment pays off in rural Myanmar within three to ten years. The timeframe depends heavily on the price of diesel. These prices typically fluctuate considerably over time. Sometimes, diesel becomes so scarce that ordinary people and even small entrepreneurs cannot afford to buy it. Before Mr. Aye switched to the gasification technology, he could never run the rice mill at all times when it was needed. Due to diesel supply shortages in this remote part of the country, his mill used to stand idle for several weeks every year leaving him and his neighbouring farmers—who desperately wanted their rice to be ground—in a destitute situation. The heavy dependence on diesel was the main driving force behind his initial interest in this technology. Now, his business has not only become more rewarding economically, but also less susceptible to world markets, embargoes, infrastructural constraints, and other disasters affecting transport services.

The gasification technology is a means of poverty reduction. It reduces external costs of rice grinding, making it less susceptible to volatile energy prices. Moreover, it builds up local purchasing power and economic development in rural areas.

When asked why more rice mill owners had not switched to biomass gasification, Mr. Aye's answer was simple: they cannot afford the high investment costs. He is convinced that if there were a system of subsidies, many more rice mills would soon be running on electricity produced from rice husks—making rice supplies to ordinary people more reliable, cheaper, and more climate-friendly. There is no shortage of rice mills in the area: almost every village has at least one, if not two or more. The potential for spreading the technology and therefore for reducing GHG emissions would be enormous.

AN UNSOLVED PROBLEM

The biggest problem in gasification technologies is the treatment of residual tar. Tar is an undesired component of the gas and has to be filtered out before it enters the engine. Latest »state-of-the-art« gasification

technologies produce less tar, but in small-scale plants it still is a challenge. Technically, tar can be dried and burnt. There are also chemical options available to dissolve the tar using oxidation and UV light. Yet all of these measures are costly and not applicable in remote areas. Accordingly, the tar problem still seems to be the main hindrance for a large-scale application of the biomass gasification technology around the world; and it is even more complicated with the husks. The tar that results from husk gasification is very poor quality. It dissolves easily in water, so that sewage treatment becomes more difficult than by using firewood. Since biomass gasification has become a very promising approach for overcoming some of the world's energy problems, research continues on how to reduce the tar content in the producer gas and treat the tar in an environmentally friendly way. The more that investment in gasification takes place, the more likely it is that a cheap and efficient way of solving the tar problem will be found.

In Htaw Paing village in rural Myanmar, wastewater treatment is unknown. For the time being, the tar simply leaks into the soil and the river.

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SUSTAINABLE LAND AND WATER MANAGEMENT IN THE ARAL SEA REGION

Komila Nabiyeva

The Aral Sea in Central Asia is one of the world's biggest man-made environmental disasters. In the 1960s, the two rivers Amu Darya and Syr Darya—which fed the sea—were diverted for agricultural irrigation. Uzbekistan, then part of the former Soviet Union, was supposed to massively increase its cotton production. Extensive and inefficient irrigation systems, with thousands of kilometres of leaky canals, caused the Aral Sea to dry up steadily. By 2007, the lake—once the fourth largest lake in the world—had shrunk to 10 per cent of its original size. The drying up led to land degradation, water pollution, and enormous economic and health problems among the local population.

Yet, 24 years after independence, agricultural practices in Uzbekistan are still remnants of the Soviet period. Although the cotton production has dropped by 35 per cent since 1991, the country is still one of the top five cotton exporters in the world. Despite various land reforms in recent years, the state retains tight control over agricultural production. Farmers are officially private operators, but in practice they lease the land from the state for up to fifty years and are given quotas for cotton and wheat production. »The experience of many farmers dates from the old time. It was valid for large-scale production systems, but it is inefficient for small-scale farming«, says John Lamers, co-ordinator of a joint German-Uzbek project on sustainable land and water use, based in the Khorezm city of Urgench. »If Uzbek agriculture wants to become competitive internationally, it has to adapt.«

A project (2001–2011) funded by the German Ministry of Education and Research (BMBF) was implemented jointly by the Centre for Development Research (ZEF) at Bonn University in Germany, UNESCO, and the Uzbek Ministry of Agriculture and Water Resources. The objectives of the project included developing sustainable land and water use methods, fighting land degradation, mitigating greenhouse gas emissions (GHG), and increasing rural outcomes in Khorezm—an Uzbek region in the lower part of the Aral Sea basin.

AFFORESTATION OF DEGRADED LANDS AND CONSERVATION AGRICULTURE

According to project estimates, up to 30 per cent of land in Khorezm region is unsuitable for cropping. This type of degraded, arid land is referred to as marginal. A two-hectare research site of the ZEF/UNESCO project in Yangibazar district represented an extreme case of such marginal land in Khorezm. The 2004 pictures of the site show a field apparently covered in snow. »This is not snow, but two to three centimetres of salt«, says John Lamers. »We said to ourselves, if our systems work on this land, they will work elsewhere.«

Figure 10: Russian olives at Yangibazar site, 2010".
Photo credit: Dela Djumaeva

The project afforested the site with several resistant and fast-growing species, including Russian Olive, Siberian Elm and Euphrates Poplar. In contrast to other crop cultures, trees need drip irrigation, a method that saves water by delivering it directly to the tree roots drop by drop through a system of tubes. Hence, trees need up

to 80 per cent less water than annual crops during the initial two years, and thereafter use groundwater. In just two years, the project field was filled with trees (see the figure 9).

In Khorezm, the average distance of planting fruit trees is eight to ten metres. The ZEF/UNESCO specialists suggested to farmers that they plant trees on marginal cropland two metres from one other. »One to two years after planting farmers can harvest the trees, perhaps even remove entire rows. In five to seven years, the fruit trees will be at the same density they are used to but during these years they will have annual products«, according to Lamers.

The rural population in Khorezm often does not have access to public gas supplies and is dependent on fuel wood for cooking and heating. By afforesting the marginal cropland, farmers do not need to wait 20 years to get timber, but can generate income every year by using fuel wood, fodder, and fruits. Meanwhile, trees enhance nitrogen and carbon stocks and improve degraded land. According to the project findings, the organic stocks in the upper soil layer proved to increase 10 to 35 per cent (with two to seven tons of carbon per hectare) within five years after afforestation. Depending on the tree species, carbon sequestration in woody biomass ranged from 11 to 23 tons per hectare within the same period of time.

In Uzbekistan, crop production is largely based on cost- and labour-intensive tillage operations, which lead to increased fossil fuel consumption and GHG emissions. Tillage operations also accelerate land degradation processes, including salinization and loss of soil. In cooperation with the Tashkent Institute of Irrigation and Melioration, the ZEF/UNESCO project has developed recommendations on appropriate conservation practices in Khorezm, including laser-guided levelling, crop rotation, and minimum or no tillage. These methods saved up to 50 per cent of costs and improved the soil-water balance and crop yields.

One of the major challenges was convincing farmers to change their practices. Maksud Jumaniyazov is one of the Khorezm farmers who allotted part of his cropland for experiments. According to him, »We have collaborated with the project for eight years now. I was very curious to see the results and I have to admit they have broken stereotypes. Following their advice, I started to rotate the crops and apply less fertilizer. My neighbours have seen the results and have now asked me to share this experience with them.«

HUMAN AND INSTITUTIONAL CAPACITY BUILDING

Another challenge was finding qualified PhD candidates. Therefore, the project focused on building local human capacity and preparing future teachers and decision-makers in the agricultural sector from the very beginning. Within ten years of the project, 253 students from all academic levels participated in the project. Out of 53 PhD students who participated, 35 successfully graduated, almost half of them coming from Uzbekistan.

In order to hold on to knowledge and expertise, former students and project alumni—economists, agronomists, and sociologists who stayed in the country—jointly formed a non-governmental organization (NGO), Khorezm Rural Advisory Support Service (KRASS) in 2009. The NGO disseminates the project findings, provides advisory and training services to local farmers on sustainable agricultural practices, and collaborates with international partners.

Since agriculture is under state control in Uzbekistan, cooperation with state authorities and municipal administrations has been vital from the outset of the project and crucial for its success. Since 2011, the consortium of ZEF, KRASS, and the Urgench State University has been invited to develop and conduct educational courses on environment and ecology at the President's Academy of State and Social Construction, preparing national cadre for the Uzbek government, and at several agricultural universities in the country. In 2010, the Uzbek Ministry of Agriculture and Water Resources confirmed the scientific validity and endorsed a range of recommendations of the project.

Within ten years, the project has generated about 700 publications in English, Russian, and Uzbek, including articles both in local Uzbek and international peer-reviewed journals. In addition, new infrastructure with offices and teaching facilities was set up in Urgench, and includes a Geographical Information System (GIS)

laboratory and a UNESCO-funded virtual laboratory permitting a direct link between the Urgench University and other research groups in the world dealing with terminal lakes. At the end of the project, the databases and training materials were handed over to KRASS and the university.

EXPANDING THE PROJECT FINDINGS

According to the ZEF scientists, the project findings could be of use not only for Khorezm, but also for similar regions in the irrigated lowlands within Central Asia and the Caucasus drylands. In the meantime, some of the project findings and methodology were tested and developed further as part of other ZEF projects in Tajikistan and West Africa (Burkina Faso and Benin).

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available material	Project website: http://www.zef.de/khorezm.0.html Documentary film on the project (in English, Russian and German) https://www.youtube.com/watch?v=FPxD0b4Cxnw&feature=plcp Website of the NGO "KRASS": http://www.krass.uz/index.html Selected publications: Martius, C., Rudenko, I., Lamers, J.P.A., Vlek, P.L.G., 2012. Cotton, Water, Salts and soums: Economic and Ecological Restructuring in Khorezm, Uzbekistan. Dordrecht: Springer. Wehrheim, P., Schoeller-Schletter, A., Martius, C., eds., 2008. Continuity and change: Land and water use reforms in rural Uzbekistan. Socio-economic and legal analyses from the region Khorezm. Halle/Saale, Germany: IAMO. http://www.iamo.de/fileadmin/documents/sr_vol43.pdf

About the author: Komila Nabiyeva is a freelance journalist, who writes on climate change, energy, and development issues in Eastern Europe and Central Asia. Her articles have appeared in *The Guardian, Reuters, Deutsche Welle*, and *GEO*.

BUILDING CLIMATE RESILIENT COMMUNITIES THROUGH LOCALLY APPROPRIATE TECHNOLOGY IN RURAL SOUTH AFRICA

Gray Maguire

In 2011, Project 90by2030 began developing a methodology to successfully introduce renewable energy technologies in poor, rural communities in South Africa. By 2015, this initiative has led to the creation of the Community Partnership Program (CPP), as an implementing body, and Participatory Community Engagement (PCE) as the functional methodology.

The programme resulted in a much broader set of outcomes than originally planned, because it became apparent that working on electricity alone provides insufficient traction to support the successful introduction of renewable energies (RE). The issues of food, water, land, and local government engagement were added as additional focal themes as a result of consistent concerns being raised by a number of communities on these issues. As such, we began to realize that building a successful RE environment requires building on strong foundations laid in the everyday struggles of the rural poor. This article will unpack the rationale behind creating multiple focus areas for engagement, share some of the lessons learnt, and reflect on key outcomes. It must be stated that the methodology applied in this pilot programme is quite different from our present modus operandi. Accordingly, I will discuss how this experience has influenced our approach towards future projects.

FROM RE TECHNOLOGIES TO BROADER ENERGY SOLUTIONS

Initial interactions with rural communities made it clear that no matter how clearly the parameters of the specific RE in question were communicated, the vast majority of people would still tamper with the systems, leading to an exceptionally high and rapid attrition rate. The overall consensus as to why this occurred came down to two primary factors. First, initial tampering was unlikely to completely disable the technology, thus encouraging further tampering. Second, the high demand for multiple modern energy utilities from refrigeration and television to sound systems and phone charging placed a high demand on energy services.

At the same time, we had begun to integrate water access as a focus area, due to high levels of concern on the topic expressed by community members. We also realized that our work would have to integrate other broader solutions, and not just focus on RE, which meant multiple possible technologies, and very often different and innovative models for the introduction of each one.

A simple example of this was one community where 270 households required rainwater catchment tanks. The community was eager to partner on the project by volunteering to do all the physical labour and the project management themselves, but we were concerned that the old, the ill, and the infirm who could not do the work themselves would be left out. To deal with this, we ensured that the tanks were only disbursed in blocks of 70, once each of those 70 households had completed their preparatory work to our satisfaction. This ensured that the able-bodied assisted the less able, and in this way all 270 households benefited from a functional system within two months.

Our initial strategy to respond to the high rate of attrition was to investigate the feasibility of using a strong collective savings culture (»stokvels«) as a mechanism to create savings for repair work and further investment. We also aimed to use local labour as sweat equity to increase both the understanding of the technology and to foster a sense of ownership. The sweat equity strategy did in fact result in a slower attrition rate of the units because people understood the units better, but the savings schemes proved ill suited to fulfil the role we had hoped they would.

WORKING WITHIN COMMUNITIES

Through further trials, we learned that placing strong emphasis on working with the community to develop their own solutions to their problems increased the sense of ownership a great deal. To do this, we needed to gain an understanding of how they experienced their problems, and also what they foresaw as a »better« scenario.

Our initial perspective had been that we would be able to narrow down the areas of greatest concern, make suggestions for possible solutions that we could partner with the community on, and give advice on how to advance issues that were outside our mandate. As it transpired, things didn't work out that way.

What we realized instead was that if we wanted to have buy-in from the community, they needed to see that they had buy-in from us. This meant not so much that we needed to bring solutions to all problems, but that the problems within the community were interwoven and that they needed to be addressed as part of the broader socio-environmental construct. Having a broader focus—very often beyond our original scope—allowed for the deepening of engagement and for setting up the right kind of enabling environment for a broad range of people to work towards improving their community.

TRAINING AND CAPACITY BUILDING IS KEY

We also found that working with the right people within any given community is really important. This is very hard to do unless one spends a significant amount of time practically working within a community. An exceptionally useful tool here was introducing practical, village appropriate training. Our focus was on food, energy, and water, but one unintended outcome here was that we were able to open people's eyes to the idea that they actually do possess useable resources within their community, and that through imagination and industry they can improve their own lives for themselves. For people who have believed their whole lives that they have nothing and that they are powerless, this gives people a real chance to imagine a different future. It also fosters trust between the development workers and the community, and allows us to develop a better understanding of the village and the dynamics within it.

Indeed, this practical training must be one of the first points of engagement with new communities, because it is the primary site where we can uncover and experiment with local skills and resources, as well as where we can introduce working with some of our existing technologies. It also allows us to identify potential candidates within the community to partner with for further project roll-out. This reflects a crucial element of our engagement philosophy, namely our belief in developing capacity within communities to meet the needs that they identify for themselves.

In the beginning, all of our interventions were sourced from the outside. Today, our focus has shifted to creating local service providers that we partner with to make the interventions within the community—from rainwater catchment tanks, to rocket stoves, solar power systems, and solar water heaters. By developing small businesses, we not only boost the internal economy of the village, but we also ensure that someone remains to provide that service after we are gone.

ACHIEVEMENTS AND THE WAY FORWARD

Having recently completed our monitoring and evaluation of our first large community project of some 250 households, three years after introducing the interventions we have discovered that the use of firewood has dropped by 17 per cent; 89 per cent of households make use of hot-boxes for efficient cooking, which reduces carbon emissions by approximately one ton over their lifespan; 84 per cent of households make use of efficient cook-stoves, which also has a significant effect on CO_2 emissions, reducing emissions by approximately 60 per cent. The use of paraffin for lighting has dropped from 82 per cent to 39 per cent, with solar lighting now being used in 89 per cent of households—up from zero three years ago. Similarly, the state of

water access has changed fundamentally. Having come from a situation in 2012—where the average amount of water per person per day was six litres through government allocation—the community now continues to benefit from increased state allocation, while simultaneously benefiting from having managed the installation of rainwater tanks on all homes.

From these initial successes, we learnt that the greater the level of local appropriateness, the greater the acceptance of the interventions, and the better the potential for sustained, community-supported projects that provide needed equipment to community members over the long term at reasonable prices.

We are now looking forward to expanding this methodology through a variety of partnerships. The Comprehensive Rural Development Program (CRDP) and rural climate adaptation strategy from the Department of Rural Affairs and Land Reform's (DRDLR), the Water Research Commission's Green Village programme, and partnerships with the EU and the Limpopo and Western Cape provincial authorities all present opportunities to introduce our findings to the mainstream.

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About the author: Gray Maguire has been involved in socio-environmental justice issues since 2003 and has worked with community-based development projects in Southern and East Africa. He currently runs the Community Partnership Programme (CPP) at Project 90by2030.

PIONEERING SOLUTIONS IN TECHNOLOGY TRANSFER, CAPACITY DEVELOPMENT, AND FINANCING

Thomas Hirsch

Decades of hard work, increasing political commitment, and recent success stories of renewable energy pioneers bear fruit: around one-fifth of global energy originates from renewables—and an end to this boom is not in sight. In the meantime, the majority of countries worldwide has established targets for renewables and agreed on instruments to promote implementation. These are some of the factors, beyond the rapid price decline of technologies, which have stimulated massive climate finance. In 2014, investments in renewables exceeded those in new power plants burning fossil energies.

The fact that almost half of the investments in green energies in 2014 took place in developing countries clearly indicates that the energy transition is not restricted to industrialized countries. Still, however, the large part of low carbon investments in the Global South takes place in a small group of emerging economies, and China in particular. The majority of developing countries, including the groups of low and low-middle income countries and small developing island states, need special attention to better benefit from low carbon opportunities.

In a recent study published by Friedrich-Ebert-Stiftung, key requirements for a successful energy transition in developing countries have been identified[16], and include the support expected from international cooperation. The study found that apart from investments, crucial elements are broadened exchange, knowledge dissemination, technology transfer, financial support and capacity building. This chapter gives some insights on good practice examples.

The first article argues that the International Renewable Energy Agency (IRENA) has made first significant steps to serve as a clearing house and future hub for the promotion of renewables in developing countries, in particular the smaller and less developed ones. Key instruments that have been developed since the agency's founding are discussed.

The second contribution introduces the Berlin-based Renewable Energy Academy (RENAC) and its »Center for Research and Development in Renewable Energies«, which was founded in co-operation with EARTH University in Costa Rica, as the first laboratory of its kind for renewable energies in Central America.

The third article is on the »International Climate Initiative« as an innovative funding scheme of the German Federal Ministry for the Environment. This important initiative came into operation in 2008 and has supported more than 440 projects in developing and transitional countries with 1.3 billion euros since then. The annual call for proposals is open for applications focusing on low carbon development, climate adaptation, and forest protection and rehabilitation.

Enabling policy conditions are ultimately decisive for transformational change. This is why this publication closes with two good practice examples from Salvador and Nepal, two of the world's most vulnerable countries, which are currently introducing new policies to guide low carbon development with a particular focus on the needs of poor and vulnerable people, who form a huge segment of the population of these countries.

[16] Thomas Hirsch (2015): Learning from the »Energiewende«:What Developing Countries Expect from Germany. Berlin: FES Study.

IRENA: THE INTERNATIONAL RENEWABLE ENERGY AGENCY AS A COMPETENCE CENTRE FOR THE DISTRIBUTION OF RENEWABLE ENERGY

Christine Lottje

Energy generation from wind, solar, hydropower, and biomass is on the rise internationally. From 2000 to 2014, the installed technical performance of renewable energy increased by 120 per cent (see figure 11). The »Renewables 2015 Global Status Report« published by REN21 declares that in 2013 renewable energies generated about 19 per cent of global primary energy and 23 per cent of global electricity. In 2014, investments in renewable energy sources were at around USD 270 billion and were thus higher than the net investments in fossil fuel power plants. It is noteworthy that not only are the industrialized countries investing in renewable energy; with USD 131 billion, developing countries invested almost as much as developed countries (USD 139 billion). Meanwhile, at least 164 countries have set expansion targets for renewable energy and 145 states have introduced support schemes for expansion.

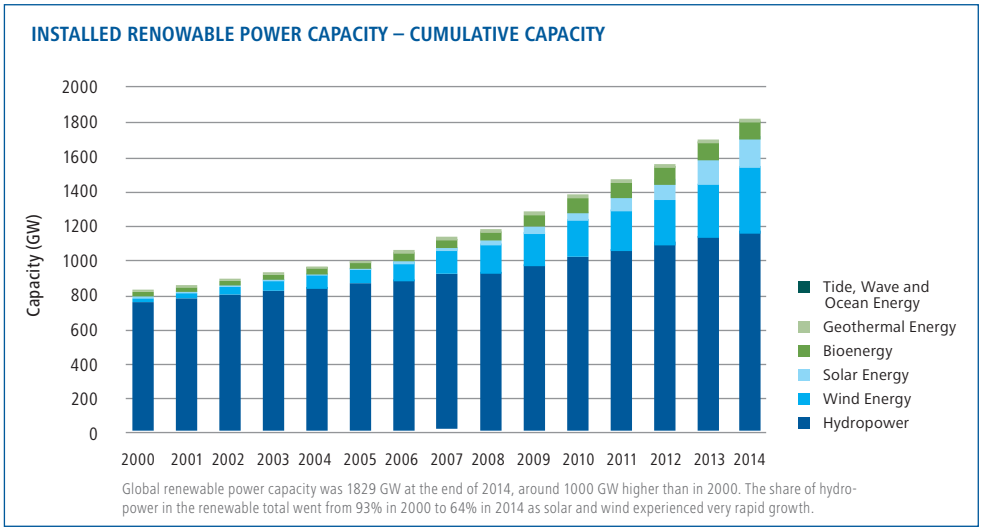

Figure 11: Renewable Energy Capacity Statistics 2015, Source IRENA

All of these figures show that renewables energies are developing rapidly. Worldwide, there are countless initiatives and actors who are working on innovative solutions and their implementation.

IRENA: INTERNATIONAL AGENCY FOR THE PROMOTION OF RENEWABLE ENERGIES

The foundation process for an international agency for renewable energy began with a German initiative after the Bonn Renewable Energy Conference in 2004. Following the successful inaugural conference in early 2009, IRENA got off to a shaky start, which was marked by tight budgets, leadership disputes, and confusion about the role and tasks of IRENA. However, with the new Director Adnan Amin, IRENA has gained momentum since 2011. IRENA's mandate was defined »to promote the introduction and sustainable use of all forms of renewable energy«. Thereby, the combined application of renewable energy and energy efficiency measures should reflect national priorities as well as their contribution to climate protection, economic growth, and poverty reduction. Meanwhile, IRENA has over 141 members, and is headquartered in Abu Dhabi in the United Arab Emirates.

IRENA sees itself as an independent actor, which provides reliable information and in particular supports developing countries in the expansion of renewable energies with special offers. In addition to cooperation with governments, IRENA also cooperates with various international governmental and non-governmental organizations, as well as the private sector.

IRENA differs in several respects from comparable organizations in the energy sector: in contrast to the International Energy Agency (IEA), in which only OECD countries are members, IRENA has a global membership structure. This provides a high degree of legitimacy. At the same time, IRENA is not a UN organization, but an amalgamation of progressive states to promote renewable energy. This makes IRENA more flexible and ensures a certain independence. In addition, IRENA is quite small. With only a few staff members and a budget of only USD 21 million in 2013, which is supplied by the voluntary contributions of its members, IRENA has to set priorities and use its resources as effectively as possible.

KNOWLEDGE MANAGEMENT

One of IRENA's central fields of work is the development of instruments, which maintain data and information on the development of renewable energies, available technologies, and good project planning. To this end, IRENA has developed several instruments:

1. **REsource** is a search engine that contains analyses and country-specific data on renewable energies and can produce its own graphics,
2. **Renewable Energy Costs** provides data on the cost and performance of different technologies,
3. **Global Atlas for Renewable Energy** is a platform that presents the energy resources of each country on a world map, and
4. **REmap 2030** is a »roadmap« that presents the realistic potential for countries, regions, and the world to increase the share of renewable energies in the global energy mix.

SUPPORT FOR DEVELOPING COUNTRIES

In addition, IRENA has programmes and activities that are specifically aimed at developing countries. Thus, IRENA has assisted developing countries since 2011 in the implementation of *Renewables Readiness Assessments*, which are developed in a country-based process. The instrument is used to analyse the national energy policy and strategy, institutions, and markets, as well as the analysis of the potentials that are needed for the expansion of renewable energies. Important here is not only the analysis of existing resources and required technologies—which have to be adapted to the needs or national conditions (see table 3)—but also the involvement of different interest groups from the government, private sector, and civil society. In the final step, a business model is developed, which in the newer Readiness Assessments, partly includes a quantitative analysis. Since 2012, 14 countries have completed their Readiness Assessments—including some of least developed countries (LDCs), such as The Gambia, Niger, Mozambique, and Senegal.

SERVICE	RENEWABLE ENERGY RESOURCE					
	BIOENERGY	GEOTHERMAL	HYDRO	MARINE	SOLAR	WIND
On grid – electricity	√	√	√	√	√	√
Off grid – electricity	√	√	√		√	√
Off grid – motive power			√			√
Thermal energy*	√	√			√	
Transport	√					
* heating and cooling						

Table 3: Renewables Readiness Assessment, Design to Action, Source: IRENA 2013

In 2014, IRENA also launched the *SIDS Lighthouse Programme*, to support the small island developing states in the conversion to renewable energies. The programme emphasizes moving away from individual projects that are planned independently from each other. Instead, an approach is taken that propagates holistic planning that begins with long-term needs. By 2020, IRENA's goals are that:

1. all small island states develop renewable energy plans (roadmaps),
2. a significant number of small hydropower, geothermal, as well as a series of tidal power plants go into operation,
3. 100 MW of new photovoltaic systems develop, and
4. USD 500 million for renewable energies in small island states be mobilized.

While IRENA acts as an intermediary for the participating states, which offers technical and analytical expertise as well as assistance in fundraising, the funds for implementation should come from donors out of development financing.

Third, IRENA has taken a leading role in the implementation of the UN initiative, *Sustainable Energy for All* (SE4All), for overcoming energy poverty.

CONCLUSION: IRENA AND POVERTY-ORIENTED, LOW CARBON DEVELOPMENT

IRENA has taken the first steps in the right direction and has a great potential to become the driving force in the further development of renewable energies in developing countries. In particular, small island states and LDCs can benefit from this, which are otherwise often overlooked as priority countries, compared to emerging countries. IRENA has occupied an crucial niche here and could play an important role with a view to poverty-oriented and human rights-based energy policy. Nevertheless, as a young organization IRENA needs to sharpen its profile, in particular with respect to the IEA. In addition to acting as a knowledge broker, IRENA should therefore continue to expand the consulting and training activities for developing countries, so that they can take advantage of the immense potential in the field of renewable energies more quickly and purposefully.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
Available material	http://www.irena.org/Menu/index.aspx?PriMenuID=53&mnu=Pri

About the author: Christine Lottje is a freelance developmental consultant. Her priorities include climate finance, adaptation to climate change, and food security. In addition to various publications on these topics, she manages among others the website www.germanclimatefinance.de.

REN@EARTH: CAPACITY DEVELOPMENT ON SUSTAINABLE ENERGIES IN CENTRAL AMERICA

Elena Cantos & Katie Brown

Despite its abundant renewable energy (RE) resources, Central America is currently only using a fraction of its renewable energy potential to meet its rising energy demands. However, the sustainable supply of energy is high on the political agenda across the region. In recent years, several countries have initiated various legal and fiscal policy measures to set up an investment-friendly political environment for green technologies.

In order to implement renewable energy technologies, one of the most important instruments is the education of people who are able to handle technology and design, as well as the compilation, building, operation, and maintenance of systems.

The Renewables Academy AG (RENAC)—based in Berlin, Germany—is an international leading provider for training and capacity building on renewable energy and energy efficiency. Besides classroom and online training seminars, RENAC offers customized education solutions, taking into account the differing demand for capacity building between regions and sectors. Since its founding in 2008, about 5,800 participants from more than 141 countries have participated in RENAC trainings.

In 2011, when there were hardly any possibilities for gaining know-how on RE technologies in Central America, RENAC launched the three-year project REN@EARTH in cooperation with EARTH University in Costa Rica. REN@EARTH had the support of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety in the framework of the International Climate Initiative (ICI).

The objective was to enable EARTH University to provide high-quality capacity building on wind, photovoltaic, solar thermal, small hydropower, and bioenergy in Central America. EARTH University, with its strong focus on agricultural studies, saw the manifold opportunities that RE technologies offer for this sector and wanted its students to familiarize themselves with sustainable energy supply.

This project was integrated into the »National Strategy of Climatic Change«, a governmental initiative to combat climate change in Costa Rica and the transformation into a carbon-neutral country by 2021. By educating qualified personnel and future decision-makers, REN@EARTH aimed at strengthening the basis for an increased use of RE, in order to reduce carbon emissions and energy imports. Additionally, the development of a growing renewable energy industry would contribute to job creation as well as to the reinforcement of the local economy.

FIRST STEP: ADAPTATION TO LOCAL NEEDS

To ensure sustainable knowledge transfer, it is essential to have a good understanding of the local needs and the target groups. In the case of REN@EARTH, this became especially challenging, because the project aimed at building up future professionals who would reshape the electricity supply in Central America. REN@EARTH had to cover a variety of RE technologies and diverse applications, while addressing different target groups from several countries of Central America.

In order to approach this challenge, RENAC conducted an assessment of the local capacity needs for renewable energy. Based on the outcomes of this report, REN@EARTH was designed, and included different training formats, activities, and academic content adapted to the various profiles of the future participants and the climatic preconditions of the region.

IMPLEMENTING REN@EARTH

REN@EARTH offered a comprehensive educational approach by facilitating know-how transfer to students, lecturers, and the RE private sector. Students from Costa Rica, Guatemala, Honduras, El Salvador, Nicaragua, and Panama attended courses on the basics of RE. A strong focus was laid on practice-oriented training.

Other activities included the organization of weekend seminars for the interested public in Costa Rica—potential investors, local industry, students, and private users, amongst others—to raise awareness about these new technologies and to promote a dialogue between local stakeholders.

To guarantee the long-term sustainability of the project, three Train-the-Trainer seminars for local lecturers took place at RENAC's training centre in Berlin. These seminars aimed at equipping the participants with the necessary skills for the implementation of further seminars in adult education.

Furthermore, RENAC designed and installed »The Center for Research and Development in Renewable Energies«—or in Spanish, Centro de Investigación y Desarrollo de Energías Renovables (CIDER). This training centre, which was officially inaugurated on 30 November 2011, was the first laboratory of its kind for RE in Central America.

While designing CIDER, RENAC engineers had to deal with several complications: in order to guarantee the correct functioning of the laboratory, RENAC had to find solutions to adapt all system components to Costa Rica's average temperature and levels of humidity. Additionally, complex custom's barriers had to be overcome in order to import the necessary components to build the centre.

CIDER addresses the challenges presented by different forms of renewable energy and the installation of these technologies in tropical developing countries. In this way, students learn about the potential applications and technical aspects of renewable energies in a practical learning environment. »We have an international student body that could take the information learned at the lab back to their communities and improve the livelihoods of those around them«, said Professor Ramón León, former Director of EARTH's research unit.

While participants showed a high interest in CIDER's trainings, most of them did not have access to funds to financially support their education in RE. Thus, the project goals could have not been achieved without ICI's partial scholarships.

Finally, an essential aspect for REN@EARTH's success was the good cooperation between RENAC and EARTH University. In a complex project like REN@EARTH, a key factor is to establish a cooperative relationship to facilitate decision-making processes and problem-solving mechanisms. Even though this sounds obvious, working together can sometimes become a major challenge for partners if the different working approaches lead to disagreements. In this case, however, the positive relationship between EARTH University and RENAC made it possible for REN@EARTH to evolve in a satisfactory way, while ensuring its sustainability in the long term.

CREATING NEW PROFESSIONAL ACTIVITIES IN LATIN AMERICA

Some of the key achievements of REN@EARTH have been:

1. The project has contributed to the training of engineers and technicians from Costa Rica, Guatemala, Honduras, El Salvador, Nicaragua, Panama, Puerto Rico, and Mexico in different technologies, including photovoltaics, as well as wind, small hydro, and solar thermal power.
2. Since 2012, the training centre has received more than 1,000 visitors—for example, from high schools, universities, NGOs, governments, from the United States, Canada, Mexico, Central and South America, Europe, Asia, and Africa.

3. Based on the courses on clean energy in agriculture and rural households, EARTH University has expanded its current academic offer. Students from Latin America and Africa have been trained in the applications of RE technologies in agriculture and rural communities.
4. Several seminars have been organized at CIDER for technical and community leaders, and one national workshop for deputies and advisers of the Government of Costa Rica. Lecturers of these seminars included former participants of RENAC's Train-the-Trainer programmes.

Upon finalization of REN@EARTH in 2014, EARTH University took over the task of conducting the programme. CIDER has become well known in Central America. After the success of REN@EARTH, RENAC and EARTH University have since launched »Especialización en Energías Renovables«. This one-year interdisciplinary distance learning programme delivers knowledge about technology, all phases of project development, support mechanisms, financing, and profitability. The objective is to provide professionals from Latin America with the competencies to develop or support a career in the field of renewable energy.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available material	www.renac.de/ES/Proyectos Actuales

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INTERNATIONAL CLIMATE PROTECTION INITIATIVE: FINANCING FOR INNOVATIVE PROJECTS

Jan Peter Schemmel

Since 2008, the International Climate Initiative (IKI) of the German Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety Building (BMUB) has promoted climate and biodiversity projects around the world. It supports developing and emerging countries in implementing their international commitments. The funding areas of the IKI include reducing greenhouse gas emissions, adaptation to the consequences of climate change, as well as the protection of biodiversity and conservation of natural carbon sinks. In the early years, the IKI was financed by auction proceeds from emissions trading. Meanwhile, the funds come from the budget of BMUB. Since the beginning of the initiative, more than 440 projects with a funding volume of around 1.3 billion euro have been launched.[17]

With their projects, the IKI supports innovative responses to the challenges of climate change and biodiversity loss. Together with its partners, new political, economic, and regulatory approaches are developed and flagship projects and cooperation models implemented. As a replicable approach, the supported concepts should show an impact beyond the individual project and be replicable.

The projects are selected via an annual, advertised ideas competition.[18] Consideration is given in the funding decision for criteria such as innovation, replicability, relevance for international climate negotiations, and ambition—particularly in terms of a contribution to transformative change. A variety of national and international organizations implement the projects: from the two large German implementing organizations, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the KfW Entwicklungsbank, through multilateral organizations, to non-governmental organizations, research institutes, and foundations or private companies. In the implementation of the IKI, the BMUB is supported by the Programme Office International Climate Initiative. In the following section, the focus is on the presentation of the activities for reducing greenhouse gas emissions.

INITIATING TRANSFORMATION PROCESSES FOR CLIMATE PROTECTION

Some IKI projects strengthen climate policy capacity in partner countries through negotiation training, networking activities, and scientific analyses, or in the development of national or regional positions. Since mid-2014, for example, the IKI has supported a wide range of partner countries in the preparation of their national contributions for a new climate agreement (INDCs, Intended Nationally Determined Contributions). With a total volume of 5 million euros for INDC-supported projects, Germany is currently one of the world's largest donors for the development of INDCs in partner countries. Close, political coordination ensures that IKI projects are oriented towards the needs of the respective countries and are coherent with other international cooperation initiatives.

In the mitigation funding area, the projects focus primarily on the development and implementation of low carbon development strategies and nationally appropriate mitigation actions (NAMAs). Often, the former create the basis for the design of NAMAs, which can be implemented in a variety of sectors—for example, in the energy or transport sector.

Also funded is the introduction of national and project-specific systems for measurement, reporting, and verification (MRV) of greenhouse gas emissions and mitigation measures. These systems are used to monitor achieved reduction success and coherence of applied tools and methods.

[17] As of June 2015; Doha counting system

[18] The tender for the competition is updated each year and published on the IKI website (www.international-climate-initiative.com/de)

Another focus in the reductions funding area is the mobilization of additional public and private funding sources. Thus projects are supported that enable greater involvement of the private sector—for example, by lowering financial risks for investments in climate technologies in developing and emerging countries.

The attention of many actors in climate policy is directed toward the major Conference of the Parties (COP) in December 2015 in Paris. However, the views are increasingly reaching far beyond this. The transition time between Paris and the entry into force of the Convention planned for 2020 is critical to meet the 2-degree target, and should be determined by a continuous intensification of mitigation and adaptation measures. Therefore, the continuous support of the implementation of NAMAs or INDCs is as important as the development of technical expertise and the targeted expansion of climate policy capacity in the partner countries. Accordingly, the IKI will continue to support the implementation of national programmes and strategies in partner countries after the COP in Paris.

SUPPORT FOR CLIMATE PROTECTION PROGRAMMES IN MEXICO

The IKI has supported climate policy in Mexico since 2010. The project »Mexican-German Climate Alliance« has advised the partner government in the implementation of the first national climate protection programme PECC I (Programa Especial de Cambio Climático), and the development of the successor program, PECC II. The reporting for PECC I about the planning was independently and externally evaluated in order to analyse the reliability of the aggregated impact assessment of the programme, as well as to identify the most effective measures to reduce greenhouse gases and adapt to climate change. The results of the validation were used by the partners for the development of the PECC II. With this, the Mexican government wants to reduce 30 per cent of the emissions with regard to »business as usual«, and by 2050 as much as 50 per cent compared with 2000.

The Mexican-German NAMA programme arose from the Climate Alliance, which developed the first NAMA on energy efficiency implemented worldwide on social housing construction. The implementation has been carried out since 2013 with funding from the German-British NAMA Facility, among others. Moreover, the NAMA programme has also developed approaches for improved energy efficiency in more than 8,000 small and medium enterprises. A third NAMA approach in freight transport is aimed at small and micro enterprises in the logistics sector. Together with the Ministry of Transport, a scrappage allowance to modernize the fleet was made more attractive for these hauliers. In addition, the Department of Transportation was advised on the introduction of an emissions standard based on Euro VI.

RENEWABLE ENERGIES IN THE NORTH AFRICAN GRID

Because of its geographical conditions, direct sunlight, and partially high wind speeds, the MENA region (Middle East and North Africa) has great potential for the use of renewable energies. At present, however, they cannot be widely exploited due to the lack of specialized staff. The project »Education and Training for Grid Integration of Renewable Energies in the Power Supply« draws on this point, and trains engineers and experts from Algeria, Egypt, Jordan, Lebanon, Libya, Morocco and Tunisia—for example, in the areas of grid connection requirements, performance and reserve forecasts for networks, as well as capacity planning and investment. More than 400 participants have now successfully completed the training and obtained a certificate as ReGrid Manager, which was developed within the project framework.

INNOVATIVE FUND FOR CLIMATE FINANCING

Private investors are hesitant when it comes to investing in the often small-scale projects for renewable energies or energy efficiency. There is a lack of experience and trust. At the same time, national financial institutions do not have suitable products in their portfolios, which are geared towards this relatively new sector. To address this, the Global Climate Partnership Fund (GCPF), founded in 2010, provides funding for energy

efficiency and renewable energies in emerging and developing countries. Public funds in the GCPF assume the first credit default risk (First Loss), and thus serve as a risk buffer for private capital. This new and innovative approach motivates private investors to invest in energy efficiency and renewable energies. The mobilized funds will be awarded mainly as loans to financial institutions in developing and emerging countries, which they pass on to small and medium enterprises or to private households in their own lending programmes. Equipped with an initial investment of 42.5 million euros from the IKI, the GCPF has grown steadily since then and currently has USD 327 million of committed funds from public and private investors. The portfolio currently covers 15 investments in 13 countries. Energy savings of 16 million MW could be achieved through the disbursed credits in the total of all of the projects. In addition, slightly more than 5.6 million tons of CO2 were saved.

The IKI-funded projects generate a large number of so-called co-benefits. Climate protection and emissions reductions in transport, for example, result in improved air quality in cities and thus help to improve the health situation for the people who live there. Measures to increase energy efficiency in SMEs, which are the major employers in many countries, improve their competitiveness through lower energy costs. The promotion of renewable energies opens up new career fields and the reduction of risks for private investment in new climate-friendly technologies strengthens sustainable economic development in the partner countries of the IKI.

In the eight years since its launch, the IKI has made a name for itself in the international climate cooperation. It has filled an important gap in the international promotion of climate protection and emissions reduction with the ideas competition as a basis for the funding commitments; the focus on supporting approaches that combine implementation and negotiation and the prompt integration of new developments and demands from the climate negotiations in the funding priorities; and finally the focus on innovative and transformative acting project approaches. In 2015, it once again took on a leading role in international climate cooperation, with the systematic introduction of standard indicators for reporting the aggregate effects of the funding programme.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available material	www.international-climate-initiative.com

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PIONEERING SOLUTIONS IN LOW CARBON DEVELOPMENT POLICIES

A NEW STRATEGY FOR POWER GENERATION IN EL SALVADOR: RENEWABLE ENERGIES AND POVERTY ERADICATION IN A POST-CONFLICT ENVIRONMENT

Antonio Cañas

El Salvador is a small, low- to middle-income country, without own fossil energy resources. Its greenhouse gas (GHG) emissions account for less than 0.04 per cent of the global emissions, and 1 ton per capita.[19] In the last decade, extreme weather events have increased in frequency and intensity, with severe impacts on the people and the economy. According to an assessment of the International Monetary Fund from 2013, »the Salvadoran economy has slowly grown as a result of low domestic investment and the impact of climate shocks.«[20] One of these extreme events was the Tropical Depression 12E in October 2011, which broke historic records, with economic losses exceeding 4 per cent of the 2011 GDP.

For this reason, climate adaptation has become one of the country's main priorities, with large public investments in systematic observation, early warning systems, and the design and partial implementation of adaptation plans in strategic sectors.

The Salvadoran government, however, maintains that fostering resilience, overcoming poverty, and investing in renewable energies (RE) and energy efficiency can be combined. Accordingly, a low carbon development strategy was initiated in 2010, aiming at reducing emissions associated with the strategic objectives of development and poverty reduction, and with a particular focus on the most vulnerable social groups. This approach is reflected in the two main national policy instruments on energy and the environment—the Energy Policy 2010–2024 (EP)[21] and the National Environmental Policy 2012 (NEP)[22]—together with the documentation of public consultations.[23]

Social and environmental concerns are reflected in three out of four general objectives of the Energy Policy:

1. Ensuring a secure energy supply at reasonable prices to all people
2. Reducing energy dependence on oil by encouraging the use of RE
3. Minimizing the environmental, climate, and social impacts of energy projects

[19] World Bank. Data. CO2 emissions (metric tons per capita). http://data.worldbank.org/indicator/EN.ATM.CO2E.PC

[20] International Monetary Fund (IMF). Misión de Consulta de Artículo IV para El Salvador, 19 de Marzo de 2013. Press release. https://www.imf.org/external/spanish/np/sec/pr/2013/pr1384s.htm

[21] Consejo Nacional de Energía. http://www.cne.gob.sv/index.php?option=com_phocadownload&view=category&id=22:p&Itemid=63

[22] Ministerio de Medio Ambiente y Recursos Naturales, MARN. Política Nacional del Medio Ambiente 2012 (PNMA). http://www.marn.gob.sv/especiales/pnma2012/Politica_Nacional_MedioAmbiente_2012.pdf.

[23] MARN. Documento de consulta pública de la PNMA. »Consulta pública: Nace la Política Nacional de Medio Ambiente«. Junio 2011. http://www.marn.gob.sv/index.php?option=com_phocadownload&view=file&id=407%3Anace-la-politica-nacional-del-medio-ambiente-consulta-publica&Itemid=249

Obviously, reducing the dependence on imported oil has advantages in terms of the national budget and the trade balance. However, RE also need adequate frameworks in order to minimize their social and environmental impacts, and to maximize their benefits—i.e., by correcting market distortions, and by ensuring social and environmental standards. El Salvador has experienced huge economic and environmental problems in the past, which were caused by unsuitable policies that were supposed to boost the electricity supply and energy security by all means—regardless of negative environmental and social impacts. Consequently, the public consultation of the National Environmental Policy in 2012 resulted in the following statement:

> … it is also important to break with the logic of the past that did not adequately reflect the impacts and tangible benefits for populations in cases of investments in energy projects that were supposed to be clean. Therefore, in future, renewable energy projects should only be considered as clean energy when tangible benefits for the territories involved are ensured and when the local development processes are being strengthened. Hydroelectric projects in particular, as much as they are needed from the low carbon and energy security perspectives, should be designed in a way fulfilling multiple objectives beyond power generation. Dams should be designed in a way that leads to additional benefits in terms of risk reduction, agriculture, fishing, drinking water and recreation.[24]

Designing energy policies in a way that results in tangible developmental and environmental co-benefits is challenging. However, the new Energy Policy 2010–2024 has already led to first positive results, as expected.

On the one hand, it has been necessary to create or modify laws and regulations in a way that allows the effective promotion of RE and the strategic diversification of the national energy matrix—for example, by facilitating electricity market access for renewables, and by ensuring preferential feed tariffs for the surplus of small renewable projects into local distribution grids. In the 1990s, the laws and regulations implemented under neo-liberal reform, led to the opposite—i.e., an extremely weakened planning and regulatory function of the state, and a high dependence on petroleum products. Indeed, according to figures compiled by the Inter-American Development Bank (IADB), in the early 1990s the contribution of petroleum derivatives in electricity generation was barely 8 per cent, compared to 63 per cent from hydroelectric power plants and 27 per cent from geothermal power plants.[25] Already by the beginning of this century, the share of petroleum in the production of electricity rose to 45 per cent, while that of hydropower dropped to 34 per cent and geothermal to 21 per cent.[26]

This drastic change is also closely related to the twelve years of civil war beginning in 1980, when no new power generating projects were developed. To meet rising electricity demand, privatization rules—which were further unleashed by the end of the conflict—led to the marginalization and dismantling of public companies to the benefit of private investment. Under these rules, investors sought to maximize profits in the short term, against the interest of consumers, public finances, and the environment. As a result, consumer prices increased sharply, and the state paid subsidies to investors, even if their plants were not operating and supplying power to the system. Subsequently, the country lost the necessary long-term vision that would have enabled strategic planning to develop renewable energies.

The most important measure to correct these problems occurred in 2011, when the new market model based on production costs took effect. This step—together with the requirement for energy distributors to sign long-term contracts (up to 20 years) for power supply—led to the stabilization of short-term prices, put an end to speculative practices, and opened up new market opportunities and planning security for RE and energy-efficiency services. In 2012, the price per kilowatt decreased by about 13 per cent.

[24] Ibid., 7.

[25] Inter American Development Bank (2013): Dossier Energético El Salvador, p. 42; available at: http://publications.iadb.org/bitstream/handle/11319/3854/Dossier%20Energ%C3%A9tico%2004%20-%20El%20Salvador%20%28Web%29.pdf;jsessionid=A54AF51203270AA47A4C253FC26A57C7?sequence=1

[26] Ibid., 46.

Additional measures were taken to ensure the diversification of the energy mix, excluding oil-based projects from bidding, and giving priority to non-conventional RE. At the same, as a strategic guideline of the Energy Policy, a part of the income generated by long-term contracts has to be invested into the social and economic development of the communities where the projects are realized. Such development projects are to be agreed under the participation of communities and local governments.

Under this framework, a long-term contract over 355 MW of liquefied natural gas (LNG) was awarded in 2013. This project will serve as a buffer, stabilizing the grid and enabling more renewables to be safely fed into the grid. The entry of LNG to the country will allow for the conversion of the old oil power plants to be retrofitted by modern gas plants.

In June 2014, another long-term contract for the supply of 94 MW of photovoltaics was awarded. With the entry into operation of this project in 2018, the share of oil in electricity generation will fall to 15 per cent.[27]

As for hydroelectric dams, it is clear that the unfortunate history of negative social and environmental impacts left by these projects in the territories in which they operate has raised understandable social rejection of these initiatives.

Renewable energies, climate mitigation, and poverty eradication can go hand in hand—if the right policy frameworks are set up. El Salvador will continue the path chosen.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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Available material	http://www.marn.gob.sv/index.php?option=com_phocadownload&view=file&id=407%3Anace-la-politica-nacional-del-medio-ambiente-consulta-publica&Itemid=249

About the author: Antonio Cañas, an engineer and social scientist by profession, leads the climate and renewable energy policy unit in the El Salvadoran Ministry for the Environment and Natural Resources.

[27] Del Sur. »CNE. Lineamientos de Política Energética«. http://www.delsur.com.sv/images/documentos-licitacion/presentaciones-1a-reunion/lineamientos-politica-energetica-cne.pdf

NEPAL: ADVANCING A LOW CARBON FUTURE IN A CONTEXT OF HIGH RISKS

Raju Pandit Chhetri

Nepal is a beautiful Himalayan country with a population of 27 million. It is rich in natural resources with perennial rivers, forests, fertile land, and plenty of flora and fauna. This is primarily due to its topography, which ranges from high mountains to hills and plains.

However, Nepal has a long way to go in terms of its socio-economic development. Many Nepali struggle to meet their daily needs, because the average yearly income amounts to only around USD 700 per capita. Much needs to be done in the area of education, health, income generation, infrastructure development, and food security. The country is reeling under an acute energy shortage fuelling poverty in the country. Nepal ranks 145th in the United Nation's Human Development Index.

Climate change is an additional burden to Nepal. Its contribution to the global share of greenhouse gas emissions (GHG) is less than 1 per cent. Nonetheless, it is regarded as one of the most vulnerable countries to its impact. Nepal already faces risks of glacier lakes outburst floods, distorted monsoons, exceptional flooding, and landslides attributed to climate change. Nepal has no option but to adapt to these risks. To address these problems, Nepal has taken several policy and institutional measures and invests over 5 per cent of the national budget in climate change interventions.

One of the areas that Nepal has heavily invested in is the promotion of renewable energy (RE) technologies in the country (see figure 12). Small-scale RE provides quick and cheap energy suitable for Nepal's rural context. Nepal has prioritized technologies like micro hydropower, biogas plants, solar, biomass, and wind. These technologies contribute to reducing carbon emissions, while avoiding the problems of mega energy projects, which can be environmentally unsound, costly, and time consuming.

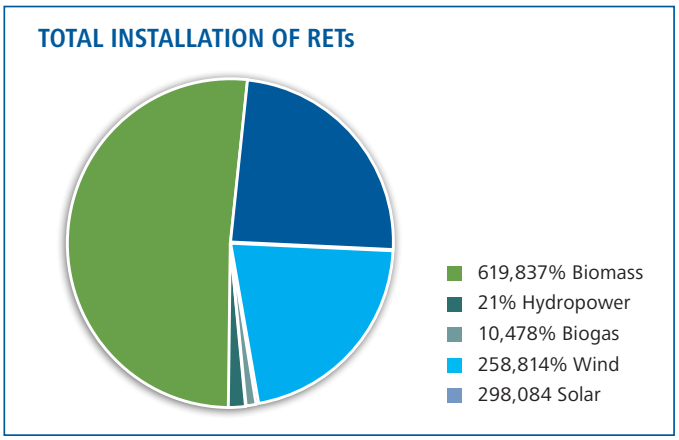

Figure 12: Total installation of renewable energy technologies (till mid July 2011), Source: AEPC

On 25 April 2015, a massive 7.8 Richter scale earthquake struck Nepal, inflicting severe damage to this already poor country. The earthquake took nearly 9,000 lives, injured over 22,000 people, and left a large share of the population homeless. In a country where one-fourth of the population suffers from chronic poverty, the earthquake has created a huge obstacle in tackling climate change and moving towards a low carbon development future. The earthquake also destroyed many household solar systems, hydropower stations, and biogas plants that provided energy to rural communities. Nepal will thus have to help its communities to rebuild these facilities.

NEPAL'S POLICY INITIATIVES

Nepal has a vision to upgrade from the status of a Least Developed Country (LDC) to a middle-income country by 2022. In order to achieve this goal, considerable investment in the energy sector, infrastructure development, and industries is needed. This provides a huge prospect for the transition to a low carbon and resilient development future, if the right policies and plans are put in place.

The government of Nepal has formulated a number of policies and strategies to embrace resilient and low carbon development. As early as 1992, Nepal formulated a hydropower development policy with the objective of meeting the energy demands in the urban and rural areas. Nepal's Rural Energy Policy, which came into effect in 2006, is also a key policy document that promotes rural and renewable energy in Nepal. Five years later, the government introduced the National Climate Change Policy, prioritizing renewables as a major source of energy.

In 2015, the government initiated the crucial process of drafting a Low Carbon Economic Development Strategy (LCEDS), which is currently being finalized. It prioritizes major sectors, such as energy, agriculture and livestock, forest, industry, building and waste, commerce and transportation. These prioritized sectors are in the process of modernization and at the critical juncture to transform them towards low carbon paths.

KEY STEPS FOR A LOW CARBON FUTURE

One of the key areas Nepal is promoting is the RE sector. In July 2012, Nepal launched a five-year programme called the National Rural and Renewable Energy Program (NRREP). Its objective is to improve the living standard of rural people and reduce dependency on traditional energy. Some of the targets include producing 25,000kW of energy from mini and micro hydropower and distributing 600,000 solar photovoltaic systems for rural villagers. More than USD 170 million will be invested in the NRREP. Apart from the government of Nepal, international donors—including Germany, Norway, UK, and Denmark—will provide financial support. Nepal imports all of its fossil fuels from India, worth more than USD 1 billion annually. Additionally, 19 per cent of electricity is imported from India to meet Nepal's growing demand, at least partially. A study shows that Kathmandu alone produces nearly 200MW of energy from private diesel generators to compensate energy shortfalls. In a country where energy is 40 per cent deficient and the demand rapidly increasing, RE can play a very big role.

Nepal's industry is small but evolving. Accordingly, the concept of low carbon development can be injected from the very early stage. Polluting industries such as the brick kiln sector, garment industry, food processing factories and cement can become less pollutant. Similarly, transportation is another sector that needs assistance. Old and polluting vehicles are not only a source of high emissions, but are also deteriorating the health of the population.

After the earthquake, debates emerged on rebuilding Nepal and making the country more resilient. The government has been providing guidelines and floating modern ideas on how to redesign cities, housing facilities, and infrastructure. At this crucial time, Nepal has an opportunity to imbed the concept of climate resilient and low carbon development into the design plans. The Ministry of Science, Technology and Environment is working on a carbon emission reduction target for Nepal, which is very encouraging. With the launch of the LCEDS, it should become easier for Nepal to switch to a low carbon development path.

Nepal is increasingly experiencing climate-related extreme events. Apart from earthquake resilience, future development must become climate resilient. The government's decision to imbed indicators for climate resilience into its development interventions—including the low carbon development strategy—is a positive and innovative step.

CHALLENGES AND OPPORTUNITIES ON THE ROAD AHEAD

Nepal is in the initial stage of advancing its low carbon development, and the new strategy provides a good framework and many opportunities to fight poverty, while addressing climate change at the same time.

As an LDC, ample hurdles lie ahead of Nepal. Adequate and timely mobilization of financial resource is a major obstacle. Acting alone, Nepal will neither be able to achieve the targets it has set nor to implement all of the plans and policies. International development partners will have to come to its assistance.

Access to technology is another hurdle. Nepal has to acquire technologies at international markets. They are often expensive and difficult to maintain. Low-skilled human resources and capacity constraints are a hindrance for any available technology.

Nepal's political instability is another risk factor. Similarly, inadequate coordination, low institutional capacity, and a lack of qualified human resources present obstacles. Without adequately addressing these existing challenges, Nepal will struggle to adopt a low carbon future.

Nepal's CO2 emissions are insignificant. However, adopting a climate resilient and low carbon development model to ensure environmental sustainability and economic development is in Nepal's interest. Nepal should not follow the same carbon-intensive, Western-style development model, but rather embrace a different path that is environmentally friendly and sustainable. To some extent, this has already been realized by national policymakers and there has been some progress; nevertheless, much more needs to be done. International development partners can be a real crusader in this endeavour.

TOOLBOX: WHERE TO FIND MORE INFORMATION ON THE PROJECT?	
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