SMART VILLAGES
New thinking for off-grid communities worldwide

ENERGY4IMPACT
ACCELERATING ACCESS TO ENERGY

Smart Villages workshop on the water, energy, and food nexus: Lessons from West Africa

Workshop Report 25

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WEST AFRICA

Key words:
Water-energy-food nexus, West Africa, energy access, rural development

Smart Villages

We aim to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial and political—and how they can be overcome. We have chosen to focus on remote off-grid villages, where local solutions (home- or institution-based systems and mini-grids) are both more realistic and cheaper than national grid extension. Our concern is to ensure that energy access results in development and the creation of "smart villages" in which many of the benefits of life in modern societies are available to rural communities.

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About Energy4Impact

Energy4Impact (formerly known as GVEP) was launched in 2002 as a World Bank initiative and in 2006 it was registered as an NGO. The organization has offices in East Africa and in Senegal. The organization provides support to businesses that aim to accelerate access to energy in developing countries. Energy4Impacts' basic philosophy rests on the premise that as opposed to direct donations, business development is likely to be more sustainable. Since its inception, Energy4Impact has supported more than 260 small and medium enterprises and 2,800 micro enterprises. It has also raised capital of US$86 million and helped create 7,800 jobs in rural areas. Over 10 million people have been provided with improved access to energy through these projects.

In Senegal, Energy4Impact, in partnership with the Social & Ecological Management (SEM) fund, is leading on the implementation of two initiatives funded by the ENERGIA Network. The first initiative, "Energy opportunities for women in Senegal", aims to support the development and growth of 250 women SMEs across the value chain, and to increase productive use of energy by women across the value chain. The second initiative, "Tenderizing Energy Policies in Senegal" aims to a) advocate for the integration of clear gender objectives within the SE4ALL national action plan and investment prospectus and to increase awareness of the importance of gender and energy amongst key regional SE4All stakeholders and b) to implement a national campaign on energy, women, children & health, and other key events. Thus, Energy4Impact is implementing a
programme to support development and growth of energy focused businesses in 4 countries in Africa, including Senegal: The objective is to strengthen the capacity of micro, small and medium enterprises (MSMEs) to provide access to energy to rural communities as well as to support them in productive uses of energy.

Publishing

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Summary

Agricultural activities account for 70% of global water usage. Food production and the associated supply chain account for about 30% of total global energy consumed. While there is an awareness of the water, energy, and food (WEF) nexus, there is a lack of effective and integrated initiatives to address it. As described by the United Nations: "The global community is well aware of food, energy and water challenges, but has so far addressed them in isolation, within sectoral boundaries. At the country level, fragmented sectoral responsibilities, lack of coordination, and inconsistencies between laws and regulatory frameworks may lead to misaligned incentives." Despite the emphasis on taking a nexus approach for sustainable development, there is limited knowledge of what this means in a rural context.

From 24 to 25 August 2016, the Smart Villages Initiative along with Energy4Impact organised a regional workshop in West Africa in Saly, Senegal to develop a better understanding of the water-energy-food (WEF) nexus in the region. The workshop brought together stakeholders from 15 countries from across the region and garnered substantial interest among a wide-range of stakeholders including representatives from the public sector, the donor community, non-governmental organisations (NGOs), the private sector, and academia.

Participants at the workshop were informed that an integrated approach needs to be taken to have a positive effect on those living in rural areas. An inter-sectoral approach is required to deal with the WEF nexus. An integrated approach that balances the utilisation of these resources is important for sustainable development in West Africa.

The Economic Community of West African States (ECOWAS) comprises 15 countries. The majority of the people living in these countries, especially in rural areas, do not have access to electricity and are heavily dependent on using biomass to meet their cooking needs. Agriculture remains the main source of income for most of the population. However, lack of access to energy for irrigation means that it is largely rain-fed and is negatively affected by climate change.

Workshop participants considered that the immense development challenges facing the region require a shift in the development paradigm from a siloed approach to policymaking towards one that is cognisant of the inter-sectoral linkages between various resource systems. There has to be capacity at national and sub-national levels to understand competing interests, synergies and needs between water, energy, and food systems. Local institutions and communities can play an important role in managing potential trade-offs and improving synergies between the various sectors.

The agriculture system in the region is dominated by smallholder farms, and, for sustainable development, it is necessary to work with these farmers and the broader community to improve resilience to exogenous shocks such as climate change. Smallholders who depend on rain-fed agriculture are likely to be most affected by climate change. A participatory approach to development projects based on nexus thinking can ensure buy-in within the community, improve sustainability, and help deal with potential trade-offs between the resource systems. If the various components of the nexus are not dealt with holistically, there are likely to be major challenges for the most vulnerable sections of the population such as women-led households.

While there is a realisation that inter-sectoral policies are important for holistic policymaking, there is a lack of coordination on these issues both at a multilateral level and within countries. There is also a dearth of human capital within the public sector in developing countries that can adequately understand and deal with these chal-

lenges in developing countries. For development agencies and academics working at the local level in rural areas, there is an urgent need to develop a robust body of evidence for policymakers to show that an integrated approach to dealing with these issues works. This will create greater buy-in for nexus-based interventions.

Energy access can play a central role in helping improve rural livelihoods and agricultural productivity across the board. Lack of energy can inhibit the growth of productive enterprises in rural areas and negatively affect access to water and food. Meagre access to electricity, however, is not enough. Energy supply projects, whether implemented by the public sector or private firms, have to be linked to generating sustainable livelihoods for those based in rural areas, especially women. Reliable access to energy can have a number of positive effects on development in rural areas. It can contribute to improved food security and rural incomes through investments in improved crop processing technologies and groundwater irrigation. It can also help reduce post-harvest losses. Utilising indigenous resources for electricity generation such as organic waste can help reduce costs and improve farmer incomes. To take advantage of this link between electricity generation and locally available fuel sources, there is an urgent need to raise awareness in rural areas regarding technologies that can utilise locally available fuels to generate energy.

Access to finance and a conducive policy environment are necessary to improve access to energy as well as other resources like food and water for those based in rural areas. For women, especially smallholders, in the absence of credit, there is often a stark choice between investing in energy access solutions and buying necessities like food and water. Banks and micro-finance institutions are often unwilling to lend to the poorest households in the absence of collateral. Providing low-interest credit is necessary to ensure that there is uptake of modern energy solutions by households at the bottom of the pyramid.

For communities that lack access to resources and collateral, organising cooperatives can play a major part in ensuring access to resources and can help reduce transaction costs. Social enterprises can play a role as well, as they can contribute towards market development. Initiatives aimed at improving energy access and balancing the trade-offs in the WEF nexus can be much more effective and successful if communities are encouraged to give input at the project design phase. It is highly likely that solutions that do not take culture into account, and do not deal effectively with the trade-offs between resource systems, will fail.

Water, energy, food nexus workshop attendees listen attentively.

Introduction

The Smart Villages Initiative continued its regional engagement in West Africa with a workshop in Saly, Senegal in August 2016. From 24 to 25 August, the workshop brought together 36 key stakeholders representing the public sector, private companies, academia, civil society organisations, and entrepreneurs that are engaged in the off-grid energy sector across West Africa. The workshop provided an extremely useful forum to develop a better understanding to the water-energy-food (WEF) nexus and its implications for the region. The discussions also provided key learnings for the Smart Villages Initiative and the workshop participants.

This report summarises key points arising from the presentations and discussions and is accompanied by a policy brief that distils the main messages for the policy and development communities. Copies of the presentations are available on the Smart Villages website (www.e4sv.org). This report can also be accessed on the website. The workshop agenda and the list of participants along with their organisational affiliations are provided in Annexes 1 and 2 of this report respectively.

In parallel to the main workshop, a workshop was also held to engage with journalists on the issues associated with WEF issues in West Africa. The journalists attended, and contributed to, the plenary sessions of the main workshop and also had their own sessions over the course of the two days. The report of the journalists' workshop will be available at www.e4sv.org.

The workshop was well-attended by participants from across West Africa.

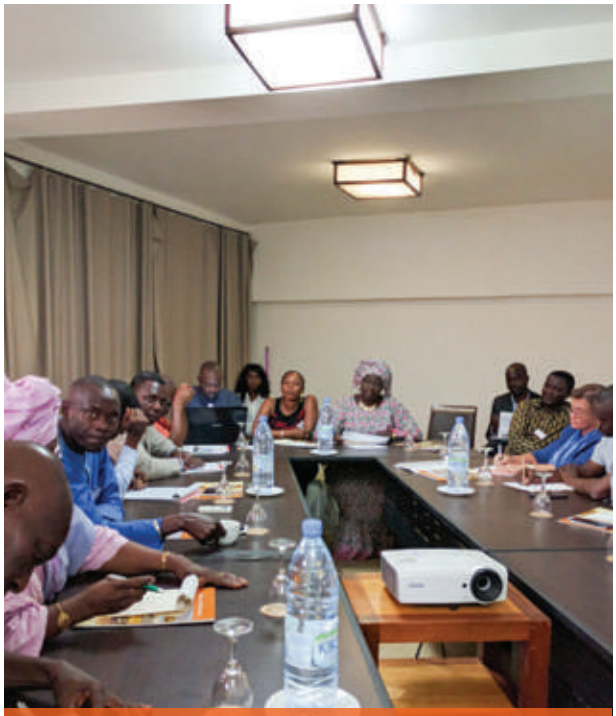
Inauguration of forum

Welcome Address

Louis Seck, Energy4Impact

Welcoming participants to the workshop, Louis Seck proposed that the WEF nexus lies at the heart of sustainable development and the fight against poverty. He explained that Energy4Impact (formerly Global Village Energy Partnership) was launched in 2002 as part of a World Bank initiative. Central to its philosophy is that supporting entrepreneurs is more effective than cash handouts.

Energy and food security are key issues for developing countries and an integrated development approach is needed linking water, energy and food. Too often, the different sectors are considered in isolation, however, development will only be sustainable if the sectors are linked. Linking water, energy and food initiatives will help sensitise international organisations to integrated development. Concrete actions need to be taken on such integration. It is extremely important to address gender because women often bear the brunt of the problems arising from a lack of energy and water.



The French-speaking breakout session on Day 1 addressed pressing issues for the WEF nexus in West Africa.

In the 21st century, there needs to be a focus on rural populations who otherwise may suffer discrimination and are often overlooked by policy makers in developing countries. Agriculture is the main source of income for the majority of the people in rural areas and access to energy can boost rural incomes. An inter-sectoral approach is needed on the WEF nexus. Louis Seck said that the workshop should make proposals to make the integration of water, energy, and food possible.

Introduction to the Smart Villages Initiative

John Holmes, SVI

John Holmes opened his presentation with the figures that provide the motivation for the Smart Villages Initiative: globally, 1.1 billion people remain without access to electricity, 3 billion people still cook on inefficient and dirty stoves, and 4.3 million people consequently die each year through inhalation of smoke and fumes. Goal 7 within the Sustainable Development Goals seeks to ensure access to affordable, reliable, sustainable, and modern energy for all by 2030. Importantly, energy access is a key enabler of nearly all of the Sustainable Development Goals.

Smart villages are intended as a rural analogue to smart cities recognising that nearly half of the world's population, and almost 70% of those living in extreme poverty, are based in rural villages. In smart villages, energy access, along with modern information and communication technologies, enables the provision of key services such as education, health, clean water and sanitation. Moreover, energy access supports the creation of new productive enterprises capturing more of

the agricultural value chain. Smart villages enable greater participation in governance processes and build more resilient communities better able to respond to shocks. Technological advances are shifting the balance of opportunities between cities and villages.

The Smart Villages Initiative is focusing on identifying the framework conditions necessary to support the creation of sustainable local energy solutions for rural communities that catalyse development. A series of engagement activities and workshops in Africa, Asia, and Latin America bringing together the key players is enabling the development of insightful "views from the frontline" of the challenges of village energy provision for development and how those challenges can be overcome. A key aim is to identify the framework conditions to foster entrepreneurial activities in delivering and using energy services and which maximise the leverage of public sector funding. An underlying premise is that to maximise social benefit and development impact, energy access initiatives must be integrated with other development initiatives and a community-level approach should be taken. An important concern is to catalyse rapid progression through the various levels of energy access.

With regard to the WEF nexus, it is estimated that by 2050 demand for energy will increase by 80%, and the demand for water and food will increase by 55% and 60%, respectively. Nexus thinking dictates an interdisciplinary approach that bring to the fore inter-linkages between water, energy and food systems and helps understand the potential trade-offs and synergies in utilisation of these resources. Such an approach can have a positive impact on sustainability by reducing trade-offs, improving resource allocation and policy coherence.

John Holmes concluded his presentation by reviewing the key questions for the workshop to address and the agenda for the two days.

Keynote Address 1: What are the global challenges arising from the interrelation between food, water and energy and how do they impact at a local level in West Africa?

Secou Sarr, ENDA Energy

ENDA Energy's vision is to support universal access to sustainable energy services and build adaptive capacity of vulnerable populations to environmental crises, particularly in Africa. Sekou Sarr explained that the 15 countries in ECOWAS have a total population of around 300 million, of which 60% have no access to electricity (with wide disparities between rural and urban populations), and 80% use traditional biomass for cooking fuel. The region is heavily dependent on rain-fed agriculture, leaving it vulnerable to climate change, and women are marginalised despite their work to produce and prepare food.

Key energy challenges are to supply affordable and secure energy services, ensuring equity of access, and mitigating climate change and environmental impacts. Governments in the region are trying to diversify energy sources and are increasingly concerned with energy services to support productive enterprises, not just meet household needs. Despite these efforts, there remains systemic discrimination between rural and urban populations, and policymakers are generally blind to the gender dimension.

With regard to current issues in agriculture, Sekou Sarr indicated that countries should be able to meet their food security requirements, however, this capacity is under pressure due to climate change and population growth. Improvements are needed in agricultural productivity, water control, and product marketing in the region. Three transitional elements should support each other: ecological transition, transition from family farms to competitive social enterprises, and transitions to renewable energy technologies and energy efficiency.

Access to water, energy, and food is now considered a right. In the case of water, there are global movements such as Water for All that aim to deliver such access. There are wide ranging links between energy, water, and agriculture, which are complex and diverse. A cross-disciplinary approach is needed to planning and issues should not be addressed in isolation. Advantage should be taken of decentralisation in West Africa. He stressed the need to capitalise on good practices in the region and observed that many people are taking an integrated approach without thinking about it. Policies and territorial planning approaches should not be compartmentalised, and planners should be sensitive to inter-sectoral linkages.

For sustainable poverty alleviation in rural areas, rural communities should capture more value from the value chain. Each area has distinctive natural resources that can be harnessed to create value. Ending with some examples, Sekou Sarr pointed to a project financed by the European Union in Senegal and Mauritania to enhance the milk value chain by providing solar platforms for the conservation and pasteurisation of milk; it aims to support the economic empowerment of women. A second project supports improved bread making, reducing by one-third the amount of fuel required, improving the quality of the bread, and strengthening local food security.

Keynote Address 2: Experience of the WEF nexus at village level: How can farmers cultivate co-benefits?

Mary Allen, Practical Action

Mary Allen identified the nexus approach as one in which the "solution for any one problem, like energy, must give equal consideration to others in the nexus, finding interconnected solutions that maximise synergies and manage trade-offs". Taking a nexus approach is important at small, localised scales: most food in sub-Saharan Africa is produced locally by smallholder farmers, fishers, or herders, and 55% of all new electricity supply needs to be from decentralised systems.

Practical Action's Poor People's Energy Outlook has explored the range of energy needs for farmers across the agricultural value chain. Practical Action has advocated for a Total Energy Access approach, which seeks to encourage a move away from a business as usual approach to energy supply. It focuses instead on the range of energy supplies and services that poor people need in households, at work, and in the community to support human, social, and economic development. A holistic approach is needed to energy access.

Mary Allen drew lessons from previous experience with micro-hydro schemes in Nepal and Peru. These schemes have proved to be sustainable and electricity has brought positive impacts for the local community. These benefits include: substantially reduced spending on energy, positive effects on the quality of education and healthcare provision, and an increase in incomes for 60% of local families. However, the design of these schemes did not consider how energy or water could support cultivation and livestock practices, and they were not designed on the basis of eventual productive uses for increasing incomes.

In one example, the river level was affected by upstream farmers building irrigation canals, disrupting electricity supply in the summer months. In another, some of the water source needed to be diverted for drinking water for a nearby town , which reduced the capacity for electricity generation.

The poorest households were less likely to have an electricity connection, and if they did have a connection, they were less likely to use it for productive purposes. In her experience, productive uses are almost always based in off-farm enterprises and require additional investments such as buying a refrigerator or other appliances.

However, a UNDP study of electricity and water power for milling revealed that such power dramatically reduced time spent on agro-processes such as grinding grains, hulling rice and pressing oils, saving 155 hours per year for women and 85 hours for men.

Many households in the villages supplied by the micro-hydro schemes in Nepal and Peru benefited economically, but the benefits were greater in the larger and better-developed areas where there was more scope for non-agricultural livelihoods and small businesses. Evidence from the projects suggests that more deliberate attempts are needed to make the connection with energy needs in smallholder agriculture which will bring further benefits.

Practical Action has built five micro-hydro schemes in the Eastern Highlands of Zimbabwe over the last 14 years in which a more deliberate attempt has been made to connect the energy scheme with agricultural livelihoods. In the Himalayan villages, attention was given to energy services for agricultural livelihoods: electricity pumps were installed for irrigation water, and a cold storage facility is being set up to help keep produce fresh before it is sold. Trained community members are responsible for all future maintenance of the plant and energy delivery. Two cooperatives have been established: one to make and sell fencing and electricity poles, another to manage the irrigation scheme. All this has been made possible by a sophisticated and organised community structure.

A successful approach to dealing with the WEF nexus needs a good understanding of the competing needs and trade-offs during project implementation. Strong community institutions are necessary, built up through the approach taken to planning and constructing the scheme. Clear and effective ownership and management structures need to be in place, so that trade-offs can be effectively dealt with.

In conclusion, Mary Allen indicated that there should be a focus on productive use of decentralised energy alongside household and community services use. A deliberate attempt should be made to connect energy and water uses with mainstream agricultural livelihoods, and bottom-up approaches should be taken which ensure local institutions can handle trade-offs as they arise. It is important to make the most efficient use of the resources available to produce the best development outcomes.

At national and international levels major donors should build the needs of rural communities and smallholder farmers into their programmes. Cross sectoral working requires high-level commitment and encouragement. New ways of working are needed between ministries of agriculture, water and energy which may otherwise have competing objectives. The SE4ALL High Impact Opportunity for nexus issues needs to be championed.

Smart Villages and Energy4Impact welcomed more than 40 participants interested in WEF nexus issues.

Panel Session 1: What are the synergies and trade-offs between water, food, and energy, and how can these be balanced in a rural context?

Water, energy, and food nexus

Gabrielle Schwarz, Bonergie

Gabrielle Schwarz, the Managing Director of Bonergie, a social enterprise, informed the participants that the organisation combines a purpose-driven NGO approach with a profit-driven enterprise approach. They aim to deliver customised energy services to off-grid communities. Bonergie has been operational in Senegal for six years, has four regional offices, more than 20 employees, and over 1,000 customers. The company uses a decentralised approach by providing energy products, which are adapted to the local needs of their customers. These include, for example, light solutions, solar home systems, solar refrigerators/freezers, processing units, solar water pumps, and bio-digesters. Looking at the WEF nexus in relation to Senegal, Gabrielle Schwarz highlighted that the country depends heavily on agriculture: there is no reliable rainy season due to changing climatic conditions, and farmers lack access to energy and modern irrigation systems. All of these factors work together to increase the vulnerability of farmers, especially smallholders.

To deal with these challenges, Bonergie aims to improve food security by making smallholder farmers more resilient to shocks such as changing climatic conditions. The company works with customers along all stages of the value chain, including: production (e.g., solar irrigation), conservation (e.g., solar cold chambers), transformation (e.g., fruit dryers), and distribution (e.g., trucks). Bonergie also provides a link to sales outlets.

The company aims to build 16 papaya processing centres across Senegal and to establish national as well as international sales channels to guarantee income generation for local farmers. The projects seek to reduce migration towards cities, as the organisation helps villagers to find job opportunities in their villages.

To illustrate, Gabrielle Schwarz gave the example of a farm in Casamance, where Bonergie helped to introduce a papaya production mechanism, as part of Senegal's desire to become a major producer of papayas. The project is organising 200 small independent farmers in a cooperative and 60 of these farmers have received funding to purchase necessary inputs through a programme called Apran. To facilitate the papaya production, over 50 solar water pumps are being installed. As part of the project, local women started a seed nursery and within a few months Bonergie trained all the women to use the solar pumps.

To diversify risk, the farmers grow different vegetables apart from papayas. For example, in one case, chili plants are planted amongst the papayas. Bonergie ensures that technical experts are available to assist farmers and to evaluate as well as assess the progress of the plants. Since the beginning of the programme, Bonergie has been looking for clients that may be interested in different papaya-based products such as fresh or dried papayas and latex. To be able to export the fruit, and meet stringent certification requirements Bonergie invited an expert with over 30 years of experience to establish certification.

For Gabrielle Schwarz and her team, sustainability is paramount. To facilitate this, each project is designed for a specific customer, through an individual finance plan. Clients have to repay the cost of equipment in three years based on each customer's resources. This allows farmers to purchase the necessary equipment such as a solar dryer on a credit basis. This project has played an important role in increasing farmers' incomes as they are no longer dependent on the rainy season and can produce all year round, which in turn has greatly improved their standard of living.

Early outcomes of the project have been positive, and they show that some farmers have been able to repay their loans ahead of schedule. They have reinvested their money to purchase other electronic equipment, for example, a women's group has bought a TV.

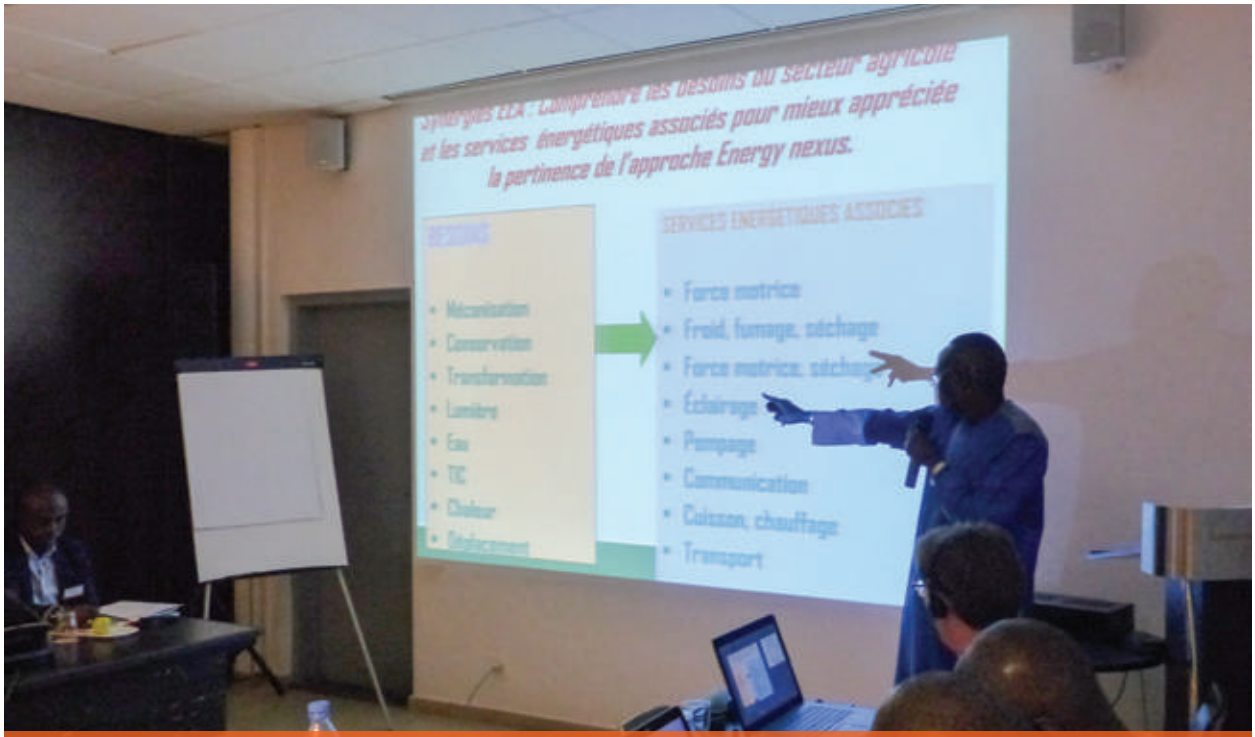
Talking about the future plans, Gabrielle Schwarz observed that they aim to expand the project's remit to an additional 140 farmers. To capture more of the value, they aim to install 16 processing facilities to produce natural latex. There are also plans to install solar fruit driers and to convert part of the crop into juice and puree.

Mobilising Eco-villages for inclusive sustainable rural development

Ibrahim Sall, ANEV

Ibrahim Sall presented on the Eco-villages initiative in Senegal—a project that is in line with the Smart Villages Initiative objectives. Talking about the situation in Senegal, he observed that to date, there is a clear problem in rural villagers to a) increase private sector involvement and b) improve the resilience of the poorer population, especially in the southern region where poverty levels are high. ANEV have initiated a project to improve agricultural productivity, whilst keeping the environmental impact to a minimum. The Eco-villages initiative is a publicly funded project. To ensure local buy-in, civil society was involved from the outset to identify a project that can sufficiently address the above problems.

There are four key steps that should be part of any intervention, these include: 1) establish partnerships with other stakeholders including development organisations and research institutions for example; 2) test the business plan before scale-up; 3) establish linkages with the local community itself instead of simply giving development assistance; and 4) ensure good governance. Additionally, Ibrahim Sall emphasised that there has



Secou Sarr of ENDA Energie highlights the energy services that can meet agricultural needs.

to be a participatory approach in place to ensure that the people know how to help themselves.

In line with the above four points, the Eco-villages initiative is being implemented in six eco-geographical areas. The approach was piloted in each area and it was ensured that the project was adapted to the specific local conditions. For example, in one project in the southern region of Senegal the project implementers assumed that the greatest concern is the water. In fact, water availability wasn't a problem—it was the lack of access to energy that inhibited the use of this water. This was identified by involving the community in project design. Energy can also help improve utilisation of water and to minimise wastage through solutions like drip irrigation. Energy is not only important for irrigation but is also important for producing food, storing and pumping water, and operating grain mills. Availability of energy for irrigation will allow more intensive farming. Farmers are no longer limited by seasons, i.e. only being able to undertake farming activities for three months a year. Instead, in this particular village, they can work for nine months.

It is also important to take the financial capacities of the villagers into account in the project design. In the village in southern Senegal, farmers are very poor and thus there is a need to facilitate the organisation of cooperatives to purchase capital goods such as a community refrigerator to reduce post-harvest losses. Moreover, there are fewer tangible benefits to utilising agricultural equipment. For example, a solar-operated grain mill helps to reduce the time women spend undertaking time consuming and labour-intensive tasks such as grinding millet by hand.

Ibrahim Sall highlighted that if you invest in women, this not only liberates them but also assists children who also spend a lot of time helping in the fields or with household chores. He emphasised the need to change current cooking methods. In the past, women used trees as firewood, however, with increasing population pressure there is a need to consider alternatives that are in sync with local conditions. It is important to have technical solutions that have been adapted to the local context, especially in the case of cooking. The transition towards modern cooking methods will also help reduce the carbon footprint by using more efficient stoves.

As a final remark, Ibrahim Sall highlighted that when we talk about agriculture this should include allied activities such as gardening, livestock improvement, small trading, and access to water. For sustainability, we need to articulate these requirements to national policymakers.

Water, energy, and food nexus: A case study in Ghana

Benedicta Fosu-Mensah, University of Ghana

Benedicta Fosu-Mensah began her presentation by highlighting that to solve the nexus problems, the development community has to look at all its components holistically. This means that a cross-sectoral approach has to be adopted to balance the different resources.

To illustrate what can happen if a cross-sectoral approach is not adopted, Benedicta presented a case study from Ghana. The main focus of policymakers in the country was on generating power to provide neighbouring countries with energy. Initially, farmers along the Volta River used the water from the reservoir to irrigate their fields. However, in the face of climate change, there was a substantial reduction in the amount of stored water. Over time, there was not enough water to generate electricity which has not only affected energy provision but also irrigation and subsequently the local people. In this particular case, the project design did not consider changes in climatic conditions; the reduction of rainfall has led to the river drying up. As a result, farmers have to pump water from further away, which requires more energy and lowers the water table.

The reduction in water flow in the river has also resulted in health problems.

People have lost their livelihood, and some have migrated to other parts of the country. For those who remained behind, there has been an increase in the cost of production, which has to be transferred to consumers. Farmers are no longer able to invest in modern technologies such as drip irrigation. These kind of technologies are more efficient when it comes to water consumption and energy usage. There seems to be a siloed approach towards policymaking—each sector only looks at their own objectives even though the impact of the river drying up can be felt by all sectors.

Benedicta Fosu-Mensah informed the audience that ASSAR is a project that is looking at climate change in semi-arid regions. This project focuses on the adaptation capacity of smallholder farmers to climate change. This project is not just trying to find solutions but instead is bringing all stakeholders on board at the beginning of the project so they can raise their concerns and jointly discover solutions for all stages along the project cycle. In this particular region of Ghana, which is located in the north of the country, water access is a major problem, as this is the region most negatively affected by climate change. Through dialogue and consultation stakeholders have come up with some ideas to deal with the challenges facing farmers in the region.

Naturally, rainfall leads to improved food production. If there is no water, farmers will not be able to produce food. With climate change, there will be an increase in instances of droughts, and there are many other implications. Lack of resources available to smallholder farmers means that they will be the most vulnerable to the impact of climate change.

To overcome some of the challenges highlighted above, cross-sectoral thinking should be incorporated into the project design from the start.

Question & Answer Session

The panel session was followed by an interactive and animated question and answer session. Workshop participants raised questions about the cost of alternative energy sources. It was highlighted that alternatives like off-grid solutions are expensive, making it difficult for people to access them. Gabrielle Schwarz agreed with this sentiment, however, she highlighted that there are ways to make off-grid renewable energy solutions affordable. One option is to offer products on credit with an individual financing plan. Furthermore, she highlighted, that there is a need to work with a number of stakeholders including the government, private sector, and social businesses. Working together it is possible to shift to more affordable alternative energy sources and provide sustainable energy solutions.

Members of the audience raised concerns about the lack of adaptation of improved cookstoves to the local conditions. Ibrahim Sall observed that progress has been made in the area of cookstoves in Senegal, and many of the improved cookstoves help save energy and are suited to local cooking needs. There are many solutions in different areas, and every technology has pros and cons but the technology exists.

Participants also raised questions regarding the negative impact of solar systems, especially batteries, on the environment in the absence of proper recycling facilities. Ibrahim Sall observed that there are solutions to deal with the toxic waste. In Senegal, for example, there is a department that specifically focuses on the issue of toxic waste. Nevertheless, there is a need for technological solutions to reduce the toxicity of batteries

Another question focused on the suitability of certain technologies in specific regions based on the local environmental characteristics. Gabrielle Schwarz stressed that there are a number of solutions available and energy sources have to be in-sync with the local environmental conditions.

Hybrid systems are also available that combine different technologies.

A number of questions centred around how the local context can be taken into account or what happens with existing local technologies. All the panellists agreed that the local context is paramount and solutions must improve people's conditions by taking into account the local context. Ibrahim Sall highlighted that when introducing modern technologies such as a solar mill into communities, there is a need for a transition period to allow people to get used to the new technology. He gave the example of a project in one village where a traditional mill was modified by adapting the motor system.

There were a number of questions about the Eco-Villages initiative. Responding to these queries, Ibrahim Sall outlined that in ANEV's Eco-villages there is an emphasis on project sustainability and consumers have to pay for services. Ensuring a stable revenue stream enables the project to be more sustainable as operation and maintenance costs are covered. Furthermore, he highlighted that to have a sustainable project, the environmental impact has to be taken into account.

Tina Abdou Saleye and Ousmane Dambadji listen carefully to the presentations.

Breakout session 1: How the challenges surrounding the water-energy-food nexus impact on women and what the global community can do to overcome the challenges

After the morning sessions, the participants divided into two groups for a breakout session. The groups were asked to deliberate on three pre-set questions. These were:

1. How does the lack of access to energy impede women smallholders' productivity in West Africa?

2. How does this negatively impact household level food and income security in the region?

3. What can multilateral stakeholders, including businesses, do to improve energy access for women-led households and create the enabling conditions for sustainable rural development?

On the **first question** of how a lack of energy access impedes the productivity of smallholder women farmers in the region, participants observed that in the absence of energy, everything has to be done manually, which means productivity is low. Access to energy has a positive impact on local productivity. For example, the installation of a solar crop dryer increases productivity by 40% and reduces the spoilage inherent in roadside drying which is otherwise the norm. Also, it is generally the responsibility of women to fetch water, which can require long journeys and takes much time in the absence of water pumped to the village. Similarly, it is often the responsibility of women to collect firewood, which is very time-consuming.

In The Gambia, though there is a large river running through the centre of the country, the lack of energy to pump it means that the water cannot be used to enhance agricultural productivity. Similarly, in Burkina Faso, most farmers are unable to irrigate their crops in the absence of energy. In Senegal, there is a limited season to grow produce if groundwater is not pumped. If there are no systems to exploit natural resources, then it is extremely difficult to make progress.

In Senegal, there are periods of time in the year when men do not work, whereas women have to work year-round. This, together with the manual and inefficient labour consequent on the lack of energy access, means that women have little chance to focus on, or be involved in, other things. Due to the burden of work women are unable to get involved in political issues and have no voice, they are excluded from social engagement and do not have opportunities to study to enhance their skills.

Cooking on "dirty" stoves that produce toxic fumes impacts women's health, which negatively affects their productivity. Delivery of babies in the absence of light and good medical facilities is dangerous and can lead to long-term health implications. The absence of streetlights also brings dangers for women if they need to venture out at night. The absence of energy for lighting restricts the hours in which women can work and therefore impacts on their productivity. More generally, the absence of energy limits productive activities.

Deliberating on the **second question** regarding food and income security, participants said that the inefficiencies consequent on the lack of energy means that processing of agricultural produce is slow and wastage is higher, resulting in lower incomes for households. Even if people produce more agricultural products, if they cannot process them, they cannot sell them on the market. Energy is also needed for transport to get produce to markets. Often, by the time the produce is transported to the town for sale, the money earned is very small. All this results in many families being stuck in subsistence agriculture and being food insecure. If there is not enough food to feed the

household, there are a number of social problems that might arise. Children may be pushed onto the street to get money, and husbands may abuse their wives.

Turning to the **third question**, it was considered that to improve energy access for the most vulnerable sections of the population such as women-led households, a good investment environment needs to be created which requires a supportive policy framework. The policy should be to electrify, rather than just to provide lightbulbs, but the definition of energy access will be context specific. Energy should be seen as a source of increased incomes, not just as a social service, which has tended to be the case historically. Policies need to be implemented, not just created, and should be complemented by effective monitoring and evaluation systems. And rural development is not just for government but also for other stakeholders such as the private sector. Initiatives and policies should be based on an evaluation of the whole community. Cultural aspects need to be taken into account, otherwise projects are likely to fail.

Business people should recognise that there is a lot of opportunity in rural communities. Businesses need to make money, and it is important that the right investment framework is established. If that framework is not clear, or is too complex, it will create a disincentive for businesses to invest. Villages need innovative business models to make electricity affordable, and villagers need to appreciate the benefits, so creating awareness is important. Entrepreneurs have a role in creating that awareness. A pragmatic view is needed on quality standards taking account of what can be afforded.

A focus on women brings business opportunities. Women are more prone to save and hence are better able to develop a good credit history. Micro-finance institutions have a role to play in supporting income generating activities, but ways need to be found to ensure that they charge affordable rates of interest. More generally, better savings plans are needed and more efficient banking systems. Whereas in Europe bank accounts are free, in West Africa bank customers have to pay $10 per month for a bank account, and banks still lose money. West African banking needs to develop more effective approaches, for example, making use of mobile phones.

Keynote Address 3: What is the role of multilaterals and governments to facilitate WEF?

Nathalie Rami, Energy4Impact

Natalie Rami began by noting that there is a lot of debate about the role of multilaterals and governments at the national and supranational level as they relate to the food, water, and energy nexus. But an important question is: how can we create this nexus and move from just a slogan to actual action?

She aimed to discuss how off-grid, decentralised energy solutions, including mini-grids, can help to create this nexus and better connect the three sectors of agriculture, water, and energy with appropriate solutions on the ground.

To give a brief overview of Energy4Impact, formerly known as the Global Village Energy Partnership, Natalie Rami explained that it works primarily in African countries, and its regional office is in Nairobi, Kenya. Its mission is to accelerate access to energy and deploy decentralised energy solutions. Energy4Impact works closely with the private sector to create sustainable solutions that can have more impact than some other energy solutions that exist.

Energy access is a global challenge. Energy4Impact wants to show that the world of energy access has an impact on all aspects of people's lives: education, health, productivity, the economy, and food security. Today, access to energy has become a priority and is a key issue for sustainable development. Providing energy services can do much to

improve food production and consumption, and ultimately, to safeguard food security. Access to energy services is needed to facilitate economic activities and improve livelihoods. A significant segment of the population in low-income countries live in households that depend primarily on agriculture and the food-based economy for their livelihoods. Improved practices in agricultural production, agro-processing, post-harvest and storage facilities, and distribution and retail can contribute to poverty alleviation. All this requires the local availability of modern energy services.

To explain why energy access is crucial to rural communities in developing countries and how it connects with agriculture and water, she highlighted several factors:

- Increasing energy services in rural areas has the potential to spur agricultural development by increasing productivity, for example through irrigation, and improving crop processing and storage.

- It could also strengthen the development of non-farm commercial activities, including micro-enterprises, and create opportunities for other types of income generation

- Energy development, especially renewable energy, also has the potential to create green jobs in rural communities, in areas such as fuel crop cultivation and the provision and maintenance of energy services.

- Energy can improve irrigation: According to the Food and Agriculture Organisation (FAO), irrigated lands produce higher yields than rain-fed systems and allow for double and triple cropping. In Africa, only 4% of the land is irrigated.

- Aquaculture enterprises (fish farming and mariculture) are expanding. Some of these enterprises, such as shrimp farming, rely on direct energy for pumping and aerating water as well as on indirect energy for producing and delivering feed.

Between these three sectors, both similarities and differences exist. In the energy sector, the focus tends to be on providing electricity and deploying technology. In the agricultural sector, increasing agricultural productivity tends to be the primary focus, but energy is rarely seen as central to this goal. Those focused on water, on the other hand, prioritise the sustainable management and supply of water, along with storage and irrigation.

Given the different priorities of each sector, what conversations do we need to have to improve coordination between these three sectors? Multilateral organisations and governments clearly have an important role to play in linking them. However, there is a lack of coordination between governments and within governments at a national level. A single country often has a minister for each of these topics but little cross-cutting coordination. In Senegal, however, CIMES is an agency set up to connect these sectors, which may be an example for others as it improves.

It is evident that we must understand the challenges of all three sectors to find a good solution that links food, water, and energy. We also need to reinforce the capacity of people who work in ministries and their knowledge. One idea would be to have a focal point or coordinator, a role that could be replicated across each of the ministries to make this connection concrete. We must seek to simplify as much as possible and adopt a pragmatic approach to solving all the sectors' challenges in this nexus.

There is a need to show proof that thinking about these issues using the water, energy, and food nexus can lead to an integrated solution. But to do that, we must test this approach on the ground and show the proof to governments. It will be important to map out likely energy needs of farmers and food processors to get a better understanding of issues and priorities. Moreo-

ver, it is important to understand the impact of this approach on smallholders' productivity and livelihoods as well as private sector challenges in delivering an economically viable model. Again, we must build evidence to guide policymakers and funders. Interventions should be designed to support farmers to articulate their needs in term of energy, water resources, and value chain linkages. Lastly, interventions need to address all barriers to development and to scale up of a more integrated approach to water, energy, and food, alongside natural resources.

Nathalie Rami emphasised that water, energy, and food are high on the development agenda; numerous organisations are dedicated to these issues. The private sector will play a critical role in this development agenda since most communities that lack electricity will require off-grid and mini-grid decentralised solutions.

For off-grid energy interventions to be effective, they need to go beyond lighting. There has to be a focus on developing markets and improving villagers' access to markets. In terms of access to finance, there is a need to move beyond micro-finance approaches and think bigger, especially in terms of equipment purchases. A stronger focus on productive uses of energy is absolutely critical, and this offers an opportunity for improving agricultural production, for example. Rural communities, farmers, and local food processing enterprises need to be more involved in the solutions. Moreover, gender issues must be mainstreamed; after all, women compose 43% of the agricultural workforce. As in the government, a pragmatic approach is necessary on the ground as well.

The Energy4Impact (E4I) approach focuses on enterprise development for productive use of energy. Many mini-grid projects forget to focus on activities that not only improve productivity but also improve the profitability of the mini-grids themselves. Technical support, guarantee funds, and project management are other crucial factors for ensuring the success of mini-grids, which can have significant impacts on food security and the agricultural sector. Access to financing is of course always a factor in their ability to get off the ground and start operations.

Natalie Rami then gave several examples of projects that have sought to improve the water, energy, and food nexus. In Senegal, an initiative has been led by l'Agence Sénégalaise d'Electrification Rurale (ASER). It supports small projects and businesses in various sectors (health, agriculture, water, food production, education) and aims to improve productivity by meeting their energy needs. E4I has supported several projects that aim to generate revenue for local communities, including dairies, agricultural businesses, food processing, and a tourist camp, while also contributing to sustainable development. The World Bank provided seed funding with equity contribution and debt. In the end, three grid-connected and nine standalone solutions were established. US$1.3m in grant support was provided, and jobs were created, providing sustainable development.

In terms of better connecting energy, water, and agriculture, she informed the audience that in Rwanda, there is a three-year energy and farming programme that focuses on irrigation for smallholder farmers. In this project, E4I is working with three ministries: the Ministry of Energy, the Ministry of Environment, and the Agriculture Board. In the first six months, the energy needs of small holders were mapped and a partnership with agri-initiatives/organisation and farmers' cooperative started. The work also includes supplier surveys and assessment, design of distribution model analysis, and finding the appropriate financial mechanism for both suppliers and end-users. In such a project, the risk is that poorly managed or designed irrigation systems can result in wasted water or energy, deplete or pollute water resources, fail to produce good crops, or cause soil degradation and salinisation. For these reasons, an environment and climate change impact analysis was carried out. Gender

is mainstreamed in this project, and awareness raising is being carried out.

To give another example, a pico-hydro project is being carried out in Rwanda as well. In this case, 30 pico-hydro micro utilities were established and supported with technical, financial and business mentoring. 450kW of electricity was installed, and 4,500 households in rural areas will be connected to electricity. The connection between water and energy in this project is evident, but, crucially, it has important effects for agriculture-based businesses that need agro-processing or irrigation. The stakeholders involved included the target communities, Ministry of Natural Resources (water, energy, forestry), and the energy and water national utility (EDCL). In terms of the challenges for this project, the dry season poses a barrier to producing enough power. Other challenges are mainly financial: the capital investment is high and requires a capital subsidy. Banks are hesitant to finance projects like this due to their perception of high risk. In addition, most developers of such projects lack the equity or collateral to get it off the ground. They also often lack both technical and business skills to make it a viable business.

In a final example, Nathalie Rami described the national biogas programme in Senegal. It is a programme that has been further developed. From 2010-2013, in the first phase, the programme only thought of using biogas for cooking and was not very successful. It is clear now that biogas can be used for increasing agricultural productivity. The prevalence of subsidies is still a problem, but this type of project is worthwhile. The big question is: how to create a business model in the long-term? In its current phase (2015-2020), a more integrated food, water, energy approach will be included, with a strong focus on production of organic fertiliser and compost, water resource management, fish farming, and energy for cooking. All of these new factors should result in improved income and food security. The private sector will play an important role, as will capacity building, access to finance, and close links with the Ministry of Agriculture.

Question and Answer Session

In the question and answer session, participants expressed the importance of providing guidance and assistance to smallholders regarding investment, finance, and how to access markets. The importance of partnerships was emphasised, including partnerships with governments, financial institutions, the private sector, and communities.

Others were interested to understand whether micro-finance could play a role. Smallholder farmers are often not able to access micro-finance or other types of credit. How can E4I's ideas help these smallholder farmers?

In response, Nathalie Rami commented that they are helping smallholders at all levels, for example, through a guarantee for equipment cost. She noted that sometimes larger sums are necessary for equipment and micro-finance cannot cover these sums. In that case, other solutions need to be found, and E4I helps small businesses access loans, create a business plan, and pursue their goals.

Elevator pitches

In Senegal, wind turbines link wind and water

Bineta Kamara, EOLSENEGAL

EOLSENEGAL is a special type of start-up that looks to exploit wind resources for energy production in Senegal. The company decided to produce a wind turbine locally because Western wind turbines are not necessarily appropriate to Senegalese conditions. Work has been ongoing with the Centre International de Formation et Recherche en Energie Solaire (CIFRES) since 2006 to see what possibilities for wind energy exist in Senegal.

In 2013, EOLSENEGAL was founded as a company after seven years of R&D, and they seek to:

- Prove the potential of wind energy
- Produce and assemble wind turbines
- Install and ensure wind turbines, hybrid, and solar systems function well
- Provide after sales support and maintenance
- Produce and install solar ovens and solar dryers
- Provide technical assistance

EOLSENEGAL created Piggott technology, a wind turbine that is three metres in diameter that produces 500 W at 7.5 m/s. This wind turbine is produced locally with 95% of materials available locally; in addition, the team is from the area. Replacement parts are readily available, and installation and maintenance services are provided. This system is used for two main purposes: electricity production and water pumping.

To explain the pump's integration into the wind turbine, the pump is immersed in the shaft and is powered by the batteries. The pumped water is stored in a tank above these elements. The water is then distributed to the crops via the micro-irrigation system operated by valves. Just one day of wind can allow the pump to function for one whole week. As an example, the Champ Ecole Paysan de Mbawane of the Federation of Agropasteurs de Diender uses this system in the zone des Niayes, where 80% of Senegal's vegetables are grown. These wind turbines have been working since 2009.

Of course, it is not only wind energy that is necessary. EOLSENEGAL has also worked on solar dryers, for example. They allow farmers to dry fruit and vegetables. The dryers are priced affordably for those with low incomes, and they are easy to produce. This is a good example of technology transfer as the dryer was developed in Guineau Bissau. Another way of drying agricultural products is using greenhouse dryers. A second prototype was installed in Salémata, Kédougou and is used to dry fonio (a grain), fruit and vegetables, and leaves and stems. When drying a large quantity, there are usually losses, so the system aims to improve that with lower humidity.

Appropriate energy solutions for agri-food processing SMEs

Neil Bianchi, Fullwell Mill

Fullwell Mill is a small and medium-sized enterprise (SME) that dries various fruits and promotes health food, with a focus on organic and fair trade products. The company purchases 150 metric tonnes of value-added produce from five fair trade partner exporters who are served by around 12,000 farmers. It works with key partners in Burkina Faso on dried mango and cashew production, while in Uganda it procures dried pineapple, banana, and mushrooms. Developing appropriate renewable energy solutions is a key activity of their ongoing work with exporter SMEs.

In terms of energy and food, Fullwell Mills has focused most of its work and attention on processing dried fruits and nuts. With regards to water/food and energy/water, both link closely to irrigation, which is extremely important in the Sahel region, and is an area in which to undertake further work.

Fullwell Mills aims to help smallholder farmers and communities develop by adding value and generating a high quality product; however, most basic forms of value addition involve post-harvest processing such as grinding, drying, cracking, milling, etc. These are productive activities that generally require equipment and an energy source.

There are a number of challenges for SMEs working in the area of agro-processing, including: small production volumes, geographic constraints, access to markets, limited ability to invest in state-of-the-art technology, a stable and affordable energy source, product marketing, access to capital, and waste management.

There are a number of links between energy and food that can be utilised to improve energy access for smallholders. For example, mango waste can be converted to biogas, and the gas can then be used for fruit drying and cooking. Improved solar tunnel dryers for pineapple and banana in Uganda also help to prevent post-harvest losses. Similarly, cashew shells can be converted to heat: only 25% of shell waste is sufficient for cashew cooking, steaming, and drying, which means that wood and butane are no longer necessary. Fullwell Mill has replicated this system at three satellite women's SME cashew processors and supplies all their heating requirements. The other 75% excess of cashew shells results in other activities that require energy, for example: fruit drying, vegetable oil processing, bakeries and

Louis Seck of Energy4Impact discusses the WEF nexus in the context of Senegal (pictured: Abdoul Karim Dosso of Energy4Impact (L) and John Holmes of Smart Villages (R)).

gasifier technologies adapted for small cashew SMEs

Gasification is an accessible technology solution applicable to both small-scale processes as well as larger, industrial settings. Gasification can also treat difficult to handle organic residues that are extremely oily, produce excessive smoke, etc. The energy produced can then be used for a range of applications: mechanical, electrical, or heating.

Husk-powered electricity generation can also be a powerful source of energy. One 35 kW plant can supply electricity to 400 homes and uses 10 tonnes of rice husk per month. The installation cost is $1,000 per kW, and the technology is transferable to rice producing areas of West Africa and adaptable to other types of biomass.

These technologies are designed to suit SMEs, not micro or large businesses. They are always developed with the following guidelines:

- Low upfront cost
- Able to be built and repaired locally
- Robust and easy to use
- As efficient and with as short a payback period as possible
- Trade-offs between efficiency and the other parameters

It is important to spread awareness of these agriculture-related energy generation technologies with as many relevant SMEs as possible. A lack of access to appropriate and affordable finance remains a major obstacle to uptake of these technologies and requires the development of appropriate subsidies and cost sharing arrangements. There is also a need to effectively demonstrate these solutions.

The long-term benefits of these solutions include sustainable energy production; an opportunity to develop region-leading know-how and technical capacity in biomass gasification technology; established, accessible technology adaptable to various organic-waste producing industries at small, medium, and industrial-scale; a sustainable, long-term model of domestic fabrication, installation and development of industry. And last but not least, it provides an example of technology appropriate to West Africa.

Project experiences in Cabo Verde on the energy, water, and food nexus (UNIDO and ECREEE)

Heleno Sanches, ECREEE

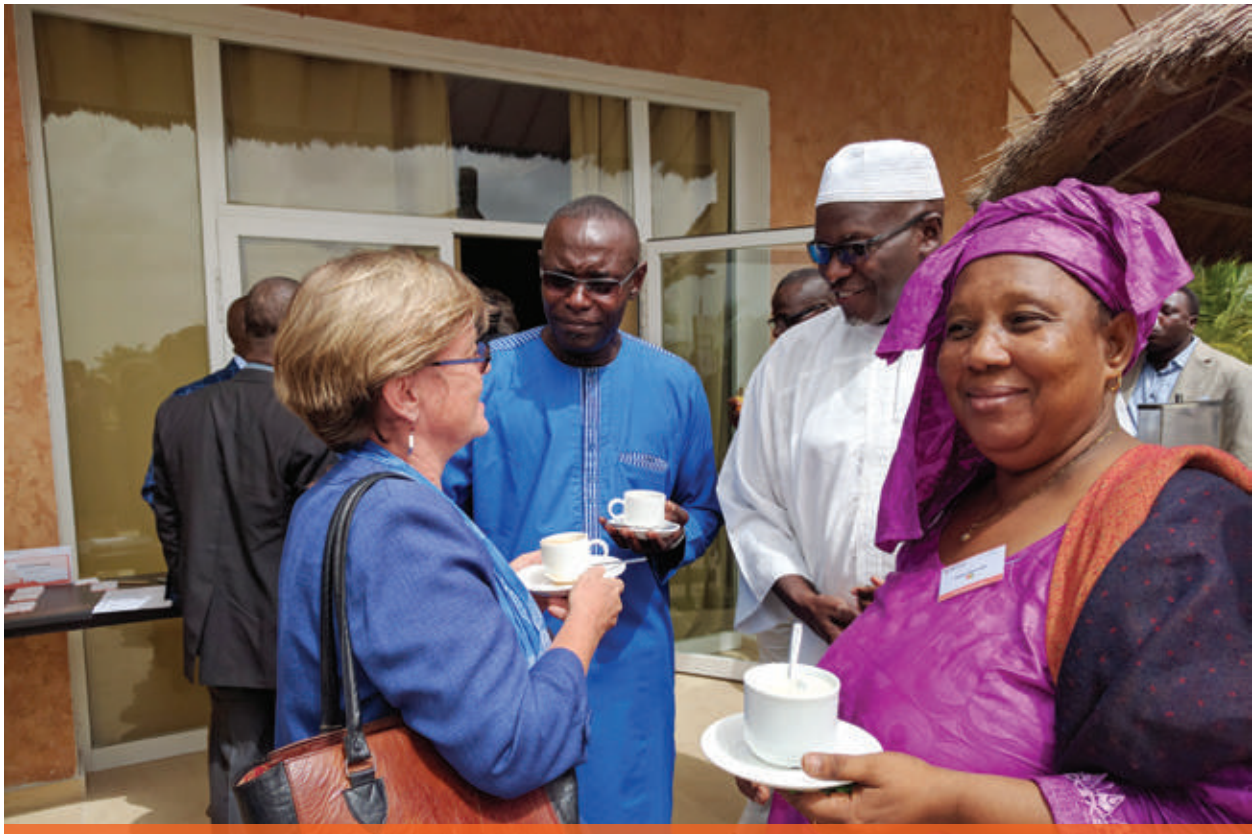
Heleno Sanches described the water and power sector in Cabo Verde. There are nine islands, and in each one, there is a power and water system. To produce water, Cabo Verde relies on electricity for desalination as there isn't enough fresh water. For irrigation, underground water must be pumped. The price of water for consumers is very high: US$2.88 per m^3 plus taxes.

GEF Cabo Verde IV, also known as "Promoting market based on development of small to medium scale renewable energy systems in Cabo Verde" is a project co-funded by UNIDO and ECREEE. Its main objective is to "contribute to climate change mitigation by reducing the emissions of greenhouse gases using renewable energy technologies for productive uses". The total budget is US$8.6 million. These funds are to be utilised in the water-energy sector particularly for capacity building. Eight pilot projects are currently being implementation. Heleno Sanches described two of the projects: one uses solar energy to pump water, while the other uses solar energy for ice production in a fishing community.

In the case of the fishing community on Brava Island, they were paying a lot of money for electrici-

ty to produce ice, and it was not sustainable. They needed over 600 tonnes of ice per day. Working with the Ministry for Rural Development, Fisheries, and the Environment, additional funding was generated, and the project implemented. The ice production system was connected to the national grid at a cost of US$33,000. After 6-7 months, the project was clearly doing well. Prior to this intervention, they had an electricity bill of around US$402 per month. Now, their monthly bills have been reduced to US$111.

In the second project, which focused on a solar system to pump water for irrigation, 32 farmers in Praia Branca, São Nicolau Island, benefited from this system. Each day, they required 100 m^3 of water and were receiving very high electricity bills. Following the implementation of this project, their electricity bills were reduced by more than half, from US$476 per month to US$204. The project was even replicated on another island. In terms of the impact, the water tariff for irrigation decreased from US$0.28 to US$0.22 per m^3, there was more water for agriculture, farmers' income increased, and CO_2 emissions from agriculture were reduced.



Workshop participants take the opportunity to network during a break (L to R: Mary Allen, Secou Sarr, Cheikh Oumar Wade, and Kadiatou Thierno Diallo).

Panel Session 2: What are the sectoral barriers, how can these sectoral barriers be overcome and how can the sector work in synergy and avoid conflicts of interest?

Agriculture-water-energy: Obstacles, synergetic solutions, and conflict management

Matar Sylla, National Programme for Domestic Biogas in Senegal

Matar Sylla began by giving a global overview of the situation for water, energy, and agriculture, which emphasised the stress that the planet is currently under. A large numbers of households still rely on wood, charcoal, and butane to meet their energy needs. In Senegal, 61% of households use wood as their primary energy source, followed by 29% and 10% that use charcoal and butane, respectively.

In terms of the relationship between energy and water, they are fundamental to basic, acceptable living conditions. Energy is used to pump, treat, and distribute potable water as well as for collecting and treating waste water. Lighting, conservation of food and other agricultural products, heating, cooking, small-scale processing, and irrigation are all important uses of energy for rural communities.

There are a number of obstacles for rural farmers that relate to water and energy. For example, a region may receive little rainfall; poor or no infrastructure may exist (such as irrigation systems); agricultural production may not be intensive; there may be little use of technology in agriculture, such as mechanisation, use of agricultural waste, etc.; farmer organisation may be poor; the climate may be variable, etc. Perhaps most crucially, a lack of access to water and energy threatens farmers' abilities to improve their incomes.

To address these many obstacles, Matar Sylla gave an example of a bio-digester, which allows all of these elements to be connected. For example, the waste from cows can be used for the production of gas for cooking and for electricity generation. Moreover, combined with a solar pump, it can allow for drip irrigation, which helps improve water conservation. Other productive uses can be powered not only by animal waste but also by using agricultural and other organic waste. He closed by emphasising the importance of multi-sector partnerships, which his organisation has worked hard to develop within Senegal and beyond.

Water, food, and energy nexus: Lessons from West Africa

Segun Adaju, Consistent Energy

Consistent Energy is a Nigerian company composed primarily of former bankers. They started operations in 2012 as BlueOcean Energy distributing pico-solar technologies, but refocused and restructured in 2015 to provide stand-alone, rooftop solar energy for productive uses. They focus on productive uses because it is important that people have energy to do business and pay back loans. The company operates a rent-to-own business model that is pay as you go (PAYG).

In Nigeria, most people use generators for their businesses, and 9 out of 10 businesses are small- to medium-scale. Farmers use generators for irrigation as well, however, this is not sustainable. Consistent Energy aims to promote affordable, reliable, and clean energy, and they are focusing on solar since it is used a lot in Nigeria. The government is promoting agriculture and is trying to diversify its economy beyond oil. Solar-powered irrigation could be very useful in this context.

Consistent Energy has been running three pilot projects. One is a drip irrigation project located near Nigeria's capital, Abuja. One of the conflicts in the water, food, and energy nexus is the quantity of water that you need for agriculture. But this can be best managed via drip irrigation, which

conserves water by targeting it on the crop. In setting up this system, they realised people also need drinking water and water for other uses. The question they faced was how much should be dedicated for domestic use? It was clear that without drip irrigation, they could not meet both agricultural and domestic needs.

Solar dryers are another important solution, which prevent post-harvest losses. They are currently aiming to expand this to several communities. Segun Adaju told the story of his mother, who has a small okra farm in the village. The farm is her main source of income and also provides vegetables for her domestic use, however, due to post-harvest issues, she was losing a part of her crop. The solar dryer decreased these losses and has had a positive impact on her food security.

In addition, a solar-powered grinding machine can improve farmers' incomes by processing their crops before sale. They no longer have to transport their crops to a processing location on poor roads. Consistent Energy has partnered with the government in Nigeria to do this as a pilot. The grinding machine can produce several kilograms per hour. In addition, there is a small house where women meet and keep their products, and one person manages the system for the community. Thanks to this equipment, the income and productivity of farmers, who are mainly women, improve: they witness a 29-32% increase in income.

Segun Adaju found finance and policy to be the primary barriers to energy access. In terms of finance, it is a major challenge. Women have difficulties adopting technologies if they cannot afford them. There is a conflict between the need to invest in technology and to buy food and water. Policy remains an area that needs more work, but he observed that the Nigerian government is moving very strongly into renewables.

Question and Answer Session

The audience had questions regarding Consistent Energy's business model. Segun Adaju responded that they work with groups, cooperatives, and associations; they do not work with individual clients. For example, barbers and hairstylists have an association. Within the association, beneficiaries of the electricity are nominated. They give a 10% down payment before installing the system, and balance payments are made on a weekly basis. A treasurer within the association does the collection on their behalf. The systems are fully paid-off in 18-24 months. In the agricultural space, these are new pilots, but the same business model is also reflected there. Consistent Energy is using its own capital, and like its clients, it is in business for profit, too.

The audience also wanted to know more about Matar Sylla's presentation on bio-digesters. He gave an example of an organisation where they installed bio-digesters in 2012. They were raising livestock in an extensive manner, but they are now developing a more intensive way of raising livestock. Agricultural residues allow them to feed the animals correctly, too.

He noted that they are currently documenting the data of their projects. They can reduce the use of water in the fields by up to 30%. They are sharing the results with the farmers, too. The goal is also to keep the water in the soil without using chemical fertilisers, which is better for the long-term.

Breakout session 2: How can the removal of sectoral barriers spur rural development in West Africa?

The participants were divided into two groups for a breakout session. The groups were asked to deliberate on three pre-set questions. These were:

1. What are the most important sectoral barriers identified in the previous panel session? Are there others?

2. Do you agree with the solutions given by the presenters? What other solutions could be adopted?

3. What has been your experience of taking an integrated approach to addressing the challenges of the water-energy-food nexus? What are the key lessons for future initiatives?

In response to the **first question**, workshop participants said that energy played a central role in development and cuts across all sectors. They identified the following sectoral barriers:

- Lack of access to affordable finance: This hinders sectoral development and negatively affects the ability of the poorest households to procure products that improve energy access. There is weak support from local banks who are not giving loans to farmers.

- Lack of supportive policies and weak institutional structures with little accountability or transparency: Commitment from national governments to address nexus issues is missing.

- Poor implementation of projects and policies, due in part to insufficient technical capacity: This problem is further exacerbated due to insufficient education which has a negative impact on the availability of skilled human capital.

- No coordination between projects and between sectors: donors often compete rather than collaborate (though this is improving). There is also a lack of collaboration between the actors working on the nexus at the national level, for example, the ministries of agriculture and energy generally do not work together.

- Limited resources and lack of appropriate follow-up of projects: This follow-up is necessary in order to learn lessons of what worked and what did not, and why.

- Insufficient consideration of what end-users want during design and implementation

- Low levels of villager awareness due to a lack of communication strategies

- Barriers arising from traditions and cultures, for example, in respect of cooking

With regard to the **second question,** participants broadly agreed with the solutions given by the presenters. They observed that it is better to work with organised groups, such as cooperatives, rather than with individuals as this reduces transaction costs. Public-private-partnerships should be encouraged, and NGOs should work in partnership with the private sector: this can be a good way of leveraging donor money. There should be a move away from charity towards a more market-based approach. Access to finance, including micro credit, is necessary to enable a market-based approach.

Social entrepreneurs have an important role to play, achieving a good balance between making a profit and doing social good. NGOs are often

good at working with local communities, but they are not so good at commercial activities, which is why they need the partnerships with business. NGOs should have an exit strategy, so they should include capacity building of the local community in initiatives to ensure they are ready to take on ownership. In Nigeria, many NGOs see themselves as protest/pressure groups. They need to move away from this to deliver positive action. NGOs are used to getting free money but often do not spend it wisely. They should be required to demonstrate sustainability to get funding.

A more market-based approach requires investment in capacity building. Rural populations need more education, but their needs should be researched first. Interventions should be based on a good understanding of what is already happening in the community and should be informed by local knowledge. A good starting point is to identify what technologies are already being used in the village and to consider how they can be improved. Participants also stressed the role of research and universities in working on nexus-related issues. Such work needs to ensure that connections are made between disciplines including through identifying common topics to work on.

Turning to the **third question,** participants said it is highly likely that development initiatives will have a greater impact if they are integrated across sectors rather than if they focus narrowly on energy access. For example, water resources can be used for drinking, washing, and irrigation: all uses need to be taken into consideration. In evaluating initiatives, a broader set of measures are required including, for example, increases in incomes.

"Transformation scenario planning", which involves stakeholders and takes a crosscutting approach, can be helpful. Scenarios and stories of likely futures are constructed, which inform how institutions need to be transformed. Relevant institutions, in particular ministries such as energy, agriculture, and water, need to be brought together to address nexus issues to create synergy. For example, in Senegal, these ministries currently work separately on energy, agriculture and water. A coordinating committee should be established to bring together all the players.

A key lesson for the future is that it is essential to engage with communities and end-users to consider how initiatives will impact on their lives and cultures. New technologies may otherwise be resisted if they require villagers to change their lifestyles. Impacts on other potentially affected communities should also be considered. Potential impacts on ecosystem services should be evaluated. Follow-up activities are also required to evaluate the outcomes of projects. Governments can contribute to this process by establishing monitoring at national and local levels. An overall plan is needed that takes account of the living conditions of rural populations and their needs.

Key messages for policymakers

Based on the useful discussions over two days, workshop participants also agreed in a final session on a number of key messages for policymakers at the national and international level. These are:

- Encourage public-private partnership (PPP) concerning the WEF nexus and work with the private sector so that there is a better understanding of nexus issues
- Increase political commitment to the WEF nexus: This includes enabling investments, as off-grid projects are high risk due to low return on investment.
- Increase governments' and development partners' engagement with international financial institutions and establish a blueprint as to how these funds can be accessed
- Facilitate cross-sectoral engagement: Different sectors and bodies should come together to achieve uniform decision making and develop an integrated approach to development. Development projects' design should include the WEF nexus.
- Increase awareness and understanding of the WEF nexus by involving the media: This can help create increased pressure on the government to include the WEF nexus in their national public policies.
- At the design stage of development projects ensure that the project addresses the requirements of the local community: Projects need to addresses issues outside of water, energy, and food security and look at the broader impact of these projects on employment and income generation. Also, consider the WEF nexus beyond the project community, i.e. what effects does the project have on neighbouring communities.
- Highlight the importance of the WEF nexus: Without energy and water there is no food security
- Invest in facilitating local innovation
- Involve women in the debate as they are the ones that are most likely to be affected by nexus related issues: Women's inputs are extremely important for interventions aimed at developing improved cooking and adoption of new domestic appliances.

Ousmane Dambadji shares his comments with the WEF nexus workshop.

Annex 1: Agenda

Smart Villages workshop on water, energy, and food nexus: Lessons from West Africa

August 24 -25, 2016, Saly, Senegal

0900 **Registration**

0930 **Welcome Address**

Mr. Louis Seck, Energy4Impact

0945 **Introduction to the Smart Villages Initiative**

Dr. John Holmes, Co-Leader, Smart Villages Initiative (SVI)

1015 **Keynote 1: What are the global challenges arising from the interrelation between food, water, and energy and how do they impact at a local level in West Africa?**

Mr Sekou Saar, Executive Coordinator, ENDA ENERGY

1045 **Tea Break**

1115 **Keynote 2: Experiences of the WEF nexus at village level: how can farmers cultivate co-benefits?**

Mary Allen, West Africa Coordinator, Practical Action

1145 **Q&A**

1215 **Lunch break**

1330 **Panel Session 1: What are the synergies and trade-offs between water, food, and energy, and how can these be balanced in a rural context?**

Water, energy, and food nexus, Gabrielle Schwarz, Bonergie

Mobilising Eco-villages for inclusive sustainable rural development, Ibrahim Sall, ANEV

Water, energy, and food nexus: A case study in Ghana, Benedicta Fosu-Mensah, University of Ghana

1415 **Question and answer session**

1440 **Tea break**

1515 **Breakout Session 1: How the challenges surrounding the water-energy-food nexus impact on women and what the global community can do to overcome the challenges**

Day 2

0915 **Keynote 3: What is the role of multilaterals and governments to facilitate WEF?**

Ms. Nathalie Rami, Director of Programme, Energy4Impact

0945 **Question and Answer Session**

1000 **Elevator pitches**

In Senegal, wind turbines link wind and water, Bineta Kamara, EOLSENEGAL

Appropriate energy solutions for agri-food processing SMEs, Neil Bianchi, Fullwell Mill

Project experiences in Cabo Verde on the energy, water, and food nexus (UNIDO and ECREEE), Heleno Sanches, ECREEE

1030 **Tea break**

1100 **Panel Session 2: What are the sectoral barriers, how can these sectoral barriers be overcome and how can the sector work in synergy and avoid conflicts of interest?**

Agriculture-water-energy: Obstacles, synergetic solutions, and conflict management, Matar Sylla, National Programme for Domestic Biogas in Senegal

Water, food, and energy nexus: Lessons from West Africa, Segun Adaju, Consistent Energy

1145 **Question and answer session**

1215 **Lunch break**

1330 **Breakout session 2: How can the removal of sectoral barriers spur rural development in West Africa?**

1500 **Tea break**

1530 **Key messages for policymakers**

Annex-2: List of Participants

Abayomi Adebisi	Federal Ministry of Power, Nigeria
Abdoul Karim Dosso	Energy4Impact, Senegal
Abdoulaye Outtara	Agence des Energies Renouvelables du Mali, Mali
Adama Ndione	Journalist
Alimatu Kroma	Ministry of Energy, Sierra Leone
Armelle Bonkoungou	Journalist
Augustus Goanue	Rural and Renewable Energy Agency, Liberia
Baba Diallo	Agency for Rural Electrification, Senegal
Benedicta Fosu-Mensah	Institute for Environment and Sanitation Studies, University of Ghana, Ghana
Charles Okine	Journalist
Cheikh Oumar Ba	Initiative Prospective Agricole et Rurale, Senegal
Cheikh Wade	INGENIEUR-CONSEIL POUR LE DEVELOPPEMENT DURABLE SARL (I2D), Senegal
Didier Hubert Madafime	Journalist
Djicknoum Diof	Université Gaston Berger de Saint Louis, SENEGAL
Emmanuel Kobla Dogbevi	Journalist
Gabrilele Schwartz	Boenergie, Senegal
Gevanis Doh	Journalist
Grégoire Bazié	Journalist
Heleno Sanches	ECREEE, Cape Verde
Henry Karmo	Journalist
Hope Moses	Journalist
Ibrahima Niane	Ministry of Energy, Senegal
Ibrahima Sall	Senegal
Issouf Kamagaté	Journalist
John Holmes	University of Oxford and Smart Villages Initiative, UK
Josiane Kouagheu	Journalist
Kadiatou Thierno Diallo	Journalist
Kamara Bineta	EOLSENEGAL, Senegal

Kanteh Bakary	National Water and Energy Company Ltd., Gambia
Kouadio Kouame Felix	Directorate General of Energy, Ministry of Petroleum and Energy, Cote D'Ivoire
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Maguette Thiandoume	Boenergie, Senegal
Mahamadou Mamodou Mory	Niger
Mamadou Barry	Action Solidaire International, Senegal
Mamadou Saidou Diallo	Agence Guinéenne de l'Electrification Rurale - AGER, Guinea
Mary Allen	Practical Action, Senegal
Matar Sylla	PNB, Senegal
Mathias Mouende	Journalist
Molly Hurley Dépret	Smart Villages Initiative, France
N'Faly Yombouno	Ministry of Energy, Guinea
Nathalie Rami	Energy4Impact, Kenya
Neil Bianchi	Fullwell Mill Limited, Burkina Faso
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Ousmane Dambadji	Journalist
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Secou Sarr	ENDA ENERGY, Senegal
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Stephanie Hirmer	University of Cambridge and Smart Villages Initiative, UK
Tina Abdou Saleye	Journalist
Todeman Assan	Renewable Energy Department, Benin
Victoria Saffa	Journalist
Vincenzo Capona	Oolu Solar, Senegal
Youba Konaté	Journalist

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SMART VILLAGES
New thinking for off-grid communities worldwide

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ENERGY4IMPACT
ACCELERATING ACCESS TO ENERGY

Energy4Impact (formerly known as GVEP) was launched in 2002 as a World Bank initiative and in 2006 it was registered as an NGO. The organization has offices in East Africa and in Senegal. The organization provides support to businesses that aim to accelerate access to energy in developing countries. Energy4Impacts' basic philosophy rests on the premise that as opposed to direct donations, business development is likely to be more sustainable. Since its inception, Energy4Impact has supported more than 260 small and medium enterprises and 2,800 micro enterprises. It has also raised capital of US$86 million and helped create 7,800 jobs in rural areas. Over 10 million people have been provided with improved access to energy through these projects.

In Senegal, Energy4Impact, in partnership with the Social & Ecological Management (SEM) fund, is leading on the implementation of two initiatives funded by the ENERGIA Network. The first initiative, "Energy opportunities for women in Senegal", aims to support the development and growth of 250 women SMEs across the value chain, and to increase productive use of energy by women across the value chain. The second initiative, "Tenderizing Energy Policies in Senegal" aims to a) advocate for the integration of clear gender objectives within the SE4ALL national action plan and investment prospectus and to increase awareness of the importance of gender and energy amongst key regional SE4All stakeholders and b) to implement a national campaign on energy, women, children & health, and other key events. Thus, Energy4Impact is implementing a programme to support development and growth of energy focused businesses in 4 countries in Africa, including Senegal: The objective is to strengthen the capacity of micro, small and medium enterprises (MSMEs) to provide access to energy to rural communities as well as to support them in productive uses of energy.