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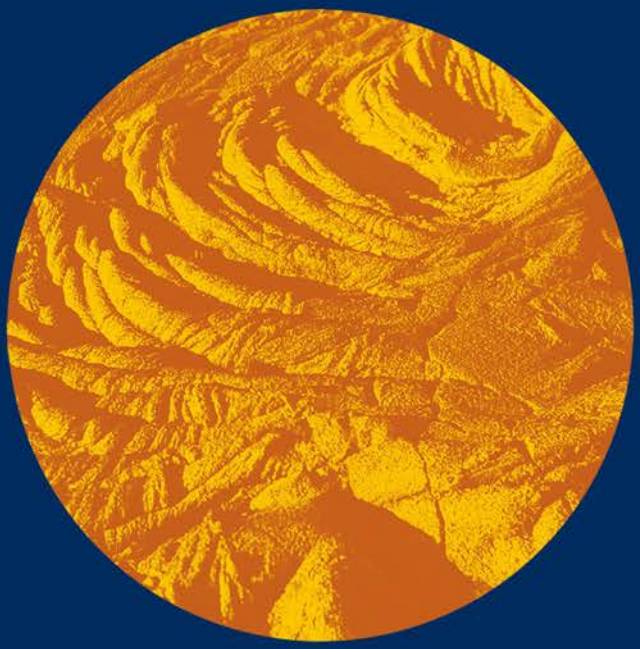
renforus
Renewable Energy Futures for UNESCO Sites



GOOD PRACTICES

success stories on sustainable and renewable energies in UNESCO Sites

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2013

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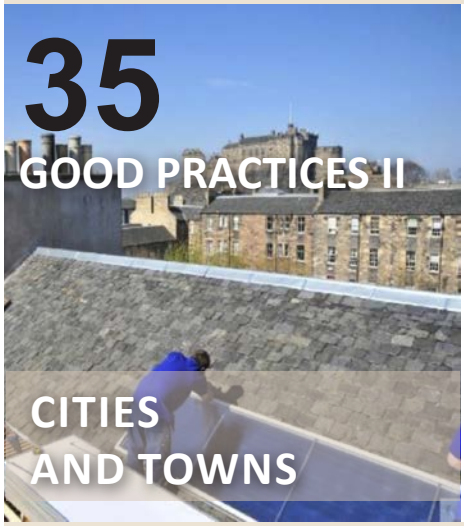
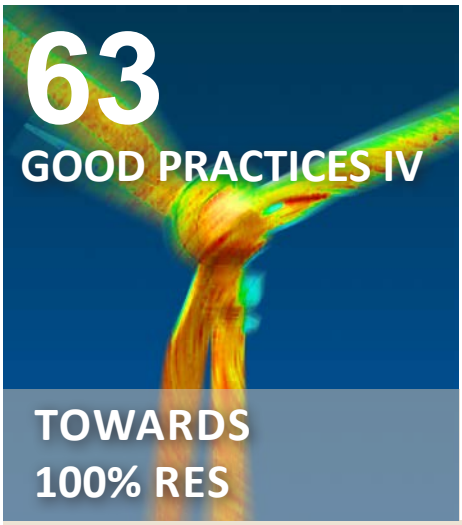
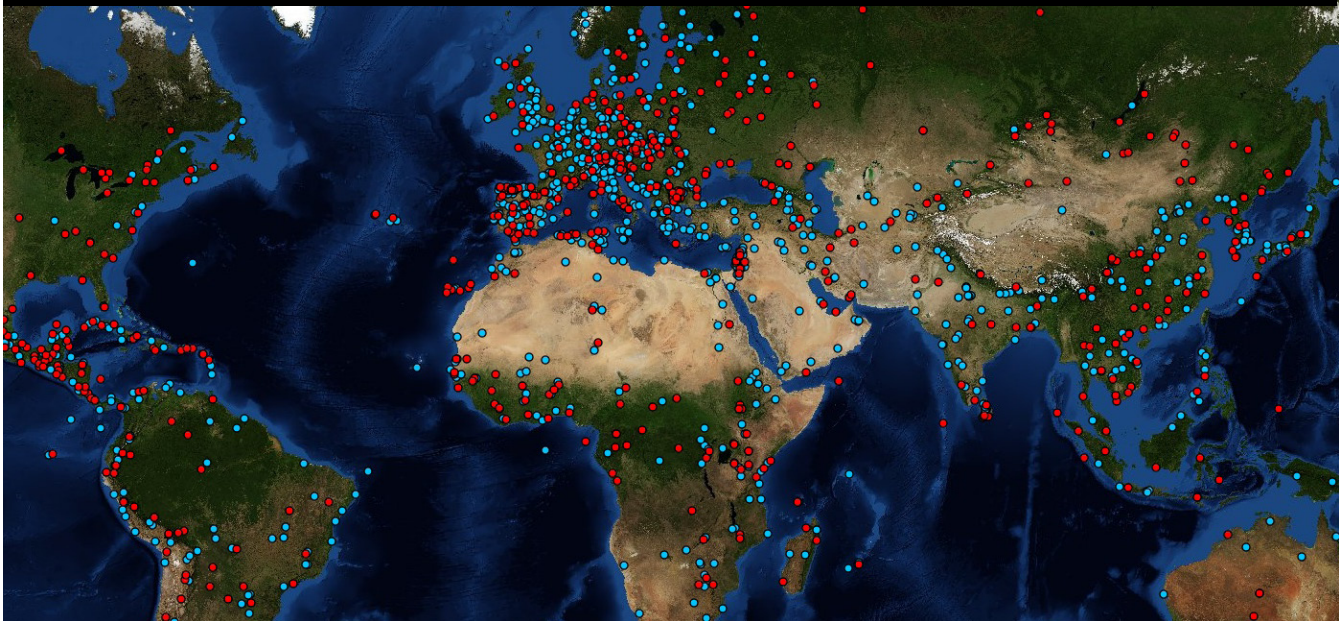




UNESCO SITES - BiosphereSMART viewer



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© José María Pérez de Ayala. Doñana biosphere rereseve.

RENFORUS INITIATIVE

As part of the UNESCO overarching Climate Change Initiative that aims at enhancing and applying the climate change knowledge base for building green societies, the RENFORUS Initiative promotes the use of UNESCO Biosphere Reserves and World Heritage Sites as field observatories on the sustainable use of renewable energy sources.


© Acciona Solar

RENFORUS

Renewable Energy Futures for UNESCO Sites

By drawing on decade-long experiences in World Heritage Sites to promote preservation of environmental and cultural assets, and in Biosphere Reserves to combine nature conservation objectives with sustainable development goals based on local community and private sector participation, the UNESCO Sites constitute a unique asset for exploring the role of renewable energy in reaching and promoting their important objectives.

The large number of UNESCO Sites around the world, in critical ecosystems ranging from small islands to mega cities, makes it possible to build and share a comprehensive knowledge base on good practices and policies on the use of environmentally sound energy technologies and their adaptation to specific contexts and needs. RENFORUS plays therefore a catalytic role in an essential international process to promote comprehensive, holistic approaches to energy, climate change and global sustainability.

Energy is at the heart of human, social, economic, and sustainable development issues. Decisions taken on the use of energy sources and on the technologies to use have a major influence on opportunities for development, as well as on the wellbeing of human beings and ecosystems. Energy and environment issues cannot be dissociated with development concerns and they are linked to other physical resources like forest and agriculture, water, land, air, in fact the entire biosphere.

Energy is also at the core of the climate mitigation agenda. As energy demand continues to grow, the ability to address energy issues, including energy access, efficiency, and renewable energy sources, will be paramount in enabling development and climate change priorities to be met in a mutually reinforcing way. In the phase following the 18th Climate Change Conference - COP18, and as identified by the UN Conference on Sustainable Development - RIO+20, there is a need to address energy as the main and critical driver of sustainable development and the new global Climate Change deal.

In this context, renewable energy has become a cornerstone of the UN strategy. The aim is to anticipate the solutions to avoid events that mortgage our common future over time. Access to basic, clean and affordable energy services is essential for sustainable development and poverty eradication and can provide major benefits in the areas of health, non-delocalized job creation, socio economic empowerment and equity.

Addressing the challenge of a new sustainable energy system involves an increased use of renewable energy sources. Renewable sources of energy offer win-win solutions by increasing the access to energy while reduc-

© Christina Quanz. Aldabra team assembling solar modules. Aldabra Atoll, World Heritage Site.

© Tonle Sap biosphere reserve

ing environmental impacts and mitigating climate change. This requires local competencies as well as endogenous scientific capacity as a foundation for an enhanced knowledge of the different related technologies and their adaptation to different contexts and needs.

Sites of excellence to foster the integration of renewable energies

Biosphere Reserves and World Heritage Sites are globally considered as sites of excellence where new and optimal practices for managing nature, heritage and human activities.

Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme to promote sustainable development based on local community efforts and sound science. By definition, they are ideal for testing and demonstrating innovative approaches to sustainable development from local to international scale. The World Network of Biosphere Reserves consists of a dynamic and interactive network made up of 610 biosphere reserves in 117 countries, including 12 transboundary sites.

The 24th session of the International Coordinating Council of the Man and the Biosphere (MAB) Programme stated that the different networking initiatives are important for promoting biosphere reserves (BRs) as sites for energy-efficient and renewable energy-driven development alternatives, thereby contributing to climate change mitigation efforts and to sustainable development in general.

The World Heritage List includes 962 properties forming part of the cultural and natural heritage that the World Heritage Committee considers as having outstanding universal value.

At its 29th session, the World Heritage Committee highlighted the importance of climate change and its impact on World Heritage Sites (WHS), on their outstanding universal value, integrity and authenticity.

The preservation of UNESCO Sites remains among the highest development priorities of the Governments concerned. Having been declared UNESCO Sites, they are both places that seek to reconcile the conservation of biological and cultural diversity and economic and social development. Although the socio-economic development within UNESCO Sites is highly vulnerable due to human activities, their careful management remains one of the goals of all countries concerned. This calls for urgent and necessary measures to achieve self-sustained socio economic development, involving the sustainable management of natural and locally available resources.

Among other factors, the energy system plays

© Nicholas Heath. Changeworks.
Edimburgh Renewable Heritage.World Heritage Site.

a key role in providing the resident communities and the whole existing infrastructure with basic energy services in UNESCO Sites. Thus, the wide use and application of local renewable energy sources will help to reduce the damage caused to the ecosystem by energy production, while contributing to the sustainable development of local communities through access to energy services.

RENFORUS in action

The RENFORUS Initiative strives to demonstrate the value added of UNESCO Sites as privileged windows for developing sustainable energy projects based on the maximum use of renewable energy sources. This initiative aims to promote energy efficiency and the use of renewable energy in a selected number of UNESCO Sites that could serve as global climate change field observatories as well as models of Sustainable Energy Communities.

While addressing climate change mitigation, this initiative aims to demonstrate the benefit of harnessing the locally available renewable energy sources that could replace other energy sources with negative impact on the socio-ecological system of UNESCO Sites. At the level of local communities and households, renewable energy can ensure access to basic energy services even in the most remote areas, including lighting and communications, transport, cooking, heating and cooling and pumping water. Thus, besides contributing to climate change mitigation, it will also help address local sustainable development.

The Initiative will include the following main actions:

- Mobilize UNESCO sites for practical learning on renewable energy solutions and commitment to the efficient use of energy;
- Offer a platform for interaction between multiiple stakeholder working in the renewable energy field, identifying barriers and working to bridge existing gaps to increase the maximum deployment of renewable energy;
- Disseminate opportunities, benefits, and practical applications of renewable energy technologies in UNESCO sites: photovoltaic, solar thermal, geothermal, biomass, windpower and small hydropower;
- Develop a system of consultations with authorities and managers of each site to identify opportunities, barriers and challenges related to renewable energy uses/ policies;
- Identify good practice as projects that demonstrate a positive contribution to energy efficiency and the use of renewable and are suitable for replication by energy actors at local and regional level;
- Promote capacity building and awareness-raising on the use and application of renewable energy systems targeting local communities, including an advanced web platform focusing on renewable resource potential in UNESCO Sites.

© Doñana National Park.
Biosphere Reserve and World Heritage Site

© Acciona Microenergy. Solar powered school. Community project in Cajamarca, Peru.

- Promote the use of renewable energy systems for the electrification of public and local community facilities in the selected sites;

Looking ahead What outcomes can we expect?

RENFORUS is designed as an initiative that will consolidate a lasting commitment to renewable energies. UNESCO sites face the combined challenge and opportunity of transforming existing energy services, and they have the opportunity to adopt energy efficiency practices and renewable energy solutions from local decisions. These three objectives reinforce each other in many instances, and achieving the three together will power opportunity, maximize development benefits and help stabilize climate change.

The following represents the main expected outcome:

- Demonstrate a positive contribution to energy efficiency and the use of renewable energy in UNESCO Sites.
- Facilitate knowledge exchange, policy development and joint action for a rapid transition to renewable energy.
- Reduction of environmental and ecological degradation produced by the use of conventional energy sources in UNESCO sites through the use of renewable energy sources.
- Promotion of the use of environmentally sound renewable energy sources in UNESCO Sites to serve as observatories for climate change mitigation and models to be replicated.
- Empowerment of local communities through renewable energy development and capacity building.
- Identification of suitable good practices for the use of renewable energy solutions in UNESCO Sites.
- Promotion of co-operation among UNESCO Sites at international level, particularly in the areas of education and training, information and exchange of knowledge and best-practices.
- Effective use of the World Network of Biosphere Reserves as demonstration sites for the potential of renewable energies, exploiting their capacity for network co-operation.
- Broadest possible dissemination of renewable energy applications in UNESCO Sites by taking advantage of their implementation in the selected sites.
- Establishment of priorities in renewable energy matters for UNESCO Sites.
- Consolidation of a partnership for renewable energy futures in UNESCO Sites.
- Involvement of local and regional authorities voluntarily committing to increasing

energy efficiency and the use of renewable energy sources on their UNESCO Sites.

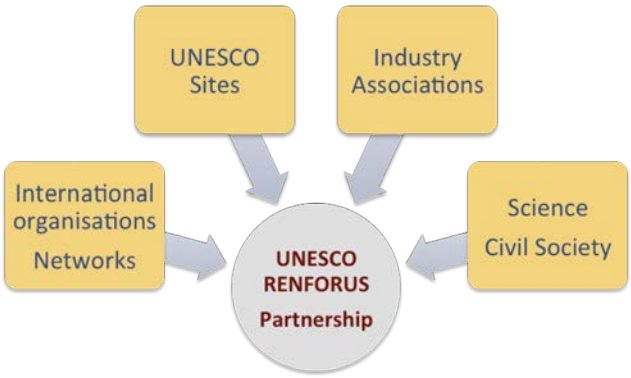
- Improvement of energy efficiency at all levels with a view to doubling the rate of improvement by 2030 and by at least doubling the share of renewable energy in the mix by 2030 in UNESCO Sites by promoting the development and use of renewable energy sources and technologies.

Why join?

RENFORUS promotes partnerships with leading public and private stakeholders, including international organizations, networks, RE industry, NGOs and governments interested in supporting the Initiative.

By joining RENFORUS, partners will have access to a tool for promoting networking and exchange of knowledge, information and best practices related to renewable energy and energy efficiency. A selected number of these practices will benefit from enhanced visibility through RENFORUS and will be promoted as models for replication nationally and internationally.

RENFORUS is a platform to consolidate partnership among its partners as well as with leading public and private stakeholders for renewable energy projects in UNESCO Sites.



© Schorfheide-Chorin biosphere reserve, Germany. Solar research vessel.
Unique and exceptional environmental education program in the UNESCO Biosphere Reserve.

LEADING THE WAY FOR RENEWABLES

Success stories on sustainable and renewable energies in UNESCO Sites

A RENFORUS good practice is not only a sustainable energy practice that is good, but also a practice that has been proven to work well and produce good results, and is therefore recommended as a model. It is a successful experience, which has been tested and validated, in the broad sense and deserves to be shared so that other UNESCO Sites can adopt it.

The RENFORUS Good Practices are relevant examples of initiatives which the communities living in UNESCO Sites have carried out in their territories, feel particularly proud of, and endorse as useful actions for other sites to replicate. As a whole, they represent the commitment of UNESCO Sites to improve energy efficiency, reduce emissions and using renewable energy sources in a local level.

RENFORUS Good-Practice are projects or initiatives that:

- Demonstrate a positive contribution to use of the renewable energy and energy efficiency in UNESCO Sites.
- Represent a model of excellence to foster integration of renewable energies.
- Aim to meet the needs of local population living in the UNESCO Sites, as well as their right of access to clean and safe energy.
- Encourage green economies, capacity building, and empowerment of local communities.
- Make use of resources without jeopardising the ecosystem functions and the heritage values of UNESCO sites.
- Provide examples of how to overcome barriers to RE technology deployment.

© Chirripó National Park. La Amistad biosphere reserve

- Are suitable for replication by energy stakeholders and decision makers at the local level in other UNESCO Sites.
- Are experiences which have been tested, accepted, and adopted by those who implemented them.
- Are initiatives that contribute to paving the way toward Sustainable Energy Communities.

The RENFORUS Good Practices report are the result of extensive outreach and analysis conducted to identify the best practices in renewable energy and energy efficiency in the UNESCO Sites.

CRITERIA FOR GOOD PRACTICE SELECTION

Representativeness

Sustainable energy governance

Universal clean energy access

Diversity of scope and outcomes

Effectiveness and successfulness

Environmental sustainability

Economic feasibility and technical practicability

Participatory approach

Replicability and adaptability

Relevance for local energy sustainability

© Feynan Ecolodge Photo Escape. Dana biosphere reserve, Jordan.

Good Practices I

EMPOWERING COMMUNITIES

Access to safe, clean energy is fundamental to local fuel poverty eradication, to reduce energy dependency, and to stopping climate change. A core objective is to enable communities to lead local renewable energy projects to provide cost-effective sustainable energy services to all citizens.


© Gorona del Viento. El Hierro biosphere reserve.

LIGHTINGH SUNDARBAN

Building an energy-secure and environment-friendly future

The Sundarban Biosphere Reserve (SBR) is located in the vast Delta of the Ganges, south of Calcutta and bordering Bangladesh in the east. Sunderban is the largest contiguous mangrove area (along with Bangladesh) in the world.

In India today, many thousands of villages are without access to safe and clean energy. These villages are often too remote for grid electricity to be considered a technically or economically feasible option. For these villages to be electrified, the only solution is a standalone (distributed generation) power system. This is the case of the Sundarbans Delta, where the lack of access to modern energy services limits development and human well-being opportunities. Poor access to energy services and the consequent lack of opportunities is further compounded by very high population density and poverty in the Sundarbans. An extremely high proportion of the population (about 34 percent) subsists below the poverty line. This is accompanied by a high dependence on the natural system for biomass and other terrestrial and aquatic resources leading to further degradation of the natural ecosystem.

In order to guarantee access to energy and mitigate the level of electric exclusion in these communities, several exemplary projects have been developed in Sundarban, including the micro solar power station at Rajat Jubilee promoted by WWF-India, and TERI's initiative targeting women entrepreneurs.

LIGHTING SUNDARBANS' HOMES

WWF-India and CAT Projects Australia set up a micro solar power station at Rajat Jubilee on Satjelia Island in the SBR using the Bushlight India Model. The 'Model' is a comprehensive process for planning and establishing technically and financially sustainable, off-grid centralised renewable energy-based village energy systems. It is based on the highly successful 'Bushlight' project which, since 2002, has been providing remote indigenous communities in Australia with access to reliable renewable energy services. It is a scalable solution that can provide access to safe and clean energy in the form of grid quality electricity in remote areas. The micro solar power station at Rajat Jubilee connects 50 households, six local businesses and three community buildings and supplies uninterrupted grid quality power.

The 'Bushlight' model involves a comprehensive community engagement and energy planning framework. At Rajat Jubilee, local residents underwent energy efficiency education and training which enabled them to draw up energy budgets for 24 hour cycles. The energy budgets then led to system design allowing provisioning of a predetermined, assured amount of daily energy to all consumers and providing the community with the information and tools to use this energy to complement and build their livelihoods as they need and choose on a day to day basis. This is made possible through the installation of unique demand side management hardware (programmable energy meter) called Urja Bandhu. It is hoped that the energy planning framework and programmable energy meter will prove to be of relevance to the remote village electrification work going on in the country and contribute simultaneously to human wellbeing and environment protection.

PEOPLE'S POWER

The power station is owned and managed by a consumer cooperative society that was registered in late 2010 as part of the collaborative process. Energy service delivery is based on prepaid model akin to

© WWF-India. WWF-India & CAT Projects Australia's micro solar power station at Rajat Jubilee in Sundarbans.

telecom services. The revenue so collected should cover the operating expenses and the cost of Annual Maintenance Contract (AMC) from year six until year 15 which is the design life of the power station. Cost of AMC for the first five years and cost of battery replacement has been capitalised in the project cost. The consumer cooperative has set the tariff based on energy slabs opted for by the consumers and has taken into account life cycle cost of the power station.

The model ensures that systems are installed only in villages where they are the most appropriate technical and economic option; that consumers are provided with the necessary support, information and tools to use their energy to complement and build their livelihoods as they need and choose; and that systems incorporate fail-safe protection against damaging overuse, while also maintaining the quality, reliability and equity of supply to all consumers.

The system cost is little more than the standard centralised solar Photo Voltaic systems being installed in India today. However, the quality of the energy services delivered to consumers exceeds all existing models of service delivery using decentralised generation. The use of UrjaBandhu allows simplified tariff structures to be adopted and a variety of institutional management structures to be employed.

WOMEN OF THE SUN

TERI (The Energy and Resources Institute), in collaboration with the Ramakrishna Mission (RKM), is empowering the women of the Sunderbans to promote the use of solar power. This pilot project has successfully created viable enterprises, on the supply side, targeting women entrepreneurs. These enterprises have been created not only to provide solar PV-based services in remote and interior villages, but also to provide repair and maintenance services to already existing products and systems. An organizational set up, called MFEDO (Market Facilitating and Enterprise Development Organization), has been created within the cluster organization Kalpataru of the RKM, to oversee the development of these enterprises. MFEDO provides comprehensive support by way of procuring raw material, facilitating market linkages and forming Self-Help-Groups. This initiative has been sponsored by the National Renewable Energy laboratory, USA.

The specific beneficiaries of this pilot project were determined on the basis of a study which revealed that women take pride in using the systems and demonstrate an eagerness to learn about new designs and products. Men, on the other hand, once trained to service the solar systems, migrate to the cities in search for better opportunities. As a result, the project succeeds on two fronts – empowering women and fostering sustainable development.

LESSONS LEARNED AND REPLICABILITY

Access to safe, clean energy is fundamental to poverty eradication, to stopping deforestation, and to stopping climate change. Most poor people and inhabitants of remote locations meet the majority of their energy needs by collecting biomass (fuel wood, agricultural waste and dung). Many also have to use other expensive resources like kerosene.

Use of biomass and kerosene has bearing on biodiversity and deforestation (through the impacts of collecting firewood and human-wildlife conflict), and equally to climate change since black carbon (soot) and kerosene are significant contributors to global warming. Access to clean energy therefore, has clear connections between human wellbeing and environment protection.

At present about 20% of the area's population, approximately 216,000 people, are using solar PV electricity. That percentage that can be progressively increased starting from this kind of exemplary models and projects. In fact, the SBR is already a reference territory in India for the development of renewables, including other sources such as biogas projects, like the experience on Gosaba Island.

BIOSPHERE RESERVE
SUNDARBAN - INDIA

Source:
WWF-India
TERI (The Energy and Resources Institute)

LUZ EN CASA

Providing energy access to remote rural communities

In Latin America around 34.5 million people are excluded from the electricity service. The majority of them are living in poor, rural and isolated communities, such as the indigenous populations. They are not only excluded from access to the electric service, but also from future plans of grid extension, because of their low energy needs, the dispersion and difficult access of their dwellings, etc.

Within this framework, the *Luz en Casa* (Light at Home) Programme was started in Peru to demonstrate that rural electrification through renewable energy is technically feasible, economically sustainable, and affordable to users. Nowadays, another programme called Luz en Casa Oaxaca is being started in Mexico, driven by an innovative development partnership which actively involves authorities and the private initiative.

The Huatulco Biosphere Reserve and some World Heritage properties, such as the Historic Centre of Oaxaca and Archaeological Site of Monte Alban, and the Prehistoric Caves of Yagul and Mitla in the Central Valley of Oaxaca, are in the Mexican scope of action of this programme

LUZ EN CASA - CAJAMARCA, PERU.

Luz en Casa operates in isolated and scattered communities of the Northern Mountains of Cajamarca, on the Andes. This programme demonstrates the success of rural electrification by means of photovoltaic technology. It uses a delivery model based on the installation and operation of Solar Home Systems (SHS), with a project management that involves the beneficiaries and the collection of a service- fee. This model has been implemented since 2009 by the non-profit small company ACCIONA Microenergia Peru (AMP).

AMP is a regulated electricity provider that supplies basic electricity services to low-income people, within a regulatory framework that allows affordability for those users. In Peru there is a solidarity fund that finances access to electricity for people of little or no income. Therefore this fund allows Luz en Casa 's beneficiaries to pay only a monthly fee of S/.10 (around 3.5 US$) for operation and maintenance services, as well as AMP to access to the revenues, around S/.30 (or 10.5 US$) by each user, making it economically sustainable, being their current operational cost of 3,000 SHS.

Providing electricity to these communities prevents health hazards that arise from the use of candles and kerosene, such as lung and eye disorders, and safety risks like fires- It also favours the extension of the working day for educational or productive purposes. Those SHS give four hours of efficient lighting and access to electronic devices, such as TV or radio. Their purchase and installation had been financed through ACCIONA Corporation's donations (1,300 systems in 2010 and 2012), and a BID-FOMIN's long-term credit (1,700 systems in 2013).

However, beneficiary engagement is the cornerstone of the development of the Luz en Casa Programme. It is the user who makes the decision to participate in the programme, paying for the offered service and being trained to use and maintain the SHS appropriately. Beneficiaries also participate as members in the Photovoltaic Electrification Committees, the community body in charge of communicating with AMP, collecting fees, and maintaining preventively the SHS.

Furthermore, beneficiaries' engagement has made possible the start of new related projects, such as electrification of community centres (schools, churches…), at the communities' request in the localities

© Acciona Microenergía

where the programme operates, or training beneficiary people to become local technicians in installation and maintenance of PV systems. In short, capacity building has been developed in the communities involved.

LUZ EN CASA - OAXACA (MÉXICO)

The *Luz en Casa* Oaxaca Programme started in 2012 in order to give access to electricity basic services to 9,500 households of Oaxaca. Oaxaca is one of the Mexican States with a severe lack of access to basic services, having more than 800 communities with less than 100 inhabitants without access to electricity and without plans to be electrified.

The delivery model of Luz en Casa Oaxaca is different from the first Luz en Casa programme. In this case the programme is driven by a Development Public-Private Partnership (DPPP), an innovative collaboration involving the Government of the State of Oaxaca, the Spanish Agency for International Development Cooperation (AECID) and ACCIONA Microenergia Mexico (AMM), which also implements the programme on-site.

Furthermore, the PV systems supplied by AMM are Small Solar Home Systems (SSHS), more technologically advanced and more environmentally friendly than SHS, and with similar performances. SSHS are bought by the beneficiaries at an affordable cost thanks to a 50% DPPP subsidy and 40% through micro-credits from financing institutions. This electricity service is expected to benefit 25,000 people in Oaxaca by 2016.

LESSONS LEARNED AND REPLICABILITY

Luz en Casa has reached 3,000 poor households in isolated and scattered communities in mountain areas, giving them access to lighting through clean energy. The programme has therefore achieved its original objective to demonstrate the feasibility, sustainability, and affordability of rural electrification with the use of photovoltaic energy.

Replicability of this project has already been shown. The development of Luz en Casa has been divided into different phases, which replicate and extend the previous ones, within the Cajamarca region: 10 systems were put into operation in 2009, 600 in 2010, 700 in 2012, and 1,700 in 2013.

Luz en Casa Oaxaca, on the other hand, is starting the development of a new delivery model which involves a new technological model, a new economic model, and a new management model. This programme is expected to show as well the feasibility of rural electrification with renewable energy.

In conclusion, involvement of all stakeholders is essential for the success of this kind of initiatives. The support of authorities and private companies, as well as the engagement of the involved communities, is fundamental to achieve the objectives.

SUSTAINABLE ENERGY FOR ALL

BIOSPHERE RESERVES & WHS - MULTIPLE LOCATIONS
OAXACA WHS - HUATULCO BR

Sources:
ACCIONA Microenergía Perú (AMP)
ACCIONA Microenergía Mexico (AMM)

IBEKA EXPERIENCE IN GUNUNG LEUSER

Developing community-managed hydro schemes

The Gunung Leuser biosphere reserve and national park covers a vast area of 1,094,692 ha of tropical rain forest in northern Sumatra. More than four million people live within or adjacent to the Gunung Leuser BR, with many different ethnic groups represented. Most of them are farmers and depend very much on the protection of this park for their subsistence. Paddy fields, mixed gardens, and small-scale and medium estates of rubber and oil-palm receive a consistent water supply from this park. But this water flow also represents a way for many communities to resolve their energy-poverty status.

Despite a rapidly growing economy and thriving cities, over one third of the population of Indonesia lacks an electricity grid. Many people live in scattered communities on remote islands. Even on the densely-populated main island of Java, there are mountainous areas where the grid has not reached. This is the case of Putri Betung Subdistrict, within the biosphere reserve, where IBEKA has developed several projects.

IBEKA (Institut Bisnisdan Ekonomi Kerakyatan) works in partnership with communities to develop off-grid hydro schemes that stay in use. Through long-term involvement IBEKA makes sure that the community has the skills to manage and maintain the scheme, and community ownership which brings a continuing source of income.

MICRO-HYDRO POWER AT GUNUNG LEUSER

The thirteen villages in Puteri Betung did not have electricity. Some people and village institutions used generators to fulfil their daily needs of electricity. The idea to develop micro-hidro projects to cover energy needs in this area started with a reset conducted by BRR (Agency for the Rehabilitation and Reconstruction of Aceh and Nias) with IBEKA, following the Indian Ocean tsunami.

One of the projects carried out, which is still showing tangible benefits is the construction of a micro-hydro power plant at Jamur Gele Village with a generating capacity of 43 KVA. Electricity is distributed to 350 homes at Jamur Gele Village and its surroundings. The community has created a Cooperative Economic Enterprise that would maintain the scheme, manage the subscriptions, operations and other village potentials.

The next step of this process was the construction of another plant at Aih Nuso with a capacity of 2 x 180 KVA. This scheme was handed-over in October 2008 and, along with Jamur Gele, will provide electricity for 7 villages in Northern Gumpang.

Another programme that is worth mentioning has been developed at Kreung Kala Village, in the Aceh province. The village was damaged by Tsunami and earthquake. Electricity was one of the critical needs to recover the village. Through international cooperation this problem was overcome by developing electrical power supply based on micro hydro. A 40 KVA plant was installed in the village by IBEKA and Nurani Dunia Foundations, financed by PT Coca Cola, achieving the electrification of 200 households. Besides giving the benefit in the form of electrification and local welfare improvement, the program also aimed to improve the local awareness in nurturing their forest.

© Taman Nasional Gunung Leuser

© IBEKA

COMMUNITY OWNERSHIP AND MANAGEMENT

IBEKA's core principles are that a hydro scheme must be developed with the community, in order to meet its specific needs, that the community should have long term responsibility for management, and that the community should have long-term benefits. For off-grid schemes, a community organisation manages and legally owns the scheme. This could be an existing organisation or a specially established community co-operative. The organisation is responsible for collecting fees, paying staff, and building up the maintenance and community funds. Each year the community reviews performance and prioritises the use of funds.

For grid-connected schemes, the community organisation is usually constituted as a social enterprise. This is responsible for making payments for bank loans or private investors, as well as the operation, maintenance and community fund.

The social benefits of bringing electricity to off-grid communities are substantial. Smoky kerosene lamps are no longer needed, and bright electric lights make study and housework easier, and homes more pleasant. Having lights outside houses makes families feel less isolated at night. Radio, television and mobile phones bring information, entertainment and connection to the wider world.

© IBEKA

LESSONS LEARNED AND REPLICABILITY

There is a continuing need for off-grid hydro in Indonesia, since over one third of the population is not connected to the grid. IBEKA continues to source grant funding and work with communities to provide off-grid systems.

Given the shortage of capacity on the Indonesian grid, there is also significant potential for grid-connected micro and mini hydro. IBEKA has seven such schemes totaling nearly 10 MW (four times its current installed capacity) under development, and is sourcing loan and investment finance for them. IBEKA itself is investing in grid connected schemes, to generate a reliable income stream for its work.

IBEKA has demonstrated that community management of hydro systems, and community benefit from them, can be achieved with a range of different financing mechanisms. The successful solutions acquire special importance if we take into account that, according to a survey by GTZ found over 1,000 micro-hydro plants that had been abandoned through lack of maintenance. This model is widely relevant in other countries.

BIOSPHERE RESERVE
GUNUNG LEUSER - INDONESIA

Source:
IBEKA - Institut Bisnisdan Ekonomi Kerakyatan
Taman Nasional Gunung Leuser

BRO DYFI COMMUNITY RENEWABLES

Green power and local ownership in action

Situated at the coast of Mid Wales around the estuary of the Afon Dyfi, this biosphere reserve is representative of salt marshes, estuarine systems, farmland, woodland and moorland in the west of the United Kingdom. Biosffer Dyfi Biosphere consists of the catchment of the river Dyfi plus the town of Aberystwyth.

Bro Dyfi Community Renewables Ltd (BDCR) is a community owned renewable energy company. It aims to promote wind and other renewable energy projects that benefit local people and that are subject to a significant degree of local control.

BDCR is an example of communities and environmentally conscious investors coming together to create and deliver local schemes that are a direct response to climate change, boost local regeneration and strengthen self-reliance.

WIND ENERGY FOR THE COMMUNITY

BDCR owns two wind turbines near Machynlleth: a 75kW Vestas and a 500kW Nordtank.

In April 2003 the UK's first wind turbine owned and developed by the community was switched on in the Dulas valley, a tributary of the Dyfi. Residents of Pantperthog village initially conceived the idea for a community-owned wind turbine in October 1999, which led to the installation of the 75kW second-hand Vestas wind turbine, located on the hill above the Centre for Alternative Technology (CAT).

BDCR's most recent project was to replace an existing non-operational wind turbine (MS4) on Mynydd Glandulas, above the Centre for Alternative Technology, using finance raised by a further share offer. Using European funding secured through Mid Wales Energy Agency and ecodyfi, and shareholders' investments, a second hand Nordtank NTK500/37 (500KW) wind turbine was acquired and installed on Mynydd Glandulas in 2008. It became operational in 2010.

© BDCR. Community-owned wind turbine in the Dulas Valley

THE BENEFITS OF A PROJECT DESIGNED AND DELIVERED AT THE LOCAL LEVEL

The wind turbine project has resulted in a number of direct economic benefits to the local community, many of which would not have occurred if the installation had been by a non-local developer:

- The work undertaken in developing the project was carried out by members of the local community;
- The partnership placed the construction contract

© BDCR. Shareholders help wash the turbine

with a local company (CAT) and other local suppliers;

- Some of the people involved in the project agreed for some or all of their work on planning and finance to be paid in shares in the project;
- The first project alone brought approximately £55,000 into the local economy (70% of the total project cost);
- The administration and operation and maintenance contracts have been placed locally;
- Local and national shareholders continue to draw share interest payments from the revenue of the electricity generated;
- 58% of the revenue from the project will be retained within the local economy, with nearly all the other shareholders being elsewhere in the UK;
- The wind turbine provides an additional demonstration turbine and educational resource for CAT;
- The project is a community-owned scheme where each shareholder has one voting share irrespective of the amount of investment, and
- 17% of the annual project profit goes into community regeneration and energy efficiency measures, through ecodyfi and a community energy fund, respectively.

LESSONS LEARNED AND REPLICABILITY

When running a community energy project it is essential that thinking is given to the ongoing running and administration of the organisation once it is up and running. Preferably a proportion of generation income should be channelled towards employing persons locally on a part time basis to run the affairs of the business. Some issues were resolved more slowly by the voluntary Committee members than would have been the case in a commercial organisation.

While many communities have the organisational and financial skills needed to manage such a project, not many have the technical skills needed to develop it, for example choice of turbine technology, civil engineering needs, the planning application and associated reports (predicted noise, landscape, archaeology etc. impacts). These services will usually have to be bought in, while the project is still at risk, so public funding of such feasibility work is desirable.

The project has received significant publicity and helped raise the profile of the community dimension of wind developments as seen, for example, in the Technical Advisory Note on renewable energy in Wales. In addition, academics and other communities have either visited the site or sought information to inform their own studies or plans.

BIOSPHERE RESERVE
BIOSFFER DYFI BIOSPHERE - UK
Sources:
Bro Dyfi Community Renewables
ecodyfi
Energy Saving Trust

FUERTEVENTURA RENEWABLE WATER

A model for islands and dry coastal areas

The entire island of Fuerteventura was declared a biosphere reserve in 2009. It is the most ancient of the Canary Islands, the most arid, and the closest to the African coast. It has a surface area of 1659 square kilometers, a population of 106,456 inhabitants, and attracts 1.6 million tourists each year.

Water and energy are the key factors for the survival of the island and the maintenance of tourism as the main driver of the economy. Dependence on fossil energy has so far been absolute, representing an inadmissible risk for the future of the island.

Since its declaration as a Biosphere Reserve, the island of Fuerteventura set water self-sufficiency combined with renewable energy sources as a target to be achieved by 2020. Three action lines converge towards the objective of energy and water self-sufficiency from renewable energy sources.

THE WIND ENERGY – WATER DESALINATION BINOMIAL

At present natural surface and underground water resources of the island are just enough to cover a mere 10% of demand, being the rest obtained from seawater or brackish water desalination.

Partnership between wind farms and desalination plants has been the solution to reduce water dependence. The most important demonstration project has been carried out at Corralejo, in the north of the island. The project consists of a 1.7 MW wind farm for self consumption associated with a sea water desalination plant with a capacity to produce 4000 m3 of water per day. In 2012, the wind farm was able to supply 87.42% of the energy consumption of the desalination plant which supplies the whole tourist area of the north of the island, as well as nearby towns.

The first phase of the Corralejo Renewable Water project has fully demonstrated its technological and economic feasibility. Data obtained from the operation of the plants at Corralejo indicate payback periods not exceeding seven years, despite the current financial situation.

The public water company was also the promoter of the 10.7 MW wind farm of Cañada del Rio in the south of the island, built in 1994 and that is now being increased to 24 MW. Being them the owners of 60% of the wind farm, water price support has been possible in the last years, favoring social water consumption by reducing costs in the main desalination plant of the island.

BIOFUELS, WATER RE-USE, AND FIGHT AGAINST DESERTIFICATION

The renewable water strategy links the water cycle with the production of biofuels. The University of La Laguna is in fact successfully developing a pilot project aiming at biofuels production in arid areas from

© Carlos González. 1.7 MW wind farm associated with a sea water desalination plant.

© Fuertventura BR. Local authorities and UNESCO representatives visiting the desalination plant.

Jatropha curcas seeds in the experimental farm of the Cabildo of Fuerteventura. The project is funded by the Disa Renovables company. A great advantage of this project is the use of non-conventional water resources, such as desalinated water surplus and treated wastewater, for irrigation.

Preliminary results available on oil and biodiesel quality from Fuerteventura crops are really promising. This initiative is also being developed in the framework of the biosphere reserve's actions related to the fight against desertification, taking advantage of this crop's ability to fix soil against erosion, on an island classified of high risk. This is also a project where knowledge is transferred from the University to the productive sector, and that promotes public-private partnership, both being important aspects of the National Innovation Strategy and of the Fuerteventura Biosphere Reserve Action Plan.

© Fuerteventura BR. Solar Ice project in Morro Jable.

SOLAR ICE FOR THE FISHERMEN

Energy consumption to maintain the fish cold for storage and distribution is a relevant part of fishermen communities' cost structure. Fisheries located in coastal or island areas they have to rely on electricity and fresh water for their ice production process. Lack of one or both is quite common.

The pilot project carried out at Morro Jable, in the south of Fuerteventura, uses a well known set of technologies (absorption chiller, solar thermal, photovoltaic, and wind energy) to green the fisheries business: improving performance while diminishing the environmental impacts. Furthermore, it improves water efficiency by innovating in the production of ice from sea water instead of fresh water, which is crucial in arid areas such as Fuerteventura.

LESSONS LEARNED AND REPLICABILITY

Desalinated water production from renewable energy sources is not just an option, but the most viable solution in dry coastal areas and islands, especially when solar or wind resources are widely available. The tourism sector should commit to plan its activities making use of renewable water.

Fuerteventura Renewable Water Project has a significant potential for replication in other thirsty island territories or isolated coastal areas, especially in presence of some tourist development. Through Africagua, a RENFORUS-associated forum, the Fuerteventura model attempts to replicate on other islands such as Principe, Cape Verde, or in the African coast of Mauritania.

BIOSPHERE RESERVE
FUERTEVENTURA - SPAIN

Sources:
Fuerteventura Biosphere Reserve
La Laguna University (ULL)

EQUIMETH PROJECT

Biogas and an innovative model of governance

Located in the Ile de France region, some 70 km south-east of Paris, the “Fontainebleau - Gâtinais” biosphere reserve, has an area of 150,000 ha. The forest has been studied by well known naturalists (Linné, Jussieu and Buffon) since the 17th century and painters were also attracted to the forest (e.g Millet, Rousseau, Corot), and created the Barbizon school in the 19th century.

Fontainebleau and Gâtinais Biosphere Reserve, Mines ParisTech and Naskeo Environment have teamed up to valorise by digestion the local horse manure and bio-waste. They experienced an innovative model of governance from which, on the basis of permanent confrontation of expertise, knowledge, economic dynamics and social aspirations of civil society, arose a project likely to promote territory resilience

EQUIMETH PROJECT

Equimeth is a project of biogas production from manure. It is based in the equine industry, a major economic sector in the department of Seine-et-Marne. The Fontainebleau region is well known for its equestrian tradition and there are at least 3,000 horses in over a hundred stables and equestrian centres. All these horses produce about 30,000 tons of manure per year.

The relocation of the neighbouring mushroom farms, which historically were the main manure recipient, has forced to think of alternative forms of recovery of this biomass locally. This was the trigger and the opportunity to develop the Equimeth project.

Equimeth will use 40,000 tons of material per year, 50% of which will be horse manure and the remaining will come from agricultural and food industry bio-waste. The digestion process should provide 34,000

© Fontainebleau et du Gâtinais biosphere reserve

© Equimeth Project

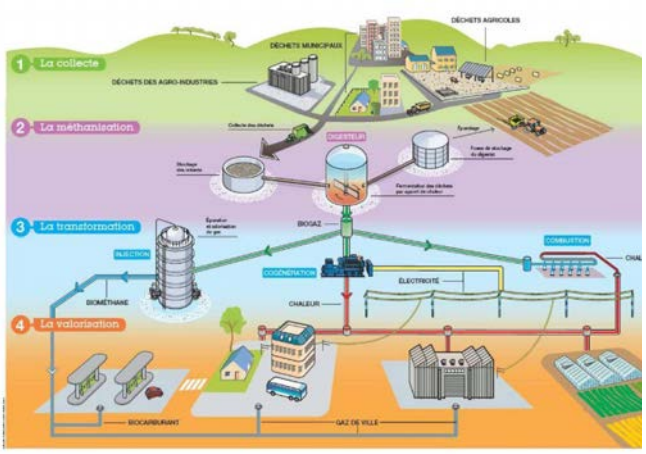
tons of digestate to be used by farmers on about 4,700 hectares. Equimeth will produce 250Nm3/h of biogas, refined and brought up to standard city gas. This production of methane is equivalent to the annual gas consumption of 1,350 households per year (household average size of 100 m²). This will prevent the emission of nearly 7,200 tons of CO2-eq per year.

The Equimeth project allows closing the circle of recovery of this waste. All biogas produced will be injected into the gas system, creating direct and indirect jobs as well as new synergies between different nearby companies. Finally, local farmers will make use of the digestate, closing the circle of ecological and energy efficiency.

A MODEL OF GOVERNANCE

The Equimeth project has come a long way in five years, where participation becomes a crucial aspect. The follow-up committee established to monitor the project groups together all local actors involved in the project (Chamber of Agriculture, the General Council of the community, equestrian group of Normandy, equestrian facilities, manure collectors, farmers, etc.),

© Equimeth Project



as well as Naskeo Environment , responsible for the design and implementation of the biogas plant.

Under the governance model established with the follow-up committee, the Fontainebleau-Gâtinais biosphere reserve in partnership with Naskeo Environment becomes an advisory body to assist in the development of Equimeth. Furthermore, the “Moret, Seine et Loing” federation of municipalities has provided the space for the facilities at its development centre.

The launch of the project was preceded by a preliminary detailed study of technical, economic, and environmental viability developed by Mines Paris Tech in association with Creden and EDHEC.

LESSONS LEARNED AND REPLICABILITY

In terms of territorial ecology, a biogas production process requires a global view of all unit operations to manage the inlet and outlet flow of matter in/out the digester: relationships with producers and collectors of fermentable material (manure, but also other biowaste) and the users (farmers) for the digestate spreading.

The project has succeeded in implementing an innovative model of governance, with the participation of all local actors, from local administrations to the end users.

BIOSPHERE RESERVE
FONTAINEBLEAU ET DU GÂTINAIS - FRANCE
Sources:
Association de la biosphère de Fontainebleau et du Gâtinais.
EQUIMETH Project.

SOLAR ENERGY FOR ALTAISKY BR

Supplying energy needs in remote areas

The Altaiskiy biosphere reserve is located in the area of the north-eastern and eastern Altai and occupies the eastern part of the Teletskoye Lake basin in the Russian Federation. The Teletskoye Lake has the additional status of being a UNESCO World Nature Heritage Site.

On 2013, a 100 kW hybrid diesel-solar power station was put into operation in Yailyu village, within the Altaisky biosphere reserve. The power station is the only one to use solar energy in the country and supplies a large village with electricity 24 hours a day.

OFF-GRID SOLAR DIESEL POWER PLANT

This project is of particular importance given the problems that affect electricity supply in the remote villages of this region. Previously the village used an old diesel generator and electricity was supplied only during the daytime.

The autonomous hybrid power station, which includes solar modules and a diesel generator, is controlled automatically. When there is insufficient solar energy output, the diesel generator starts. It is expected that operation of this station will lead to a 50% reduction in annual consumption of diesel fuel in this remote village. The warranty period is 25 years. At present, the power station is working in test mode and all technical parameters are being monitored.

The solution combines the benefits of solar and diesel generation as well as the latest technological achievements in electrical accumulators and intelligent management systems that enable efficient load distribution between PV system, accumulators and the diesel generator.

This power plant will serve as an educational and demonstration resource for students and visitors to the Teletskoe Lake and the Altaisky biosphere reserve, educating them about the use of renewable

© Green Evolution

energy sources. Scientists believe that the installation of the hybrid power station could mark the beginning of large-scale development and deployment of solar energy in Russia, starting in its remote regions.

The project was implemented through the joint efforts of various organizations and agencies. The power station was financed by the federal budget with co-financing from Hevel, Moscow, (a joint venture between Russian Corporation of Nanotechnologies and Renova Group of Companies). Other organizations were also involved in project implementation, helping mostly with equipment installation. These were: A.F. Ioffe Physics-Technical Institute (St. Petersburg), the Russian Academy of Science, LLC 'Avelar Solar Technology' (Moscow) and 'Solar Energy' (Altai Republic).

The Altaisky biosphere reserve demonstrated great initiative and contributed significantly to this project.

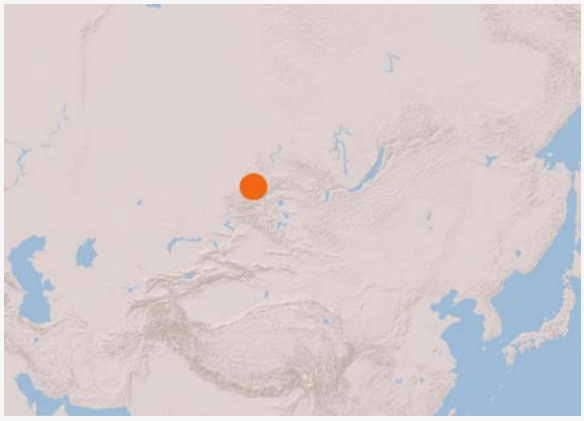
© Altaisky biosphere reseve

LESSONS LEARNED AND REPLICABILITY

This diesel-solar power plant, by its type and capacity the first in Russia, will serve as an effective base for scientific researches and education programs in solar energy, which is of great importance in remote areas of Russia.

Yailyu pilot project is the first step in an ambitious plan to extend this model to the whole region. The partners plan to build similar facilities in Yakutia, Tyva, Trans-Baikal and Far East regions.

© Hevel Solar



BIOSPHERE RESERVE
ALTAISKY - RUSSIA
Sources:
Altaisky Biosphere Reserve
Avelar Energy Group Russia
UNESCO - MAB

Good Practices II

THE ENERGY TRANSITION OF CITIES AND TOWNS IN UNESCO SITES

Cities and towns in UNESCO Sites can significantly reduce their ecological footprints and that they can become engines of innovation for green, climate-friendly economies, promote climate sensitive development, demonstrate energy efficiency, and advance the use of renewable energy sources.

EDINBURGH WORLD HERITAGE

Towards a Sustainable Energy City

Edinburgh has been the Scottish capital since the 15th century. Its World Heritage Site comprises of two distinct areas: the Old Town, dominated by a medieval fortress; and the neoclassical New Town, whose development from the 18th century onwards had a far-reaching influence on European urban planning. The harmonious juxtaposition of these two contrasting historic areas, each with many important buildings, is what gives the city its unique character. The Old and New Towns of Edinburgh were inscribed in the World Heritage list in 1995.

Edinburgh has become a worldwide reference in demonstrating that energy transition towards sustainable models in historic cities is possible. Edinburgh World Heritage (EWH), a charity funded by a broad alliance of partners, has deployed a wide array of initiatives and projects that define a way towards energy sustainability.

ENERGY HERITAGE & RENEWABLE HERITAGE

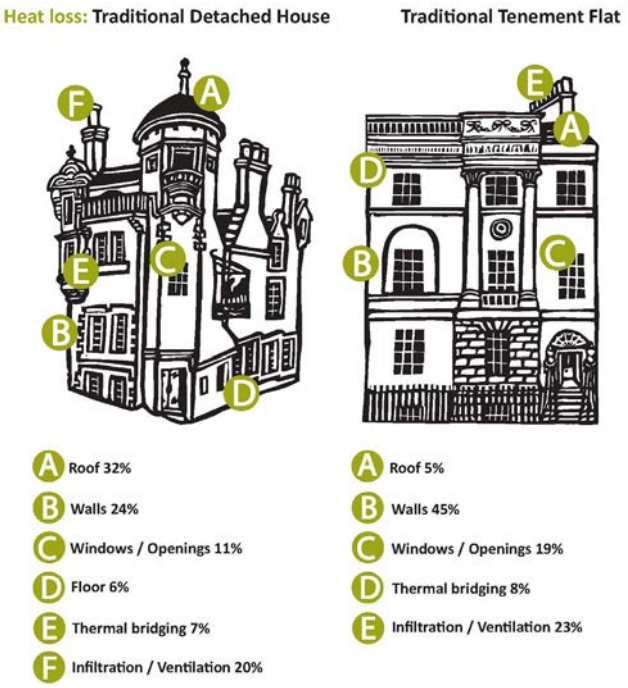
The Old and New Towns of Edinburgh World Heritage Site boast an outstanding variety of buildings with different architectural styles, materials and unique characters. These traditional buildings already have certain benefits in terms of environmental sustainability, including their longevity, thermal mass, locally-sourced materials and natural ventilation. Contrary to popular belief, it is possible to reduce energy inefficiency in traditional buildings, without compromising their authenticity.

Building conservation and energy efficiency are both key aspects of sustainability for Edinburgh World Heritage (EWH). Traditionally-built properties were built to last: many have been standing for hundreds of years, and well-maintained properties will continue to stand for many more. In order for them to continue to be comfortable in the future - without putting occupants at risk of fuel poverty – EWH promotes a range of viable interventions than can be adopted to improve their energy efficiency.

In partnership with Edinburgh-based Changeworks, EWH promoted the Energy Heritage project, providing a guide to improving energy efficiency in traditional and historic homes, covering all aspects of construction.

As a complement, the Renewable Heritage project sought to introduce clean energy technologies into traditionally-built, protected properties in Edinburgh's Old Town, a Conservation Area and part of the UNESCO World Heritage Site. This work built on the success of Energy Heritage project, which has subsequently been nationally and internationally recognised as an example of best practice. Renewable Heritage has shown that the sustainability and efficiency of energy in historic homes can be furthered by sensitive and appropriate use of clean energy generation systems.

© EWH. Renewables in a B-listed Georgian tenement - solar panels on a valley gutter roof.



© EWH. Diagram heat loss.

GILMOUR'S CLOSE PROJECT

Gilmour's Close is a 4 storey, 19th Century stone tenement, with commercial ground floor, located in the World Heritage site of Edinburgh's Grassmarket. Refurbishment of this building was completed in 2008 to provide social rented and supported housing for Hillcrest Housing Association.

The refurbishment process sought not only to conserve the historic aspects of this listed structure, but also to incorporate low energy principles to the design in the form of ground source heating, passive solar strategies, mechanical ventilation with heat recovery (MVHR) and upgrade of the fabric's thermal performance by internal lining.

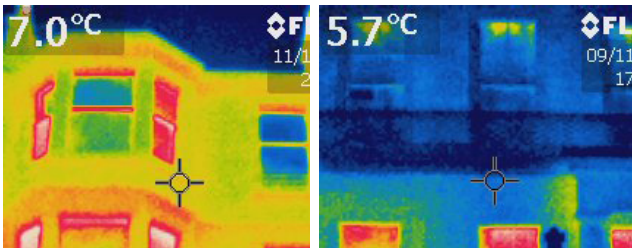
© EWH. Energy Efficiency for Post-War Listed Buildings.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

The idea of developing sustainable energy projects in heritage cities has been taboo for a long time, and in many cases it has been considered incompatible with their conservation.

Edinburgh's experience shows that good levels of energy efficiency could protect the sustainability of traditional homes (both their fabric and their function), and ensure that householders achieve affordable warmth and improved comfort levels. It has also demonstrated that clean renewable energy can also be generated on site and on a much smaller scale, without compromising the quality and authenticity of the heritage. With the appropriate knowledge and good governance, microgeneration has a future role to play in historic cities.

Edinburgh can be a powerful performance reference for the 252 cities that host properties included in the World Heritage List, and for the thousands of historic cities and villages within the World Network of Biosphere Reserves. In fact, there are very few experiences of sustainable energy in historic cities worldwide.



WORLD HERITAGE SITE
OLD AND NEW TOWNS OF EDINBURGH - UK

Sources:
Edinburgh World Heritage
Changeworks

KLiP (2010-2020)

The City of Vienna's Climate Protection Programme

Vienna was developed from early Celtic and Roman settlements into a Medieval and Baroque city, the capital of the Austro-Hungarian Empire. It played an essential role as a leading European music centre, from the great age of Viennese Classicism through the early part of the 20th century. The KLIP program covers the entire city of Vienna and therefore the historic centre which was inscribed on the World Heritage List in 2001.

On December 18th, 2009 the city council of Vienna enacted the update of the climate protection programme of the city of Vienna (KLiP II), which will be valid until 2020. The objective of KliP II is to reduce greenhouse gas emissions by 1.4 million tonnes by 2020 by using a package of 385 individual measures. Including the 3.1 million tonnes of emissions already reduced by 2008, the total reduction will amount to 4.5 million tonnes of CO2 equivalent by 2020.

KLiP II MEASURES

This programme is the update of the so called KLiP I, which was enacted in 1999 and consists in a set of measures in the following large fields of action: energy supply, use of energy, mobility and town-structure, and procurement, waste management, agriculture and forestry, nature conservation.

The KliP II measures aim to reduce per capita emissions by 21% of the 1990 level by 2020. An analysis of the development of greenhouse gas emissions per capita shows that the emissions in 2009 were already 21% below the 1990 level (KLiP I). The ambitious implementation of the planned measures of KliP II includes the following:

- increase the share of district heating to 50%
- continue the thermal renovation of buildings
- increase the share of public transport, reduce car traffic, and promote ecomobility by focusing on public transport, cycling, and pedestrian traffic
- more than double the amount of end-use energy produced from renewable energy sources from 1990
- develop an energy supply security plan.

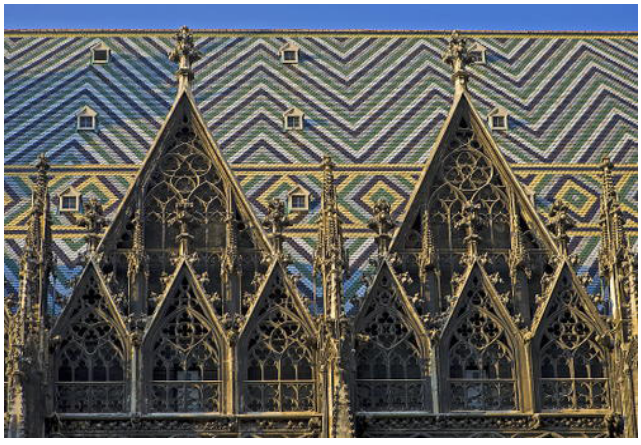
CLIMATE PROTECTION, RENEWABLE ENERGIES AND ENERGY SAVING MEASURES

The City of Vienna is pushing for an increased use of renewable energy sources to replace fossil fuels. Projects realised to date include hydropower plants, wind farms, solar thermal plants, photovoltaic installations and a wood biomass power plant. As there are constraints on the installation of renewable energy plants within the city limits, the City of Vienna is increasingly turning to new projects in the region, both within and outside the borders of Austria.

Development of Vienna's per capita emissions according to Emikat (excl. emissions trading installations) and BLI

A significant number of solar-thermal power installations are used in the city to supply hot water and heating, and photovoltaic plants convert sunlight into electricity. Wind and water are used as energy sources in wind power plants and a mini-hydropower station, and buildings are heated by means of geothermal energy. The final result will more than double the amount of final energy produced by renewables compared to 1990.

One of the basic problems of climate protection lies in the fact that mankind consumes more and more energy despite various positive measures (such as better insulation for buildings). Countering this development is one of the greatest challenges of the future. Therefore the City of Vienna has given special importance to energy saving measures. This is why a "Municipal Energy Efficiency Programme (SEP)" has been worked out after 2009. Households, trade, the services sector, industry, public institutions, agriculture, and transport were investigated with a view to the opportunities and potential for energy savings and the framework conditions and measures required for this purpose were defined.



LESSONS LEARNED AND POTENTIAL REPLICABILITY

The climate protection programme of the City of Vienna has not only succeeded in reducing greenhouse gas emissions and improve the quality of life, but has also stimulated the economy considerably. Between 1999 and 2010, the implemented measures generated an investment volume of more than 20 billion, creating an added value of approximately 18.7 billion. This secured over 58,600 jobs in 2011.

This vision is a driving force for replication of the experience from Vienna to many cities and villages included in the UNESCO Sites.

KLiP WIEN

WORLD HERITAGE SITE
HISTORIC CENTER OF VIENNA - AUSTRIA

Sources:
City of Vienna
World Heritage Centre

INTEGRATED ENERGY SYSTEM IN FERRARA

Geothermal and waste energy sources

Ferrara, City of the Renaissance, and its Po Delta, with an area of 46,712 ha, was inscribed on the World Heritage List in 1995. The humanist concept of the 'ideal city' came to life here in the neighbourhoods built from 1492 onwards by Biagio Rossetti according to the new principles of perspective. The completion of this project marked the birth of modern town planning and influenced its subsequent development. Today Ferrara continues in this creative spirit in such fields as energy.

Ferrara is one of the most sustainable cities of Italy and environmental issues are seriously taken into account by the Municipality. It subscribed the Aalborg chart in 1996 and in 1998 it started the Local Agenda 21 process. It has also been awarded by Legambiente (the Italian environmental agency) as best environment-friendly city in 2001. The municipality is member of several Italian and European networks of sustainable cities (ICLEI, BigNet, and Car Free Cities) and is signatory of EU's Covenant of Mayors.

THE GEOTHERMAL PROJECT

The use of geothermal energy as energy source starts with its discovery in 1956, during explorations for oil reservoirs at a depth of 1,000 m, 4 km NW from the city centre of Ferrara. At that time the well was abandoned and only after the energy crisis of the 70's it was taken again into account, to utilize this important energy source.

Recent geo-structural and geothermal investigations carried out by HERA Group (Energy Resources Environment Holdings) in collaboration with the University of Ferrara and the Emilia-Romagna Region, confirm the presence of geothermal reservoirs in the east part of Ferrara. Three hydrothermal systems have been identified. Each reservoir can be considered hydraulically separated from the others by aquitards that prevent significant leakages.

At the beginning of the 80's, the Municipality of Ferrara developed a Geothermal Project in order to exploit this resource as a primary source for an urban heating system and to reduce, in a solid way, the en-

© HERA. Renewable Energy Hub

vironmental impact created by the traditional energy sources (coke, oil and methane gas, etc…).

At first, the geothermal fluid (hot water, ca 100°C) is pumped from depths of 1,000 m to the surface; then the hot water transfers thermal energy to the heating system. Finally, it is re-introduced in the subsoil in order to ensure the geotechnical stability.

Works began in 1987 and in 1990 the first buildings were connected to the district-heating network. In 1993 the CHP plant for the thermo-destruction of solid wastes was built, while a second well was opened in 1995. In 1999 a turbo alternator fed with the vapour generated by the CHP plant was installed. At the end of 2010 the installed geothermal power was about 23 MWt.

INTEGRATED ENERGY SYSTEM

Now, the network in Ferrara is fed with the so-called "Integrated Energy System", because the energy from the Waste Treatment Plant was added to the geothermal source. This system has more environmental and economic benefits than a traditional one because it allows to have significant cost savings and to reduce CO2 emissions.

© HERA. District Heating Pumps.

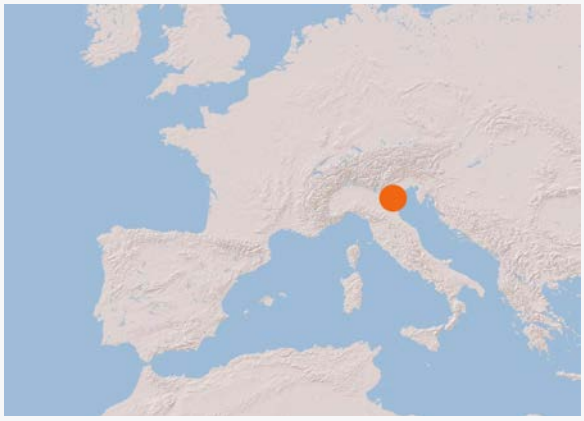
The system incorporates geothermal sources, CHP (combined heat and power) units installed in the solid waste processing plants, together with boilers running on biogas and used as backup systems. The urban heating network supplies the equivalent of 22,000 housing units, mostly in private and public buildings.

But the future is more promising. The proposed new Renewable Energy Hub will allow increasing this figure to 37,000 housing units, meaning that the district heating would cover the 40% of households. Another new development is that solar thermal will be incorporated to geothermal, with the capacity to convert solar energy into thermal energy for heating with a power of 1 MWt.

The energy mix will reach 90% of renewables. With the new Hub, 56.4% of the energy in the grid will come from geothermal sources, 34.3% from the Cassana incinerator, exploiting energy from waste and agricultural biomass, 0.3% from solar thermal, and only 9% from natural gas, the only non-renewable source.

LESSONS LEARNED AND REPLICABILITY

The District Heating System of Ferrara represents one of the most important examples of 'Integrated Energy System' that will be further increased by the future development. Due to its high energy efficiency this system is thought to be highly advisable and transferable although some issue can be related to the construction size required, market-related, and economic and technical reasons.



WORLD HERITAGE SITE
FERRARA, CITY OF THE RENAISSANCE, AND ITS PO DELTA
ITALY
Sources:
City and Province of Ferrara
HERA

PUERTO PRINCESA - PALAWAN

Towards a Model City in Sustainable Development

The Palawan Biosphere Reserve is a cluster of islands composed of one long main island and smaller groups of islands around it. The 1,150,800 hectares of the biosphere reserve include the entire Province of Palawan Island, which is the westernmost province of the Philippines.

Puerto Princesa, capital of the Palawan province, is also known worldwide thanks to the underground river flowing close by, where the Puerto-Princesa Subterranean River National Park was created. The park was included in UNESCO's World Heritage List in 1999.

Puerto Princesa is a multiawarded and pioneer city for environmental initiatives in the Philippines. 'The City in a Forest' is the designation that embraces the sustainable city strategy.

SOLAR AND HYDRO POWER FOR A SUSTAINABLE CITY

In June 2010 the City of Puerto Princesa formed a technical partnership with Optimal Power Solutions (OPS) in order to address the city's power shortage, currently estimated at 5 to 10 MW.

An ongoing and significant issue has been the provision of sustainable energy for Puerto Princesa. At present, diesel-powered gensets provide a capacity of 30 MW of power to the inhabitants of Puerto Princesa. OPS and the City Council plan to design and implement renewable energy sources to generate additional power supply, reduce diesel fuel consumption and promote a viable and sustainable energy future. It is envisaged that new renewable sources of up to 10 MW capacity will be integrated over successive phases. This renewable capacity will prioritise the export of photovoltaic power into the grid to better support and lower use of the current diesel generators. Phase One of 1 MW capacity progressing up to 2MW, 5MW and finally 10 MW providing for future load growth of the City.

Furthermore, the Palawan Electric Cooperative (PALECO), the City Government of Puerto Princesa and WEnergy Global PteLtd have signed a Memorandum of Understanding (MoU) for the development of a hybrid electric power plant (1.5 MWp) to cover electricity supply of the Barangay Cabayugan.

Hydro power is also part of the city's energy strategy. The twin 3.4MW hydro-turbines provide at least 32 million kWh of electricity to the Palawan grid. Hydropower will replace the old and expensive to run NPC generators.

© James Albert A.Mendoza
Solar highway in Barangay Cabayugan

MORE ENERGY-EFFICIENT HOMES

The rising urban population of Puerto Princesa has led to congestion in the city's bay area, threatening the people's quality of life and coastal reserve areas. Housing projects on the coast in Puerto Princesa City have been designed to reduce energy demand through increased natural light, improved ventilation, the cooling effect of the roofing material and strategically planting at least one fruit tree per household.

The potential annual carbon savings is estimated to be at least 72 tonnes for the 330 households. Other green features of the housing projects include the installation of a rainwater catchment facility that reduces the demand for water pumping, prohibiting the use of wood for the roof and interior frames and an appropriate disposal system for non-recyclables and non-biodegradables.

GREENING PUBLIC TRANSPORT

The local government of Puerto Princesa has entered a partnership with the Institute for Climate and Sustainable Cities (iCSC), a non-governmental organization based in the Philippines working on "sustainable energy solutions and fair climate policy." This partnership is under the Climate-Friendly Cities initiative of the iCSC, an initiative which combines waste management, renewable energy generation and sustainable transport programs for sustainable, climate-resilient city and community development.

Currently, Puerto Princesa has electric jeepneys (e-jeepneys) in the local government fleet and for private use, as well as electric tricycles (e-trikes), which are makeshift three-wheeled vehicles from motorcycles. The concept of e-jeepneys was developed by iCSC through a funding by Dutch foundation, Stichting DOEN. E-jeepneys were introduced in Puerto Princesa in 2009, with political cooperation playing a major role in the institutionalization of the electric vehicles as public transport. The power requirements of the electric feedjeeps and tricycles will be partly covered by the Waste-To-Energy project, jointly developed with the Institute of Climate and Sustainable Cities.

REDUCING TOURISM'S CARBON FOOTPRINT

Puerto Princesa is currently among the top 10 major tourist destinations in the Philippines, and is striving to be the country's number one tourist destination for eco-tourism.

Puerto Princesa has extended the concept of energy sustainability to the tourism sector, one example being its participation in the SWITCH-Asia 'Zero Carbon Resorts' project that seeks to enable tourism SMEs, such as hotels and resorts, to provide their energy services in an efficient, cost effective, and environmentally sound way.

The project applies the 3R strategy: Reduce-Replace-Redesign. The first step is to reduce the energy consumption in hotels and resorts, and the second step is to replace inefficient fossil-based devices with better, greener technologies. In the Redesign stage, a showcase 'Zero Carbon Cottage' will be built in Palawan, which will operate using solar- and biomass-based energy generation systems.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

Consistent with the vision of an environmentally sustainable city, Puerto Princesa will take a lead role in promoting environmental stewardship building mutual support and cooperation with cities in the Asia-Pacific region.

The 'City in the Forest' becomes the stage for the future of energy supply in The Philippines by enabling the mix in energy to contribute to stable prices for consumers and the mitigation of global warming.

BIOSPHERE RESERVE & WORLD HERITAGE SITE
PALAWAN - PHILIPPINES

Sources:
Puerto Princesa Subterranean River National Park
ICLEI

ENERGY CENTRE AT FONTEVRAUD ABBEY

The largest Abbey of Europe goes to renewable energy

The Loire Valley is an outstanding cultural landscape of great beauty, containing historic towns and villages, great architectural monuments, and cultivated lands formed by many centuries of interaction between their population and the physical environment, primarily the river Loire itself.

The Abbey of Fontevraud, in the heart of the Loire Valley World Heritage site, is impressive both in its size and by the strength of its history. It is one of the largest monastic cities from the Middle Ages.

The Abbey has undertaken an ambitious and daring energy conversion project, for which the major achievement was the construction of the Energy Centre, aimed at achieving 100% self-sufficiency in heating and electricity by means of a combination of biomass boilers and photovoltaic cells. The project also intends to halve energy consumption and reduce greenhouse emissions by over 80%.

SUSTAINABLE FONTEVRAUD

Establishing the Abbey as a living site also requires working on the conservation of buildings, and improving the comfort offered to users by relying on new technologies, and the latest advances in sustainable development. To adapt its practices to the requirements of preserving natural heritage, Fontevraud has set up several resources management projects: waste, greenery, lighting, transport, etc.

With regard to energy efficiency, building renovation projects systematically include insulation measures based on the installation of double-glazed windows which maintain their historic appearance The Abbey has an automated and centralised system for lighting management when necessary (sensors in all areas frequented by the public) and to set the warm-up of buildings according to their utilization. This system has allowed reducing by 90% the consumption of electricity for lighting since 2009.

The complex also has a fleet of electric vehicles that closes the cycle of energy self-sufficiency from renew-

© Mission Val de Loire. The Energy Centre.

able energy sources and reduces emissions generated by transport.

But the most important and innovative project is the Energy Centre, inaugurated in 2013. It combines several energy resources with a wood boiler, solar panels but also rainwater collection and waste recycling.

THE ENERGY CENTRE

The Energy Centre is the first new building at the Abbey in a century, and the first major achievement of the Fontevraud Sustainable city programme, and as such is a unique experience in France in a historical monument. It will supply the bulk of Fontevraud's energy transition as sought by the Pays de la Loire region and brings the Abbey fully into the 21st century.

Partly buried, the building rose out of the ground, fitting perfectly into the site's architecture and landscape. Its roof garden/terrace provides a choice scenic setting for holding concerts and shows against the backdrop of the abbey church's chevet, which boasts a remarkable architectural style.

Energy self-sufficiency has been achieved through the careful integration within the complex of this new infrastructure that includes two boilers each with 500 kW capacity and 92 PV panels, which will replace fuel and electric heating.

The objectives identified in the program of energy conversion are:

- Decrease by 2 energy consumption compared to 2011
- Decrease by 4 contribution to the greenhouse gas emissions compared to 2011
- Cover 90% of energy needs from renewable energy
- Ensure 100% supply through local resources.

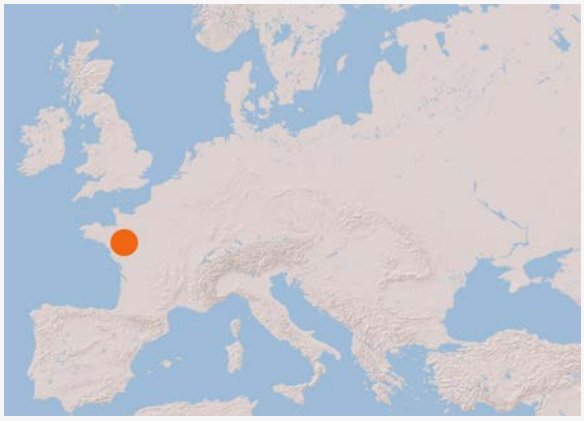
The wood pellets supplying the heaters are produced in the Saumur region. Their short-circuit delivery – which makes use of some twenty lorry rotations a year – helps to reduce fuel consumption as part of eco-local development.

Not far from Fontevraud, in Saumur, the École Nationale d'Équitation has fitted thermal and photovoltaic solar panels onto the Cadre Noir Ring and its stables to generate electricity and hot water.

LESSONS LEARNED AND REPLICABILITY

This example is focused on self-sufficiency of renewable energy supply, and as such it achieves the additional advantage of energy security for the site. The installations have been carefully integrated into the complex, and thereby also protect the Heritage Significance of the site at the urban district scale.

The Abbey of Fontevraud example shows a model to follow in the large historical heritage complexes.



WORLD HERITAGE SITE
THE LOIRE VALLEY BETWEEN SULLY-SUR-LOIRE AND CHALONNES - FRANCE
Source:
Loire Valley World Heritage
Abbaye de Fontevraud

THE HANSEATIC TOWN OF VISBY

Bio-fuelled district heating

A former Viking site on the island of Gotland, Visby was the main centre of the Hanseatic League in the Baltic from the 12th to the 14th century. Its 13th-century ramparts and more than 200 warehouses and wealthy merchants' dwellings from the same period make it the best-preserved fortified commercial city in northern Europe.

As an element in the preservation of Visby's buildings, construction of a district heating network began some 30 years ago. Now, all heat in Visby's district heating system is produced using a mix of renewable energies.

Visby's district heating project is not an isolated case on an island where the use of renewable is guaranteed. Gotland is a showcase for a number of interesting and innovative renewable energy initiatives. This is not really surprising. Gotland has Sweden's highest sunshine figures, enjoys good access to biofuels and is one of the best European locations for wind power. These natural assets, the entrepreneurship of the islanders and the municipality's focus on strategic environmental planning have led to the realisation of many ideas for increasing the sustainability of Gotland's local energy supply.

BIOFUEL IN VISBY'S DISTRICT HEATING

The World Heritage City of Visby consists of many unique buildings and mediaeval ruins that are built from limestone. Some of its oldest buildings also have beautifully carved portals and friezes in Gotland sandstone. Both these stones are sensitive to airborne contaminants and, in particular, emissions from the burning of fossil fuels.

In Visby as a whole, district heating accounts for over 80 percent of all heating supplied to commercial premises and dwellings. To the benefit of Visby's residents and the town's heritage, this heating contributes to a sustainable society.

Environmental benefits are evident, since fossil fuels have not been used in Visby's district heating since 2006. District heating removes the need for fuel transport in the narrow streets of Visby's town centre. Furthermore, the use of biofuels reduces the emission of sulphur and nitrogen oxides. Compared to the use of fossil fuels, it also lowers the net addition of carbon dioxide to the atmosphere.

Since 1980, sulphur emissions from Visby's district heating have fallen by 95 percent. In comparison with individual heating, district heating leaves the air cleaner and healthier for Visby's residents and the town's sensitive cultural heritage.

The district heating network in Visby takes its heat from:

- Bark, twigs, branches and other (chipped) residues from forest clearances and sawmills.
- A sea water based heat pump with an 11 MW capacity.
- Biogas from the now closed landfill site in Visby.
- Biogas from the wastewater treatment plant.
- Bio-oils that replace fossil oils.

District heating plant in Visby

© Żeglarz

In addition to that, the municipality has set very high standards for energy efficiency and they have launched a new plan for the historic centre, where energy aspects are integrated with a general plan for building conservation.

ECO-MUNICIPALITY OF GOTLAND

Visby is the seat of Gotland Municipality, which took the view to become “an ecologically sustainable society within the course of a generation”. Many years ago, the Municipality of Gotland adopted a route which would lead away from fossil fuels and towards reduced climate impact. Today, all electricity used in the municipality’s operations is certificated as Good Environmental Choice, which means that it is produced solely from renewable energy sources.

Gotland has implemented interesting reference projects in a wide range of experiences that include wind power, biogas, solar PV and sustainable architecture. The island has been a pioneer in promoting local ownership by wind co-operatives, where around 2000 households are involved.

At present, one of the smartest electricity network in the world is currently under development on the island. This allows that by using modern technology, large quantities of renewable energy sources can be integrated in the grid.

© Gotland Municipality

LESSONS LEARNED AND REPLICABILITY

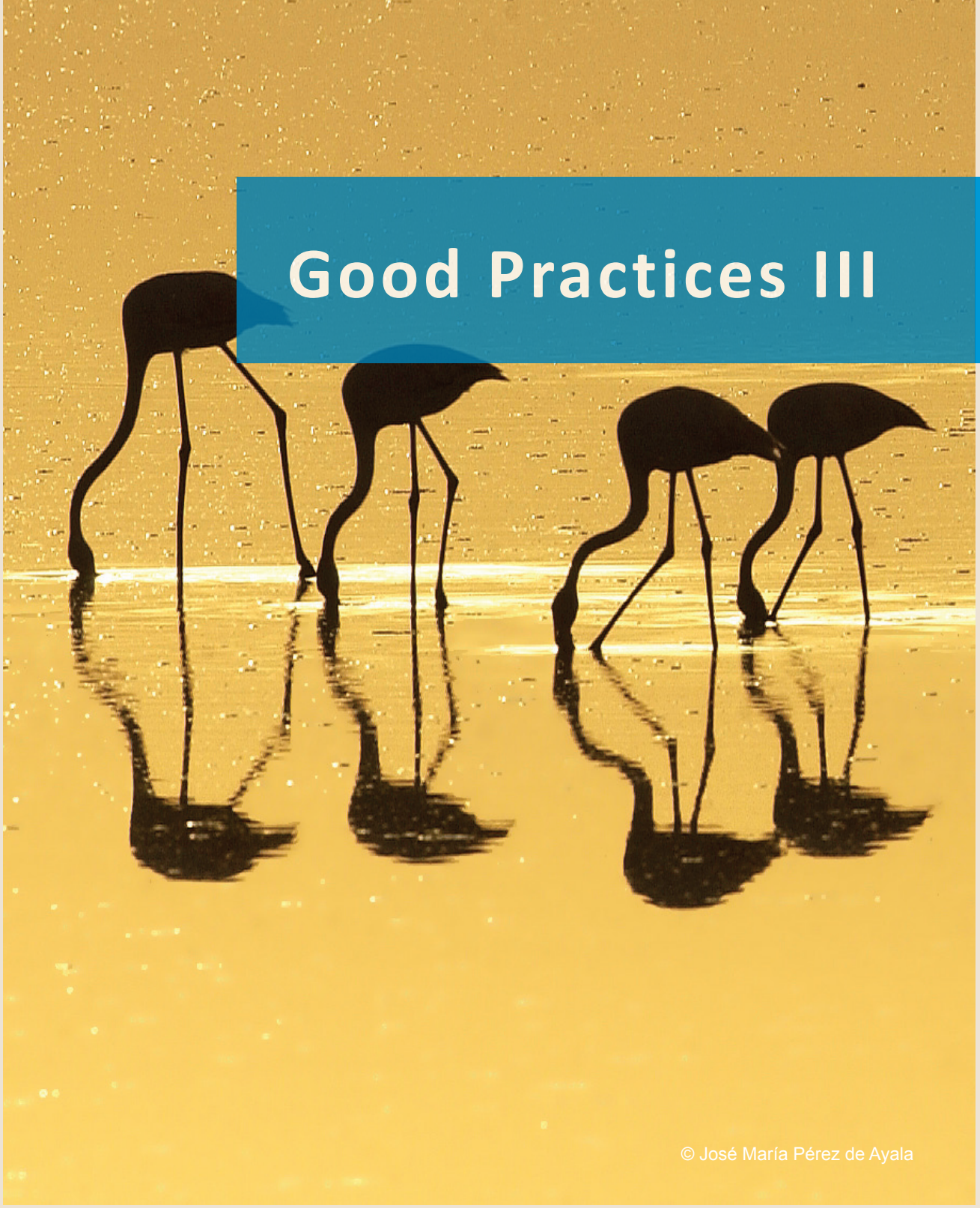
Visby’s bio-fuelled district heating case shows the advantages of a smart alliance between renewable energy and heritage conservation, and can be taken as a model for many historic centres at those latitudes. This project is part of the common objective of achieving energy self-sufficiency from renewables by 2025, taking into account that the realisation of a Sustainable Energy System requires action at all levels of society.

The experience of Visby, and of Gotland in general, becomes more relevant if we take into account the geographical position of the island, in the middle of the Baltic Sea, that makes it a natural meeting place for cooperation between regions in the Baltic Sea Region.

WORLD HERITAGE SITE
HANSEATIC TOWN OF VISBY - SWEDEN

Source:
Municipality of Gotland

Good Practices III



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BUILDING AN ENERGY SECURE AND ENVIRONMENT FRIENDLY FUTURE

Access to clean energy has clear connections between human wellbeing and environment protection. Proper use of renewable energy in the UNESCO Sites can help reduce the impacts and pressures on ecosystems and contribute to eradicating energy poverty.

© Agua y Paz biosphere reserve. Hydropwer produced in the Agua y Paz biosphere reserve (Costa Rica) supplies 12% country's power needs.

THE IFUGAO-AMBANGAL MINI-HYDRO PROJECT

Global Sustainable Electricity Partnership project

In 1995, the Ifugao Rice Terraces of the Philippine Cordilleras were inscribed in the World Heritage List. For 2,000 years, the high rice fields of the Ifugao have followed the contours of the mountains. The fruit of knowledge handed down from one generation to the next, and the expression of sacred traditions and a delicate social balance, they have helped to create a landscape of great beauty that expresses the harmony between humankind and the environment.

Deforestation, modernisation and climate change, however, threaten to destroy the rice terraces. Hence, in 2001, confronted with the deterioration of the rice terraces and citing deficiencies in conservation planning for the rice terraces, UNESCO placed them on the list of World Heritage in Danger.

CLEAN, RENEWABLE HYDROPOWER PROTECTS "STAIRWAYS TO HEAVEN".

In keeping with its mission to address electricity issues and promote sustainable development, the Global Sustainable Electricity Partnership proposed to the Philippine authorities the development of a 200 kW run-of-river hydropower project that would generate sustainable revenues allocated to the conservation of the rice terraces. The Republic of the Philippines is blessed with abundant hydropower resources that can help address climate change, while providing a model of local sustainable energy-based development, regional vitalization and heritage conservation.

After several years of pre-feasibility, feasibility and environmental studies, including extensive public consultations, and a 10-month construction period, the mini-hydropower plant on the Ambangal river was inaugurated on January 25, 2010. The entire project was focused on the dual objective of maintaining and improving the quality of life for local communities engaged in rice-terrace farming and rehabilitating the Ifugao Rice Terraces World Heritage Site.

Building a hydropower plant is a challenging task. In

© Global Sustainable Electricity Partnership. Mini-hydro plant.

the case of the Ifugao Ambangal Mini-hydro Power Plant, the construction was even more demanding. Steep slopes, limited site accessibility and severe weather that could provoke landslides posed additional difficulties with regard to performing the work in a timely and safe manner. Under such astringent conditions, the use of heavy machinery was very impractical. In this respect the project represented an innovative challenge with regard to construction techniques and minimisation of the environmental impact.

The whole project was funded by the Global Sustainable Electricity Partnership, with the main contribution provided by TEPCO (Tokyo Electric Power Company). Other GSEP participating members were KANSAI Electric Power Company, Électricité de France, ENEL S.p.A., RWE AG and Hydro-Québec.

EMPOWERING THE STAKEHOLDERS AND CONSERVING THE HERITAGE

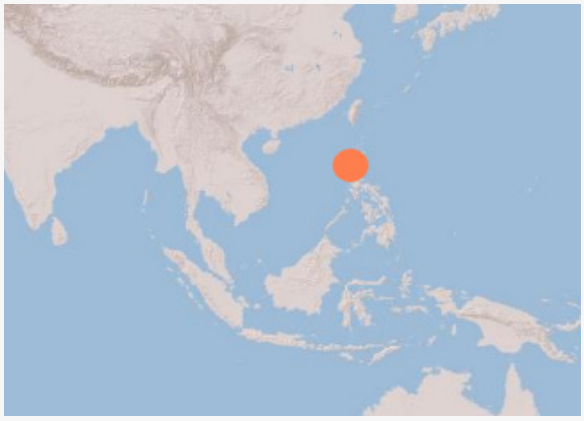
During all phases of project implementation, the Global Sustainable Electricity Partnership team members shared their expertise with participants from the Philippine Department of Energy and the Ifugao Provincial Government technical and management staff who formed a Technical Working Group dedicated to the project's development. Various activities were assigned to the group members, creating a participation process where each individual could contribute, share his/her experience, develop a methodology to integrate the different aspects of the project's implementation for future replication, and develop the tools to manage the Rice Terraces Conservation Fund.

Central to this project was the establishment of the Rice Terrace Conservation Fund. All proceeds from the power generated by the Ifugao-Ambangal Mini-hydro Power Plant, except for those needed for the operation and maintenance of the plant, will go to terraces conservation purposes: maintenance and stabilisation of the rice terraces, and irrigation systems to reverse their deterioration. Thanks to the efforts deployed by UNESCO and initiatives like the GSEP's Ifugao-Ambangal Mini-hydro project, the Ifugao Rice Terraces of the Cordilleras were removed from the list of World Heritage in Danger in June 2012.

LESSONS LEARNED AND REPLICABILITY

The project is a perfect example of true sustainable energy development, providing much needed clean, renewable electricity to the region, improving quality of life for people working in the rice terraces, and contributing to the conservation of a world-renowned cultural heritage. Local communities, who were involved at all stages of the project's development, welcomed the new hydropower plant and benefit from it in several ways.

Sustainable energy projects such as the Ifugao-Ambangal Mini-hydro Project can protect our heritage while improving quality of life today. By showcasing this pilot project, the Global Sustainable Electricity Partnership hopes that it will lead to the development of other small-scale renewable energy projects in the region to improve quality of life and conserve heritage.



WORLD HERITAGE SITE
RICE TERRACES OF THE PHILIPPINE CORDILLERAS
PHILIPPINES
Sources:
Global Sustainable Electricity Partnership (GSEP)
The Philippine Ifugao-Ambangal Mini-hydro Project

VIRUNGA NATIONAL PARK

Green energies to preserve a World Heritage Site

Virunga National Park is located at the heart of the conflict, and straddles the border between the DRC, Rwanda and Uganda. Home to some of the world's last remaining Mountain Gorillas,it is Africa's first national park, a World Heritage Site and is known to contain more species ofmammals, birds and reptiles than any other protected area on the planet.

In the aftermath of the Rwandan Genocide, 15 years of violent conflict in eastern Congo produced one of the worst humanitarian tragedies in recent history. Conflict over natural resources is an underlying cause of armed conflict. Illegal trafficking of forest resources, in particular charcoal, provided armed groups with one of their primary sources of income. Over 70,000 tons of charcoal is illegallyproduced every year. Thisrepresents the destruction ofover 15,000 hectares of tropicalhardwood forest.

BRIQUETTE PRODUCTION: AN ALTERNATIVE SOURCE OF FUEL AROUND VIRUNGA

A 2008 study of the charcoal market in Goma by the African Conservation Fund estimated that 59,000 tonnes were consumed each year, with 80% coming from Virunga.

In these circumstances, the Village Briquette Factories project provided a viable solution to replace the consumption of charcoal in the region with a viable and sustainable alternative, thereby preventing the massive destruction of Virunga's forests. Combustible biomass briquettes are an ecologically sustainable fuel source available to households living in extreme poverty. They aresignificantly cheaper than charcoal and can be produced from a verywide range of abundant resources including grass, leaves, agricultural-waste, sawdust and recycled paper.

The expected impact of the project should be of 34,000 sustainable employments. Complete factory kits, consisting of the necessary equipment, training, support and a guaranteed purchase of production will

© Institut Congolais pour la Conservation de la Nature

be given to 5,000 teams of 6 people. Briquette producers can generate enough income to support their families within 10 days of their 2-day training.

The project contributes to sustainable financing Virunga National Park. The Village Briquette Factories will be developed as a high yielding business model. Profits will be partly re-invested to further develop the program, and partly used to cover a significant proportion of the running costs of Virunga National Park.

The project is complementary to another project started by WWF in 2008, aimed to tackle illegal charcoal production in Virunga in ways that would benefit local people. It has established local production of efficient stoves to cut the use of charcoal, and helped to start small plantations to supply wood for charcoal production on a sustainable basis.

This project is a true model of international cooperation. The pilot programme for the Village Briquette Factories was funded by the European Union, The African Conservation Fund (UK) the US Fish and Wildlife Service, theBritish Foreign and Commonwealth Office, the Daey Ouwens Fund, the Belgian Ministry of Foreign Affairs, UNESCO/Région Wallone, Government of Germany, the World Wide Fund for Nature (WWF), the Greater Virunga Transboundary Collaboration/government of the Netherlands and several private donors.

HYDRO POWER TO DEVELOP VIRUNGA

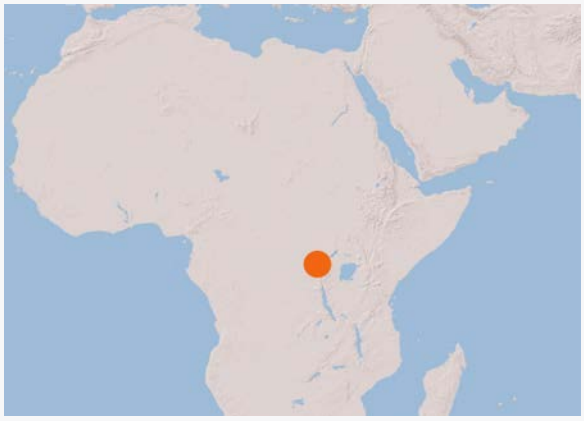
A hydro-electric project using water run-off from the park's Ruwenzori Mountains has been finalised in 2013. This has allowed Virunga to have an electricity grid for the first time

The facility has an installed capacity of 400 kW to serve the people of Mutwanga near Virunga's northern sector headquarters, and has the potential for increased economic development in the region and start ensuring access to electricity. The revenue that will be generated by the Mutwanga hydroelectric plant is also a big first step on the path toward helping the park fund operations even when tourism is closed by conflict.

LESSONS LEARNED AND REPLICABILITY

The implementation of an arduous campaign was central to the success of the Briquettes Programme. In 2009 there were 500 presses in production, generating over 4000 sacks of briquettes a month, with over 3000 people involved in that production. Assembling a team of trainers and business advisors, and build a very effective logistics, finance and administrative support system were necessary to drive the project forward.

The creation of the Renewable Energy and Efficient Technology Center has been a major supporting measure. A growing number of businesses and households are turning away from charcoal as a result.



WORLD HERITAGE SITE
VIRUNGA NATIONAL PARK
DEMOCRATIC REPUBLIC OF CONGO
Sources:
Institut Congolais pour la Conservation de la Nature
Virunga National Park / Gorilla.cd

NABU'S CLIMATE AND FOREST PROJECT

Forest preservation through wood-saving stoves

Kafa is the birthplace of wild coffee, Coffea arabica, where it has been consumed for more than 1,000 years. There are now close to 5,000 wild varieties of coffee in this biodiversity hotspot. A unique coffee culture is deeply ingrained in the Ethiopian economy and history. This culture is a key element of the participatory forest management scheme created in the Kafa Biosphere Reserve to avoid deforestation and boost economic development.

NABU (The German Nature and Biodiversity Conservation Union) and its partners have worked towards the preservation of these forests obtaining the establishment of the UNESCO Kafa Biosphere Reserve in June 2010 and implementing the project: "Climate Protection and Preservation of Primary Forests – A Management Model using the Wild Coffee Forests in Ethiopia as an Example".

The project achieved the production and distribution of 11200 energy saving stoves to inhabitants though collaborative effort with department of energy. 70 jobless youth were trained organized and equipped and deployed in 11 production and 25 satellite sites.

THE DEPENDENCY ON BIOMASS ENERGY: A DRIVING FORCE FOR DEFORESTATION

Only 40 years ago, some 40% of the Ethiopian land surface was occupied by forests. Today, less than 3% remains, largely in the Kafa coffee biosphere reserve, which still boasts large areas of mountainous afromontane cloud forest. The forest ecosystem makes an important contribution to the livelihoods of people in the area. It provides wild coffee, valuable spices and honey from wild bees. It also contains some 25 million tons carbon in above-ground biomass. Some 600,000 tons of carbon could be removed from the atmosphere annually through natural forest growth – if the forest remains intact. But it is endangered due to clear-cutting for smallholder agriculture and industrial coffee and tea plantations, and the intensive use of biomass.

Ethiopia currently caters for 96 percent of its energy requirement using biomass. Due to this fact many households satisfy their demand by cutting trees form the available natural forests/woodlands and shrub lands. This situation has been cited as one of the driving forces for deforestation. Similar to other parts of the country people of Kafa mainly use wood products for fire. The firewood comes from the nearby forests. On top of that, the biomass fuel is mostly used inefficiently. This has a direct relationship with the household income and time budget. The more inefficiently the wood is used the more time women and children will spend on firewood collection.

There is no electric power plant in the Biosphere Reserve. Electricity is supplied only to a few areas of the reserve by an external hydro-power plant.

© Mesfin Tekle

© Katrin Lammers. The solar system in Gimbo.

ENERGY-EFFICIENT STOVES AND OTHER RENEWABLE ENERGY SOURCES

Among the activities carried out by NABU's Climate and Forest Project to mitigate the impact of meeting energy requirement using biomass, there are two main lines of action: promotion of community plantations with fast-growing tree species as fuel wood and introduction of efficient wood-burning stoves.

In this last case, the target of the project is to introduce energy-saving stoves to the communities in Kafa Biosphere Reserve. 11200 stoves were distributed until September 2012. The plan says that 10000 stoves will be distributed to households with high wood consumption by September 2012. The new technique of these stoves not only reduces the amount of wood needed for cooking by half, it also saves the forests, time for the user and produces less smoke and fire. The stoves are therefore a source of great relief to the people and the forest and have been very well received.

To produce and distribute the stoves NABU is working closely with the Kafa Zone Department for Water, Mines and Energy. As part of this cooperation 70 young unemployed people were trained as stove producers and supported to start their production business.

In collaboration with GLEN (Global Education Network of Young Europeans) a study has been conducted on alternative energy sources where coffee husk briquets, bio-gas and solar appeared as equally relevant.

Annually, in the area of biosphere reserve, about 100 t of coffee husk is produced. This represents an ideal material for briquetting. But not only the coffee husk: dry leftovers from other crops processing (e.g. maize, sorghum etc.) can be used as well. Another source is biogas production, based on two big potential sources: cattle dung and coffee pulp.

The Kafa Water, Mining and Energy Department has started to implement some renewable energy programs in its "5 years strategic plan" – starting from 2011. 450 PV solar panels were distributed until September 2012.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

The acceptance of wood-saving stoves is very high and they are easily adapted by users. Within this context, local communication and education are essential. The importance of the training programme for young people to help them expand their own knowledge of climate and forest protection is recognised. In turn, they can share this knowledge and raise the awareness of other members of their communities.

With regard to energy, solar power has a high potential and there are multiple benefits of using solar energy in the area. But before installing new panels it is necessary to prepare and train technical staff that will work in the zone.

The successful results of this project may have a significant impact on other areas of the region with similar characteristics and needs. This would be the case of Yayu Biosphere Reserve, also in Ethiopia, and of other similar areas, like the Ituri region in the Democratic Republic of Congo.

BIOSPHERE RESERVE
KAFA - ETHIOPIA

Sources:
UNESCO - Natural Sciences Sector
NABU (Nature and Biodiversity Conservation Union)

TONLE SAP

Waste converted to energy for floating communities

The Tonle Sap is the largest freshwater lake in Southeast Asia. It is connected to the Mekong River by the Tonle Sap River. The ecological importance of Tonle Sap was recognised in 1997 when UNESCO registered the area on the World Network of Biosphere Reserves.

Unfortunately, the area's ecosystem is under serious threat due to factors such as deforestation as forests are at an accelerating rate being used for fuel wood, and a lack of sanitation as faeces and waste are directly disposed of into the lake. Around 1.5 million Cambodians live on the Tonle Sap lake and river system, many in floating villages.

Currently, there is limited access to affordable and sustainable energy sources for the floating communities of the Tonle Sap and there are no effective affordable sanitation options available. Live & Learn Environmental Education, with partners such as Engineers without Borders Australia, are implementing a program in the Tonle Sap region that aims to reduce these problems.

APPROPRIATE ENERGY FOR FLOATING AND FLOOD-AFFECTED COMMUNITIES

The program aims to develop and demonstrate appropriate and sustainable energy solutions for floating and flood-affected communities, particularly waste-to-energy biodigesters and solar enterprises, as part of an integrated approach incorporating agriculture, sustainable livelihoods, and sanitation.

Biodigesters convert human, animal, and organic waste into biogas for energy, and treat waste so it can be safely disposed of or used as fertiliser. The conversion reduces the pathogens considerably, improving sanitation and water quality in the community, while producing a valuable agricultural resource. The biogas produced from the biodigesters can be used by the community for cooking and lighting, and will reduce

© Live & Learn Environmental Education. Adaptable Biodigesters.

time, effort, and money used for families' energy needs, while also reducing deforestation pressures.

Until now biodigesters have only been feasible for farmers with several animals and no flooding challenges, but the development of new designs under this program has made them suitable for many more users, especially the poor and marginalised.

The project involves the transfer of knowledge to the community in a number of ways, including training local entrepreneurs in production, sales, and operation/maintenance of the systems, as well as their products like biogas and fertiliser. The community have also been supported to introduce solar systems for homes, schools, and night tuition classes.

Demonstrating appropriate energy for floating and flood-affected communities will support the Royal Government of Cambodia's energy and environment policies in a number of ways. The program aims to contribute to a greater coverage and diversity of appropriate and renewable energy options, in the significant number of floating and flood-affected communities.

© Live & Learn Environmental Education
Controlled experiments

LESSONS LEARNED AND REPLICABILITY

Floating and small-scale biodigesters are an innovation of particular use for floating and flood-affected communities, and for users with limited waste. Addressing sanitation in these communities is also significant as there are no existing solutions to this problem. Micro-solar contributes a new approach to energy that is both more sustainable and cost-effective.

Live & Learn plan to use the solutions to improve energy access, sanitation, livelihoods, and agricultural integration at a larger scale. The knowledge gained from the demonstration of these innovative and appropriate solutions is being shared and transferred locally and internationally for further replication in similar contexts.

Women and girls suffer most from lack of access to energy and sanitation, and stand to benefit most from the opportunities, services and solutions within their communities. The program has sought to understand and engage with women and girls on their practices, preferences, needs and ideas from the earliest stages of the work, in order to ensure they are visible and vocal.

The lack of suitable technical sanitation and energy solutions in challenging environments continues to be an issue worldwide and there remains significant responsibility and opportunity to continue focus on these. Successful solutions need to be appropriate for the environmental, social, and economic contexts of the community.

BIOSPHERE RESERVE
TONLE SAP - CAMBODIA
Sources:
Live & Learn Environmental Education
Energy and Environment Partnership (EEP) - Mekong
Engineers Without Borders Australia

ALDABRA ATOLL

Improving the sustainable operation of a World Heritage Site

The UNESCO World Heritage Site of Aldabra Atoll is an important conservation and research area. The atoll comprises four large coral islands which enclose a shallow lagoon; the group of islands itself is surrounded by a coral reef. Due to difficulties of access and the atoll's isolation, Aldabra has been protected from human influence, and thus retains over 100,000 giant tortoises (*Aldabrachelys gigantea*), the world's largest population of this reptile.

The Seychelles Islands Foundation (SIF) is dedicated to researching and preserving the atoll and therefore runs a research station on Aldabra. Since its founding in the 1970s, the research station was operated solely on diesel generators. Keeping the atoll supplied with fuel was a major logistical and financial challenge and a constant threat to the fragile ecosystem.

In 2008, the Seychelles Islands Foundation started investigating ways to increase energy efficiency, and developing a renewable energy system aiming to reduce operational costs.

THE FIRST STEP: ENERGY AUDIT AND ENERGY EFFICIENCY MEASURES

Renewable energy options and their applicability were assessed following an energy audit and alongside research into energy efficient measures.

Aldabra is an off-grid location, so baseline data on energy consumption was collected by making a detailed inventory of all electrical appliances and measuring electricity consumption for key consumption groups such as air-conditioning (AC) units, household appliances, and computer equipment. The baseline energy study culminated with a workshop on Mahé attended by local experts in renewable energies, electricity generation, and island operation.

Energy demand is an important factor to determine the optimal size of a renewable energy system and decisive for the required investment costs. A protocol

© Michal Sur. Giant Tortoise.

was developed to complement the energy efficient infrastructure by ensuring prudent use of electricity by the staff.

RE SYSTEM IMPLEMENTATION

At the end of 2010, following the findings of the SWOT analysis and the available data, the decision was taken to implement a hybrid PV-diesel system. A hybrid system was opted for because it ensures reliable and efficient system operation, since PV power only would have had weather related fluctuations. The company IBC solar, based in Germany, was selected on the basis of relevant experience, especially with off-grid systems in remote locations that have difficult logistics.

The PV hybrid system at Aldabra is composed of 108 IBC PolySol 235 TE solar modules with a total nominal power of 25.35 kWp, and 96 batteries of the type 12 OPzV.solar 2200 made by Moll, which have a total capacity of 315 kilowatt hours at 48 volts.

Energy efficient measures reduced electricity demand by 57 per cent. 38,171 kWh of solar electricity was generated in the first year of operation, covering 94 per cent of the station's new demand. This has avoided a total of 97,523 kg CO2 per year. Since implementation of the photovoltaic system, diesel demand has decreased by 97 per cent and operational savings of up to €68,000 are projected, resulting in system payback in only three years. This clearly shows that investments into both energy efficiency and renewable energies are required for environmental and financial sustainability.

LESSONS LEARNED AND REPLICABILITY

Bringing renewable energy to a site as remote and logistically challenging as Aldabra was viewed as unattainable for a long time. The outcome of this project demonstrates that it is not only possible but even more successful than predicted. The project showcases a highly effective environmental management solution in a protected area with economic benefits via substantial reductions in operation costs.

The following lessons learned on Aldabra can be applicable to other protected areas:

- Include a comprehensive energy audit as a preparatory step.
- Consider and plan energy efficiency measures to reduce energy consumption. Demand reductions are more cost effective than investments into PV power and should be fully explored first.
- When defining your energy demand consider the implementation of energy efficient measures for an economical system size since the system size dictates your investment costs.
- Integrate the local community for long-term success of the project.
- Build ownership into project implementation.
- Investments into energy efficiency and renewable energies can increase sustainability of financing your operations.
- Remote monitoring options for systems in isolated places can substantially reduce maintenance costs.
- Publicity is vital to enlist support, disseminate information and galvanise efforts to initiate similar projects elsewhere.

WORLD HERITAGE SITE
ALDABRA ATOLL- SEYCHELLES

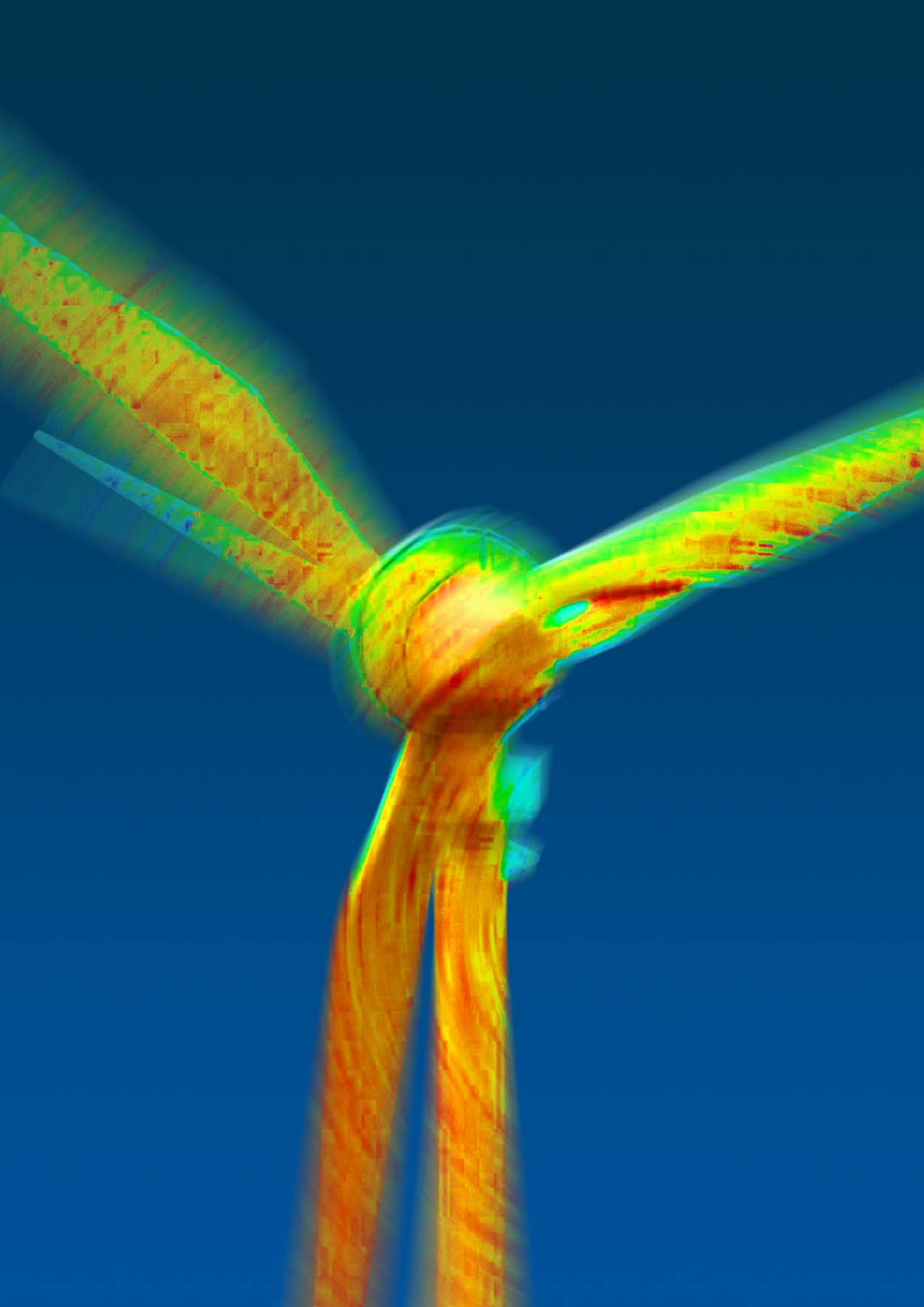
Source:
Seychelles Islands Foundation (SIF)
Aldabra Research Station

Good Practices IV

© Gorona del Viento - El Hierro biosphere reserve

PAVING THE WAY TOWARDS
100% RENEWABLE ENERGY SUPPLY

Fossil fuels are finite, there is an insecurity of energy supply and prices are unstable and destabilising. In addition climate change and nature loss is at our doors, so finding tangible and immediate solutions is critical. Some UNESCO's Sites provides real solutions by developing a harmonious transition towards 100% Renewable Energy Supply.



GROSSES WALSERTAL

Towards 100% power from renewable energy sources and Energy Region of the Future

Six villages within a single alpine valley form the Grosses Walsertal Biosphere Reserve, situated in the western part of Austria. The valley is a prime example of a living cultural landscape, where, since its occupation by the Walser people in the 13th and 14th centuries, a system of highly adapted mountain farming, pasture, and extensive forestry has been developed.

With the declaration of the biosphere reserve the inhabitants of the "Walsertal" contributed to protect the valley "Grosses Walsertal" by applying sustainable and ecologically compatible development. Thus, the fascinating region ensures a high quality of life and living space for following generations. In doing so, a future proof energy production with renewable energy sources plays a major role, with regard to the increasing global warming and the limited supplies of fossil fuels.

The goal is clearly defined: 100% power from renewable energy sources and 100% regional energy supply. With a quota of 84% eco-power the goal of supplying 100% power from renewable energy sources is placed within reach.

USE OF RENEWABLE REGIONAL RESOURCES FOR ENERGY-EFFICIENT COMMUNITY

With regard to renewable energy sources, the use of timber from the forests in the valley is of primary importance. In addition to greater emphasis on the use of timber for construction purposes in Vorarlberg, the forest biomass is to be utilised primarily for energy generation purposes, along with hydropower and solar energy. The goal is to meet 50% of thermic energy generation requirements (especially heating) with the help of a network of central and decentralised biomass heating plants.

The Grosses Walsertal valley is taking part in the e5 Programme for energy-efficient communities. This program involves the support, awarding and networking of municipalities in the sectors of energy efficiency and climate protection. The main goal is to distrib-

ute an advanced energy policy. Every three years the e5 municipalities undergo a control and get awarded with up to five "e". Currently the "Grosses Walsertal" has four "e", awarded by an international jury and supported by the energy department of Vorarlberg.

The six communities of Großes Walsertal BR take their function – to act as 'living laboratories' for testing sustainable solutions – seriously. In February 2010, the BR was awarded the European Energy Award® in silver. The EEA is the highest recognition in Europe awarded to energy efficient communities.

ENERGY CONSULTING AND ADVISORY SERVICE

To achieve the goal of supplying energy only out of renewable energy sources of the valley, the active co-operation of local people is very important. Various initiatives try to create awareness of the importance of economical and energy-efficient usage of energy: Energy consulting institutions deliver free information about energy-efficient building and redevelopment; municipalities support the installation of biomass-heating systems, constructions of thermal solar equipment as well as Energy Performance Certificate-calculations for residential buildings.

SMART GRID SOLUTIONS

In rural areas with low population density and little demand for electricity connecting a large number of local power stations to the conventional distribution grid soon runs into difficulties. The feed-in points are distributed all over the grid region, including remote areas on the fringes of the grids, where their performance is more limited. A new approach here is a bidirectional, so-called "active" distribution grid. In future the lowest grid levels connected to consumers are increasingly to accept and distribute electricity fed in from local generators and to transmit surplus power on to higher grid levels.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

Grosses Walsertal experience shows how a small area can become a regional and international model of energy sustainability thanks to the involvement of local authorities and strengthening of several programmes and initiatives in the same direction: energy efficiency labels, "e-Regio" projects, promotion of sustainable mobility among tourists and local population, and free energy consulting. "e-Regio I" and "e-Regio II" are projects accomplished as one of the Austrian Climate and Energy Model Regions. Within the framework of e-Regio I a concept was developed in order to reach 100% eco-energy self-supply, in the framework of the e-Regio II measures are implemented.

Part of the success consists in the adoption of an integrated energy and environmental planning system and instruments for its governance, ensuring the guidance and the evolution of the future development of the region in accordance to the ecological, economic, cultural and social aspects.

Grosses Walsertal is a living model of sustainable regional development with the participation of the local people, replicable in rural mountain areas with low population density.

BIOSPHERE RESERVE
GROSSES WALSERTAL - AUSTRIA

Sources:
Grosses Walsertal Biosphere Reserve
Bundesministerium für Verkehr, Innovation und Technologie

EL HIERRO BIOSPHERE RESERVE

The first 100% Renewable Energy Island

The island of El Hierro, nicknamed the "Meridian Island", has a population of 11,030 inhabitants and an area of 269 km^2. It was declared a biosphere reserve in 2000. It is the smallest island of the Canary archipelago and a sustainability model for the whole region. El Hierro is an active member of the World Network of Island and Coastal Biosphere Reserves (WNICBR).

From the end of 2013 El Hierro will be the first energy-isolated territory in the world able to power itself entirely from renewable energy sources. For the first time the traditional problem of intermittency of renewable energy sources is overcome through combining the power generation of a wind farm with a hydraulic storage system.

THE WIND-HYDRO PUMPED STORAGE POWER PLANT

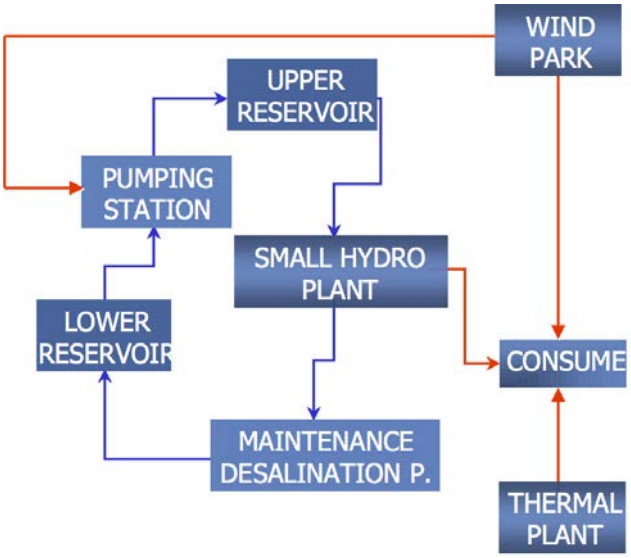
The wind-hydro system consists of a wind farm (11,5 MW), two water reservoirs, a pumping unit, hydropower plant, and seawater desalination plant. The wind farm supplies electricity directly to the network and excess power feeds the pumping unit that raises water to a higher reservoir dam, which works as energy storage system. The power plant uses the stored potential energy, ensuring power supply and network stability.

The operation's philosophy is based on supplying the electrical demand of the island with renewable sources, thus guaranteeing the stability of the electrical network. The diesel engine plant will only operate in exceptional or emergency cases, when there is not enough wind or water to produce the demanded energy.

This wind-hydro project will avoid the annual consumption of 6,000 tons of diesel, equivalent to 40,000 barrels of oil imported by sea to the island, saving over 1.8 million euro yearly if compared with conventional power generation costs. Likewise, it will avoid the emission of 18,700 tons of CO_2 per year into the atmosphere. That amount of CO_2 is equivalent to that fixed by a forest of 10,000-12,000 hectares, about the double of the forests in the island.

The project, whose cost amounts to approx. 80 million Euros, is promoted by the local corporation Gorona del Viento El Hierro, S.A., whose shares are held by Cabildo de El Hierro (Local Authority - 60%), Endesa (30%) and the Canary Islands Institute of Technology - ITC (10%).

Aerial photos showing wind farm and upper reservoir.



© ITC. Wind-hydro plant project scheme.

TOWARDS SUSTAINABLE ENERGY COMMUNITY

The Energy Sustainability Strategy of El Hierro aims not only at electric self-sufficiency. Taking into account that about 46% of energy consumption is due to internal transport, the El Hierro Biosphere Reserve, with the support of IDAE and the Canary Islands Government, has launched the Sustainable Mobility Plan (PDMS). The PDMS is a clear commitment for a change in the transportation modes and vehicles aimed at local population and tourists. El Hierro bets on the generalization of electric vehicles and alternative modes of transport, and gives also high priority to public transport or innovative solutions such as transportation on request.

Seawater desalination is essential in order to ensure a constant supply of water for the wind-hydro system. It is also clear that another of storing the surplus energy generated by the wind farm is to produce desalinated water. In this context, the final implementation of the 100% RES project implies an important increase in the desalination capacity of El Hierro and, as a consequence, a significant increment in water for fragile ecosystems and irrigation capacity. In this way, new organic farming projects can be linked to renewable energy.

The energy sustainability strategy is complemented by other measures such as the promotion of domestic solar water heating systems, distributed PV microgeneration, exploitation of biomass resources and, particularly, the energy saving campaigns jointly developed by the Biosphere Reserve and the ITC (with the support of the Canary Islands' Regional Ministry of Industry).

© El Hierro biosphere reserve. Electric cars powered by RES.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

The experience of El Hierro demonstrates that it is actually possible to achieve energy self-sufficiency using renewable energy sources in certain areas such as small mountainous islands and isolated rural areas. It also teaches that the process of replacing energy sources should be accompanied by the development of a culture of energy saving and efficiency and by new ways of governance.

The Wind-hydro project provides a viable and innovative solution replicable in small and medium island territories and areas isolated from the energy grid. The experience is serving as a reference for territories such as Aruba, Easter Island, some Japanese islands, and other biosphere reserves such as Minorca.

BIOSPHERE RESERVE
EL HIERRO - CANARY ISLANDS - SPAIN
Sources:
Gorona del Viento El Hierro, S.A.
ITC (Instituto Tecnológico de Canarias)
Reserva de Biosfera de El Hierro

LOW ISLES - A MODEL OF SUSTAINABILITY

An island powered by the Sun

Low Isles is a coral cay located 15 km off Port Douglas on the northern Queensland coast and is within the Great Barrier Reef World Heritage Area. The Low Isles is surrounded by Marine National Park Zone (IUCN Category II).

Low Island is a Commonwealth Islands Zone within the Great Barrier Reef Marine Park and is held on behalf of the Commonwealth of Australia by the Great Barrier Reef Marine Park Authority. The island is jointly managed by the Authority and the Queensland Parks and Wildlife Service. It is a high visitation area where on a busy day there are typically between 200-300 visitors, and in the low season about 100.

In 2012 Low Isles became the first island in the Great Barrier Reef World Heritage Area to be powered exclusively by renewable energy.

OFF GRID STAND ALONE SOLAR POWER STATION

The total energy requirements of the island's infrastructure are at present supplied by the renewable energy system, providing a carbon neutral environment.

The case of Low Isles shows a continuous improvement process towards 100% renewable energy. In 1963, diesel generation was introduced to provide 240 volt mains power supply to the island's infrastructure and lighthouse. During 1998, a hybrid power station was constructed consisting of a solar array, inverter and battery bank. These were designed to operate in conjunction with the diesel generator to provide continuous power to the islands residences 24 hours a day. Finally, in 2013, the renewable energy system was once again upgraded introducing state of the art equipment with a commitment to ensure that the islands operations remain carbon neutral well into the future.

The renewable energy system implemented is relatively simple. There are two solar arrays with 80m^2 active solar surface area, providing 11 kW peak pow-

© Great Barrier Reef Marine Park Authority.
Solar array 24 x 250W PV modules.

er. One array is mounted on a free standing structure tilted 5 degrees to the South for maximum yield during the summer months. The second array is roof mounted on a 15 degree tilt to the North for optimal yield during the winter months. The system uses an inverter with a comprehensive data logging system, directly monitored via a computer system, and relies on a battery bank (60 cells configured to provide a 120 volt system with a 700 ampere-hour capacity).

ENERGY MANAGEMENT PLAN

Low Isles has an Energy Management Plan that was implemented in 2012 which resulted in a 40% reduction in energy use for the island operations.

© Great Barrier Reef Marine Park Authority.
Solar array 30 x 170W PV modules.

The Energy Management Plan covers the proper operation of such systems as wastewater treatment, water pumping and supply, and includes a detailed catalogue of energy saving initiatives. Since the implementation of the Energy Management Plan, the greatest energy use on the island is powering refrigeration in each residence, and the Wastewater Treatment Plant.

The island power usage is monitored consistently and recorded four to five times a day, to ensure that the operations are within specified guidelines.If excessive energy is being used, an investigation is undertaken to find the source of the unscheduled energy use.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

The experience at Low Isles shows the importance of continuous monitoring of renewable energy based solutions, and especially the importance of energy efficiency and saving plans in such circumstances.

This showcases a commitment to a carbon neutral policy well into the next decade, providing a model of environmental sustainability within the Great Barrier Reef World Heritage Area.

Low Isles' solution and management model can serve as a reference for a large number of small isolated areas in UNESCO Sites that are visited for tourism or research-related activities.

BIOSPHERE RESERVE
WORLD HERITAGE AREA
GREAT BARRIER REEF - AUSTRALIA

Source:
Great Barrier Reef Marine Park Authority

ERGAL PROJECT

Zero fossil fuels on the Galapagos Islands

Situated in the Pacific Ocean some 1,000 km from the South American continent, these 19 islands and the surrounding marine reserve have been called a unique 'living museum and showcase of evolution'. The Galapagos Islands, officially called Archipiélago de Colón, were inscribed on the World Heritage List in 1978 and declared a Biosphere Reserve in 1984.

In 2007, the government of Ecuador launched the "Zero fossil fuels on the Galapagos Islands" initiative, planning to phase out the consumption of fossil fuels at the Galápagos Islands by the year 2015. During these years, a diverse range of projects on the use of different energy sources (wind power, solar PV, and biofuels), have gradually been developed, including actions related to energy efficiency and training.

The ERGAL project (Renewable Energy for Galapagos) coordinates the implementation of renewable energy projects at the archipelago of Galápagos. These projects contribute to the Government Zero Fossil Fuels for the Galápagos Initiative executed by the Ministry of Electricity and Renewable Energy, and rely on the support of UNDP and the Global Environmental Facility (GEF).

THE OBSERVATORY OF RENEWABLE ENERGIES IN LATIN AMERICA

The Galapagos experience is based on a wide range of projects in different parts of the archipelago that are paving the way towards energy self sufficiency.

Renewable Energy will gradually phase out fossil fuels in the electricity generation of Santa Cruz/Baltra and will gradually replace gasoline utilization in the transport sector. The Baltra wind farm (2.25 MW) generates power for the neighbouring island of Santa Cruz, which has the highest energy demand within the Galapagos Archipelago. The country's first large-scale wind project (2.4 MW) was funded and implemented by the Global Sustainable Electricity Partnership. In operation since 2007 on the island of San Cristobal, it meets nearly a third of the electricity demand of the island.

Another dimension of the project regards the use of solar energy (photovoltaic) to replace diesel consumption at the islands of Isabela and Floreana, and to complement wind energy contribution in the Santa Cruz/Baltra system.

© Galapagos National Park

© ERGAL Renewable Energies for Galapagos.

The initial project on Floreana was funded by the Spanish Agency for International Cooperation, the Galapagos National Park, the local Council of Floreana, and ERGAL. After its launch in 2004, the reported fuel saving has been of 35%.

Isabela Island will have a photovoltaic-diesel hybrid system with a capacity of 3.3 MW. Furthermore, in cooperation with BMZ, a PV power plant of 1.1MW is being developed, aiming to reach 100 % renewable power supply in combination with a 1.2 MW (dual-fuel) thermal power plant, and 0.9 MW in batteries.

Biomass is also integrated into ERGAL's strategy through biofuel production from the Jatropha nut (piñón) to fuel small diesel generators on the islands. The"piñon oil energy program" has been so successful on Floreana that they are considering expanding it to the town of Puerto Villamil on the island of Isabela. It relies on the support of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

The original renewable islands plan included large scale energy efficiency in the form of cogeneration with a new thermal power plant in Baltra and in small scale applications in the form of domestic energy efficiency measures.

© ERGAL Renewable Energies for Galapagos.

LESSONS LEARNED AND REPLICABILITY

The ambitious targets of ERGAL and the "Zero fossil fuels on the Galapagos" initiative can only be achieved when the implementation of the different project components is accompanied and actively supported by a special targeted training of the stakeholders, the administration on regional and municipality level and the political decision makers.

Although the geographical boundary of the project is limited initially to the four inhabited Galapagos Islands (San Cristobal, Floreana or Santa Maria, Santa Cruz/Baltra, Isabela) the project is expected to have a substantial impact on the development of non-conventional (renewable) energy technologies in the whole country and, eventually, in the region. In this sense, the project is conceptualised as a laboratory for testing different alternative options for renewable energy technologies like wind/ PV/ biofuels.

Galapagos strategy is a reference to the UNESCO sites for its capacity to generate projects in cooperation with several countries, agencies, and companies in the renewable energy sector. It stands out for its potential to share experiences, as demonstrated by the project with Mali, started from the biomass experience. Finally, it is a model of cooperation in favour of renewable energies in a paradise of biodiversity on the planet.

WORLD HERITAGE SITE & BIOSPHERE RESERVE
GALAPAGOS ISLANDS (ARCHIPIÉLAGO DE COLÓN)
ECUADOR
Sources:
ERGAL project – Energías Renovables para Galapagos.
Factor 4 Energy Projects GmbH

CARBON-FREE ISLAND JEJU BY 2030

Renewable energies and Smart Grid Test-Bed

Jeju was designated a Biosphere Reserve in 2002, World Natural Heritage Site in 2007 and a Global Geopark in 2010. Jeju has now become a 'treasure island of environmental assets' that the world has to preserve.

The sunny and windy climate makes the island an ideal location to test the concept of distributed energy generation and micro-grids. By 2030, the island plans to become carbon-neutral and fully-sustainable through the use of renewable energy. It is a great challenge, if we take into account that renewable energies currently make up about 5% of the total electricity supply on Jeju Island. Furthermore this plan would bring to the creation of about 40,000 green jobs.

The plan will replace all fossil fuels through utilizing wind via land and sea turbines, solar energy, small hydropower and electrical storage facilities. Jeju residents will also see the proliferation of electric cars and smart homes, among many other improvements.

BUILDING A 100% RES ISLAND

The "Carbon Free Island Jeju by 2030" is being implemented in three phases: the first phase has been to make Gapa Island carbon free, turning it into the laboratory of this ambitious initiative. The second phase is to raise the share of new and renewable energy in the total energy market to 50 percent by 2020; and the third phase is to make Jeju Island a world-class carbon free and green growth city by 2030.

The community of Gapa Island, a small island located South of Jeju, previously received its power from diesel generators, which produced over 780-tons of greenhouse gas emissions every day. In cooperation with local and central government agencies, Gapa Island has now completely switched over to a carbon-free energy grid. The island is now 100% powered by new and renewable energy. Electric vehicles for transportation and a smart home system have been installed in every household on the island. Furthermore, power lines burial underground, forestation, and landscape improvement projects were completed in 2013.

Wind and solar power for the island.

Based on projections, wind and solar power sources can supply approximately 6,561 gigawatt-hours which is more than the total used amount on Jeju Island. By 2020, one gigawatt offshore wind power, 350 megawatts inland wind power, and 30 megawatts solar power will make up 3,585 gigawatt-hours, 68% of Jeju's total electricity demand of 5,268 gigawatt-hourss. By 2030, offshore wind power generation will rise to two gigawatts and solar power generation to 100 megawatts.

© Jeju Especial Self-Governing Province

SMART GRID TEST-BED & ZERO EMISSION MOBILITY

Jeju will aim to be the world's smart grid leading city by supporting the development and implementation of smart grid technologies. The Korean government selected Jeju on June 2009 as the location for Smart Grid Test-bed. Jeju Smart Grid will become the world's largest Smart Grid community that allows the testing of the most advanced Smart Grid technologies and R&D results, as well as the development of business models.

The aim of Jeju Test-Bed is to optimise energy usage by utilizing new and renewable energy sources and energy storage facilities. A total of 168 companies are participating in the project, which covers approximately 6,000 households.

The smart grid - an intelligent power transmission and distribution system - collects real-time data on energy usage and demand. That data can be used to limit the unnecessary use of electricity and increase the efficiency of energy consumption.

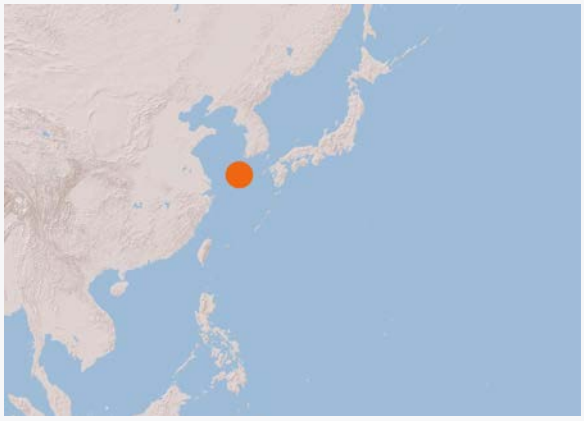
The energy sustainability strategy is completed with the commitment for sustainable mobility based on electric vehicles chargeable from renewable energies. The Plan provides 371,000 electric cars and 225,000 rechargers will be available across the island by 2030. In addition, improvement of law and regulations for vitalizing electric cars and incentives for spreading battery cars will help Jeju to be a model city of electric cars. A total of 160 electric cars have been distributed thus far, including models such as the Kia Ray, the SM3 from Renault Samsung Motors, and the GM Spark.

LESSONS LEARNED AND REPLICABILITY

In South Korea, the government has set ambitious goals to reduce CO2 emissions by 30% from the anticipated "business as usual" levels in 2020. As part of these efforts, Korea launched a Smart Grid national project to achieve green growth in a transparent, comprehensive, effective, and efficient way. This project envisions laying the foundation for a low carbon, green-growth economy by building a Smart Grid. Thus, it can serve as a yardstick to evaluate the future of Korea's green-growth economy. In light of this, Korea came up with a proactive and ambitious plan to build a Smart Grid Test-bed on Jeju Island to prove its determination in the low carbon, green-growth strategy.

Jeju's experience provides an innovative model of transition to green economy from renewables. Taking into account that the Biosphere Reserve hosts the technical headquarter of the World Network of Island and Coastal Biosphere Reserves (WNICBR), which focuses on climate change issues, this is an excellent opportunity to promote and replicate advanced experience in renewable energy self-sufficiency on island territories.

With regard to education and dissemination of sustainable energies, Jeju has carried out another innovative project, constructing the world-class new & renewable energy theme park by creating "carbon free island" and linking "Jeju smart grid". In 2010, the New & Renewable Energy Exhibit Hall was opened to convert tourism related to renewables into a revenue source domestically and globally.



BIOSPHERE RESERVE & WORLD HERITAGE SITE
JEJU ISLAND - REPUBLIC OF KOREA
Sources:
Jeju World Natural Haritage Center
Jeju Special Self-governig Province
Korea Smart Grid Institute

SMARTREGION PELLWORM

Germany's green energy island

Pellworm is one of the North Frisian Islands located in the North Sea coast of Germany. It is a part of the Wadden Sea and Hallig Islands of Schleswig-Holstein biosphere reserve. The island has an area of 37 km^2 and a population of about 1,600 inhabitants.

Pellworm is the greenest North Sea island, in both senses of the word, with its many dikes with many sheep, many meadows and fields, and many inhabitants who actively pursue environmental protection. Against this background, renewable energy has played an essential role in the local sustainable development.

Pellworm Island points the way to the energy supply system of the future. The project "SmartRegion Pellworm" brings a new dimension to the integrated use of renewable energy sources.

A PIONEER ISLAND IN THE USE OF RENEWABLE ENERGIES

Pellworm Island has pioneered the utilization of renewable energy since early 80's. After that period, the development is increasing. The island economy is based on farming and tourism, with an overwhelming predominance of the service sector. Due to the volatility of the dominating energy sources wind and photovoltaics, the power generation is up to eight times higher than the load on the island. Another essential aspect that defines the case of Pellworm is the fact that the island is connected to the mainland electricity grid in Germany via submarine cables, which affects the maximum transferrable power.

In 1997, a renewable energy plan for Pellworm was drawn up. The title was "Energy Supply on the Basis of Renewable Energy Sources Using the Example of the North Sea Island Pellworm - A Local Development Plan". The goal of the development plan was to present model concepts for energy supply based on renewable energies and to access a broad spectrum of applications. Special emphasis was given to energy management and the ways of storing energy. Pellworm's strategy for the future is based on fully ex-

© E.ON. Hybrid storage system combines a redox flow and a lithium ion battery to provide high energy and high power.

ploiting its main sources of renewables: wind, sun and biomass.

SMARTREGION PELLWORM

The purpose of the SmartRegion Pellworm project is to address several challenges of the energy transformation at the same time. It aims to balance the intermittent output of renewables and to use more of this output locally. The nearly €10 million project is coordinated by E.ON Hanse AG and Schleswig-Holstein Netz AG. It is being conducted by a broad-based innovation alliance consisting of partners from industry and science: : Gustav Klein GmbH & Co. KG, (power electronics), Saft Batterien GmbH, West Coast University of Applied Sciences, Fraunhofer Insitute IOSB-AST and RWTH Aachen University. SmartRegion Pellworm received funding from several federal ministries as part of the Federal Energy Storage Initiative.

INNOVATIVE STORAGE CONCEPT

Using a combination of innovative storage technologies, E.ON is looking to provide a stable, cost-efficient and market-oriented electricity supply based on renewable energies. On Pellworm, energy generation from photovoltaics (about 2.7 MW), wind power (5.7 MW) and biogas (around 530 kW) is on average three times higher than consumption. The pioneering energy storage system uses of a hybrid battery storage system comprising a redox-flow (200 kW, 1.600 kWh) and a lithium ion (1 MW, 560 kWh) battery to store renewable electricity centrally, electric storage heaters in homes for demand response and residential batteries for balancing distributed photovoltaic systems. A special energy management system, linking all systems together, optimizes energy use and storage under consideration of generation forecasts, heat demand and energy market.

As part of the SmartRegion Pellworm project, the island's existing power infrastructure was supplemented by a variety of components that make it possible to better control energy flows and to achieve an optimal balance between power output and usage. The integration of large-scale batteries into the regional power grid is one of the new approaches taken by the project. Another is the hybrid storage system concept, which combines two state-of-the-art battery technologies to provide high power and high energy with reduced investment costs: lithium ion and redox flow. Other key components of the island's innovative power system include automated distribution substations, smart meters and grid communication infrastructure.

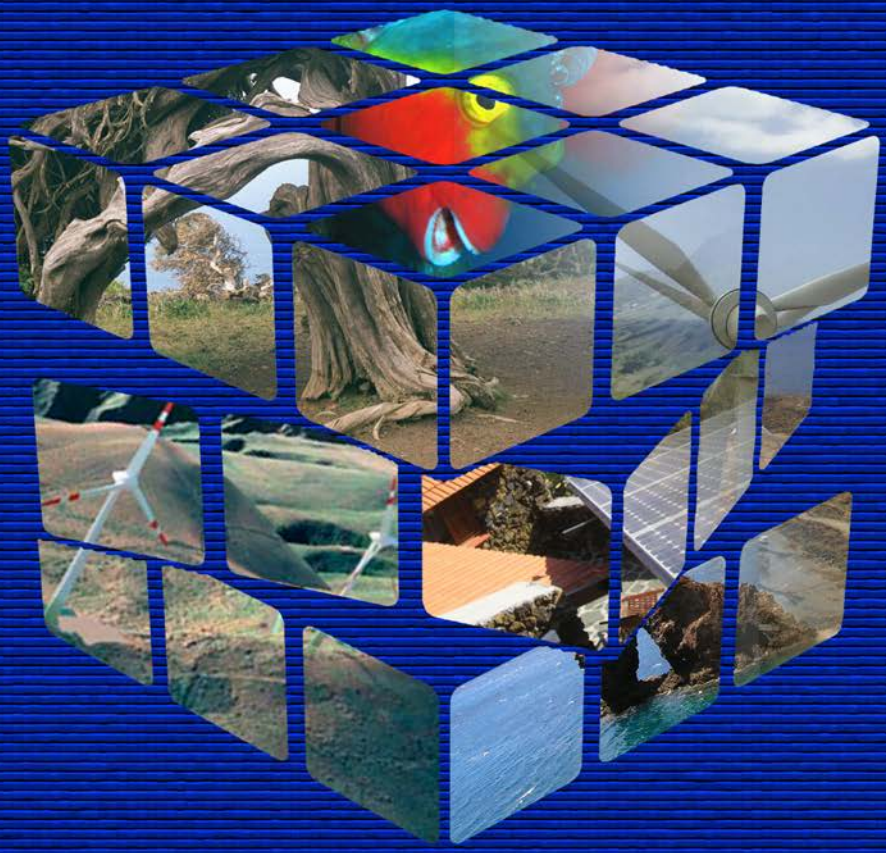
LESSONS LEARNED AND REPLICABILITY

Pellworm has now become a platform for testing and improving the local renewable energy storage system. The technology already deployed on Pellworm is a storage blueprint for a future decentralized energy system which could help to reduce the need for transporting large quantities of bulk power across Germany and Europe and, consequently, reduce the need for network expansion.

SmartRegion Pellworm
www.smartregion-pellworm.de

BIOSPHERE RESERVE
WADDEN SEA AND HALLIG ISLANDS OF SCHLESWIG-HOLSTEIN - GERMANY
Sources:
E.ON
International Study of RE-Regions

Good Practices V



SUSTAINABLE TOURISM & RES

Tourism has significant potential as a driver for green economies and energy sustainability in many UNESCO Sites. Tourists are demanding the greening of tourism, and both accommodations and visitor centres can become showcases of sustainable energy. Investing in the renewables for tourism can reduce the cost of energy and water, and enhance the value of biodiversity, ecosystems, and cultural heritage.

FEYNAN ECOLODGE

A model of sustainable hotel in Dana BR

Feynan Ecolodge lies in the Dana Biosphere Reserve, the largest reserve in Jordan covering 320 km^2 of land. Dana is an area of tremendous biodiversity and importance in terms of wildlife, geology and landscape. It is the only reserve in Jordan that encompasses the four different bio-geographical zones of the country: Mediterranean, Irano-Turanian, Saharo-Arabian and Sudanian.

Feynan Ecolodge is a first for ecotourism in Jordan. Owned by the Royal Society for the Conservation of Nature (RSCN) and operated by EcoHotels (a Jordanian start up), Feynan Ecolodge integrates conservation and socio-economic development whilst having a minimal impact on the environment and offering a unique tourism experience. Feynan Ecolodge has garnered international recognition, receiving a number of awards including being listed as one of National Geographic's top 25 ecolodges in the world in 2013.

A LODGE BASED ON ENERGY SUSTAINABILITY

Feynan Ecolodge is completely off grid. What little electricity is consumed is generated through solar photovoltaic (PV) panels. Batteries store 50kWh, enabling the lodge to store 3 days' worth of electricity to account for cloudy days.

In order to efficiently utilize the energy generated, usage is kept to a minimum and closely monitored. Only essential electrical appliances are used, and those employed are certified to use very low amounts of energy. The kitchen, guest bathrooms and office are the only areas with electric lighting and use CFL 8W bulbs. Appliances such as the refrigerators in the kitchen are Energy Star (US rating) or A/A+ (EU rating) certified. Laundry is air dried, reducing the need for energy consuming driers and towels are changed on request rather than every day. As a result the lodge uses less electricity than a typical two bedroom apartment in Jordan's capital, Amman.

At night, the lodge is lit by candlelight providing an innovative solution and drawing on traditional techniques. Candles made onsite by local Bedouin women are positioned in carved niches throughout the lodge and in guests' rooms giving light, an enchanting ambience and allowing guests to view the beautiful night sky.

Hot water needs at Feynan are also met by solar power. An extensive solar heating system provides all nec-

Feynan Ecolodge © Feynan Ecolodge. Photo by Brian Scannell.

Feynan Ecolodge at night © Feynan Ecolodge

essary hot water for the kitchen, guests, and washing machines (the washing machines do not heat water electrically).

Due to warm climate at Feynan, space heating is only required for a short part of the year. For 60-90 evenings each winter, waste from olive pressing known as jift in Arabic, or olive pit charcoal, is burned in the two fireplaces at the lodge to provide heat. This preserves Jordan's trees and utilizes a renewable source of energy that is a natural by-product of Jordan's annual olive harvest.

The ecolodge was designed following bioclimatic criteria. A well conceived design provides the lodge with an integral courtyard linked to outer patios providing soft breezes and shady spots to rest. Perpendicular outcrops on the lodge's facades provide shade on outer surfaces and aesthetically appealing contrasts.

INTEGRATED IN THE COMMUNITY AND THE ENVIRONMENT

The vision of Feynan is to operate in complete harmony with its environment. From the local staff, to the design of the lodge and its rooms, to its environmentally friendly policies, Feynan embodies sustainability whilst offering guests a unique experience. Feynan also directly contributes to conservation as a sizable proportion of revenue goes to the RSCN for investment in programmes to preserve the natural environment in the Dana Biosphere Reserve.

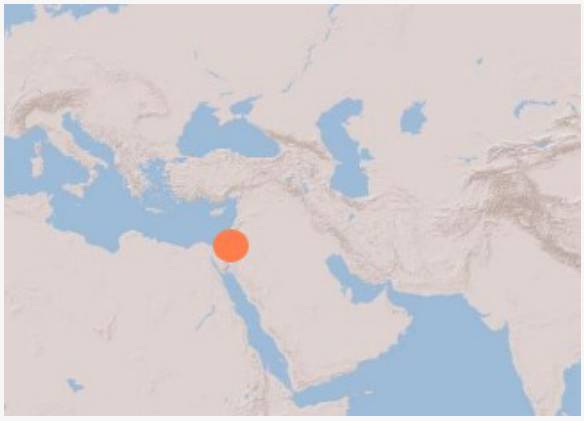
Feynan's approach to energy is just one part of its environmental strategy. Water use and waste are minimised. Only minimal amounts of paper and plastic are used and residual waste is recycled if possible. Food waste is transformed into fertiliser through on-site composting. Disposable plastic PET water bottles have been eliminated from guest rooms and replaced by locally produced clay water jars, saving 8,000 – 10,000 bottles from the environmental annually. Overall Feynan has reduced the amount of waste going to landfill by 60% since 2009.

In line with EcoHotels's mission and the Royal Society for the Conservation of Nature's (RSCN) policies to employ staff from local areas and communities, Feynan Ecolodge has an entirely local team working onsite. In addition, the candle-making and leather workshops on site give women in the community the opportunity to work to help support their families and showcase their art. Local businesses provide supplies for the lodge and all revenue generated from transportation to and from the lodge goes directly to the drivers from the local Bedouin community. In total the lodge provides direct benefits to over 80 local families which equates to 400 people or 14% of the local population.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

The experience of Faynan Ecolodge shows how an intelligent use of renewable energy sources not only helps the environment and solves the scarcity of resources, but it is also an added value to the tourism experience. The adoption of clean energy solutions and energy responsible behaviours becomes an attraction and a sign of identity rather than a problem.

Feynan model is a replicable experience in many isolated tourist destinations in the UNESCO sites. The development of the self-sufficient Ecolodge concept by integrating local cultural and environmental values is an excellent way to improve the tourist activity in the sites.



BIOSPHERE RESERVE
DANA - JORDAN

Sources:
Feynan Ecolodge
EcoHotels

SCHUK TOAK VISITOR CENTRE

Sustainable building inserted into an ecosystem

The 'Alto Golfo de California' biosphere reserve comprises the 'Pinacate' area, the 'Gran Desierto del Altar' and the 'Bahía de Adair' in the Gulf of California's border, covering an area of 1,652,110 ha. Geological volcanic formations with craters, dunes, oasis and beaches, and the diversity of plants associations determine its special landscape.

One of four fundamental elements of the Biosphere Reserve model it's the research and promotion of its biological resources, reason why, in a combined effort with the National Commission of Natural Protected Areas (CONANP) and the Tourism Promotion Commission for the State of Sonora (COFETUR), through El Pinacate and Gran Desierto de Altar Biosphere Reserve, negotiated the construction of a space dedicated to the education of conservation, in addition to supporting the development of sustainable tourism in this natural protected area.

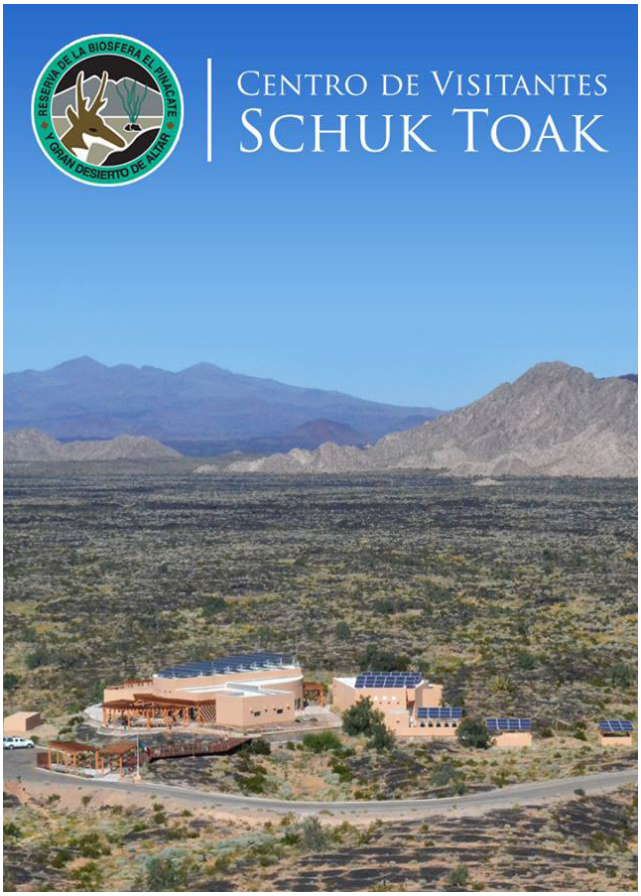
The 'Schuk Toak' Visitor Centre, Sacred Mountain in Pápago dialect (Tohono O'odham), represents a model of integrated and sustainable intervention in line with the ideas recommended for actions in biosphere reserves.

THE VISITOR CENTRE PROJECT

Having into consideration as one of the main factors the integration to the local ecosystem and the autonomy of economic resources, the project for the Visitors Center was conceptualized into an autonomous building: "an active system that would be inserted into an ecosystem"; as a consequence of which the concept establishes more in a way of in habitat than just an architectural design with a low energy consumption criteria.

The project it's constituted by a main axle that favors orientation achieving by bioclimatic design strategies cross ventilation, taking advantage of the sun´s path will naturally illuminate the interior of the building. Concerning the constructive system we choose the one that would have less impact on site: a prefabricated steel structure and autoclaved aerated concrete blocks that allows a clean constructive procedure, these offer a high thermal resistance grade which is

© Entorno Urbano



© Visitors Centre Schuk Toak

why they result a key factor in the design strategy of the building´s skin.

Another premise for the Visitors Centre is the application of "green technologies", incorporating a PV system as a primary energy source, as well as an absorption chiller, will offer a higher energetic performance coefficient than the traditional system.

Thanks to its PV system, the visitor centre has stopped emitting 149.9 metric tons of CO_2 into the atmosphere in its first year, which is equivalent to the environmental service provided by 449 trees.

© Visitors Centre Schuk Toak

The design and building process of these facilities are in line with an innovative and responsible vision. The best options and techniques of alternative energies were taken into consideration, as well as efficient use of water, orientation, insolation, prevailing winds, thermal materials, etc., so that the building is self-sufficient in energy and educational. In addition to the facilities, the centre has a Desert Botanical Garden of 30,000 m².

LESSONS LEARNED AND POTENTIAL REPLICABILITY

Tourism and education are extremely important activities in biosphere reserves. The facilities that support these activities express what biosphere reserve managers seek to transmit to visitors. Such projects open the possibility to demonstrate, besides the natural value, how it is possible to design a habitat in harmony with the environment using renewable energies.

Visitor centres are the gateways to the biosphere reserves and their perception determines the visitor's experience. Within this context, centres such as Schuk Toak, bring a new dimension of compromise with responsible and sustainable tourism.

The visitor centre was the first self-sufficient public building in the country. This pioneer role strengthens its capacity for replication in similar areas in Mexico and in other biosphere reserves in desert areas of the world.

BIOSPHERE RESERVE
ALTO GOLFO DE CALIFORNIA - MEXICO

Source:
Entorno Urbano
Reserva de la Biosfera El Pinacate y Gran Desierto de Altar

LADY ELLIOT ISLAND ECO RESORT

Clean Energy for Ecotourism

Lady Elliot Island is located at the southern tip of the Great Barrier Reef World Heritage Site. The Lady Elliot Island Eco Resort is surrounded by Marine National Park Zone (IUCN Category II).

Through a combination of solar and gas technology, water desalination and complementary demand management strategies, the Lady Elliot Island Eco Resort now runs on approximately 40% renewable energy, with a goal to operate on 100% renewables in the next three years.

PROMOTING ENERGY EFFICIENCY

The resort has undergone a series of transformations over the years to improve the visitor experience while at the same time reducing its energy usage.

The Resort operates under an Environmental Management System approved by the Great Barrier Reef Marine Park Authority. Under this system, the Resort has an Energy Management Plan. This plan helps the Resort to stay focused on reducing energy consumption and increasing the amount of energy supplied by renewables.

Following an energy audit in consultation with the Great Barrier Reef Marine Park Authority, the Resort introduced a number of low-cost, energy saving measures which resulted in an initial 20-25% reduction in energy costs. The resort staff identified the need for further load reduction and energy savings to maximise the overall effectiveness of the solar hybrid system. The audit also identified the opportunity to develop a hybrid off-grid power station to reduce carbon emissions, noise and the reliance on fossil fuels.

USING RENEWABLE ENERGY

The resort decided to establish a hybrid power station. The power station was funded as a joint venture between Lady Elliot Island Eco Resort and the Australian Governments Renewable Remote Power Generation Programme.

There was much effort put into design to ensure the structure of the power station had the smallest possible environmental footprint. Normal solar farms are spread out low in multiple rows on the ground. The Resort aimed to reduce the size of the area so the solar panels were contained into a single structure, with the space underneath used to build the rest of the

© Lady Elliot Island Eco Resort. Interpretive tour.

station. This compact design reduced the footprint by more than half and resulted in an unusual design.

The highly complex nature of this power system required eight organisations to be involved in the design, construction and running of the system.

In 2005, when the current owners assumed responsibility for the resort operation, the resort was using 550 litres per day of diesel (200,000 litres per year) to produce power using 220 kilowatt diesel generators running 24 hours per day. After four subsequent upgrades to improve how the resort produces power, the resort is now producing renewable energy from 188 solar panels that produce 43 kilowatts (kW) of power and 45kW of battery storage. This has reduced generator run time to 10/11 hours per day, therefore reducing daily fuel usage to approximately 100 litres per day. The system now includes three battery banks with 72 cells, three inverters and a new generator a quarter the size of the resort's original units. The system has a combined capacity of 133 kW, and is housed in a timber-framed structure. The structure is positioned for maximum ventilation and shading of electronics and batteries, and is a self-supporting, ballasted structure, eliminating the need for concrete slab or ground screws.

The Resort would like to add wind power to their renewable energy production but this will require impact assessment to ensure the wind generators are able to function without disturbing the numerous nesting seabirds that utilise the island.

The resort now enjoys a 60% reduction in fuel consumption and emissions, with this expected to increase further as additional solar panels or wind generators are added over time. The resort's long-term goal is to run the resort entirely on solar power and other renewable power sources thereby eliminating the use of generators except as backup.

Interpretive tours are conducted for guests and educational groups. Tour topics include the effects of climate change on a coral cay, the activities that Lady Elliot Island Eco Resort is doing to help slow down climate change, calculating carbon emissions and touring the hybrid solar power station to discover how the resort has managed to substantially reduce carbon emissions on the island. The island's history is also explored by touring the historic generator room which still houses the old diesel generators.

LESSONS LEARNED AND REPLICABILITY

As a leader in the introduction of new technologies on offshore islands, the resort has faced unforeseen challenges and has needed to respond accordingly.

The Resort has found that the most controversial and challenging part of making the switch to renewables was convincing guests and staff to focus on ensuring they use as little power as possible.

Through this installation, not only are reductions in fuel consumption and emissions an immediate result, but there is a greater awareness for both people that live on the island and people visiting which will further encourage the integration of sustainable principles. Energy sustainability is promoted to visitors with a take home message of considering energy sustainability options in their own lives, making Lady Elliot's experience a replicable model beyond the technical solutions used.

BIOSPHERE RESERVE
WORLD HERITAGE AREA
GREAT BARRIER REEF - AUSTRALIA

Source:
Great Barrier Reef Marine Park Authority

EIELSON VISITOR CENTER

Off-grid project in Denali biosphere reserve

Denali Biosphere Reserve and National Park is situated in south-central Alaska centred on the Alaska Range which separates the coastal lowland from the interior. Denali comprises Mount McKinley, the highest peak in North America towering 4,800 meters above the surrounding landscape as well as Denali fault system, the largest crustal break in North America.

As one of the leaders in sustainable design, the National Park Service made a priority of re-modelling Eielson Visitor Center using sustainable building methods and materials. The planning and construction of Eielson included strategies such as maximizing natural daylighting, selecting energy-efficient heating / venting systems, the use of renewable energies to power the building and thoughtful selection of recycled and locally produced. This infrastructure is an exceptional showcase for energy sustainability, being an educational landmark for visitors and a starting point and shelter for backcountry hikers.

The new Eielson Visitor Center - based on the designs of RIM Architects and RMI's Built Environment Team - was completed in 2008 and sustains itself without an electricity grid lifeline.

BUILDING INTO THE TUNDRA

A main goal of the project was to design a low-profile building that blends into the landscape. The steep slope enabled the designers to partially bury the building, which visually screens the structure from the Park Road. The roof is literally "green," as tundra mats salvaged from the construction of the site were relocated to planters dispersed on the roof terrace. These camouflage the roof deck, helping it blend into the landscape. The green roof also assists in storm water run-off reduction and thermal energy conservation.

Eielson Visitor Center demonstrates that passive design measures and energy efficient technologies help cut the building's energy use by half. Passive design features include:

- South-facing, high-performance windows that maximize solar gain and are well insulated to accommodate for the extreme climate.

© Ron Niebrugge

In the past, the remote location of the center spurred the park to implement various renewable energy strategies at the site, including a hybrid generator system with photo-voltaic panels and a battery bank. Information gained from analysis of this and other strategies led to expanding the solar panels and battery bank, installing a solar hot-water heating system for the restrooms, and constructing a small hydroelectric system in a nearby stream.

In recognition of Denali's achievements, the Eielson Visitor Center achieved a platinum level certification from the Leadership in Energy and Environmental Design (LEED). Platinum is the highest level achievable.

- The building is constructed partially underground, which allows the advantage of ambient earth temperatures and protects the building's walls from strong winds.
- Apertures in the side of the building and skylights, which provide the majority of daytime light. Daylight sensors monitor light levels to reduce the use of electric lighting during the long summer days.
- The ability to go cold. In the extreme Alaskan winters, temperatures reach -40 degrees Fahrenheit and Denali becomes impassable for six to seven months. This could have resulted in the expenditure of large amounts of energy. Instead, when the visitors stop coming, the building "goes cold."
- Heat recovery ventilators that recover heat from exhausted air to warm the cold incoming air. This is especially useful when waves of visitors create large volumes of stale air.

© RIM Architects

LESSONS LEARNED AND REPLICABILITY

Denali National Park and Preserve is a National Park System Center for Environmental Innovation. The park has committed to showcase new technologies, motivate and educate the public and park service employees about environmentally friendly practices, and install systems and alter behaviours to reduce energy needs and adverse environmental impacts. The design effort for the replacement Eielson Visitor Center embraces that challenge and exemplifies these goals.

The visitor center proves that integrated design and cutting edge technologies can indeed be cost effective. Eielson is set to be a model for future National Park Visitor Centre designs.

BIOSPHERE RESERVE
DENALI - USA

Source:
The Eielson Visitor Center / NPS
RIM Architects

STARLIGHT INITIATIVE

Save Energy and recover the Stars

The Starlight Initiative is designed as an international action in defence of the quality of the night sky and its associated values. One of the main actions within the Initiative is the development of a network of Starlight Reserves as sites that promote intelligent outdoor lighting with the double function of saving energy and reducing light pollution.

Light pollution is a growing problem over a large part of the planet, including the UNESCO sites. The waste of outdoor lighting increases energy consumption and is economically unjustified. It also increases the level of emissions that contribute to climate change.

The Starlight Initiative, in partnership with UNESCO-MaB, has promoted certification systems for territories committed in the fight against energy wastage and the conservation of the starry sky as a resource, including its associated cultural, scientific, and environmental values. Several UNESCO sites, such as the Biosphere Reserves of Fray Jorge (Chile), La Palma, and La Rioja (Spain), and World Heritage Sites such as Amalfi Coast (Italy) and Doñana (Spain), have become the role models in this initiative.

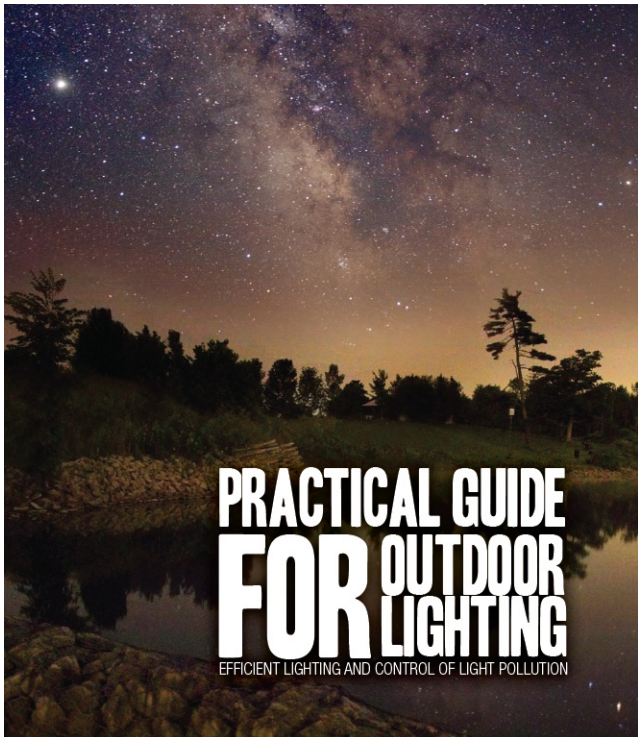
THERE IS ANOTHER WAY TO LIGHT UP THE NIGHT

The combination of increased awareness of the need to minimize the impacts of light pollution, growing need to promote energy efficiencies in rural and urban development planning for mitigating climate change consequences and a better appreciation by citizens of the associated benefits, are the main premises for the development of this action. Reducing light pollution and adopting intelligent lighting systems are not only acts of responsibility, but also an obliged smart choice that brings economic benefits, improve health, saves energy, and allows recovering the starry sky dimension as a threatened landscape.

Article 7 of the Starlight Declaration, adopted in 2007 with the support of UNESCO in the Biosphere Reserve of La Palma, states that “The intelligent use of artificial lighting that minimises sky glow and avoids obtrusive visual impact on both humans and wildlife has to be promoted. Public administrations, the lighting industry, and decision makers should also ensure that all users of artificial light do so responsibly as part of an integral part of planning and energy sustainability policies, which should be supported by light pollution measuring, both from the ground and from space. This strategy would involve a more efficient use of energy so as to meet the wider commitments made on climate change, and for the protection of the environment.”

In its Practical Guide to Outdoor Lighting (OTPC-OP-PC), the Starlight Initiative demonstrates that switching to intelligent lighting systems is possible and is at reach, as already demonstrated in the mentioned UNESCO sites.

The first step toward efficiency is to limit the unnecessary light. It is nonsense to install high efficiency lights that are unnecessary. They will have an infinite cost/utility ratio. We keep our cities, villages, infrastruc-



© OTPC. Teide World Heritage Site and light pollution.

tures lighted all night long with illuminances that are higher and higher.

The following steps to take are undoubtedly achievable:

- prevent the emission of light towards the sky or the horizon;
- do not waste downward light flux outside the area to be lit;
- avoid over lighting;
- shut off lights when the area is not in use;
- aim for zero growth of the total installed flux, then a decrease (like it is happening to all other pollutants);
- ensure all artificial lighting installations are designed to the lighting needs and minimise obtrusive light and energy use.
- strongly limit the short wavelength 'blue' light because of the serious implications for human health and the preservation of many species.

© Giuseppe Orlando. Cover of the Starlight Reserve Concept, developed in cooperation with the World Heritage Center.

The loss of quality of nocturnal skies has become a serious threat for many species, disturbing their habits and habitats, as well as the basic functions of ecosystems. Darkness and natural night light are indispensable for the healthy functioning of organisms and ecosystems. We usually forget that life lives 24 hours a day and that ecosystems adapted themselves to the natural rhythms of the moon and stars during millions of years of evolution. Taking into account these considerations, the Starlight Initiative promotes a new dimension in preserving the integrity of the UNESCO sites.

LESSONS LEARNED AND REPLICABILITY

Energy audits carried out in the Starlight sites indicate reductions in energy consumption of up to 40% from the original situation before the introduction of corrective measures.

In several UNESCO sites, the recovery of sky quality has opened new possibilities to local economies through the creation of Starlight Tourism Destinations. Starlight Destinations are visitable places characterised by excellent quality for the contemplation of starry skies and the practice of tourist activities based on this resource

Furthermore, the experience of the Starlight Initiative points to the need to support and promote research works related to the effect of artificial lighting on human health and biodiversity conservation (wildlife and ecosystems).

BIOSPHERE RESERVE & WORLD HERITAGE SITES MULTIPLE LOCATIONS
BR: FARY JORJE (CHILE), LA PALMA & LA RIOJA (SPAIN)
WHS: COSTIERA AMALFITANA (ITALY), DOÑANA (SPAIN)
Source:
Starlight Initiative

SOTAVENTO EXPERIMENTAL WIND FARM

A new vision of energy education and intelligent tourism

Terras do Miño was designated a Biosphere Reserve in 2002 and covers a large area of the Lugo province (Spain) that hosts outstanding natural and cultural values. The Sotavento Experimental Wind Farm is located on the north side of the reserve. Since its inauguration in 2001 it has become a benchmark experience that include outreach and research as essential part of its activity.

In addition to energy uses, the wind farm is a visitable place where a wide range of renewable energy technologies is present, becoming a showcase of different applications. The user facilities include a visitor center and other R&D facilities. Since opening its doors, more than two hundred thousand visitors have used their installations.

EDUCATION CAN POWER RENEWABLE ENERGY

Sotavento Galicia, S.A. was established in 1997 with the support of the Government of Galicia. This partnership has made it possible to establish the Sotavento Experimental Wind Farm, a unique facility that, besides energy business, provides other services to the community. The additional efforts are focused on three areas: Research, Education-Information and Training.

In addition to the exploitation of the 17.5 MW wind farm, the goal of Sotavento, according to its foundational purpose, is to pursue four objectives:

- become a "showcase" park with different renewable energies technologies;
- provide service facilities to promote sustainable energy by supporting R&D projects and related activities;
- establish a platform for learning, training and the exchanging ideas on energy issues;
- become a dissemination center for renewable energies and energy efficiency.

The quality of wind farm as "showcase" is understood in the sense that in the same area are represented the diversity of wind turbine technologies showing the state of the art of the wind energy. 24 turbines

© Sotavento Experimental Wind Farm

© Sotavento Galicia Foundation

from five different technologies and 9 different models compose the wind farm.

The repertoire of available renewable energy extends to other technologies, highlighting the solar farm and the green demonstration house which has implemented a wide range of “active” and “passive” solutions. Sotavento also includes a biomass facilities and hydrogen seneration and storage system designed to explore RES energy storage systems and their potential linked to the management of renewable energies.

Sotavento Galicia Foundation, which managed the educational activities, offers a unique environment for conducting its activities. Energy-efficient building designed as the blades of a wind turbine supports the Educational Project. Inside the building, models, panels and interactive applications illustrate the operation of these renewable energy systems, enabling their comparison with non-renewable sources of energy. It is equipped with themed spaces such as the Energy Efficiency Room, or the Energy Atelier, designed so that visitors can observe the operation of the machines more directly.

© Sotavento Galicia Foundation

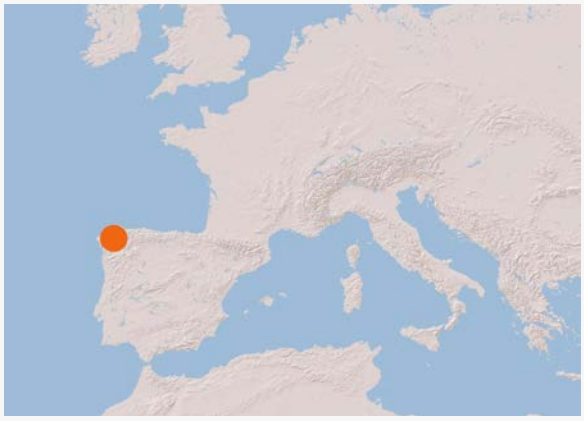
Outside and in addition to RET resources available, it was enabled an energy crops area conducted by the Soil Science Department of the University of Santiago de Compostela, and also thematic elements related to cultural diversity of the site, highlighting the recovery of nine burial mounds and tombs from the Megalithic period. It is one of the few energy plants around the world that has integrated the heritage conservation in its design and operational management.

LESSONS LEARNED AND POTENTIAL REPLICABILITY

Sotavento Experimental Wind Farm is a successful example of public private partnership initiative that combine their efforts in the field of renewable energy, linking power generation with the educational activity and the ability to create a smart offer for visitors in a biosphere reserve.

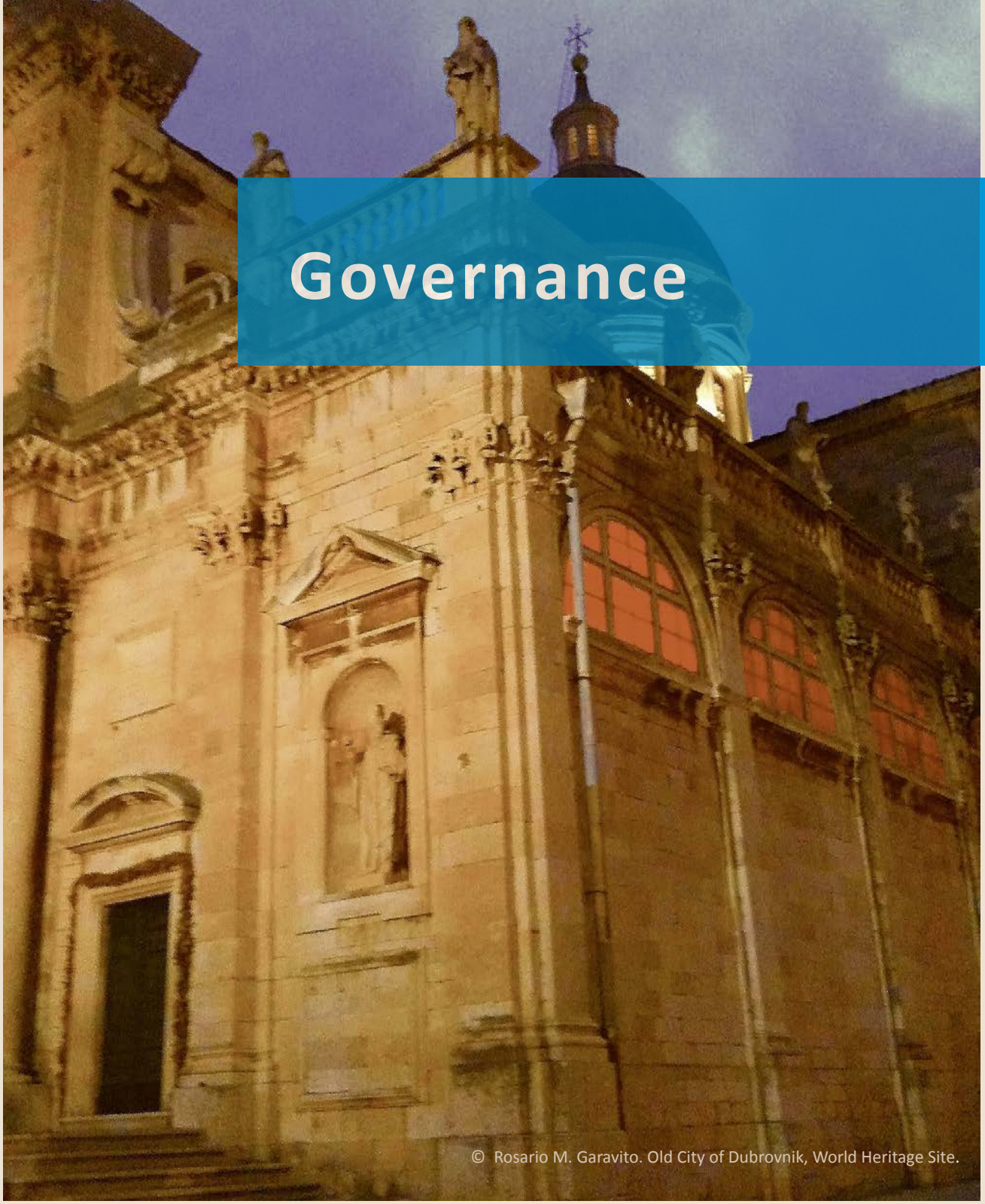
Some UNESCO sites had been launched similar experiences, such as Jeju New & Renewable Energy Exhibit Hall (Korea), or Whitelee Windfarm Visitor Centre in Galloway and southern Ayrshire BR (UK). They all offer a replicable models for the development of the logistics function of the biosphere reserves in the areas of education, outreach and sustainable tourism.

The Sotavento Wind Farm opens the possibility to develop new forms of intelligent and responsible tourism, where renewable energy knowledge becomes an attractive.



BIOSPHERE RESERVE
TERRAS DO MIÑO - SPAIN

Sources:
Sotavento Galicia Foundation
Terras do Miño Biosphere Reserve



© Rosario M. Garavito. Old City of Dubrovnik, World Heritage Site.

ENERGY GOVERNANCE

UNESCO designated sites can lead the way in terms of sustainable energy governance and climate change mitigation policies acting as exemplars for other sites. This should be operated by educating, disseminating best practices and mainstreaming energy through an integrated system embedded in the sites' governance.

© Nancy Bunbury. Lagoon Island., Aldabra Atoll. World Heritage Site..

PROPOSAL FOR SUSTAINABLE ENERGY GOVERNANCE PRINCIPLES IN UNESCO DESIGNATED SITES

The following set of recommendations on sustainable energy governance in UNESCO designated sites was developed by the core team of the Summer School in South East Europe on Sustainable Energy Governance in UNESCO World Heritage sites and is a follow-up of the international workshop, "Upgrading Life in Historical Towns – Renewable Energy". Both events were held in Dubrovnik, Croatia in October 2013. The workshop was co-organised by the UNESCO Regional Bureau for Science and Culture in Europe, Venice (Italy), the Municipality of Dubrovnik and Marco Polo System G.E.I.E. with the support of the RENFORUS Initiative.

In line with the UN Secretary General's Sustainable Energy for All Initiative and the upcoming Decade of Sustainable Energy for All, and considering the role played by UNESCO within the United Nations family to strengthen capacities in the field of sustainable energy, and in compliance with the UNESCO Strategy for Action on Climate Change, which considers energy as a key element for climate mitigation policies and, endeavours to enhance the knowledge base for the rational use and application of sustainable energy through institutional and human capacity-building by sharing scientific knowledge and best practices

© Dubrovnik Tourist Board. World Heritage Site.

School group. Dubrovnik 2013.

through its own networks and the promotion of national and regional renewable energy policies and training initiatives such as the Global Renewable Energy Education and Training Programme (GREET);

Also in line with the 24th session of the International Coordinating Council of the Man and the Biosphere (MAB) Programme which stated that the combination of coastal, island, rural and urban ecosystem networking initiatives are important for promoting biosphere reserves (BRs) as sites for energy-efficient and renewable energy-driven development alternatives, thereby contributing to climate change mitigation efforts and to Sustainable Development in general;

In full consistency with the RENFORUS Initiative (Renewable Energy Futures for UNESCO Sites), devised as part of UNESCO's overarching Climate Change Initiative, which aims at enhancing and applying the climate change knowledge base for building green societies and at promoting the use of UNESCO Biosphere Reserves and World Heritage sites as field observatories for the sustainable use of renewable energy sources and as models for the efficient use of energy;

Thus, the participants of the Summer School in South East Europe on Sustainable Energy Governance in UNESCO World Heritage sites, along with the those of the International Workshop, "Upgrading Life in Historical Towns – Sustainable Energy" held in Dubrovnik in October 2013, organised by the Municipality of and the World Heritage Site of Dubrovnik and the UNESCO Regional Bureau for Science and Culture in Europe, in cooperation with the RENFORUS Initiative, have identified ten strategic principles to facilitate the mainstreaming of sustainable energy in UNESCO designated sites:

Governance

1. UNESCO designated sites should rely on an integrated management system that must necessarily include the sustainable energy dimension among its strategic components under the frameworks of Sustainable Development and its climate change mitigation strategy.

2. Clear objectives, concrete sustainable energy action plans and reliable monitoring functions should all be put in place to ensure both compliance and effectiveness of declared sustainable energy principles on site.

3. A sense of ownership and of appropriateness of the concept of a sustainably-run site should be fostered among its social constituents (communities, users, local authorities, national governments) with dedicated actions and project-based activities carried out to bridge the gap between formal statements and substantial policies and practices.

4. A dedicated and recognised support structure should be set in place, comprised of experts with sufficient interdisciplinary skills to act as a driving force for enhancing sustainable energy on site, empowering local actors and offering a voluntary service of mentoring and counselling on sustainable energy to citizens and local administrators.

© Josep Loaso. Abertis Foundation. The participants of the Workshop on Renewable Energy Strategy in the Spanish Biophere Reserves Network (Barcelona, November 2013), discussed the principles proposed in Dubrovnik.

Capacity building and education

5. Capacity building in the field of sustainable energy governance in UNESCO designated sites should be enhanced through dedicated training programmes, using the sites as learning cases, bringing together representatives from energy, cultural and environmental sectors and integrating natural and cultural conservation requirements with sustainable energy-related applications and innovation.

6. Public awareness of the pathway to apply sustainable energy concepts and practices to UNESCO designated sites should be enhanced as a part of the overall objective of Education for Sustainable Development, through the sharing of science-based evidence of direct experiences and successful case studies applied in other UNESCO sites as made available through the RENFORUS Initiative.

Implementation strategy

7. By prioritising both energy-related opportunities and conservation requirements, apply a holistic approach to project and site activities including, wherever applicable, the concept of Historic Urban Landscape, in order to a) valorise the relationship between people and their places, b) engender a sense of long-term custodianship of the site's tangible and intangible heritage, and c) establish a baseline of reference for operational and budgetary purposes.

8. The entity in charge of sustainable energy management at the site should be able to establish a range of improvement measures, from simple to more complex, and analyse their impact on the site's assets and communities. These measures should be implemented through an integrated approach combining practical solutions both from a conservation and an energy point of view with a dedicated monitoring system to assess achieved results.

9. The entity in charge of sustainable energy management at the site should be capable of a) supporting the delivery of effective and necessary actions of consultation and interfacing with public and private institutions; b) designing and coordinating community-based project implementation and monitoring functions on site; and, c) providing feedback to governing bodies on possible policy changes and relating with national/international actors and possible donors to mobilise extra financial and institutional resources to increase the impact of its activities.

10. Achievements are to be two-fold:

a. Reduce energy poverty of local inhabitants, improving their living conditions and comfort without undermining their financial capacity and securing ownership and a self-sustaining management of their energy system;

b. Curb CO2 emissions to the greatest extent possible by applying suitable energy efficiency measures combined with renewable energy systems, whenever applicable, according to the characteristics of the site and its zoning, finding a joint path between traditional knowledge/expertise and advanced technologies and materials in a compatible and smart way.

The way forward

UNESCO designated sites can lead the way in terms of sustainable energy and climate change mitigation policies acting as exemplars for other sites and foremost inspiring policies and practices of energy sustainability for non-designated sites globally. This should be achieved by educating, disseminating good practices and mainstreaming sustainable energy management through an integrated system embedded in the sites' governance whilst preserving the sites' unique assets, both at cultural and natural levels, and fostering an improved quality of life and comfort of their communities.

Summer School in South East Europe on Sustainable Energy Governance in UNESCO World Heritage sites

Organized by the Science Unit of the UNESCO Regional Bureau for Science and Culture in Europe, Venice (Italy), at the University of Dubrovnik in Croatia from 29 September to 4 October 2013, the school represents a unique educational opportunity to enhance capacity building in sustainable energy by conveying in a single venue a substantial capital of knowledge developed on sustainable energy governance in World Heritage sites in Europe. UNESCO designated sites have proved they have an important word to say about sustainability, in terms of education, management, and scientific knowledge to be regionally shared and applied. The goals of the school were to:

- Offer educational support to World Heritage local-central governmental officials, site planners and managers, scientists, practitioners and researchers with applied interest on sustainable energy governance issues;
- Build capacities on renewable energy and energy efficiency promotion using UNESCO designated sites for learning and sharing knowledge;
- Strengthen the dissemination of information on renewable energy and energy efficiency potentials in UNESCO designated sites;
- Enhance problem solving capacity and critical thinking through the adoption of an interdisciplinary approach of sustainable energy issues;
- Promote the interface between young researchers and practitioners with industrial partners of high profile for the improvement of summer school technical provision and follow-up.

In its second edition, the school trained about 40 young professionals and scholars from South East Europe.

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UNESCO SCHOOL IN SOUTH EAST EUROPE
Sustainable Energy Governance in UNESCO World Heritage sites
UNESCO Regional Bureau for Science and Culture in Europe, Venice (Italy)
Municipality of Dubrovnik - World Heritage Site
RENFORUS (Renewable Energy Futures for UNESCO Sites)

GOOD PRACTICES CONTACTS

LIGHTINGH SUNDARBAN
Building an energy-secure and environment-friendly future

BIOSPHERE RESERVE

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LUZ EN CASA (LIGHT AT HOME)
Providing energy access to remote rural communities

BIOSPHERE RESERVES & WHS
MULTIPLE LOCATIONS

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IBEKA EXPERIENCE IN GUNUNG LEUSER
Developing community-managed hydro schemes

BIOSPHERE RESERVE

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BRO DYFI COMMUNITY RENEWABLES
Green power and local ownership in action

BIOSPHERE RESERVE

BIOSFFER DYFI BIOSPHERE - UK

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FUERTEVENTURA RENEWABLE WATER
A model for islands and dry coastal areas

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FUERTEVENTURA - SPAIN

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EQUIMETH PROJECT
Biogas and an innovative model of governance

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EDINBURGH WORLD HERITAGE
Towards a Sustainable Energy City

WORLD HERITAGE SITE

OLD AND NEW TOWNS OF EDINBURGH - UK

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KLiP (2010-2020)
The City of Vienna's Climate Protection Programme

WORLD HERITAGE SITE

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PUERTO PRINCESA - PALAWAN
Towards a Model City in Sustainable Development

BIOSPHERE RESERVE & WHS

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THE HANSEATIC TOWN OF VISBY
Bio-fuelled district heating

WORLD HERITAGE SITE

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THE IFUGAO-AMBANGAL MINI-HYDRO PROJECT
Global Sustainable Electricity Partnership project

WORLD HERITAGE SITE

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VIRUNGA NATIONAL PARK
Green energies to preserve a World Heritage site

WORLD HERITAGE SITE

VIRUNGA NATIONAL PARK - DR OF CONGO

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NABU'S CLIMATE AND FOREST PROJECT
Forest preservation through wood-saving stoves

BIOSPHERE RESERVE

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TONLE SAP
Waste converted to energy for floating communities

BIOSPHERE RESERVE

TONLE SAP - CAMBODIA

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ALDABRA ATOLL
Improving the sustainable operation of a WHS

WORLD HERITAGE SITE

ALDABRA ATOLL- SEYCHELLES

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GROSSES WALSERTAL
Towards 100% power from RES

BIOSPHERE RESERVE

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EL HIERRO BIOSPHERE RESERVE
The first 100% Renewable Energy Island

BIOSPHERE RESERVE

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LOW ISLES - A MODEL OF SUSTAINABILITY
An island powered by the Sun

WORLD HERITAGE SITE & BR

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ERGAL PROJECT
Zero fossil fuels on the Galapagos Islands

BIOSPHERE RESERVE & WHS

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CARBON-FREE ISLAND JEJU BY 2030
Renewable energies and Smart Grid Test-Bed

BIOSPHERE RESERVE & WHS

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FEYNAN ECOLODGE
A model of sustainable hotel in Dana BR

BIOSPHERE RESERVE

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SCHUK TOAK VISITOR CENTRE
Sustainable building inserted into an ecosystem

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LADY ELLIOT ISLAND ECO RESORT
Clean Energy for Ecotourism

WORLD HERITAGE SITE & BR

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SOLAR RESEARCH VESSEL
Environmental education program

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ALBERGUE BASE CRESTONES
Center powered by solar energy

BIOSPHERE RESERVE

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SUMMER SCHOOL IN SOUTH EAST EUROPE

Sustainable Energy Governance in UNESCO Designated sites.

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SMARTREGION PELLWORM
Germany's green energy island

BIOSPHERE RESERVE

WADDEN SEA AND HALLIG ISLANDS OF SCHLESWIG-HOLSTEIN

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SOTAVENTO EXPERIMENTAL WIND FARM
A new vision in education and intelligent tourism

BIOSPHERE RESERVE

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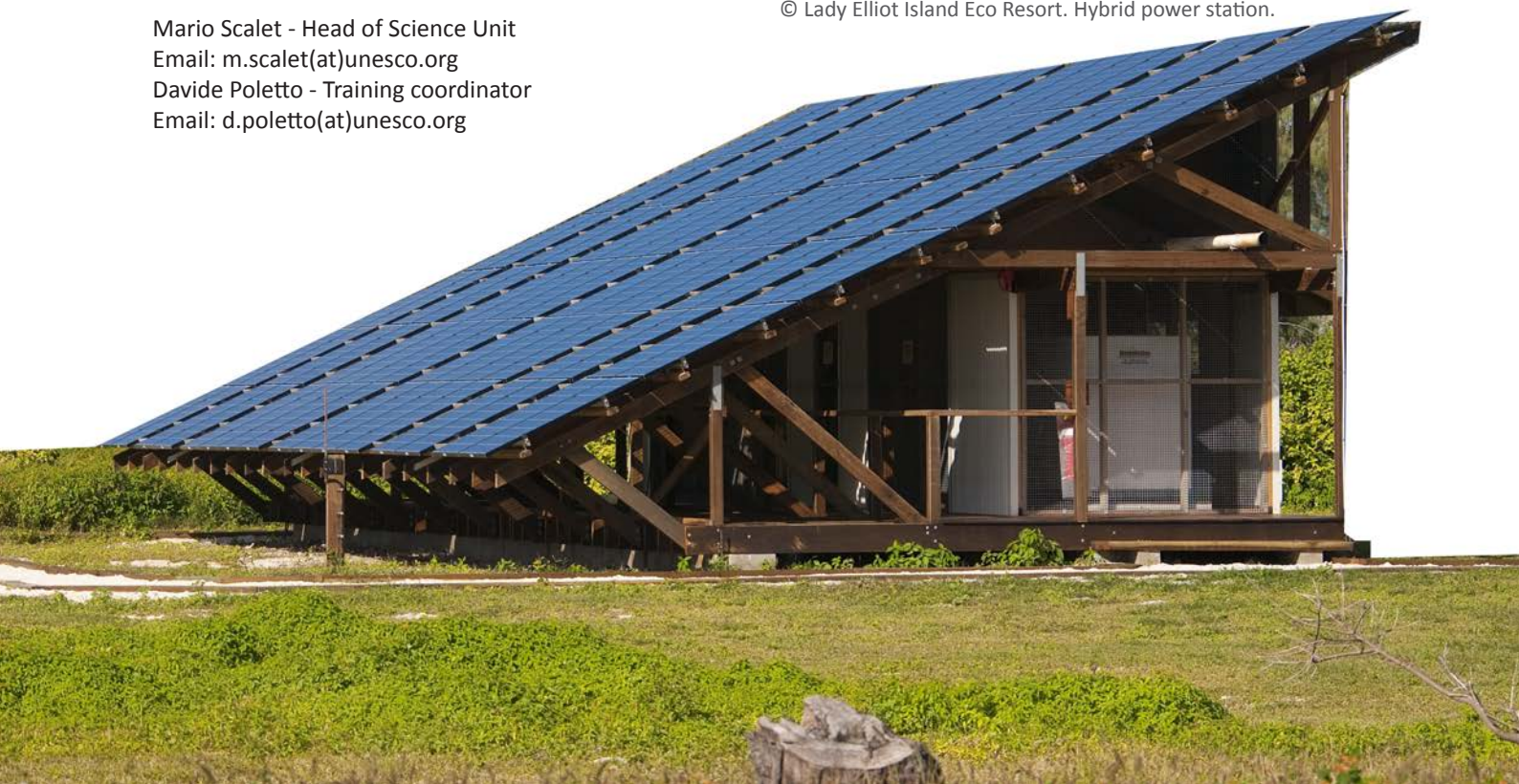


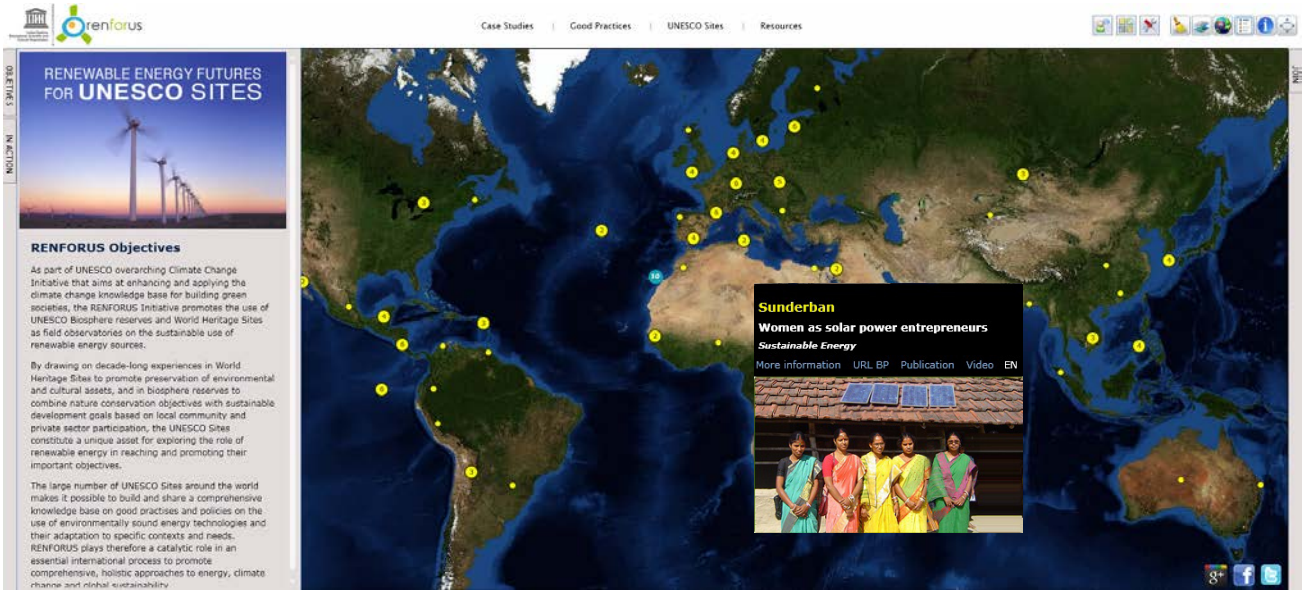
RENFORUS PLATFORM

Smart Tools - Website & Interactive map service

RENFORUS MAP VIEWER

RENFORUS provides an advanced map viewer to visualize the most important information related to the initiative. It includes georeferenced information about case studies, projects, best practices, and indicators. The viewer provides thematic maps related to energy, particularly to renewables and their potential. It also includes some basic information about the World Network of Biosphere Reserves and the World Heritage Sites.

www.renforus.net/mapping/



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Biosphere Reserves
World Heritage Sites

Models of excellence to foster the integration of renewable energy for global sustainability