ENERGY PORTRAITS

Universal access to sustainable energy

photos by
Marco Garofalo

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A project by Matteo Leonardi
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Photos
Marco Garofalo

Texts
J.Ignacio Pérez-Arriaga, Pippo Ranci, Matteo Leonardi

Graphic project
Claudia Brambilla

Supervision
Pia Lovengreen Alessi

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GLOBAL FORUM
World Energy Transition

Be it entrepreneurs in India/Africa or wind engineers in Denmark;
all stakeholders have a key role in giving energy access to all.
Universal access to energy means humanity sharing the goal,
the burden and the success.
Only the sky is the limit, as both the sun and the wind seem
to be found under the sky.

Jean-Michel Glachant
Director, Florence School of Regulation

Energy portraits project

In 2015, ensuring universal access to affordable, reliable, sustainable and modern energy became one of the 17 UN Sustainable Development Goals to be achieved by 2030. The UN SDG number 7 on energy access is now firmly recognized as a prerequisite to any development target.

Energy Portraits aims to represent a variety of contexts in which energy access challenge takes place challenges are present.

The camera of Marco Garofalo respectfully enters the households of nearly a hundred families in three continents: Africa, South America and India, to depict, with a common format, ordinary families with their electric appliances.

It is a reverse depiction of the energy access challenge, proceeding from the end-users up along the wire to identify the power source. Where is the service coming from? Isolated systems, mini-grids or conventional network connections? In some cases, decentralized solutions are found to be more economic, more efficient and reliable, in others they appear too costly, technically inaccurate, and unable to sustain economic development. In a growing number of places, different electricity access options overlap, duplicating costs without guaranteeing full availability of service.

The variety of technological solutions and consumers' needs combine to create countless different situations. Photography captures and documents the complexity of the energy access challenge, which mostly occurs in extreme poverty conditions.

A mix of obvious as well as unexpected cases: an Indian family connected to the grid for more than 20 years owns the same electrical appliances as a Maasai family surviving with a 5W solar system; kerosene lamps found in grid-connected households more often than in remote islands of the Volta river; solar systems installed in the absence of a grid as well as solar systems installed because of the grid; mini-grids operating few hours a day, supplemented by domestic PV systems, outplaced by the national grid and finally all coexisting with the polluting, costly but dependable diesel generator. Not to mention the economics of energy access: portable lamps purchased through microfinance schemes; mini-grid suppliers who include the purchase of electronic appliances into the tariff; pay-as-you-go systems with bill settlement via SMS; the costs of an illegal connection charged for as part of the monthly rent; the examples went well beyond our imagination.

Stop thinking about standard solutions when approaching the energy access challenge, and forget monthly bills. All portraits share one common feature only: we were asked to take our shoes off before entering in all the houses we visited.

Energy Portraits, and its reportage format, wants to be an original contribution to acknowledge the complexity of the energy access problem, far from the celebratory pictures of energy access *"success stories"*.

Matteo Leonardi

Introduction

by J.Ignacio Pérez-Arriaga and Pippo Ranci

The Florence School of Regulation works towards the establishment and world diffusion of good regulation in the energy services industry.

Good regulation is greatly helpful in directing energy systems towards achieving a sufficient supply of clean energy to meet the needs of all citizens and to support economic growth.

Energy supply should be sustainable in the multiple dimensions of this word. It should be environmentally friendly, it should be provided with continuity over time, and at a quality adequate to the needs of modern life. Competition among suppliers should assure free choice by

the customer and a favorable context for innovation to continually increase efficiency in the production and utilization of energy services.

Very rarely are these optimal conditions fully implemented, therefore approaching them requires a continuous effort by policy makers and responsible economic and social operators.

In large regions of the planet, the picture is vastly different, and billions of people live in conditions of serious, if not tragic, energy deprivation.

Recent technical advances make the goal of universal access to energy easier and cheaper to reach. At the same time, an unprecedented consensus has been expressed at many levels, calling and pushing governments, private companies and civil society organizations to act. It has been skillfully expressed by the United Nations Sustainable Development Goal number 7: *"Ensure access to affordable, reliable, sustainable and modern energy for all"*.

We at the Florence School are engaged in doing what we can by spreading better knowledge of the issue and of some possible actions. *Our training courses for young professionals in the regulatory institutions and in energy companies underline the need for diffused awareness of the challenges of environmental, economic and social sustainability.*

The starting point is a deeper understanding of the real conditions prevailing in diverse areas of the world. To this purpose, data gathering and analytical work are essential. Further, the educated eye of a photographer, along with an experienced social operator, may open wider horizons and deeper perception.

For this reason we are offering this photobook to the participants of our 2019 Global Forum on the World Energy Transition.

The switch

When we think about having electricity we think of a switch that is either on or off. This usually relates to a connection to a reliable national grid. Across the world this is not always the case, and electricity access may rather be described as an endless number of combinations matching available technology with the specific needs of the consumer.

The other side of the wire

Over 6 billion people are connected to national grids, this represents more than 80% of the world population. At the other end of the cable we find a number of situations not properly matching the SDG 7 definition of energy access.

◂ Satellite, Nairobi, Kenya; each member of the family has his or her own pre-paid meter. The kerosene lamp is fought over when money for electricity vouchers runs short and during black outs: *"power failures occur when it is not raining as no water remains in the dam, and when it is raining for the frequent short-circuits"*

▾ Middle class family in El Alto, La Paz, Bolivia, over 4000m altitude. Average night temperature between – 4 and 4°. Electricity is available, but for most families it is not affordable for space heating. 12/25€ per month summer/winter time.

▾▾ Remote village in Ho province, Ghana. The grid has reached the village and connected the house for free, a few months ago. There is nothing inside the house, no table, no bed. "*No bill has arrived, yet, but we will not be able to afford the service. We will go back to our 5W solar panel."*


BRITANIA

Where mini-grids dare

Pediatokope island on the Volta river, Ghana. There are places in the world where extending the grid is not a viable option. The IEA estimates that to supply universal electricity access by 2030, an additional 300 million people need to be reached through mini-grid solutions. National policies are increasingly addressing mini-grid regulatory issues, however they rarely address the technical and economic rules related to national grid integration, once available.

Solar mini-grids

Mini-grid tariffs vary widely from case to case. Sometimes they are equal to the national tariff, sometimes they are cost reflective and may exceed 1€/kWh. Sometimes flat tariffs are found and no meter is installed. Mini-grids' capacity cost is often an obstacle which makes supplying important services for rural communities not an easy option.

▶ Life has changed for the fisherman's family since a solar mini-grid has been installed on Pediatokope Island on the river Volta river, Ghana. Now the fridge assures better price contracting power for the fishermen. The connection was granted for free and a flat tariff of 2€ is charged monthly.

▼ A Maasai family enjoying solar mini-grid electricity in Kitumbeine, Northern Tanzania. Although the service is expensive compared to national standards, it is available all the time. The family estimates monthly savings of 60€ compared to the diesel generator.

▼▼ The solar mini-grid of 16kW supplying the village is not powerful enough to operate the indispensable milling machine. Diesel fuel hasn't arrived today. A Maasai woman can only wait to grind her maize before going home where she still has to light the fire, cook the food and finish all her chores. Her house is 10km away and is not reached by the mini-grid. *"I just hope to get home before darkness"*

Hydro mini-grids

In Bolivia, where 92% of the population has electricity access, hydro mini-grids contribute to electrification by connecting remote villages perched on the *cordillera*.

▸ The Umapalca village in Guanay, Bolivia, can be reached via a 5200m mountain pass. Little chance for the grid to be extended up here. Since the late eighties, a hydro mini-grid supplies the village with electricity at less than 2€ per month.

▾ The family gathers near the lama-dung fueled stove to enjoy some heat. Lamas supply most of the energy needs of the mountain Aymara tribal groups: wool to weave clothes, dung for cooking and heating and, before the hydro came, fat to light the wick in the darkness of the night. It does not power a TV, charge a mobile phone or activate the mixer.

▾▾ Cocatajes village, Cochabamba, Bolivia. The hydro station, built by a La Paz company started up by a local NGO, provides enough power for more demanding electricity service. The presence of a welding machine and a well-equipped carpentry in the village is possible only due to the significant electricity supply.


YUASA
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Ultimate option

In the Altaramani community in Amazonas, alongside the river Beni, the population density is not high enough to sustain a mini-grid. Independent solar systems have proven to be the best option for electricity access. Solar equipment costs are still high, given the limited market in a country with high electrification rates. Without a specific energy access policy, as well as economic support, the community is bound to remain in darkness for the time being.

Panels on the roofs

In Tanzania the electrification rate is around 30%. Independent solar systems can be found everywhere on the metal roofs of the countless households without network access.

◂ Solomoni shifts the panel to collect the last few rays of the sun. There's a party tonight and the batteries need to be fully charged. The 80W panel provided by a start-up company is paid for in monthly installments of 20€, via on-line banking with the phone. The system is managed remotely and maintenance is assured in the middle of the Savannah.

▾ Alongside shoes, fabric and trousers, a shop sells panels in a village on Kilimanjaro. A small 40W solar system costs around 100€, a gigantic sum in a country where income is very limited.

▾▾ Solar equipment shop in Arusha, Tanzania. A few years ago, the only option for the 1 billion people worldwide without access was to light a kerosene lamp to get some light in the darkness. It is reported that over 130 million independent solar power systems are already operating in the world.


TEL: +255 682 762 7
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Solar families

The photovoltaic cost reduction has opened up new market opportunities. More and more, photovoltaic technologies are emerging as the best solution where the grid is not available. The scalable size of photovoltaic from few W to kW, makes it a technology to suit every pocket.

- ▶ Oldonyosambu, Maasai tribe, Tanzania. N'golupa (scorpion) family, in their hut. The solar panel can charge the family's mobile phones, which would otherwise have to get charged at the weekly local market for 20€c/each. A LED light completes the electrical equipment assets.
- ▼ Simanjiro, Tanzania, more than 100km from the nearest electricity pole. A forest-honey trader enjoys his 80W photovoltaic system purchased with the pay-as-you-go formula.
- ▼▼ Tres Hermanos community, Amazonia, Bolivia. The 20W solar panel, for charging torches and mobile phones, has been donated by a local NGO. "It does not supply enough power to play the DVD", laments the lady of the house.


Emirates

Biogas in a home

Joyce, a widow with seven sons, "*I use cow dung biogas to make the children's breakfast. The school is a two hours' walk away. They get back in the afternoon and almost never have lunch. I used to get up at half past four to light the fire. Now with biogas the fire is ready in an instant, the water boiling in a few minutes*"

A market for goats

Orkejuloongishu market, Longido, Tanzania. Sometimes communication, and therefore mobile phones, are more important than lighting for semi-nomadic people whose survival depends on information: "*where are the herds? Where has it rained? Will we find grass on the other side of the hill? How much do the goats cost in the next village? Where are you?*"

Smartphones and lamps

The light from smartphone screens merges with that of the kerosene lamps and the flames of the fire, in a hut on the slopes of Mount Meru Tanzania, "*not the light will change my hut, to be connected with the world changes my life*".

Sun on a thatched roof

Maasai steppe, Manyara, Tanzania. Rongsaeli climbs onto the roof to wipe dust off the solar panel. The 40W panel supplies the community with around 40kWh a year, as much as an average Italian family uses in 5 days. It provides light and a socket to recharge the phones, as well as an electric bulb outside; *"at night there are lions"*.

Sun for tigers

Satjelia Island, 24 Parganas, West Bengala. The island faces the tiger sanctuary of Sundarban, where the remaining tiger population is kept to avert extinction. A number of NGO projects have supplied the local population with solar systems as compensation for not exploiting Sundarban natural resources.

The night before the exams

Terrat secondary school, Tanzania**.** In the dark of the night, students discover the most important source of energy, the inner drive to better themselves through education. But it is a struggle. The United Nations goal of providing universal access to electricity by 2030 is an ambitious one. It might not be achieved. A school without electricity is a missed opportunity for the development of an entire generation of students.

Hybrid in a school

Ngarenanyuki, Tanzania. A 3kW hydro system on an irrigation channel and a 3kW photovoltaic system on the roof power the school's classrooms, library, dormitory and the teachers' houses. For generations, great efforts have been put into getting children to register for secondary school. This effort may be in vain if the school has no access to electricity. Everyone expects electricity to be available for professional education.

Electrified country

From 2015 to 2018, the remaining unserved 20,000 remote villages in India have been electrified. Statistics now claim the country has reached universal electrification. This does not necessarily mean all households have a connection or that the electricity service is reliable.

No power for all

Dwarf island, Lake Volta, Ghana. The Akosombo dam was built in 1965 to give power to the nation. A number of communities were displaced from their villages. They moved to the western islands, which emerged as a result of the rising lake levels. 50 years later, a 5W solar panel is still the only source of power.

Rice for all

Orissa, India. The village was electrified more than 20 years ago, thanks to the connection of an iron factory nearby. Nevertheless, most agricultural processes are still conducted with traditional methods. India is the world's second largest rice-producing country.

Colors of light

Olkun'guado village, Tanzania, is hardly recognizable just a few months after grid connection. The market road is now colored with lights. Shops, hairdressers, butchers, bars and restaurants are blossoming here and there. Electricity access does not always bring social and economic development, yet certainly development is not happening where there is no electricity.

Iron and light

Gourpur, Orissa, India. Working in the nearby iron factory provides an average income of 80€ a month. The electricity bill, thanks to the social tariff, is limited to 3€ a month in winter and 4.5€ in the hot summer, still an affordable price. However, electricity is not available during peak times; in the morning and the afternoon, precisely when it is most needed. The family has obtained a 500€ micro-finance arrangement, and with the improved economic situation they purchased a small solar system to cover the peak time.

We prefer solar

Marangu, Kilimanjaro slopes, Electricity comes from a 60W solar panel. It is a present from their children. Two out of five have migrated. *"We prefer solar. I don't want grid electricity and then worry about the bill"*. A charcoal iron. For cooking an open fire and when money is available, a refill for the gas cylinder.

Overlapping technologies

Sadhupur, West Bengala, India. There are 5 mini-grid systems on the island. 4 in DC and 1 in AC, with different tariff schemes and reliability factors. Household PV systems are visible in most houses, to complement the mini-grid service and recharge the household battery. In late 2018, the national grid arrived. Some connected to the new service, others did not. No rules are in place to integrate the existing services. Systems are competing in terms of tariffs and reliability. A flat tariff of 2€ for the mini-grid, little more for the main grid. In doubt, the Mandal family has joined all options: the new grid, the old DC network and a family panel worth 200€.

Average consumption

Patel Nagar, Delhi, India. With 350,000MW installed capacity, and a consumption of around 1,500TWh year, India has the world's third largest electricity consumption. Nearly 70% of national production comes from coal. Yearly per capita consumption is estimated at 1150kWh, a quarter of China's and a tenth of United States' per capita consumption. For well-off families the monthly bill is affordable. From 30 to 60€/month in winter and summer time for 7000kWh per year. Block tariff is in place.

Energy access for adaptation

Climate change impacts are worst where there is no technology for adaptation. Energy access is a key component for adaptation strategies.

- ▸ Urus Villaneque village, Bolivia, 3600m, has been re-located from the salt lake Poopò by the central government, following changes to the water regime. The increased frequency of droughts and floods transformed life around the lake, resulting in poor fishing due to higher salt concentration in the water. The grid has been extended to reach the new settlement

- ▾ Simiano Valero's family gave up fishery in 2014. Now he has turned to agricultural activities. A small solar panel supplements the grid to pump water into his greenhouse. Monthly electricity bill is 1.5€.

- ▾▾ Miguel Mauricio Choque, a former fisherman, now produces 4t of quinoa and 1t of potatoes per year; not enough to make a living. He and his wife have opened a tailor shop to complement their income by weaving alpaca jumpers.

Urban jungle

A jungle of poles over Kibera roofs, Nairobi. One of the largest slums in Nairobi, Kenya. Almost one billion people live in slums around the world. Energy access here faces different challenges. Absence of property rights make connection and meter installation a difficult task. Illegal connections are the norm and so are power outages and service interruptions, more proof that the energy access challenge coincides with the fight to end extreme poverty.

Slum connections

- ► Kibera, Nairobi, electricity is provided via a cable running into the neighboring house and arrives hand in hand with an informal charge of 10€ a month. TV, stereo, light and mobile phone. The cardboard packaging of a fridge is only part of the house wall.
- ▼ Delhi Shadipur slum. Electricity bills range from 2.5-3.5€/month as compared to a family income of approximately 90€. When there is no money to settle the bill, it is borrowed from neighbors using land property in the state of origin, Bihar, as collateral.
- ▼▼ Agbogbloshie, Accra. One fridge, one kettle, one rice cooker, one TV, one radio, one iron, one bed, one wife, one son, two chairs, three illegal electricity connections to supply the rented 8sqm house. *"We have three connections; it is the only way to have some chances to have power when you need"*. 2€ each per month.

The ultimate scrap yard

An elegantly dressed woman carries water to the incinerators at Agbogbloshie, Accra, Ghana, one of the world's biggest electronic waste dumps. The men burn cables, packaging and tires to recover metal from electronic appliances for resale. No international conventions can effectively control the traffic in electronic devices between developed and developing countries.

The label

Ghana has introduced an energy label for refrigerators. In parallel, a ban on second-hand fridges has been introduced in the country. It has not been an easy policy to implement because of the opposition from international electric brands, coupled with opposition of those living from the second-hand fridge market and waste processing. Today almost no second-hand fridges are being imported, compared to the 400,000 units per year entering the country in the past. Energy savings of around 100€/year per family are calculated by the Energy Commission.

Modern services

Simanjiro, Tanzania. In this mud hut, there is an overwhelming concentration of technologies. Mobisol is an emerging company selling small solar systems with the so called pay-as-you-go formula. A panel on the roof, a lithium battery, a smart meter with remote control. Monthly bills via SMS and mobile banking. The hut becomes a focal point for the village to charge mobile phones. A charging console is clearly an available extension.

Signs of light in the darkness

Kashipur village, West Bengala. The grid has reached the village, but this is little use for the thousands of street sellers of the crowded night. A local micro-finance organization has combined cash loans with the provision of portable solar lights. 30€ each in 12 installments with a 10% interest rate. Standard micro-finance schemes usually charge around 24%.

Fireflies

Kashipur village, West Bengala. Monday and Thursday are market days. An old diesel generator provides electricity to nearly 200 lights. 20€c per bulb per day. All lights are gently flickering to the unique rhythm of the generator. 20€ per year, as compared to the 30€ for the portable solar lamps, which are more and more entering into the picture.

Inverter charger

Tararat, West Bengala. An inverter charger charges batteries when the grid is available and works as a back-up unit during the frequent power cuts. Electricity bills jump to 15-20€ a month, a considerable amount, considering the monthly income of 100€ and an open micro finance loan of 1300€. The micro-finance company would like to offer a solar inverter instead, still connected to the grid, but where the battery is charged by the sun. More renewables in the energy mix, higher efficiency, and lower impact on the grid stability. So far, it has not found capital support to finance the scheme.

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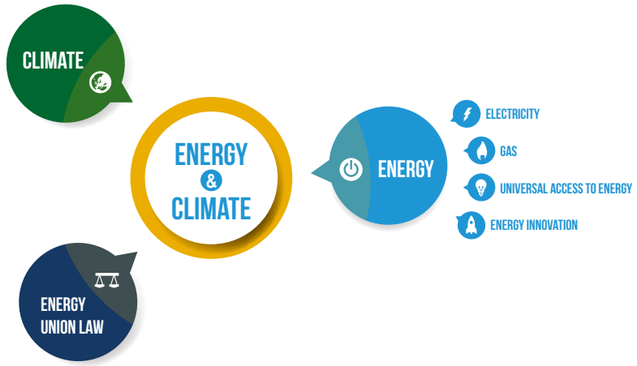
The Florence School of Regulation (FSR) was established in 2004 as an independent knowledge hub bringing together **Regulators**, **Policy Makers**, **Academia** and **Industry** to develop and share innovative thinking on energy regulation.

Today the FSR operates as a global platform, engaging in the development of **research**, **training** and **policy dialogue** in Europe, Asia, Latin America, Africa, and beyond.



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