SPECIAL FEATURE

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THE POWER OF HUMAN CAPITAL

MULTI-LEVEL CAPACITY BUILDING FOR ENERGY ACCESS

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INTRODUCTION

Over the past decade, the debate on access to energy has tended to lean mostly on technology, finance, and policy as key drivers. Thanks to this approach, there has been some progress in expanding global energy access—although the goal of universal access is still far off and is likely to remain so for the next two decades. Scaling up the strategies for access to energy requires a different perspective and an innovative approach to capacity building.

In line with the ethical imperative of the 2030 Agenda for Sustainable Development of "no one left behind" and its focus on people, the cross-cutting role of human capital (individually and collectively, as communities and institutions) becomes crucial both as a catalyst and a booster. Indeed, without the proper human resources, it will be impossible to achieve a transformative change in energy access—one that is efficient, effective, equitable, empowering, and long lasting. That is why human capital is now recognized as a core dimension for any strategy designed to reduce energy poverty at the global and local levels.

The right skills and competencies are needed for the design, uptake, and sustainable management of technologies, business models, and the policy framework. At the same time, the introduction and adoption of new or improved energy technologies require new skills for installation, maintenance, and service. The innovative business models that form the basis of the new energy markets require that the various actors (including consumers, communities, policy makers, regulators, and financial institutions) understand their role and the key drivers. In strengthening the role of people throughout the entire energy supply chain—from production to users—capacity building and training activities become essential components of any successful project aimed at enhancing energy access. If properly designed, they develop the local expertise needed to replicate and scale-up successful initiatives, support ownership of stakeholders, and foster sustainability beyond the withdrawal of external partners.

This paper examines the power of human capital in expanding energy access and a possible multi-level framework. It beings with the concept of capacity building and its evolution, and then moves to how human capital contributes to energy access, highlighting objectives, principles, approaches, and lessons learned. The role of smart distributed generation and local prosumers is also discussed as an innovative example integrating capacity building within the new framework of a transformative approach to access to energy. The paper ends with a set of recommendations for access to energy—including a proposed systematic approach to interventions that would fully utilize the power of human capital.

POWERING HUMAN CAPITAL FOR ACCESS TO ENERGY

Relevance of the human factor

Energy access is a pre-requisite for improving the quality of life and enabling socio-economic development. It fosters access to goods and services (health and education), supports industrial processes (transformation of local resources) and agriculture (agronomy and food processing), and may become an income generating opportunity for local populations. Moreover, appropriate energy solutions and technology choices must respond to the needs, capacities, and aspirations of people and be absorbed within the local culture, or adapted and later improved by the local population.[1]

For these reasons, people should be at the center of any strategy to promote energy access and capacity building and are considered a key asset for achieving the goal in a sustainable manner (see Box 1). This viewpoint is even highlighted in a recent report by the International Energy Agency (IEA) and World Bank's "Sustainable Energy for All 2015—Progress Toward Sustainable Energy," which includes capacity building as one of the four complementary themes that are crucial for making any progress in broadening energy access.

To date, there is still no systemic approach to capacity building that is specifically tailored to energy access. However, the recent experiences of four international entities—UNEP, IRENA, UNHCR, and GEF—can at least provide some insights and possible general principles and approaches that can drive any strategy in the field. A short summary of their respective philosophies is reported in Tables 1 to 4.

BOX 1

How the Concept of Capacity Building is Evolving

Over the past 20 years, there has been a major rethink of the concept of capacity building. To begin with, the notion of "capacity" has evolved from one that focuses on the ability of organizations and people to be resilient and successful to one that zeroes in on self-reliance. Here, the emphasis is on the ability of individuals, organizations, and societies to set and achieve their own development objectives, and the ability of human beings to perform, self-sustain, and self-renew. In this context, capacity building is a process to unleash, strengthen, and maintain such capacities—and a strategic means for long-lasting and autonomous development.

There is also a recognized need to go beyond the direct equivalence that defined "capacity building as training," and to extend the functional dependency of capacity building toward a wider vision of education as a fundamental human right. This approach is also in line with the original statement included in the 1992 UN Sustainable Development Agenda 21: "The ability of a country to follow sustainable development paths is determined to a large extent by the capacity of its people and its institutions that complements its ecological and geographical conditions." Such a holistic vision includes various sets of actions like: (i) building abilities, relationships and values; (ii) strengthening the processes and the rules that influence collective and individual behavior; and (iii) enhancing people's technical competences, soft skills, and attitudes to enable them to be proactive players for development.

TABLE 1 United Nations Environment Program—Energy and environment nexus

FOCUS	DESCRIPTION
Energy Interest	United Nations Environmental Program (UNEP) has a strong interest in energy. On the one hand, the production and use of energy may induce a number of environmental problems at the local, national, regional, and global level. On the other hand, a lack of access to energy hinders the economic and social development of billions people.
Capacity Building	UNEP is working with countries to help them meet the challenge of sustainable energy from a life-cycle perspective. This includes varied approaches, like analyzing energy policies, climate change mitigation, energy sector reform, and industrial energy efficiency. One of the essential elements in their strategy is the UNEP Collaborating Centre on Energy and Environment (UCCEE)—a group of international scientists, engineers, and economists that provides technical and analytical support to UNEP and its developing country partners.
Targets	UNEP focuses on enabling decision makers to deepen the link between energy choices and sustainable development, and helping financial institutions profit from the good investment opportunities available. It also works on strengthening an informal network of centers of excellence to build a tighter global community of sustainable energy practitioners.
Keywords	Diversification of approaches (including finance and policy), energy nexuses with other resources, networking.

AN INNOVATIVE SCHEME BY UNIDO

Building local capacities through industrial prosumers and renewable energy

Energy access is a means to achieve sustainable development and not an end in itself. Rather, the success of the energy access initiatives will be measured by the improved health of the beneficiaries, number of new jobs created locally, number of lives saved, increased local/national economic output, and increased level of education—and not just kilowatts per hour of energy generated.[2] To provide universal energy access in the near future, a transformational approach to the existing energy system is required. It will involve a switch away from a few large centralized power plants coupled with widely extended distribution lines to a more flexible, upgradable, and diverse model that focuses on distributed energy generation based on renewable energy technologies (RETs).

Indeed, the traditional energy chain will soon no longer exist. The energy supply chain from the generation plant to the consumer, once fairly straightforward, is evolving into a complex, multi-layered system of a few large and many small plants. Consumers are turning into producers, transforming the energy conversion chain into a multi-dimensional, multi-layered energy matrix that is growing more complex and articulated.

The search for effective solutions to increase energy access in developing countries has led to the recognition that industries can and should play a crucial role. Industries that generate their own energy can also increase their

TABLE 2 **International Renewable Energy Agency—Renewable energies**

FOCUS	DESCRIPTION
Energy Interest	The International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports countries in their transition to a sustainable energy future and serves as the principal platform for international cooperation, a center of excellence, and a repository of policy, technology, resource, and financial knowledge on renewable energy.
Capacity Building	IRENA operates on the principle that the process of empowerment needs to be comprehensive, issue-based, regional, participative, and accountable. In keeping with this principle, it supports the following approaches to capacity building: • Readiness and capacity need to be assessed, given that renewable energy requires a systemic shift and additional skills and competencies that can: (i) apply to off-grid or on-grid; and (ii) be used at a variety of levels, such as residential, industrial, and small or large scale. • A global repository of capacity building information should allow connections among the many stakeholders active in the renewable energy field in order to increase the way in which global resources, information, and experiences are shared and used. • Regional capacity building initiatives should be conducted at the regional level and in close cooperation with local partners (such as the Renewable Energy Learning Partnership).
Targets	IRENA aims at supporting member countries formulate long-term capacity building responses that are integrated into national policies and processes.
Keywords	Comprehensive, issue-based, regional, participative, accountable.

TABLE 3 **United Nations High Commissioner for Refugees—Energy and the humanitarian aid**

FOCUS	DESCRIPTION
Energy Interest	United Nations High Commissioner for Refugees (UNHCR) has recently defined a first strategy to promote appropriate household fuel and energy technologies (including the expanded use of renewable energy) to improve the protection and well-being of refugees. Capacity building is recognized as one of the essential elements to ensure the strategy's success.
Capacity Building	The strategy will seek to integrate energy requirements into emergency preparedness and response. Moreover, innovation needs to play a crucial role in humanitarian settings, either for technological solutions or for funding opportunities. Data collection and documentation should be reported to distill good practices and replicate them in other contexts.
Targets	UNHCR believes that an effective strategy needs to be based on multi-stakeholder partnerships (including national entities) and should empower the humanitarian actors as well as the refugee community by also creating synergies with other sectors.
Keywords	Partnership, synergies with other sectors (the nexus approach), innovation, monitoring, reporting.

TABLE 4 **Global Environment Facility--From environment to energy**

FOCUS	DESCRIPTION
Energy Interest	The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing environmental problems. Its interest in energy is thus mainly focused on the impact that the energy sector may create on the environment.
Capacity Building	The GEF strategy on capacity building is designed around a number of principles: • Partnership needs to be promoted so that multi-stakeholder consultations and decision-making processes can be held at the regional level. • A comprehensive and holistic approach is required so that capacity building is fully integrated into wider sustainable development efforts, and the dynamic nature of capacity building may be acknowledged by adopting a learning-by-doing approach. • National ownership and leadership need to be acknowledged so that capacity building efforts are based on a sort of self-needs assessment
Targets	The GEF has become an international partnership of 183 countries, international institutions, civil society organizations, and the private sector to address global environmental issues.
Keywords	Partnership, holistic approach, dynamic nature, learning by doing, national and regional approaches.

income by selling excess energy and providing an essential community service. A win-win situation can be established by increasing the efficiency of energy processes in industries through the use of waste; or applying any source of renewable energy, along with introducing electricity as a revenue stream. The diversification of products and services by local industries increases their resilience and market competitiveness and simultaneously contributes to developing the local community. Local industries that both produce and use renewable energy sources (such as solar, wind, and bioenergy) for their own needs, along with selling the excess energy to the surrounding community, can be defined as "industrial prosumers."[3]

This innovative model is based on the fact that local industries possess the necessary business capacities to run an enterprise and therefore represent a low hanging fruit in the expansion of energy services for the local community. Nevertheless, on top of the business capacities, local industries need the support of energy specialists, technicians, operators, researchers, investors, and supporting institutions (such as governments, universities, and financial organizations) to become effective industrial prosumers. Expanding capacity building initiatives to develop and retain a skilled workforce to meet these new opportunities will be critical to ensure that new energy markets are developed to achieve universal energy access.[2]

Drivers and barriers

As businesses and industrial power users move in this direction, the reliable availability of power remains a major issue in many areas of the world. In Africa, for example, a recent survey found that reliable access to electricity was the single largest issue for businesses.[3] So far, the industrial sector's response to this concern has often been simply to produce power via fossil fuel captive generators. But as renewable energy technologies improve and continue to come down in cost,[4] the industrial prosumers model will become a clear business opportunity for many industrial sites around the world.

Interventions to promote sustainable energy access markets must go beyond installation projects. Market development requires the availability of local capacity to support providers and consumers. Without a supportive environment for market participants, projects for energy access can be perceived as less reliable or unworthy of investment. RETs are a unique business opportunity for the local population only if the local capacities are properly developed.

Policy needs

The new model is particularly significant in remote areas where expanding the electricity grid is cost-prohibitive. The involvement of local industries in providing energy access reduces the risks and time associated with establishing new energy companies or community-based energy enterprises. Local entrepreneurs and industries are aware and capable of dealing with their market's human, financial, and legal conditions—and thus have a much larger chance of success in providing modern energy services and could form the basis for developing the skills and competences locally needed.

There is a clear role for policymakers to support developing industrial prosumers as an excellent driver for energy access. For instance, the ECOWAS Renewable Energy Policy[5] (jointly developed by the ECOWAS Regional Center for Renewable Energy and Energy Efficiency,[1] UNIDO, RECP,[1] and EUEI-PDF[2]) offers a model of guiding principles for a conducive policy development for industrial prosumers. The regional policy provides a framework for the soon to be developed National Action Plans. It specifies that: (i) ECOWAS members shall guarantee (through their transmission system operator and distribution system operator) the purchase and transmission of all available electricity from renewable energy-based electricity producers; and (ii) grid operators have to contribute financially to necessary grid upgrades, provide a stable and long-term favorable pricing mechanism, and ensure unhindered access to the grid for renewable energy independent power producers (IPPs) and public private partnerships (PPPs), along with adapting the grid code to incorporate RETs. The policy also requires reforming the legal and regulatory national framework for member state power sectors.

Case studies

Since 2009, UNIDO and its partners have undertaken many projects in developing countries that focus on building local human capital to promote energy access in rural areas. As the four case studies highlight, this can be done with a variety of renewable energy technologies (biomass gasification, solar PV, small wind, small hydro, and biogas) and in a variety of ways.

In all of the cases, the critical success factor is empowering human capital through capacity building and technology demonstration. In addition, the understanding of the local market, combined with the entrepreneurial capacities needed to run a business, form the basis for introducing energy services. In Cambodia and Nigeria, energy access enables existing companies to earn additional revenue and thus turn a profit; in The Gambia, it enables businesses to demonstrate corporate social responsibility; and in Kenya, it offers a way to not only enhance income but also reduce environmental impacts.

A "win-win" human capacity based approach

Industrial prosumers represent a low hanging fruit for programs that aim at increasing energy access by developing energy companies. As IRENA puts it: *"To date, the most effective model for providing distributed energy services to local consumers in a replicable and reliable model involves engaging small entities, such as private SMEs. With proper support and financing, small local enterprises can understand local markets and nimbly provide services that meet customers' needs"*.[6] With the right technical assistance and regulatory and policy conditions, industrial prosumers can play a leading role in boosting access to modern energy services in both the electricity and heating and cooling sectors. Local prosumers offer not only the technology and economic conditions but also the knowledge and experience to facilitate developing and expanding the required human capital.

CASE STUDY 1 Rice Husk Gasification, Cambodia

PROJECT	PROJECT TYPE	LOCATION
Rice mill	**Rice husk gasification + rural electrification**	**Charchuk Commune, Ankor Chum District, Siem Reap Province**

Rural Cambodia suffers from a very low electrification rate, and energy prices are high as fossil fuels are imported. In 2014, a 150 kW rice husk gasifier was installed to replace a diesel generator in a rice mill and connect an additional 300 households (700 people) to a local grid.

MAIN OUTCOME: Through this fuel substitution, 900 tons of CO2 per year could be saved and energy costs could be reduced. The biomass waste, which had been a problem, is now an income generation opportunity for the operator. Furthermore, the rice mill owner now receives income from supplying electricity to the surrounding communities.

HUMAN CAPITAL DEVELOPMENT: In this project the human capital development was done at several levels:

- The introduction of biomass gasification technology as a substitute to diesel generators required training on operations and maintenance. Technical training was provided to local manufacturers and technicians.
- Industrial prosumer model demonstration: The generation of excess electricity through the use of waste created an additional revenue stream for the company and interest from other companies to replicate the success.

CASE STUDY 2 Biogas plant at Nyongara Slaughterhouse, Kenya

PROJECT	PROJECT TYPE	LOCATION
Biogas plant at Nyongara Slaughterhouse	**Slaughterhouse waste for biogas production**	**Dagoretti, Kenya**

Dagoretti is a suburb of Nairobi well known for its slaughterhouses. In 2009, the high-level pollution in the Nairobi River due to the waste from the slaughterhouses almost caused their closure. Moreover, frequent power cuts have forced the abattoirs to use diesel generators for their operation. The project aimed at introducing a new technology, pursuing capacity building, and demonstrating the use of slaughterhouse waste in biogas production. In 2010, a 15 kW biogas plant was installed (with a high-performance, temperature-controlled digester, using solar heating) to replace a diesel generator and recover waste heat to replace wood and charcoal for hot water to clean the abattoir.

The project was co-funded by the GEF and was based on a public private partnership between the abattoir, UNIDO, UNEP, the Kenyan Ministries of Environment and Industrialization and the Kenyan Industrial Research and Development Institutes.

MAIN OUTCOMES: Economic benefits include reducing the cost of energy from $0.20 to $0.09 per kWh and cutting CO2 emission by 108 tons per year. The process also yields organic fertilizer as a by-product, bringing additional income to the abattoir.

HUMAN CAPITAL DEVELOPMENT: At the institutional level, the government is planning to adopt this approach as part of its policy on waste management for Kenya's slaughterhouses. The human capital development achieved through training in new technological solutions for energy production created business opportunities. The introduction of a new technology that could both reduce environmental impacts and generate additional income for the enterprise has triggered interest from several training institutions and firms to replicate the experience.

CASE STUDY 3 Telecommunication Towers, The Gambia

PROJECT	PROJECT TYPE	LOCATION
QCell telecommunication towers	**Hybrid solar and wind**	**10 sites in The Gambia**

Qcell Company Limited is a mobile GSM operator in The Gambia, which began operating in July 2009. Before the introduction of RETs, Qcell estimated that 80 percent of its operational costs come from running the transceivers at the rural areas using diesel generators. In 2012, the project installed solar PV and wind turbines (total 84 kW) to power Qcell transceivers in 10 sites, in an effort to lower operational costs and stop pollution. The 4 x 1kW wind turbines were mounted on each tower, while solar PV systems were fixed to the ground. This hybrid system works 24 hours per day. Qcell agreed to provide power to each of the 10 health facilities where its new transceivers are located.

MAIN OUTCOMES: The daily energy supply is enough to provide basic services for the critical areas within these health facilities (such as lighting and refrigeration), enabling Qcell to contribute to better health in the rural communities. RETs allowed for a greater mobile coverage combined with electricity for additional social needs (such as electricity for health centers or schools, local internet cafes, mosques, or community centers).

HUMAN CAPITAL DEVELOPMENT:
The use of renewable energy solutions (solar PV and wind energy) for telecommunication towers and local community services required local training on the mounting, operation, and maintenance of the equipment.
The newly acquired skills represent an important asset for technicians in the Gambian market.

CASE STUDY 4 Highland Tea Factory small hydropower plant, Nigeria

PROJECT	PROJECT TYPE	LOCATION
Highland Tea Factory	**Small hydropower plant (SHP)**	**Kakara, Nigeria**
The Highland Tea Factory in Kakara employs 350 to 500 workers, and the related tea plantation consists of 6,000 farms. Running on diesel generators and wood-fueled boilers for drying, the tea factory has been economically drained by the energy costs involved. The lack of power supply meant no new businesses or industries could be established. To revive existing economic activities and create additional income generating opportunities for the local communities, it was necessary to focus on providing reliable and affordable electricity for the area. In 2013, a small hydropower plant with a capacity of 400kW started operation. It is owned by Taraba State and managed by the Highland Tea Factory, supplying clean electricity to the factory and local communities.		
MAIN OUTCOMES: The new technology enabled the tea factory to explore plans to expand production capacity and provide additional job opportunities in the area. Moreover, the factory has reduced its environmental impact and cut its greenhouse gas emissions. Local technicians have been trained in the operations and maintenance of the SHP plant. A large amount of trees have also been saved since clean power replaced the burning of wood to dry the tea.		
HUMAN CAPITAL DEVELOPMENT: The introduction of a reliable and sustainable source of energy facilitated local economic activities and provided new jobs, and is now helping communities set up small-scale businesses such as milk and meat processing. Human capital development proved to be critical for this rural energy enterprise.		

Promoting industrial prosumers is important globally, but it is particularly important for countries with limited grid coverage, reduced energy access rates, and an agricultural-based economy with large and often untapped waste streams. In light of the significant benefits that can flow from increasing access to modern energy and electricity services, policymakers should recognize industrial prosumers as a priority policy area and develop pro-active regulatory frameworks. The industrial prosumer approach is based on the understanding that qualified human capital is required that needs to be promoted as a critical resource to catalyze and maintain local ownership, foster economic development, and ensure long-term impacts.

RECOMMENDATIONS FROM LESSONS LEARNED

So what lessons can we draw in terms of insights of general validity for any capacity building action? Here, we draw on the literature on capacity building[7, 8, 9, 10] and the key references specifically tailored for access to energy provided by IEA[11] IRENA,[6] UNHCR,[12] and SE4ALL:[13]

- *Diversified targets.* Capacity building should address different beneficiary groups, which may have different access to training opportunities at technical, vocational, or institutional levels.
- *Different skills.* Capacity building interventions should be diversified to address the different needs for skills existing at different levels of the energy supply chain and within different local contexts—and be aligned with the ability of the different target groups.
- *A multitude of stakeholders.* Due to the diverse nature of the required competences, a variety of local, national, and international stakeholders should be involved (even beyond the traditional players of the educational systems).
- *Life-cycle perspective.* People are the catalyst and the drivers of change. Their capacity needs to be developed all along the supply chain of the design solution, and within this approach, linking skills and work needs to be a guiding principle.
- *Comprehensive approach.* Capacity building for energy access should encompass a comprehensive approach based on human, scientific, organizational, and institutional capabilities.
- *National/regional and local strategies.* The need to strengthen national capacities should be shared by all countries and should be able both to drive national-based priority definition and regional coordination and to assure the support to project-based or specific local actions.
- *Teaching tools.* A mix of tools may be used, varying with the targets and the expected learning outcomes (including training, seminars, workshops, on-the-job tutoring, and site visits).

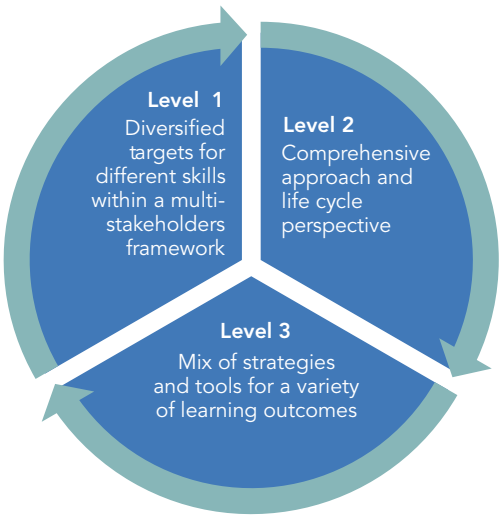
A multi-level approach to capacity building for energy access

These essential elements can then be grouped into three macro-dimensions to help us discern a rational base for capacity building and a multi-level structure of capacity building for access to energy.[3]

Three interconnected levels emerge (Figure 1), each responding to a crucial component of the sector:

- Energy access is a long-term process that needs planning and qualified human resources over a variety of diversified subjects and requiring a multitude of skills.
- An integrated approach is crucial in the whole life-cycle perspective, from identification to monitoring and evaluation. Capacity building strategies should also benefit from a multi-stakeholder approach, including local teaching institutions,[14] NGOs, and the private sector.
- To couple diversification with integration, ad-hoc strategies need to highlight different teaching tools for different learning outcomes. These strategies should in-

FIGURE 1 Multi-level breakdown for capacity building



clude adequate financing over the long term to ensure ownership and sustainability of energy access initiatives.

Level 1: Diversified targets. If the goal is diversifying targets to benefit from any formal (governmental-based) or informal (community-based organization) learning programs[15] initiatives should also include people working in small enterprises, rural industries, the informal economy, self-employment, unemployed, and irregular or precarious employment. Moreover, capacity building should propose a scheme of diversified skills to match today's challenge on sustainable development. Competencies and skills are needed to improve employability and livelihood opportunities, reduce poverty, enhance productivity, and promote inclusive sustainable development.

Given the diverse nature of the competencies required, a variety of local, national, and international stakeholders[16] need to be involved. Agenda 2030[17] also highlights the relevance of local institutions and civil society organizations, as well as international cooperation and partnership, to support national plans and create networking among competent people. Furthermore, capacity building is required across many sectors, organizations, and groups, and it needs to be diversified from country to country. By expanding the original subdivision proposed by IRENA, three major categories—individual, organization, and government—and within them, a further breakdown (youth, municipalities, and ministries)—we can formulate a more ready-to-use taxonomy (Table 5). It is worth underlining that different players could be both targets and beneficiaries for capacity building actions—for example, women trained in certain energy areas can also contribute to spreading technology within their families and local community.

Level 2: Comprehensive approach and life-cycle perspective. People are the catalyst and the global driver of change, and technological solutions need to be designed to meet today's and tomorrow's capacity requirements. A good way to do this is with a life-cycle perspective that links skills with labor needs. By establishing solid bridges between the labor market and vocational training and skills development, capacity building becomes more effective and can contribute to closing the gap between job opportunities and required skills.[18]

TABLE 5 Level 1: Diversified targets

INDIVIDUALS	ORGANIZATION	GOVERNMENT
Youths Citizens Educators Technicians Researchers Entrepreneurs Prosumers Public officers Civil society operators	Public bodies (municipalities, local authorities) Private sector (SMEs, cooperatives.) Civil society organizations	National entities (ministries, national authorities) Regional level (overarching organizations, networks)

Moreover, beyond the technological capacities and competences linked to the implementation phase of any energy access project, capacity building encompasses a comprehensive approach, including the country's human, scientific, organizational, and institutional capabilities. The goal is to enhance the ability of a country or a body (or a project consortium) to evaluate and address crucial questions related to the economy, finance, and enabling policies—such as a full understanding of potential environmental and social impacts. Monitoring, evaluation, and accountability are key to significantly increase the availability of high-quality, timely, reliable, and disaggregated data and their ex-post analysis. This facilitates designing appropriate corrective measures and pursuing knowledge-based local research and innovation to ensure local ownership and thus the long-term sustainability of energy access initiatives.

To scale up access to energy, a systemic shift is required, involving home-based systems, community-based services, productive industrial or agricultural uses, small- or large-scale systems, and off-grid or on-grid solutions. Capacity building needs to cover the complete life cycle of the different technological solutions proposed—ranging from awareness raising, assessment and selection of technology options, and preparation of business plans, to product development, establishment of community-based utilities, and setting tariff structures. For level 2 in our taxonomy, the five main categories are: cultural, technological, economic, political, and a cross-cutting dimension (Table 6).

Level 3: A mix of strategies and teaching tools. Countries should pursue their strategies based on national priorities on capacity building—and whenever available[19] embedding capacity building components within all the existing projects[20] and enforcing national or regional coordination. It is also crucial to promote individual actions following a decentralized and project-based approach for activities that are part of existing projects at the country level. For access to energy, our level 1 and 2 breakdowns may be used to set up a level 3 structured matrix of interventions (strategies and teaching tools)—which combine

TABLE 6 Level 2: Comprehensive, life-cycle approach

CULTURE	TECHNOLOGY	ECONOMY	POLICY	CROSS CUTTING
Behaviour	Ex ante assessment *Resources* *Local constraints* *Needs/loads*	Business planning	Enabling environment	Networking
Awareness	Identification & formulation *Energy Solution Planning/ Optimization* *Implementation and field work*	Entrepreneurship	Regulatory framework	Capacity building and lifelong learning
	Implementation *Operation and Maintenance* *Monitoring and Data Analysis*	Financial Scheme	Coherence	
	Ex post *Impact Evaluation* *Continuous Research and Innovation*			

TABLE 7 Level 3: Mix of strategies and teaching tools

TRADITIONAL	PARTICIPATIVE	LEARNING BY DOING
Lecture	Exposure	Assignment
Seminar & Workshop	Assignment	Joint project
Visit	e-collaboration	Technical assistance
e-learning	Project work	Tutoring on the job
Informative campaign	Business Case	Local, regional lesson learnt

traditional or participative education, and learning by doing (Table 7).

These three levels can then be combined to help policymakers come up with a multi-level approach that combines targets, skills, and strategies/teaching tools. Take the case of the target group being organizations, and skills requirement falling the economic category. As Table 8 shows, the appropriate strategies and teaching tools for public entities might be: technical assistance for a business plan, local or regional lessons learned for entrepreneurship, and international exposure.

FINAL CONSIDERATION

Achieving universal energy access is a long-term undertaking. Capacity building at both individual and institutional levels plays a key role in ensuring the success of energy access strategies and complementing the technical, financial, and political efforts. Capacity building needs to go beyond adding a training component to any intervention. It needs to be designed to fully deploy the power of human capital as one of the crucial assets of any community.

As highlighted by Agenda 2030, innovation and shared knowledge, as well as new competencies, capacities, and skills, are deeply needed to cope with today's challenges. The role and centrality of human capital is especially relevant within a transformative path for universal energy access. People-oriented and people-driven approaches need to be designed and adopted. In this context, capacity building becomes the leverage to achieve local ownership and long-term empowerment—the true engines of the needed transformative path.

We propose a systemic approach to capacity building that identifies: (i) a mix of target groups, skills, and stakeholders; (ii) a comprehensive life cycle approach, within the energy supply chain; and (iii) a mix of strategies and tools that can be selected for the various targets and the expected skills to be generated or reinforced. This will facilitate the transformative change that is required to scale up access to energy and sustain local ownership, promote economic development, and ensure long-term impact.

TABLE 8 **Example of an economic multi-level approach for organizations**

		ECONOMIC		
		Business plan	Entrepreneurship	Financial Scheme
ORGANIZATIONS	Private company	*Participative* Assignment	*Learning by doing* Tutoring on the job	*Traditional* Workshop
	Civil society	*Traditional* Seminar	*Participative* Case Studies	*Traditional* Workshop
	Public entities	Technical Assistance	*Learning by doing* Local, regional lesson learnt"	Participative Exposure

NOTES

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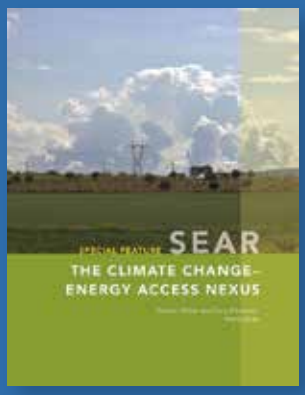
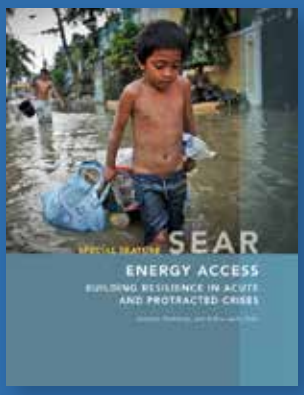
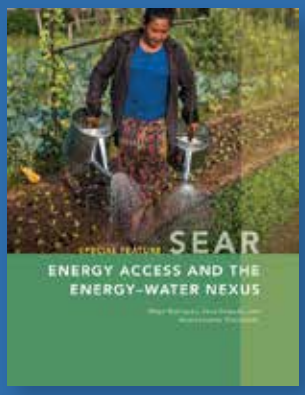
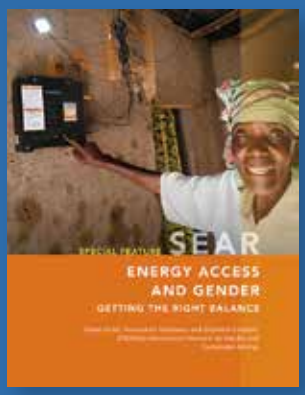
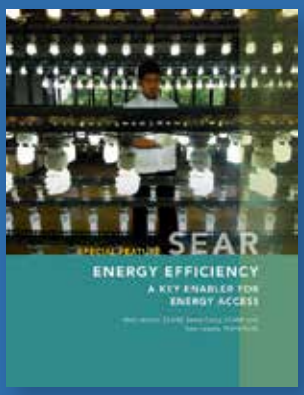
SPECIAL FEATURES

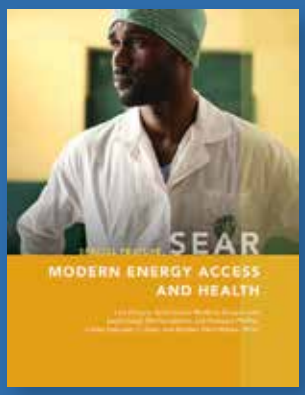


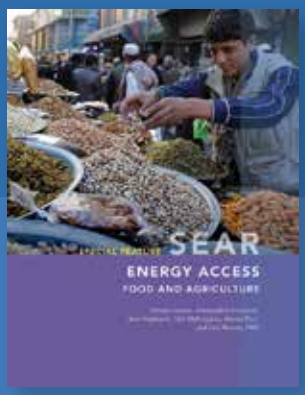


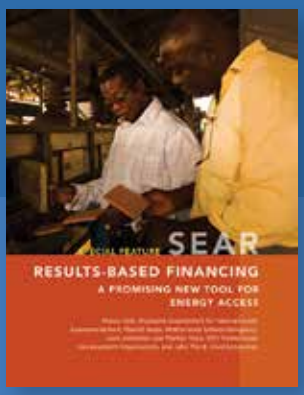


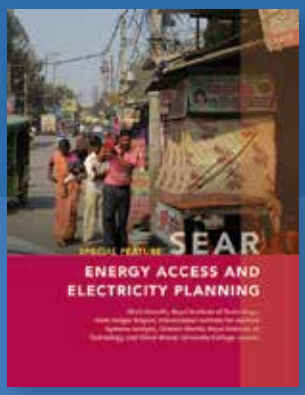












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