SUMMARY REPORT AND RECOMMENDATIONS

Virtual Workshop on Energy Access and Empower a Billion Lives II (EBL-II)

June 30, 2021, 8:00 am – 12:30 pm EST

organized by

Institute of Electrical and Electronics Engineers - Power Electronics Society (IEEE PELS)

BACKGROUND

Lack of access to energy is a key inhibitor of economic growth, particularly for almost 1 billion people with no access to electricity and over 2 billion people with poor and unreliable energy access. Despite tremendous and sustained efforts by governments, NGOs, private sector, utilities, multilateral agencies and philanthropic investors, the goal of affordable, sustainable and equitable energy access for all remains an elusive objective. This limits the ability for this segment of the population to achieve their life goals and further expands the disparity between the haves and have-nots.

Climate change brings a growing sense of urgency to this discussion. Rapid technology cycles and continued declines in cost of PV solar, battery and transportation solutions have brought the developed world to the cusp of a transformation in the energy ecosystem, with potentially cost-effective solutions that are also sustainable and climate friendly. As the developed world rapidly changes, there is a danger that the energy access world will once again be left behind, trying to deploy 20th century solutions that are not economically viable or environmentally sustainable. There is an opportunity for the emerging markets to leapfrog the developed world and to build a new energy ecosystem that is both economical and environmentally sustainable and can jump-start economic growth. But what is needed to achieve this, and how do we get there?

To facilitate a conversation among diverse energy access stakeholders, IEEE PELS organized a global virtual workshop on June 30, 2021, bringing together a representative group of energy access stakeholders, including policy, technology, business, social impact, finance, end-users and NGOs, to create alignment in goals, metrics, strategy and approach to achieve the objective of universal access to abundant and sustainable energy for all by 2030.

The workshop also served to launch **Empower a Billion Lives - II (EBL-II)**, a global competition to help create an ecosystem of technologists and entrepreneurs who develop, demonstrate, derisk and deploy new energy access solutions that are holistic, economically viable and can scale rapidly in the target market segments. More information on the competition can be found at www.empowerabillionlives.org.

A detailed agenda for the workshop and attendees is included in Appendix 1. The actively participating studio audience included 40 people from 34 global organizations (Appendix 1) actively involved in all facets of energy access, along with 200 attendees from 54 countries who attended the workshop online. A summary of the discussions and recommendations are shown below.

Key Challenges:

Many challenges were identified during the presentations and discussions. Some key issues are shown below:

- Integrated Energy Plans

A robust national IEP with government buy-in and long-term commitment creates a point for various organizations to converge around, creating fertile ground for coordinated efforts by the private sector, donors and other financing sources. Ambition and political will are critical, and Nigeria is a good example. However, IEPs need to be flexible, data need to be validated, and stakeholder collaboration is critical. The question though is - how do these plans stay flexible in this very dynamic landscape, including fast technology developments with 1-2-year cycles? Value-stacking needs to be a part of this integrated planning approach, going beyond energy provision only. Productive energy use, transport and cooking are large energy consumers, are key to both making business models work and creating impact and need to be included in the plans.

- Organizational Silos

Energy access is a sector of huge stakeholder diversity: governments, private sector, NGOs, academia, DFIs, global organizations, multilateral agencies, civil societies etc. Each stakeholder is trying to solve a piece of this enormously complex puzzle, in the hope that these joint efforts will get us all to the elusive finish line — universal energy access. However, each stakeholder or a group of stakeholders is operating within their mandates, capacities and boundaries, with their own organizational priorities, targets and KPIs, typically focusing on different small-scale interventions over short time horizons. As a result, we work in silos, insufficiently leveraging each other's work, sharing lessons learned, and aggregating available financing. Moving past this will require a shared vision of success realized through pragmatic horizontal alignment with vertical specific activities. It should be a merge of a bottom- up approach and can-do attitude, but with a holistic solution as if it was top-down. The shared vision and holistic solutions must be a joint effort realizing strategic alignment with all the relevant stakeholders represented, rather than being specified only by policy makers. The desired outcome is that governments know where to focus, funders which solutions to support, technology developers what high level attributes are required and what they should work on, and solution providers which communities to deploy their solutions to. To achieve this, not only is it important to know where we are going, but equally important to know where we are at this time.

- Technology Approaches – Centralized or Decentralized

Energy access space has largely diverged into two separate pathways, centralized (grid) and decentralized (stand-alone solar and microgrids). This manifests itself in all the relevant aspects – financing sources, deployment, stakeholder collaboration, and – a different vision of what success is. On one hand utilities are forced to pursue the grid extension model even when the demand levels are too low, and economics simply don't work. On the other hand, in the decentralized space, utilities are largely left out of the discussion while they have to be part of the solution. Decentralized approaches, such as solar home systems and microgrids have emerged in response to the shortcomings of centralized grid extension, sparked private sector innovation and are increasingly being integrated in national electrification plans. However, affordability, scalability, business models, interoperability of solutions, quality, technology obsolescence and life-cycle sustainability remain a challenge. Furthermore, the past decade has shown that energy access should not be seen as a silver bullet but viewed through a broader cross-sectoral lens including food security, access to water, health, and economic and institutional development.

The silo-ed approach at the government and policy level does not track technology evolution and leaves behind the weak grid and under-the-grid contexts. Ensuring that we don't end up with islands of viability is a matter of policies and regulations, but also of technology, providing flexibility, interoperability and scalability, enabling growth and smooth transition from small, decentralized solutions to a 21st century grid. This is also critical to be able to unlock financing opportunities and amortize the capital over the lifecycle, which has proven challenging for many decentralized solutions. It is also an enabler for the real climbing up the energy ladder, a worthy promise of the energy access sector that is yet to be fulfilled.

- Productive Use of Energy and Value Stacking

Productive use of energy has been a focus of the energy access sector in the past years, recognizing it as a critical direction in terms of both socio-economic impact on communities, but also keeping solution providers in business in the long run who recognize they are currently fighting for the share of a small wallet. Solar water pumps, cold storage and agri-processing machines show large potential, but further R&D and funding is needed for off-grid suitability in terms of ultra-high energy efficiency and context customization. E.g., a reduction of milking machine from 500-700W to 150W can drastically reduce the cost of solar solutions needed to power these and improve overall accessibility and affordability. However, even for highly efficient appliances, successful market adoption remains a challenge. Building ecosystems are necessary, including data analysis, availability and affordability of appliances, access to finance, business development support, market linkages among others.

Clean cooking has proven to be an extremely tough problem to solve, in magnitude (3X larger than electricity access), social acceptance and context dependence (different to a solar home system that can power lights and television anywhere in the world) and technology (high power levels are needed for existing solutions, making them unsuitable for standalone solar or low-capacity connections). Technology development breakthroughs in highly efficient electric cooking are needed. Similarly, energy requirements for transportation are a necessary part of an evolving society and can be an integral part of the overall energy use equation.

Domestic value chains need to be strengthened as we look at energy access and the energy transition more broadly. The energy transition in these communities should not mean replacing one form of (technology or commodity) dependence with another. The accompanying benefits for jobs, local economy development in the long-term can be significant.

- Enabling Technologies and Potential Impact

Key technologies, often referred to as exponential technologies, show sustained steep learning rates, 1-2-year technology cycles, and the ability to scale rapidly. These technologies include computing, communications, internet, PV solar, battery energy storage, LED lighting, electric transportation and automation. The rapid growth of the technologies has transformed our lives over the last 20 years, and promises an even faster rate of change over the next two decades. This rapid and simultaneous change in multiple areas has created profound shifts in the economics of systems that have been widely deployed across the globe – including the power grid, transportation, communications and entertainment infrastructure, financial networks, agriculture, industrial manufacturing and 21st century jobs. Today PV solar (with storage) is much cheaper than conventional generation and promises to continue to decrease in price. Electric transportation will replace fossil-fuel-based vehicles, not because of climate change, but because they are cheaper to make and operate. Sophisticated technology makes the smart phone easy to use, even for uneducated villagers in remote communities. Advanced nano-manufacturing techniques provide low-cost methods for desalinating water, and even extracting carbon from the air. Many of these technologies can be modularized and miniaturized, allowing deployment across the globe.

The simultaneous and rapid evolution of so many technologies, all interacting with each other, makes it very difficult to predict exactly how the systems will evolve. This by itself suggests that it may not be wise to build very large plants that are too expensive and cannot compete with more modular systems that can track changes in technology. Challenges with justifying the first and operating costs of traditional microgrids suggests that they may also face a steep hurdle. A preferred approach may be to look at modular distributed solutions that can autonomously form a bottom-up microgrid, connecting to the grid when it becomes available. This also requires that for rapid scaling, multiple solutions from different vendors be interoperable at the customer end-use level. Traditional standards-based processes can take 6-10 years (versus the 1-2-year technology cycles) and may not be the best vehicles for assuring interoperability. Industrial consortia and a mix of public-private funding and early adoption orders can shape the solutions that are developed (e.g., Bluetooth and 3-5 G systems).

Technology can help with many areas:

- Cost reduction and affordability: systems that allow productive use of energy and value stacking making cost-justification easier; system cost reduction through smaller PV and storage size due to ultra-efficient appliances and advanced energy management; interoperability can drive down industry costs through economy of scale
- Reliability and sustainability of supply: automated operation; easy install, commission, operate and maintain (even with non-skilled workers); advanced diagnostics and battery health analytics for prevention of electricity supply interruption; design of plug-and-play systems that can operate across multiple vendors and technology generations
- Climbing up the energy ladder: systems that can start small and scale up as needed, energy sharing among end-users
- Circular economy and e-waste: advanced tracking to enforce a circular economy and waste management; new battery technologies made from easily recyclable materials; extending battery lifetime by advanced battery management systems
- Unlocking (commercial finance) and enabling business models: advanced transaction management; IoT technologies for remote control enabling risk management, data analytics for enabling new products and services offerings.

However, it is critical that these opportunities are communicated among energy access stakeholders, and in particular policy makers in order to be included into energy planning and implemented on the ground.

- Financial Gap and Subsidies

There is a financing gap to reach universal energy access — it is estimated that annual investments of US$41 billion are needed, while 2018 tracked $16 billion, only 1% of it being for off-grid despite the projections that off-grid solutions will electrify 30% of the remaining population without energy access. Subsidies are to the decentralized sector events what tax is in the halls of Davos but will be absolutely necessary to leave no-one-behind. No rural electrification has been performed without subsidies and it is unreasonable to expect it to work in some of the poorest countries in the world.

Similarly, incentives (as opposed to taxes) can play a big role in accelerating viable solutions. While a carbon tax has been proposed (and continues to be of interest in Europe), it has been difficult to enforce. Further, it tends to heavily penalize the emerging nations (who did not contribute to anthropogenic carbon emissions anyway). A better solution is to incentivize a solution with a steep learning rate and desired attributes, and to do it at a time when the solution is approaching price parity with a conventional less desirable solution. As in the case of PV solar, batteries, EVs, and even LEDs, this spurs innovation and accelerates the development of needed solutions. Today, governments rarely take this approach in the energy access area, using available technologies in making decisions, rather than guiding the market to develop solutions which meet their social and financial objectives.

Recommendations:

Based on the discussions at the Energy Access workshop and the above summary, a few recommendations are shown below.

- There is a significant need for a forum where people from different silos can interact, to create alignment in goals, metrics, strategy and approach to achieve the objective of universal access to abundant, affordable and sustainable energy by 2040.
- Need a mechanism for sharing information on needs as defined by the energy access community and end-users, and new capabilities that can be enabled by fast-moving technologies, business and financing models, as well as policies and end-use cases.
- Given the challenges of both pure grid-extension and current microgrid models, a desirable approach may be to specify a plug-and-play building block that can interoperate across multiple vendors and technology generations and can scale from a small system to full grid-connected operation and can do so autonomously without the need for technical expertise along the last mile.
- One way for the energy access markets to leapfrog the current technology base is to move towards such modular systems that are based on exponential technologies with steep learning curves, using subsidies and incentives to accelerate deployment and further price reductions.
- Productive use of energy along with new 21st century manufacturing approaches can provide the livelihood and economic development for communities that can overcome the challenge that many of the grid and microgrid providers face today.
- There is a need for an ecosystem of technologists and entrepreneurs who are in the regions and areas most impacted by energy access challenges, and who can develop, demonstrate, derisk

(technology, business and finance) and deploy holistic new energy access solutions at scale. The availability of such solutions can in turn reduce risk for venture and growth capital and can accelerate the time to impact.

- Importance of raising technology awareness and communicating opportunities among policy makers is paramount. Technology can alleviate many challenges that are perceived as socio-economic.
- Standards and interoperability can drive down industry costs through economies of scale.

- Interoperability and bottom-up growth can enable true integrated energy planning and supply-demand match and bring different providers together thus avoiding the danger of islands of viability

Global Energy Access Forum (GEAF)

organized by the IEEE Power Electronics Society

Need:

Lack of access to energy is a key inhibitor of economic growth, particularly for almost 1 billion people with no access to electricity and over 2 billion people with poor and unreliable energy access.

Approach:

Bring a diverse group of energy access stakeholders together, including policy, technology, business, social impact, finance, end-users and NGOs, to create alignment in goals, metrics, strategy and approach to achieve the objective of universal access to abundant and sustainable energy for all by 2040.

Provide a forum and mechanisms for sharing information on needs defined by the energy access community, and new capabilities enabled by fast-moving technologies, business and financing models, and use-cases – which together can accelerate the access to energy and its utilization at scale.

Organize a recurring global competition - **Empower a Billion Lives (EBL)** - to help create an ecosystem of technologists and entrepreneurs who develop, demonstrate, derisk and deploy new energy access solutions that are holistic, economically viable and can scale rapidly in the target market segments.

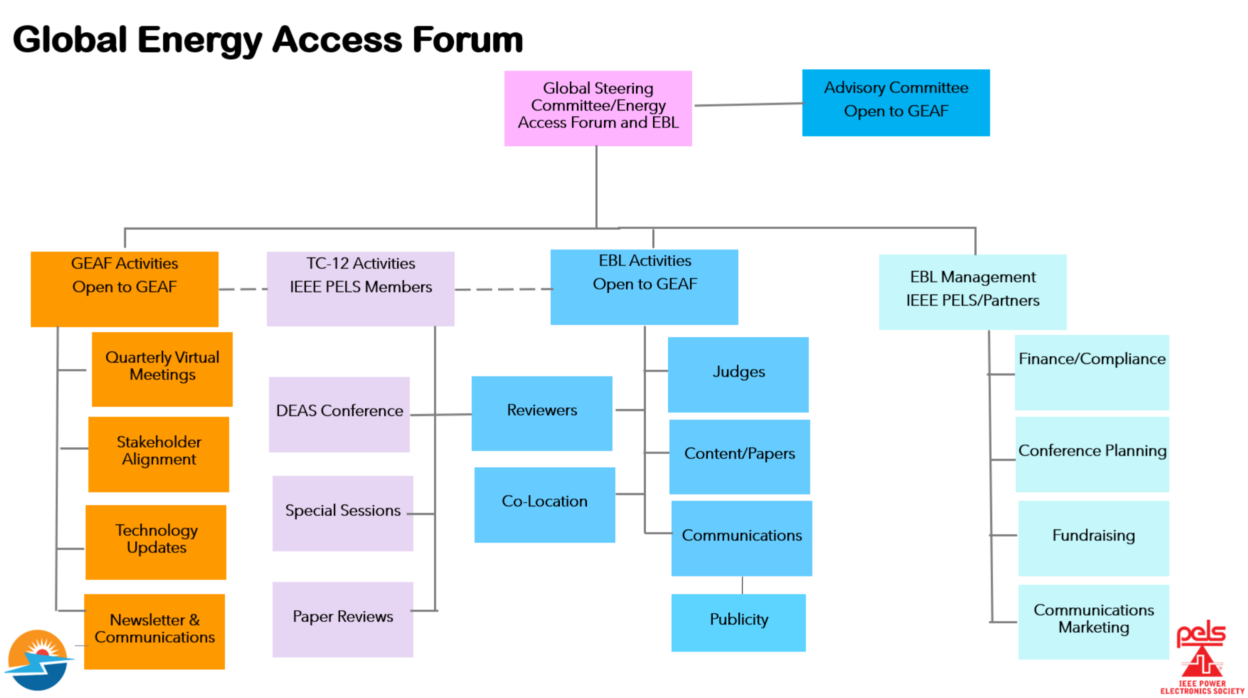
Organize regional and global events to support EBL and GEAF objectives – such as a newsletter, webinars and workshops covering topics such as enabling technologies, best-practices, open-source solutions, value-stacking, design of plug-and-play systems, business models, standards, interoperability, entrepreneurship, circular economy, end-use application requirements, etc.

GEAF Membership:

Open and free for all participants on an individual basis, including both IEEE and non-IEEE members. GEAF Members can participate in all GEAF organized events, including virtual workshops and webinars, and be part of an EBL team. All costs associated with organizing and managing GEAF are covered by the IEEE Power Electronics Society.

Costs associated with organizing and managing EBL and associated events are covered separately by IEEE PELS and its various partners and sponsors.

GEAF Organization Chart:



Appendix 1: Workshop Agenda and Attending Organizations

Virtual Energy Access Workshop Agenda

8:00 Welcome and Stage-Setting
Deepak Divan, EBL Global Steering Chair
Presentations from EBL-I teams: Chetan Singh Solanki - Team SouLS and Olusegun Odunalya - Team Havenhill

8:30 Panel Session 1: Towards universal energy access - barriers and pathways to scale
Moderator: Nana Nuamoah Asamoah-Manu - IFC
Panelists: Divyam Nagpal - IRENA,
Nishant Narayan - SEforALL,
Suleiman Babamanu - Nigerian Rural Electrification Agency

9:15 Panel Session 2: Technologies enabling universal energy access
Moderator: Silard Liptak, Agsol
Panelists: Nick Singh - ESKOM,
Makena Ireri - CLASP,
Claudio Shawawreh - Solaris Off-Grid

10:00 Break

10:15 Panel Session 3: Energy access stakeholders' collaboration and the role of IEEE
Moderator: Jelena Popovic, EBL Vice-Chair, University of Twente
Panelists: Rajan Kapur - VP IEEE Smart Village, Larankelo Ventures,
Sampathkumar Veeraraghavan Global Chair IEEE Humanitarian Activities
Lwanga Herbert - IEEE Sight Chair, Logel Science Foundation,
Anuradha Annaswamy, Past-President IEEE Control Systems Society

11:00 Stakeholder's Perspective:
'If we could wave a magic wand, what is the outcome we would want?'
Moderator: Issa Batarseh, EBL Vice-Chair, UCF
Presenters: Olivier Jacquet, Schneider Electric
Bill Nussey, Freeing Energy

11:30 Panel Session 4: Empower a Billion Lives II Global Competition - stakeholder input
Moderator: Deepak Divan, EBL Global Steering Chair
Panelists: Ali Husain - On Semiconductor,
Richard Mori - EBL I Team Xpower, Meshpower,
Nana Nuamoah Asamoah-Manu, IFC,
Silard Liptak, EBL I Project Manager, Agsol

12:15 Next Steps & Open Discussion

12:30 Adjourn

Organizations represented at the Virtual Workshop for Energy Access 30 June 2021

(Studio Audience and Participants)

IEEE
- IEEE Power Electronics Society – Host
- IEEE Empower a Billion Lives
- IEEE Foundation
- IEEE Standards Association
- IEEE Control Systems Society
- IEEE Smart Village
- IEEE SIGHT
- IEEE Humanitarian Activities
- IEEE Industrial Applications Society
- IEEE Electronic Devices Society
- IEEE Power and Energy Society

Netherlands Enterprise Agency
The World Bank
Schneider Electric
Energy Swaraj Foundation/EBL I Team SoULS
Havenhill Synergy
IFC
IRENA
SEForALL

Nigerian Rural Electrification Agency
Agsol
Eskom
CLASP
Solaris Off-Grid
On Semiconductor
Meshpower/EBL Team Xpower
Selco
U.S. Department of Energy
Freeing Energy
Elk Coast Institute
Global Thermostat
Global Solutions Summit
MIT
Georgia Institute of Technology, Center for Distributed Energy
University of Twente
National University of Singapore
University of Central Florida