AFFORDABLE ENERGY FOR HUMANITY

A Global University Movement to Support Universal Clean Energy Access

Detailed Program Proposal

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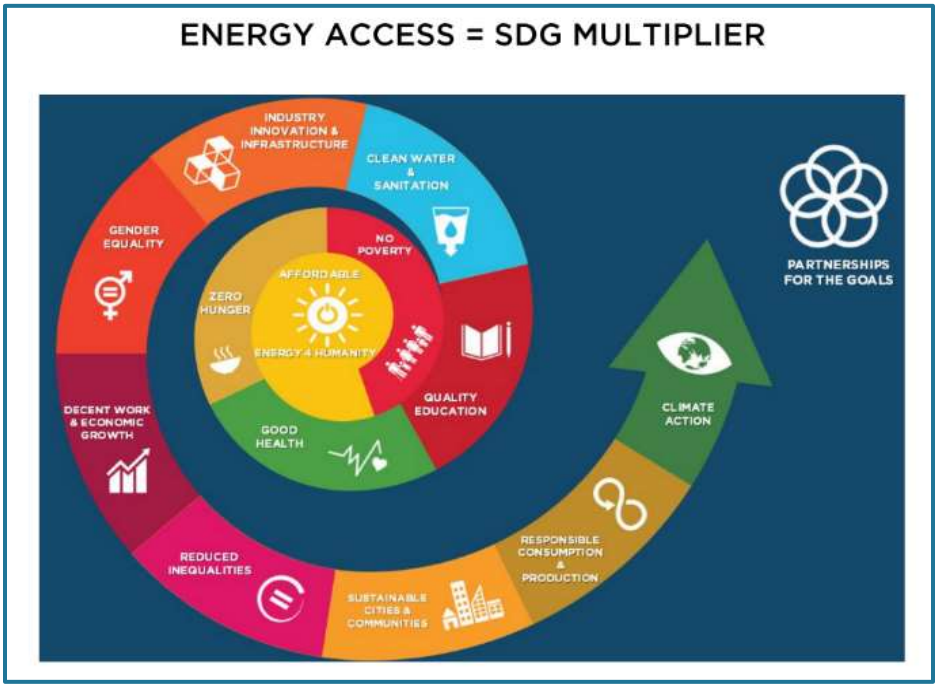
Vision

Energy Access is recognized as a powerful multiplier of the United Nations Sustainable Development Goals (SDGs) with direct links to provision of adequate healthcare, education and food, as well as gender equality and economic empowerment. Providing energy access to the over one billion people on the planet who are currently living without it must be accomplished through the diffusion of clean technology, or else global climate change targets will be imperilled. The dual challenges of development and sustainability make clean energy access for those at the base of the economic pyramid the quintessential sustainable development challenge of the 21st century.

Energy poverty is a human development trap. Reliance on traditional fuels such as firewood and kerosene robs the energy poor of their greatest resource – time. Hours are spent every day collecting fuels, often by women and children. Reliance on fuels like kerosene require the ongoing purchase of fuel which becomes significantly costly over time while providing poor service. These fuels also cause significant adverse health effects from respiratory illness. Indoor air pollution is a silent killer that claims approximately 4 million deaths annually, exceeding the toll of malaria and AIDS combined.

The Affordable Energy for Humanity (AE4H) Global Change Initiative was founded in 2015 as a collaboration between leading university research labs with a shared vision to develop use-inspired innovations that will make energy poverty a footnote of history.

We believe that eradication of energy poverty with clean technology by 2030 (Sustainable Development Goal 7) will require breakthrough solutions that are designed for implementation in a diverse range of local contexts and delivered by a generation of local change-agents and entrepreneurs. If we are to take maximum advantage of the capacity for innovation that exists within university research labs, there is a need to build stronger bridges between local implementers and global knowledge networks. The proposed program operationalizes such an approach, on a global scale.



Objectives

1

Research:

We will invigorate 'Use-Inspired Basic Research' for energy access on a global scale. A range of activities will bridge the gap between leading research labs and impact-oriented organisations that work in the field, all drawn together under a single programmatic umbrella. Enhancing affordability through technological innovation is particularly important in meeting the needs of the most impoverished markets. For new technologies to be successful, they must be designed with a deep understanding of their use.

2

Capacity-Building:

We will create the next generation of leaders and 'Change Agents' that will build the energy access sector and rapidly scale solutions. Experiential learning opportunities within our global network of partner institutions, provided though a dedicated fellowship program that lies at the heart of this initiative will meet this critical need. We will deliver a pipeline of dedicated professionals that are empowered by access to global and local knowledge networks.

3

Entrepreneurship:

We will make local entrepreneurship the fundamental delivery method of innovative solutions. Financially viable social enterprises will be seeded through a network of Energy Access Innovation Centers located in five developing world regions where the change agents that we recruit will be given the support they need to bring innovative solutions to the markets that they understand.

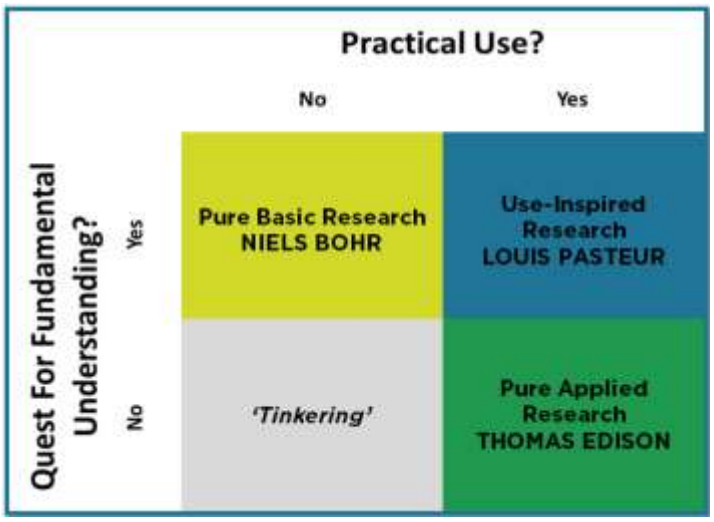
Outputs

New Businesses and Entrepreneurial Ventures will emerge out of five Energy Access Innovation Centers (EAICs) in key regions facing energy poverty. This will include one in Latin America, one in Asia and three in Africa (East, West and South). EAICs will use the incubator model, based largely on the World Bank's Climate Innovation Centers. They will provide working space, mentorship and start-up support to change agents recruited into the program.

A Generation of Change Agents will graduate from the program. They will have direct access to global and local knowledge networks of university-based research labs and regional implementers. They will take on specific projects to develop new solutions for energy poverty in their region. They will go on to be the entrepreneurs, policy influencers, innovators and leaders that are desperately needed to grow the energy access sector at the pace and scale required to meet SDG 7.

An Extension Service Benefitting Implementers including a set of annual innovation reports will draw together cutting edge insights and innovations from the lab and communicate their relevance to field-based implementers. Innovation reports will be crafted for regional relevance by the EAIC staff who will disseminate state-of-the art scientific findings to their local implementation network and change-agents.

Use-Inspired Research Centers will be supported at leading universities globally. EAICs will produce annual market research reports in consultation with their local implementation network in the field, which will be used by research labs to scope and inform their research. Participating research labs will compete for funding to support research on key themes identified by EAICs. They will host change-agents for short research stays and a well-supported pathway for disseminating their research.



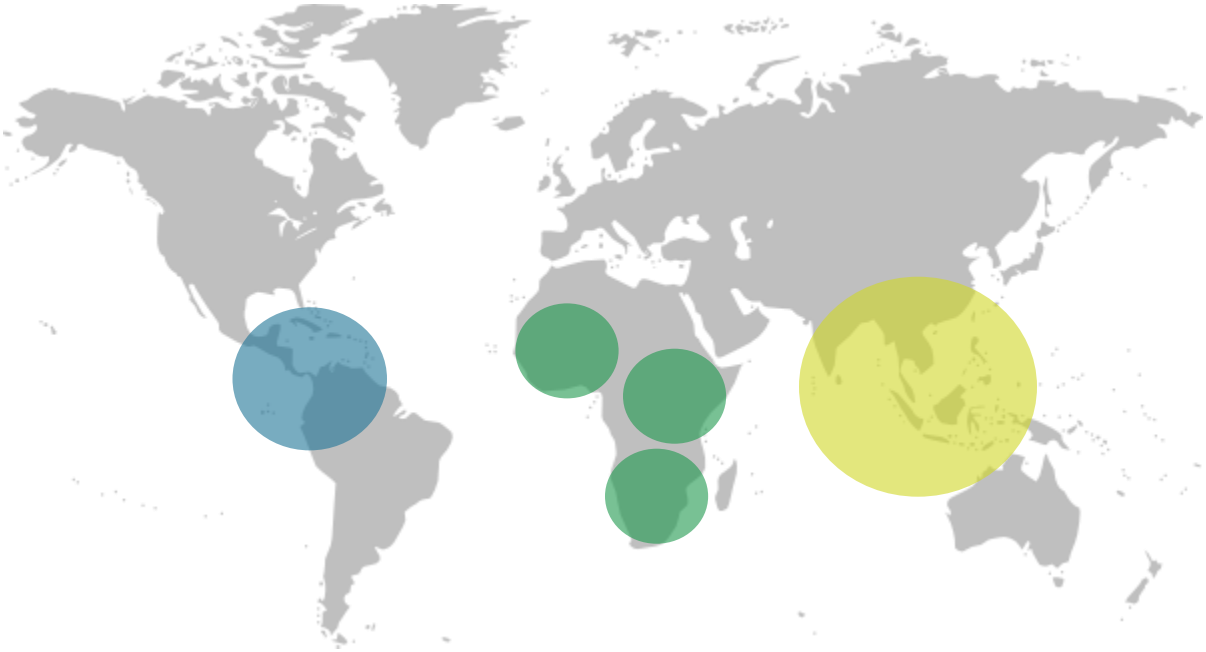
Global Innovation Summits will provide multi-day knowledge sharing opportunities between those working in the field and those working in the lab, and foster new partnerships within the program partners. Summits will be major global events where leading innovations and entrepreneurial projects gain the attention of investors and decision-makers.

Scale

The estimated investment required globally to achieve SDG 7 – over a 20 year period – is in the order of $1 trillion, or an annual investment of $50B ($50 per person).

To establish this program would require a commitment that amounts to $1 per person or 2% of the investment required, for a total cost of approximately **$300M spread over 10 years**.

This funding will be directed towards establishing the EAICs in five developing world regions – one in Latin America, one in Asia, and three in Africa (South, East & West Africa) – as well as a head administrative office. EAIC funding will support the establishment of a fellowship program and its project/enterprise support infrastructure, the extension service, global summits, and a fund for research and implementation activities managed by the EAICs on a competitive and needs basis. The latter fund will be used to accelerate upstream research and downstream deployment of locally appropriate solutions that directly serve the five EAIC regions and accounts for approximately one third of total program budget.

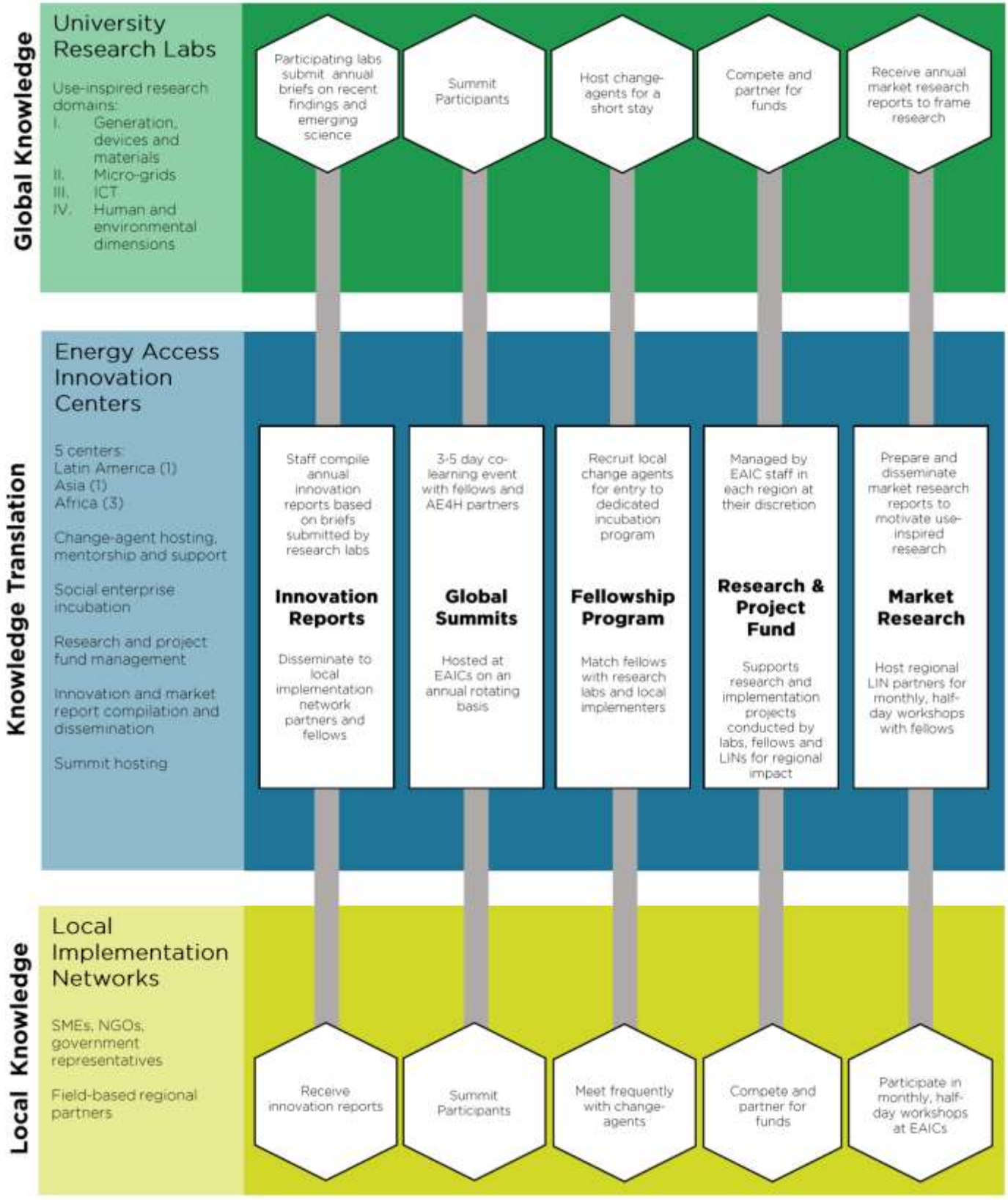


The program would have a truly global footprint, comprising 50+ research labs at universities worldwide, 5 EAICs in Asia, Latin America, East, West and South Africa, and local implementation networks of 50+ SMEs, NGOs and other organizations in each EAIC region.

EAICs will recruit and host 30 change-agents per year through the fellowship program. With 5 EAICs operating at this level the program would produce 1500 change agents worldwide over a ten year period – 300 in each EAIC region.

The annual summit will bring together all of these fellows from who have participated in the previous year, as well as representatives from universities and local implementing organizations, EAIC staff, and external invitees including policy-makers, investors and journalists. Summits are expected to take place over 3-5 days and will take place in one of the EAIC regions every year on a rotating basis.

Program Design



Exemplars

Consultative Group for International Agricultural Research (CGIAR)

Purpose and Relevance	Activities and Impact	Funding
Global scale extension service linking top research centers with a global network of implementers Conducts breakthrough discovery research, field data collection and delivery of solutions Utilizes use-inspired basic research at research centers to deliver positive outcomes across relevant SDGs Commitment to innovation and local entrepreneurship as divers of systems-level change in impoverished regions	$15 CGIAR Research Centers implement collaborative large-scale CGIAR Research Programs (CRPs) conducted in more than 60 countries with the support of over 10,000 scientists and other staff Hundreds of partners, including national and regional research institutes, civil society organization, academia, development organizations and the private sector For every $1 provided to CGIAR over its lifetime, the return on investments is evaluated at $17	$1B per year Long-term funding primarily from national governments Administered through a trust managed by the World Bank

World Bank/infoDev Climate Innovation Centers (CICs)

Purpose and Relevance	Activities and Impact	Funding
Incubators provide start-up services to support climate relevant local entrepreneurship and innovation in a number of developing world countries (Ghana, Kenya, Ethiopia, Morocco, South Africa, India, Vietnam and the Caribbean) Co-located at partner institutes including universities with existing business support infrastructure and access to talent Climate technology, agribusiness and digital entrepreneurs that participate in the CIC programs are regionally-focussed change-agents	Each CIC has its own holistic and tailored approach to innovation developed through a local stakeholder engagement and business plan development process CICs offer services including: ▪ Proof of concept funding ▪ Access to early stage capital ▪ Access to technical facilities and technology information ▪ Mentorship and networking ▪ Business training and skill-building ▪ Policy advocacy ▪ Promoting internationalization opportunities Program is in start-up phase with business plans having been developed by each CIC	Each CIC has a budget of approx. $15-20M spread over 5 years Provided by The World Bank/infoDev in partnership with a number of national governments

European Institute of Innovation and Technology – Knowledge Innovation Communities (KICs)

Purpose and Relevance	Activities and Impact	Funding
Partnership of leading research, private and public sector organizations in Europe to spur innovation and develop new enterprises for a sustainable economy Knowledge Innovation Communities (KICs) created across a range of topics including climate and energy support entrepreneurs to develop new ventures Partners and entrepreneurs given access to international knowledge network Each KIC has offices across Europe which develop local implementation networks (Climate-KIC, for example has 13 national centers)	A variety of programs integrate education, research, technology transfer and business creation A number student education initiatives on KIC themes (including 7 Masters programs in renewable energy run by InnoEnergy KIC) A range of business development services are offered for aspiring entrepreneurs and existing SMEs through each KIC Climate-KIC conducts 'Pathfinder' research projects to identify markets for climate technologies, followed by investment in market-serving solutions from existing businesses, new joint ventures and spin-off companies	€2.7B Horizon 2020 funding to establish European Institute for Innovation and Technology (2014-2020) €81.2M for Climate-KIC €77.5M for InnoEnergy-KIC

Program Elements

I. Energy Access Innovation Centers

Energy Access Innovation Centres (EAICs) will be located in 5 countries across the developing world including: one in Latin America, one in Asia, and three in Africa (South, East & West Africa). These will be located in cities with good business infrastructure, likely co-located at partner institutes such as Universities.

EAICs are places where change-agents – aspiring entrepreneurs and leaders in the energy access sector – receive day to day support to assist them in developing solutions that will serve the regional market of their EAIC. The EAIC functions like a traditional incubator in that it provides mentorship, financial, technical and other advisory services and conducts regional market research for the benefit of the change-agents that it hosts.

EAICs also recruit these change-agents into the program. They do this because change-agents should have a deep existing connection to the region, and EAICs are deeply imbedded in the regions in which they operate. Co-located institutions and local implementation networks have can assist in identifying and recruiting change-agents. EAIC staff admit change-agents based on an open and constantly running application and interview process. Approximately 150 change-agents participate in the program at any one time, 30 at each EAIC.

EAICs can also host established local enterprises in the energy and related sectors in order to create a more dynamic environment. They would make up approximately 1/3 of the people working at the EAIC on a day to day basis at any one time. They would also have access to advisory and other services in addition to having office space. This would come at a small cost.

EAIC staff support the transfer of knowledge between local and global knowledge networks in the program. They provide an extension service benefitting local implementers by working with university research labs to develop reports on the latest science and innovation and how it can help improve the operations of local implementers in their regional network. In addition, they will work with local implementers to develop and disseminate regional market trends reports that benefit change-agents, as well as university researchers and the broader energy access sector.

Each EAIC will manage a fund of X per year to be used to fund research and implementation activities on a competitive basis. Areas of investigation will be identified by both university research labs and local implementation partners, and EAICs will have the freedom to invest in research or other projects that will provide value in meeting the energy needs of their region.

Through the EAICs, the AE4H program provides rich information about emerging trends and solutions that will be valuable to investors, both large and small. EAIC staff will liaise with investors, primarily large institutional investors such as development banks, to provide timely information to support decision-making on the large investments that these institutions make. This includes working on behalf of change-agents and local implementation partners to secure external funding for their projects. A best practices report from the Alliance for Rural Electrification (see report here) includes brief summaries about the work of their partners which benefits investors. This could be a useful model to replicate, but with more financial granularity and regional focus.

The ultimate goal of the EAICs is to create a dynamic, information rich environment with excellent support services that foster the development of new business models, social

enterprises and innovative market-serving solutions in the region in which they operate. EAICs learn from each other through staff calls and summits.

EAICs are largely modelled on incubation hubs such as the World Bank's Climate Innovation Centers which host local entrepreneurs in a number of countries across the developing world, and enabling them to create climate friendly businesses through recruiting of local entrepreneurs and providing them with mentorship and a range of support services (see CIC business plans here).

II. University Research Labs

Leading university research labs around the world are engaged in research on the topic of energy access – from technology to data analysis and modeling to policy, finance, community engagement and more. These research groups span the natural and social sciences spectrum. They house a wealth of knowledge, resources and capacity to develop new solutions, including those that can significantly reduce costs of energy systems through breakthrough innovations.

Selected AE4H University Research Labs	
Lab & Affiliation	**Core Competencies**
Renewable and Appropriate Energy Laboratory **University of California, Berkeley** (Dr. Daniel M. Kammen)	▪ Energy system modelling (on and off grid systems and integration) ▪ Energy policy and planning ▪ Island micro-grid design ▪ Energy access and conflict in the developing world
Tata Center for Technology and Design & MIT Energy Initiative **Massachusetts Institute of Technology** (Dr. Robert Stoner)	▪ Frugal innovation and design in a developing world context ▪ Renewable energy systems design and basic science ▪ Social entrepreneurship/business model development ▪ Energy policy, planning and analysis ▪ India/Asia
KIT Energy Center **Karlsruhe Institute of Technology** (Prof. Dr. Joachim Knebel)	▪ One of Europe's largest energy research centers ▪ Renewable energy generation and storage technologies ▪ Energy efficiency ▪ Integrated water-energy cycle management
Waterloo Institute for Sustainable Energy **University of Waterloo** (Dr. Jatin Nathwani)	▪ ICT for energy systems ▪ Micro-grid/power systems design and modelling ▪ Basic science for renewable energy generation and storage technologies ▪ Energy policy and planning

A key barrier often faced by these research centers is their remoteness from regions facing energy poverty. This program would therefore aim to provide a bridge between the field and the lab that enables use-inspired basic research on energy access through quick feedback loops between on the ground implementers and lab-based researchers. This will be accomplished through a variety of activities.

Annual summits, lasting 3-5 days will provide maximum opportunity for those in the lab and field to meet in person and learn from a global network.

University labs will also host change agents for short stays during their time in the program. Change-agents will bring insights from the field in their region. This includes well-defined challenges facing organizations in their local implementation network, as well as the barriers facing their own entrepreneurial work. Change-agents and university research labs will be matched by program administrators based on the mutual relevance of their work. Lab hosting

responsibilities include providing workspace, setting up meetings and providing research assistance to change-agents.

Researchers will also benefit from market trends reports developed by EAIC staff, based on frequent meetings with their local implementation network. These market trends reports will elucidate key challenges and trends in their region, aimed at inspiring new technological, policy, business and financial solutions that university-based researchers will deliver.

Student participation will be actively encouraged, as this can contribute to capacity-building and also provide low cost research assistance to change-agents when they arrive for their visits. This also benefits students, as they will have direct access to a hands-on learning experience with real-world impact.

The program will aim to support existing labs with the above opportunities, as well as deliver significant funding to participating research labs. This funding will be managed by EAIC staff in each region and offered to university research labs on a competitive basis according to the needs and challenges identified by the EAICs and their local network of on-the-ground implementers. The program will encourage new research groups to join at any time and compete for funds. University researchers will be encouraged to partner with local implementation network member organizations in scoping and delivering projects.

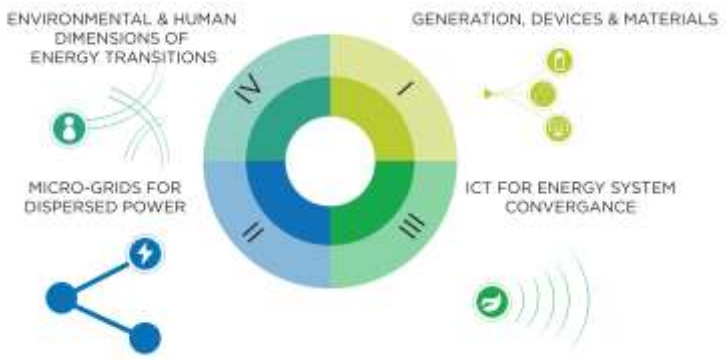
University research labs will self-select core areas of focus based on their competencies and this will help determine match-making with change-agents. Four domain areas are envisaged:

i. **Generation, devices and advanced materials**

ii. **Micro-grids for dispersed power**

iii. **ICT for energy system convergence**

iv. **Human and environmental dimensions of energy system transitions**



Participating university research labs will also compile an annual innovation brief that outlines the R&D advances that their lab has contributed to as well as any other key recent findings/innovations that they are aware of and would like to call implementers attention to. These reports will be submitted to EAIC staff in all five regions where they will be integrated into a set of innovation reports tailored to the five local contexts. This activity is inspired by agricultural extension services that have contributed significantly to increased crop yields globally since the Second World War by way of creating a quick feedback loop between advanced research labs and the farmer's field.

III. Local Implementation Networks

Local implementation networks (LINs) are comprised of organizations and individuals on the front lines of energy access project implementation - SMEs, NGOs, policy-makers, end-user representatives and others that operate in each EAIC region. Some LIN members may be hosted at EAICs, and each of them will participate in workshops and meetings at the EAIC that support the challenge definition process. Knowledge of local context, market trends, and key challenges flows through the EAICs to university research labs where it motivates use-inspired basic research.

Selected AE4H LIN partners – East Africa	
Organization & Contact	**Organizational Profile**
Mobisol Thomas Gottschalk, CEO	▪ One of the leading solar home system companies in Africa, Mobisol has developed and distributed almost 100,000 systems in East Africa to date
Practical Action - East Africa Aaron Leopold, Global energy Representative	▪ An NGO that is highly active in the enegry access sector as an advocate with deep regional networks including in East Africa
ENVenture Aneri Pradhan, Executive Director	▪ A social enterprise that provides fellowships to students and recent graduates to come to Uganda and help incubate small-scale renewable energy businesses
Kenya Power and Lighting Company Samson Ondiek, Chief Planning Officer for Corporate Planning	▪ A limited liability company that transmits, distributes and retails electricity to customers throughout Kenya, including through on and off-grid systems
Uganda Rural Electrification Agency Benon Bena, manager of Off-Grid Renewable Energy Development	▪ Government department that conducts planning and manages rural electrification projects in Uganda, including those involving off-grid renewables

LIN participants join the network because participation will offer direct access to a global knowledge network and dedicated extension services that support their work. They also get to work with change-agents and university research labs on the challenges that they face and can help shape energy access solutions for their region. Finally, they can compete for funding from their regional EAIC. These funds can go towards funding university lab based research, or local implementation or other relevant projects. Local implementers will be encouraged to partner with university labs in the application process.

Change-agents visit local implementers throughout their stay at the EAIC (enabled by their close proximity). University research labs looking for local partners to work with on specific projects within or outside of the management of the AE4H program can also find these partners through the LINs. This enables an ever-strengthening link between research labs and those working in the field. The change-agents, summits and extension services are concrete methods through which collaboration is directly fostered, however other opportunities for partnership between program participants will emerge organically and be encouraged.

Local implementers gather at the EAICs on a regular basis to discuss joint challenges. EAIC staff use these meetings to create annual market trends reports which benefit change-agents, university labs and the wider energy access sector. Change-agents will participate in these meetings/workshops, keeping them up to date on the markets that they aim to address through their projects.

IV. Fellowships

'Fellows' are the change-agents recruited by EAICs to join their center for a period of one year. At the EAIC, change-agents receive mentoring, financial, technical and other services as in a traditional incubator. Change-agents will work on a well-defined projects which could involve creating a new business. However they may also work on solutions-driven projects that don't require setting up a new business, for example working on a policy or finance related project, or developing a business model or technology innovation.

Change-agents are recruited based on their commitment to providing energy access solutions to the region in which the EAIC operates. It is intended that most of these change-agents live in the region and have existing connections there, including with the local implementation network of SMEs, NGOs and other organizations. They should have prior experience in energy access or related sectors that they will build upon through the fellowship journey.

Change-agents are provided with office space at the EAIC in their region but travel frequently to local implementing organizations to learn about on-the-ground challenges and opportunities. They also travel internationally to at least one university research lab for a research stay of approximately 1 month. They are matched with a research lab already engaged in research on an area of direct relevance to their project/region. They conduct and learn from use-inspired research within the lab and take away insights on new innovations that can advance their fellowship project and implementation of solutions in their region.

Change-agents also attend at least one global summit where they share what they have learned and benefit from a large global network to advance their vision post-fellowship.

V. Extension Services

Agricultural extension – the transfer of knowledge from the front lines of scientific research and technological development to farmers and growers – has been a critical enabler of increased crop yields globally since the Second World War.

This program envisions creating a global extension service for energy access. It will deliver insights from university research labs and EAICs to local implementers including SMEs, NGOs, policy-makers and others on the front lines of energy poverty. Extension will be accomplished through multiple activities.

Summits will provide annual multi-day meeting places for leading researchers, innovators and on-the-ground implementers. They will be organized so as to provide maximum opportunity for insights from the lab and field to be mutually shared and for collaborations between local and global knowledge holders to be crystallized.

Though their visits to local implementers and international research centers, change-agents will play the role of knowledge broker between the field and the lab, and will use their entrepreneurial and business lens to help bring solutions to the field that are not only based on leading edge innovations but also locally appropriate, sustainable and scalable from a financial standpoint.

In addition to these activities, EAIC staff will develop reports that outline the most relevant and timely innovations from university labs and disseminate these reports to their local implementation network. This will be accomplished through a process whereby all partner university labs submit an annual innovation brief on their new findings and those made by

others that they think are of most relevance. These reports will be delivered to staff at every EAIC where they will be edited into a set of region-specific innovation reports - one for each EAIC, developed by their own staff based on the needs of local implementers in their area. Complimentarily, input from LIN partners will be used to create five regional market trends reports that outline implementation challenges in each region, from affordability to robustness of technology and more. These will be disseminated to each university lab partner to inspire their research.

VI. Global Summits

Global summits will bring together participants from all five global EAICs, local implementation network partners, university lab researchers, and change agents for multi-day events hosted at or near one EAIC per year on a rotating basis. The regional host EAIC will lead the summit organization.

Change-agents will have the opportunity to present their projects and gain input from other participants. University lab based innovators will present potential applications of state-of-the-art research and technology development efforts. Local implementer partners will discuss key challenges facing deployment efforts and trends in adoption of energy access solutions, providing motivation for use-inspired basic research.

The summit will be modelled in part after highly successful summits and innovation labs that AE4H and partners have previously organized. These summits value deep discussion and open networking time instead of lengthy PowerPoint presentations and foster a sense of common purpose amongst participants in the program. They are highly focussed on outputs and outcomes and are professionally facilitated.

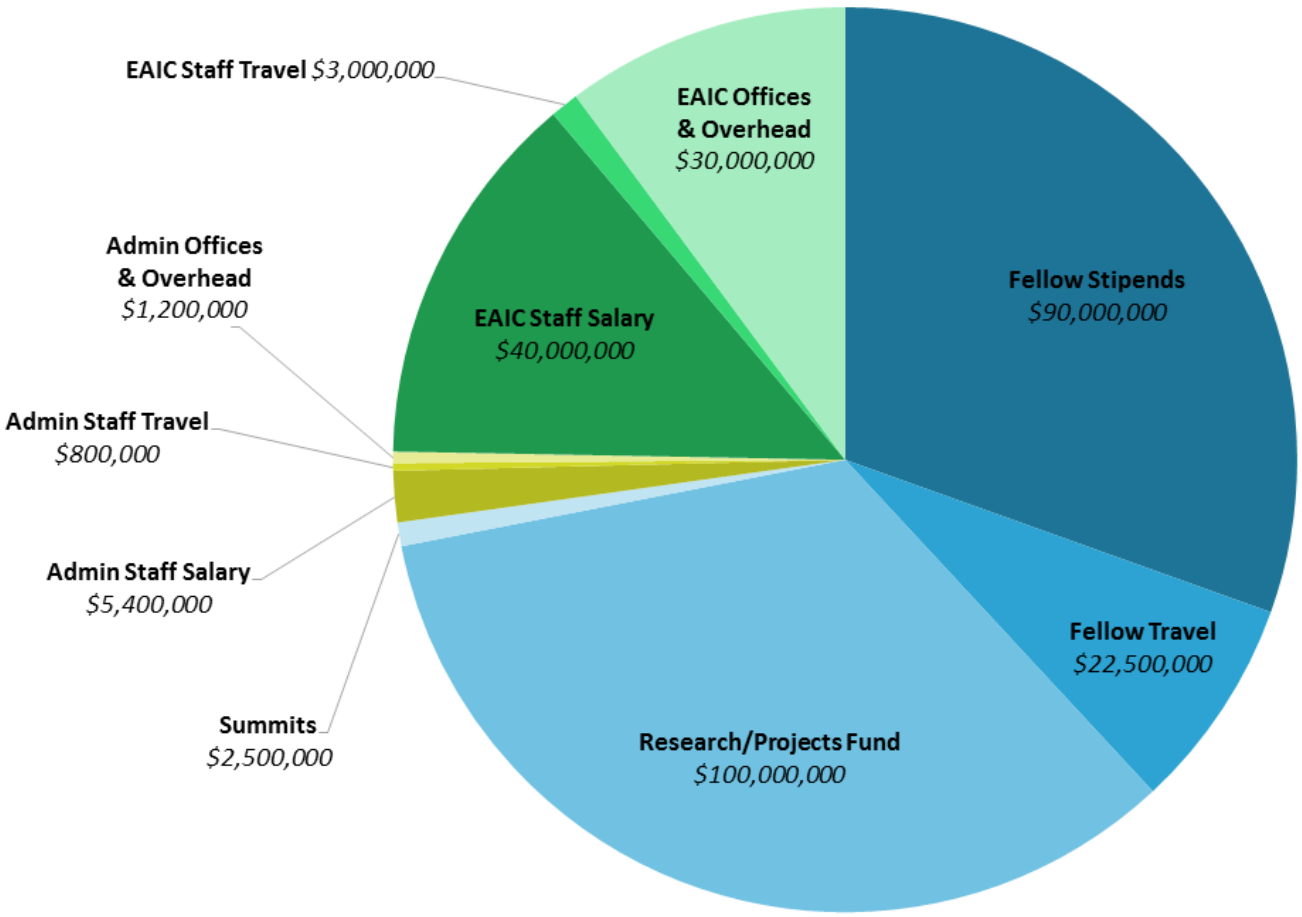
A report from each summit will outline the global state-of-play in the energy access sector including its key challenges and opportunities across five key regions. It will be open to policy-makers, media/journalists, financiers and students interesting in learning more about the sector.

Expenses:

Global Administrative Office		
Item	**Explanation**	**$US/year**
Staff Salary	6 full-time staff x $90k avg salary	540,000
Staff travel	4 senior staff x $20k	80,000
Offices and overhead	$10k/month (incl. media services, hosting visitors, hiring external consultants, etc.)	120,000
	Annual Administrative Office Expenses	**$740,000**
Energy Access Innovation Center Administration		
Item	**Explanation**	**$US/year/EAIC**
Staff salary	10 staff x $80k avg salary	800,000
Staff travel	4 senior staff x $15k	60,000
Offices and overhead	$50k/month	600,000
	Annual EAIC Administrative budget (x5 EAICs)	**$1,460,000**
Programs (budget allocated to EAICs)		
Item	**Explanation**	**$US/year/EAIC**
Fellowship stipends	30 fellows x $60k	1,800,000
Fellowship travel	30 fellows x $15k	450,000
Research/Projects Fund	Fund distributed to research and implementation partners and change agents at EAIC discretion	2,000,000
Summit	One EAIC per year receives funding for summit organization = $250k per year for a single EAIC or $50k each as an annual average	50,000
	Annual Program Budget per EAIC	**$4,300,000**
	Annual Expenses per EAIC (administration + programs)	**$5,760,000**
	Annual Expenses x5 EAICs	**$28,800,000**
	TOTAL ANNUAL EXPENSES	**$29,540,000**
	TOTAL EXPENSES OVER 10 YEARS	**$295,400,000**

Breakdown:

Total expenses by program/line item over ten years



TOTAL BUDGET OVER 10-YEAR PERIOD = ~$300M