An Energy-Development-Climate Nexus Seminar Series

Part 1 - Human Power as an Electricity Portfolio Option below 20 W/Capita
Part 2 - Health Care Facilities with Unreliable and Unavailable Grids – A Story Untold
Part 3 - Locally Built African Microgrids Viable with(out) Stagnant Centralized Grids

"We must be uncompromising in our determination to eradicate poverty" Gro Brundtant

Part 1 Abstract. Human development and electrical energy co-exist seamlessly in high Human Development Index (HDI) countries where reliability and availability of electricity is greater than 95%. In numerous low HDI countries, there is 5-50% electric grid availability with unreliability at or below 50% due to load shedding and faults. Unavailable and unreliable electric grid events are situations disconnected from a centralized grid (if the grid fails then it is off-line). In Africa, renewable energy portfolios include solar, wind, biomass, or biogas and small hydroelectric power are frequently cited to meet the disconnected grid situations and recently nuclear energy. However, human power is a missing portfolio option and if implemented in countries with average electrical power consumed below 30 Watts/Capita would impact human development directly: schools with merry-go-round generators, hospitals and health clinics with hand crank lighting during electricity outages and off-grid businesses with bicycle generators. This result is derived from (1) a new energy concept defined as PACE (People-based Activities - Caloric Efficiency), (2) free energy estimations from children's' play – energy harvesting (3) disconnected-grid fuel costs for petrol and diesel generators, and (4) policy empowerment to begin designing and building microgrids. These designs result from an innovative physics and business of energy curriculum taught at Mountains of the Moon University and Makerere University and with an association called Uganda Small Scale Industries Association as well as St. Joseph Technical Institute in conjunction with University of Michigan. Our human power-module of a multi-module curriculum for Empowering Ugandans to Power Uganda and is only considered an educational and design policy – a key gateway to co-designed and locally built microgrids. However, this process and these policy implications are applicable in many, if not all low HDI countries.

Dr. Mechtenberg

Visiting Professor
IDCE – ES&P
Assistant Research Scientist
Marsh Institute

Part 1 – Friday
September 9
(Granville Room – IDCE)
12p.m. to 1p.m.

Bring your own lunch.

Mechtenberg's research is in sustainable energy systems with a focus on understanding that global security and environmental stability rely on efficiently and effectively utilizing energy based on both cultural values and technological feasibility.

INTERNATIONAL DEVELOPMENT, COMMUNITY, AND ENVIRONMENT
CLARK UNIVERSITY

An Energy-Development-Climate Nexus Seminar Series

Part 1 - Human Power as an Electricity Portfolio Option below 20 W/Capita
Part 2 - Health Care Facilities with Unreliable and Unavailable Grids – A Story Untold
Part 3 - Locally Built African Microgrids Viable with(out) Stagnant Centralized Grids

"We must be uncompromising in our determination to eradicate poverty" Gro Brundtant

Part 2 Abstract. Doctors, nurses, surgeons, and an entire host of medical professionals are trained in a variety of health care procedures including emergencies, but are they trained to know what to do when the electricity abruptly goes off? How does electricity availability and, more importantly, reliability affect health care globally with a barrage of medical devices that require electricity – especially donated devices with technologies that have dramatically decreasing efficiencies or that are expensive to operate? This paper sets out the framework for a global public health and electricity paradigm shift. All over the world from Bill and Melinda Gates Foundation grant-receiving programs to Dr. Geoff Tabin's eye clinics, the assumption is that remote village health clinics or centers use diesel generators similar to US military forward operating bases. Alternately, back-up solar panels either (1) do not produce enough energy on cloudy days or (2) decrease in efficiency due to extreme temperatures. If both diesel generators and solar panels are risky for hospitals and health centers reliable health care, then there needs to be a stable and reliable alternative option for back-up electricity. Thus, this paper analyses the global public health sector with US and Uganda case studies. It is shown that for the measured unreliability (hazard rates) of an electric grid with back-up diesel generator and the statistical value of life, the US would pay at least $1000 USD for a 0.02% risk of both the electricity failing and the diesel generator failing whereas Uganda might be able to pay at most $30 for the same level of risk. It is also shown that health centers and rural electrification programs with small solar panels face previously not discussed risks associated to weather variations. In conclusion, by focusing on increasing the number of back-up systems at Ugandan hospitals and health center, this energy policy recommends to increase back-up systems to the point where hospitals can have their own microgrids.

Dr. Mechtenberg

Visiting Professor
IDCE – ES&P
Assistant Research Scientist
Marsh Institute

Part 2 – Thursday Lunch
November 10
(Granville Room – IDCE)
12p.m. to 1p.m.

Bring your own lunch.

Mechtenberg's research is in sustainable energy systems with a focus on understanding that global security and environmental stability rely on efficiently and effectively utilizing energy based on both cultural values and technological feasibility.

INTERNATIONAL DEVELOPMENT, COMMUNITY, AND ENVIRONMENT
CLARK UNIVERSITY

An Energy-Development-Climate Nexus Seminar Series

Part 1 - Human Power as an Electricity Portfolio Option below 20 W/Capita
Part 2 - Health Care Facilities with Unreliable and Unavailable Grids – A Story Untold
Part 3 - Locally Built African Microgrids Viable with(out) Stagnant Centralized Grids

"We must be uncompromising in our determination to eradicate poverty" Gro Brundtant

Part 3 Abstract. The 20th century centralized grid will hopefully be bypassed by a 21st century integrated set of microgrids just as the 21st century cell phone technology bypassed 20th century telephone land lines. As this happens, the centralized grid will appear as a large microgrid node in a complex system of microgrids. Furthermore, these microgrids cannot heavily depend on unsustainable imported technologies that cannot be maintained locally. Here we define sustainable in terms of being able to maintain and operate the electricity generating devices with local devices. We show the results of six locally co-designed and built electricity generating devices in Uganda including the capital costs and designs for others to build anywhere in the world. We compare each local device to common imported technologies and show that the Homer Energy optimization results rank the local devices over the imported technologies even given the large uncertainty or sensitivity ranges. To do this, Homer Energy software is used in innovative and creative ways that others might choose to incorporate in future electricity calculations. Finally, a Lorentz-function based simulation model was created to calculate a pathway Uganda can take from empowering technicians and engineers to design and build their own electricity devices compared to the unattainable implementation of a country-wide centralized grid. The assumptions of propagation are based on the successful technological program to train technicians to install solar panel systems throughout Uganda. In conclusion, we propose a hybrid sustainable development energy policy with (1) centralized grid for urban areas with back-up microgrids as well as (2) an innovative implementation of multiple microgrids for rural areas. This will result in ten years to at least the same power capacity as the current Ugandan hydroelectric and thermal power plants (over 700 MW).

Dr. Mechtenberg

Visiting Professor
IDCE – ES&P
Assistant Research Scientist
Marsh Institute

Part 3 – Thursday November 10 (Sackler Science Center, Room S-122) 4:15pm to 5:15pm

Mechtenberg's research is in sustainable energy systems with a focus on understanding that global security and environmental stability rely on efficiently and effectively utilizing energy based on both cultural values and technological feasibility.

INTERNATIONAL DEVELOPMENT, COMMUNITY, AND ENVIRONMENT
CLARK UNIVERSITY