

The Design and Impact of Rural Solar Microgrids

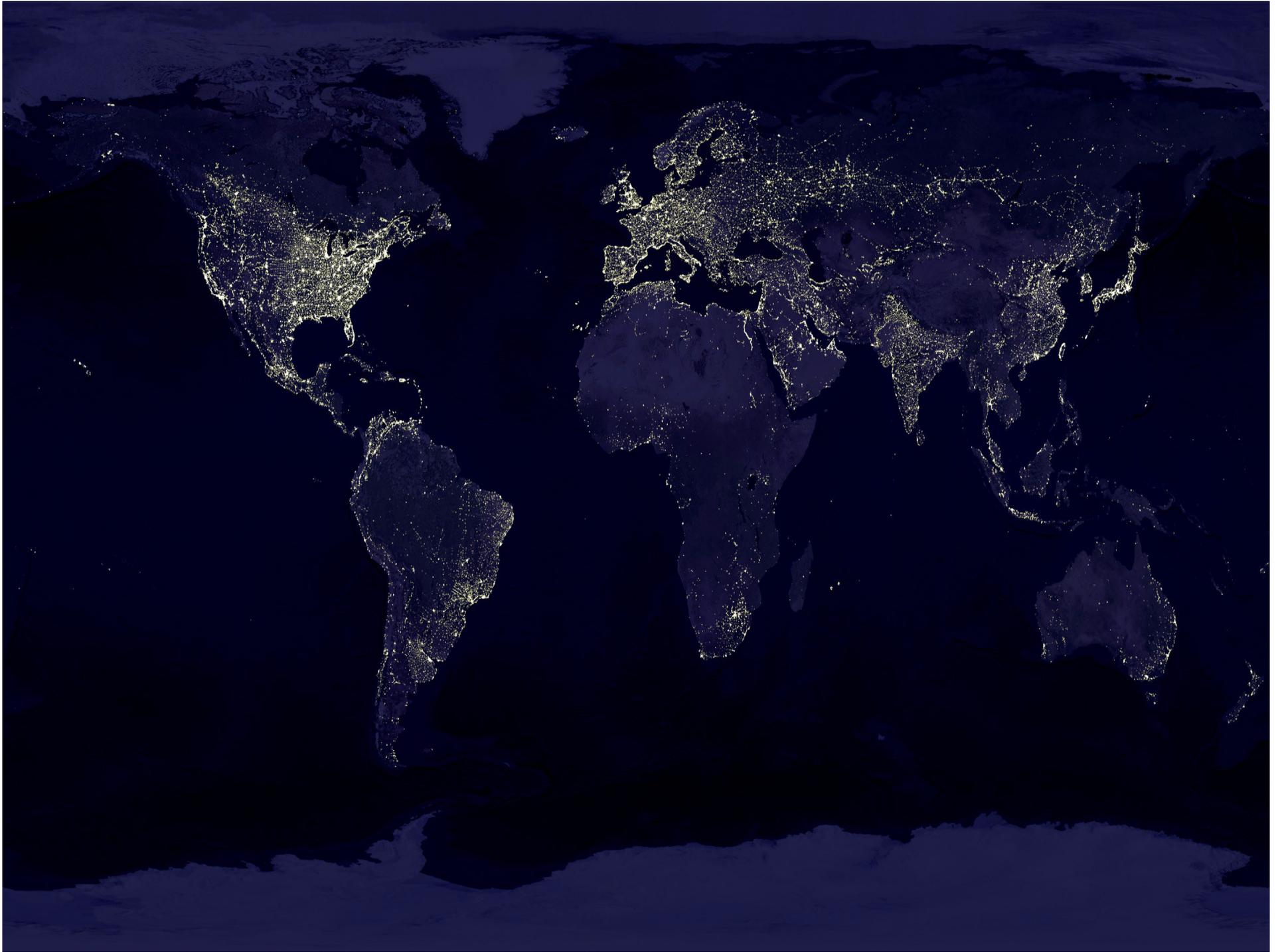
Principal Investigators:

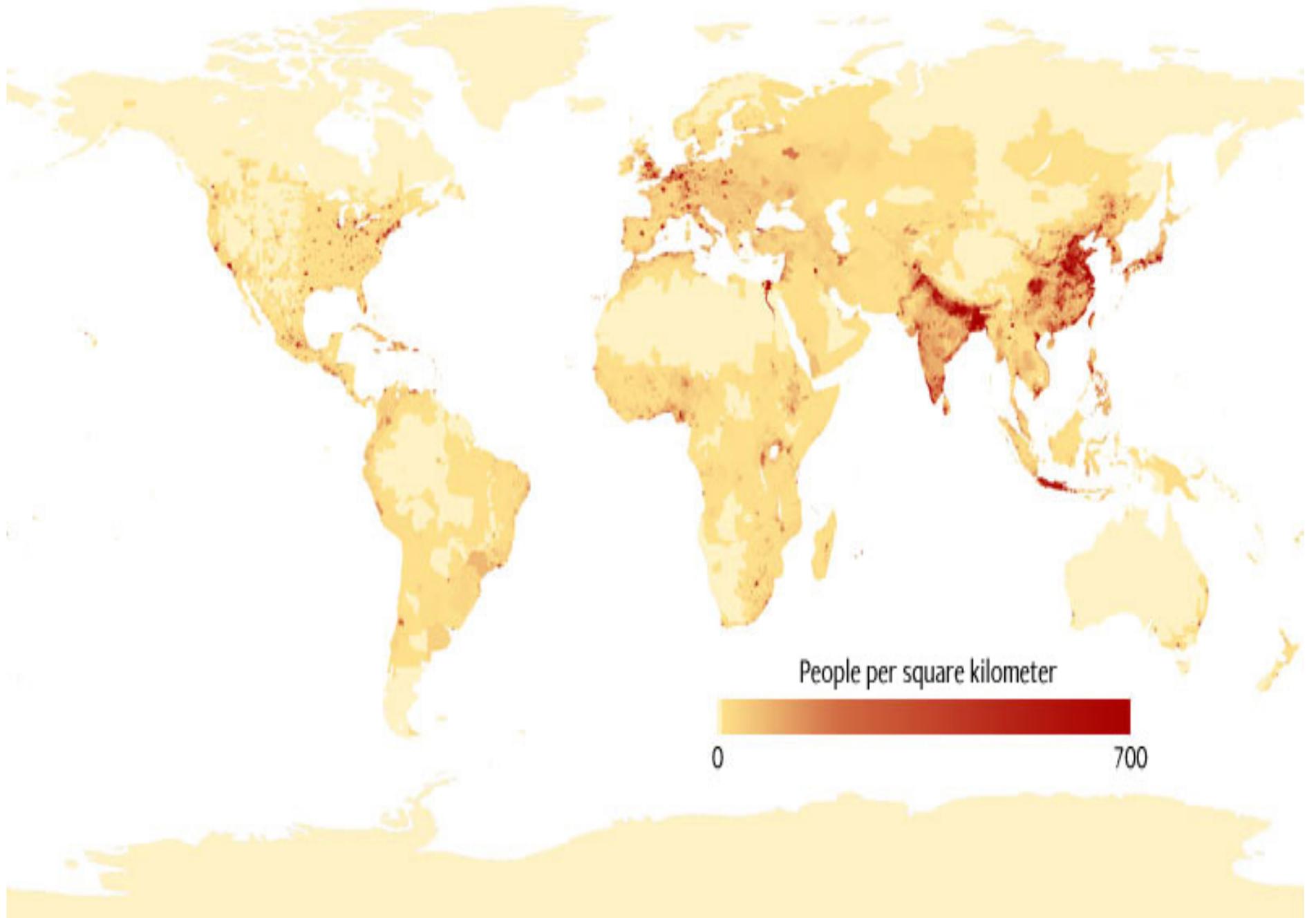
Eric Brewer (EECS)

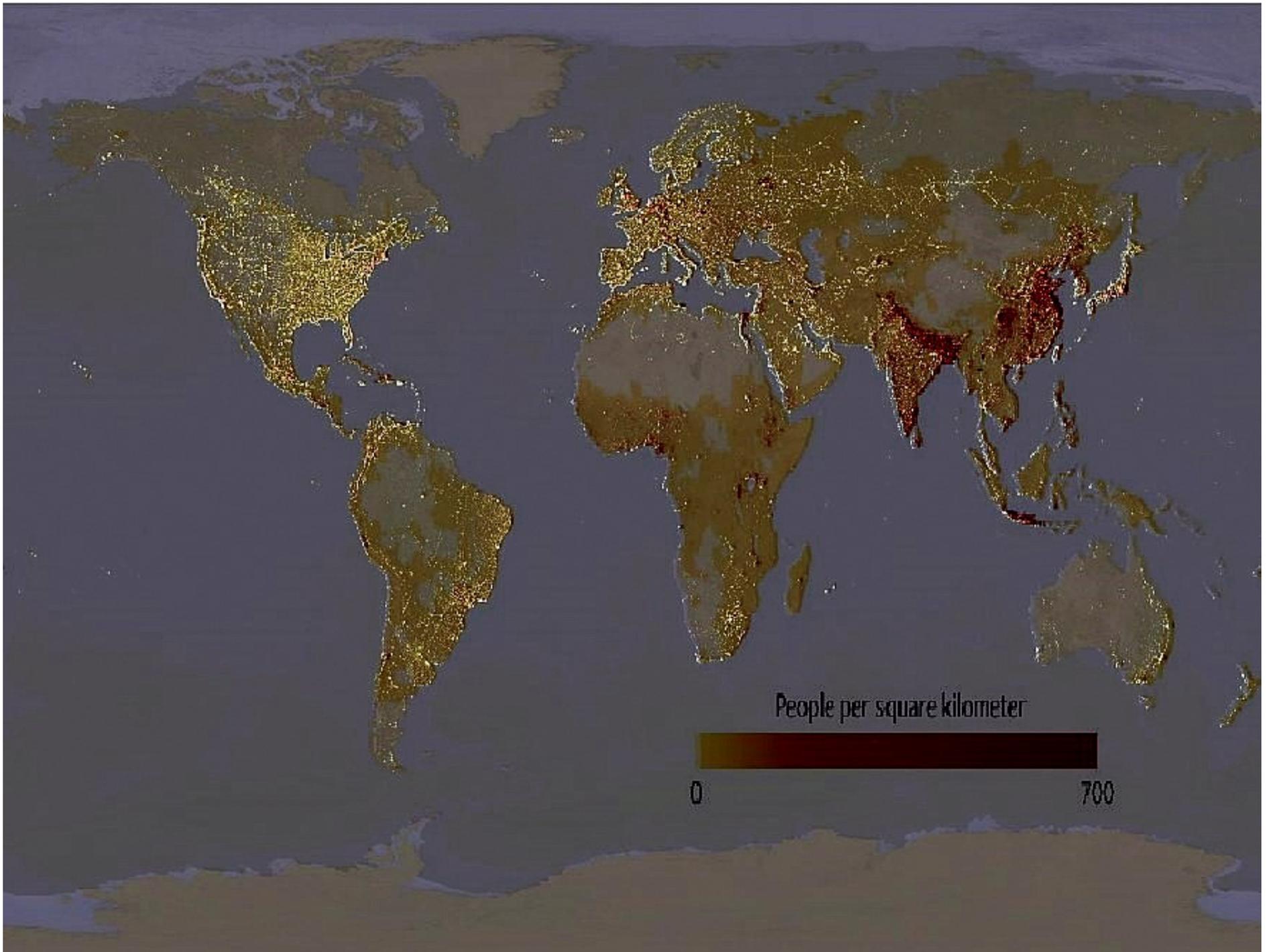
Ted Miguel (Economics)

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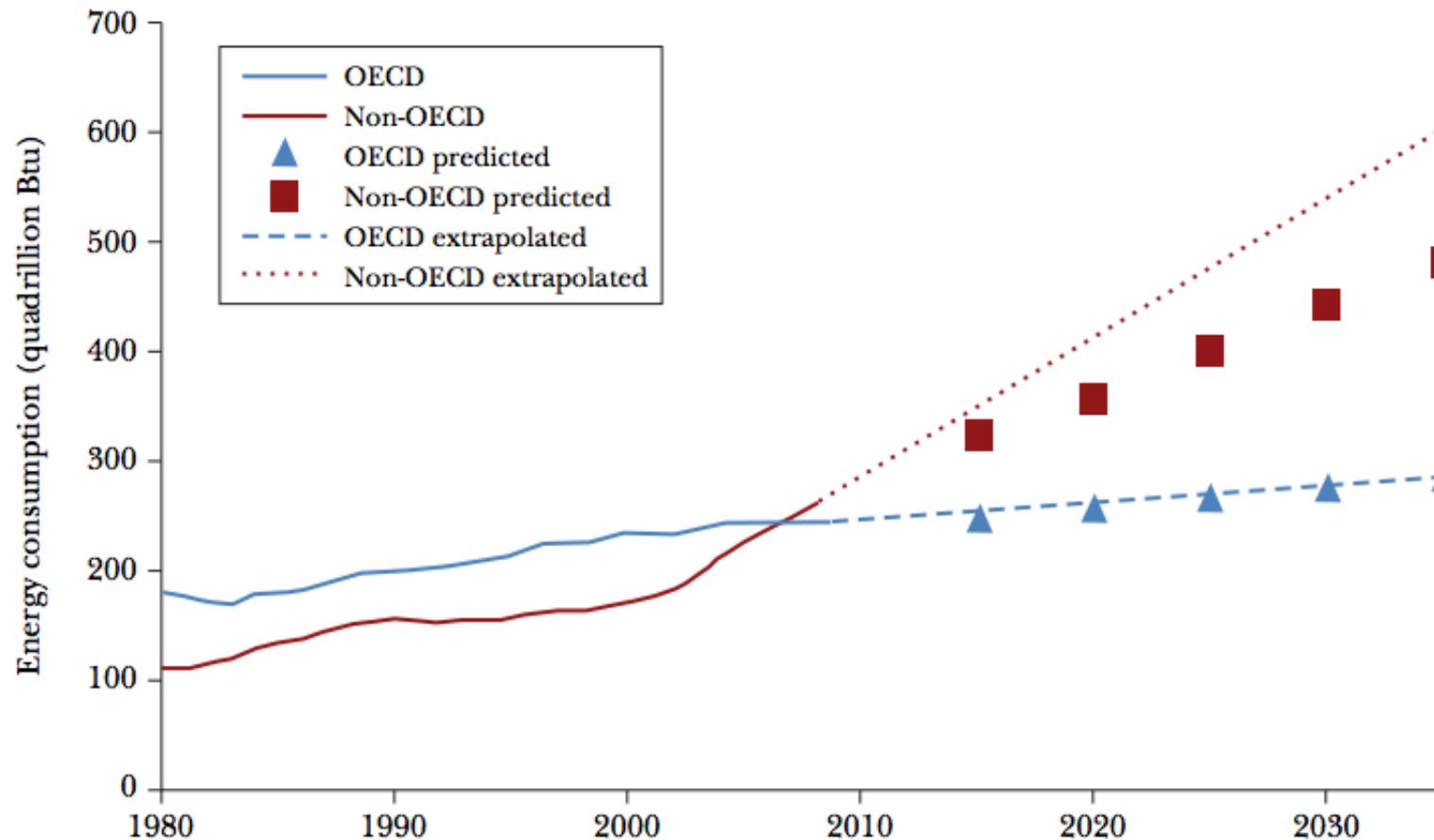






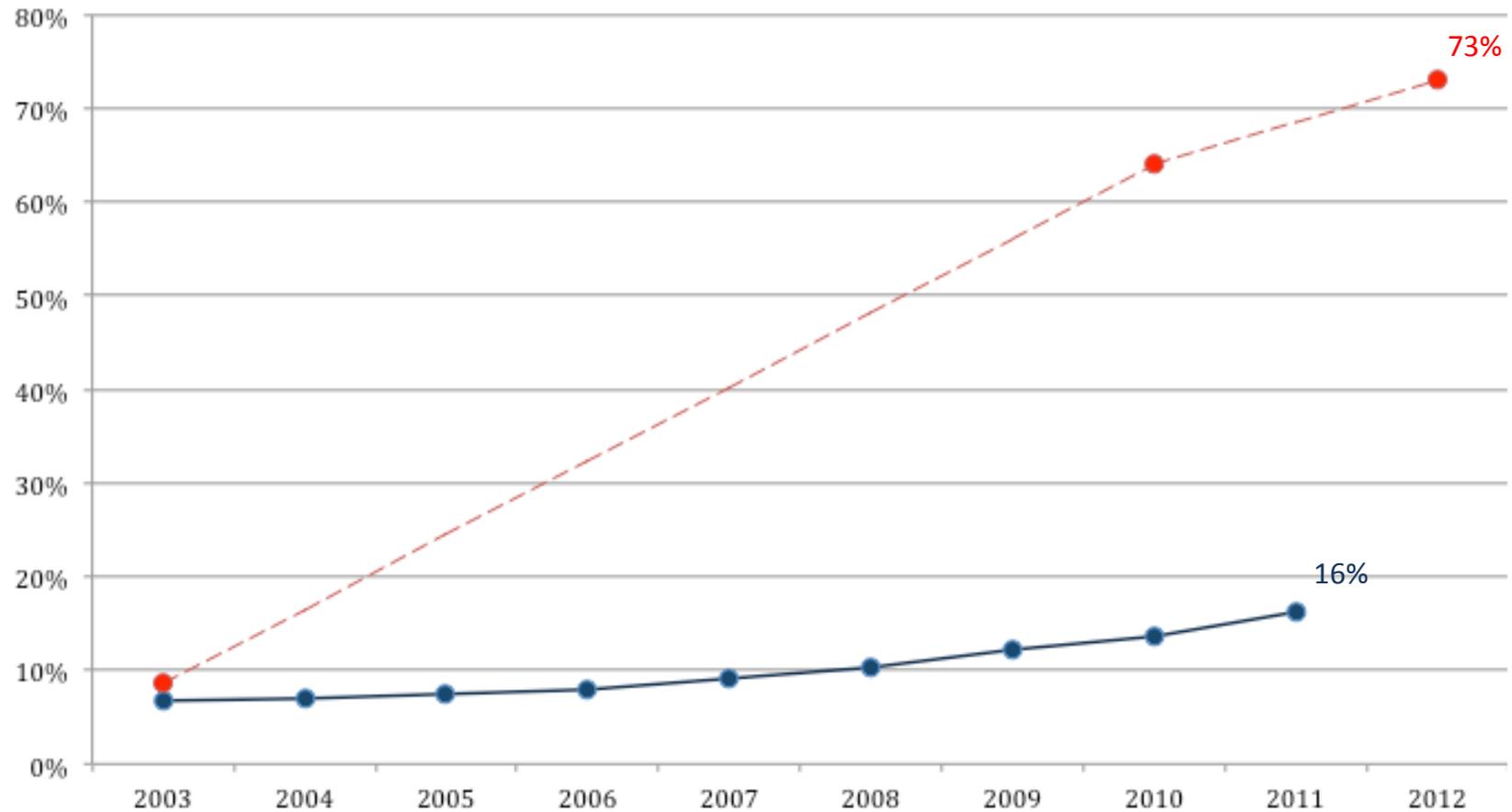


Developing world will drive future energy demand



Source: Wolfram, Catherine, Ori Shelef, and Paul Gertler. 2012. "How Will Energy Demand Develop in the Developing World?" *Journal of Economic Perspectives*, 26(1): 119–38.

Connectivity vs. “Access to electricity” in Kenya



- “Access to Electricity” based on REA press releases
- “Connectivity” based on KPLC Annual Reports (e.g. residential customers * 2009 average household size / population)

Major economic and policy questions

Connection decisions

What are the drivers of household decisions to connect to the grid?

Demand

How does the price of electricity, and/or the availability of appliances, drive energy consumption?

Appliance adoption

How and when do people decide to adopt specific appliances?

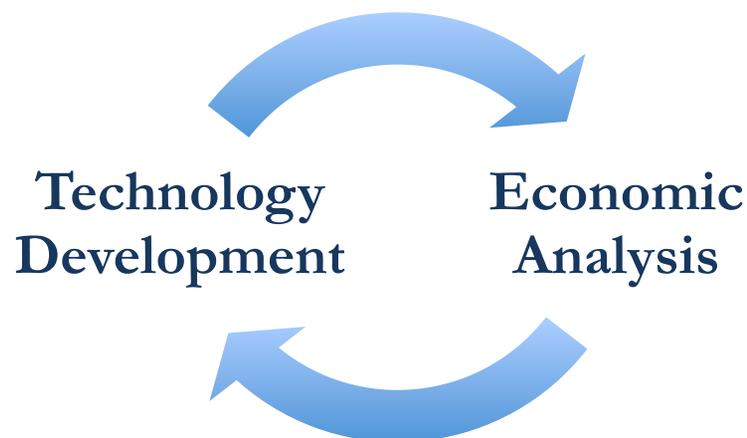
Impacts of electrification

How does electrification impact income, health, work/study hours, pollution, and the creation of new enterprises?

Microgrids Development Project

Objectives

1. Deploy solar PV microgrids in off-grid communities in partnership with local operators in Kenya and India
2. Apply experimental methods (RCT) to study the demand for, usage of, and impacts of rural electricity in Kenya and India
3. Work on new ways to curate, share, and present real-time data relating to development problems
4. Iterative “development engineering” approach:



What data will the MDP generate?

High frequency usage

- Existing economic studies limited by reliance on household surveys to measure key parameters (i.e. time use and hours of lighting)
- TIER meters are capable of capturing usage data every 30 seconds

Additional sensors

- Currently developing sensor to cheaply measure grid quality and uptime
- Working with other universities on adapting existing platforms for use in creating integrated survey tools that effectively combine the task of gathering sensor data and traditional survey data.

Grid connection study

Objectives

1. Offer randomly selected households subsidies of different levels to connect to the grid
 - Current costs are ~\$400, about half of average income
2. Study drivers of subsidy take-up, like discount rates
3. Evaluate household-level impact of grid electricity
 - Couple with careful measurement, and potentially enhancement, of reliability