6th Atlantic Workshop on Energy & Environmental Economics

A Toxa, Galicia (Spain), June 25-26, 2014

Contribution to the Roundtable

Frontiers in the economics of energy efficiency

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Two “frontiers” in ten minutes!

Frontier #1

The need for additional research on consumer behavior in the context of the "utility of the future"

2014 MITEI ASSOCIATE MEMBER SYMPOSIUM

May 12, 2014

Large Opportunities, Complex Challenges:
Seizing the Energy Efficiency Opportunity in the Commercial Built Environment

AGENDA

Among the take-aways

C.R. Knittel, M. Greenstone & C.T. de la Peña

"Designing the most cost effective policies depends not only on the existence of the **energy efficiency gap***, but also on what is ultimately causing the gap"

"Solving the energy efficiency gap begins with solving the **energy efficiency research gap**"

(*) EEG: Existence of negative-cost energy efficiency investments

Factors in the Energy efficiency gap

- Variables that enter into the **consumer's decisions** to invest into energy efficiency
- **Market failures** that lead consumers to to bypass profitable investments
- Ways in which **estimates** of the energy efficiency gap **might be biased**

Well known factors in the Energy efficiency gap *(1 of 2)*

- Factors that enter into the consumer's decisions to invest into energy efficiency
  - Basic decision rule: present discounted value of all future savings exceed the net present value of payments to cover the extra cost of the energy efficient product
  - Bounded rationality
  - Reference points *(consumers stick to default options)*
  - Non-consistent *(short, long)* discount rates
  - Consumer pro-sociality *(feel good, sign of social status)*
  - Volatility of prices *(noise & uncertainty for consumers)*
  - …

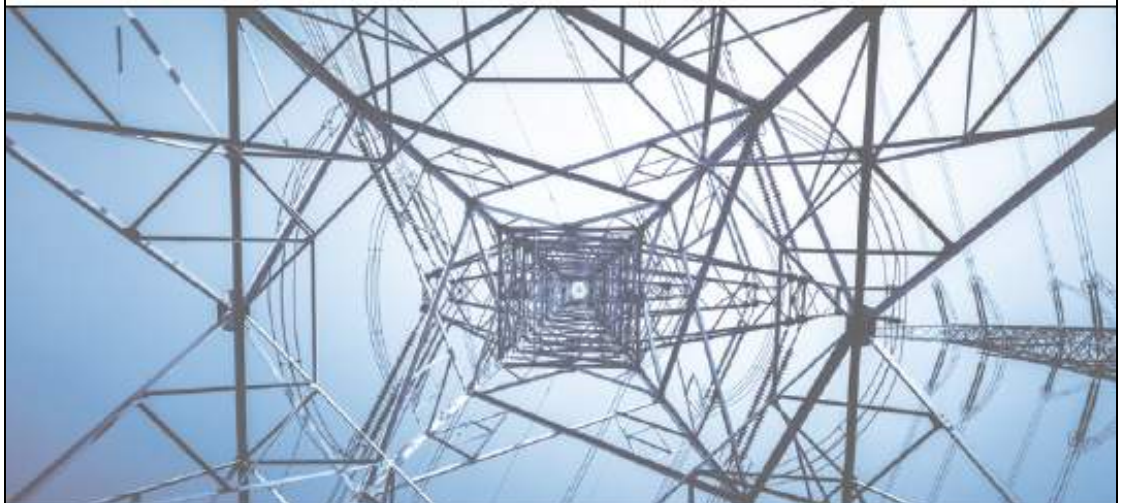
Well known factors in the Energy efficiency gap *(2 of 2)*

(continuation)

- Loss aversion *(consumers value losses more than gains)*
- Lack of complete information to value the savings
- Inattention *(consumers focus on other attributes of the product)*
- Principal-agent problem *(between tenant & landlord & between electric utility & consumer)*
- Lack of adequate access to capital markets
- The value from waiting *(potential future cost reduction of the efficient product)*

The rebound effect *(consumers end up using the efficient product more)* is an additional contributor to the EEG

THE MIT
Utility of the Future
STUDY



Prospectus for an Interdisciplinary MIT Energy Initiative Consortium

This research study seeks to determine the defining characteristics of the electric utility of 2025, identifying successful business models, regulatory trends, and transformative technologies.

Massachusetts Institute of Technology

COMILLAS
IIT-Comillas

Distributed Energy Systems

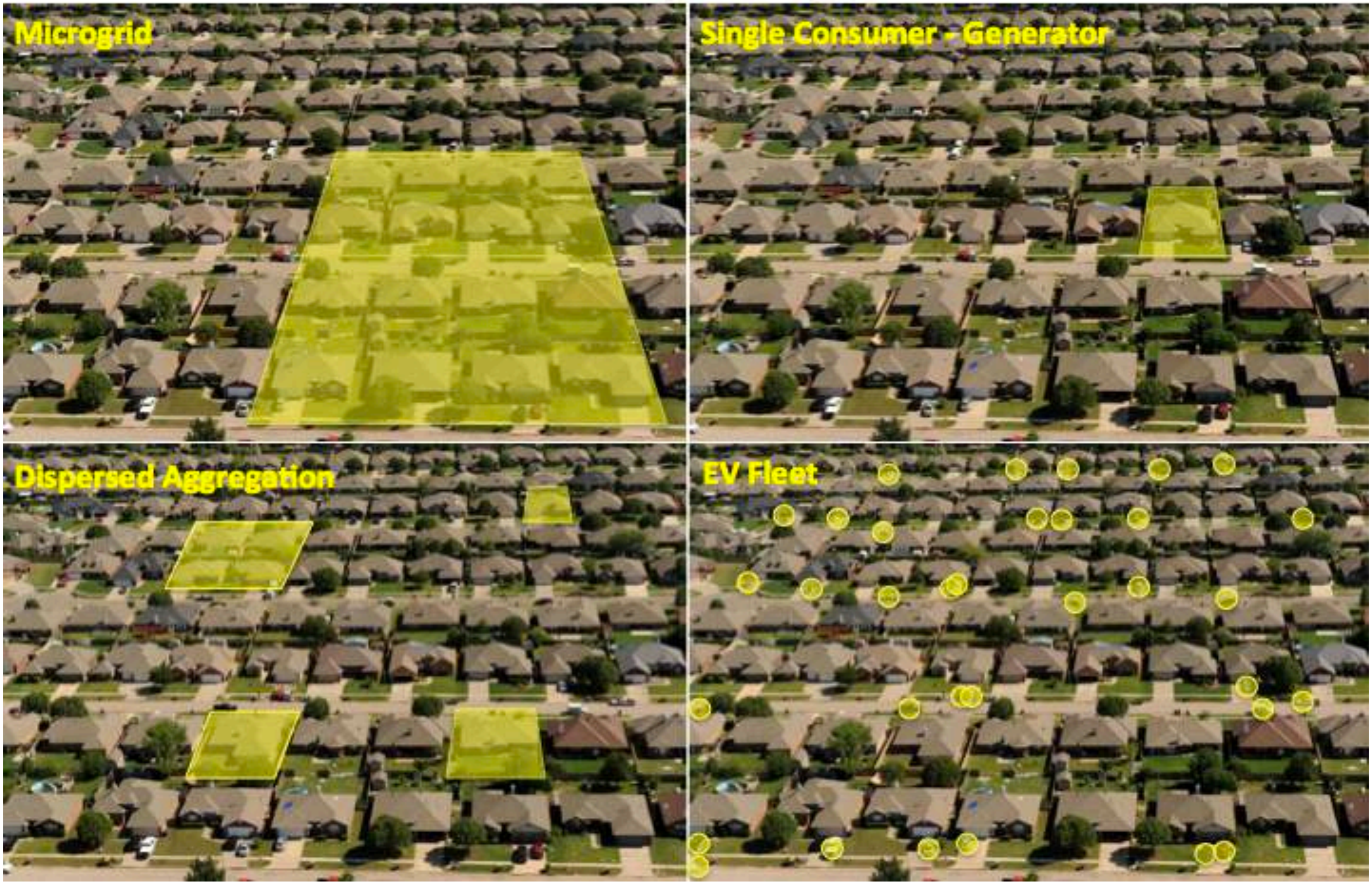
"A *Distributed Energy System* (DES) is a system combining one or more distributed energy resources (DERs), including

- distributed generation
- distributed storage
- &/or demand response
- with information and communication technologies (ICTs)

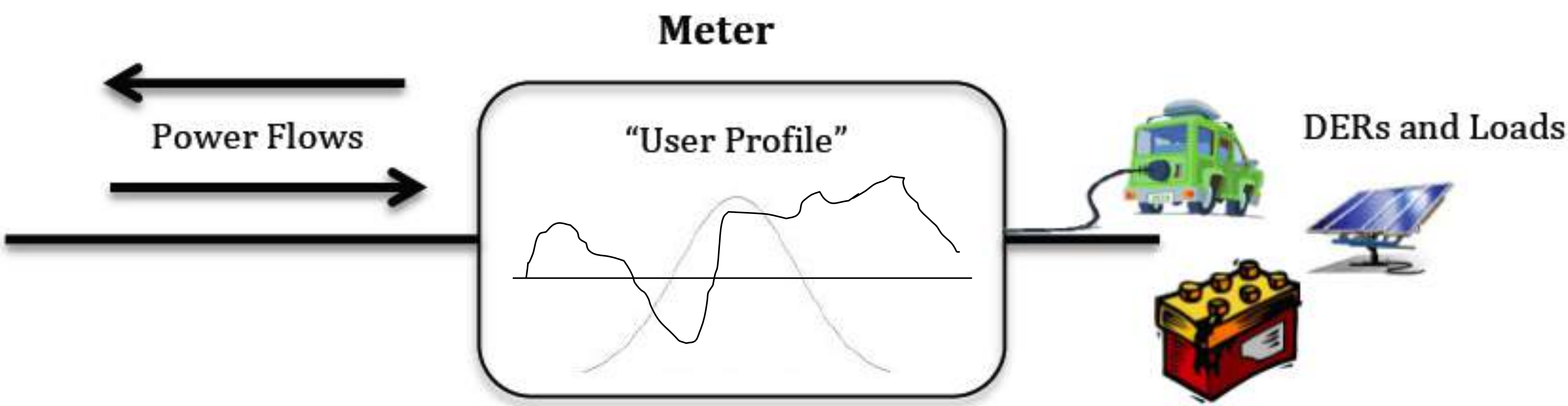
to enable a business model that provides valued services to energy end users or upstream electricity market actors."

Distributed Energy Systems

DES Topologies



Distributed Energy Systems



The challenges

- “Demand” & “consumers” are becoming a more complex mix of actual demand, embedded generation, storage & hybrid devices: “users of energy services”
- The response of these “users of energy services” will be captured & managed by aggregators running all sorts of business models

Frontier #2

A revolution from the developing world

Isolated rural community in Cajamarca (Peru). Example of dispersed population.
Source: Julio Eisman. Acciona Foundation. Peru Microenergia.

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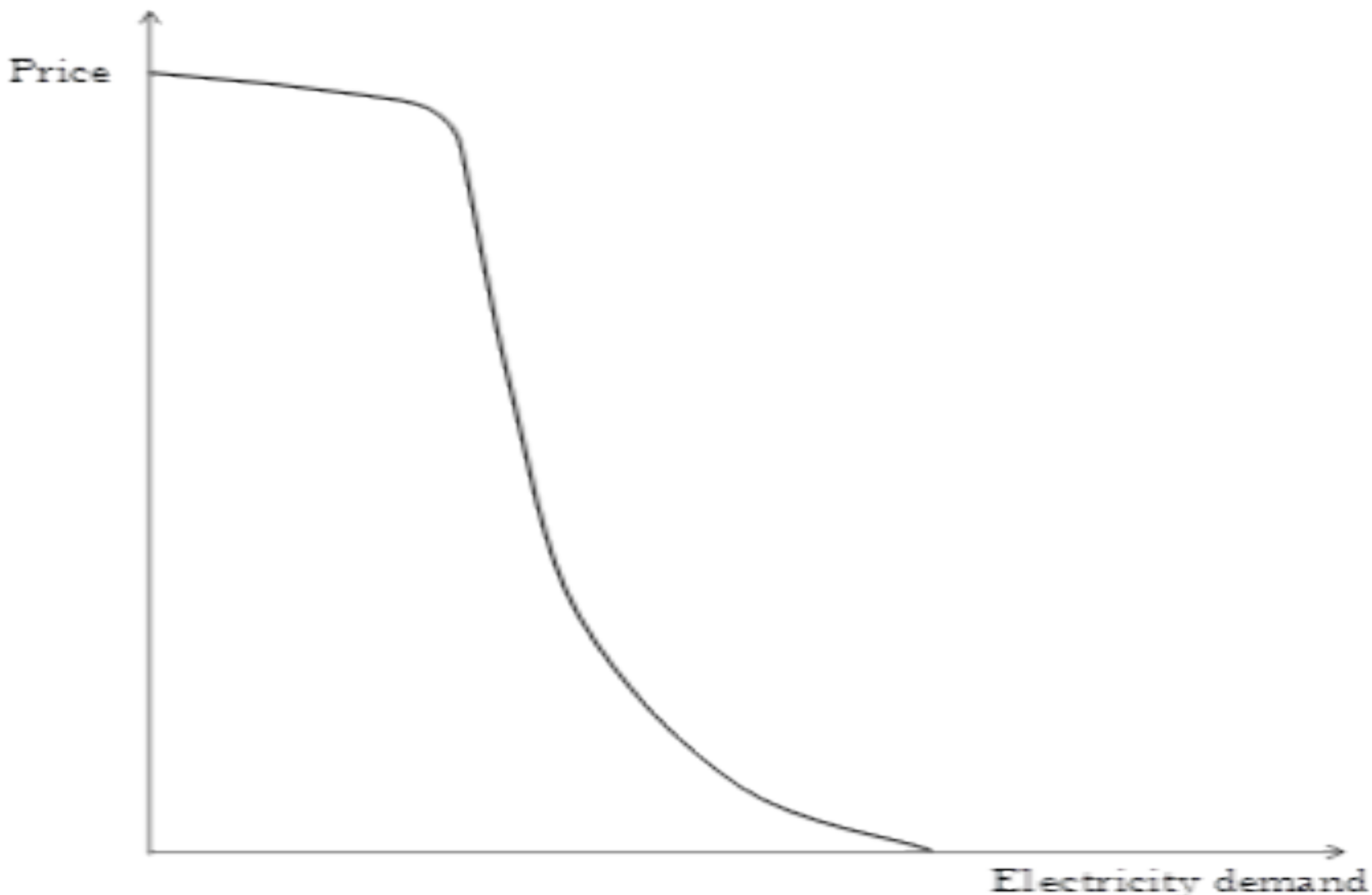
Source: Julio Eisman. Acciona Foundation. Peru Microenergia.

Energy efficiency for the developing world?

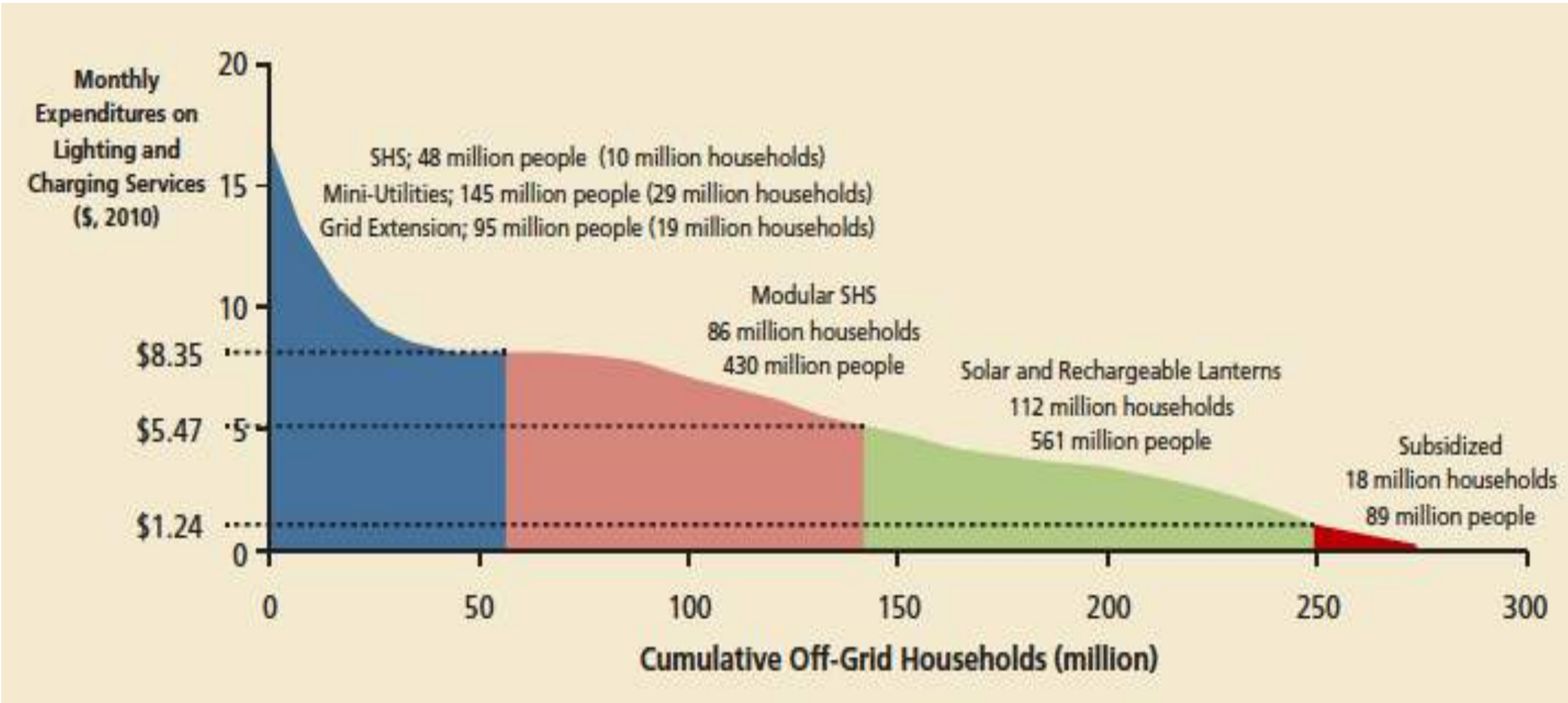
- A revolution is taking place at the very base of the electricity utilization pyramid, forced by sheer need & the existence of business opportunities
  - Stand alone solar systems and off-grid or on-grid microgrids

http://opinionator.blogs.nytimes.com/2013/09/11/the-next-wireless-revolution-in-light/

THE NEED: Consumers are willing to pay a high price for the most essential electricity services



THE BUSINESS: Addressable market for modern energy products and services



Source: IFC, "From gap to opportunity: Business models for scaling up energy access", May 2012. Figure A.1

Energy efficiency for the developing world?

- This is energy efficiency!
  - A 5 kW solar panel & battery providing 2 lights & a telephone charger for 200 households who contract as low as 15 W each
  - Light "bulbs" 3 W each
  - A radio of 1 W of capacity operating at 12 V
  - A TV set of 5 W of capacity operating at 12 V

http://opinionator.blogs.nytimes.com/2013/09/11/the-next-wireless-revolution-in-light/

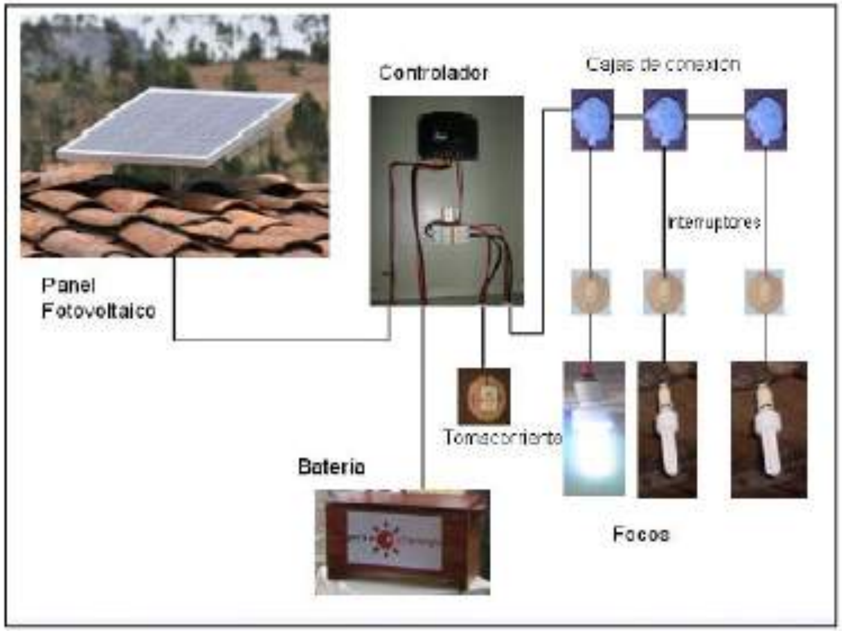
Small & pico lighting systems

Residential isolated systems

Source: Acciona Microenergia

The “classic” system

Sistema Fotovoltaico Domiciliario (SFD)



Basic technical characteristics

1.PV solar panel : 60Wp-85Wp (12Vdc).

2.Battery: 100 Ah/ 12Vdc

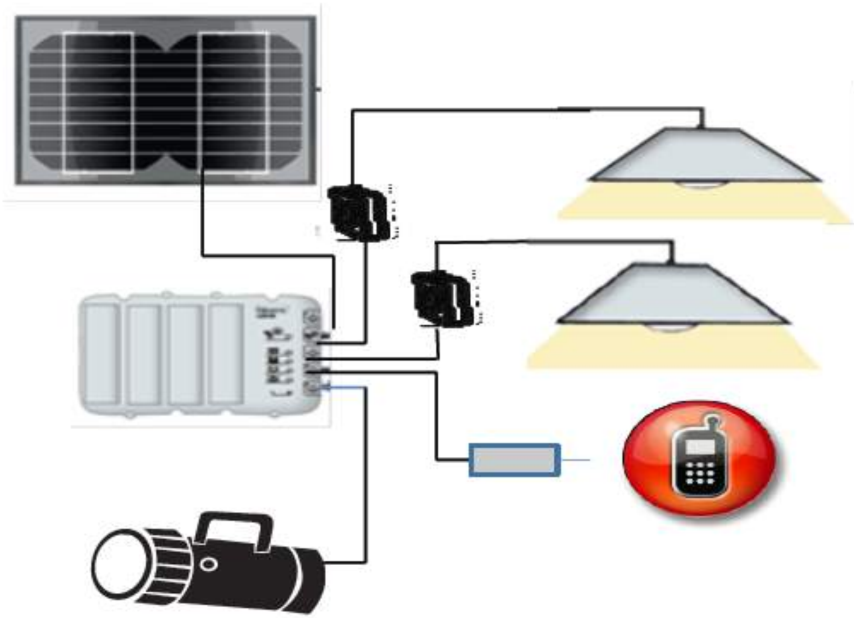
3.Controller: 10A/10A/12 Vdc

4.Lights: 3x11W / 12Vdc CFL

5.Average available energy 7.24 kWh/month

The "mobile" system

Pequeño Sistema Fotovoltaico Domiciliario (PSFD)



Basic technical characteristics

1. PV solar panel : 10Wp-50Wp (12Vdc).
2. Battery: Ion-Li/ 12Vdc
   - 2.000 cycles (80% PDD)
   - 1 day autonomy
3. Lights: Led tecnology with high power & efficiency
   - 30.000 hours lifetime
   - Min. 400 lumen & 4 hours/day
   - Two fixed lights & a portable one
4. Outlet for cell phone, radio or high efficiency TV
5. Easy to install, less than 10Kg weight

Source: https://sites.google.com/a/accioname.org/acciona-microenergia-mexico/nuestros-proyecto

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Conclusions

- The world of demand analysis *(in demand response & energy efficiency)* will not be what it used to be
  - Consumers are becoming "energy service users" & their behavior will be more complex
  - That complex behavior might be centrally managed by aggregators with a variety of business models
  - Energy efficiency may come from unexpected places

Thank you for your attention