

# An Energy Internet Platform for Sensor-driven Transactive Energy Applications

Invited Talk

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# What is the Energy Internet ?

The **Internet** allows information to flow to anyone from anywhere.

The **Energy Internet** is a vast network that will allow efficient distribution of electricity to anyone and from anywhere.

EI will utilize smart sensors, ICT technologies and algorithms to facilitate power supply in real-time, enhance storage applications, and integrate renewable energy into the grid.

# Mission of the Energy Internet

Energy Internet is an online marketplace that transacts in energy  
(One-to-One, One-to-Many and Many-to-One)

O-to-O: Between individual users for bilateral transactions

O-to-M: One electric utility sells to Many customers

M-to-O: Many customers sell to One electric utility

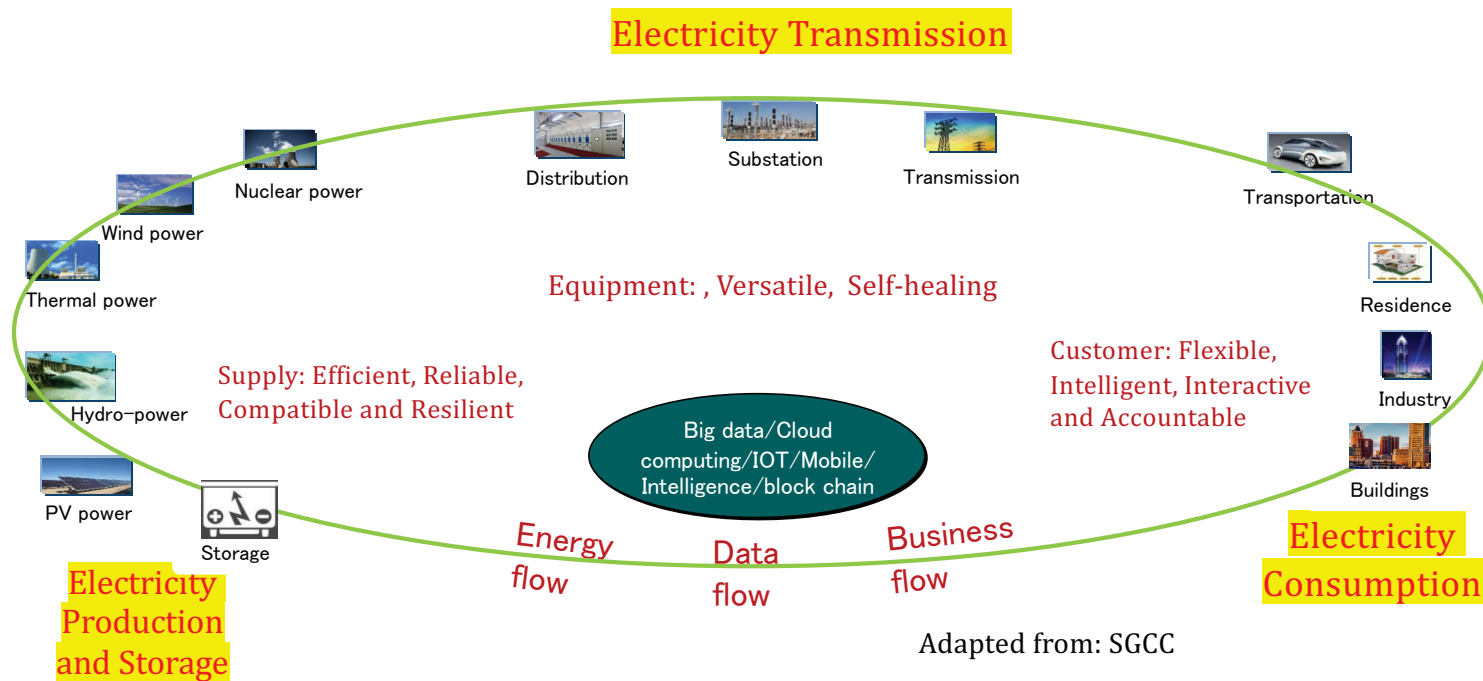


But in the Energy Internet:

All transactions must be done in real-time

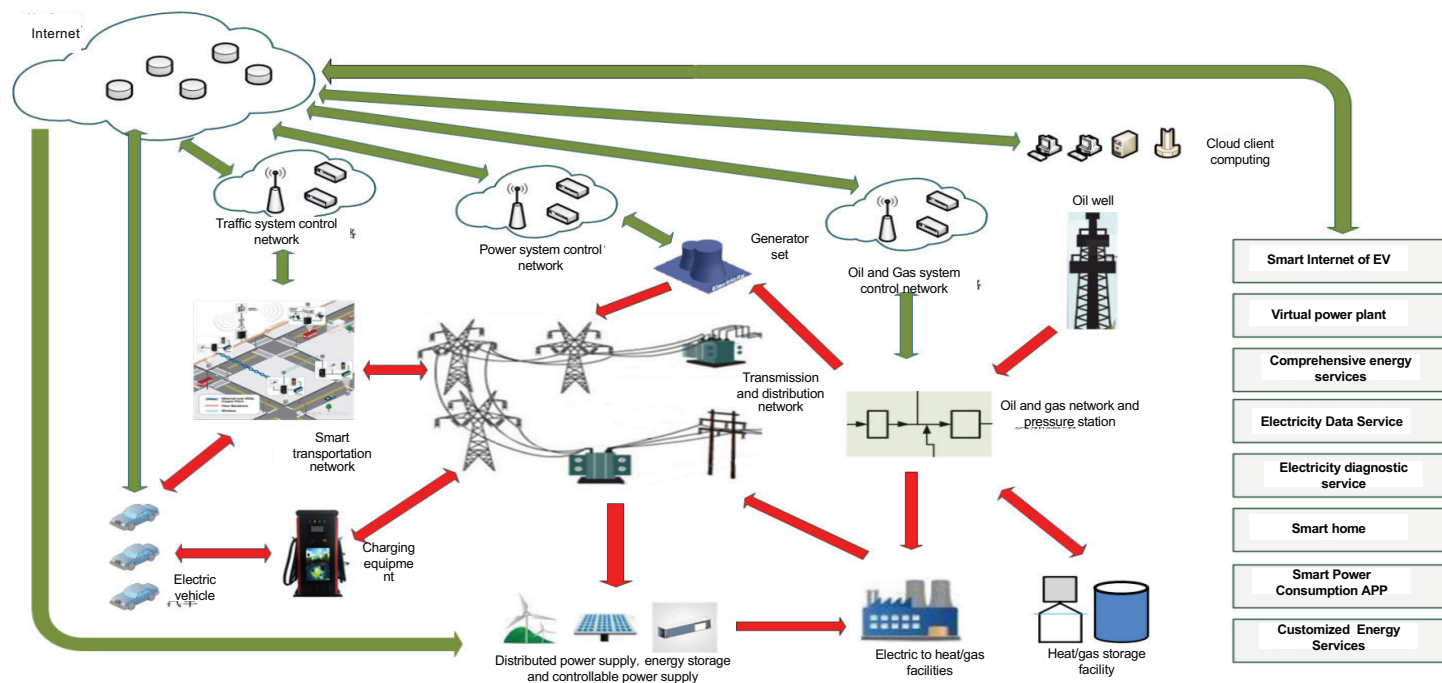
All network constraints must be met

# Vision of the Future Grid

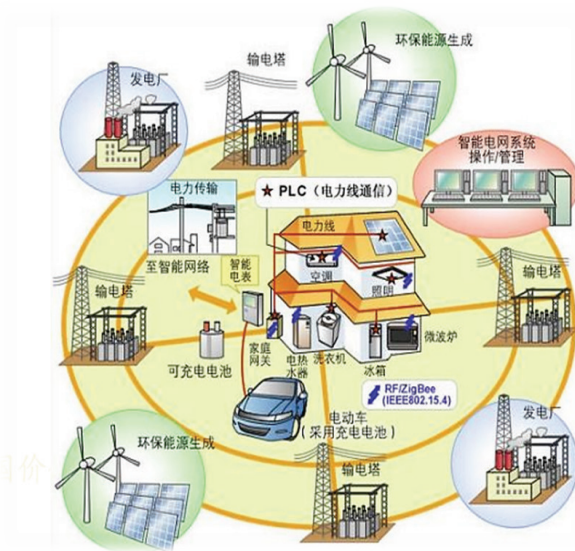




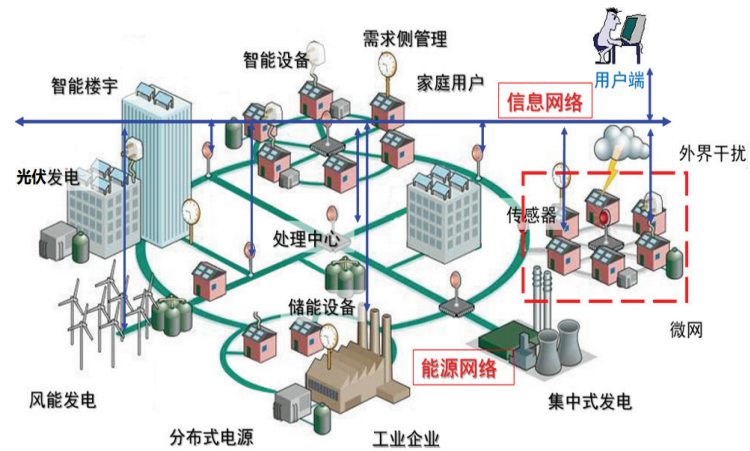
# Mapping the Energy Internet into the Future Grid



# Energy Transaction in a Future Power System



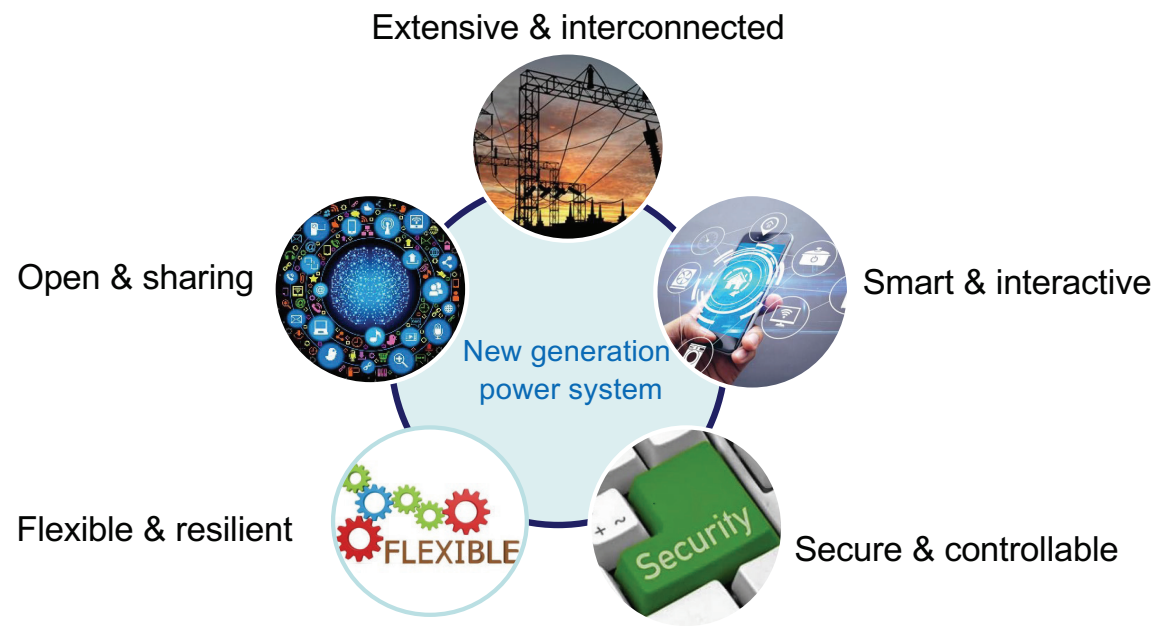
Future power system



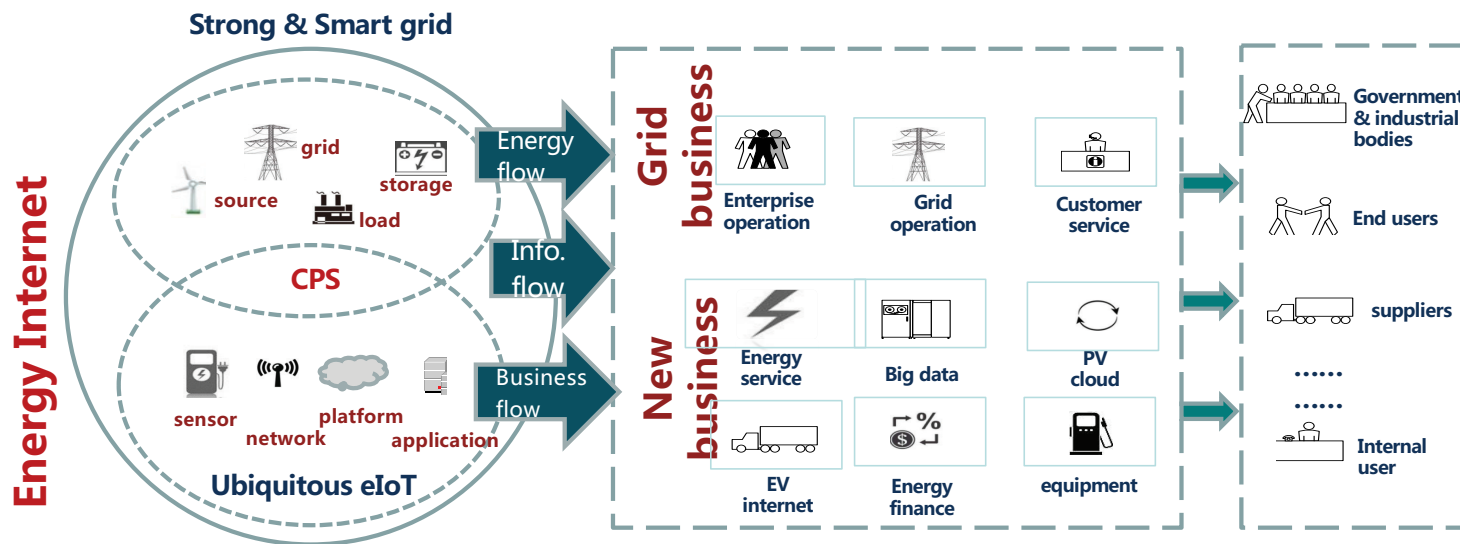
Future power system integrated with modern information technology

Source: SGCC

# Future Power System: Pathway to Energy Internet



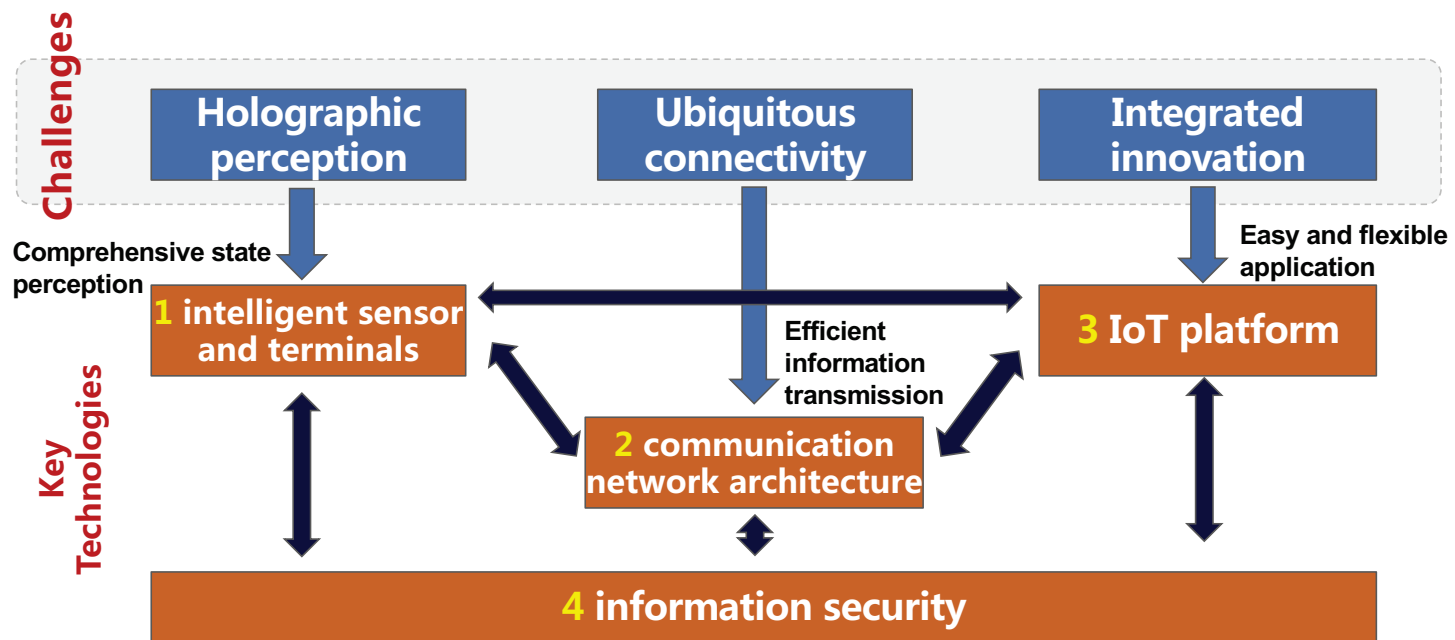
# Functions of the Energy Internet



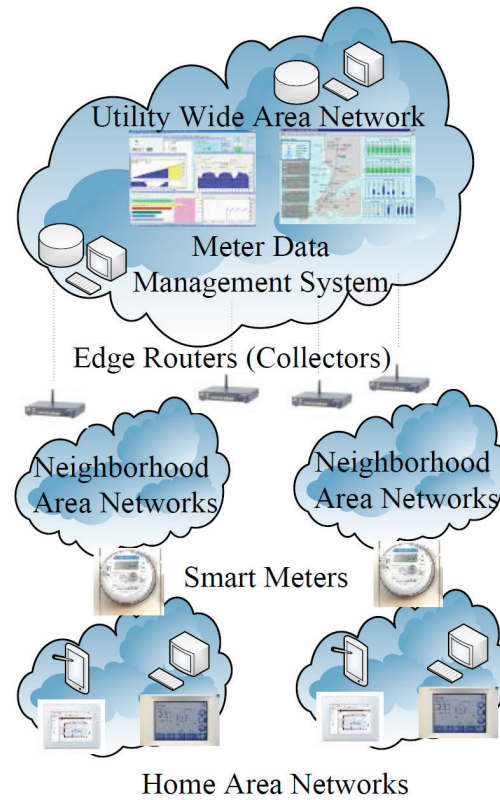
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# Key Technologies of the Energy Internet

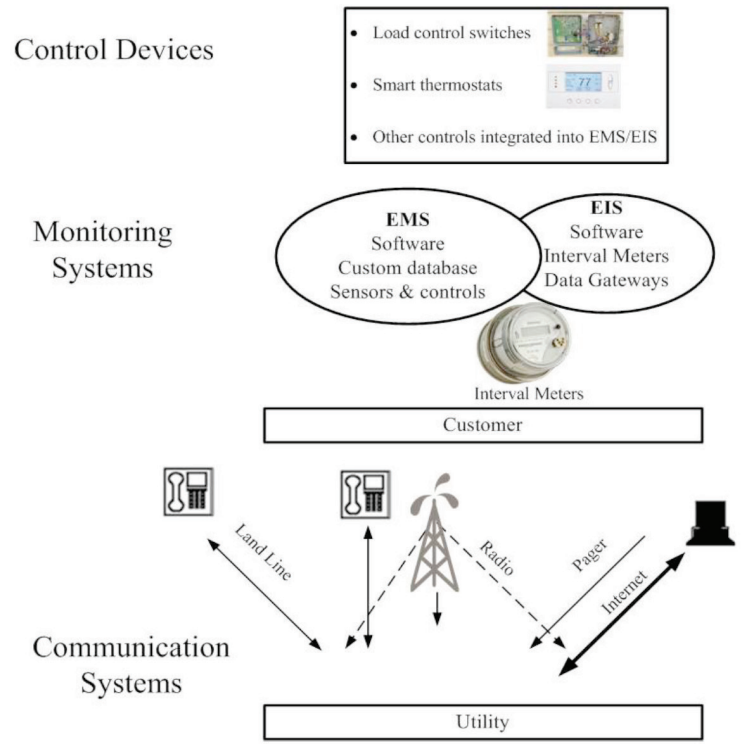


# The ICT Framework



Source: P. Siano

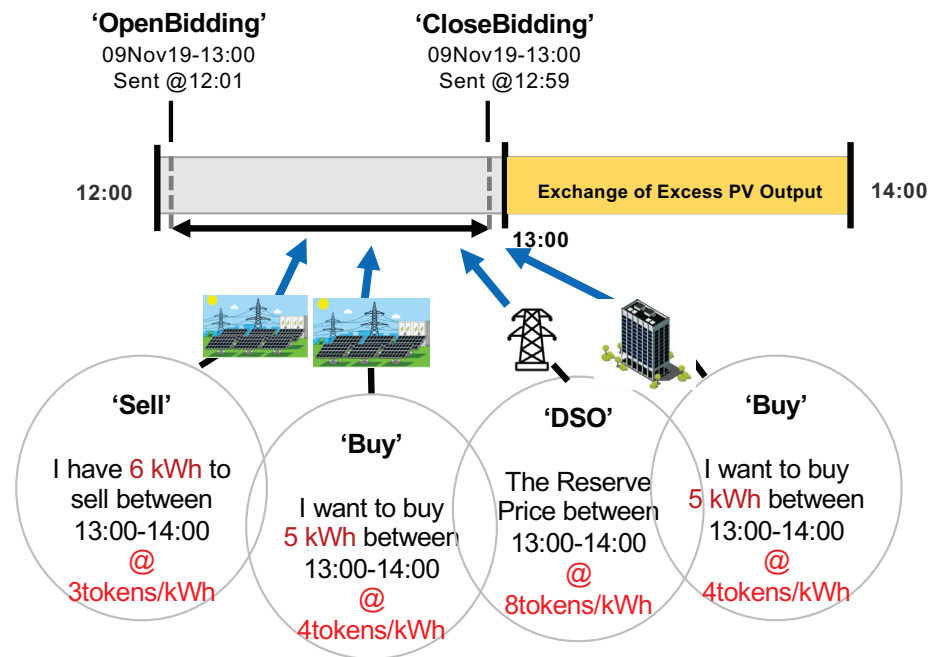
# Field Implementation



Source: P. Siano

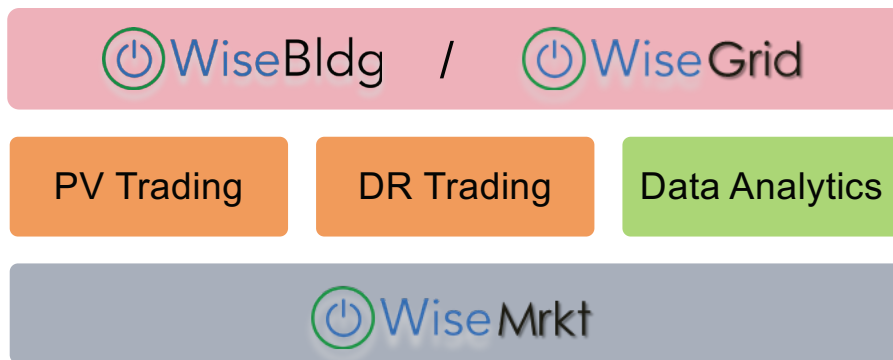


# Basic Transactive Energy Process





# Small Scale Realization of EI



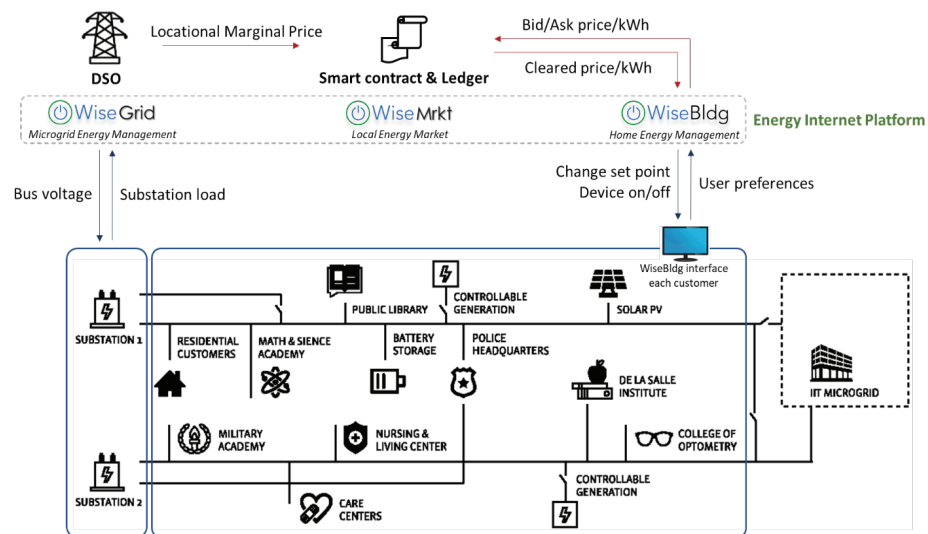
- ★ Control/user interface
- ★ Intelligent control mechanisms
- ★ Energy insights
- ★ Historical data
- ★ Current status
- ★ Locational data
- ★ Immutable data

Source: [www.bemcontrols.com](http://www.bemcontrols.com)

# Transactive Energy in a Microgrid

Focus: Top develop & pilot an Energy Internet platform that provides higher efficiency, cost reduction, and energy insights for both utilities and end-customers by leveraging

- 1) Existing IoT/smart devices in homes
- 2) Blockchain/distributed ledger/related technology to execute smart contracts and maintain records of all transactions



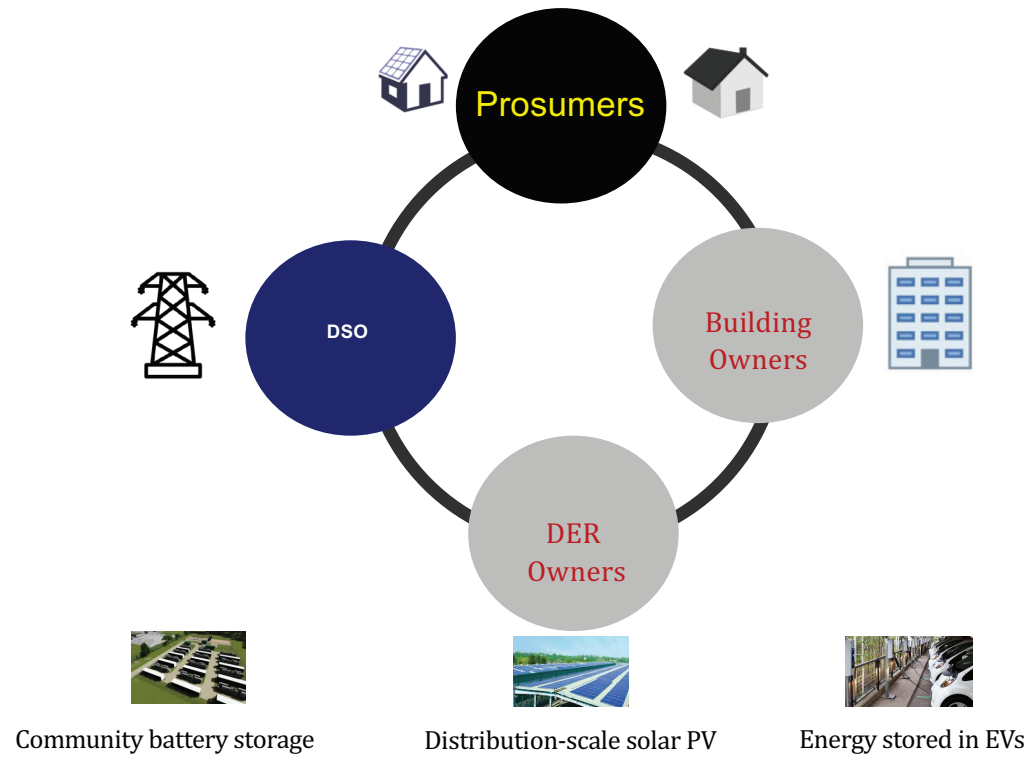
Source: [www.bemcontrols.com](http://www.bemcontrols.com)

# Roof-top Solar Photovoltaics



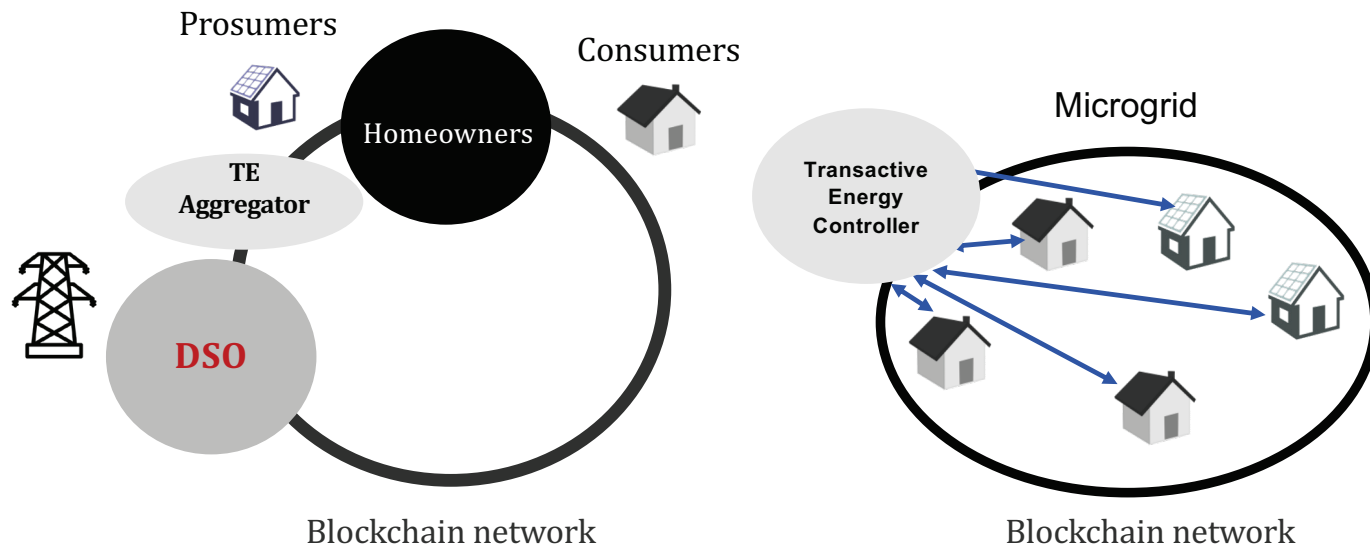


# Participants





# Energy Transaction in a Microgrid



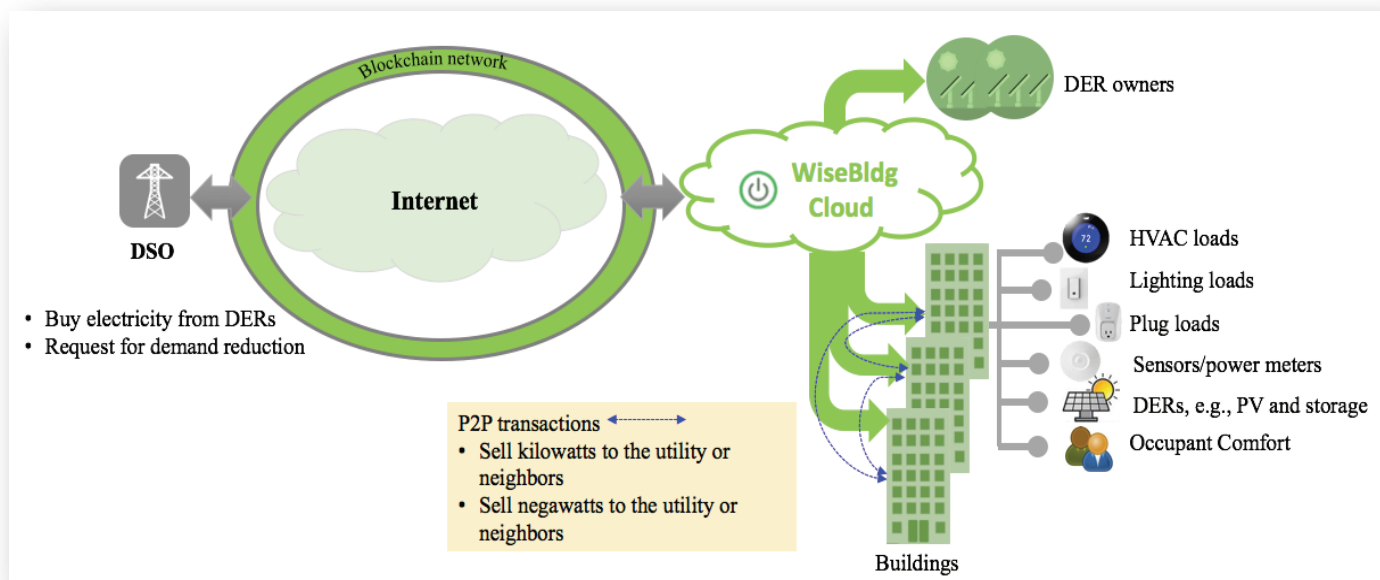


# Transactive Controllers

**Active controllers** enable customers to adjust their energy consumption depending to price changes.

**Transactive controllers** represent the most promising evolution for energy users aiming at participating in Local Energy Markets since they allow both prosumers and active users to make bids considering the real time price of electrical energy and their own energy requirements.

# Application: Building Automation Platform



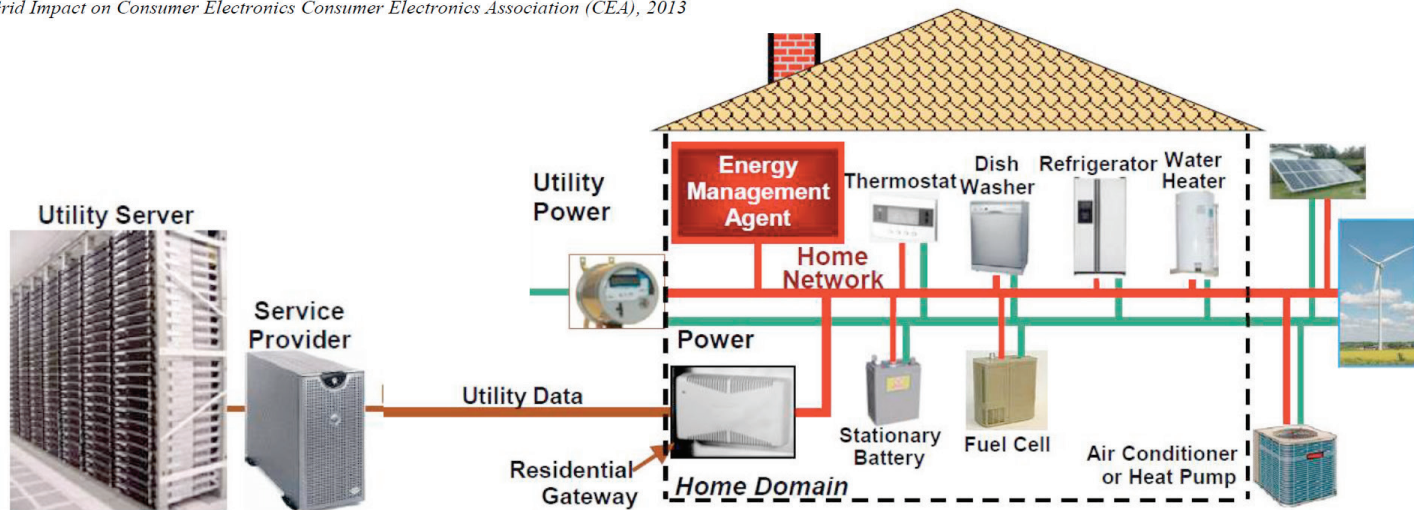
Open source software platform: [www.bemoss.org](http://www.bemoss.org)

WiseBldg is a commercial software platform, [www.bemcontrols.com](http://www.bemcontrols.com)

# Building Energy Management

These signals enter the house through a **Home Gateway**.

*Smart Grid Impact on Consumer Electronics Consumer Electronics Association (CEA), 2013*

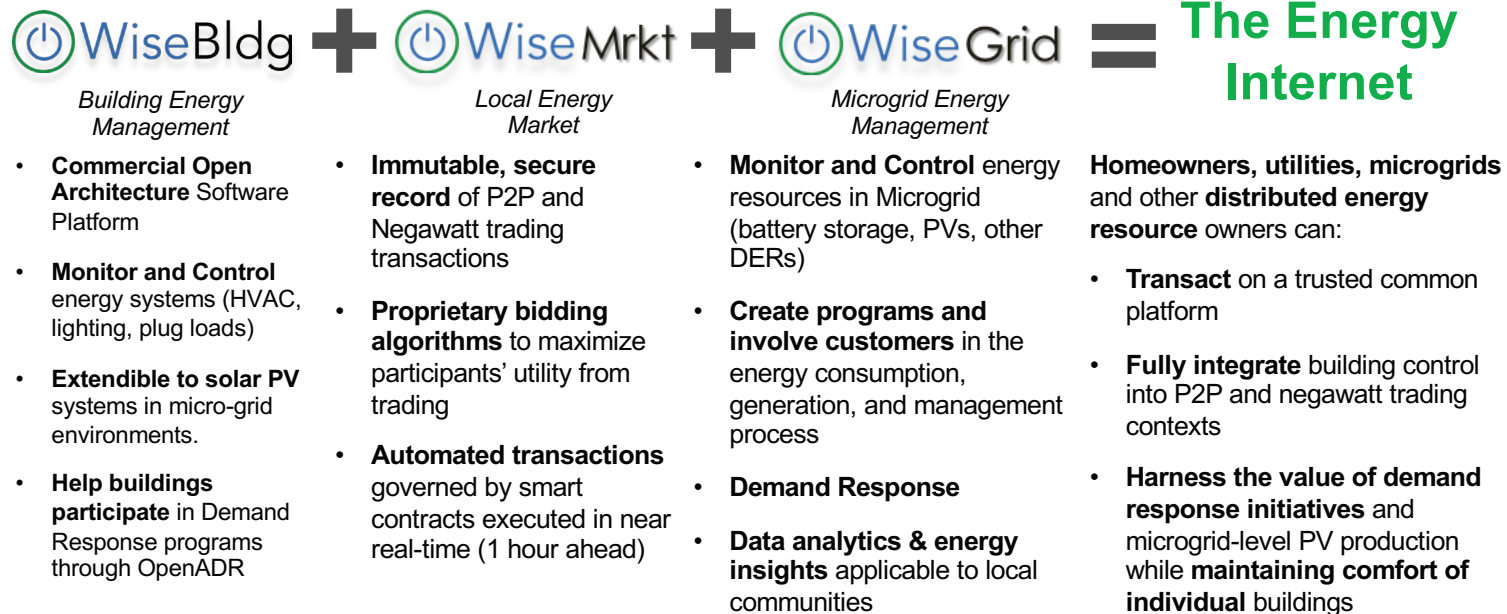


Distributed Load Control with an Energy Management System (via Utility or Aggregators)

Source: P. Siano



# Energy Internet Value Proposition



[www.bemcontrols.com](http://www.bemcontrols.com)



# IEEE President-elect Candidate 2020

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