

PLUG-IN 2014

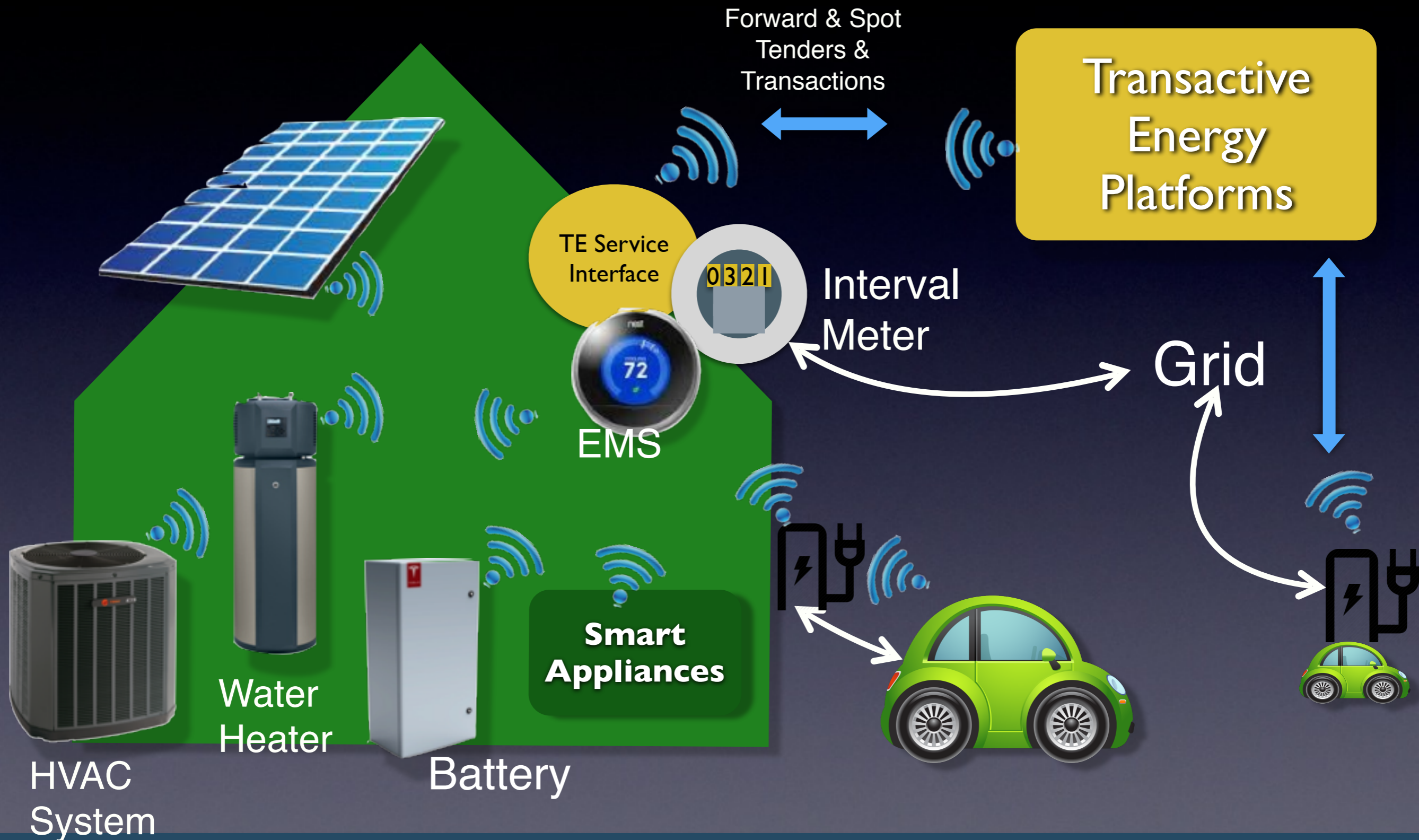
Transactive Energy for Electric Vehicles

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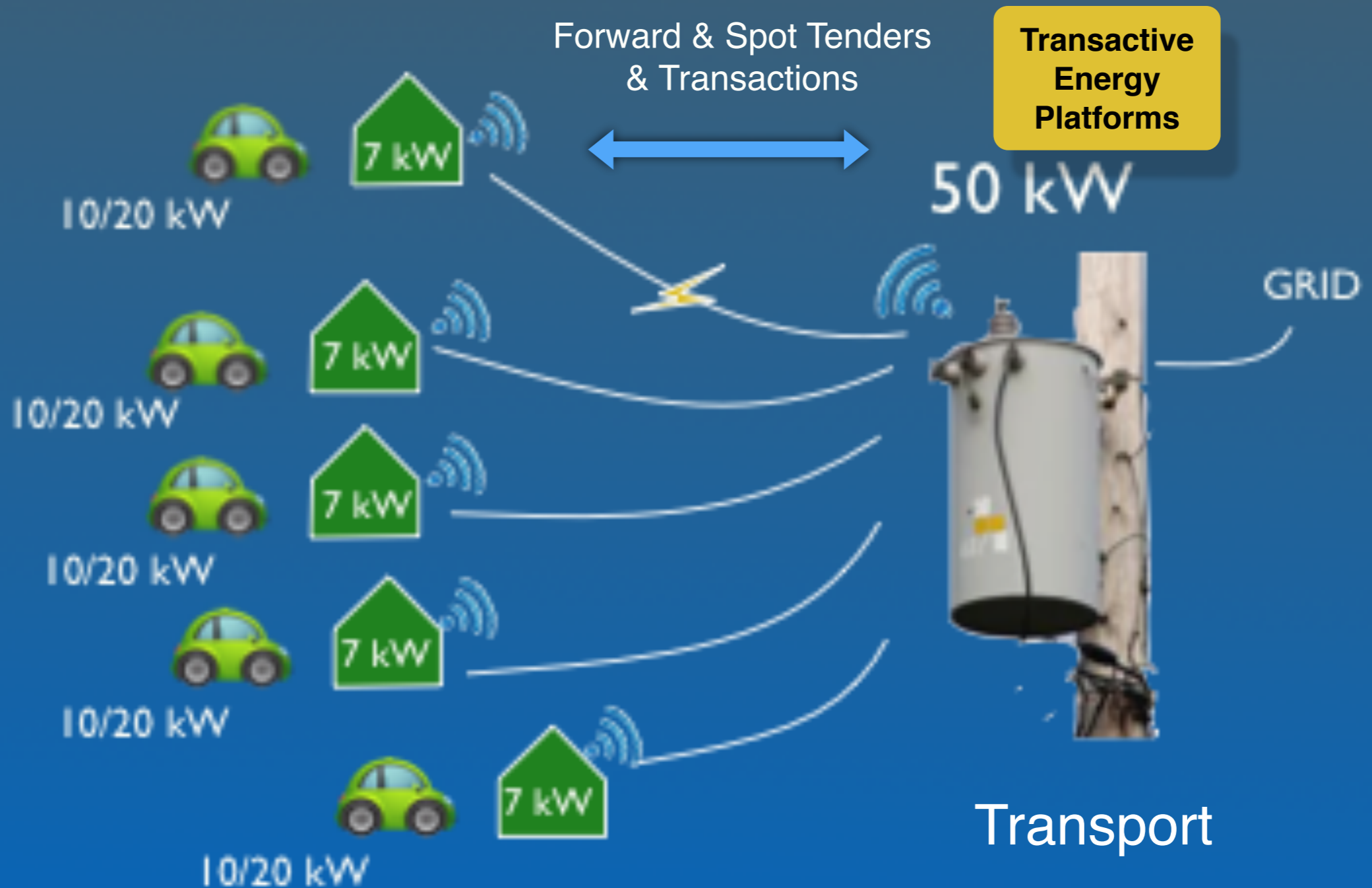
Plug-In Grid Interface: Opportunities and Challenges

- **Opportunities:**
 - **Electrification of transportation**
 - **Support solar, wind, storage and GHG requirements**
- **Challenges:**
 - **Two-way flows and net-metering**
 - **Many jurisdictions**
 - **Tariff proliferation**
 - **Retail/wholesale interface and aggregation**
 - **Ancillary services**
 - **Distribution grid operation**
 - **Communication and IT complexity**

A building (or charge station) with a plug-in looks like this in the Transactive Energy (TE) model.



Transport management with Plug-Ins.



Transactive Energy (TE) has four big ideas.

Forward transactions are used to coordinate investments and manage risk.

Spot transactions are used to coordinate operating decisions.

All parties act autonomously.

There are two products: energy and transport.

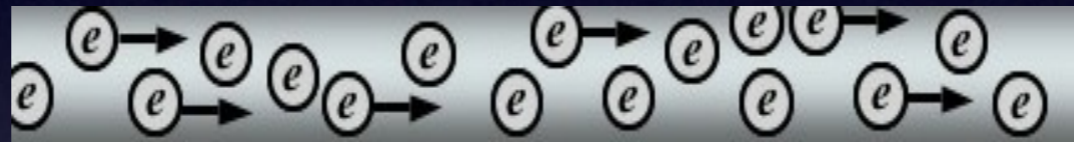
The TE business process is straightforward.



The Transport product delivers the Energy product.



Electric energy
(produced at a
place and time)



Transport



Electric energy
(delivered at a
different place
and same time)

Here's an example of how TE works for a consumer.



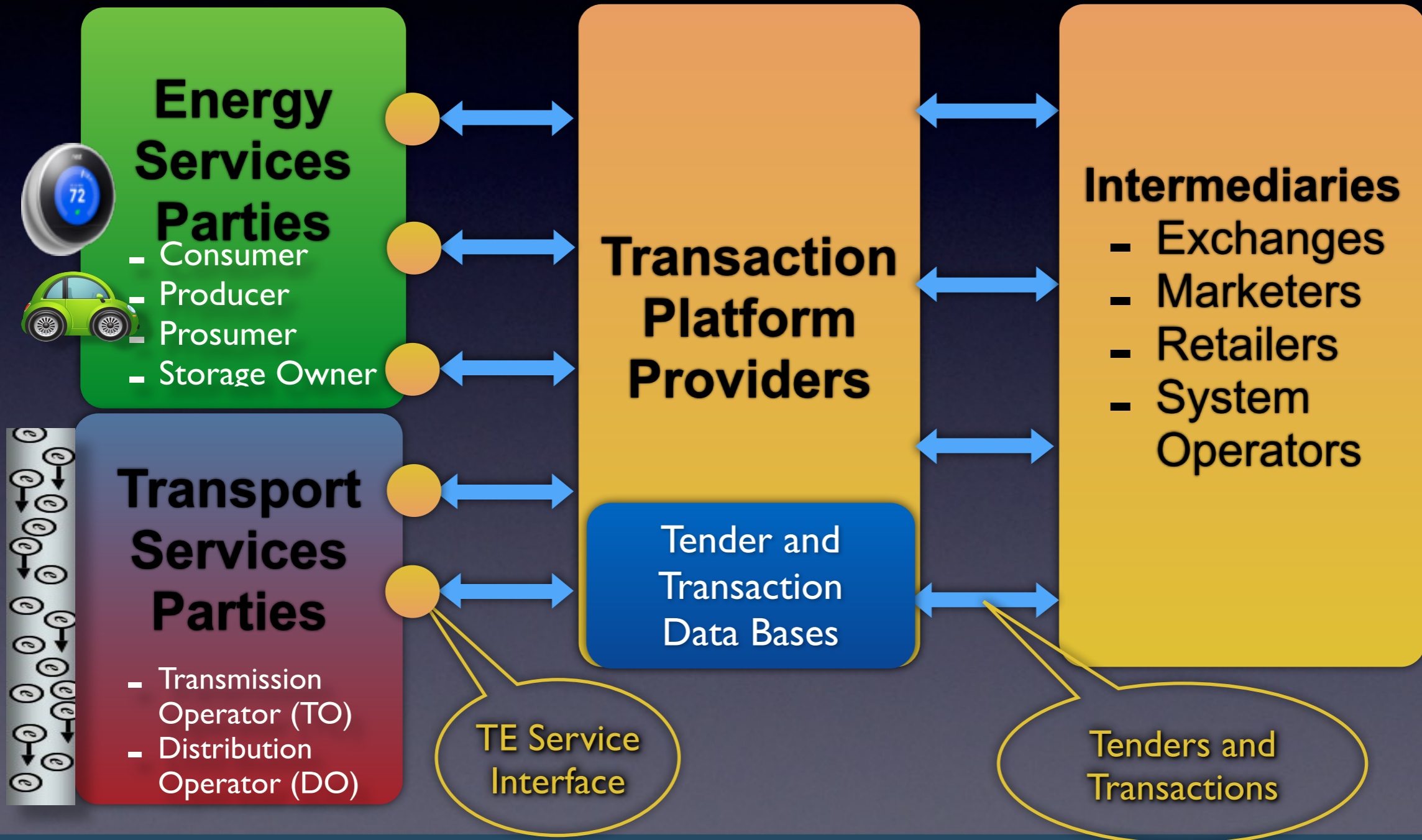
- Based on my typical usage, I automatically transact with one or more suppliers for delivery of a fixed quantity of energy in each hour of the year(s) for a fixed monthly payment (subscription.)
- If I use less than I subscribed for in each hour then I am paid for the difference at an hourly spot price.
- If I use more than I subscribed for then I pay for the difference at an hourly spot price.
- At any time I can automatically buy or sell a quantity of energy at current tendered prices.

My energy management system (EMS) automates this process for both energy and transport.

Parties interact on independent TE platforms with oversight.

Grid Custodians:

Congress, DOE, EPA, FERC, NERC, Legislatures, PUCs, Munis, CCAs, PMAs, Coops



“Open and free” TeMix protocol supports standard transactions on multiple communications systems.

TeMix Protocol

Electric energy and transport transactions



High volume,
high speed
Standards

OASIS

Advancing open standards for the information society



Internet Protocol
(TCP/IP)
Data Transfers

FIX Protocol
Financial Transactions

Visit TEA for continuing open discussion of
Transactive Energy.



www.tea-web.org

Transactive Energy

A Sustainable
Business and Regulatory Model
for Electricity

Stephen Barrager, Ph.D.

Edward Cazalet, Ph.D.

BAKER STREET PUBLISHING

Available on
the Apple
iBook Store.



Plug-In Grid Interface: Transactive Energy is a “silver bullet”

- **Single interoperable tariff/rate for all parties and devices**
- **Actionable, priced tenders for forward 4-sec, 5-min, 1- hour intervals**
- **Fully dynamic, two-way transaction interfaces**
- **Coordination of investment and operations**
- **Transparent simple billing**
- **Next steps: demos and implementations**
- **Plug-ins, renewables, storage and TE are the future.**