

Transactional Energy Market Information Exchange (TeMIX)

A Foundation for Smart Dynamic Pricing of Electricity

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Transactional Energy Offers & Transactions

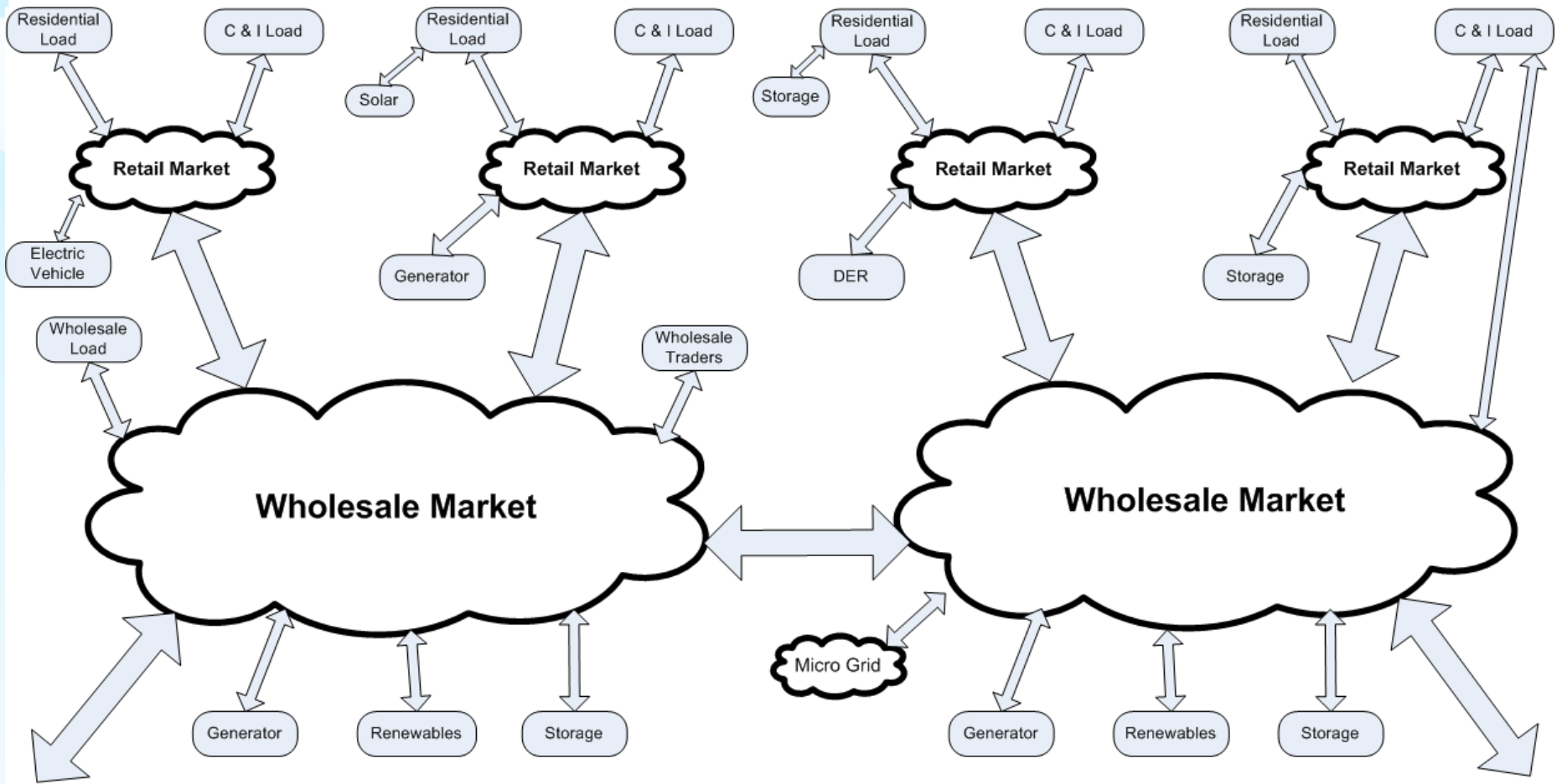
- Clear and frequent communication.
- Foreword and real-time for a quantity, in a time period, at a location.
- Many frequent, small transactions leading to a *position* in a time period, at a location.
- Periods : years, months, days, hours, minutes, or seconds.
- Applies to cost-based and open markets.

TeMIX builds on OASIS eMIX in support of PAP 03 common price communication model.

TeMIX contributes to OASIS Energy Interop in support of PAP 09 standard DR and DER signals.

Transactional Energy Markets

any party can transact with any other party



↔ Priced Offers, Transactions & (Commands)

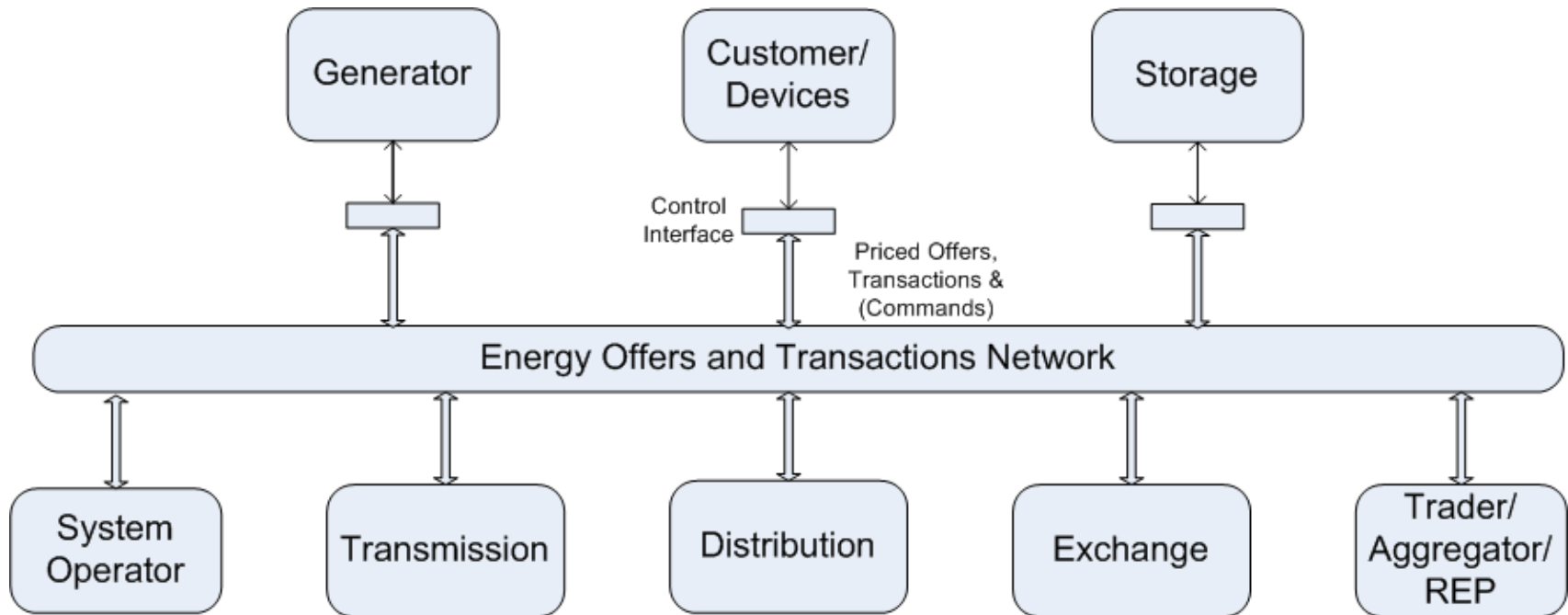
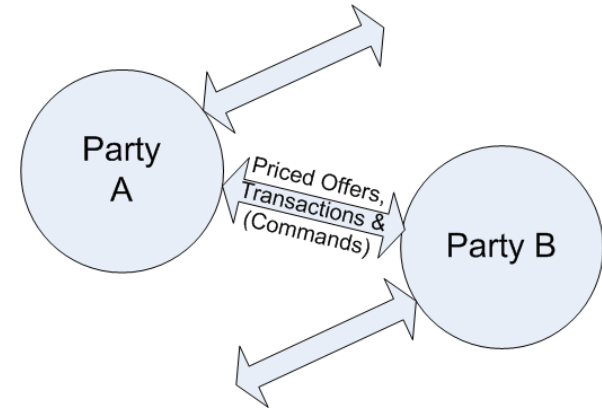
TeMIX Energy Transactions

Extends to ancillary service,
transmission, distribution &
environmental commodity products

- **Obligation energy transaction**
 - An obligation by the buyer to purchase and the seller to deliver energy over a given period of time at a constant rate-of-delivery (kW, MW).
- **Obligation energy option transaction**
 - A put (option to sell) or a call (option to buy).
- **Full-requirements transaction (limited use in TeMIX)**
 - provides any amount of energy at variable rate of delivery during interval.
 - subsequent transactions have no baseline.

Actors in TeMIX

- Party (essentially any actor)
- Party Roles :
 - Buyer
 - Seller



The Four TeMIX Information Models

Energy Offer Elements
Price
Rate of Delivery
Delivery Period
Buy/Sell Flag
Offering Party
Counter Party
Offer Availability Interval
Location
Meter ID
Currency
Units

Energy Transaction Elements
<i>Extended Price</i>
<i>Rate of Delivery</i>
<i>Delivery Period</i>
<i>Buyer</i>
<i>Seller</i>
<i>Transaction Execution Time</i>
<i>Location</i>
<i>Meter ID</i>
<i>Currency</i>
<i>Units</i>

Energy Option Offer Elements
Option Price
Strike Price
Rate of Delivery
Delivery Period
Offering Party
Counter Party
Exercise Party
Put/Call Flag
Offer Availability Period
Exercise Period
Location
Meter ID
Currency
Units

Energy Option Elements
Extended Price
Strike Price
Rate of Delivery
Delivery Period
Buyer
Seller
Put/Call Flag
Transaction Execution Time
Exercise Period
Location
Meter ID
Currency
Units

Also, time vector offers and multi-leg offers (swaps)

Filter as needed

Mature Transactional Energy Example

typical wholesale forward transactions

Forward Energy Planning:

Parties plan usage and supply, with automatic or manual response to forward **Energy Offers** and forecasts of power prices, needs, costs, weather, etc. Plans may change as the offers and forecasts change.

Forward Energy Offers:

Parties tender forward buy and sell **Energy Offers**.

Forward Energy Transactions:

Parties buy or sell a fraction of planned energy in each forward period. As plans and offers change, **Energy Transactions** add to or subtract from the customer's total rate of delivery (*position*) in each period.

Energy Metering:

After delivery, the meter reports energy delivered in each 5-minute period. The balancing energy rate of delivery (kW) is the meter reading (kWh) for the 5-minute period times 12), less the *position*.

Balancing Energy Transactions:

Balancing market operators and others make ex-post balancing **Energy Offers**. Each party purchases or sells its balancing energy as **Energy Transactions**.

Total Energy Costs and Revenues:

The total cost or revenue to a party is the sum of the *extended prices* (+or -) of all its **Energy Transactions**.

Retail Ex-Ante Hourly RTP

typical retail real-time pricing (RTP)

Day-Ahead Ex-Ante Hourly Offers:

At 12 noon, the RSP tenders to the retail customers a vector of **Energy Offers** to sell for the 24 hours of the next day. *Rate of delivery* limited only by the service connection.

Real-Time Usage:

Customer self-manages electric usage with automatic and/or manual response to the hourly *prices* of the **Energy Offers**.

Metering and Costs:

Meter reports energy delivered in each hour. An **Energy Transaction** is entered with the *rate of delivery* equal to the meter reading (kWh) for the hour. The *extended price* (cost) in each hour equals the hourly *price* of the **Energy Offer** times the meter reading for the hour.

Fixed Baseline with Hourly Ex-Ante RTP

Cost of Service Baseline Allocation:

provides cost-of-service hedge to RTP

Customer accepts a cost-of-service fixed baseline **Energy Transaction**. The baseline amount typically varies by time-of-day, day-of-week and season. The cost of the baseline transaction is a fixed amount per month.

Day-Ahead Hourly Ex-Ante Offers:

At 12 noon, the RSP tenders to the retail customers a vector of **Energy Offers** to sell for the 24 hours of the next day. *Rate of delivery* is limited only by the service connection.

Real-Time Customer Usage:

Customer self-manages electric usage, with automatic and/or manual response to the hourly prices of the **Energy Offers**.

Metering:

Meter reports energy delivered in each hour. An **Energy Transaction** is entered with a rate of delivery equal to the meter reading (kWh) for the hour **less** the baseline *rate of delivery*. *Extended price* (cost) in each hour equals the hourly *price* of the Energy Offer times the meter reading for the hour.

Total Costs:

The total cost per month is the monthly baseline **Energy Offer** *extended price* plus the hourly **Energy Transaction** *extended price* (positive or negative) over all hours in the month.

Build-Your-Own Baseline with Forward Offers and 5-Minute Ex-Post Offers

Customer Forward Planning:

forward hedging with dynamic pricing

Customer plans usage and supply, with automatic or manual response to forward **Energy Offers** by a RSP and forecasts of power prices, needs, costs, weather, etc. Plans may change as the offers and forecasts change.

Customer Receives Forward Offers:

Customer receives vectors of forward buy and sell **Energy Offers**. Vectors of offers may be for each 5-minute period for the remainder of the hour and the next hour, hourly for the rest of the day and the next day, and then daily, monthly or yearly. Each offer has an availability period and all offers close before the start of delivery.

Customer Forward Transactions (build-your-own baseline) :

Customer purchases all or some fraction of planned energy using **Energy Transactions**. The transactions change the customer's *position* in each period.

Real-Time 5-minute Ex-Post Offers:

After each 5-minute delivery period, 5-minute buy and sell **Energy Offers** are tendered.

Metering and Costs:

Meter reports energy delivered in each 5-minute period. A 5-minute **Energy Transaction** is entered with a rate of delivery equal to the meter reading (kWh) for the 5-minute interval times 12), **less** the *position* from all forward transactions.

Total Customer Costs:

Total customer cost is the sum of the *extended prices* of all transactions.

Full-Requirements Tariff with Increasing Monthly Block Rates

typical California IOU residential tariff

RSP Offers Full-Requirements Monthly Contract with Three Increasing Block Rates:

RSP offers to retail customer three monthly call options **Energy Options** for any amount of energy up to an average *rate-of-delivery (not constant)*. Each block has a strike price (rate).

1. Up to 300 kWh for month at \$0.10 per kWh
2. 300 kWh up to 1000 kWh for month at \$0.15 per kWh
3. Over 1000 kWh for month at \$0.20 per kWh

Monthly Metering and Costs:

Meter reports energy delivered in each monthly period. The monthly metered energy is allocated first to the lower price blocks. Up to three monthly **Energy Transactions** result. The extended price (cost) of each block is the call option strike price (rate) times the monthly metered energy.

Event-Based Demand Response

RSP Event-Based Demand Response Call Option:

a DR program is a call energy option

RSP offers to a retail customer a call **Option Offer** (demand response program). The **Option Offer** has an *option premium price* of \$20 per kW-month and a **strike price** of \$1 per kWh for actual energy curtailments. The call option is for any weekday peak hour (12 noon to 8 pm) in the months of June through September. The option is constrained to be exercised up to 20 hours per month.

Customer Accepts Event-Based Demand Response Offer:

Customer agrees to 2 kW of curtailment for a monthly payment of 2 kW times \$20 per kW-month or \$40 per month.

RSP Exercises Option based on ISO Demand Response Event:

At 1:30 pm, on July 16th, the ISO issues a demand response event (**Command**) for two hours from 2 pm to 6 pm (4 hours) on July 16th. Per an ISO contract with the RSP, the RSP exercises the call option for four hours. RSP then **Commands** the customer to curtail 2 kW from 2 pm to 6 pm. (Note the *chain-of-command*)

Customer Curtails Usage:

a DR event initiates a chain-of-commands

Customer reduces his rate-of-delivery by 2 kW (**Energy Transaction**) from his contracted baseline *position* or, in the case of a full-requirements contract, an *estimated baseline*.

Hourly Metering and Costs:

Meter readings verify the reduction vs. the baseline. Customer is paid 2 kW times 4 hours times \$1 per kWh or \$8 for the actual curtailment. The customer is paid for all events during the month plus the monthly premium.