Flow-Based Markets: Some Questions and Observations

Workshop on Markets for Electricity – Economics and Technology (MEET)

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Agenda

Background and Purpose
Overview of RealFlow
Some Claims for RealFlow
Some Unanswered/Unasked Questions
  • Defining the CSFs, PTRs and PTDFs
  • The Critical Real-Time Market
  • The “Highly Liquid” PTRs
Summary and Conclusions
Recent Descriptions by Proponents


These are being circulated by marketers [TCA] and academics [CPOW] advocating flow-based markets
Importance of the Unasked Questions

The recent descriptions of flow-based markets:

- Leave many details undefined
- Raise as many questions as they answer
- Appear to be contradictory in important ways

The problem is not lack of technical detail, but:

- Failure to define/make basic design choices
- The implication that there is a magic solution

More details are likely to illuminate, not eliminate, the inherent dilemmas
Some Terms and Abbreviations

CSF = Commercially Significant Flowgate
PTR = Physical Trans. Right to flow on CSF
PTDF = Power Transfer Distribution Factor defined point-to-point for each CSF
LMP = Locational (Nodal) Marginal Price
FTR = Financial Trans. Right in LMP system
RTM = RTO’s real-time market
The Concept of Flow-Based Trading

100 A-C Needs: (52-7) A-B and (-12-43) C-D PTRs
100 B-D Needs: (-31-2) A-B and (3+62) C-D PTRs

PTDFs (Hub = E)

<table>
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<tr>
<th>Node</th>
<th>A-B</th>
<th>C-D</th>
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<tbody>
<tr>
<td>A</td>
<td>+0.52</td>
<td>−0.12</td>
</tr>
<tr>
<td>B</td>
<td>−0.31</td>
<td>+0.03</td>
</tr>
<tr>
<td>C</td>
<td>+0.07</td>
<td>+0.43</td>
</tr>
<tr>
<td>D</td>
<td>+0.02</td>
<td>−0.62</td>
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[Assumes A→B = −B→A]
The RealFlow Timeline

Markets
- Defines CSFs & PTDFs, Auctions
- RTO
- Trade Energy/PTRs Bilaterally or in Exchanges
- Submit Schedules w. PTRs, Inc/Decs
- Respond to RTO/Control Area
- Trade/Settle Imbalances
- Days+
- Prices/Settles Energy & PTR Imbalances

Real-Time
- Operates Balancing/Congestion Management Market
- Schedules, Derates PTRs, Plans Ops w. Control Areas
- Buys/Sells PTRs as Capacities Change
- Day – Hour – Real-Time

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Some Claims Made for RealFlow [TCA]

Number of CSFs “is likely to be small” [p. 9]
Cost of non-CSF congestion will be “low” [p. 10]
PTDFs are “constant within seasons” [p. 12]
There will be “one single [imbalance] price in the absence of real-time congestion” [p. 20]
Trading in PTRs will be “highly liquid” [p. 8]
More price/trading certainty than with LMP

How plausible (or even logical) is this combination? What if it does not exist?
Defining the CSFs, PTRs and PTDFs

Can CSFs be few/stable, when they must reflect:
• Physical/Economic impact of congestion?
• Market, not just grid, conditions?

Can PTRs be stable, when TTC/ATCs depend on:
• The specific contingencies considered?
• Dispatch (e.g., market outcomes)?

Will PTDFs be few/stable, when flows depend on:
• Grid status over a wide area?
• Exact locations of source/sink?
How Will the RTO Select CSFs?  
(According to TCA)

Identify “historically constrained flowgates”

“Perform competitive wholesale market simulation going forward three years”

Rank flowgates based on “projected commercial cost of congestion”

With stakeholders, “develop a threshold of ‘commercial significance’” and select CSFs

Can/Should an RTO be doing this?
Will There Be “Few,” “Stable” CSFs?

We have all seen the WSCC example with the 40-60 flow split and 2 CSFs.

But 40% goes thru California, where 3 zones are being replaced by 10, with many CSFs.

Any of these may be binding.

If the World Were This Simple …
Adding CSFs

According to TCA, CSF’s “will be added” if the cost of non-CSF congestion is not “low”

But congestion patterns/costs will change when:
- A new generator comes on line
- New load or a new contingency arises

Will new congestion be managed by:
- Defining “too many” CSFs initially?
- Adding CSFs “too frequently”?
- “Protecting” the market from new congestion?

What is the design decision here?
Defining PTRs – The TCA Example

If the market decides that $Y > X$, the RTO must redefine PTRs to get an efficient market outcome.

RTO must know the market outcome in order to define the market parameters!
Defining the “Few,” “Stable” PTDFs

PTDFs must not be affected by:
- Changes in grid status that occur routinely
- Market outcomes themselves (i.e., dispatch)
  (TCA: Even phase shifters will not affect PTDFs!)

**BUT:** PTDF_{II}^{A→B} depends on:
- Status of all lines, e.g. E-F
- Dispatch (A vs. C vs. E)

**PTDFs are unlikely to be few and stable**
Adjusting PTRs to Reflect Reality

In RealFlow, when conditions change, the RTO:
• Buys/sells PTRs in forward markets
• Derates PTRs pro-rata in last hour [TCA, p. 18]

But RTO buying/selling of PTRs in forward market:
• Requires active, speculative role for RTO
• May not work for non-CSF congestion

Pro-rata “derating” of PTRs near real time:
• Is like calling TLRs for EVERYBODY
• Requires market to look for solution – FAST

Is this a good division of responsibility?
The Inherent Trade-Offs

Few CSFs
Fixed PTRs
Stable PTDFs, hence easy, efficient forward trading

Little for the RTO to do in real time, hence no need to worry about how the RTO does it

? AND ?

! EITHER/OR !

In fact, simple trading creates big problems for the RTO to manage.
How will the RTO manage them?
The Great Mystery about RealFlow: What Will the RTO Do in Real Time?

RealFlow avoids answering by asserting:
- There will be little real-time congestion, so
- The details of the RTM do not matter much

But logic & experience show that congestion:
- Will be surprisingly complex and large
- Will become larger if it is not priced in RTM

Design Choice: Will the RTO’s RTM be open and efficient, or …??
Will RTM Have “One Single Price”?  

TCA says [p. 20]: RTM will have “one single price in the absence of real-time [implying non-CSF?] congestion.”

But even one binding CSF, even if fully priced in forward market, will create a different imbalance price at every node, i.e., LMPs.

A forward market, even a very good one, is no substitute for accurate RT pricing.
Imbalance Pricing in the RTM

150 Offered @ $20/MWh

100 Offered @ $100/MWh

TTC = 100 = PTR

Flow_{Schedule} = 100 = Flow_{Actual}

LMP_A = $20

LMP_B = $100

What is (are) the correct imbalance price(s)?

If imbalance price ≠ LMP at each node, incentives to contract and to follow dispatch instructions will be all wrong
The RTM Must Use LMPs

A single binding CSF on A-B requires a different imbalance price at each node
Unclear/Contradictory Views of RTM

The forward market “need not be precise … [because] the difference between the estimated power flows and the actual flows can be reconciled in the spot market.” [CPOW, p 12]

“Redispatch to alleviate any constraints on the system other than on CSFs will be added to the cost of operating the system.” [TCA, p. 10]

Which is it? Is there a good option?
What Will the RealFlow RTM Do?

Is the RTM an open, efficient LMP market that:
• Prices ALL (not just CSF) congestion?
• Sells ALL unscheduled transmission capacity?
• Prices imbalances efficiently at LMPs?

Or is it a limited “mechanism” that:
• Socializes non-CSF congestion costs?
• Leaves unscheduled grid capacity unused?
• Penalizes imbalances to stop spot trading?

What is RealFlow’s answer?
Is the RTM an Efficient LMP Market?

If so, for real-time operations the RTO will:
• Accept schedules (with PTRs required?)
• Use inc/dec offers to balance system using FULL grid capacity, including unused PTRs
• Settle imbalances at LMPs that reflect ALL congestion, not just congestion on CSFs

But then market participants:
• Can operate in RTM w/o PTRs/schedules
• Face price risk from non-CSF congestion

PTRs become partial, illiquid FTRs
OR – Is the RTM Closed/Inefficient?

To make PTRs truly “physical”, the RTO must:
- Not use/release unscheduled PTR capacity
- Penalize imbalances (i.e., not price at LMP)

Such a limited RTM:
- Allows hoarding and underutilizes the grid
- Makes it very risky to serve retail load
- Requires the RTO to socialize large costs

*Defining details will clarify RealFlow’s dilemma but will not resolve it*
A RTM Based on LMPs/FTRs

IF the RTM prices ALL congestion at LMPs:
• FTRs (as obligations or options) will be needed to hedge non-CSF congestion
• Spot trading at LMPs can be open to all

THEN a RealFlow forward market can be:
• Consistent with reliable/efficient operations
• Operated by market makers, not the RTO

*If RealFlow is not proposing this, why not – and what is it proposing?*
How Easy/Liquid Will PTRs Really Be?

Converting an A-to-B right into PTRs requires:

- PTRs = k*PTDF$_{X-Y}$ for every CSF X-Y
- New set of PTRs when PTDFs/ CSFs change

Each energy deal needs a unique set of PTRs

- Maybe (many) dozens of different PTRs
- None can be missed if required for scheduling

Unscheduled PTRs are worthless, making it risky:

- To hold PTR inventories to make a market
- To hedge multiple positions for contingencies
Model 1: A Competitive PTR “Bazaar”

Many market makers hold/price PTR inventories
- Traders shop for individual PTRs for each deal they are thinking about doing
- PTR/Energy market(s) clear every hour

But how likely or efficient would this be when:
- Each energy deal needs a specific mix of many PTRs and deals must be compared?
- Unused inventory is worthless and unavailable for scheduling?

This is unlikely – even with “few” PTRs
Model 2: Centralized Trading of PTRs

Even proponents doubt the PTR Bazaar model

• Trading will “be automated such that [PTRs] can be sold as ‘packages’ … for common [location-to-location] transactions” [TCA, p. 9]

• Trading is “in an exchange using simultaneous multiple-round auctions” (like the FCC’s spectrum auctions) [CPOW, p. 16]

This is more logical and plausible – but is hardly the decentralized, competitive market-making implied by RealFlow
Summary on Trading of PTRs/Energy

The claim that PTRs will be “highly liquid”
- Has no basis in analysis or experience
- Is implausible, given the nature of PTRs

If the RTM is an efficient LMP market, PTRs:
- Become (inferior versions of) FTRs/hedges
- Can be combined into point-to-point hedges

If RTM is inefficient to make PTRs “physical”:
- Trading will be costly and inefficient
- System operations will be affected
What Can Make Prices/Trading “Certain”?  

If the RTO’s RTM prices ALL congestion at LMP:
  • Forward trading of PTRs will leave RTM risk
  • Traders will demand/deserve FTRs

If RealFlow gives more price certainty than a well-designed LMP/FTR system:
  • The RTO must NOT price all congestion
  • Costs ignored by market must be socialized

*Is RealFlow LMP/FTRs + Frwd Mkt?*

*Or is it a way to socialize cost/risks?*
Conclusions About RealFlow

The critical assumption that there can be both:

Few CSFs with fixed PTRs/PTDFs
AND
Little non-CSF congestion

has no logical or factual basis – just the opposite

Thus, RealFlow must choose between:

Pricing all congestion in the RTM, so that
PTRs become partial, illiquid hedges
OR
Leaving much congestion unpriced, forcing
the RTO to manage it and socialize its costs
The Logical Solution for RealFlow

True believers in decentralized markets should:
- Insist that the RTO stay out of forward markets
- Develop markets based on the RTO’s RTM

Simplified trading can be offered by:
- Creating area-to-area FTRs backed by point-to-point FTRs or by taking basis risk
- Making/Losing money depending on the ability to project outcomes and manage risks

This is clearly a job for private market makers, not for the RTO.
The Logical Solution for the RTO

Commonsense (and FERC) say the RTO should:
• Use markets to manage congestion
• Not socialize costs any more than necessary

This implies that the RTO must:
• Operate an LMP-based RTM (perhaps with a day/hour-ahead forward market)
• Provide FTRs to hedge RTM congestion

The RTO should use its RTM to manage reliability efficiently and leave (most) forward markets to others