ETA Workshop 2.2

Imbalance Settlement

Imbalance Settlement

- Imbalance Settlement must ensure that participants pay and get paid the correct amounts for electricity volumes that they consume and produce

- Balance Responsibility in I-SEM
  - Generator and Supplier units are subject to imbalance settlement

- Imbalance Settlement = (Total Metered Energy – Total Contracted Energy) * Imbalance Price

- Single marginal Imbalance Price

- Building Blocks – proposed settlement for non-energy actions
  - A unit that is 'constrained down' due to a dispatch instruction pays back the lower of its decremental offer price or the imbalance price
  - A unit that is 'constrained up' due to a dispatch instruction receives the higher of its incremental offer price or the imbalance price

- The amount a generator gets paid is then not affected by TSO classifications
- A generator is never financially worse off for having solved a constraint

Notation and Definitions for Cash Flow Algebra

Notation	Definition
C	Cashflow
P_{CON}	Ex-ante contracted price
Q_{CON}	Ex-ante contracted quantity
P_{IMB}	Energy imbalance price
Q_{DQ}	Dispatch quantity
P_{BO}	Balancing order price
Q_{FAQ}	Firm access quantity
Q_{FPN}	Final Physical Notification quantity

Settlement – Up Regulation
Physical Notification = Ex-ante Contract

- $C = P_{CON}.Q_{CON}$
  $+ P_{IMB}.(Q_{DQ} - Q_{CON})$
  $+ \max(P_{BO} – P_{IMB}, 0) . \max(Q_{DQ} - Q_{CON}, 0)$

- <u>Unit Dispatched up for Energy</u>
- Cashflow = Revenue from ex-ante trades
  + Imbalance Price * Dispatch Up Volume (Energy)

<u>Unit Dispatched up for Non-Energy</u>

Cashflow = Revenue from ex-ante trades
+ Imbalance Price * Dispatch Up Volume (Non-Energy)
+ Premium of Inc Price over Imbalance Price * Dispatch Volume Up (Non-Energy)

Settlement – Down Regulation
Physical Notification = Ex-ante Contract

- $C = P_{CON}.Q_{CON}$
  $+ P_{IMB}.(Q_{DQ} - Q_{CON})$
  $+ \min(P_{BO} - P_{IMB}, 0) \,.\, \min(Q_{DQ} - \min(Q_{FAQ}, Q_{CON}), 0)$

- Unit Dispatched down for Energy
- Cashflow = Revenue from ex-ante trades
  - Imbalance Price * Dispatch Down Volume (Energy)

Unit Dispatched down for Non-Energy

Cashflow = Revenue from ex-ante trades
- Imbalance Price * Dispatch Down Volume (Non-Energy)
+ Discount of Dec Price under Imbalance Price * Firm Dispatch Down Volume (Non-Energy)

Settlement – Up Regulation
Physical Notification ≠ Ex-ante Contract

- $C = P_{CON}.Q_{CON}$
  - $+ P_{IMB}.(Q_{DQ} - Q_{CON})$
  - $+ \max(P_{BO} - P_{IMB}, 0) . \max(Q_{DQ} - Q_{FPN}, 0)$

- <u>Unit Dispatched up for Energy</u>
- Cashflow = Revenue from ex-ante trades
  + Imbalance Price * (Dispatch Quantity over Ex-ante Quantity)

<u>Unit Dispatched up for Non-Energy</u>

Cashflow = Revenue from ex-ante trades
+ Imbalance Price * (Dispatch Quantity over Ex-ante Quantity)
+ Premium of Inc Price over Imbalance Price *
(Dispatch Quantity over FPN)

Settlement – Down Regulation
Physical Notification ≠ Ex-ante Contract

- $C = P_{CON}.Q_{CON}$
  - $+ P_{IMB}.(Q_{DQ} - Q_{CON})$
  - $+ \min(P_{BO} - P_{IMB}, 0) . \min(Q_{DQ} - \min(Q_{FAQ}, Q_{FPN}, Q_{CON}), 0)$

- Unit Dispatched down for Energy
- Cashflow = Revenue from ex-ante trades
  - Imbalance Price * (Dispatch Quantity under Ex-ante Quantity)

Unit Dispatched down for Non-Energy

Cashflow = Revenue from ex-ante trades
- Imbalance Price * (Dispatch Quantity under Ex-ante Quantity)
+ Discount of Dec Price under Imbalance Price *
lesser firm volume of (Dispatch Quantity under FPN) and (Dispatch Quantity under Ex-ante Quantity)

Numerical Examples (1)

- Unit sells 250MWh in the ex-ante markets @ 50 €/MWh
- Submits FPN of 270MWh and Inc Offer to BM of 50MWh @ 60 €/MWh
- TSO activates this Inc Offer for non-energy action by dispatching unit at 320MWh
- The Imbalance price clears @ 45 €/MWh

Unit Dispatched up for Non-Energy

Cashflow = Revenue from ex-ante trades
+ Imbalance Price * (Dispatch Quantity over Ex-ante Quantity)
+ Premium of Inc Price over Imbalance Price *
(Dispatch Quantity over FPN)

Direct from Algebra:

1) 250MWh @ 50 €/MWh
2) 70MWh @ 45 €/MWh
3) 50 MWh @ 15 €/MWh

= 12,500 + 3,150 + 750 = €16,400

Alternative Breakdown:

1) 250MWh @ 50 €/MWh (Ex-ante trades)
2) 20MWh @ 45 €/MWh (Imbalance)
3) 50 MWh @ 60 €/MWh (Activated Inc)

= 12,500 + 900 + 3,000 = €16,400

Numerical Examples (2)

- Unit sells 250MWh in the ex-ante markets @ 50 €/MWh (FAQ = 600MW)
- Submits FPN of 270MWh and Dec Bid to BM of 100MWh @ 45 €/MWh
- TSO activates this Dec Bid for non-energy action by dispatching unit at 170MWh
- The Imbalance price clears @ 70 €/MWh

Unit Dispatched down for Non-Energy
Cashflow = Revenue from ex-ante trades
- Imbalance Price * (Dispatch Quantity under Ex-ante Quantity)
+ Discount of Dec Price under Imbalance Price *
lesser firm volume of (Dispatch Quantity under FPN) and (Dispatch Quantity under Ex-ante Quantity)

Direct from Algebra:
1) 250MWh @ 50 €/MWh
2) minus 80MWh @ 70 €/MWh
3) 80 MWh @ 25 €/MWh
= 12,500 – 5,600 + 2,000 = €8,900

Alternative Breakdown:
1) 250MWh @ 50 €/MWh (Ex-ante trades)
2) minus 80MWh @ 45 €/MWh (Activated Dec)
= 12,500 – 3,600 = €8,900

Numerical Examples (3)

- Unit sells 250MWh in the ex-ante markets @ 50 €/MWh (FAQ = 600MW)
- Submits FPN of 230MWh and Dec Bid to BM of 100MWh @ 30 €/MWh
- TSO activates this Dec Bid for non-energy action by dispatching unit at 130MWh
- The Imbalance price clears @ 40 €/MWh

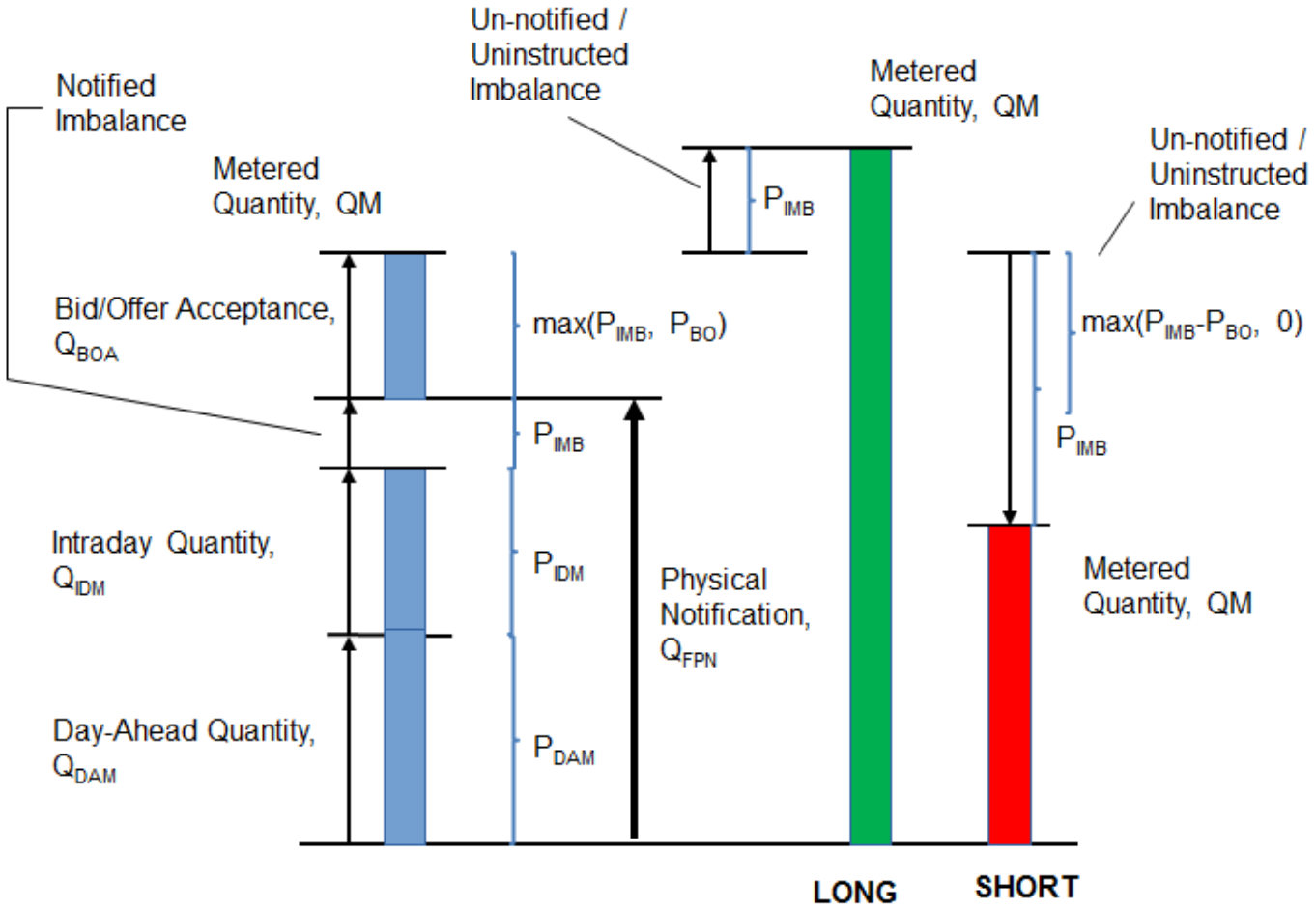
Unit Dispatched down for Non-Energy
Cashflow = Revenue from ex-ante trades
- Imbalance Price * (Dispatch Quantity under Ex-ante Quantity)
+ Discount of Dec Price under Imbalance Price *
lesser firm volume of (Dispatch Quantity under FPN) and (Dispatch Quantity under Ex-ante Quantity)

Direct from Algebra:
1) 250MWh @ 50 €/MWh
2) minus 120MWh @ 40 €/MWh
3) 100 MWh @ 10 €/MWh
= 12,500 – 4,800 + 1,000 = €8,700

Alternative Breakdown:
1) 250MWh @ 50 €/MWh (Ex-ante trades)
2) minus 100MWh @ 30 €/MWh (Activated Dec)
3) minus 20MWh @ 40 €/MWh (Imbalance)
= 12,500 – 3,000 – 800 = €8,700

Dispatch Quantity vs Metered Generation

- Un-notified / Uninstructed Imbalances
- Non-Delivery Rule



Imbalance Settlement Discussion