Flow-based Market Coupling (FMC)

A Joint ETSO-EuroPEX Proposal for Cross-Border Congestion Management and Integration of Electricity Markets in Europe
Origins of FMC

Flow-based market coupling

ETSO-EuroPEX JWG

Flow-based modelling
ETSO

Market coupling
EuroPEX
Flow-based modelling

- All modelled electrical flow paths taken into account, not just ‘contract path’
- Maximises use of inter-regional transmission capacity
Market coupling

- Efficient trading between regional markets via power exchanges
- Maximises inter-regional market efficiency
Why Market Coupling?

- A form of implicit auction similar to market splitting, with similar advantages:
  - Removes unnecessary risks of trading short-term capacity and energy separately
  - Encourages liquid, robust spot markets - promoting indices and derivative markets
  - Enables netting of schedules
  - Allows all spot market participants to benefit from cross-border access
  - Provides a transparent, rule-based, auditable methodology

- Market coupling links together separate markets in a region, whereas market splitting divides a regional market into price zones
  - Price differences minimised, convergence if sufficient capacity
  - Efficient use of interconnector capacity
Market Coupling

Import/export Curves

Impact on area price of imports to/exports from each individual area

Calculated in each area based on local area energy bids/offers

Isolated price A

Isolated price B

Area A

Area B
Market Coupling

Exports from A equivalent to imports to B
Market Coupling

Unconstrained Case

- Enough transmission capacity
- Area prices converge
- Bilaterals pay zero for capacity

Area A

Area B

Area A price = Area B price

Available transmission capacity

Imports to B/Exports from A

Exports from B/Imports to A

Area Prices
Market Coupling

Constrained Case

Limited transmission capacity

Area prices converge, but difference remains

\[ \text{Price diff} \times \text{volume} = \text{congestion revenue} \]

Bilaterals pay same price difference for capacity

Area A price > Area B price

Available transmission capacity

Imports to B/Exports from A

Exports from B/Imports to A

Area Prices

Area A

Area B
FMC day-ahead market

Regional markets

Import/export & price difference schedules

Import/export curves

Regional price bids/offers

Inter-regional price-difference bids/offers

Schedules & prices
Settlement

Transmission model
Why a Decentralised Approach?

- Minimizes the degree of standardization/centralization required
  - Avoids change to local procedures and arrangements
  - Minimizes governance complexity
- Supports local market variations
  - Compatible with financial and physical hedging instruments
  - Can combine explicit auctions and implicit auctions
  - Maintain local products (e.g., block bids) to suit local needs
- Builds on existing trading arrangements
  - PX membership: credit, settlement, trader interface
  - Trading patterns: indices, OTC/bilateral flexibility
- Can evolve over time, step by step – e.g., geographic scope and methodology
FMC builds on existing arrangements

- Grid access
- Ancillary services
- System security and balancing
- Notification and imbalance settlement*
- Regulate monopolies
- Promote competition
- Trader screen/interface
- Matching
- Settlement and credit
- Information/indices
- Audit, dispute resolution, and market surveillance

* responsibility of the PX in some countries
New requirements for FMC: inter-TSO coordination

Inter-TSO arrangements
- Calculate bottleneck capacities and flow factors
- Co-ordinated actions to ensure firmness
New requirements for FMC: inter-PX coordination

Inter-PX arrangements
- Calculate cross border flows, including operations, audit and dispute resolution
- Settle and notify Price Difference contracts
New requirements for FMC: inter-Regulator coordination

Inter-Regulator arrangements
- Regulation of FMC (e.g., rules, market surveillance, information)
- Splitting of aggregate congestion revenues
New requirements for FMC: TSO - PX coordination

TSO-PX arrangements

- TSOs: provide firm capacities and flow factors
- PXs: calculate aggregate schedules; collect and return congestion revenue
- TSOs: accept aggregate schedule and congestion revenue
TSO support for the markets

- Transmission model (essential)

- Firmness of cross-border commercial exchanges (essential)

- Allocation of transmission rights (optional for FMC)
Operational transmission model

Electrical node

Electrical circuit
Simplified transmission model for FMC

Bottleneck

Single price area
Transmission model (1)

- **Linearisation**
  - based on reference state with given generation, load and switching patterns
  - model consists of relationships between variations from the reference state

- **Flow factors**
  - FF matrix links variations in physical bottleneck flows to variations in area balances (i.e. sum of commercial exchanges)

- **Bottleneck capacities**
  - BCs are operational limits on variations in physical bottleneck flows
  - *not* the same as current NTCs
Transmission model (2)

- Bottleneck capacities and flow factors depend on the generation pattern, loads and network switching assumed in the reference state.

- The ‘chicken and egg’ problem:
  - The generation pattern is required to determine the parameters of the transmission model...
  - But the transmission model is needed for the trading that determines the generation pattern!

- ... but less severe than with NTC modelling.

- Transparency:
  - Publication of methods and results.
Firmness of cross-border commercial exchanges

- TSO action (e.g. re-dispatch, counter-trade) will be necessary to deal with:
  - ‘internal’ constraints
  - transmission model simplifications
  - the ‘chicken and egg’ problem
  - prediction uncertainties
  - production/consumption imbalances
  - production/consumption/transmission failures

- Costs of TSO action
  - socialised/targeted recovery
  - possible use of congestion income
  - allocation between intra-area and inter-area users
Allocation of cross-border transmission rights

- Transmission rights can be allocated by explicit auction before the FMC implicit market
- Availability of rights may be needed to enable users to manage transmission access price risk
- Physical or financial
  - nearly equivalent, differences depend on implementation details and market maturity
- Options
  - day-ahead notification to TSOs transforms options into firm obligations
Regulatory/contractual arrangements

- Power exchanges’ ‘institutional’ role needs to be designated and held accountable to Regulator or TSO (some already are)

- Harmonisation is needed for inter-regional transmission modelling, data transfer, publishing formats, etc.

- General structure and content of regulatory/contractual arrangements has been identified
Benefits of FMC

Congestion management
- Flow-based approach and netting of schedules
  maximises use of inter-regional transmission network

Market efficiency
- Integrating transmission access and energy trading
  eliminates unnecessary pricing risk and concentrates
  liquidity
- Inherent cross-border access for all market participants
- Variety of trading options: bilateral/exchange, blocks

Feasibility
- Builds on existing trading infrastructure and liquidity
- Can evolve over time
Development issues

- Technical development
  - market coupling mechanism
  - transmission model
  - TSO actions to ensure firmness of cross-border commercial exchanges
- Regulatory and contractual matters
- Compatible Regional development
Current regional initiatives

- Iberia (Spain, Portugal, Morocco)
- Spain – France
- France – Belgium – Holland
- Holland – Norway
- Denmark – Germany
- ex-Yugoslavian countries