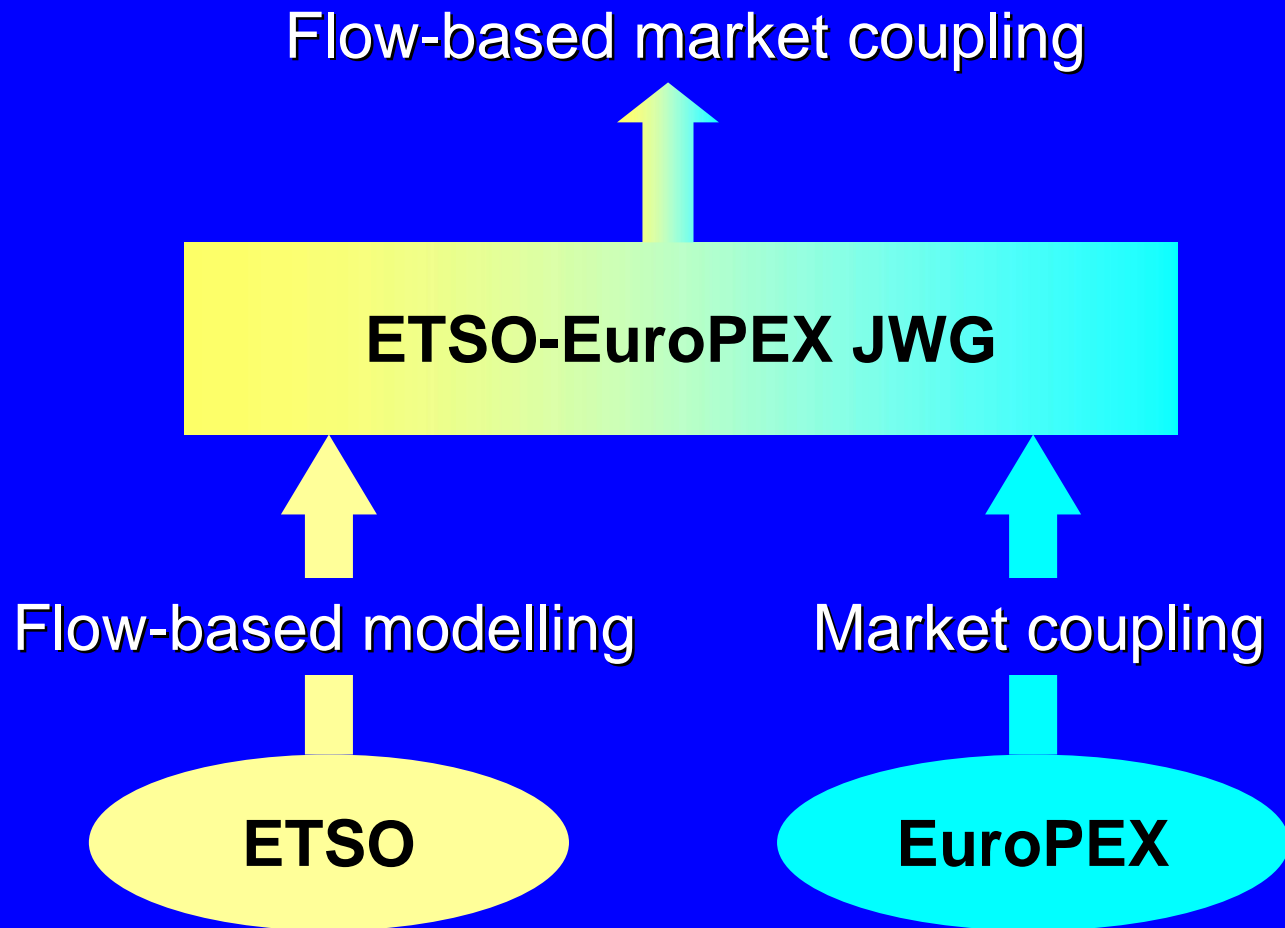


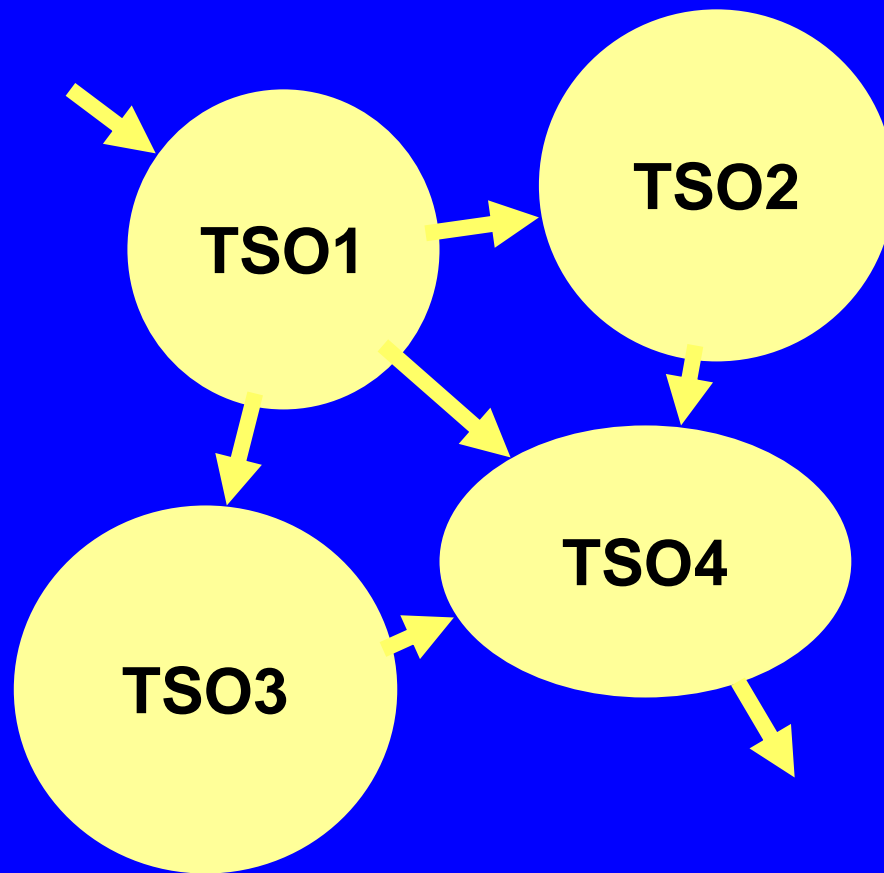
Flow-based Market Coupling (FMC)

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

Origins of FMC

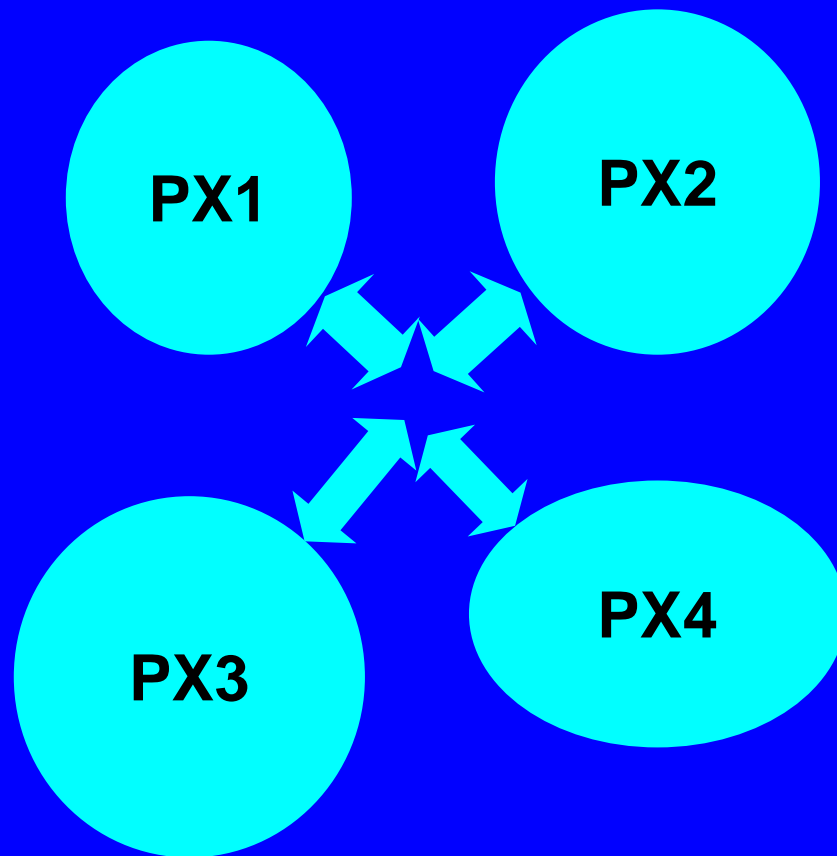


Flow-based modelling



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

Market coupling

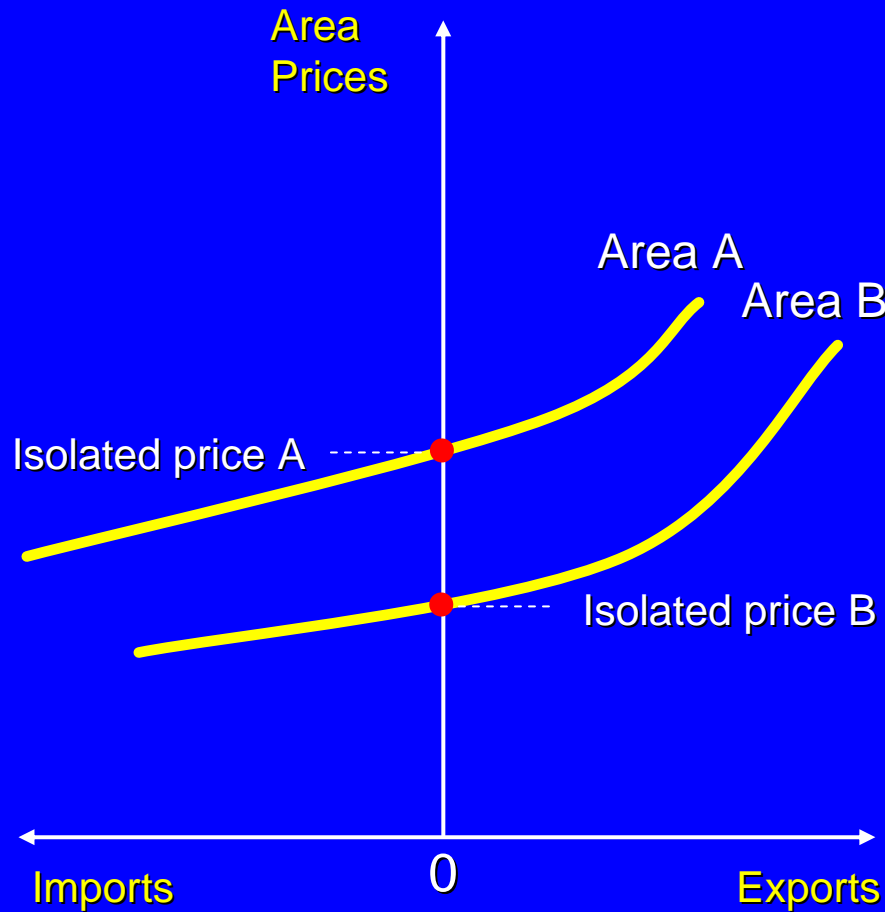


- Efficient trading between regional markets via power exchanges
- Maximises inter-regional market efficiency

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

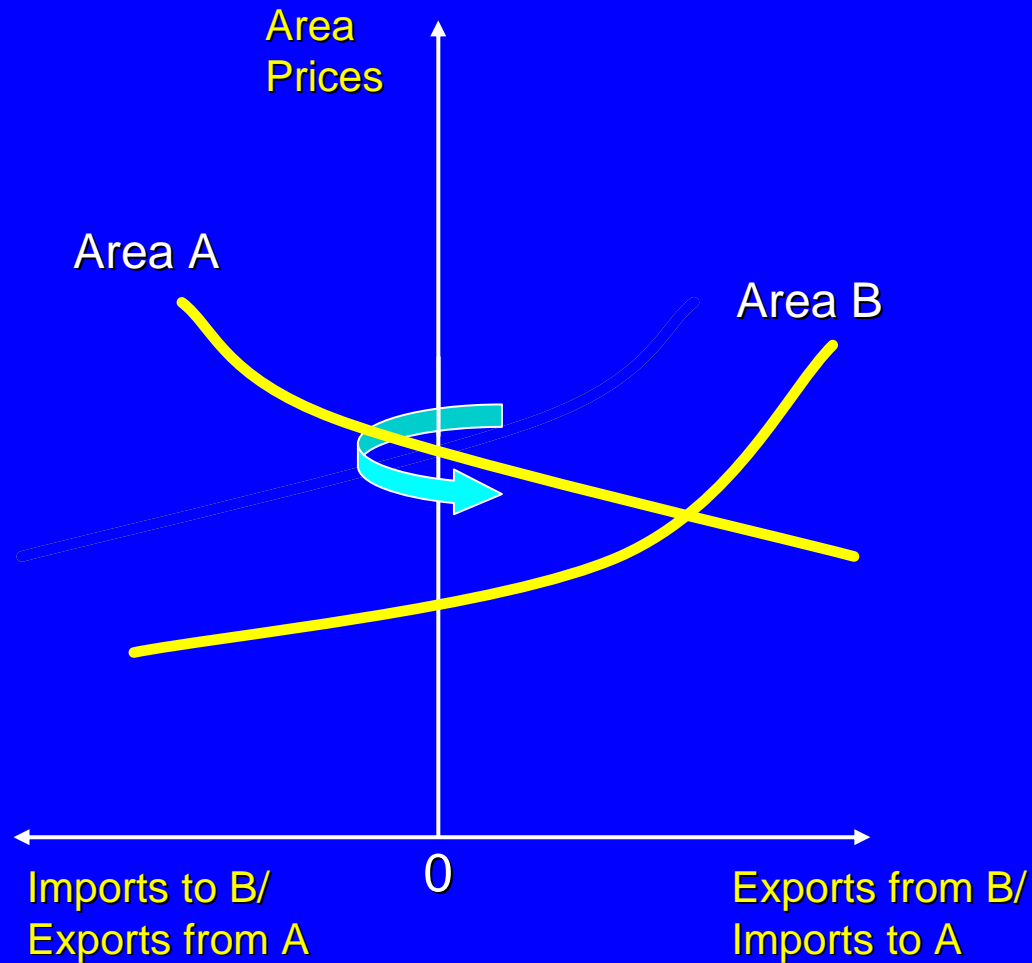


Import/export Curves

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

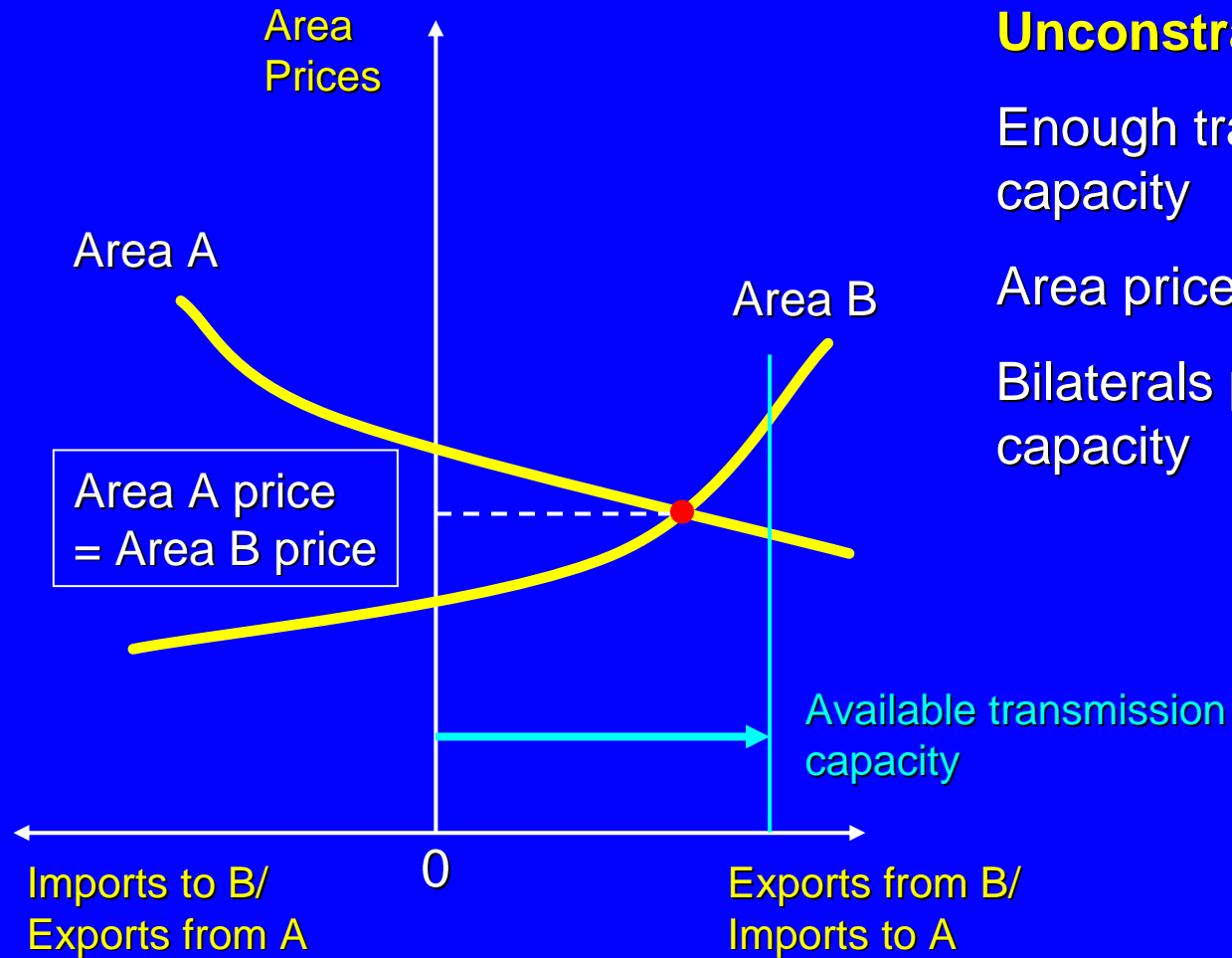
Calculated in each area based on local area energy bids/offers

Market Coupling



Exports from A
equivalent to
imports to B

Market Coupling



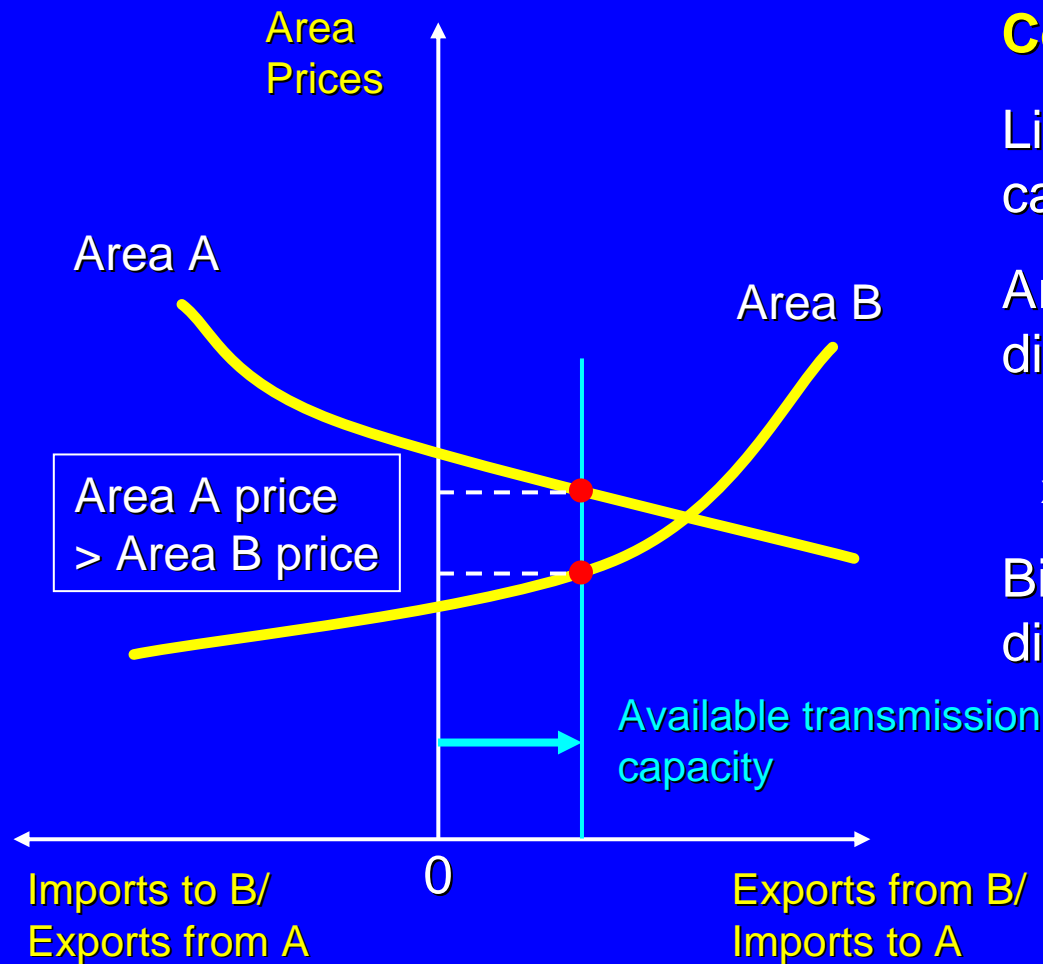
Unconstrained Case

Enough transmission capacity

Area prices converge

Bilaterals pay zero for capacity

Market Coupling



Constrained Case

Limited transmission capacity

Area prices converge, but difference remains

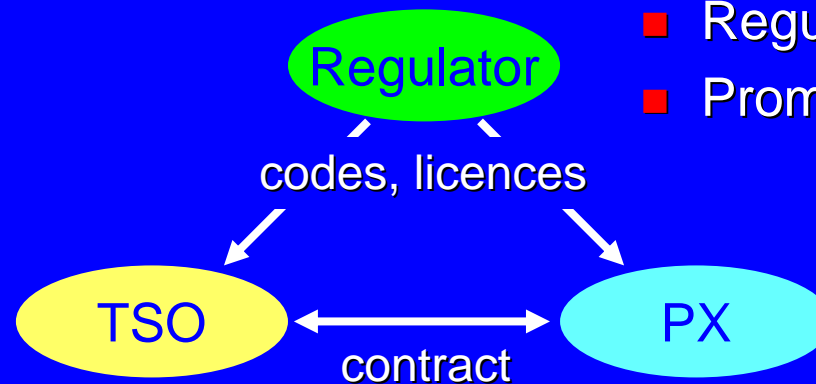
$$\text{Price diff} \times \text{volume} = \text{congestion revenue}$$

Bilaterals pay same price difference for capacity

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



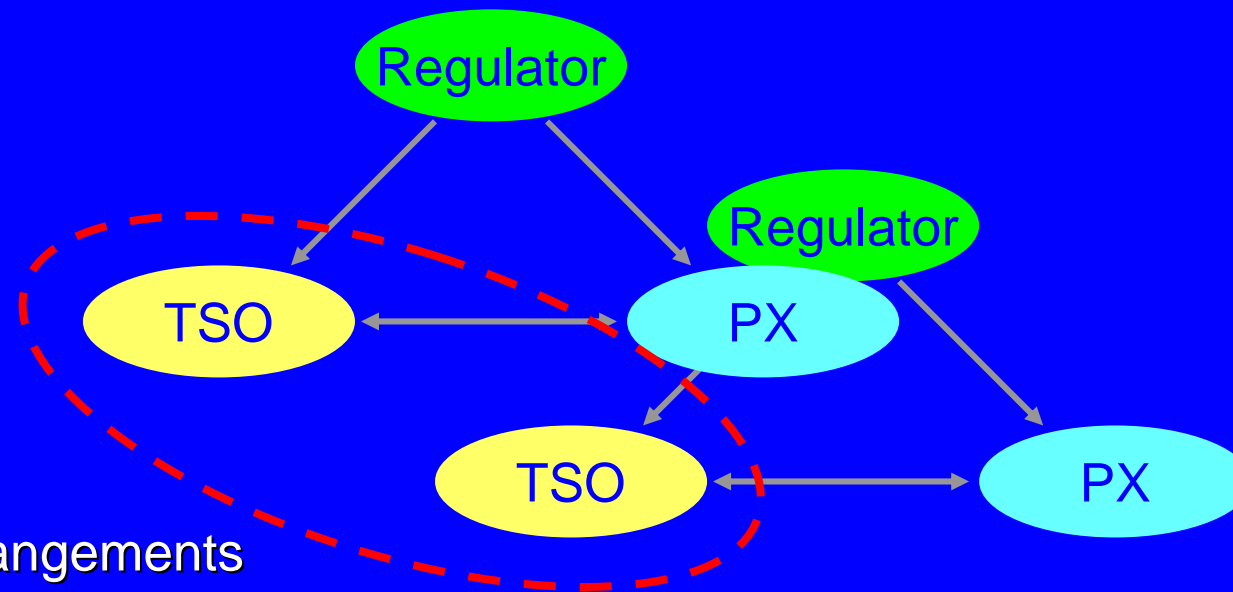
- Regulate monopolies
- Promote competition

- Grid access
- Ancillary services
- System security and balancing
- Notification and imbalance settlement*

- Trader screen/interface
- Matching
- Settlement and credit
- Information/indices
- Audit, dispute resolution, and market surveillance

* responsibility of the PX in some countries

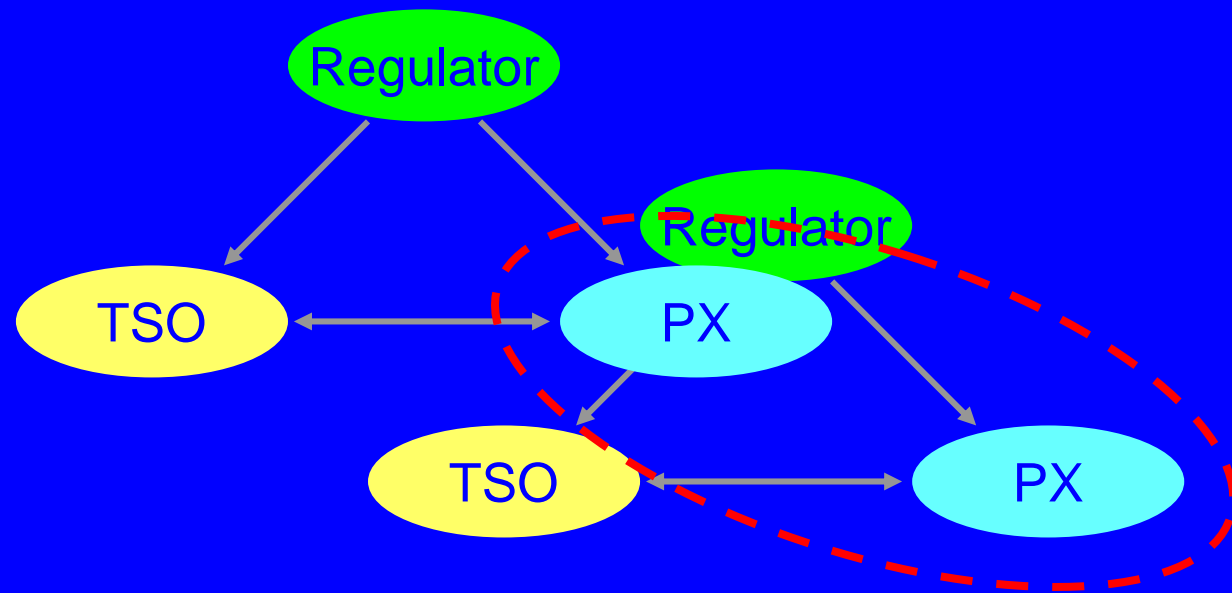
New requirements for FMC: inter-TSO coordination



Inter-TSO arrangements

- Calculate bottleneck capacities and flow factors
- Co-ordinated actions to ensure firmness

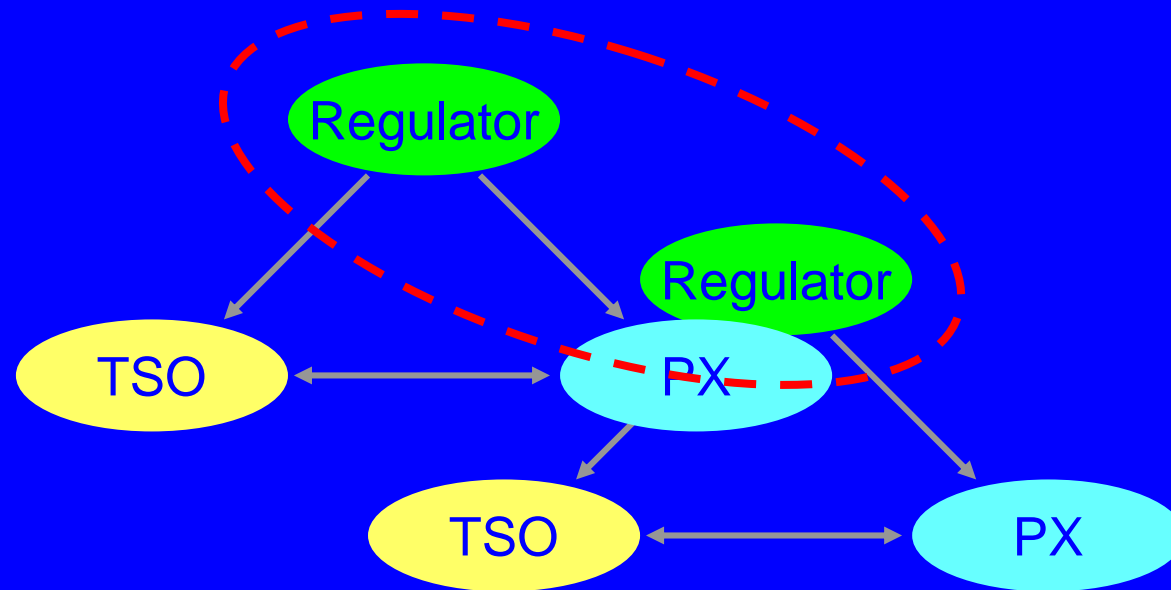
New requirements for FMC: inter-PX coordination



Inter-PX arrangements

- Calculate cross border flows, including operations, audit and dispute resolution
- Settle and notify Price Difference contracts

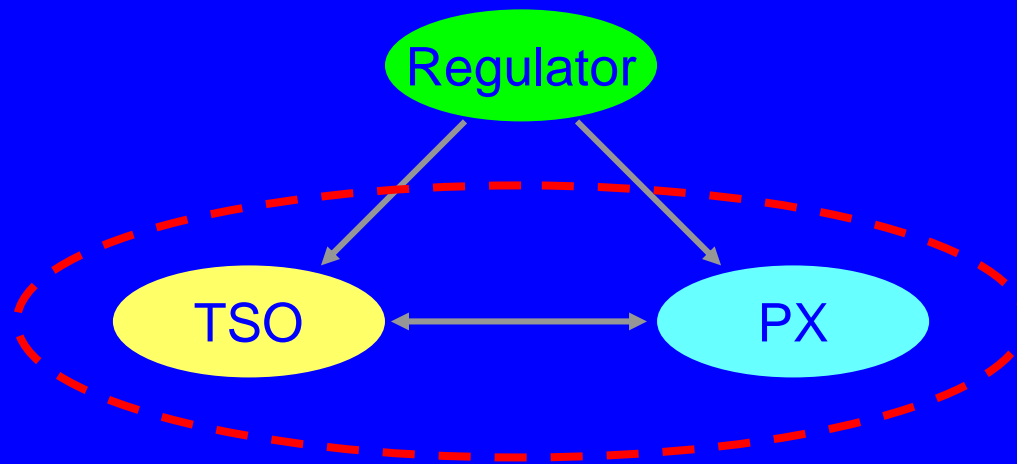
New requirements for FMC: inter-Regulator coordination



Inter-Regulator arrangements

- Regulation of FMC (e.g., rules, market surveillance, information)
- Splitting of aggregate congestion revenues

New requirements for FMC: TSO - PX coordination



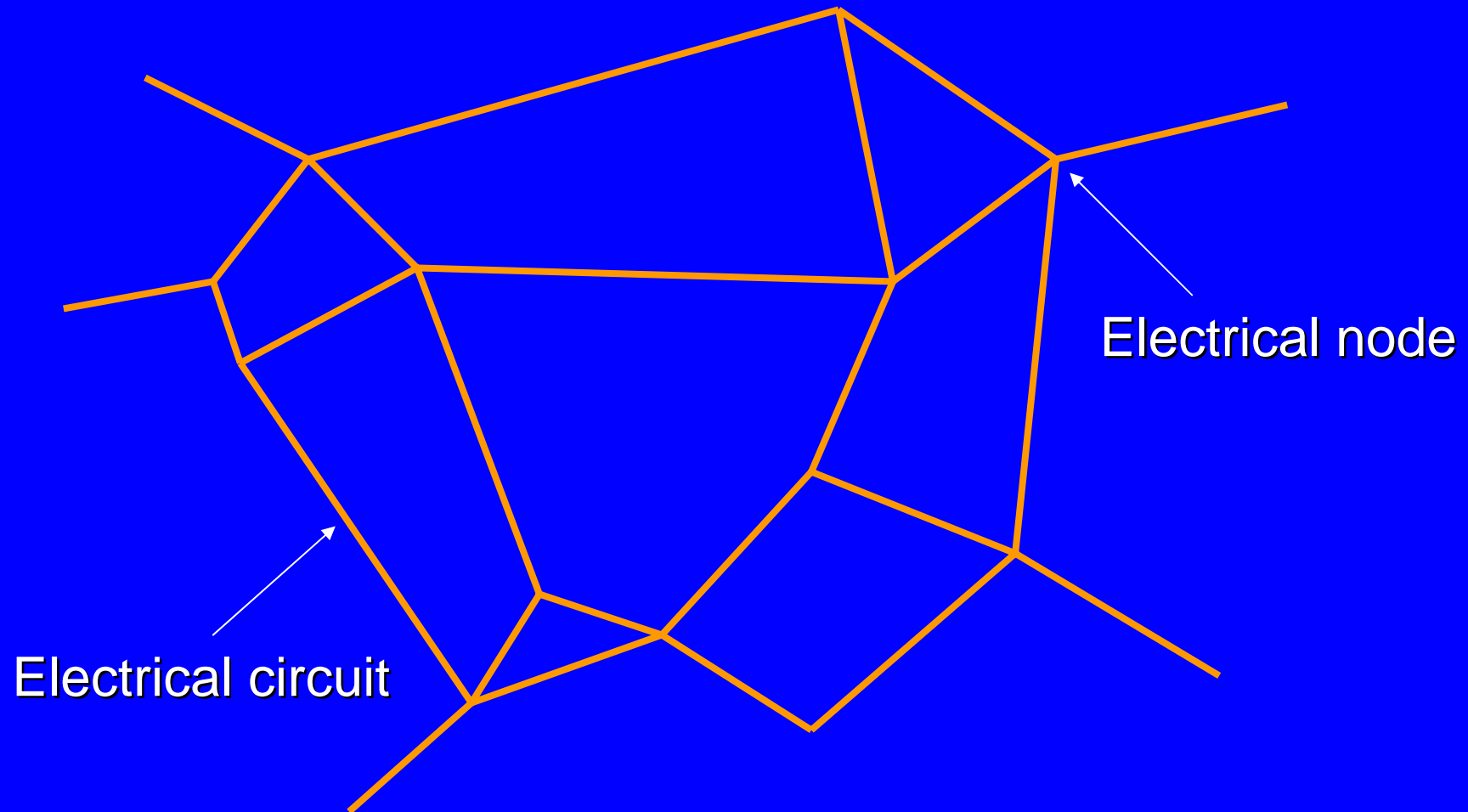
TSO-PX arrangements

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

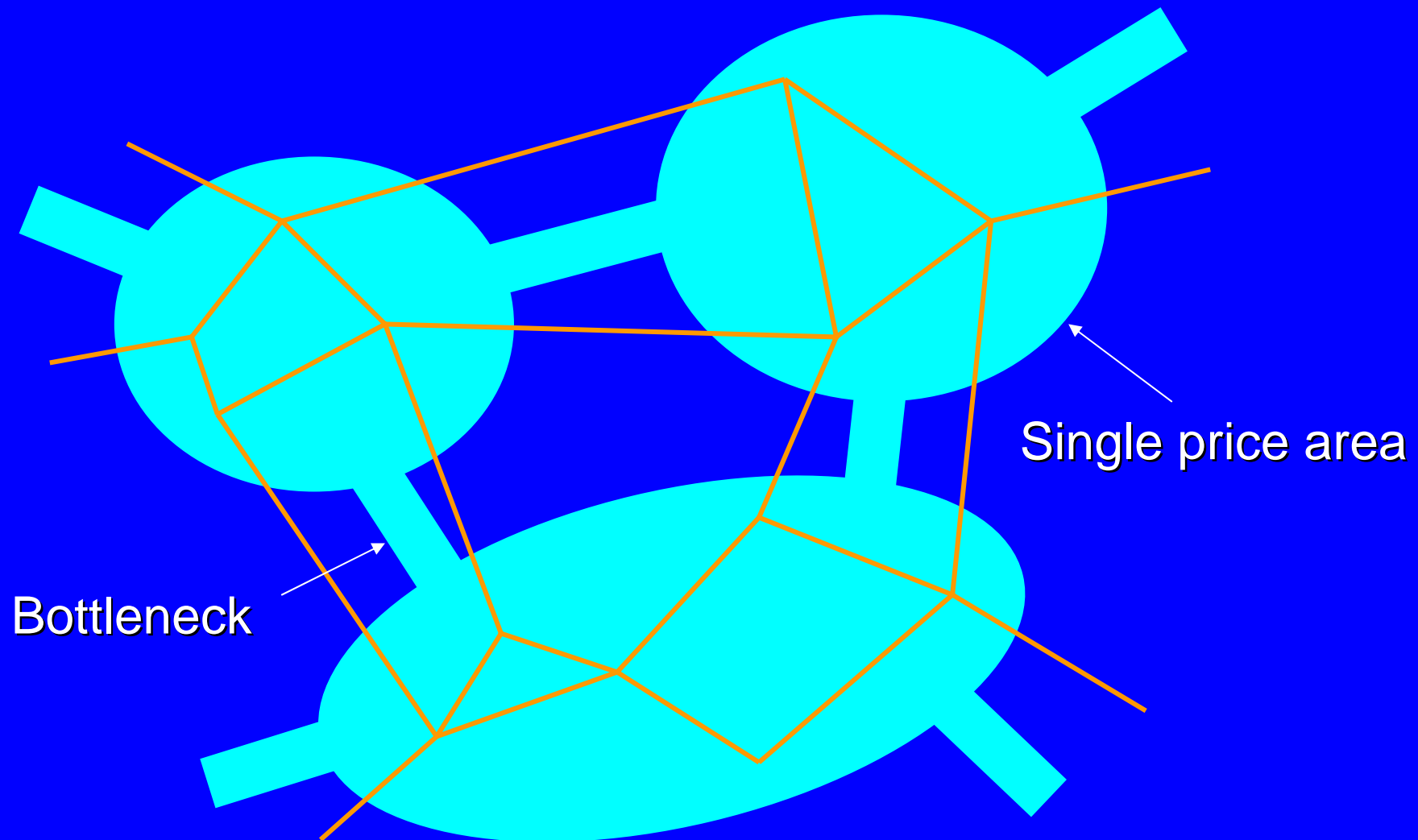
TSO support for the markets

- Transmission model (**essential**)
- Firmness of cross-border commercial exchanges (**essential**)
- Allocation of transmission rights (**optional for FMC**)

Operational transmission model



Simplified transmission model for FMC



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