Available Transmission Capacity

PAEM Committees (TSO & ARC)

14 May 2024

Andrew Claxton

External Expert, Energy Department, League of Arab States

Introduction

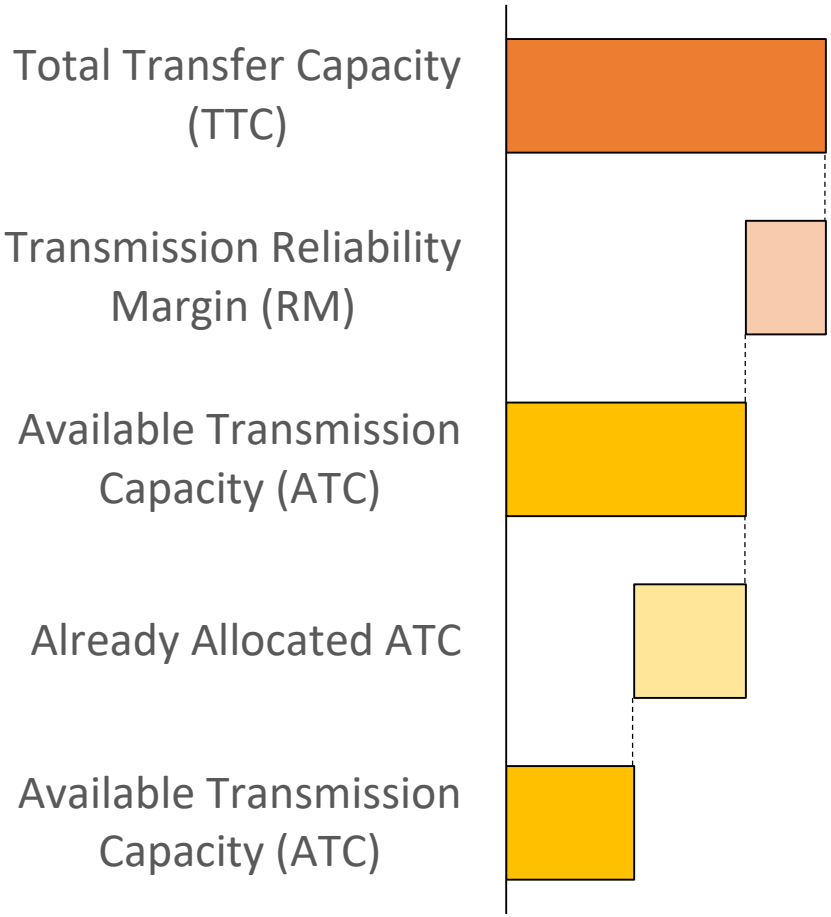
PAEM target model is a *multilateral market*

- All qualified parties in a connected region able to trade with each other
- Trade is no longer restricted to adjacent countries
- Requires fair, non-discriminatory access to cross-border transmission capacity

Available Transmission Capacity (ATC) is the cross-border transfer capacity available for trade between two interconnected areas at any point in time. There are three particular considerations:

1. How ATC is determined
2. How ATC is allocated to particular trades (critical when demand for cross-border capacity exceeds the ATC: constrained/congestion)
3. Use of revenue arising from cross-border flows

1. ATC – simple border



- Maximum technical capacity between two areas
- Adjustment to take into account the technical uncertainties of future network conditions
- Gross ATC available for trade
- Cross-border capacity already allocated to trades in a prior process – e.g., pre-existing trades/commitments; forward trades
- Cross-border capacity available to new trades

1. Determining ATC – simple border

- Typically, NTC is determined independently by the two TSOs on the border, and the lower value is used. Important considerations:
  - Resolution of the ATC determination: potentially down to hourly
  - Timing of the calculation: long-term calculation (e.g., year ahead); revisions closer to real time
- Potential incentive on TSOs to overstate the Reliability Margin to reduce costs of handling internal constraints and uncertainty
  - Potentially ARC could consider whether an NTC calculation is reasonable (but likely to be a difficult challenge to manage without a strong multinational framework)
  - Not an issue until trade develops and there is pressure to increase the NTCs
- "Already Allocated ATC" could include capacity allocated to pre-existing contracts/commitments (so only the residual ATC is available to the market)

1. ATC – meshed grids

"Loop flows" are a particular problem in meshed grids

- Loop flows are inadvertent flows across parallel paths in a meshed grid (following Kirchhoff's laws). They can have a significant (and often hard to predict) impact on the NTC on a particular border. In effect, the physical flow on the border between areas A and B is impacted by trades between other areas, not just A-B
- Has driven the development of more complex regional solutions:
  - Europe: "flow-based" allocation between market zones (typically countries)
  - US: Locational Marginal Pricing, involving nodal prices
- Fortunately, the Pan Arab grid is largely linear or radial, and loop flows are not likely to be a critical issue
  - Assumed model in PAEM is, therefore, border-specific capacity allocation
  - Unpredictable loop flows can be avoided on the meshed KSA-Egypt-Jordan-KSA grid because the need to convert frequency enables the flows to be controlled (as for an HVDC link)

2. Cross-border capacity allocation

If there are multiple parties wishing to flow across a particular border, a mechanism may be needed to allocate the cross-border transmission capacity between them

Constrained Scenario	Unconstrained Scenario
Demand for cross-border transmission capacity greater than the ATC	*Demand for cross-border transmission capacity less than the ATC*
Allocation mechanism required; not all trades can be fully satisfied	All trades can be fully satisfied

2. Cross-border capacity allocation mechanisms

First-come, first-served (FCFS)	Allocation based on the order in which the requests were received by TSO – i.e., a queuing model. All requests for capacity are met in full until the ATC is used up	Simplest approach, but risk of abuse Adequate if constraints are very rare
Pro rata	TSOs set a deadline for capacity requests and, if demand exceeds availability, apply a pro rata rule curtailing all requests by the same proportion	Preferred alternative to FCFS if constraints are very rare
Explicit auctions	Transmission capacity rights auctioned by the TSO to the highest bidder. Winning bidders pay the same auction-clearing price for the capacity acquired.	Recommended approach if constraints are likely (approach adopted by GCCIA)
Implicit auctions	Transmission capacity is allocated via simultaneous energy auctions in the countries on either side. Energy and capacity trading is integrated. This is also called market coupling, and is the basis for the European day ahead market	More complex arrangement requiring regional energy auction (MedTSO proposal for Maghreb)

Explicit auctions

- Parties undertaking a cross-border trade need to secure the necessary cross-border transmission capacity in the explicit auction operated by TSOs
- Either trading party (buyer or seller) could acquire the rights and undertake the cross-border *shipping* role (responsibility for nominating the export volume from one country and the import volume into the other)
- Auctions can be run for various timeframes (annual, monthly, day ahead); depends on what the market needs
- TSOs typically sell "transmission rights" that entitle (but don't normally oblige) the owner to nominate a cross-border flow. But parties must confirm intended flow by a deadline set by the TSO ("use-it-or-lose-it") – normally before next auction so that unused capacity can be re-offered
- Only likely to sell at a price above zero if capacity is constrained

Explicit Allocation - Multiple Borders

In a region with several borders there is the option of a regional allocation mechanism

Separate border mechanism	Regional mechanism
Discrete explicit auction mechanism for each border *Responsibility of the TSOs on the border (could use an independent service provider)*	*Regional auction mechanism serving several borders simultaneously* *Joint responsibility of all TSOs in the region*
+ Simple to set up and operate - Complex and risky to secure capacity for trades crossing several borders - Trading parties need to deal with several platforms (nominations, payments, etc)	+ Possible to secure capacity on multiple borders at the same time + Trading parties need to deal with only one platform (nominations, payments, etc) - More complex to set up and operate

Capacity allocation – Other considerations

- Mechanisms need to be efficient and transparent – e.g.:
  - Publishing ATCs in good time on readily accessible platform
  - Providing easy access for qualified parties to obtain transmission rights (with rapid confirmation)
  - Facilitating nomination of committed flows by parties
  - Invoicing and settlement
- Clear terms/rules are needed – e.g.: firmness/compensation for capacity curtailment by TSO; use-it-or-lose-it/use-it-or-sell-it rights
- Procedures are needed to manage anti-competitive or discriminatory behaviour, such as hoarding of capacity (to block others from using it) and then not using it, or requesting inflated volumes to distort pro rata share (international experience on best practice likely to be useful)

Implicit auctions

In Europe, day ahead transmission capacity is instead sold via *implicit auctions* (also called *market coupling*)

- Capacity allocated via an integrated energy auction across the region
- Requires day ahead auctions for energy in each of the coupled markets and a single matching algorithm seeking to maximise economic surplus consistent with the energy offers/bids and the available transmission capacity
- Facilitates efficient market pricing/price discovery and optimal utilisation of transmission capacity; reduces barriers to entry
- Avoids risks to trading parties of allocating cross-border capacity separately from energy trading (i.e., FCFS, pro rata, and explicit auctions)
  - May not be able to secure necessary cross-border transmission capacity for an energy trade already committed to
  - May not be able to agree an energy trade after having already bought transmission capacity

3. Revenue - Sources

Revenues can arise from the use of cross-border capacity

Usage fees	• Fixed $/MWh charges which can in theory be levied on any cross-border flow
Explicit auction income	• Winning parties pay the clearing price ($/MW/h) for the transmission rights acquired • Setting a minimum clearing price is equivalent to a usage fee, payable even if unconstrained
Congestion income (implicit auctions)	• TSO earns a congestion revenue for flowing electricity from a low price to a higher price market congestion revenue = flow x price difference • No congestion revenue if unconstrained (no price difference between the adjacent markets)

3. Revenue - Uses

The use of any revenues received by the TSO arising from the use of cross-border capacity is normally subject to local or regional regulation

Socialised grid asset	Commercial grid asset
Cross-border interconnection part of national grid infrastructure	*Privately funded grid investment – e.g.: HVDC interconnector*
Any sources of income (usage fees, explicit auction income, congestion revenue) can be used for approved purposes – e.g.: • Reducing network wheeling charges • Funding investment in expanding the grid	Common model in Europe for non-socialised investments to be funded from sale of explicit transmission rights or congestion revenue Regulator may impose “cap and collar” to limit upside and downside of such investments