I-SEM Training
IMB Settlements

September 2017

Agenda

- Process and Data Inputs
- Ex-Ante Quantity
- Imbalance Component Payments or Charges
- Administered Imbalance Settlement
- Imperfections Charge
- Residual Error Volume Charge
- Currency Adjustment Charge
- Market Operator Charge
- Testing Charge
- Bid Offer Acceptance Quantities
- Losses
- Premium and Discount Component Payments
- Uninstructed Imbalance Charges
- Instruction Profiling

Agenda

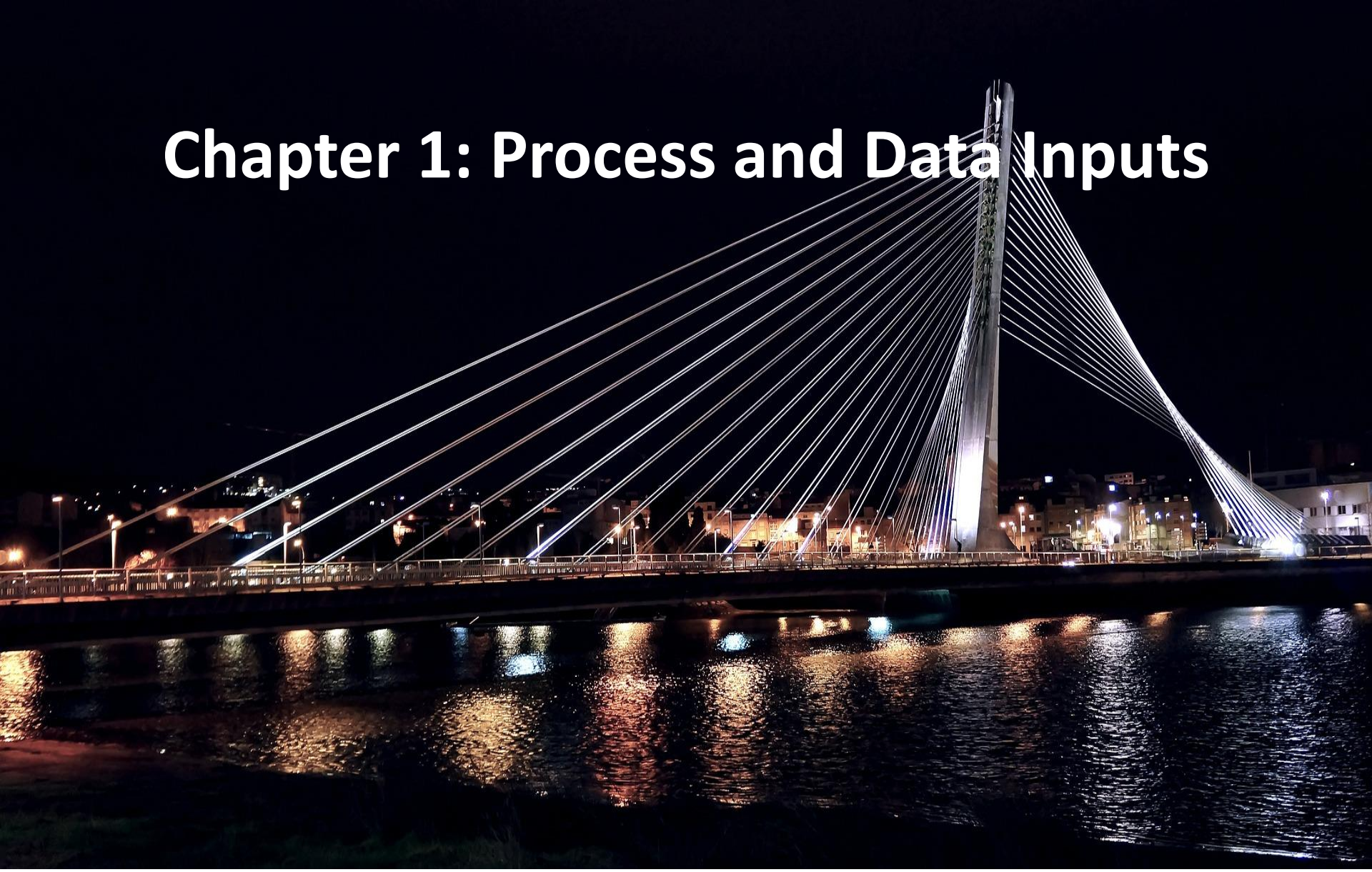
- Selection of Commercial Offer Data
- Undelivered Quantities
- Biased Quantities
- Non-Firm Quantities
- Curtailment
- Offer/Bid Price Only Undo Actions
- Trade Opposite TSO Quantities
- Fixed Costs Payments or Charges
- Information Imbalance Charges

Learning Objectives

After completing self-learning and instructor-led training for this course, you will have an understanding of:

- the timing and processes for IMB Settlement
- how quantities are calculated
- unit specific settlement items
- the supplier charging regime

Chapter 1: Process and Data Inputs



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Process and Data Inputs

- Imbalance Settlement implements Balance Responsibility:
  - Participants are financially responsible for differences between their trade volumes and their actual generation or consumption, at a price which represents the cost of keeping the system balanced;
  - Balance responsibility is intended to encourage efficiency in the market, as it links the trading outcomes to physical reality. Below gives a few examples of potential outcomes:
    - If a unit has traded to an output or consumption amount, they need to deliver it or consume no more, otherwise they will have to pay for someone else to provide it instead, or pay someone to provide it to them, possibly at a higher price than they received from its trade based on the constraints of who is available at such short notice;
    - If a unit has generated more, or consumed less, than their traded amounts then this is likely to be paid to them at a lower price than if that extra generation or less consumption had been incorporated into the traded amounts in the first place – the need for energy balancing actions is reduced by these units generating more or consuming less, so lower priced units can be taken for these actions.
  - Imbalance Settlement ensures that the correct quantities and cash flows for participants to pay associated with these differences are calculated.
- Imbalance Settlement is mandatory for everyone:
  - This includes suppliers, generators, assetless traders, NEMOs, and interconnectors;
  - For participants other than generators, the settlement is only to calculate cash flows associated with imbalances, and some other market charges;
  - For generator participants, their full output range is also available for balancing services which the SOs use to help keep the system energy balanced and to ensure the system is secure. Imbalance Settlement also covers the settlement of these actions.

Process and Data Inputs

- Activities related to imbalance settlement include:
  - Submission, collection and processing of data;
  - Calculation of settlement amounts by the Market Operator;
  - Publication and receipt of settlement data and settlement documents through the Balancing Market Interface;
  - Payment of amounts owed to and owed by participants;
  - Repeat process for settlement reruns.

- These training materials concentrate on the calculation of the Settlement Amounts by the MO.

- Imbalance settlement is related to energy market settlement and its components are therefore defined as “Trading Payments and Charges”:
  - They are all included on the same Settlement Documents on a Billing Period basis (i.e. weekly).

- Market Operator Charges are considered separately and have a separate Settlement Document and timetable.

Process and Data Inputs

- A note on sign conventions:
  - Power (MW) or energy (MWh):
    - Being input into the SEM are positive values;
    - Increases to the amount being input into the SEM / decreases to the amount being taken from the SEM, are positive values;
    - Being taken from the SEM are negative values;
    - Decreases to the amount being input into the SEM / increases to the amount being taken from the SEM, are negative values.
  - Power (MW) or energy (MWh) in relation to an Interconnector or related units:
    - Being imported into the SEM are positive values;
    - Increases to the amount being imported into the SEM / decreases to the amount being exported from the SEM, are positive values;
    - Being exported from the SEM are negative values;
    - Decreases to the amount being imported into the SEM / increases to the amount being exported from the SEM, are negative or zero values.
  - Amounts (in € or £):
    - Due to a Participant or Unit from the Market Operator are positive values;
    - Due from a Participant or Unit to the Market Operator are negative values.

Process and Data Inputs

- A note on subscripts:
  - Same as in current SEM:
    - u is a Generator Unit;
    - v is a Supplier Unit;
    - l (lowercase L) is an Interconnector;
    - d is a Settlement Day;
    - t is a Trading Day;
    - b is a Billing Period;
    - c is a Capacity Period;
    - y is a year.
  - Changing with I-SEM:
    - h is a general subscript for a period of time:
      - E.g. Day-ahead and Intraday Markets may have different Trading Periods, h is used to describe both of them and its length is considered by context.
    - i is a Price Quantity Pair band, and since Bid Offer Acceptances are split up by band, it is also used as a band identifier for the quantities and prices associated BOAs;
    - k is used for both Contiguous Operating Period for fixed costs calculations, and as an identifier of a position in a ranked set.
  - New with I-SEM:
    - γ, Greek letter gamma, is Imbalance Settlement Period;
    - o is a Bid Offer Acceptance;
    - Ω, Greek letter omega, is a Capacity Market Unit.

Process and Data Inputs

Below is a list of all the payments and charges, with a one-line explanation:

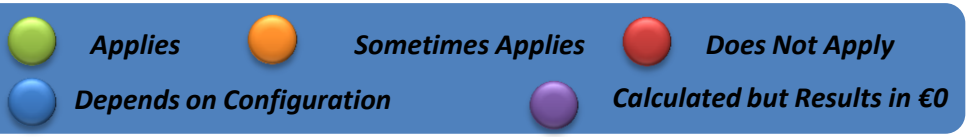
$CIMB_{\gamma}$	Imbalance Component Payment or Charge.
$CPREMIUM_{u\gamma}$	Premium Component Payment or Charge.
$CDISCOUNT_{u\gamma}$	Discount Component Payment or Charge.
$CAOOPO_{u\gamma}$	Offer Price Only Accepted Offer Payment or Charge.
$CABBPO_{u\gamma}$	Bid Price Only Accepted Bid Payment or Charge.
$CCURL_{u\gamma}$	Curtailment Payment or Charge.
$CUNIMB_{u\gamma}$	Uninstructed Imbalance Charge.
$CII_{u\gamma}$	Information Imbalance Charge.
CFC_{ub}	Fixed Cost Payment or Charge.
$CTEST_{u\gamma}$	Testing Charge.
$CIMP_{u\gamma}$	Imperfections Charge.
$CREV_{v\gamma}$	Residual Error Volume Charge.
$CCA_{v\gamma}$	Currency Adjustment Charge.
$CMOA_{py}$ / $CVMO_{vb}$	Fixed Market Operator Charge / Variable Market Operator Charge

Process and Data Inputs

Below is a list of all the payments and charges, with a one-line explanation:

$CIMB_{\gamma}$	All differences between meter and trades at imbalance price.
$CPREMIUM_{u\gamma}$	Extra for TSO inc actions if offer price better than imbalance price.
$CDISCOUNT_{u\gamma}$	Extra for TSO dec actions if bid price is better than imbalance price.
$CAOOPO_{u\gamma}$	If there is an undo of a TSO dec action, ensure unit gets inc/dec price difference.
$CABBPO_{u\gamma}$	If there is an undo of a TSO inc action, ensure unit gets inc/dec price difference.
$CCURL_{u\gamma}$	Pay back revenue for output turned down for system stability reasons.
$CUNIMB_{u\gamma}$	Charge if dispatch instruction was not followed within tolerance.
$CII_{u\gamma}$	Charge changes in Physical Notifications affecting efficiency of schedules.
CFC_{ub}	Make-whole extra fixed costs incurred, pay back fixed costs saved.
$CTEST_{u\gamma}$	Extra risk due to test = extra reserve = cost to be recovered.
$CIMP_{u\gamma}$	Charge suppliers to ensure money in = money out.
$CREV_{v\gamma}$	Recover cost of differences between generator and supplier meters.
$CCA_{v\gamma}$	Cost or benefit created through different exchange rates.
$CMOA_{py}$ / $CVMO_{vb}$	Pay for administrative costs of the Market Operator.

Process and Data Inputs



Payment / Charge ID	Dispatchable Generator	Controllable / non-dispatchable Generator	Demand Side Unit	Aggregated Generator Unit	Supplier Unit (incl. ASU)	Trading Site Supplier Unit	Assetless Unit; Trading Unit; Non-controllable / non-dispatchable Generator	Pumped or Battery Storage Generator	Interconnector Error Unit	Interconnector Residual Capacity Unit
$CIMB_{uy}$	●	●	●	●	●	●	●	●	●	●
$CPREMIUM_{uy}$	●	●	●	●	●	●	●	●	●	●
$CDISCOUNT_{uy}$	●	●	●	●	●	●	●	●	●	●
$CAOOPO_{uy}$	●	●	●	●	●	●	●	●	●	●
$CABBPO_{uy}$	●	●	●	●	●	●	●	●	●	●
$CCURL_{uy}$	●	●	●	●	●	●	●	●	●	●
$CUNIMB_{uy}$	●	●	●	●	●	●	●	●	●	●
CII_{uy}	●	●	●	●	●	●	●	●	●	●
CFC_{ub}	●	●	●	●	●	●	●	●	●	●
$CTEST_{uy}$	●	●	●	●	●	●	●	●	●	●
$CIMP_{uy}$	●	●	●	●	●	●	●	●	●	●
$CREV_{vy}$	●	●	●	●	●	●	●	●	●	●
CCA_{vy}	●	●	●	●	●	●	●	●	●	●

Process and Data Inputs

Energy Market

- Ex-ante Market Trade Quantities (Day-ahead and Intraday Trades, Interconnector Schedule, Market Area)
- Market Prices (Day-ahead and Intraday Trades, Imbalance, Curtailment, Market Back Up)
- Charge Prices (Imperfections, Currency, Testing, Market Operator, Residual Error, Information Imbalance)
- Exchange Rates (daily)

Market and Physical

- Physical Notification (PN)
- Commercial Offer Data (COD)
- Technical Offer Data (TOD)
- Parameters

Physical System

- Capacities (Registered, Firm Access Quantity)
- Dispatch Instructions (DIs)
- Dispatch Quantities (qD)
- Metered Quantities (QM)
- Outturn Availability (qAVAILO)
- Flags and Tags
- Frequency
- Loss Factors

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Process and Data Inputs

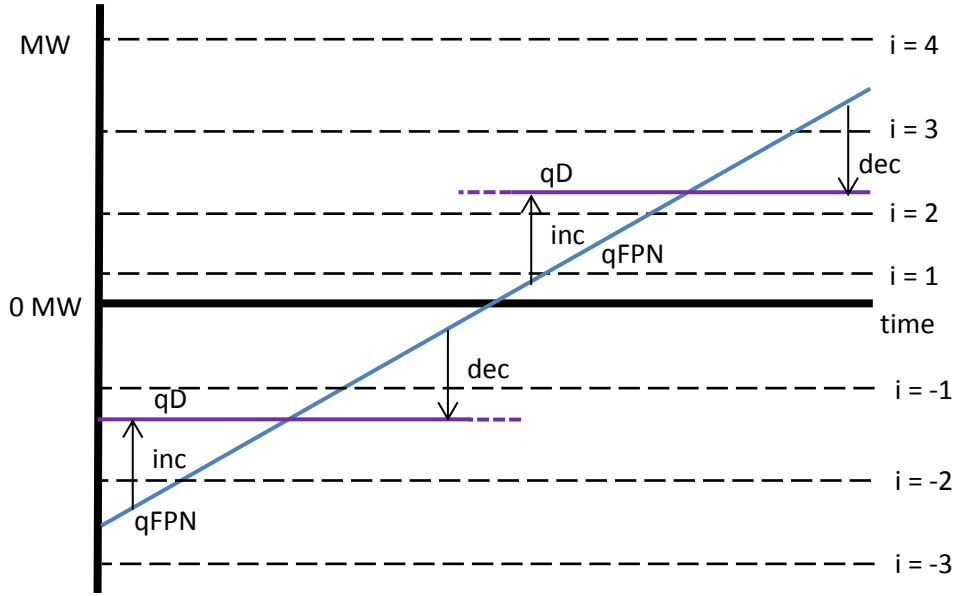
- There is a general rule that if a quantity or settlement amount is not to be calculated for a unit, but another equation which is relevant to the unit references that quantity or amount, then a value of zero is taken:
  - In this way the same equation can be used for all units even when not all elements of the equations are relevant for all units, for example this happens with the Premium and Discount Component where not all quantities are relevant to all units.

Process and Data Inputs

- Some Generator Units have a negative output range in addition to the conventional positive output range, for example pumped storage and battery storage units when they are in pumping or charging modes;
- They submit Commercial Offer Data (in particular Price Quantity Pairs), Physical Notifications and Technical Offer Data to the balancing market reflecting this negative output range;
- Storage units, since they have no governor control in pumping or charging mode, would not have uninstructed imbalances settled when in pumping mode;
- These units are deemed to be in pumping or charging mode if their dispatch quantity is in negative output range within an Imbalance Settlement Period;
- Battery Storage units are modelled in the systems as a Pumped Storage Unit, but the Trading and Settlement Code uses separate terminology, mirroring Pumped Storage data.

Process and Data Inputs

The imbalance settlement calculations, and in particular the calculation of Accepted Bid and Accepted Offer quantities, reflects the fact that and ensures that incs and decs are correctly calculated. The graph below illustrates the relationship between the Dispatch Quantity and Final Physical Notification profiles in calculating quantities in the positive and negative output ranges.



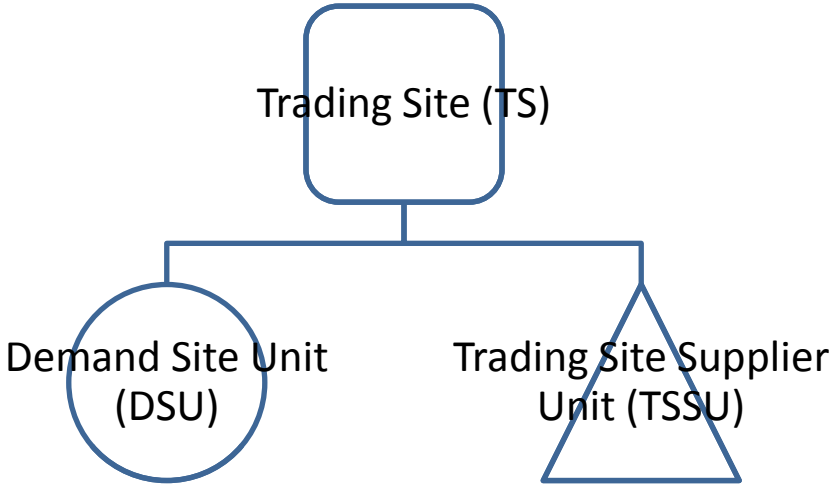
Process and Data Inputs

- Autoproducer Sites can trade their net generation position in the ex-ante markets through a Trading Unit (TU):

	GU1	GU2	TSSU	TU
QEX	No	No	No	Yes
PN	Yes	Yes	Optional	No
QD	Yes	Yes	No	No
QM	Yes	Yes	Yes	No
Imbalance	Yes	Yes	Yes	Yes

- Net settlement across all of the units ensures that it is the net imbalance across the Trading Site that is settled:
  - For example, if the site generates and consumes according to its QEX, the "notified imbalance" from the GUs and TSSU cancels with the "unnotified imbalance" from the TU at the same imbalance price, and the site is left with its ex-ante market revenue.
- Autoproducers have different rules in other areas which consider ex-ante market trade in imbalance settlement, including not calculating biased quantities.

Process and Data Inputs



- Input data for DSUs are different;
- For DSUs, QM = QD:
  - This assumes that the DSU delivered, i.e. metered level is deemed to be same as dispatched level;
  - This approach gives flexibility to include functionality to incorporate actual delivery in the future, removing this assumption and incorporating the actual performance of the DSU into settlement.
- For a DSU's TSSU, QM = -QD:
  - Another separate Supplier Unit experiences the benefit in energy terms of the reduction in demand at the imbalance price;
  - This provision removes the benefit from the DSU to ensure against double counting the same energy reduction on two separate participants.

Process and Data Inputs

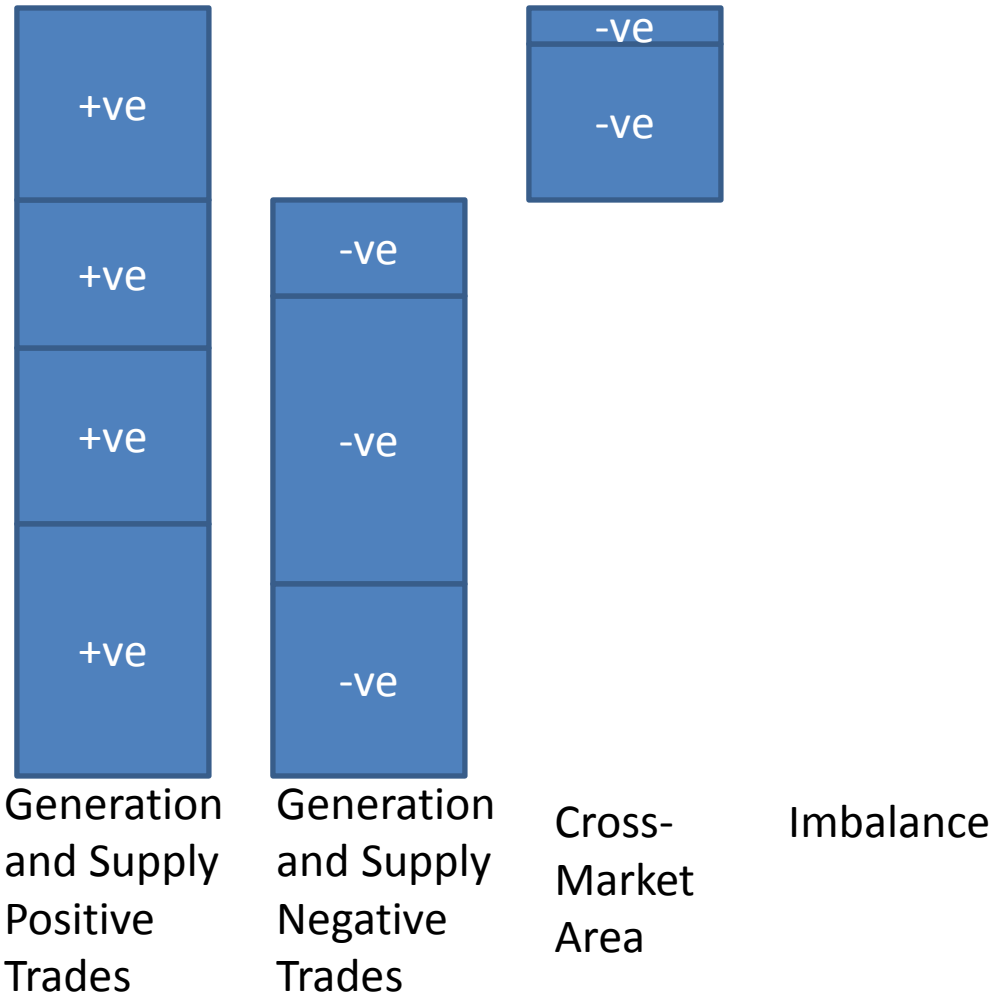
- Assetless Units:
  - Assetless traders have no physical assets, and therefore make no submission of COD, TOD, PN, Availability, no Bid Offer Acceptances, etc.;
  - Only the Imbalance Component applies, to cover when net ex-ante trades for a period are not closed to zero, represented by the unit's Ex-ante Quantity (QEX), with QM being deemed equal to zero.
- Each NEMO acting as Scheduling Agent registers an Assetless Unit for imbalance settlement;
- NEMO imbalances can be due to:
  - Incorrect notification of Contracted Quantities;
  - Refusal of contracts on one of the NEMO's participants due to a Credit Assessment.
- A NEMO unit's Ex-Ante Quantity is calculated differently to other units:
  - It is calculated as the sum of the final net positions of all participants under the NEMO and energy flows into or out of the NEMO's "market area";
  - For participants under the NEMO, the sum of all Contracted Quantities (positive and negative) relevant to the Imbalance Settlement Period is taken;
  - If there is a single NEMO, the cross-market area amounts would be the same as the cross-border amounts into or out of the SEM. If there are multiple NEMOs, there may be an element of amounts flowing between the NEMOs in addition to these cross-border flow elements.
- The following slides illustrate the components of the NEMO's Ex-Ante Quantity, and how imbalances could arise on such a unit.

Process and Data Inputs

- The submission of ex-ante trade information for participants, Interconnectors and NEMOs is done by Scheduling Agents, with structures to accommodate potential multi-NEMO environment;
- The Scheduling Agent for Participant submits quantities and prices for ex-ante market trades:
  - In all cases, the Scheduling Agent is the NEMO with whom the Participant has a cleared market trade.
- A Shipping Agent can be appointed for the interconnector, with the Scheduling Agent for Shipping Agent submitting quantities for ex-ante market interconnector flows:
  - If there is a single NEMO environment, the Shipping Agent would be the NEMO and the Scheduling Agent would be the NEMO;
  - In a multi-NEMO environment, the Shipping Agent would be a designated body and the Scheduling Agent would be that designated body;
  - The Scheduling Agent submits ex-ante market scheduled interconnector flows as they are updated throughout the day for use by the SOs in scheduling an Interconnector Reference Programme for the interconnectors physical flow, and the sum of these market schedules is considered in imbalance settlement.
- The Scheduling Agent for the SEM NEMO submits quantities for ex-ante market area exchanges (qEMAID), in addition to the quantities of the trade of its members:
  - In all cases, Scheduling Agent is the NEMOs themselves.

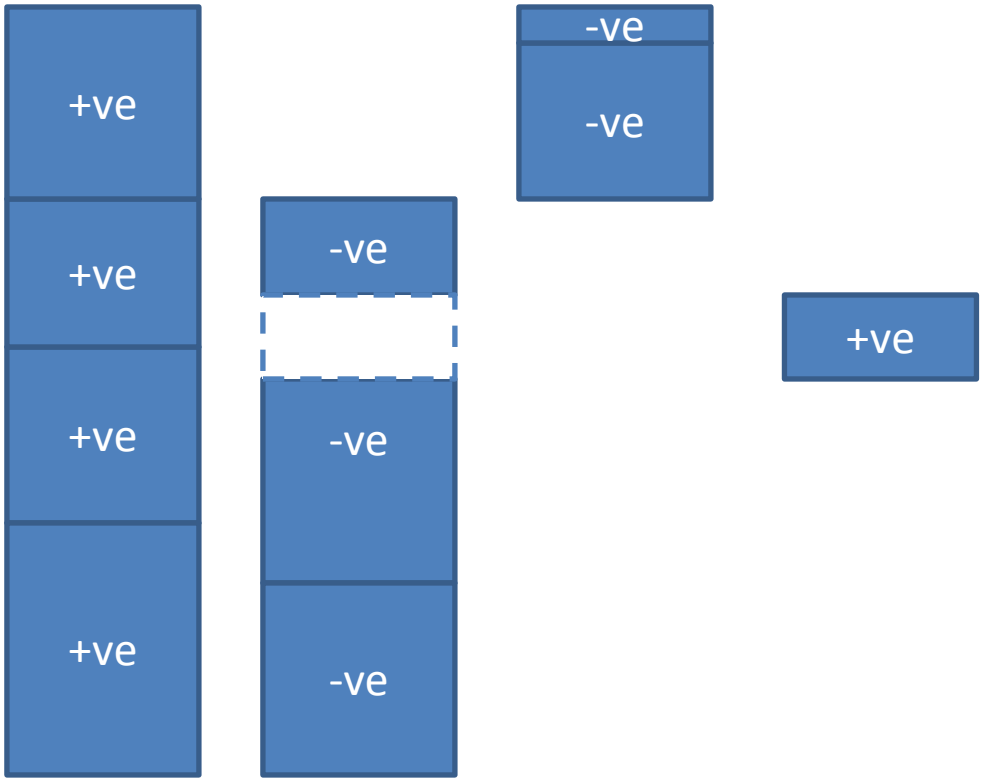
Process and Data Inputs

- Balanced:



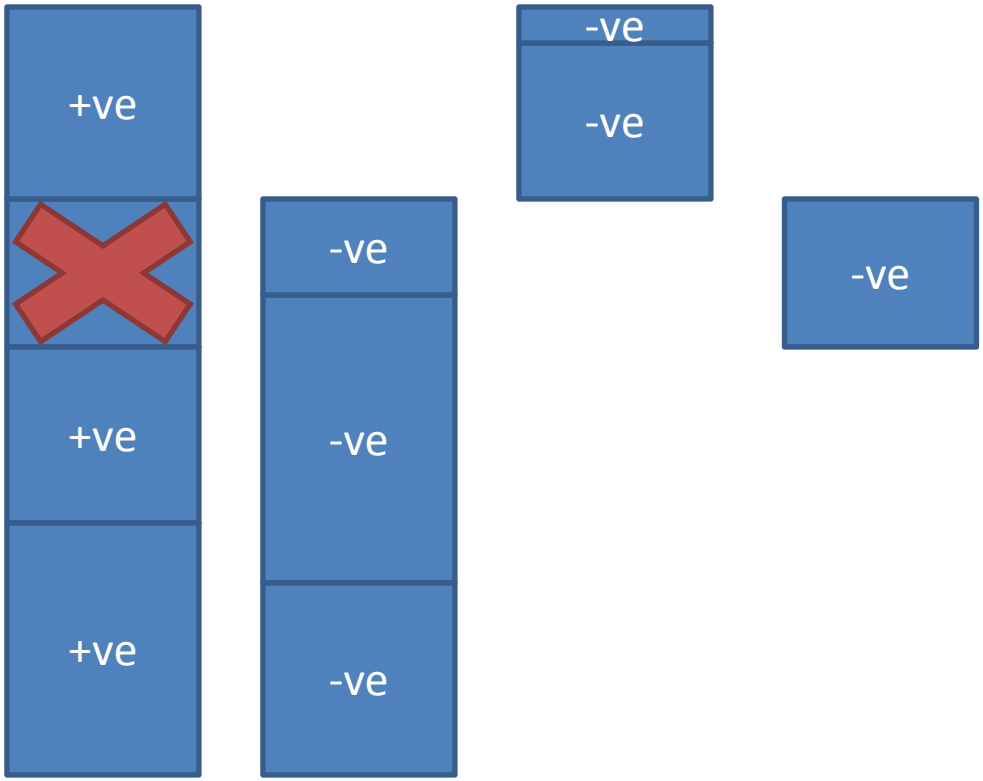
Process and Data Inputs

- Imbalance due to incorrect Contract Notification:



Process and Data Inputs

- Imbalance due to Contract Refusal:



Process and Data Inputs

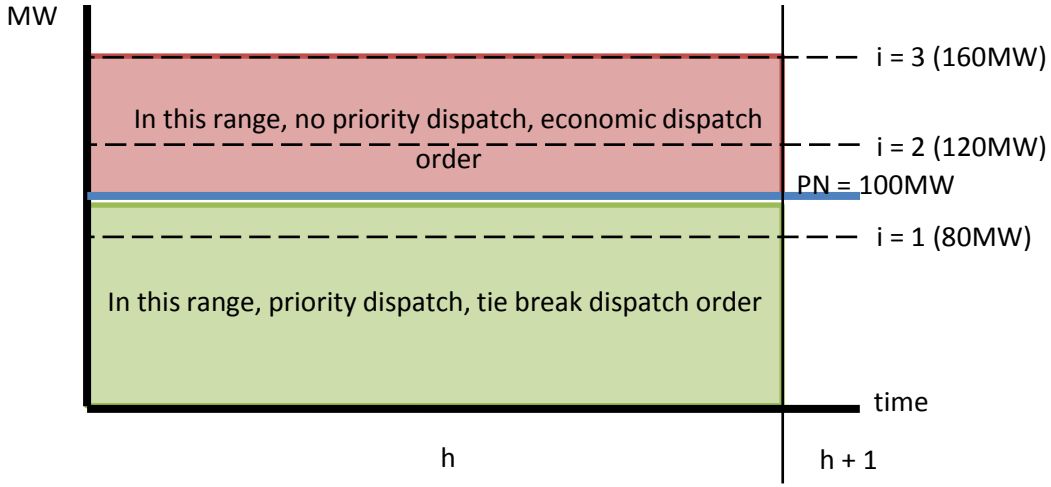
- The high level approach for the treatment of interconnectors in imbalance settlement is:
  - As much as possible, treat the same as any other unit;
  - Make adjustments where necessary to recognise difference.
- Interconnectors are facilitators of trade rather than active participants in the energy markets;
- Who are sources of data:
  - QEX (flow results from ex-ante markets sent by Shipping Agents), PN (profile representing physical scheduling of the flow results from the ex-ante markets sent by TSOs), QD (final dispatch profile instructed by the TSOs), QM (actual flow on the interconnectors sent by the MDPs).
- Instructed Imbalances:
  - Bid Offer Acceptances, representing cross border trade in the balancing market, and any associated volumes;
  - Due to SO agreeing cross border trades with a SO in another jurisdiction;
  - Incorporated into Imbalance Settlement through an Interconnector Residual Capacity Unit (IRCU) under the governance of the SOs.
- Uninstructed Imbalances:
  - These arise from differences between how the interconnector was scheduled (QD) and its actual outturn flow (QM) and undelivered BOAs which may result;
  - Incorporated into Imbalance Settlement through an Interconnector Error Unit (IEU) under the governance of the Interconnector Administrator.

Process and Data Inputs

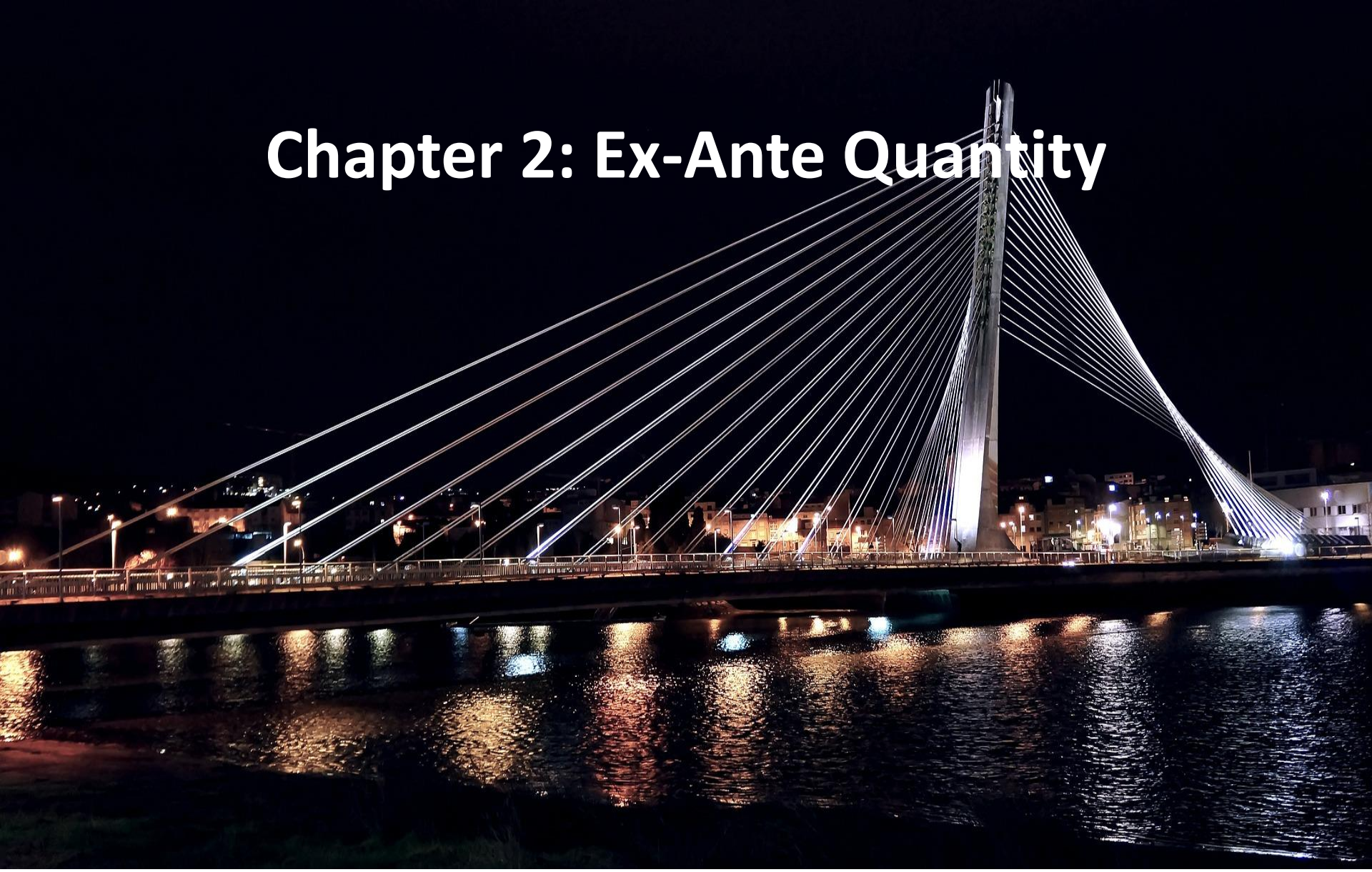
- Interconnector Residual Capacity Unit:
  - Instructed Imbalances only, i.e. those to change the interconnector flow from that scheduled in the ex-ante markets, which can happen with trades agreed between System Operators;
  - Different Imbalance Component equation to only include quantities for Accepted Offers and Bids;
  - Quantities and prices taken from agreed SO-SO trades are direct feed into pricing and settlement;
  - There is separate SO-SO counterparty settlement, and the imbalance settlement approach incorporates the settlement into the market according to the I-SEM rules;
  - Any quantities which can happen on QAB and QAO, which are relevant to interconnector, are settled on the IRCU:
    - Biased quantities (QFPN vs QEX) could occur due to differences between ex-ante market scheduled flow values and scheduled physical flow values;
    - Non-delivery (QD vs QM) of SO-SO trades could occur due to actual physical flow being different to that dispatched, or due to trips.
- Interconnector Error Unit:
  - All other imbalances;
  - Different Imbalance Component equation to subtract QAB and QAO;
  - Uninstructed Imbalance Charge Component (i.e. applying premium for under generation or discount for over generation);
  - If an Interconnector is under test, this unit covers the Testing Charge;
  - The parameters for Uninstructed Imbalance Charges should mean that it doesn't apply when the Interconnector is under test;
- Elements not included on either unit are not relevant in the context of an Interconnector (e.g. undo, non-firm, etc.).

Process and Data Inputs

- Priority Dispatch units:
  - For units which are not dispatchable, they are treated as priority dispatch for their entire available generation;
  - For dispatchable priority dispatch units, their PN is considered their priority dispatch level – scheduling the unit below this level should only be taken according to the priority dispatch tie-break decisions, but scheduling the unit above this level can be taken on an economic basis with prices provided by the unit;
  - Dec prices used in settlement for priority dispatch units are cost based, either deemed prices (e.g. a price of zero being taken for zero marginal cost units) or complex bid offer data due to being flagged, with a licence requirement on these to be cost based.



Chapter 2: Ex-Ante Quantity



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Ex-Ante Quantity

- The Ex-ante Quantity is an energy representation of the net trades a unit carried out for an Imbalance Settlement Period in the ex-ante markets (the Day-ahead and Intraday Markets). This is the amount of energy in that period a unit must provide in order to be balance responsible;
- The Day-ahead and Intraday Trade Quantities are in MW with different durations depending on the product traded, while the Metered Quantities are in MWh for the half-hour Imbalance Settlement Period;
- Therefore to compare like-with-like, conversion to MWh and the split of longer resolution products into each Imbalance Settlement Period is achieved by multiplying the trade quantity by the relevant period of time:
  - If the trade is for a period of time smaller than, and wholly within, the Imbalance Settlement Period, the duration of the period of that trade gives the amount of energy that trade contributes to the Imbalance Settlement Period;
  - If the trade is for a period of time greater than or equal to the Imbalance settlement Period, the Imbalance Settlement Period Duration gives the amount of energy that trade contributes to the Imbalance Settlement Period.
- The SEM Committee decision outlined the need for the functionality of two approaches for calculating imbalance amounts being included in the rules, with only one of the approaches being used depending on circumstances as determined by the RAs. Therefore there are provisions for both in the TSC rules.

Ex-Ante Quantity

- The first is the equal split approach:
  - This is the baseline functionality which will be used in all cases from I-SEM go-live, only changing if the RAs make a decision to change the approach some time in the future;
  - This approach means that any ex-ante market trades which span a period of time greater than an Imbalance Settlement Period are split evenly into each Imbalance Settlement Period it spans;
  - This approach means that participants are responsible for using ex-ante market products at the same resolution as the Imbalance Settlement Period to ensure that their Ex-ante Quantity will equal their actual output or consumption;
  - For example if a Supplier Unit traded -100MW consumption over an hour Trading Period in the Day-Ahead Market, but thinks that their customers' consumption would be more like -97MW in the first half hour and -103MW in the second half hour, they would need to trade in the Intraday Market +3MW for a half hour Trading Period for the first half-hour, and -3MW for a half hour Trading Period for the second half-hour.

Ex-Ante Quantity

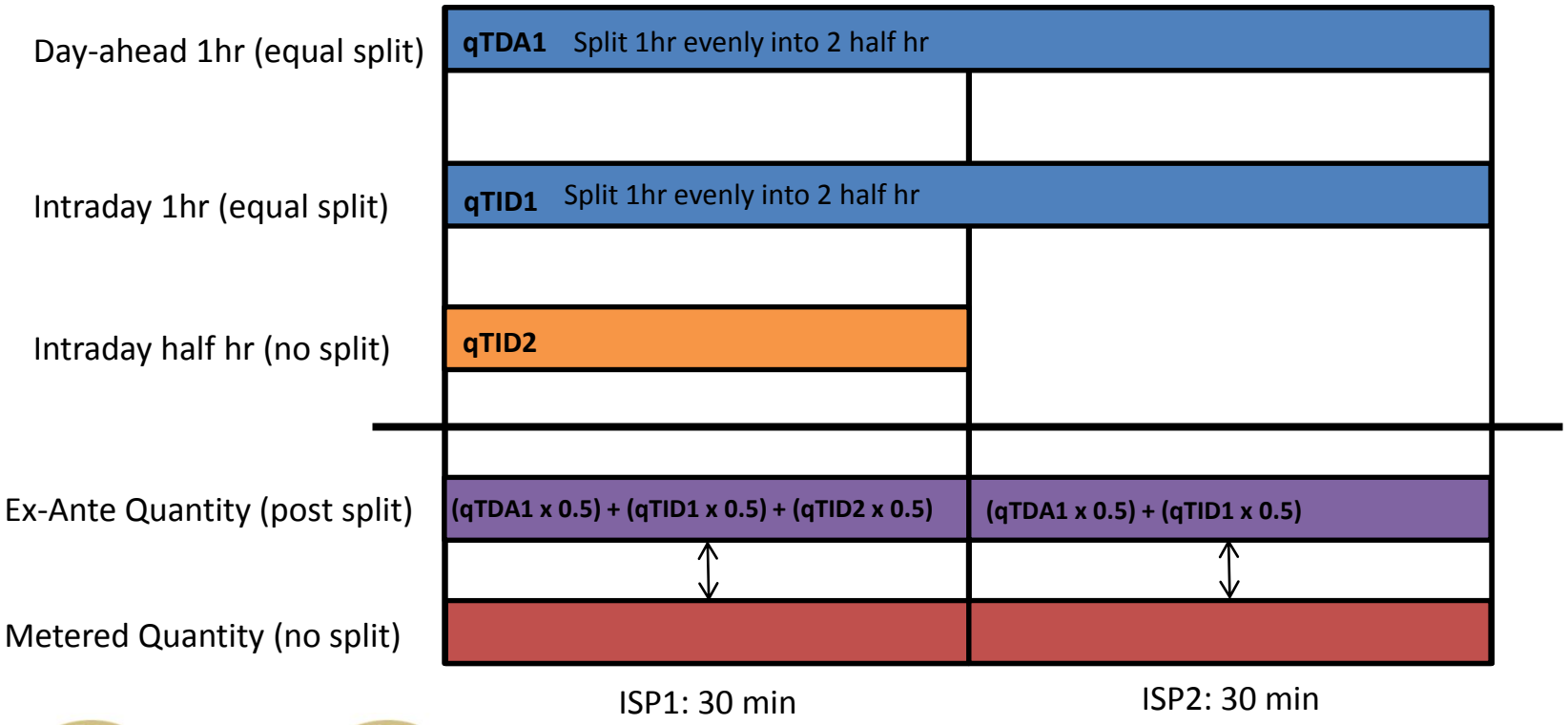
- The second is the hourly weighted average price approach:
  - This will not be used for go-live, but the rules have been developed to allow for its use if the RAs decide it is required;
  - This approach is only to be used if participants have no route to manage exposure to imbalances through having ex-ante trading products at Imbalance Settlement Period resolution;
  - The functionality is based on calculating over an hour the imbalance of ex-ante market trades which have longer resolution than the Imbalance Settlement Period, by comparing the total quantity of those trades against the total metered quantity over that hour, and applies a weighted average price to this hourly imbalance;
  - For example, if a Supplier Unit traded -100MW for an hour in the Day-ahead Market, and their customers' actual consumption was -97MW in the first half hour and -103MW in the second half hour, the imbalance to be settled would be seen as zero over the hour. This is different to what would happen under the approach to apply from go-live, which would see a +3MW imbalance in the first period and -3MW imbalance in the second period, which have to be traded by the unit to remove the imbalance exposure;
  - The means of implementing the average price is to calculate the Ex-ante Quantity to split the trade quantities between the Imbalance Settlement Periods in such a way that the net of the resulting Imbalance Component Payments or Charges in each individual half hour period would be the same as if a single hourly payment or charge, with the average of the prices over the hour, were calculated. This allows for the general settlement structure to be maintained between the approaches.

Ex-Ante Quantity

- The reason for the second averaging approach was concerns over the imbalances which could arise from having a shorter imbalance settlement period than the trading period for ex-ante products:
  - If a unit does not have access to products with the same granularity as the Imbalance Settlement Period, they could provide / consume over an hour the exact amount they have traded but still be subject to imbalances in each individual half hour.
  - For example, a unit could trade 100MW in an hourly Day-ahead Market product, meaning 100MWh needs to be produced in that hour. However the unit may need to physically ramp over the hour in order to provide that amount, for instance having an instant MW output of 80MW at the start of the hour and 120MW at the end of the hour. If this results in 45MWh metered output in the first period, and 55MWh metered output in the second period, under this approach these would be added together to be compared with the hourly product traded of 100MWh, meaning zero imbalance. Under the approach to apply from go-live, the 45MWh QM in the first period would be compared with 50MWh QEX, meaning an imbalance unless the unit trade -10MW (resulting in -5MWh) in that period, and similar for the second period.
- There are half-hour resolution products in the interim intraday solution, so this average price approach will not apply for I-SEM go-live, the equal split approach will apply;
- The approach chosen will apply to all units in all periods, with a change in approach only possible if the RAs decide that such a change to all units is required in general, i.e. this cannot change from period to period, but can be a wholesale change in approach following an RA decision.

Ex-Ante Quantity

- Example of equal split approach:
  - Generator Unit wants to output at 150MW but needs to ramp up in first period to get there;
  - Imbalance Settlement Period Duration 30 minutes, products of this length available.



Ex-Ante Quantity

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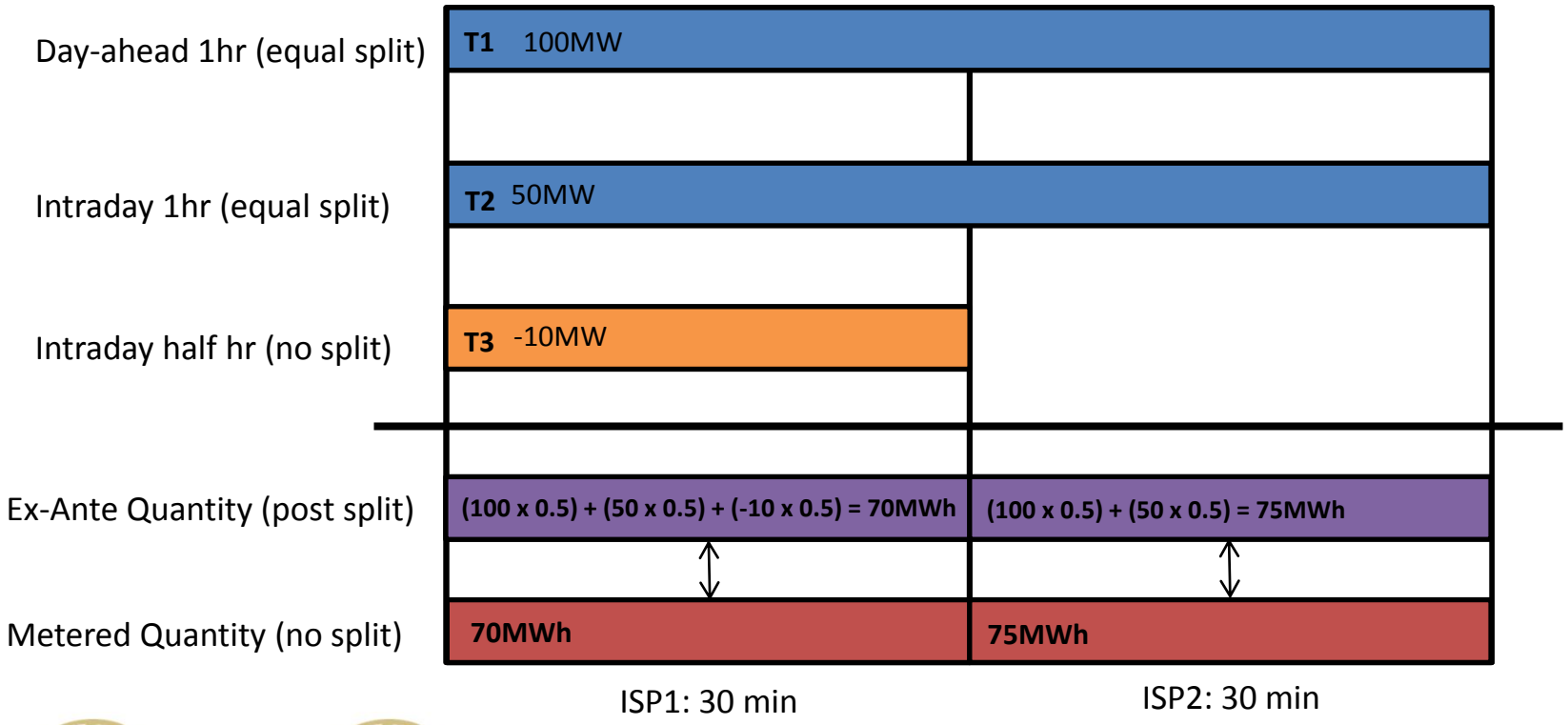
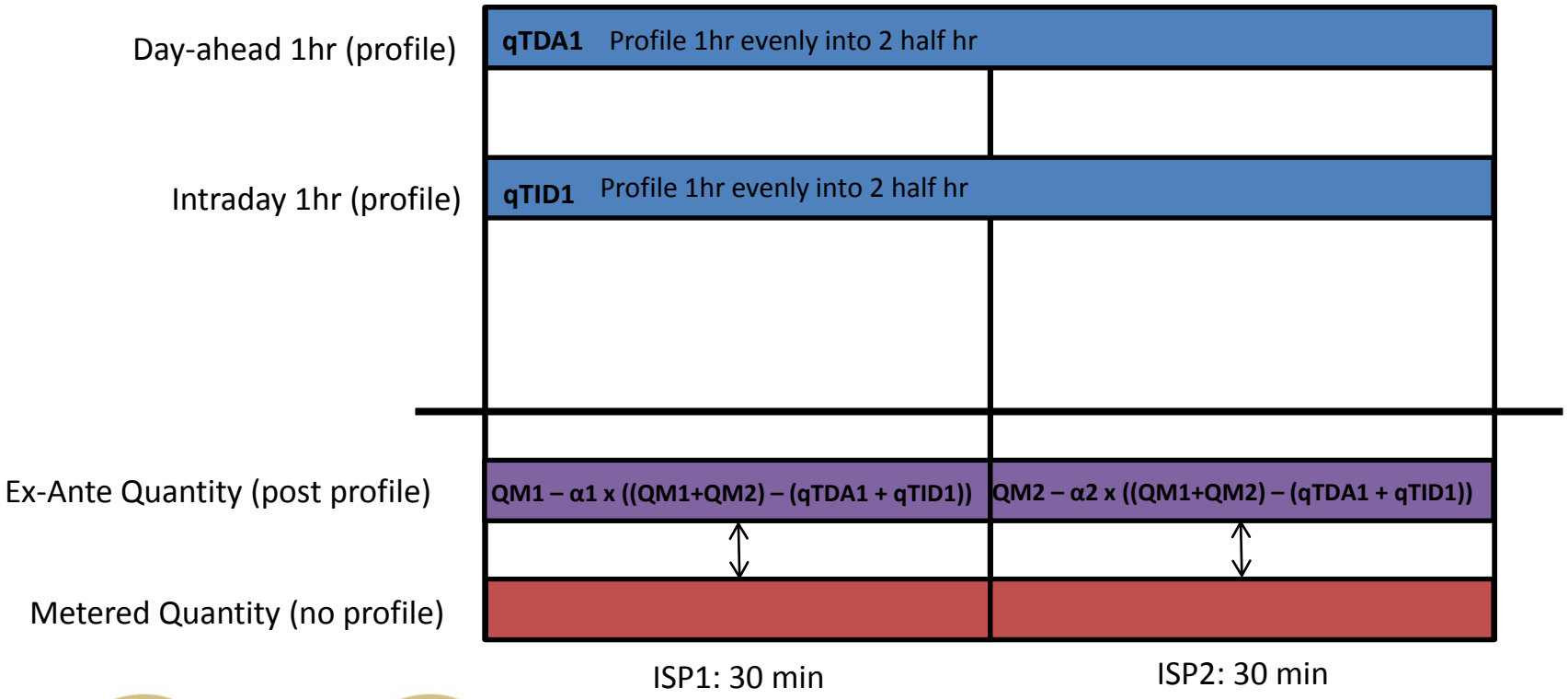


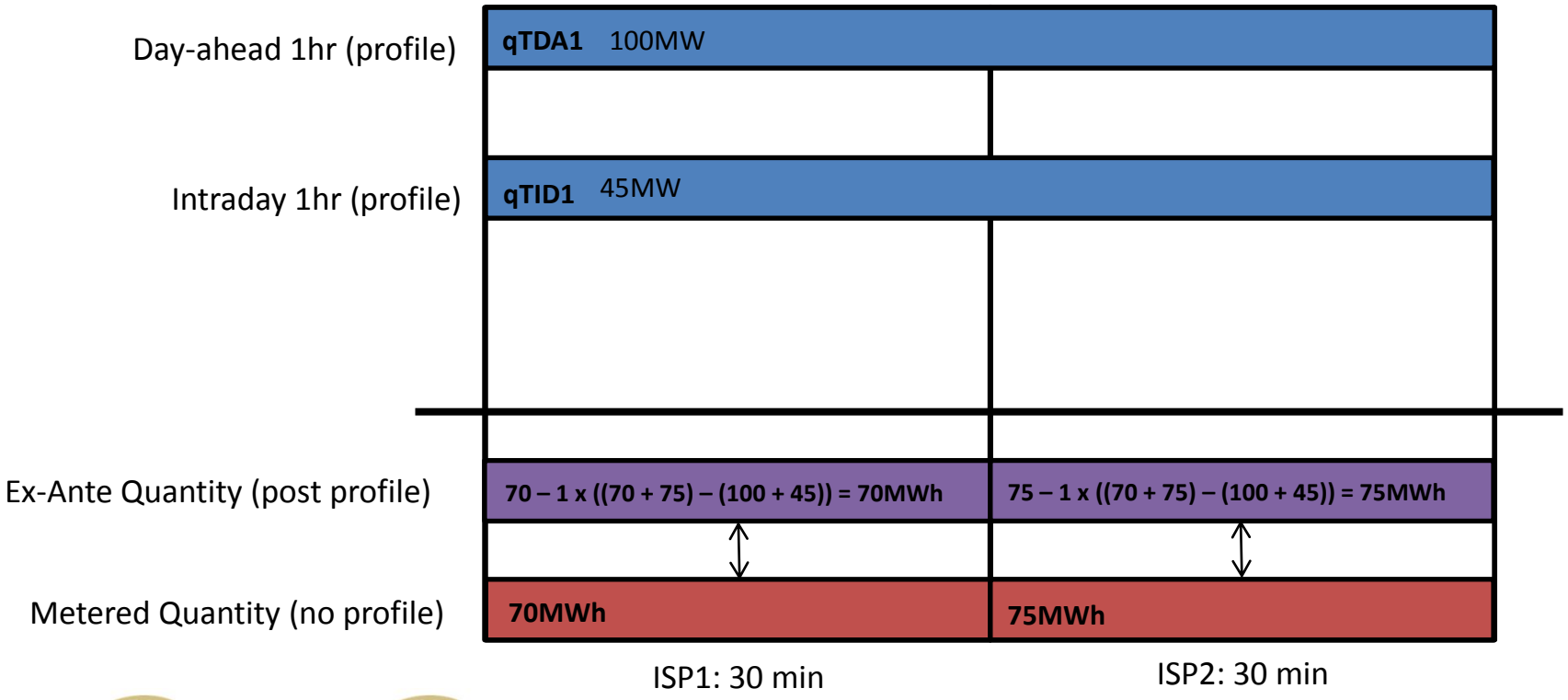
Ex-Ante Quantity

- Example of average price approach (unweighted):
  - Generator Unit wants to output at 150MW but needs to ramp up in first period to get there;
  - Imbalance Settlement Period Duration 30 minutes, products of this length not available.

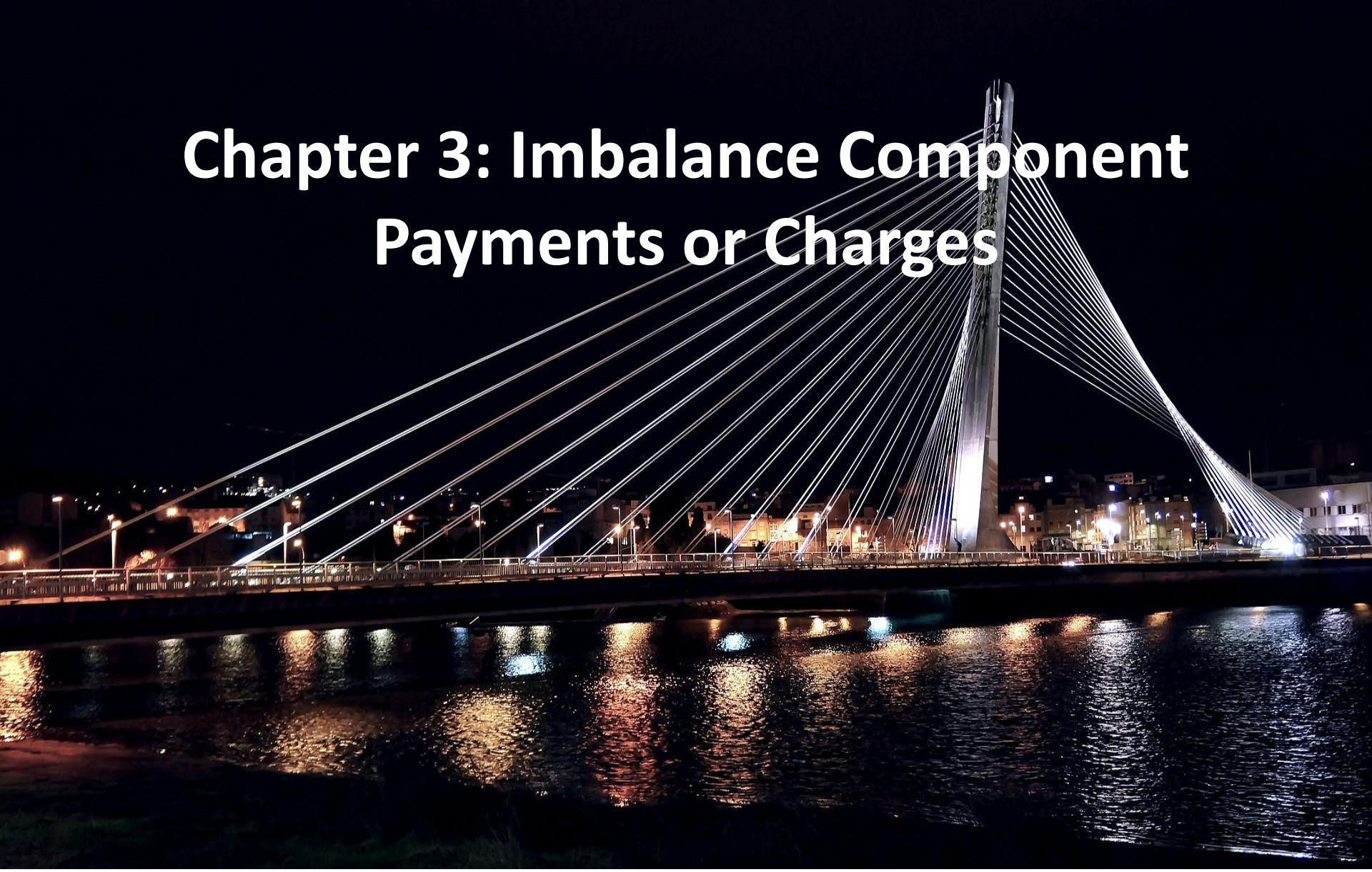


Ex-Ante Quantity

- Example of average price approach (unweighted):
  - Generator Unit wants to output at 150MW but needs to ramp up in first period to get there;
  - Imbalance Settlement Period Duration 30 minutes, products of this length not available.



Chapter 3: Imbalance Component Payments or Charges



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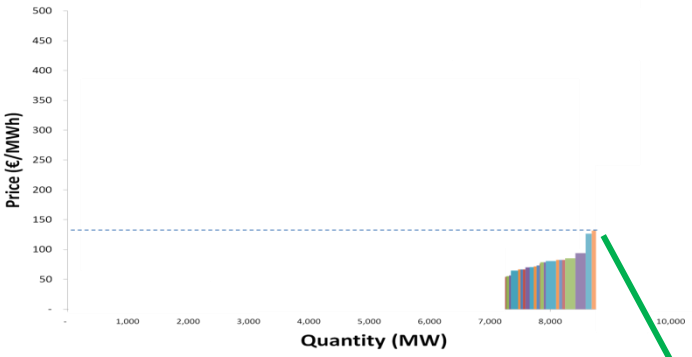
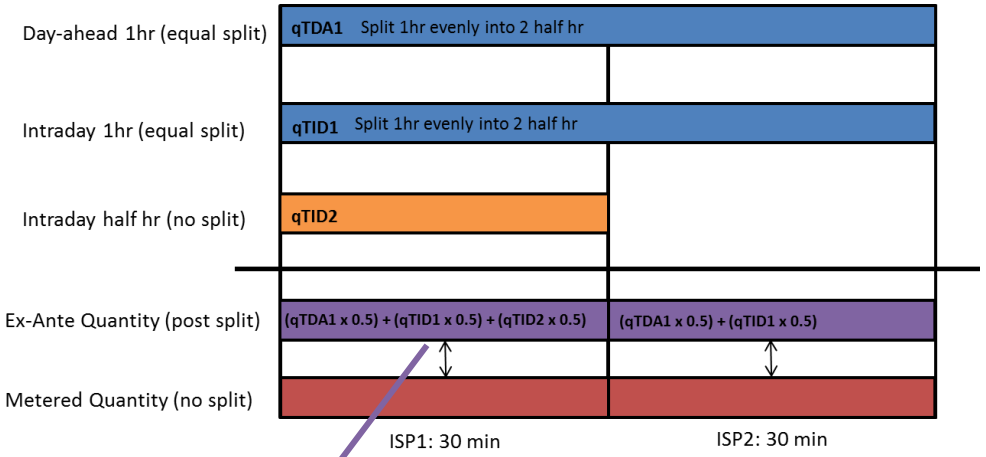
Imbalance Component Payment or Charges

- Once the Ex-Ante Quantity has been calculated, there is a half hour quantity to compare with the Metered Quantity;
- All differences between a unit's trades and its actual output or consumption are settled at the Imbalance Settlement Price. This allows for other elements of imbalance settlement to make adjustment payments or charges which ensure that, through net settlement, another price other than the Imbalance Settlement Price is used based on the reason for that imbalance:
  - For imbalances from Assetless Units and Supplier Units, this is the only settlement of this difference in quantities – only the Imbalance Settlement Price applies;
  - For imbalances on Generator Units due to being dispatched to a Physical Notification level which is different to the Ex-ante Quantity, this is the only settlement of this difference in quantities – only the Imbalance Settlement Price applies;
  - For imbalances from Generator Units which are due to the SO accepting offers or bids by dispatching them different from their market position, there are adjustments through the Premium or Discount Payments which ensure through net settlement that if the Bid Offer Price was better than the Imbalance Price that it is the price which applies. If the Bid Offer Price is not better, then this is the only settlement of this difference in quantities;
  - For imbalances from Generator Units which are due to the unit's actual output being different to the output level to which it was dispatched by the SO, outside of a certain tolerance, there are adjustments through the Uninstructed Imbalance Charges which ensure through net settlement that a price reduced by the Discount for Over Generation Factor for payments to the unit, or a price increased by the Premium for Under Generation Factor for charges from the unit, is the one which applies;
  - For imbalances from Wind Generator Units which are curtailed, there are adjustments through the Curtailment Payments or Charges which ensure through net settlement that the Curtailment Price is the one which applies.

Imbalance Component Payment or Charges





$$CIMB_{u\gamma} = PIMB_{\gamma} \times \left(QMLF_{u\gamma} - QEX_{u\gamma}\right)$$

Chapter 4: Administered Imbalance Settlement

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Administered Imbalance Settlement

- Administered Imbalance Settlement is an alternative process undertaken in exceptional circumstances where the MO is unable to calculate settlement amounts for reasons that are outside of market control;
- Administered Imbalance Settlement can be declared in the event of:
  - Electrical System Collapse (ESC);
  - General System Failure (GSF), when a system failure means that the MO is unable to receive, transmit or process data to calculate settlement amounts or carry out financial settlement processes:
    - This means that the GSF does not include not being able to calculate an Imbalance Settlement Price. If such an event happens in isolation, this does not result in Administered Imbalance Settlement – the Market Back Up Price is used instead, and settlement is carried out as normal.
- The process revolves around trying to find quantities and prices for participants which can be used to at least keep the majority of the funds flowing through the market. These need to be:
  - Based on data which is accessible despite the trigger for the alternative process; and
  - Easy to use to calculate settlement amounts manually in the absence of systems to do so.

Administered Imbalance Settlement

- The MO needs to strike a balance between the following principles when administering this kind of settlement:
  - make use of all available data, and limit to the maximum extent practicable the use of estimated values;
  - operate within the Settlement timescales, and be subject to the Settlement Query and Settlement Dispute provisions as set out in Section 6;
  - seek results which are as close as possible to those which would have been calculated under the normal Settlement processes;
  - obtain the prior written approval of the Regulatory Authorities for the detailed calculations and methodology used; and
  - publish details of the calculations and methodology used as soon as practicable thereafter.

Chapter 5: Imperfections Charge

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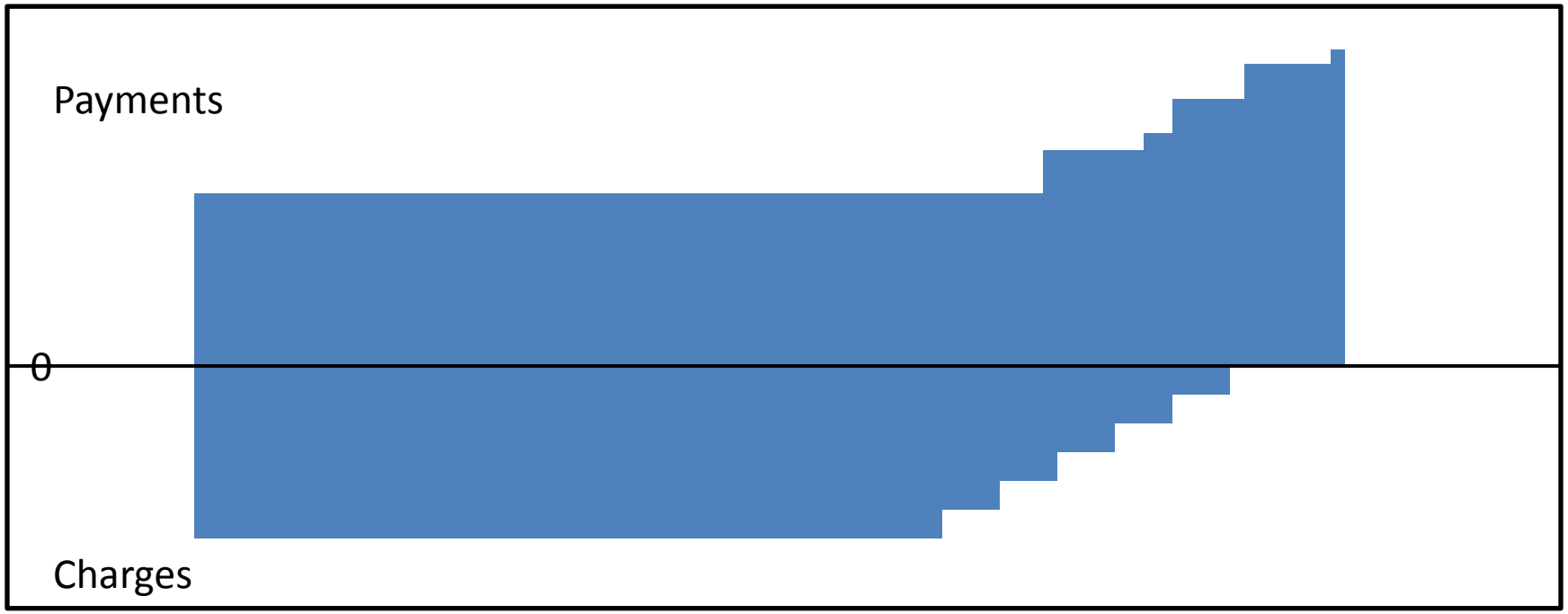
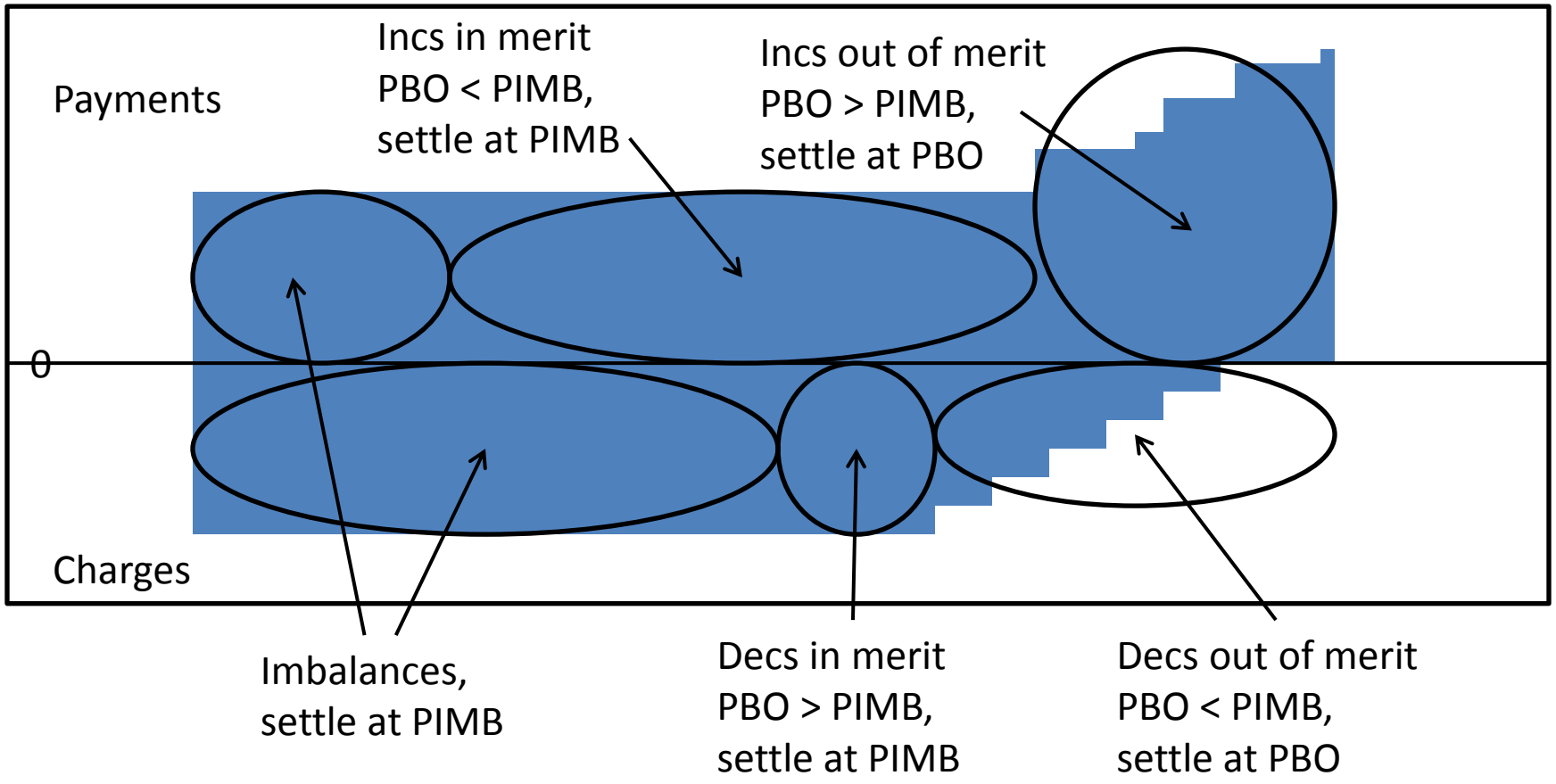
Imperfections Charge

- The purpose of the Imperfections Charge to recover costs which cannot be recovered through the other charges in Imbalance Settlement. These costs include:
  - Dispatch Balancing Costs;
  - Fixed Cost Payments and Charges;
  - Net imbalances between Trading Payments and Trading Charges, and in some cases between Capacity Payments and Capacity Charges (although there are other mechanisms in place to handle this last case in the first instance).
- Dispatch Balancing Costs can arise when the SOs need to take actions on units out of merit, i.e. dispatching up a unit at a price higher than the Imbalance Settlement Price, or dispatching down a unit at a price lower than the Imbalance Settlement Price;
- The charge is levied on all Supplier Units based on their net metered demand, with a fixed tariff in all hours based on a forecast of the costs for the following year with adjustments for the current year if required;
- There is also an Imperfections Charge Factor, which can be made equal to a value other than one following consultation and RA approval if there is a need to adjust the charge, for example if the actual amounts recovered are insufficient based on the Imperfections Price and if recovering the shortfall as a factor in the following year's tariff is deemed inappropriate;
- The following slides illustrate how costs which are not recovered through charges can arise, focussing on the core concept that Generator Units should be settled at the better of the Imbalance Settlement Price or their Bid Offer Price.

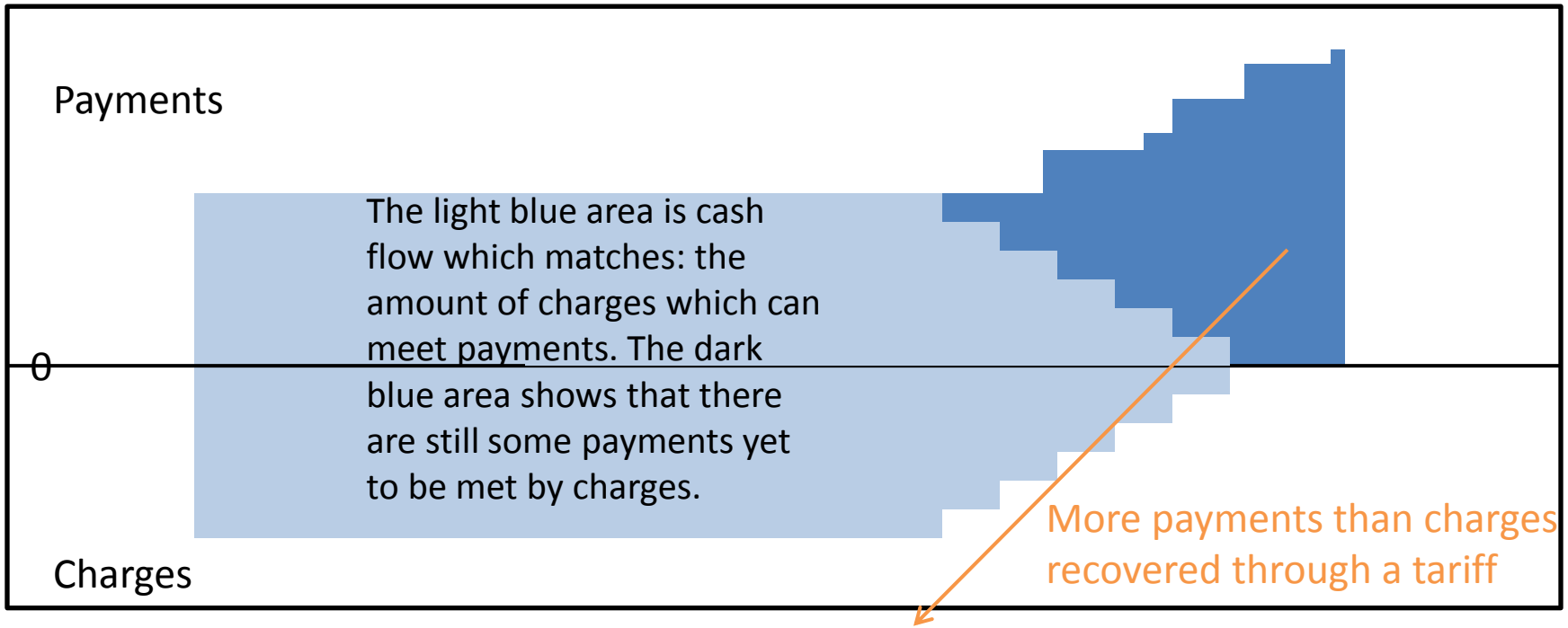
Imperfections Charge



Imperfections Charge

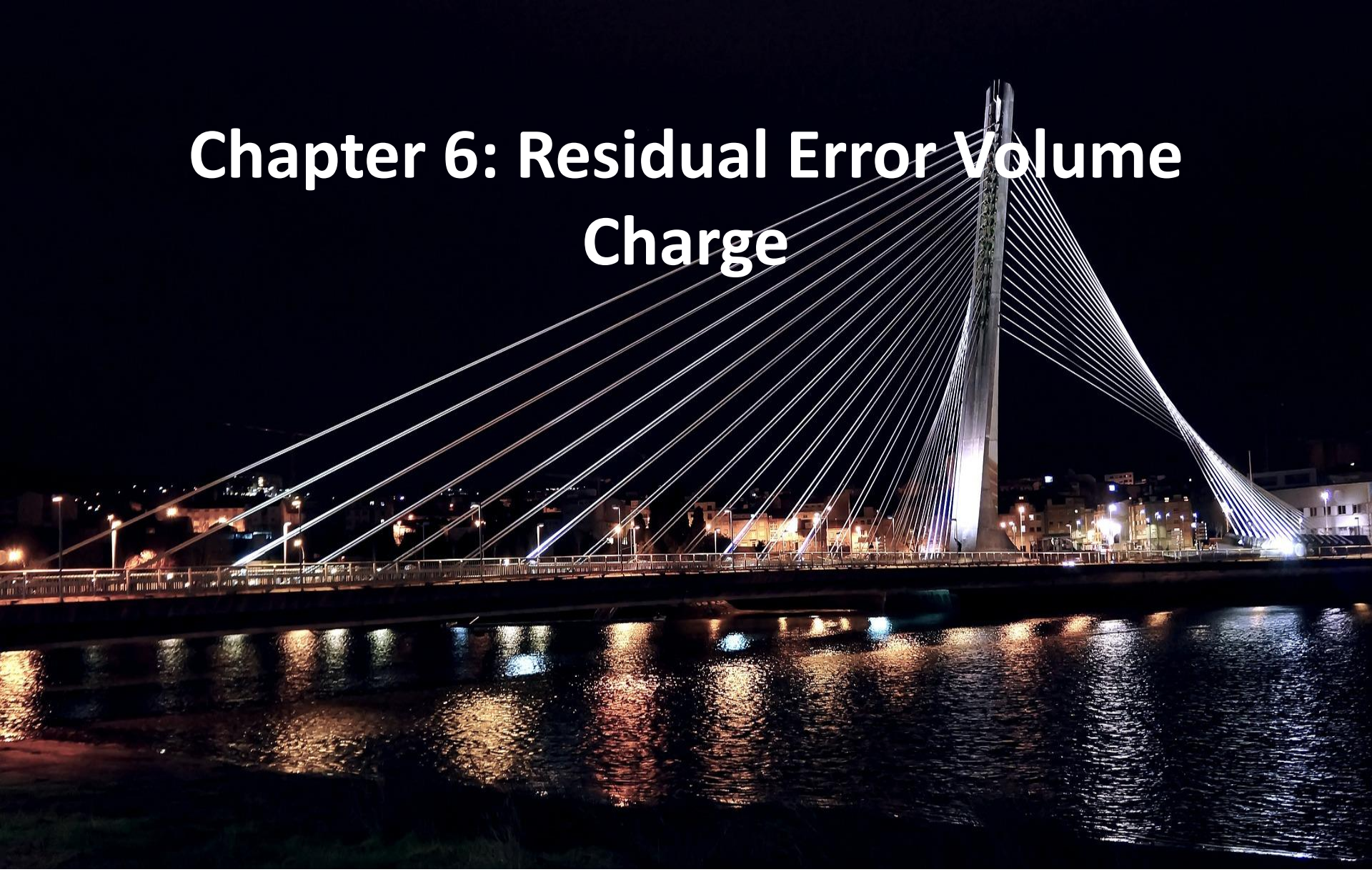


Imperfections Charge



$$CIMP_{v\gamma} = QMLF_{v\gamma} \times PIMP_{y} \times FCIMP_{\gamma}$$

Chapter 6: Residual Error Volume Charge



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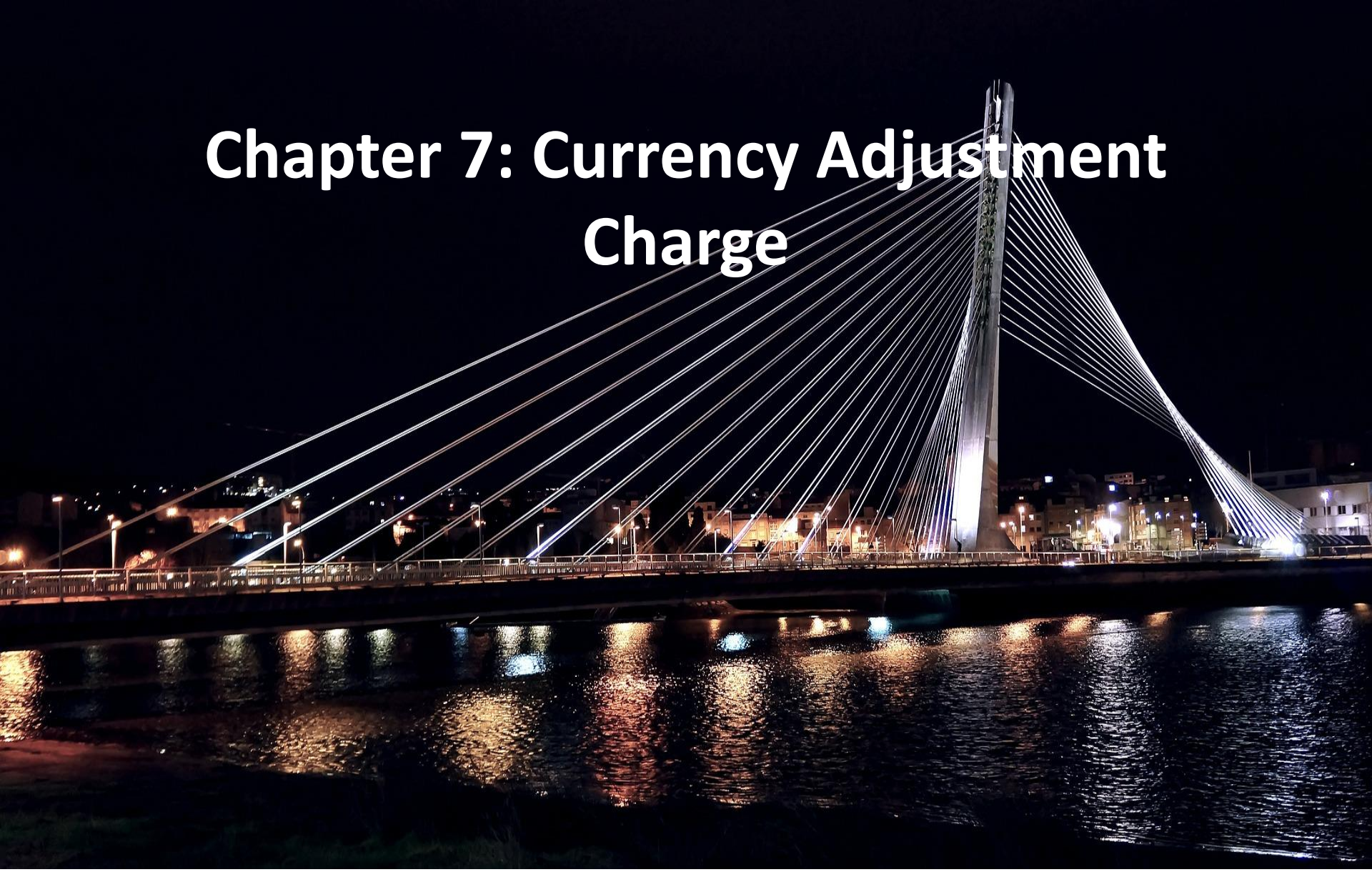
Residual Error Volume Charge

- The approach for global aggregation intends to cover the costs of any residual error volume:
  - This is the difference between generator output and metered demand;
  - This error volume could mean that there is insufficient funds through supplier charges to help meet generator payments, which needs to be recovered in order to ensure money out = money in.
- This error volume can occur due to a number of reasons including:
  - Differences between actual consumption and profiled consumption of non-interval metered customers;
  - Differences between loss-adjustment factors and actual losses on the transmission and distribution systems;
  - Theft.
- The approach has changed between SEM and I-SEM:
  - In the current arrangements, this **volume** is calculated and distributed among Supplier Units through an adjustment to their net demand used in settlement;
  - In the I-SEM, there is no such volume adjustment to the metered quantity of Supplier Units – the cost is initially borne by the Market Operator, who recovers it through a charge applied to Supplier Units based on their net demand throughout the year, based on a fixed **tariff** determined annually in advance of the year.

Chapter 7: Currency Adjustment Charge



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Currency Adjustment Charge

- Dual currency will continue to be included in the SEM as it transitions to I-SEM;
- Costs and benefits arise due to differences between the exchange rates agreed at the time of data submission and the rates applied by the SEM bank at the time of processing the payments;
- This by itself would not lead to costs if the amounts in and the amounts out were equal within the same currency. However this may not be the case, for example since generators in Northern Ireland can provide energy for Suppliers in Ireland and vice versa, the energy charges on Suppliers in Northern Ireland in £ may be less than the energy payments due to Generators in Northern Ireland in £ as those charges are coming from Suppliers in Ireland in €;
- Policy decisions in this area mean the risk associated with this currency exchange rate fluctuation should not be borne by the participants submitting data: their settlement amounts should be based on a currency fixed at point of submission;
- Any costs or benefits arising from the fluctuations in exchange rates are socialised across all Supplier Units through this charge;
- The complexity of the current approach for managing these was not favoured by the SEM Committee, and they decided to replace it with a simple approach where a tariff, determined annually by the MO based on the forecast of costs and benefits, is levied on Supplier Unit's net demand.

Currency Adjustment Charge

- To determine the tariff, the MO will need to consider the following in energy terms:
  - Determine where monies cross between Northern Ireland and Ireland:
    - Energy flows on North-South tie-line may be driven by the Day-ahead Market / Intraday Market as well as Balancing Market activity;
    - What share of North-South activity is relating to Day-ahead Market / Intraday Market trading;
    - Extent to which Balancing Actions are funded from charges in different jurisdiction.
  - Forecast exchange rate variations over the course of the tariff period.

Currency Adjustment Charge

- To determine the tariff, the MO will need to consider the following in capacity terms:
  - Capacity Payments based on exchange rate at the time of the Auction or Secondary Trade;
  - Capacity Charges based on annual exchange rate set at the beginning of the year;
  - Actual cost of payments, and receipt of charges, to the MO will be at the exchange rate at the time of financial settlement;
  - Need to determine total capacity quantities by jurisdiction and compare to forecast demand by jurisdiction;
  - This will reveal the quantity of capacity quantities that are funded in a different currency;
  - There may be differences of a number of years between the exchange rate in T-4 auctions and the time of actual payment;
  - Issues may arise where payments out are based on multi-year contracts (e.g. up to 10 years) set in different auctions, with different exchange rates applying;
  - The currency cost will have to use a weighted average exchange rate based on all that apply;
  - This can be assessed against forecast of exchange rate fluctuations and used to determine the forecast cost / benefit for the Capacity Market;
  - Considering all of this, the MO needs to forecast the currency cost / benefit on the basis of contract quantities and prices to calculate a tariff for this charge.

Chapter 8: Market Operator Charge

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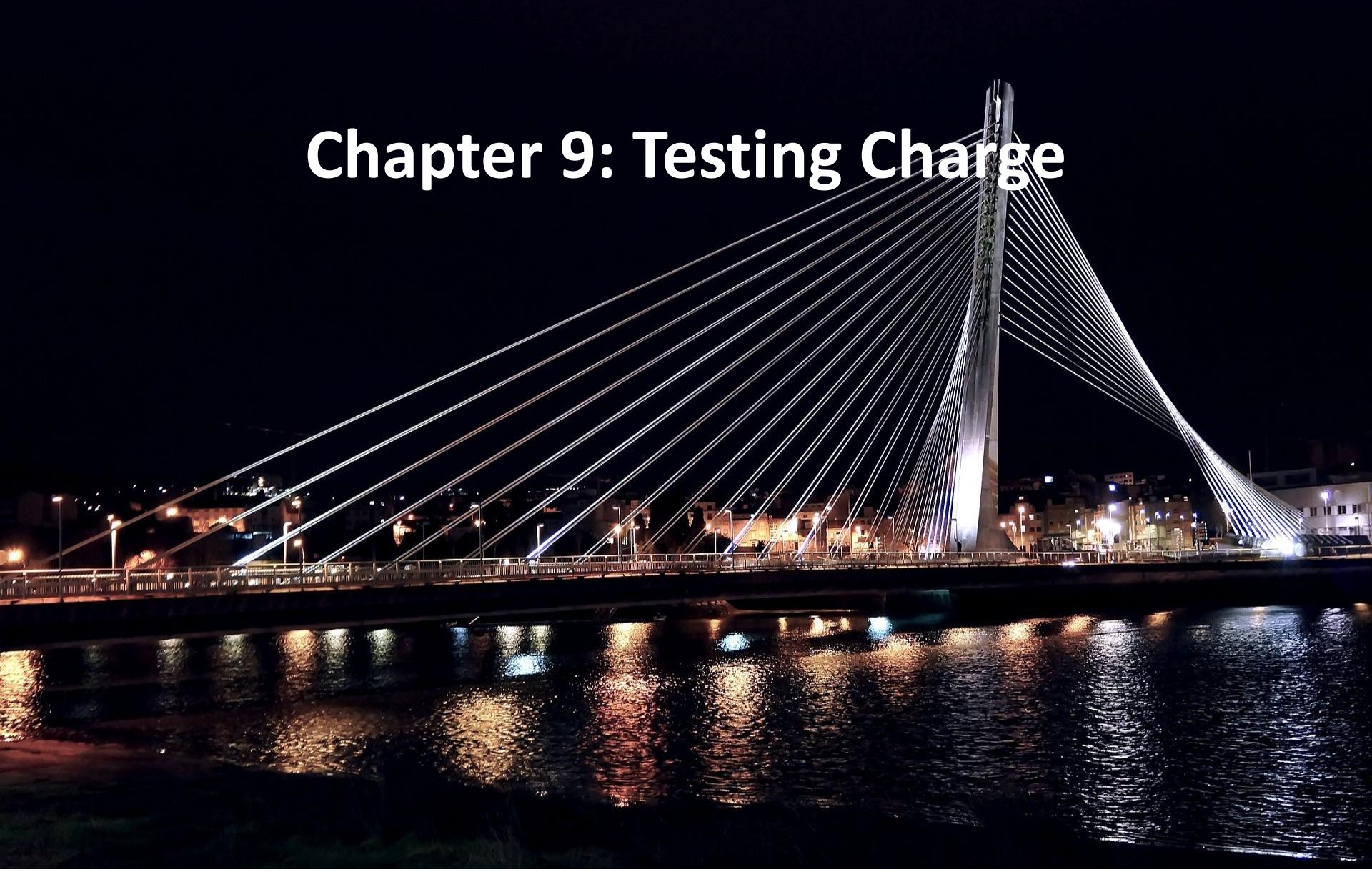
Market Operator Charge

- Market Operator charges are used to recover the costs of administering the market;
- The current approach of fixed charges on Suppliers and Generators with variable charges on suppliers has been retained, except variable charges are based on net metered quantity:

$$CVMO_{vb} = \sum_{\gamma \ in \ b} QMLF_{v\gamma} \times PVMO_{y}$$

- If other approaches are desired, these can be addressed in the tariff setting process. The format of having fixed and variable charges allows for different approaches to be taken, such as setting the variable costs to zero if fixed charges only were desired;
- These will be the sole charge that will appear on a separate Settlement Document to other charges;
- Similar to Capacity Charges and Imperfections Charges, Trading Site Supplier Units will be subject to Market Operator if their site is net importing.

Chapter 9: Testing Charge



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Testing Charge

- Testing Charges are applied to units who are Under Test to recover some of the additional costs incurred through accommodating such a test;
- The appropriate testing tariff will be selected by TSO when approving under test Physical Notification;
- Currently there are two tariffs which can be applied. Tariff A is generally for commissioning, and Tariff B is generally for late stages of commissioning or existing units, with the type of test and previous performance of the unit determining which tariff would be selected, and the value of the tariff varies with the size of the unit;
- Tariffs are reviewed annually, the table below gives an example of the current 2017 values for these tariffs, and some of the components which are included in calculating them.

Generating Unit Size (MW)	TARIFF A					TARIFF B
	Reserve Premium	Reserve Constraint Cost	Additional Run Hours	Tripping	Total Charge	Tripping
GEN <50			€ 9.01		€ 9.01	
50 < GEN ≤100			€ 7.76		€ 7.76	
100 < GEN ≤ 150			€ 7.82		€ 7.82	
150 < GEN ≤ 200			€ 6.91	€ 0.35	€ 7.27	€ 0.22
200 < GEN ≤ 250			€ 7.02	€ 0.57	€ 7.59	€ 0.35
250 < GEN ≤ 300			€ 6.87	€ 0.93	€ 7.80	€ 0.57
300 < GEN ≤ 350			€ 6.65	€ 1.50	€ 8.16	€ 0.93
350 < GEN ≤ 400	€ 0.05	€ 0.12	€ 5.49	€ 2.44	€ 8.10	€ 1.51
400 < GEN ≤ 450	€ 0.24	€ 0.74	€ 4.45	€ 3.97	€ 9.41	€ 2.46
450 < GEN	€ 0.45	€ 1.66	€ 3.48	€ 6.47	€ 12.06	€ 4.01

Chapter 10: Bid Offer Acceptance Quantities

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Bid Offer Acceptance Quantity Calculation

- Bid Offer Acceptances (BOAs) are the actions taken by the SOs in the Balancing Market. The quantities associated with Bid Offer Acceptances can be thought of as the energy procured by the SOs to balance the system for both energy and non-energy purposes, considering each unit's schedule from the ex-ante markets as a start point (as indicated by their Physical Notification submissions);
- If a unit is dispatched to a different level of output than it has stated in its Final Physical Notifications, then this is calculated as a Bid Offer Acceptance Quantity;
- Each Dispatch Instruction is a Bid Offer Acceptance. This includes the Physical Dispatch Instructions issued by the SOs in the real-time operation of the system, and also Pseudo Dispatch Instructions which are a settlement concept only, created to reflect the fact that the instructions issued in the operation of the system are open, while settlement of these actions is for closed volumes;
- BOAs are calculated based on what was instructed, not based on what was delivered:
  - Any adjustment to settlement amounts required for non-delivery is separately calculated, and information on non-delivery is not known in time for pricing calculations.
- There are a number of pieces of functionality needed to correctly calculate BOAs:
  - Differences between Imbalance Settlement Periods, and within those periods with multiple Price Quantity Pair Bands and multiple acceptances;
  - Open instructions in operations with closed acceptances in settlement;
  - Substitutive PNs;
  - Availability.
- While all of this functionality builds in layers which can be complex, it could be simply thought of as calculating the correct quantity at the price which is active at the time the quantity was accepted;
- Bid Offer Acceptances relevant to Interconnector Units are an input from the SOs of the quantities and prices agreed for the cross-border SO-SO trade, and are not calculated as explained in this section.

Bid Offer Acceptance Quantity Calculation

- Bid Offer Acceptances is the general term used to describe all actions taken by the SOs. When calculating quantities and prices to apply in pricing and settlement, they are split into two types of actions:
  - Accepted Offers, which are positive quantities (QAO), meaning the unit was dispatched greater than its Final Physical Notification Quantity (or previous closed dispatch position). These are also referred to as Increment actions, or “Incs”;
  - Accepted Bids, which are negative quantities (QAB), meaning the unit was dispatched less than its Final Physical Notification Quantity (or previous closed dispatch position). These are also referred to as Decrement actions, or “Decs”.
- A single Bid Offer Acceptance could have an Accepted Offer and an Accepted Bid, for example if the Dispatch Instruction requires the unit to ramp, with the start of this ramp being below its FPN and the end of that ramp being above its FPN, but there are different calculations needed to calculate positive and negative quantities;
- This means that for each Bid Offer Acceptance, the quantity calculation needs to be carried out twice: once with inputs for Incs, and once with inputs for Decs. If there are only Incs or only Decs relevant to a Bid Offer Acceptance, the algebra is set up so that the irrelevant calculation will return a value of zero;
- When calculating Accepted Bid and Accepted Offer Quantities for each unit (u) and each BOA (o), the calculation splits these into the volumes present in each Imbalance Settlement Period (γ) and present in each Price Quantity Pair Band (i). This is done to have a single price which applies to the quantity;
- The calculations are carried out ex-post close to real-time for a five minute period for use in calculating the Imbalance Price, and then carried out again within settlement timelines for use in calculating settlement amounts. Most of the information between the two will be the same, however there may be situations where data which was not present in time for the pricing calculations is present for the settlement calculations, for example the logging of a manual Dispatch Instruction or updating in EDIL the availability declaration of a unit which has tripped. Therefore in a small number of cases the quantities in settlement could be different to those calculated for pricing.

Bid Offer Acceptance Quantity Calculation

- When open instructions are issued in the physical operation of the power system, they need to be closed in settlement in order to calculate the quantity and price associated with a BOA. The principle used to determine how BOAs are closed and what quantity is calculated for a BOA is that each BOA accepts the minimum physically feasible quantity implied by the Dispatch Instruction and the unit's TOD;
- This means for Dispatch Instructions to change a unit's output level, a quantity is calculated which reflects the unit ramping from its previous position to its Target Instruction Level according to its TOD, then once it reaches this output level immediately ramping back to its FPN profile, closing the BOA. This could be thought of as an initial closed acceptance.
- To reflect the fact that in the physical operation of the power system the unit maintains its output at the Target Instruction Level, a new BOA is opened, where for every minute that passes in real-time operations where the previous instruction is not closed, there is a deemed acceptance of the quantity associated with ramping back to the FPN curve starting at the following minute. This could be thought of as continuous open acceptance until another instruction is issued.
- How instructions are opened and closed is handled in Instruction Profiling through Dispatch Instructions and Pseudo Dispatch Instructions:
  - Each instruction opens a new Bid Offer Acceptance and has an individual instruction profile to calculate the quantity vs the previous BOAs instruction profile – this approach allows for multiple acceptances in a single period to be considered with different sets of COD.

Bid Offer Acceptance Quantity Calculation

- If change in prices affects quantities from continuous acceptance, a new BOA needs to be opened to reflect the time the data was updated to ensure that the new data can apply in the relevant periods for every subsequent continuously accepted minute;
- While conceptually quantities in continuous open acceptance are accepted for each minute that passes in real-time operations, there is no need to actually open and close a BOA to calculate quantities for every individual minute :
  - The exact events where a BOA should be opened can be tracked by timestamps of when other BOAs are opening and closing, profiles for minimum physically feasible quantity, gate closure for Imbalance Settlement Period boundaries, timestamps of then Participants update COD, etc.;
  - The exact events are managed through the instruction effective times of Dispatch Instructions and Pseudo Dispatch Instructions.
- The following examples are intended to visualise how quantities can be calculated for a certain Dispatch Instruction, and which prices apply to different BOAs depending on the timing of actions.

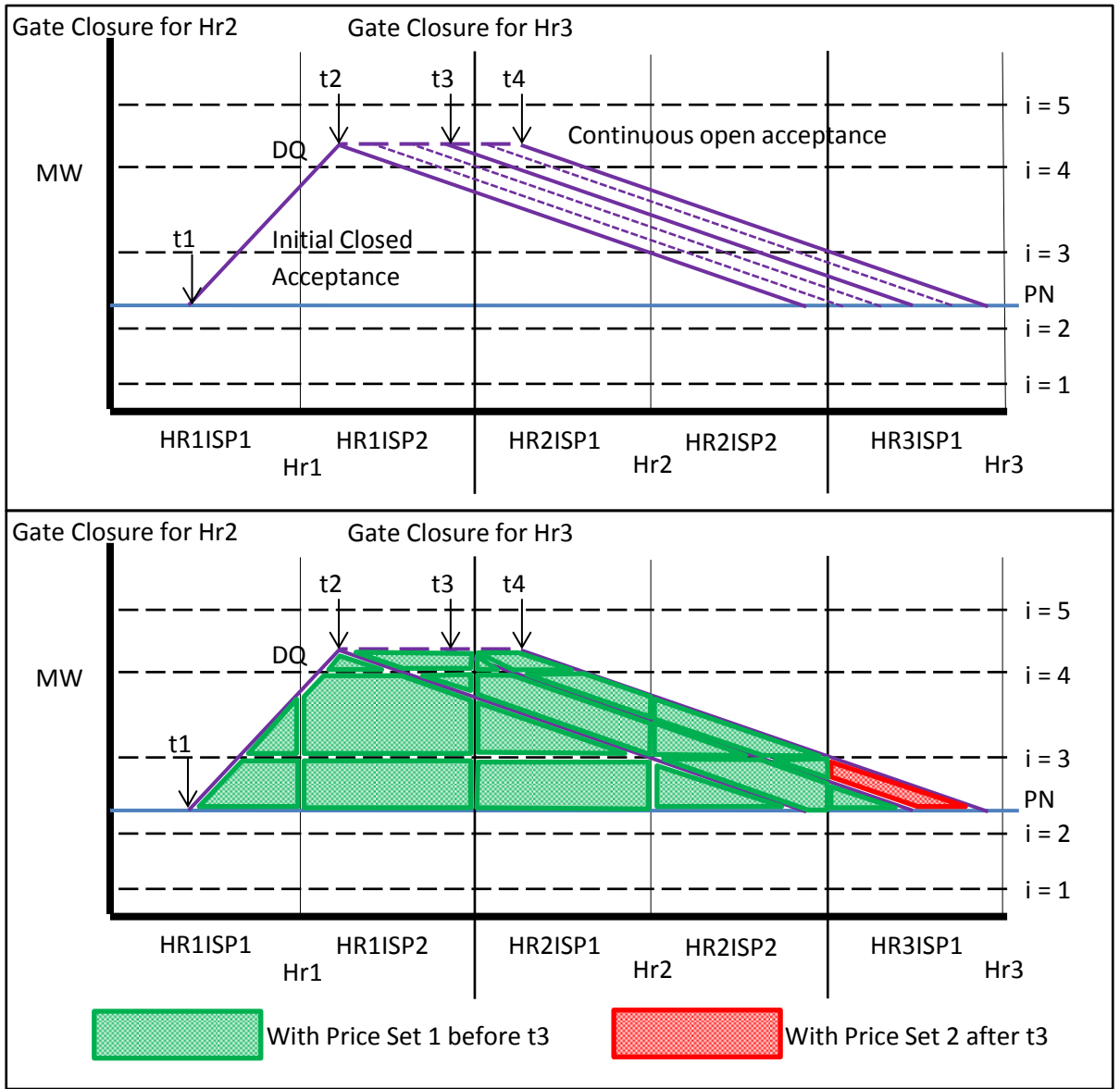
Bid Offer Acceptance Quantity Calculation

Price Change in Hr1
t1: BOA 1 is opened through a dispatch instruction to go to a certain output level;

t2: BOA 2 opened as instruction is not closed;

t3: participant resubmits prices which apply from Hr3 onward where gate is not yet closed;

t4: TSO closes instruction by instructing participant go to a certain output level (equal to the PN).



Bid Offer Acceptance Quantity Calculation

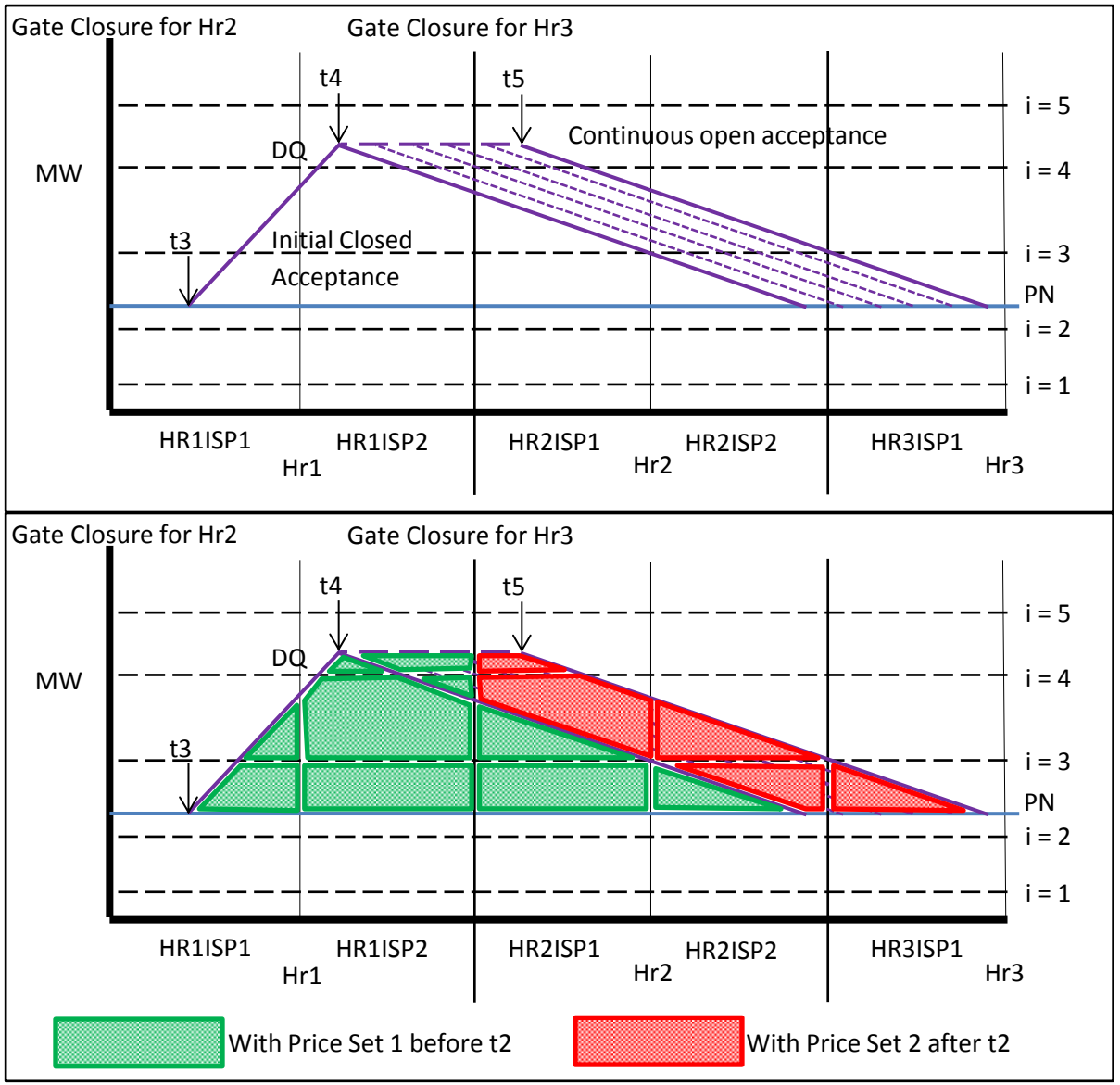
Price Change before Hr1
t1 before Hr1: Instruction issued by TSO to go to a certain output level;

t2 before Hr1 but after t1: participant updates price, applicable from Hr2 onwards where gate is not yet closed;

t3: BOA 1 is opened (after notice time of instruction, etc.);

t4: BOA 2 opened as instruction is not closed;

t5: TSO closes instruction by instructing participant to go to a certain output level (equal to the PN).

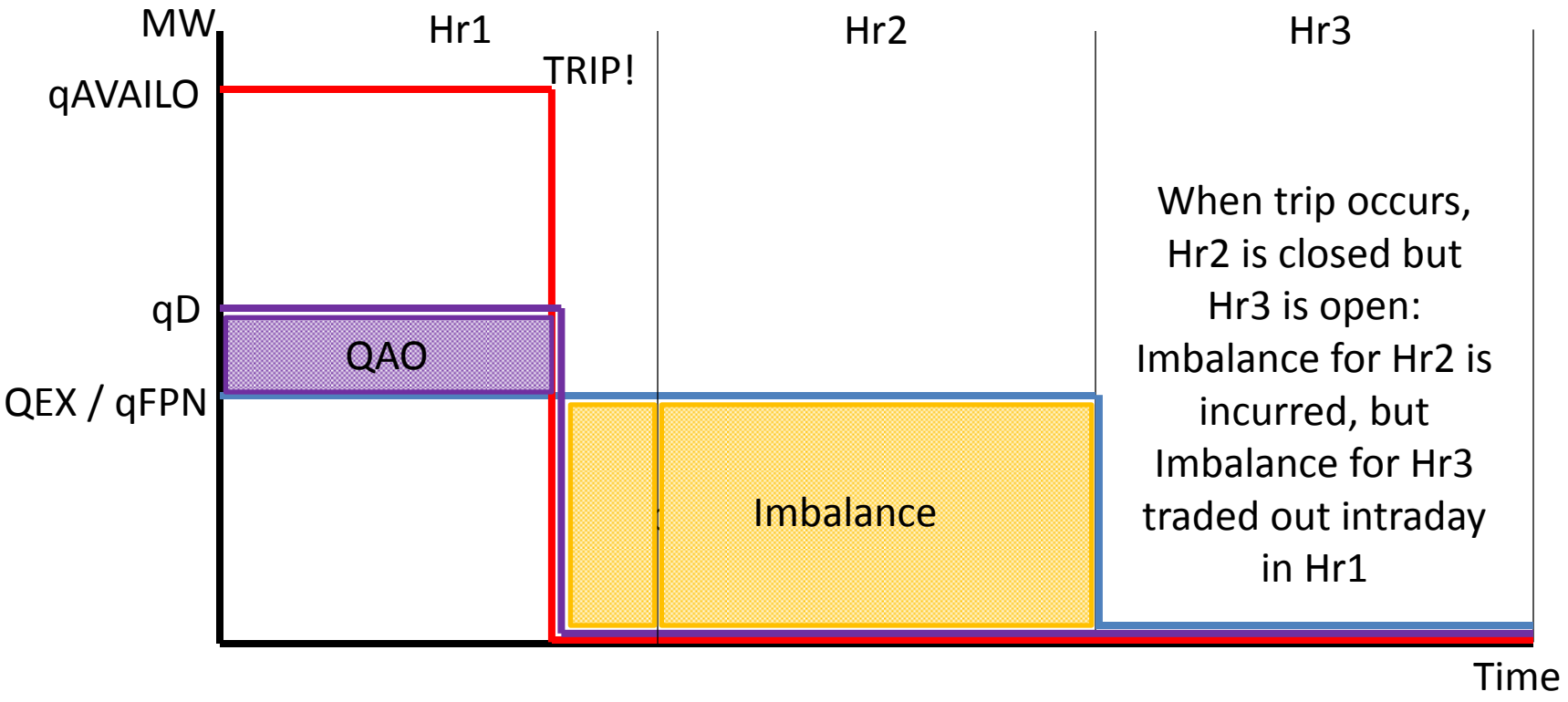


Bid Offer Acceptance Quantity Calculation

- Outturn Availability in Bid Offer Acceptance Quantity (qBOA) calculation:
  - This is a separate data feed to the Physical Notifications, being updated in real-time (including after Gate Closure 2) through EDIL in accordance with the Grid Code.
- It is included in the calculations of BOAs for both pricing and settlement functions, in particular for the calculation of Dec actions;
- The decision to dispatch a unit away from its PN may be driven by availability, rather than based on energy or non-energy balancing economic merit, for example if a unit trips the SO must dispatch that unit to zero to match the fact it cannot provide power during the trip;
- Availability is included in the algebra for the calculation of Decs to ensure that any decrease in output from PNs due to reduced availability is seen as an imbalance, rather than an Accepted Bid;
- This is done by taking the minimum of the FPN and the Outturn Availability in the equation: if the availability is lower, then this is the point from which Decs are calculation, not from the FPN. The difference between the unit's trades / FPN and their availability would turn up through the metered quantity;
- For Non-Dispatchable units who do not need to submit PNs (e.g. wind units), their FPN quantity profile is taken to be their Outturn Availability profile.

Bid Offer Acceptance Quantity Calculation

- Example of a unit tripping:



Chapter 11: Losses

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Losses

- Generators are not attributed the power they generate which does not get to end consumers, i.e. which have been lost on the transmission and distribution systems;
- This is removed by estimating the relationship between the location of a particular generator and the losses resulting when trying to transport power to end consumers suppliers (e.g. if a unit has a lot of the system to get through to get to end consumers then their loss factor may be higher). This estimate is through Transmission and Distribution Loss Adjustment Factors, which are multiplied together to form Combined Loss Adjustment Factors;
- Applying these loss factors to all generators means they can be compared on a like-with-like basis at the same notional point on the system rather than the actual distributed physical points on the system with their different losses. The notional point is known as the "Trading Boundary", and the actual physical point where the unit is located is known as the "Station Gate";
- Any variable in the code which has an "LF" at the end prior to the subscripts means that the value of the variable is multiplied by the relevant loss-factor;
- Ex-ante market trades must be at the "Trading Boundary" when the unit submits them, i.e. they need to have loss factors incorporated into their quantities and prices.

Losses

- Physical system operation is seen at the Station Gate, and it is at this point that dispatch instructions will be issued:
  - Physical Notification Quantities need to be at the "Station Gate" also, i.e. not adjusted for losses, to reflect the fact that Dispatch Instructions from the SOs to follow this output level or a level above/below it will be issued for MW output levels at the "Station Gate".
- However in order to settle correctly, and in order to compare like-with-like against the ex-ante market quantities, the balancing market quantities need to move from the "Station Gate" to the "Trading Boundary":
  - Metered quantities are loss-adjusted (QMLF) for comparison with net ex-ante market trades (QEX, already implicitly loss adjusted from the trade quantity inputs);
  - BOAs will initially be calculated minute-by-minute at the "Station Gate", before being converted to an integrated Imbalance Settlement Period quantity, and then to a quantity at the "Trading Boundary" by multiplying it by a loss factor prior to its being used in settlement;
  - Since the quantities are being adjusted for losses, to get the same revenue for an action Participants will need to incorporate loss factors into their Bid Offer Prices.
- Loss factors for interconnectors are intended to be the same across all market timeframes, therefore the basis of their calculation is different under I-SEM – a single value reflecting the losses on the line as it is represented in the ex-ante markets, rather than the impact of the line on the losses of the system.

Chapter 12: Premium and Discount Component Payments

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Premium and Discount Component Payments

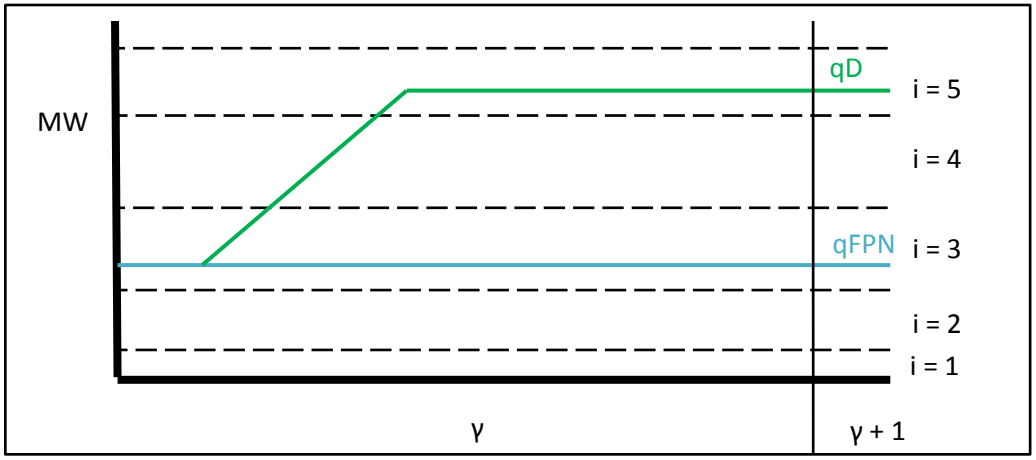
- This element ensures that units whose Bid Offer Price is more beneficial than the Imbalance Settlement Price for their BOAs gets a payment which ensures that, through net settlement with the Imbalance Component, the unit is settled at the Bid Offer Price:
  - For Accepted Offer Quantities, if the Bid Offer Price is greater than the Imbalance Settlement Price, it should receive a Premium Component Payment, i.e. they get paid more;
  - For Accepted Bid Quantities, if the Bid Offer Price is less than the Imbalance Settlement Price, it should receive a Discount Component Payment, i.e. they have to pay back less.
- Any quantities which are not eligible for such treatment are subtracted from the Accepted Offer and Accepted Bid Quantities:
  - The maximum volume of the elements which are not eligible for a premium or discount are subtracted from the Bid Offer Acceptance Quantity;
  - This is done because the volume may be a component of multiple of these elements.

Premium and Discount Component Payments

- This approach of settling at the better price is taken to ensure that Participants can submit prices which reflect their costs without being disadvantaged by being taken for a non-energy action and only being paid-as-bid;
- For example, in a pure pay-as-bid approach, an action taken for non-energy reasons would be settled at the price they submit even if it is in-merit when compared with the Imbalance Settlement Price – in this scenario, the Participant would be incentivised to submit prices which reflect their expectation of the Imbalance Settlement Price, so that they can receive that price when they are in-merit whether they are used for energy or non-energy reasons;
- The approach taken of settling units at the better price means that they can submit prices reflecting their costs with a guarantee that if they are in-merit against the Imbalance Settlement Price then that will be the price used in its settlement – it won't be disadvantaged for having been used for non-energy balancing reasons rather than energy balancing reasons. This allows for the signals of the cost of generation to be more accurately reflected in price formation, encouraging the efficiencies that entails;
- Also, if the final Imbalance Settlement Price is adjusted away from a pure marginal level for some reason, for example through Price Average Referencing, this approach ensures that the Participant with the marginal energy action is not disadvantaged by this adjustment – its Bid Offer Price will be used for settlement rather than the Imbalance Settlement Price which now potentially does not reflect its costs.

Premium and Discount Component Payments

Calculate Bid Offer Acceptance Quantities and pay a premium or discount if their Bid Offer Price is better than the Imbalance Settlement Price:



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\Big(Max\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QAOLF_{uoi\gamma} - Max\big(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

$$CDISCOUNT_{u\gamma} = \sum_{o}\sum_{i}\Big(Min\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QABLF_{uoi\gamma} - Min\big(QABBPOLF_{uoi\gamma}, QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma}, QABNFLF_{uoi\gamma}, QABCURLLF_{uoi\gamma}, QABTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

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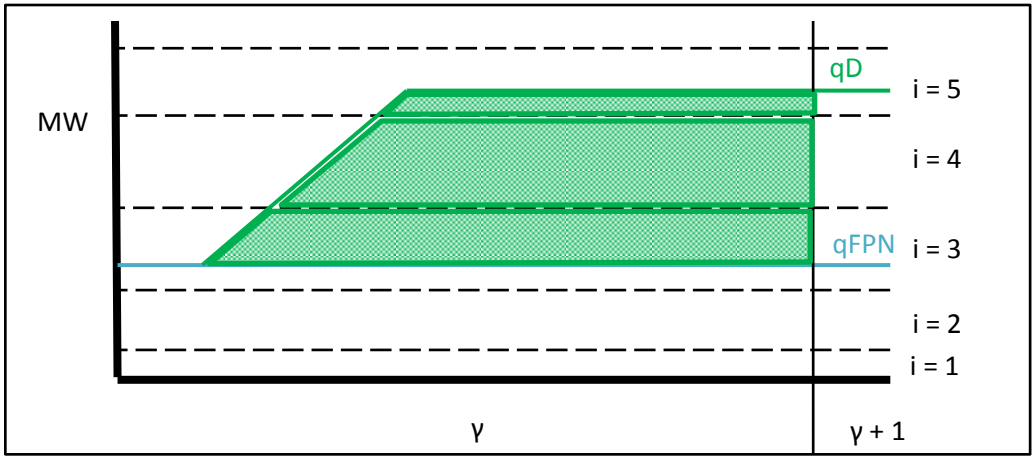

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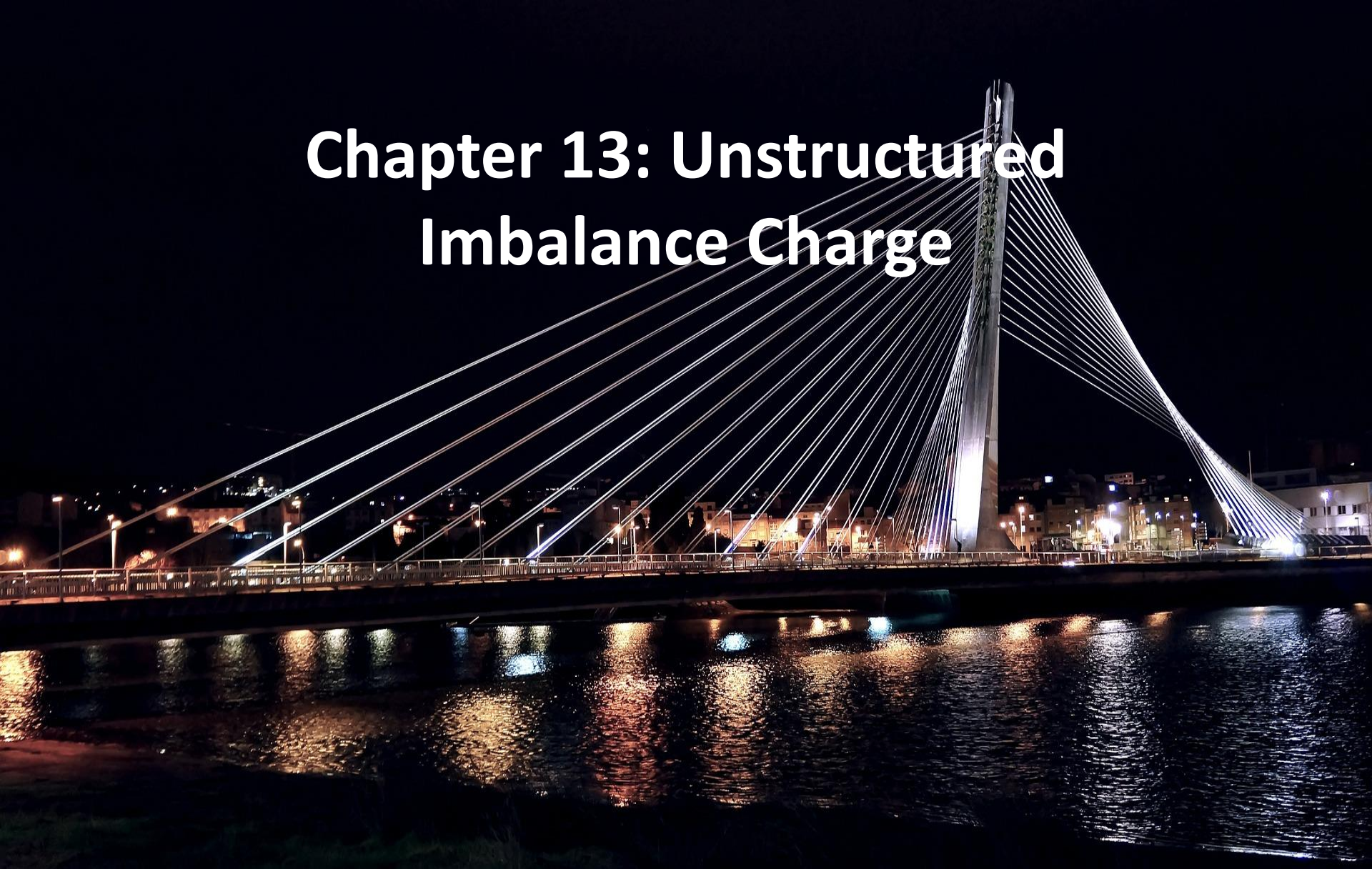
Chapter 13: Unstructured Imbalance Charge



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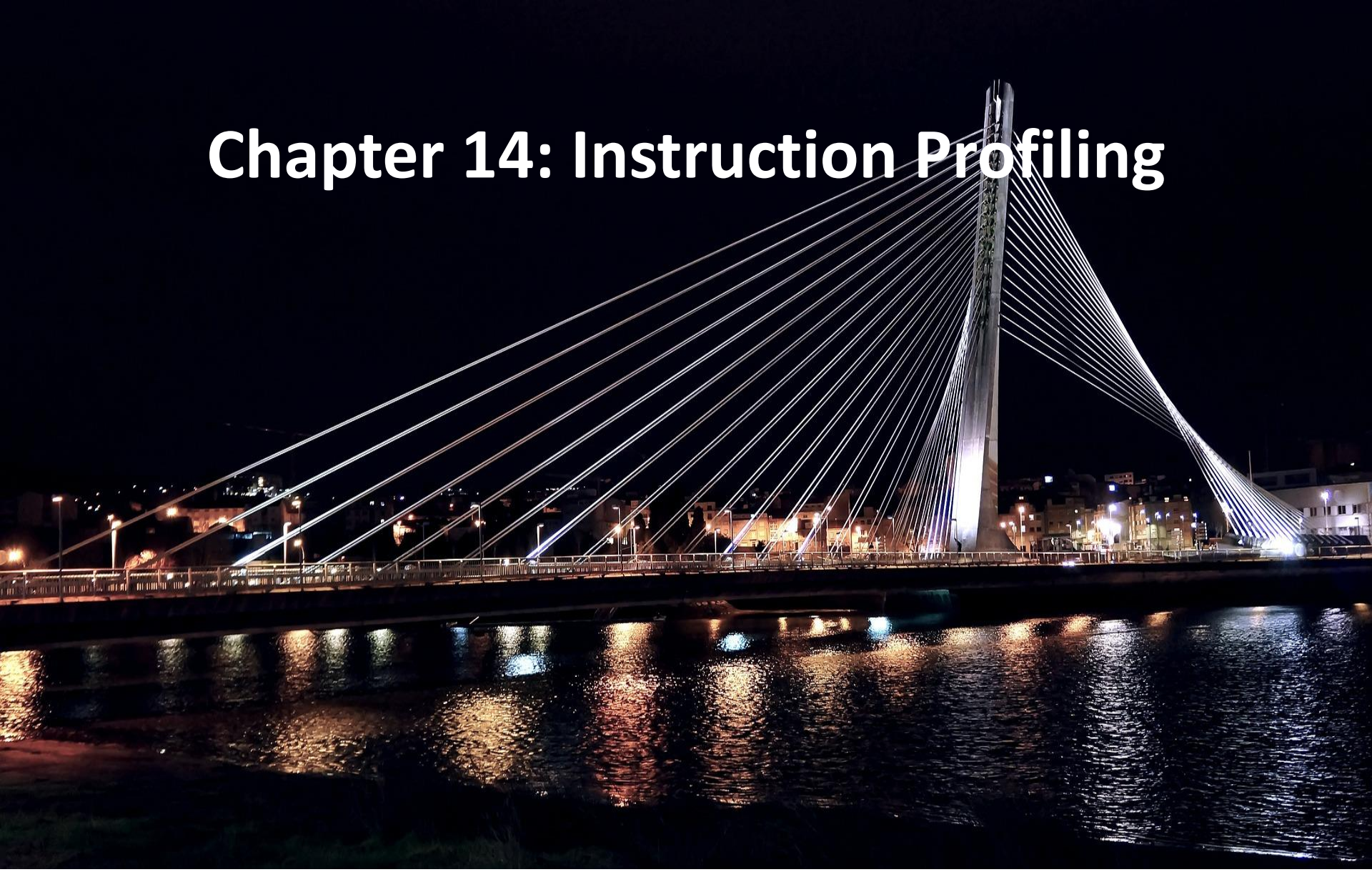
Uninstructed Imbalance Charge

- These charges apply to imbalances outside of a tolerance:
  - The tolerance is calculated in a way which considers a general minimum imbalance expected of units of a particular size, and if the imbalance was due to the unit responding to frequency deviations through Automatic Governor Control.
- This is an additional charge which results in net settlement of that imbalance at a reduced price for payments or an increased price for charges;
- The intention of this charge is to incentivise units to match their Dispatch Instructions as close as possible through their actual generation;
- The approach includes multipliers which adjust prices:
  - Discount for Over Generation Factor, FDOG, decreases price;
  - Premium for Under Generation Factor, FPUG, increases price.
- The multipliers apply to the price at which unit was settled:
  - To the Imbalance Settlement Price for all quantities;
  - To the premium/discount for undelivered BOAs outside tolerance.
- Undelivered BOAs outside tolerance are determined with similar approach to determining original undelivered BOAs.

Chapter 14: Instruction Profiling



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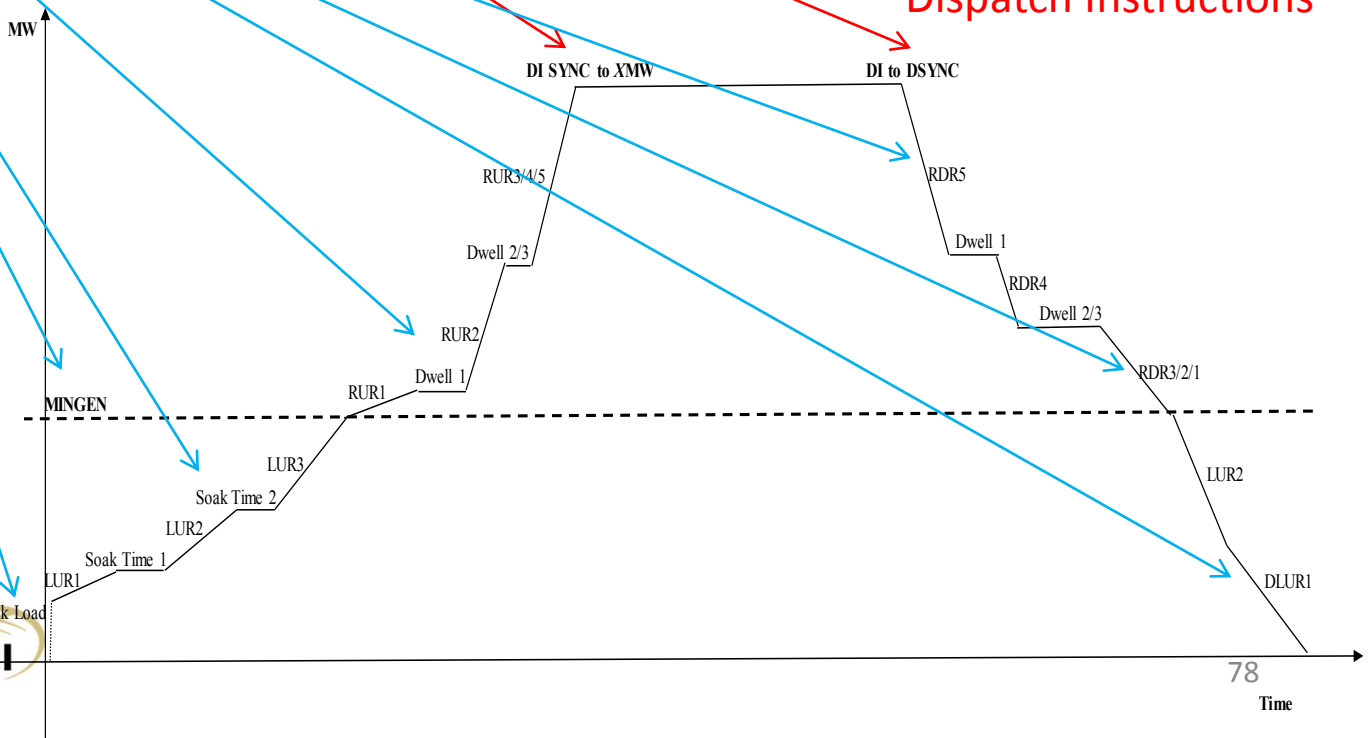
Instruction Profiling

SEM Inputs

TOD is used in Instruction Profiling to calculate the MW output a unit should be performing to meet its dispatch instruction. Instruction Profiling has uses in two areas.

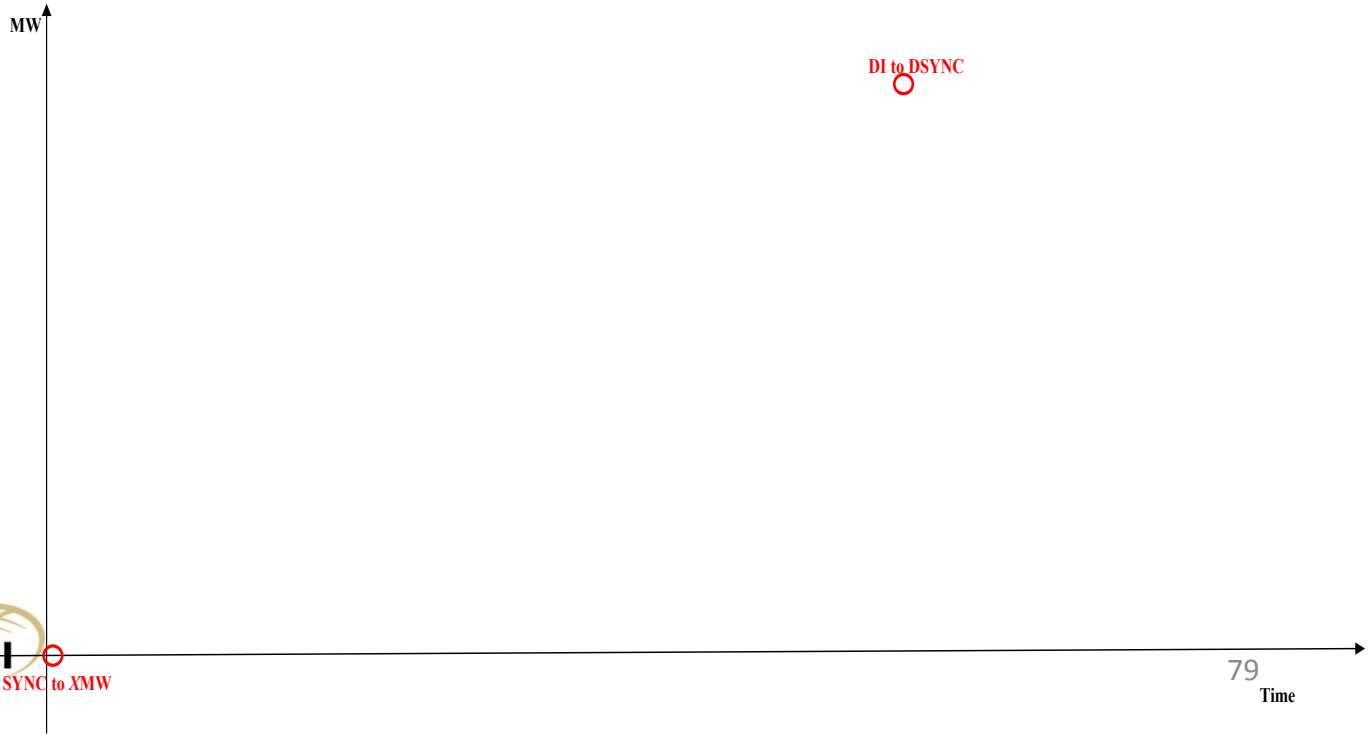
Technical Offer Data

Dispatch Instructions



Instruction Profiling

- Like today this is used to calculate the half-hour resolution Dispatch Quantity, which considers the output of the unit over an Imbalance Settlement Period;
- This is used to have a half-hour resolution quantity for dispatch to compare with other half-hour quantities, such as against Metered Quantities in calculating Uninstructed Imbalance Charges;
- Three step process to calculate this:
    1. Dispatch Instructions recorded and validated from EDIL;



Instruction Profiling

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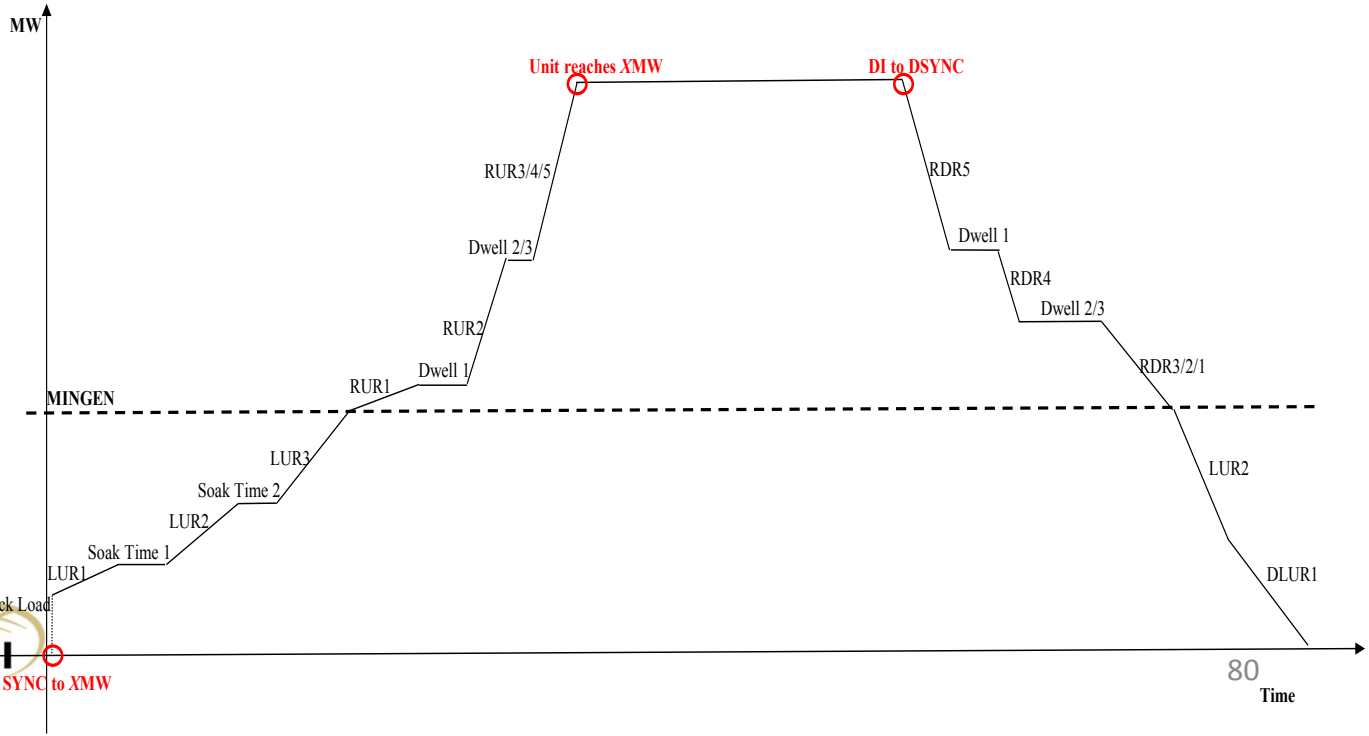
- This is used to have a half-hour resolution quantity for dispatch to compare with other half-hour quantities, such as against Metered Quantities in calculating Uninstructed Imbalance Charges;
- Three step process to calculate this:
  1. Dispatch Instructions recorded and validated from EDIL;
  2. Create a Profile joining all the DI according to Technical Offer Data (TOD);



Instruction Profiling

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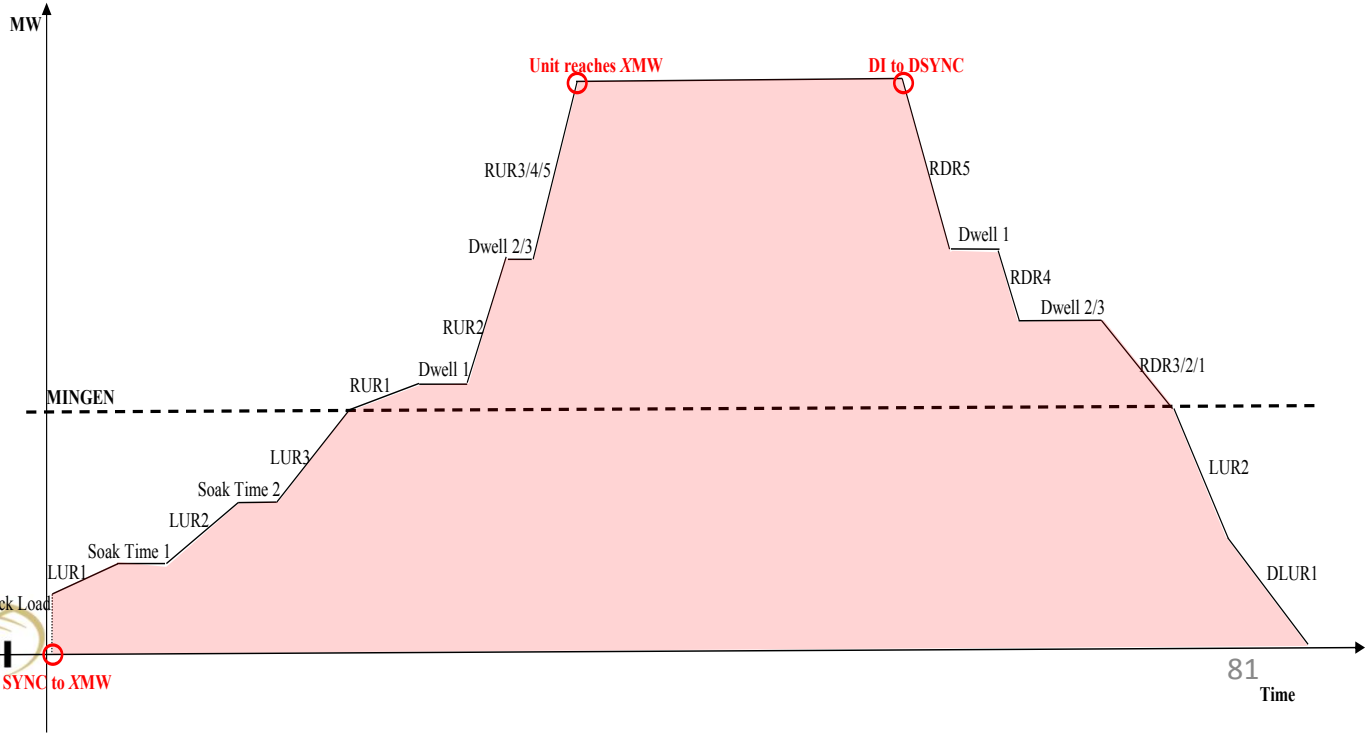
- This is used to have a half-hour resolution quantity for dispatch to compare with other half-hour quantities, such as against Metered Quantities in calculating Uninstructed Imbalance Charges;
- Three step process to calculate this:
  1. Dispatch Instructions recorded and validated from EDIL;
  2. Create a Profile joining all the DI according to Technical Offer Data (TOD);
  3. Calculate Dispatch Quantity as the area under the curve divided into each Imbalance Settlement Period in MWh.



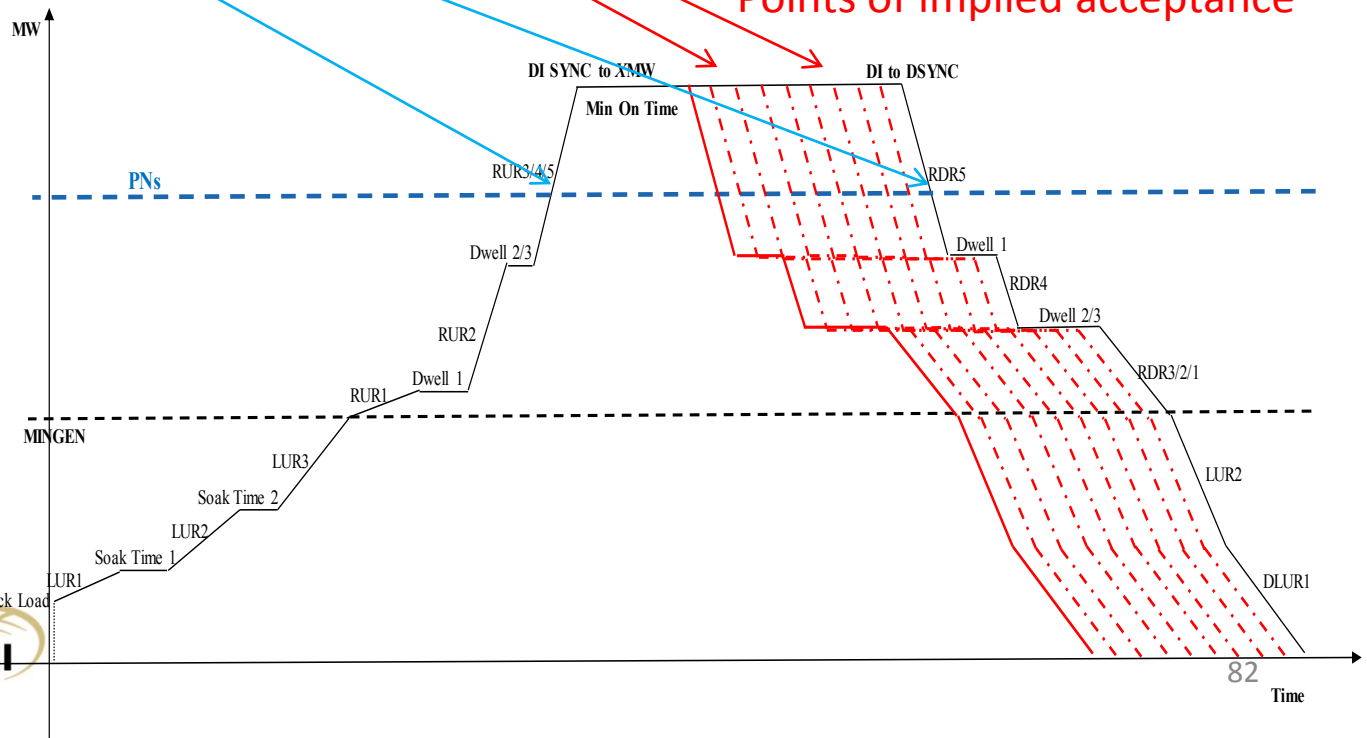
Instruction Profiling

Additional Outputs

Another use of TOD in instruction profiling is to create a minute-by-minute resolution Dispatch Quantity profile which is used along with the PN profile to calculate Bid Offer Acceptances. Every Bid Offer Acceptance has its own Dispatch Instruction and its own Dispatch Quantity profile to calculate the accepted quantity for that particular acceptance.

Cross points between profiles of Instructions and PNs

Points of implied acceptance



Instruction Profiling

- Today's approach to Instruction Profiling (high level):
  - Carry out functionality in settlement timeframe;
  - Inputs are all Physical Dispatch Instructions (DIs) recorded from EDIL;
  - Create a single instruction profile taking into account all DIs;
  - The instruction profile follows the DIs, joining the dots according to the TOD;
  - From this instruction profile, calculate DQ (half hour value representing final dispatch output level unit should be following).

Instruction Profiling

- I-SEM approach (high level):
  - Carry out functionality in pricing timeframe and again in settlement timeframes;
  - 2 types of Instructions are used:
    - Physical Dispatch Instructions (as currently understood, input from EDIL); and
    - Pseudo-Dispatch Instructions (created ex-post in Instruction Profiling, according to a ruleset, for settlement purposes only);
  - Create an instruction profile per Instruction:
    - For Physical Dispatch Instructions, take into account all Dispatch Instructions prior to and including the current instruction;
    - For Pseudo-Dispatch Instructions, take into account all Dispatch Instructions prior to and including the current instruction and take into account the next instruction to know when to end the profile.
  - The instruction profiles are created to reflect the following:
    - All Physical Dispatch Instruction profiles should follow TOD, representing the minimum technically feasible profile to reach the instructed level (and maintaining that level if required by the TOD, e.g. min on time, "Effective Until Time"), then ramp back to FPN and maintain FPN;
    - All Pseudo-Dispatch Instruction profiles should be to maintain the level intended by the instruction, until the next instruction, then ramp back to FPN and maintain FPN.
  - Use these profiles to calculate a qBOA for each instruction:
    - Each instruction closes the previous BOA and opens a new BOA, therefore need instruction profiles for each instruction;
    - The inputs to the $qBOA_{uoih}(t)$ calculation are the instruction profile for the current order ($qD_{uoh}(t)$), and the instruction profile for the previous order ($qD_{u(o-1)h}(t)$).
  - Also use the final profile, taking into account all DIs, to calculate QD_{uy} (equivalent to DQ today).

Instruction Profiling

- Why are Pseudo Dispatch Instructions needed?
  - To have open instructions in physical operation, with closed acceptances of order in settlement:
    - Orders are accepted considering “the minimum quantity given the relevant technical offer data, particularly ramp-rates and minimum on time, of a unit, and then subsequent acceptances minute-by-minute of the minimum additional quantity given the technical data”.
  - To reflect the fact that orders accepted at different times can have different prices applying:
    - E.g. an instruction to start issued hours in advance could use COD set 1, while keeping the unit on in that same period could need to use COD set 2.
  - Need to be able to close an order and open a new one to reflect the fact that output is still at the last instructed level;
    - Close order from Physical DI according to TOD;
    - Open order using Pseudo DI to reflect fact output level is being maintained at previously instructed level.
  - Need to keep continuously opening orders to reflect the fact that they are being accepted in real-time, rather than at the time of the previous physical instruction:
    - Closes the previous order and opens a new one in a way which ensures that the Simple Incs and Decs COD (if submitted and relevant) is used, and that the latest submitted COD before gate closure for that period are used;
    - Opens a new order to keep accepting quantities, reflecting the fact that the instruction and the action are still open in operations until a physical Dispatch Instruction is issued.

Instruction Profiling

The table below gives the list of the Pseudo Dispatch Instructions used in Instruction Profiling.

Title	Code
Continuous Open Acceptance After MWOF	PMWO
Continuous Open Acceptance After MXON	PMXN
Continuous Open Acceptance After MXOF	PMXF
Continuous Open Acceptance After SYNC	PSYN
Continuous Open Acceptance After DESY	PDES
Continuous Open Acceptance After PGEN	PPGE
Continuous Open Acceptance Keeping Unit Off	POFF
Continuous Open Acceptance After COD Change	PCOD
Continuous Open Acceptance After Imbalance Settlement Period Boundary	PISP

Chapter 15: Selection of Commercial Offer Data

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Selection of Commercial Offer Data

- Which set of COD is used for pricing and settlement is based on:
  - The timing of the Balancing Market actions taken;
  - What formats of COD are submitted; and
  - The reason for which the action was taken (energy vs non-energy) – this only influences the COD used for settlement, not for pricing.

Selection of Commercial Offer Data

- For timing of actions taken:
  - This depends on the timing of the Dispatch Instructions which open Bid Offer Acceptances;
  - Each Dispatch Instruction has the following time attributes:
    - Instruction Issue Time (i.e. the time the SO sends, or would have had to send, the Dispatch Instruction to the unit to result in a Bid Offer Acceptance); and
    - Instruction Effective Time (i.e. the time when, in order to comply with the instruction of meeting its instructed level in time, the unit must start changing its output).
  - If the Instruction Issue Time is before GC2 for the Imbalance Settlement Period with the Instruction Effective Time, then Complex COD must be used, otherwise Simple COD may be used.

Selection of Commercial Offer Data

- For the formats submitted:
  - When Complex COD needs to be used, the following is the priority of submissions used:
    - Use Trading Day Specific Complex COD if submitted; else
    - Use Default Complex COD.
  - When Simple COD needs to be used, the following is the priority of submissions used:
    - Use Trading Period Specific Simple COD if submitted; else
    - Use Inc/Dec curve from Trading Day Specific Complex COD if submitted; else
    - Use Inc/Dec curve from Default Complex COD.

Selection of Commercial Offer Data

- For the reason for which the action is taken:
  - If a unit is deemed to be used for non-energy actions in an Imbalance Settlement Period, its Complex Bid Offer Data is used the calculation of Bid Offer Acceptance quantities and prices in settlement for that period.
- Determining when unit deemed to be “non-energy”:
  - In imbalance pricing through combination of:
    - SO Flagging (the most accurate information available to tell if an action was taken for non-energy reasons);
    - NIV Tagging (where there are less SO Flagged actions than what can be removed to result in the Net Imbalance Volume, there may be non-energy actions taken for which the accurate information was not available, e.g. there are less SO Flagged actions than the NIV, or SO Flagging switched off, NIV tagging assumes that the most expensive actions are non-energy).
  - If unit SO Flagged or NIV Tagged within an Imbalance Settlement Period, it is deemed to be non-energy, and its Complex Bid Offer Data will apply in settlement calculations.

Selection of Commercial Offer Data

- A Balancing Market Principles Code of Practice (BMPCOP) applies to Complex Bid Offer Data:
  - This document is the market power mitigation approach for settlement of non-energy actions decided by RAs, and is enforced through a generation licence condition;
  - The BMPCOP outlines requirements and guidance for the values allowed to be submitted to be reflective of costs;
  - **N.B.** This does not apply for calculation of quantities and prices for the Imbalance Pricing process:
    - Actions taken for non-energy reasons would be SO Flagged or NIV Tagged and therefore unable to set the Marginal Energy Action Price, and any out-of-merit prices would be removed from the remainder of the Imbalance Pricing Process through the Replacement Bid Offer Price, although the prices of in-merit non-energy actions could still impact the final Imbalance Price through the NIV and PAR Tagging process;
    - Results in different set of BOA quantities and prices in Imbalance Pricing process and Imbalance Settlement process.
- The BMPCOP does not apply to Simple Bid Offer Data:
  - Participant can submit values based on desired value, does not just have to be reflective of costs;
  - Actions taken for energy reasons after gate closure can reflect the desired value in the Imbalance Pricing process and the settlement process.

Chapter 16: Undelivered Quantities

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Undelivered Quantities

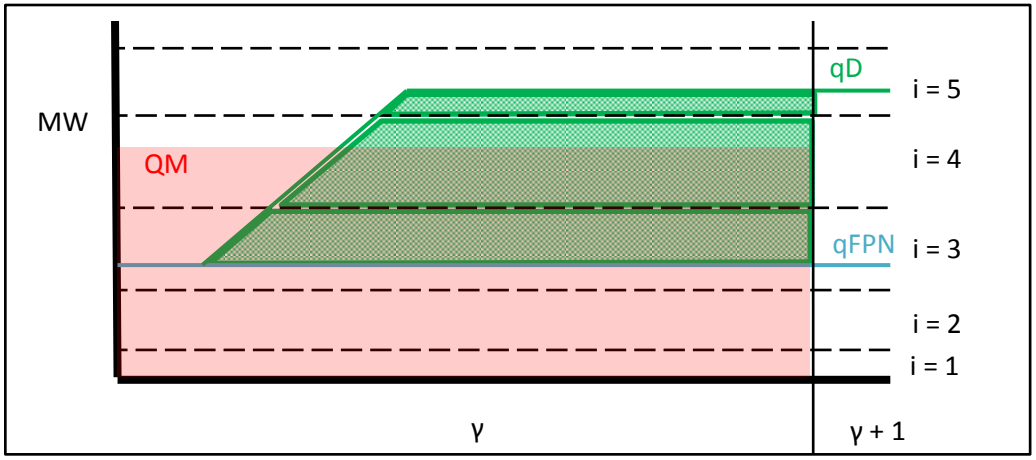
- Undelivered quantities are ones which have been calculated as a BOA due to the difference between the unit's FPN Quantity profile and their Dispatch Quantity profile, but which in reality was not delivered when considering the actual output of the unit;
- This refers to a deviation between the actual output of a Generator Unit, as represented through their Metered Quantity (QM), from the level to which they were expected to output in order to comply with their dispatch instructions, represented through their Dispatch Quantity (QD);
- Depending on the direction of the undelivery (i.e. if the Metered Quantity is at a value below QD or above QD), either offers to increase generation or bids to decrease generation could be the ones not delivered and therefore should not be settled as a delivered balancing market action:
  - If QM is below QD, then some Accepted Offer Quantities could be undelivered because the actual output of the unit is not as high as it needed to be to deliver the instructed increase in generation;
  - If QM is above QD, then some Accepted Bid Quantities could be undelivered because the actual output of the unit is higher than it needed to be to deliver the instructed decrease in generation.
- In order to compare like-with-like, a half-hour integrated MWh quantity for the Dispatch Quantity (QD) needs to be created to compare with QM to determine the undelivery.

Undelivered Quantities

- The volume due to this difference between the Metered Quantity and the Dispatch Quantity is implicitly not included in the Imbalance Component, as it only considers the Ex-Ante Quantity versus the Metered Quantity. Therefore a process of determining which of the BOAs calculated have not been delivered needs to be carried out so that this volume can be removed from the Premium and Discount Components to ensure that a BOA does not receive a payment for which it is not eligible;
- When carrying out this process, those BOAs “closest to the Metered Quantity” are considered first, as the Metered Quantity is the quantity causing the undelivery and from which the undelivery starts;
- Considering that the SOs would accept offers to increase generation from FPN level up to a Dispatch Quantity level in merit order from lowest to highest price, and the undelivery is a difference from the Dispatch Quantity, the order in which Accepted Offers are considered undelivered is from highest price to lowest price until the total volume of BOAs considered undelivered is equal to the total Undelivered Quantity;
- Similarly, considering that the SOs would accept bids to decrease generation from FPN level down to a Dispatch Quantity level in merit order from highest to lowest price, and the undelivery is a difference from the Dispatch Quantity, the order in which Accepted Bids are considered undelivered is from lowest price to highest price until the total volume of BOAs considered undelivered is equal to the total Undelivered Quantity.

Undelivered Quantities

Did you deliver it all?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\left(Max\left(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\right) \times \left(QAOLF_{uoi\gamma} - Max\left(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\right)\right)\right)$$

$$CDISCOUNT_{u\gamma} = \sum_{o}\sum_{i}\left(Min\left(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\right) \times \left(QABLF_{uoi\gamma} - Min\left(QABBPOLF_{uoi\gamma}, QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma}, QABNFLF_{uoi\gamma}, QABCURLLF_{uoi\gamma}, QABTOTSOLF_{uoi\gamma}\right)\right)\right)$$

Undelivered Quantities

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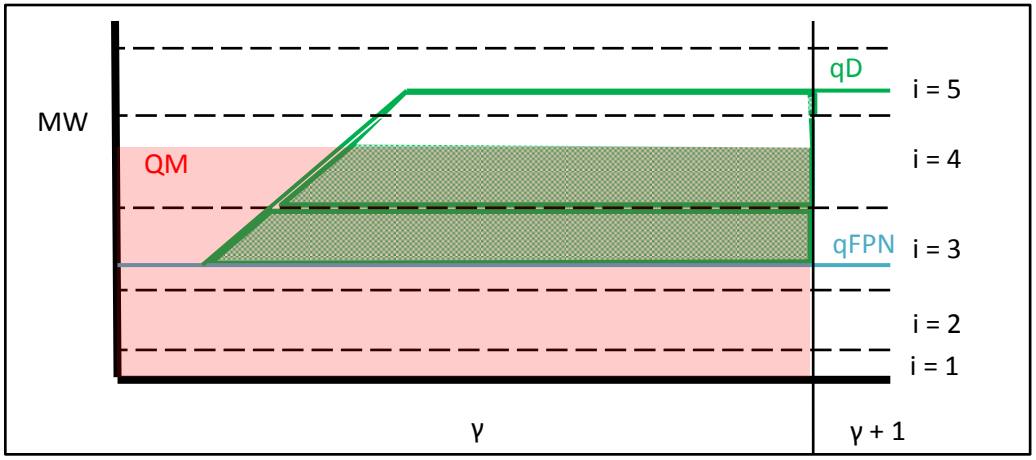

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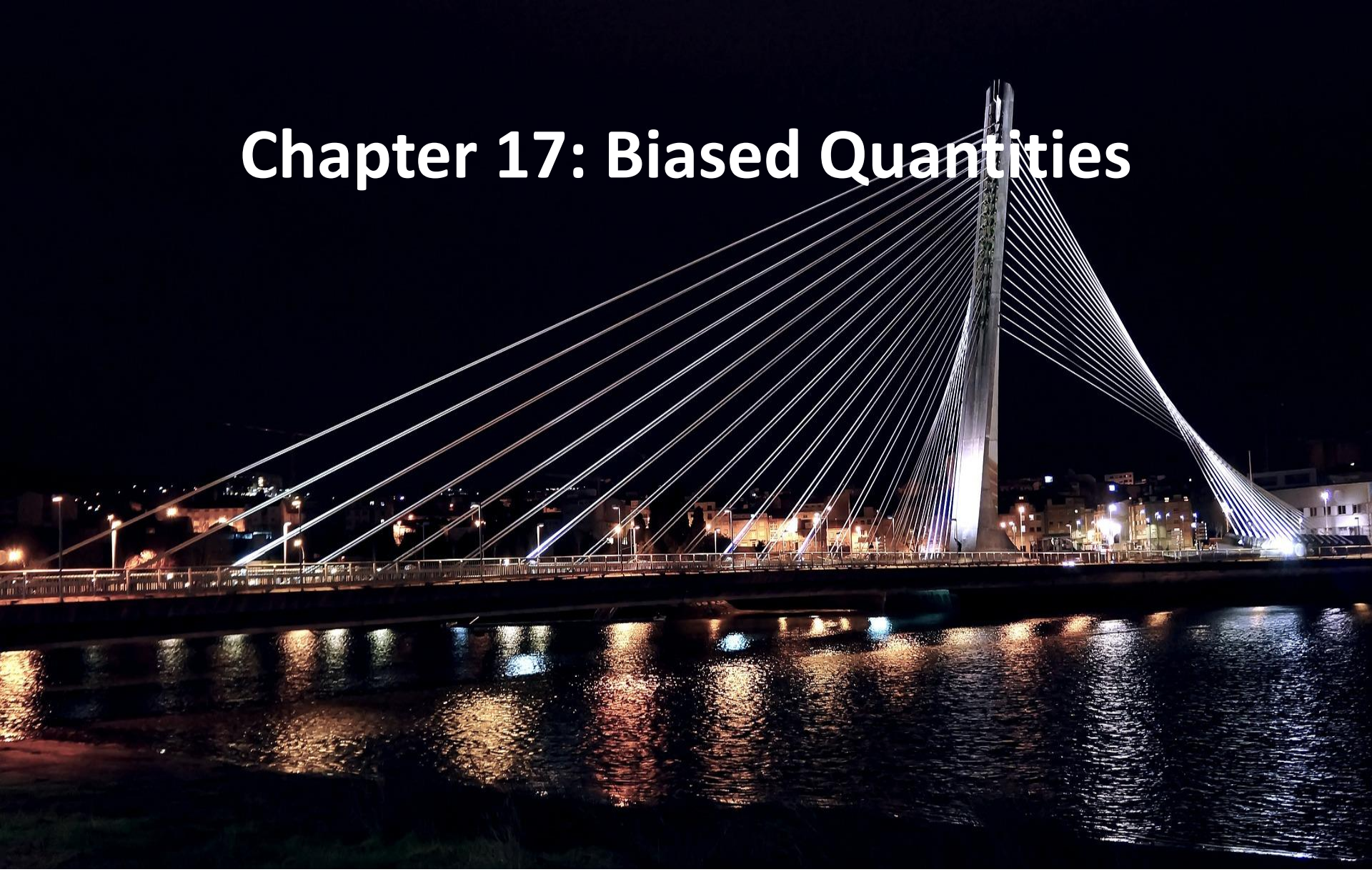
Chapter 17: Biased Quantities



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Biased Quantities

- A biased quantity is one which has been calculated as a BOA due to the difference between the unit's FPN Quantity profile and their Dispatch Quantity profile, but which in reality represents an output range which was not sold or bought in the balancing market – it was already sold or bought in the ex-ante markets. Because of this, it is not eligible to receive balancing market payments at the Imbalance Settlement Price or Bid Offer Price;
- It is a quantity which results from a difference between the unit's FPN Quantity profile that they submit, and their net ex-ante market trades (QEX) that the FPN is supposed to represent;
- Depending on the direction of the bias (i.e. if the FPN is submitted at a value below QEX or above QEX), BOAs calculated may not actually represent increasing a unit's output above their market position, or decreasing a unit's output below their market position, i.e. it should not volume which is procured in the balancing market, and should not be settled as a balancing market action:
  - If the FPN is submitted below QEX, then some Accepted Offer Quantities could be biased because the volume between the FPN and QEX has already been sold in the ex-ante markets, it is not sold in the balancing market;
  - If the FPN is submitted above QEX, then some Accepted Bid Quantities could be biased because the volume between the FPN and QEX does not represent decreasing a unit's output below their market position.
- In order to compare like-with-like, a half-hour integrated MWh quantity for the FPN (QFPN) needs to be created to compare with QEX to determine the bias.

Biased Quantities

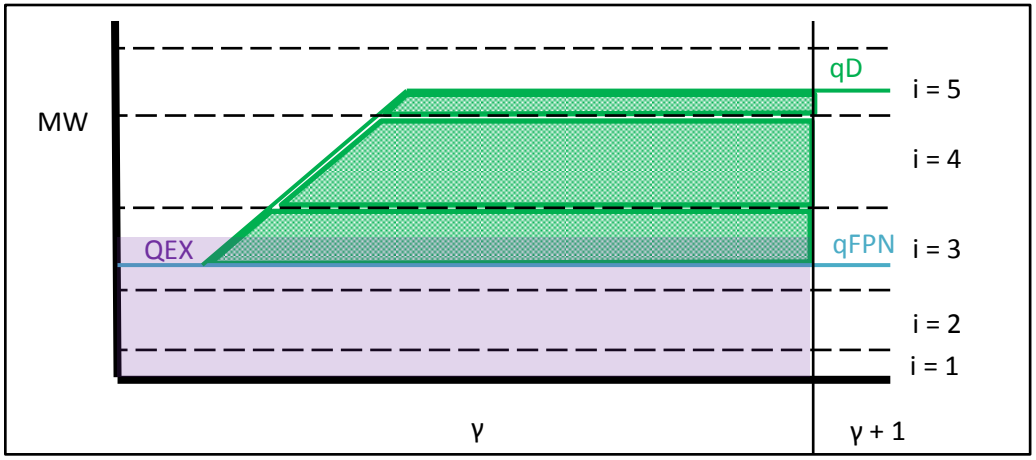
- The volume due to this difference between the Ex-Ante Quantity and the FPN is implicitly not included in the Imbalance Component, as it only considers the Ex-Ante Quantity versus the Metered Quantity. Therefore a process of determining which of the BOAs calculated are biased needs to be carried out so that this volume can be removed from the Premium and Discount Components to ensure that a BOA does not receive a payment for which it is not eligible;
- When carrying out this process, those BOAs “closest to the FPN” are considered first, as the FPN is the quantity causing the bias and from which the bias starts;
- Considering that the SOs would accept offers to increase generation from FPN level in merit order from lowest to highest price, this is the order in which Accepted Offers are considered biased until the total volume of BOAs considered biased is equal to the total Biased Quantity;
- Similarly, considering that the SOs would accept bids to decrease generation from FPN level in merit order from highest to lowest price, this is the order in which Accepted Bids are considered biased until the total volume of BOAs considered biased is equal to the total Biased Quantity.

Biased Quantities

- Autoproducers do not have biased quantities calculated on their Generator Units:
  - Their ex-ante trades would be on a Trading Unit, not on their Generator Units, but their PNs are on their Generator Units;
  - If biased quantities were calculated for them, any dec action on them would be seen as biased, which is not the correct outcome from a market design point of view.
- The biased quantity is also used to ensure that wind units do not get Curtailment Payments or Charges, or Discount Component Payments for constraints, when they have not been constrained or curtailed below their ex-ante market traded position:
  - If their availability (and therefore FPN) is above their Ex-Ante Quantity, and they are dispatched down, a BOA would still be calculated for that action, but in settlement it would be deemed biased and therefore a biased quantity equal to the BOA would be subtracted from it, removing it from the Discount and Curtailment components;
  - It would already have been removed from the Imbalance component, which would just consider their Metered Quantity (reflecting the level of output to meet their curtailment or constraint instruction) versus their Ex-Ante Quantity;
  - Overall, if a wind unit is dispatched down from an availability level which is higher than their traded position, and are not dispatched below their traded position, it would result in a reduction in the payments they would have received at the Imbalance Settlement Price for the difference between their Metered Quantity and their Ex-Ante Quantity.

Biased Quantities

Is the balancing action actually changing your ex-ante trade position?



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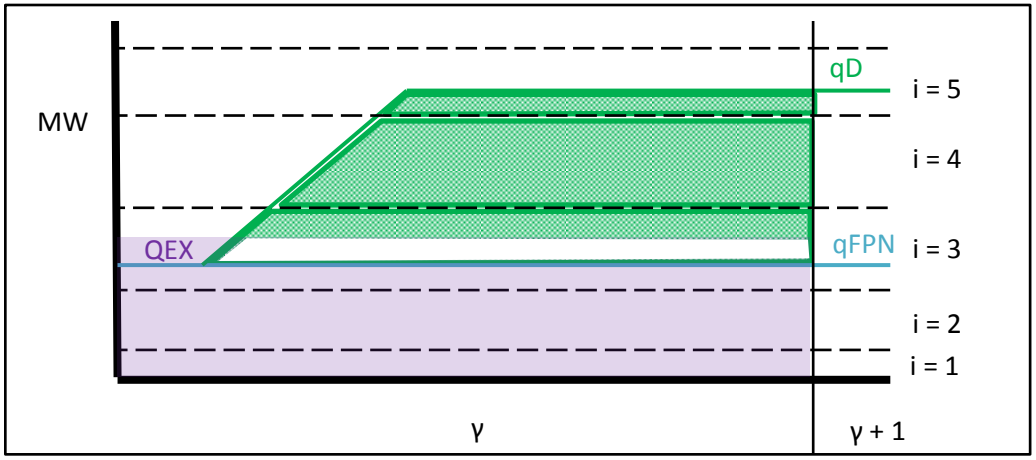
$$CDISCOUNT_{u\gamma} = \sum_{o}\sum_{i}\Big(Min\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QABLF_{uoi\gamma} - Min\big(QABBPOLF_{uoi\gamma}, QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma}, QABNFLF_{uoi\gamma}, QABCURLLF_{uoi\gamma}, QABTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

Biased Quantities

Is the balancing action actually changing your ex-ante trade position?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\Big(Max\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QAOLF_{uoi\gamma} - Max\big(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

$$CDISCOUNT_{u\gamma} = \sum_{o}\sum_{i}\Big(Min\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QABLF_{uoi\gamma} - Min\big(QABBPOLF_{uoi\gamma}, QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma}, QABNFLF_{uoi\gamma}, QABCURLLF_{uoi\gamma}, QABTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

Chapter 18: Non-Firm Quantities

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Non-Firm Quantities

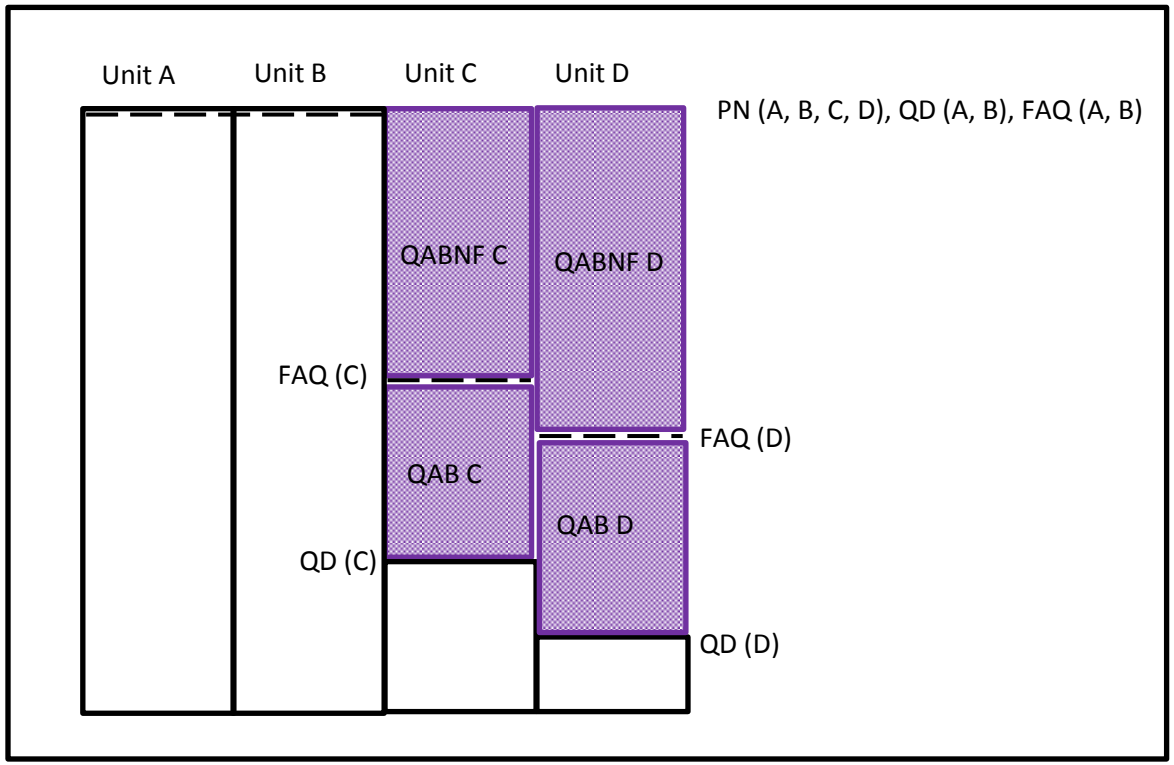
- In both the SEM and the I-SEM, a unit with non-firm access does not have the right to be compensated for not being able to have it's non-firm capacity accommodated on the system:
  - A unit's Firm Access Quantity is a value which represents the amount of a Participant's output which can be accommodated on the system based on network reinforcement. If the unit is dispatched down below that level, it is entitled to compensation.
- The way this is implemented in the I-SEM is different to the SEM, in that it only impacts the balancing and imbalance arrangements:
  - There is no longer a restriction on Participants to gain a market position for their non-firm capacity, they can trade their entire output range above their Firm Access Quantity in the ex-ante markets;
  - Normally Bid Offer Acceptances are settled at the better of the Imbalance Settlement Price or Bid Offer Price. For Dec actions to turn a unit down / off from their market position, this means that the units can be compensated for being turned down – they may only need to pay back what they've stated in the Bid Offer Price, which may only reflect their costs of running, or less through the Imbalance Price, meaning they retain any inframarginal rent they achieved from their ex-ante market revenue;
  - However this treatment is removed for non-firm Dec actions: if a unit traded its Non-Firm capacity but it could not be physically accommodated on the system, it will be treated as an imbalance and they have to pay back for the difference at the Imbalance Settlement Price only;
  - This is implemented through calculating the Non-Firm Accepted Bid Quantity and subtracting it in the Discount Component to ensure that it does not receive a discount, and therefore it is settled only through the Imbalance Component.

Non-Firm Quantities

- Firm Access is a Trading Site concept, therefore there needs to be functionality to assign the Firm Access Quantity to the units under the Trading Site to allow for unit-level non-firm quantities to be calculated:

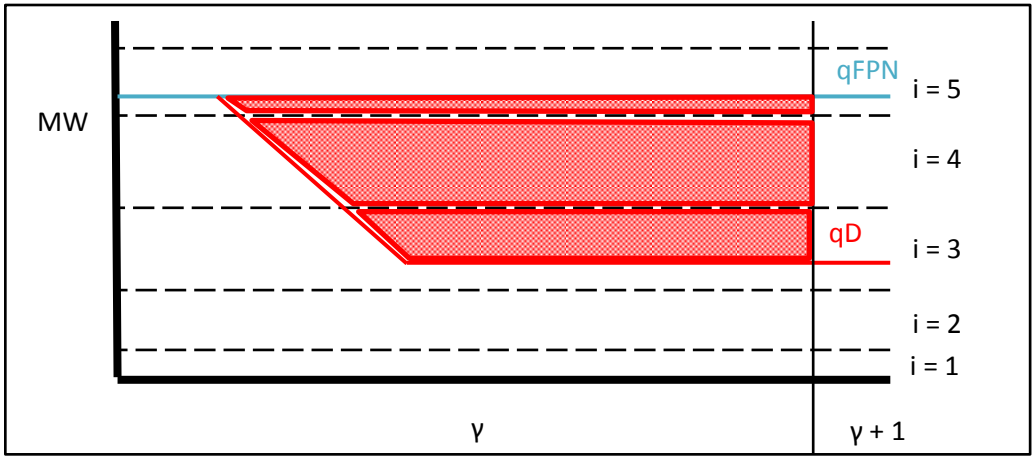
FAQ is divided in a way which is inversely proportional to the Accepted Bid Quantity on each unit:

- If unit dispatched to PN, fully firm;
- If unit dispatched below PN, non-firm;
- The greater the dec volume, the lower the firmness.



Non-Firm Quantities

Was any of that volume in non-firm range?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\left(Max\left(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\right) \times \left(QAOLF_{uoi\gamma} - Max\left(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\right)\right)\right)$$

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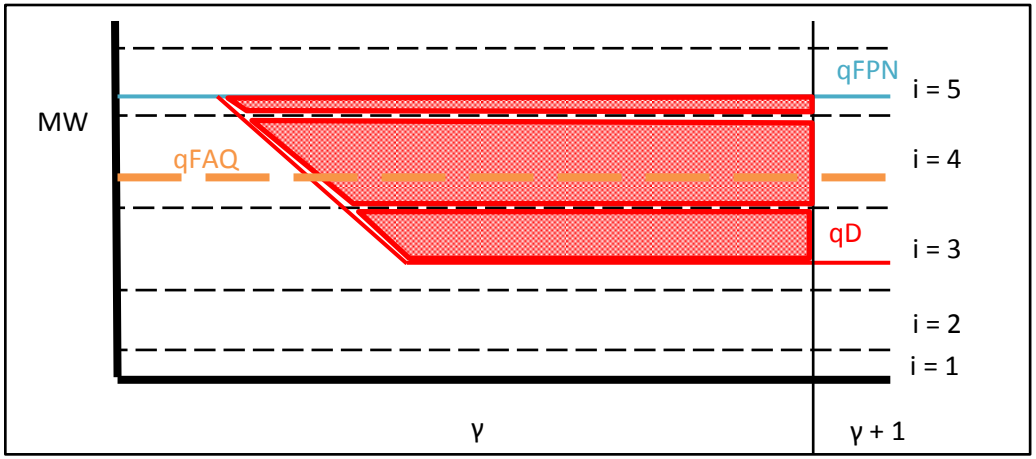

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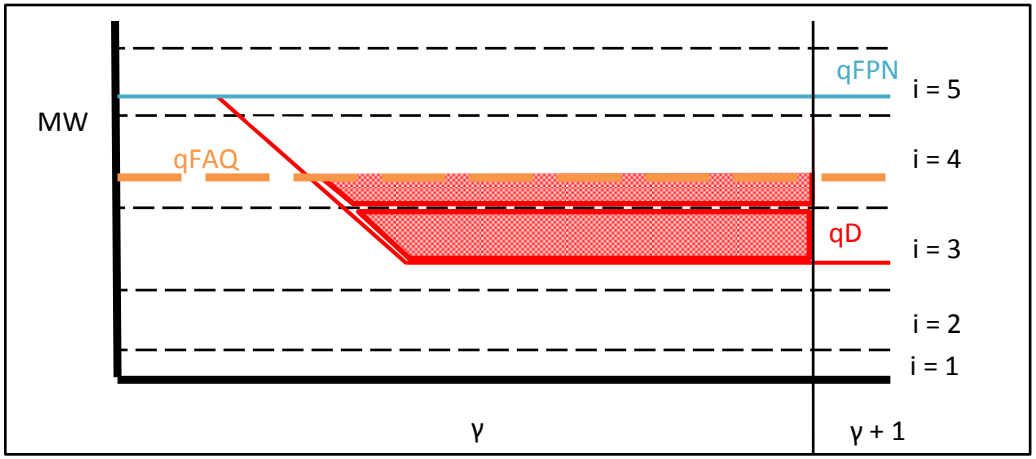

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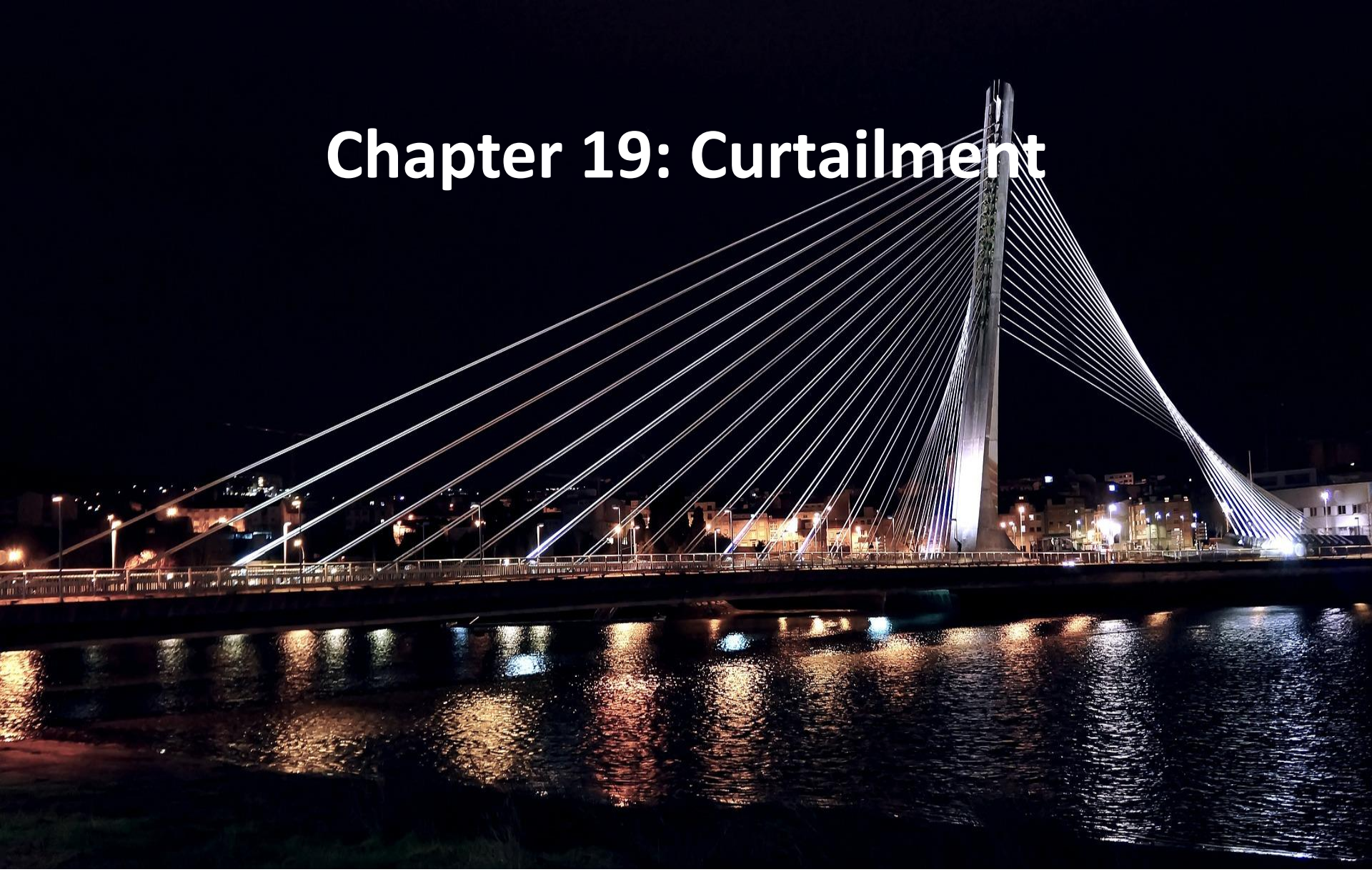
Chapter 19: Curtailment



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Curtailment

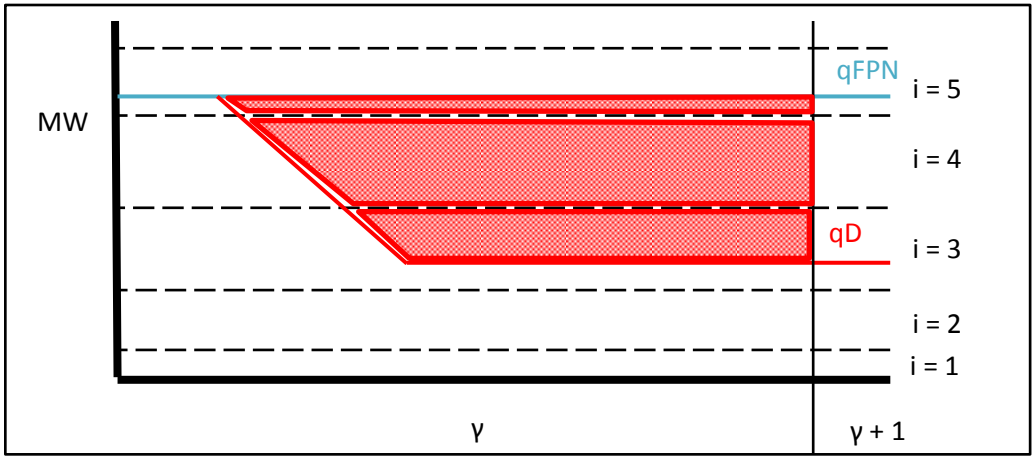
- Wind generators, which have priority dispatch, can be dispatched down for two broad reasons:
  - For constraints, where a local system reason such as congestion on transmission lines means they cannot output above a certain level. This limit is imposed by the SOs through a “LOCL” instruction, and is lifted through a “LCLO” instruction;
  - For curtailment, where there is more total wind generation available than can be accommodated within system stability limits. This limit is imposed by the SOs through a “CURL” instruction, and is lifted through a “CRLO” instruction.
- RA decisions on constraints mean that wind units can be compensated for constraints:
  - i.e. they get to retain any ex-ante market revenue they have earned for the amount they have been constrained below their market position;
  - This is implemented through having a deemed Dec price of zero on these units for use in settlement, triggering a Discount Payment equal and opposite to the Imbalance Component Charge the unit would also have, meaning net settlement for the unit of zero for the constraint in the Balancing Market.

Curtailment

- RA decisions on curtailment mean that wind units are not to be compensated for curtailment from I-SEM go-live:
  - i.e. they do not get to retain the ex-ante market revenue they have earned for the amount they have been curtailed below their market position;
  - This is implemented through calculating another quantity in addition to the Bid Offer Acceptance for a curtailment action: the Curtailment Accepted Bid Quantity. This quantity can then be removed by subtracting it from the Discount Component to ensure the same treatment as for constraints is not applied;
  - An adjustment charge on the curtailment quantity is also required to ensure that its net settlement is at a level which is representative of its ex-ante market revenue, rather than being settled at the Imbalance Settlement Price, for its curtailed action;
  - The price which applies for this adjustment charge is intended to represent the unit's ex-ante market revenue as a trade-quantity-weighted average of the prices associated with the unit's own day-ahead and intraday market trades relevant to the Imbalance Settlement Period, taking the absolute value of the trade quantities.

Curtailment

Was the volume due to a curtailment instruction?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\left(Max\left(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\right) \times \left(QAOLF_{uoi\gamma} - Max\left(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\right)\right)\right)$$

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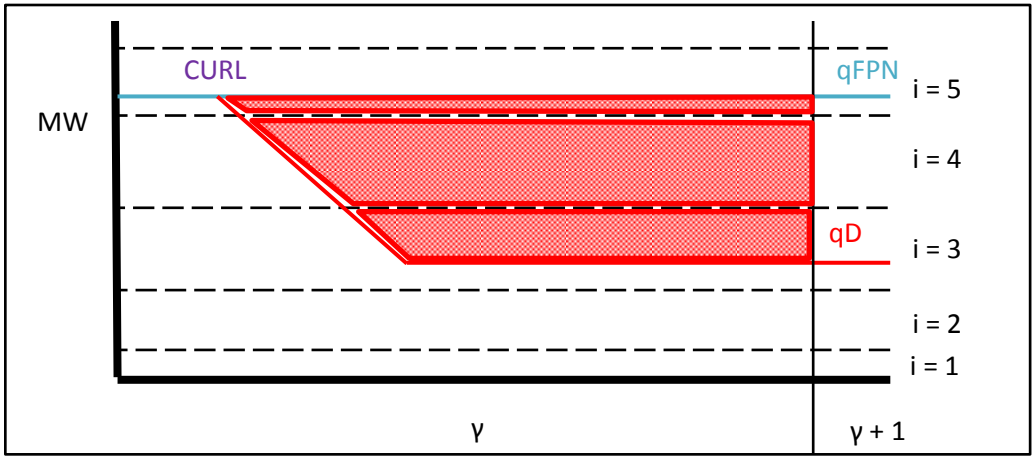
Curtailment

Was the volume due to a curtailment instruction?



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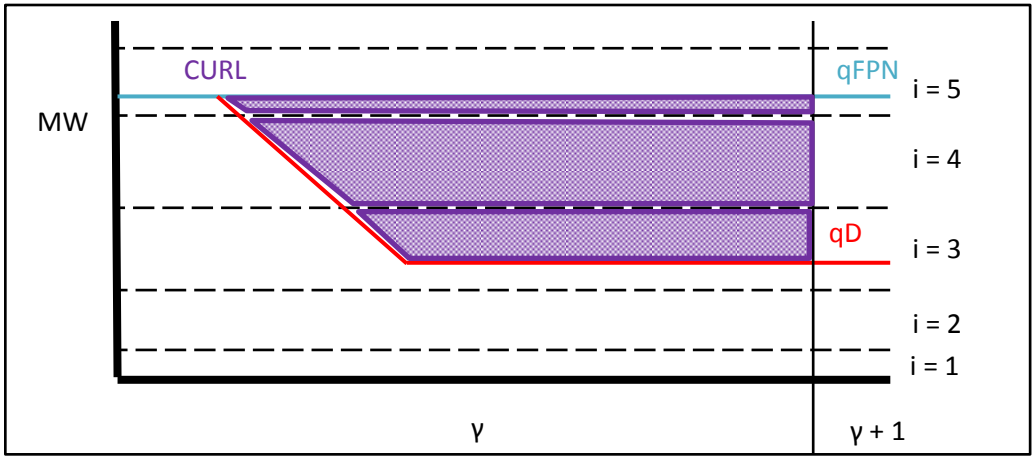

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Chapter 20: Offers/Bid Price Only Undo Actions

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Offers/Bid Price Only Undo Actions

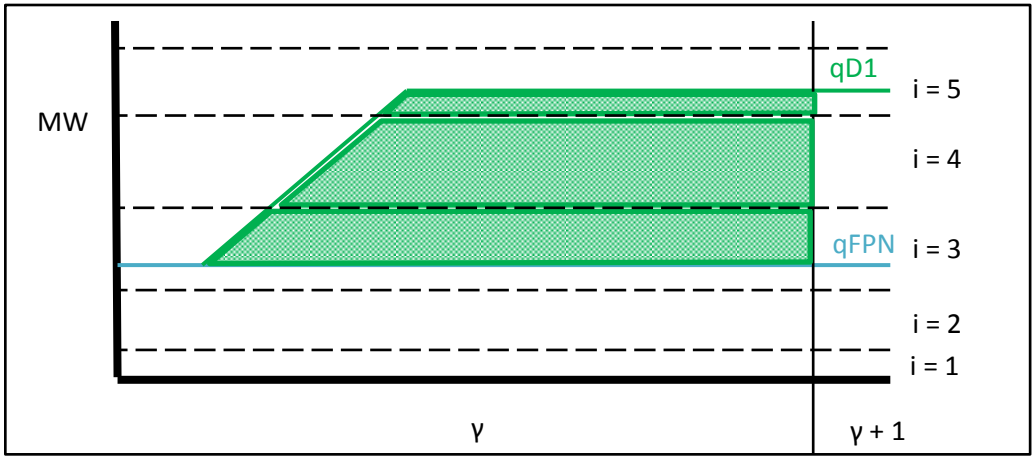
- Because units can submit different prices for Incs and for Decs, if the SO takes an action accepting a quantity over a period and then undoes that action, both of these would be seen as BOAs, one at an inc price and one at a dec price. This difference in prices allows for units to have an element of recovering costs due to the undo;
- BOAs are generally settled at the better of the Imbalance Settlement Price or the Bid Offer Price, which means that the cost of undoing an action is unclear until after the Imbalance Settlement Price has been calculation;
- A refinement to this general approach for settlement of BOAs was decided on by the RAs to apply for undo orders, where only bid or offer prices would apply for the settlement of undo actions which are:
  - Negative Dec actions calculated above the FPN; or
  - Positive Inc actions calculated below the FPN.
- This would allow for the undoing of an action at the actual cost of undoing it, as opposed to undoing it at the Imbalance Settlement Price. This would ensure that the cost of an undo is as close as possible to the cost stated by the participant.

Offers/Bid Price Only Undo Actions

- This is implemented through calculating another quantity in addition to the Bid Offer Acceptance for an undo action: the Bid Price Only Accepted Bid Quantity and Offer Price Only Accepted Offer Quantity. These quantities can then be removed by subtracting them from the Premium and Discount components to ensure the normal treatment does not apply to undo orders in those components;
- An adjustment charge on the Offer Price Only and Bid Price Only quantities is also required to ensure that its net settlement is at a level which is representative of its Bid Offer Price only, rather than being settled at the Imbalance Settlement Price through the Imbalance Component.

Offers/Bid Price Only Undo Actions

Was the order undoing previously accepted volume?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\Big(Max\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QAOLF_{uoi\gamma} - Max\big(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

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Offers/Bid Price Only Undo Actions

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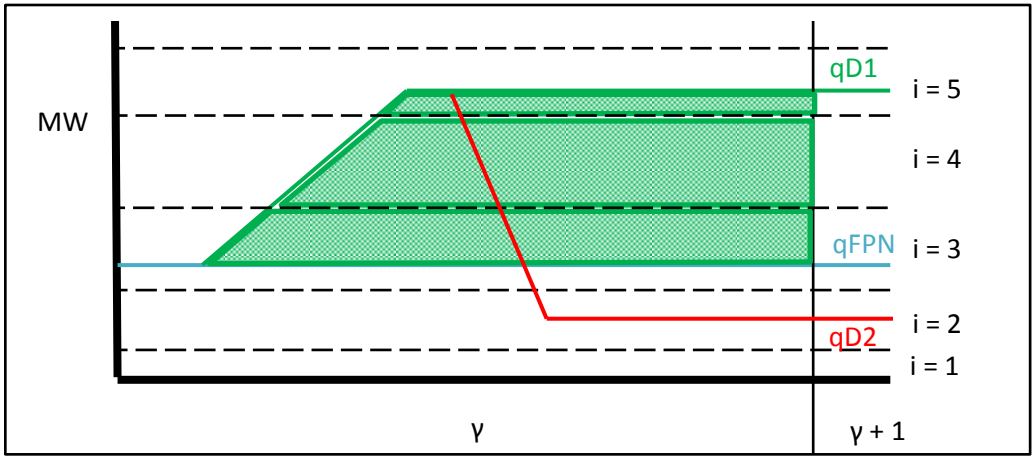

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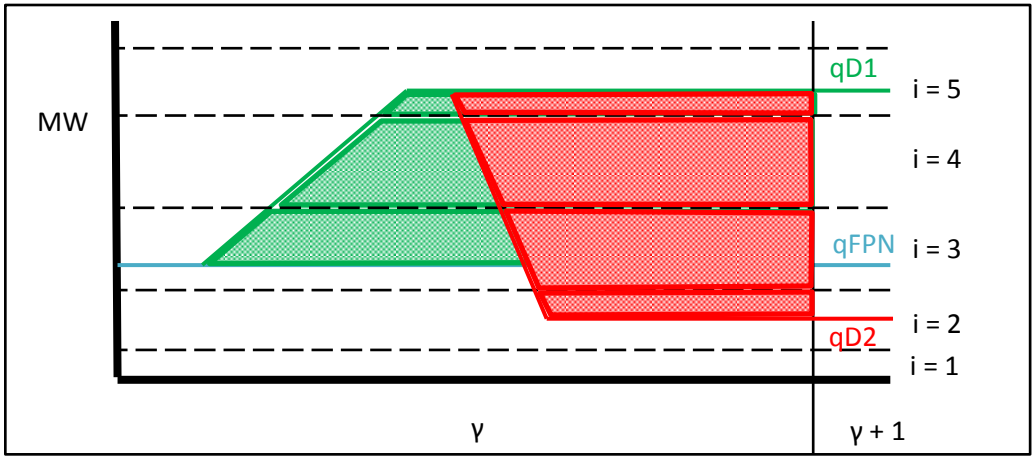

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Offers/Bid Price Only Undo Actions

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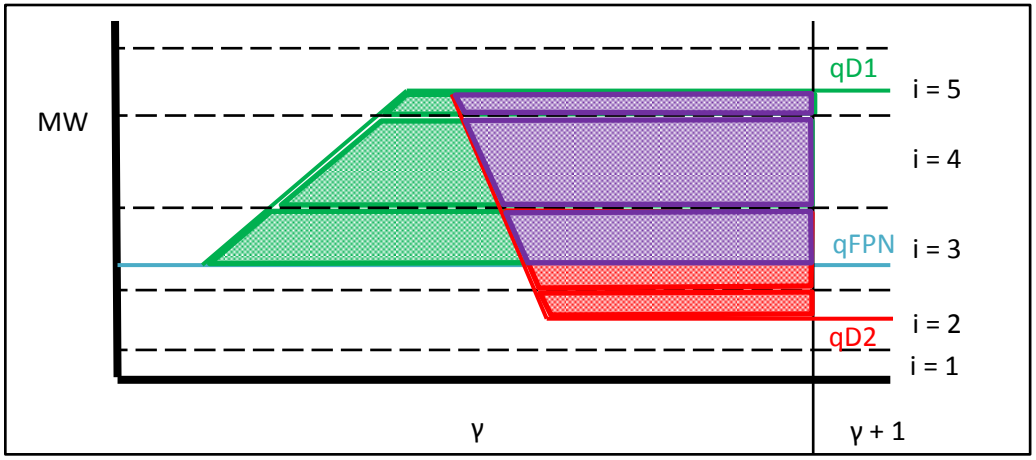

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Chapter 21: Trade Opposite TSO

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Trade Opposite TSO

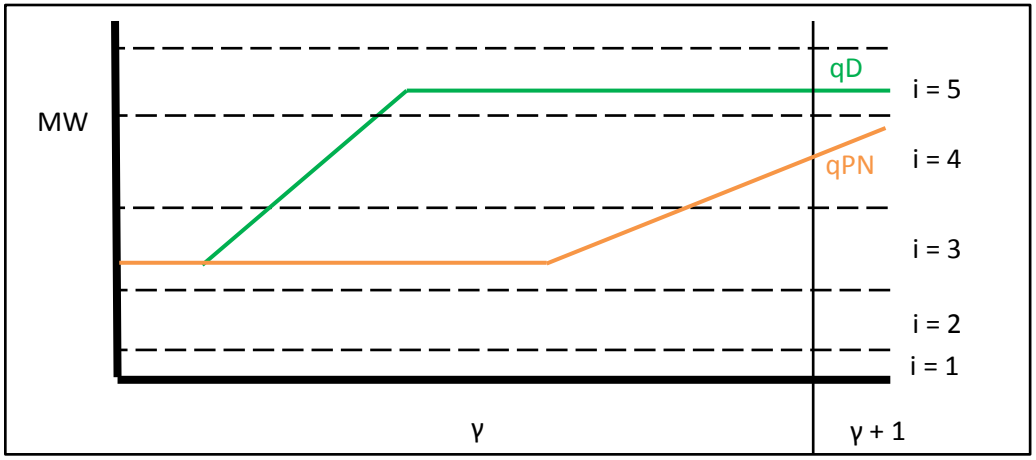
- Trade Opposite TSO is where a unit can increase the volume of a Bid or Offer accepted by the SOs after the time it has been accepted:
  - This can occur as a result of the intraday and balancing markets being open at the same time for an Imbalance Settlement Period;
  - The SOs could instruct an action on a unit which accepts a quantity in an Imbalance Settlement Period based on the PN present at the time of the decision;
  - However, before gate closure for the period, the participant could trade intraday and change its PN, becoming its FPN, in a way which results in a volume being accepted which is larger than the original one assumed at the time the SOs decided to instruct the action.
- Examples of situations where Trade Opposite TSO could occur include:
  - If a unit with a long minimum on time is instructed to synchronise; or
  - If a unit is slow to ramp between MW setpoint levels.
- Trade Opposite TSO volumes are implicit within Accepted Offer and Accepted Bid quantities as these are calculated using the FPN – it is seen in pricing and settlement as the volume of a balancing action procured by the SOs.

Trade Opposite TSO

- The functionality developed allows for the reduction in the Premium or Discount Payments in a given Imbalance Settlement Period if a change between the PN present at the time of a Balancing Market action, and the FPN, increases the volume of that action:
  - This is in response to potential market power concerns, where a unit with an offer accepted at a high price (or bid accepted at a low price) which are out of merit (for example due to a constraint) could increase the volume associated with this expensive action that must be paid a premium or discount above the Imbalance Settlement Price. While the SO made a decision to incur the out-of-merit cost with the original smaller volume on the basis of minimising the costs of non-energy actions, the SO could not have taken this increase in volume into account in its cost minimisation, and therefore may be incurring additional costs which could not have been considered in the economic decision making to take the action on the unit;
  - If the functionality is used it would mean that, instead of being eligible for the Premium or Discount payment, the Trade Opposite TSO quantity would only be settled at the Imbalance Settlement Price.
- This functionality will not be switched on for I-SEM go-live:
  - The SEMC decided that they could switch the functionality on in the future in the context of market power mitigation, for example if such increases in BOAs were considered to be exercising market power.

Trade Opposite TSO

Was the order volume increased by changing PN after acceptance?



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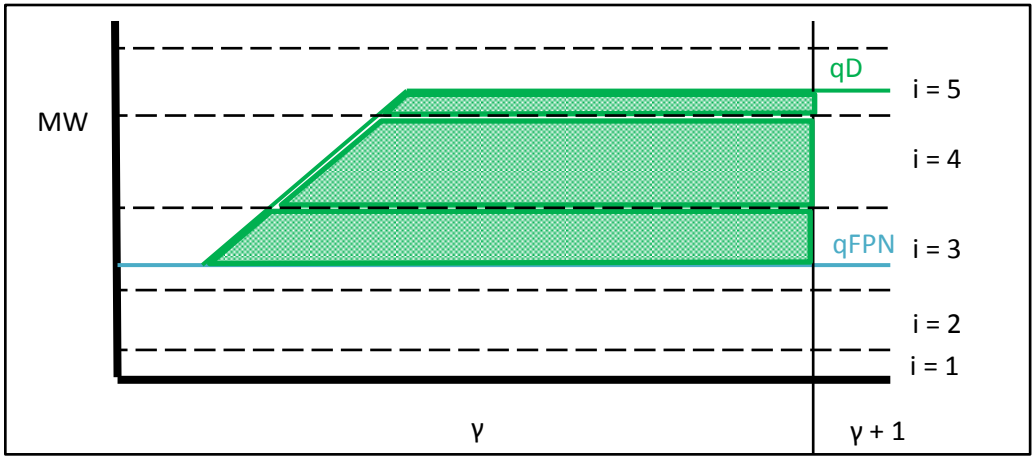

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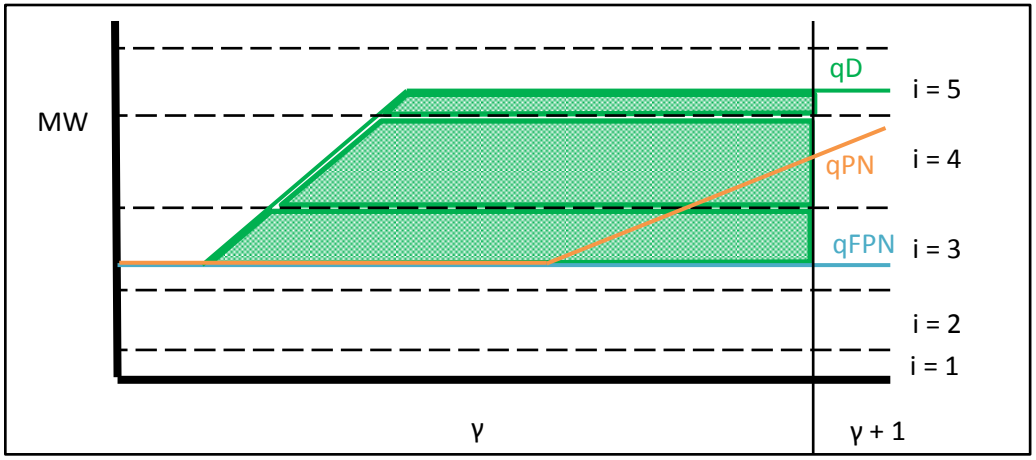

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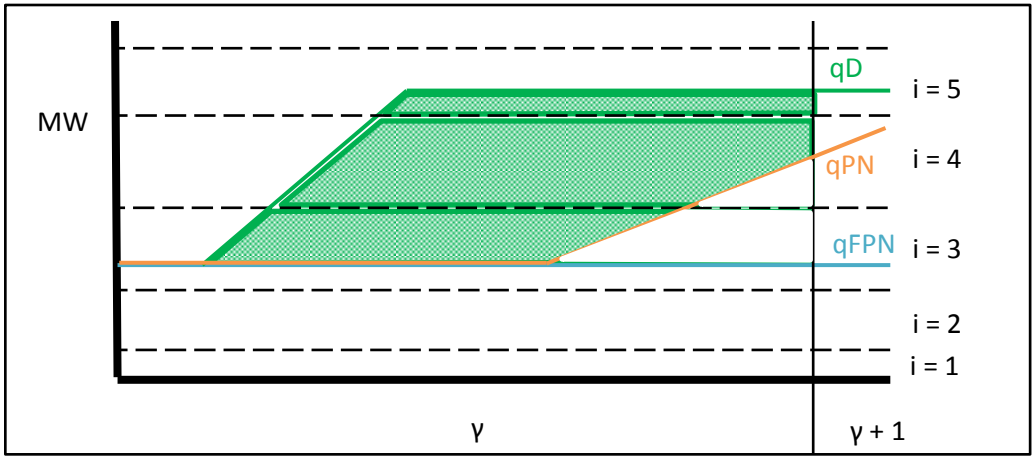
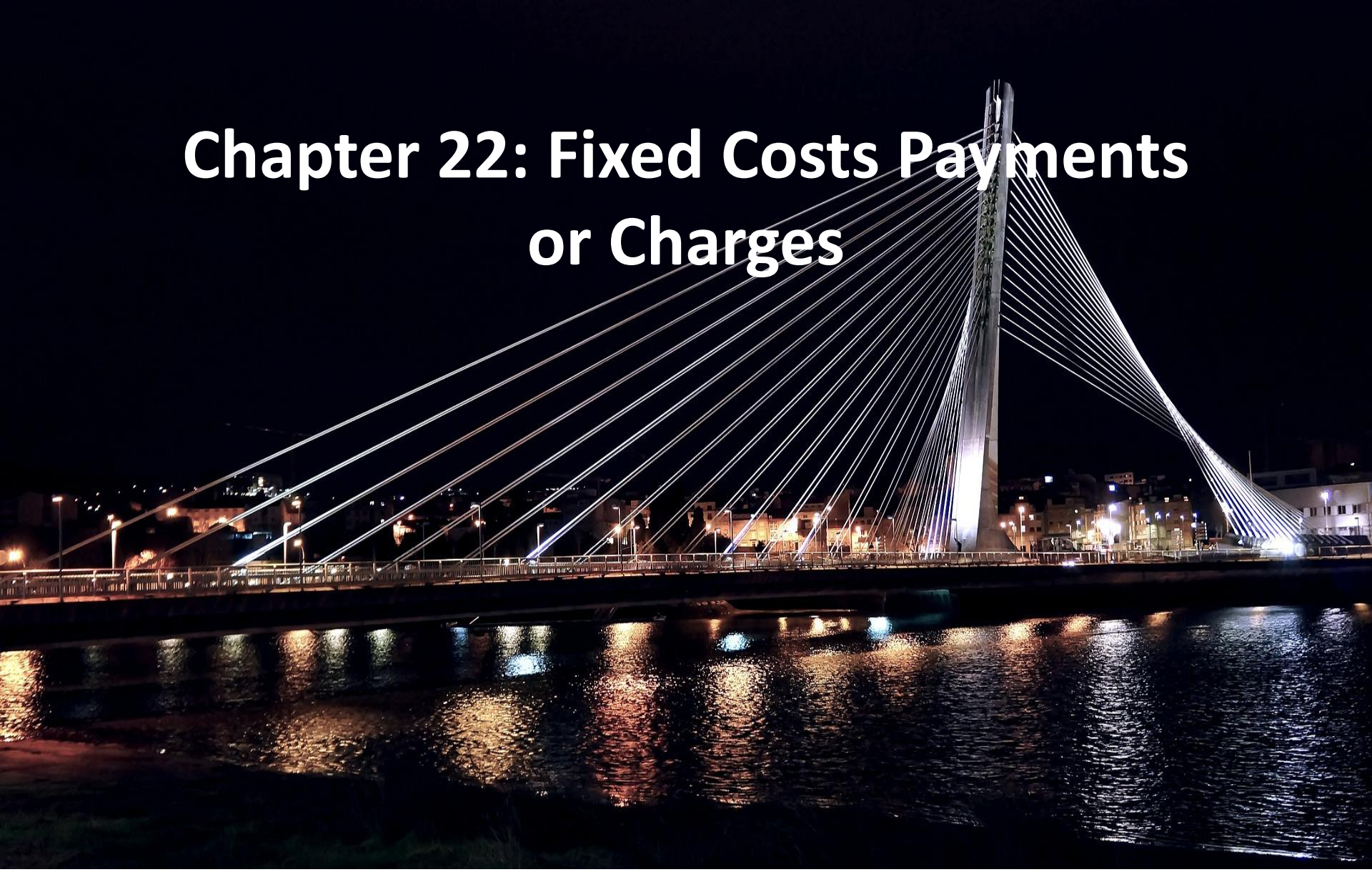
Was the order volume increased by changing PN after acceptance?



$$CPREMIUM_{u\gamma} = \sum_{o}\sum_{i}\Big(Max\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QAOLF_{uoi\gamma} - Max\big(QAOOPOLF_{uoi\gamma}, QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma}, QAOTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

$$CDISCOUNT_{u\gamma} = \sum_{o}\sum_{i}\Big(Min\big(PBO_{uoi\gamma} - PIMB_{\gamma}, 0\big) \times \big(QABLF_{uoi\gamma} - Min\big(QABBPOLF_{uoi\gamma}, QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma}, QABNFLF_{uoi\gamma}, QABCURLLF_{uoi\gamma}, QABTOTSOLF_{uoi\gamma}\big)\big)\Big)$$

Chapter 22: Fixed Costs Payments or Charges



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Fixed Cost Payments or Charges

- Fixed Cost Payments or Charges:
  - Difference between Market Operations (i.e. how a unit would ideally wish to run to meet its ex-ante market trade quantities) and Physical Operations (i.e. how the unit is actually run by the SOs in the operation of the power system) can result in units incurring or saving additional fixed costs versus those incurred in a unit's ex-ante market schedule;
  - Fixed costs include additional or reduced number of starts, and additional or reduced number of Imbalance Settlement Periods where the unit is synchronised and incurring fixed costs for operating.
- Whether these charges or payments apply depends on Commercial Offer Data used in settlement:
  - If settlement is based on Simple format, fixed costs can be incorporated into those Price Quantity Pairs, with fixed costs recovered through the Imbalance and Premium Components;
  - If settlement is based on Complex format, fixed costs are explicitly stated while Price Quantity Pairs represent variable costs, therefore this side-payment mechanism is needed to recover fixed costs.
- This Payment or Charge is intended to:
  - Make the unit whole if their balancing market revenues are not sufficient to cover their additionally incurred fixed costs; and
  - To recover the unit's fixed costs which were saved.
- The mechanism needs to reflect the following:
  - As much as possible, starts for energy balancing reasons should be reflected in, and recovered through ,the Imbalance Price, starts for non-energy reasons should be recovered through side-payments (i.e. this charge);
  - The mechanism must ensure against overrecovery of costs over a Contiguous Operating Period (i.e. take into account if inframarginal rent from Imbalance Settlement Price over period of running covers costs);
  - Build in substitutive Physical Notification functionality so that Intraday Market trades and hence prices fully replace the settlement of Balancing Market orders if they both represented the same output range.

Fixed Cost Payments or Charges

- There are different mechanisms for ensuring that units recover their fixed costs depending on which set of COD applies in settlement;
- If Simple Bid Offer Data applies, then participants have to build their fixed costs into their prices, as the only recovery of these costs they will receive is through their Imbalance Component Payment if they are in-merit (in this way fixed costs are included in the Imbalance Settlement Price also, as they are included implicitly in the Bid Offer Prices which are used to set the Imbalance Price), or through the combination of this and their Premium Component Payment if they are out of merit.

Fixed Cost Payments or Charges

- There are different mechanisms for ensuring that units recover their fixed costs depending on which set of COD applies in settlement;
- If Complex Bid Offer Data applies, fixed costs are intended to be recovered through a make-whole payment for the extent that they have not been recovered through net balancing market revenue:
  - Calculate the sum of the operating costs incurred due to balancing market actions taken on the unit (i.e. the costs of the Incs and Decs, and the additional fixed costs incurred, according to the unit's COD submissions) over a contiguous operating period;
  - Calculate the sum of the revenue in the balancing market (i.e. a sum of all of the energy Payments and Charges highlighted in this training). Uninstructed Imbalance Charges are excluded from this, as this is intended to be a reduction in payment or an increase in charge incurred by the unit, to include it here may mean that the make-whole payment counters this charge and therefore the incentive it creates would be removed.
- Therefore a unit's inframarginal rent (the amount they earn above their offered prices by being settled at the Imbalance Settlement Price) can be considered in meeting their costs first, and if there are additional costs they can be recovered through the make-whole payment. This ensures against overrecovery of these costs.

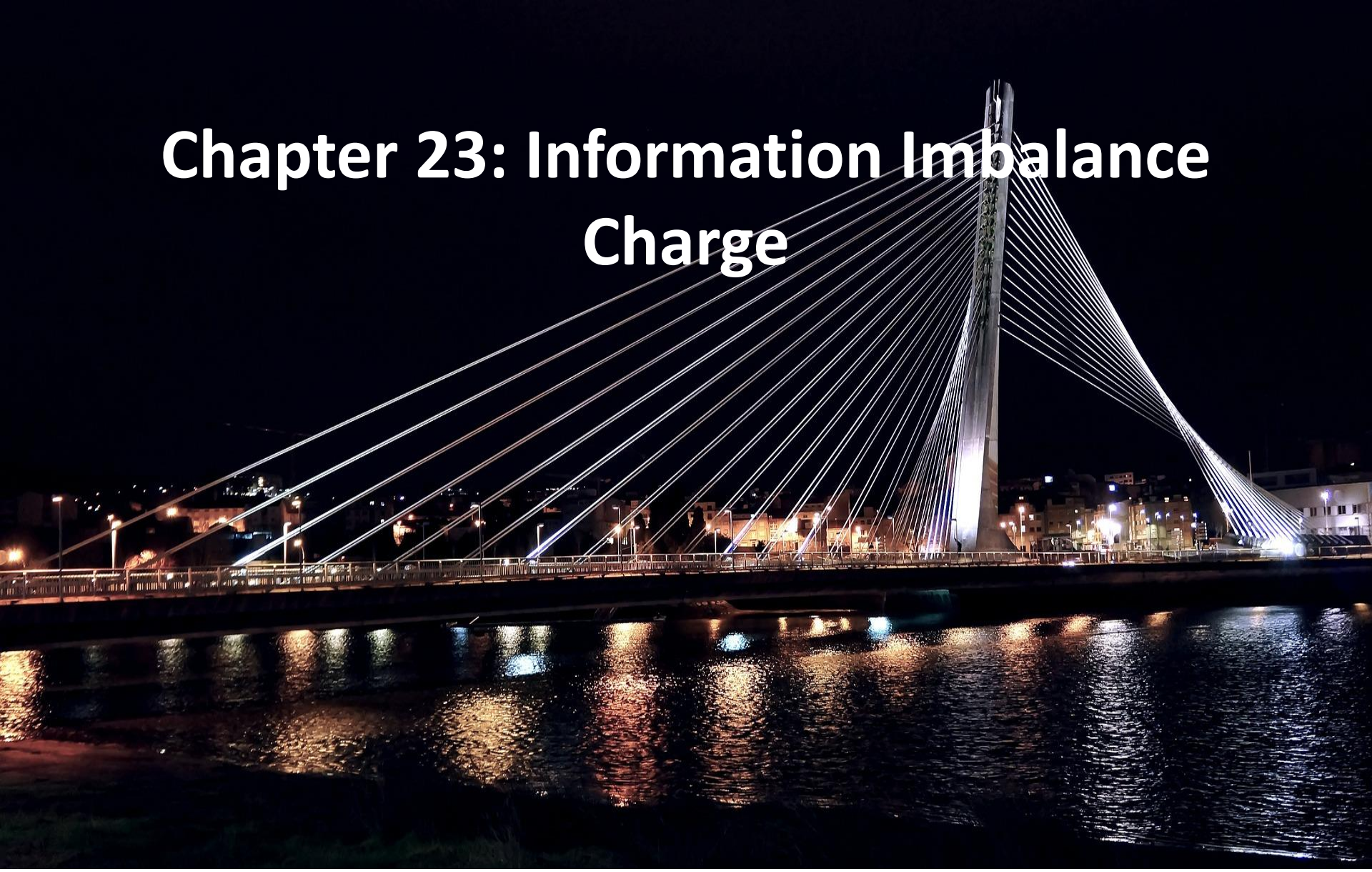
Fixed Cost Payments or Charges

- In determining the fixed costs which were incurred, the market position of the unit is compared against the dispatch position of the unit. The market position is taken from the unit's Final Physical Notification Quantity, which ensures that "substitutive PN" functionality is built into the fixed cost element:
  - For example, if the SOs initially instruct a unit to start without any market start, this would be seen as a start up cost incurred under the balancing market, however if the unit subsequently trades in the intraday market for the same period and updates its FPN to reflect this, then the start will not be calculated as having been incurred due to a balancing market action – it substitutes the recovery of the fixed cost through the balancing market for being recovered through the intraday market.
  - This means that the unit will have to consider their fixed costs in the ex-ante markets even if the SO has already started them, as a market start up would remove the cost as being one incurred under the balancing market, and so the unit would need to recover the cost through the intraday market trade.

Fixed Cost Payments or Charges

- The mechanism works by carrying out the following five steps:
  1. Works out Physical and Market Operation characteristics for the Billing Period, including when the unit started, ended, and initial conditions at beginning of Billing Period;
  2. Works out if additional fixed costs incurred or saved by comparing Physical and Market Operation characteristics;
  3. Calculates balancing market revenues received, and costs incurred by the unit due to balancing market operations (including additionally incurred fixed costs);
  4. Compares balancing market revenues and costs to calculate make-whole payment if revenue was insufficient to cover costs;
  5. Calculates final Fixed Cost Payment or Charge by subtracting recoverable fixed costs which were saved.

Chapter 23: Information Imbalance Charge



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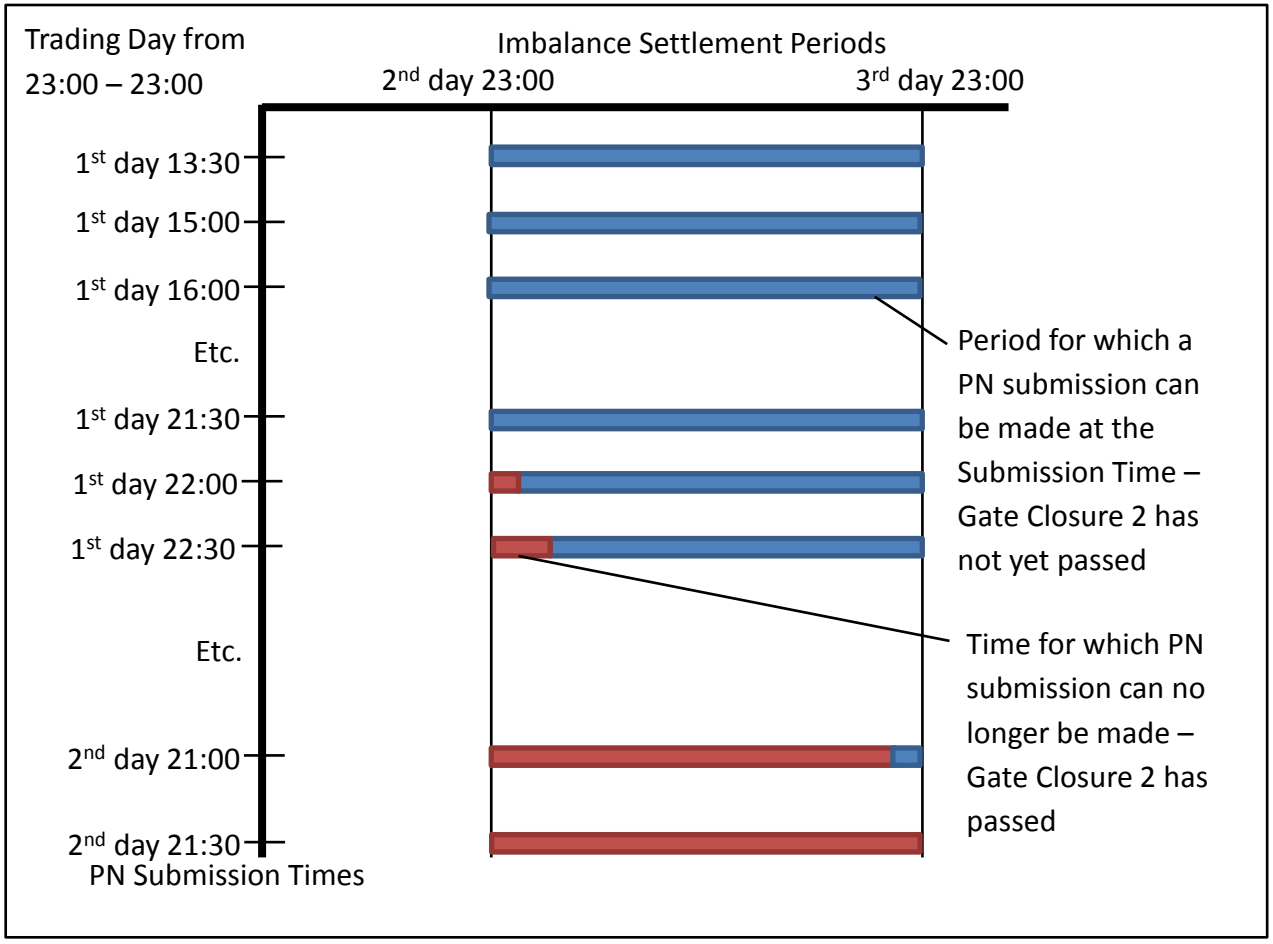
Information Imbalance Charge

- The Information Imbalance Charge is one which is intended to incentivise certain behaviour in how participants submit their Physical Notifications over time:
  - The intention is to incentivise participants to submit PNs throughout the day which most accurately reflect their final intended running (their FPNs);
  - This is on the basis that the PNs are the start point of SO scheduling, and depending on the timing of the submission and timing of SO scheduling and dispatch decisions, large changes in PN data could result in higher cost actions needing to be taken than what could have been taken if the accurate information was known in time.
- It considers the difference in the volume of PNs submitted over time vs the FPN for a given Imbalance Settlement Period, and if the volume of change is above a certain tolerance a charge can be applied;
- It will not apply for I-SEM go-live:
  - The RAs can decide to switch the functionality on at some point in the future if they see market power or efficiency issues arising from the submission of Physical Notifications over time.

Information Imbalance Charge

- The diagram on the following slide illustrates how different Imbalance Settlement Periods have different numbers of half-hour periods after Gate Closure 1 at 13:30 TD-1, and Gate Closure 2 for the Imbalance Settlement Period;
- The final Imbalance Settlement Periods in a Trading Day have the most amount of periods in which PNs can be submitted and resubmitted, while the first Imbalance Settlement Periods in a Trading Day have the least;
- A quantity is calculated for every Imbalance Settlement Period and every PN Submission Period, looking at the differences in PN submitted for an Imbalance Settlement Period in that half-hour PN Submission Period, and the Final Physical Notification for that Imbalance Settlement Period;
- Parameters can then be used to determine how large a tolerance is appropriate for changes between PN and FPN quantities in each PN Submission Period, and the weighting that the difference in PN and FPN quantities for each PN Submission Period should have in the final Information Imbalance Quantity.

Information Imbalance Charge



Information Imbalance Charge

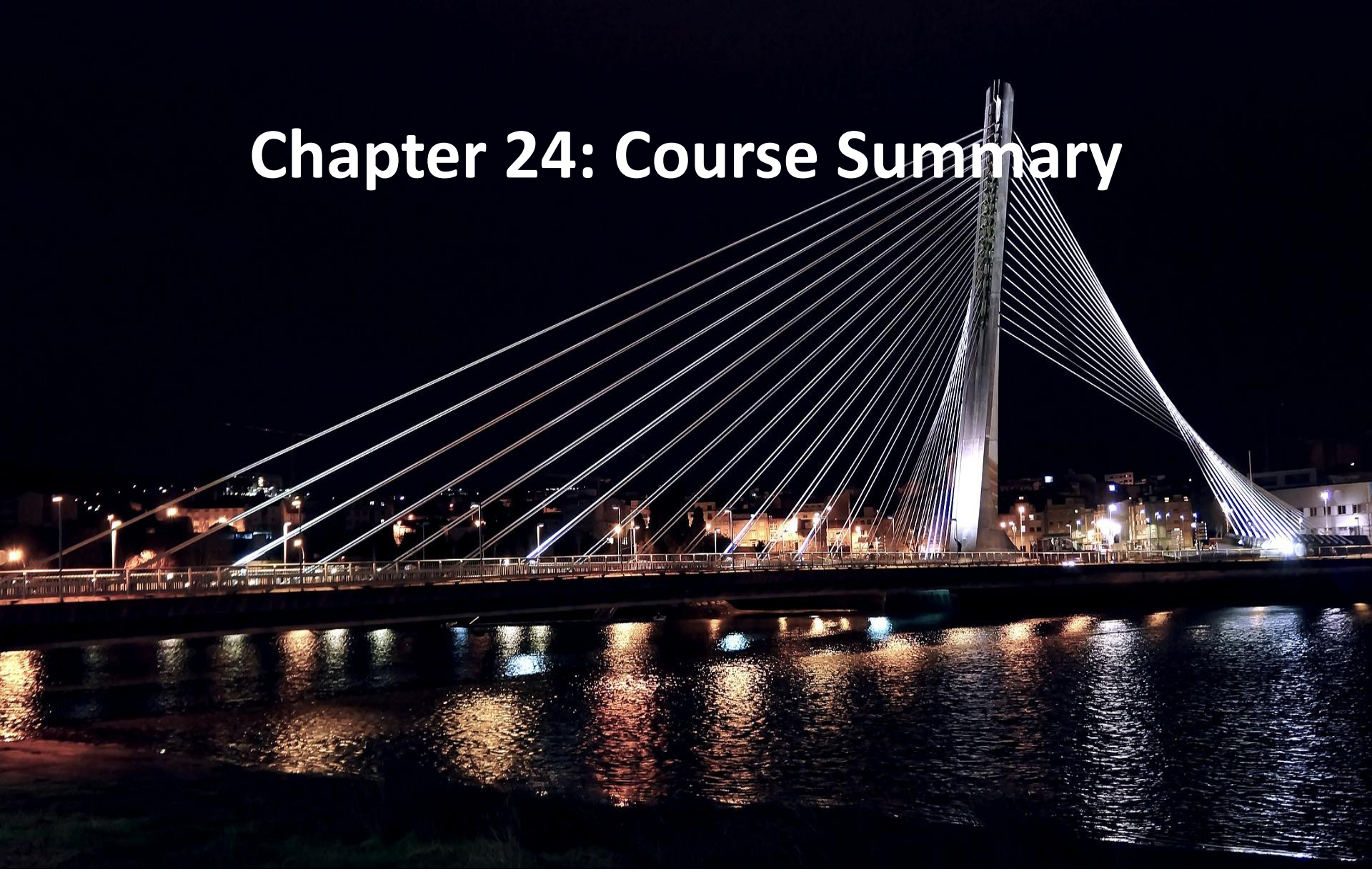
- Each Imbalance Settlement Period has:
  - Previous PN Submission Periods (β) where PNs could be submitted or resubmitted for that Imbalance Settlement Period; and
  - The FPN which is the last PN submitted prior to Gate Closure 2 for that Imbalance Settlement Period.
- Integrated Imbalance Settlement Period MWh values are created for the FPN and the PN prevailing for that Imbalance Settlement Period at the end of each PN Submission Period;
- A difference in these quantities greater than the tolerance for that period is considered an Information Imbalance Quantity to the extent that a weighting factor determines differences in quantities in this period should have a charge applied;
- The Information Imbalance Quantity (QII) is calculated as follows:

$$QII_{u\gamma} = \sum_{\beta\ relevant\ to\ \gamma} Max\left(\left|QPN_{u\beta\gamma} - QFPN_{u\gamma}\right| - TOLII_{u\beta\gamma}, 0\right) \times WFQII_{u\beta\gamma}$$

- The Information Imbalance Price (PII) parameter will have a value of zero for I-SEM go-live;
- The Information Imbalance Charge (CII):

$$CII_{u\gamma} = PII_{u\gamma} \times QIILF_{u\gamma}$$

Chapter 24: Course Summary



Review of Learning Objectives

After completing self-learning and instructor-led training for this course, you should understand:

- the timing and processes for IMB Settlement
- how quantities are calculated
- unit specific settlement items
- the supplier charging regime