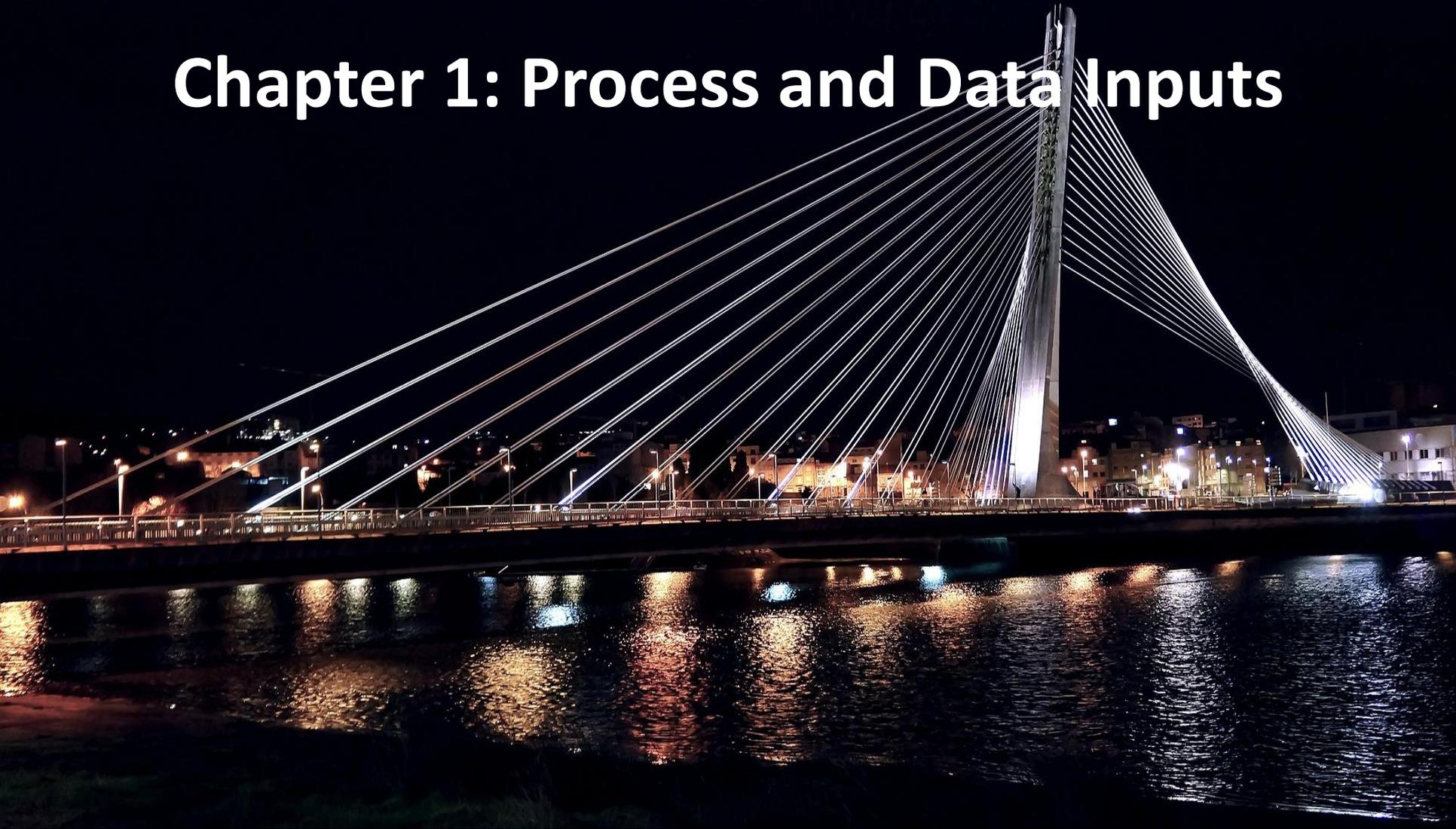


Chapter 1: Process and Data Inputs



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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:

$CIMB_y$	Imbalance Component Payment or Charge.
$CPREMIUM_{uy}$	Premium Component Payment or Charge.
$CDISCOUNT_{uy}$	Discount Component Payment or Charge.
$CAOPO_{uy}$	Offer Price Only Accepted Offer Payment or Charge.
$CABBPO_{uy}$	Bid Price Only Accepted Bid Payment or Charge.
$CCURL_{uy}$	Curtailment Payment or Charge.
$CUNIMB_{uy}$	Uninstructed Imbalance Charge.
CII_{uy}	Information Imbalance Charge.
CFC_{ub}	Fixed Cost Payment or Charge.
$CTEST_{uy}$	Testing Charge.
$CIMP_{uy}$	Imperfections Charge.
$CREV_{vy}$	Residual Error Volume Charge.
CCA_{vy}	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:

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

Process and Data Inputs



Applies



Sometimes Applies



Does Not Apply



Depends on Configuration



Calculated but Results in €0

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-dispatchable / non-dispatchable Generator	Pumped or Battery Storage Generator	Interconnector Error Unit	Interconnector Residual Capacity Unit
<i>CIMB_{uy}</i>										
<i>CPREMIUM_{uy}</i>										
<i>CDISCOUNT_{uy}</i>										
<i>CAOPO_{uy}</i>										
<i>CABBPO_{uy}</i>										
<i>CCURL_{uy}</i>										
<i>CUNIMB_{uy}</i>										
<i>CII_{uy}</i>										
<i>CFC_{ub}</i>										
<i>CTEST_{uy}</i>										
<i>CIMP_{uy}</i>										
<i>CREV_{vy}</i>										
<i>CCA_{vy}</i>										9

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

Process and Data Inputs

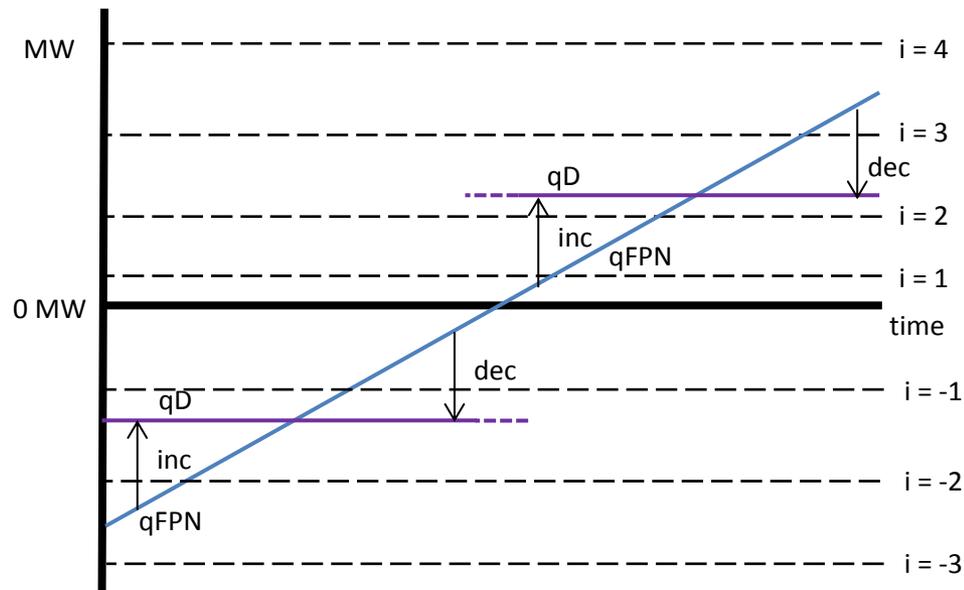
- There is a general rule that if a quantity or settlement amount is not to be calculated for a unit, but another equation which is relevant to the unit references that quantity or amount, then a value of zero is taken:
 - In this way the same equation can be used for all units even when not all elements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



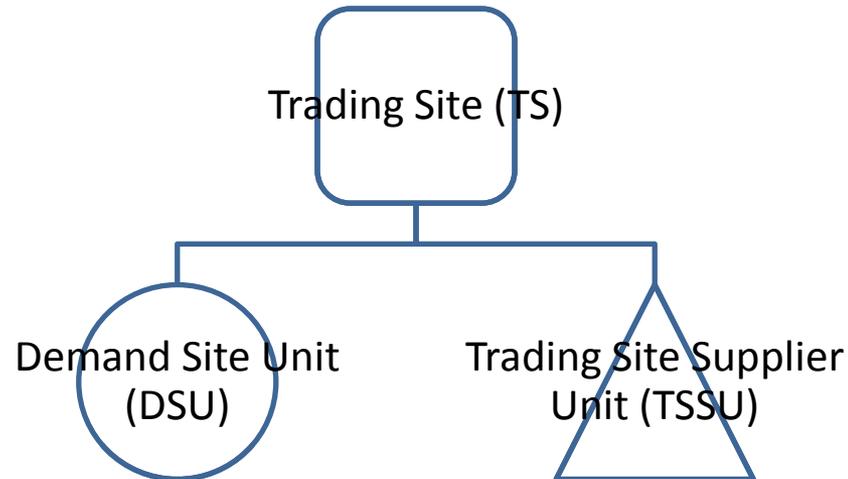
Process and Data Inputs

- 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, $Q_M = Q_D$:
 - 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, $Q_M = -Q_D$:
 - 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

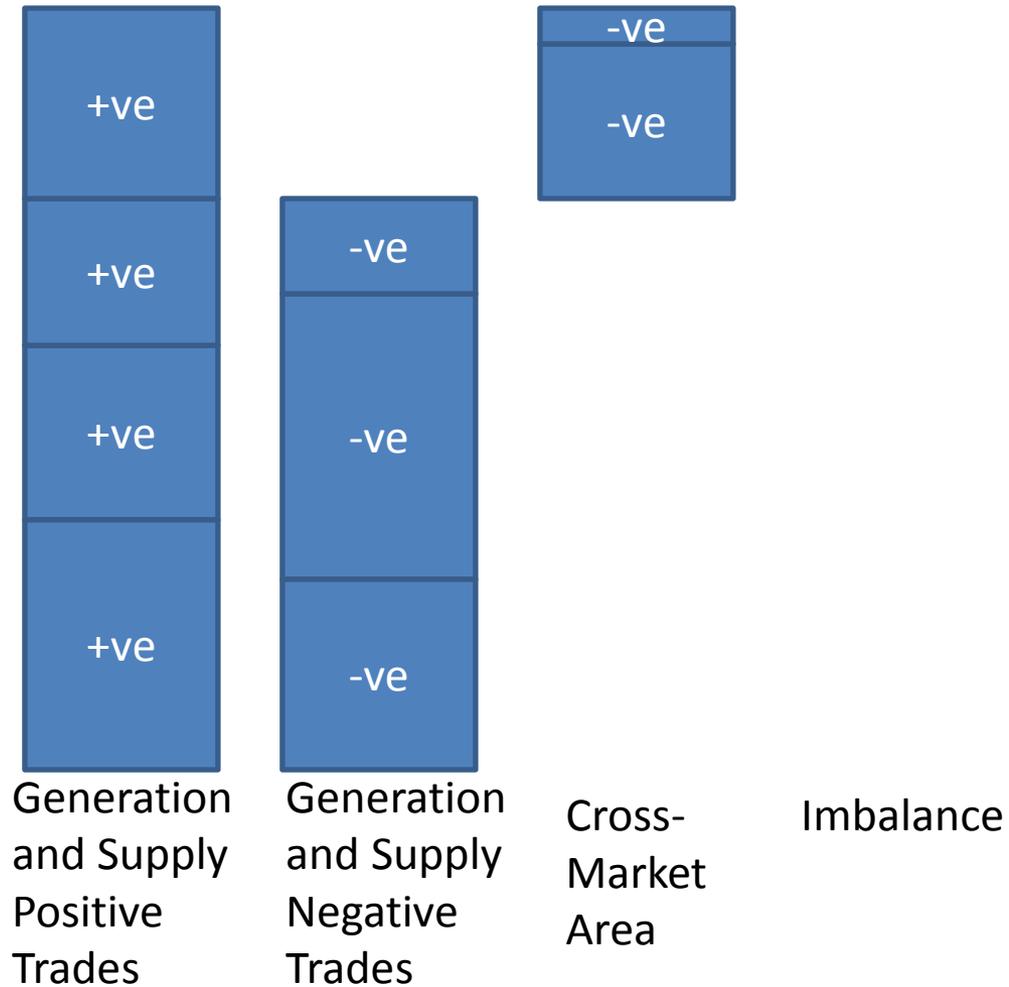
- Assetless Units:
 - Assetless traders have no physical assets, and therefore make no submission of COD, TOD, PN, Availability, no Bid Offer Acceptances, etc.;
 - Only the Imbalance Component applies, to cover when net ex-ante trades for a period are not closed to zero, represented by the unit's Ex-ante 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.

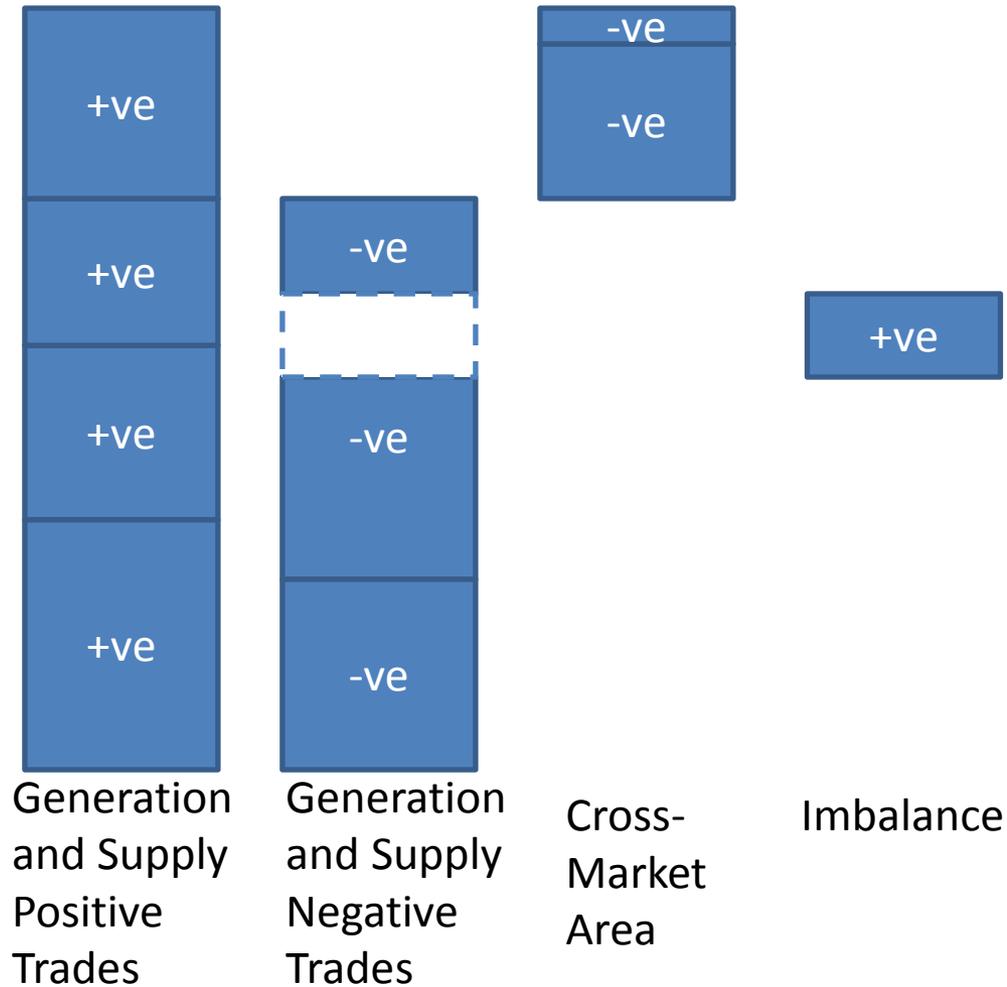
Process and Data Inputs

- Balanced:



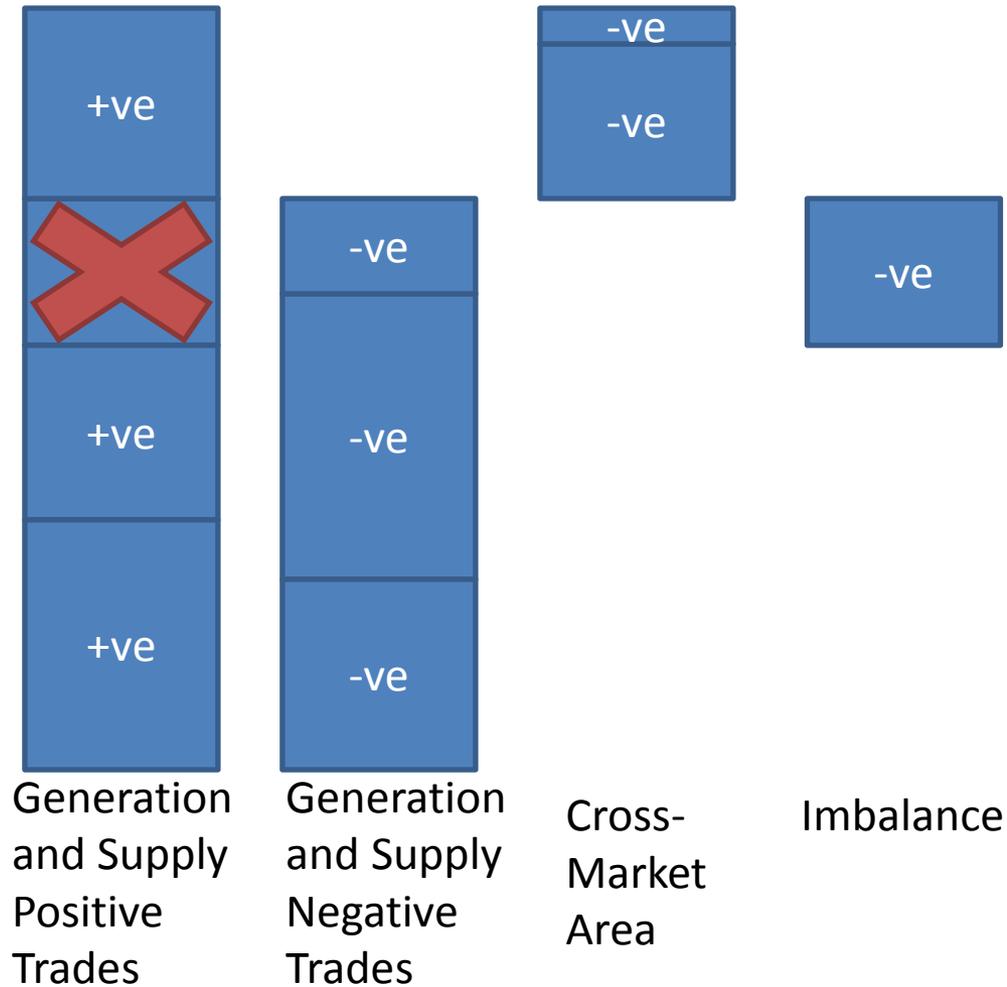
Process and Data Inputs

- 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.

