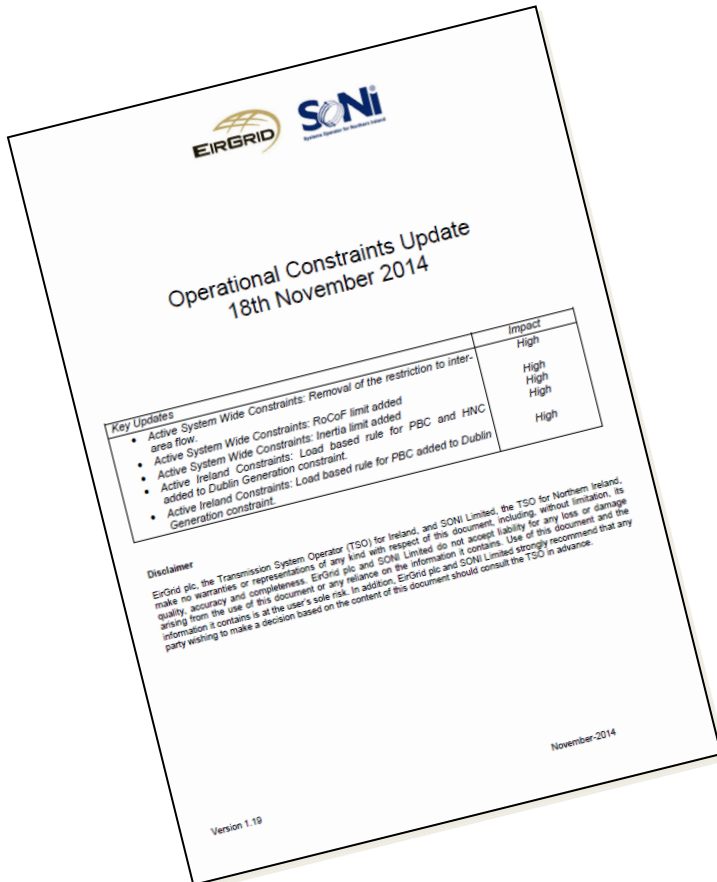# Reaching a Feasible Dispatch

Background

- The Day Ahead Market (DAM) and Intra-Day Market (IDM) objectives are to match supply and demand but they are not designed to meet the other technical requirements of operating a power system.

- The aim of the operational scheduling and dispatch process is to ensure that, in addition to matching supply and demand, these other technical requirements are met, these requirements include:
    - Operating reserves
    - Inertia
    - System Non-Synchronous Penetration - SNSP
    - Rate of Change of Frequency - RoCoF
    - Regional voltage support
    - Regional transmission constraints

Operational Security Constraints

Operational Constraints Update
18th November 2014

Link

3.3.2 Active Northern Ireland Constraints

Name	TCG Type	Limit Type	Limit	Resources	Description
System Stability	NB	N:>=	3 Units at all times	C30, B31, B32, B10, BPS4, BPS5, BPS6, K1, K2	There must be at least 3 high-inertia machines on-load at all times in Northern Ireland. Required for dynamic stability.
Replacement Reserve	MW	X:<=	211 MW	AGU IPOWER, CGT8, BGT1, BGT2, KGT1, KGT2, KGT3, KGT4	Combined MW output of OCGTs must be less than 211MW (out of a total of 311MW) in Northern Ireland at all times.100MW Required for replacement reserve
North West Generation	NB	N:>=	0 or 1 Unit depending on NI system demand	C30	Coolkeeragh must be on load when the NI system demand exceeds 1000 MW. This operational constraint is required to ensure voltage stability in the northwest of Northern Ireland and to prevent possible system voltage collapse above the indicated system demand.
Kilroot Generation	NB	N:>=	1 or 2 Units depending on NI system demand	K1, K2	There must be at least one Kilroot unit on load when the NI system demand exceeds 1400 MW and 2 units are required above 1550 MW. This operational constraint is required to ensure voltage stability in the Belfast area and to prevent the requirement for an inter area flow reduction in a post fault scenario.
Ballylumford Generation	MW	X:<=	1344 MW Dec - Feb, 1174 MW Mar - Nov	B31, B32, B10, BGT1, BGT2, B4, B5, B6	The output from Ballylumford Power Station must be limited seasonally due to a circuit rating limitation.

The unused capacity from Moyle is transferred to Ballylumford, until Moyle returns to full availability. |
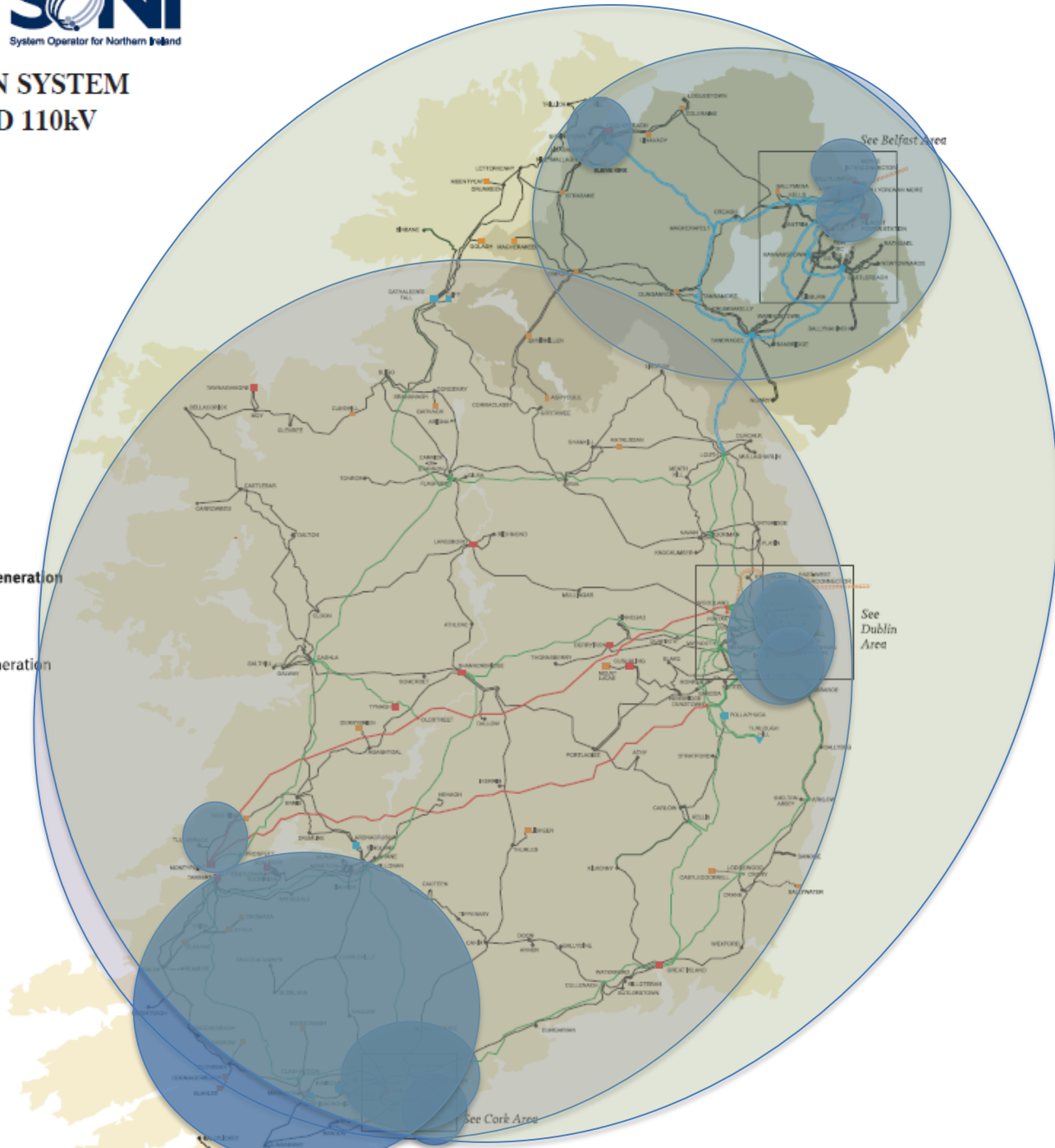
TRANSMISSION SYSTEM
400, 275, 220 AND 110kV
JANUARY 2014

———	400kV Lines
———	275kV Lines
———	220kV Lines
———	110kV Lines
– – –	220kV Cables
– – –	110kV Cables
┅┅┅	HVDC Cables
●	400kV Stations
●	275kV Stations
●	220kV Stations
●	110kV Stations

Transmission Connected Generation

■	Hydro Generation
■	Thermal Generation
▼	Pumped Storage Generation
■	Wind Generation

Energy Schedule vs Operational Schedule

- On the All-Island power system these additional requirements result in a significant deviation (>30%) between the energy only market schedule and the secure operational schedule.
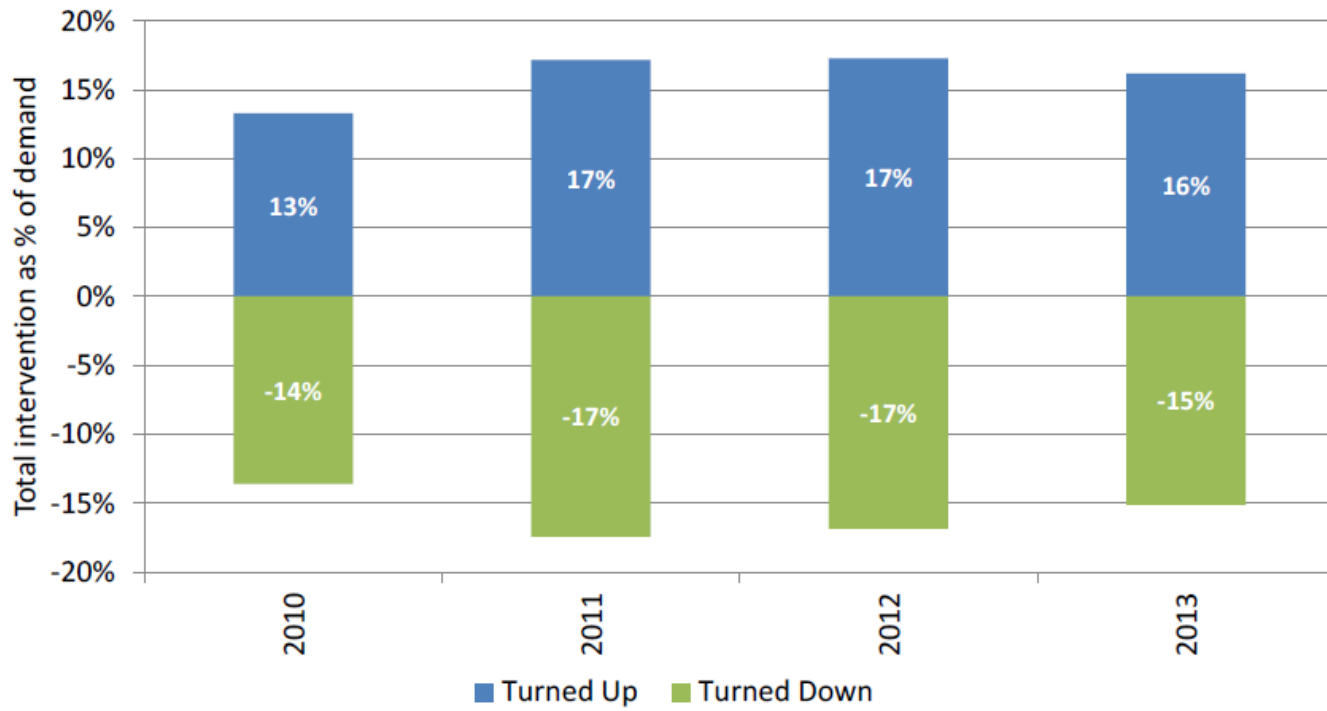
(Source: SEM-14-008, 5th Feb 2014)

Secure Dispatch Objective

- Every hour the TSO will endeavour to arrive at 1 hour before real time with a feasible dispatch plan and all required plant for that schedule on line or able to come on line within the hour.

    - the 'final hour' is used to:
        - further optimise reserves (and other Constraints) based on final PNs, INC and DEC prices
        - deal with demand and wind forecast deviations
        - determine and schedule cross-zonal actions

    - ....and in real time:
        - balance supply and demand – keep frequency within limits
        - enable cross-zonal exchanges
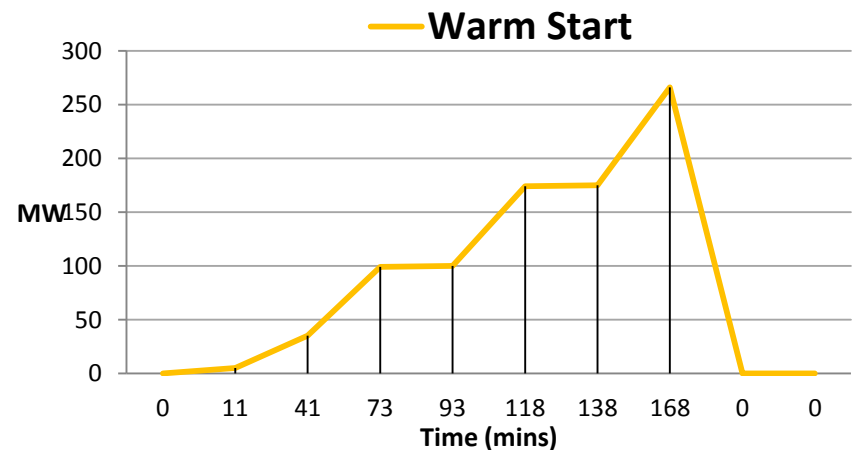   - manage contingencies (generator and interconnector trips)

Timing of Unit Commitment & Dispatch Instructions

- 'SYNC' instructions are issued at the time required less the total time to get to minimum load (unit notification and loading times). Ranges from minutes to > 15 hours
- 'MW Dispatch' instructions are issued in line with unit ramp rates.
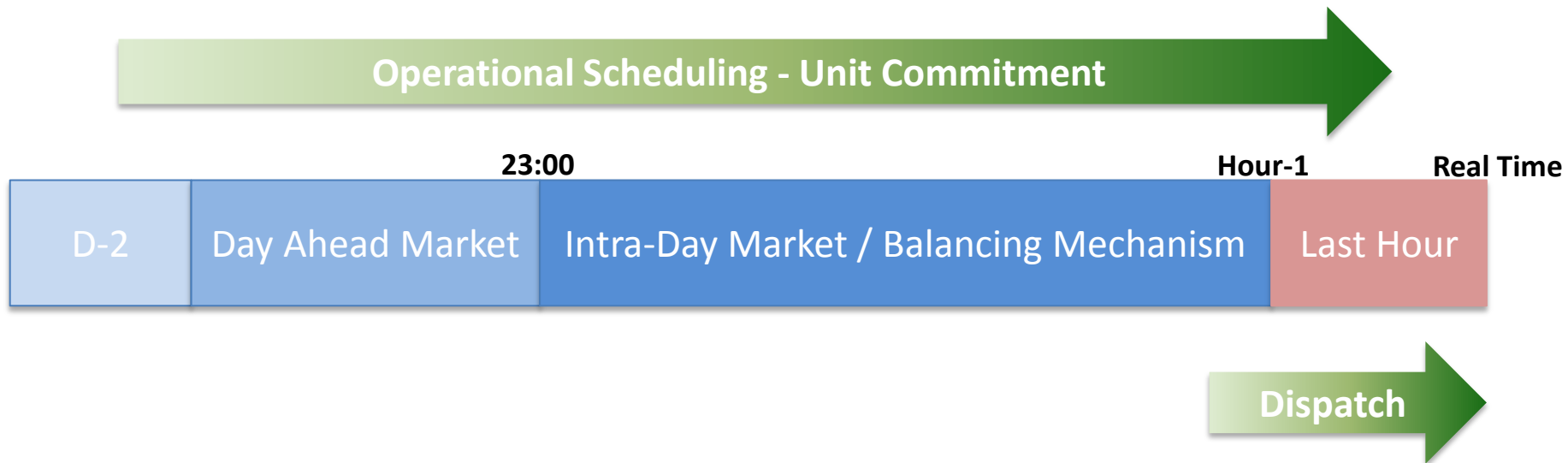
Unit	Type	Notification Times (time to Sync.) Hrs		
		Hot	Warm	Cold
MP1	Coal	5	8	15
TB4	Oil	3	7	10
DB1	CCGT	2	3.5	5
HNC	CCGT	3	5	9
WG1	CCGT	3	5	12
TYC	CCGT	3	5	10
LR4	Peat	6	12	12
AT1	OCGT	0.33	0.33	0.33
TP1	OCGT	0.17	0.17	0.17

+ Time to get to min load and ramp up (e.g. MP1)

Warm Start

MW — y-axis: 0, 50, 100, 150, 200, 250, 300

Time (mins) — x-axis: 0, 11, 41, 73, 93, 118, 138, 168, 0, 0

Operational Scheduling & Dispatch

- The following slides discuss approaches for the operational scheduling and dispatch process in I-SEM

Operational Scheduling - Unit Commitment →

23:00   **Hour-1**   **Real Time**

| D-2 | Day Ahead Market | Intra-Day Market / Balancing Mechanism | Last Hour |

Dispatch →

One Extreme

- Last time to order
  - Leave market to resolve energy actions up to one hour before real time
    - TSO does not activate a start/stop while BM and IDM both open unless there is a security requirement to do so

- Positive
  - Provides strong energy balance signal to generators
  - Allows energy market greatest freedom to schedule generators

- Negative
  - Will lead to higher production costs (material increase)
  - Higher curtailment of wind generation
  - High reliance on quick start plant
  - Market participants get late notification of schedule/dispatch
  - Energy only markets will not deliver the required level or location of system services so earlier security constrained unit commitment decisions will still be required.

The Other Extreme

- Binding operational schedule [full day]
  - On time commitment actions taken by TSO on basis of full day ahead schedule

- Positive
  - Lowers operational schedule production costs
  - Maximises priority dispatch
  - Greater security
  - Market participants get earlier notification of potential running

- Negative
  - Dilutes the signal for market participants to balance
  - Interferes with IDM (TSOs paying for start-ups)

The Middle Ground

- Only take actions from unit commitment tool *X* hours before real-time
    - Start requirements which are up against notice time constraints are issued
    - No other action taken during IDM
        - Resolve exact reserve 1hr before real time

- Use market demand in SCUC unless more than *X00 MW or fn(wind,demand,…)* short/long
    - If market demand more than X00 MW short
    - Add to or subtract from market demand

- Approach could be based on a 'Balancing Principles' document agreed by RAs
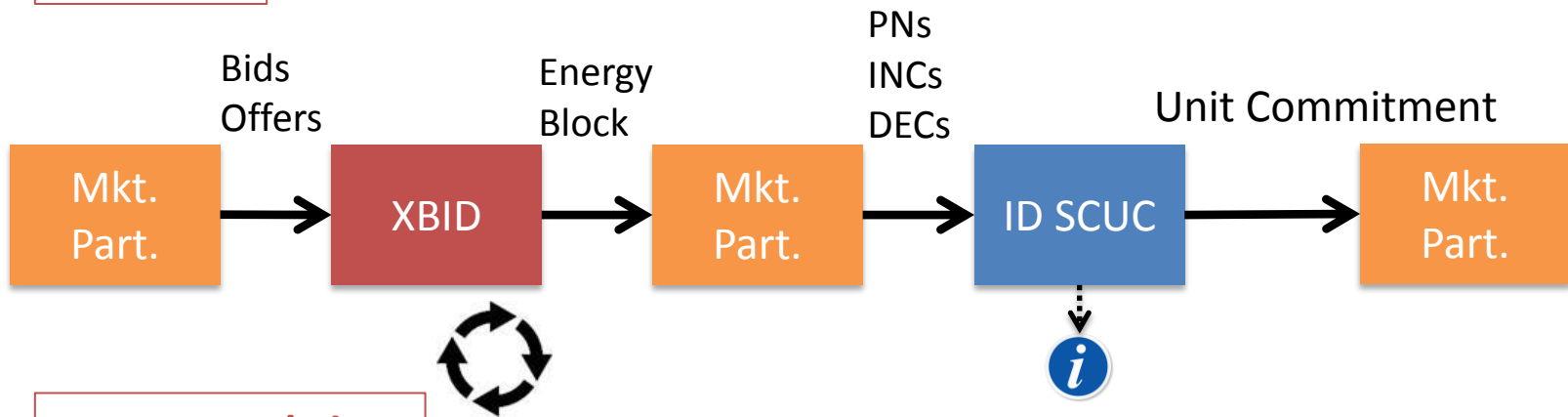
Scheduling & Dispatch Tools

- **S**ecurity **C**onstrained **U**nit **C**ommitment
- **S**ecurity **C**onstrained **E**conomic **D**ispatch
- Inputs:
  - Generators PNs, INC and DEC prices
  - Start-up and No-load costs (?)
  - Technical offer data
  - Security constraint rules, e.g.:
    - Reserve
    - Inertia
    - Security constraint groups
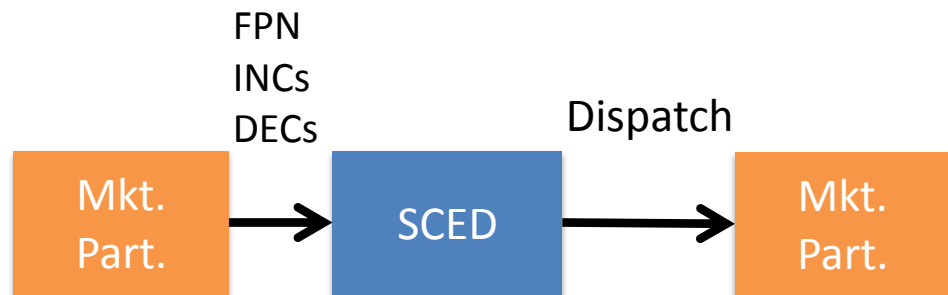   - Transmission network representation (?)
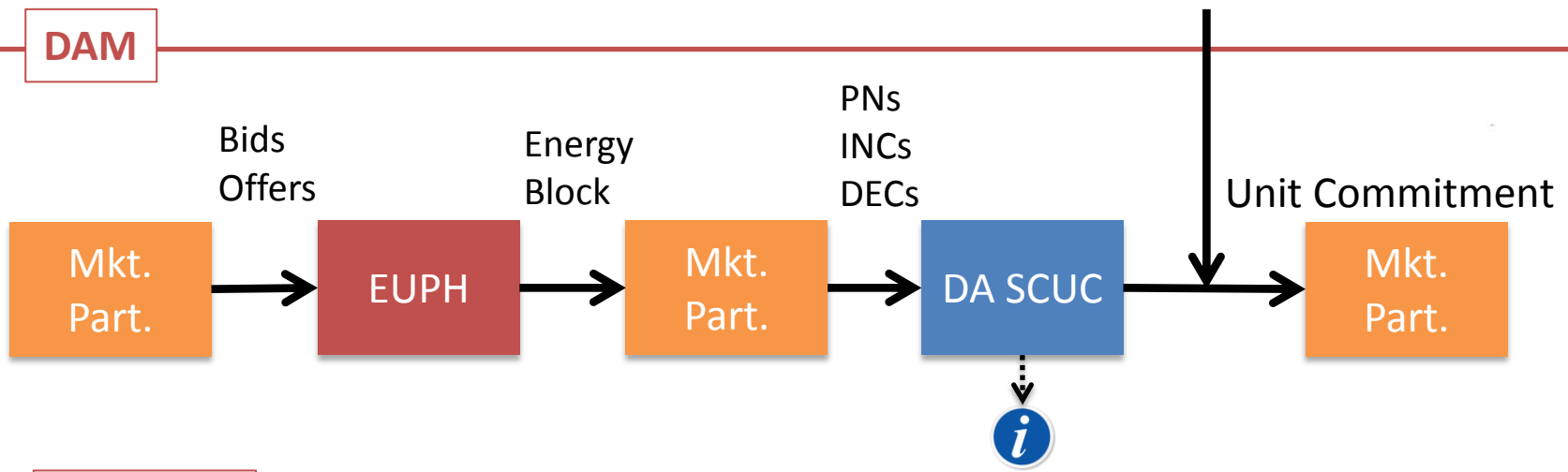
Example

Unit off in DAM but required for local Voltage Support, Inertia and Operating Reserves