



Smart TSO-DSO interaction schemes, market architectures and ICT
Solutions for the integration of ancillary services from demand side
management and distributed generation

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WP4 – T4.4 Cost-benefit analysis methodology

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Structure of the CBA

- Goal: Elaborate an ad-hoc CBA methodology for analysing TSO-DSO interaction schemes and identify the best of them for each national case

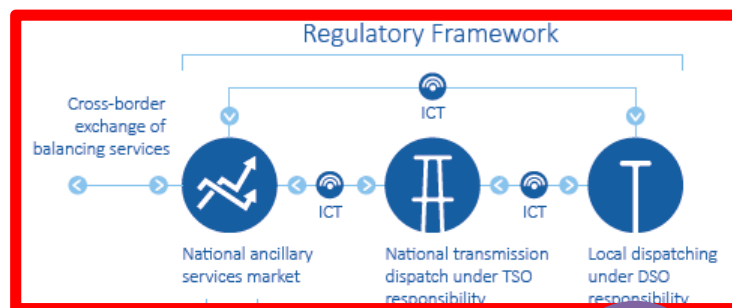
Relationship between main system actors



Analysis of TSO-DSO coordination schemes

Country-specific aspects and regulation

ICT specification and planning

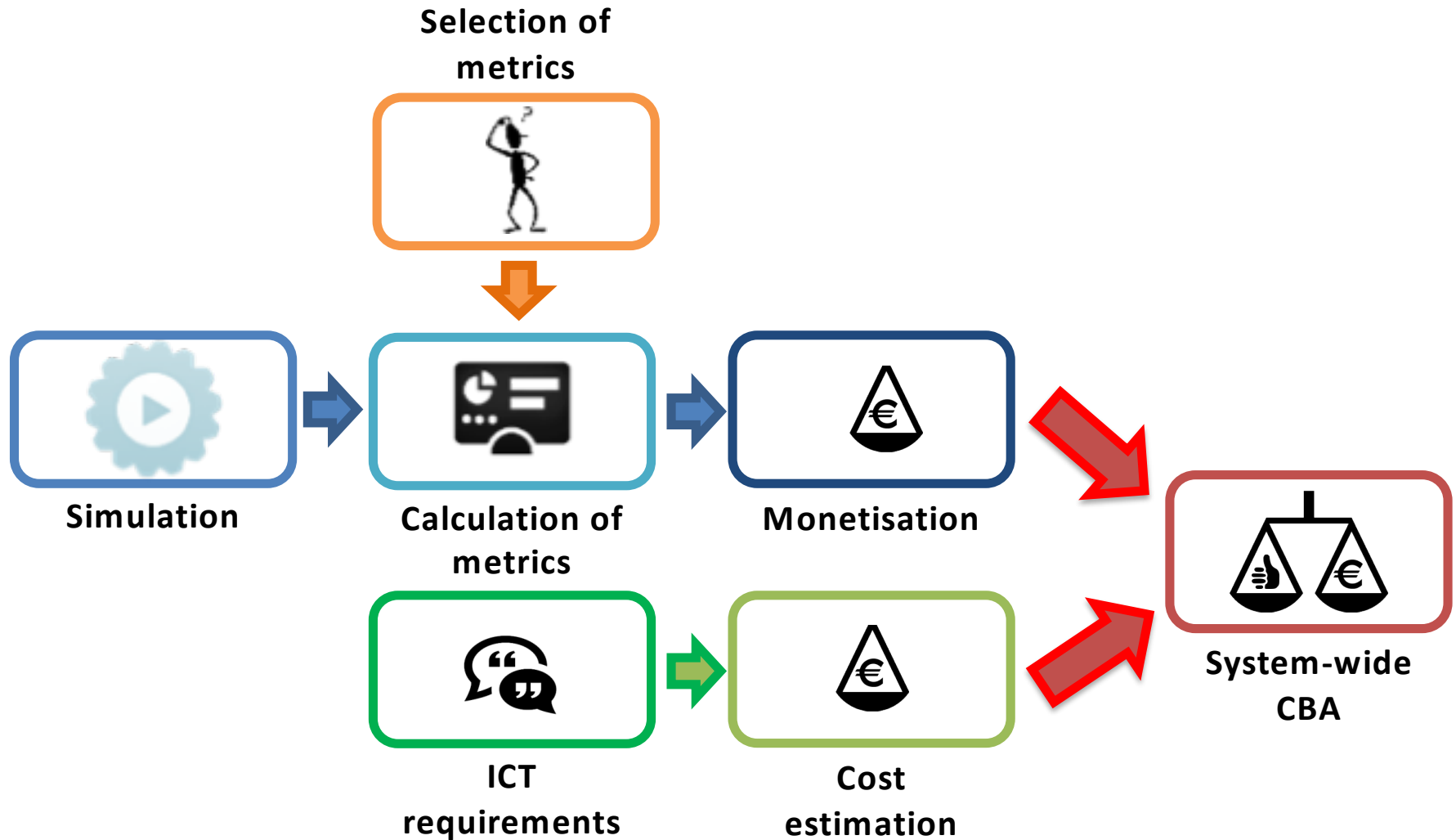


System-wide benefits and costs (Macro)

Appropriate allocation of costs and benefits (Micro)



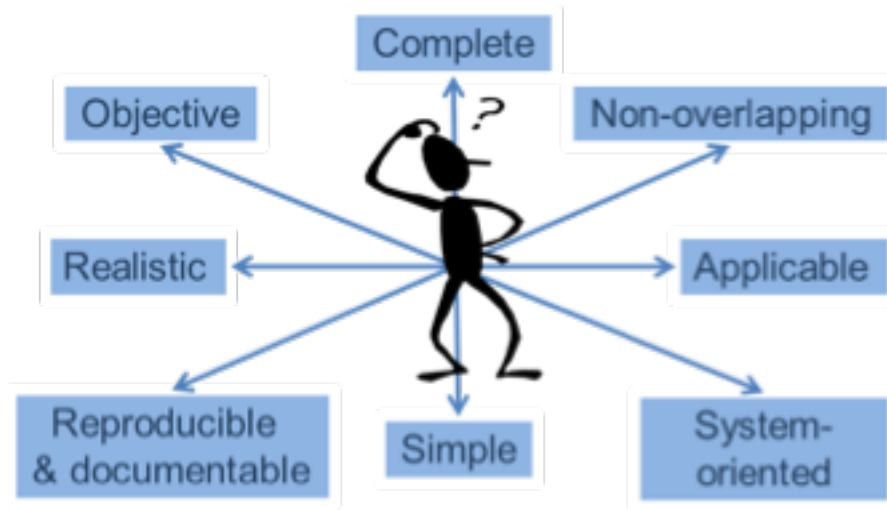
Structure of the Macro Analysis



Indicators for the Macro Analysis



Calculation
of metrics



Economic indicators

- **Total Tertiary Regulation Cost:** cost of the market defined in SmartNet).
- **Total Cost of Secondary Regulation:** cost of the balancing actions performed after dispatching the units matched in the market defined in SmartNet
- **ICT cost:** Cost of implementing the required ICT systems for the coordination scheme.

Additional indicators

- **CO₂ emissions:** with standard emission rates for each generation technology. NOT to be monetised as CO₂ prices are already included in aggregators' bids.
- **Energy lost due to unwanted measures:** unexpected congestions solved with curtailment of load/generation, etc.



Literature
review

EPRI/JRC
REALISEGRID
e-Highway2050



Consultation with the
Advisory Board



Preliminary results of the Macro Analysis

Analysis of the full Italian scenario (all devices, full T & D networks)

Simulations run for 68 time steps (7 a.m. till midnight)

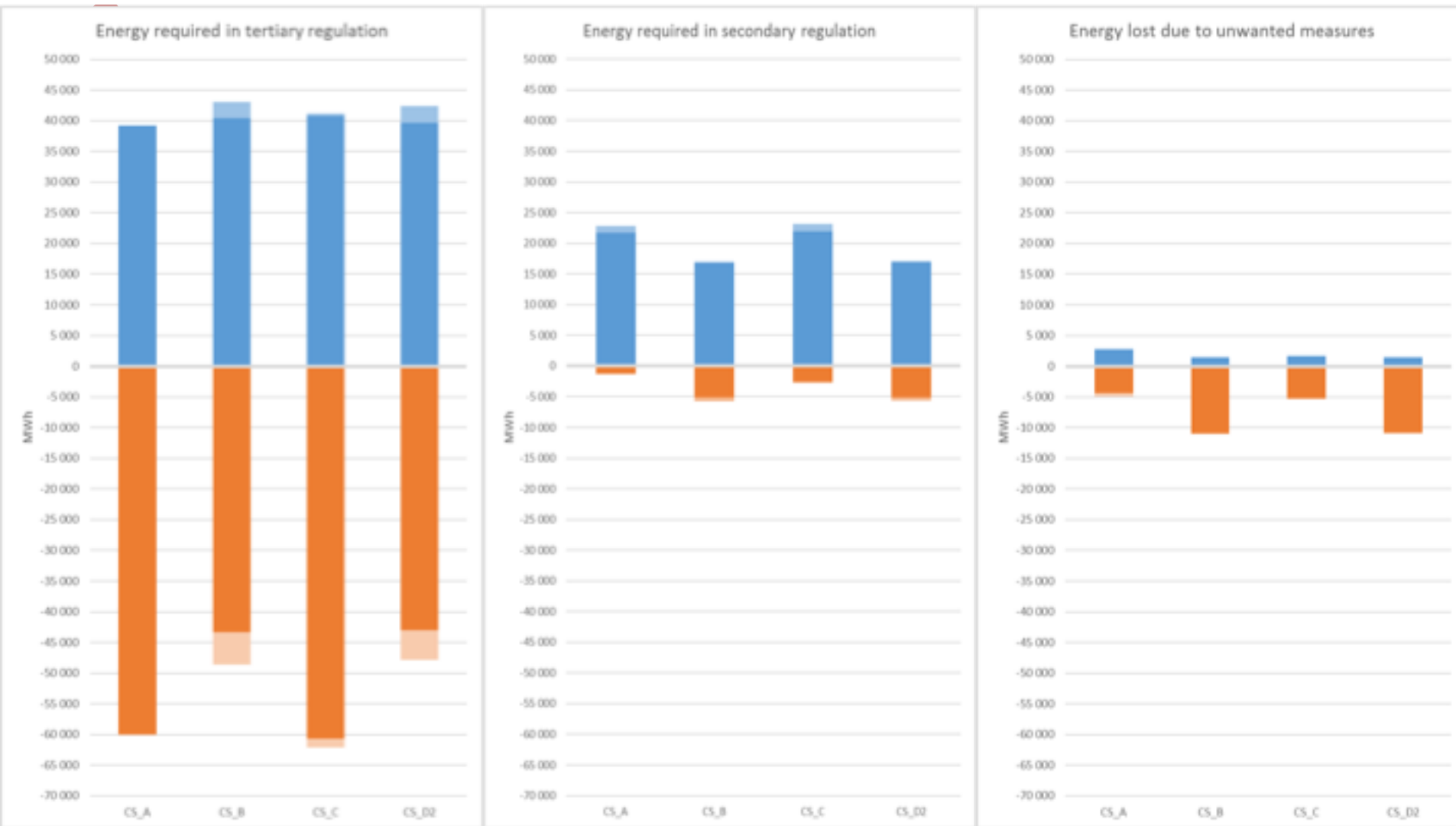
Utilisation of balancing energy for:

- The market defined in SmartNet (tertiary regulation) +
- Balancing the system after that market (secondary regulation)

Energy lost due to unwanted measures by grid operators



Preliminary results of the Macro Analysis -



Upward energy provided by units at transmission

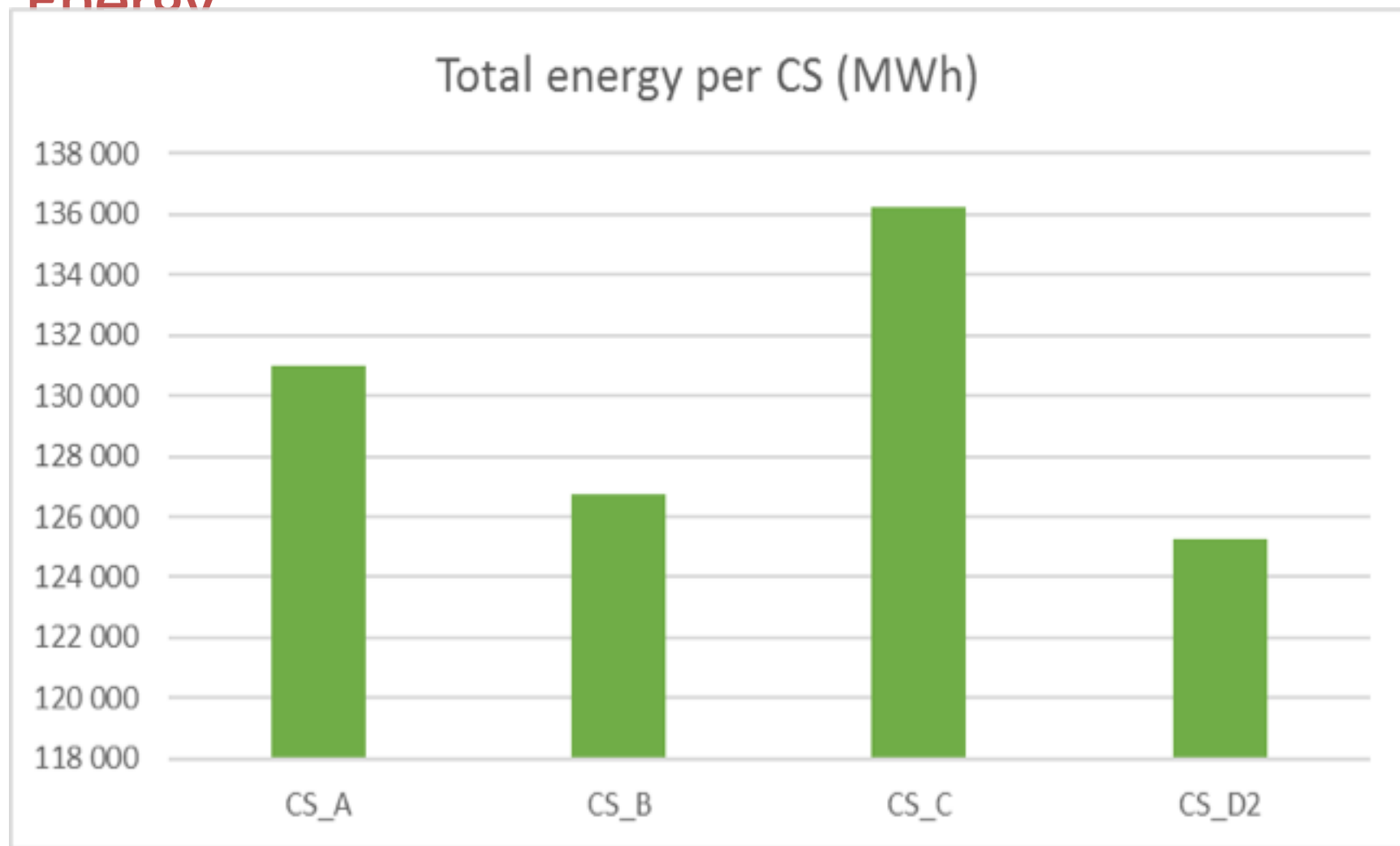
Upward energy provided by units at distribution

Downward energy provided by units at transmission

Downward energy provided by units at distribution

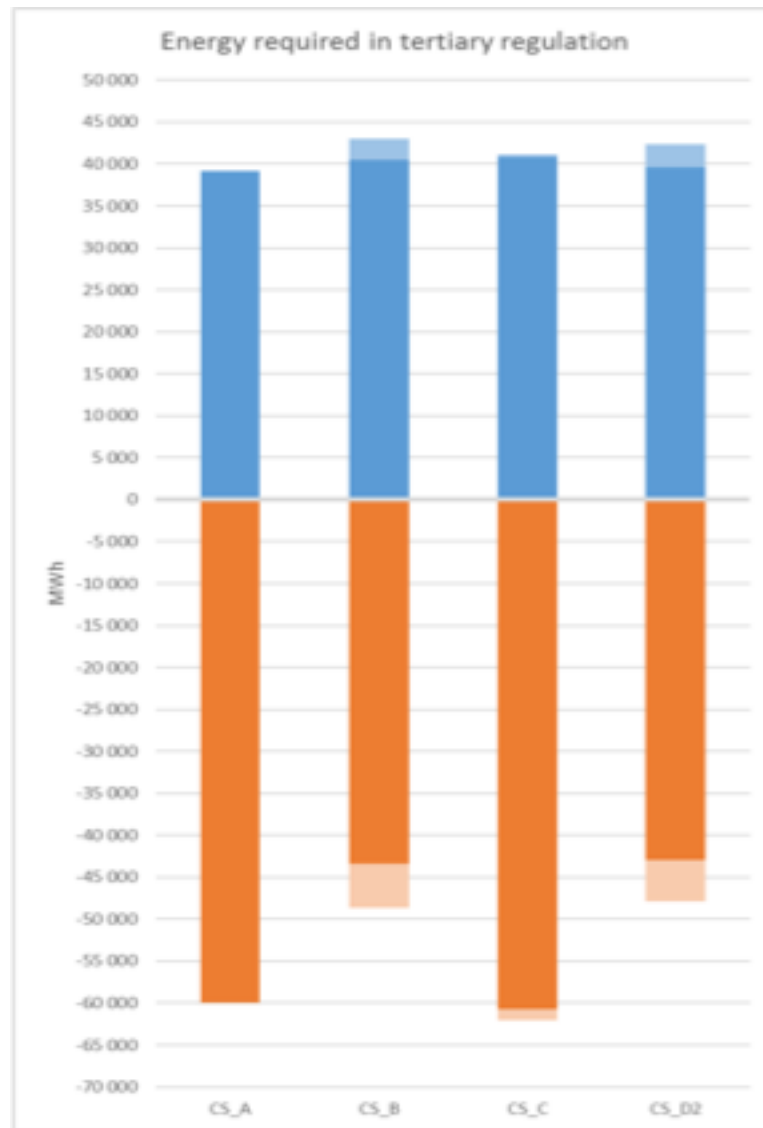
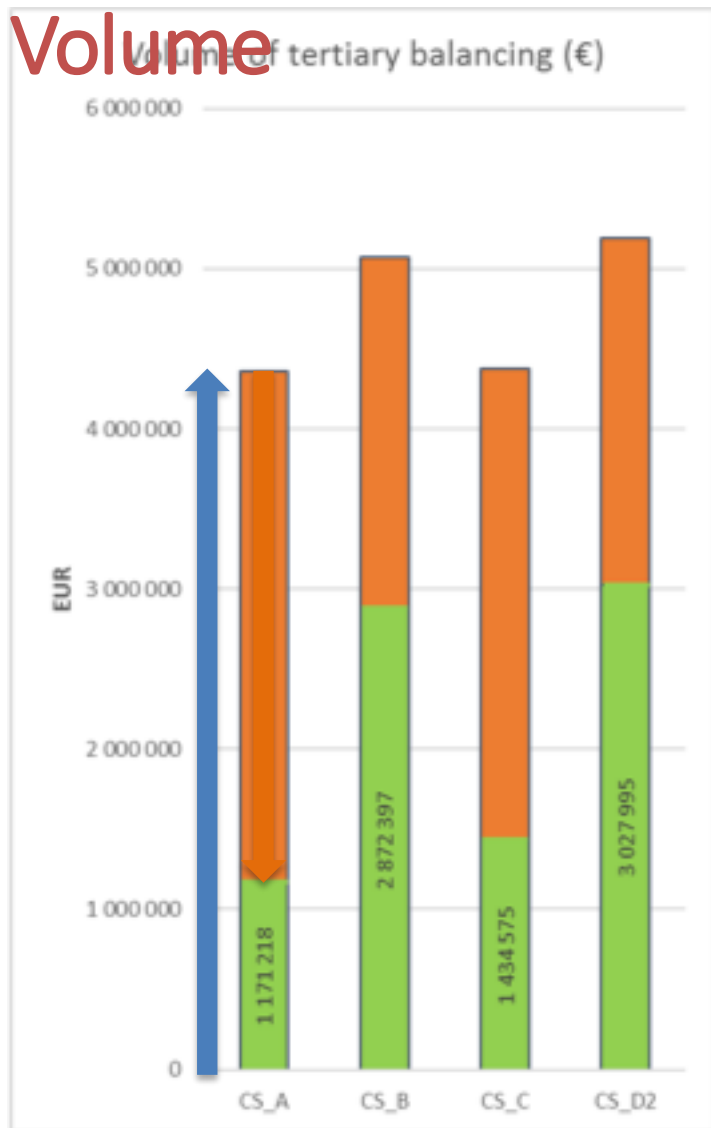


Preliminary results of the Macro Analysis - Energy



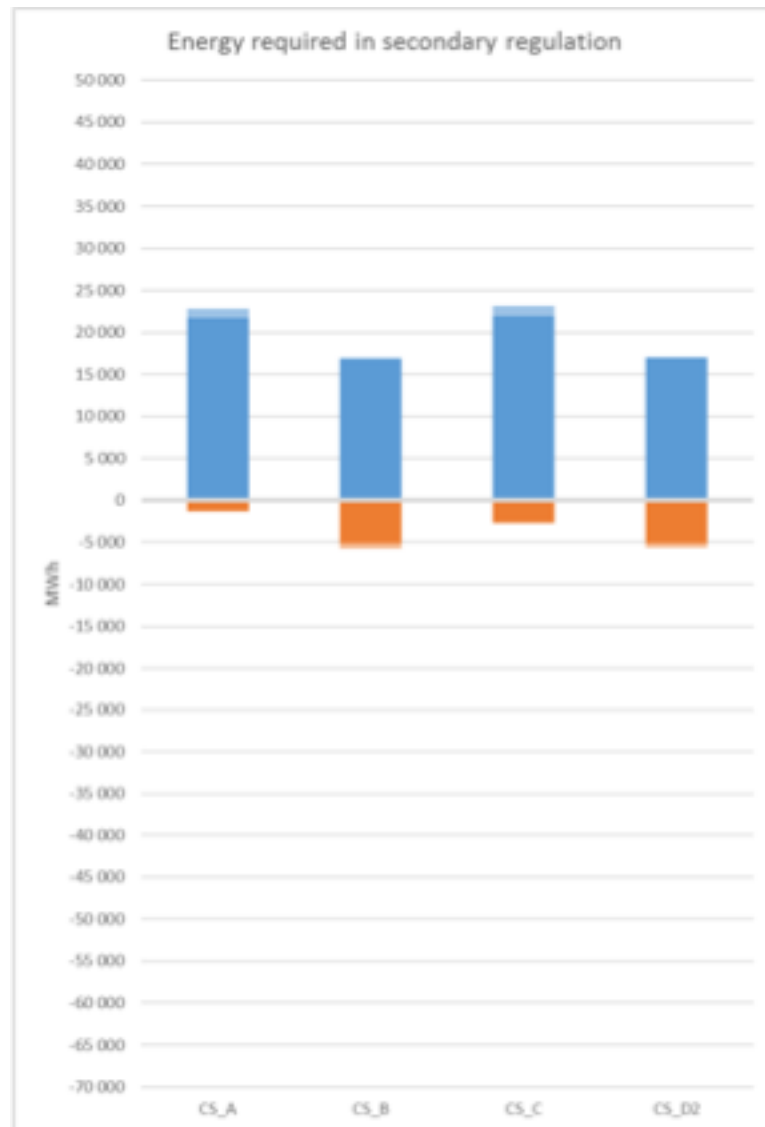
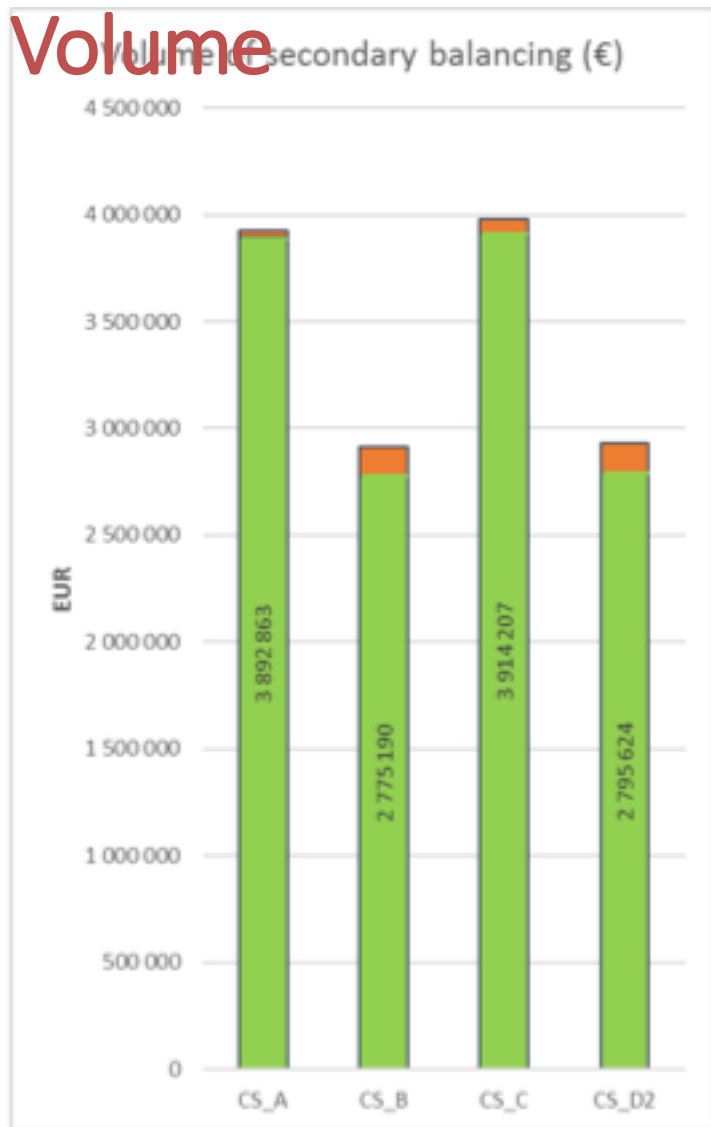


Preliminary results of the Macro Analysis - Volume





Preliminary results of the Macro Analysis - Volume





Next steps for the Macro Analysis - Balancing cost

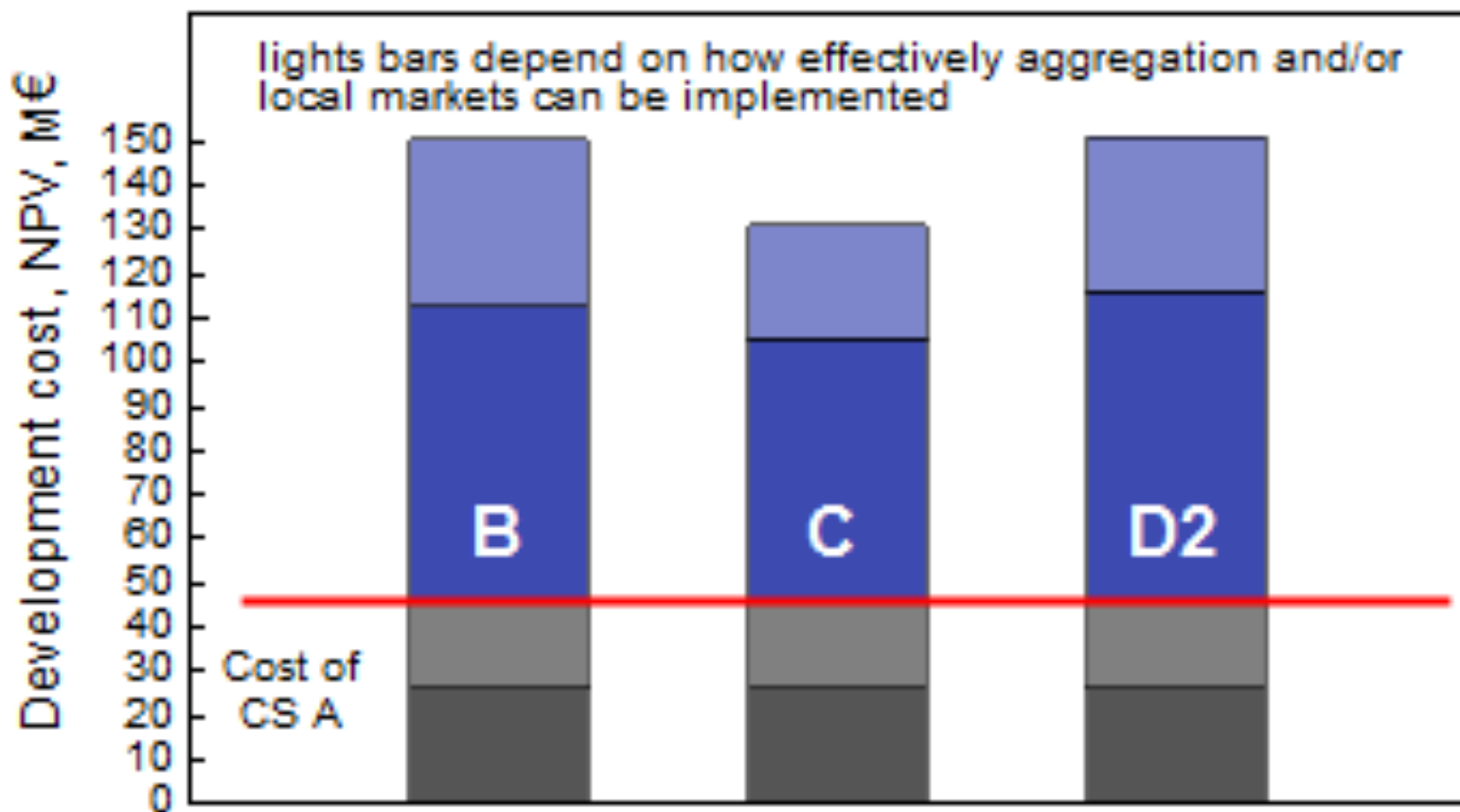
Calculate pay-as-clear prices for secondary regulation

Assign a price to the energy lost due to unwanted measures by grid operators?

Calculate the overall economic impact of each coordination scheme

Preliminary results of the Macro Analysis - ICT

Aggregation and market clearing implementations

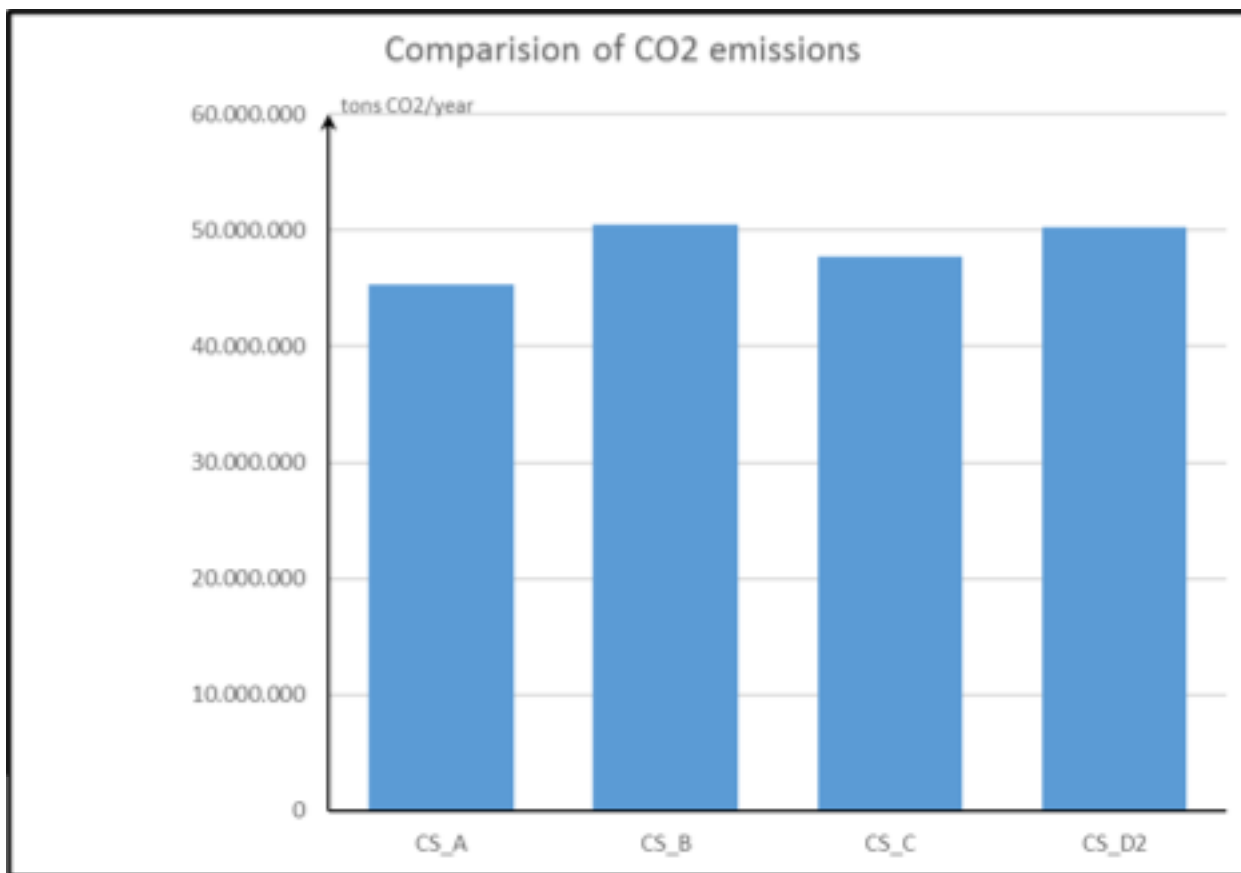


Cost of CS A (gray) and upgrade from A to 3 alternatives

Total ICT costs are only 1-2 % of the volume of balancing requirements in a single year!!



Preliminary results of the Macro Analysis - Emissions



Differences are again $< 10\%$!

Structure of the Micro Analysis

**System-wide
CBA**



Micro-level CBA

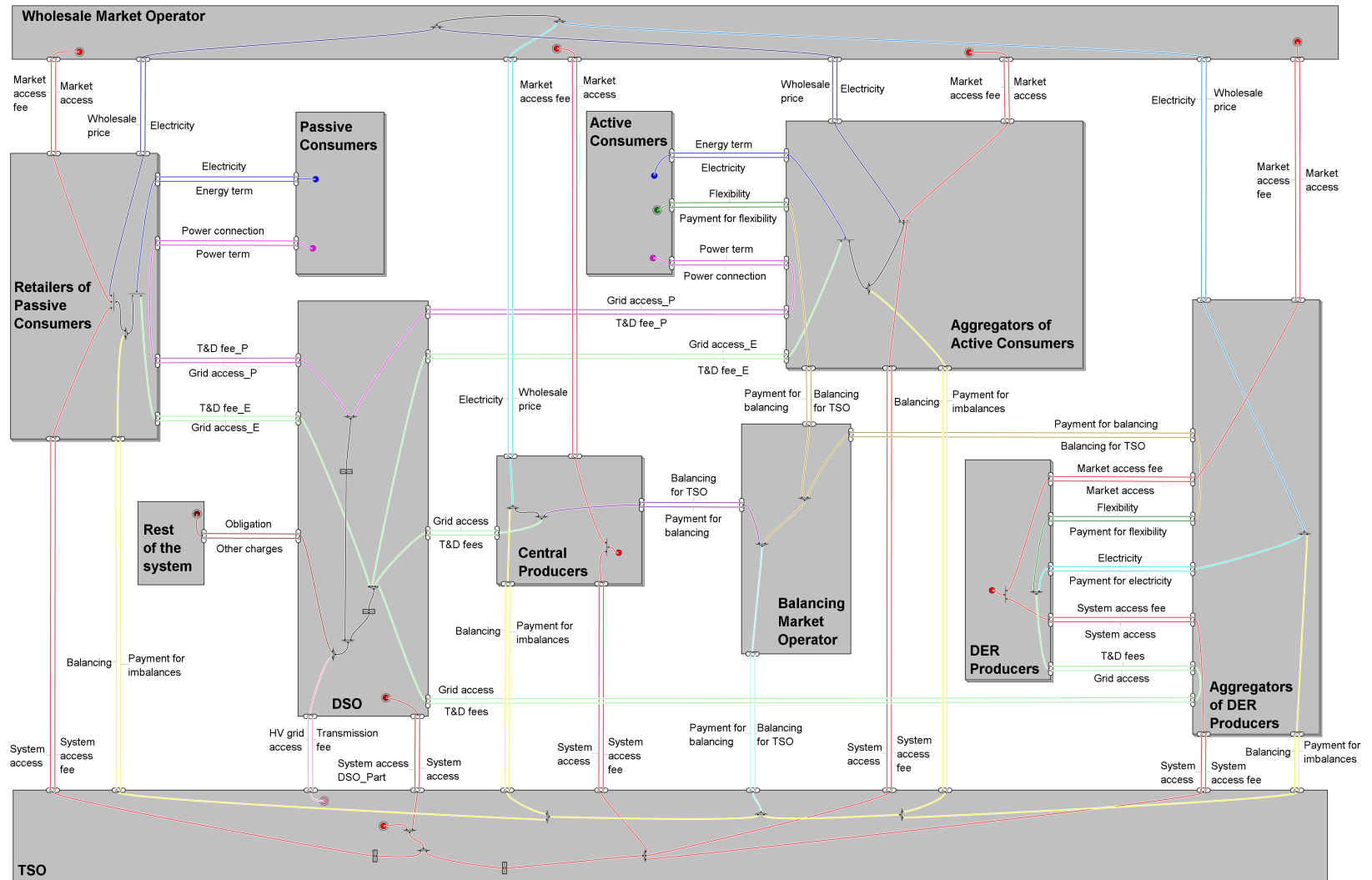
- Identification of the value chain
- Allocation of cost and benefits for each stakeholder
- Sensitivity analysis



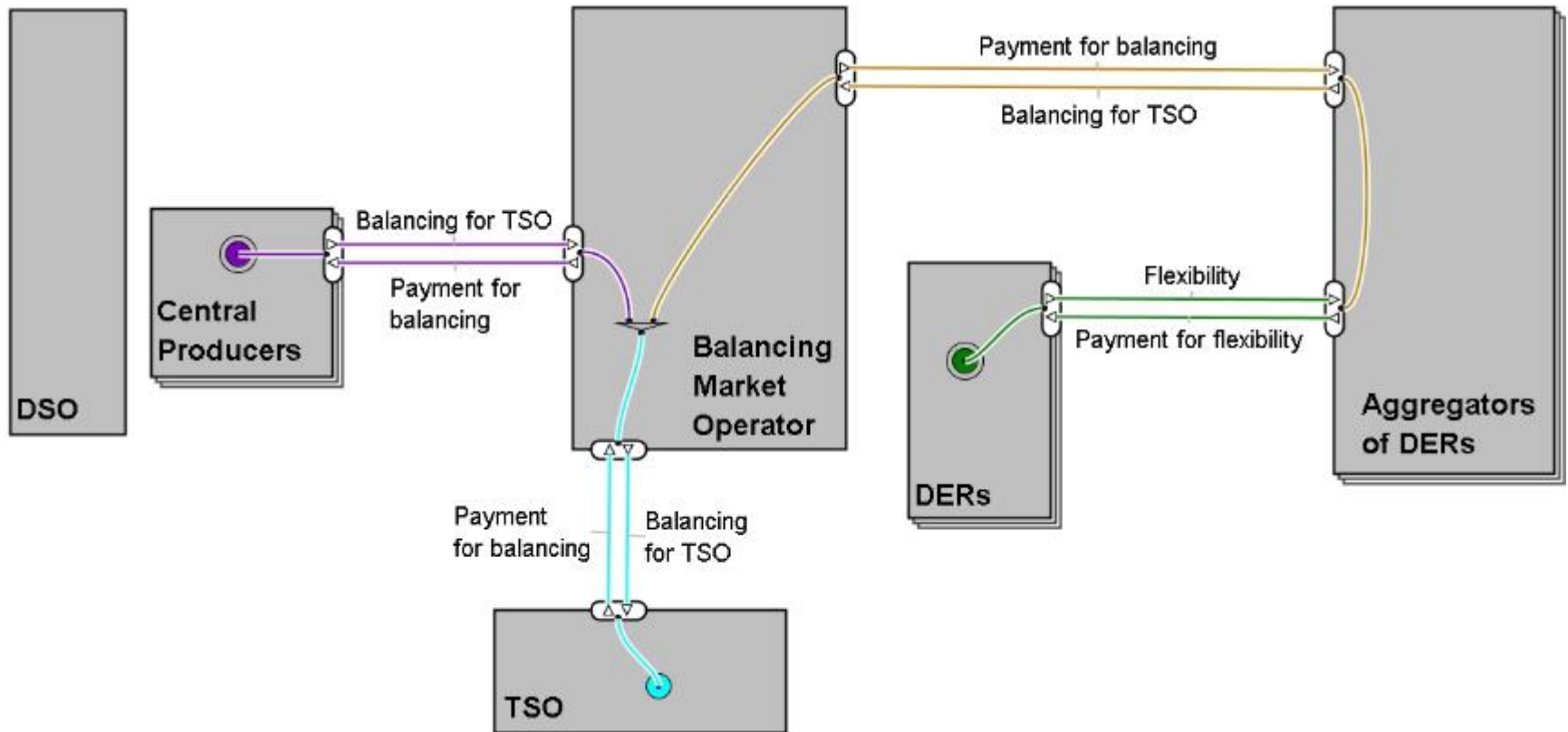
Status

- Value models are created for Spain, but valid for Italy and Denmark (in 2030)
- Formulation for Spain is available. Must be adapted for Italy and Denmark
- Data collection started. Also definition of the parameters to be obtained from simulations

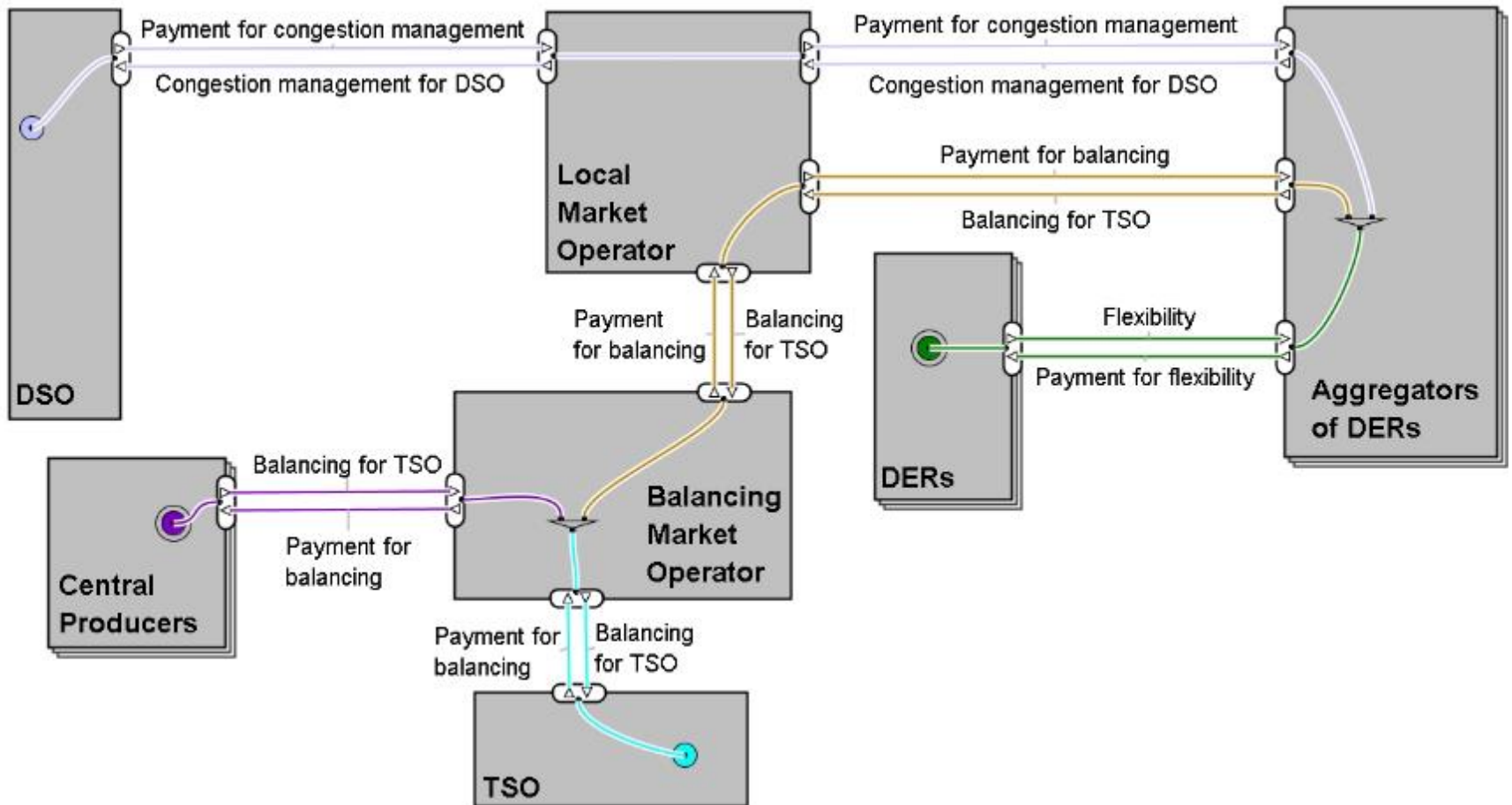
Coordination scheme_A



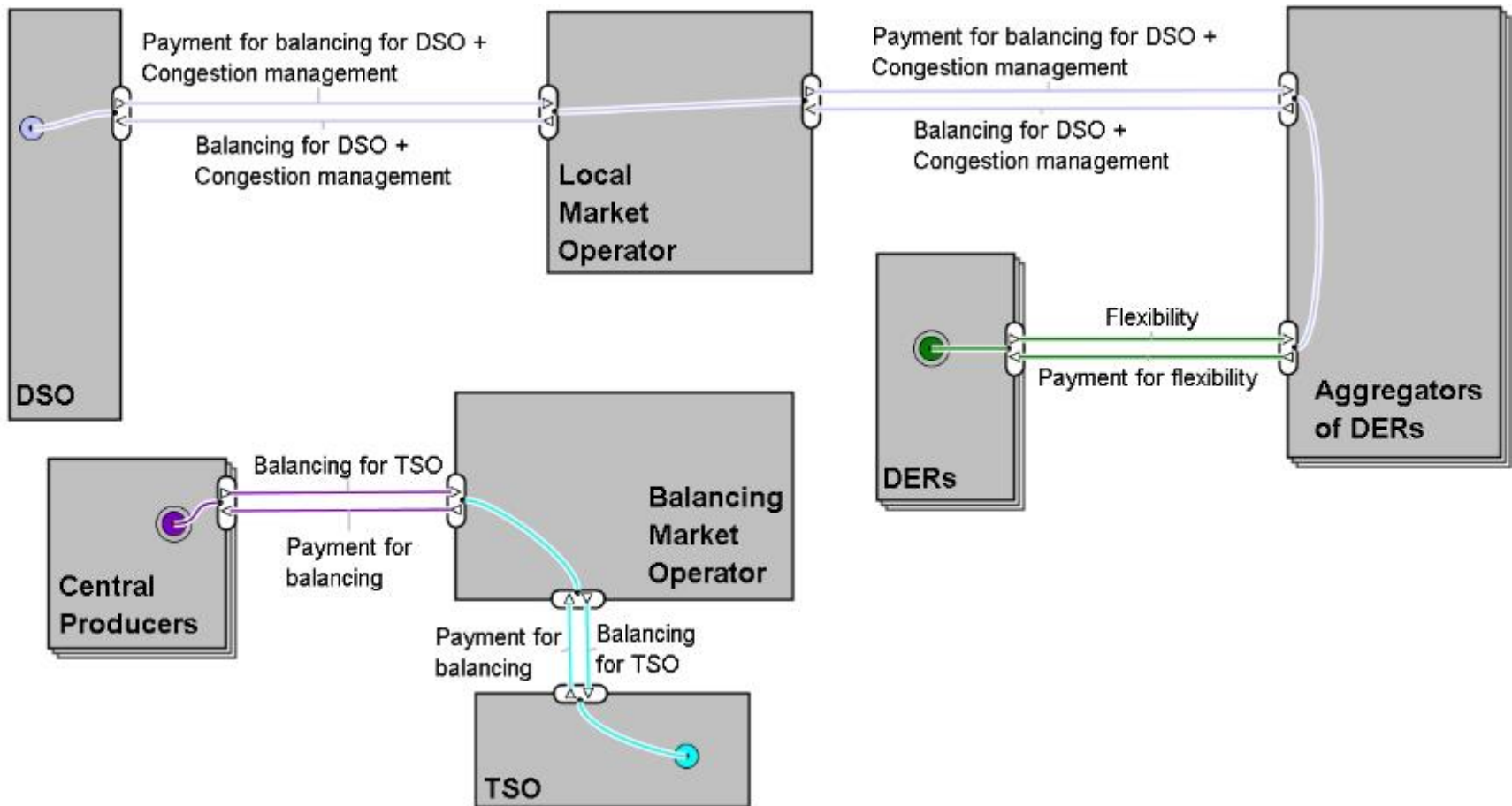
Balancing mechanisms. CS_A



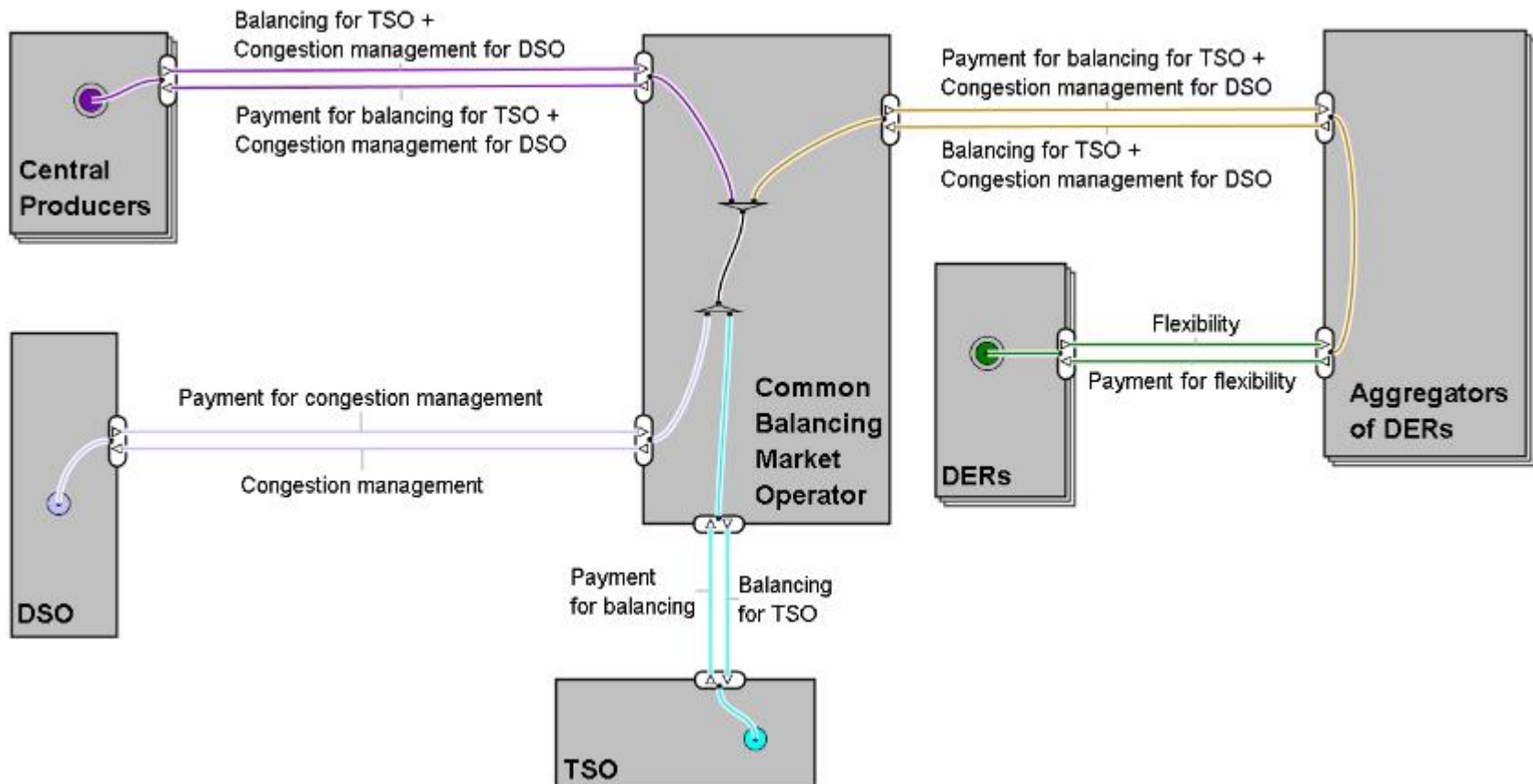
Balancing mechanisms. CS_B



Balancing mechanisms. CS_C



Balancing mechanisms. CS_D



SmartNet



SmartNet-Project.eu

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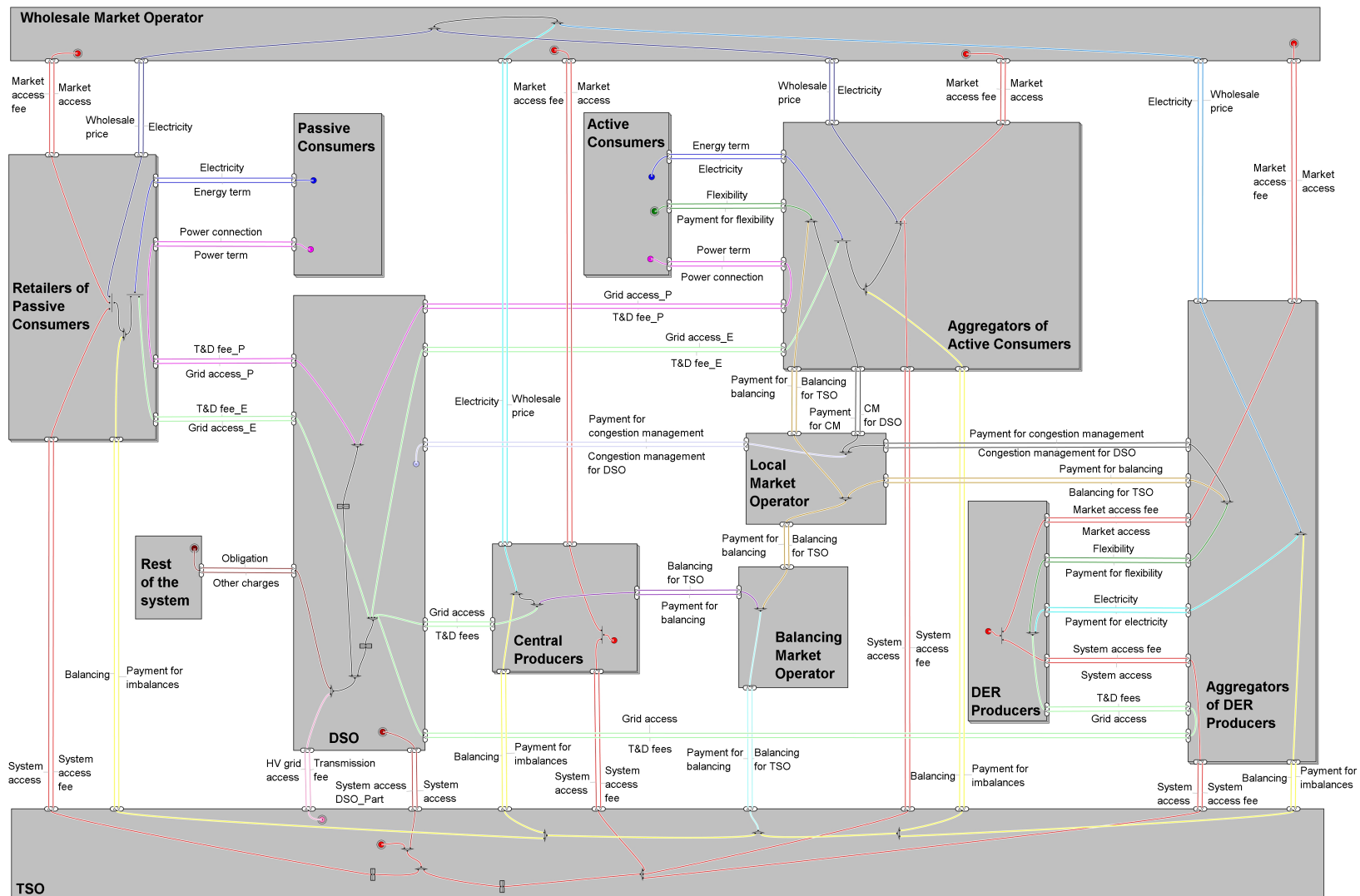
Thank You

Carlos Medina

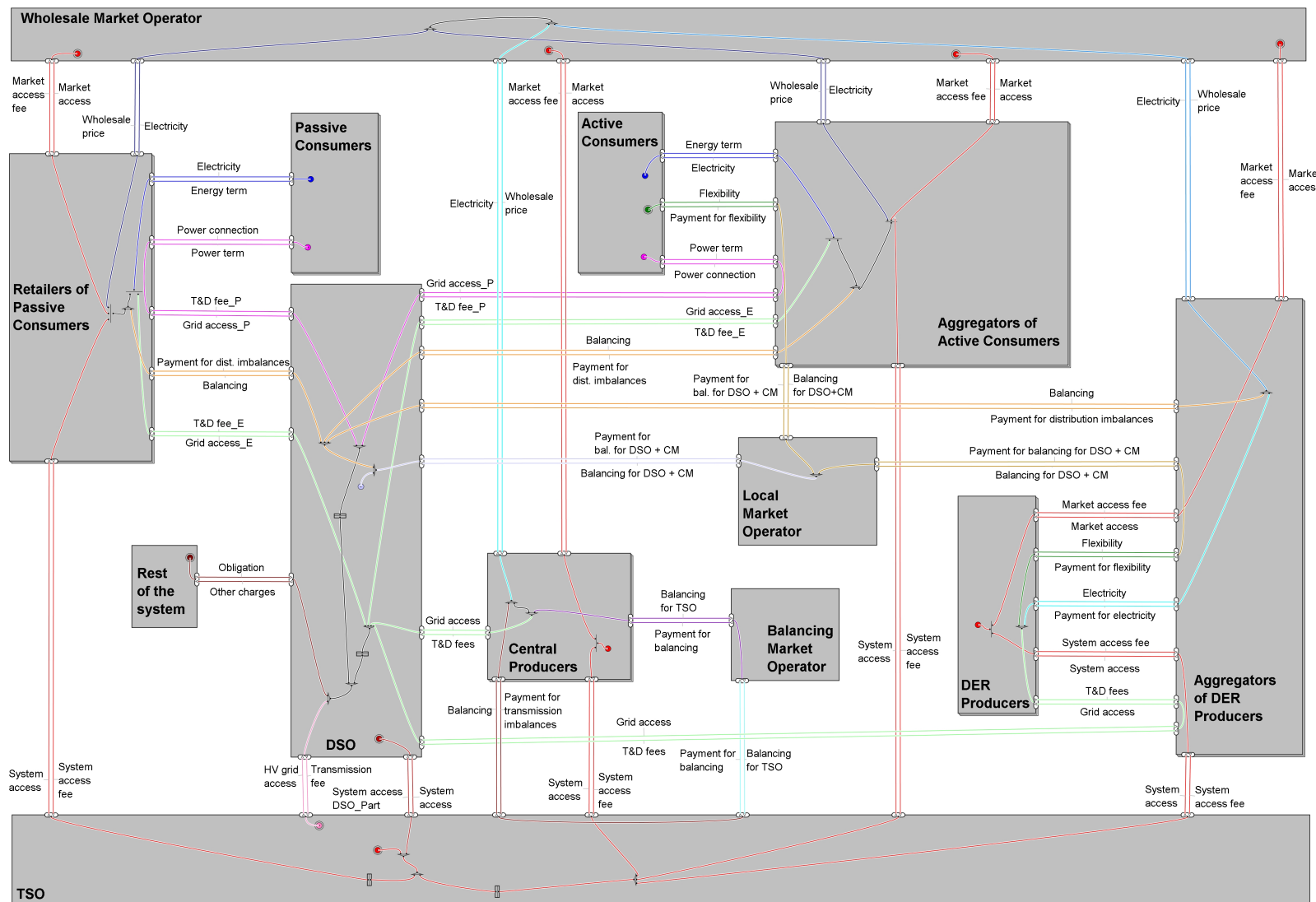
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Coordination scheme_B



Coordination scheme_C



Coordination scheme_D

