Market Equilibria and Cross-Border Balancing Platforms

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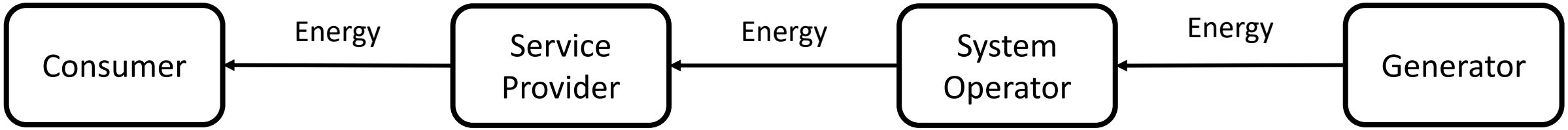
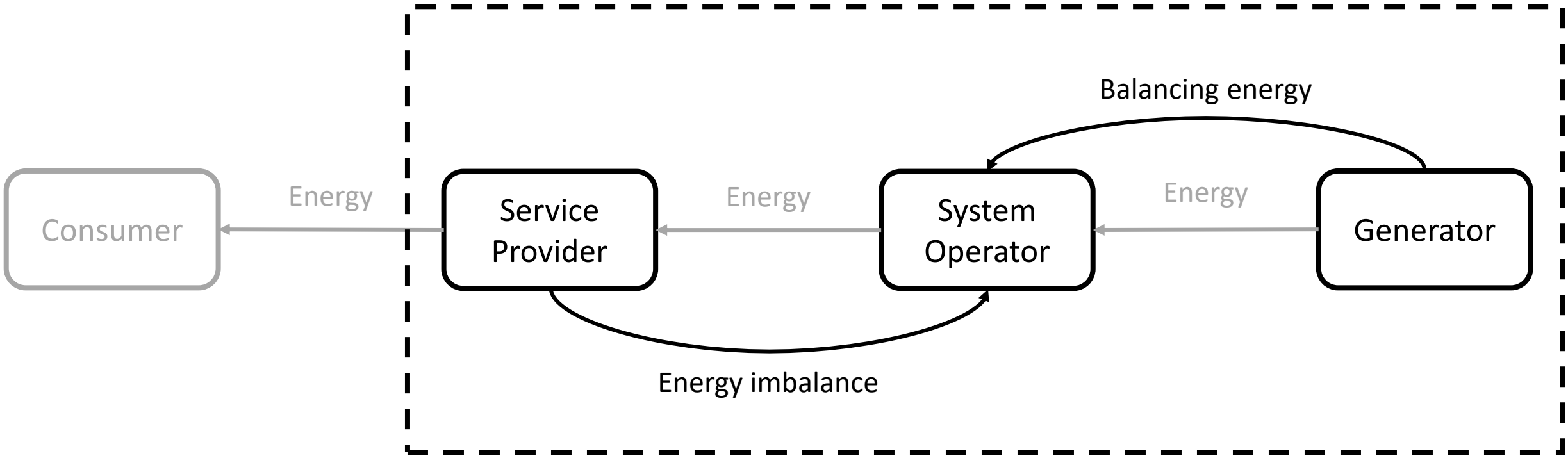
Summary

1. Introduction
   a. Balancing market
   b. Cross border balancing platform
   c. EU market distortion
2. Market design options
3. Results
4. Conclusion

Basic Electricity Market



Keeping the Balance



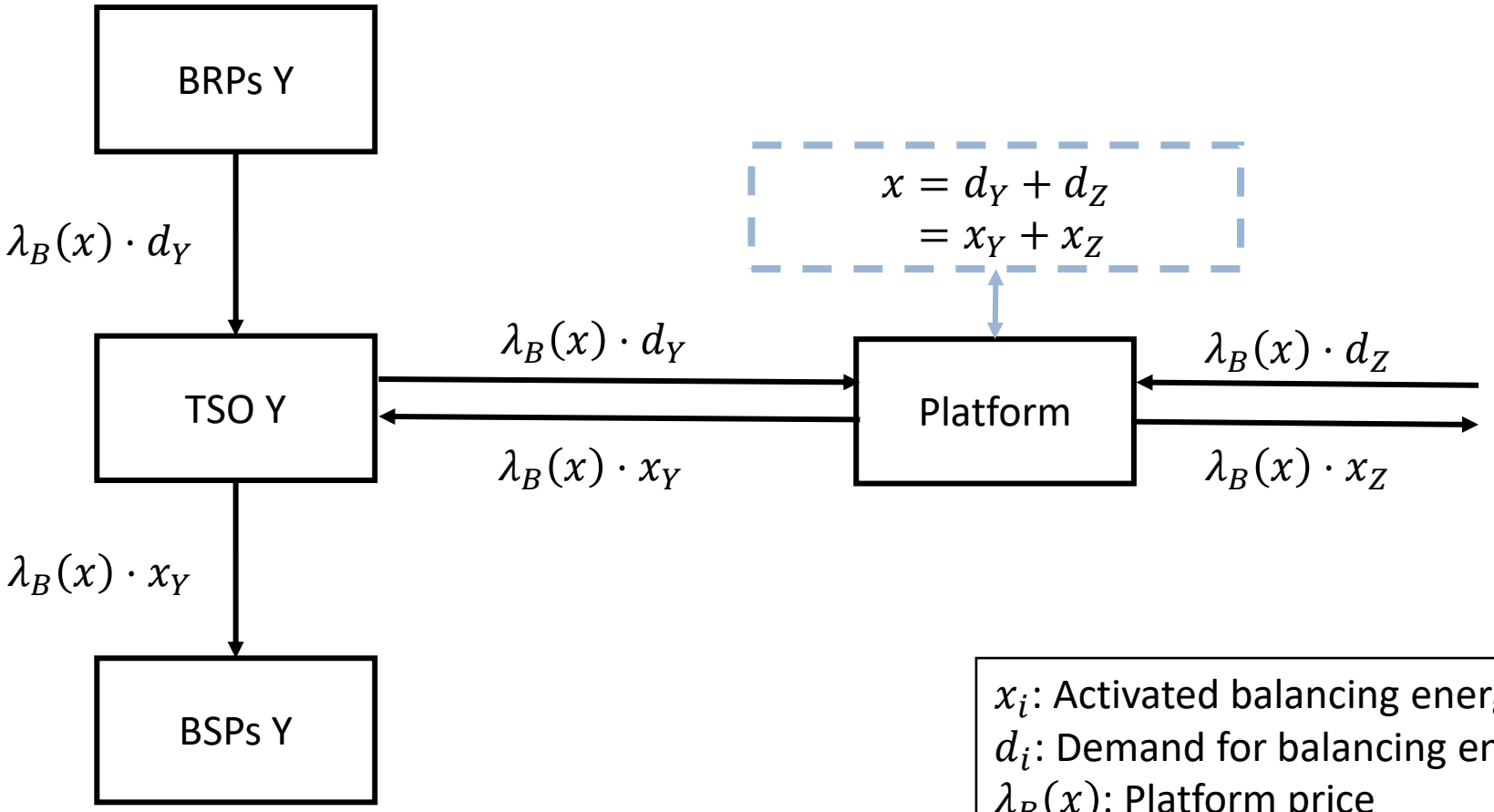
- Transmission System Operators (TSOs) balance supply and demand
- European balancing market terminology:
  - Balancing Service Providers (BSPs) price-elastic supplier of real-time energy
  - Balancing Responsible Parties (BRPs) price-inelastic buyer of real-time energy

Next Phase of European Electricity Market Integration: Cross-Border Balancing Platforms

- Coordinate the dispatch of balancing energy from different zones
- Have gone live in 2022 and operate over Germany, Czech Republic and Austria
- Other European TSOs are expected to join the platforms in 2023 or 2024

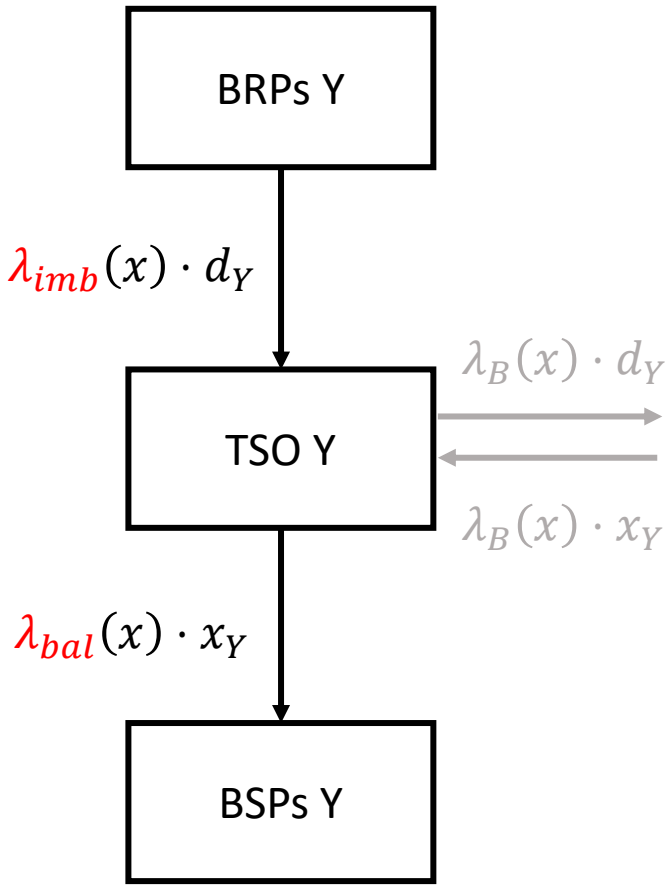
- European Balancing Market Terminology:
  - Platforms MARI and PICASSO for the trading of automatic and manual frequency restoration reserve (mFRR and aFRR)

Stylized One Product Platform



x_i: Activated balancing energy in zone i
d_i: Demand for balancing energy in zone i
$\lambda_B(x)$: Platform price

EU Market Distorsion: Imbalance Settlement ≠ Balancing price



- By example in Belgium

$$\lambda_{imb}(x) = \lambda_B(x) + \lambda_R(x)$$

- $\lambda_R(x)$ is an adder on the energy price
- Increases with x, the demand for balancing energy

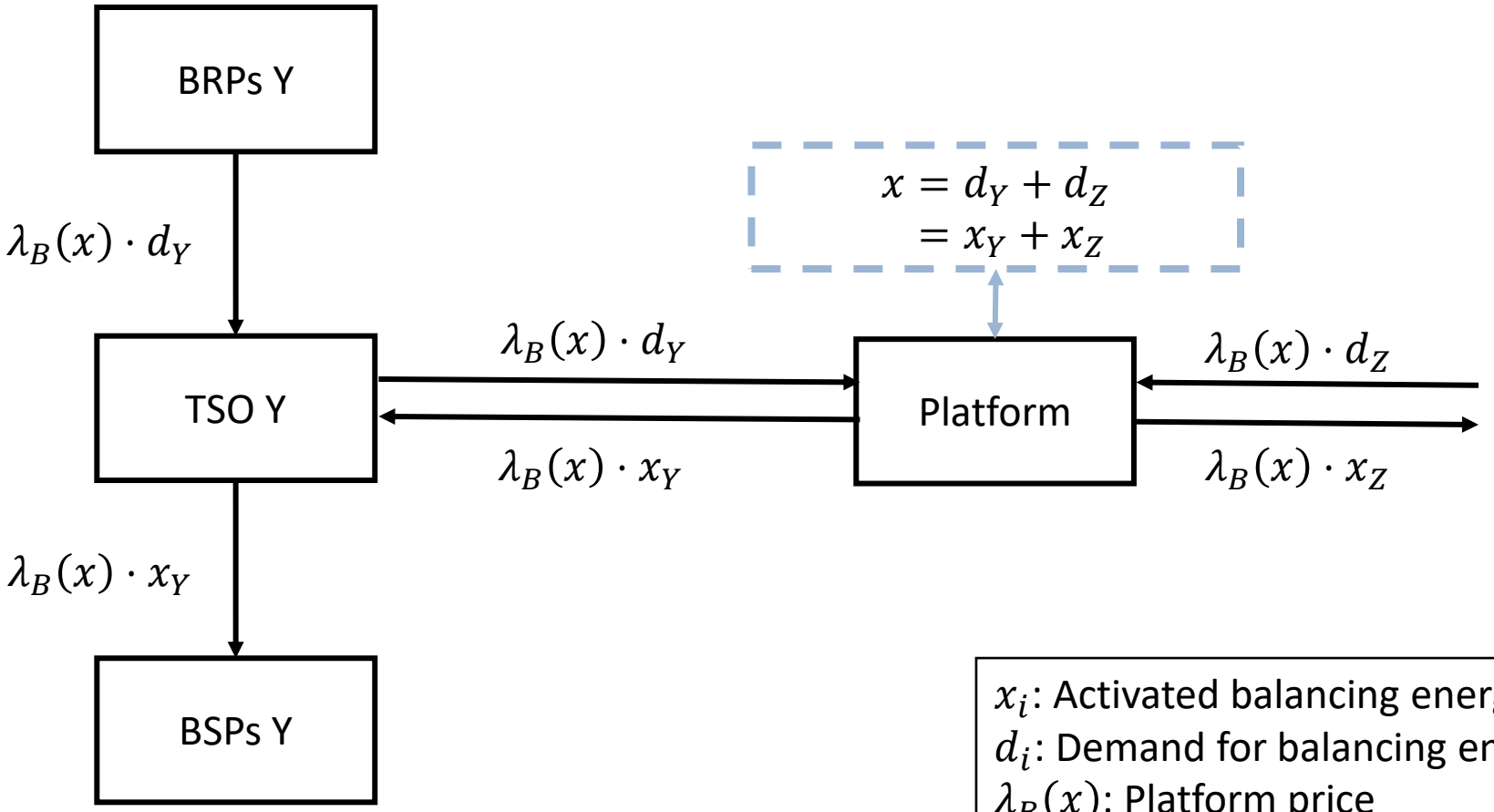
Objective:

- Keep the system imbalance stable
- Prevent long-lasting imbalance by BRPs by holding them accountable for their use of balancing capacity

Objective of the Research

- Assess the impact of having adder on the balancing and imbalance price for price taking agents
- Market design proposal to mitigate the distortions

Design 1: *No Adder*



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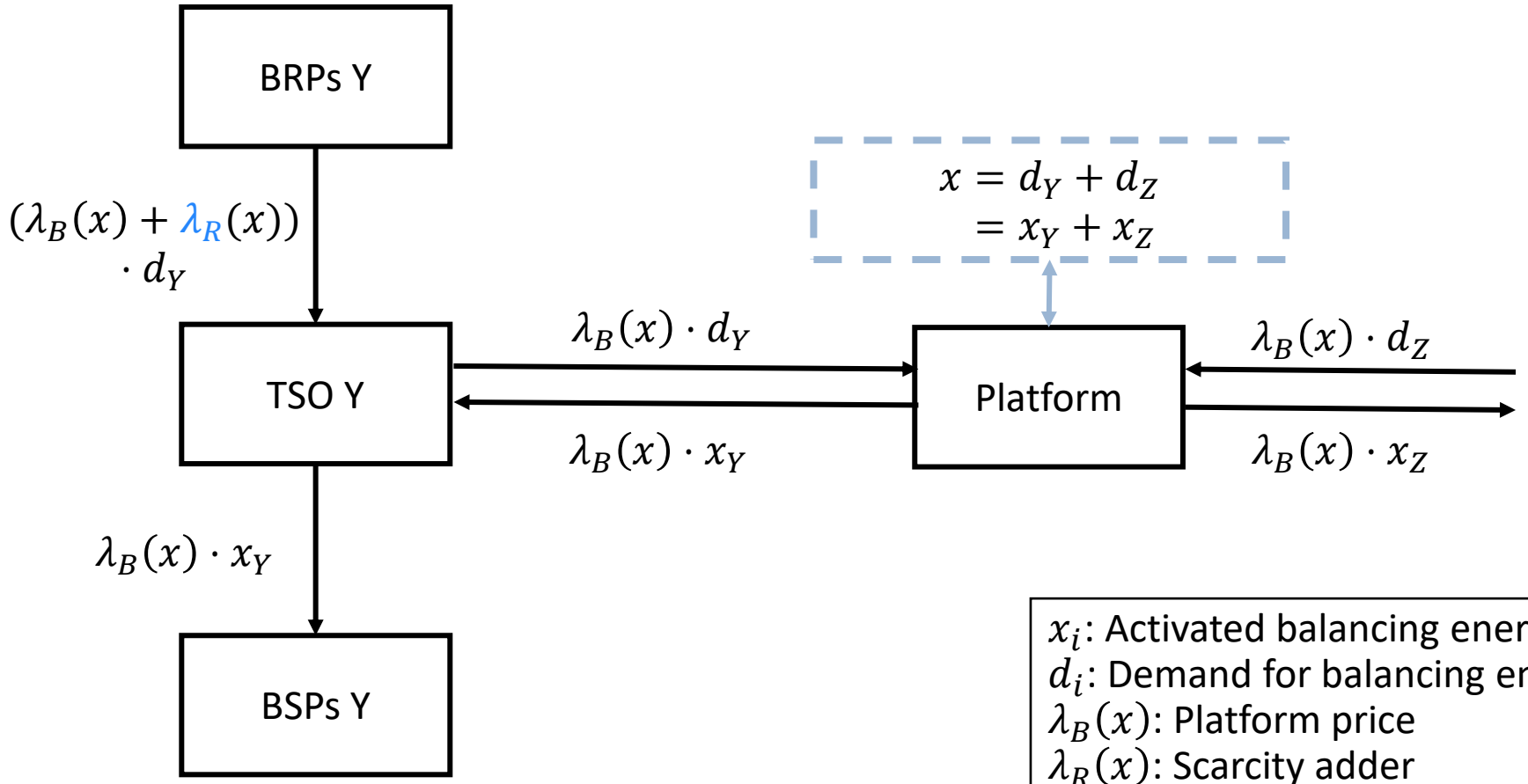
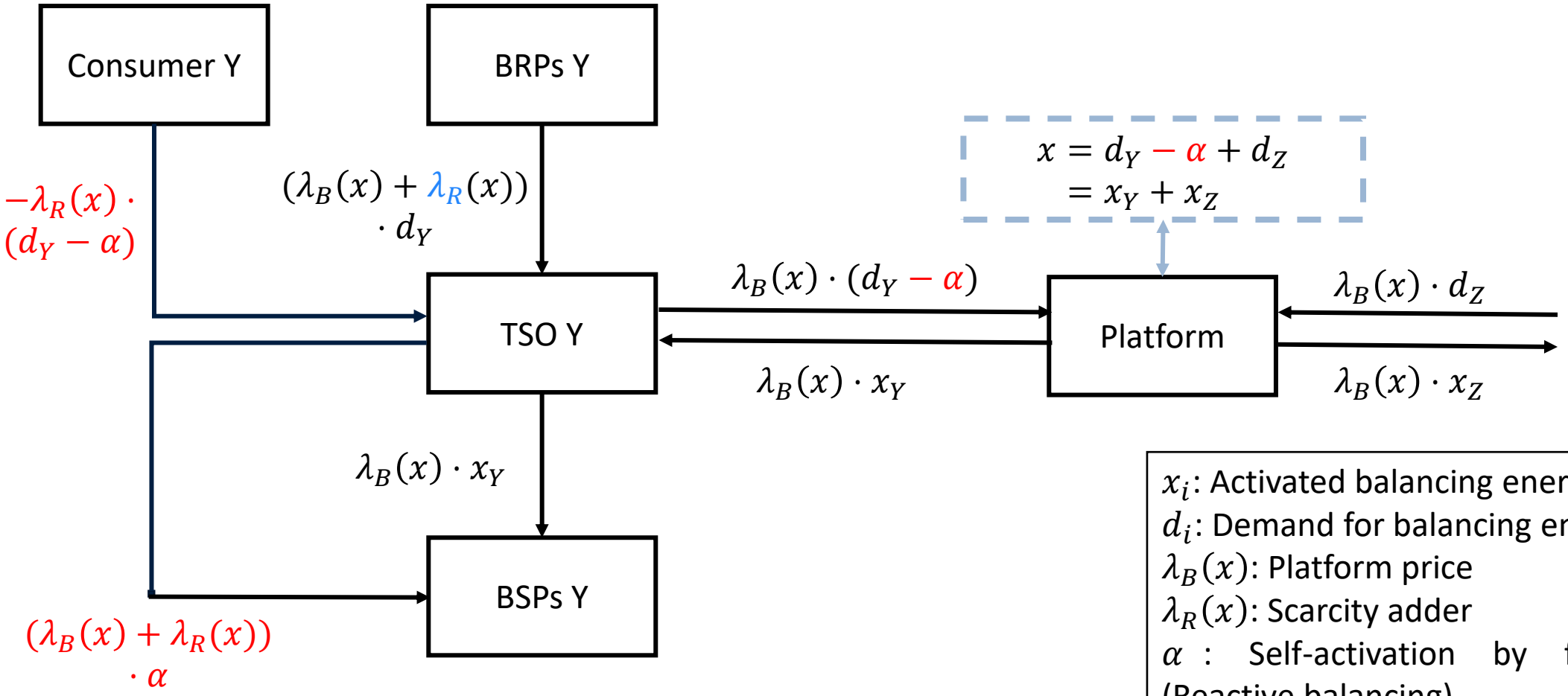
Design 2: *Adder on the Imbalance Price*



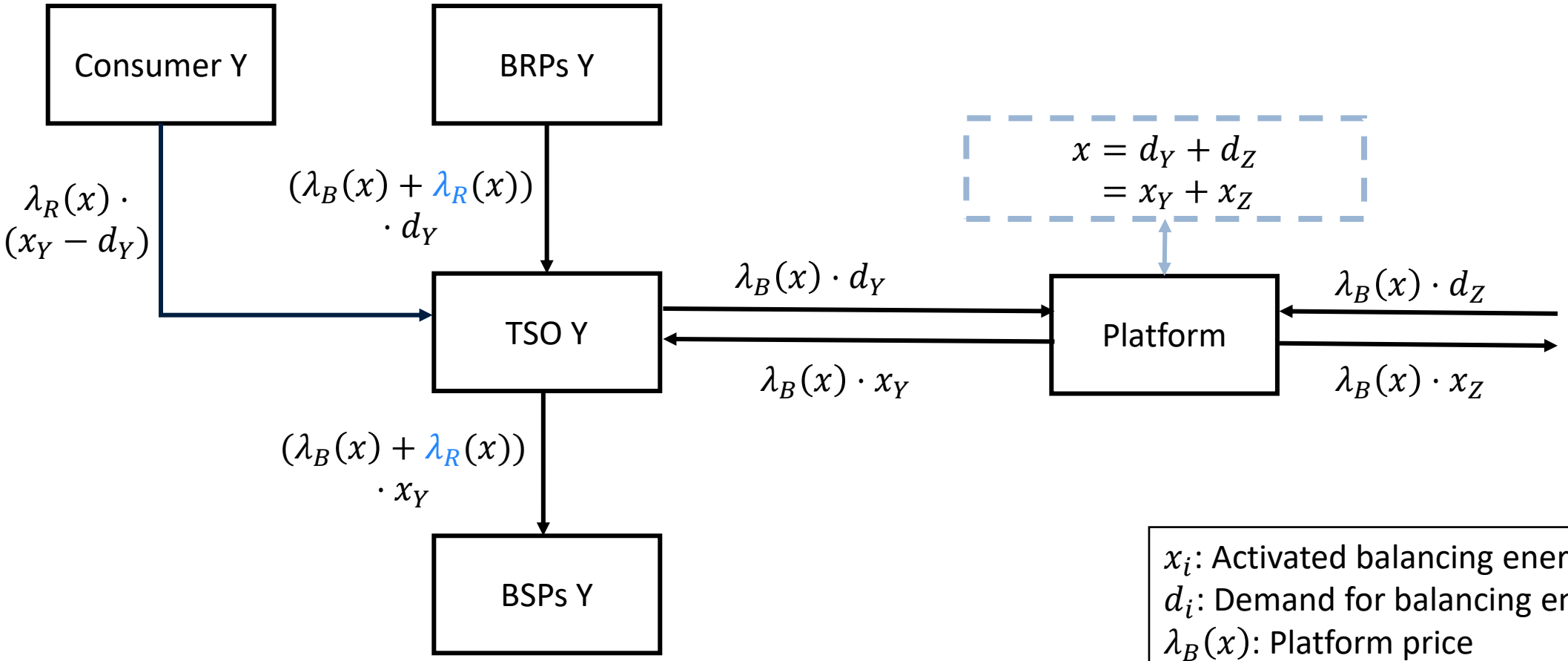
x_i: Activated balancing energy in zone i
d_i: Demand for balancing energy in zone i
$\lambda_B(x)$: Platform price
$\lambda_R(x)$: Scarcity adder

Design 2: *Adder on the Imbalance Price*



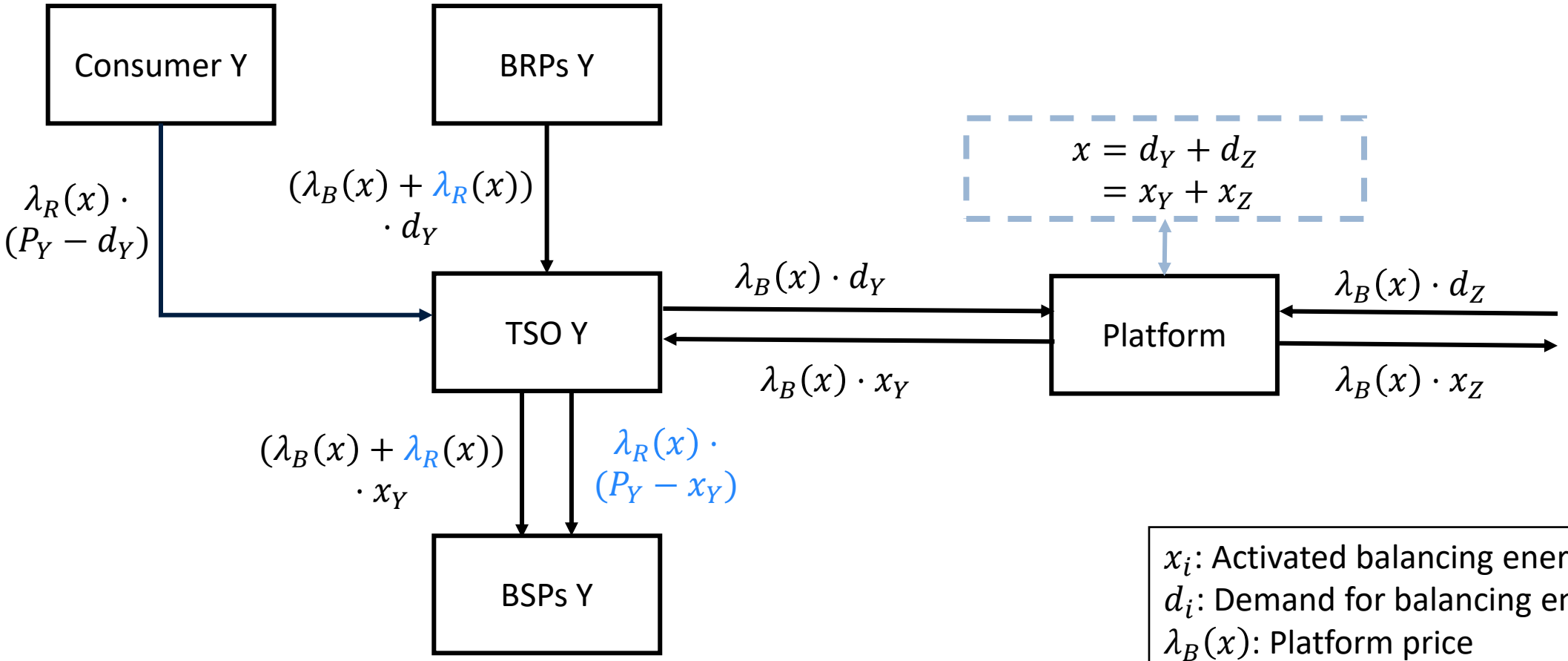
x_i: Activated balancing energy in zone i
d_i: Demand for balancing energy in zone i
$\lambda_B(x)$: Platform price
$\lambda_R(x)$: Scarcity adder
α : Self-activation by flexible assets (Reactive balancing)

Design 3: *Adder on the Imbalance and Balancing Price*



x_i: Activated balancing energy in zone i
d_i: Demand for balancing energy in zone i
$\lambda_B(x)$: Platform price
$\lambda_R(x)$: Scarcity adder

Design 4: *RT Market for Reserve* (our proposal)



x_i: Activated balancing energy in zone i
d_i: Demand for balancing energy in zone i
$\lambda_B(x)$: Platform price
$\lambda_R(x)$: Scarcity adder
P_Y: Total flexible capacity in zone Y

Optimal Bidding Strategy

1. *No adder* → Bid truthfully in the balancing energy auction
   - Agent may lose potential payoff (in the case of overbidding) or be unprofitable (in the case of underbiding)
   - Reactive balancing is always less profitable than balancing energy auction
2. *Adder on the imbalance price* → Some agents may do reactive balancing
   - Tradeoff between risky reactive balancing with potentially greater payoff and safe balancing energy with lower settlement
3. *Adder on the imbalance and balancing price* → Internalize the value of the adder in the balancing energy auction
   - Ensure always being activated when the balancing price is higher than its marginal cost
4. *RT market for reserve* → Bid truthfully in the balancing energy auction
   - The capacity payment restore the truthfull bidding incentives as receiving the scarcity adder is not dependent on being activated

Single-Zone Equilibrium

- *No adder* and *RT market for reserve* → Everybody bids in truthfully in the balancing energy auction

- *Adder on the imbalance price* → Equilibrium level of self-activation
  - Cheaper generators will tend to self-activate
  - Out of merit activation leads to inefficiencies

- *Adder on the imbalance and the balancing price* → Everybody internalizes the value of the adder
  - Bidding distortion but no out of merit activation

Multi-Zone Equilibrium

Simple 2 zones examples

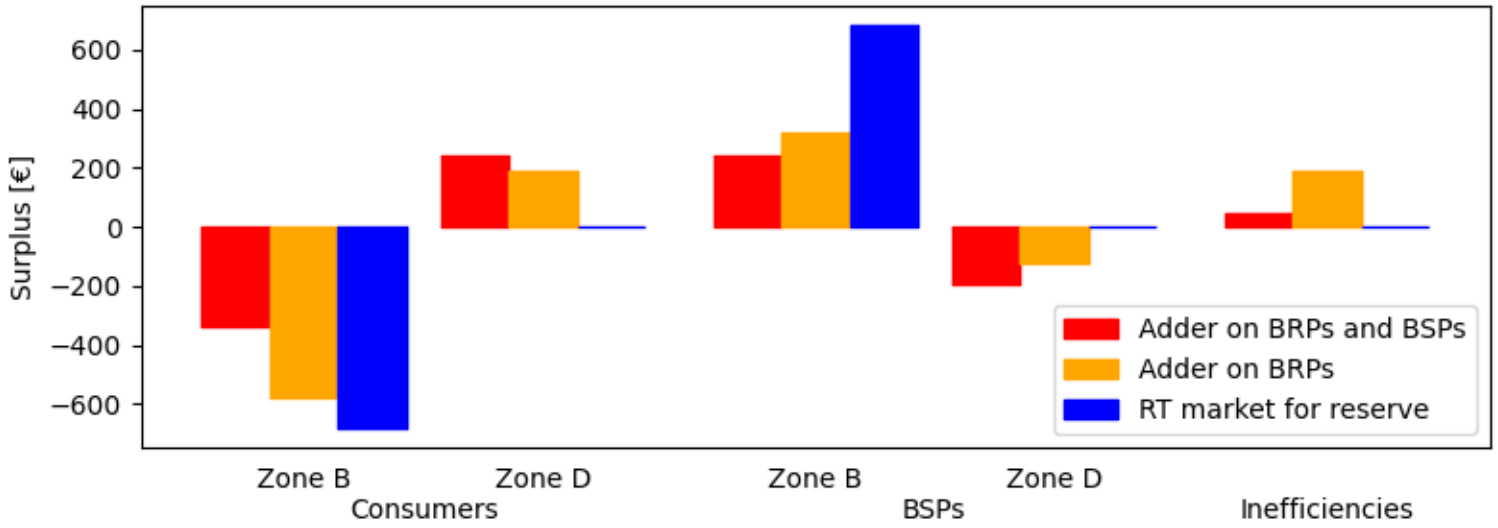
- One zone with *No adder*
- One zone with one of the 4 designs

Benchmark *No adder – No adder*

1. *No adder – RT market for reserve* → Same aggregated merit order

2. *No adder – Adder on the imbalance price* and *No adder – Adder on the balancing and imbalance price* → Lower aggregated merit order curve

Cross-Border Distributionnal Effect



Surplus comparison with *no adder* benchmark

Adverse effects from the Adder on the imbalance price (orange) and Adder on the balancing and imbalance price (red)

- Out-of-merit activation leads to an increased activation cost (article 3(m) of the Clean Energy Package)
- Cross-zonal distributive effect between consumers: Consumers in zone B subsidize the consumption in zone D
- Discrimination between BSPs from different zones.

Only intra-zonal surplus distribution effect for RT market for reserve

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Thank you!

Clearing the Market