FHP Project – 28th June 2018

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FHP project is funded by European Union under the grant agreement no. 731231.

FHP project

Flexible Heat and Power, Connecting heat and power networks by harnessing the complexity in distributed thermal flexibility

- ***Context***: Massive penetration of uncontrollable PV and Wind and progressive electrification of transport (EVs) and heating (P2H, e.g. heat pumps)
- ***Challenge***: Avoid RES curtailment due to grid constraints or commercial reasons
- ***FHP approach***: Use the P2H distributed thermal flexibility to make most effective use of available RES energy, and to create the conditions to increase the amount of such RES also at distribution system level
- ***Scenarios***: Three use cases modeled on the FHP scenario, compared to the "Business as Usual" BAS scenario

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Use cases

- ***localRESCurtailmentMitigation*** : Activates local distribution grid connected P2H flexibility to solve local distribution grid problems that may be caused by excess of local distribution grid connected RES (grid related curtailment).
- ***systemRESCurtailmentMitigation***: Activates distribution grid connected P2H flexibility to avoid market based curtailment of RES. RES may be located anywhere, but in order to prevent its curtailment, distribution grid connected P2H resources are used in consultation with the local DSO.
- ***balancingServices***: Changes flexible P2H consumption schedules based on intra-ISP imbalance price forecasts coming from the TSO, acting on the imbalance position of the BRP on either surplus or shortfall situations.

Business use case definition methodology

- Definition of roles
- Definition of value exchanged between roles
- Design of associated monetary exchanges
- Formulation of the spending and the revenues of each role, to calculate its associated cash flow
- Comparison of the cash flow of each role in the BAS and FHP scenarios
- Utilization of the e3 value methodology (https://www.e3value.com/)

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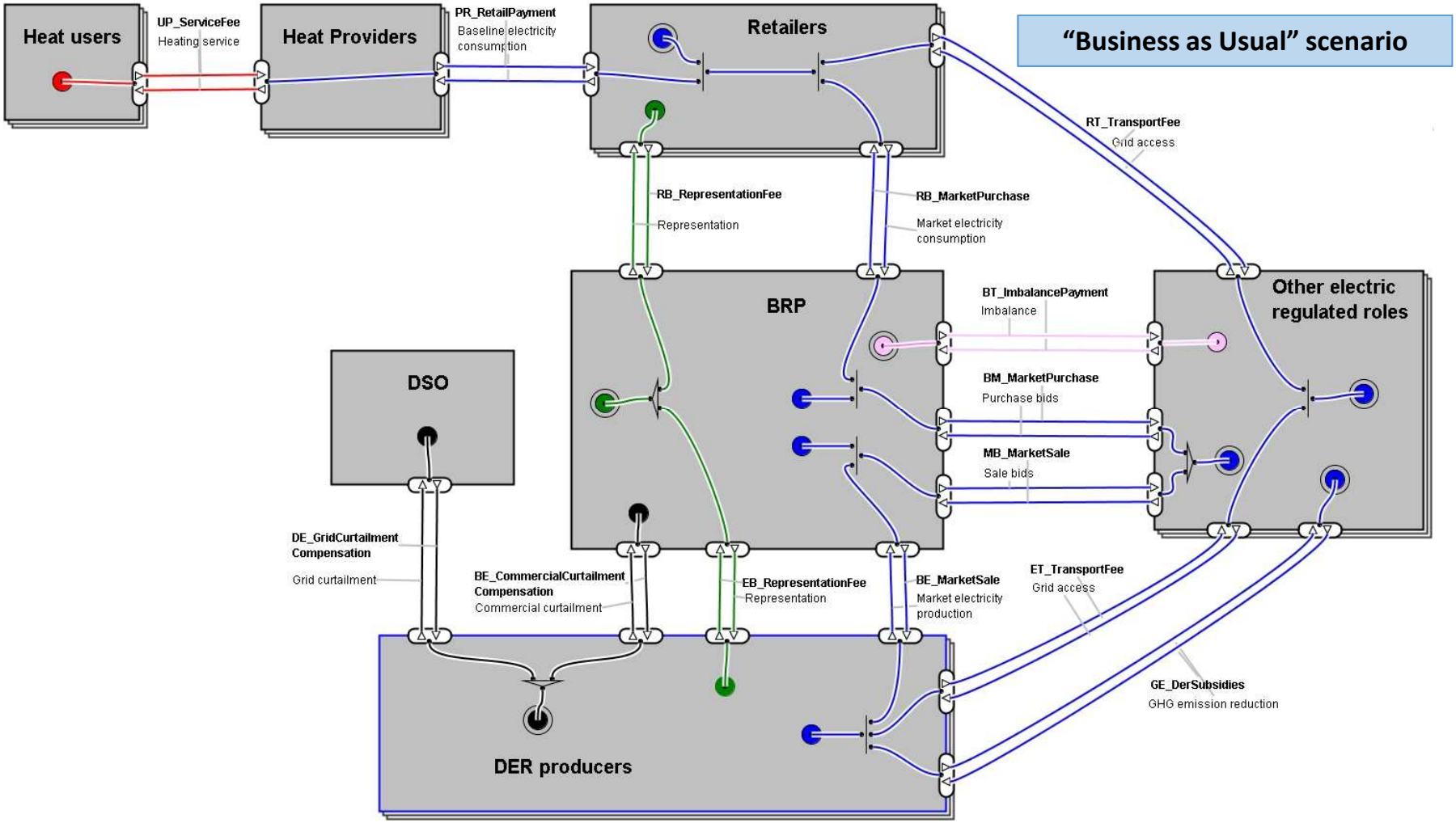

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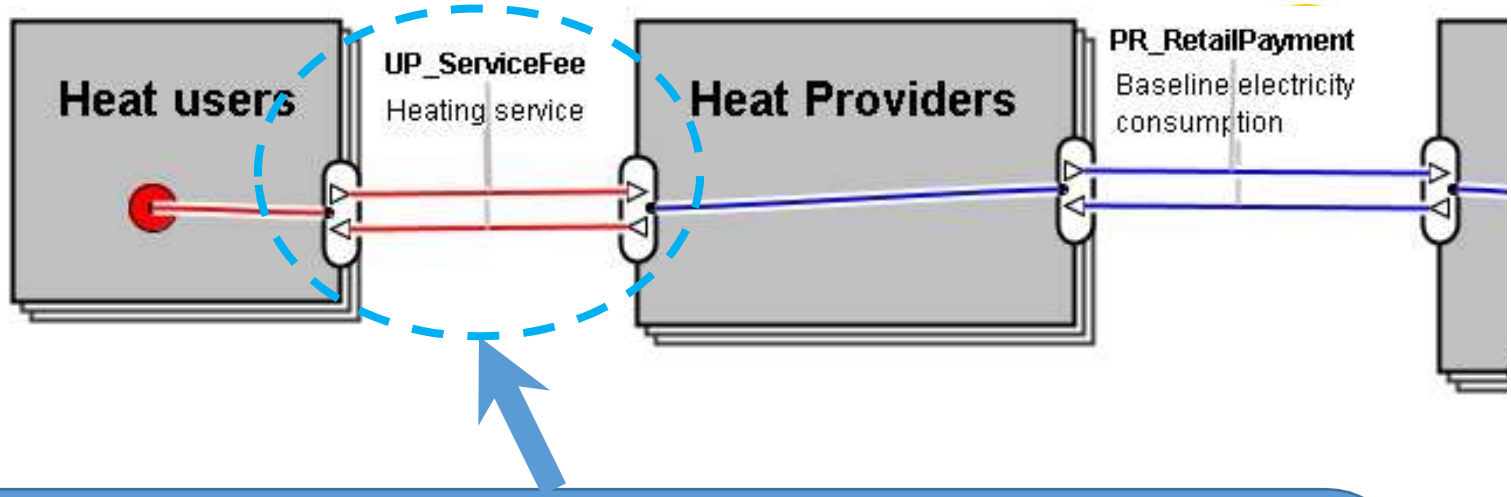
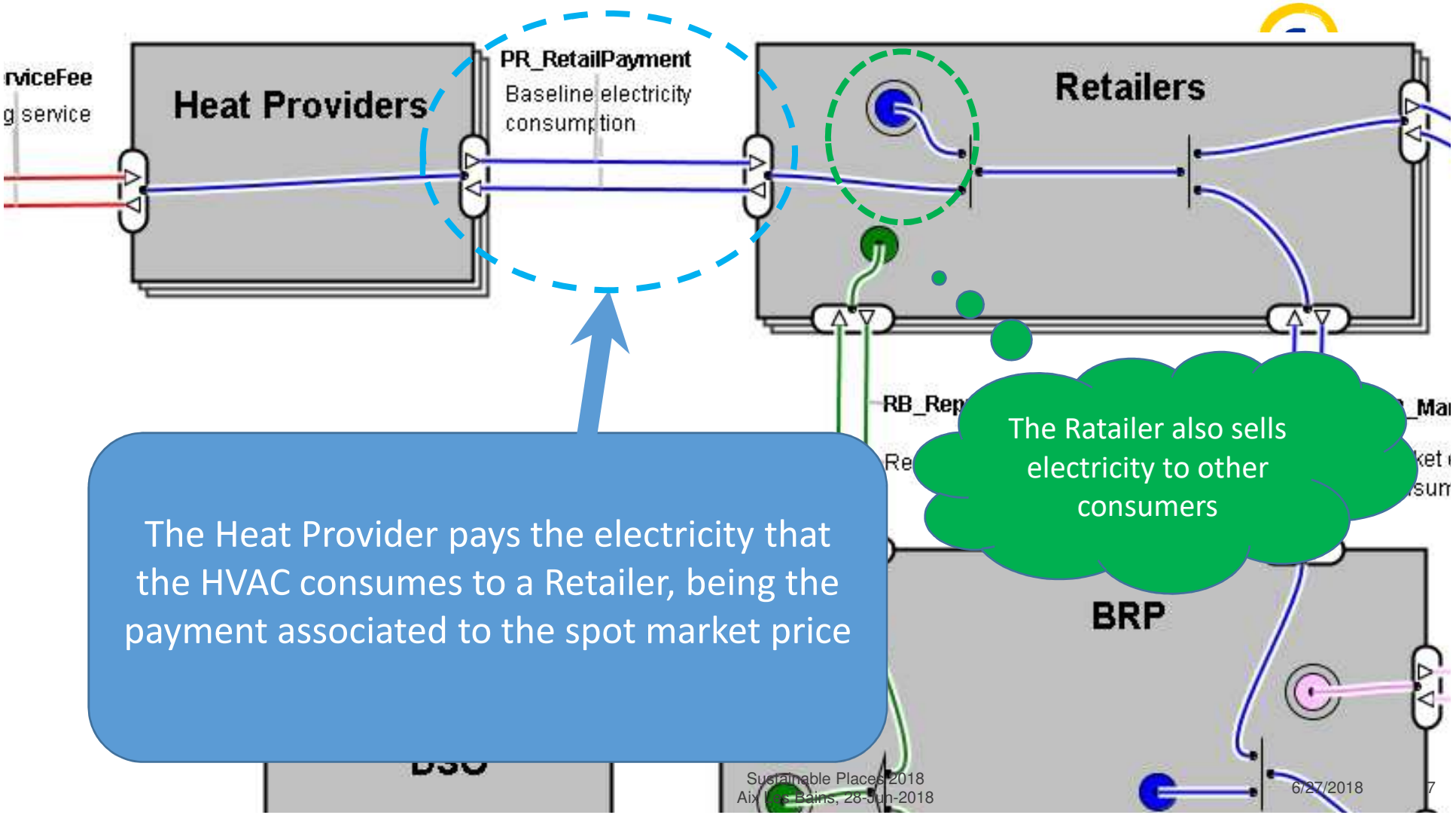
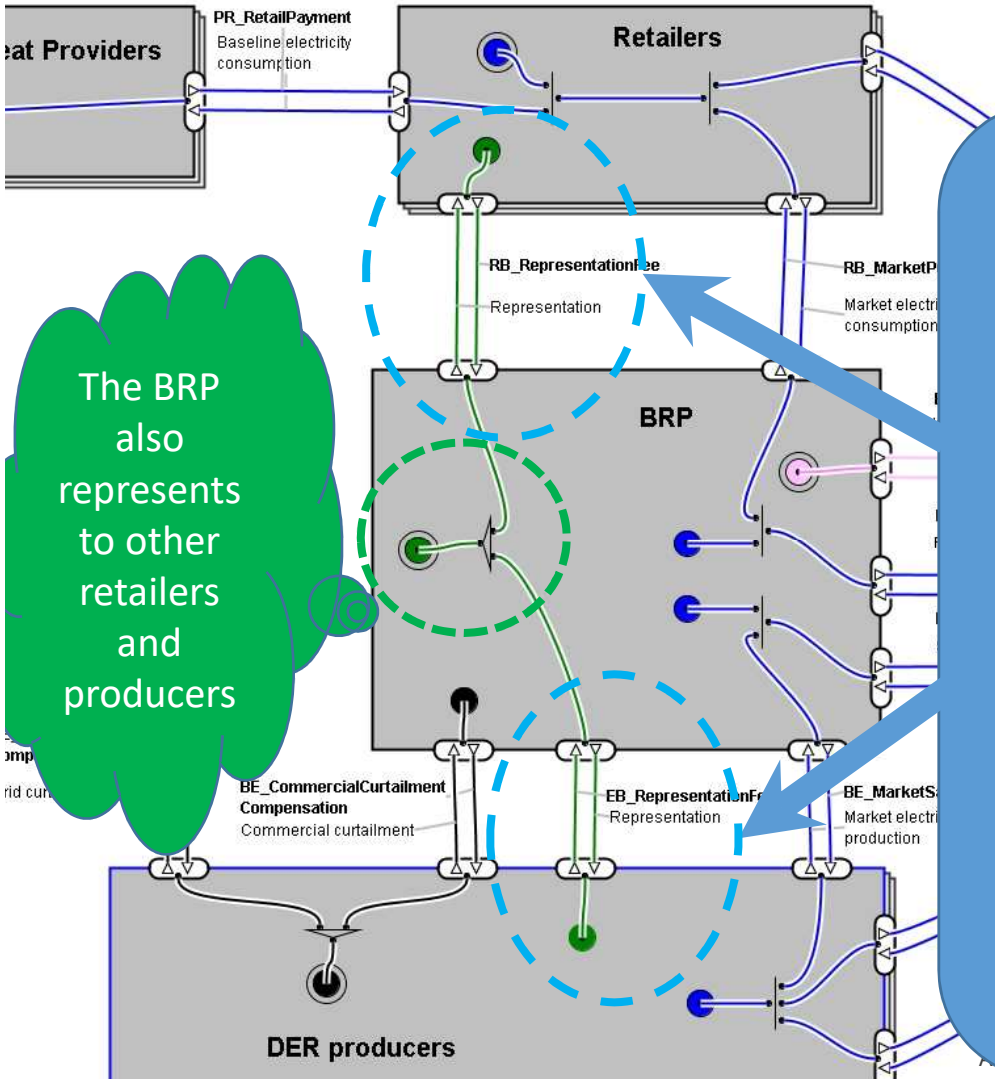


The Heat User contracts a Heat Provider, which operates the HVAC (primary energy source of HVAC is based on heat pumps) to provide a heating service.

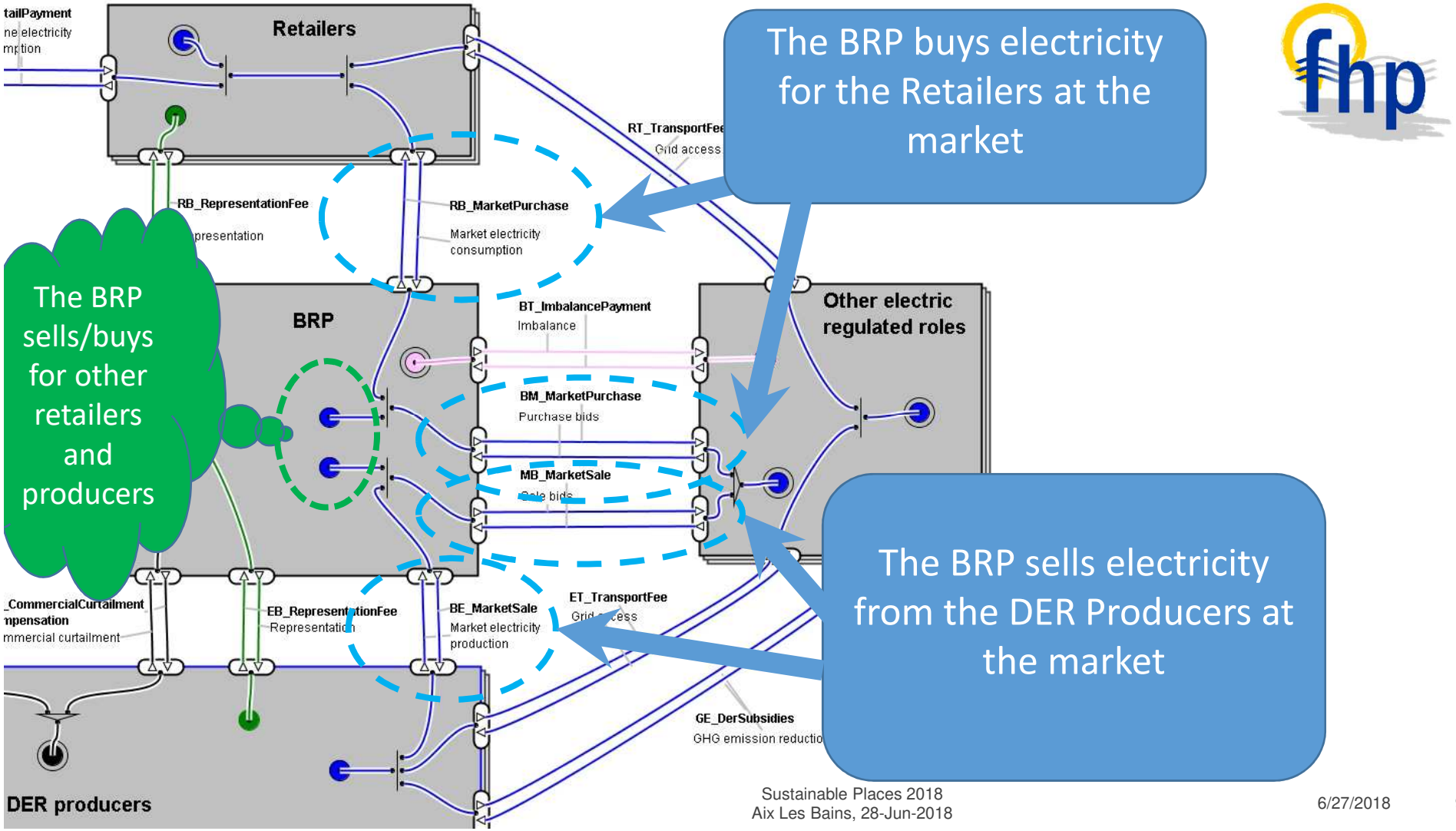
- ✓ Agreement on acceptable comfort range (indoor temperature). BAS operation is based on a fix temperature setpoint
- ✓ Possibility of override by the Heat User.
- ✓ Fee based on surface, type, comfort range…

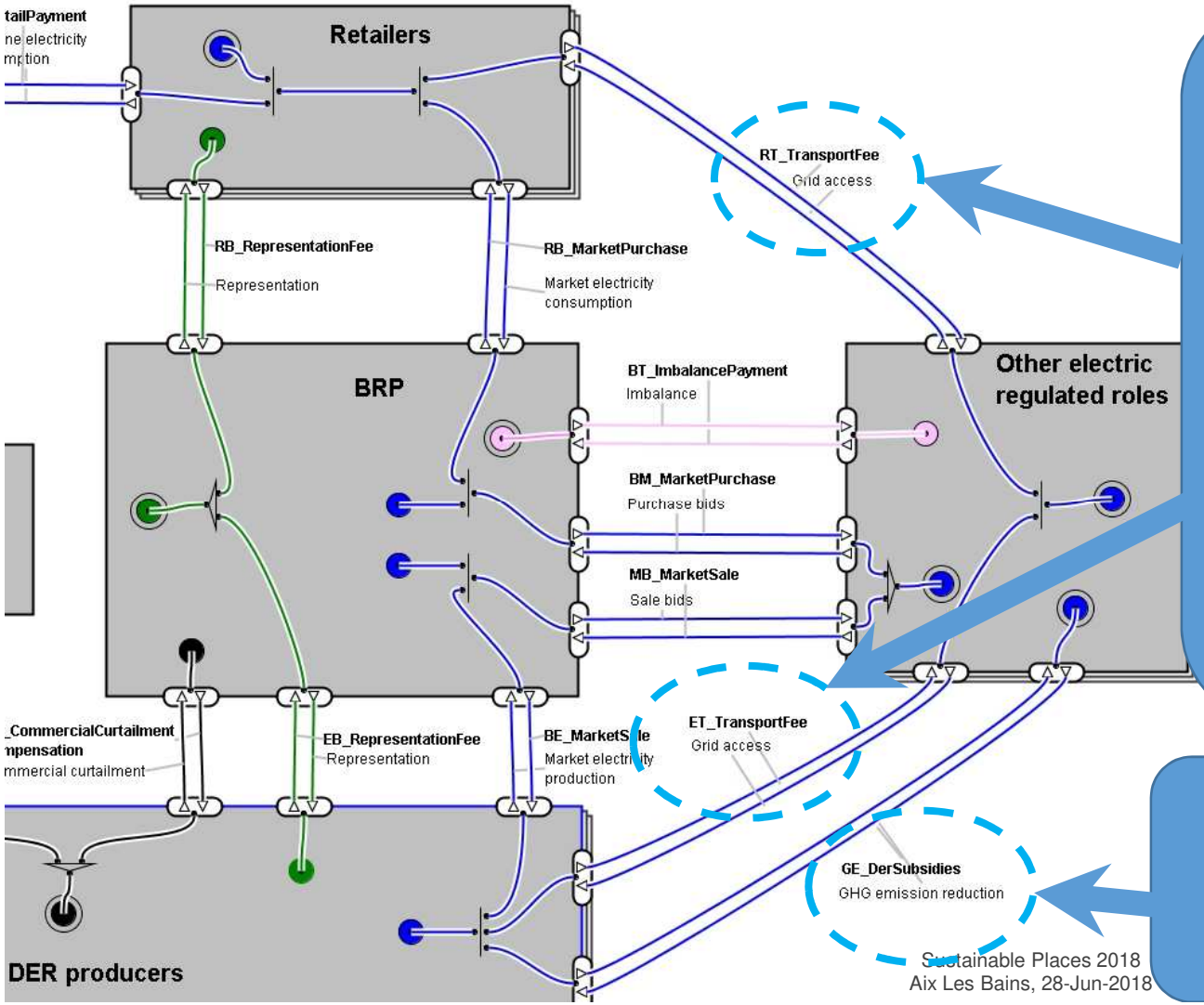

rviceFee
g service
Heat Providers
PR_RetailPayment
Baseline electricity consumption
Retailers
RB_Rep
Re
The Heat Provider pays the electricity that the HVAC consumes to a Retailer, being the payment associated to the spot market price
The Ratailer also sells electricity to other consumers
BRP



The BRP also represents to other retailers and producers

The BRP represents Retailers and DER producers at the marketplace. It assumes the risk of their imbalances and the responsibility of electricity purchase/sale

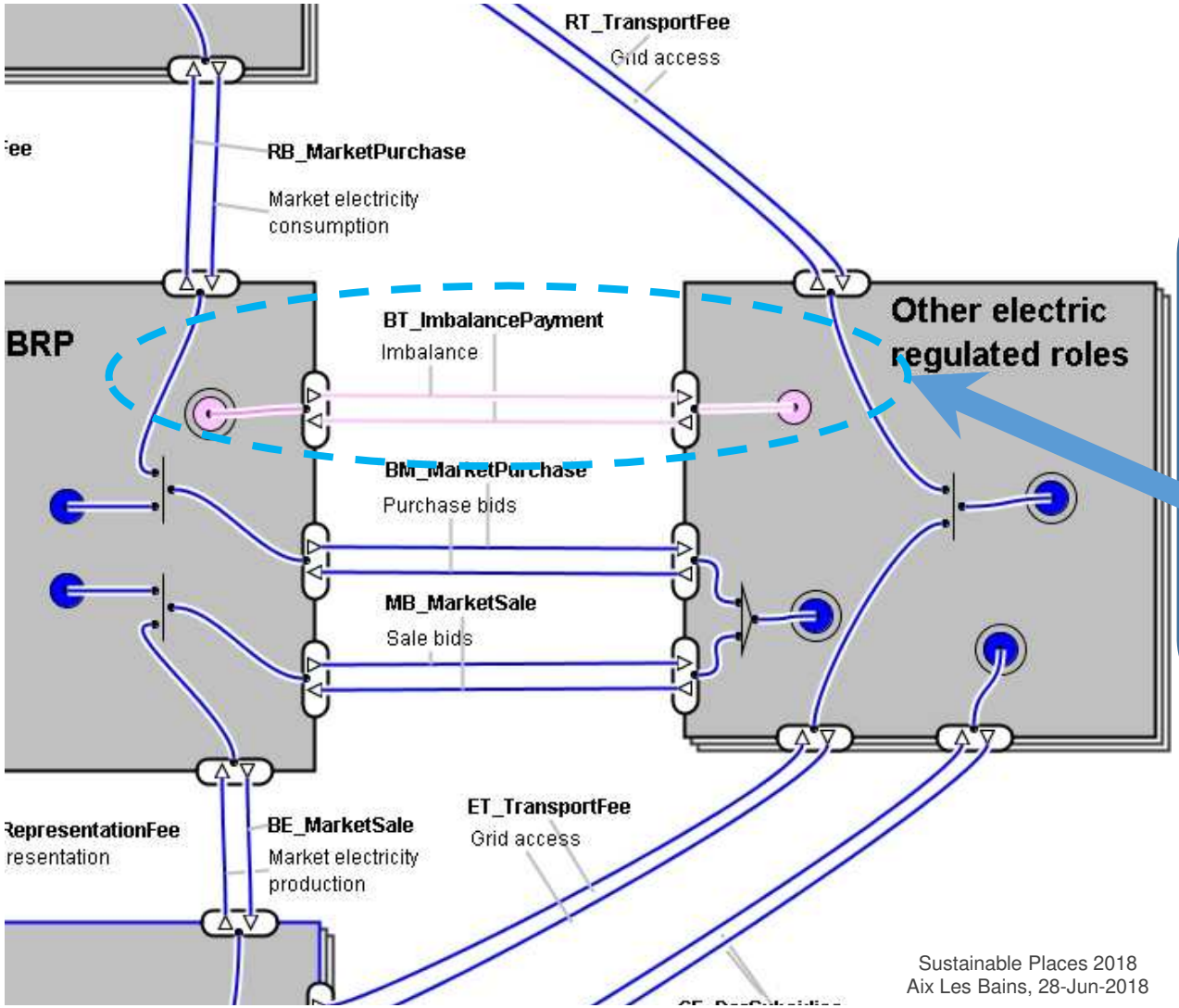

Retailers
RB_RepresentationFee
RB_MarketPurchase
Market electricity consumption
RT_TransportFee
Grid access
BRP
BT_ImbalancePayment
Imbalance
BM_MarketPurchase
Purchase bids
MB_MarketSale
Other electric regulated roles
EB_RepresentationFee
Representation
BE_MarketSale
Market electricity production
ET_TransportFee
GE_DerSubsidies
DER producers
The BRP buys electricity for the Retailers at the market
The BRP sells/buys for other retailers and producers
The BRP sells electricity from the DER Producers at the market



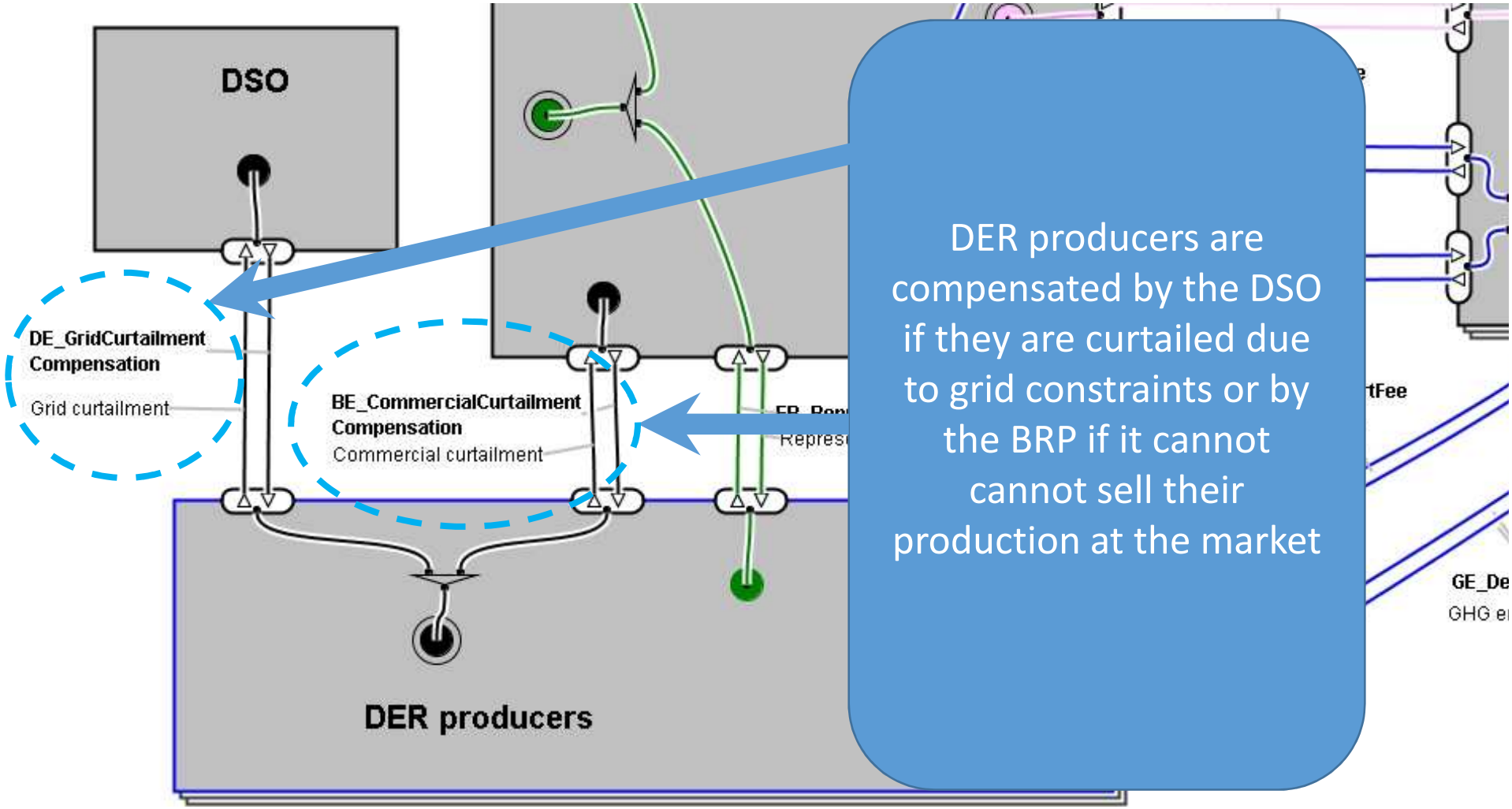
Both Retailers and DER Producers pay to the TSO the transport fee:

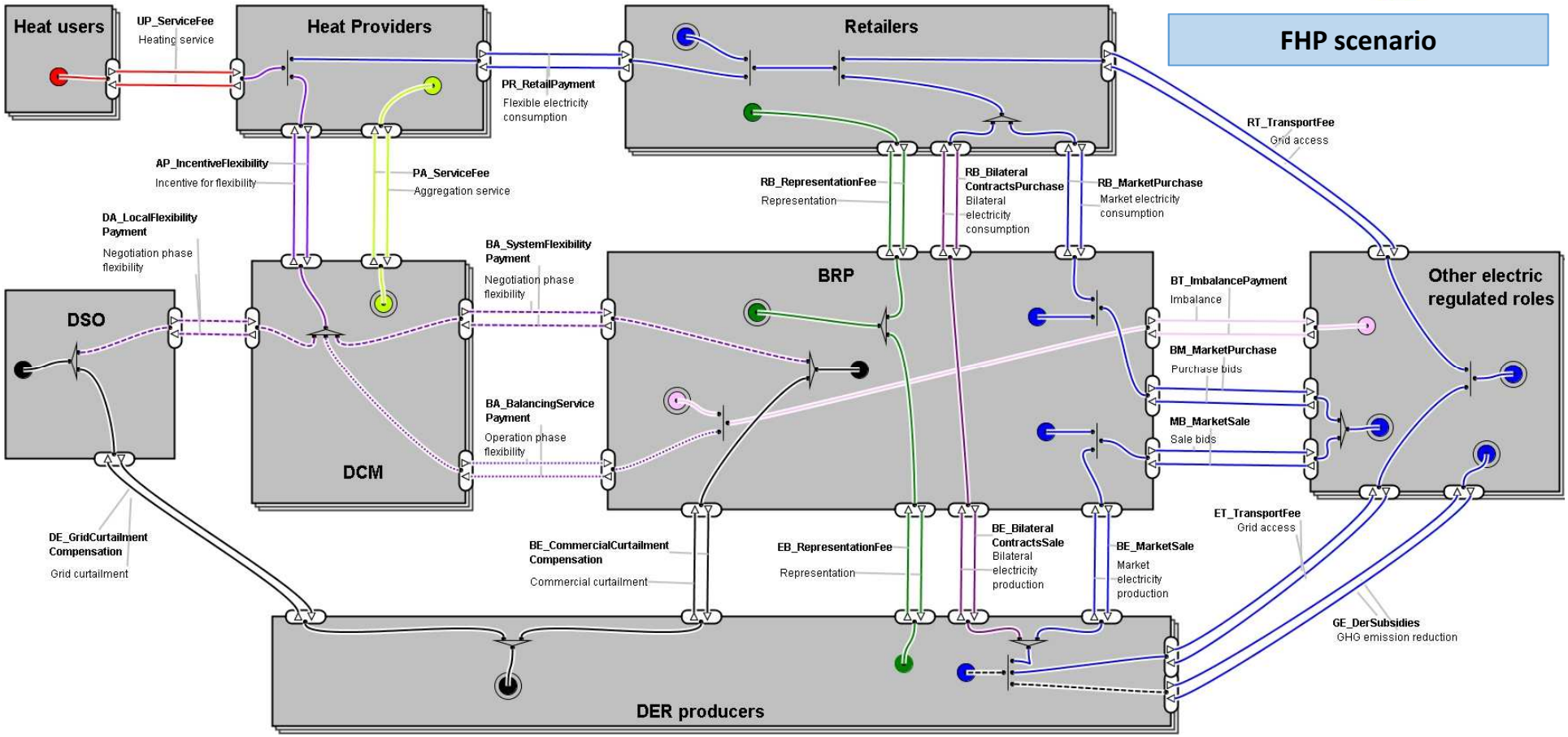
- ✓ Retailers depending on the real consumption of its portfolio of consumers
- ✓ DER Producers depending on their real production

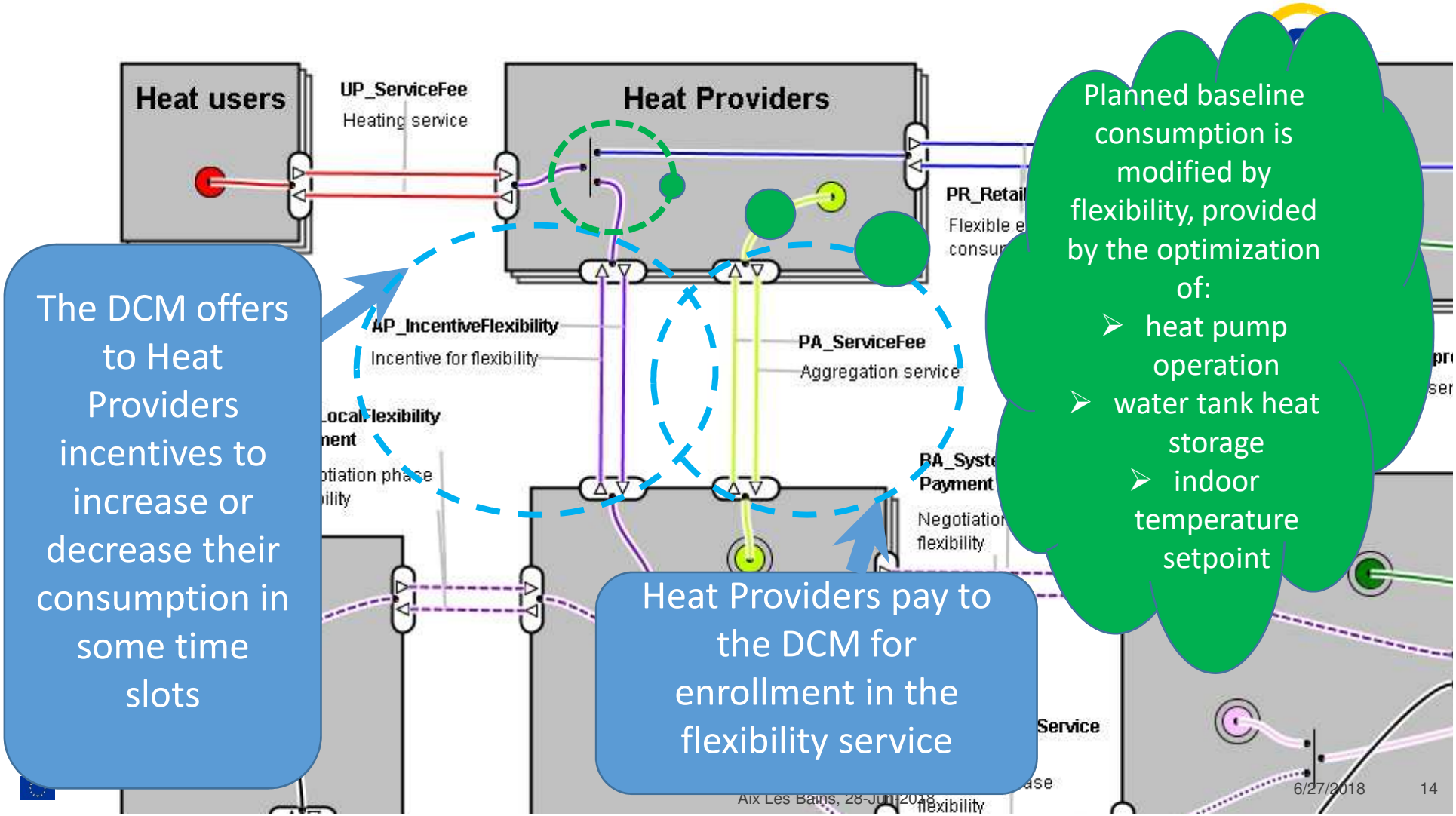
DER Producers can get a subsidy from the government due to a renewable prime

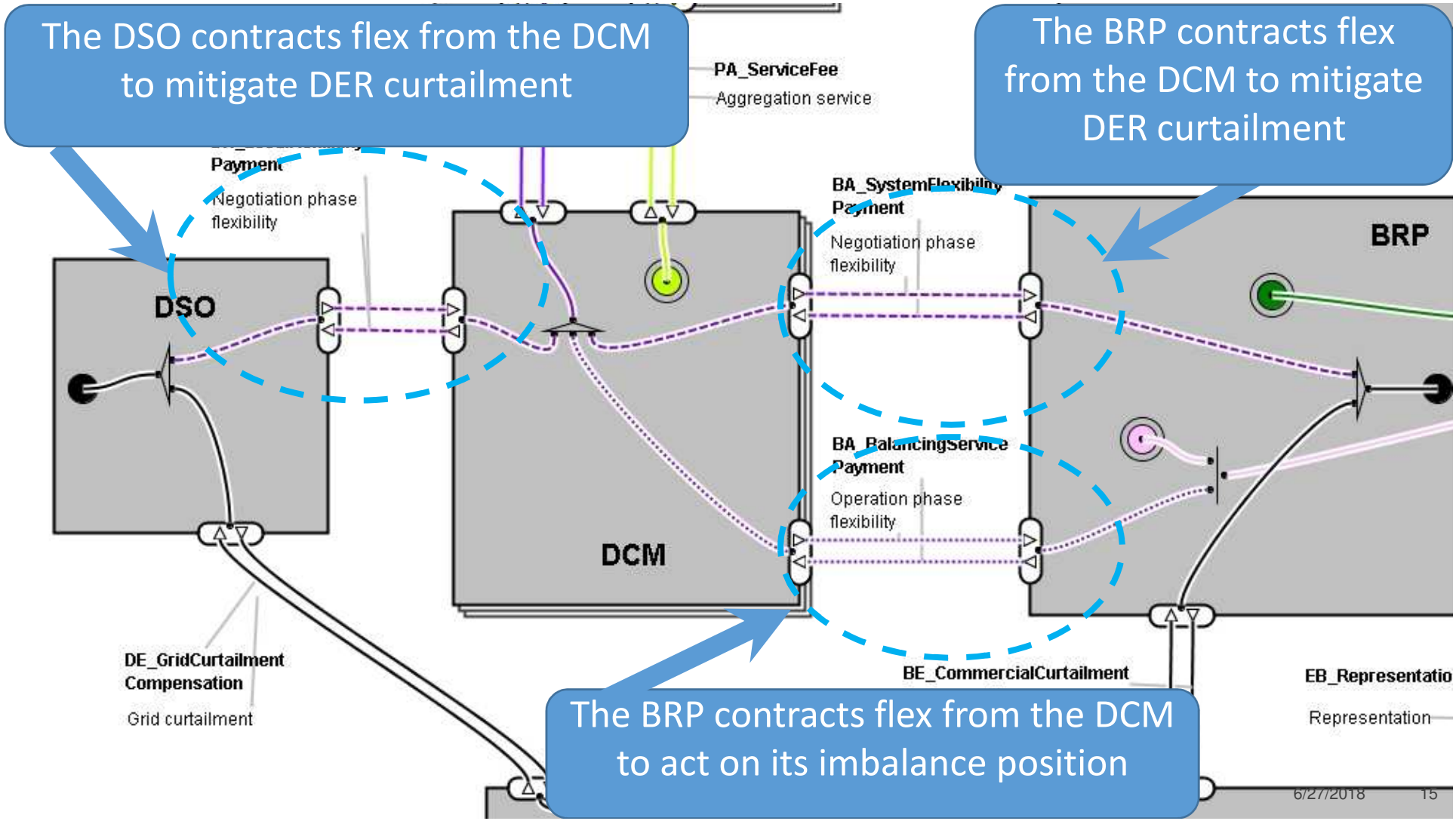


The BRP pays to the TSO depending on the amount of its imbalance, and if it is on the same direction of the TSO's imbalance


DSO
DE_GridCurtailment
Compensation
Grid curtailment
BE_CommercialCurtailment
Compensation
Commercial curtailment
DER producers
DER producers are compensated by the DSO if they are curtailed due to grid constraints or by the BRP if it cannot cannot sell their production at the market


FHP scenario
Heat users
UP_ServiceFee
Heating service
Heat Providers
PR_RetailPayment
Flexible electricity consumption
Retailers
RT_TransportFee
Grid access
AP_IncentiveFlexibility
Incentive for flexibility
PA_ServiceFee
Aggregation service
RB_RepresentationFee
Representation
RB_Bilateral ContractsPurchase
Bilateral electricity consumption
RB_MarketPurchase
Market electricity consumption
DA_LocalFlexibility Payment
Negotiation phase flexibility
BA_SystemFlexibility Payment
Negotiation phase flexibility
BRP
BT_ImbalancePayment
Imbalance
Other electric regulated roles
DSO
DCM
BM_MarketPurchase
Purchase bids
MB_MarketSale
Sale bids
BA_BalancingService Payment
Operation phase flexibility
ET_TransportFee
Grid access
DE_GridCurtailment Compensation
Grid curtailment
BE_CommercialCurtailment Compensation
Commercial curtailment
EB_RepresentationFee
Representation
BE_Bilateral ContractsSale
Bilateral electricity production
BE_MarketSale
Market electricity production
GE_DerSubsidies
GHG emission reduction
DER producers


Heat users
UP_ServiceFee
Heating service
Heat Providers
PR_Retail
Flexible e
consur
AP_IncentiveFlexibility
Incentive for flexibility
PA_ServiceFee
Aggregation service
Payment
Negotiation
flexibility
Service
The DCM offers to Heat Providers incentives to increase or decrease their consumption in some time slots
Heat Providers pay to the DCM for enrollment in the flexibility service
Planned baseline consumption is modified by flexibility, provided by the optimization of:
heat pump operation
water tank heat storage
indoor temperature setpoint


The DSO contracts flex from the DCM to mitigate DER curtailment
The BRP contracts flex from the DCM to mitigate DER curtailment
PA_ServiceFee
Aggregation service
Payment
Negotiation phase flexibility
BA_SystemFlexibility Payment
Negotiation phase flexibility
DSO
DCM
BRP
BA_BalancingService Payment
Operation phase flexibility
DE_GridCurtailment Compensation
Grid curtailment
BE_CommercialCurtailment
EB_Representatio
Representation
The BRP contracts flex from the DCM to act on its imbalance position
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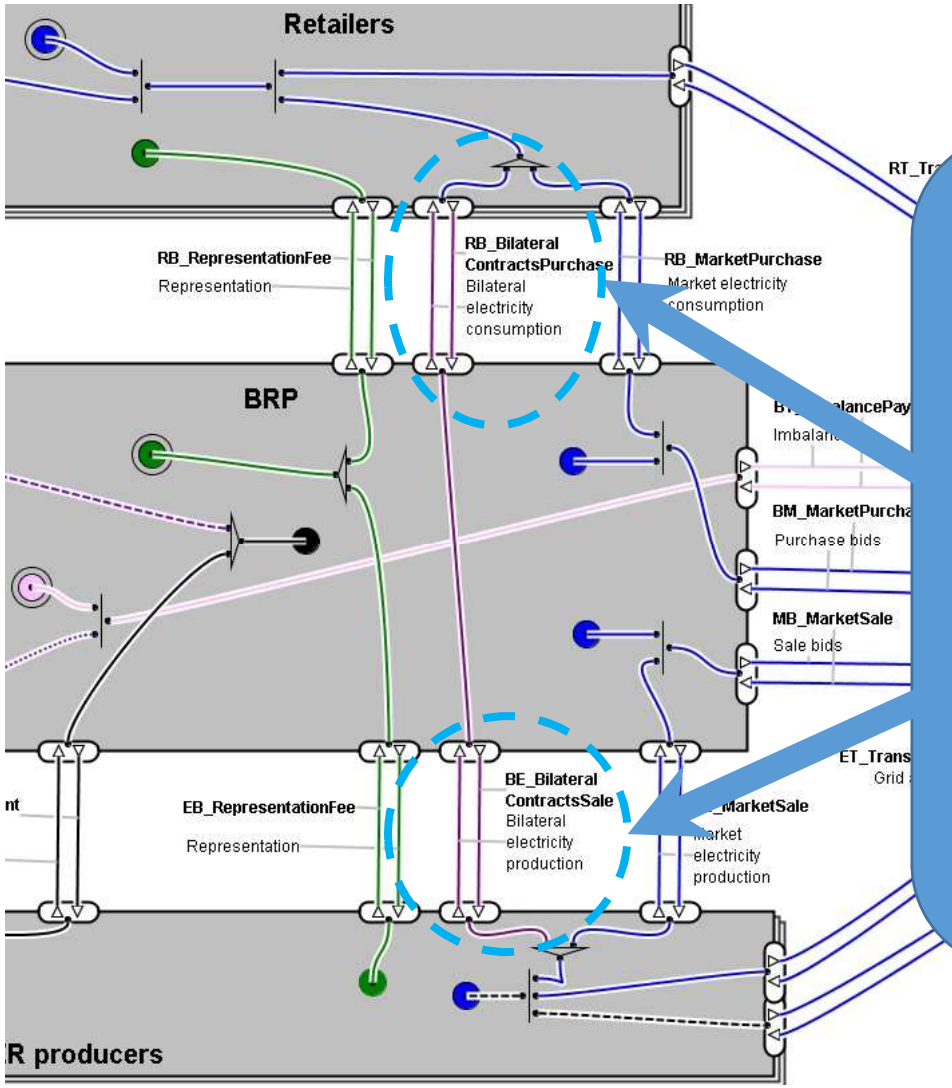
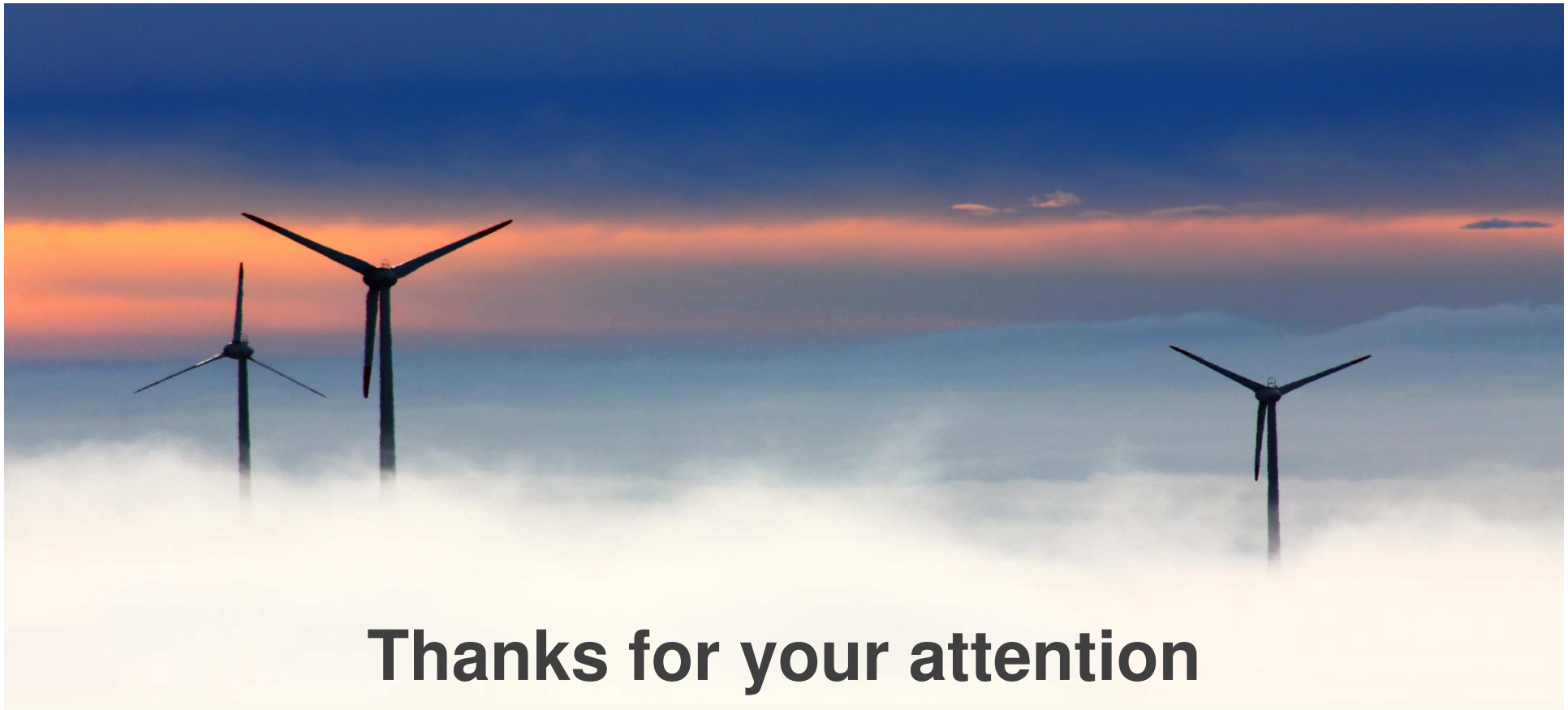


Consumption increase is allocated to bilateral contracts between the Retailers and the DER producers.
Consumption decrease is compensated at the intra-day markets

Findings

- ***DCM service fee:*** Baseline operation scheduling tools (Model Predictive Control - MPC) provide an added value to Heat Providers, compared to BAS thermostatic operation, which justifies its engagement.
- ***DCM incentives***: Absolute incentives, which settlement is not based on baseline estimation, are the entry point to trigger Heat Providers' flexibility provision.
- ***Flexibility optmization:*** Strategy depends on timing.
  - ***Short term flexibility***: Based on the management of water tank storage, which decouples the heat pump thermal energy production and the building thermal energy demand.
  - ***Day ahead (or intraday) flexibility***: Provided by a combination of water tank storage management and indoor temperature optimization.



Thanks for your attention

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