7. November 2025

Transmission access guarantee (TAG) – design option & interaction with CfD

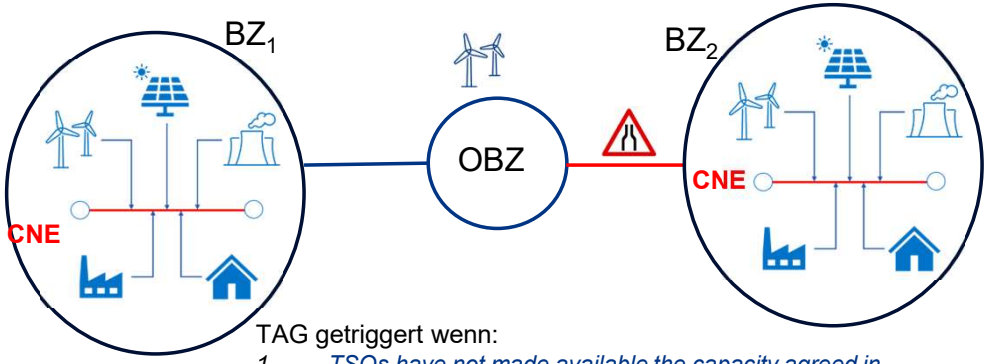
Agenda

1. Design parameters
2. Design principles
3. Interaction TAG & CfD
4. TAG in DA&ID
5. Annex

„Simple“ model - TAG design : reference price & volume[1]

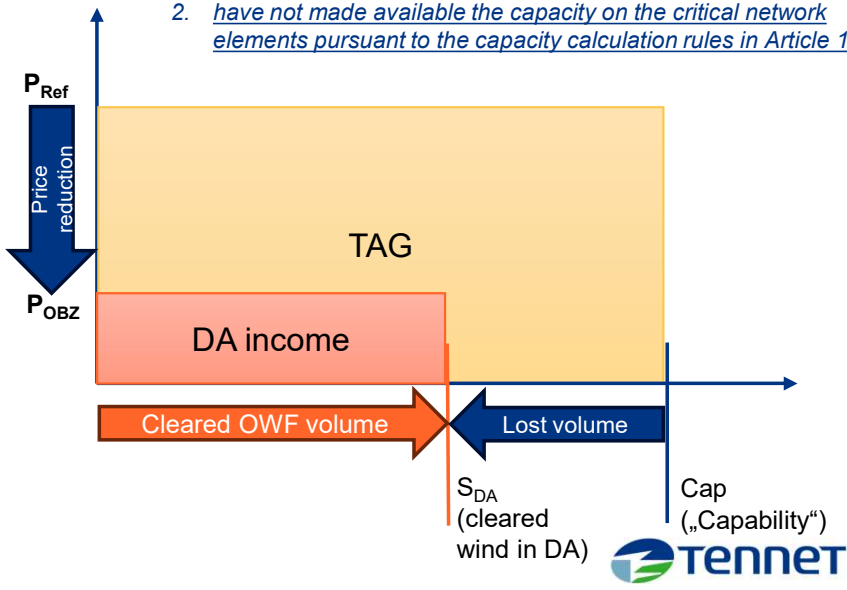
- **Reference price** i.e. the price based on which the compensation is calculated
  - In principle, the price of the OBZ will be converged to the lowest price of the surrounding bidding zones. Therefore, it is recommended to use as reference price for TAG the minimum of the prices of the connected bidding zones:
    $P_{Ref} = Min\{P_{BZ1}, P_{BZ2}\}$

- **Reference volume** i.e. the amount of electricity to be compensated
  - The price difference ($P_{Ref} - P_{OBZ}$) applies to the cleared wind volume and the full reference price to the difference between the cleared wind volume and the generation potential based on e.g. **real-time wind measurements and certified power curves of WTs i.e.** “**capability**”. Alternatively, “capability” could be defined based on a centralized wind forecast.
  - To avoid distortive effects, e.g. bidding volume being lower than “capability” in expectation of higher TAG payments, the reference volume for TAG should be defined as the minimum of capability and OWFs‘ bid: **V_{Ref}= min {Cap, OWF bid volume}**



TAG getriggert wenn:

1. *„…TSOs have not made available the capacity agreed in connection agreement on the interconnector or*
2. *have not made available the capacity on the critical network elements pursuant to the capacity calculation rules in Article 16(8)”*



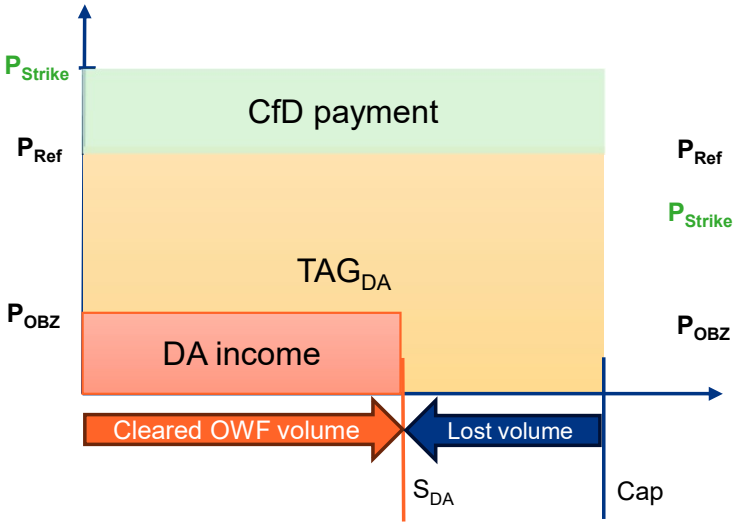
[1]Das Modell wurde bereits innerhalb ENTSO-E diskutiert und wird als nächster Schritt mit EUPHEMIA Counterfactual verglichen werden.

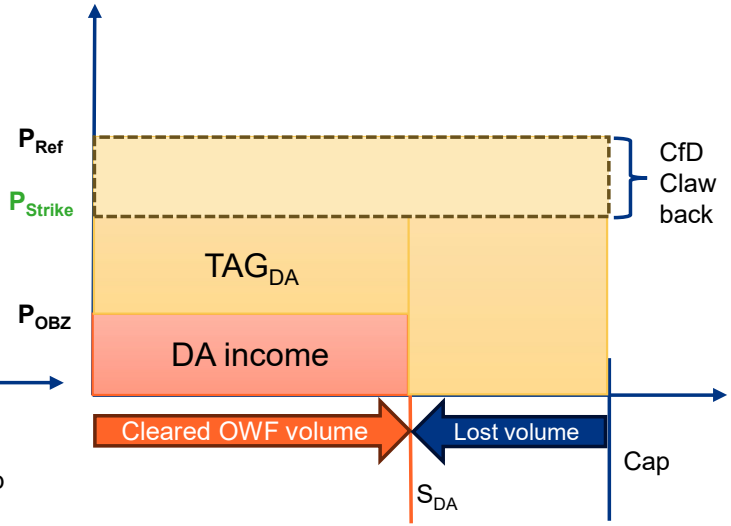
General principles to be considered in TAG design

1. Within TAG framework OWF bidding prices and volumes should be checked/ validated e.g. cases where OWF bid price > P_{OBZ} should disqualify from TAG completely.
2. Overbidding/underbidding in expectation of higher TAG payments should be avoided.
3. Double compensation when both TAG and support or compensation schemes apply should be avoided.
   - The volume/price definition of a support scheme may be different from TAG and so an exact elimination of the double risk coverage may be difficult. In this case and in those hours where TAG is triggered, applying the support scheme (e.g. CfD) first and having TAG covering any remaining revenue lost could be a solution (see slide 5).
   - If both TAG and support or compensation schemes apply, their settlement might need to be coordinated and executed by one entity to avoid any unintended money redistribution/reallocation.
4. In case, the TAG reference volume is defined based on real-time wind measurements, TAG should not be applied to each market separately but the final overall position of OWFs needs to be considered (see slide 6).
5. TAG should not compensate OWFs for the cost for balancing their market position in intraday (i.e. wrong forecast) (see slide 6, 7)
6. The cost distribution for TAG payments can be determined based on shadow prices of TAG-related CNECs in factual.

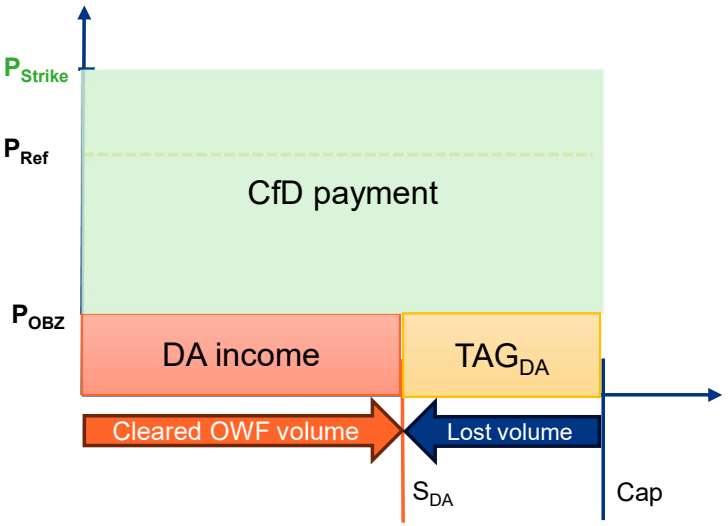
Interaction TAG – „capability“ CfD

1. TAG applies first, CfD on top





2. CfD applies first and TAG compensates only for lost volume below the OBZ price

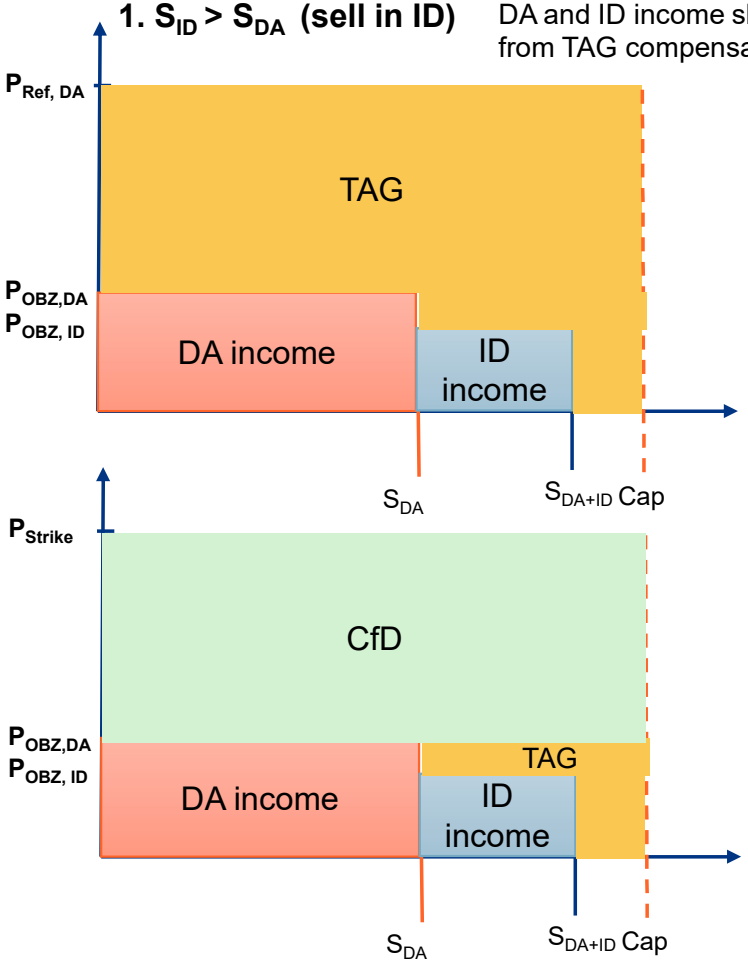


- How to avoid double compensation at those hours where both TAG and CfD apply?
  - ➢ CfD could apply first and TAG could cover remaining revenue loss
- How to avoid unintended money reallocation when both TAG and CfD apply?
  - ➢ TAG and CfD payments come from different pots of money - need for coordination and execution of TAG and CfD settlemet by one entity

1. TAG compensation applies in DA & ID market timeframe („capability“ based on real-time wind measurements)

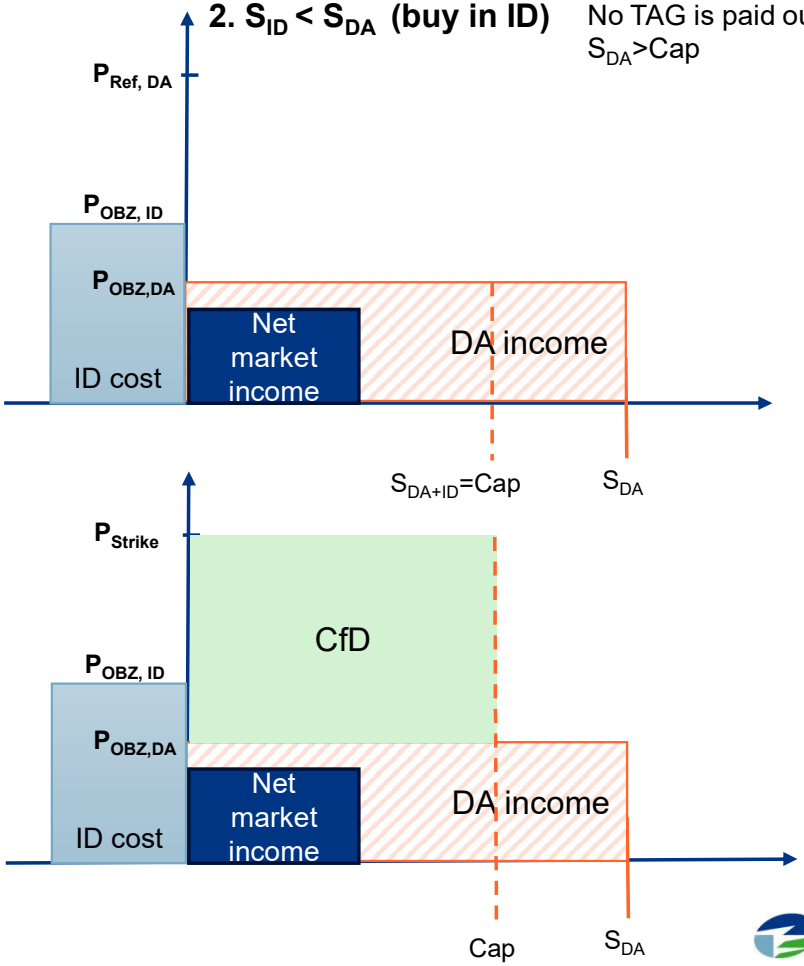
1. $S_{ID} > S_{DA}$ (sell in ID)

DA and ID income should be deducted from TAG compensation



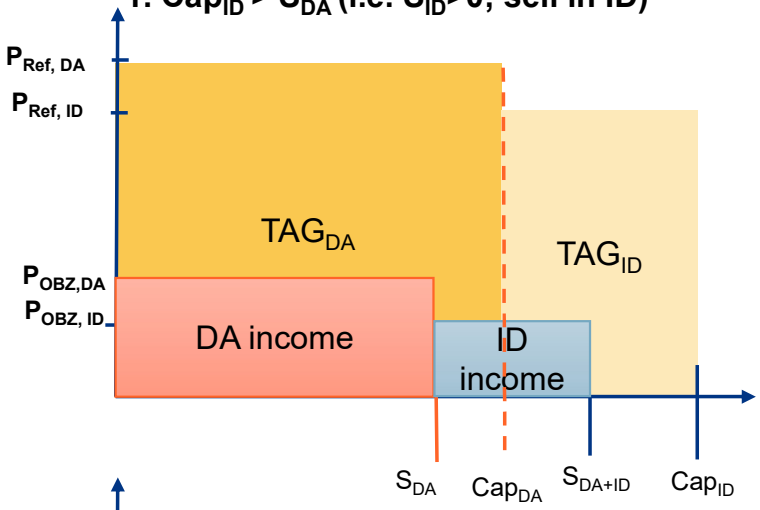
2. $S_{ID} < S_{DA}$ (buy in ID)

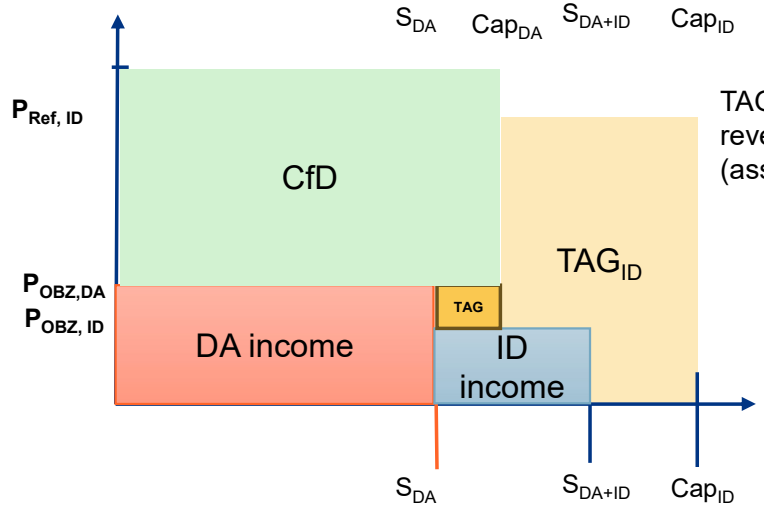
No TAG is paid out because S_{DA}>Cap



2. TAG compensation applied in DA & ID market timeframe („capability“ is based on centralised forecast for DA and ID)

1. $Cap_{ID} > S_{DA}$ (i.e. $S_{ID}>0$; sell in ID)

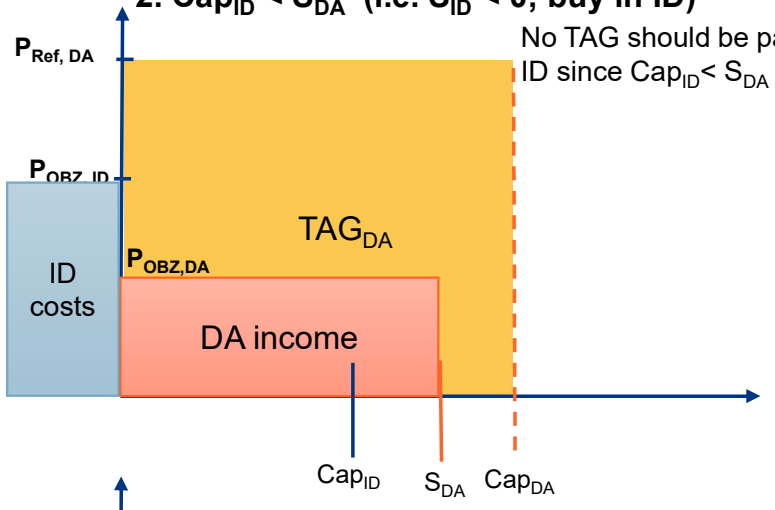


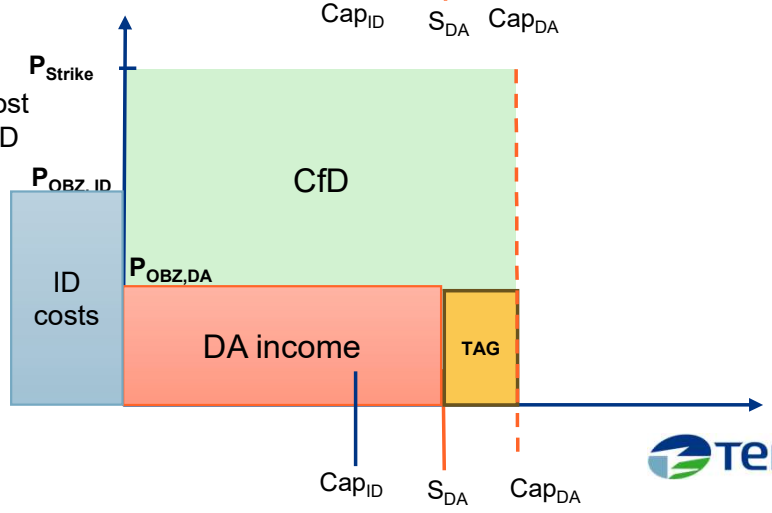


TAG in DA would compensate only for lost revenues that are not covered by the CfD (assuming that the CfD applies first)

2. $Cap_{ID} < S_{DA}$ (i.e. $S_{ID} < 0$; buy in ID)

No TAG should be paid out in ID since $Cap_{ID} < S_{DA}$





Annex

Possible distortive effects – scenario 1

Assumptions: only one OWP in the OBZ (i.e.monopolist)

Example case 1 – normal bidding:

- P_{Ref} = Max {P_{BZ1}, P_{OBZ}} = 10 €/MWh
- Cleared wind volume = 1100 MWh,
- „Capability“ = 1200 MWh
- TAG compensation = 8700 €
- Market revenue = 3300 €
- **Total revenue = 12 000 €**

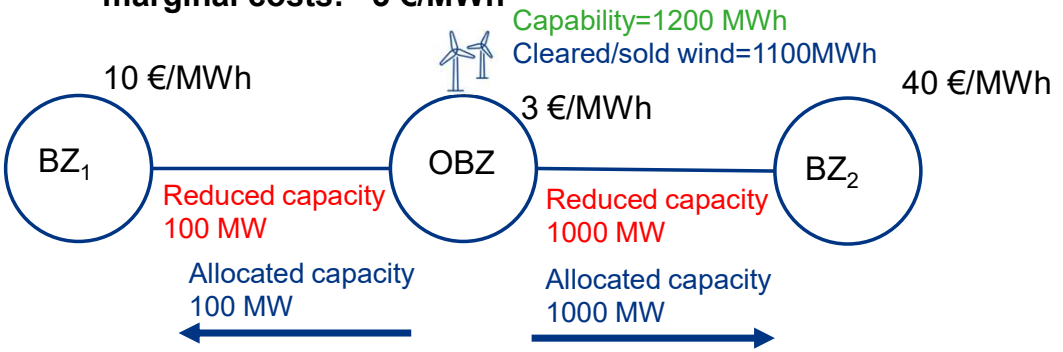
Example case 2 – strategic bidding - underbidding:

- P_{Ref} = Max {P_1, P_{OBZ}} = 40 €/MWh
- Cleared wind volume = 899 MWh,
- „Capability“ = 1200 MWh
- TAG compensation = 12040 €
- Market revenue = 35960 €
- **Total revenue = 48 000 €**

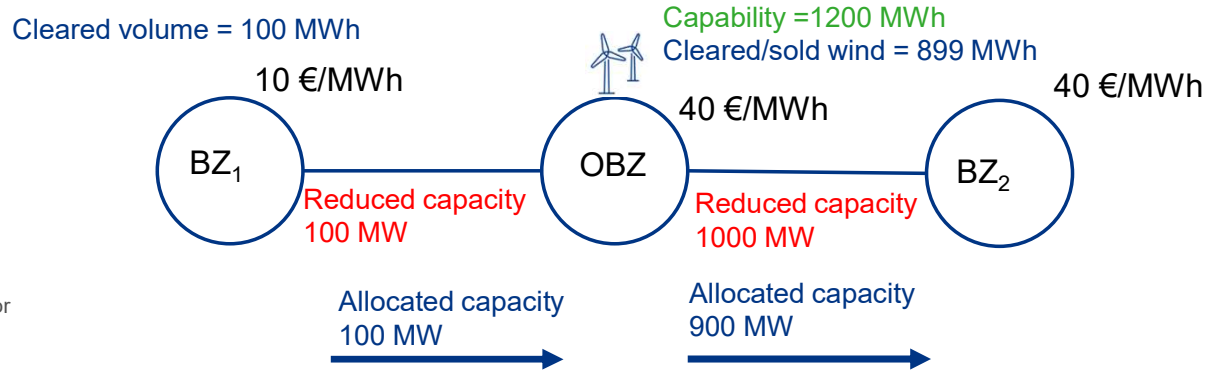
Observations:

- If OWF can anticipate that only 100MW are cleared from BZ_1 towards BZ_2 , then he will bid a volume just below the remaining capacity (i.e. 899MWh) to get the highest bidding zone price. This effect would have happened even w/o TAG and it should be monitored.
- However, it would be difficult to verify if the lower volume bid was due to strategic bidding or bad forecast. In this case, **TAG should be paid out only for the minimum of the real-time wind measurements (i.e. capability) and OWF‘s bid and at the minimum of the prices of the connected BZs : TAG = min {Cap, OWF bid} * min{P_{BZ1}, B_{Z2}}**

1. OWF bidding based on marginal costs: ~3 €/MWh



2. OWF strategic bidding to max. TAG compensation: bids only 899 MWh



Possible distortive effects – scenario 1

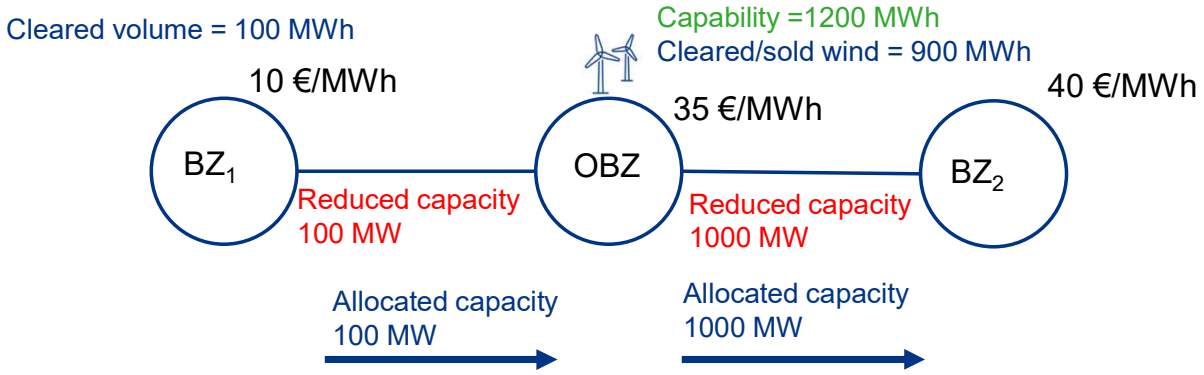
. **Example case 3 – strategic bidding – pricing out of the market**:

- P_{Ref} = Max {P_1, P_{OBZ}} = 35 €/MWh
- Cleared wind volume = 900 MWh,
- „Capability“ = 1200 MWh
- TAG compensation = 10500 €
- Market revenue = 31500 €
- **Total revenue = 42 000 €**

Observations:

- Incentive for inefficient dispatch decisions - OWFs price themselves out of the market in anticipation of a higher total revenue (market revenue+TAG).
- Within TAG framework OWF bidding prices should be checked/ validaded: Cases where OWF bid price > P_{OBZ} should disqualify from TAG completely.
- Underbidding (example 2) seems to be a better strategy to maximise total revenue.

3. OWF strategic bidding to max. TAG compensation: 35 €/MWh



Conclusions:

- **To avoid TAG being dependent on P_{OBZ} which can be manipulated by OWFs, it is recommended to use as reference price for TAG the minimum of the prices of the connected bidding zones: P_{Ref} = Min{P_{BZ1}, P_{BZ2}}**
- This approach is very close to the reality since, most of the time P_{OBZ} converges to P_{BZ1}. The only case where P_{OBZ}> P_{BZ1} is only at time with capacity restrictions by the TSO where OWFs have market power or it could be due to FB effects.

Possible distortive effects – scenario 2

Assumptions:

- Two OWFs in the OBZ (i.e. competition)
- Same wind conditions i.e. same „capability“

Example case 1 – normal bidding:

- P_{Ref} = Max {P_{BZ1}, P_{OBZ}} = 10 €/MWh
- Cleared wind volume each OWF= 550 MWh,
- „Capability“ each OWF = 600 MWh
- TAG compensation for each OWF = 4350 €
- Market revenue each OWF = 1650 €
- **Total revenue each OWF = 6 000 €**

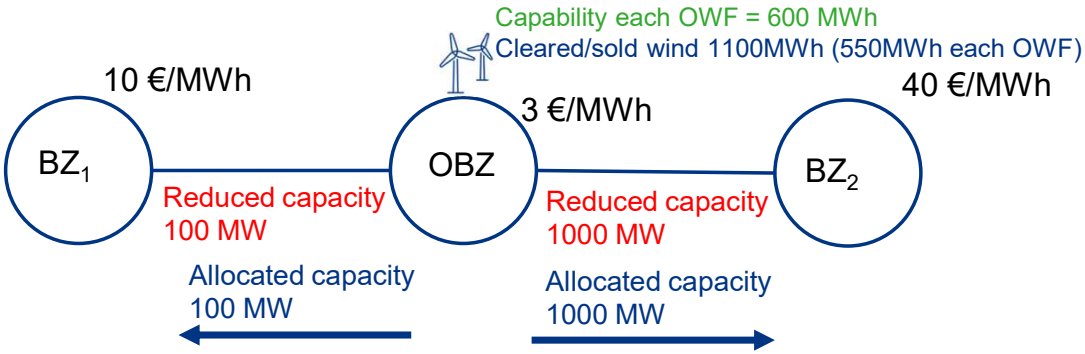
Example case 2 – strategic bidding - underbidding:

- Each OWP bids: 3 €/MWh, 449MWh
- P_{Ref} = Max {P_{BZ1}, P_{OBZ}} = 40 €/MWh
- Cleared volume each OWP = 449 MWh
- TAG compensation each OWF1 = 151* 40= 6040 €
- Market revenue each OWF = 449*40=**17960 €**
- **Total revenue each OWF =24000 €**

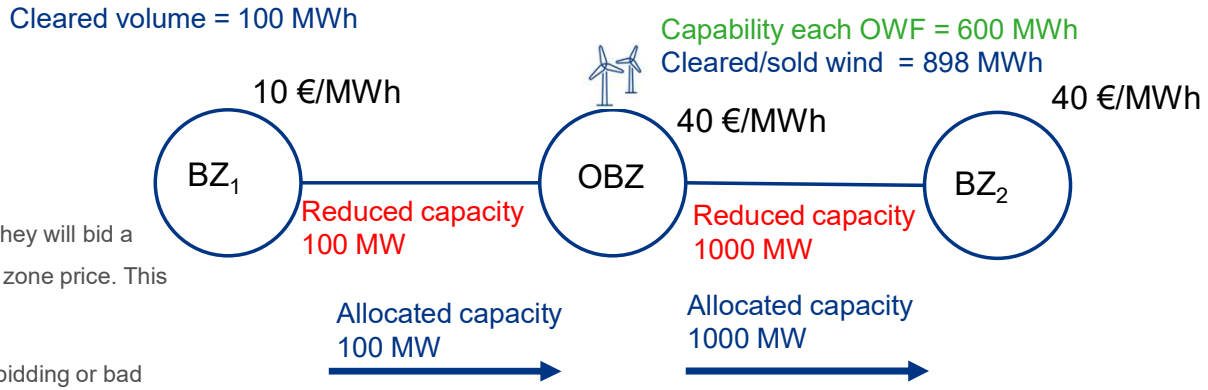
Observations:

- If OWsF can anticipate that only 100MW are cleared from BZ_1 towards BZ_2 , then they will bid a volume just below the remaining capacity (i.e. 898MWh) to get the highest bidding zone price. This effect would have happened even w/o TAG and it should be monitored.
- However, it would be difficult to verify if the lower volume bid was due to strategic bidding or bad forecast. In this case, **TAG should be paid out only for the minimum of the real-time wind measurements (i.e. capability) and OWFs‘ bid and at the minimum of the prices of the connected BZs : TAG = min {Cap, OWF bid} * min{P_{BZ1}, B_{Z2}}** (this is valid for both DA and ID)

1. OWF bidding based on marginal costs: ~3 €/MWh



2. OWFs strategic bidding to max. total revenue: bid only 449MWh

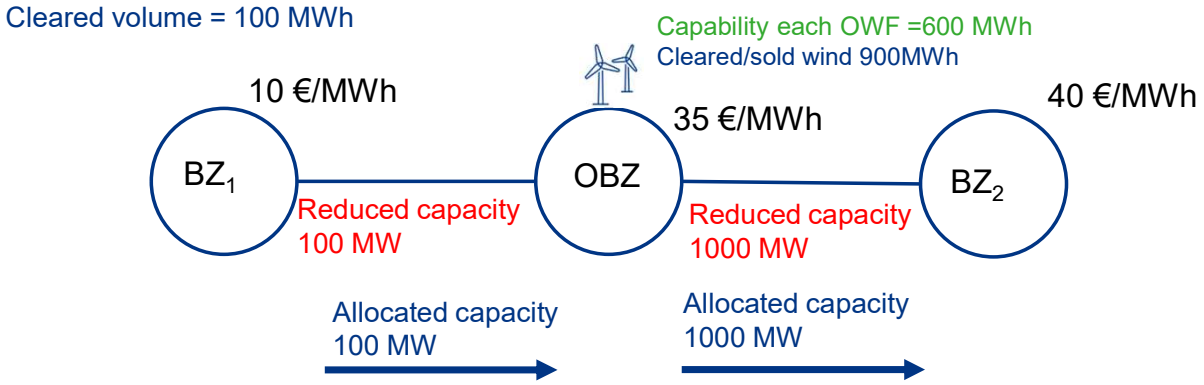


Possible distortive effects – scenario 2

Example case 3 – strategic bidding – pricing out of the market:

- OWP1 bid: 3 €/MWh, 600MWh
- OWP2 bid: 35 €/MWh, 600MWh
- P_{Ref} = Max {P_{BZ1}, P_{OBZ}} = 35 €/MWh
- Cleared volume OWP1 = 600 MWh
- Cleared volume OWP2 = 200 MWh
- TAG compensation OWF1 = 0
- Market revenue OWF 1= 600*35=21000 €
- TAG compensation OWF2 = 400*35 =14000 €
- Market revenue OWF2= 200*35=7000 €
- **Total revenue each OWF =21000 €**

3. OWFs strategic bidding to max. total revenue: 35 €/MWh



Observations:

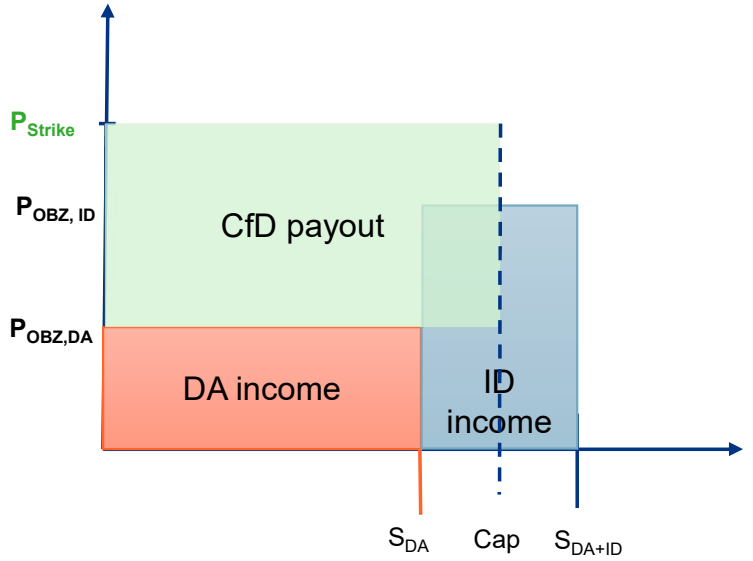
- OWF price himself out of the market in anticipation of a higher total revenue (market revenue+TAG).
- Windfall profits for the OWF who bids at marginal costs.
- Within TAG framework OWF bidding prices should be checked/ validaded. Cases where OWF bid price > P_{OBZ} should disqualify from TAG completely.
- Underbidding (example 2) seems to be a better strategy to maximise total revenue.

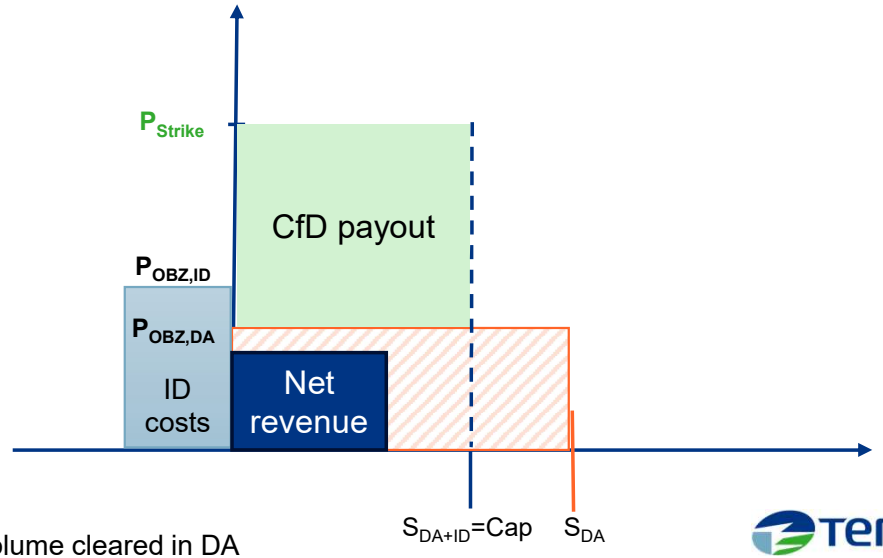
Conclusions:

- **To avoid TAG being dependent on P_{OBZ} which can be manipulated by OWFs, it is recommended to use as reference price for TAG the minimum of the prices of the connected bidding zones: P_{Ref} = Min{P_{BZ1}, P_{BZ2}}**
- This approach is very close to the reality since, most of the time P_{OBZ} converges to P_{BZ1}. The only case where P_{OBZ}> P_{BZ1} is only at time with capacity restrictions by the TSO where OWFs have market power or it could be due to FB effects.

„Capability“-based CfD

- **Capability CfD = (P_{Strike}-$P_{OBZ,DA}$)*Cap**
  - P_{strike}= competitively determined via tenders
  - $P_{OBZ,DA}$ = hourly DA market price in OBZ
  - Cap= potential of injection of OWF („capability“) based on **real-time wind measurements**
- **Total revenue = Capability CfD + actual market revenue**
  - Regardless whether market revenue comes from DA or ID
- Capability CfD functions as a capacity-based mechanism that rewards OWFs for being available when the system needs them. This means CfD will be paid out also when OWFs participate in ID and balancing markets e.g. by offering downward regulation.





S_{DA}= wind volume cleared in DA
S_{DA+ID}= total wind volume cleared in DA+ID

Cost distribution – „polluter pays“ principle

Solution 1 (“simple” model): Defining cost distribution proportional to shadow prices in factual:

- It needs to be checked for all CNECs with TAG-relevant reductions whether they have a non-zero shadow price (in the factual).
- If there is more than one CNEC, the costs would be distributed among the CNECs proportionally to the shadow prices. From there, they would be distributed to the TSOs “owning” the CNECs (see table below).

Solution 2 (euphemia model): Defining cost distribution based on shadow prices' sensitivity on the capacity reduction:

- The restriction of the TAG-related CNECs is relieved to 70% in the Euphemia counterfactual to estimate how big an impact the CNECs had on the OWF’s curtailment (see table below). It is a more accurate and fair way to distribute costs among “polluter” TSOs.

Example:

	TSO_A	TSO_B	Cost ratio
Factual	Shadow price 10 €/MWh (factual)	Shadow price 5 €/MWh (factual)	2:1 (solution 1)
Counterfactual	Shadow price 8 €/MWh (counterfactual)	Shadow price 1 €/MWh (counterfactual)	
Difference	2 €/MWh	4 €/MWh	1:2 (solution 2)

Effect works in both directions, more analysis needed, should be resolved in TAG methodology

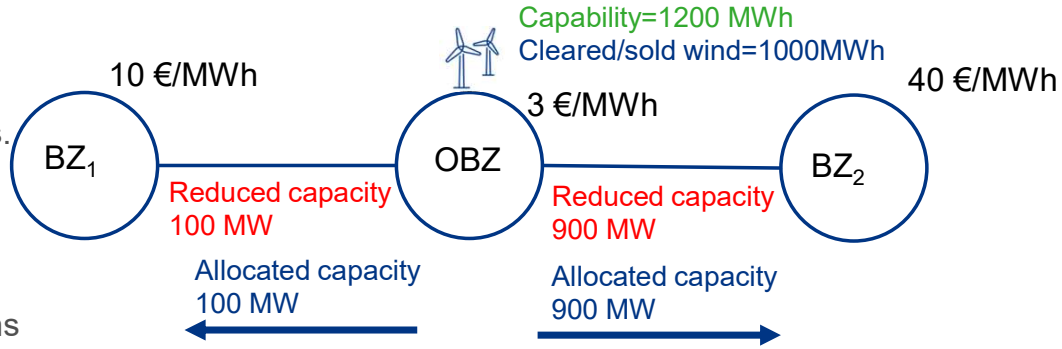
Combined solution: advanced model applied for DA and simple model for ID

- While the advanced model in DA timeframe where the counterfactual is determined via a Euphemia re-run relieving capacity restrictions to 70%, could provide more accurate results regarding TAG compensation payments using the original order books based on ceteris paribus principle (e.g. assuming non-strategic bidding at marginal costs), the original IDA order books do not reflect the counterfactual DA result.
- If the difference between factual and counterfactual DA results is small (e.g. 65% vs. 70% cross-zonal capacity on some remote network element with limited impact on the results), the difference might be ignored, and the original IDA order books could be used to calculate the IDA counterfactual.
- However, if the difference between factual and counterfactual DA results is significant, a counterfactual based on unmodified IDA order books for IDA can lead to misaligned compensation (over- or under-compensation, see next slide).
- Therefore, the IDA order books would need to be corrected in a EUPHEMIA counterfactual in IDA (based on historical data, bids, etc.) to reflect the DA counterfactual results ensuring a proper compensation. This can be very complex and not an accurate estimate of the TAG in IDA.
- An alternative then could be to use the simple model for calculating TAG in IDA based on a reference volume and price. The cost distribution for TAG payments in ID timeframe can be determined based on shadow prices of TAG-related CNECs in ID factual.

TAG compensation in IDA under the advanced model

Example 1 – no change in wind forecast:

- OWFs forecast 1200 MW and bids 1200 MW at 3 Euros/MWh
- Capacity in factual is restricted to 1000 MW and only 1000MW of offshore wind is cleared at 3 Euros/MWh due to capacity restrictions.
- In DA counterfactual the cleared price would have been 10 Euros/MWh and the cleared volume 1200 MW.
- Assuming the forecast does not change, the OWF offers the unsold 200 MW in the first IDA, which is fully blocked by capacity restrictions
- Using the unmodified IDA order books for TAG compensation in IDA, would lead to the OWF selling the 200 MW resulting in these 200 MW to be compensated twice (first in DA and later in IDA).
- To avoid such a situation, the IDA order books would need to be corrected to reflect the DA counterfactual results (reducing the volume for sale in IDA).



Example 2 – change in wind forecast:

- If at IDA OWF expects only 1100MW (instead of 1200 MW), he will offer 100 MW in IDA based on its factual DA sales.
- A correctly modified IDA order book would assume a purchase order of 100 MW since 1200 MW would have been sold in the counterfactual DA auction.
- Therefore, the factual IDA revenues shall be deducted from the DA TAG compensation.
- Should the counterfactual costs of buying back 100 MW in IDA also be deducted from the DA TAG compensation as saved costs?