Scalable Complex Orders
Project Meeting #2

17th September 2021

Agenda

Session 1: Project Management (15 min)

- Project Plan Review
- Reminders and Updates

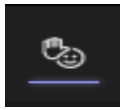
Session 2: Conversion Analysis (1hr 30min)

- Further Analysis and Conclusions on Conversion 1 (30min)
- Member Insights Sharing (10min)
- Conversion 2 Update (30 min)
    - Explanation of possible adaptions for Conversion 2
    - Questionnaire Clarifications & Responses
- Next Steps (5min)
- Q&A (15min)

Housekeeping Rules

- ✓ *Keep your video switched off*

- ✓ *Raise the hand if you have a question*



- ✓ *Keep your line muted unless asking a question*

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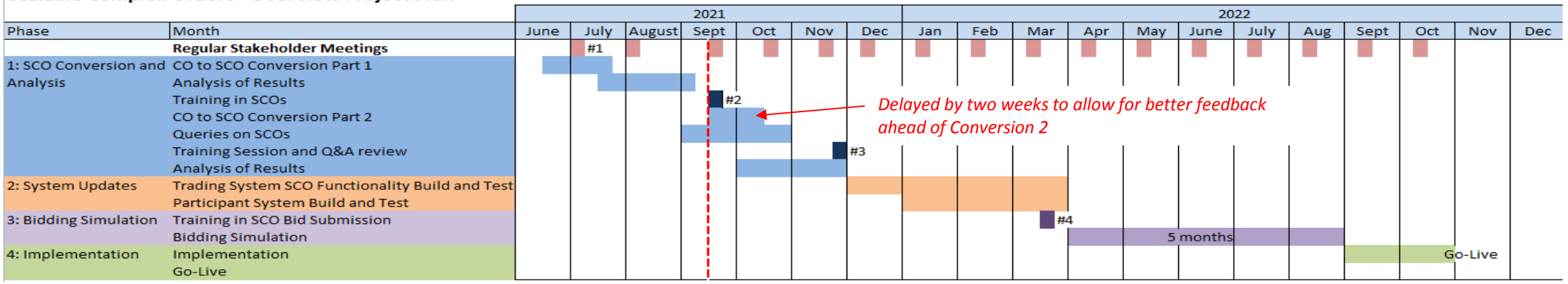
Session 1: Project Plan Review

Scalable Complex Orders - Overview Project Plan



Complete Tasks	Current Tasks	Future Tasks
Initiation of Market System Design	Member Meeting #2 (17/09)	Provision of Conversion 2 Data
Initiation of Algorithm Testing	Analysis and Feedback of Conversion 1 Data	Analysis and Feedback of Conversion 2 Data
Member Meeting #1 (13/08)	Adaptation of Conversion 1 Methodology	Member Meeting #3 (15/10)
	Questionnaire	
	Support Queries on Analysis & SCO's (N-Side Support)	

*red items indicate member involvement requested

Session 1: Reminders

#2 – 17th September 2021 (Today`s Meeting - Conclusion on Conversion 1 Results)

#3 – 15th October 2021 (Conversion 2 Results)

#4 – 19th November 2021 (Conclusion on Conversion 2 Results)

#5 – 10th December 2021 (System Implementation)

#6 – 14th January 2022 (System Implementation Progress)

Meeting invites will be issued ahead of each event.

Session 1: Updates

In order to refine the conversion methodology ahead of Conversion 2, we have prepared a questionnaire to assist you with targeted feedback.

The questionnaire provides the background and examples of the conversion methodology used, examples of how the conversions could be adapted, and specific questions for you to respond to.

Please Note: Final responses will be accepted until the 24th September.

Please remember to send your response to info@semopx.com

Agenda

Session 1: Project Management (15 min)

- Project Plan Review
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Session 2: Conversion Analysis (1hr 30min)

- **Further Analysis and Conclusions on Conversion 1 (30min)**
- Member Insights Sharing (10min)
- Conversion 2 Update (30 min)
    - Explanation of possible adaptions for Conversion 2
    - Questionnaire Clarifications & Responses
- Next Steps (5min)
- Q&A (15min)

Agenda

Market impact analysis based on the conversion tool 1

- Impact on market prices (including statistics on price differences “CO – SCO” (€/MWh) per delivery hour of the day)
- Impact on costs, revenues and profits of complex orders
- Impact on cleared volumes
- Impact on the number of paradoxically rejected complex orders

Market impact analysis based on the conversion tool n° 1

Conversion rule n°1

- Designed in the Euphemia Lab Iteration 1 as a “proof of concept” for the transition from CO to SCO.
- **Doesn’t use the Min. Acceptance Volume feature**.
- **Already delivers very good results** in terms of low market impacts (differences between CO and SCO in terms of market prices, revenues of complex orders, cleared volumes, etc)

Key remarks

- In theory, **not possible to have no market impact**, as **products are slightly different**
- **“Low market impact”** essentially **good to “ease the transition”** but **doesn’t mean that market results with Classic Complex Orders are an ideal benchmark**
  - The “Classic Complex Order” misses e.g. Min Acceptance Volumes and features “two types of variable costs”
  - The increased expressiveness of the SCO product should benefit to market participants
  - The increased expressiveness of the SCO product should benefit to the overall market efficiency

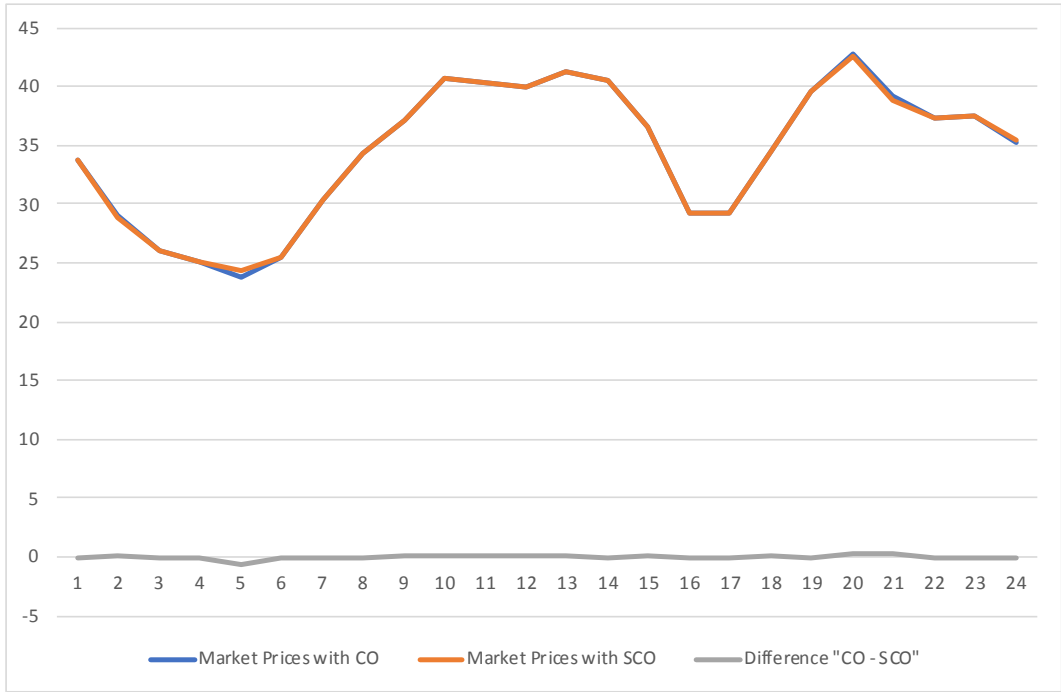
Agenda

Market impact analysis based on the conversion tool 1

- **Impact on market prices (including statistics on price differences “CO – SCO” (€/MWh) per delivery hour of the day)**
- Impact on costs, revenues and profits of complex orders
- Impact on cleared volumes
- Impact on the number of paradoxically rejected complex orders

Impact on market prices is most of the time null or marginal
(even with a relatively simple conversion rule)

Comparison of Market Prices (€/MWh)
Production data 2020. Euphemia 10.6
The chart represents the price dynamics for the session of July 1st 2020



Distribution of non-zero price differences – ~28 % of the periods (2475/8784 periods)
(€/MWh)
Production data 2020. Euphemia 10.6

Over 2020, market prices are
- ***identical* 72% of the time** (6309 hourly periods out of 8784)
- **different by less than 1 €/MWh 92 % of the time** (8098 hourly periods out of 8784)

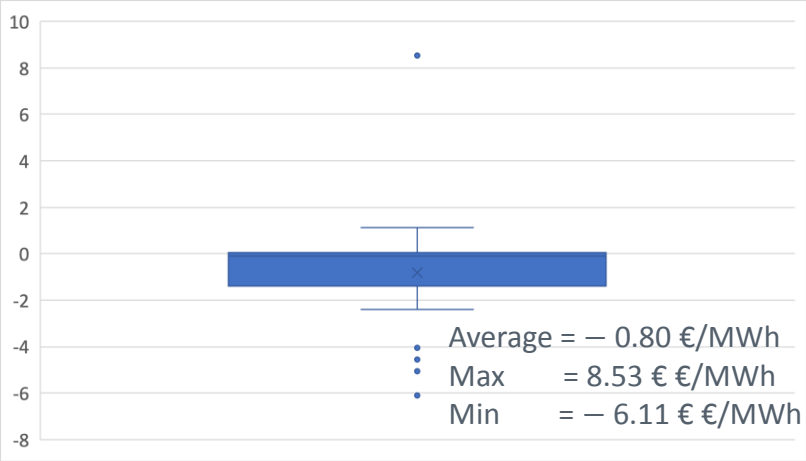
A few market price difference "outliers" remain, with an absolute price difference above 4 €/MWh in 2% of the hourly periods over 2020 (181 periods out of 8784).

SEM (SEMOpx Zone)

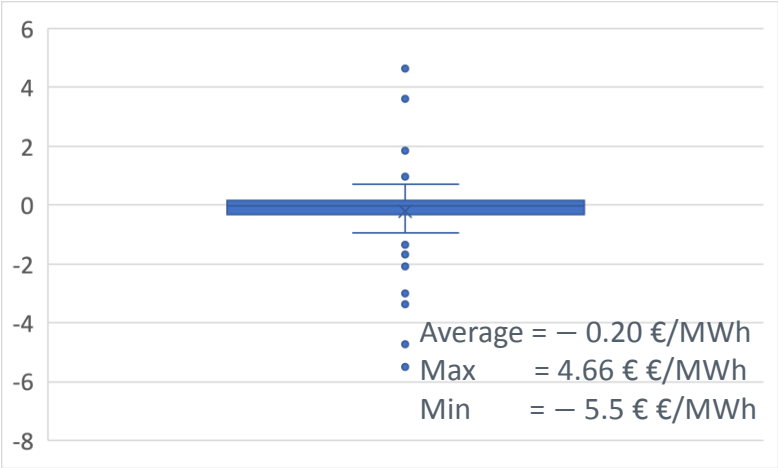
Price differences “CO – SCO” (€/MWh) per delivery hour

Production data 2020 - Euphemia 10.6

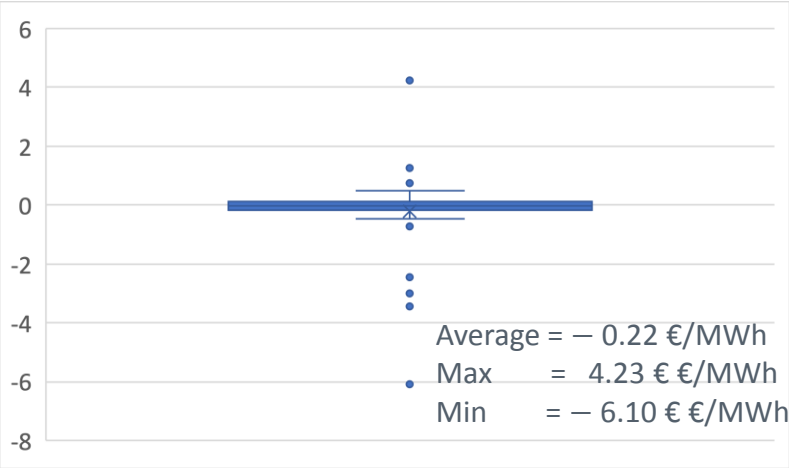
Hour 1
Price diff. in only ~17 % of the sessions (64/366 observations)



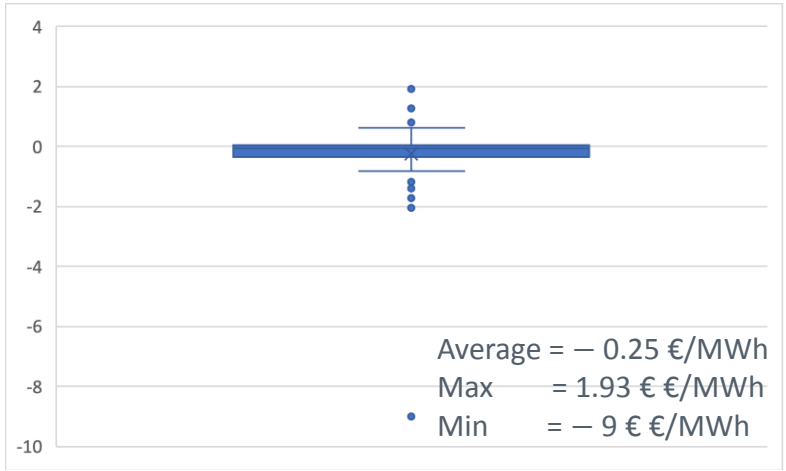
Hour 2
Price diff. in only ~22 % of the sessions (64/366 observations)



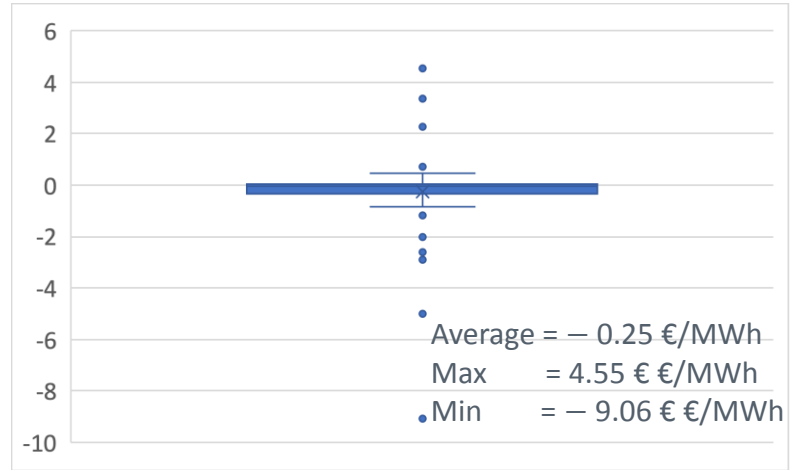
Hour 3
Price diff. in only ~21 % of the sessions (76/366 observations)



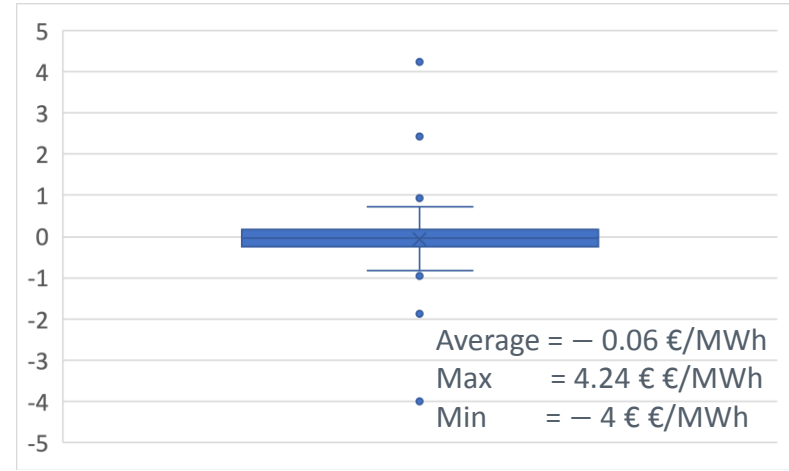
Hour 4
Price diff. in only ~21 % of the sessions (76/366 observations)



Hour 5
Price diff. in only ~22 % of the sessions (81/366 observations)



Hour 6
Price diff. in only ~22 % of the sessions (81/366 observations)

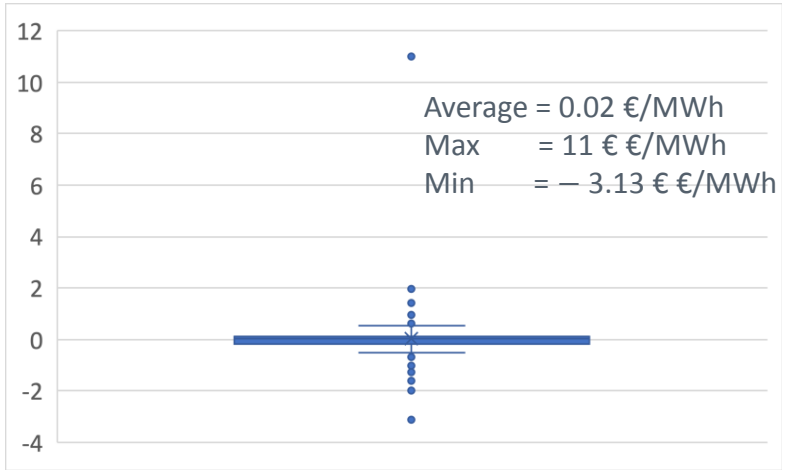


N.B. Average price differences reported above are averages over *non-zero* price differences

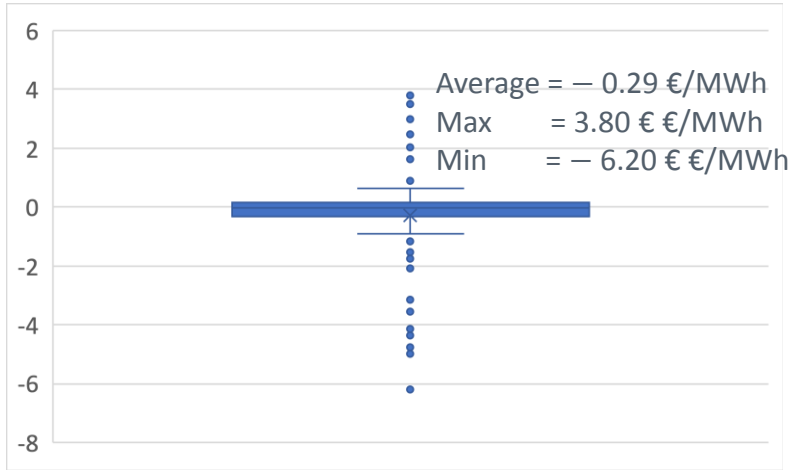
Price differences “CO – SCO” (€/MWh) per delivery hour

Production data 2020 - Euphemia 10.6

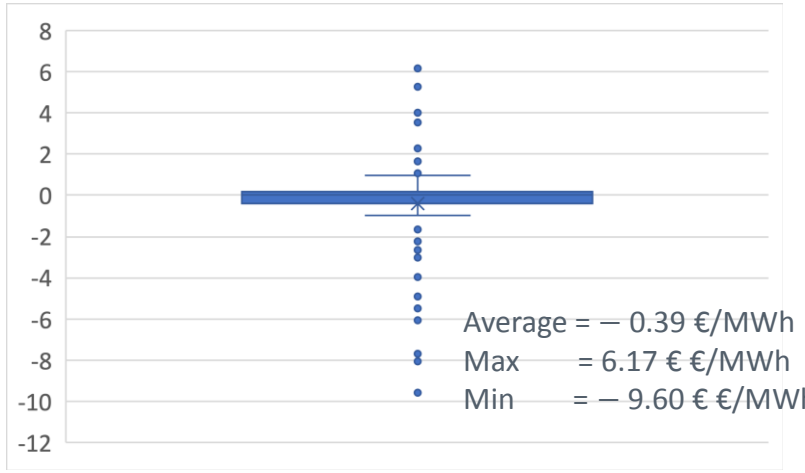
Hour 7
Price diff. in only ~26 % of the sessions (95/366 observations)



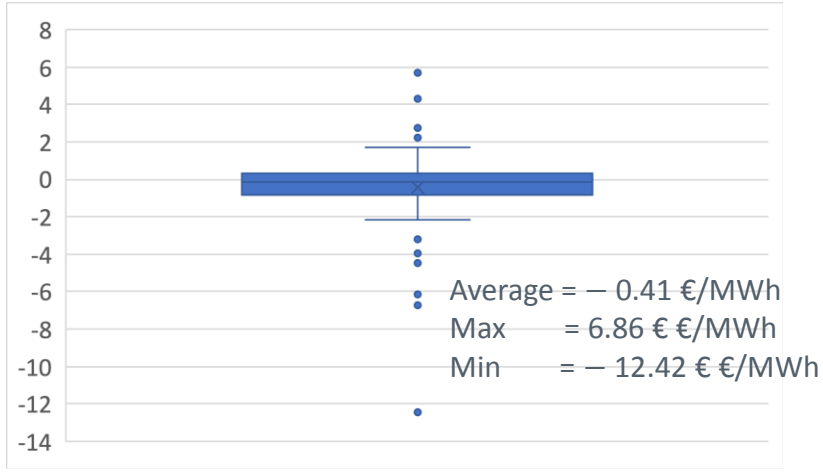
Hour 8
Price diff. in only ~23 % of the sessions (85/366 observations)



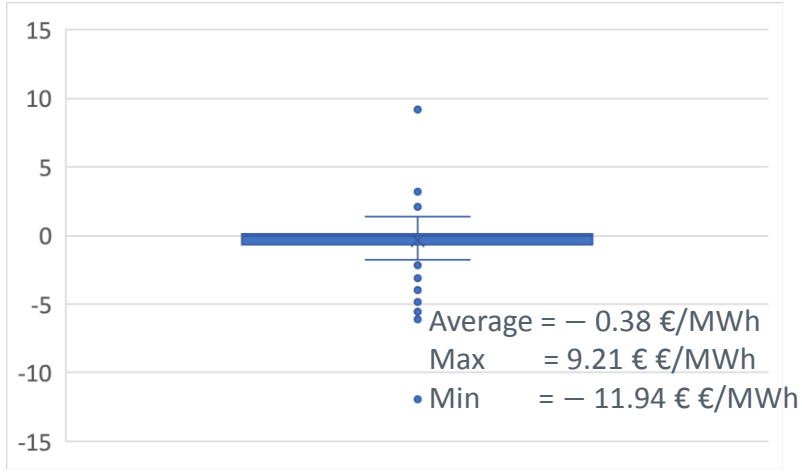
Hour 9
Price diff. in only ~31 % of the sessions (115/366 observations)



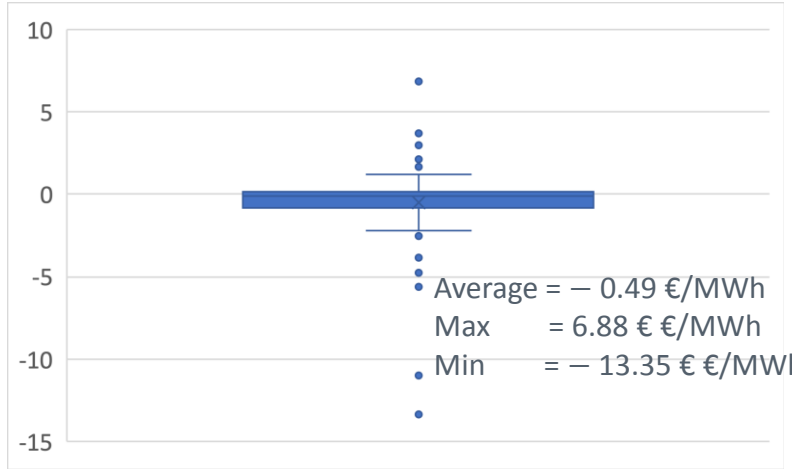
Hour 10
Price diff. in only ~32 % of the sessions (119/366 observations)



Hour 11
Price diff. in only ~32 % of the sessions (116/366 observations)



Hour 12
Price diff. in only ~31 % of the sessions (113/366 observations)

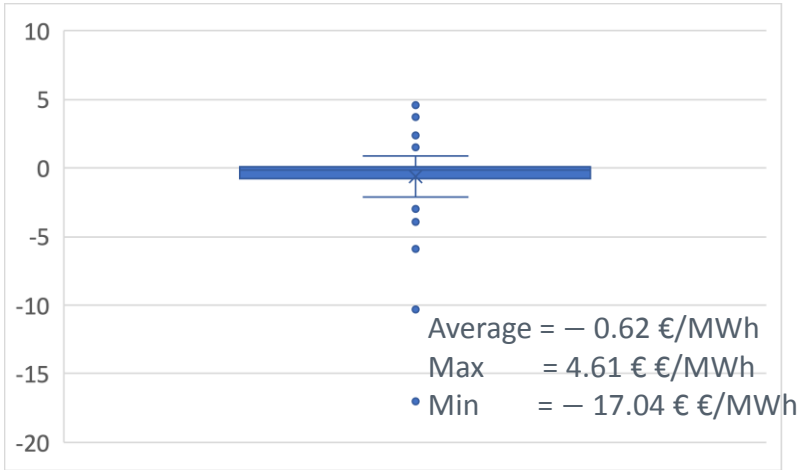


N.B. Average price differences reported above are averages over *non-zero* price differences

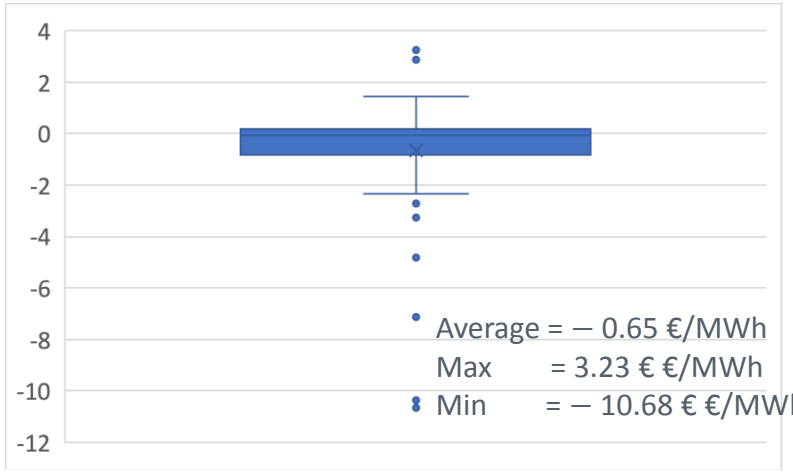
Price differences “CO – SCO” (€/MWh) per delivery hour

Production data 2020 - Euphemia 10.6

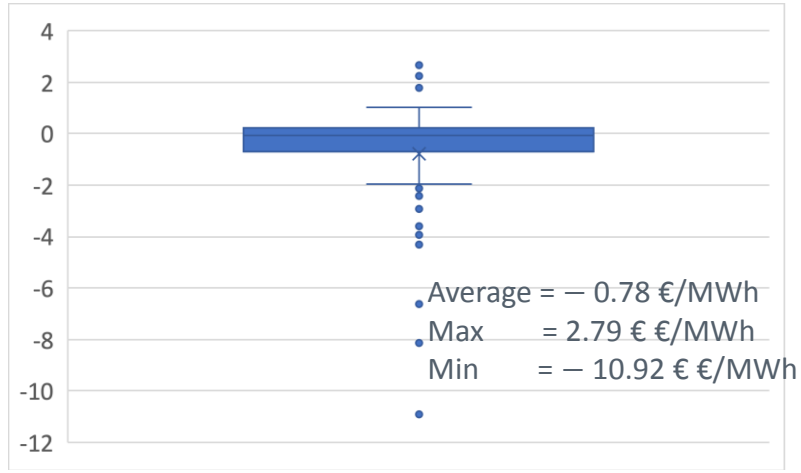
Hour 13
Price diff. in only ~31 % of the sessions (113/366 observations)



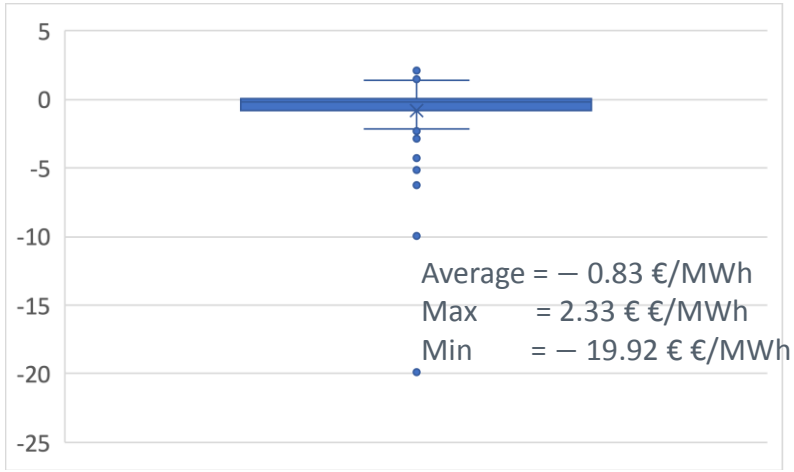
Hour 14
Price diff. in only ~29 % of the sessions (105/366 observations)



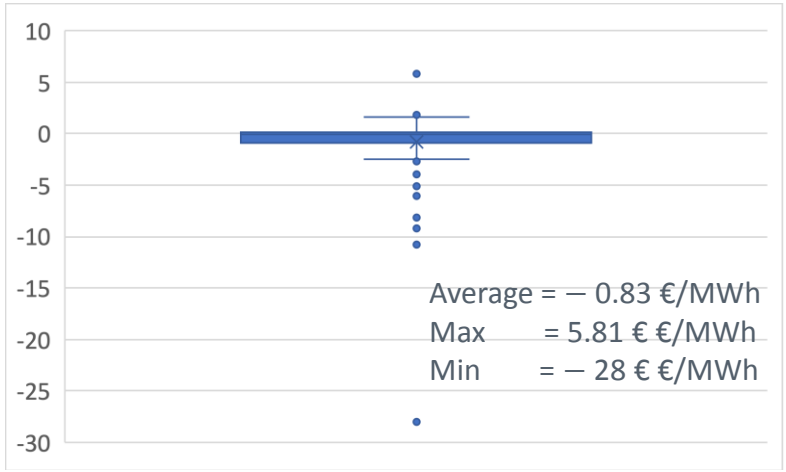
Hour 15
Price diff. in only ~31 % of the sessions (114/366 observations)



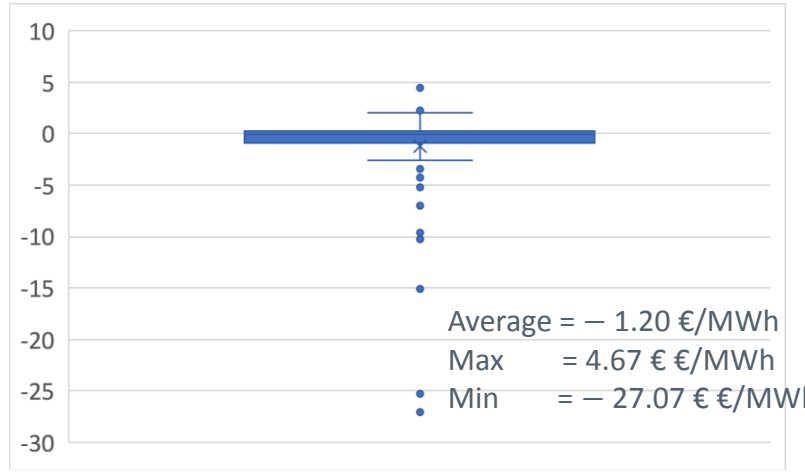
Hour 16
Price diff. in only ~29 % of the sessions (106/366 observations)



Hour 17
Price diff. in only ~x33 % of the sessions (121/366 observations)



Hour 18
Price diff. in only ~34 % of the sessions (126/366 observations)

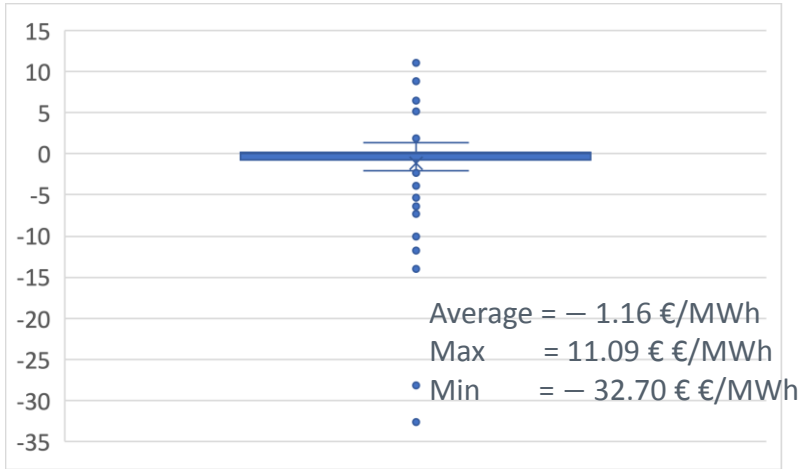


N.B. Average price differences reported above are averages over *non-zero* price differences

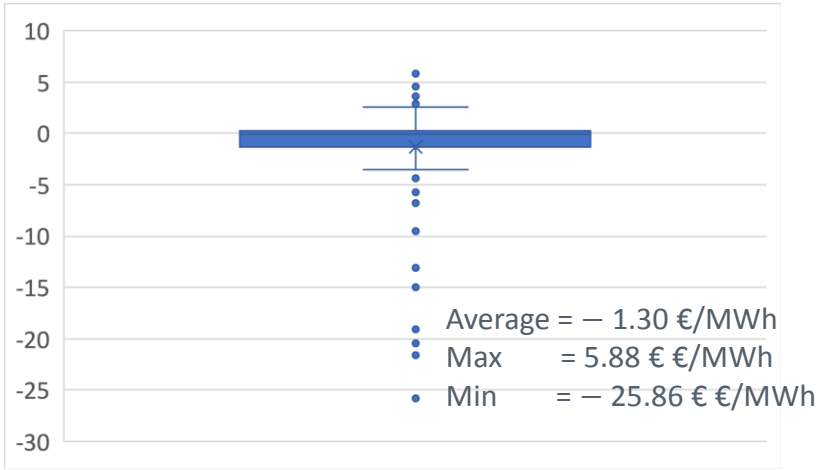
Price differences "CO – SCO" (€/MWh) per delivery hour

Production data 2020 - Euphemia 10.6

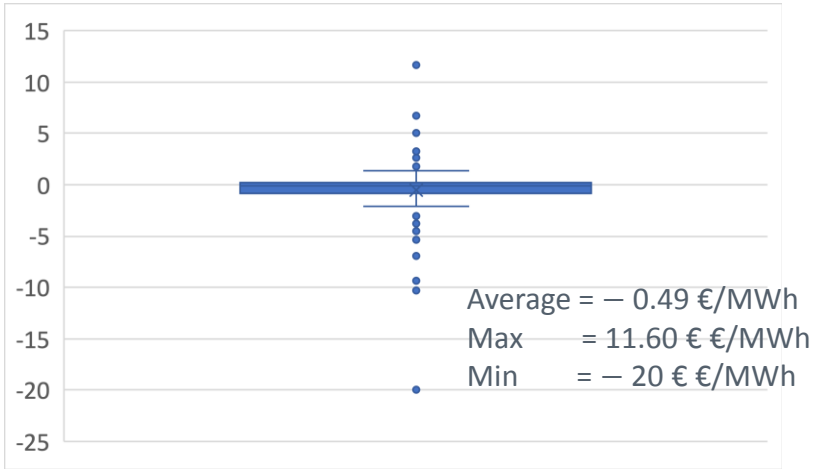
Hour 19
Price diff. in only ~33 % of the sessions (121/366 observations)



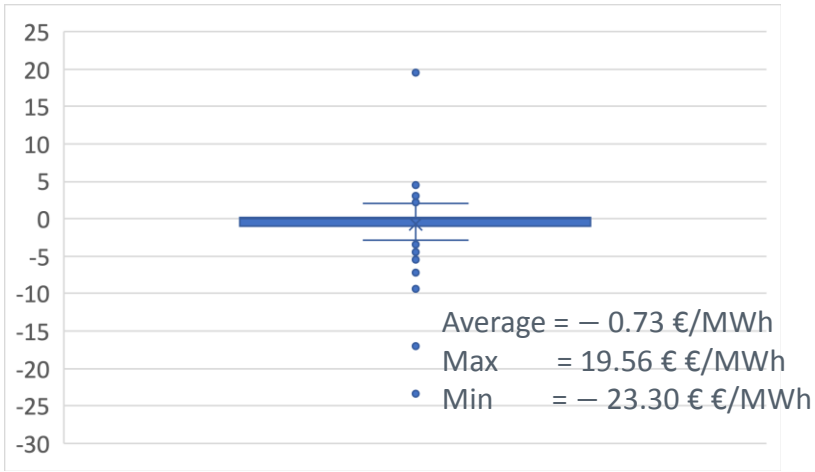
Hour 20
Price diff. in only ~31 % of the sessions (115/366 observations)



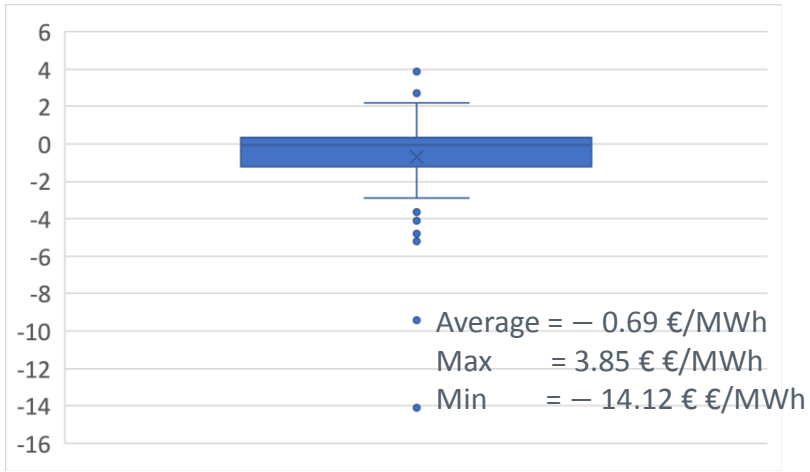
Hour 21
Price diff. in only ~33 % of the sessions (120/366 observations)



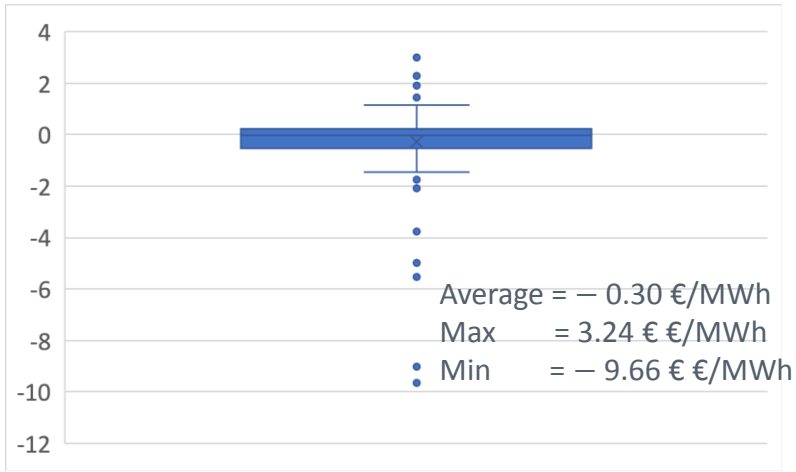
Hour 22
Price diff. in only ~33 % of the sessions (120/366 observations)



Hour 23
Price diff. in only ~30 % of the sessions (111/366 observations)



Hour 24
Price diff. in only ~28 % of the sessions (101/365 observations)



Hour 25 on October 25: there is no price difference.

N.B. Average price differences reported above are averages over *non-zero* price differences

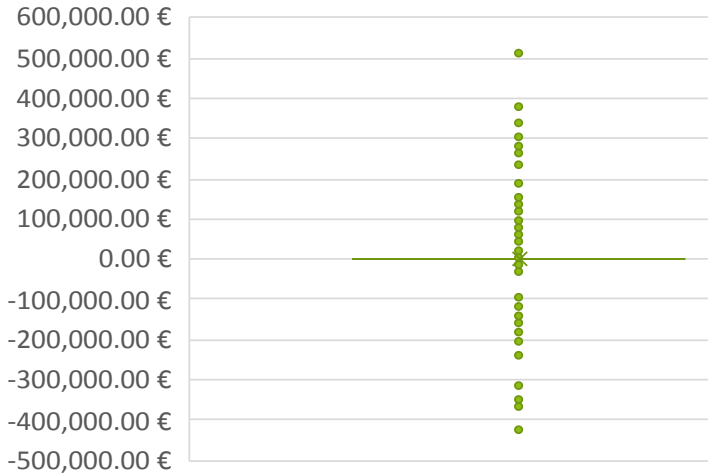
Agenda

Market impact analysis based on the conversion tool 1

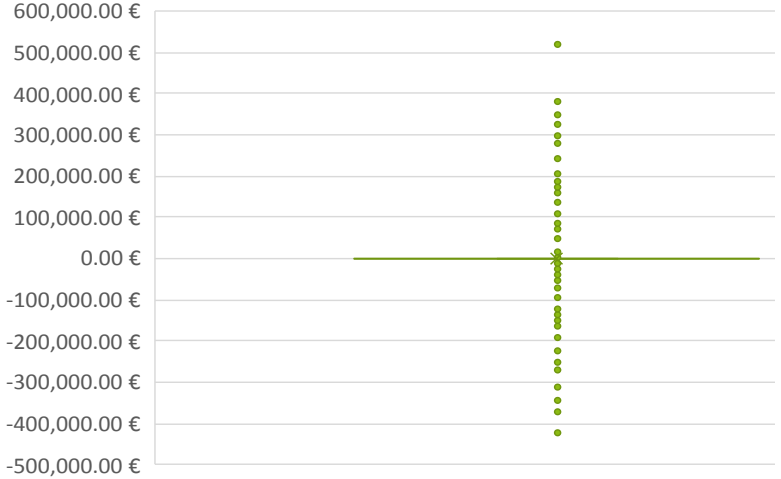
- Impact on market prices (including statistics on price differences “CO − SCO” (€/MWh) per delivery hour of the day)
- **Impact on costs, revenues and profits of complex orders**
- Impact on cleared volumes
- Impact on the number of paradoxically rejected complex orders

Impact on costs, revenues and profits of complex orders is small
(even with a relatively simple conversion rule)

Differences of total costs per complex order (€)
Costs based on the original Fixed and Variable Terms
Production data 2020. Euphemia 10.6
8948 observations (only non-zero values appear in the chart)



Differences of total revenues per complex order (€)
Production data 2020. Euphemia 10.6
8948 observations (only non-zero values appear in the chart)



Differences of profits per complex order (€)
Production data 2020. Euphemia 10.6
8948 observations (only non-zero values appear in the chart)

Costs

- **Costs are identical to within 1€ for > 95 % of the complex orders! (8559 out of the 8948 complex orders over 2020)**
- For the few outliers, the larger differences are explained by a difference in acceptation / cleared volumes of the complex order after conversion to SCO (if acceptance changes, the incurred costs change accordingly). N.B. as the same fixed and variable terms are used on both sides of these ex-post cost calculations (classic vs scalable complex orders), this is the only possible explanation.

Revenues

- **Revenues (cleared volumes x market prices) are identical within 1 € for > 71 % of the complex orders! (6370 out of the 8948 complex orders over 2020)**
- Outliers with larger differences are explained by differences in acceptance / cleared volumes and differences in market prices.

Profits

- **Profits (revenues – costs) are identical within 1 € for > 71 % of the complex orders!**
- **Absolute differences in profits are lower than 5000 € for ~ 98 % of the complex orders ! (8763 out of the 8948 complex orders over 2020)**
- Outliers with larger differences are explained by differences in acceptance / cleared volumes and differences in market prices.

The few outliers are orders accepted on one side and rejected on the other side

Key observations

1. Large revenue and cost impacts net out, leading to much smaller “declared” net profit impacts.
2. In view of the small number of outliers more largely impacted, assuming the same unit is always impacted (not realistic), that unit would be impacted ~ 15 days in 2020.
3. Outliers correspond to
   a) Complex orders end up being slightly out-of-the-money after the translation to SCO, or becoming in-the-money and cleared.
   b) Paradoxically rejected Classic Complex Orders ending up being accepted after the translation to SCO.
   c) Accepted Classic Complex Orders ending up being paradoxically rejected after the translation to SCO
4. The Fixed Terms in the welfare objective in the SCO case, and their adaptations during the translation, have an impact on the complex order selection, market prices, and which ones end up being rejected because they are out-of-the-money.
5. Different complex order selections may also result from the fact that the algorithm may be able during some runs to explore further the solution space and find better solutions.
   - As calculations are faster with SCO, the solution space is more explored and different complex orders may be selected even if one assumes a “perfect translation” (such a perfect translation is just theoretical as products are slightly different).

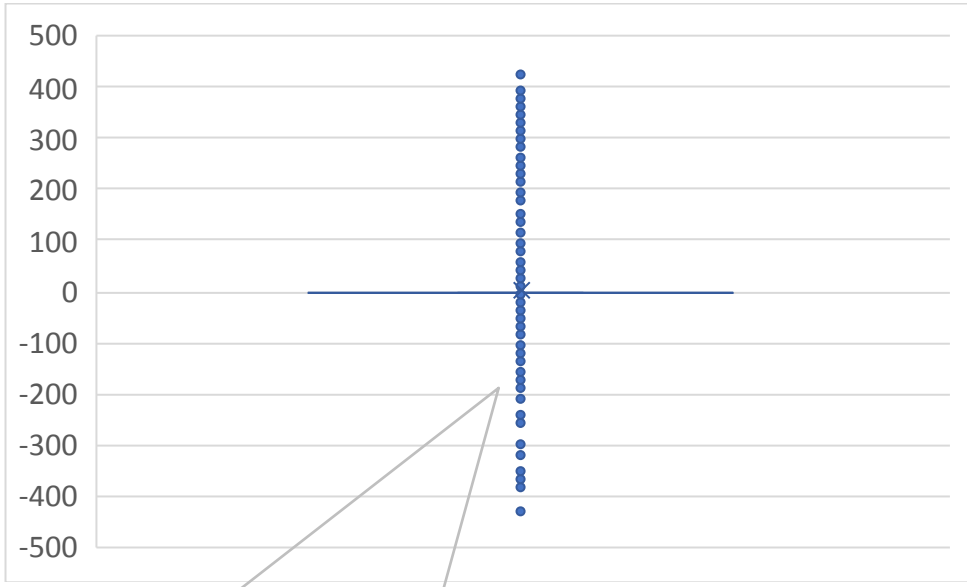
Agenda

Market impact analysis based on the conversion tool 1

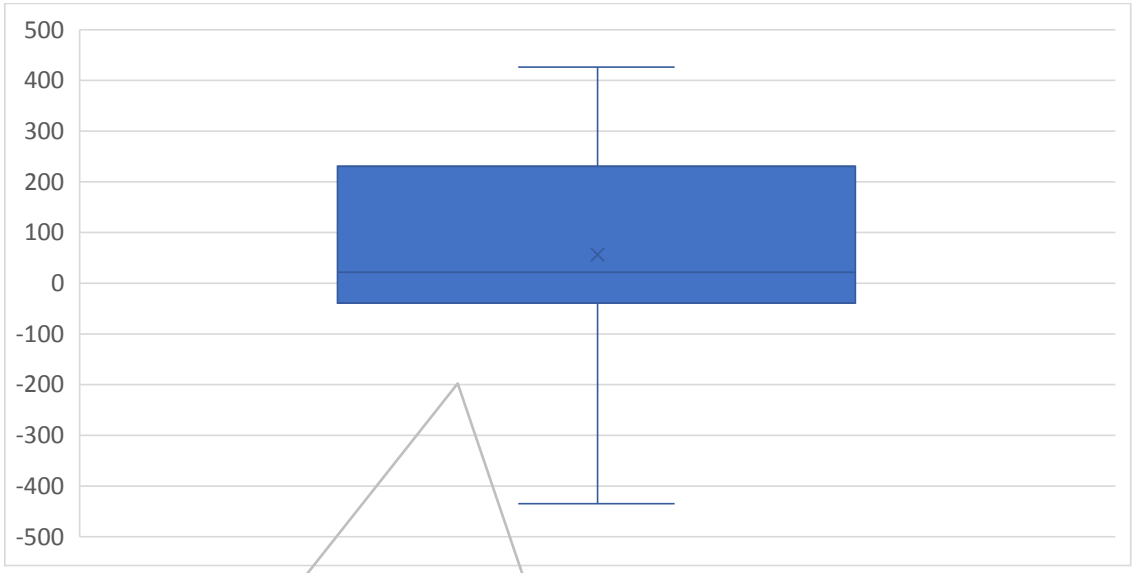
- Impact on market prices (including statistics on price differences “CO − SCO” (€/MWh) per delivery hour of the day)
- Impact on costs, revenues and profits of complex orders
- **Impact on cleared volumes**
- Impact on the number of paradoxically rejected complex orders

Impact on cleared volumes is most of the time null or marginal
(even with a relatively simple conversion rule)

Comparison of cleared volume per period for all complex orders (MWh)
Production data 2020. Euphemia 10.6
(214 752 observations)



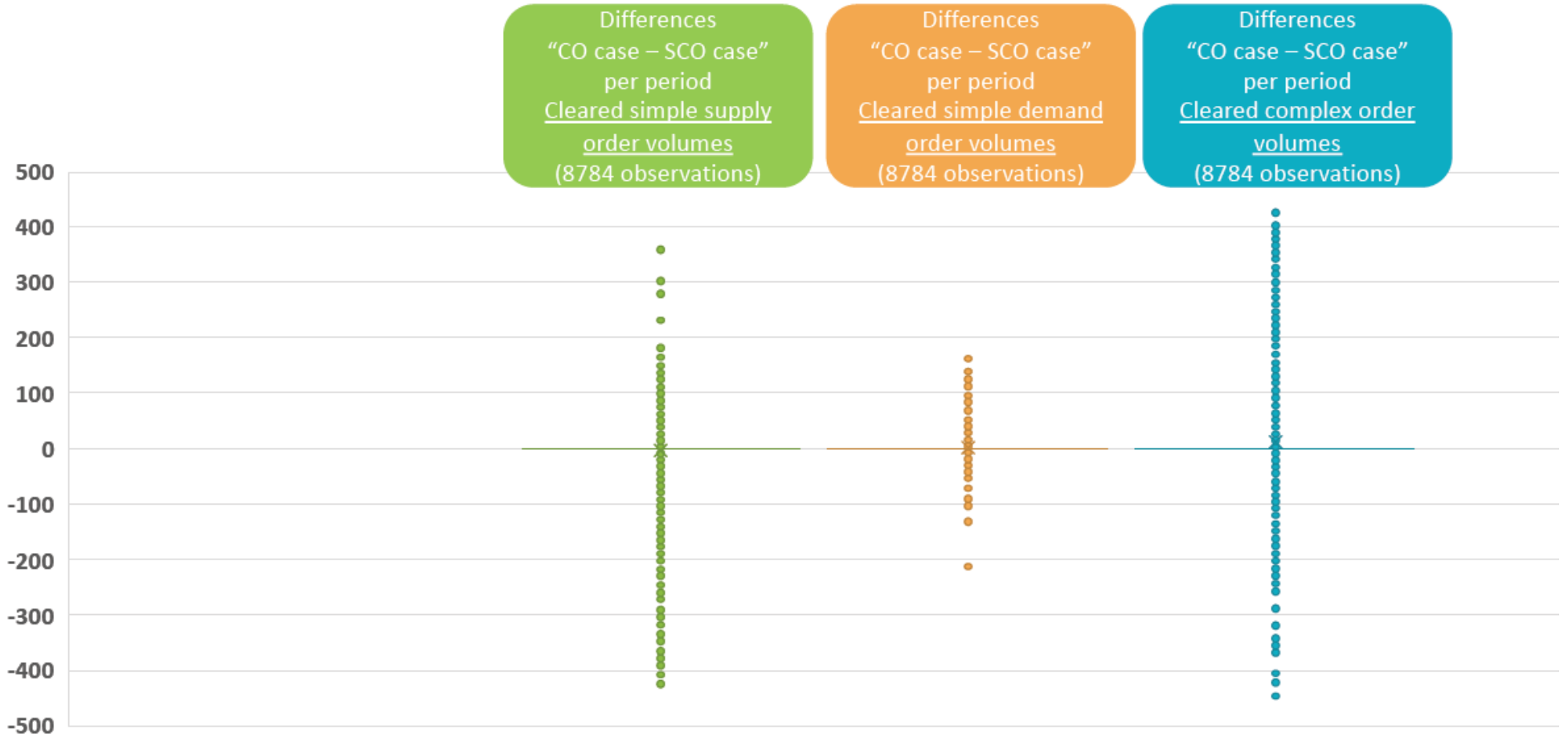
Distribution of non-zero cleared volume differences
< 1 % of all complex orders x covered periods (1947 / 214 752)
(MWh)
Production data 2020. Euphemia 10.6



Over 2020, considering differences in cleared volumes per period for all complex orders

- ***Cleared volumes are identical within 0.001MWh (=1KWh)*** ***in*** **99% of the cases** (212 800 cases out of 214 752)

For the remaining 1 % of the cases, differences can be quite large and seem essentially due to a few differences in complex order selections.
It is important to note that adaptations in the conversion rule could further mitigate this market impact.



Observations

- Differences in cleared volumes for complex orders do not necessarily correspond to same differences in cleared volumes of simple supply orders.
- Differences in terms of cleared volumes of simple supply orders, simple demand orders and complex orders do not necessarily net out.

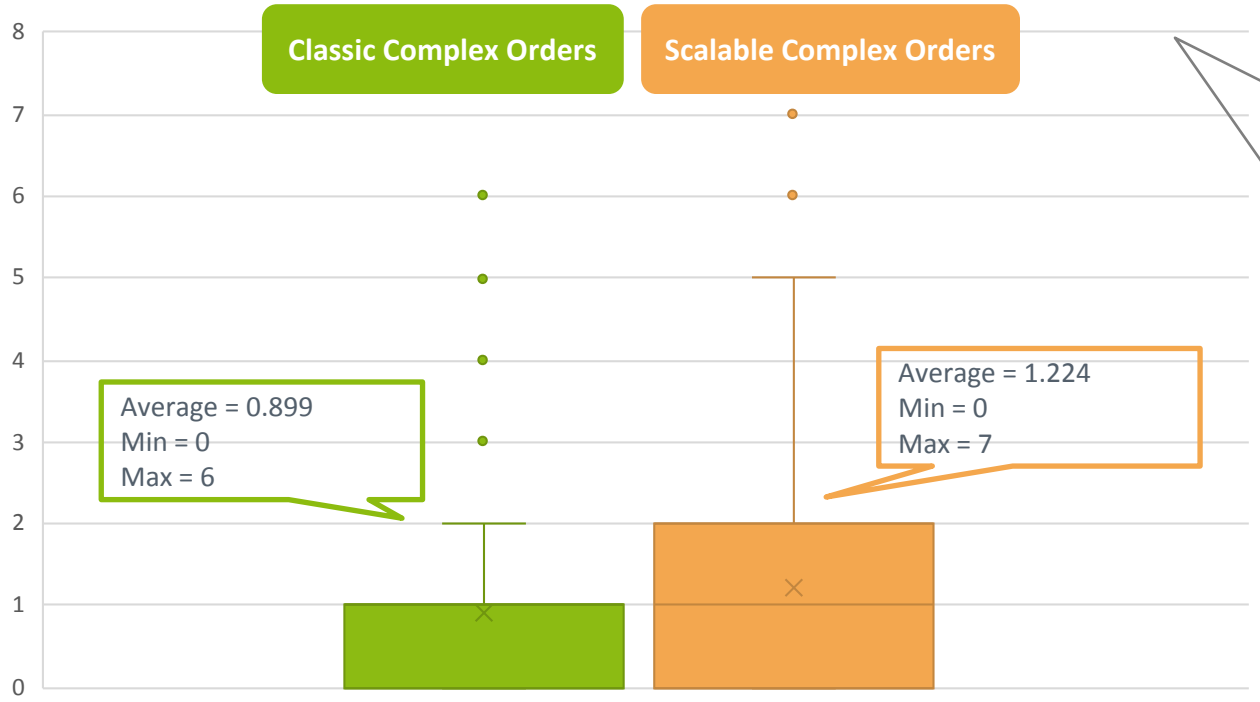
Agenda

Market impact analysis based on the conversion tool 1

- Impact on market prices (including statistics on price differences “CO − SCO” (€/MWh) per delivery hour of the day)
- Impact on costs, revenues and profits of complex orders
- Impact on cleared volumes
- **Impact on the number of paradoxically rejected complex orders**

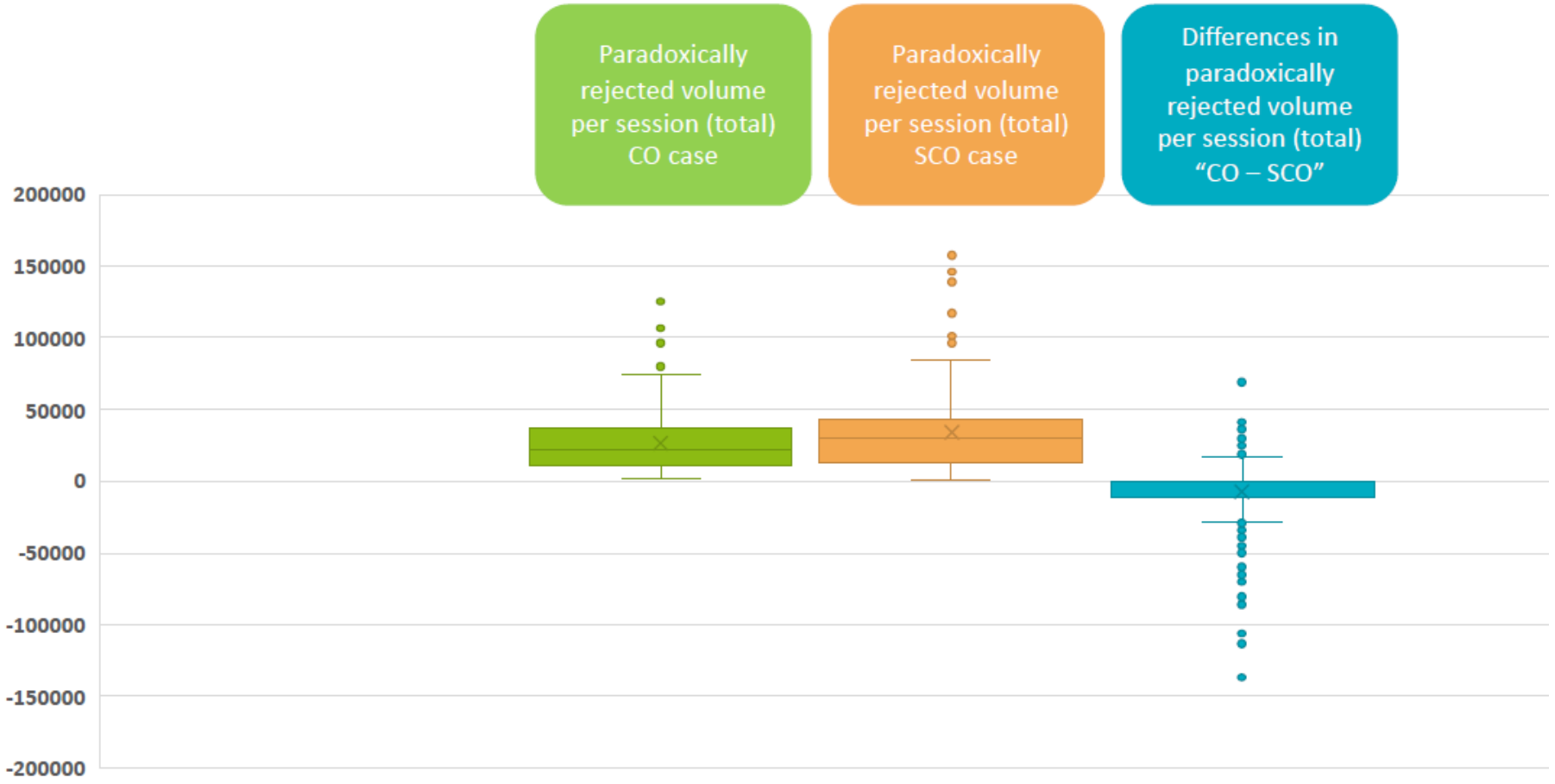
The number of paradoxically rejected complex orders is very slightly increased (global statistics taking into account all complex orders in SDAC)

Comparison of the number of paradoxically rejected complex orders per session
Production data 2020. Euphemia 10.6
(366 observations)



Important note for the comparison

- *Note that the minimum income conditions of SCO are slightly different from the minimum income conditions of Classic CO: with SCOs, the Variable Term is replaced by the marginal cost curves in the computations of the variable costs.*
- *This factor might explain the slight increase in paradoxically rejected orders once the paradoxical rejection is assessed based on the new cost calculations with SCOs: if the variable costs of SCOs are recomputed according to the original Variable Terms (before conversion), some paradoxically rejected SCO may actually not be paradoxically rejected.*



Observations

- Slightly higher volumes tend to be paradoxically rejected after the translation from CO to SCO *with the current conversion tool 1*
- The same disclaimer as on the previous slide applies → some scalable complex orders considered here as "PR" may actually violate their original minimum income condition as stated before the translation (i.e. considering the original variable and fixed terms)

Agenda

Session 1: Project Management (15 min)

- Project Plan Review
- Reminders and Updates

Session 2: Conversion Analysis (1hr 30min)

- Further Analysis and Conclusions on Conversion 1 (30min)
- **Member Insights Sharing (10min)**
- Conversion 2 Update (30 min)
    - Explanation of possible adaptions for Conversion 2
    - Questionnaire Clarifications & Responses
- Next Steps (5min)
- Q&A (15min)

Session 2: Member Insights Sharing

Open floor discussion on Conversion 1 Results and any insights members might have from their own analysis.

Agenda

Session 1: Project Management (15 min)

- Project Plan Review
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Session 2: Conversion Analysis (1hr 30min)

- Further Analysis and Conclusions on Conversion 1 (30min)
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- **Conversion 2 Update (30 min)**
    - **Explanation of possible adaptions for Conversion 2**
    - **Questionnaire Clarifications & Responses**
- Next Steps (5min)
- Q&A (15min)

Agenda

Improvements in the conversion tool 2

- **A closer look at the conversion rule n°1**
- Questions on venues for improvements of the conversion tool 1
  1. Increasing or decreasing further Fixed Terms ?
  2. Modifying bid curves to reflect Variable Terms ?
  3. Considering different prices "$P*$" at different periods in the conversion tool 1 to make it more realistic ?
  4. Leverage the Min. Acceptance Volume ?

Main objective of the conversion rule n°1 → adapt the Fixed Terms since Minimum Income Conditions

…and hence Fixed Term recovery conditions are different:

CO

$$\sum_t PRICE_t * QUANTITY_t - \boxed{Variable\_Term * \sum_t QUANTITY_t} \geq Fixed\ Term$$

versus

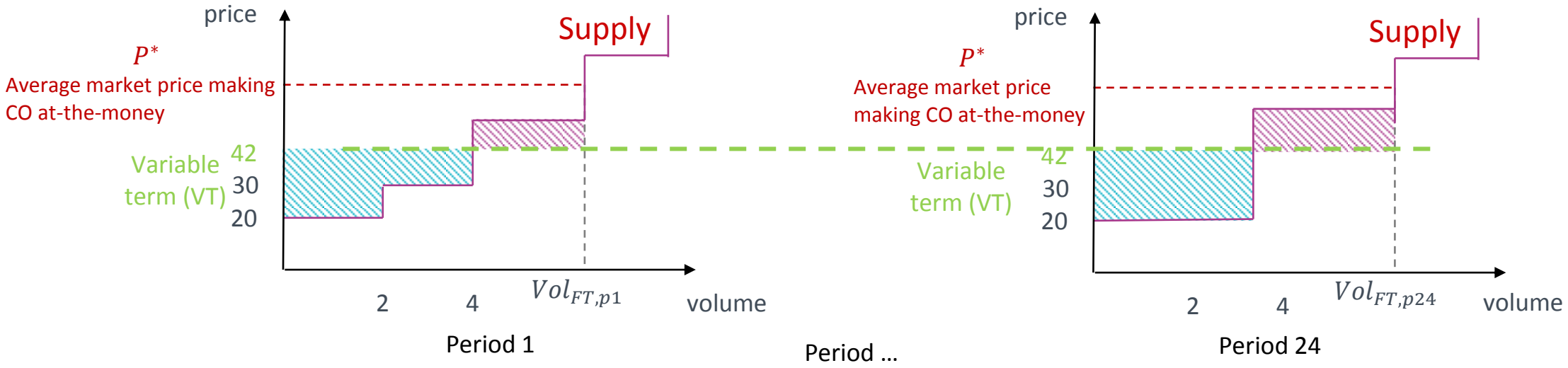
SCO

$$\sum_t PRICE_t * QUANTITY_t - \boxed{Marginal\_Costs\ (bid\ curves)} \geq Fixed\ Term$$

Differences in Variable Costs will be accounted for in the change of Fixed Term

Main objective is to adapt the Fixed Terms since Fixed Term recovery conditions are different

Adaptations consist in shifting *an estimation* of differences in "Variable Costs" (see previous slide) to the Fixed Term



Conversion rule

1. SCO Cost Curve = CO Cost Curve
2. CO Variable Term (VT) dropped → no VT in SCO
3. Find a price P^* (currently a single "daily average price") making the CO is "at-the-money" (Fixed Term and Variable Costs covered by revenues)
4. Find a new Fixed Term for the SCO such that the SCO equivalent to the CO is also at-the-money for P^*

SCO Fixed Term = CO Fixed Term + Area – Area

Area = **areas below Variable Term and above Curves**

Area = **areas above Variable Term and below Curves**

N.B. Considering only blue areas in the Fixed Term correction tends to lead to more SCO rejected than CO. More generally, a trade off exists between rejection induced by the conversion, and the satisfaction of the Min. Income Condition.

Agenda

Improvements in the conversion tool 2

- A closer look at the conversion rule n°1
- **Questions on venues for improvements of the conversion tool 1**
  1. Increasing or decreasing further Fixed Terms ?
  2. Modifying bid curves to reflect Variable Terms ?
  3. Considering different prices "$P*$" at different periods in the conversion tool 1 to make it more realistic ?
  4. Leverage the Min. Acceptance Volume ?

Objectives and questions

New simulations will be ran with improved translations: for that purpose, actionable feedbacks are looked for.

1. **Increasing or decreasing further Fixed Terms ?** (**Questionnaire Question 1.** Should further modifications of the Fixed Term be considered in the translation of CO to SCO, to mitigate the fact that Fixed Terms are part of the welfare objective function (as fixed costs) when SCO are in scope?

2. **Modifying bid curves to reflect Variable Terms ?** (**Questionnaire Question 2.** Should we consider modifying bid curves to reflect Variable Terms which are dropped during the translation, or the conversion rule n°1 modifying Fixed Terms is more suited? (modifying bid curves a priori not needed and not recommended)

3. **Considering different prices "$P*$" at different periods in the conversion tool 1 to make it more realistic ?** (**Questionnaire Question 4.** Should a refinement of the conversion rule n°1 be considered, where the computation of the prices $P*$ such that a complex order is at-the-money would be refined, by considering for a same complex order different prices $P*$ at different periods?

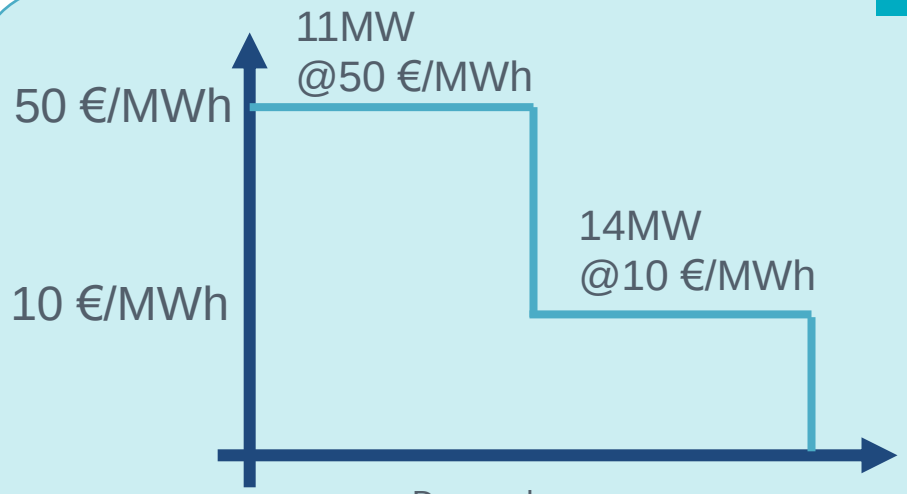
4. **Leverage the Min. Acceptance Volume ?** (**Questionnaire Question 5.** Are low price steps and higher Variable Terms used with CO to ensure the acceptance of a minimum volume? If yes, would there be an interest in some examples on how to use the minimum acceptance volume feature to better model this requirement with SCO?

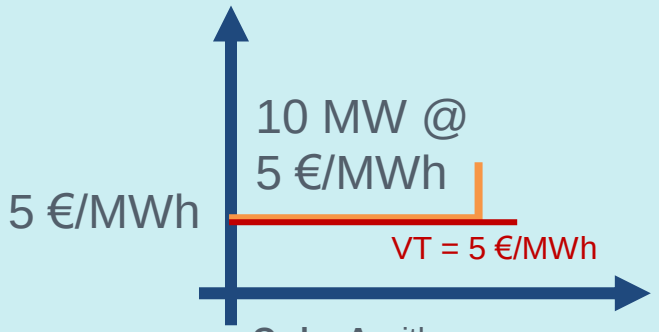
Q1:Further modifications of the Fixed Terms e.g. Lowering Fixed Terms in the translation

to balance the fact that SCO Fixed Terms are in the welfare objective and impact acceptances

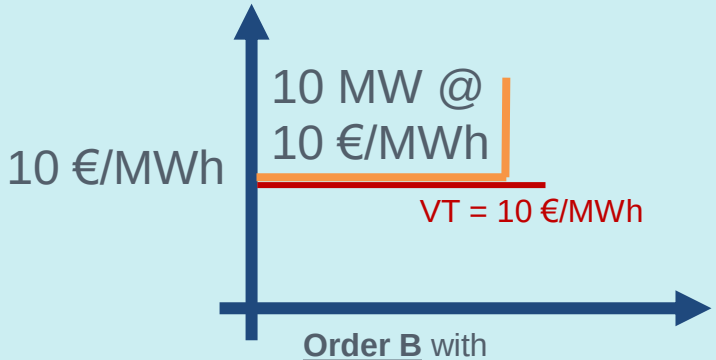
In this example → translation from CO to SCO leaves FT unchanged, and VT = curve cost, but still different outcomes with CO and SCO

Input data



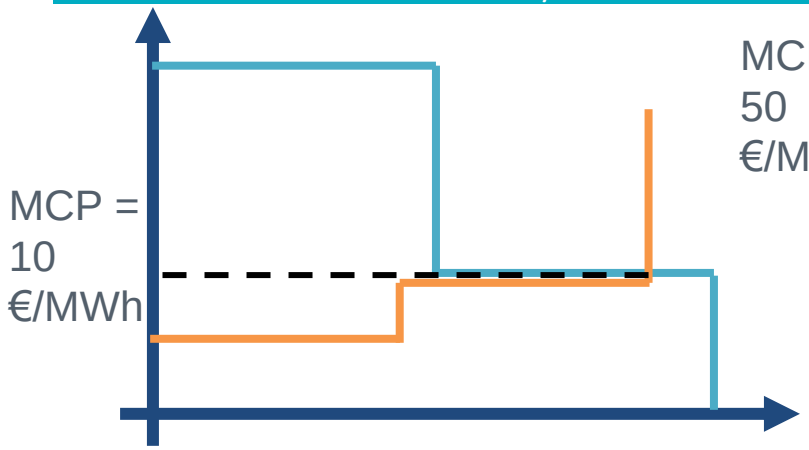


Order A with
FT = 400 €
VT = 5 €/MWh = price of the marginal cost cure

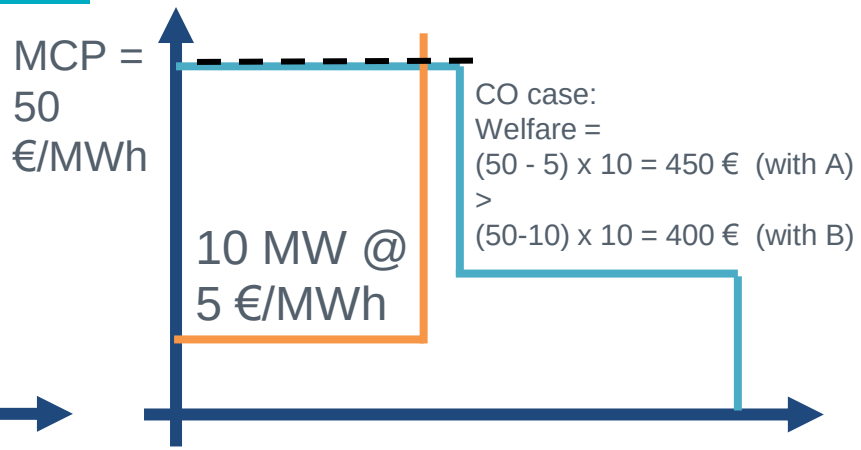


Order B with
FT = 100 €
VT = 10 €/MWh = price of the marginal cost cure

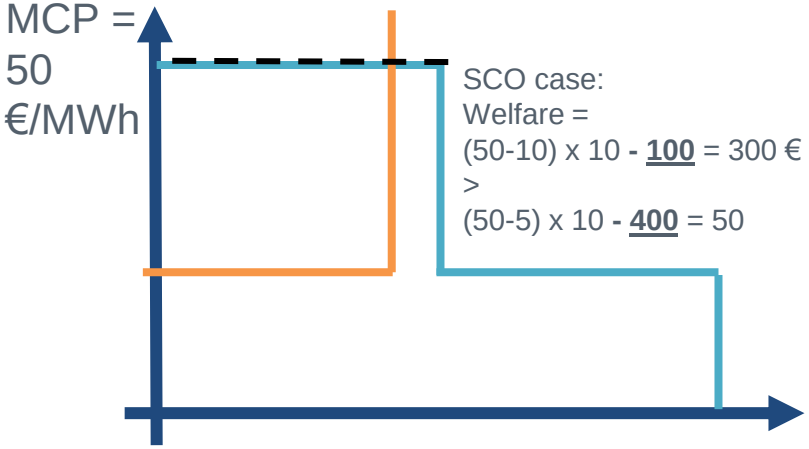
Matching 1: impossible to match both orders A & B → income conditions of A and B not satisfied because MCP = 10€/MWh too low



Matching 2: Best matching **with CO → match A**
→ Fixed Term not counted in optimized welfare



Matching 3: Best matching **with SCO → match B**
→ Fixed Term *is counted* in optimized welfare



Q1:Further modifications of the Fixed Terms e.g. Lowering Fixed Terms in the translation

to balance the fact that SCO Fixed Terms are in the welfare objective and impact acceptances

Observations

- Lowering Fixed Terms will have the effect that more SCOs will be accepted, potentially cleared even if actually less profitable or violating their minimum income condition.
- Increasing Fixed Terms will have the effect that more SCOs will be rejected, potentially rejected even if actually more profitable → more paradoxical rejections

Questions

Should we keep:

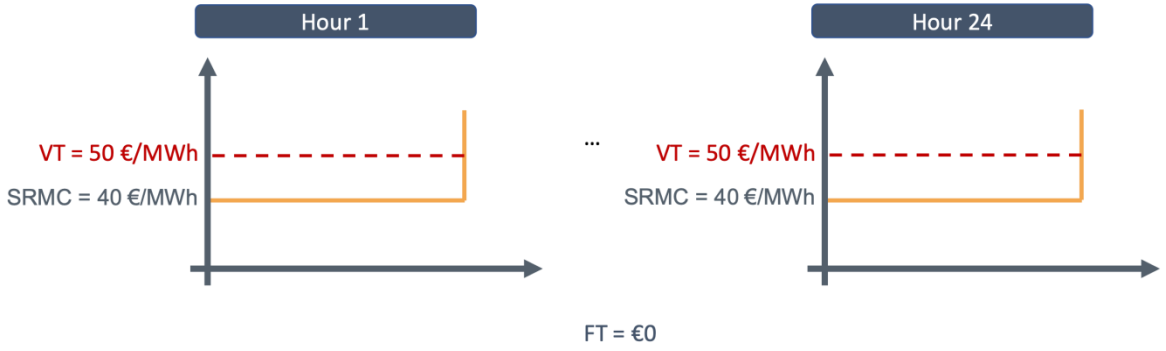
1. Keep Fixed Term adaptations as specified by the conversion rule n°1 ?
2. Increased Fixed Terms ?
3. Decrease Fixed Terms ?

Feedback received so far

There probably should be some increase in Fixed term to account for the starts that a unit can avoid through the complex orders. This would only apply when a unit is otherwise able to stay on overnight.

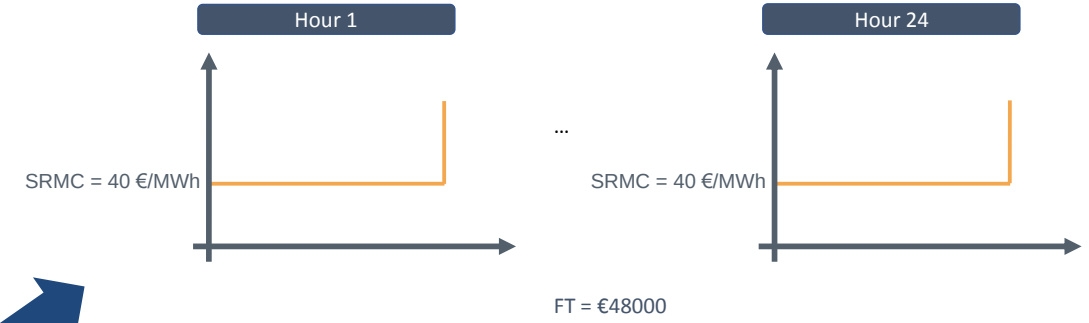
Q2: Should we consider modifying bid curves to reflect Variable Terms which are dropped during the translation, or the conversion rule n°1 modifying Fixed Terms is more suited?

Classic Complex Order (has Variable Term VT)



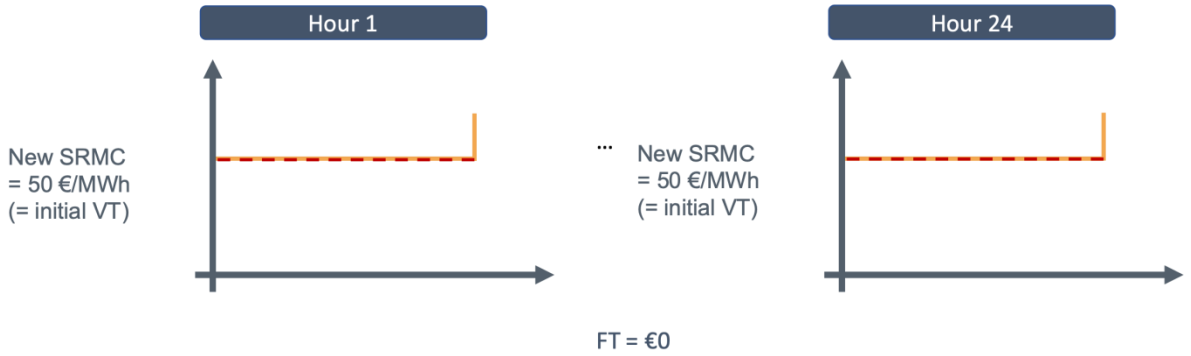
Scalable Complex Order (without VT)

Conversion rule n°1 adapts Fixed Terms



Scalable Complex Order (without VT)

An alternative could be to modify bid curves



Other alternatives leveraging Min. Acceptance Volumes are discussed next

Q2: Should we consider modifying bid curves to reflect Variable Terms which are dropped during the translation, or the conversion rule n°1 modifying Fixed Terms is more suited?

Observations

- Lifting first steps to the Variable Term level will lead to
  - less SCOs accepted, as it makes more difficult to meet the new Minimum Income Conditions.
  - Some “first steps” potentially rejected at some hours (less interesting price), if no Min. Acceptance Volume is used
  - N.B. OMIE tested a rule where a Min Acceptance. Vol is forcing acceptation of all steps initially below the Variable Term → led to more paradoxical rejections.
- Leaving bid curves unchanged must be balanced with Fixed Term adaptations as in the conversion rule n°1, potentially complemented with Min. Acceptance Volumes

Questions

Should we:

1. Modify bid curves e.g. lifting first steps to the Variable Term level ?
2. Leave bid curves unchanged and rather appropriately playing with Fixed Terms and Min. Acceptance Volumes ? (recommended)

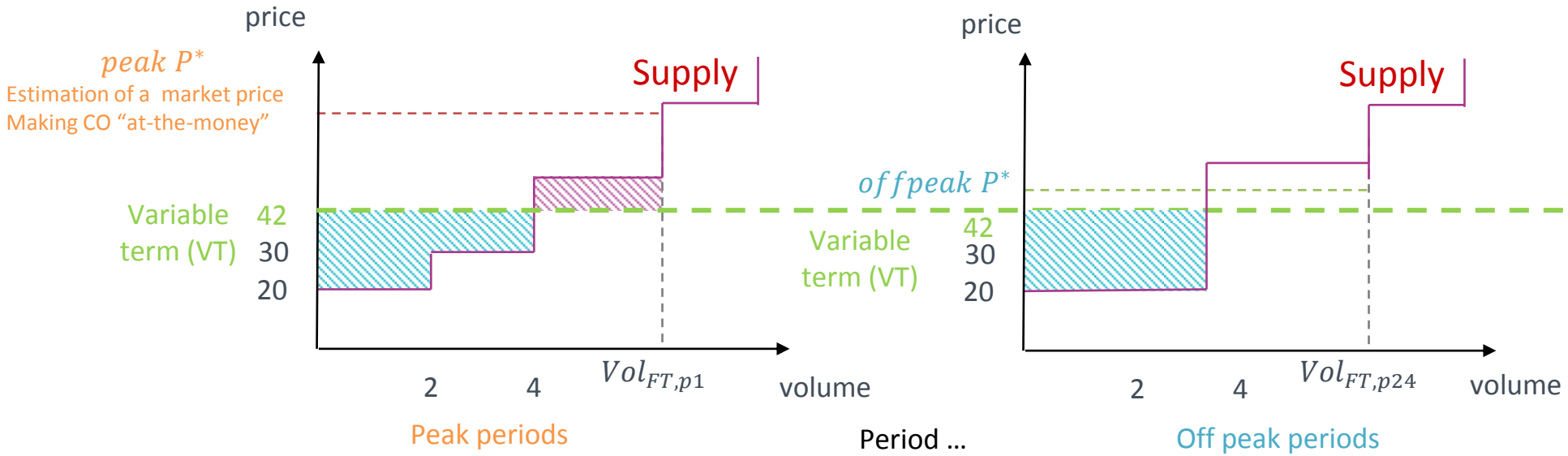
Feedback received so far

Lowest bid curve for the SCO conversion should match the VMIC with subsequent steps to ensure that it is monotonically increasing

Q3. Considering, for a same complex order, different prices "$P*$" at different periods?

Instead of the simplifying assumption of a single "average daily price" $P*$ making a complex order break even

- In the conversion rule n°1, one assumes a single "daily average price P^*" uniform over the whole day to later determine adaptations needed in the Fixed Term of the SCO
- However, market price deviating from P^* (making CO and its equivalent SCO at-the-money) have different impact on costs for CO and for SCO, e.g. SCO would become in-the-money while the CO would become out-of-the-money
- Assuming different P^* in different periods of the day (e.g. peak vs off peak) would be more realistic and avoids more of the discrepancies in terms of CO vs SCO acceptances



Q3. Considering, for a same complex order, different prices "$P*$" at different periods?

Instead of the simplifying assumption of a single "average daily price" $P*$ making a complex order break even

Observations

- Perfect forecasts of market prices would enable to perfectly adapt Fixed Terms so as to avoid any discrepancies between CO and SCO acceptations (assuming there is on differences in "paradoxical rejections")
- More realistic assumptions on prices P* should enable to further reduce the remaining minor discrepancies in terms of CO vs SCO acceptations

Questions

Assuming one refines assumptions for P*, should we:

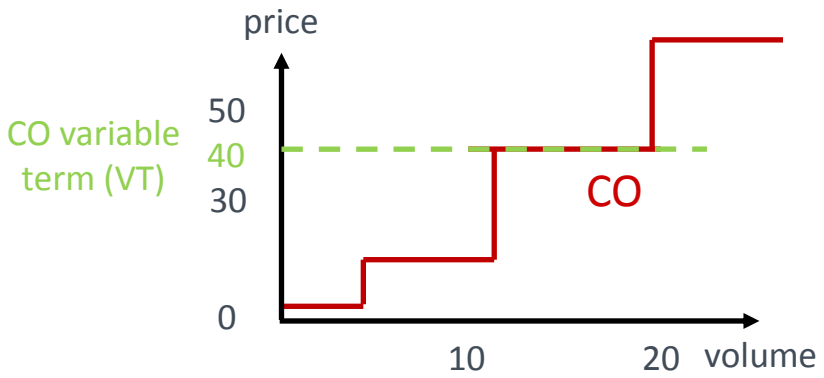
1. Peak and off peak prices ? (previous slide)
2. Estimate and then fix ratios "Price Hour H / Price hour 1" then estimate a price "P* hour 1"?
3. Use "price forecasts" for the ref. year 2020 = historical prices with CO + forecast errors ?
4. Other options ?

Feedback received so far

Yes [different prices P* should be considered]

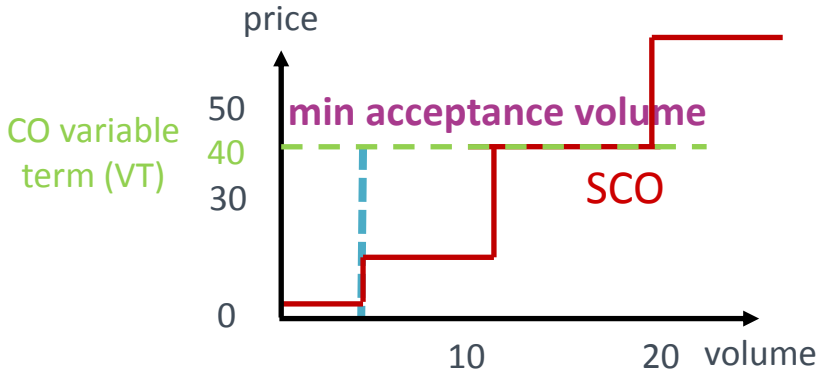
Q4. Should we leverage the Min. Acceptance Volume ?

Classic Complex Order (without MAV + low steps)



Scalable Complex Order (with MAV)

OMIE's suggestion to combine MAV and existing conversion rule N°1 (promising option)



- A minimum acceptance volume is defined to ensure the acceptation of the 1st step (= technical minimum volume)
- Instead of changing the price of that step, Fixed Terms are adapted in the spirit of the conversion rule n°1 (developed by N-SIDE) used in the first round of simulations
- Adaptations of the Fixed Terms can take into account or overlook the so-called "purple areas" as illustrated in backup slides

Q4. Should we leverage the Min. Acceptance Volume ?

Observations

- Some COs use very low curve steps to ensure that at least a given volume is cleared if they are accepted.
- They could be translated into SCO by using the new Min. Accept. Volume feature

Questions

Should we leverage the Minimum Acceptance Volume (MAV), and if yes, how:

1. OMIE proposition in the previous slide: MAV at the end of the first step of each curve + conversion tool 1 Fixed Term adaptations ?
2. MAV after all steps below the Variable Term (apparently led to more paradoxically rejected SCO in tests performed by OMIE) ?
3. Other options ?

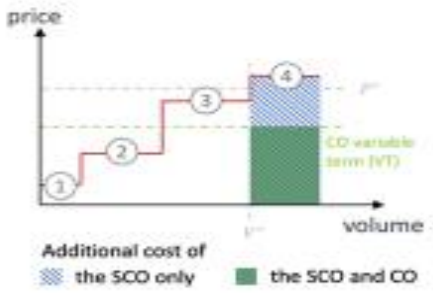
Feedback received so far

Certainly for some participants this is the case and more examples of the Minimum Acceptance Volume would be useful.

Session 2: Conversion Analysis Appendix

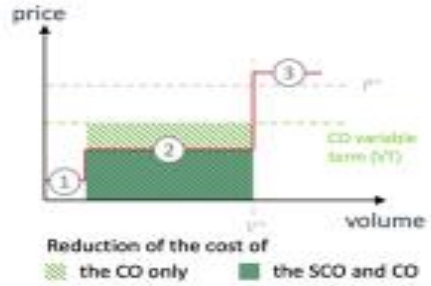
Rationale for different P^* over the day

Market prices deviating from P^* in a single period have different cost effects for CO and SCO



As the price of the accepted step 4 is above the Variable Term of the CO, the "variable cost" of the SCO, given by the bid curve, is higher than the "variable cost" of the corresponding CO in that period.

As the price of the rejected step is above the Variable Term of the CO, the cost of the SCO for this period is lower than the cost of the corresponding CO (cf. the cost reductions compared to when the market price is P^*).



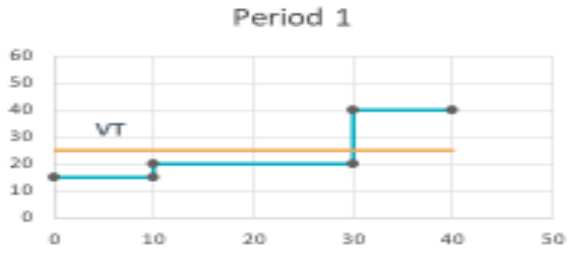
As the price of the rejected step is below the variable term of the CO, the cost of the SCO for this period is higher than the cost of the corresponding CO (cf. the cost reductions compared to when the market price is P^*).

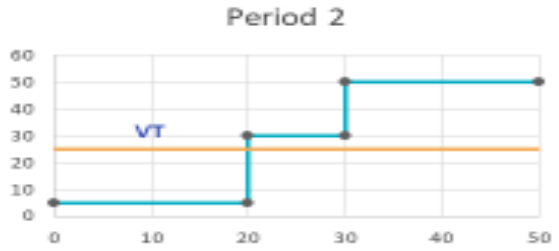
Session 2: Conversion Analysis Appendix

Classic Complex Orders: Minimum Income Orders (MIC)

Stepwise hourly orders with two terms:

- FT: **Fixed term** in Euros ➔ Fixed costs of the whole amount of energy traded in the order
- VT: **Variable term** in Euros per MWh (accepted) ➔ Variable costs of the whole amount of energy traded in the order *(average variable cost information besides variable cost information in bid curves)*





Revenue received by an activated CO must be greater or equal to Fixed Term + Variable term x Energy matched

$$\sum_t PRICE_t \times QUANTITY_t \geq FT + VT \times \sum_t QUANTITY_t$$

Flexible formulation for bidders

- ☑ Different rates of acceptance per hour
- ☑ Load gradients (ramp constraints)
- ☑ Fixed term FT ~~*in welfare objective*~~
- ☑ Marginal cost curves
- ☑ Variable cost **VT** *besides cost curves*

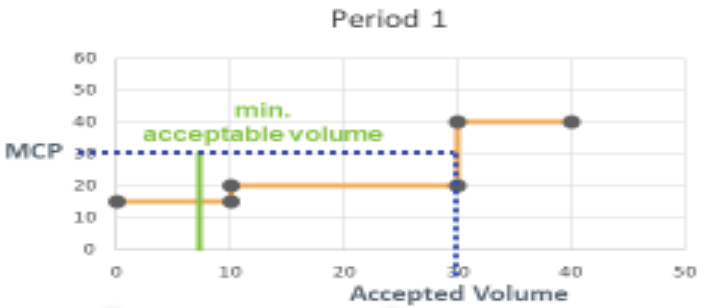
- ~~✗ *Minimum acceptances per hour*~~
- ☑ Can be out-of-the-money for some hours as long as in-the-money for the whole day (considering **VT** & FT)
- ☑ Demand side version with a Maximum Payment Condition

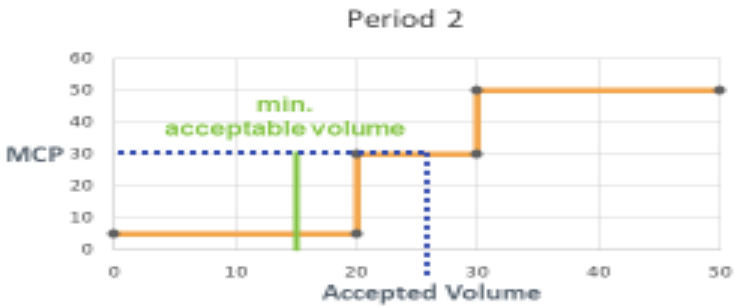
Session 2: Conversion Analysis Appendix

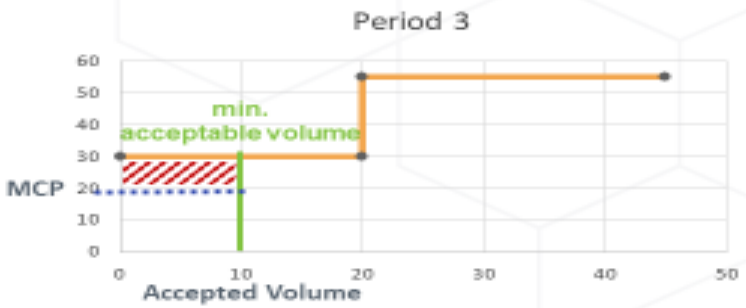
Scalable Complex Order (SCO)

New product

- FT: **Fixed term** in Euros and ***costs in bid curves*** **(or utility on the demand side)**
- ***Minimum acceptance volume*** can be specified (param. *can vary per hour!* → more flexible than curtaible blocks)
- **Ramp conditions** (called load gradients) can be specified, see next slides







Revenue received by an activated SCO must be greater or equal to Fixed Term + Marginal Costs*

*Marginal Costs = areas below bid curves for accepted volumes

$$\sum_t PRICE_t * QUANTITY_t \geq FT + Marginal\ Costs\ (bid\ curves)$$

Flexible formulation for bidders

- ☑ Different levels of acceptance per hour
- ☑ Load gradients (ramp constraints)
- ☑ Fixed term FT ***in welfare objective***
- ☑ Marginal cost curves
- ✗ ~~Variable cost VT (besides cost curves)~~

- ☑ **Minimum acceptances per hour**
- ☑ Can be out-of-the-money at some hours (due to min. acceptance) as long as in-the-money for the whole day (considering **bid curves** & FT)
- ☑ Demand side version with a Maximum Payment Condition

Algorithmically easier and more scalable than Classic Complex Orders!

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    - Explanation of possible adaptions for Conversion 2
    - Questionnaire Clarifications & Responses
- **Next Steps (5min)**
- **Q&A (15min)**

Next Steps for Members

- Review and consider:
  - *Content on Conversion 1 from the August meeting*
  - *Content on Conversion 1 from today's meeting*
  - *Published Conversion 1 data set*

- ***Very Important:*** Provide final responses on Conversion 2 questionnaire **by 24th September**, at the latest.

- Review and submit queries on Conversion 2 results (results to be published by 15th October)

- Next Meeting (#3) – 15th October 2021 – to look at Conversion 2 initial results

All correspondence through info@semopx.com please

Q&A

Questions?