Market Response 2018

Task Force ISR presentation

Brussels, July 9th 2018
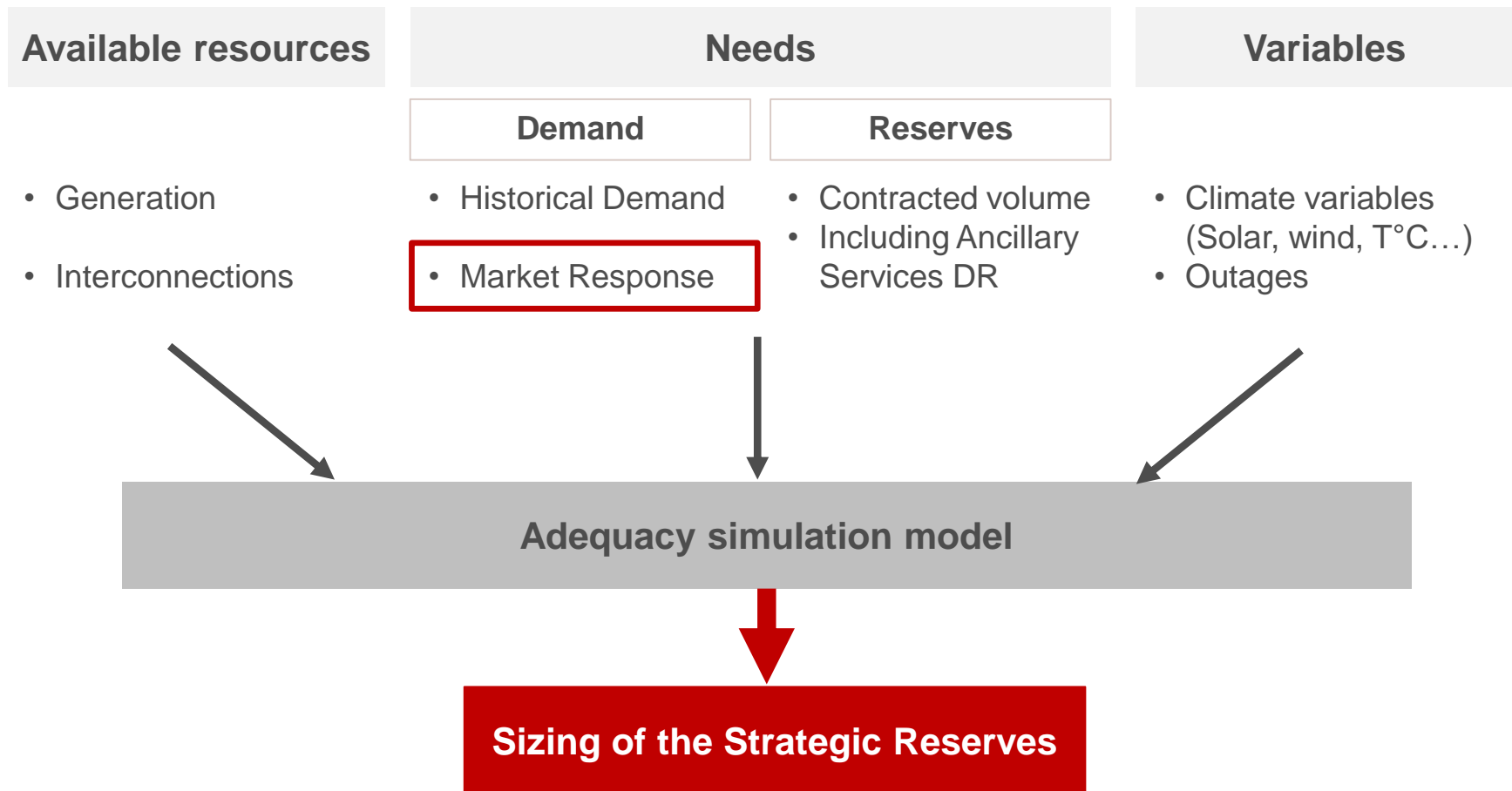
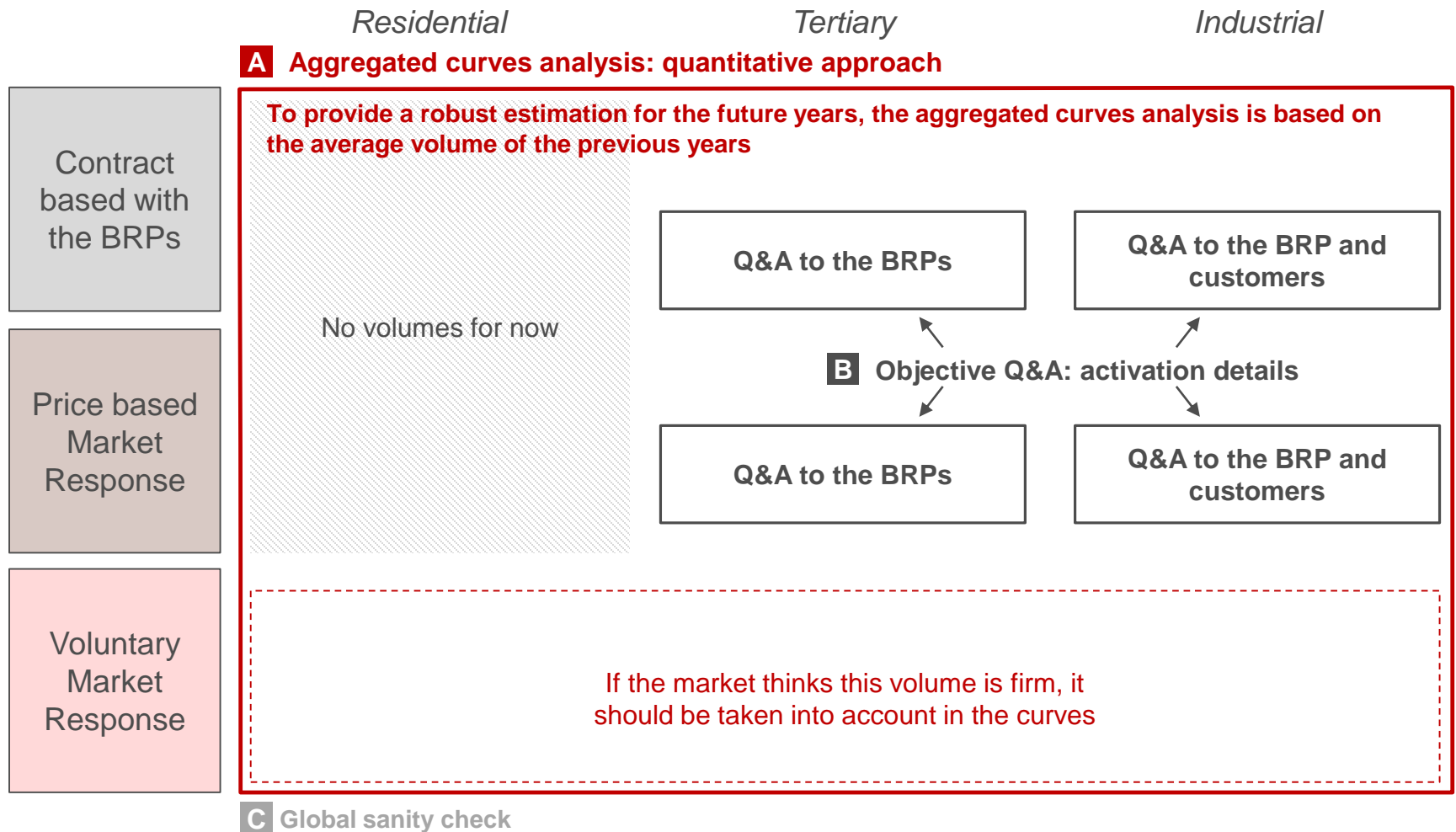# Table of content

Market Response volume determination is essential to size the volumes of Strategic Reserves

Market Response corresponds to the response of electricity consumers in periods of tension and high prices in the electricity grid

Available resources	Needs		Variables
	Demand	**Reserves**	
• Generation	• Historical Demand	• Contracted volume	• Climate variables (Solar, wind, T°C…)
• Interconnections	• Market Response	• Including Ancillary Services DR	• Outages

Adequacy simulation model

Sizing of the Strategic Reserves

In 2017, a robust methodology was established based on the aggregated curves, and complemented with a qualitative Q&A to define the details of the activation

	Residential	*Tertiary*	*Industrial*

A **Aggregated curves analysis: quantitative approach**

To provide a robust estimation for the future years, the aggregated curves analysis is based on the average volume of the previous years

Contract based with the BRPs

No volumes for now

Q&A to the BRPs	Q&A to the BRP and customers

B **Objective Q&A: activation details**

Price based Market Response

Q&A to the BRPs	Q&A to the BRP and customers

Voluntary Market Response

If the market thinks this volume is firm, it
should be taken into account in the curves

C **Global sanity check**

This methodology was established thanks to a robust and transparent process involving all market parties

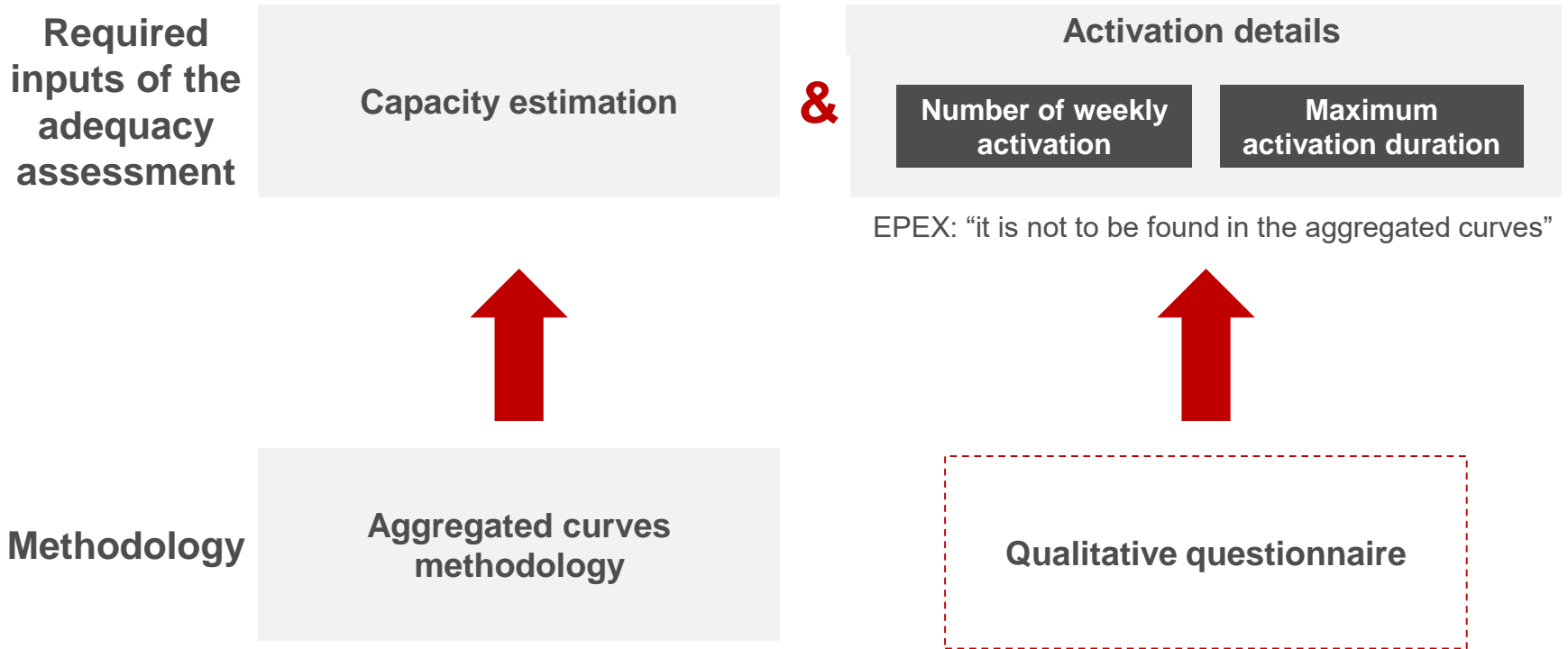|	Key milestone	Stakeholders involvement
January 2017	Brainstorm on the possible methodologies	Workshop 1
	Benchmark & review of the methodologies	Workshop 2
Phase 1: Design	Selection of the methodology	Workshop 3
	Final methodology proposal	Workshop 4, TF presentation, public consultation
April 2017	Questionnaire design	Consultation on the questionnaire
Phase 2: Implementation	First analysis of the aggregated curves	Workshop 5 (Intermediary results)
July 2017	Final results: additional analyses requested and results of the questionnaire	Workshop 6, TF presentation

This achieved process enabled to design the most adequate methodology and then to implement it, all of this in full transparency with the subgroup members and all stakeholders of Market Response

Source: E-CUBE Strategy Consultants

As agreed upon with the stakeholders last year, only the quantitative part of the methodology is to be updated every year

1. Thanks to the 2017 process, a **robust methodology** was agreed upon with consensus from stakeholders. This overall methodology is **not to be updated**.

2. The **quantitative part of the methodology**, based on the aggregated curves analysis, is calculated based on historical data. This year, an **update** of this part of the methodology with the new MR volumes was performed**, to take into account new market trends**.

3. **As agreed upon with stakeholders**, the other parts of the methodology, such as the **qualitative part**, **do not need to be updated** as their results are expected to be less subject to changes from one year to the other
   – The **qualitative questionnaire** is less sensitive to yearly evolutions, while the survey is resource intensive for Elia and market parties. An update of the qualitative aspects could be foreseen after a few years or whenever the need would become apparent
   – The **cross check** was mainly based on the answers from the questionnaire and should also follow the same update schedule

The update of the methodology in 2018 targets the aggregated curve methodology and not the qualitative questionnaire

Required inputs of the adequacy assessment

Capacity estimation	**&**	Activation details

Activation details:
- Number of weekly activation
- Maximum activation duration

EPEX: "it is not to be found in the aggregated curves"

Methodology

Aggregated curves methodology		Qualitative questionnaire

In the aggregated curves of EPEX DAM Belgium, Market Response volumes appear as a demand decrease or as an offer increase

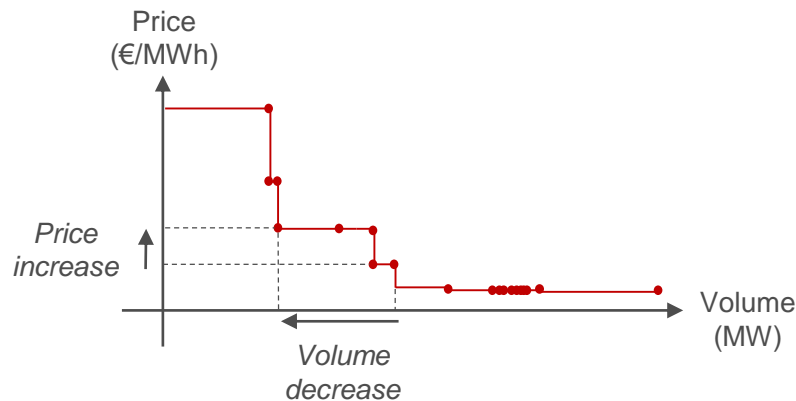**Market Response volumes valued in the DA market**

Demand decrease

- This part can be analyzed directly in the aggregated demand curve, by studying the decrease of volume when price increases

Demand curve for a given hour

Price (€/MWh)

Price increase

Volume decrease

Volume (MW)

Offer increase

- Instead of a demand decrease, suppliers can value Market Response as new offer in the market: this part would appear in the supply curve

- Due to the possible presence of generation bids in the offer curve, two price thresholds have been set up:
  - Volumes above 150€/MWh, which correspond to the base case of Market Response volumes
  - Volumes above 500€/MWh, which enable to exclude all possible generation bids

Disclaimer:

The details on the activation cannot be estimated with the aggregated curve methodology, it is not possible to extract it from the curves. This has been validated with EPEX
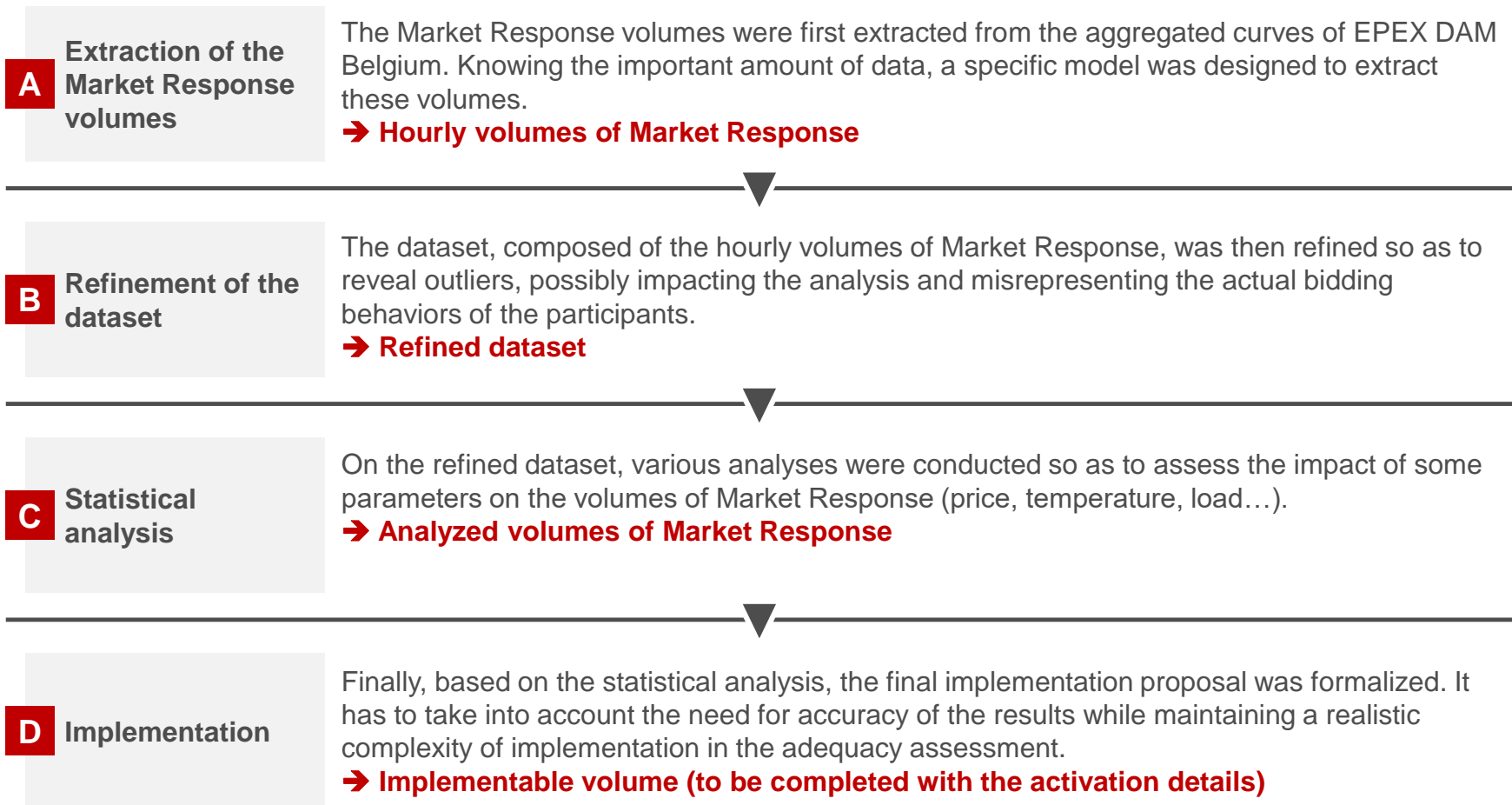
Source: E-CUBE Strategy Consultants

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1 Goal, scope and planning of the project – *Reminder*

2 **Results of the update of the volumes for MR**

3 Conclusion

The update of the Market Response Study is based on the exact same methodology as the one performed in 2017

The process followed four key steps to come to a pertinent volume of Market Response:

A — **Extraction of the Market Response volumes**

The Market Response volumes were first extracted from the aggregated curves of EPEX DAM Belgium. Knowing the important amount of data, a specific model was designed to extract these volumes.
➔ **Hourly volumes of Market Response**

▼

B — **Refinement of the dataset**

The dataset, composed of the hourly volumes of Market Response, was then refined so as to reveal outliers, possibly impacting the analysis and misrepresenting the actual bidding behaviors of the participants.
➔ **Refined dataset**

▼

C — **Statistical analysis**

On the refined dataset, various analyses were conducted so as to assess the impact of some parameters on the volumes of Market Response (price, temperature, load…).
➔ **Analyzed volumes of Market Response**

▼

D — **Implementation**

Finally, based on the statistical analysis, the final implementation proposal was formalized. It has to take into account the need for accuracy of the results while maintaining a realistic complexity of implementation in the adequacy assessment.
➔ **Implementable volume (to be completed with the activation details)**

Agenda

2 | **Results of the update of the volumes for MR**

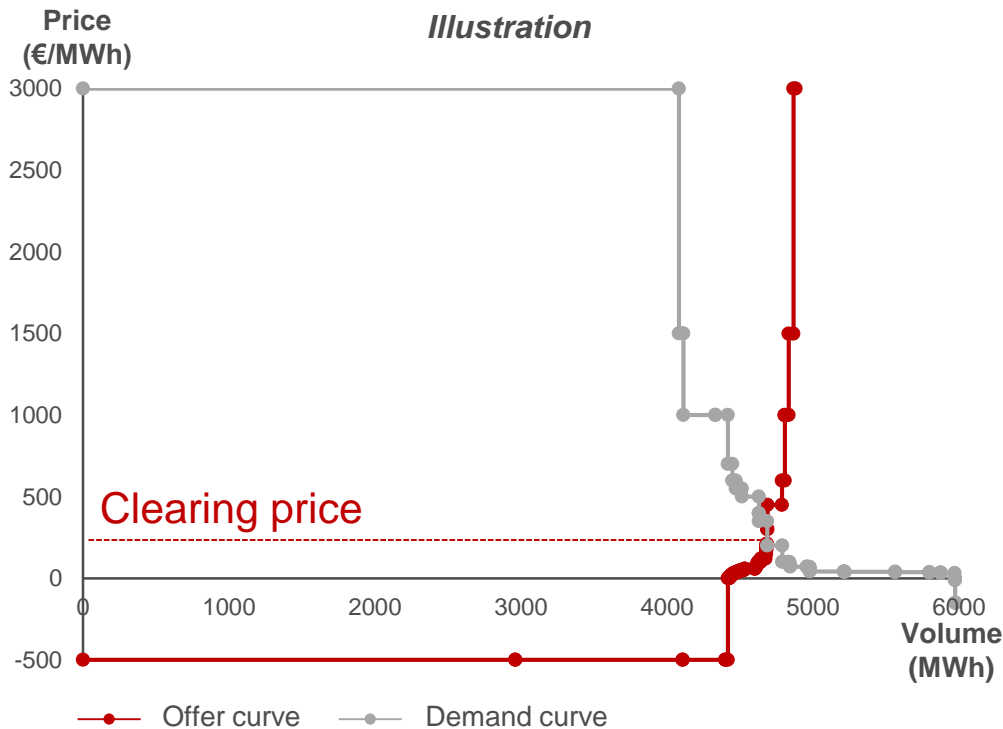**A** | **Extraction of the Market Response volumes**

B | Refinement of the dataset

C | Statistical analysis

D | Implementation

EPEX DAM Belgium provides hourly aggregated curves of the purchase and sale orders
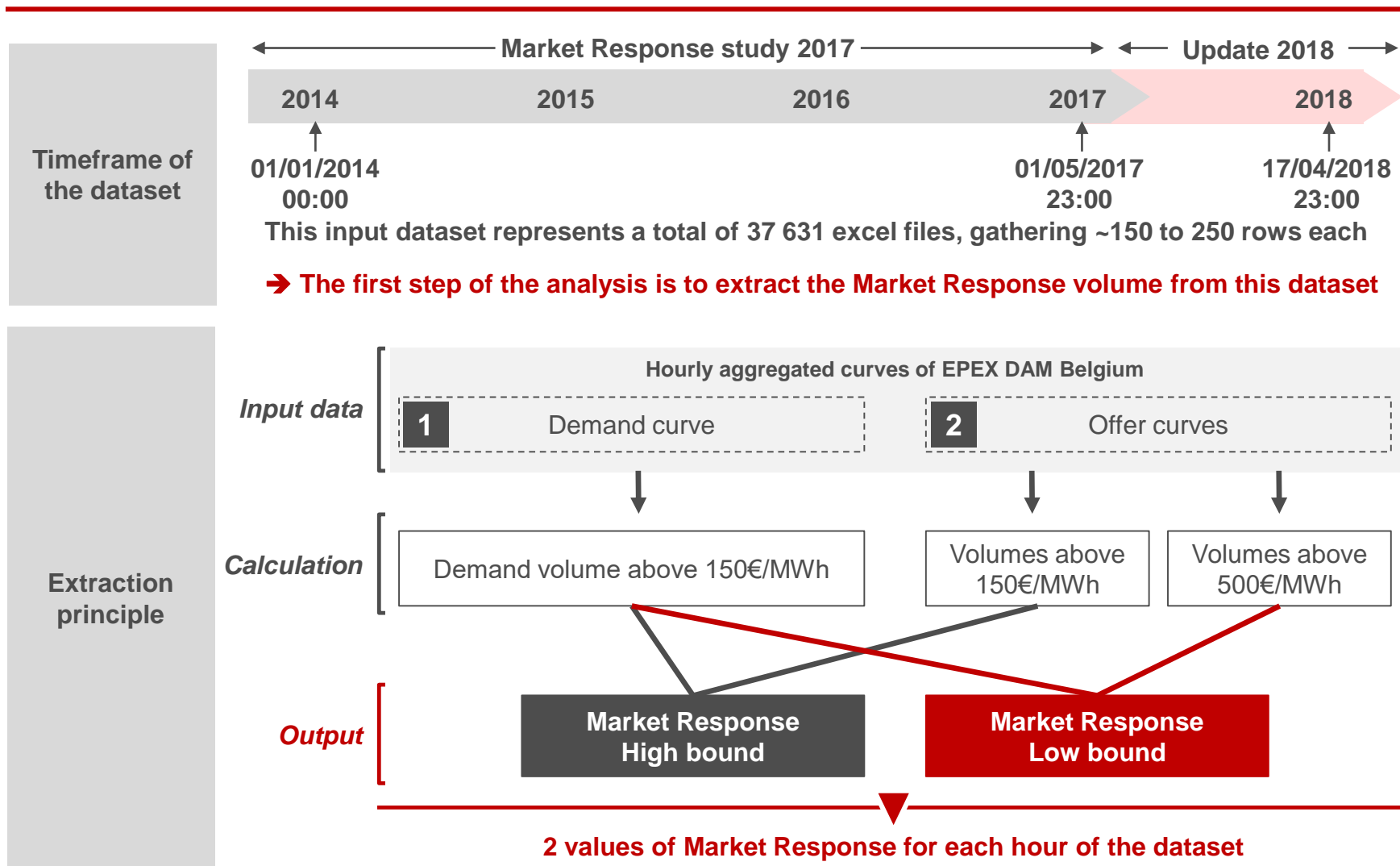
EPEX DAM Belgium aggregated curve

- **The curves determine the clearing price**: at the intersection of the demand and supply curve.

- From the curves, we can deduce the load variation corresponding to a given price increase

- This load variation **corresponds to the perimeter of Market Response** with contract based and price based MR but also voluntary DR. Indeed, if there are some volumes in the voluntary DR category, BRPs will anticipate voluntary DR events: it will impact their bidding behaviors and hence be reflected in the aggregated curves

Disclaimer:
The details on the activation cannot be estimated with the aggregated curve methodology, it is not possible to extract it from the curves

Source: E-CUBE Strategy Consultants

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The Market Response volumes were extracted from the aggregated curves. The 2018 update added ~9000 hours to the dataset

Timeframe of the dataset

← Market Response study 2017 → ← Update 2018 →

| 2014 | 2015 | 2016 | 2017 | 2018 |

01/01/2014
00:00

01/05/2017
23:00

17/04/2018
23:00

This input dataset represents a total of 37 631 excel files, gathering ~150 to 250 rows each

➔ **The first step of the analysis is to extract the Market Response volume from this dataset**

Extraction principle

Input data

Hourly aggregated curves of EPEX DAM Belgium

1 Demand curve

2 Offer curves

Calculation

Demand volume above 150€/MWh

Volumes above 150€/MWh

Volumes above 500€/MWh

Output

Market Response High bound

Market Response Low bound

2 values of Market Response for each hour of the dataset

Agenda

2 | **Results of the update of the volumes for MR**

A | Extraction of the Market Response volumes
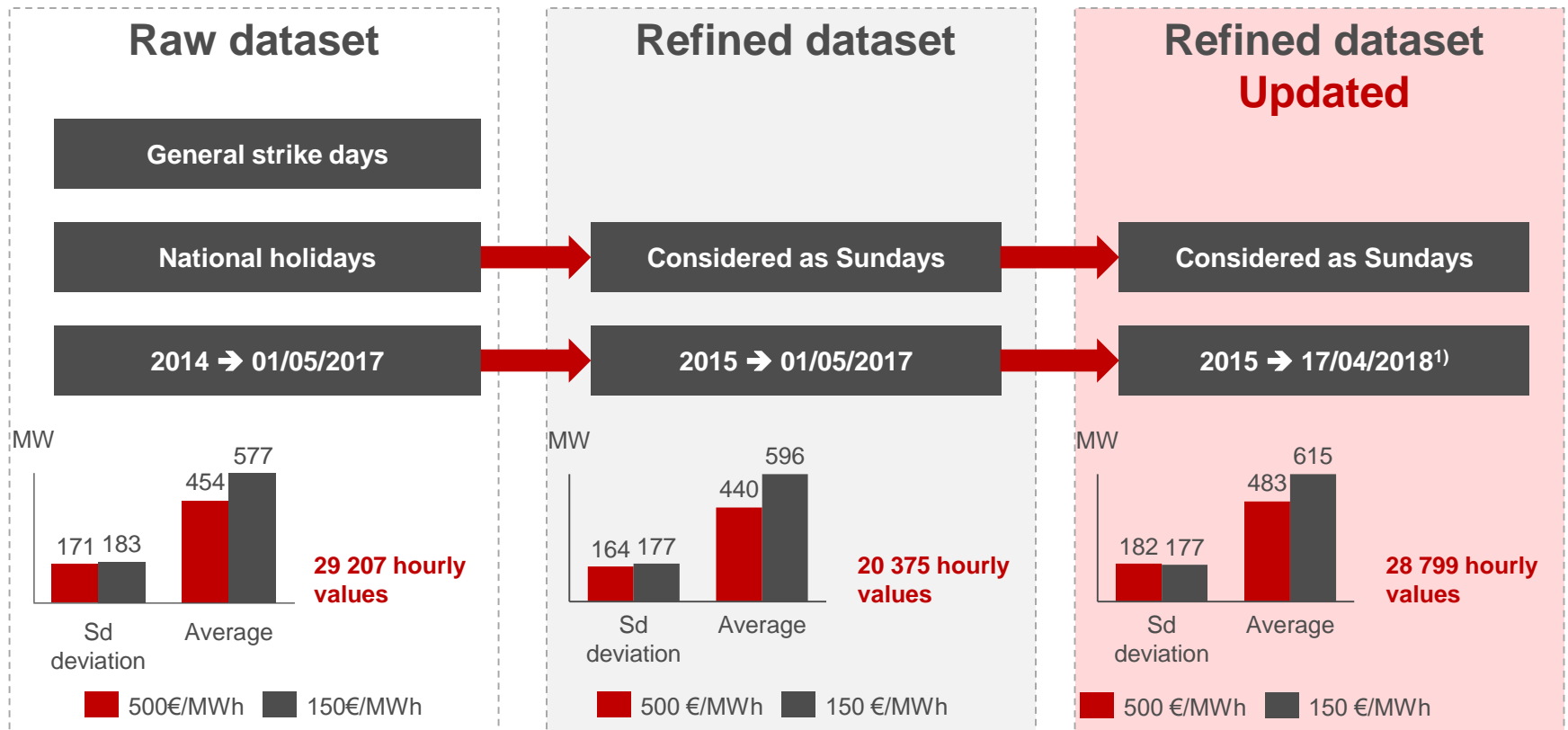
B | **Refinement of the dataset**

C | Statistical analysis

D | Implementation

The dataset was firstly refined, excluding the year 2014 and the days of national strikes as last year

Market Response study 2017

Raw dataset

| General strike days |

| National holidays | ➜ | Considered as Sundays |

| 2014 ➜ 01/05/2017 | ➜ | 2015 ➜ 01/05/2017 |

MW

```
       577
454
171 183
```

Sd deviation | Average

29 207 hourly values

■ 500€/MWh ■ 150€/MWh

Refined dataset

MW

```
       596
440
164 177
```

Sd deviation | Average

20 375 hourly values

■ 500 €/MWh ■ 150 €/MWh

Update 2018

Refined dataset **Updated**

| Considered as Sundays |

| 2015 ➜ 17/04/2018[1] |

MW

```
       615
483
182 177
```

Sd deviation | Average

28 799 hourly values

■ 500 €/MWh ■ 150 €/MWh

The refined dataset was used in the following analysis

1) The fact that the dataset now goes until 17/4/2018 is not a problem as the output of the study focuses on the winter period (from 1st of November to 31st of March)
Source: E-CUBE Strategy Consultants

Agenda

2 | **Results of the update of the volumes for MR**

A | Extraction of the Market Response volumes

B | Refinement of the dataset

C | **Statistical analysis**

D | Implementation

Numerous analyses were conducted to explain the volume patterns, yet without any strong correlations with Market Response volumes

The 2017 study started with a **statistical analysis** of the dataset so as to find specific patterns and focus the analysis on the most pertinent days for the Elia Adequacy simulation model.

The firs step consisted in computing correlations : the **analyses** conducted for the 2017 study were **conducted on the updated dataset** with both simple correlations and multivariate regressions on various parameters :

– Day-ahead prices

– Temperatures

– Normal temperatures

– Daily maximum price

– Load

– Gas prices

The same conclusion can be drawn from these correlations : no satisfying results were found from these analyses.

As in the 2017 study, the impact of the three main parameters (load, price and temperature) was assessed differently: by restricting the dataset to periods of important load, price, temperature

Various correlations were computed (temperature, price, normal temperature) without any satisfying results: R^2 remains very low (1/2)

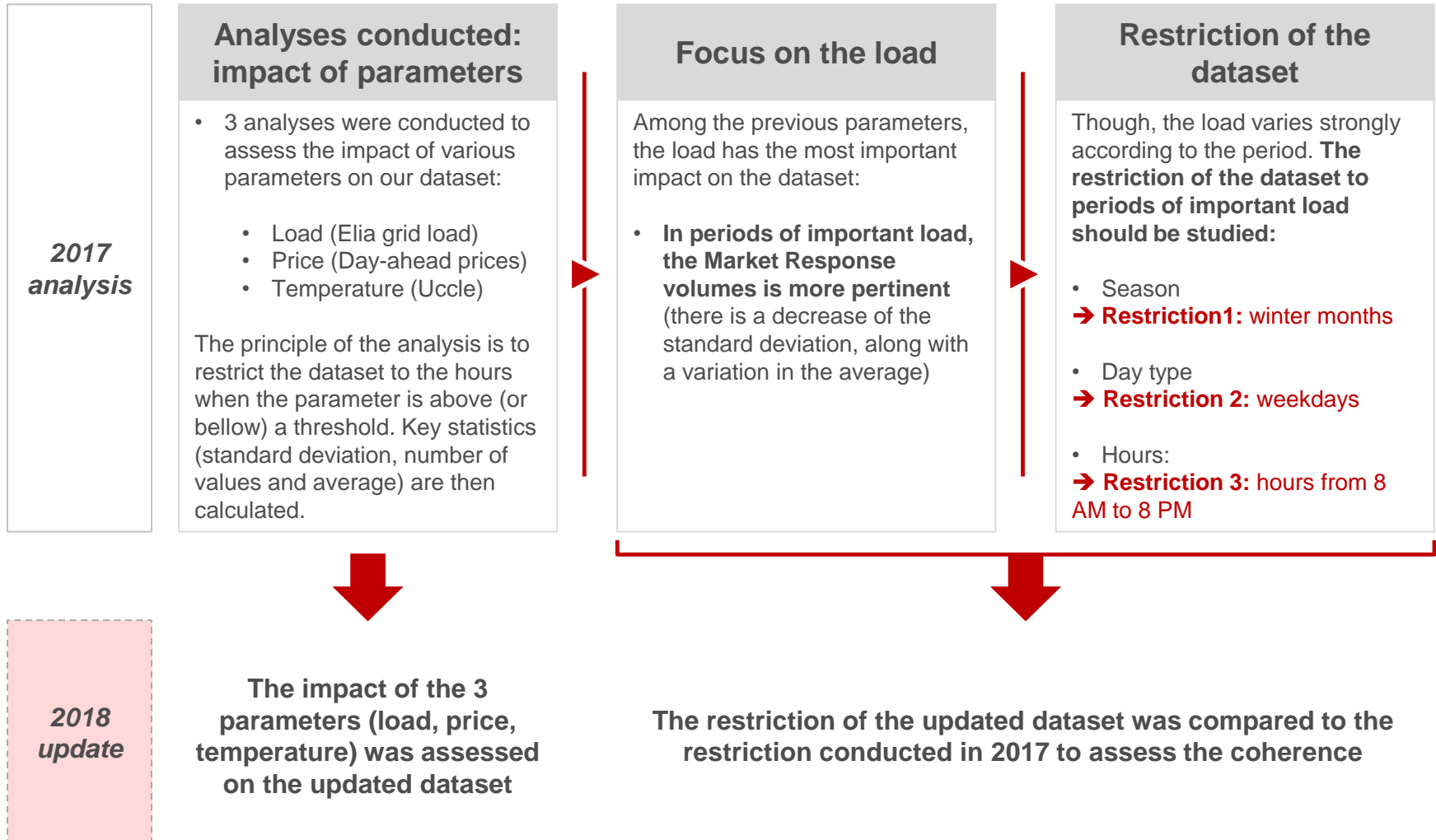|	Principle	Results – 2017 study	Results – 2018 study
Day-Ahead prices	A regression was conducted between the DA prices and the volumes of Market Response	• **150€/MWh: R^2 = 0.03** • **500€/MWh : R^2 = 0.03** • **P-value < 0.05**	• **150€/MWh: R^2 = 0.06** • **500€/MWh : R^2 = 0.06** • **P-value < 0.05**
Temperature	The regression is here conducted between the hourly temperature (Uccle reference) and the volumes of Market Response	• **150€/MWh : R^2 = 0.0003** • **500€/MWh : R^2 = 0.002** • **P-value < 0.05**	• **150€/MWh : R^2 = 0.0005** • **500€/MWh : R^2 = 0.004** • **P-value < 0.05**
Normal temperature	The regression was computed between the daily volumes and the delta between the averaged daily temperature and the monthly normal	• **150€/MWh : R^2 = 0.009** • **500€/MWh : R^2 = 0.008** • **P-value < 0.05**	• **150€/MWh : R^2 = 0.02** • **500€/MWh : R^2 = 0.02** • **P-value < 0.05**
Daily maximum price	The regression was computed between the maximum price of the day and the	• **150€/MWh : R^2 = 0.004** • **500€/MWh : R^2 = 0.001** • **P-value < 0.05**	• **150€/MWh : R^2 = 0.02** • **500€/MWh : R^2 = 0.01** • **P-value < 0.05**

When computing regressions, R^2, the coefficient of determination, enables to assess the quality of the prediction of a linear regression. When variables are correlated, the R^2 is close to 1. If this coefficient is equal to 0, there is no correlation between both variables
The P-value represents the probability to obtain the observed results if the 0 hypothesis is true. A P-value less than 0.05 indicates that the null hypothesis can be rejected.

Source: E-CUBE Strategy Consultants

Various correlations were computed (temperature, price, normal temperature) without any satisfying results: R^2 remains very low (2/2)
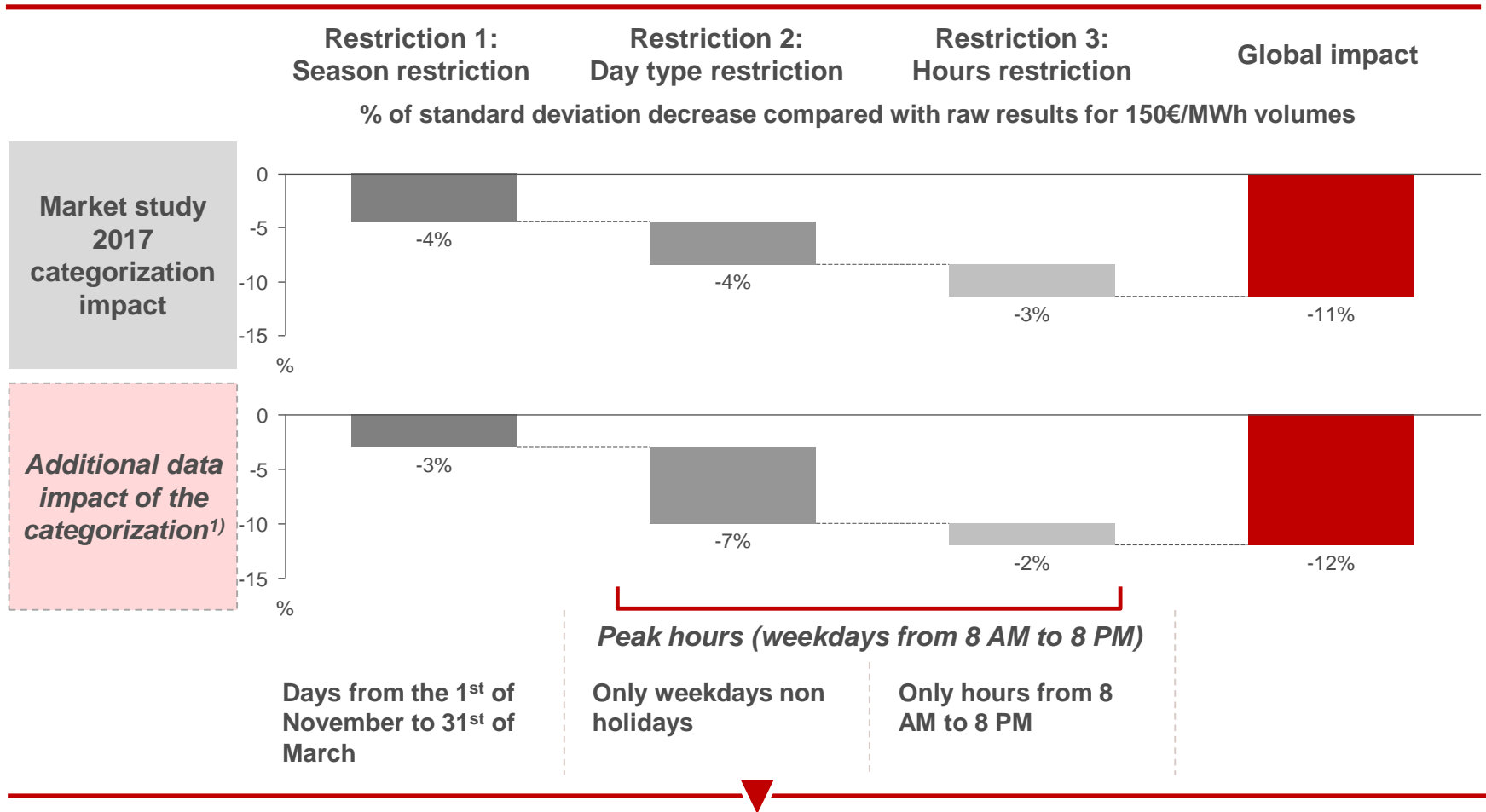
	Principle	Results – 2017 study	Results – 2018 study
Load	The regression was computed between the daily volumes and the load of Elia	• **150€/MWh : R^2 = 0.09** • **500€/MWh : R^2 = 0.06** • **P-value < 0.05**	• **150€/MWh : R^2 = 0.13** • **500€/MWh : R^2 = 0.10** • **P-value < 0.05**
Gas price	A regression was conducted between the daily gas prices and the volumes of Market response both for the offer side volumes and the overall volume	**Offer 150€/MWh: R^2 = 0.06** **Offer 500€/MWh : R^2 = 0.004** **P-values < 0.05**	**Offer 150€/MWh: R^2 = 0.05** **Offer 500€/MWh : R^2 = 0.1** **P-values < 0.05**
Day-before adaptations	A regression was conducted between the market response volumes and the prices the day before	**Total volume 150€/MWh : R^2 = 0.001** **Total volume 500€/MWh : R^2 = 7,9.10^{-6}** **P-values > 0.05**	**Total volume 150€/MWh : R^2 = 0.01** **Total volume 500€/MWh : R^2 = 0.02** **P-values < 0.05**

When computing regressions, R^2, the coefficient of determination, enables to assess the quality of the prediction of a linear regression. When variables are correlated, the R^2 is close to 1. If this coefficient is equal to 0, there is no correlation between both variables
The P-value represents the probability to obtain the observed results if the 0 hypothesis is true. A P-value less than 0.05 indicates that the null hypothesis can be rejected.

Source: E-CUBE Strategy Consultants

The impact of the same parameters as last year was assessed on the new dataset to verify the coherence with the analyses conducted last year

2017 analysis

Analyses conducted: impact of parameters

- 3 analyses were conducted to assess the impact of various parameters on our dataset:

  - Load (Elia grid load)
  - Price (Day-ahead prices)
  - Temperature (Uccle)

The principle of the analysis is to restrict the dataset to the hours when the parameter is above (or bellow) a threshold. Key statistics (standard deviation, number of values and average) are then calculated.

Focus on the load

Among the previous parameters, the load has the most important impact on the dataset:

- **In periods of important load, the Market Response volumes is more pertinent** (there is a decrease of the standard deviation, along with a variation in the average)

Restriction of the dataset

Though, the load varies strongly according to the period. **The restriction of the dataset to periods of important load should be studied:**

- Season
➔ **Restriction1:** winter months

- Day type
➔ **Restriction 2:** weekdays

- Hours:
➔ **Restriction 3:** hours from 8 AM to 8 PM

2018 update

The impact of the 3 parameters (load, price, temperature) was assessed on the updated dataset

The restriction of the updated dataset was compared to the restriction conducted in 2017 to assess the coherence

Source: E-CUBE Strategy Consultants

The impact of the restriction of the dataset to the most relevant hours of the adequacy assessment is in the same order of magnitude for the additional data as it was for the 2017 study

	Restriction 1: Season restriction	Restriction 2: Day type restriction	Restriction 3: Hours restriction	Global impact

% of standard deviation decrease compared with raw results for 150€/MWh volumes

Market study 2017 categorization impact

- Restriction 1: -4%
- Restriction 2: -4%
- Restriction 3: -3%
- Global impact: -11%

(axis: 0, -5, -10, -15 %)

Additional data impact of the categorization[1]

- Restriction 1: -3%
- Restriction 2: -7%
- Restriction 3: -2%
- Global impact: -12%

(axis: 0, -5, -10, -15 %)

Peak hours (weekdays from 8 AM to 8 PM)

Days from the 1st of November to 31st of March

Only weekdays non holidays

Only hours from 8 AM to 8 PM

The focus on the most relevant hours in the context of the adequacy assessment (peak hours of the winter period) is still pertinent in the updated dataset

1) The additional data goes from May 2nd, 2017 to April 17th, 2018

Source: E-CUBE Strategy Consultants

The categorization of the additional data is coherent with the 2017 dataset : we observe an increase of the market response volume to reach 691MW for the 150€/MWh volume threshold
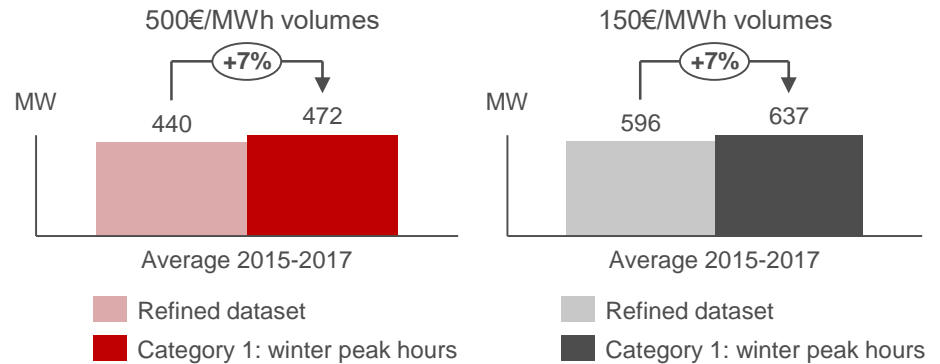
Summary of the two categories

| Category description | Comparison with the refined results |

Market study 2017 categorization impact

During the 2017 study, the most important hours for Elia: the peak hours (8 AM to 8 PM during weekdays) in the winter are treated as a separate category.
The creation of this separate category leads to a non negligible decrease of the standard deviation (see previous slide).
➔ **The volumes for the most important hours of Elia leads to an average increase of +7%**
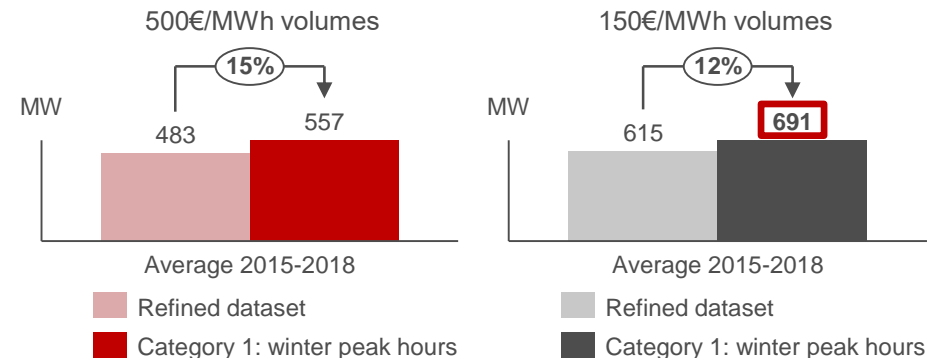
500€/MWh volumes

MW
+7%
440   472

Average 2015-2017

■ Refined dataset
■ Category 1: winter peak hours

150€/MWh volumes

MW
+7%
596   637

Average 2015-2017

■ Refined dataset
■ Category 1: winter peak hours

2015 ➔ 2018 dataset

In the 2015-2018 dataset, the restriction to the most important hours for Elia also leads to an average volume increase and a decrease in standard deviation (see previous slide).

➔ **The categorization leads to a market response volume of 691MW for the high bound and 557MW for the low bound**

500€/MWh volumes

MW
15%
483   557

Average 2015-2018

■ Refined dataset
■ Category 1: winter peak hours

150€/MWh volumes

MW
12%
615   **691**

Average 2015-2018

■ Refined dataset
■ Category 1: winter peak hours

As for the 2017 study, the **MR volume for 150€/MWh threshold** was considered as the output by default after verifying that, for years 2015 to 2018, the gas price still have a limited impact on the price thresholds (see analysis in appendix). This parameter is still to be verified in the update of the analysis in the future.

Agenda

2 | **Results of the update of the volumes for MR**
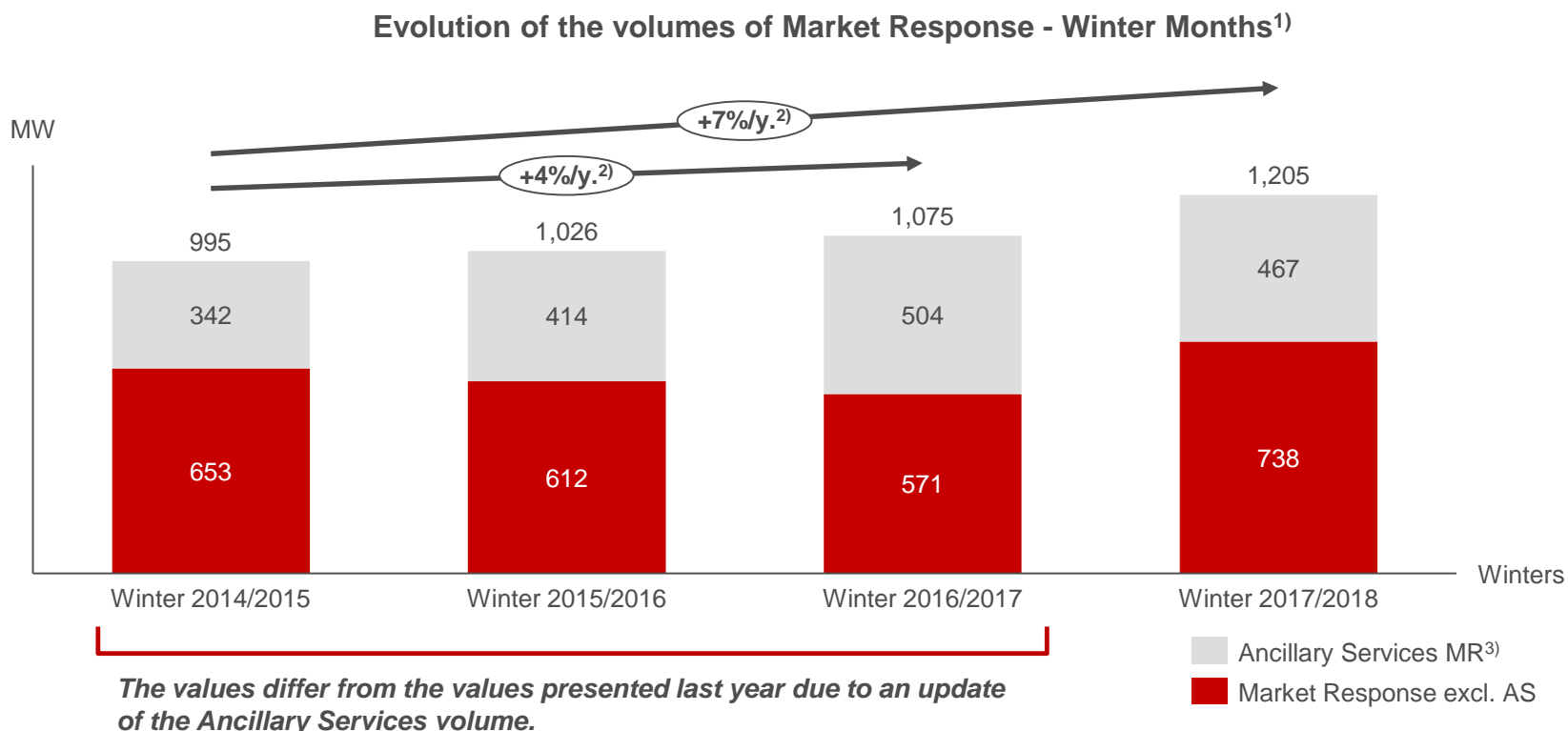
A | Extraction of the Market Response volumes

B | Refinement of the dataset

C | Statistical analysis

D | **Implementation**

Over the last winters, the global volume evolution follows a +4% growth per year from winter 2014/2015 to winter 2016/2017 and +7% per year on the last 4 years

Evolution of the volumes of Market Response - Winter Months[1]

The values differ from the values presented last year due to an update of the Ancillary Services volume.

The extrapolation of the Market Response volume can be based on a +4% global growth or a +7% global growth, based on the historical trend.

1) Winter months: from the 1st of November to the 31st of March
2) The rates are Compound Annual Growth Rate (CAGR) : the mean of the annual growth rate over the period
3) The volumes of DR in the Ancillary Services gathers: up to 2016, the volumes ICH, R3DP and R1Up and for the year 2016, the volumes are ICH, R3Flex and R1Up. The volumes of Ancillary Services are contracted for yearly periods, the volumes were indeed weighted according to the number of month (November, December vs January, February and March)

Source: E-CUBE Strategy Consultants, Elia

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Several extrapolations can be defended

4% global volume growth

- The +4% global market response volume is a more cautious approach based on the trends observed in the previous years, based on the update of last year approach
- The strong increase in 2017/2018 is in itself not excluded as it is integrated in the output of the study as starting point
- Though, this extrapolation does not take into account all years to calculate the future trend

5% global volume growth

- The +5% extrapolation corresponds to the extrapolation factor agreed with the stakeholders last year
- This factor reflects the excepted growth of Market Response volumes based on the qualitative approach of last year
- Yet, this doesn't correspond to a factual extrapolation from historical data
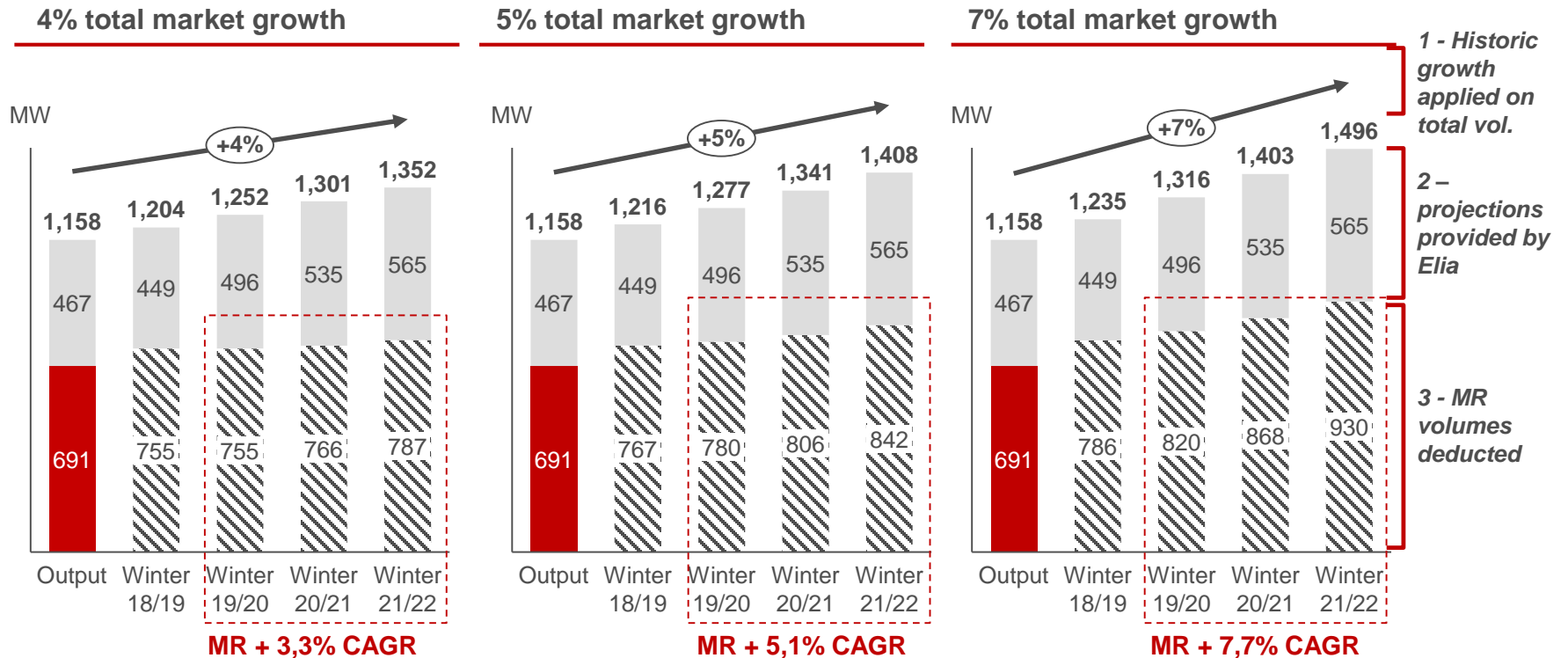
7% global volume growth

- This extrapolation scenario takes into account all the years available and all ancillary services evolutions
- This value is very impacted by the strong increase of year 2017/2018, which might not necessarily be repeated in the future
- The market response potential is not intrinsically unlimited, showing the limits of a historically based approach

Based on the historical growth trends, the total market growth extrapolation growth varies from +4%/y. to +7%/y.

Two historical extrapolation factors can be suggested : +4% based on 3 years (14/15 to 16/17) and +7% based on 4 years (14/15 to 17/18).
An additional scenario taking +5% total growth per year, corresponding to last year study extrapolation

4% total market growth

MW

+4%

	Output	Winter 18/19	Winter 19/20	Winter 20/21	Winter 21/22
Total	1,158	1,204	1,252	1,301	1,352
AS	467	449	496	535	565
MR	691	755	755	766	787

MR + 3,3% CAGR

5% total market growth

MW

+5%

	Output	Winter 18/19	Winter 19/20	Winter 20/21	Winter 21/22
Total	1,158	1,216	1,277	1,341	1,408
AS	467	449	496	535	565
MR	691	767	780	806	842

MR + 5,1% CAGR

7% total market growth

MW

+7%

	Output	Winter 18/19	Winter 19/20	Winter 20/21	Winter 21/22
Total	1,158	1,235	1,316	1,403	1,496
AS	467	449	496	535	565
MR	691	786	820	868	930

MR + 7,7% CAGR

1 - Historic growth applied on total vol.

2 – projections provided by Elia

3 - MR volumes deducted

-> Volumes to be implemented in the adequacy assessment

Ancillary services[2] ▮ Market Response excl. AS ▨ Extrapolated volumes

1) The yearly volumes were weighted according to the number of month (November, December vs January, February and March). Without definite volumes for 2018, the average between 2019 and 2017 was retained.
Source: E-CUBE Strategy Consultants, Elia

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1 | Goal, scope and planning of the project – *Reminder*

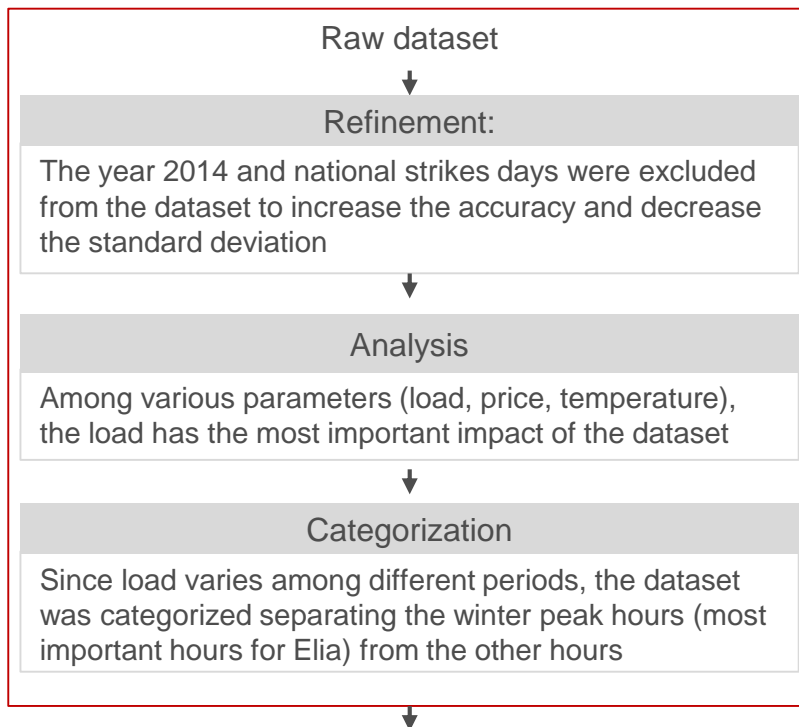**2** | Results of the update of the volumes for MR

3 | **Conclusion**

According to the methodology designed in 2017, the quantitative part (aggregated curve analysis) was updated with recent data

2017 Market response study

A **Aggregated curves analysis**

Raw dataset

↓

Refinement:

The year 2014 and national strikes days were excluded from the dataset to increase the accuracy and decrease the standard deviation

↓

Analysis

Among various parameters (load, price, temperature), the load has the most important impact of the dataset

↓

Categorization

Since load varies among different periods, the dataset was categorized separating the winter peak hours (most important hours for Elia) from the other hours

↓

- **Volumes of Market Response above 150€/MWh**

- **Extrapolation of these results**

2018 Study update

Verification of the coherence of the additional data
➔ **Coherent data addition**

The analyses conducted in the 2017 study have a similar impact on the updated dataset
➔ **Load is still the most important factor**

Since the analyses have the same impact, it is pertinent to use the same categorization as in the 2017 study
➔ **The restriction to the winter peak hours is still pertinent to use**

Updated Market Response volume above 150€/MWh

New extrapolation of the results

The update of the study leads to a 691MW Market Response volume and 3 extrapolation scenarios ranging from 4% to 7% total volume growth

Output of the 2018 study

3 extrapolation scenarios

691 MW
Market Response Volume

+4% total market growth

+5% total market growth

+7% total market growth

Source: E-CUBE Strategy Consultants