TYPICAL FLOW-BASED DAYS SELECTION

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Marion LI: marion.li@rte-france.com
Baptiste SEGUINOT: baptiste.seguinot@rte-france.com

https://antares.rte-france.com

Summary

The flow-based method is used to calculate cross-borders capacities since May 2015 in the CWE area (Belgium, Germany, France, Luxemburg and the Netherlands). Two phenomena have been observed: this method has been on overall increasing the exchanges (in capacity and volume) while the winter 2016-2017 has proven that the increase is not necessarily correlated to tensed situations during which the French adequacy of supply is threatened. Furthermore, the variability of flow-based domains from an hour to the following, and from a day to another makes them hard to represent and their impact hard to predict.

The selection of typical flow-based days presented in this note aims to identify a possible seasonality in flow-based shapes, while summarising their variability into a few representative situations. A second RTE's note: *Modelling of Flow-Based Domains in Antares for Adequacy Studies*, presents the modelling of these typical days in adequacy studies.

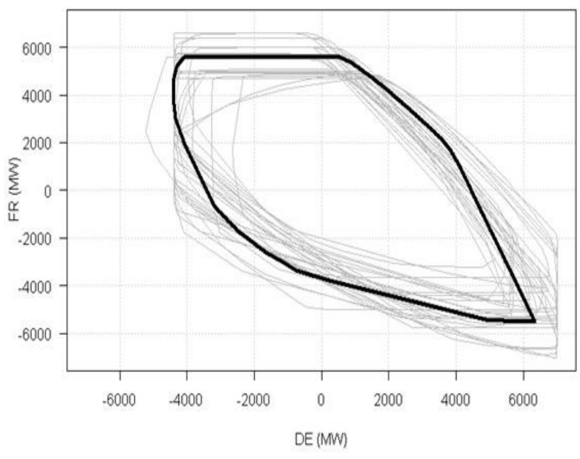
The typical days are extracted out of a recent history running over around a year. This database is divided into 6 categories, defined by the season and type of day: for each, one or several typical days are calculated (Table 1).

Table 1: Number of typical days per category

	Winter	Summer	Interseason
Working days	3	3	3
Weekends	1	1	1

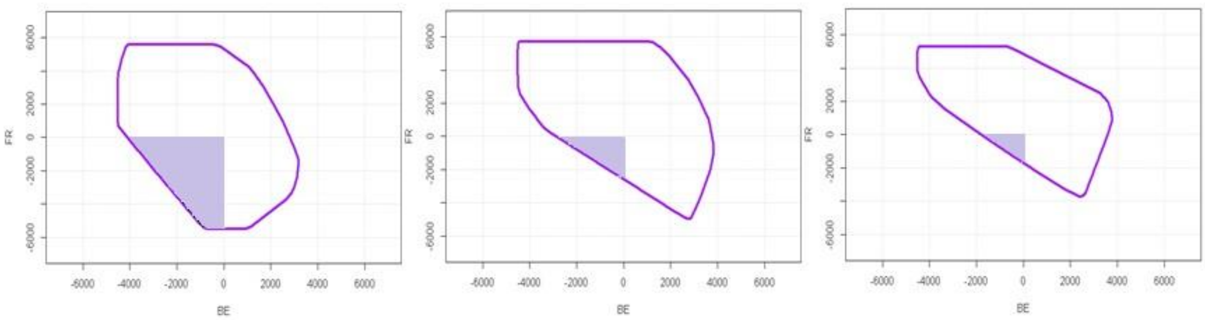
A clustering algorithm is then applied on each category: its principle is to create clusters by gathering the most similar days in each category before choosing among them the best representative: it will be a typical day. The metric used to determine the similarity of days is the sum of the 24 hourly distances, meaning the distances between the domains of the two days at the same hour. This distance is defined by projecting all the vertices of each domain on the second one and adding the differences.

Figure 1: Representation of the domains of a cluster at 18:00 (projected on axis De-Fr), the chosen typical day is represented in black



With this method, the typical days are chosen based on the geometrical shapes of the domains, which enables to model variable exchanges capacities. The area highlighted in Figure 2 represent the possible cumulated import by France and Belgium: with a maximum of 8 GW, 3 GW or 2 GW, most of winter 2016-2017 can be described by these three days.

Figure 2: Simultaneous cumulated import capacity France + Belgium at 18:00 in the three winter typical days



All the steps of this methodology have been implemented in an open source R package called flowBasedClustering.

This method has been used to calculate sets of typical days for adequacy studies: the French Adequacy Report 2017 and the Winter Outlook 2017-2018 (RTE), the Belgian Adequacy Report (Elia), the PentaLateral Energy Forum (PLEF), and for impact assessment studies led by Power System Economics Division of RTE and the other CWE's TSOs.

SOMMAIRE

1. Introduction

Flow-based is the name of a method calculating cross-border exchange capacities. Its role is to provide the market (D-1) with hourly sets of possible exchanges which do not endanger the safety of the electrical network, these sets being called flow-based domains. It has been applied in the CWE area (France, Belgium, Germany, Luxembourg and the Netherlands) since May 2015.

Figure 3: Evolution of the French exchanged energy (extracted from the French Adequacy Report 2016)

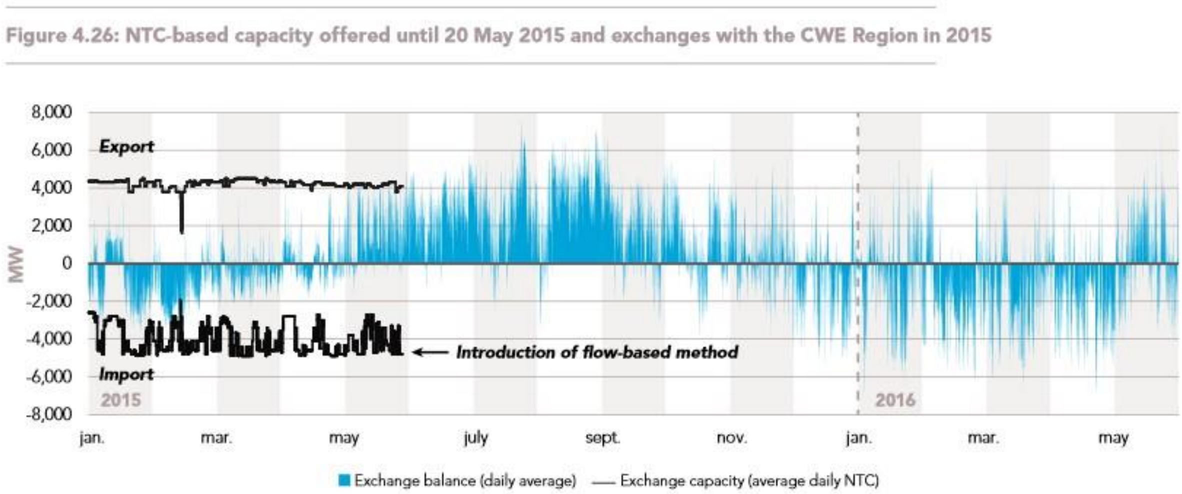


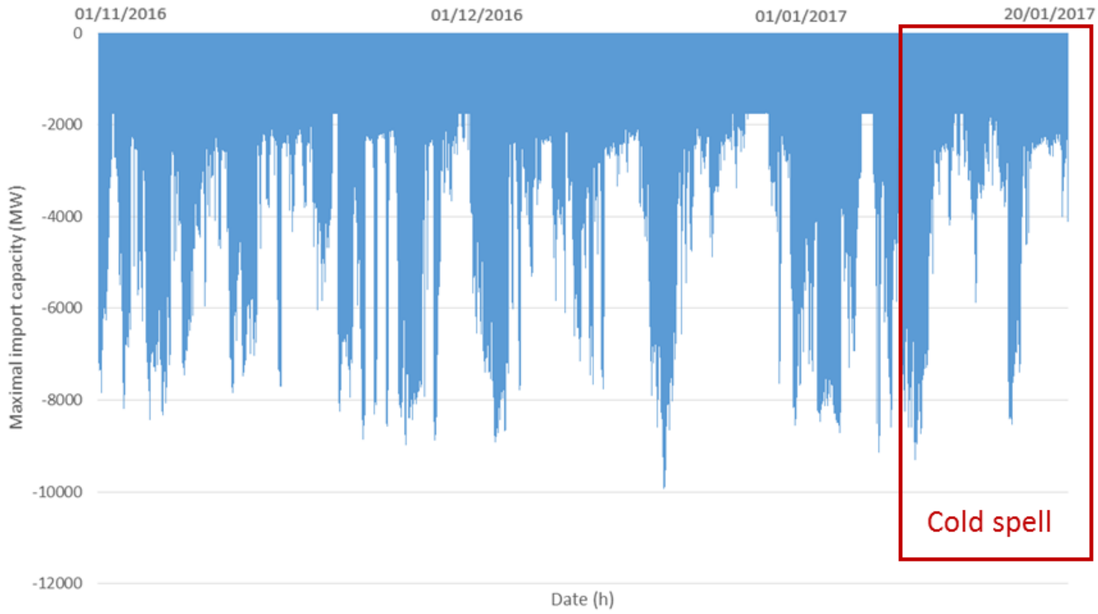
Figure 3 presents an extract of the French Adequacy Report of 2016[1], displaying the French export and import, before and after the introduction of the flow-based method. On the represented period, the exchanges in the area have increased both in volume and in amplitude. The former maximal capacities, the Net Transfer Capacities (NTC), are drawn in black on the diagram: their maximal value is regularly exceeded since the flow-based method is used, over 6 GW are reached in export (summer 2015) and import (spring 2016).

The flow-based method has therefore a significant impact on the French import capacity and consequently on the balance between demand and supply: modelling flow-based domains in adequacy studies has become necessary to ensure the real capacities of cross-border exchanges are taken into account.

However, the flow-based method has been in place for over two years, and **the initial assumption that these domains always bring increased exchanges capacities has been contradicted by the winter 2016-2017**. The maximum cumulated import of France and Belgium over a large part of the winter is presented for each time step (hour) in Figure 4. During this specific period, two tense events for the adequacy of the system happened: numerous nuclear plants in France were unavailable (over the entire represented period) and in January, a cold spell caused a high consumption. Both these events theoretically concur to an increased need for import in France.

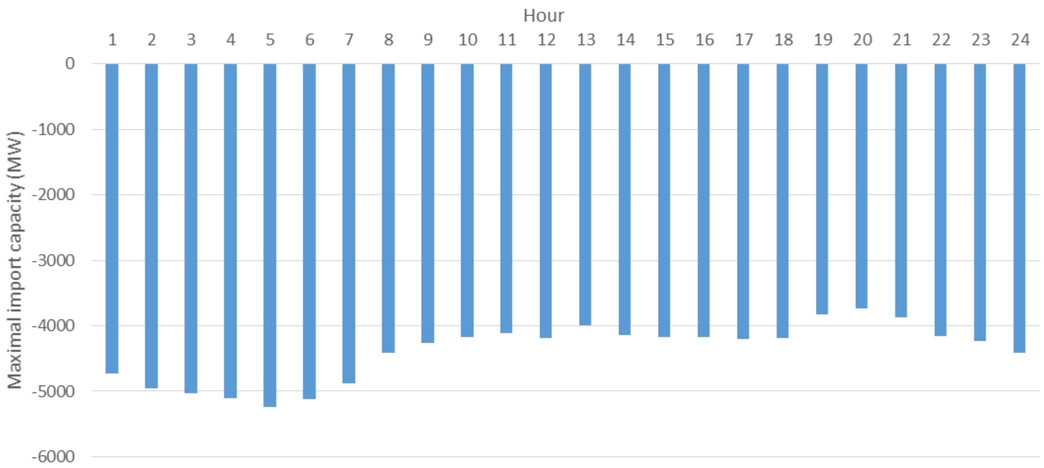
[1] http://www.rte-france.com/sites/default/files/bp2016_complet_va.pdf

Figure 4: Maximum hourly cumulated import capacity of France + Belgium from the 1st of November 2016 to the 20th of January 2017



The first observation deduced from this figure is the variability of the domain over this season, offering from 10 GW to only 2 GW importable by France and Belgium together. Moreover, the two above mentioned periods' domains reveal that an increased need of imports is not necessarily translated into increased capacities: the higher capacities are reached during the weekends (over 8 GW) while during the cold spell especially, most domains did not allow over 3 GW imported simultaneously by France and Belgium.
A similar observation can be made by zooming in on each day of the winter: within the day, the peak hours are the ones where a maximum import capacity would be needed. Figure 5 presents the mean maximal cumulated import capacity per hour over winter: the difference between peak hours such as hour 19 and 20 (18:00 and 19:00) and off peak hours such hour 5 (4:00) is over 1 GW.

Figure 5: Mean maximal cumulated import capacity of France + Belgium for each hour over the winter 2016-2017



What can be concluded is that the flow-based method enables to increase the maximal reachable exchange capacity, but not permanently and not necessarily when it is most necessary. The first question then raised is: **during strained situations for the demand/supply balance, what is the flow-based domain actually offering in terms of capacities, and what is its contribution to the security of supply?**

To this first interrogation is added a second one: **how can the shape of flow-based domains be predicted?** The real time domains are calculated at D-1, with high knowledge (or prevision) on the grid state, the production plan and the market estimated direction. There are however no indicator currently enabling one to predict an approximate shape of the domain at a further horizon.

The following study presents a beginning of an answer to these questions. It is divided into two documents dealing with the following topics:

- The selection of typical days, aiming to represent the variability of flow-based shapes over a season and the daily variations within.
- The addition of a flow-based simulation for adequacy studies (with the software Antares), containing:
    - The identification of possible correlation between flow-based shapes and production/consumption patterns
    - The creation of a flow-based model adapted to Antares simulations

The following document will present the typical days selection. It is a process pursuing several objectives:

- **Summarise the variability of the flow-based domains into a few representative days** which cover most of the observed situations.
- **Identify potential seasonality** in flow-based patterns (yearly, weekly and daily seasonality)
- The variability of the flow-based domains makes it difficult for the market players to get a **clear view of the cross-border capacities**, providing them with representative typical days is an answer to that issue
- **For adequacy studies** purposes: having typical days enables to project them on other situations and achieve probabilistic studies on multiple different scenarios (see RTE's note *Modelling of Flow-Based Domains in Antares for Adequacy Studies*).

This document will first present a brief reminder of flow-based domain before explaining further the selection process of typical days, the results of the first clustering and its prospects.

An R package, named flowBasedClustering, has been developed to facilitate the use of these methods. The matching R functions of each step of the methodology presented in this document will be written in boxes like this one.

2. Reminder: Flow-based domains

2.1 How is a flow-based domain built?

The NTC calculation, today used for all but CWE borders, consists in setting for each border an export and import upper limit, on which the two grid operators agree. Having a flow-based approach aims to take into account the interdependencies between the flows crossing the different borders and proposing a new methodology, shared by all the countries in the CWE area, to maximise the achievable net position, meaning the difference between its exports and its imports of each country.

A flow-based domain is calculated from an initial situation called base case, in which critical branches (elements in the grid that may limit the exchanges) are identified. Two kinds of coefficients are calculated from this case: GSK (Generation Shifts Keys) representing how additional exchanges would impact the production units and coefficients measuring how the resulting flows would be distributed among the critical branches. Finally, **a matrix of PTDF** (Power Transmission Distribution Factors) is established and **links to the variation of net position of each country (additional export or import) a corresponding flow variation in every critical branch**. For the exchange to be safely executed, the flow variation must stay below the available margin of the critical branches.

The domain is geometrically defined by, for each critical branch i:

$$\Delta F_i = ptdf_{FR,i} \times NP_{FR} + ptdf_{BE,i} \times NP_{BE} + ptdf_{DE,i} \times NP_{DE} + ptdf_{NL,i} \times NP_{NL}$$

$$\Delta F_i \leq marge(i)$$

With ΔF_i the flow variation on the branch i, $ptdf_{X,i}$ the PTDF coefficient on line i for the country X and NP_X the net position variation of X.

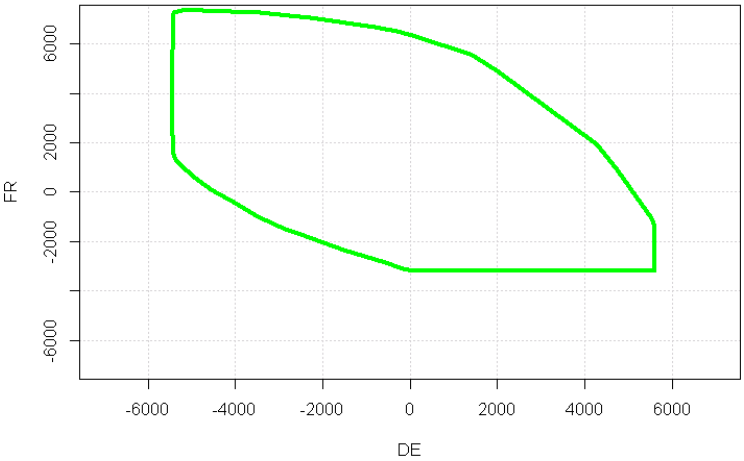
2.2 Display of flow-based domains

Flow-based domains are described according to the net position of the four countries in the CWE area. A flow-based domain should then be represented by a four dimensional polyhedron. But within the area, exports and imports must match: what is exported by a country must be imported by another. The balance of net positions is therefore null – and the position of a country can be expressed out of the positions of the three others.

A flow-based domain is finally represented as a three dimensional polygon, where the faces are the most restrictive critical branches limitation (an example is depicted in Figure 8, later presented in this document).

In this document, the examples presented will often be projections in two dimensions, which can be read as the possible net positions of two chosen countries. The perimeter is defined by the projection of the 3d-polyhedron on a 2d-plane: to simplify, each straight line delimiting the 2d domain will also be a projected critical branch.

Figure 6: Example of projection of a flow-based domain on France and Germany axis (15/07/2015 at hour 15)



In the case presented above, the grid is able to bear safely all the net positions inside the green area. A positive value corresponds to an exporting net position while a negative value means an importing net position. However, as the third dimension of the flow-based domain is not depicted in this figure, it has to be reminded that some positions can only be reached on condition that some other constraints are respected for example in case of Figure 6 the net position of Belgium.

3. Typical days selection

Several sets of typical days have already been published during the last two years, firstly addressed to the market operators. The selection has been initiated in the Power System Economics Division of RTE, thanks to a clustering algorithm.
To ensure the variety of situations from a day to another, the selection algorithm has been improved in association with the Power System Economics Division of RTE.

3.1 Features of typical days

The typical days have the following features:

- They are chosen as **representative of a predefined category (season and type of day)**. For each season (summer, winter and "interseason" – spring and autumn), 4 typical days are chosen, 3 being weekdays and the last being representative of weekends and bank holidays (12 typical days in all);
- They come from a **statistical learning on a rolling historical period of 1 year**: to be representative, the learning period must be as large as possible, but flow-based domains are linked to the grid infrastructures and to the calculation methodology, which are always evolving, that's why the learning period should also be kept reasonably recent;
- They are **actual days**;
- Flow-based domains are hourly, but the categorisation is daily: **a typical day is a succession of 24 domains**. This aims to respect a logical evolution of the domains within the day (as they are influenced by grid physical constraints, which are not visible);

- **Within their categories, they are clustered based on their geometrical shape**, not on the constraints responsible for it. But the aim will later be – if possible – to find a link between the shape and adequacy situations.

3.2 Selection algorithm

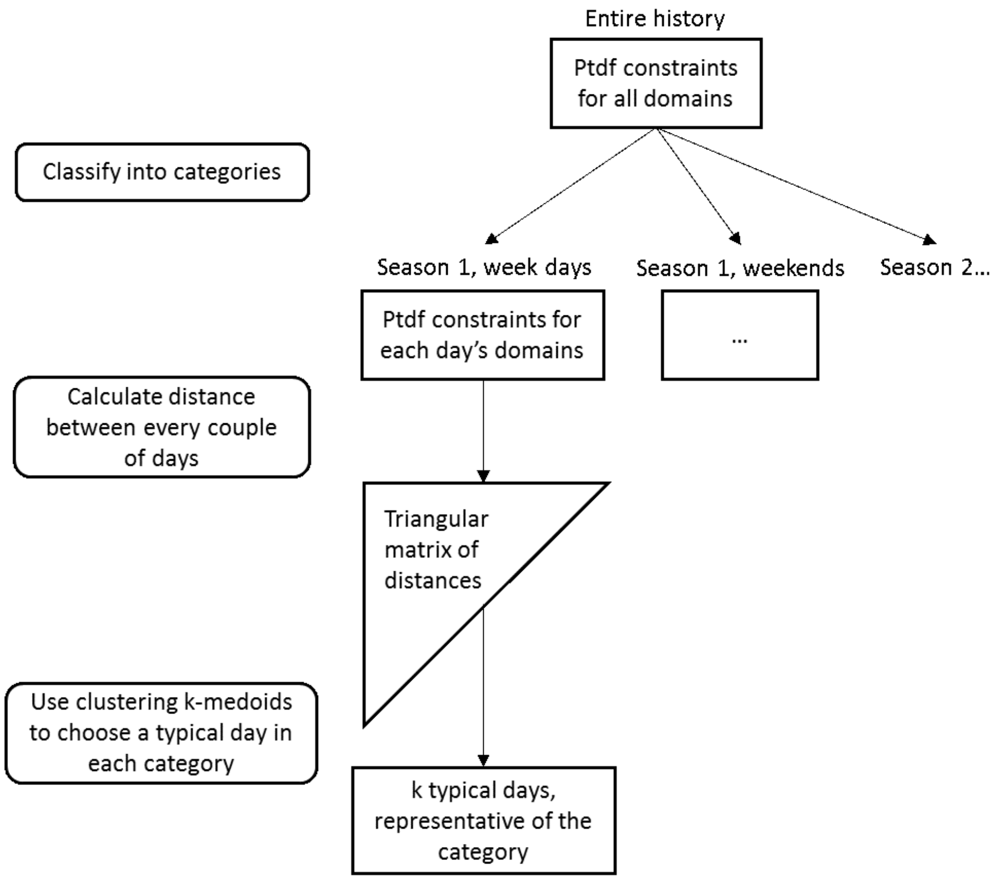
3.2.1 Presentation of the algorithm

The algorithm aims to select twelve typical days, while respecting their category of belonging. **To do so, the history is separated in six categories (defined by the season and the type of day) and the clustering algorithm is applied on each category**.

A new notion, the distance between two days, is introduced: this is a figure calculated to represent *how similar* the two days' domains are. The similarity between two sets of 24 flow-based domains can be represented by very different calculations, the chosen one is detailed in 3.2.3.

For each category, the distances between each couple of days are then calculated; the results are presented as a triangular matrix. An **algorithm of k-medoids** is then used to gather in clusters the items with a minimal distance between them and choose a representative among them. For the categories of summer-weekday, winter-weekday and interseason-weekday, three clusters are created, but for the weekends' categories, only one typical day is chosen, the algorithm will only choose the best representative in the historical data.

Figure 7: Diagram of the general clustering algorithm



3.2.2 Categories

In this clustering method, the year is parted into 6 categories, based on their belonging to a delimited season (winter, summer or interseason) and their type of day, i.e. weekday or weekend.
The reason for this partition is that flow-based domains shape is defined by its critical branches (which grid infrastructures are limiting) and their margin: they hence strongly depend on the topology of the grid and the localisation of production (itself linked, among other economic factors, to the level of consumption and non-dispatchable renewable production). Depending on the season, the maintenance of overhead lines and cables or production units are differently planned, taking into account the needs generated by the level of consumption and climatic-linked renewable production. Even within the season perimeter, consumption profiles (especially) vary between weekdays and weekends, although a certain unity exists among each type of days (range and time of peak hours).
These differences are expected to be reflected on the shape of flow-based domains; creating different categories and applying a separate clustering on each one may enable more precision.

Table 2: Example of calendar set

Season	Winter	Summer	Interseason
Dates	01/01 – 15/03 01/11 – 31/12	16/05 – 30/09	16/03 – 15/05 01/10 – 31/10
Duration (months)	4.5	4.5	3

Interseason is the shortest season, it gathers a part of spring and autumn. The clustering on its categories will be less representative, but this season can be considered as less critical for adequacy studies, an intermediate time between winter (period of high loss of load risks) and summer (consignment plans period).

Some bank holidays – defined as not working in at least three out of four countries in CWE, are added to the weekend categories. The list of these days is displayed in Annex.

<u>R package:</u> `flowBasedClustering`

This part of the algorithm is managed by the function `getCalendar`, which classifies a vector of dates into the 6 categories. The categories are defined by the interseason limits, the algorithm recognises, based on these dates, the summer and the winter periods. The beginning dates of each season can be altered, and irrelevant days can be manually excluded, for example when an unusual number of outages has occurred.

3.2.3 Distance

Within each category, the algorithm then aims to separate into clusters similar days and choose for each cluster a representative, named typical day. To do so, **the notion of distance between two days must be defined, to calculate how *similar* two days' flow-based domains are.** This will be referred as daily distance.

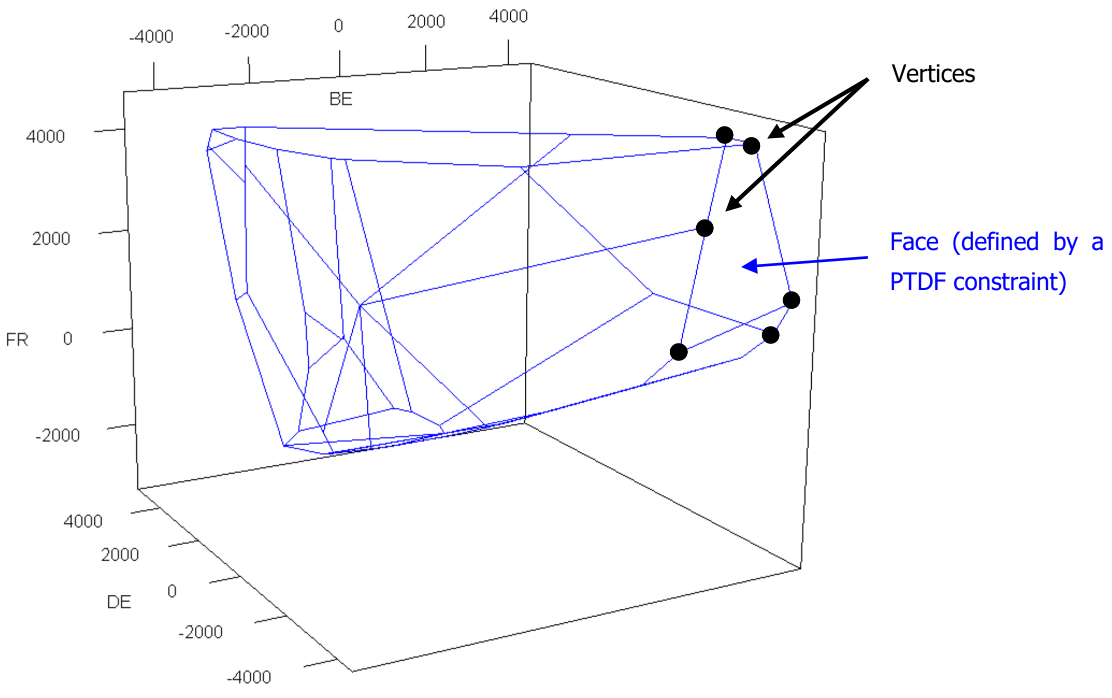
Firstly, flow-based domains are hourly, but the comparison is set between days. In this algorithm, **the daily distance is calculated as the sum of the 24 hourly distances between the matching flow-based domains of the two days**. Two variants are possible: the daily distance can be a plain sum considering all domains equally, or some hours can be weighted. The latter method enables some hours to be highlighted, meaning that in the end, clusters will gather days with similar domains at heavy weighted hours, but with sometimes less resemblance at less weighted hours. For adequacy studies for example, weighting peak hours to the detriment of off-peak hours can be very useful.

The hourly distance is then the distance between two flow-based domains. A flow-based domain being a geometrical shape in 3 (or 4, see Introduction) dimensions, the distance representing how similar they are can be calculated with several different methods – taking into account for example the volume or the maximum or minimum value in chosen directions, and thus have different values.
The chosen method consists in characterising each polyhedron by the coordinates of its vertices and then summing the distance between each vertex and the other polyhedron.

3.2.3.1 Calculate vertices

As any polyhedron, a flow-based domain can be defined either by the equations of its faces, or by the coordinates of its vertices (Figure 8). The objective of this part is to be able to translate one definition into the other, to be able to use the two sets of information.

Figure 8: Geometrical characteristics of a flow-based domain

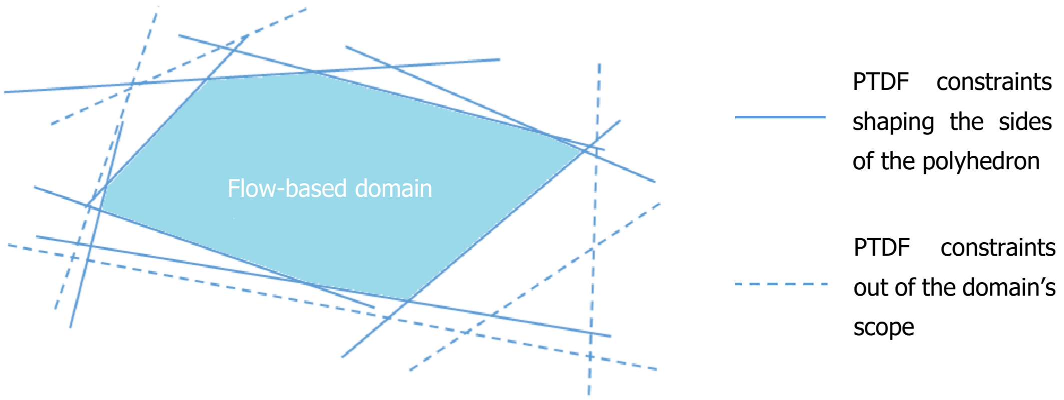


Flow-based domains are defined by a set of PTDF constraints, where a constraint represents the equation of a plane or more specifically a half-space limited by a

hyperplane. The intersection of all the half-spaces shapes the domain: the most restrictive constraints are the sides of the polyhedron.
Two operations can be led on the set of constraints: determine which ones are actually binding the domain (the most restrictive ones) and calculate the coordinates (set of Net Positions) of the vertices of the polyhedron.

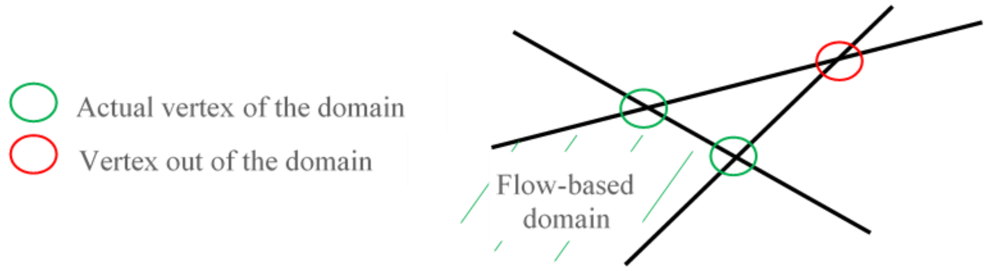
In reality for a flow-based domain, only a few tens (up to a few hundreds) of constraints are determining. As illustrated in the Figure 9, **the domain is defined by the biggest polyhedron belonging to all the half-spaces: numerous constraints are then redundant** (dotted lines in the scheme) and not useful for the delimitation of the domain. These constraints can be removed from the set of constraints, this operation is called presolve.

Figure 9: Representation in two dimensions of the two kinds of PTDF constraints



To identify the vertices, the algorithm selects every possible triplet of constraints and determines whether their intersection exists. To be an actual vertex of the domain, the intersection point must belong to the domain, so the second step is to check if the point belongs to all the half-spaces defined by the set of PTDF constraints.

Figure 10: Two kinds of intersection points represented in a 2D design



R package: `flowBasedClustering`

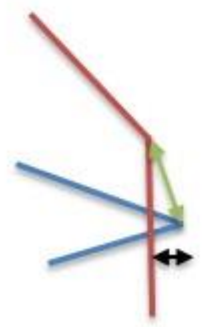
To calculate the vertices of a set of domains, the function `ptdfToVertices` takes in input a csv file. It must contain columns of date, period, BE, DE, FR, NL and RAM_0. The operation can be performed on several cores to fastened it.

3.2.3.2 Geometrical definition of the hourly distance

The distance between two 3-dimensional polyhedrons is subject to different interpretations. **This method attempts to compare the entire shapes of the domains by projecting each one on the other one**.
To do so, each vertex of the first domain A is projected on the second one B; meaning that the algorithm calculates, in Euclidian norm, the closest point to A's vertex which belongs to B. The distance between these points is saved and the same process is repeated for all the vertices of domain A. The resulting distances are added up to constitute the "distance from A to B".

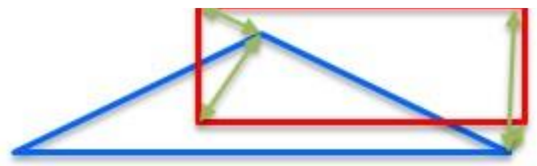
A faster calculation can take only into account the vertices of domain B: the "projected" point would then be represented by the closest vertex in B. However, in this case, the distance between two domains can be overestimated, as displayed by Figure 11.

Figure 11: Distance calculated vertex to vertex or vertex to polyhedron (2 dimensions)



To get a more precise estimation of the shape difference between the domains, the distance from B to A is also calculated.

Figure 12: Illustration of the possible mismatch by calculating only the distance from A to B



Finally, the two distances are "normalised", divided by their number of vertices, so that one is not artificially overrepresented. The total is the final hourly distance:

$$Hourly\ distance = \frac{1}{Number\ of\ vertices\ (A)} \times distance_{A \to B} + \frac{1}{Number\ of\ vertices\ (B)} \times distance_{B \to A}$$

3.2.3.3 Daily distance

Once the 24 hourly distances of two chosen days have been calculated, they are weighted and added up to constitute the daily distance.

The weights chosen differentiate morning peak (8-12) from evening peak (18-20) and off-peak hours, with a multiplying factor of respectively 2, 4 and 1. During a normal day, peak hours are less numerous than off-peak hours and the domains they display are smaller (a larger demand implies more constraints on the grid). By favouring them, the clustering aims to be more accurate for adequacy studies, where it is more important for the domains to be accurate at peak hours, when the risks of loss of load are the highest.

However, these weights are a parameter in the clustering function and as such can be modified to fit the expectations of the study:

- All can be set at 1 to consider all hours as equally important
- Some hours can be set at 0 not to be taken into account

3.2.4 Clustering

When all days have been compared two by two, the result can be observed in the form of a triangular matrix.

Figure 13 : Example of triangular matrix of distances

	01_01_2017	01_11_2015	02_01_2016	03_01_2016	03_12_2016	04_12_2016	05_03_2016	05_11_2016	05_12_2015	06_02_2016	06_03_2016	06_11_2016	06_12_2015
01_01_2017	0	16514.197	16764.446	14925.861	12253.474	10921.302	10030.182	12845.966	18146.425	11329.834	9444.421	14094.924	17246.929
01_11_2015		0	11898.439	8567.929	12668.381	14958.329	12838.213	11965.738	11736.352	9008.253	12479.858	10893.396	11752.81
02_01_2016			0	9535.703	13729.488	15795.6	15183.521	12542.238	7599.405	9779.367	15332.08	12336.297	10428.385
03_01_2016				0	11459.277	13072.883	11163.474	11128.719	9420.904	7390.978	12688.984	9211.198	9644.129
03_12_2016					0	7024.854	10602.192	7605.588	15109.563	8098.257	11277.173	7965.267	14215.66
04_12_2016						0	10102.3	10524.908	18484.711	8807.246	11561.768	11192.223	17040.41
05_03_2016							0	12233.762	16618.925	8557.438	6625.427	12303.54	14656.168
05_11_2016								0	13535.65	7550.088	12199.529	6932.65	12234.578
05_12_2015									0	10943.049	16234.363	13060.671	7506.082
06_02_2016										0	9465.816	7147.901	10800.104
06_03_2016											0	12925.678	14238.592
06_11_2016												0	12297.693
06_12_2015													0

An algorithm of k-medoids is then applied: this is a clustering algorithm (related to the k-means algorithm) based on a partition approach. The dataset is divided into k groups within which the algorithm minimises the distance. Once the k clusters have been identified, it chooses a representative inside the cluster (and does not calculate a mean value), which will be the item closest to all others in the group. This will be one of the typical day.

In the current model, the weekdays (working days) dataset is separated into three clusters, from which are deduced three typical days. **Only one typical day represents the weekends, in this case the algorithm will only selects the best representative of the entire dataset**, without dividing it beforehand.

R package: `flowBasedClustering`

The distance calculation to constitute the matrix and the clustering are carried out by the same function `clusteringTypicalDays`. Its inputs are the calendar, the vertices table and the targeted number of clusters for working days and weekends. An html report summarises the results for each cluster, by plotting each typical domain and presenting cluster diagrams (such as Figure 14).

3.3 Results

This algorithm allows numerous varieties, on the definition of the history, the number of typical days, the weights associated to each hour's distance…

3.3.1 Clustering

The first clustering designated by this clustering method is based on:

- A **learning period starting November 2015 to January 2017**, which spreads over more than a year. Advantage: the winters 2015-2016 and 2016-2017 have been very different, the first being quite mild whereas during the last, several cold spells happened while the nuclear plants unavailability was exceptionally high. The history on winters is then well-stocked.
- 12 typical days
- Weights of value 1, 2 or 4:

Table 3 : Weight distribution (hour h meaning from h-1 to h)

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weight	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	4	4	4	1	1	1

The calculated typical days are identified as:

Table 4: Typical days

Summer		Winter		Interseason	
16/05/2016 - 30/09/2016		01/11/2015 - 15/03/2016 01/11/2016 - 20/01/2017		16/03/2016 - 15/05/2016 01/10/2016 - 31/10/2016	
Weekday	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
19/07/2016	13/08/2016	03/02/2016	06/02/2016	22/03/2016	09/04/2016
22/09/2016		08/02/2016		05/10/2016	
22/06/2016		10/12/2015		13/10/2016	

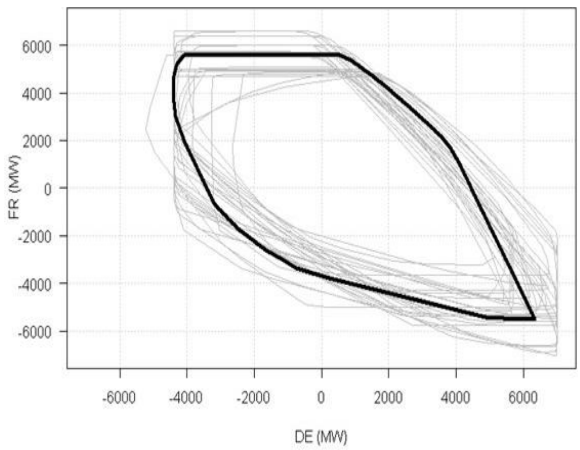
3.3.2 Focus on winter typical days

The following part focuses on the three winter typical days, and more specifically their domains during the evening peak hours, for example at hour 19 (from 18:00 to 19:00 in France).

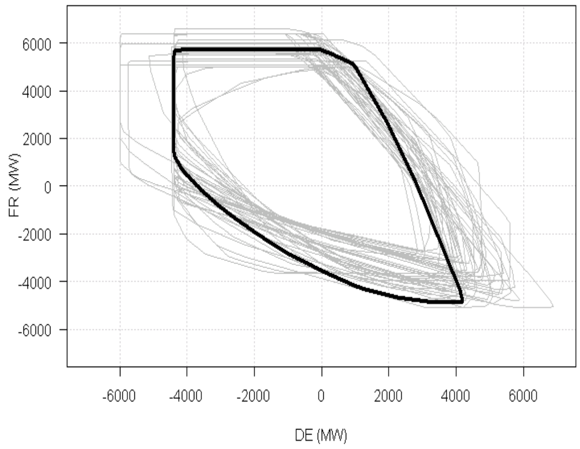
The Figure 14 displays the three domains, shadowed by the domains of the cluster they each represents at the same hour. The similarity and dissimilarity underlined by these graphs need to be considered carefully though: this is the representation of only one hour, out of the 24 contained in a day and out of the 3 heavily weighted. Such a figure displays also only two of the dimensions.

Figure 14 : Representation of the three winter typical days and their cluster at 18:00 on axis Germany-France

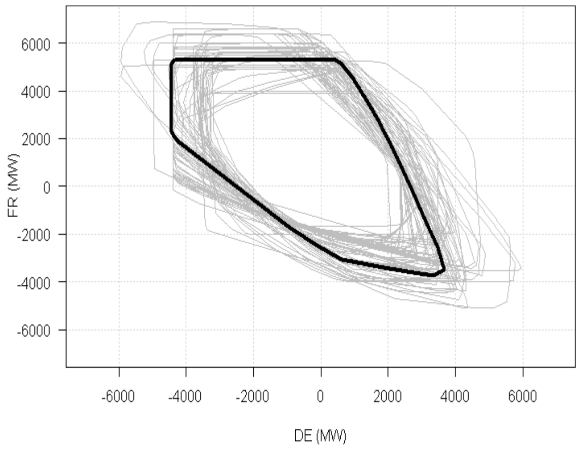
a) Typical day 5 (03/02/2016)



b) Typical day 6 (08/02/2016)



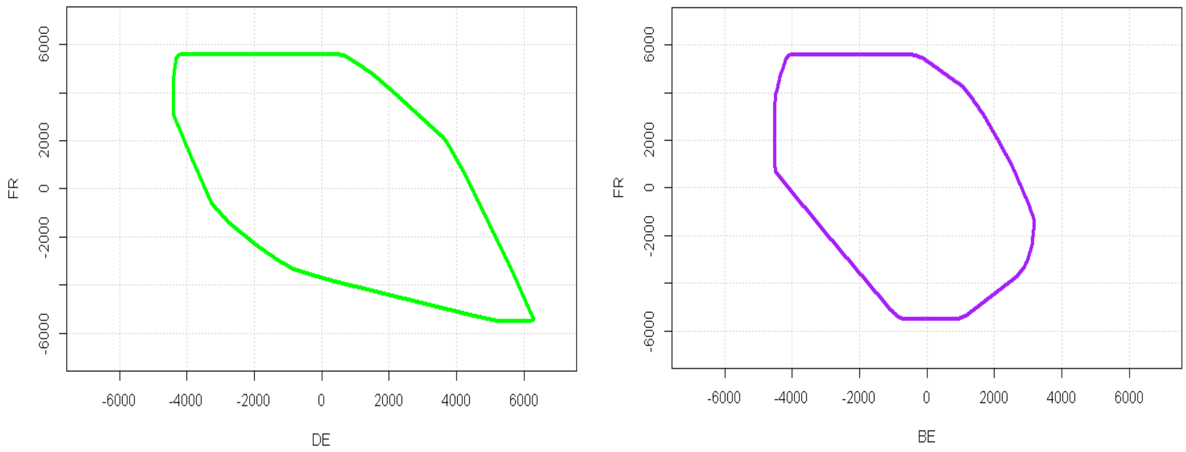
c) Typical day 7 (10/12/2015)



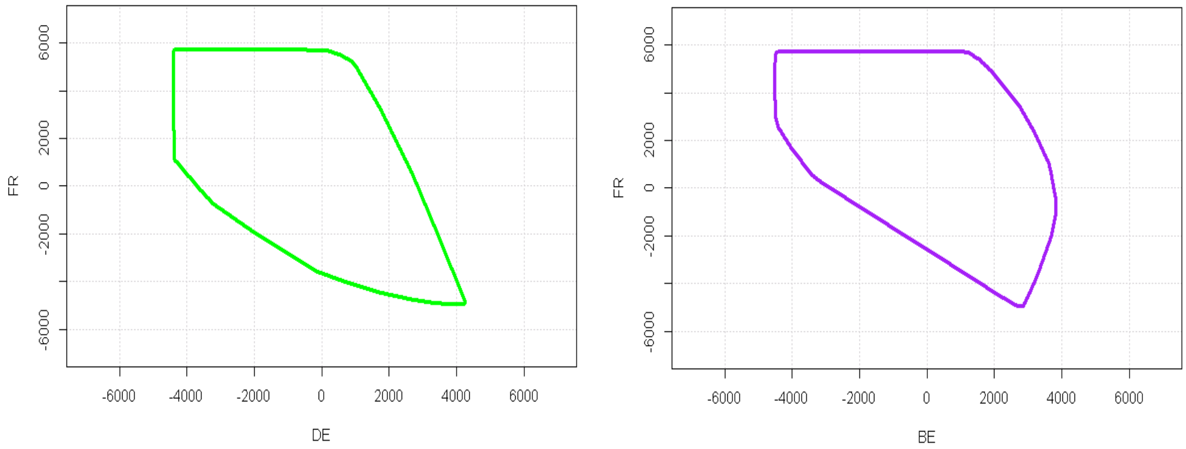
To get a more complete view, the domains are observed on three axis (Fr, Be, De) on Figure 15. From both angles, they embody a variety of sizes: large (5), medium (6) and small (7). The maximum in terms of German exports also varies from a few GW, as do for example the French import maximum capacity.

Figure 15: Projection of the three winter typical days at 18:00

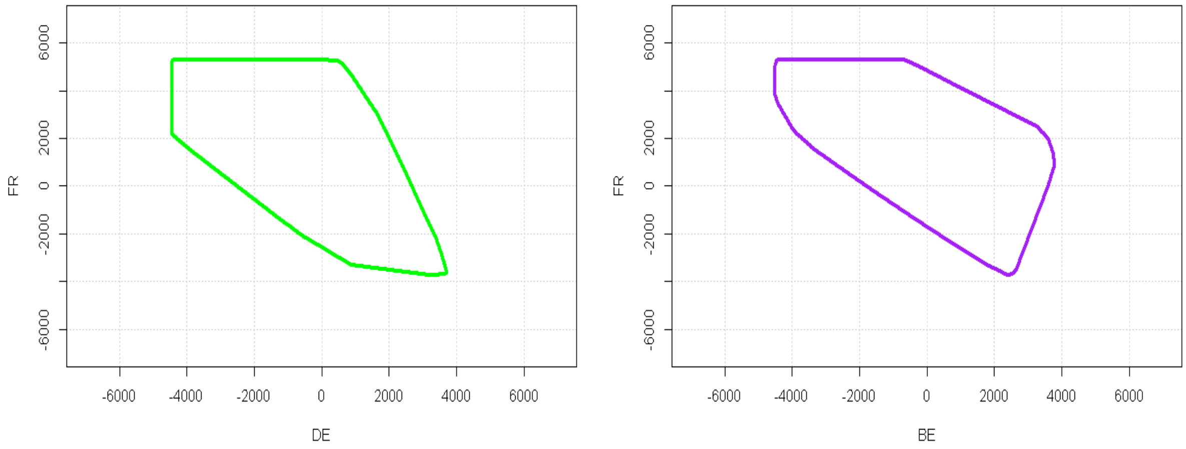
Typical day 5



Typical day 6

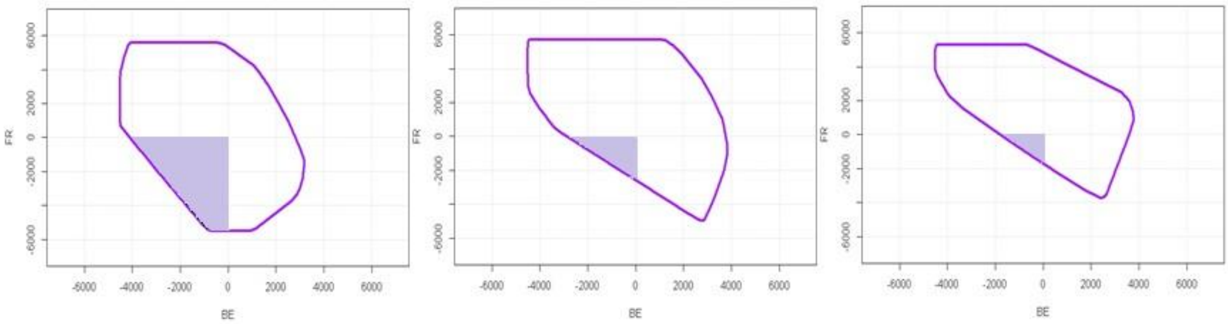


Typical day 7



Most representative is the cumulated possible import from France and Belgium; as displayed in the introduction, this is a quite clear indicator of how tense the balance is, during cold spells for example, when both countries have high probability to face loss of load situations. The cumulated import will be represented by the area bordered by the flow-based limits and in which net positions of France and Belgium are negative. Figure 16 highlights this area; the maximum cumulated import from FR and BE almost reach 7 GW in case of typical day 5, but only 3 GW can be imported in case of typical day 6 and less than 2 GW for the smallest domain.

Figure 16: Simultaneous importation capacity from France and Belgium at 18:00 for the three typical days (from left to right: 5, 6 and 7)



This diversity is coherent with the history, which runs over November 2016 to January 2017, presented in Figure 4 when focusing on 18:00: the use of these typical domains enables to quite accurately describe the season.

3.3.3 Unweighted clustering

The algorithm has been run again over a smaller history, the entire year 2016, with weights of 1 applied to all hours. The resulting typical days are different from the previous set, but the winter days present the same kind of contrasts, in size and extremes.

3.4 Adaptability of the clustering to methodological and grid evolutions

The aim of the clustering is to be able to **represent a panel of flow-based situations** by focusing on only a few, with as much accuracy as possible. This objective is achieved by the diversity observed on the typical days.

Alongside, **the limited number of domains to work with after clustering (288) enables to simulate evolutions that are not visible in the initial dataset of domains and too heavy to apply on all domains**. A European task-force has developed a methodology which takes into account future evolutions of the grid, such as the planned commissioning of the 380 kV electrical line Doel-Zandvliet. Knowing the historical situation of a typical day, the operational flow-based algorithm is run with the new grid in the same conditions to visualise what the domain would have looked like. Methodological evolutions which modify the shape of the domain can also be taken into account; for example the impact of the evolution of the Long Term Allocation inclusion patch (LTA inclusion) made by Amprion during first semester 2017, can also be modelled on the typical days.

3.5 Diffusion

The typical days selected with this method are currently used:

- For the **French Adequacy Report 2017**: first clustering with no change (weighted hours)
- For the **French Winter Adequacy Outlook 2017-2018**: Winter typical days from the first clustering

- For the **Belgian Adequacy Report**: winter typical days from the first clustering, taking into account the evolution of the LTA inclusion patch and adapted with the SPAIC method to take into account future reinforcements of the Belgian and German grid
- For the **PentaLateral Energy Forum (PLEF) 2017**: first clustering with reinforced and taking into account the evolution of the LTA inclusion patch for the winter typical days
- For the **TSOs of the Central West Europe region**: conducting an impact assessment of changes in the flow-based market coupling methodology based on cluster days

4. Annex

List of holidays automatically classified as weekends:

NewYearsDay
LaborDay
FRAssumptionVirginMary
ChristmasDay
GoodFriday
FRAscension
FRAllSaints
BoxingDay
EasterSunday
Pentecost
FRArmisticeDay
DENewYearsEve
EasterMonday
PentecostMonday
ChristmasEve