

SURVEY ON ANCILLARY SERVICES PROCUREMENT, BALANCING MARKET DESIGN 2017

ENTSO-E WGAS

May 2018

22.05.2018

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Introduction (1)

ENTSO-E Survey on Ancillary services procurement, Balancing market design 2017

The purpose of this survey is to provide an overview of the different market arrangements in place throughout Europe regarding to Ancillary services procurement and Balancing market design.

The maps illustrate how different approaches have been taken to the design elements across Europe.

The Ancillary Services Working Group members who responded to the questionnaire are as follows:

- Austria, Belgium, Bosnia & Herzegovina, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland & NI, Italy, Latvia, Lithuania, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, United Kingdom.

Introduction (2)

This document is expected to help the introduction of the Network Code Balancing.

It is meant as a quite comprehensive, but user-friendly set of information on the existing arrangements.

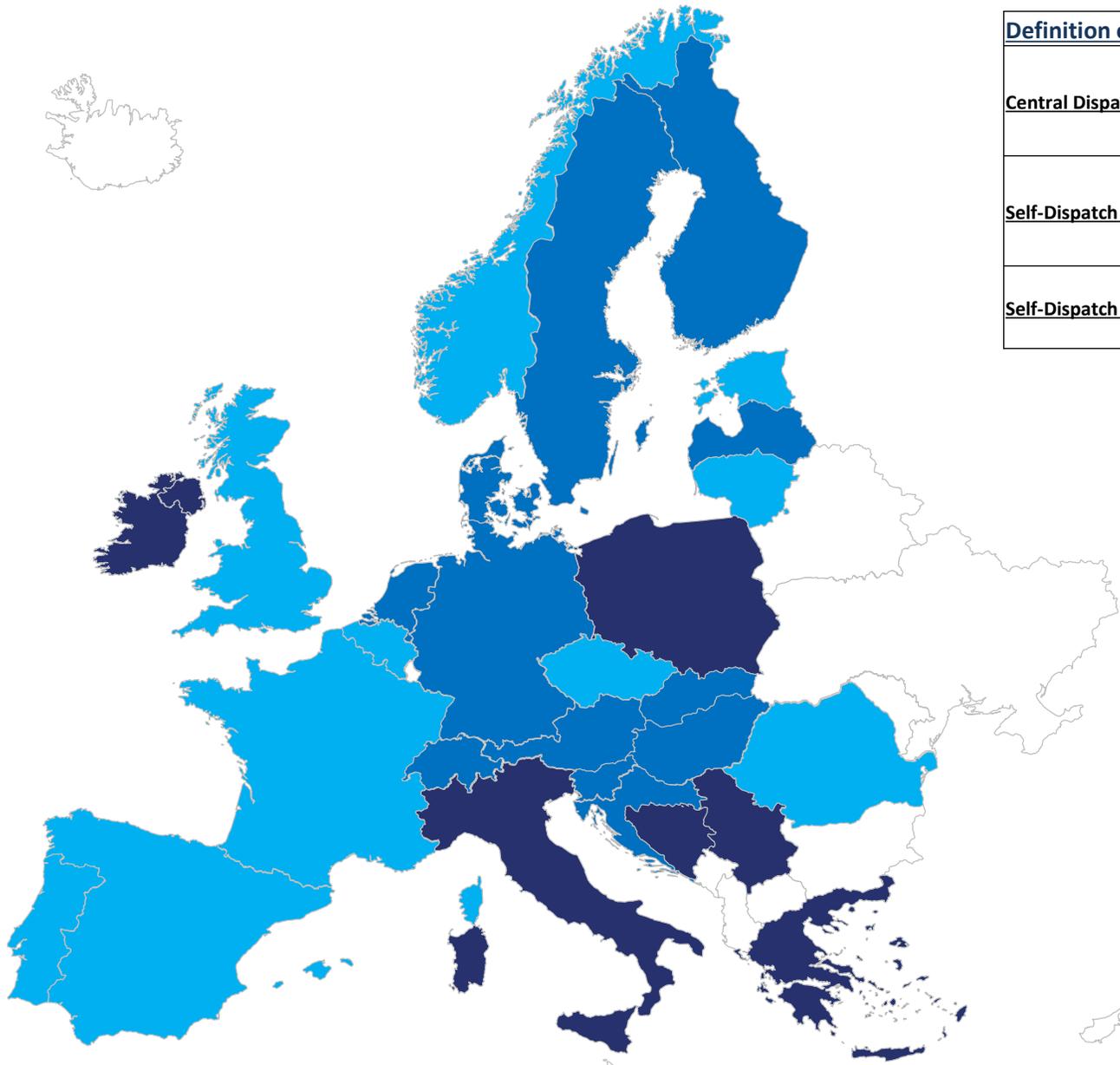
Caveats:

- This is a relatively high-level exercise (not all details are captured).
- Developing a single set of definitions for the purpose of this survey, we experienced the difficulty to match the various concepts used in different countries. As a consequence, in some specific cases, the position of a country in a certain group might be debatable.
- This is based on information updated in January 2018 and describes the mechanisms in place in 2017, irrespective of any updates which might already be foreseen for the future.
- Visualizing the answers we distinguished the TSO who responded the questionnaire, but doesn't have answer to the certain question (marked with „N/A”) from the TSO who did not response the questionnaire (marked with ”Missing data”).

Ancillary Services

(Referring to questions of AS survey from AS1.0 to AS17.0)

What is the balancing process in place?



Definition of answer

Central Dispatch

Central dispatch means a scheduling and dispatching model where the generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities, in reference to dispatchable facilities, are determined by a TSO within the integrated scheduling process.

Self-Dispatch - Portfolio Based

Self Dispatch System – Portfolio based means a scheduling and dispatching model where the aggregated generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities are determined by the scheduling agents of those facilities.

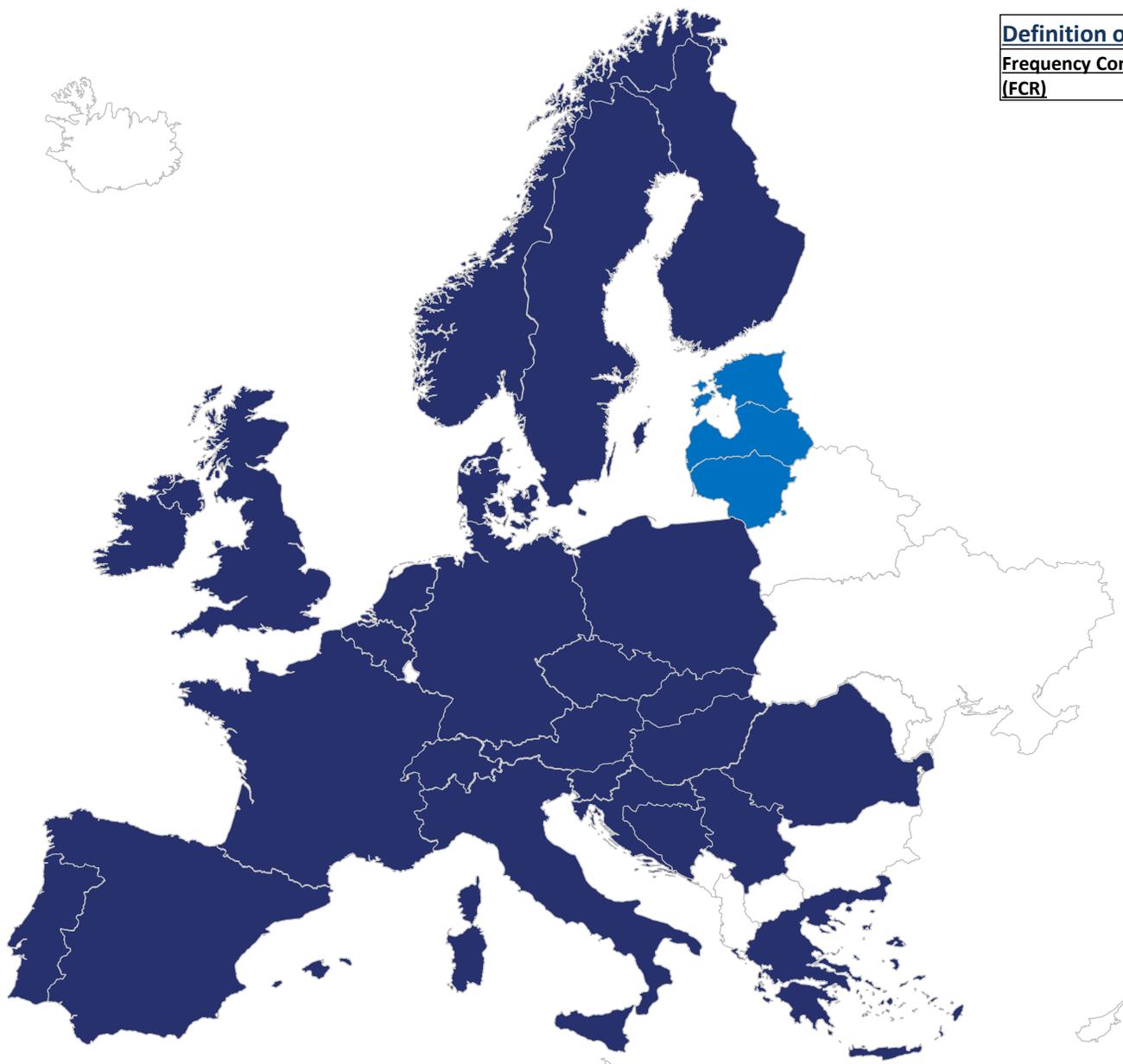
Self-Dispatch - Unit Based

Self Dispatch System – Unit based means a scheduling and dispatching model where power generating facilities and demand facilities follow their own generation schedules or consumption schedules.

Key:

| | |
|--|---------------------------------|
| | Missing data |
| | N/A |
| | Central Dispatch |
| | Self-Dispatch - Portfolio Based |
| | Self-Dispatch - Unit Based |

Using Frequency Containment Reserve



Definition of question

Frequency Containment Reserve (FCR)

Operating reserves activated for stabilizing System Frequency after an imbalance.

Key:



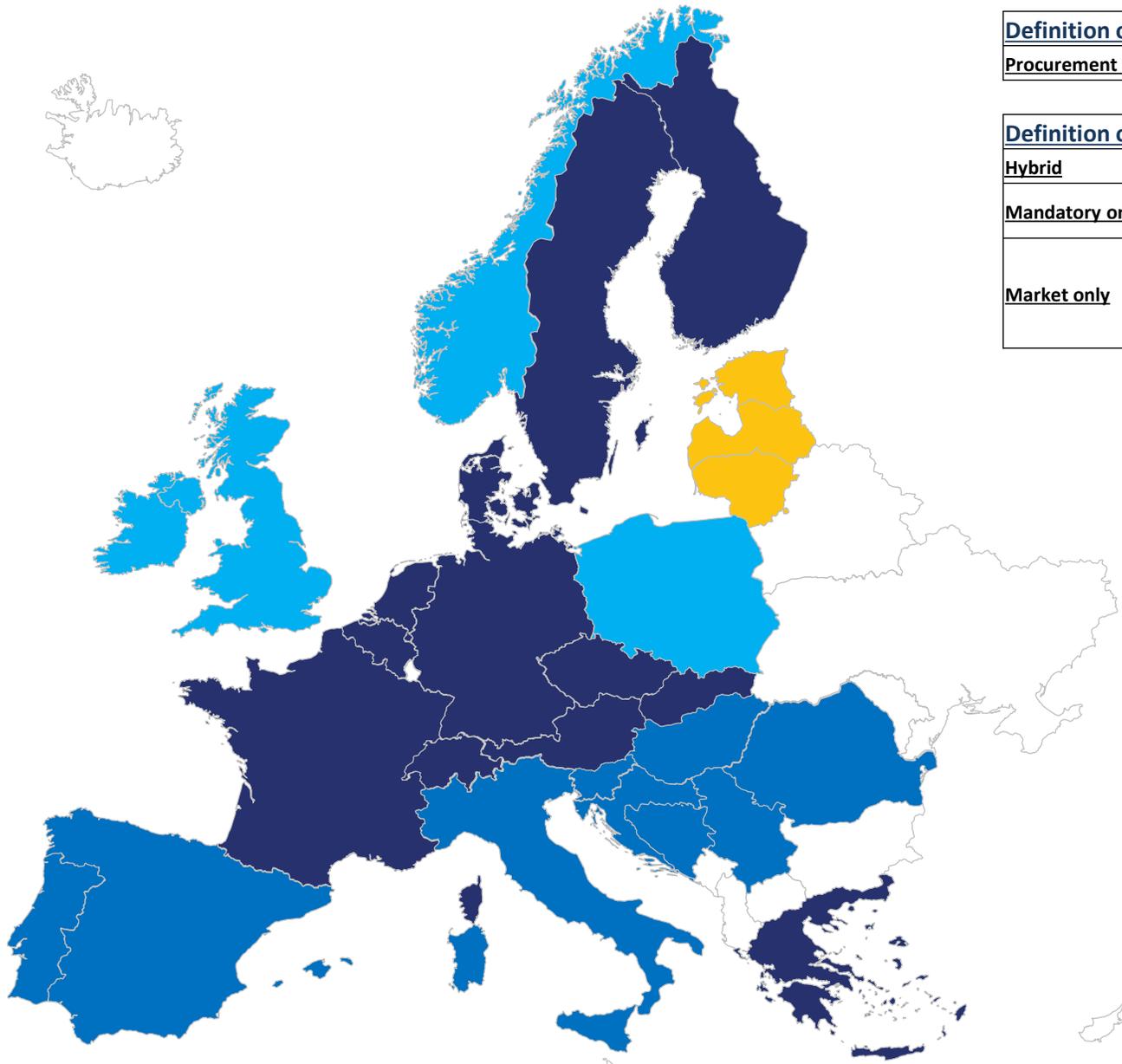
Missing data

N/A

Yes

No

Frequency Containment Reserve - Capacity - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

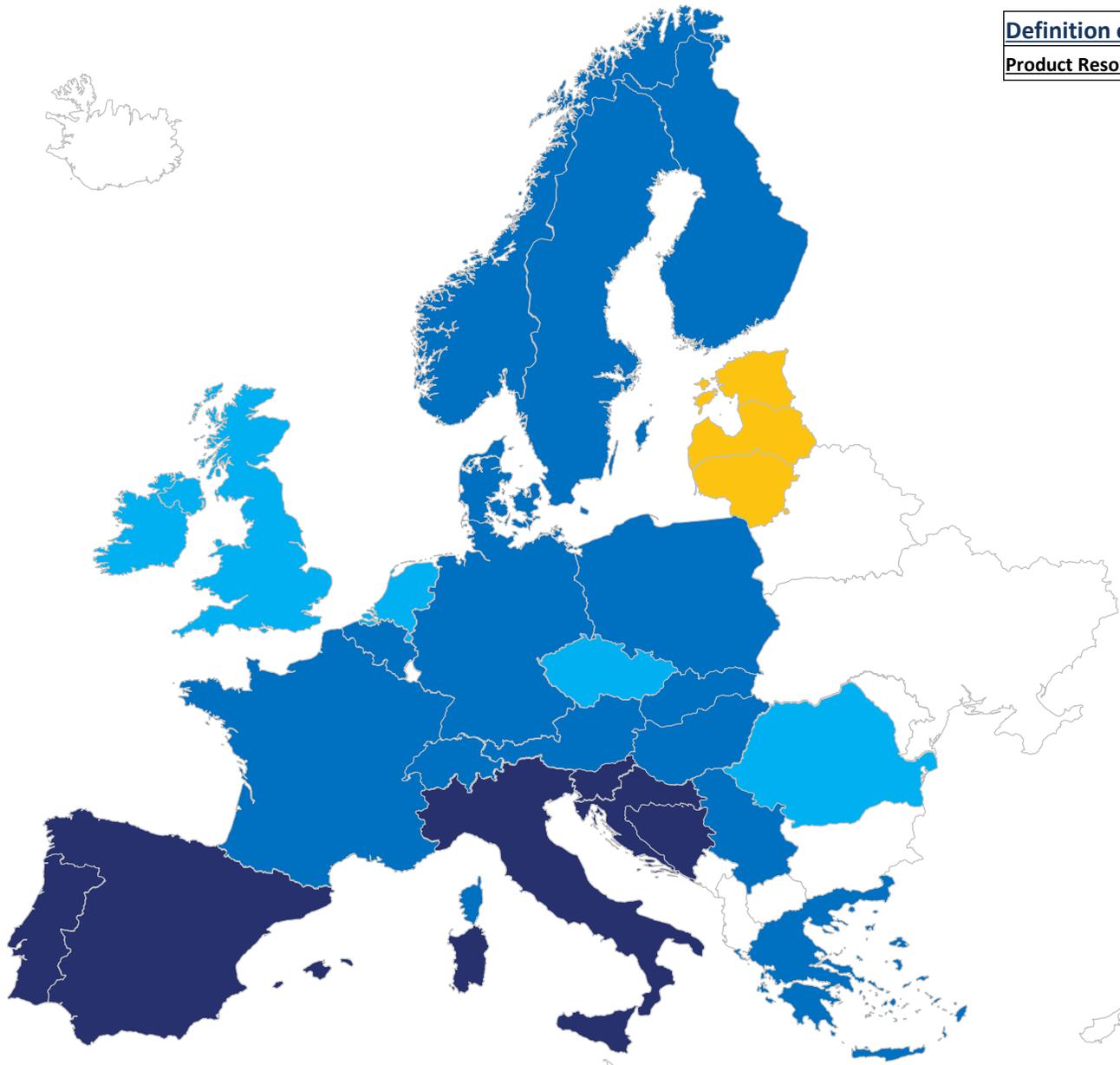
Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Frequency Containment Reserve - Capacity - Product Resolution (in MW)



Definition of question

| | |
|-----------------------------------|---|
| Product Resolution (in MW) | The minimum bid size into the balancing market. |
|-----------------------------------|---|

Key:

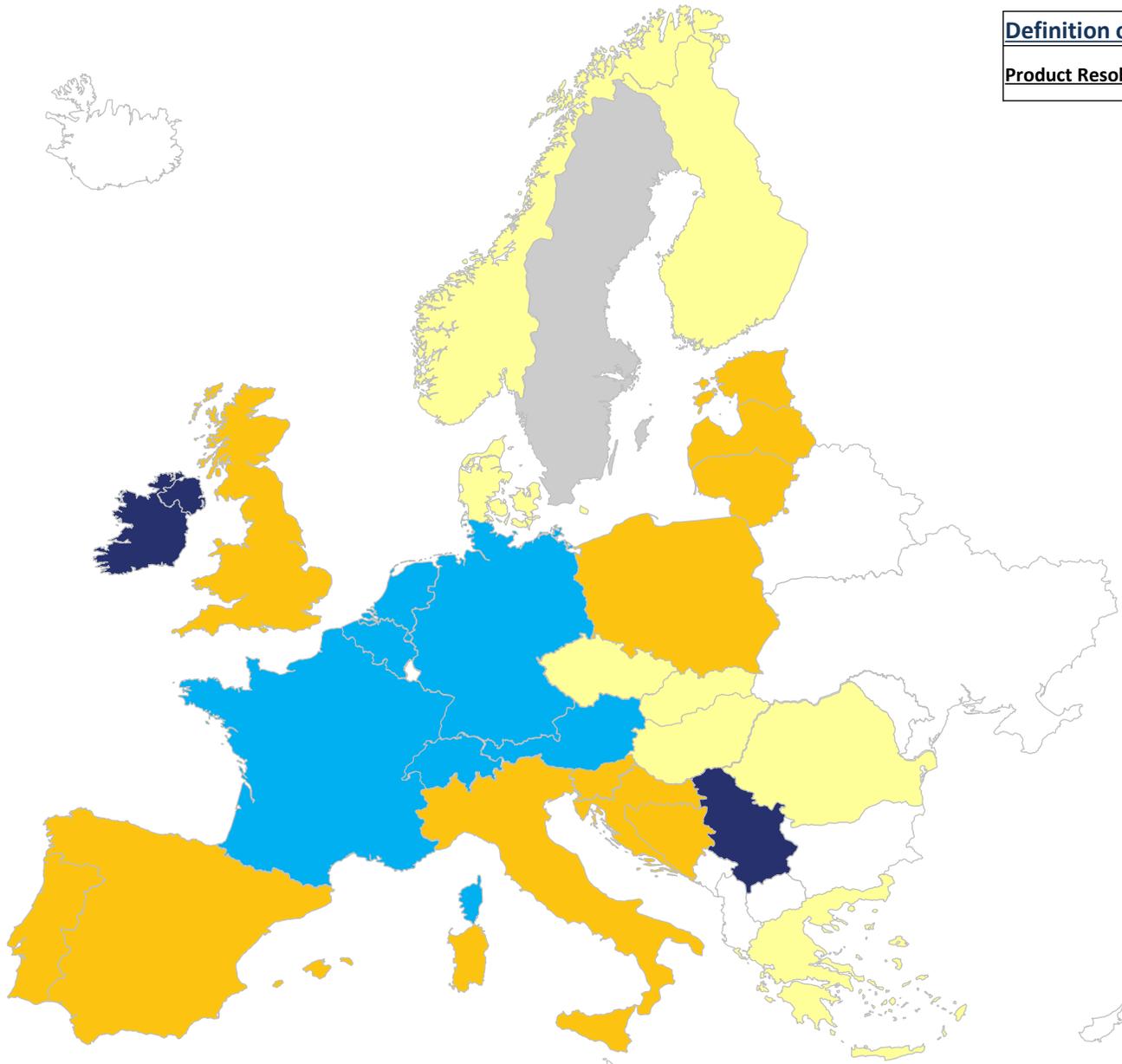
| | |
|---|-----------------------------------|
|  | Missing data |
|  | N/A |
|  | No minimum bid size |
|  | $x \leq 1\text{MW}$ |
|  | $1\text{MW} < x \leq 5\text{MW}$ |
|  | $5\text{MW} < x \leq 10\text{MW}$ |
|  | $x > 10\text{MW}$ |

Frequency Containment Reserve - Capacity - Product Resolution (in time)

Definition of question

Product Resolution (in time)

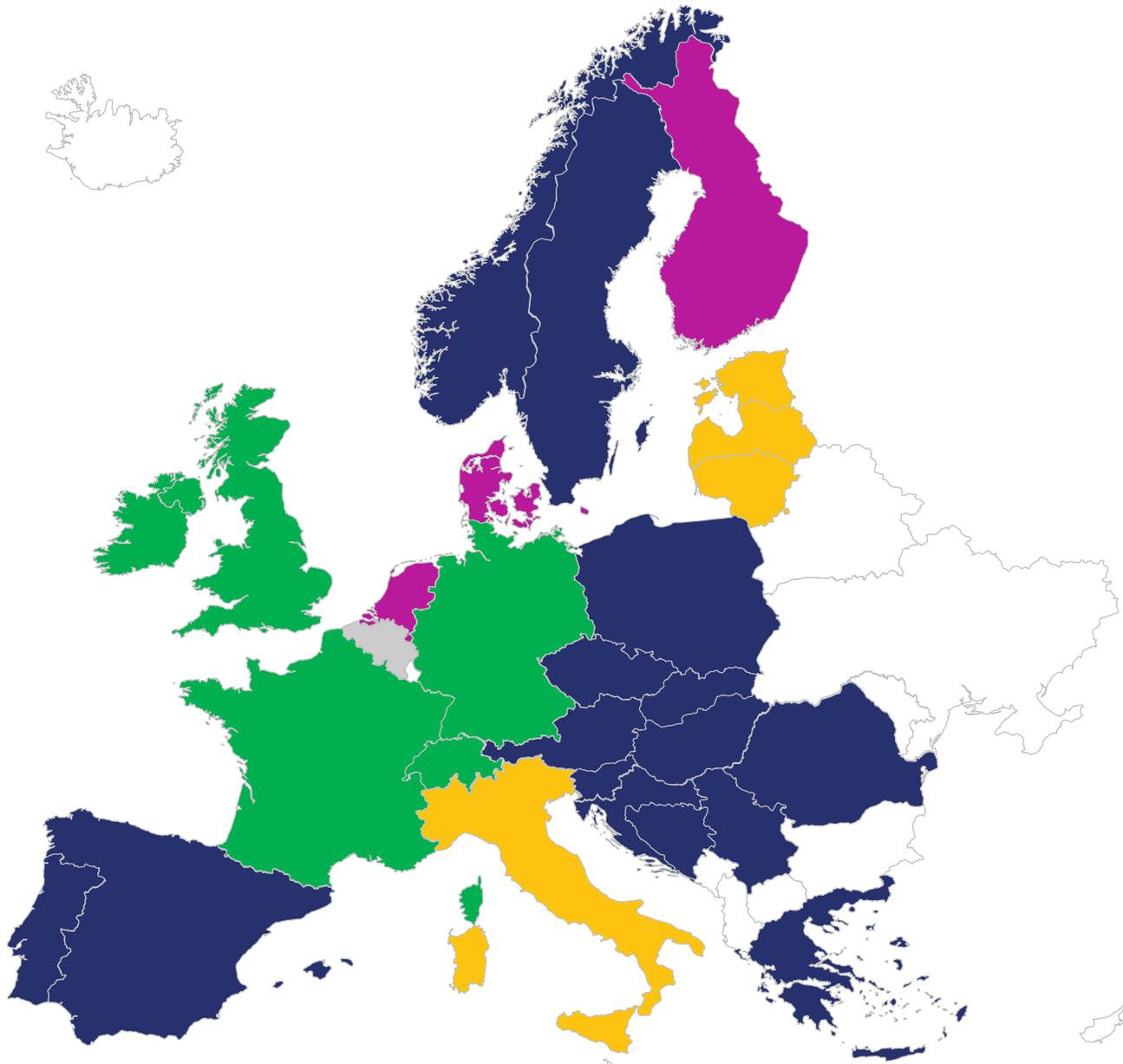
The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).



Key:

| | |
|-------------|--------------|
| White | Missing data |
| Orange | N/A |
| Dark Blue | Year or more |
| Medium Blue | Month(s) |
| Light Blue | Week(s) |
| Grey | Day(s) |
| Yellow | Hour(s) |

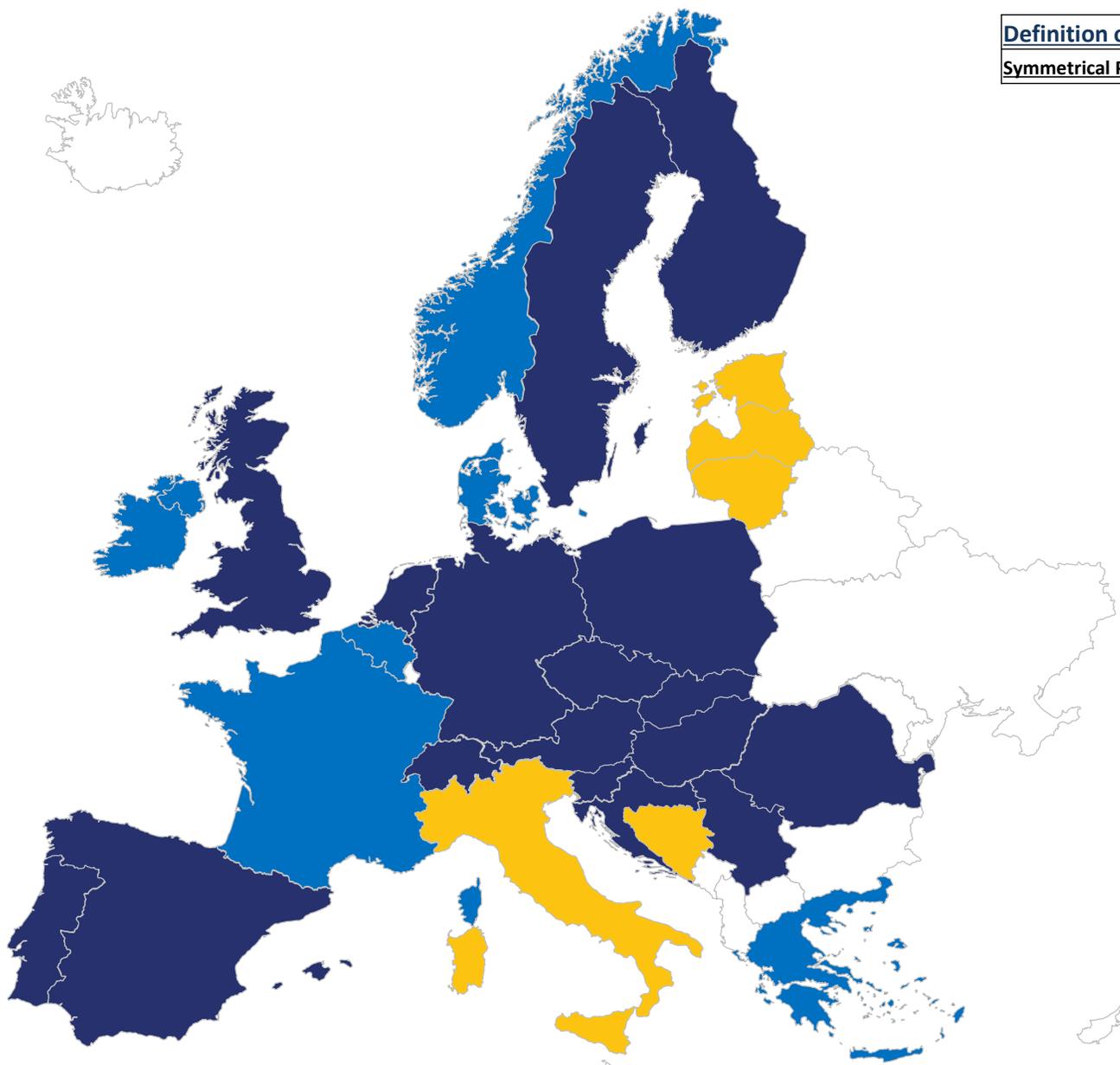
Frequency Containment Reserve - Capacity - Provider



Key:

| | |
|---|--|
|  | Missing data |
|  | N/A |
|  | Generators Only |
|  | Generators + Load |
|  | Generators + Pump Storage |
|  | Generators + Load + Pump Storage |
|  | Batteries |
|  | Generators + Load + Batteries |
|  | Generators + Load + Pump Storage + Batteries |

Frequency Containment Reserve - Capacity - Symmetrical Product



Definition of question

Symmetrical Product

Upward regulation volume and for downward regulation volume has to be equal.

Key:



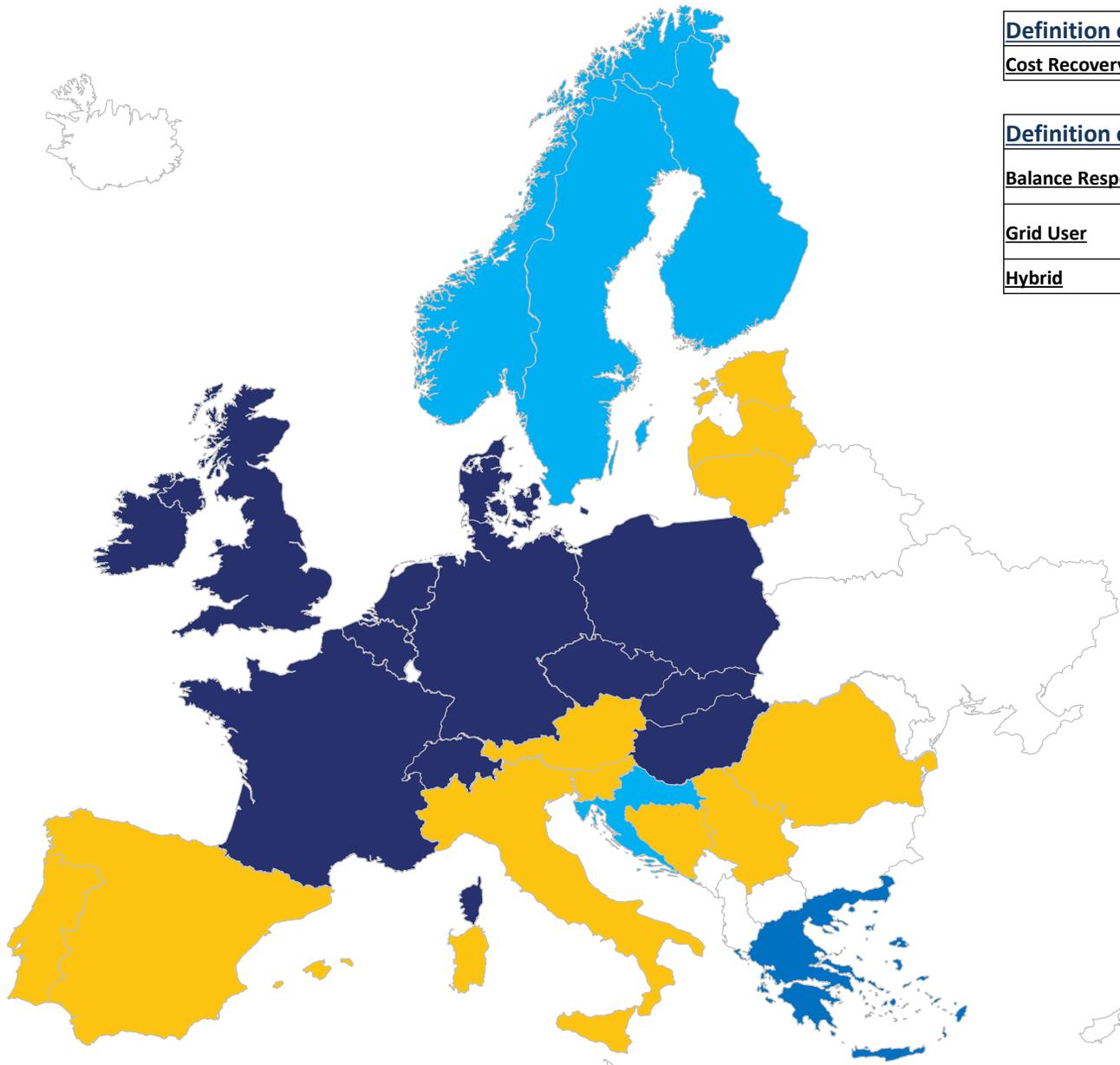
Missing data

N/A

Has to be symmetrical

Don't need to be symmetrical

Frequency Containment Reserve - Capacity - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

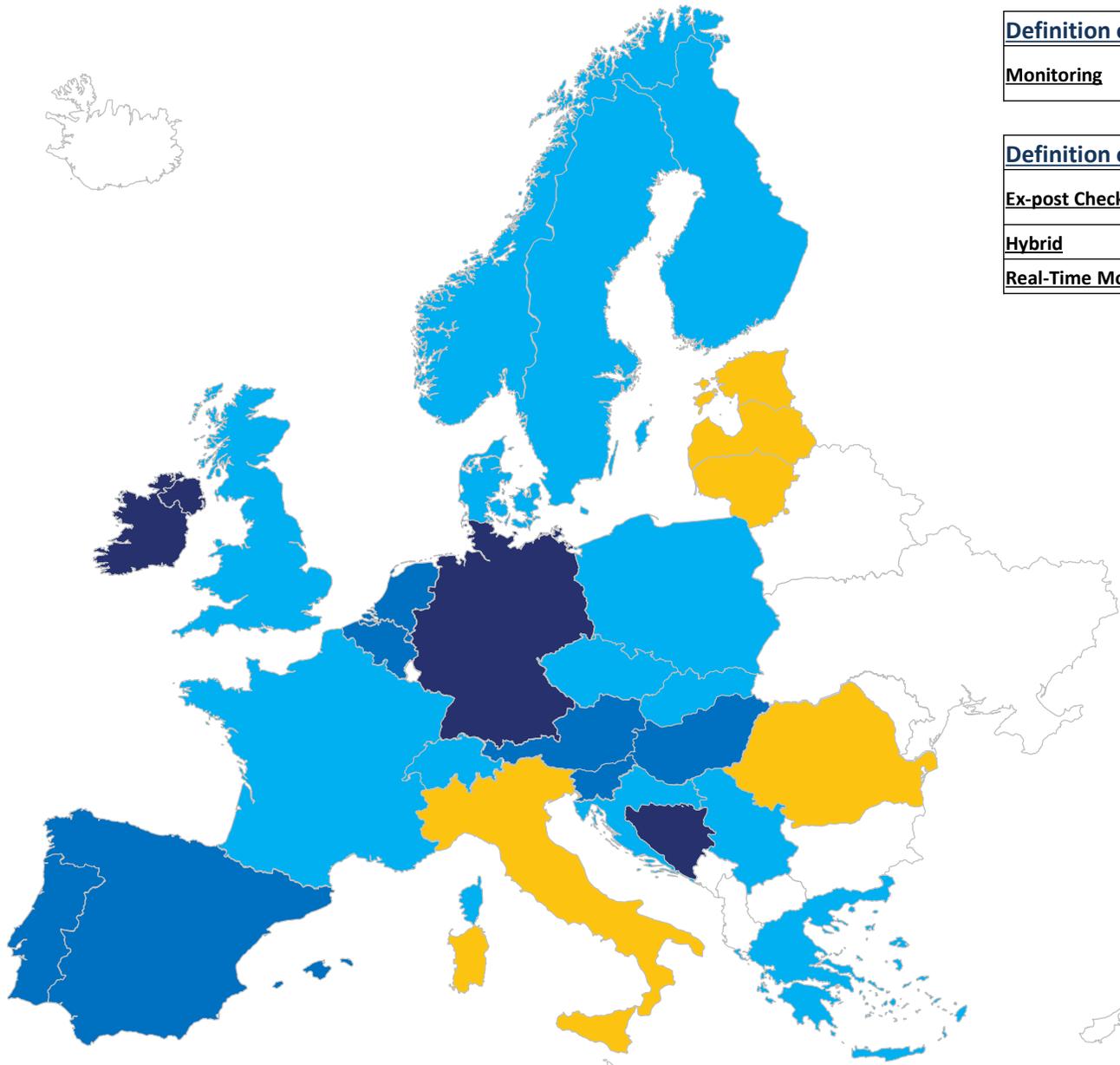
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|--|----------------------------------|
| | Missing data |
| | N/A |
| | 100% Grid Users (through tariff) |
| | 100% BRP |
| | Hybrid |

Frequency Containment Reserve - Capacity - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

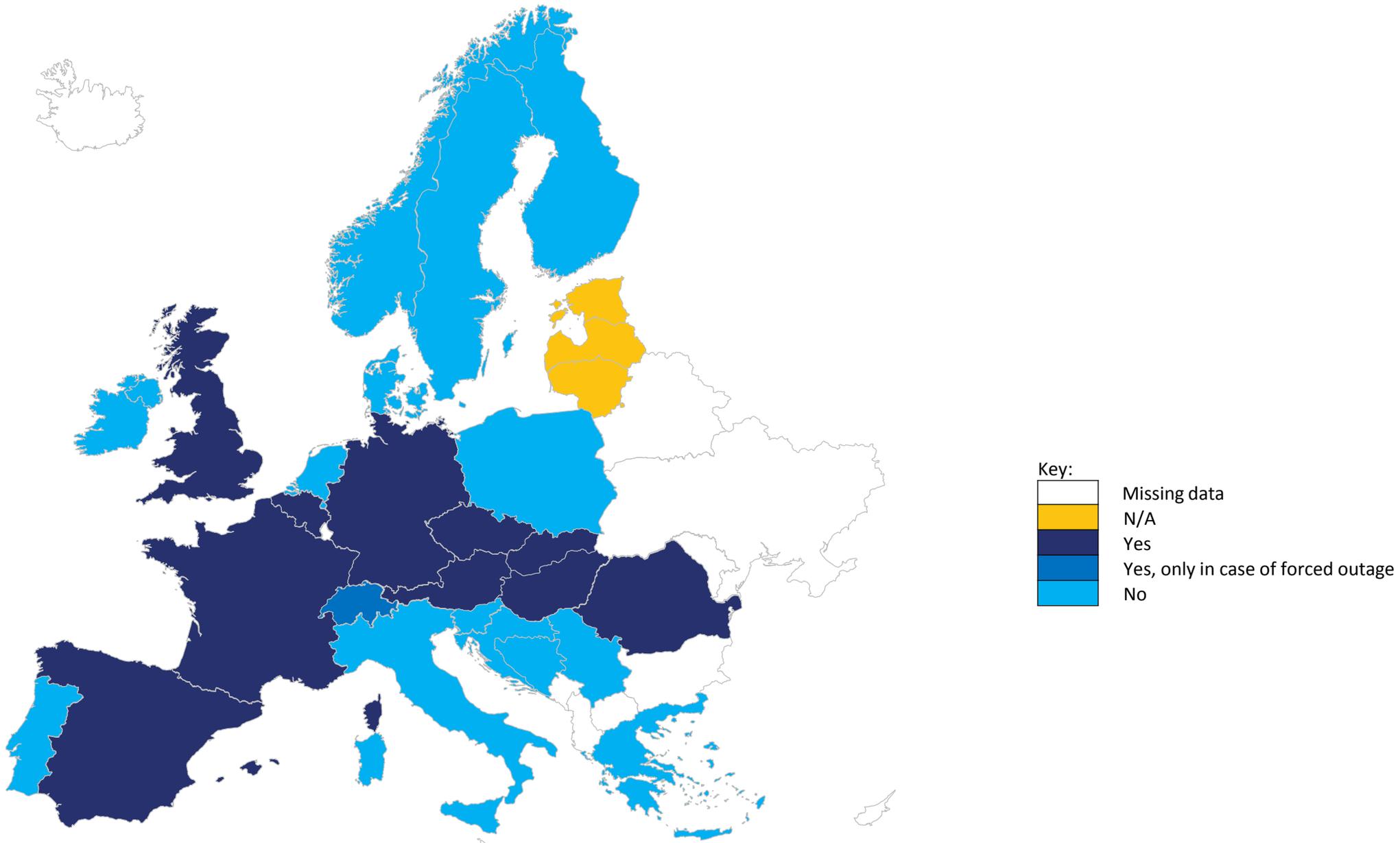
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

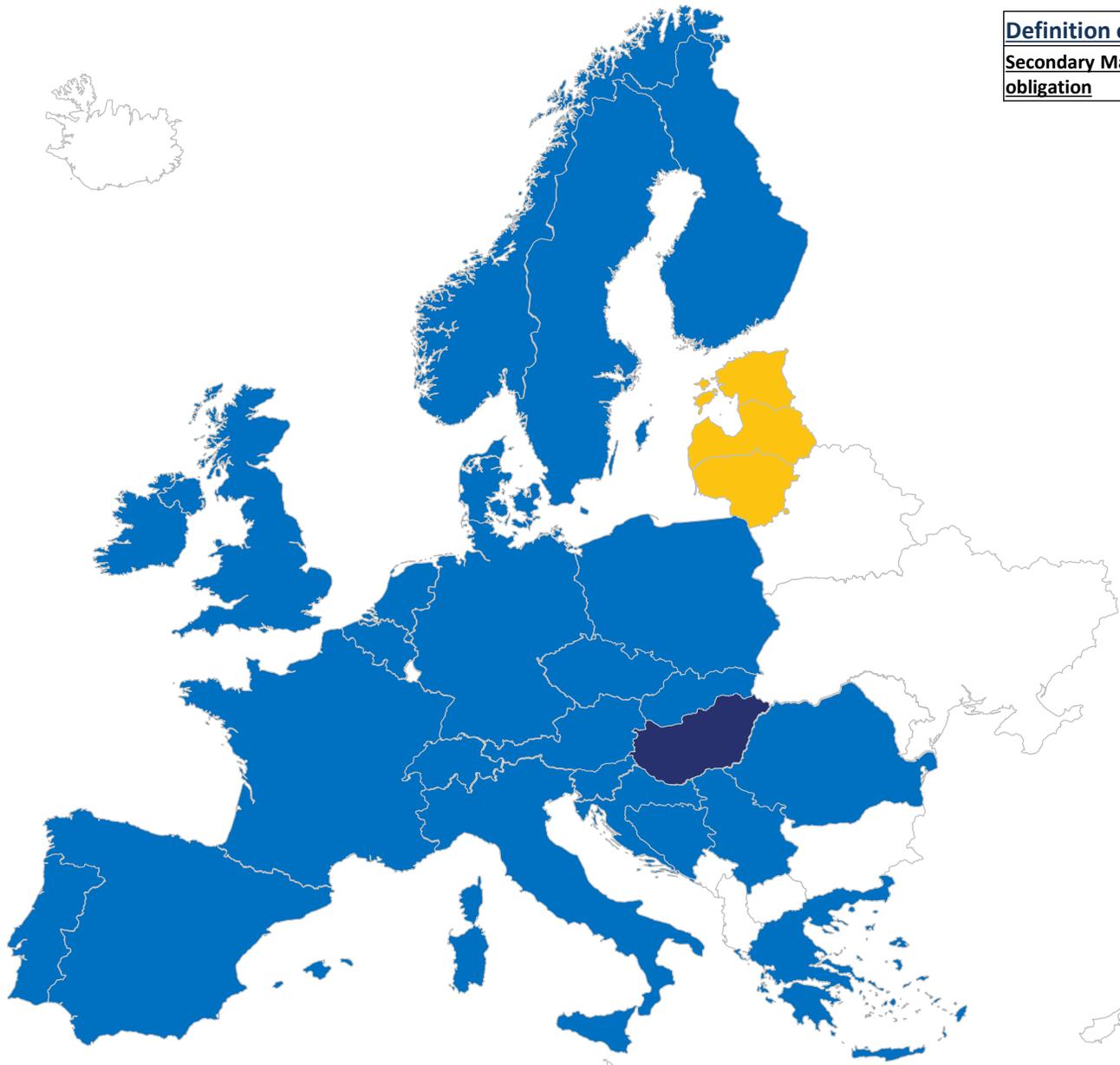
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real-Time Monitoring |
| | Ex-Post Check |
| | Hybrid |

Frequency Containment Reserve - Capacity - Transfer of BSPs obligation allowed



Frequency Containment Reserve - Capacity - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

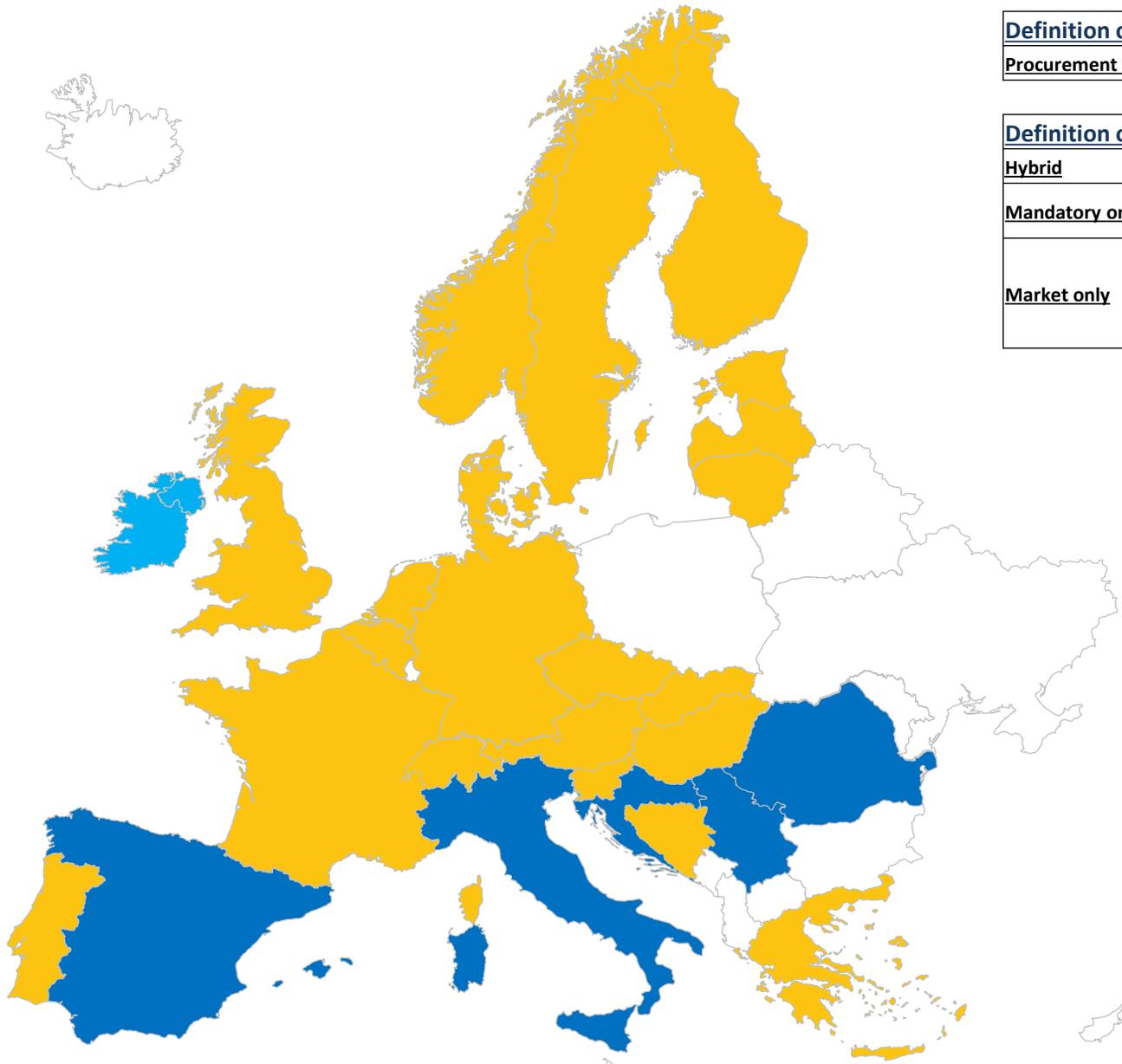
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--------------|--------------|
| Missing data | Missing data |
| N/A | N/A |
| Yes | Yes |
| No | No |

Frequency Containment Reserve - Energy - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

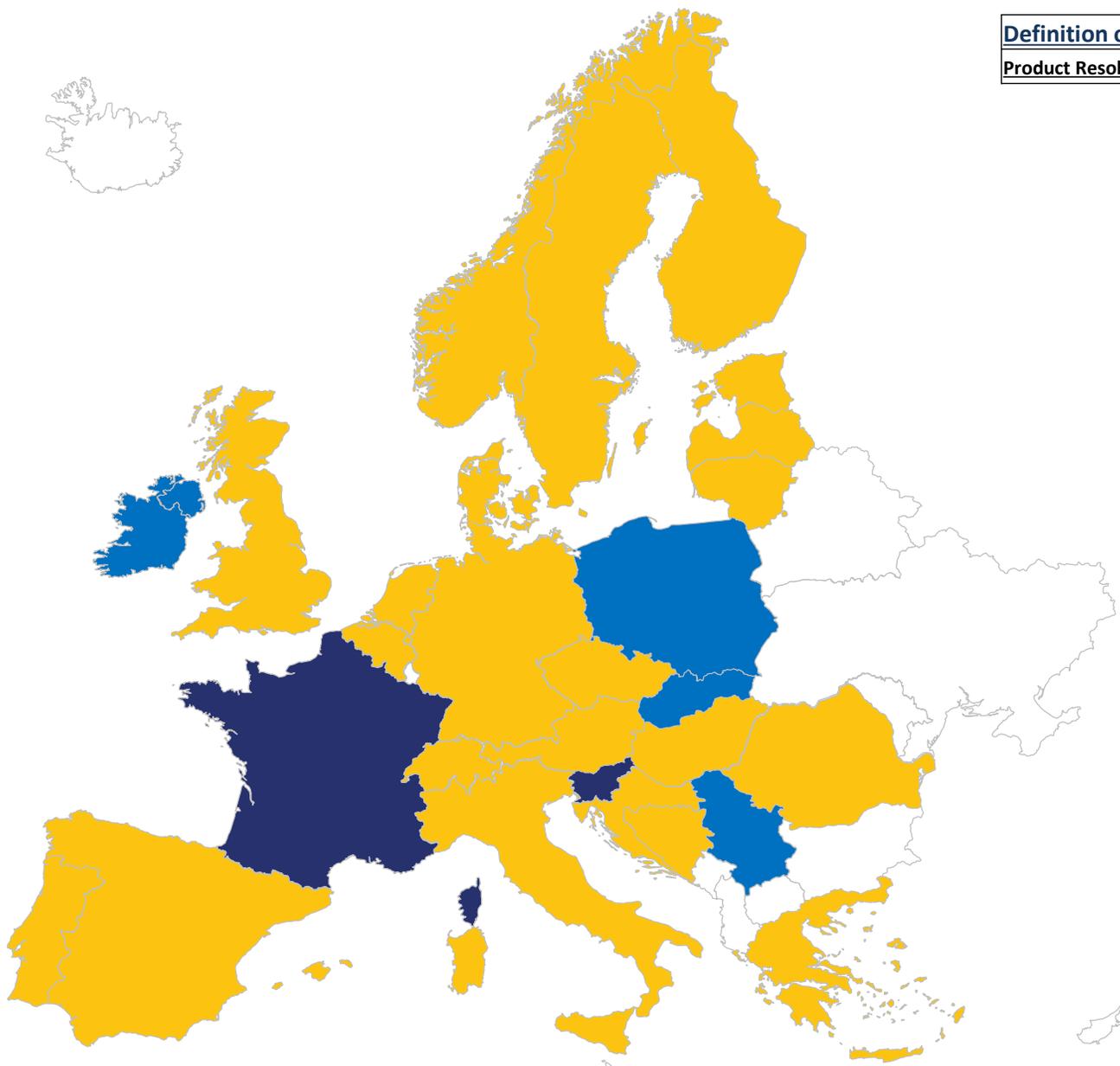
Key:

| | |
|--|-----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only, |
| | Hybrid |

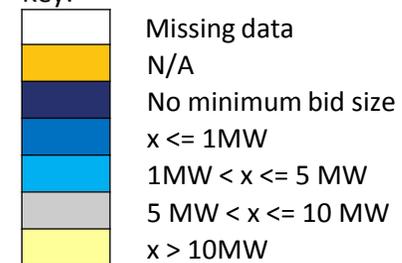
Frequency Containment Reserve - Energy - Product Resolution (in MW)

Definition of question

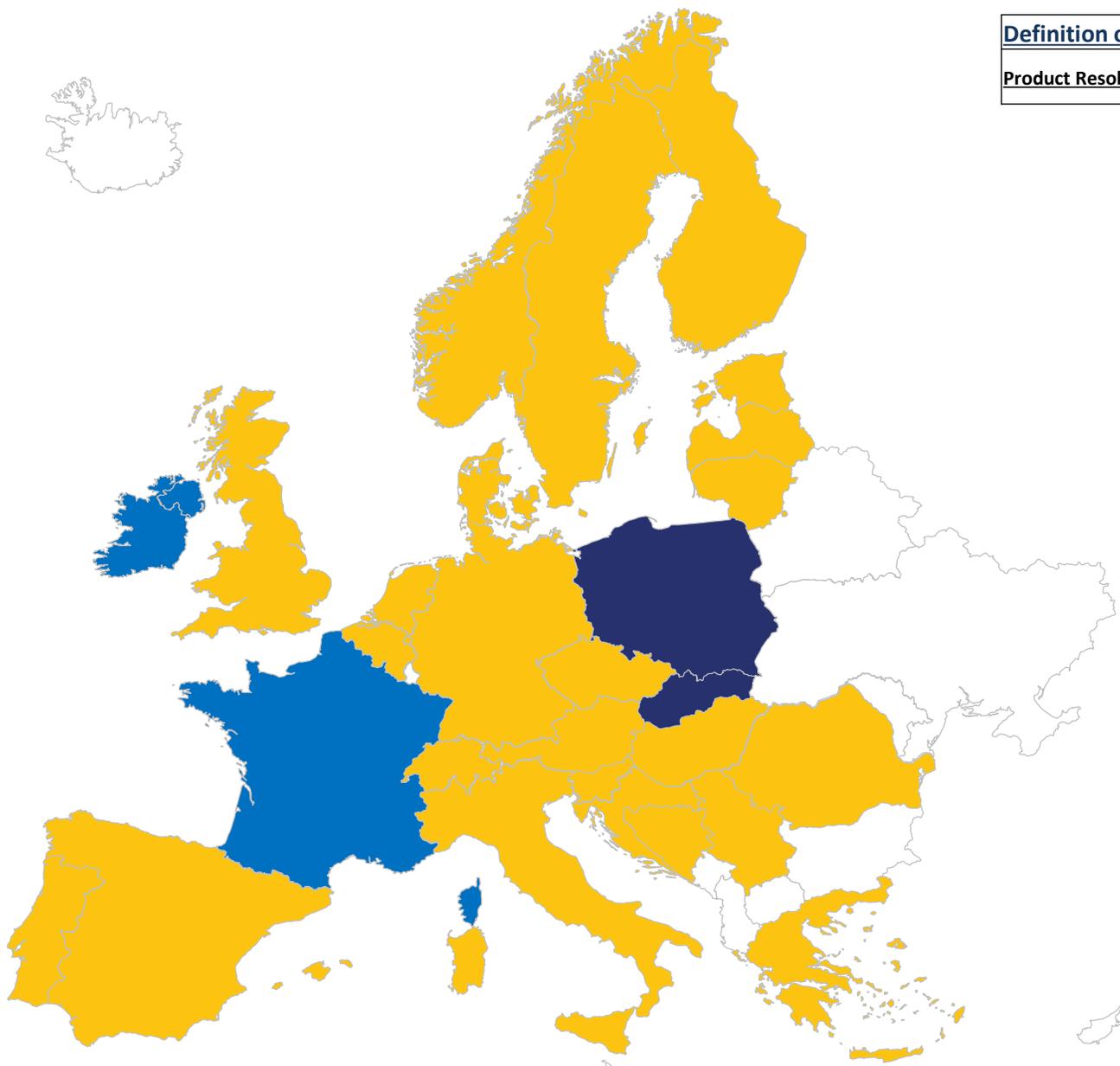
| | |
|-----------------------------------|---|
| Product Resolution (in MW) | The minimum bid size into the balancing market. |
|-----------------------------------|---|



Key:



Frequency Containment Reserve - Energy - Product Resolution (in time)



Definition of question

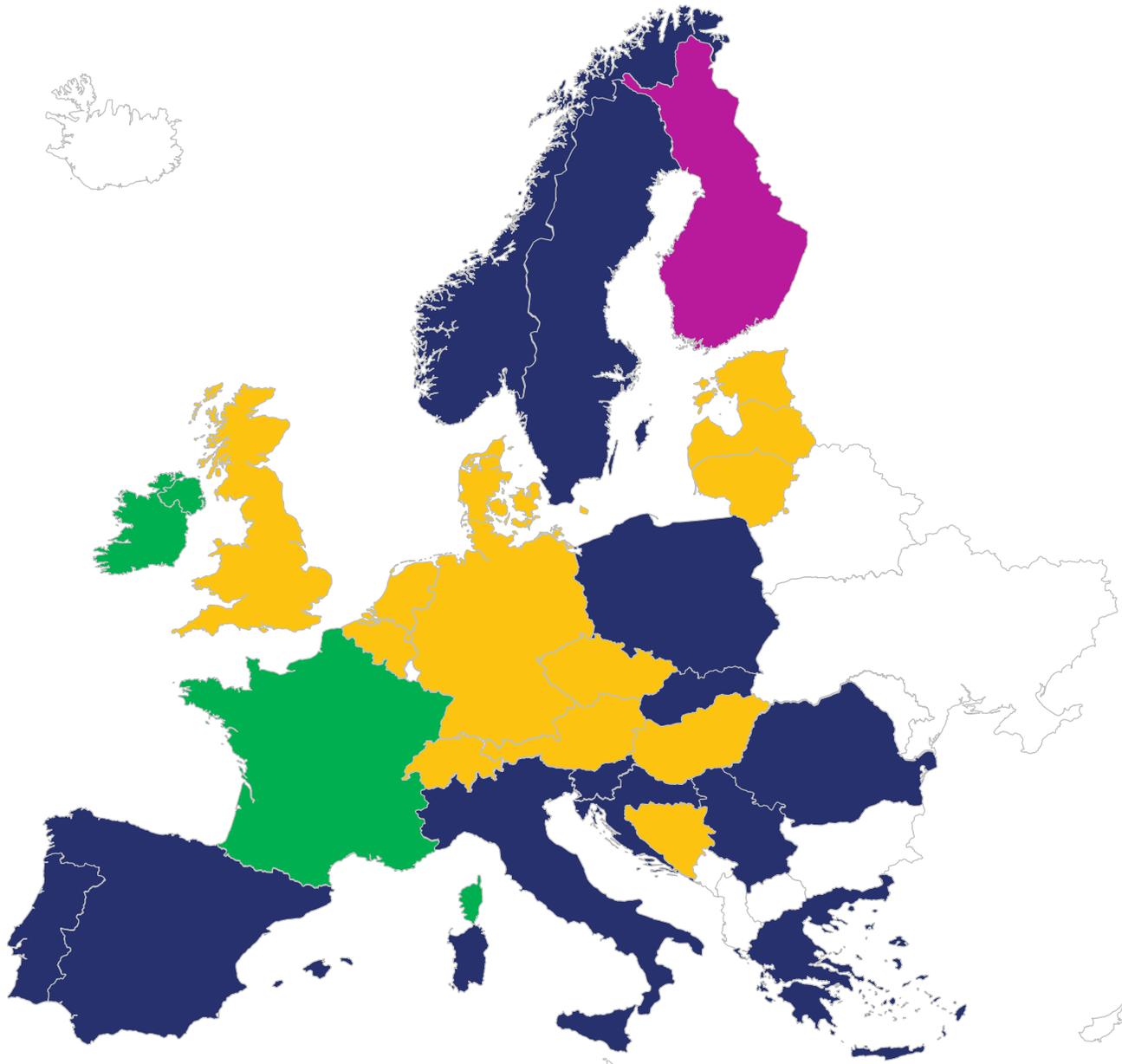
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|------------------|------------------|
| Missing data | Missing data |
| N/A | N/A |
| Hour (or blocks) | Hour (or blocks) |
| 30 minutes | 30 minutes |
| 15 minutes | 15 minutes |

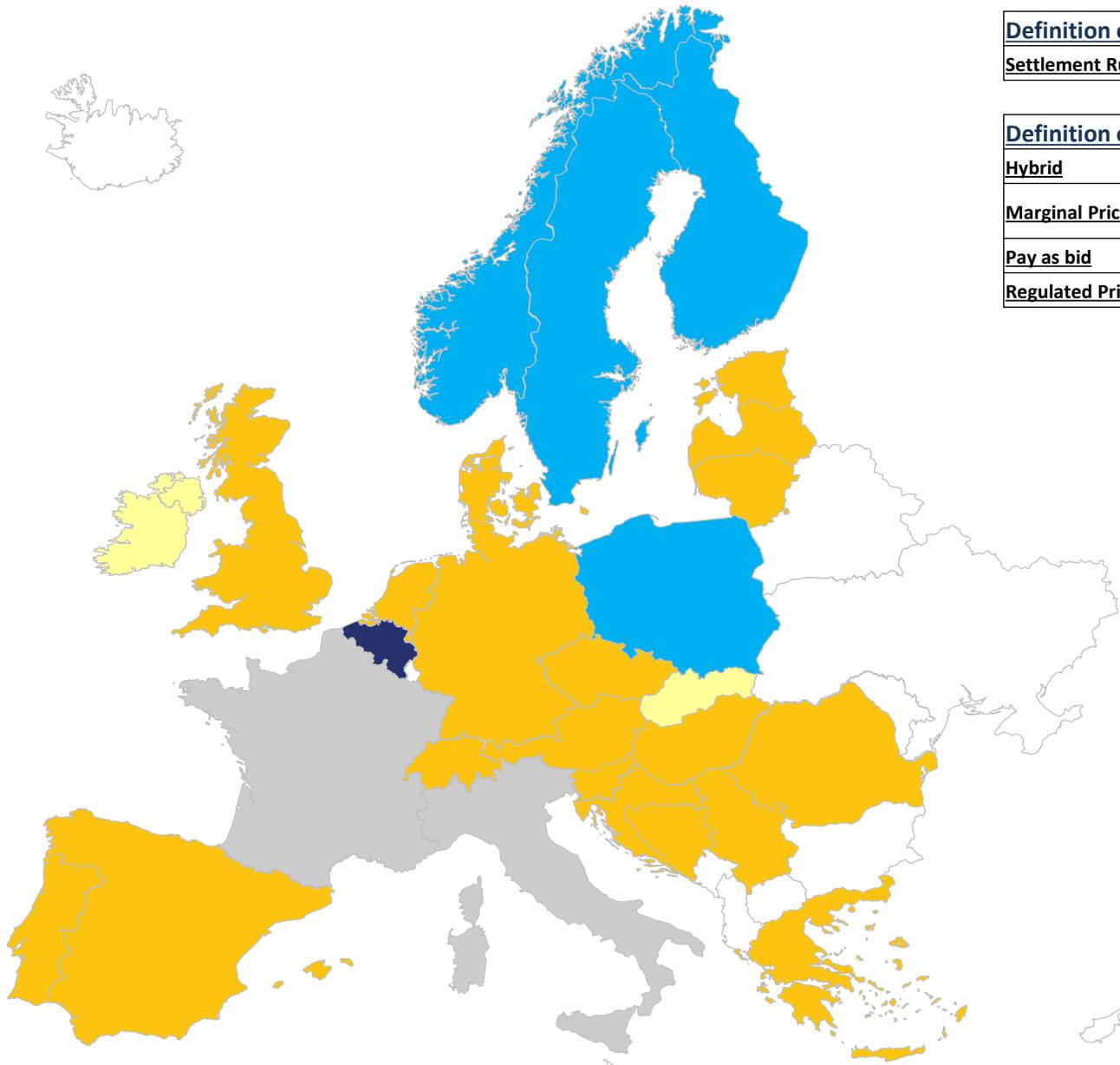
Frequency Containment Reserve - Energy - Provider



Key:

| | |
|--------------|--|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Generators Only |
| Blue | Generators + Load |
| Cyan | Generators + Pump Storage |
| Grey | Generators + Load + Pump Storage |
| Light Yellow | Batteries |
| Magenta | Generators + Load + Batteries |
| Green | Generators + Load + Pump Storage + Batteries |

Frequency Containment Reserve - Energy - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

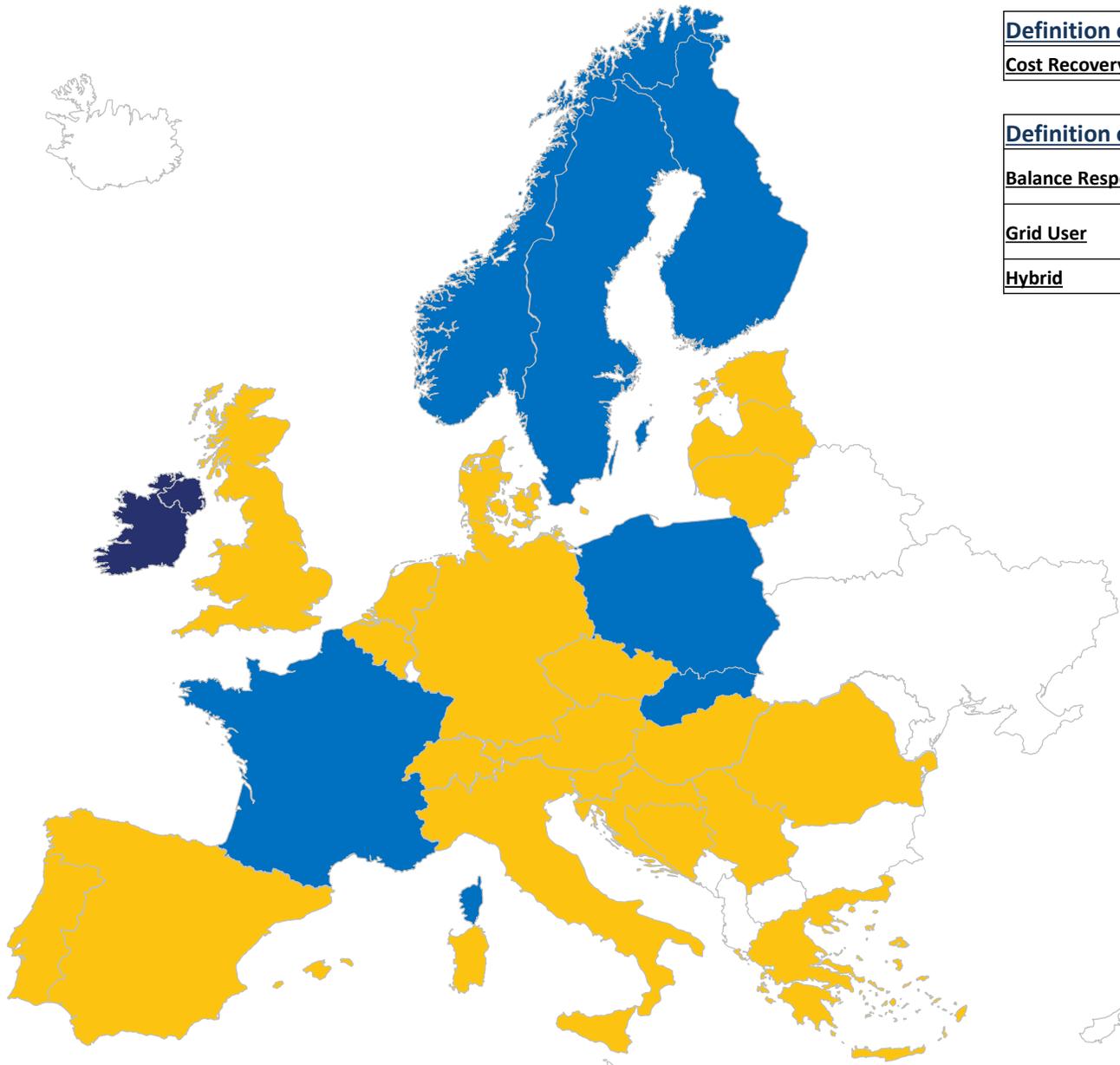
Definition of answer

| | |
|-------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|---|------------------|
|  | Missing data |
|  | N/A |
|  | No settlement |
|  | Pay as bid |
|  | Marginal Pricing |
|  | Regulated Price |
|  | Hybrid |

Frequency Containment Reserve - Energy - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

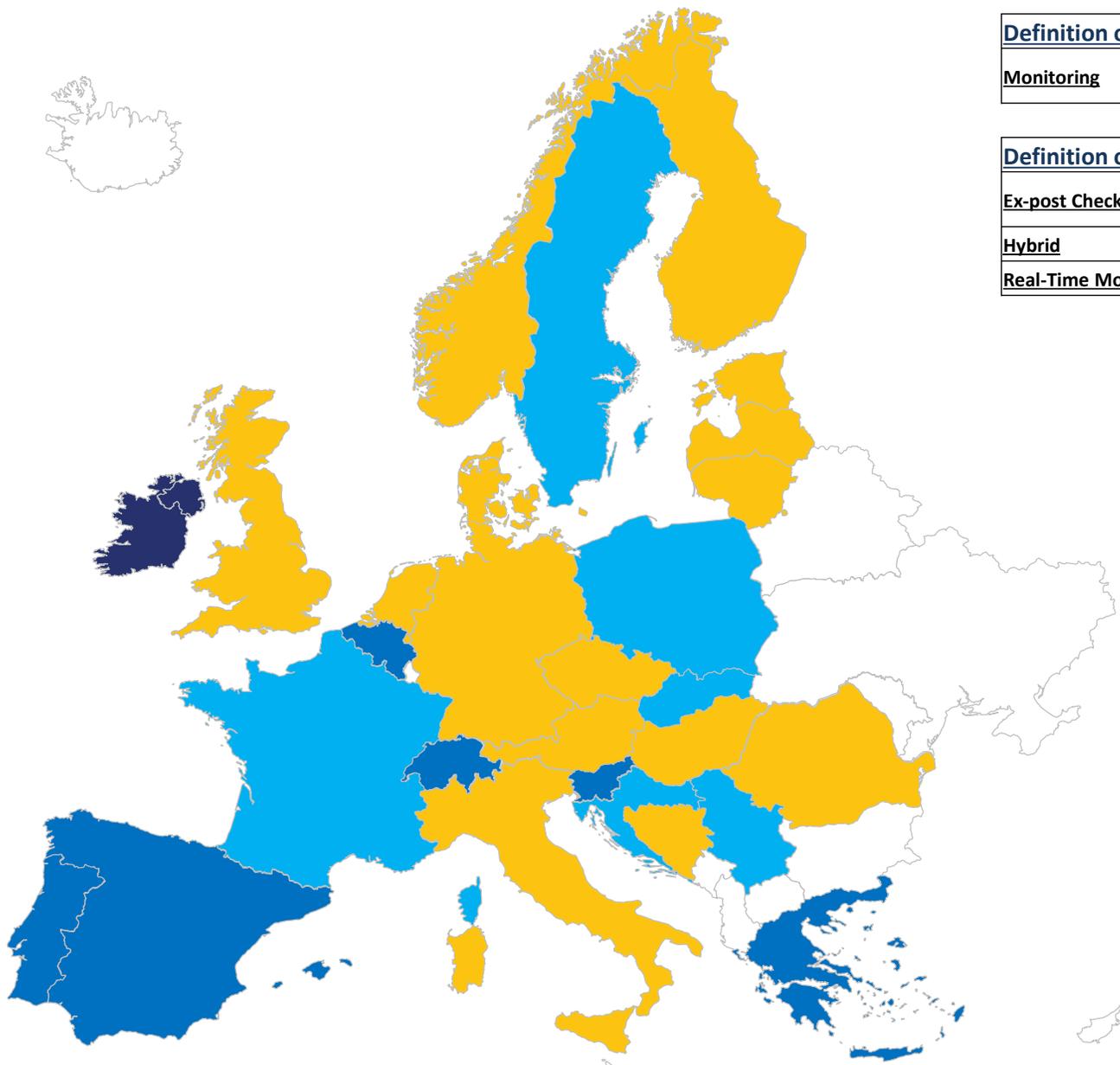
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|--|----------------------------------|
| | Missing data |
| | N/A |
| | 100% Grid Users (through tariff) |
| | 100% BRP |
| | Hybrid |

Frequency Containment Reserve - Energy - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

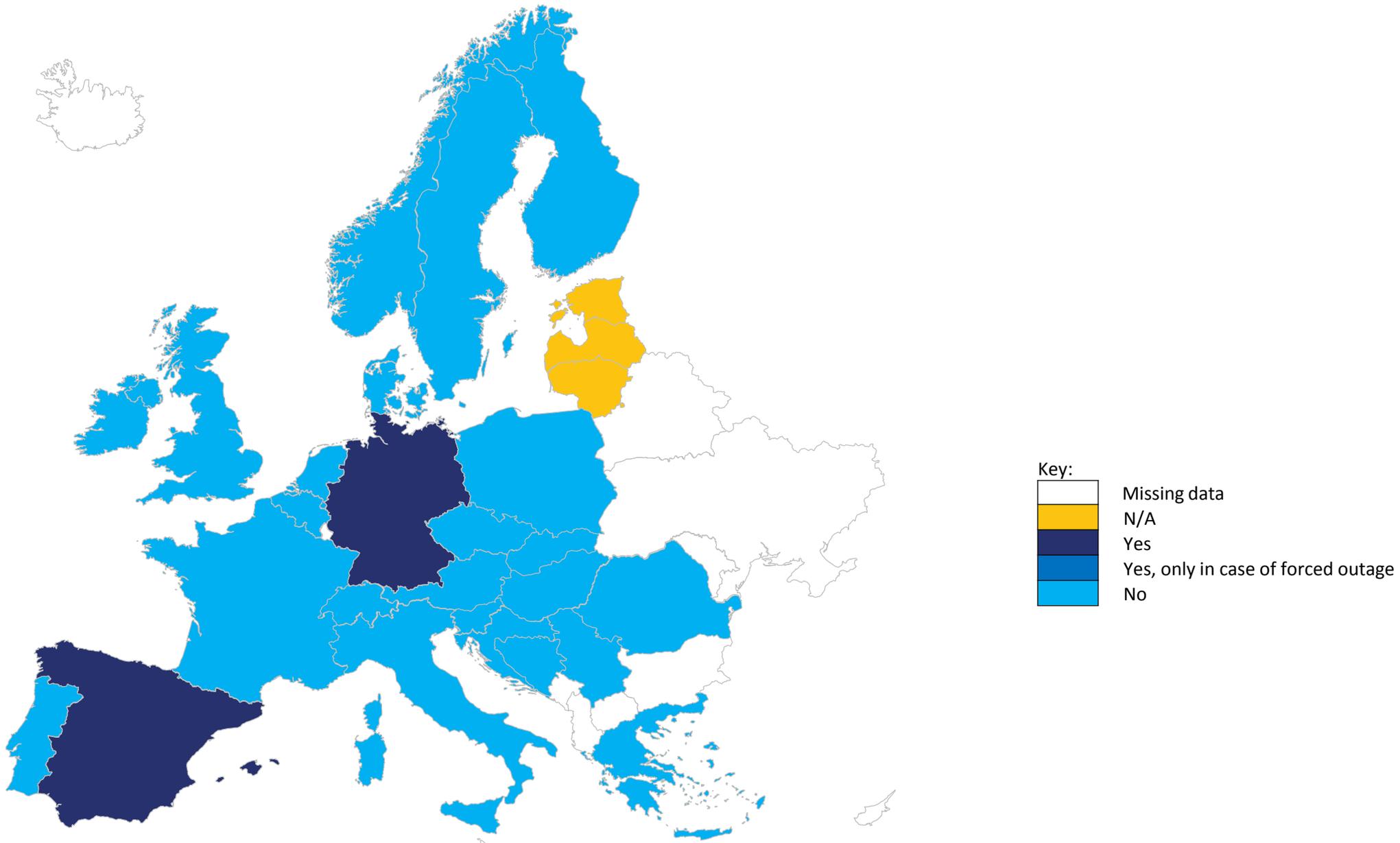
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

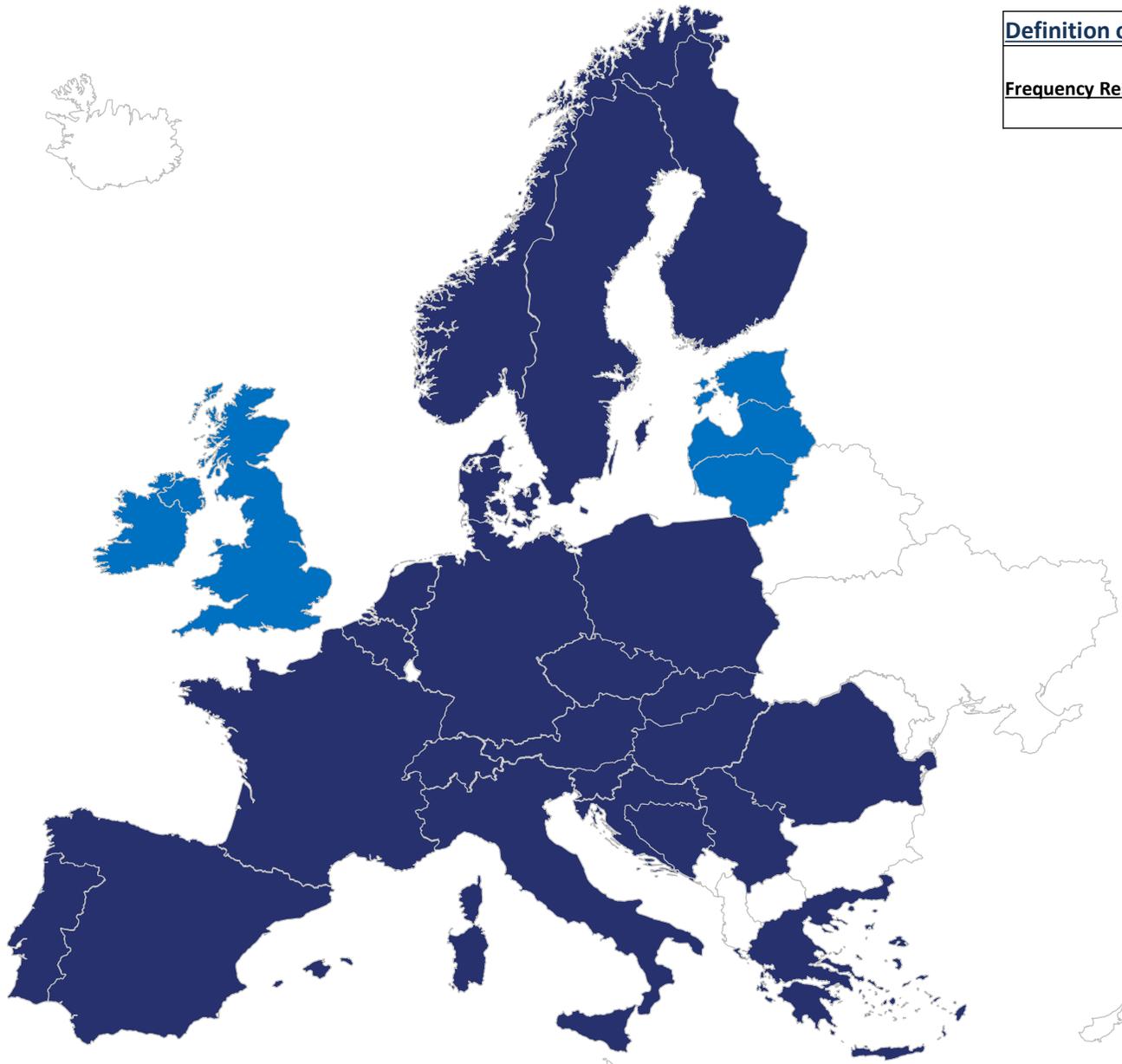
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real-Time Monitoring |
| | Ex-Post Check |
| | Hybrid |

Frequency Containment Reserve - Energy - Transfer of BSPs obligation allowed



Using Frequency Restoration Reserve (Automatic)



Definition of question

Frequency Restoration Reserve (FRR)

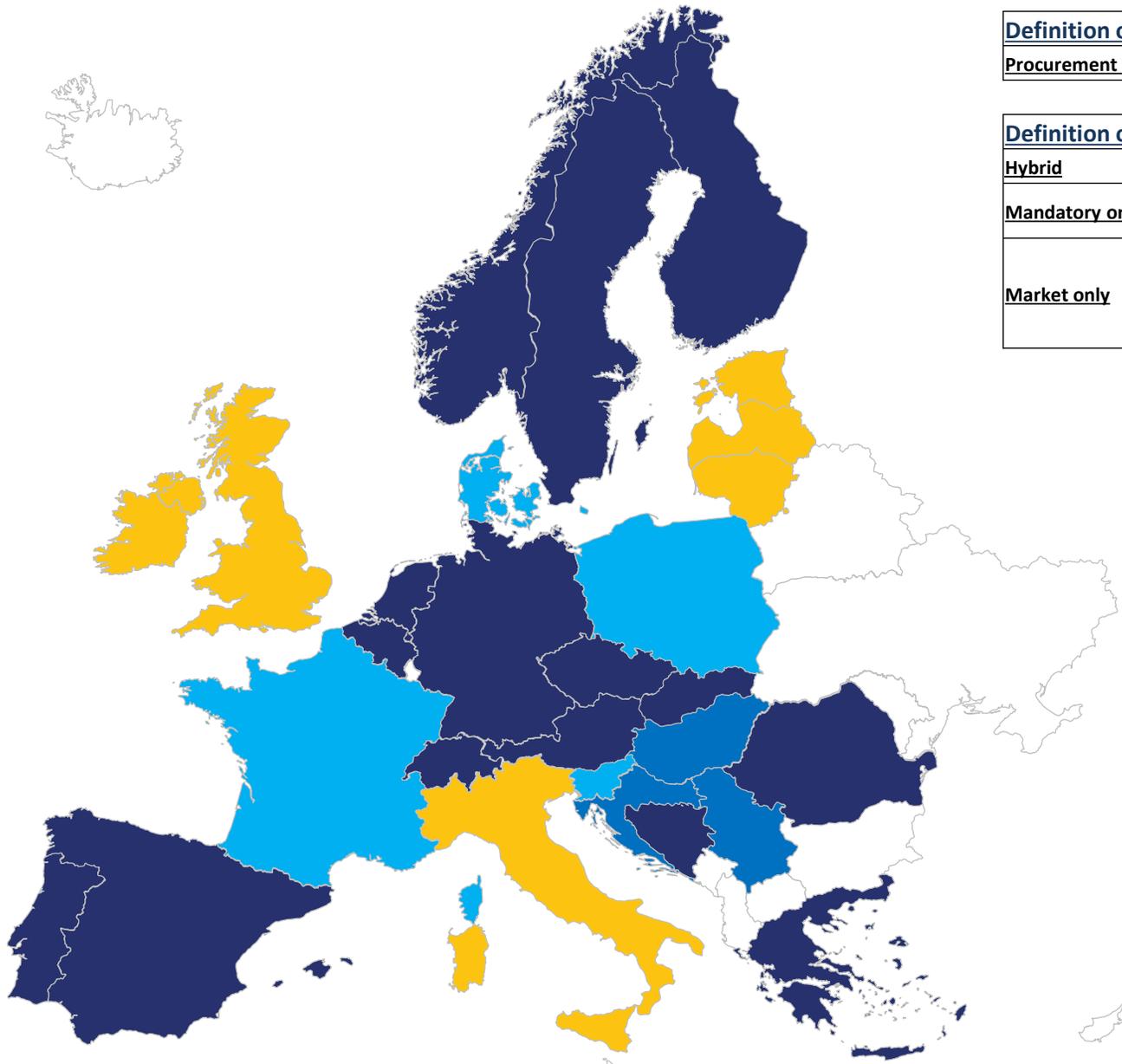
Reserves activated to restore System Frequency to the Nominal Frequency and, where applicable, power balance to the scheduled value.

aFRR means automatic FRR, mFRR means manual FRR.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Frequency Restoration Reserve (Automatic) - Capacity - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

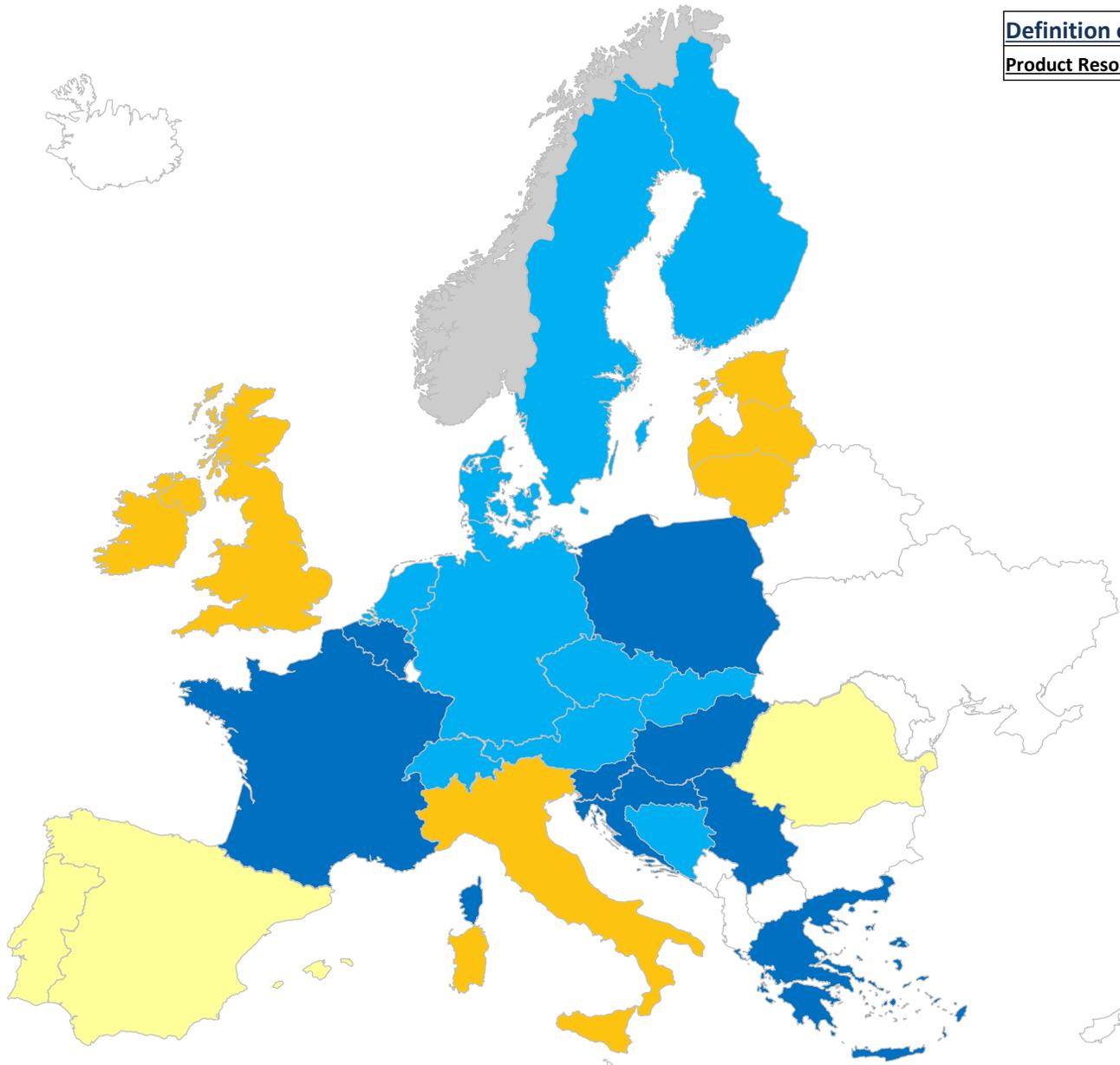
Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Frequency Restoration Reserve (Automatic) - Capacity - Product Resolution (in MW)



Definition of question

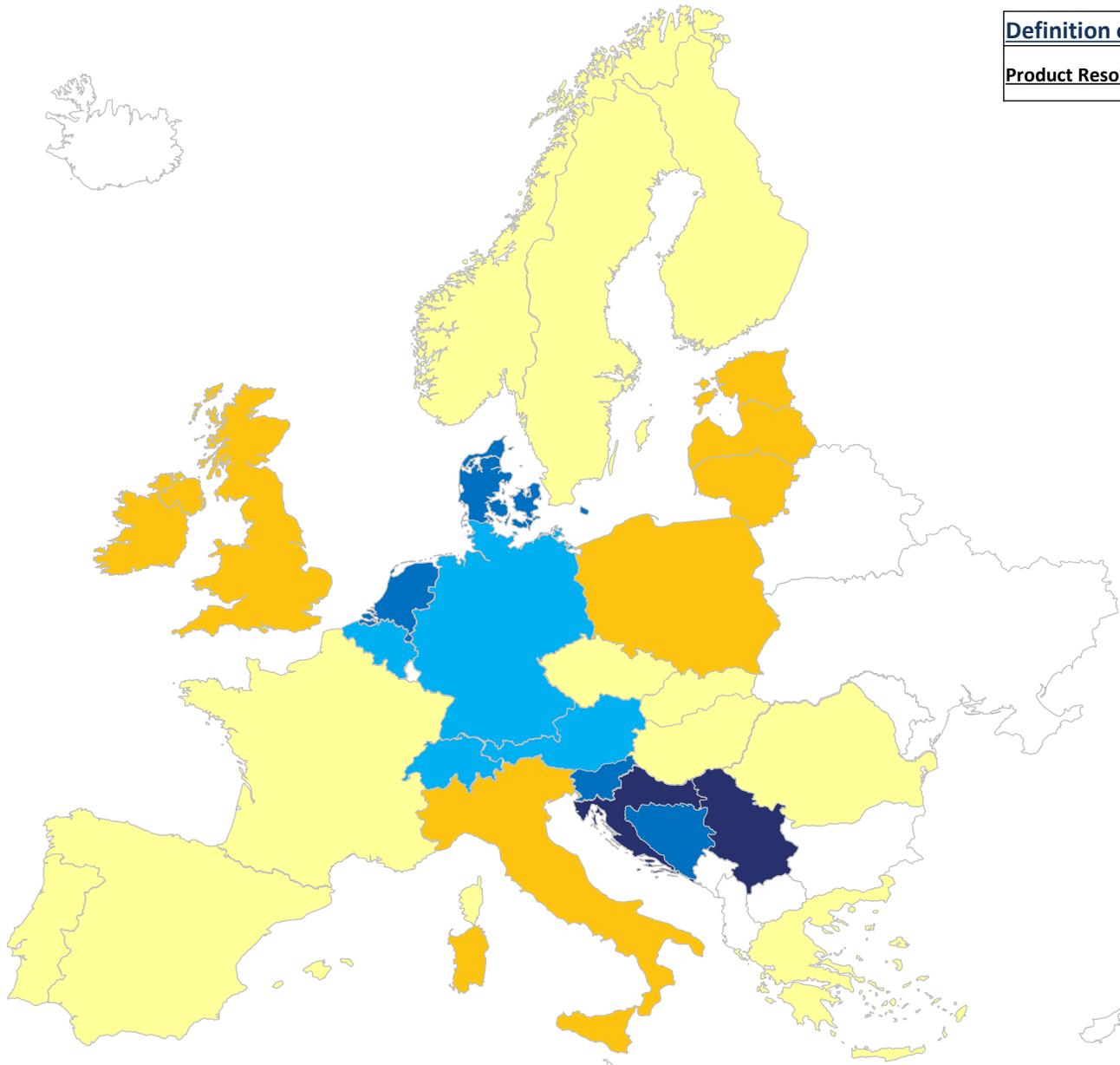
Product Resolution (in MW)

The minimum bid size into the balancing market.

Key:

| | |
|--|-----------------------------------|
| | Missing data |
| | N/A |
| | No minimum bid size |
| | $x \leq 1\text{MW}$ |
| | $1\text{MW} < x \leq 5\text{MW}$ |
| | $5\text{MW} < x \leq 10\text{MW}$ |
| | $x > 10\text{MW}$ |

Frequency Restoration Reserve (Automatic) - Capacity - Product Resolution (in time)



Definition of question

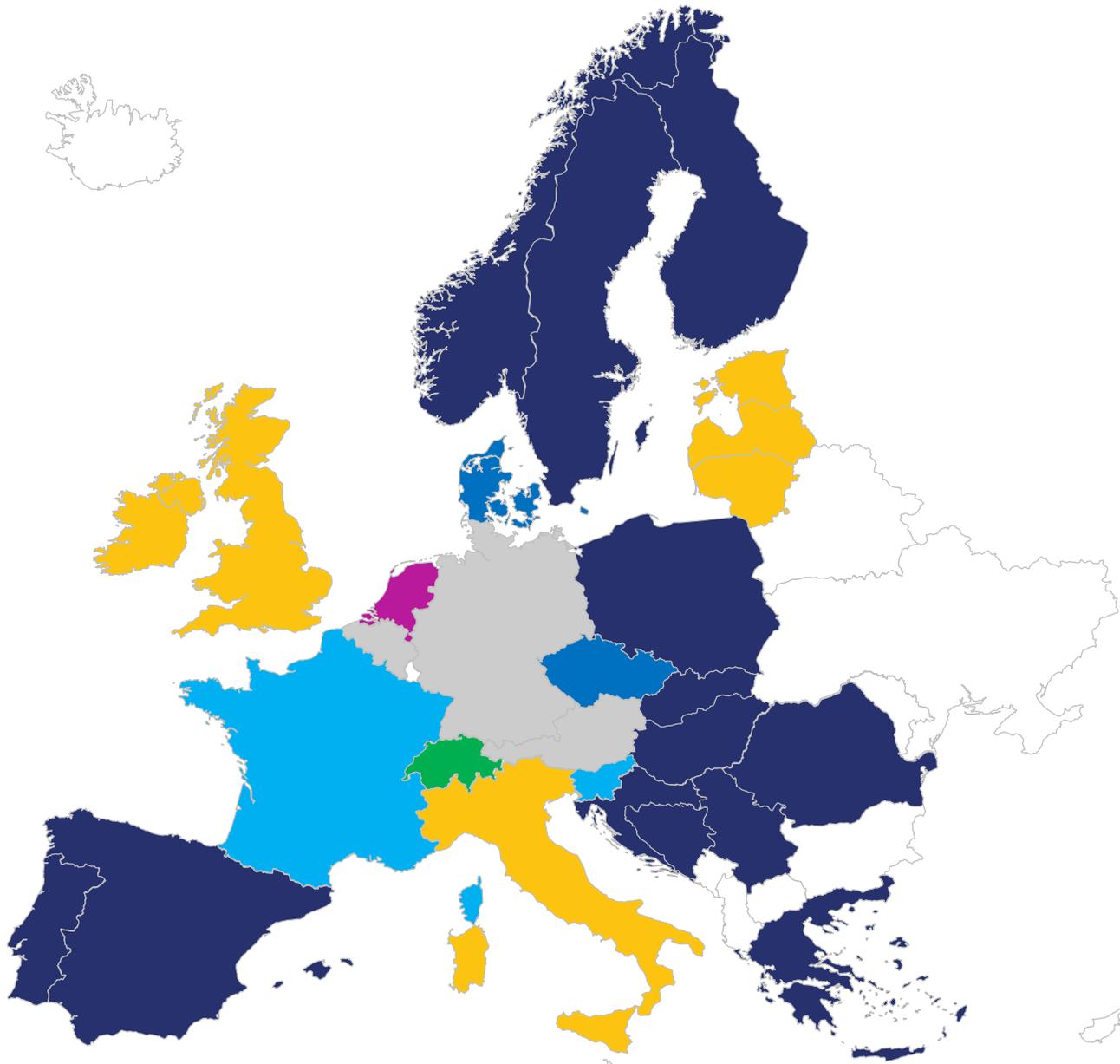
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Year or more |
| | Month(s) |
| | Week(s) |
| | Day(s) |
| | Hour(s) |

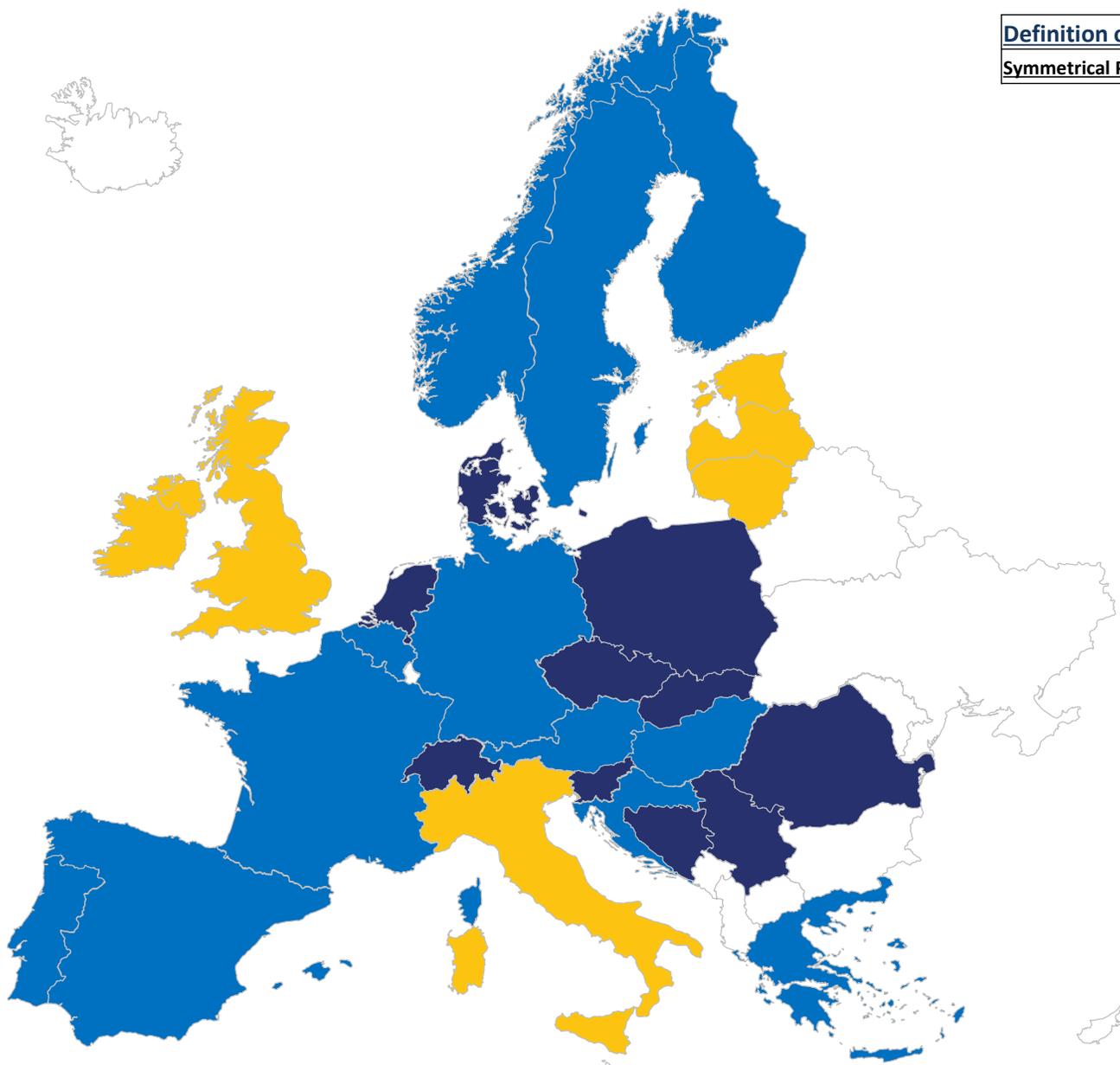
Frequency Restoration Reserve (Automatic) - Capacity - Provider



Key:

| |
|--|
| Missing data |
| N/A |
| Generators Only |
| Generators + Load |
| Generators + Pump Storage |
| Generators + Load + Pump Storage |
| Batteries |
| Generators + Load + Batteries |
| Generators + Load + Pump Storage + Batteries |

Frequency Restoration Reserve (Automatic) - Capacity - Symmetrical Product



Definition of question

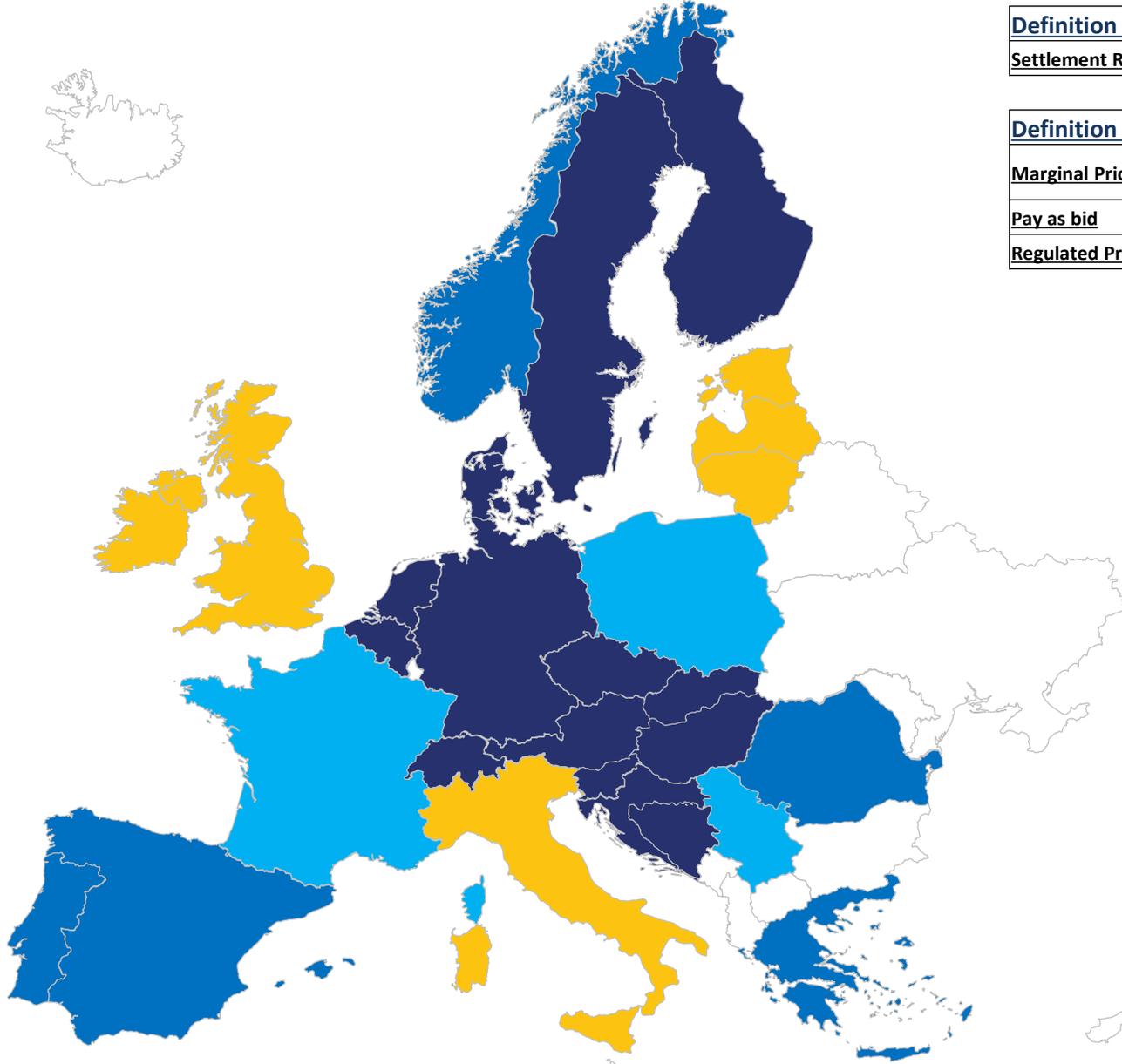
Symmetrical Product

Upward regulation volume and for downward regulation volume has to be equal.

Key:

| | |
|--|------------------------------|
| | Missing data |
| | N/A |
| | Has to be symmetrical |
| | Don't need to be symmetrical |

Frequency Restoration Reserve (Automatic) - Capacity - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

Definition of answer

| | |
|-------------------------|--|
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
|-------------------------|--|

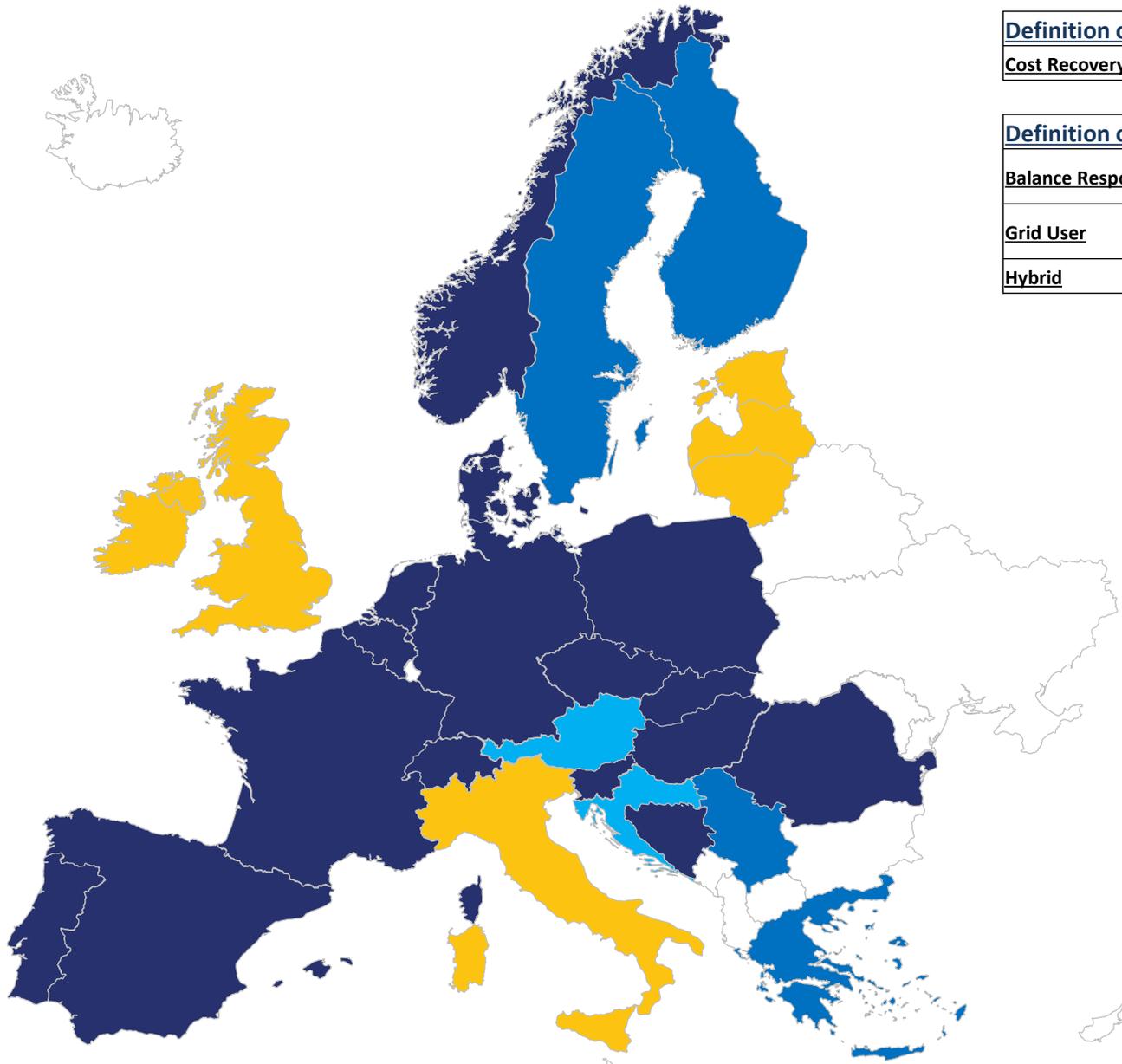
| | |
|-------------------|---|
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
|-------------------|---|

| | |
|------------------------|--|
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |
|------------------------|--|

Key:

| | |
|--|------------------|
| | Missing data |
| | N/A |
| | Pay as bid |
| | Marginal Pricing |
| | Regulated Price |

Frequency Restoration Reserve (Automatic) - Capacity - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

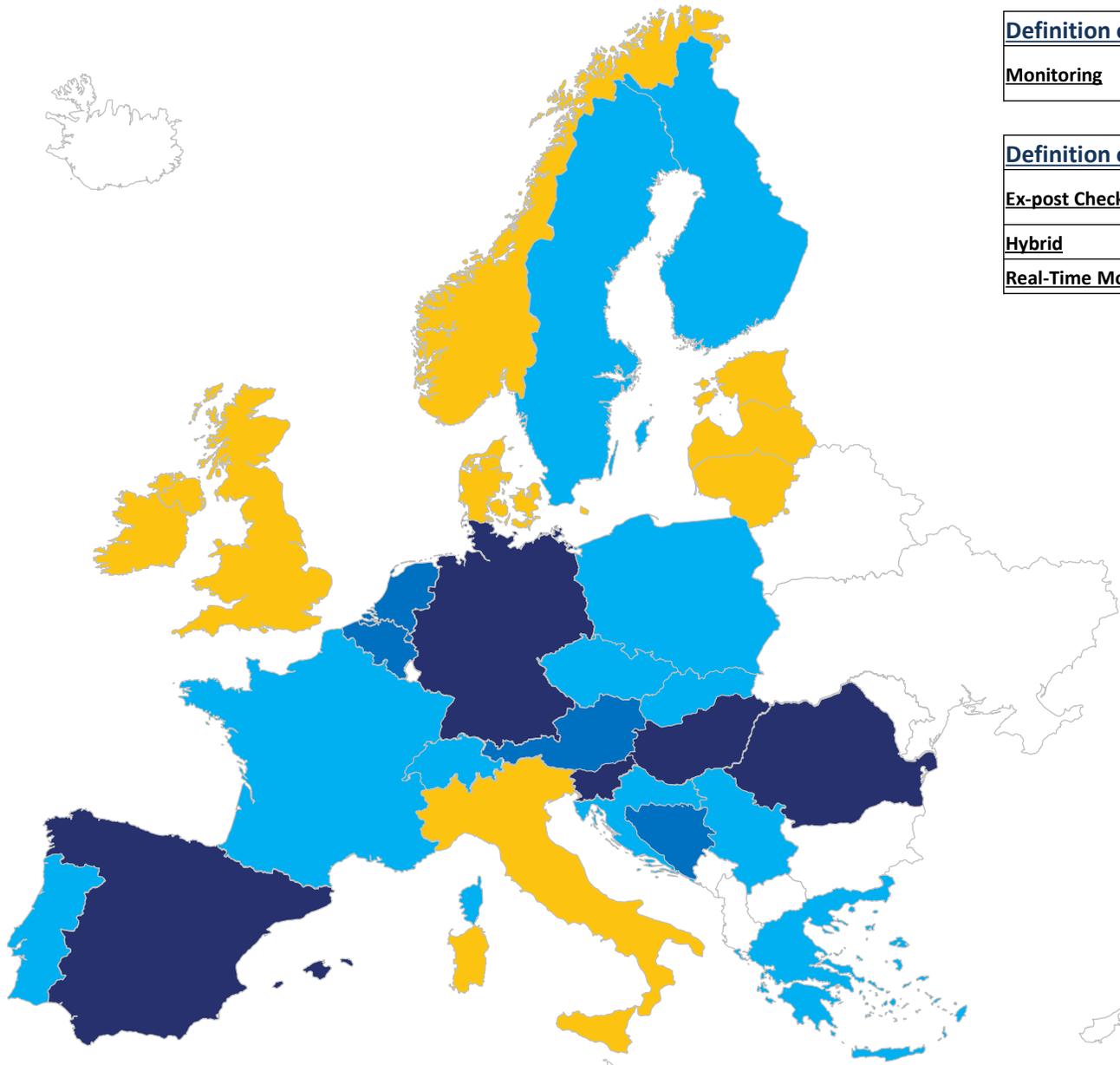
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|--|----------------------------------|
| | Missing data |
| | N/A |
| | 100% Grid Users (through tariff) |
| | 100% BRP |
| | Hybrid |

Frequency Restoration Reserve (Automatic) - Capacity - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

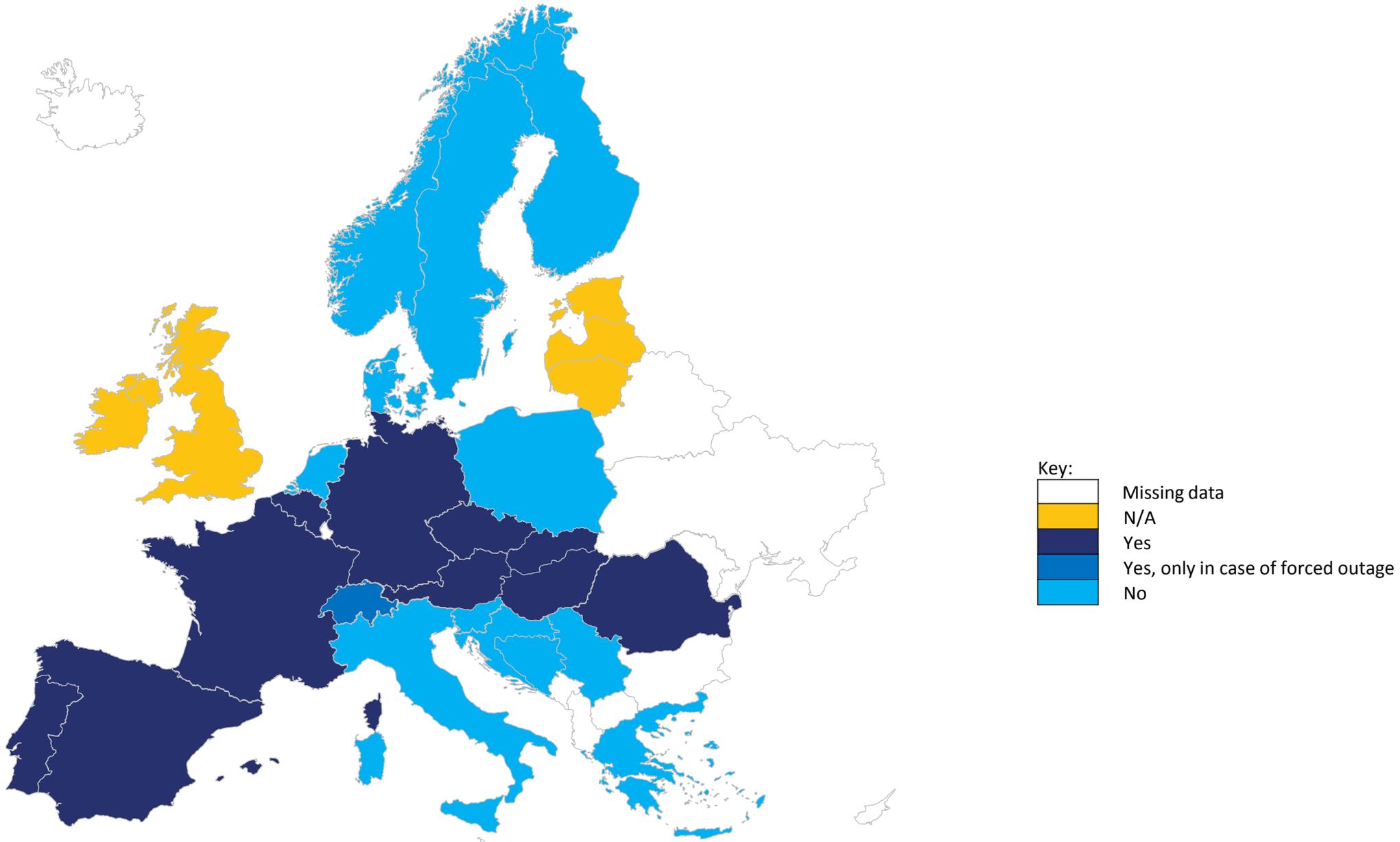
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

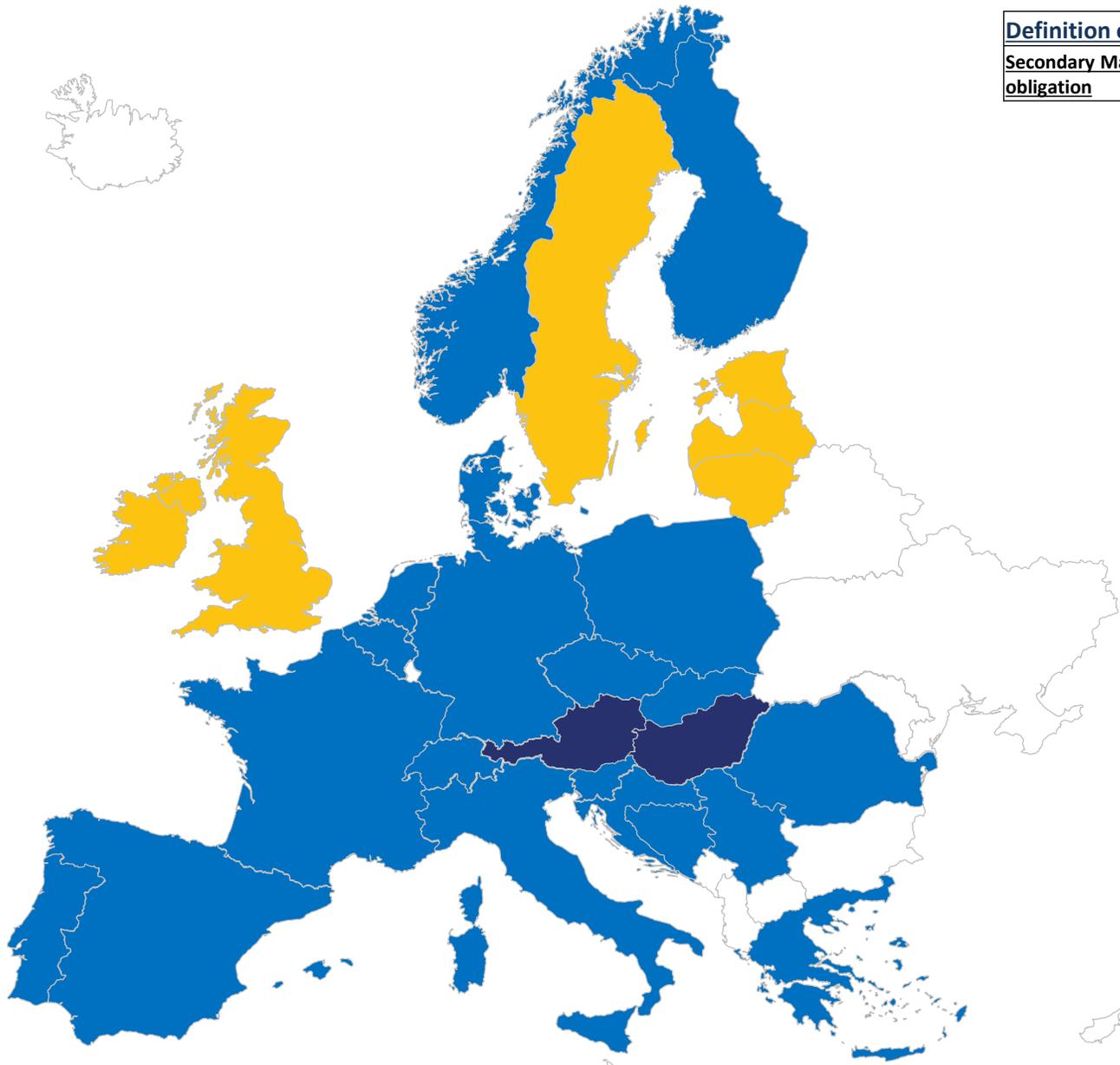
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real-Time Monitoring |
| | Ex-Post Check |
| | Hybrid |

Frequency Restoration Reserve (Automatic) - Capacity - Transfer of BSPs obligation allowed



Frequency Restoration Reserve (Automatic) - Capacity - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

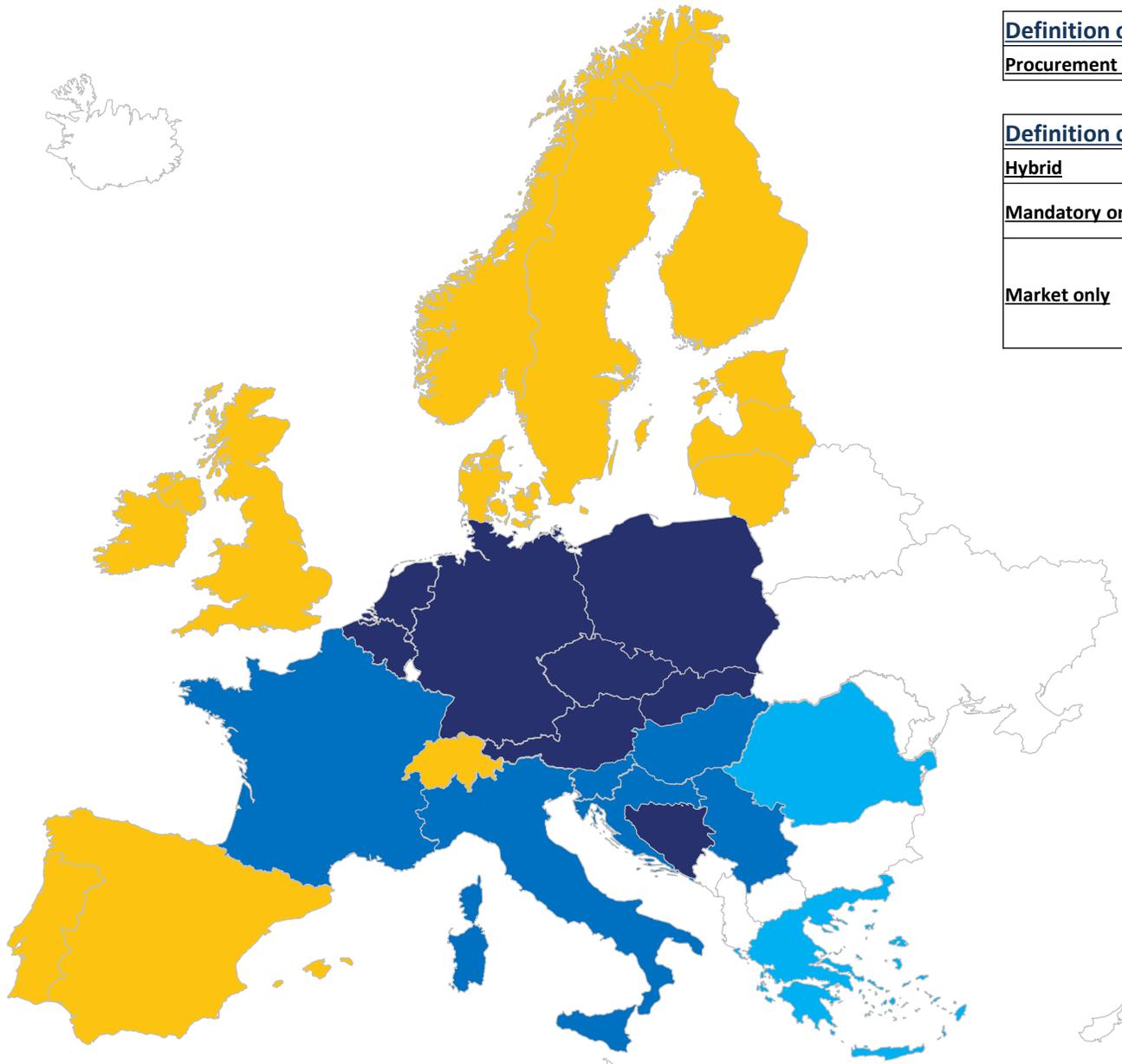
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Frequency Restoration Reserve (Automatic) - Energy - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

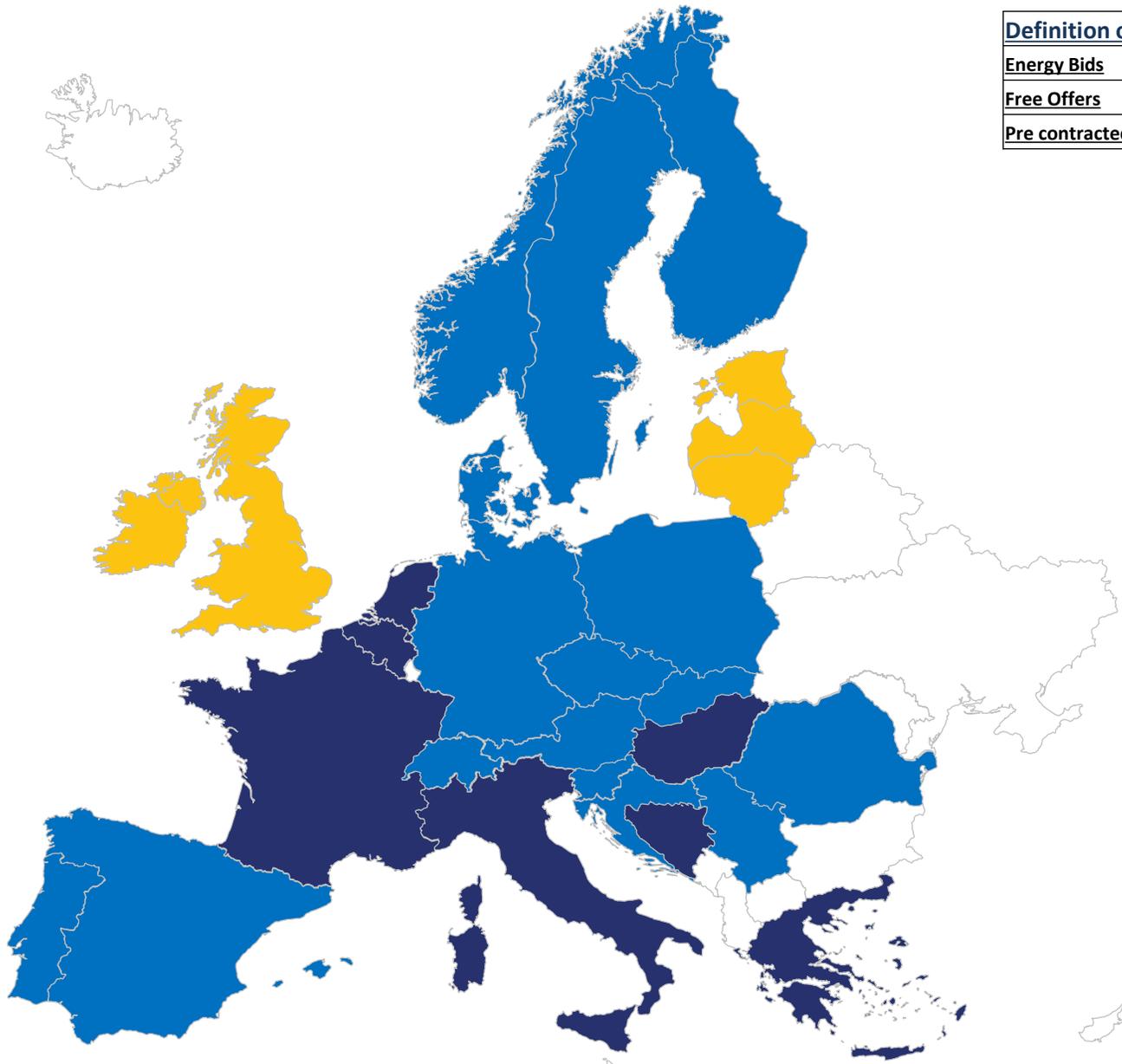
Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

Key:

| | |
|----------------|-------------|
| Missing data | White |
| N/A | Yellow |
| Market only | Dark blue |
| Mandatory only | Medium blue |
| Hybrid | Light blue |

Frequency Restoration Reserve (Automatic) - Energy - Free Bids allowed



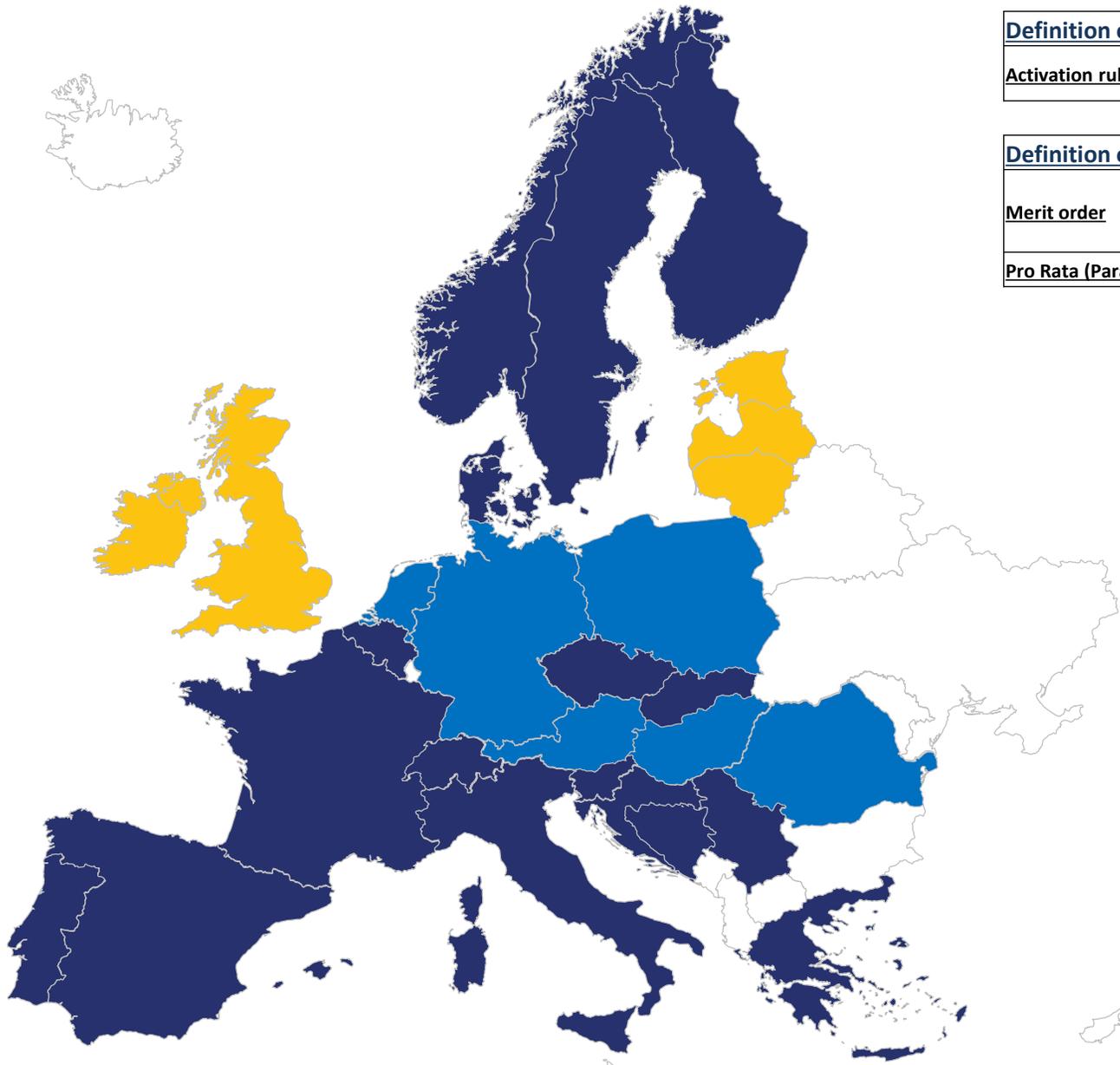
Definition of question

| | |
|-----------------------|--|
| Energy Bids | Acceptable Energy Bids. |
| Free Offers | Offers without a contract for Balancing Capacity possible. |
| Pre contracted | BSP has sold/procured Balancing Capacity. |

Key:

| | |
|--|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Frequency Restoration Reserve (Automatic) - Energy - Activation Rule



Definition of question

Activation rule

How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).

Definition of answer

Merit order

A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.

Pro Rata (Parallel Activation)

All bids always activated in parallel – proportionally.

Key:



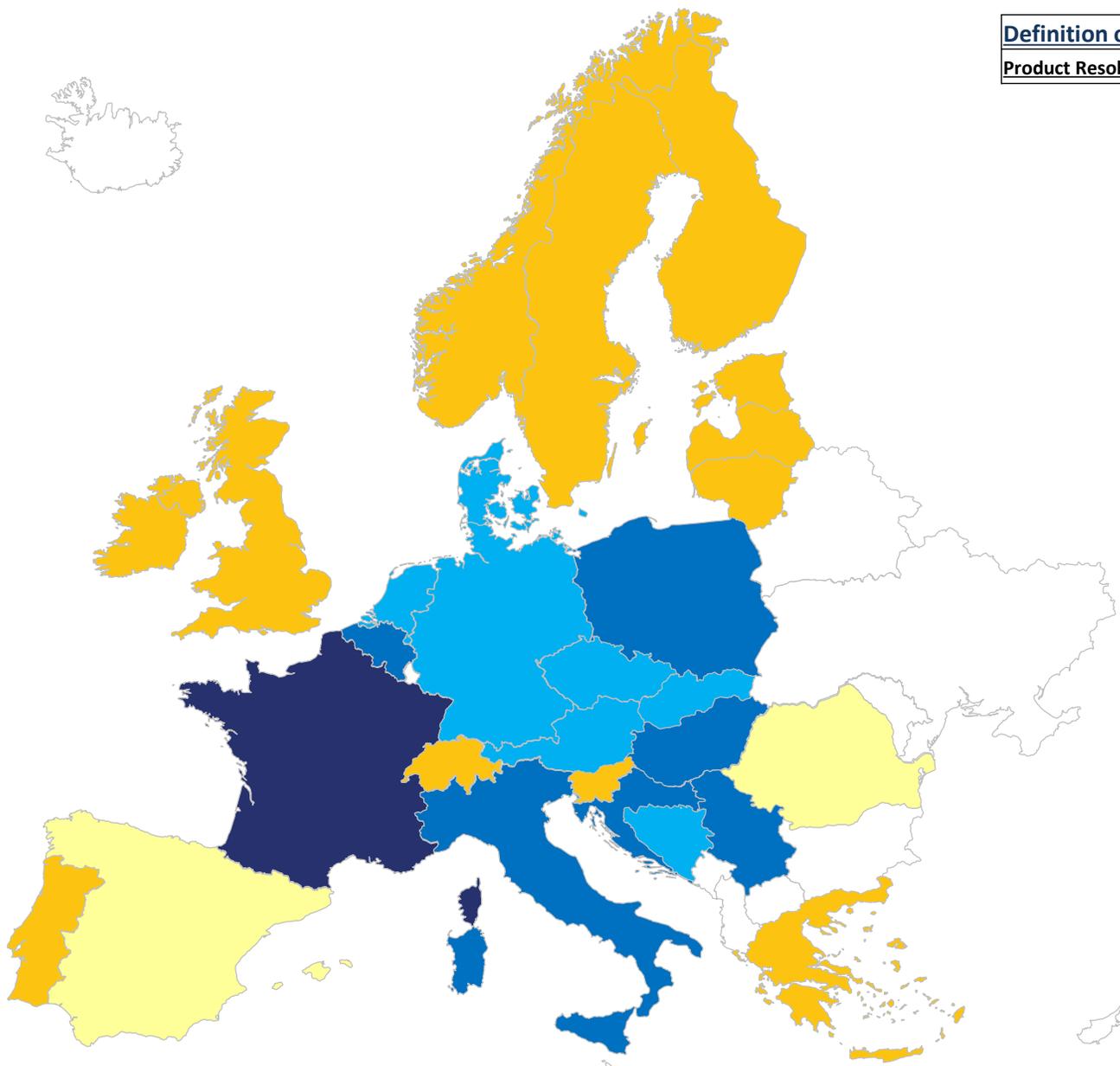
Missing data

N/A

Pro Rata (Parallel Activation)

Merit order

Frequency Restoration Reserve (Automatic) - Energy - Product Resolution (in MW)



Definition of question

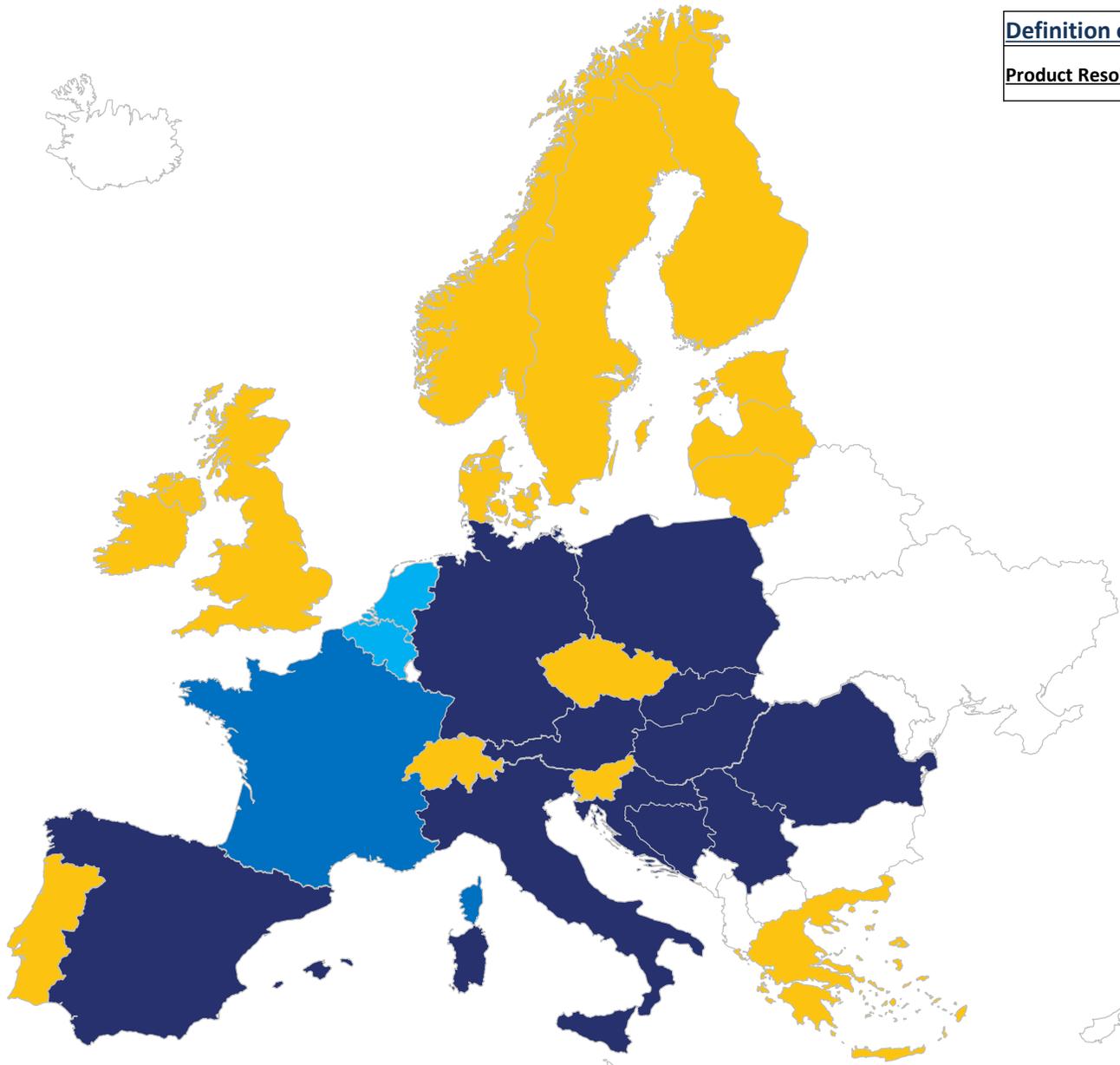
Product Resolution (in MW)

The minimum bid size into the balancing market.

Key:

| | |
|--|-----------------------------------|
| | Missing data |
| | N/A |
| | No minimum bid size |
| | $x \leq 1\text{MW}$ |
| | $1\text{MW} < x \leq 5\text{MW}$ |
| | $5\text{MW} < x \leq 10\text{MW}$ |
| | $x > 10\text{MW}$ |

Frequency Restoration Reserve (Automatic) - Energy - Product Resolution (in time)



Definition of question

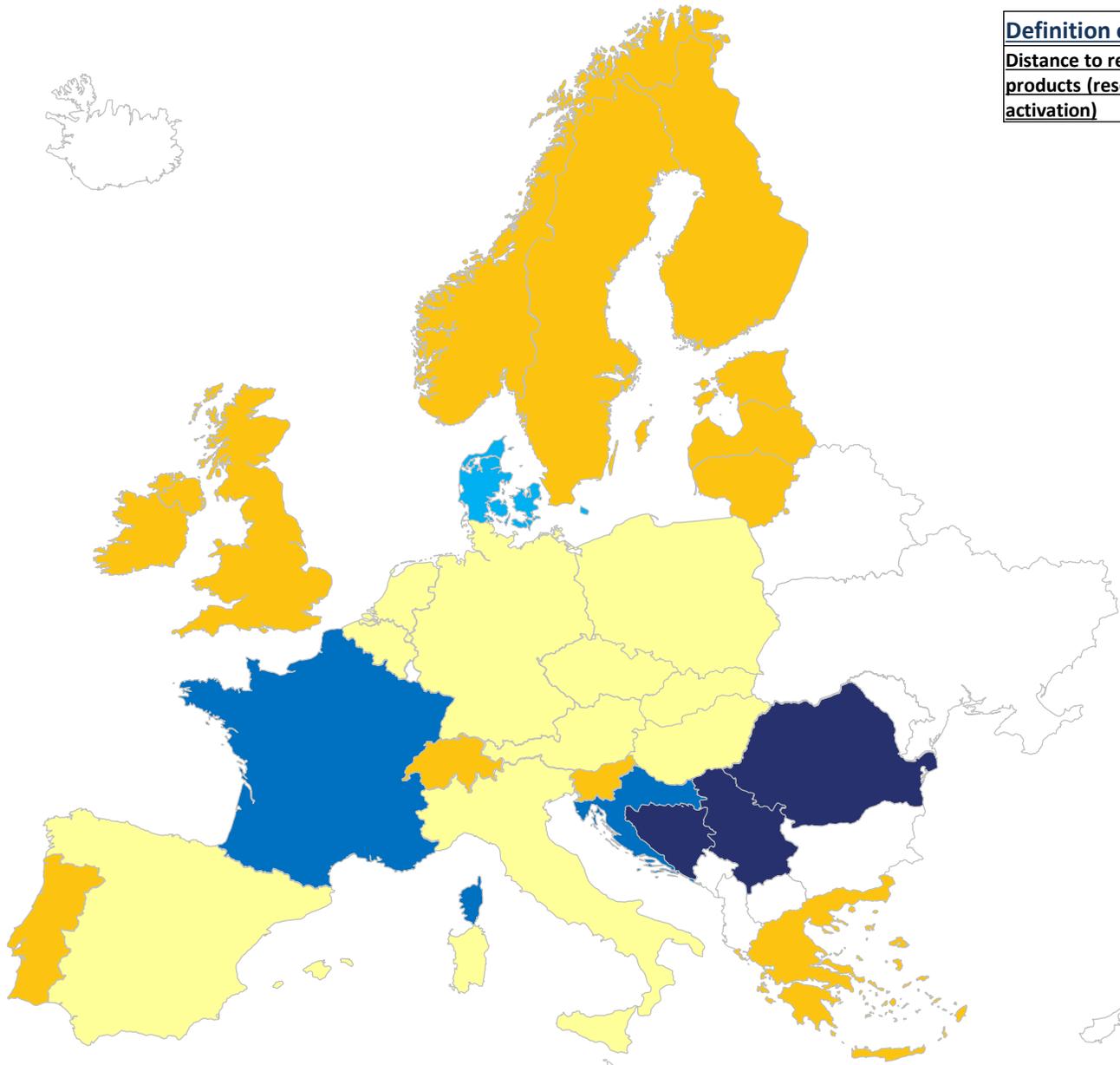
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--|------------------|
| | Missing data |
| | N/A |
| | Hour (or blocks) |
| | 30 minutes |
| | 15 minutes |

Frequency Restoration Reserve (Automatic) - Energy - Distance to real time of energy products



Definition of question

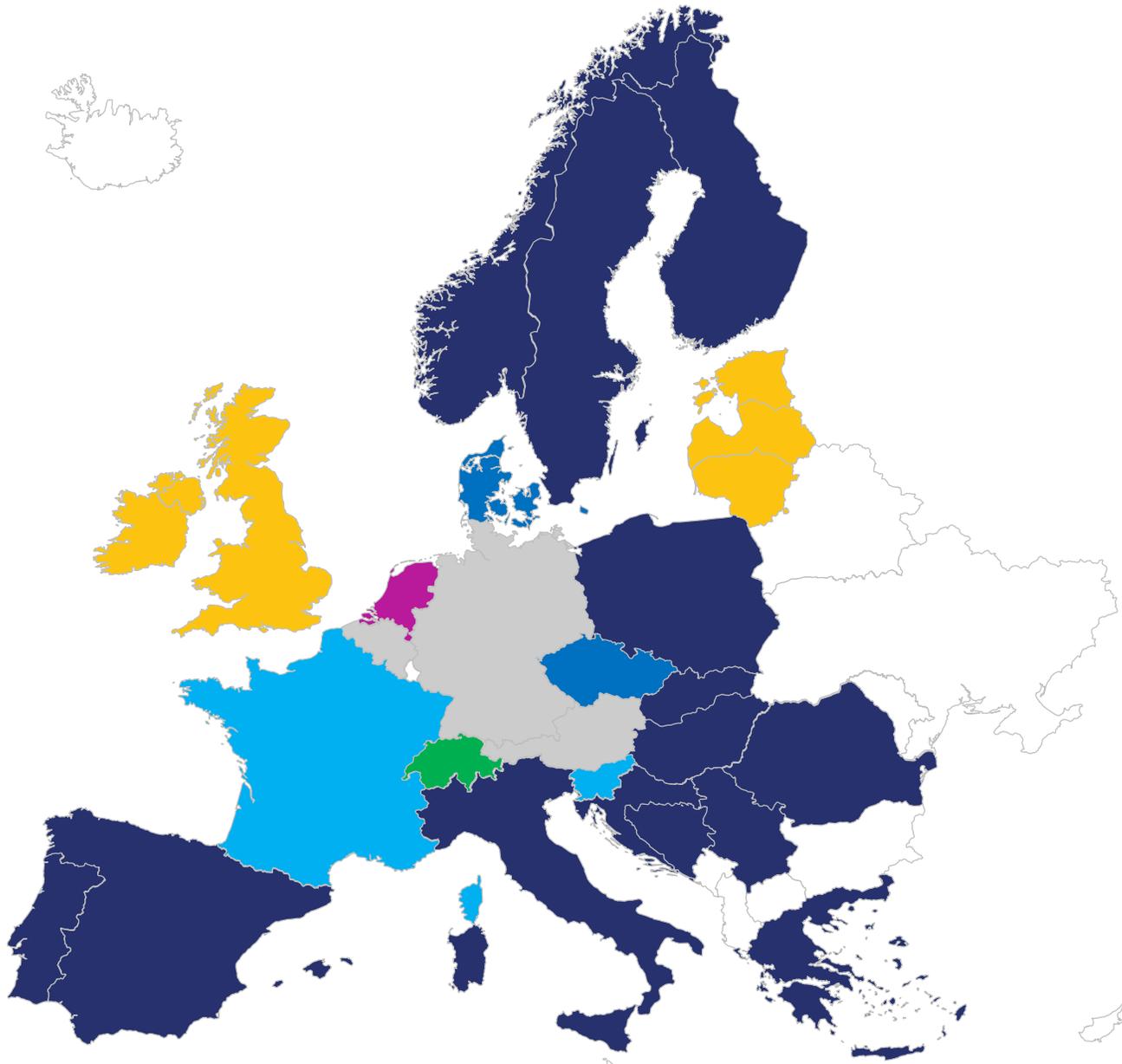
Distance to real time of energy products (reserve products activation)

The time ahead from real time when TSO activates a given product (for instance 15 minutes in the case of mFRR/tertiary energy).

Key:

| | |
|---|---|
| Missing data | Missing data |
| N/A | N/A |
| $x > H-1$ | $x > H-1$ |
| $15 \text{ minutes} < x \leq H-1$ | $15 \text{ minutes} < x \leq H-1$ |
| $5 \text{ minutes} < x \leq 15 \text{ minutes}$ | $5 \text{ minutes} < x \leq 15 \text{ minutes}$ |
| $1 \text{ minute} < x \leq 5 \text{ minutes}$ | $1 \text{ minute} < x \leq 5 \text{ minutes}$ |
| $x \leq 1 \text{ minute}$ | $x \leq 1 \text{ minute}$ |
| Depends on the unit | Depends on the unit |

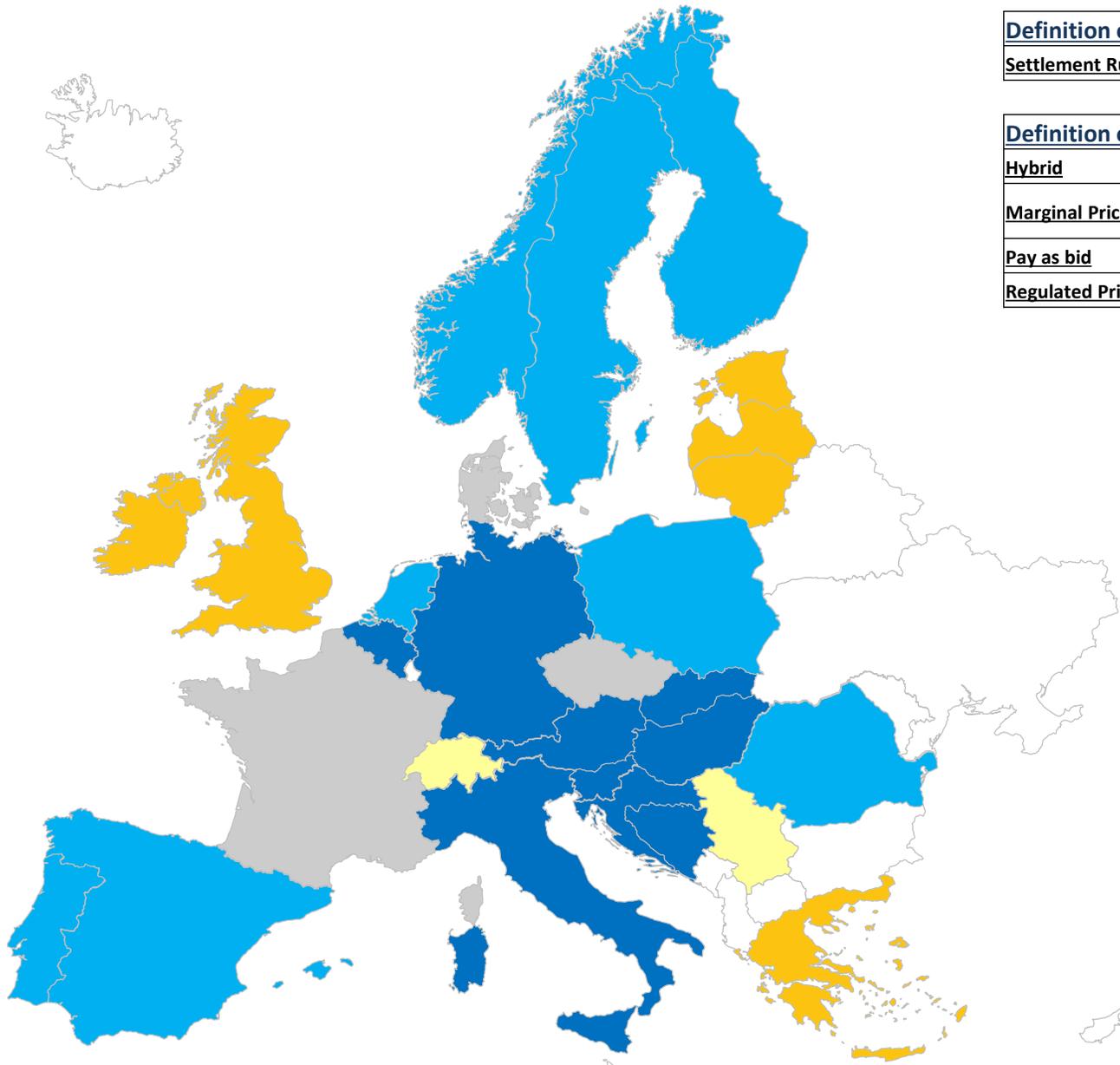
Frequency Restoration Reserve (Automatic) - Energy - Provider



Key:

| | |
|-------------|--|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Generators Only |
| Medium Blue | Generators + Load |
| Light Blue | Generators + Pump Storage |
| Grey | Generators + Load + Pump Storage |
| Yellow | Batteries |
| Magenta | Generators + Load + Batteries |
| Green | Generators + Load + Pump Storage + Batteries |

Frequency Restoration Reserve (Automatic) - Energy - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

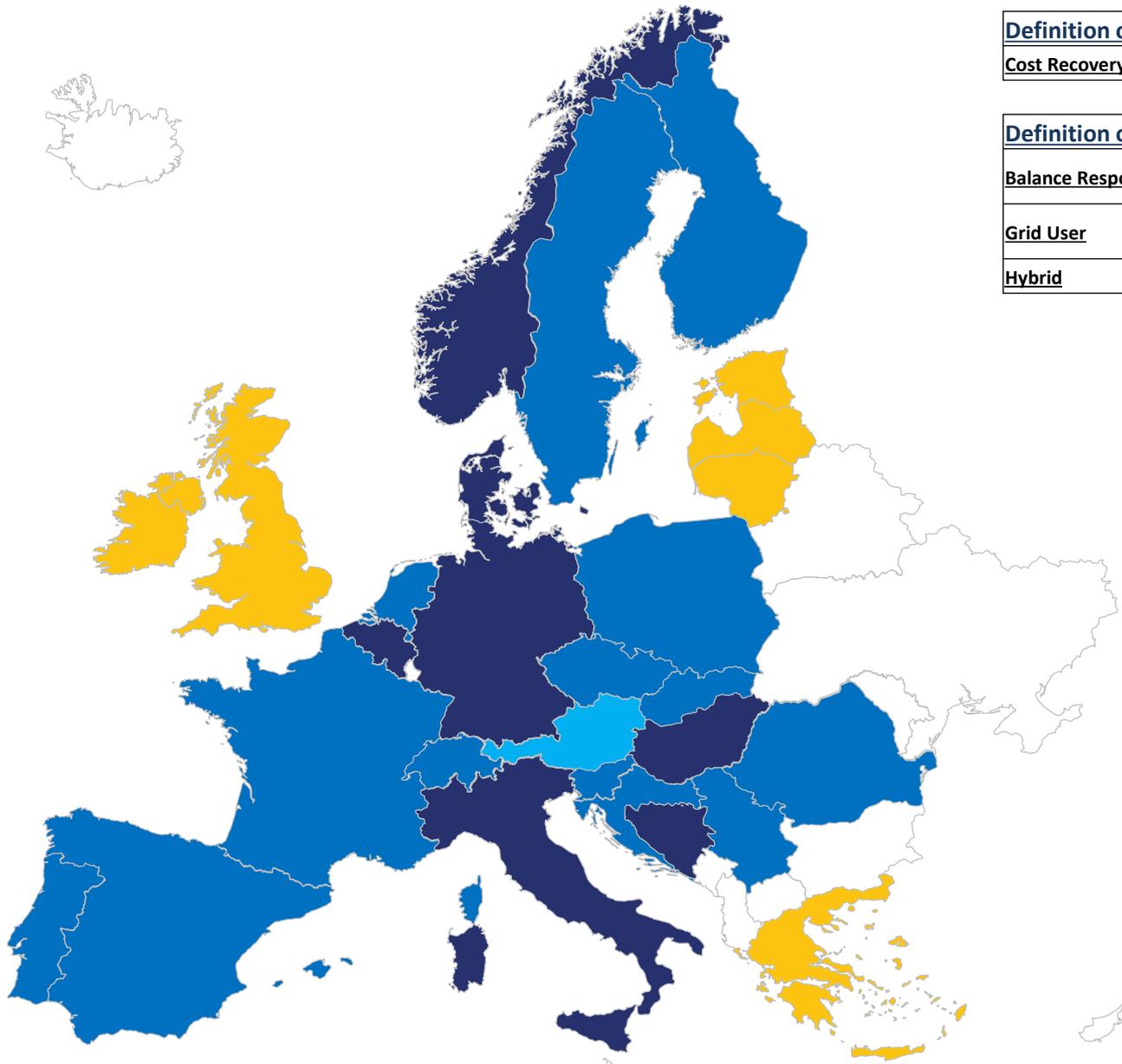
Definition of answer

| | |
|-------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|---|------------------|
|  | Missing data |
|  | N/A |
|  | No settlement |
|  | Pay as bid |
|  | Marginal Pricing |
|  | Regulated Price |
|  | Hybrid |

Frequency Restoration Reserve (Automatic) - Energy - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

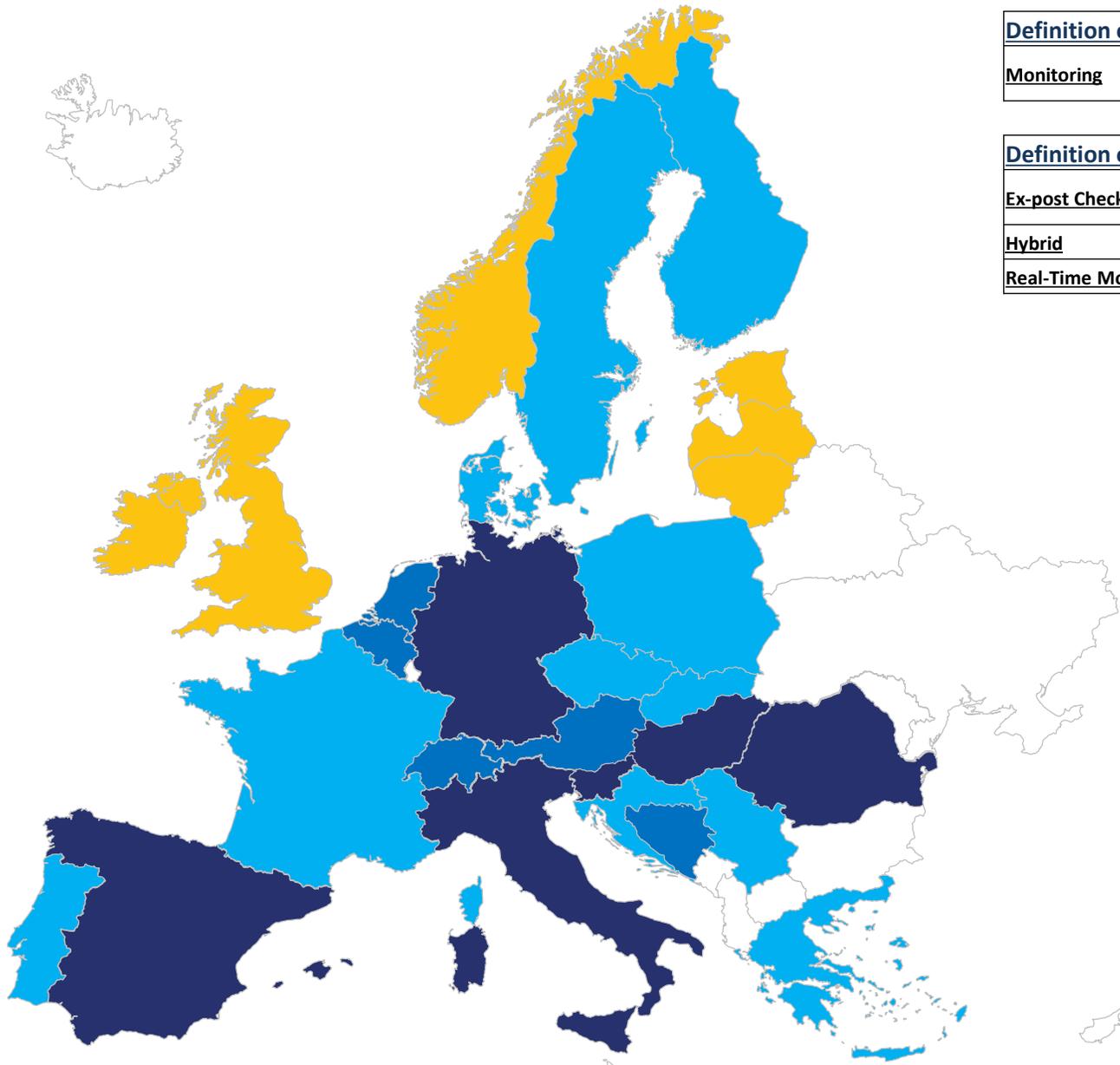
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|--|----------------------------------|
| | Missing data |
| | N/A |
| | 100% Grid Users (through tariff) |
| | 100% BRP |
| | Hybrid |

Frequency Restoration Reserve (Automatic) - Energy - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

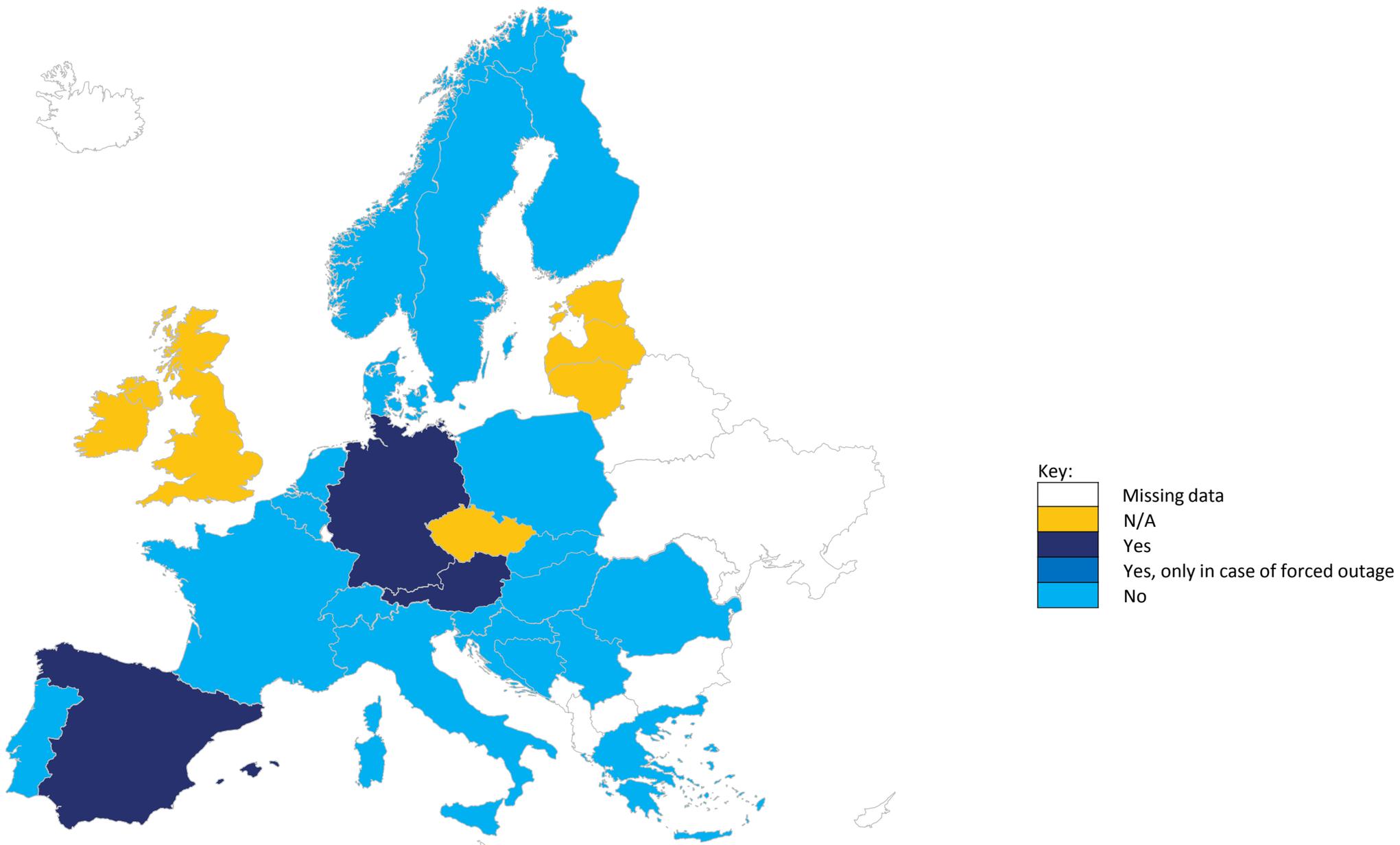
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

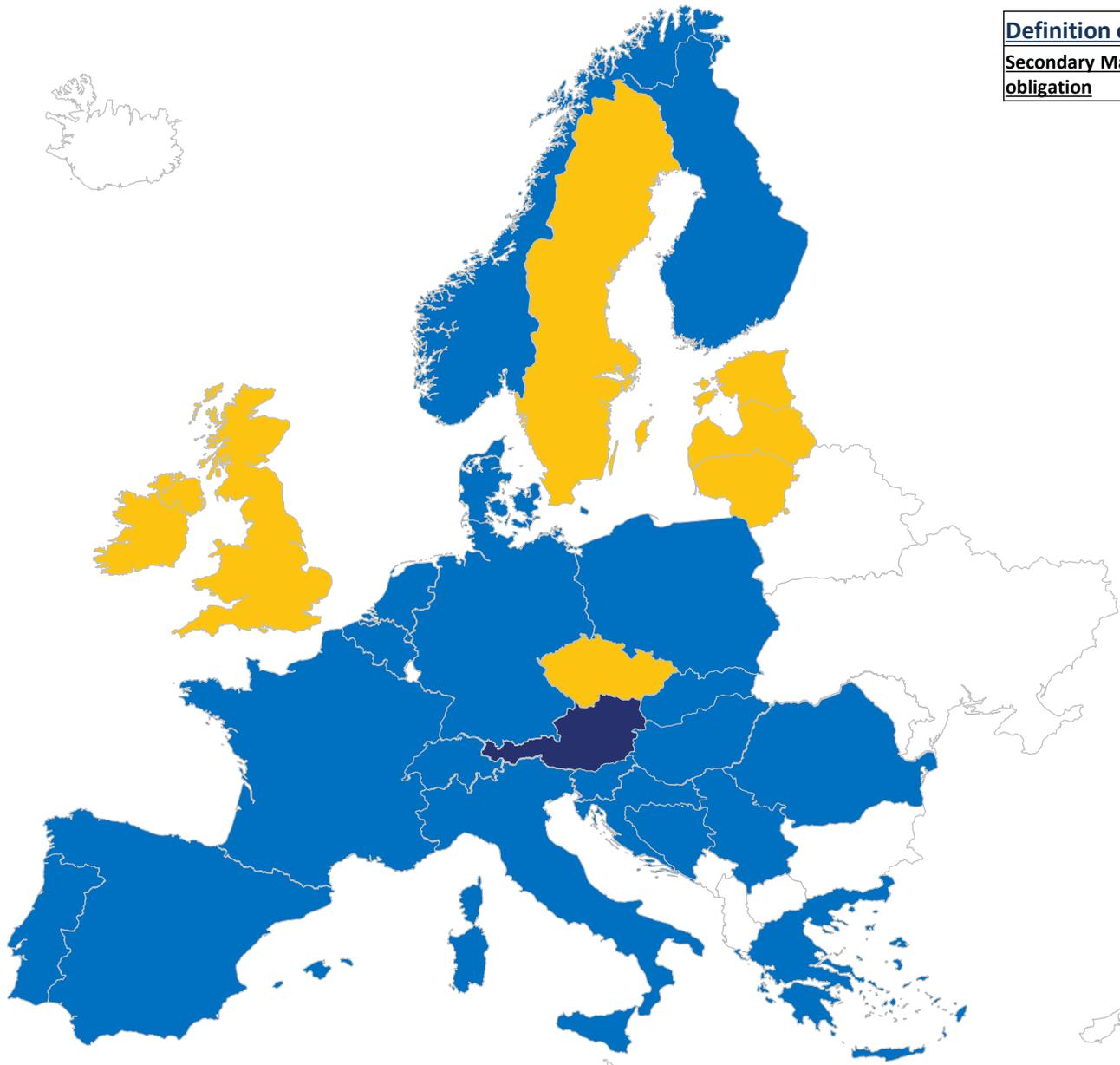
Key:

| | |
|---|----------------------|
|  | Missing data |
|  | N/A |
|  | Real-Time Monitoring |
|  | Ex-Post Check |
|  | Hybrid |

Frequency Restoration Reserve (Automatic) - Energy - Transfer of BSPs obligation allowed



Frequency Restoration Reserve (Automatic) - Energy - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

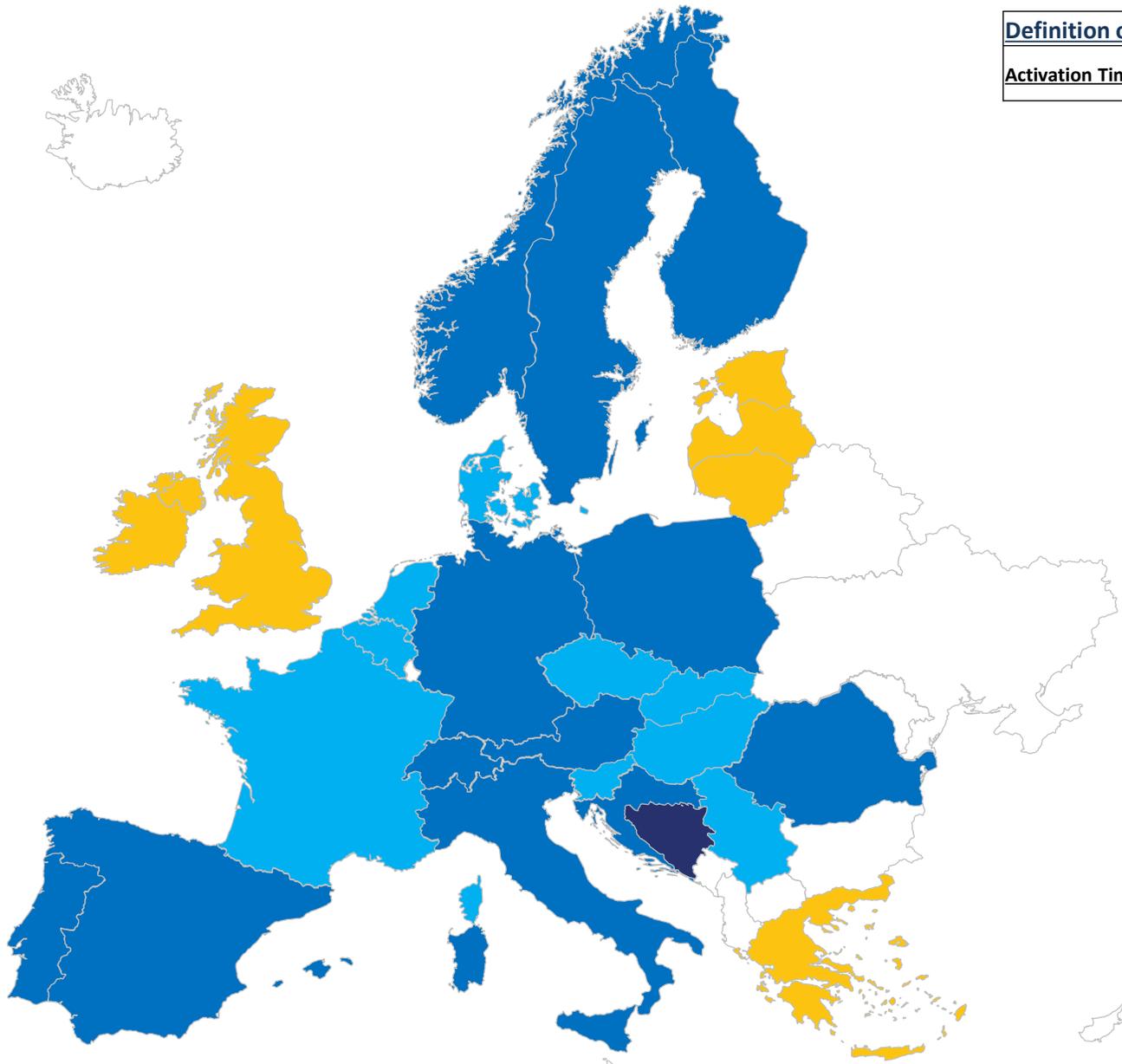
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Frequency Restoration Reserve (Automatic) - Energy - Activation time of aFRR from 0 to max



Definition of question

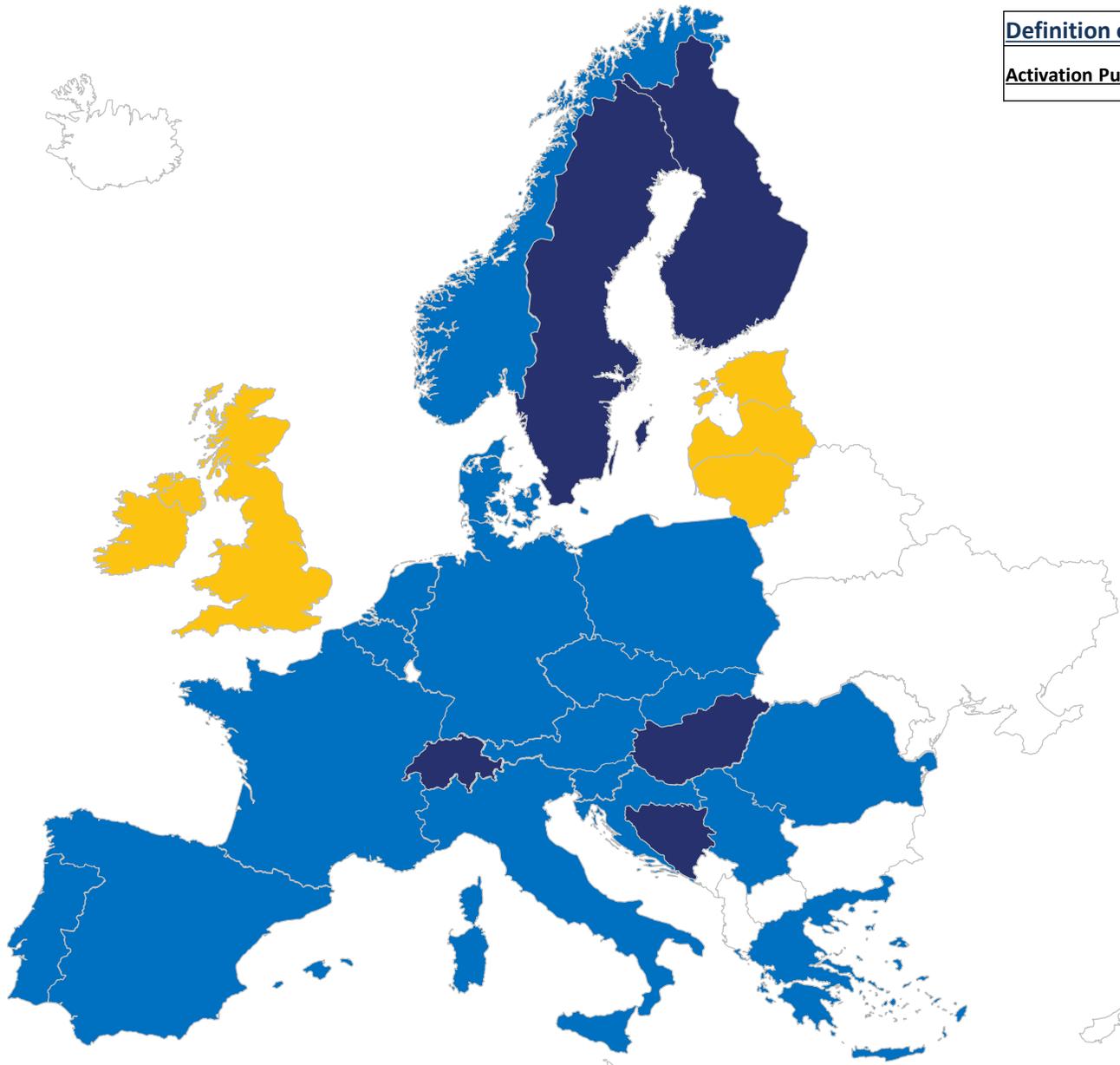
Activation Time

Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.

Key:

| | |
|--|---|
| | Missing data |
| | N/A |
| | $x \leq 90s$ |
| | $90s < x \leq 5 \text{ min}$ |
| | $5 \text{ min} < x \leq 15 \text{ min}$ |
| | $x > 15 \text{ min}$ |

Frequency Restoration Reserve (Automatic) - Energy - Are activations possible for other purposes than for balancing?



Definition of question

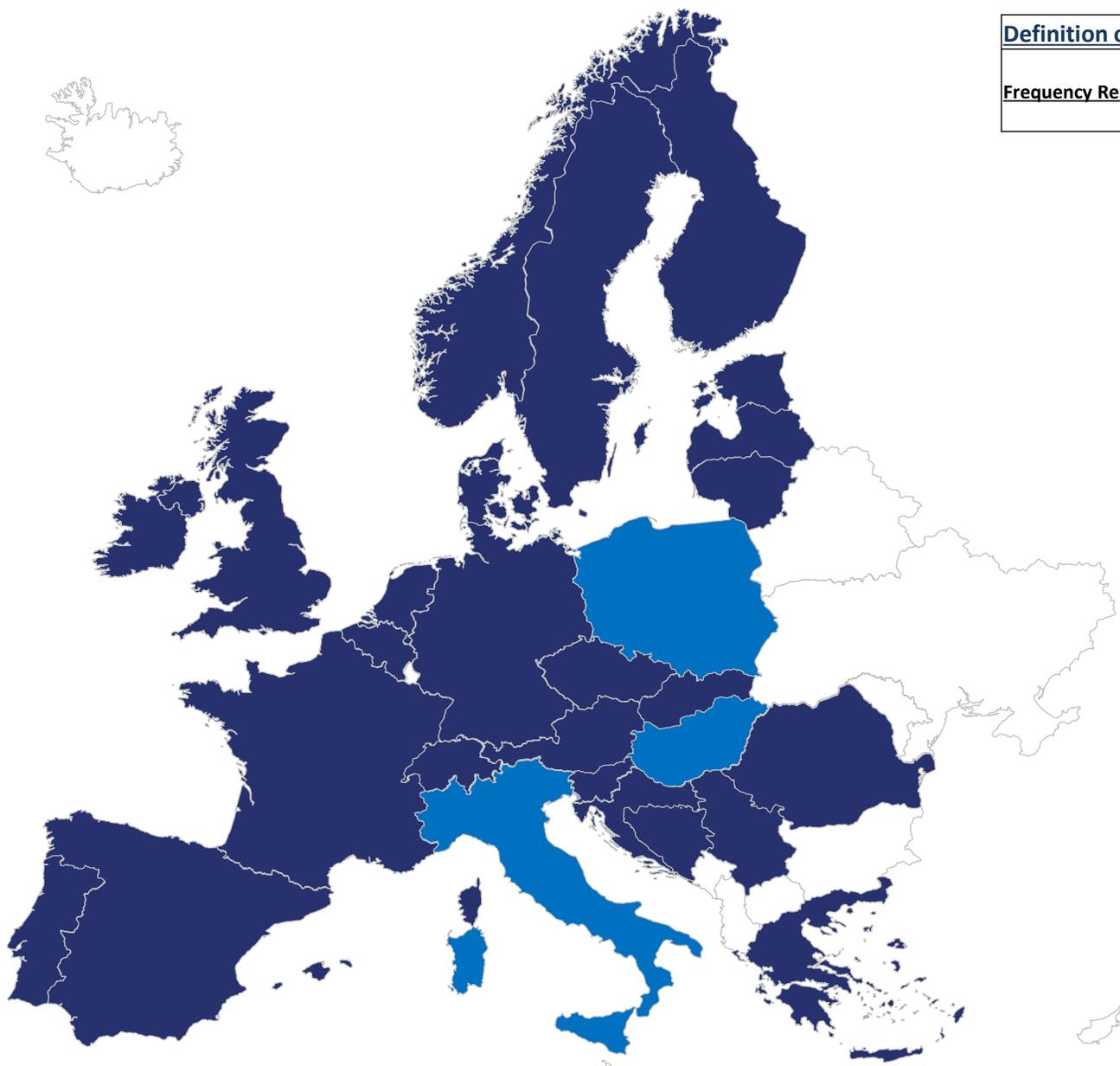
Activation Purpose

Are activations for other purposes than Balancing (e.g. congestion management) possible?

Key:

| | |
|--------------|--------------|
| Missing data | Missing data |
| N/A | N/A |
| Yes | Yes |
| No | No |

Using Frequency Restoration Reserve (Manual)



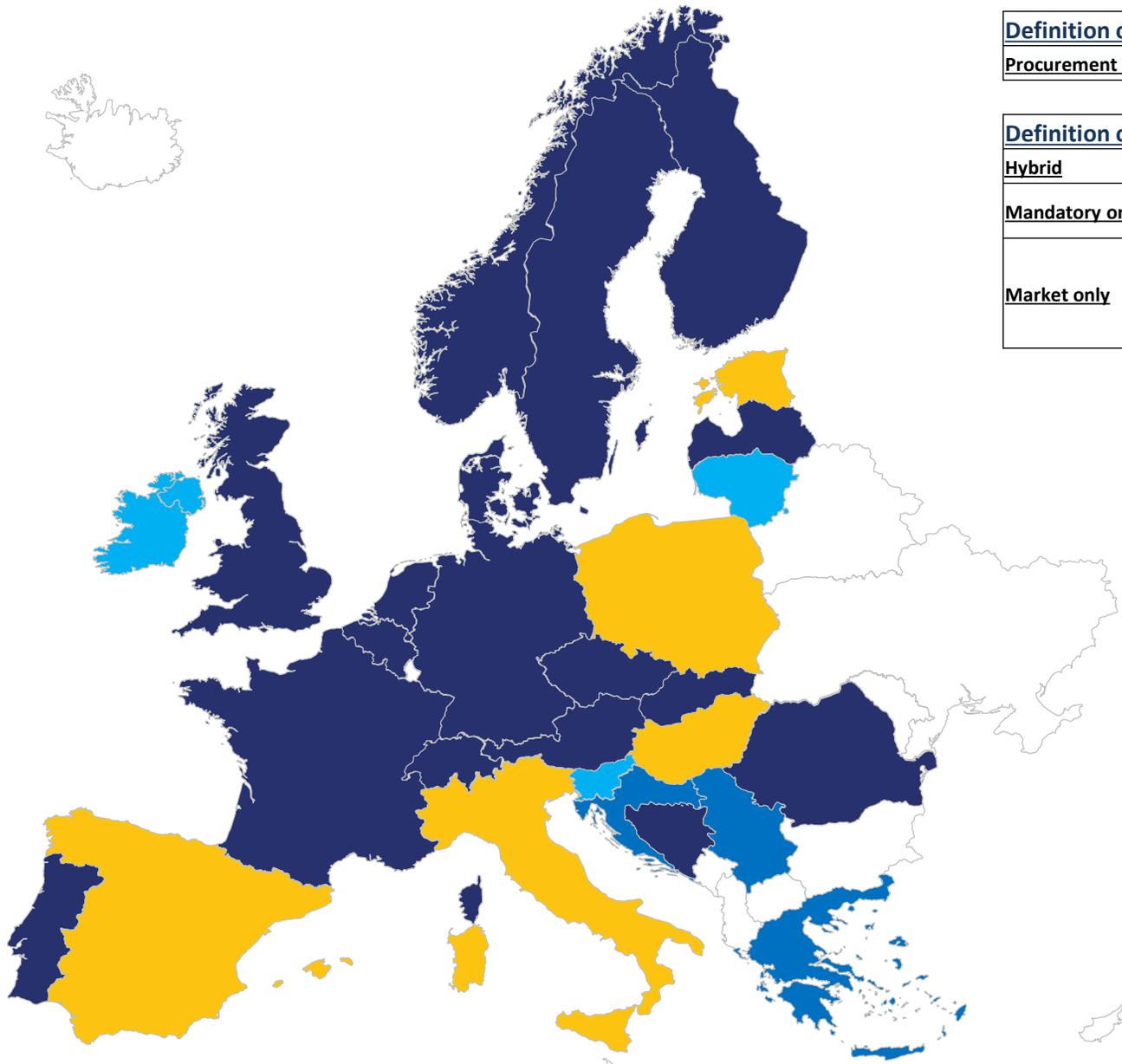
Definition of question

| | |
|--|--|
| Frequency Restoration Reserve (FRR) | Reserves activated to restore System Frequency to the Nominal Frequency and, where applicable, power balance to the scheduled value. aFRR means automatic FRR, mFRR means manual FRR. |
|--|--|

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Frequency Restoration Reserve (Manual) - Capacity - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

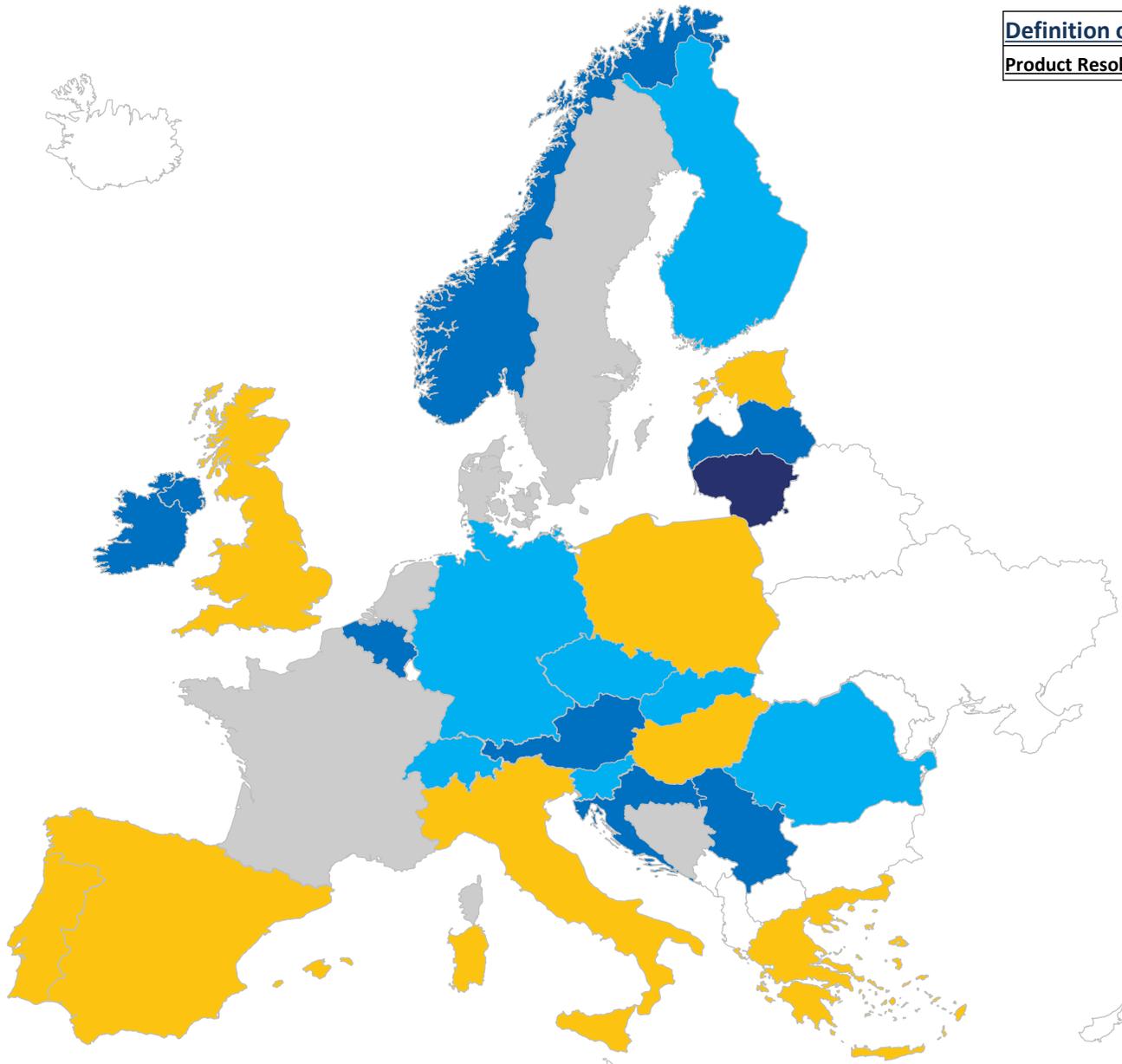
Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Frequency Restoration Reserve (Manual) - Capacity - Product Resolution (in MW)

Definition of question

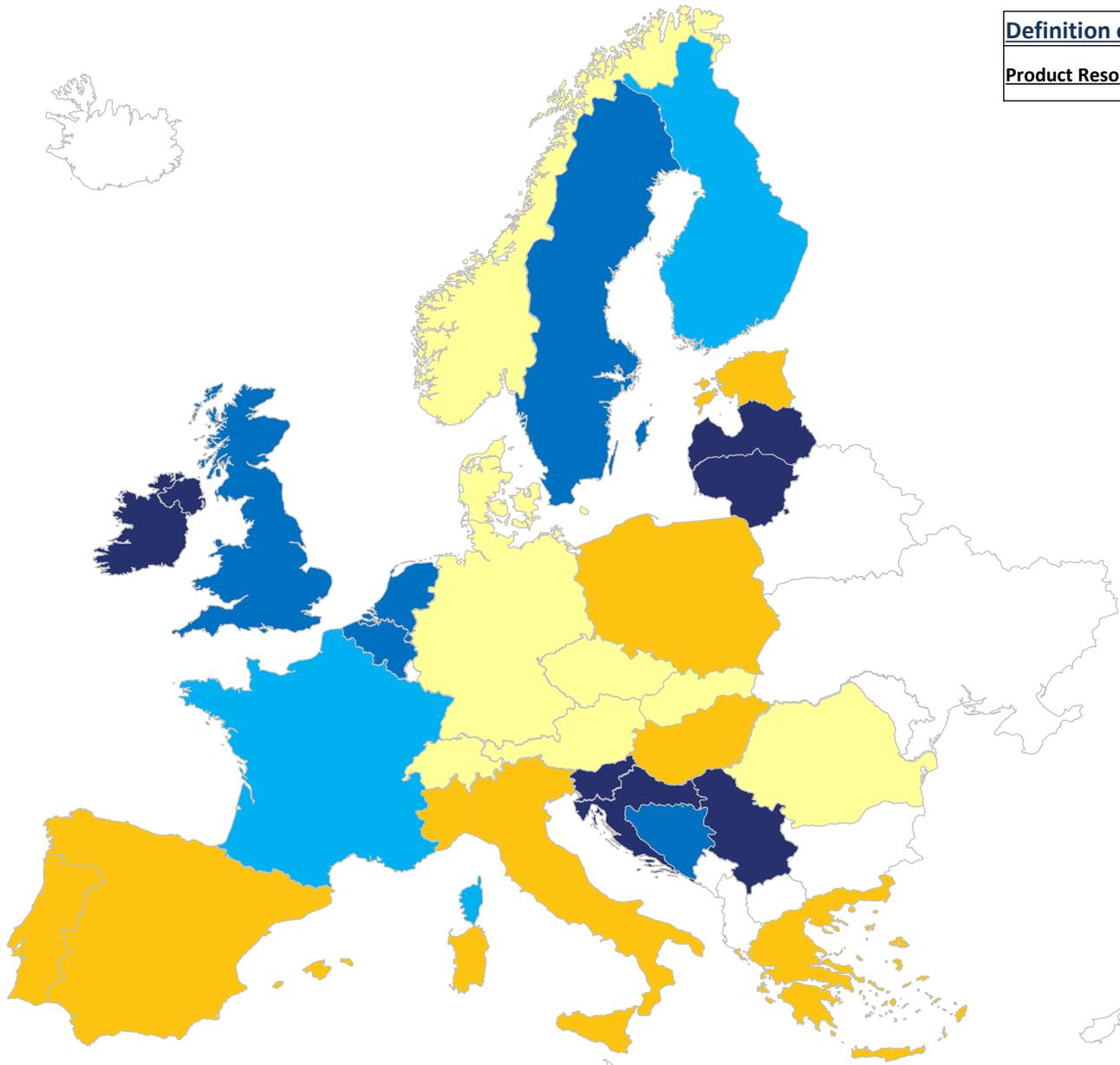
| | |
|-----------------------------------|---|
| Product Resolution (in MW) | The minimum bid size into the balancing market. |
|-----------------------------------|---|



Key:

| | |
|-----------------------------------|--------------|
| Missing data | White |
| N/A | Yellow |
| No minimum bid size | Dark Blue |
| $x \leq 1\text{MW}$ | Medium Blue |
| $1\text{MW} < x \leq 5\text{MW}$ | Light Blue |
| $5\text{MW} < x \leq 10\text{MW}$ | Grey |
| $x > 10\text{MW}$ | Light Yellow |

Frequency Restoration Reserve (Manual) - Capacity - Product Resolution (in time)



Definition of question

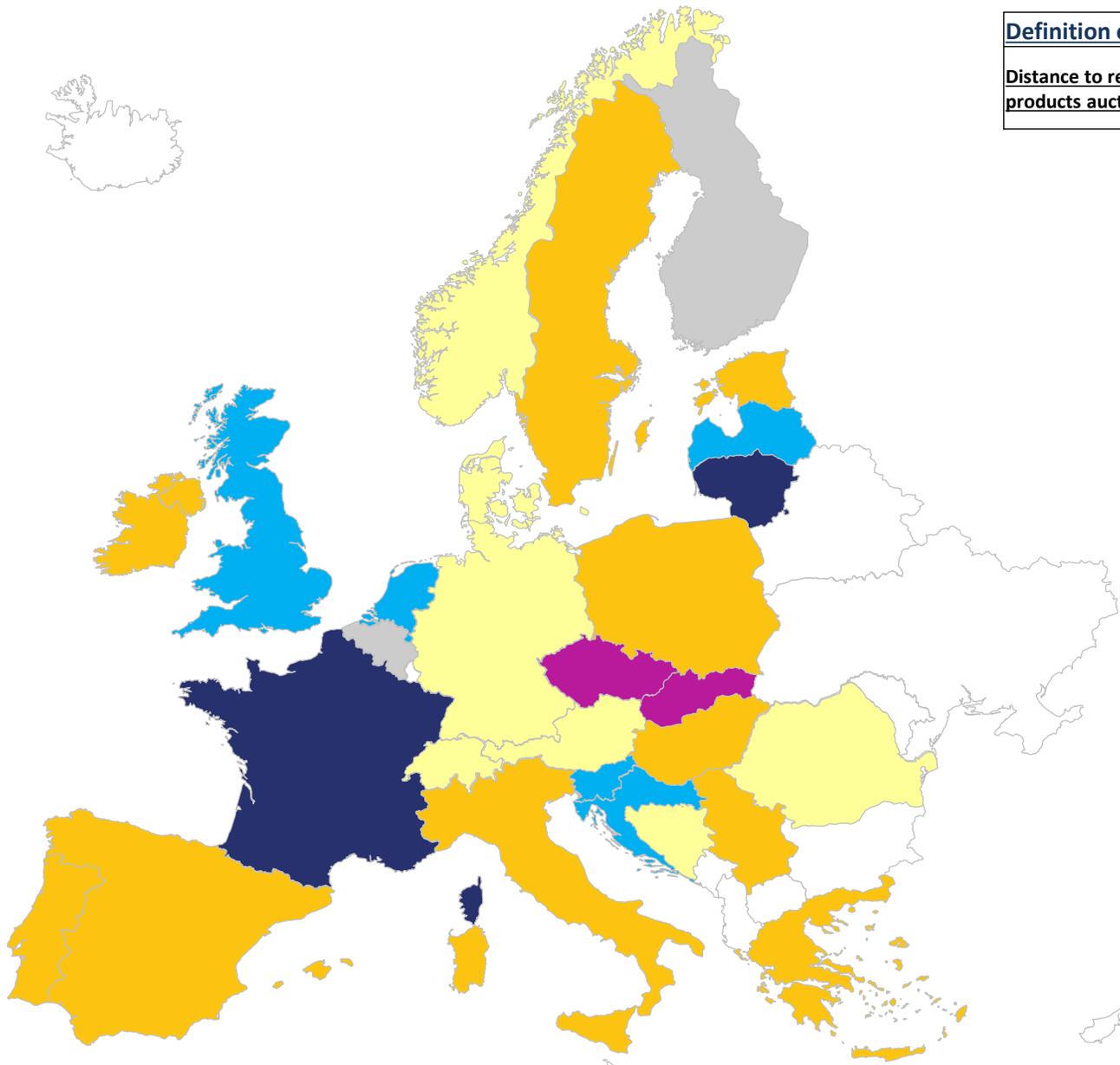
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Year or more |
| | Month(s) |
| | Week(s) |
| | Day(s) |
| | Hour(s) |

Frequency Restoration Reserve (Manual) - Capacity - Distance to real time of reserve products auctions



Definition of question

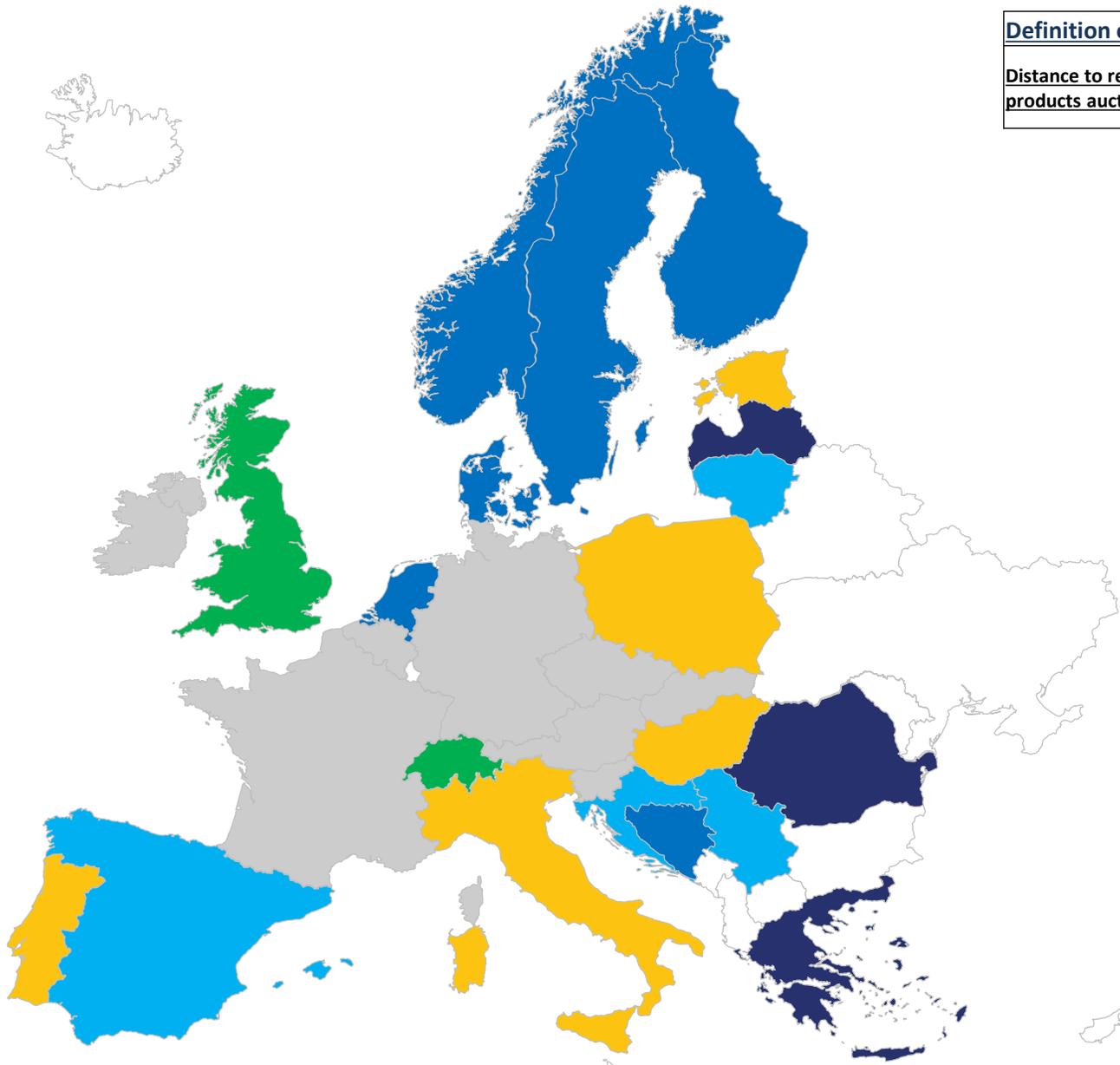
Distance to real time of reserve products auctions

The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).

Key:

| | |
|--|----------------------------------|
| | Missing data |
| | N/A |
| | Year or more |
| | Quarter year |
| | Month(s) |
| | Week(s) |
| | Day(s) |
| | Year or more + Month(s) + Day(s) |

Frequency Restoration Reserve (Manual) - Capacity - Provider



Definition of question

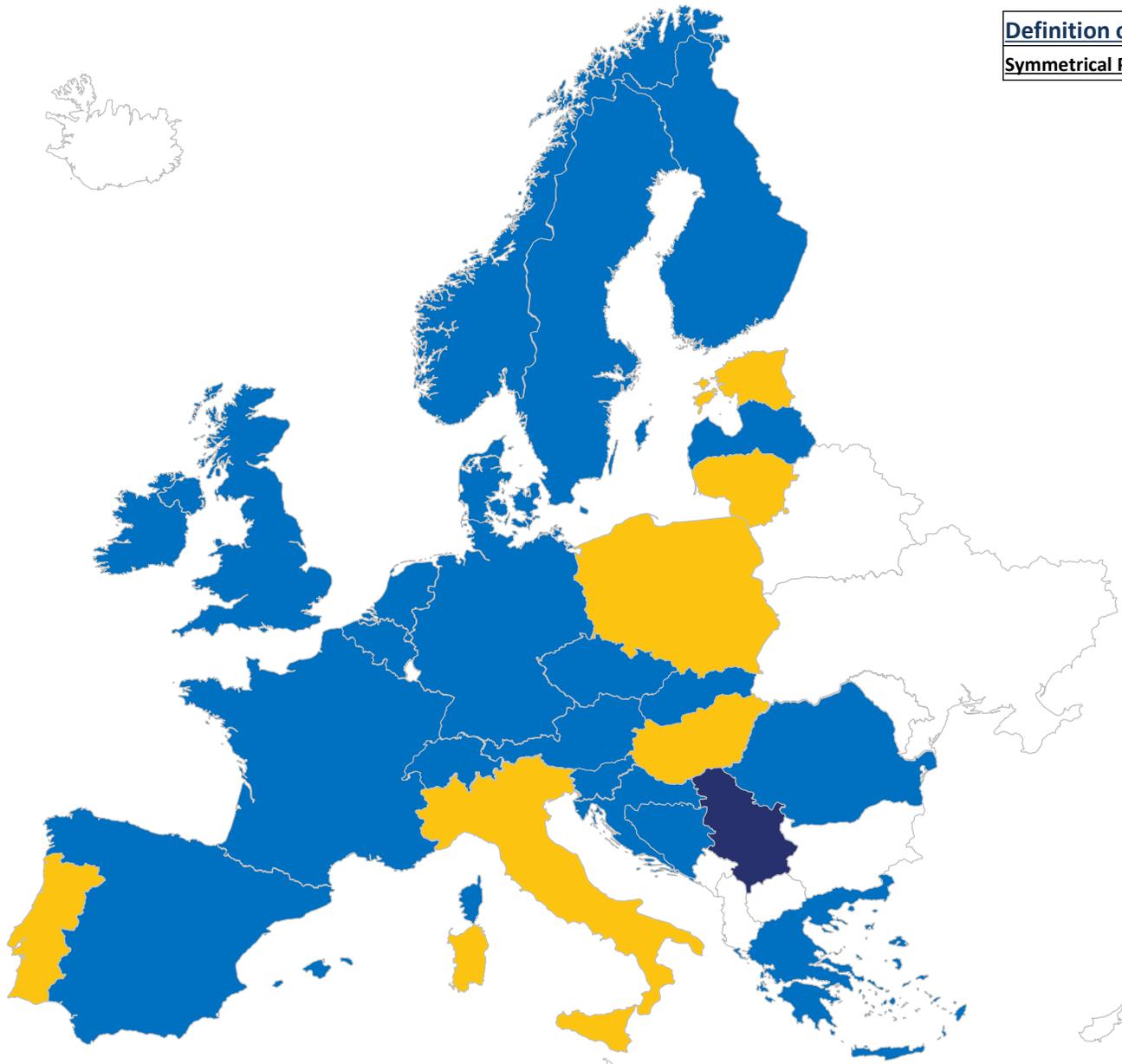
Distance to real time of reserve products auctions

The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).

Key:

| | |
|---|--|
|  | Missing data |
|  | N/A |
|  | Generators Only |
|  | Generators + Load |
|  | Generators + Pump Storage |
|  | Generators + Load + Pump Storage |
|  | Batteries |
|  | Generators + Load + Batteries |
|  | Generators + Load + Pump Storage + Batteries |

Frequency Restoration Reserve (Manual) - Capacity - Symmetrical Product



Definition of question

Symmetrical Product

Upward regulation volume and for downward regulation volume has to be equal.

Key:



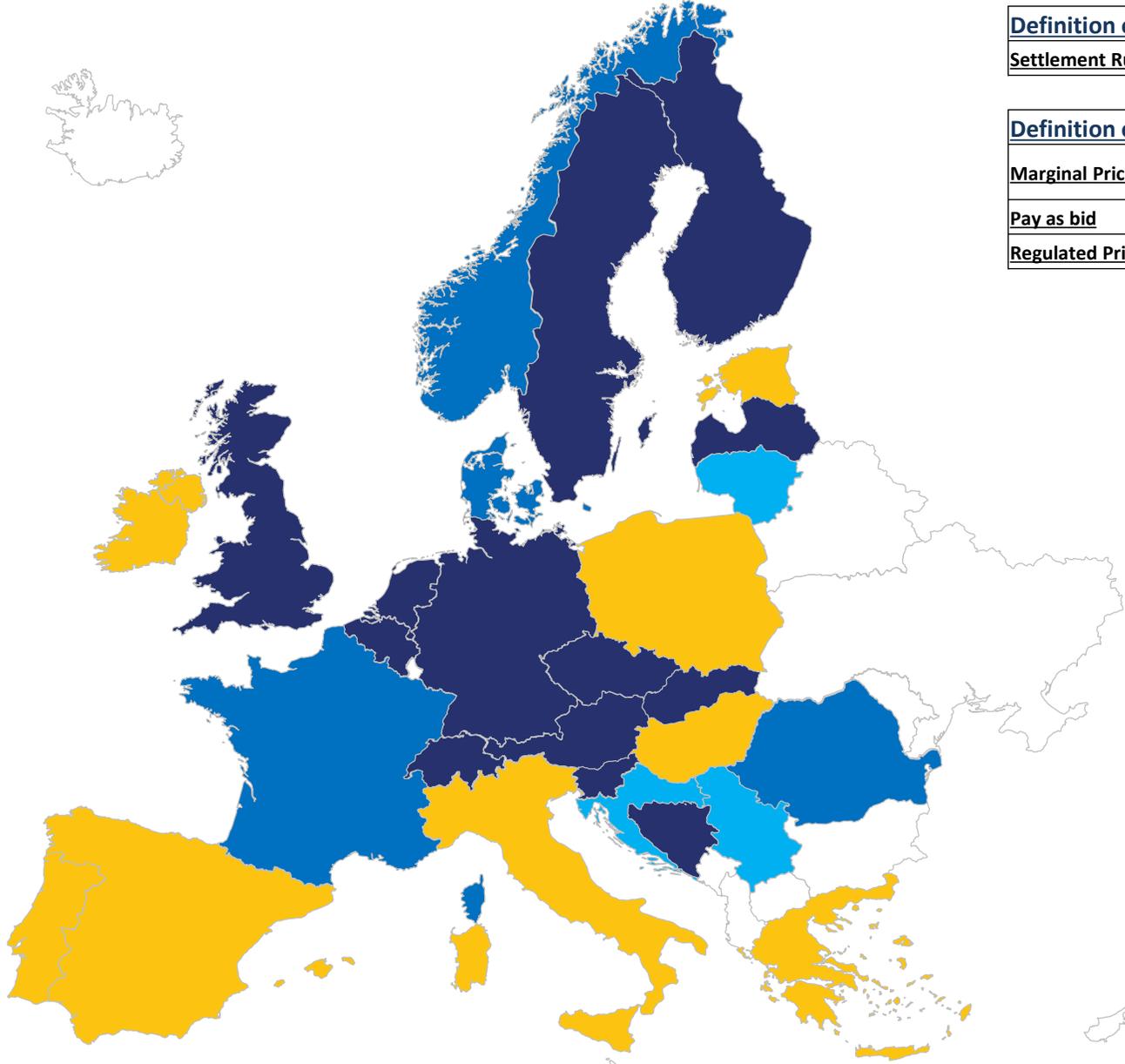
Missing data

N/A

Has to be symmetrical

Don't need to be symmetrical

Frequency Restoration Reserve (Manual) - Capacity - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

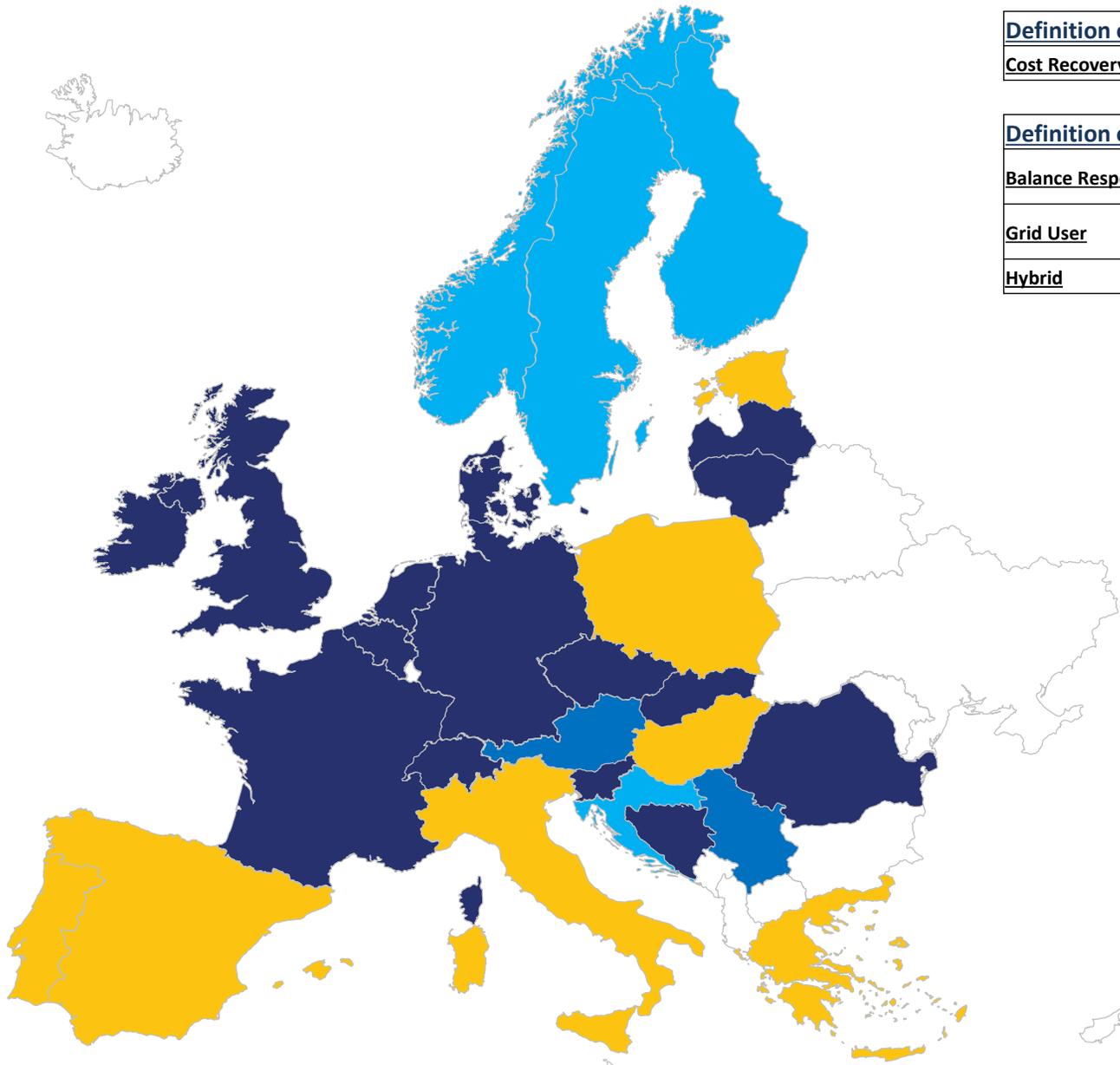
Definition of answer

| | |
|-------------------------|--|
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|--|------------------|
| | Missing data |
| | N/A |
| | Pay as bid |
| | Marginal Pricing |
| | Regulated Price |

Frequency Restoration Reserve (Manual) - Capacity - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

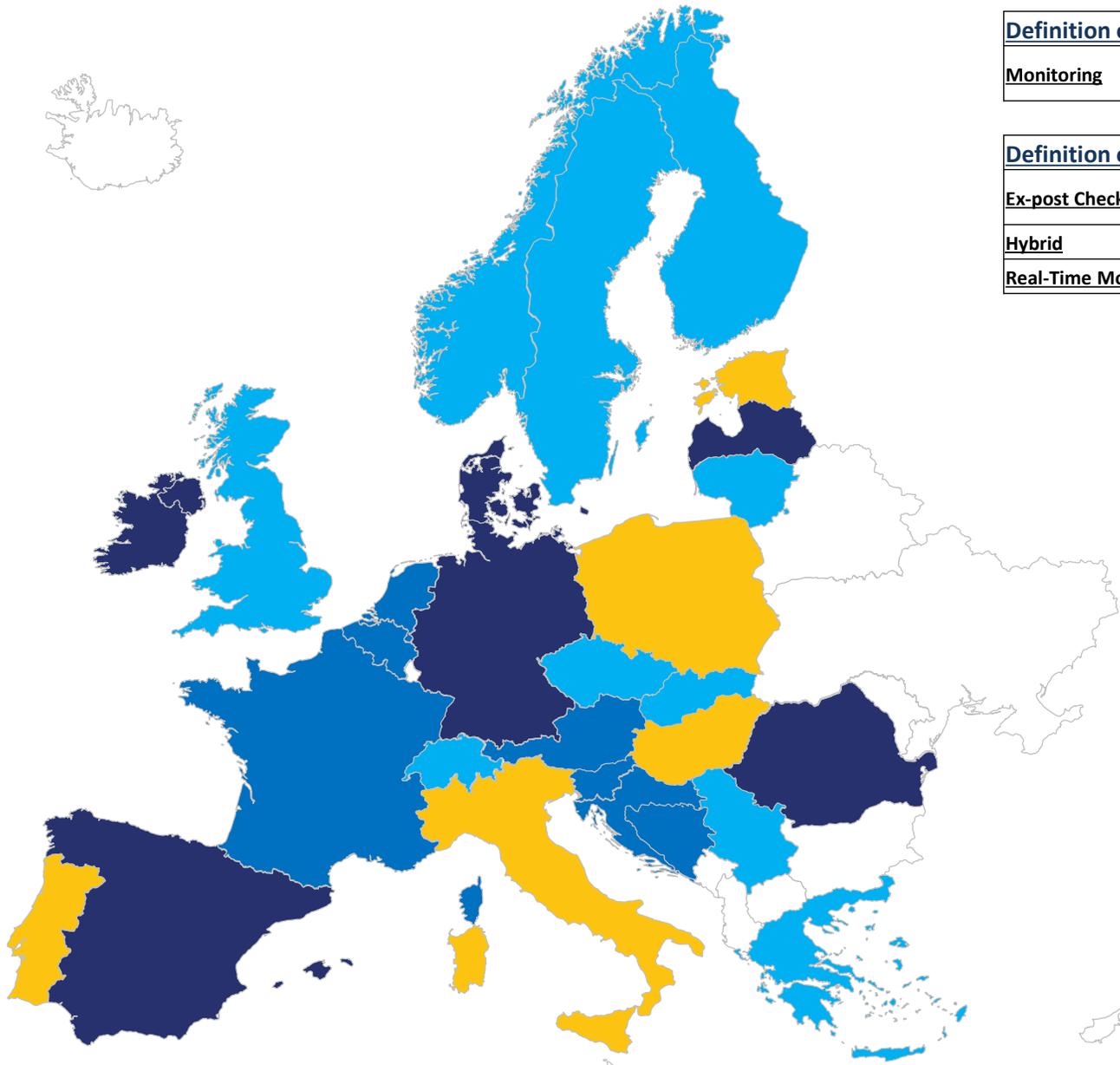
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|----------------------------------|----------------------------------|
| Missing data | Missing data |
| N/A | N/A |
| 100% Grid Users (through tariff) | 100% Grid Users (through tariff) |
| 100% BRP | 100% BRP |
| Hybrid | Hybrid |

Frequency Restoration Reserve (Manual) - Capacity - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

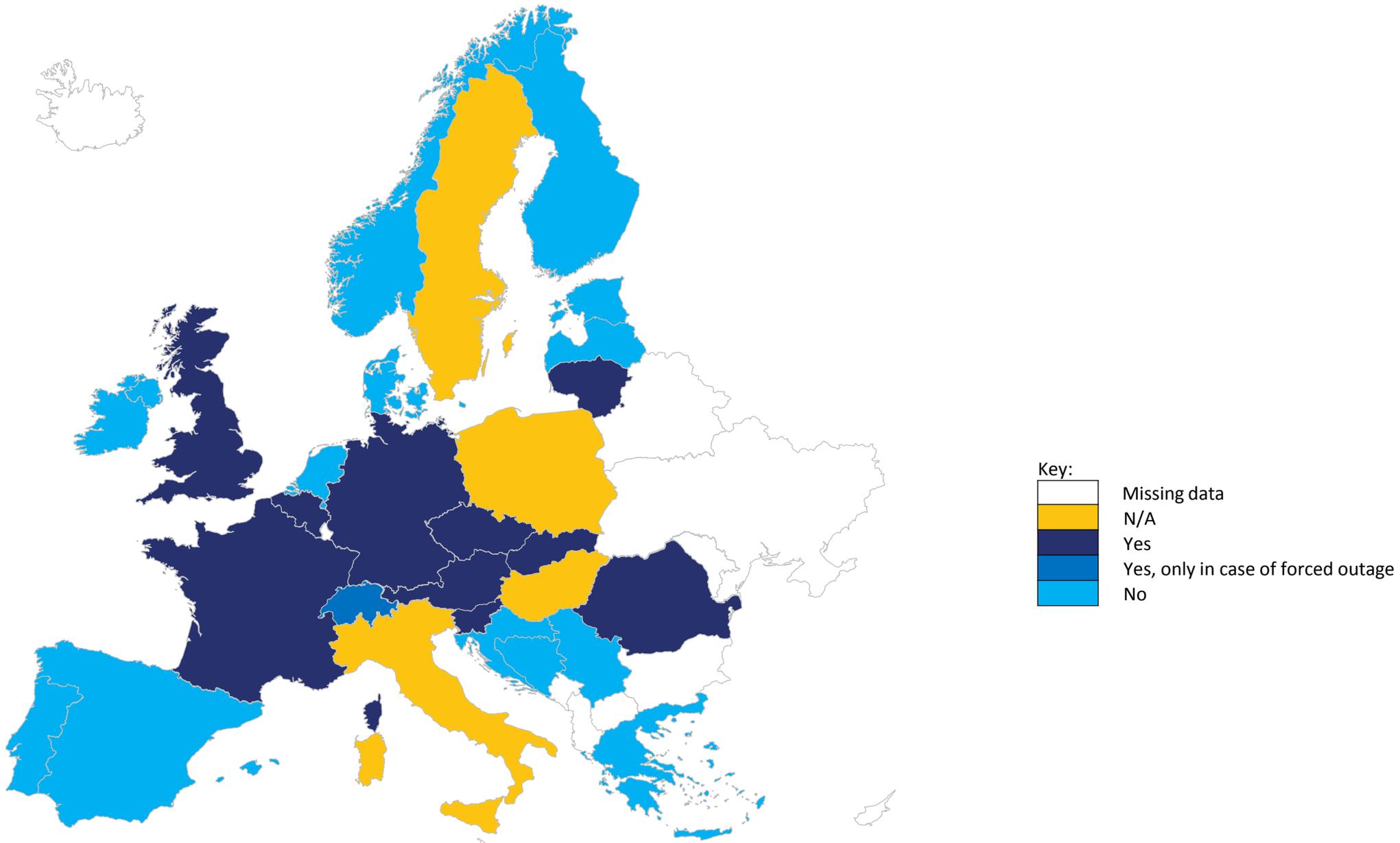
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

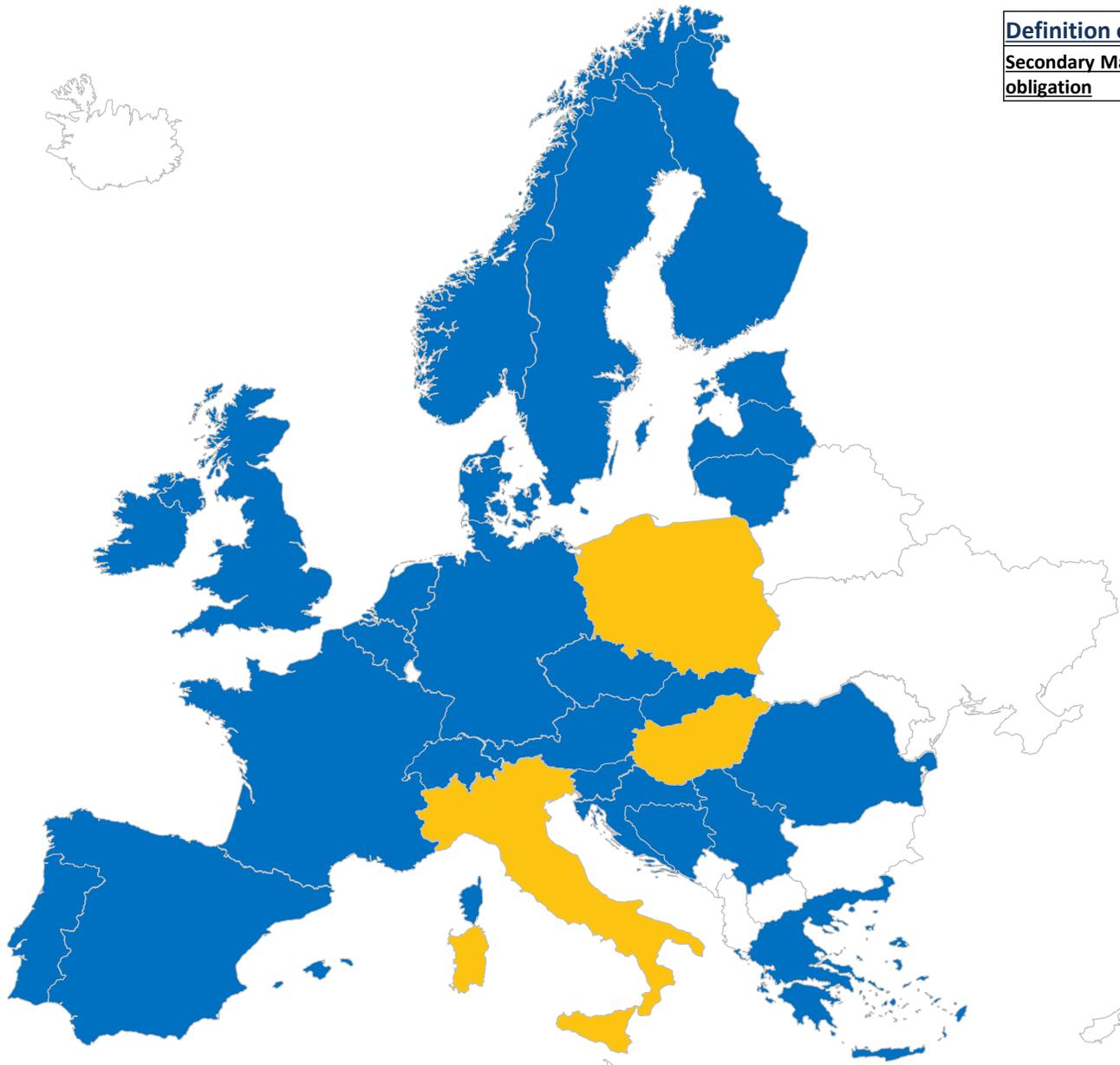
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real-Time Monitoring |
| | Ex-Post Check |
| | Hybrid |

Frequency Restoration Reserve (Manual) - Capacity - Transfer of BSPs obligation allowed



Frequency Restoration Reserve (Manual) - Capacity - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

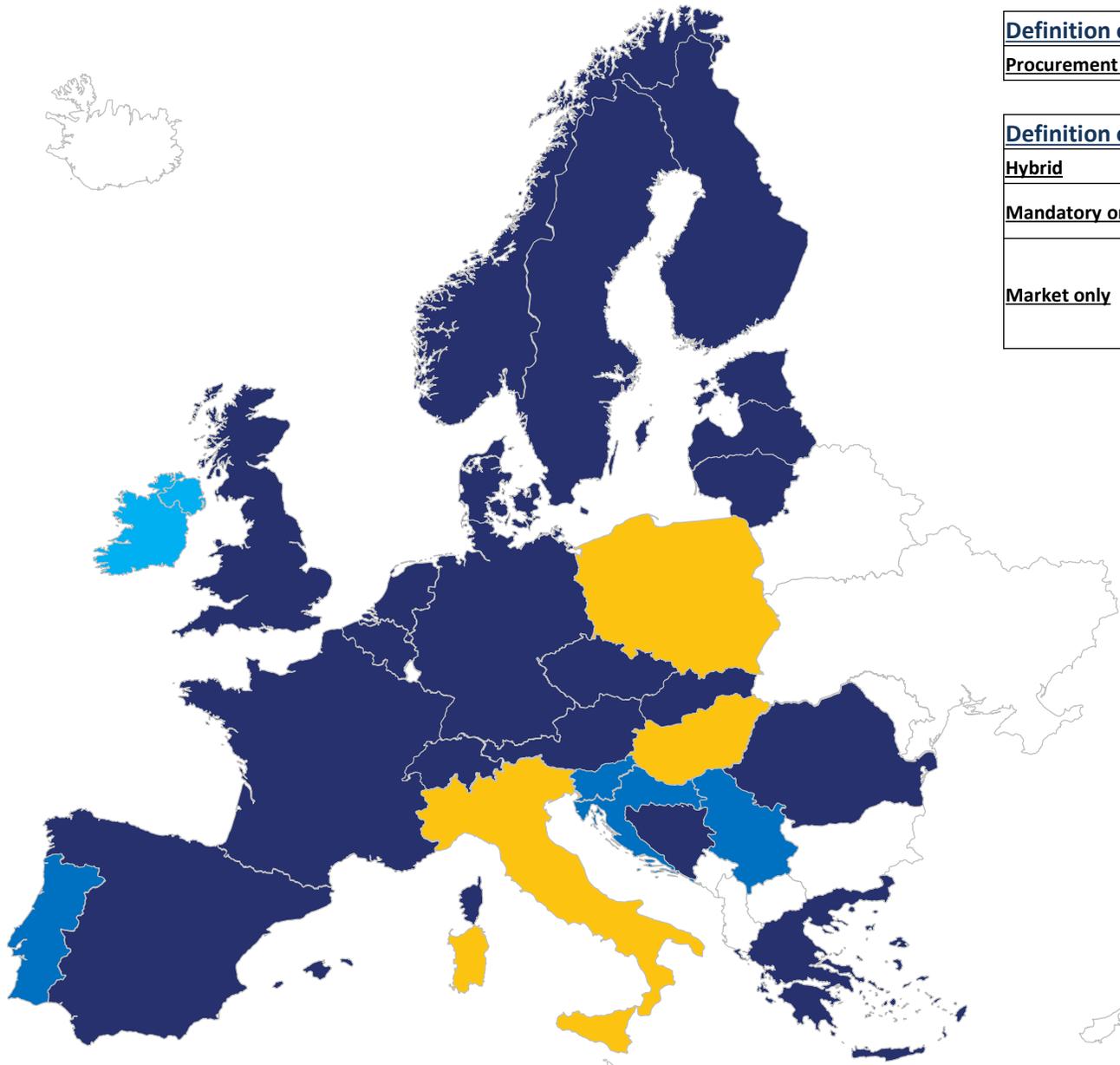
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Frequency Restoration Reserve (Manual) - Energy - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

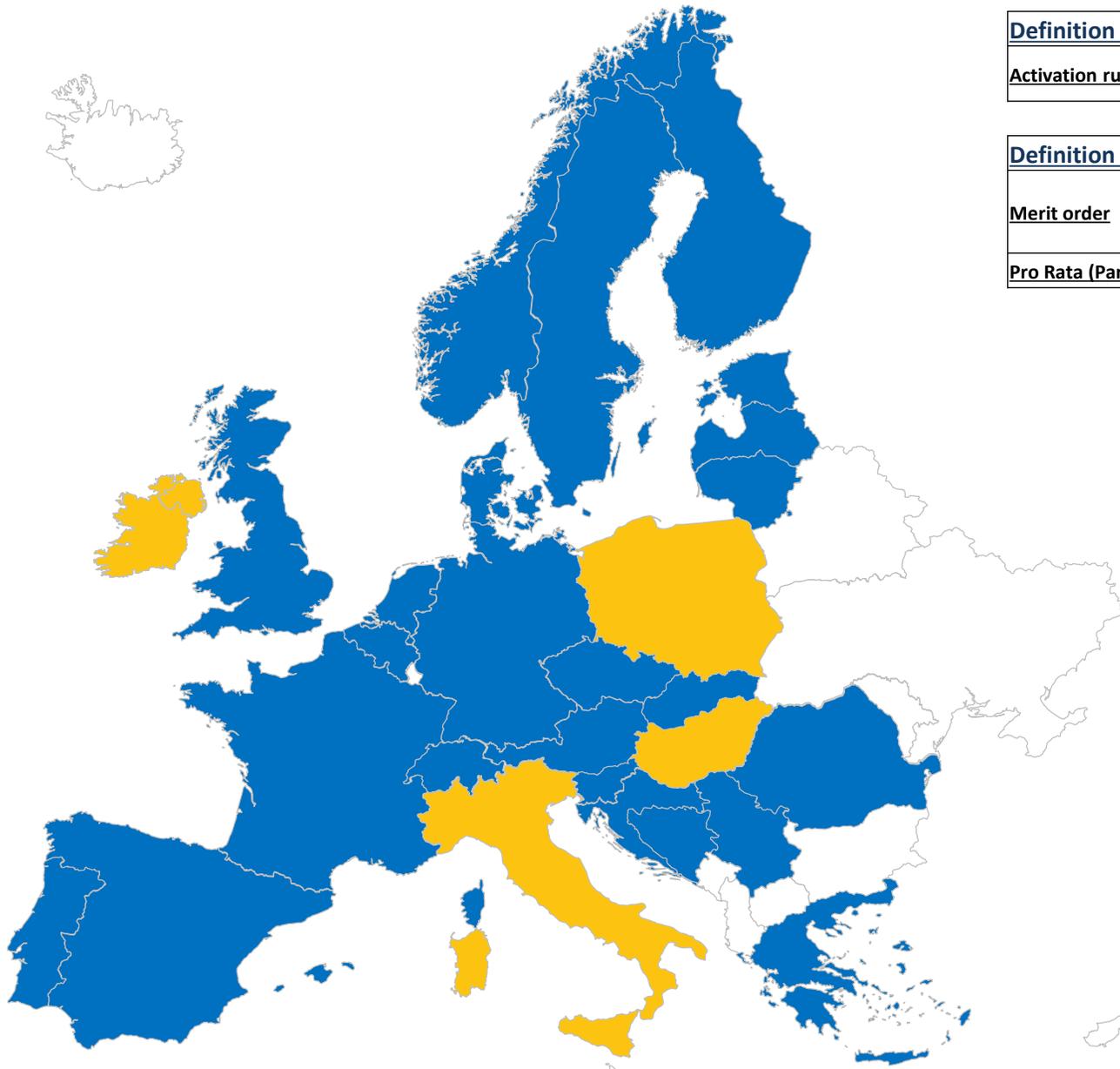
Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Frequency Restoration Reserve (Manual) - Energy - Activation Rule



Definition of question

Activation rule

How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).

Definition of answer

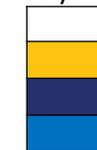
Merit order

A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.

Pro Rata (Parallel Activation)

All bids always activated in parallel – proportionally.

Key:



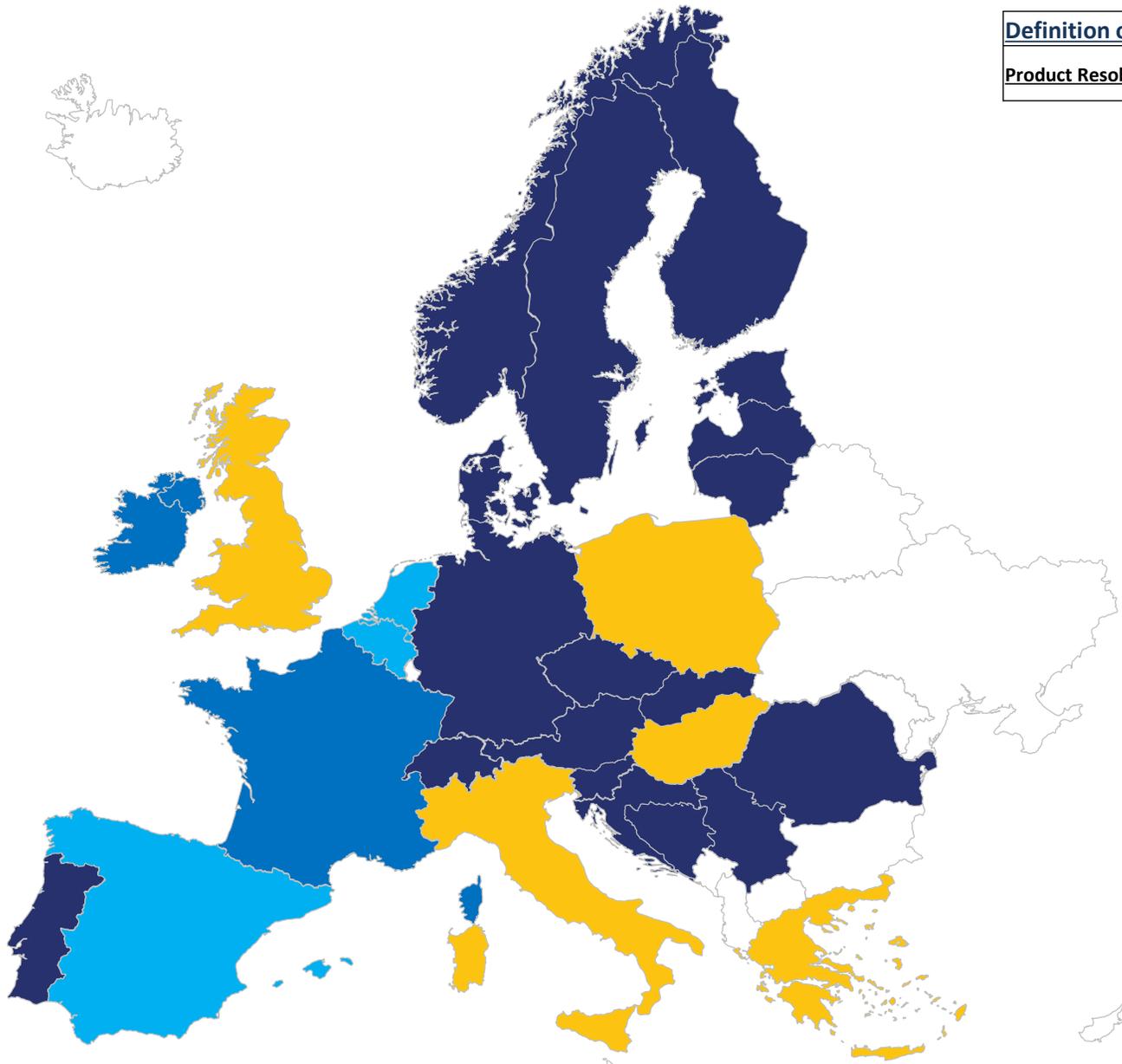
Missing data

N/A

Pro Rata (Parallel Activation)

Merit order

Frequency Restoration Reserve (Manual) - Energy - Product Resolution (in time)



Definition of question

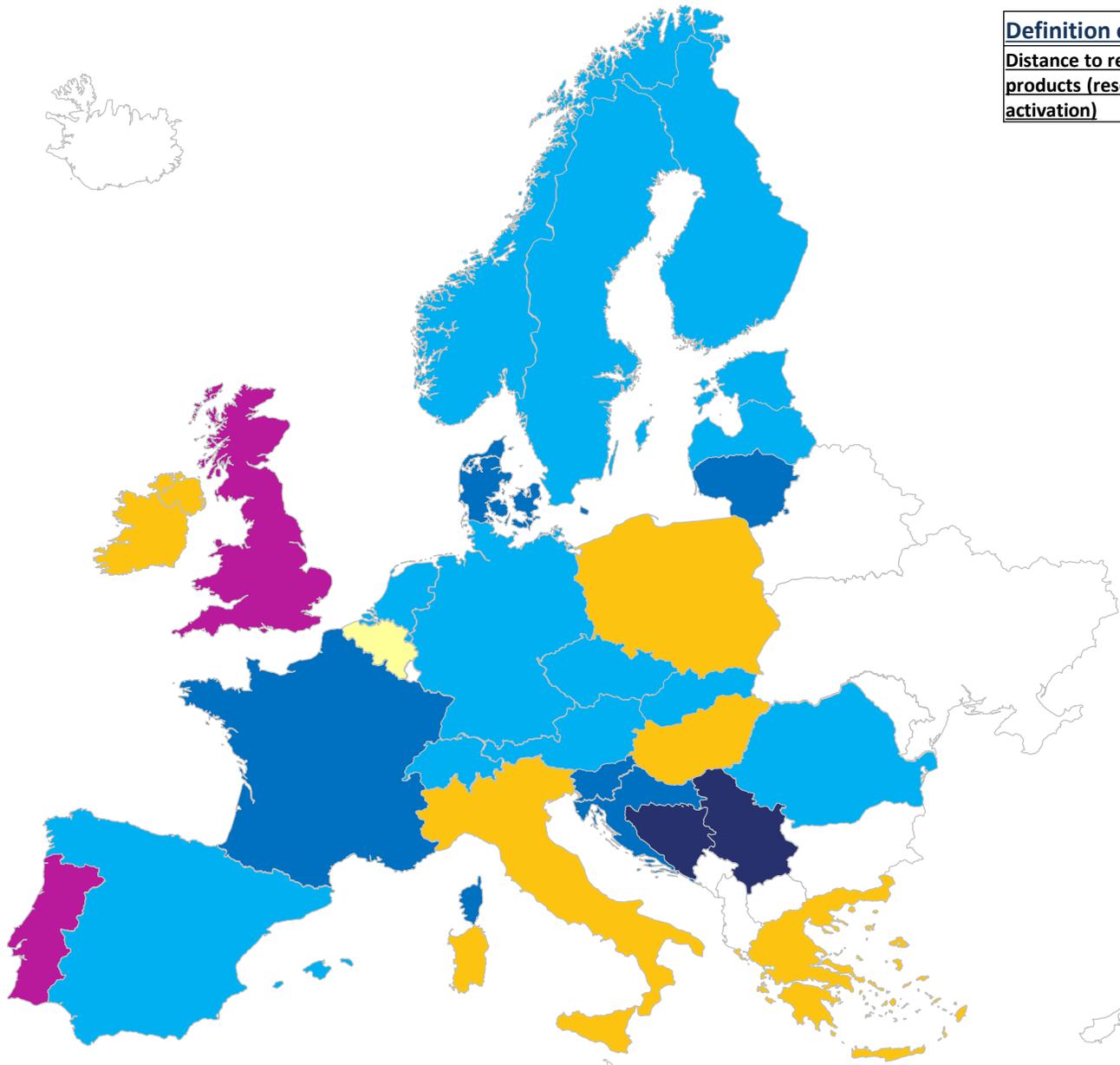
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--|------------------|
| | Missing data |
| | N/A |
| | Hour (or blocks) |
| | 30 minutes |
| | 15 minutes |

Frequency Restoration Reserve (Manual) - Energy - Distance to real time of energy products



Definition of question

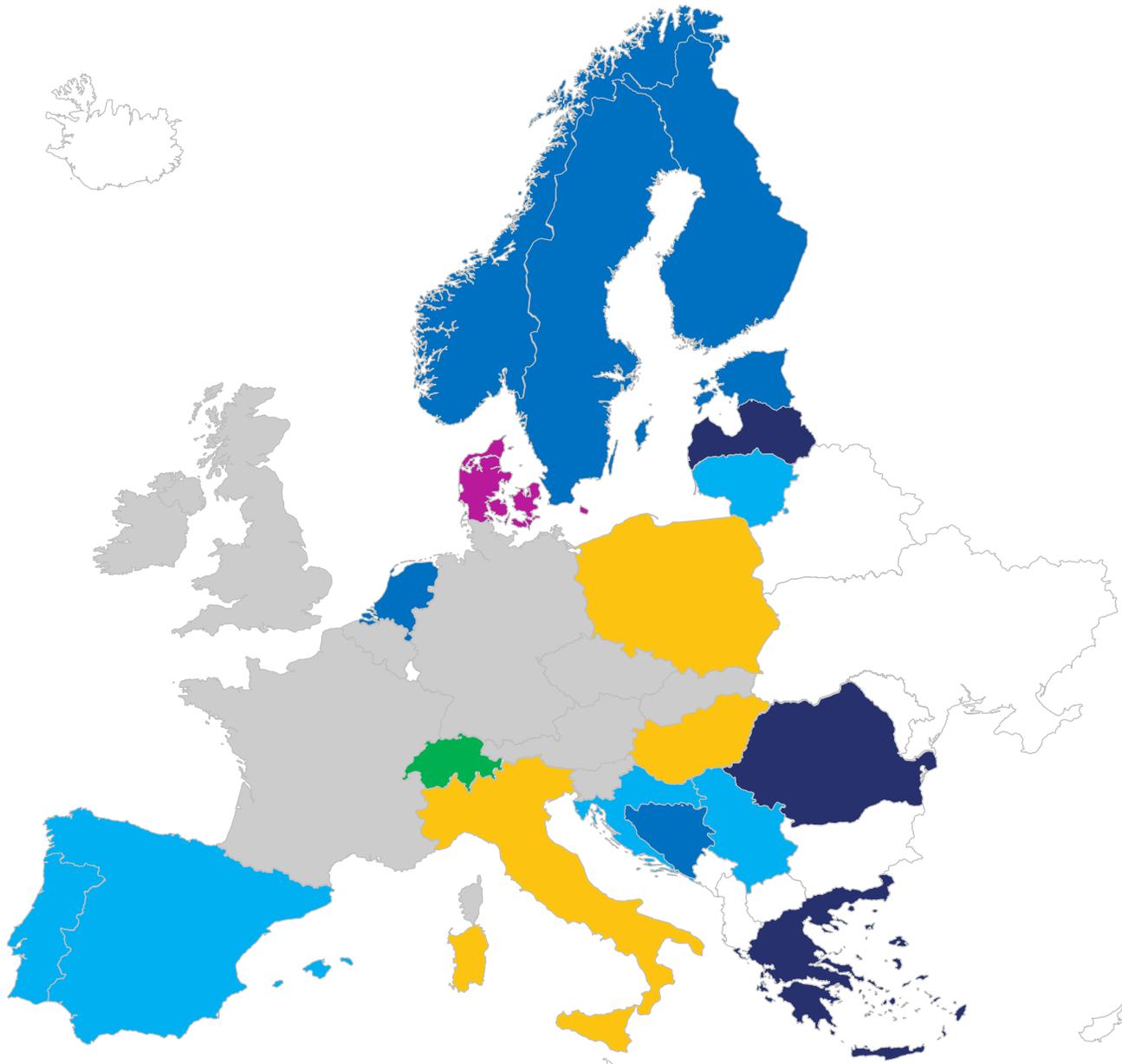
Distance to real time of energy products (reserve products activation)

The time ahead from real time when TSO activates a given product (for instance 15 minutes in the case of mFRR/tertiary energy).

Key:

| | |
|--|---|
| | Missing data |
| | N/A |
| | $x > H-1$ |
| | $15 \text{ minutes} < x \leq H-1$ |
| | $5 \text{ minutes} < x \leq 15 \text{ minutes}$ |
| | $1 \text{ minute} < x \leq 5 \text{ minutes}$ |
| | $x \leq 1 \text{ minute}$ |
| | Depends on the unit |

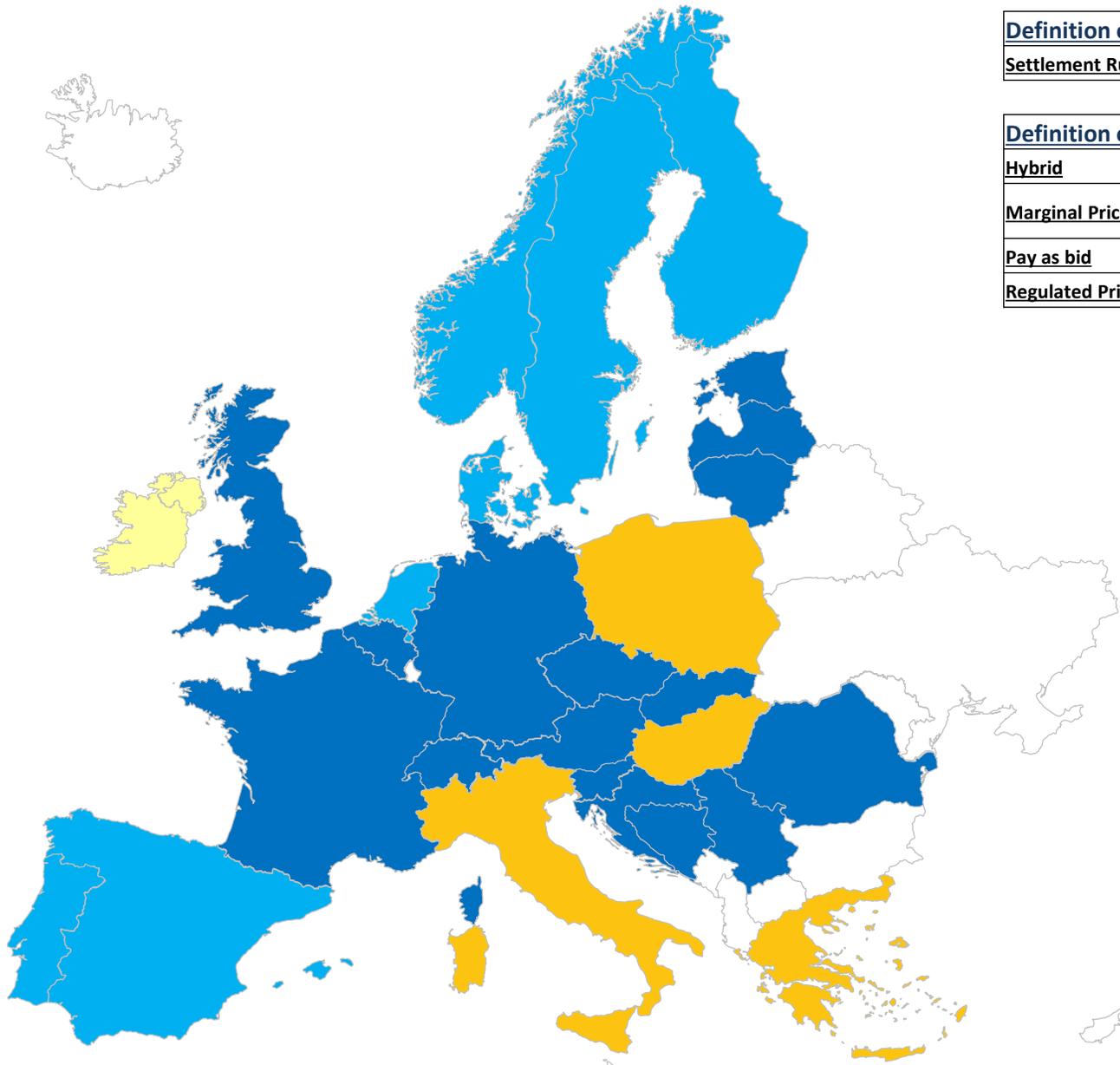
Frequency Restoration Reserve (Manual) - Energy - Provider



Key:

| | |
|---|--|
|  | Missing data |
|  | N/A |
|  | Generators Only |
|  | Generators + Load |
|  | Generators + Pump Storage |
|  | Generators + Load + Pump Storage |
|  | Batteries |
|  | Generators + Load + Batteries |
|  | Generators + Load + Pump Storage + Batteries |

Frequency Restoration Reserve (Manual) - Energy - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

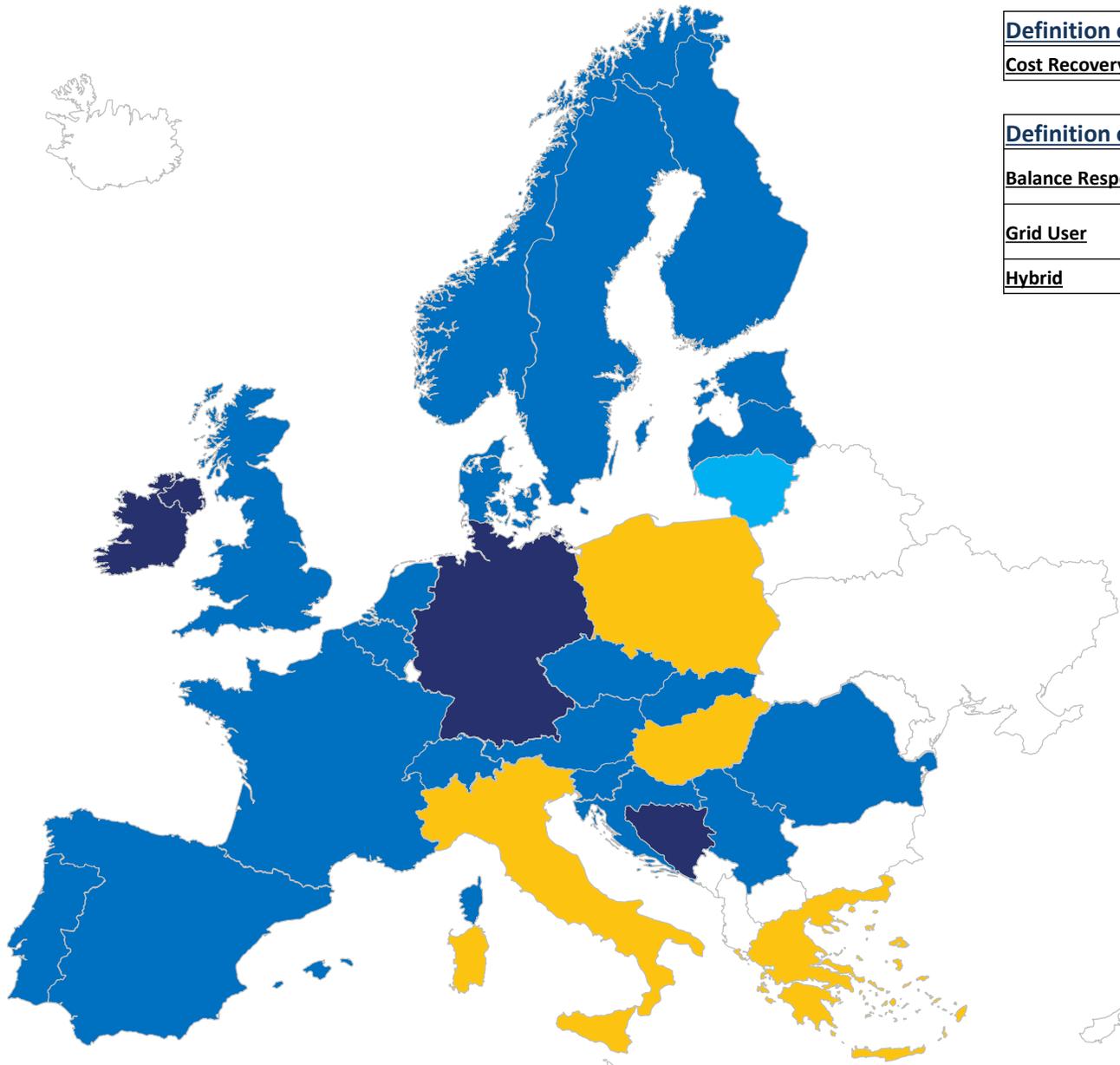
Definition of answer

| | |
|-------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|------------------|--------------|
| Missing data | White |
| N/A | Yellow |
| No settlement | Dark Blue |
| Pay as bid | Medium Blue |
| Marginal Pricing | Light Blue |
| Regulated Price | Grey |
| Hybrid | Light Yellow |

Frequency Restoration Reserve (Manual) - Energy - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

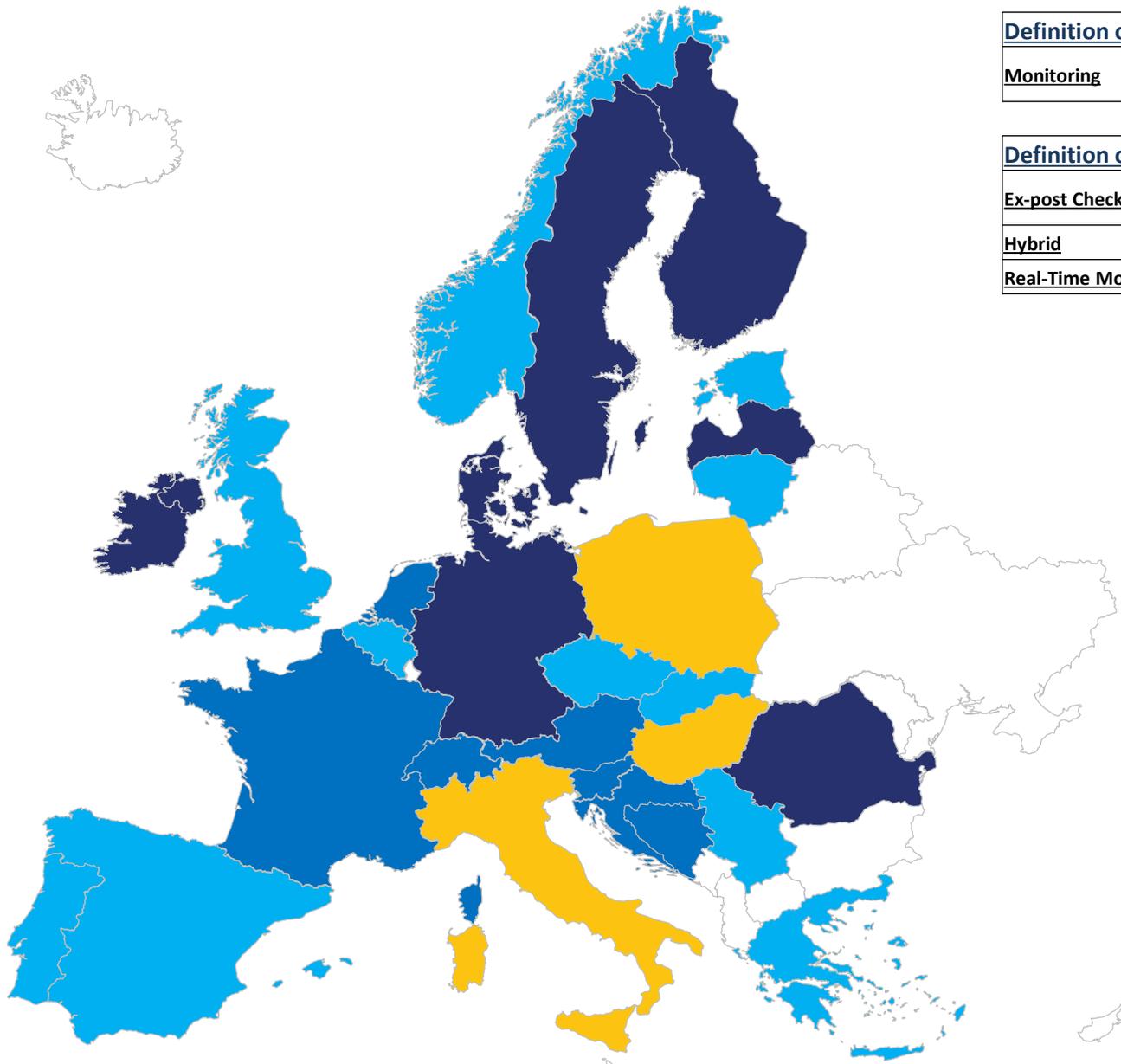
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|---|----------------------------------|
|  | Missing data |
|  | N/A |
|  | 100% Grid Users (through tariff) |
|  | 100% BRP |
|  | Hybrid |

Frequency Restoration Reserve (Manual) - Energy - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

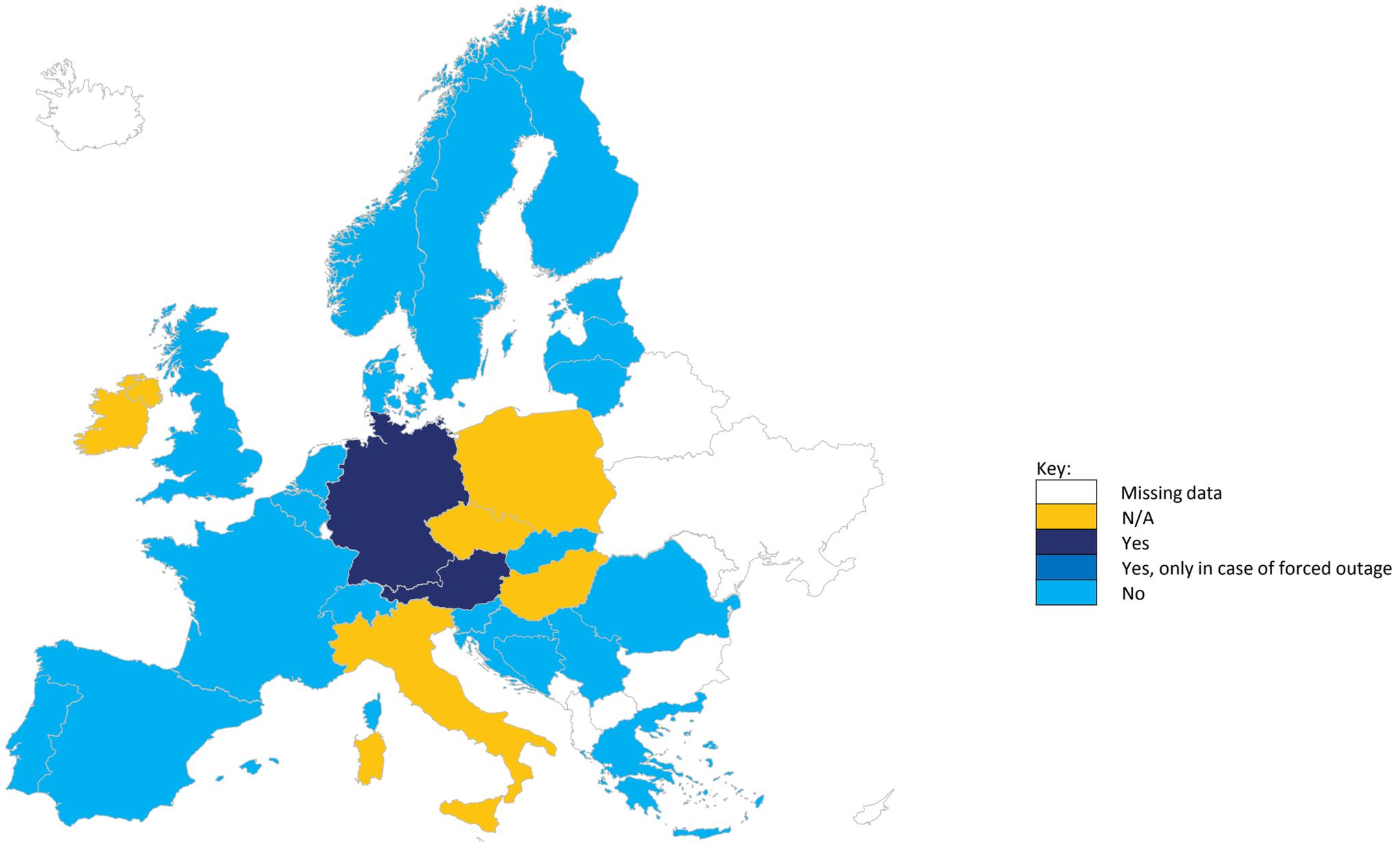
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

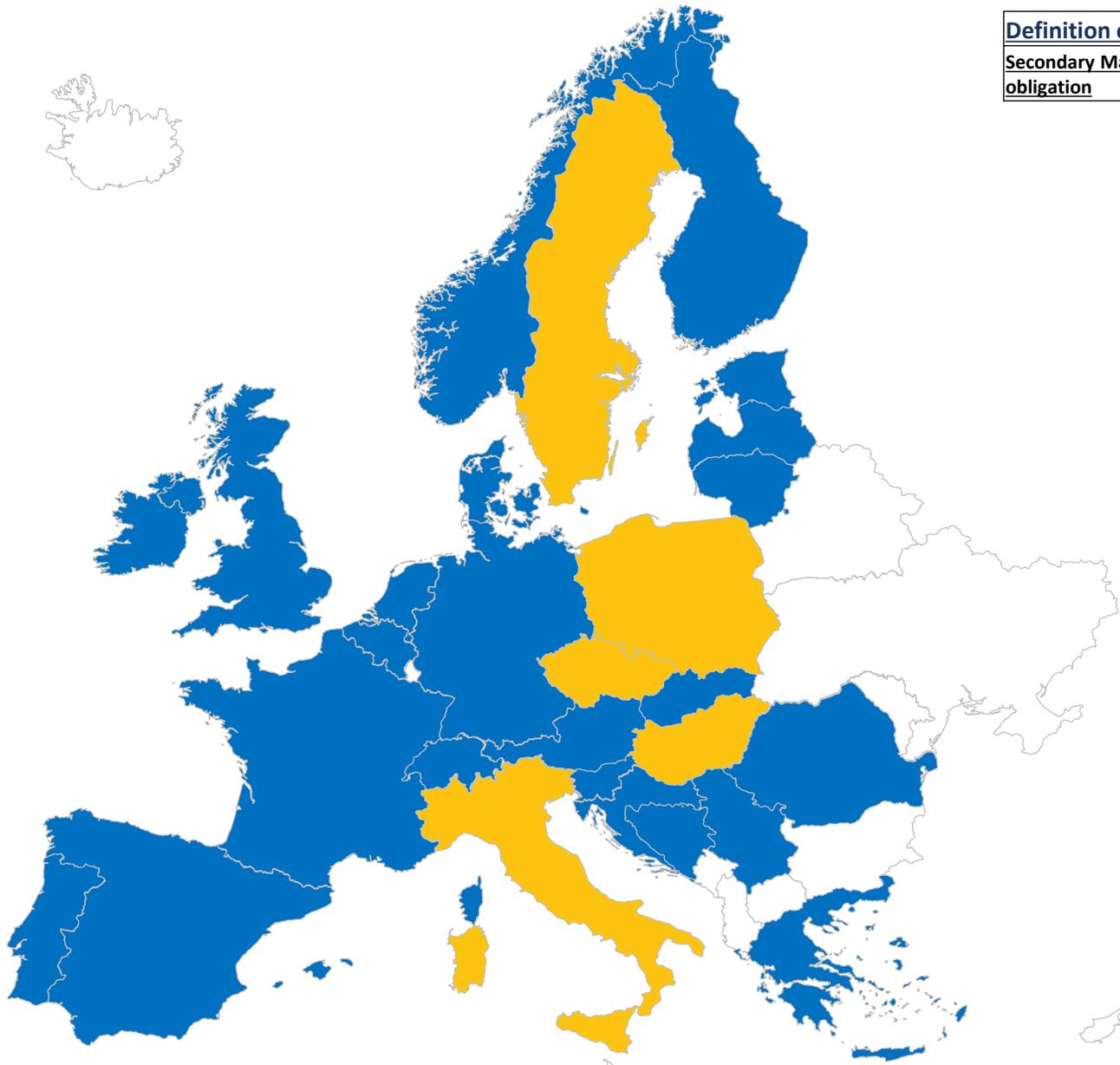
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real-Time Monitoring |
| | Ex-Post Check |
| | Hybrid |

Frequency Restoration Reserve (Manual) - Energy - Transfer of BSPs obligation allowed



Frequency Restoration Reserve (Manual) - Energy - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

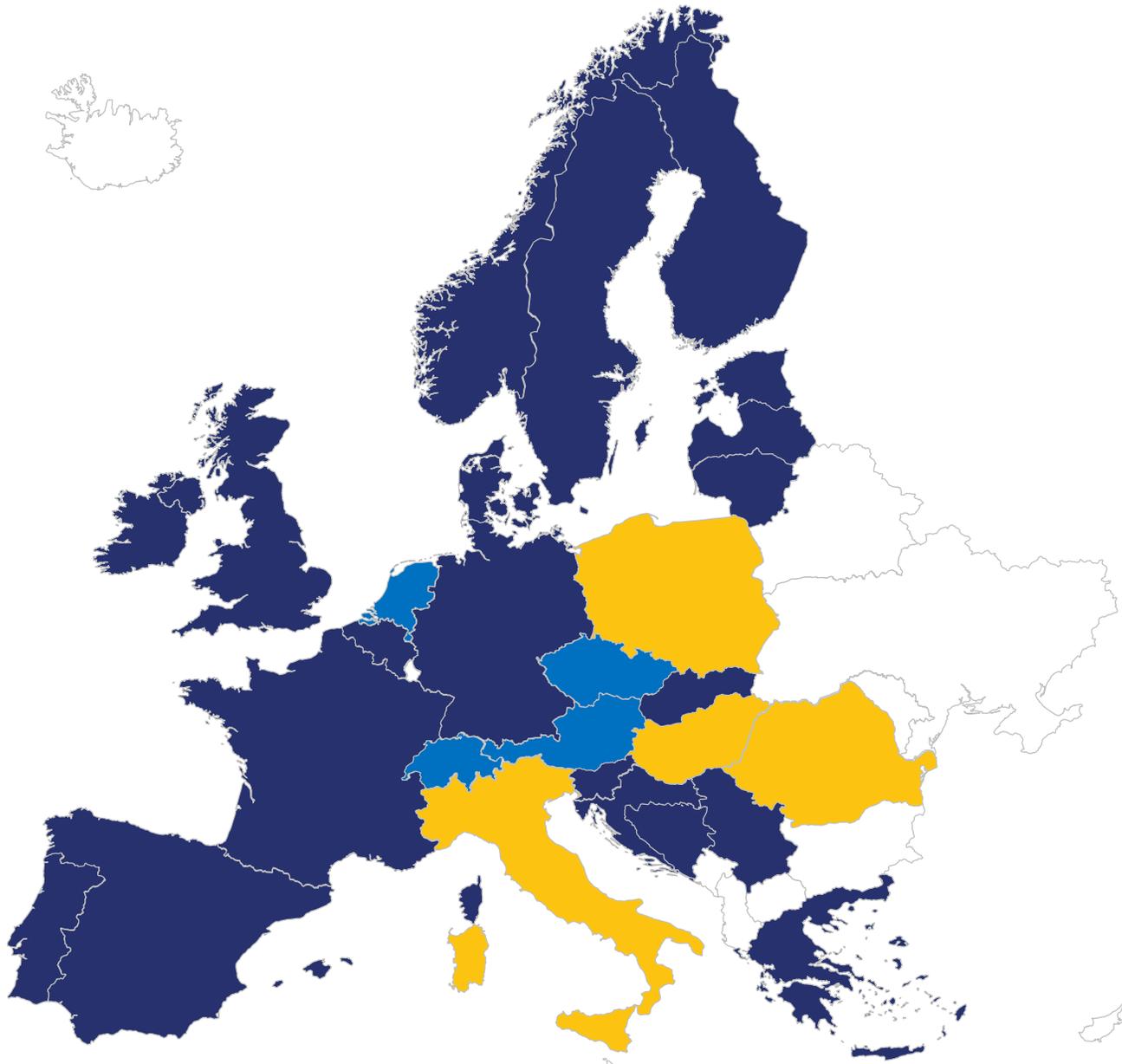
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

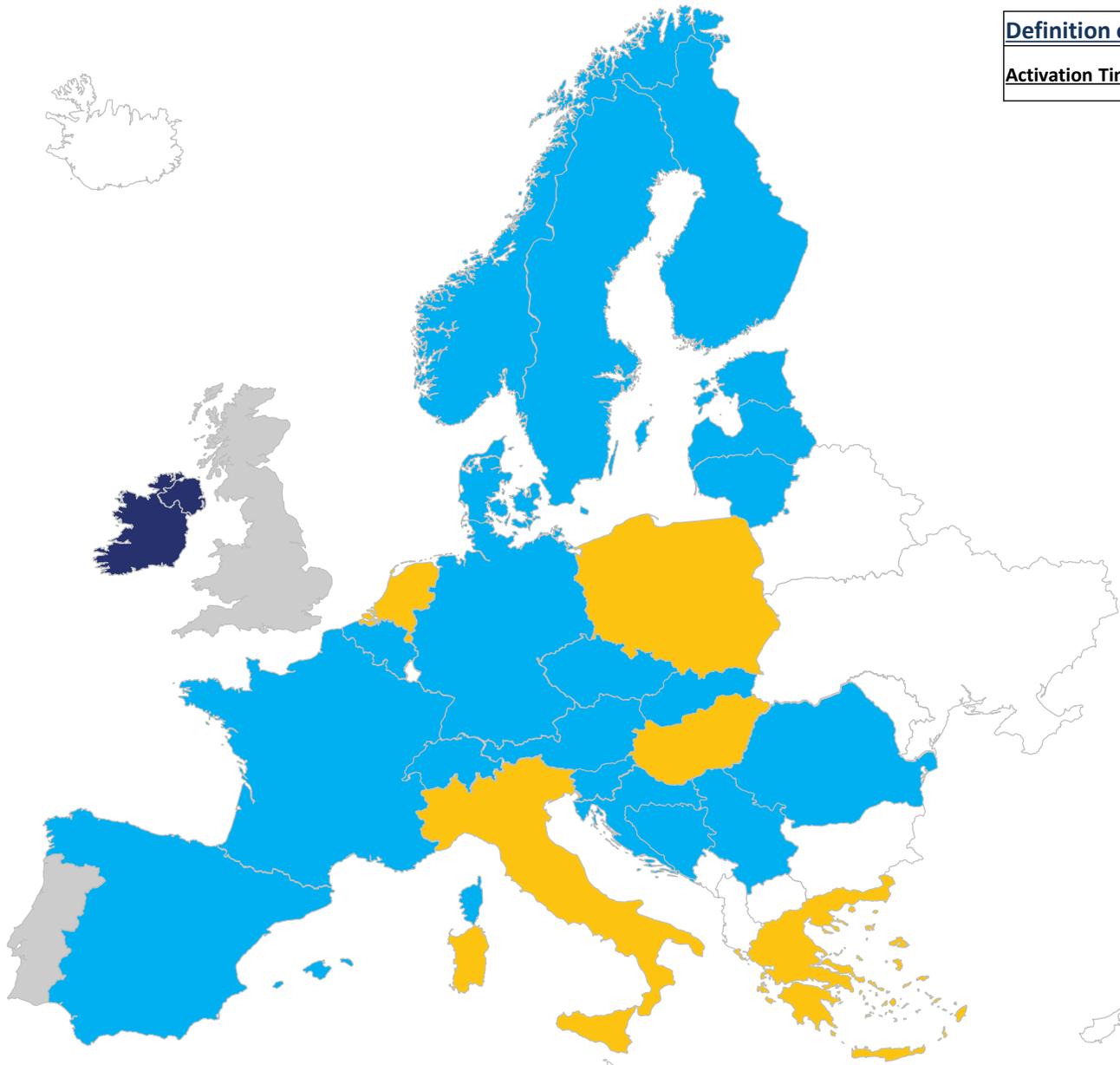
Frequency Restoration Reserve (Manual) - Energy - Can offered products be partially activated?



Key:

| | |
|---|----------------------------|
|  | Missing data |
|  | N/A |
|  | Yes, in all directions |
|  | No in none direction |
|  | Only in upward direction |
|  | Only in downward direction |

Frequency Restoration Reserve (Manual) - Energy - Activation time of mFRR from 0 to max



Definition of question

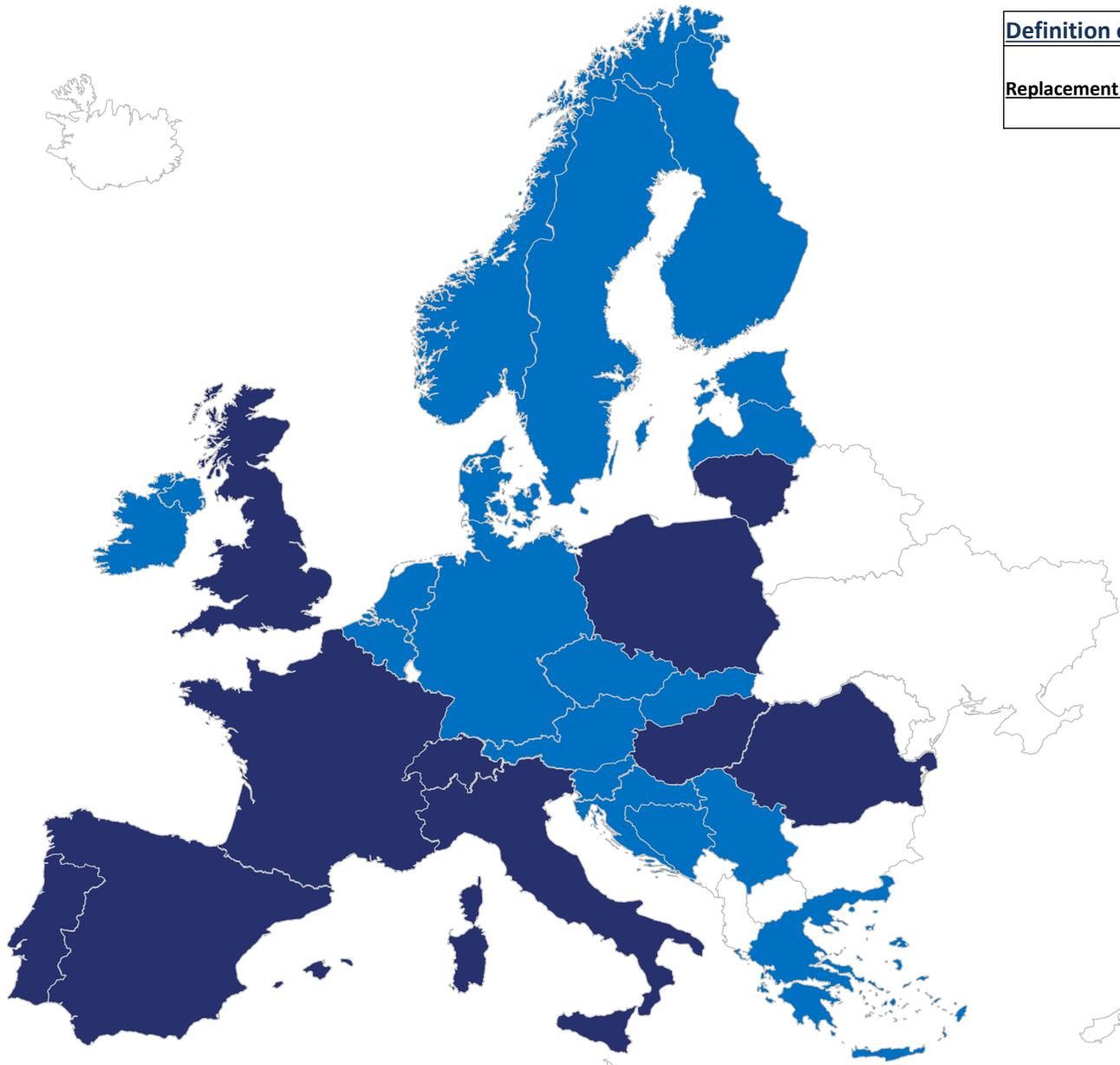
Activation Time

Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.

Key:

| | |
|--|---------------------------------------|
| | Missing data |
| | N/A |
| | $x \leq 90s$ |
| | $90s < x \leq 5 \text{ min}$ |
| | $5\text{min} < x \leq 15 \text{ min}$ |
| | Depends on the unit |

Using Replacement Reserve



Definition of answer

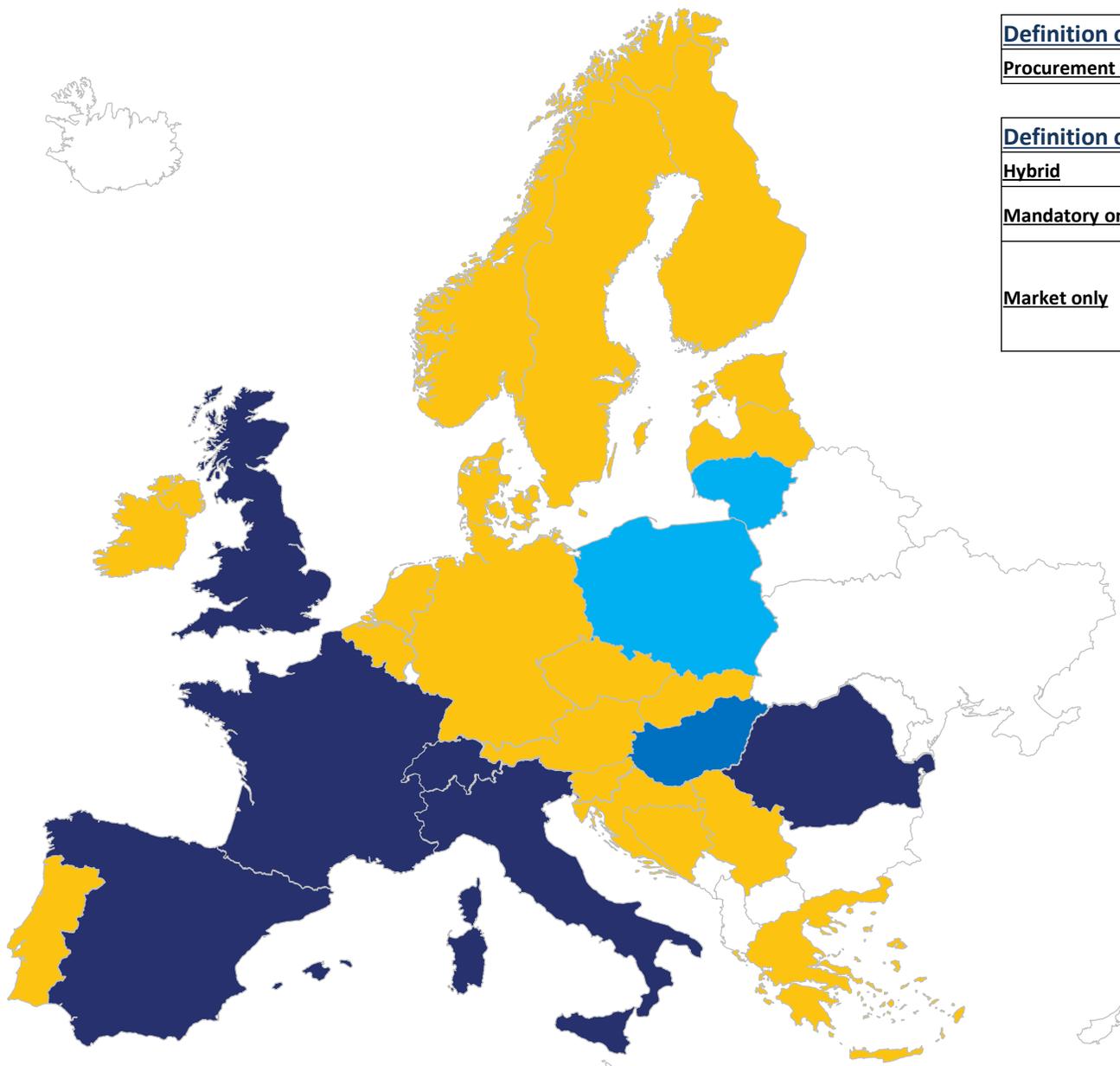
Replacement Reserve (RR)

Replacement Reserves (RR) means the reserves used to restore/support the required level of FRR to be prepared for further system imbalances. This category includes operating reserves with activation time from Time to Restore Frequency up to hours.

Key:

| | |
|--|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Replacement Reserve - Capacity - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

Definition of answer

| | |
|---------------|--------------|
| Hybrid | Combination. |
|---------------|--------------|

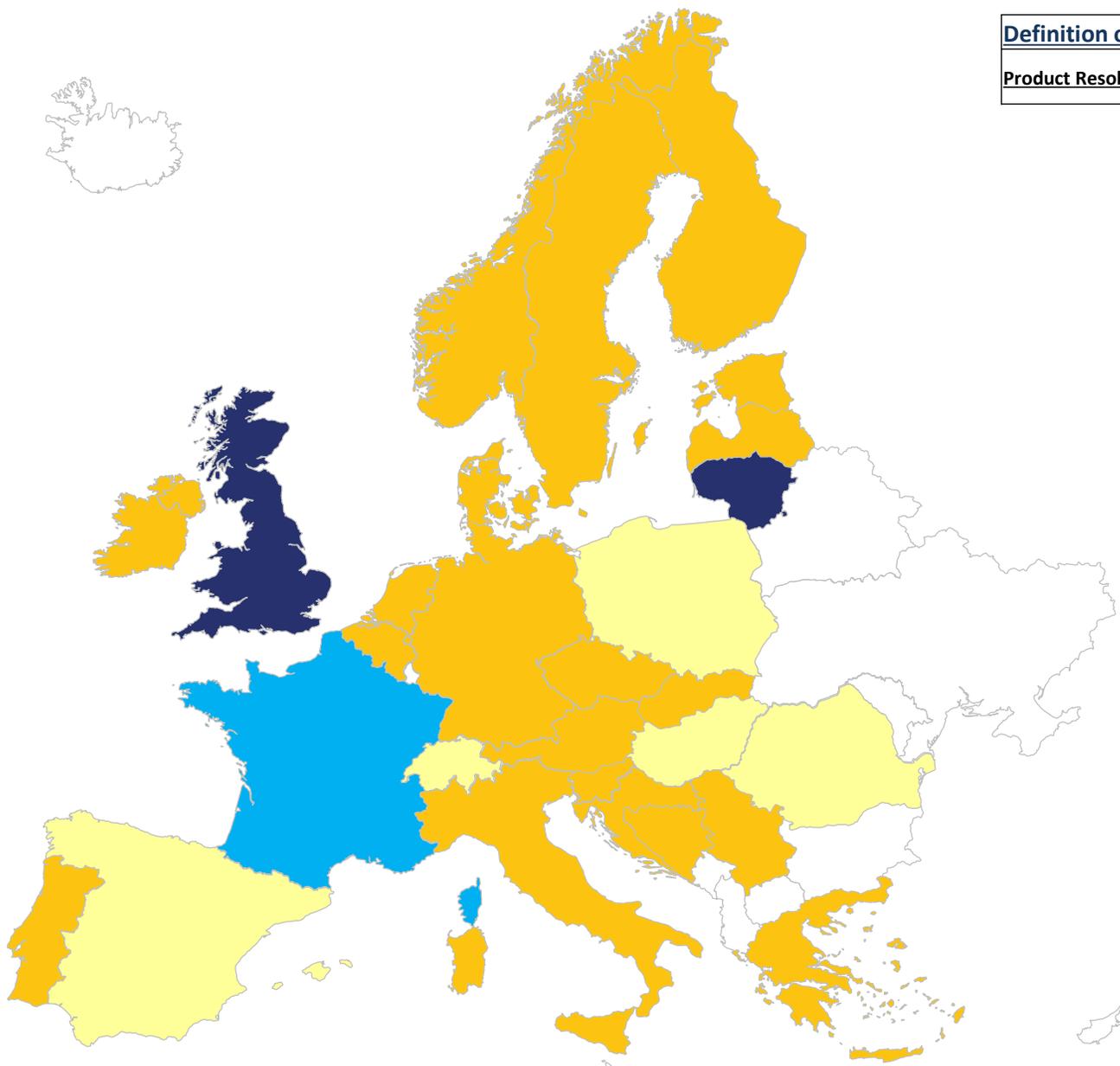
| | |
|-----------------------|--|
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
|-----------------------|--|

| | |
|--------------------|--|
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |
|--------------------|--|

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Replacement Reserve - Capacity - Product Resolution (in time)



Definition of question

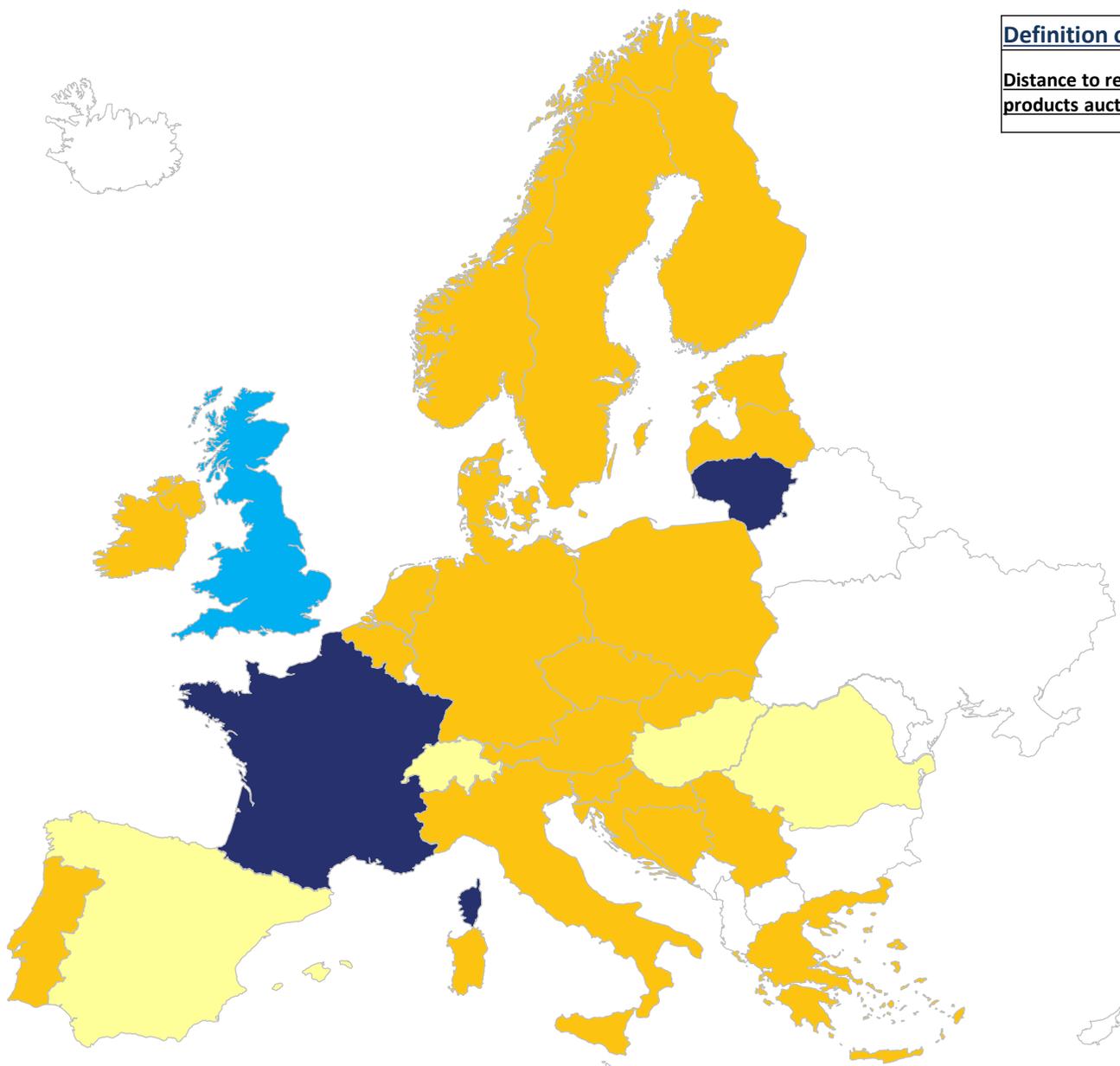
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--------------|-------------|
| Missing data | White |
| N/A | Orange |
| Year or more | Dark Blue |
| Month(s) | Medium Blue |
| Week(s) | Light Blue |
| Day(s) | Grey |
| Hour(s) | Yellow |

Replacement Reserve - Capacity - Distance to real time of reserve products auctions



Definition of question

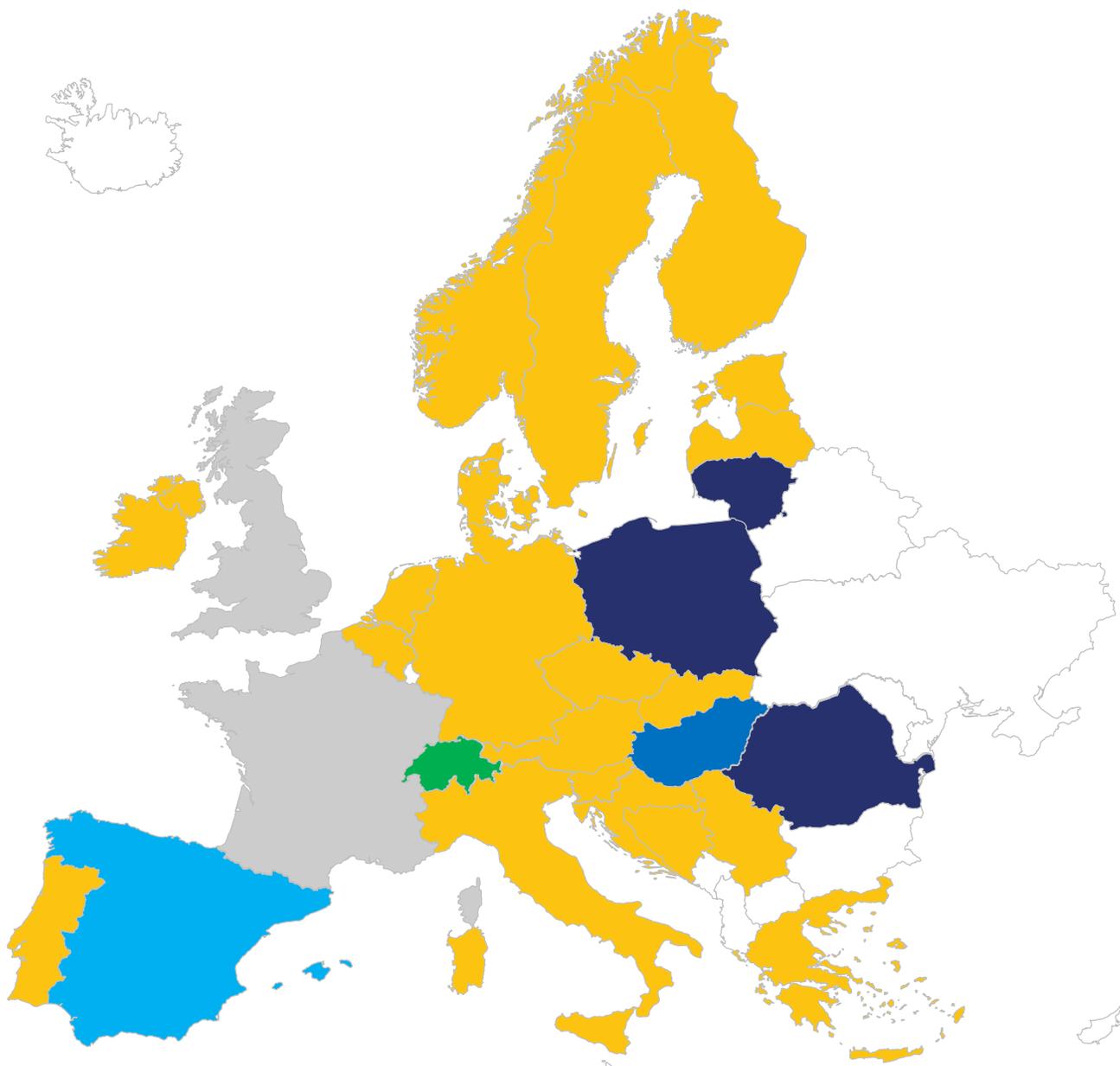
Distance to real time of reserve products auctions

The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Year or more |
| | Quarter year |
| | Month(s) |
| | Week(s) |
| | Day(s) |

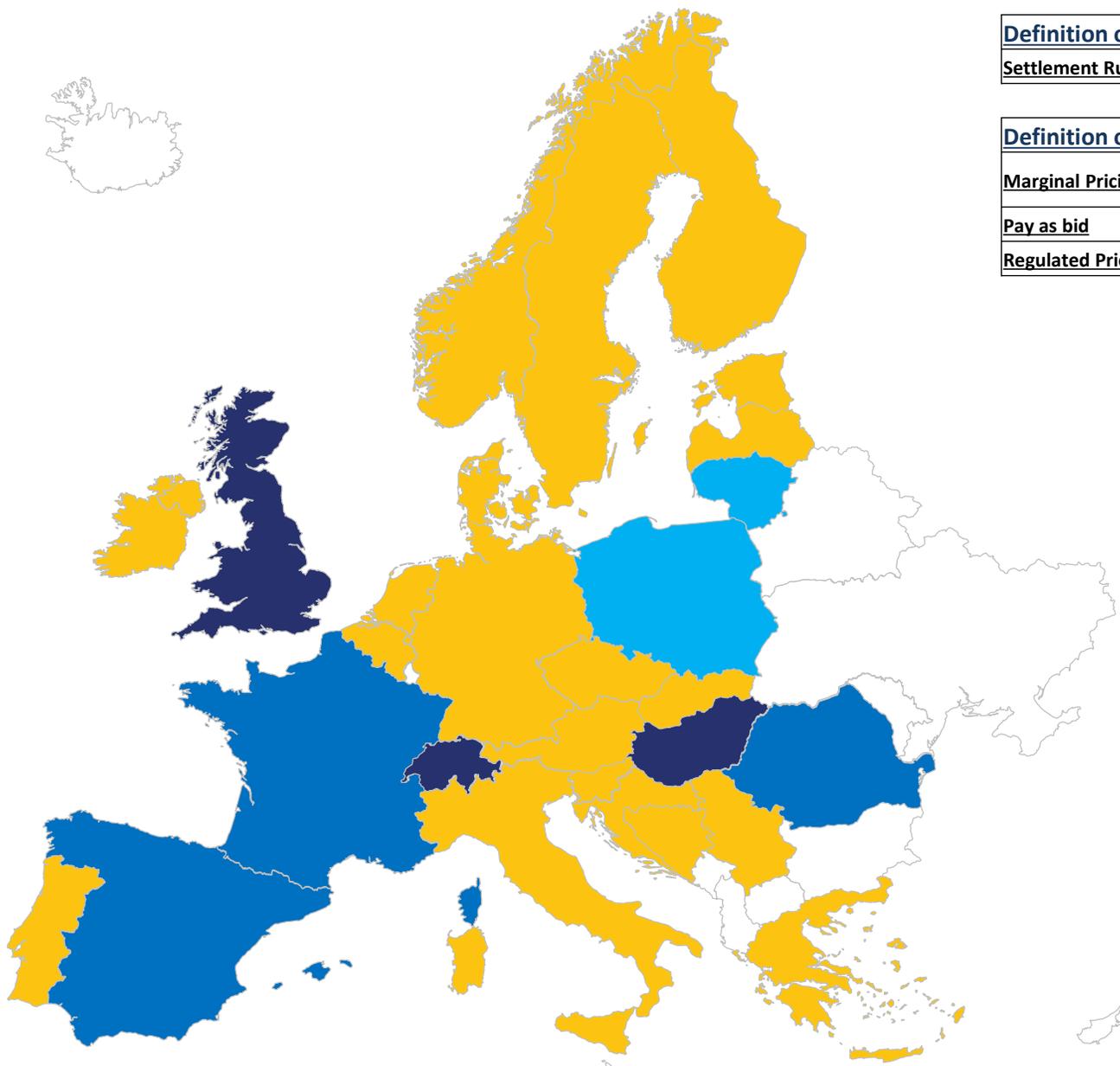
Replacement Reserve - Capacity - Provider



Key:

| | |
|---|--|
|  | Missing data |
|  | N/A |
|  | Generators Only |
|  | Generators + Load |
|  | Generators + Pump Storage |
|  | Generators + Load + Pump Storage |
|  | Batteries |
|  | Generators + Load + Batteries |
|  | Generators + Load + Pump Storage + Batteries |

Replacement Reserve - Capacity - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

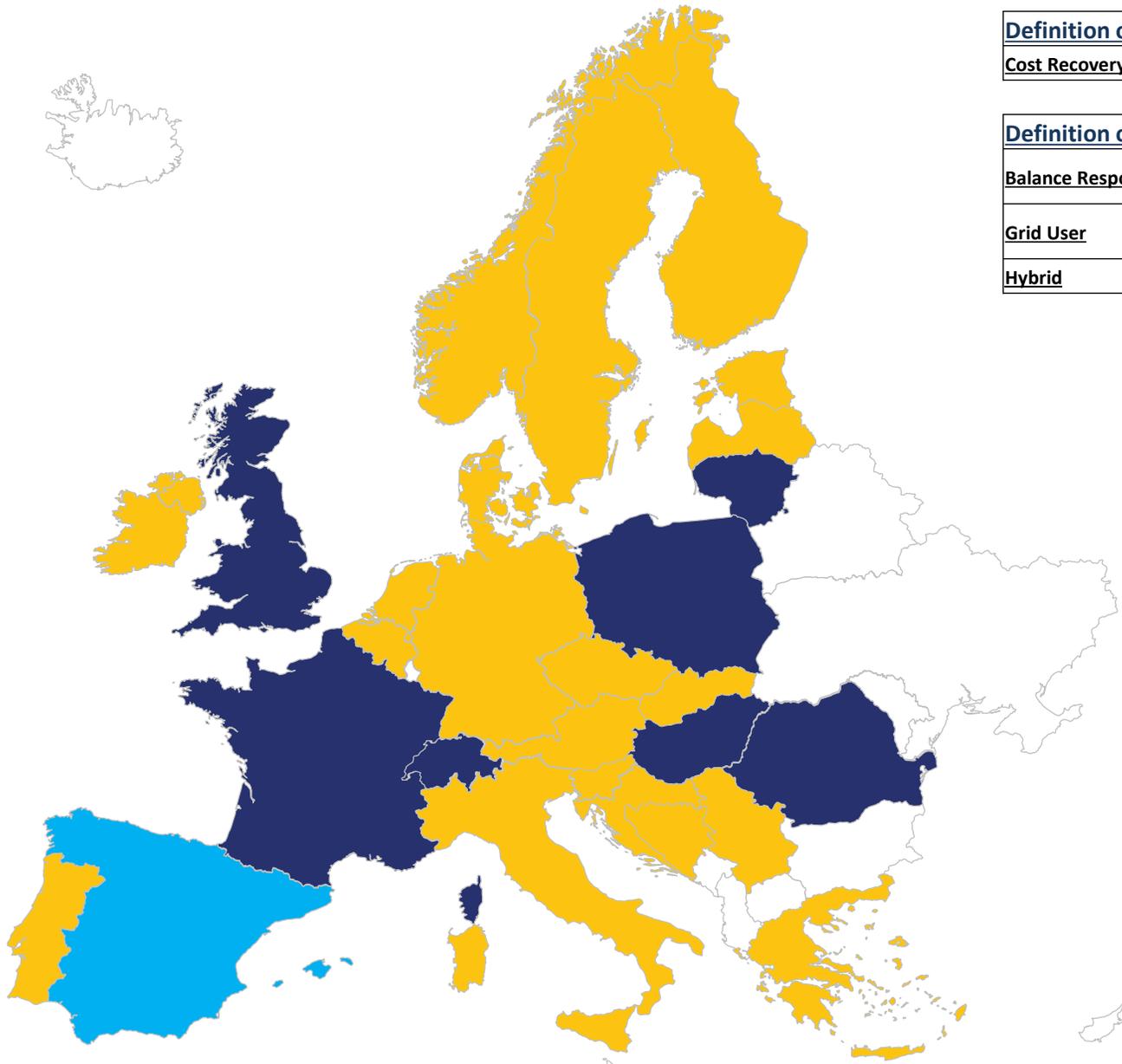
Definition of answer

| | |
|-------------------------|--|
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|---|------------------|
|  | Missing data |
|  | N/A |
|  | Pay as bid |
|  | Marginal Pricing |
|  | Regulated Price |

Replacement Reserve - Capacity - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

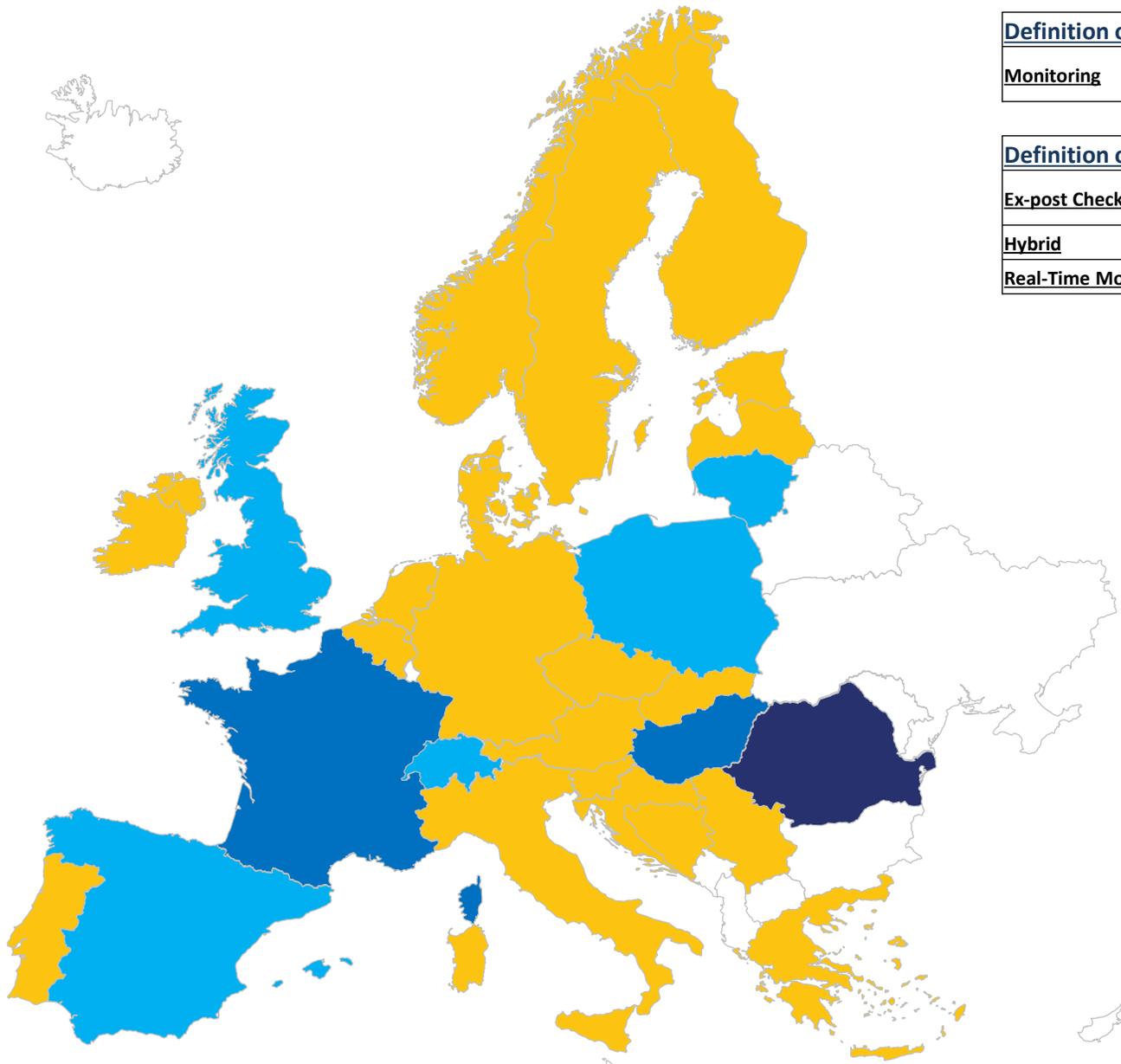
Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
| Hybrid | Combination. |

Key:

| | |
|---|----------------------------------|
|  | Missing data |
|  | N/A |
|  | 100% Grid Users (through tariff) |
|  | 100% BRP |
|  | Hybrid |

Replacement Reserve - Capacity - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

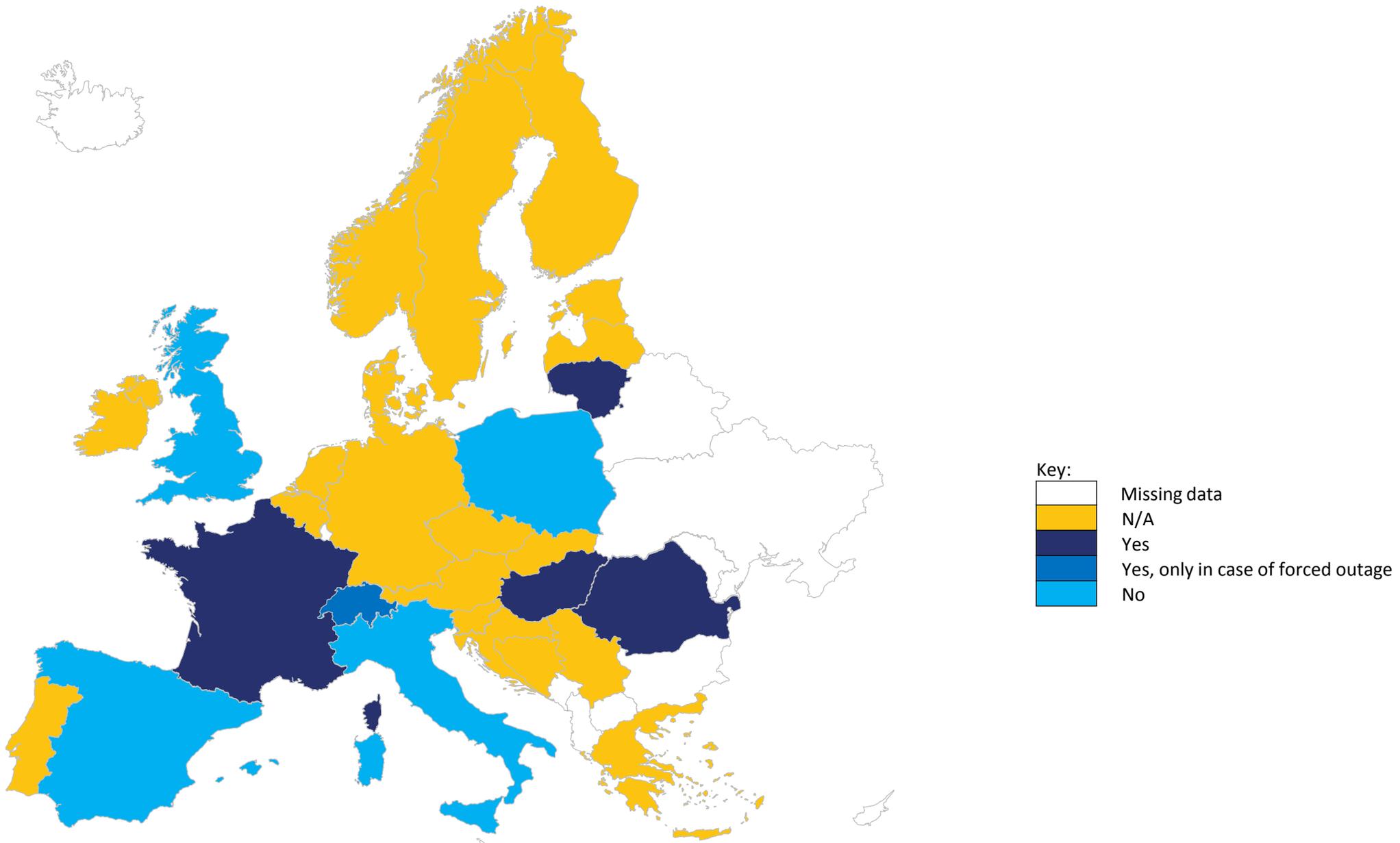
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

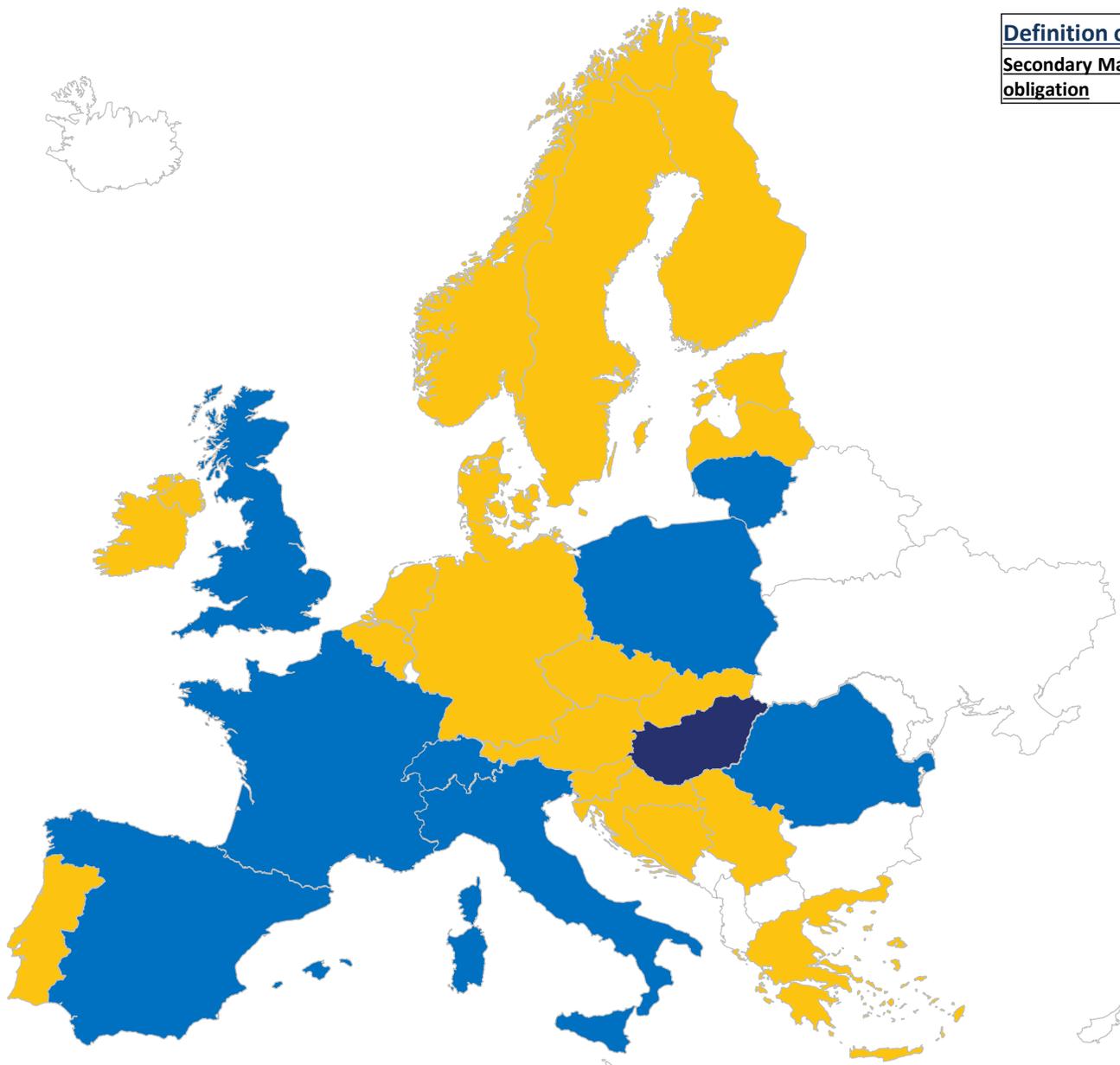
Key:

| | |
|---|----------------------|
|  | Missing data |
|  | N/A |
|  | Real-Time Monitoring |
|  | Ex-Post Check |
|  | Hybrid |

Replacement Reserve - Capacity - Transfer of BSPs obligation allowed



Replacement Reserve - Capacity - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

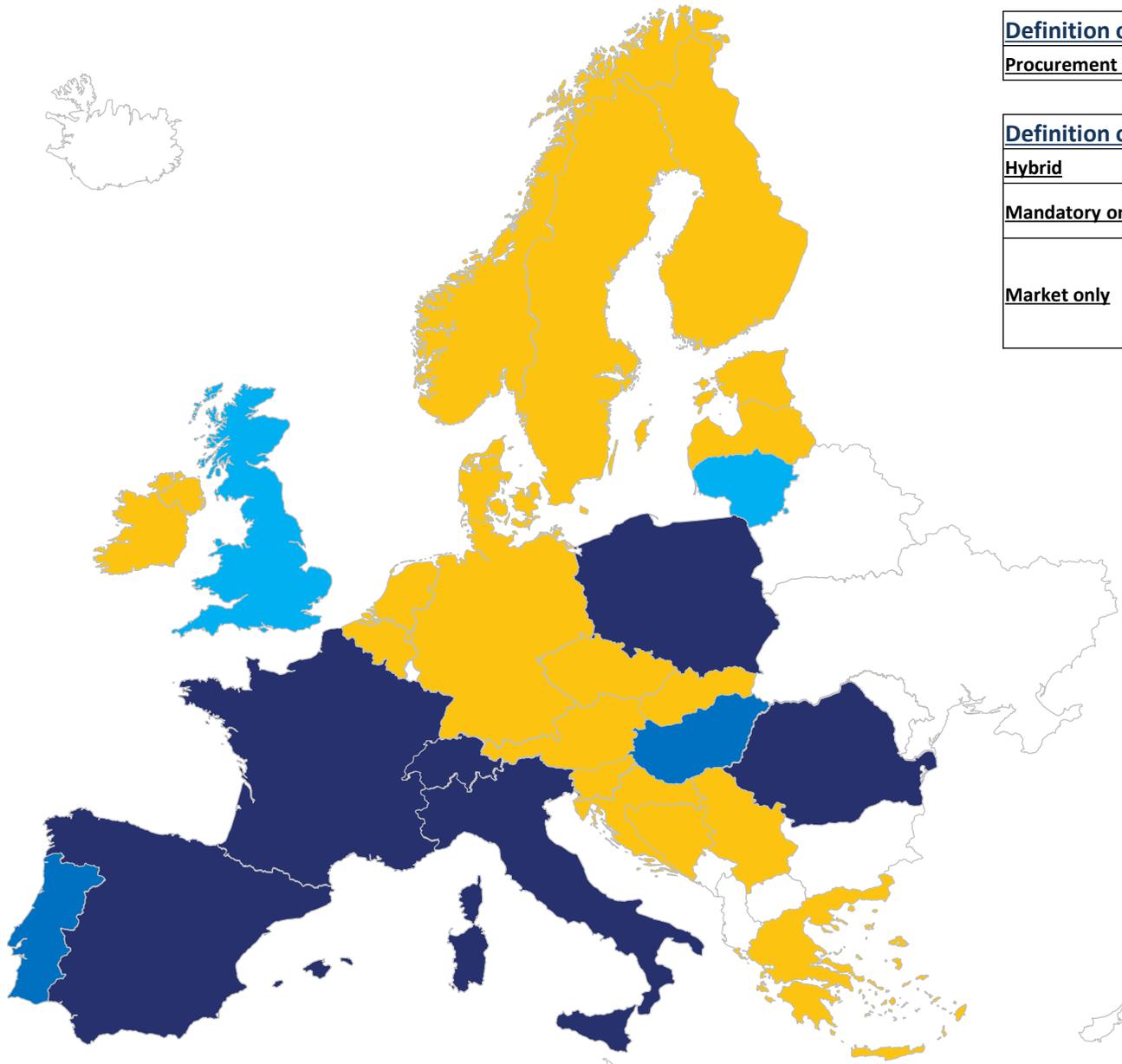
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Replacement Reserve - Energy - Procurement Scheme



Definition of question

| | |
|---------------------------|---|
| Procurement Scheme | Background of the offer, which is closest to the real operation time. |
|---------------------------|---|

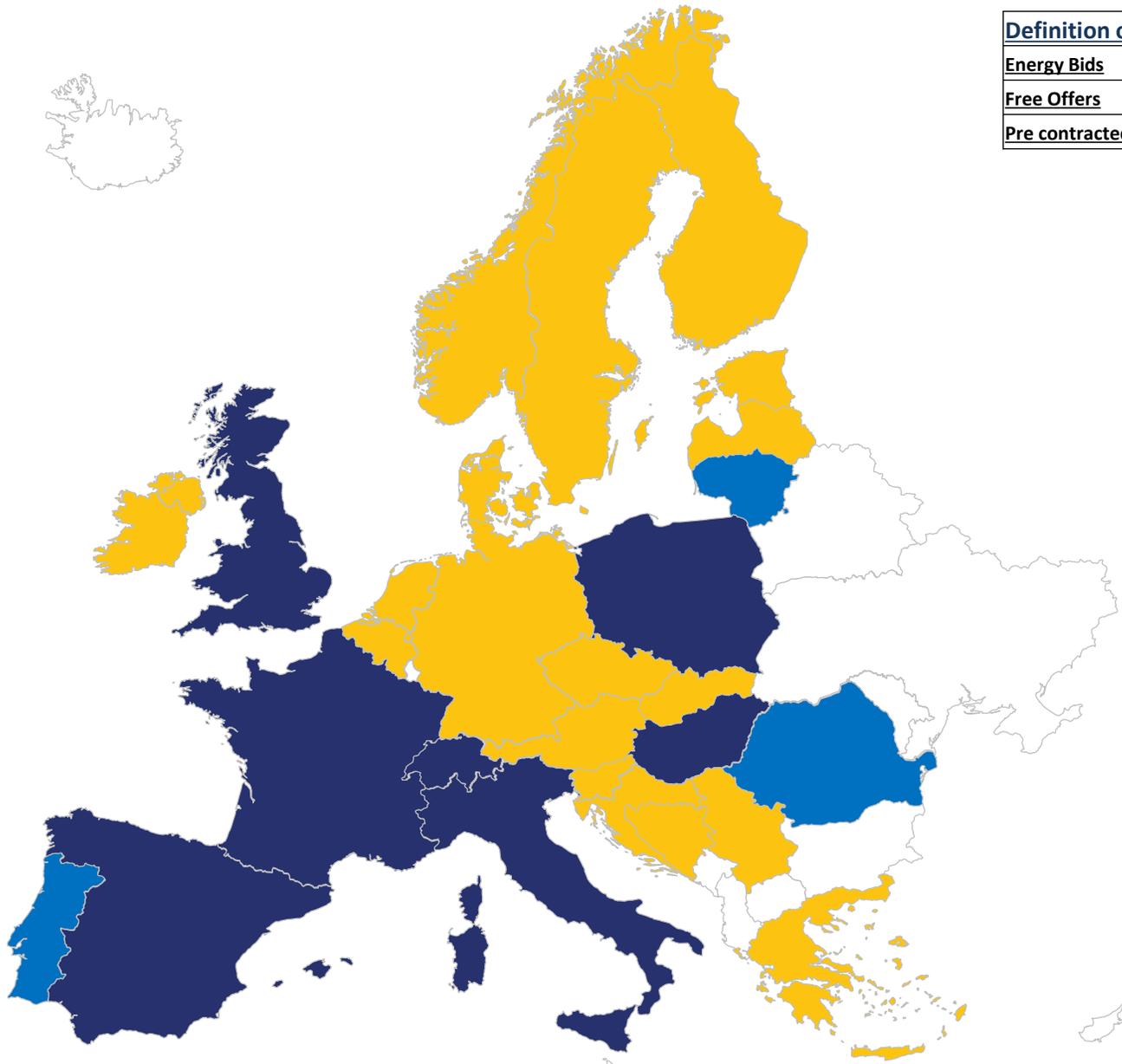
Definition of answer

| | |
|-----------------------|--|
| Hybrid | Combination. |
| Mandatory only | Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free. |
| Market only | There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract. |

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Market only |
| | Mandatory only |
| | Hybrid |

Replacement Reserve - Energy - Free Bids allowed



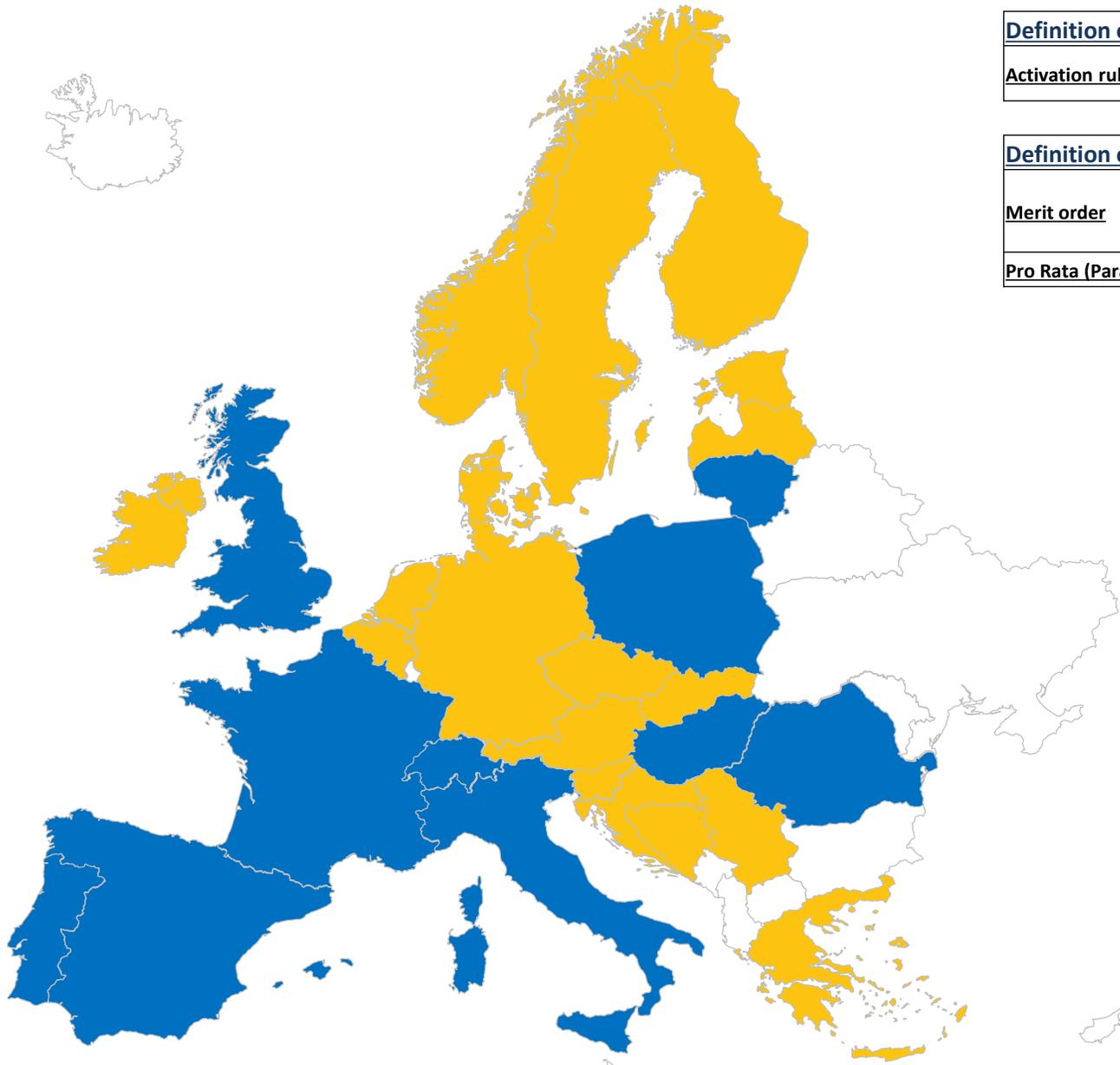
Definition of question

| | |
|-----------------------|--|
| Energy Bids | Acceptable Energy Bids. |
| Free Offers | Offers without a contract for Balancing Capacity possible. |
| Pre contracted | BSP has sold/procured Balancing Capacity. |

Key:

| | |
|---|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Replacement Reserve - Energy - Activation Rule



Definition of question

Activation rule

How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).

Definition of answer

Merit order

A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.

Pro Rata (Parallel Activation)

All bids always activated in parallel – proportionally.

Key:



Missing data

N/A

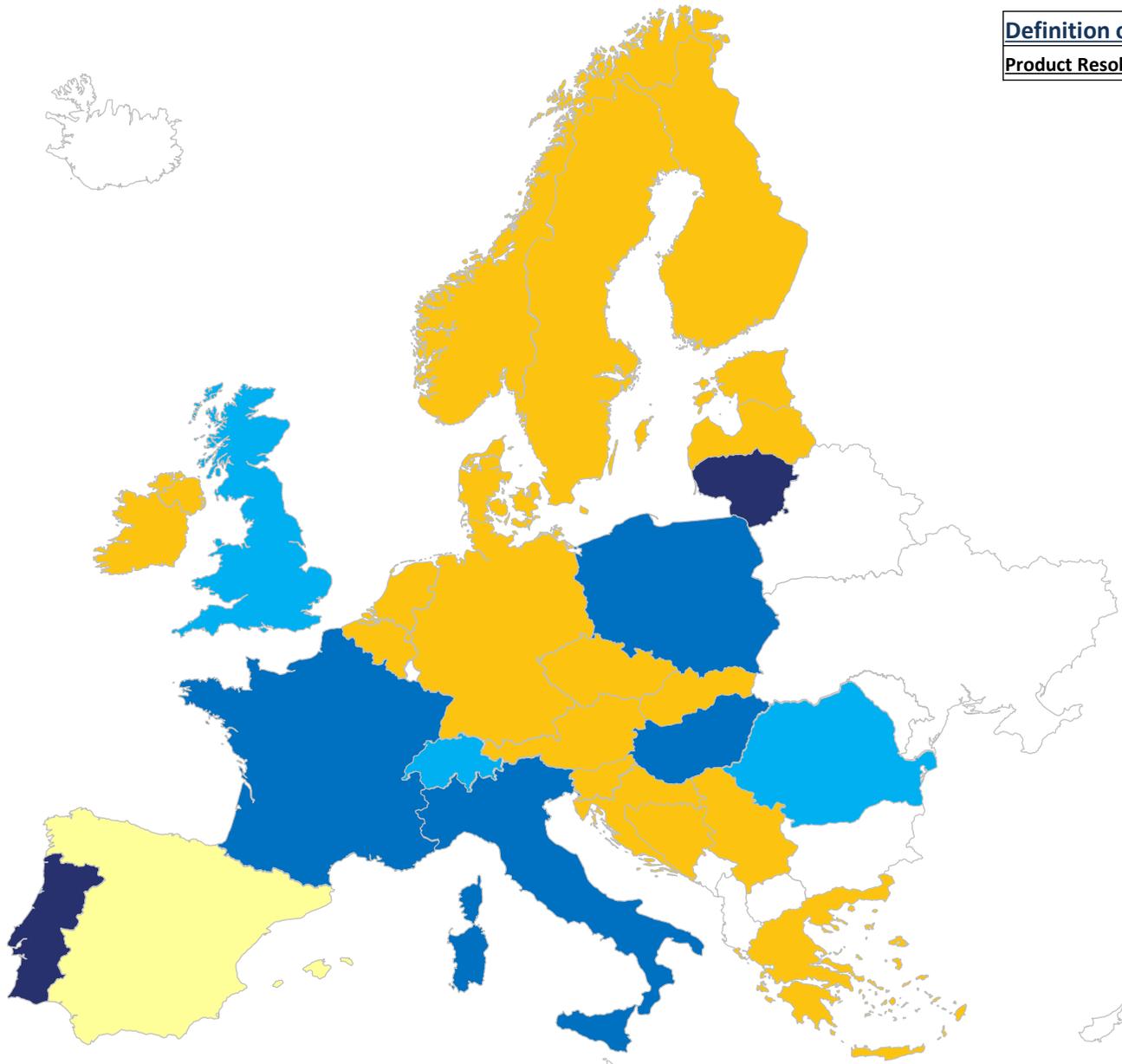
Pro Rata (Parallel Activation)

Merit order

Replacement Reserve - Energy - Product Resolution (in MW)

Definition of question

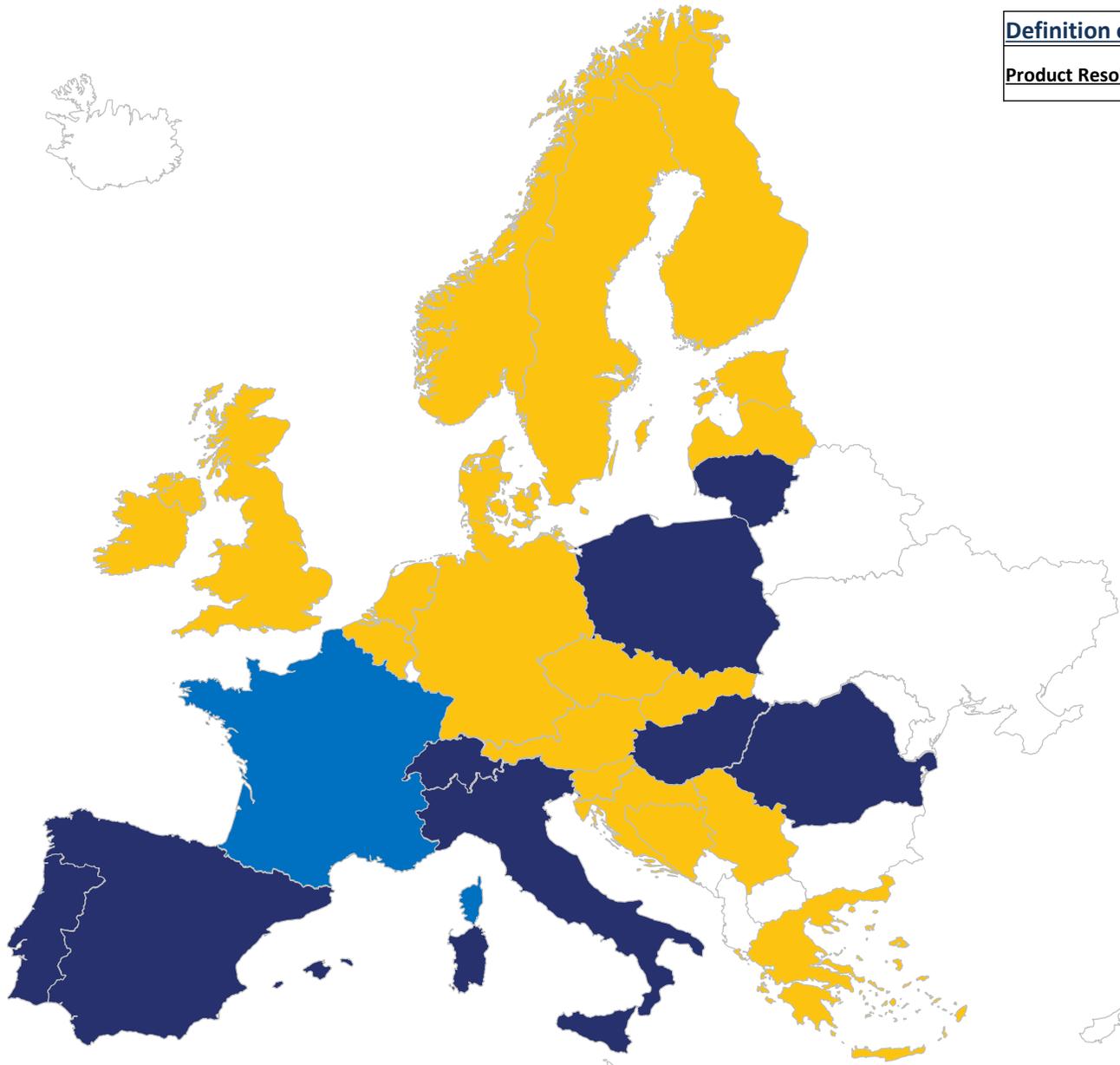
| | |
|-----------------------------------|---|
| Product Resolution (in MW) | The minimum bid size into the balancing market. |
|-----------------------------------|---|



Key:

| | |
|-----------------------------------|-----------------------------------|
| Missing data | Missing data |
| N/A | N/A |
| No minimum bid size | No minimum bid size |
| $x \leq 1\text{MW}$ | $x \leq 1\text{MW}$ |
| $1\text{MW} < x \leq 5\text{MW}$ | $1\text{MW} < x \leq 5\text{MW}$ |
| $5\text{MW} < x \leq 10\text{MW}$ | $5\text{MW} < x \leq 10\text{MW}$ |
| $x > 10\text{MW}$ | $x > 10\text{MW}$ |

Replacement Reserve - Energy - Product Resolution (in time)



Definition of question

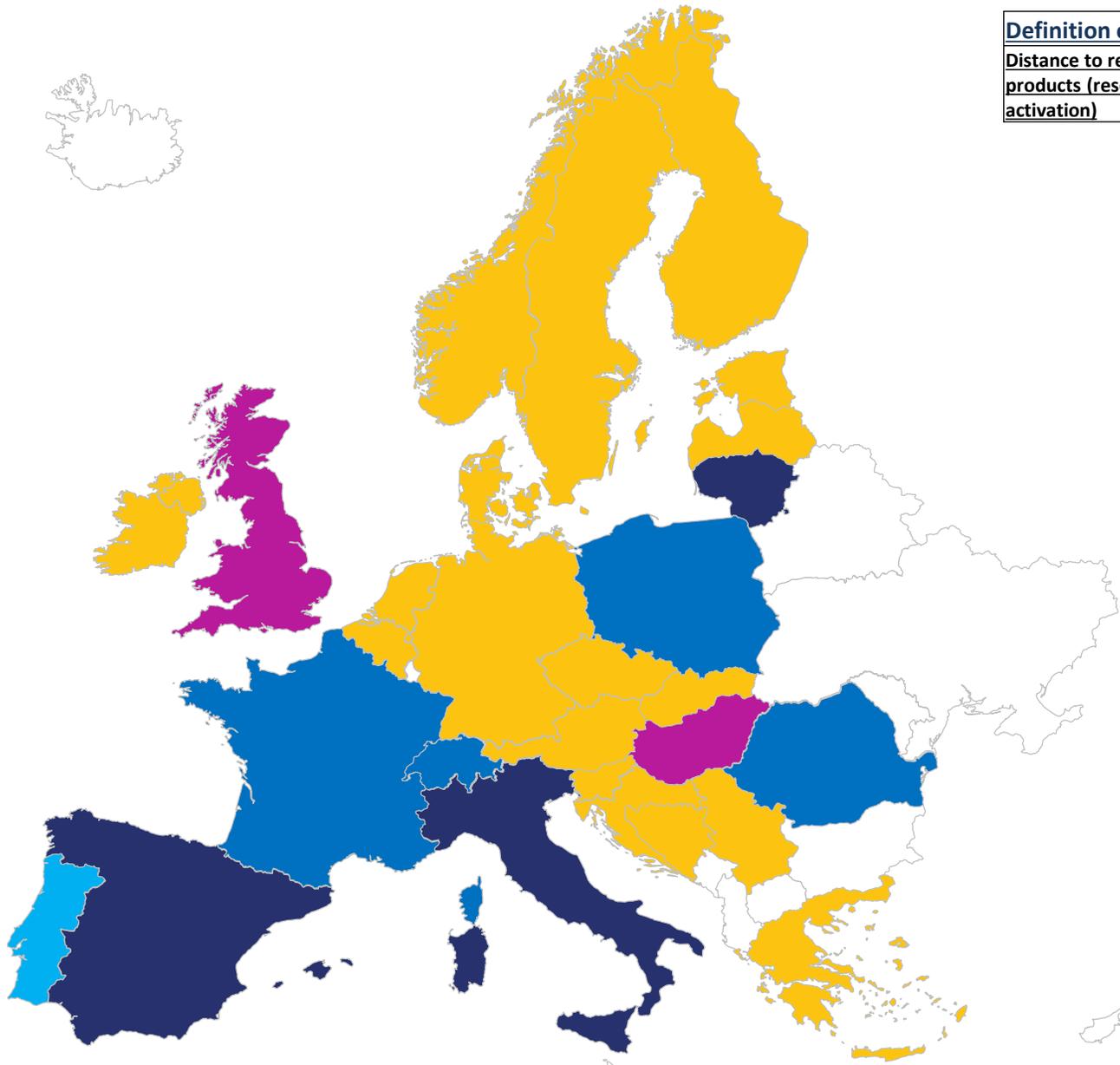
Product Resolution (in time)

The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).

Key:

| | |
|--|------------------|
| | Missing data |
| | N/A |
| | Hour (or blocks) |
| | 30 minutes |
| | 15 minutes |

Replacement Reserve - Energy - Distance to real time of energy products



Definition of question

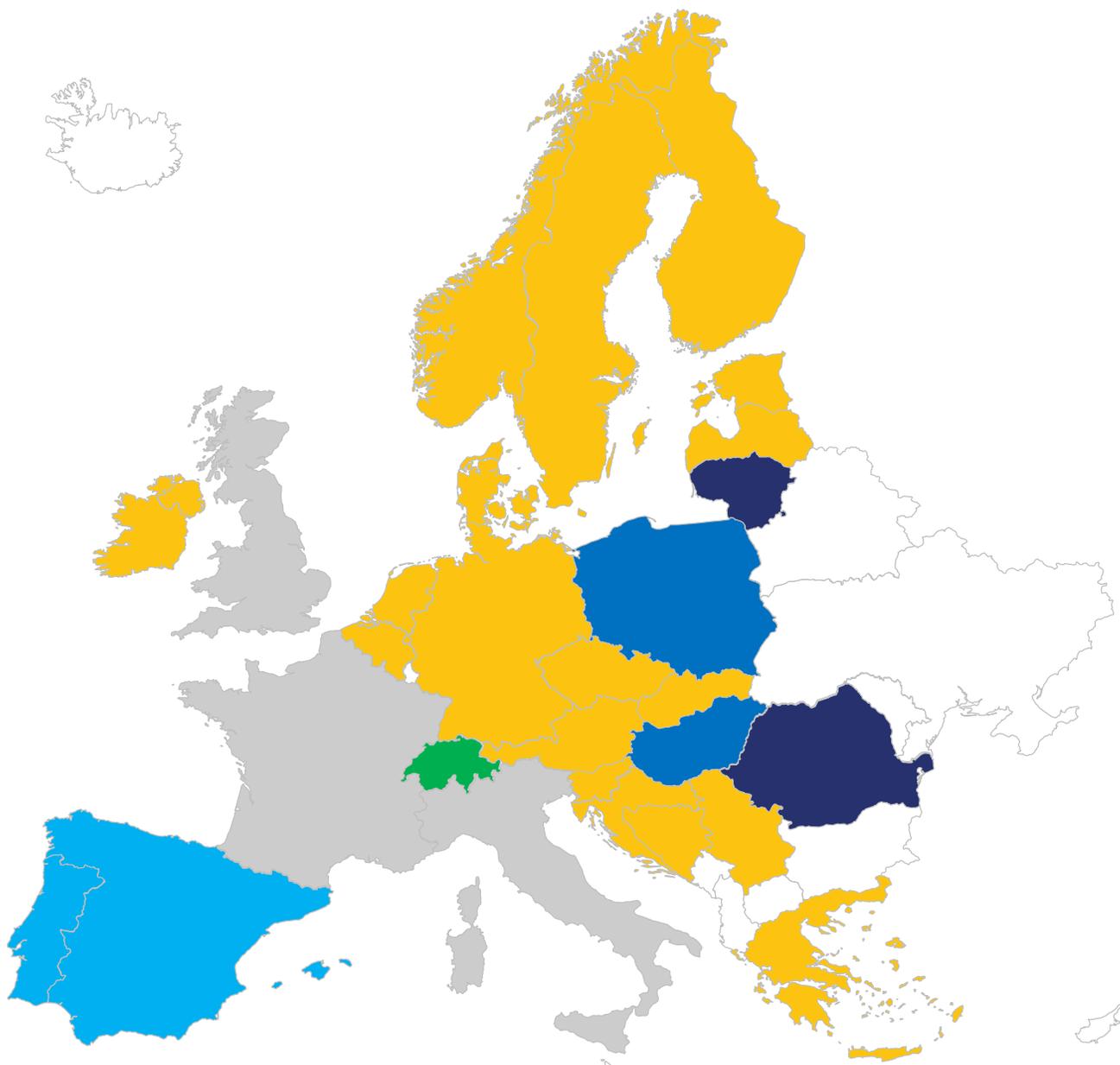
Distance to real time of energy products (reserve products activation)

The time ahead from real time when TSO activates a given product (for instance 15 minutes in the case of mFRR/tertiary energy).

Key:

| | |
|--|---|
| | Missing data |
| | N/A |
| | $x > H-1$ |
| | $15 \text{ minutes} < x \leq H-1$ |
| | $5 \text{ minutes} < x \leq 15 \text{ minutes}$ |
| | $1 \text{ minute} < x \leq 5 \text{ minutes}$ |
| | $x \leq 1 \text{ minute}$ |
| | Depends on the unit |

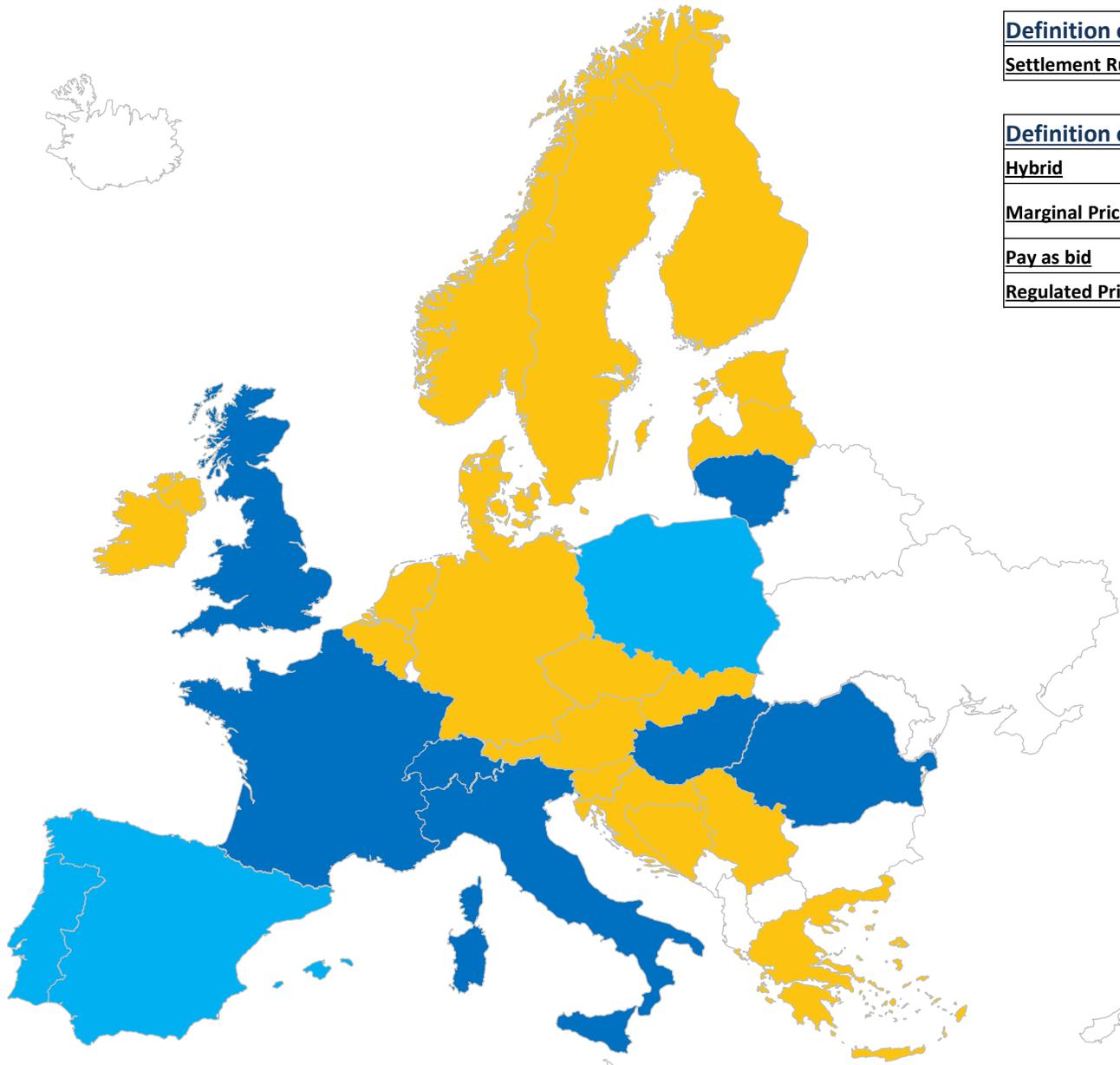
Replacement Reserve - Energy - Provider



Key:

| |
|--|
| Missing data |
| N/A |
| Generators Only |
| Generators + Load |
| Generators + Pump Storage |
| Generators + Load + Pump Storage |
| Batteries |
| Generators + Load + Batteries |
| Generators + Load + Pump Storage + Batteries |

Replacement Reserve - Energy - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

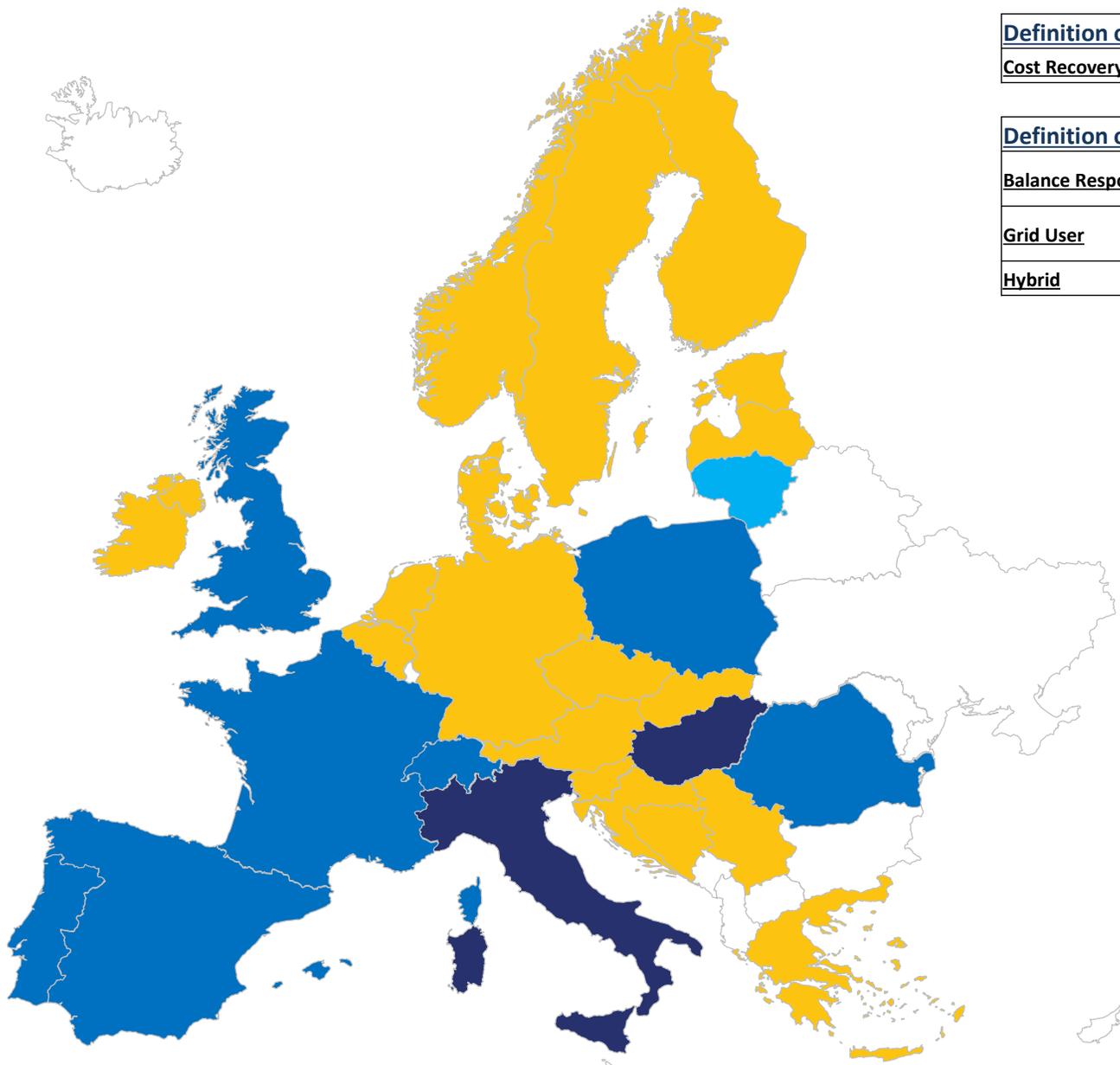
Definition of answer

| | |
|-------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|--------------|------------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | No settlement |
| Blue | Pay as bid |
| Light Blue | Marginal Pricing |
| Grey | Regulated Price |
| Light Yellow | Hybrid |

Replacement Reserve - Energy - Cost Recovery Scheme



Definition of question

| | |
|-----------------------------|-----------------------------------|
| Cost Recovery Scheme | From who are the costs recovered. |
|-----------------------------|-----------------------------------|

Definition of answer

| | |
|--|---|
| Balance Responsible Party (BRP) | Balancing Responsible Party means a market participant or its chosen representative responsible for its imbalances. |
|--|---|

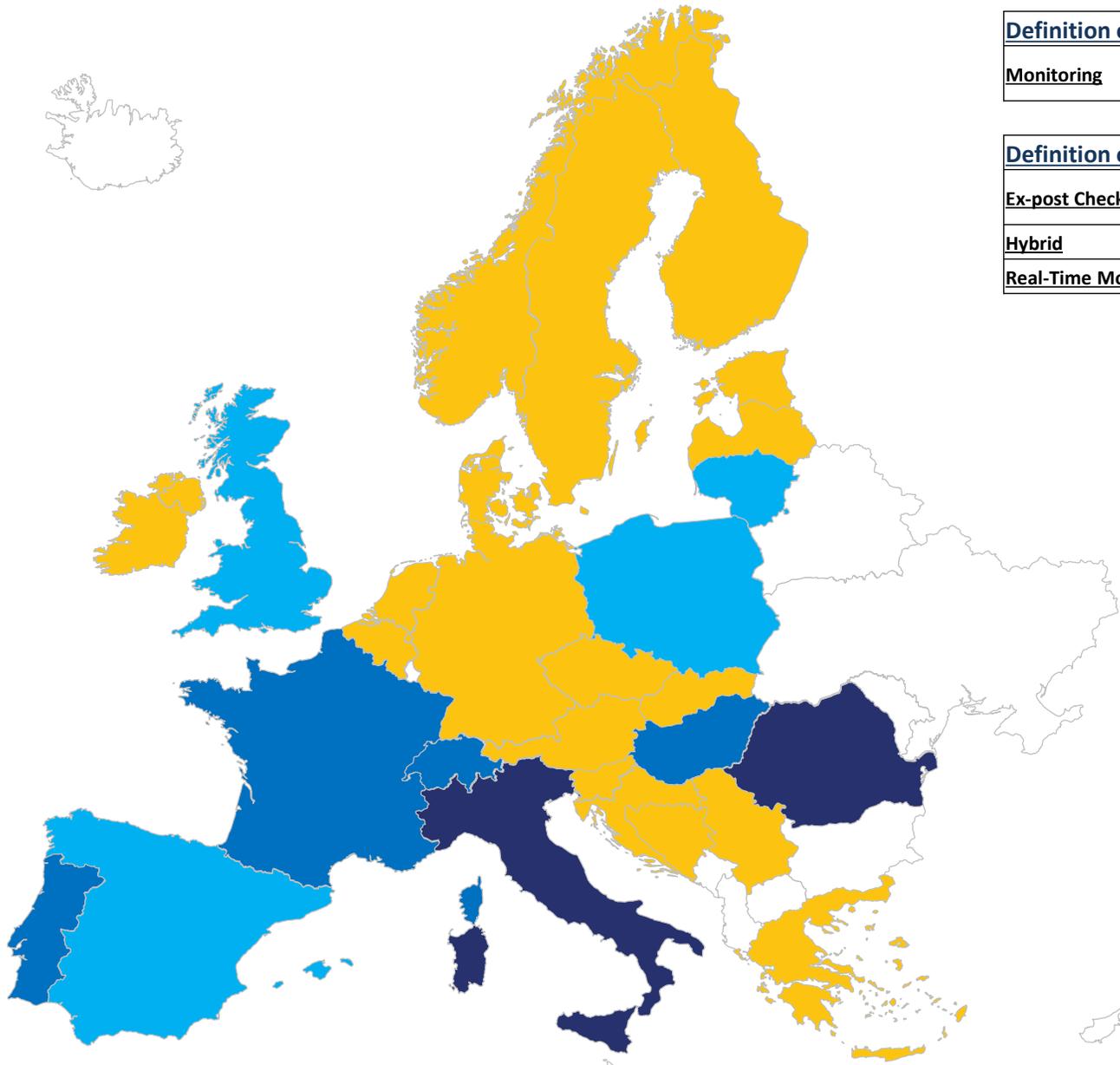
| | |
|------------------|--|
| Grid User | The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO. |
|------------------|--|

| | |
|---------------|--------------|
| Hybrid | Combination. |
|---------------|--------------|

Key:

| | |
|---|----------------------------------|
|  | Missing data |
|  | N/A |
|  | 100% Grid Users (through tariff) |
|  | 100% BRP |
|  | Hybrid |

Replacement Reserve - Energy - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

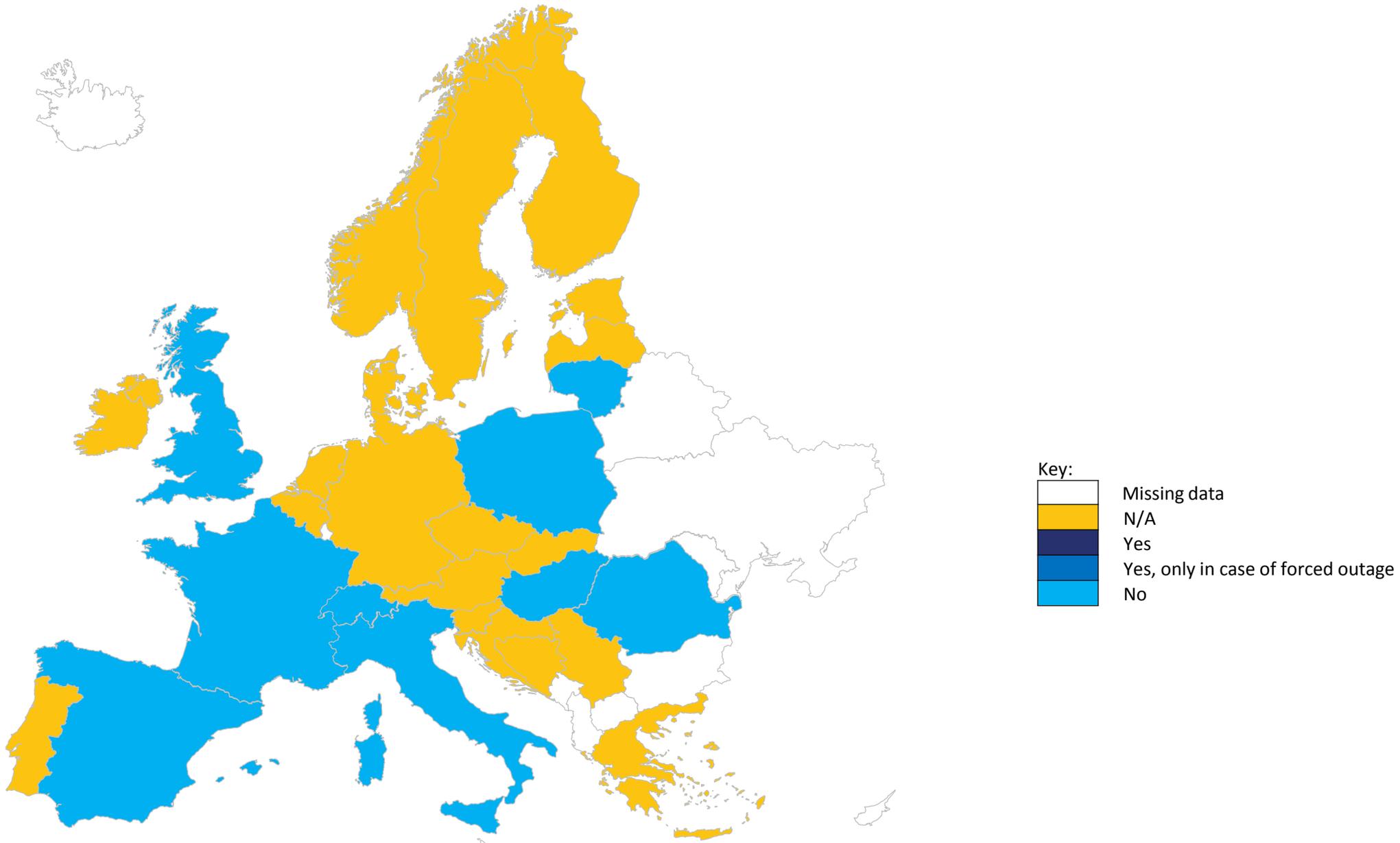
Definition of answer

| | |
|-----------------------------|---|
| Ex - post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

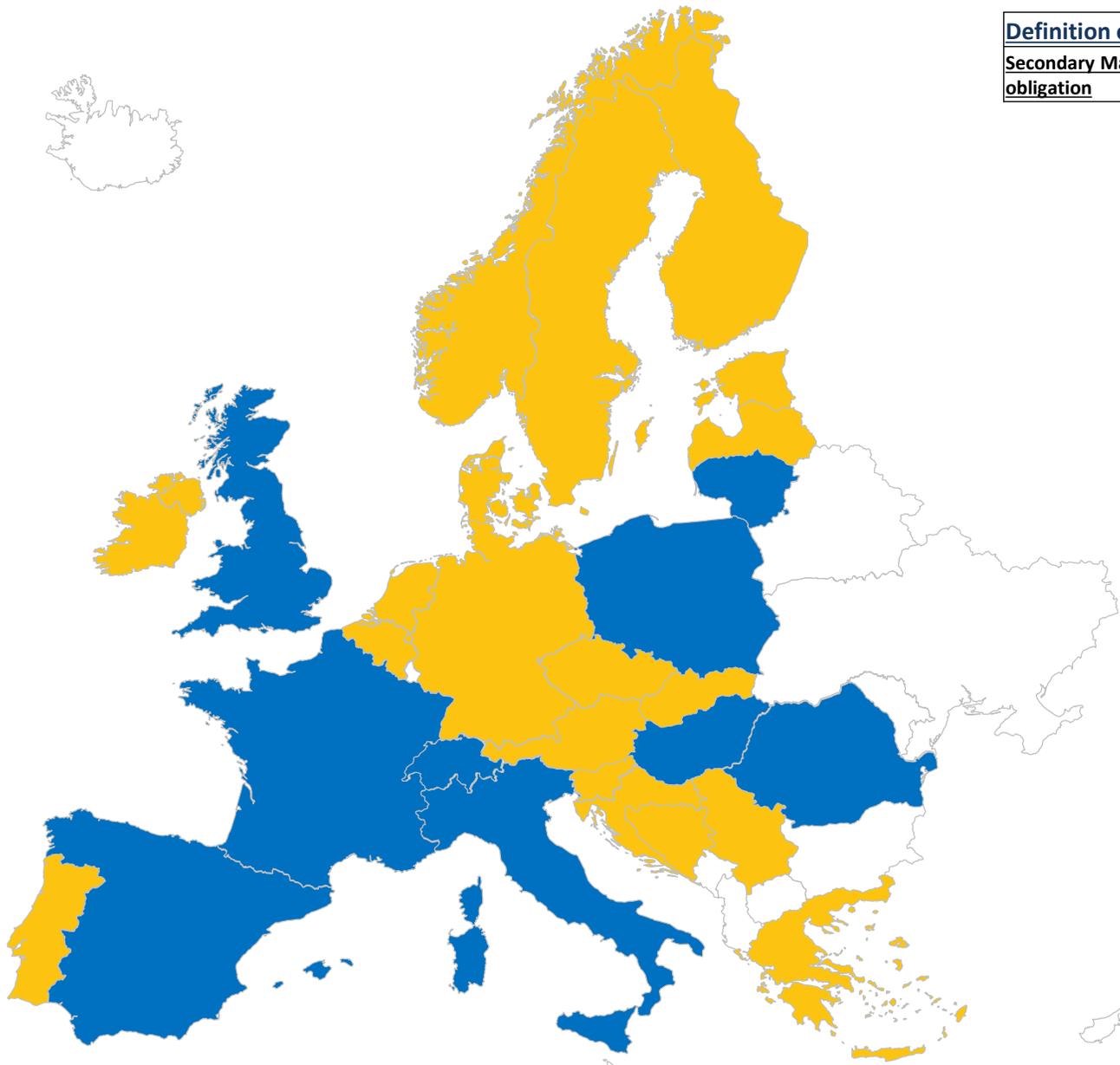
Key:

| | |
|---|----------------------|
|  | Missing data |
|  | N/A |
|  | Real-Time Monitoring |
|  | Ex-Post Check |
|  | Hybrid |

Replacement Reserve - Energy - Transfer of BSPs obligation allowed



Replacement Reserve - Energy - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer

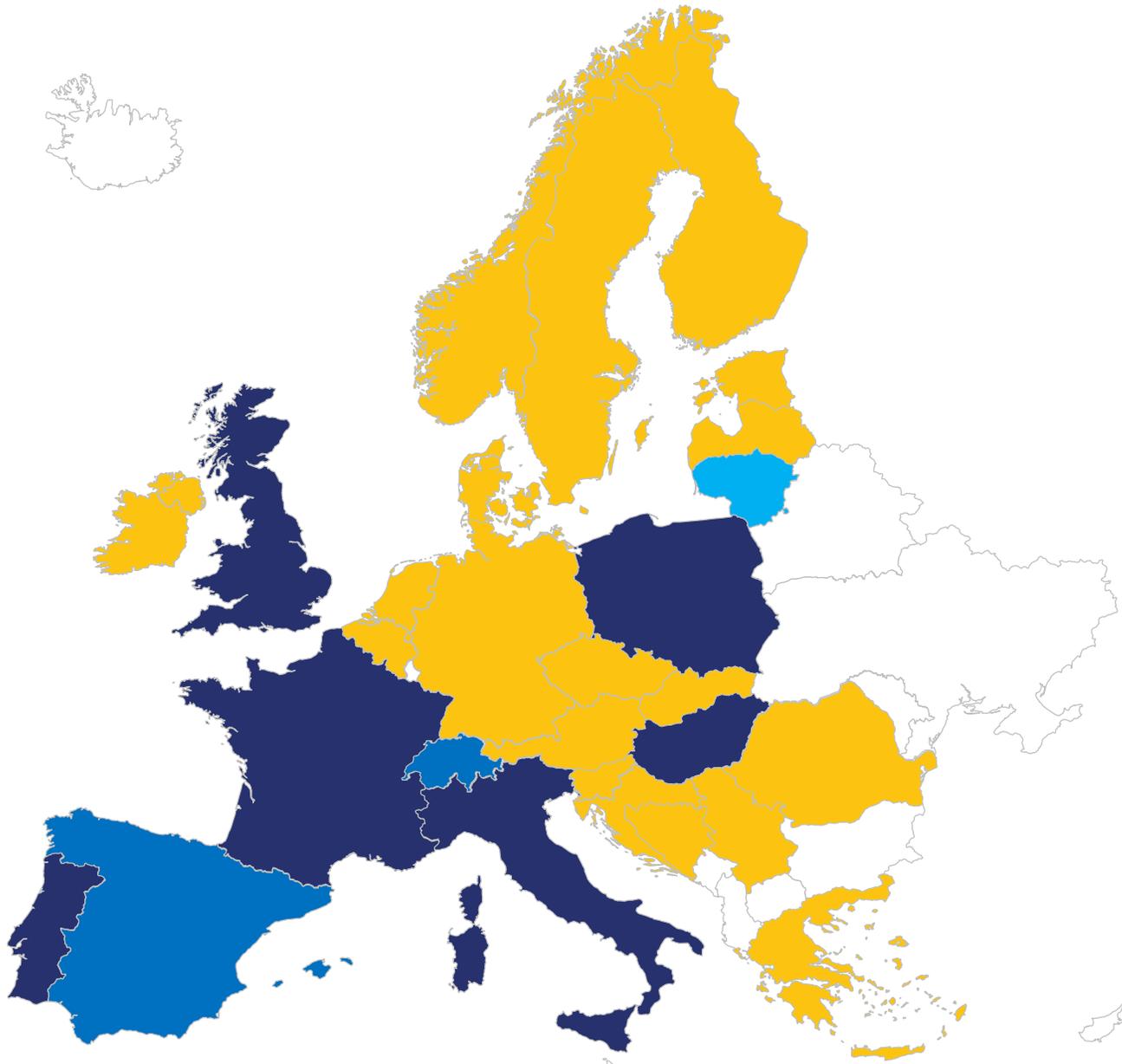
Secondary Market for reserve obligation

Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to ensure the prescribed reserve amount of the TSO.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

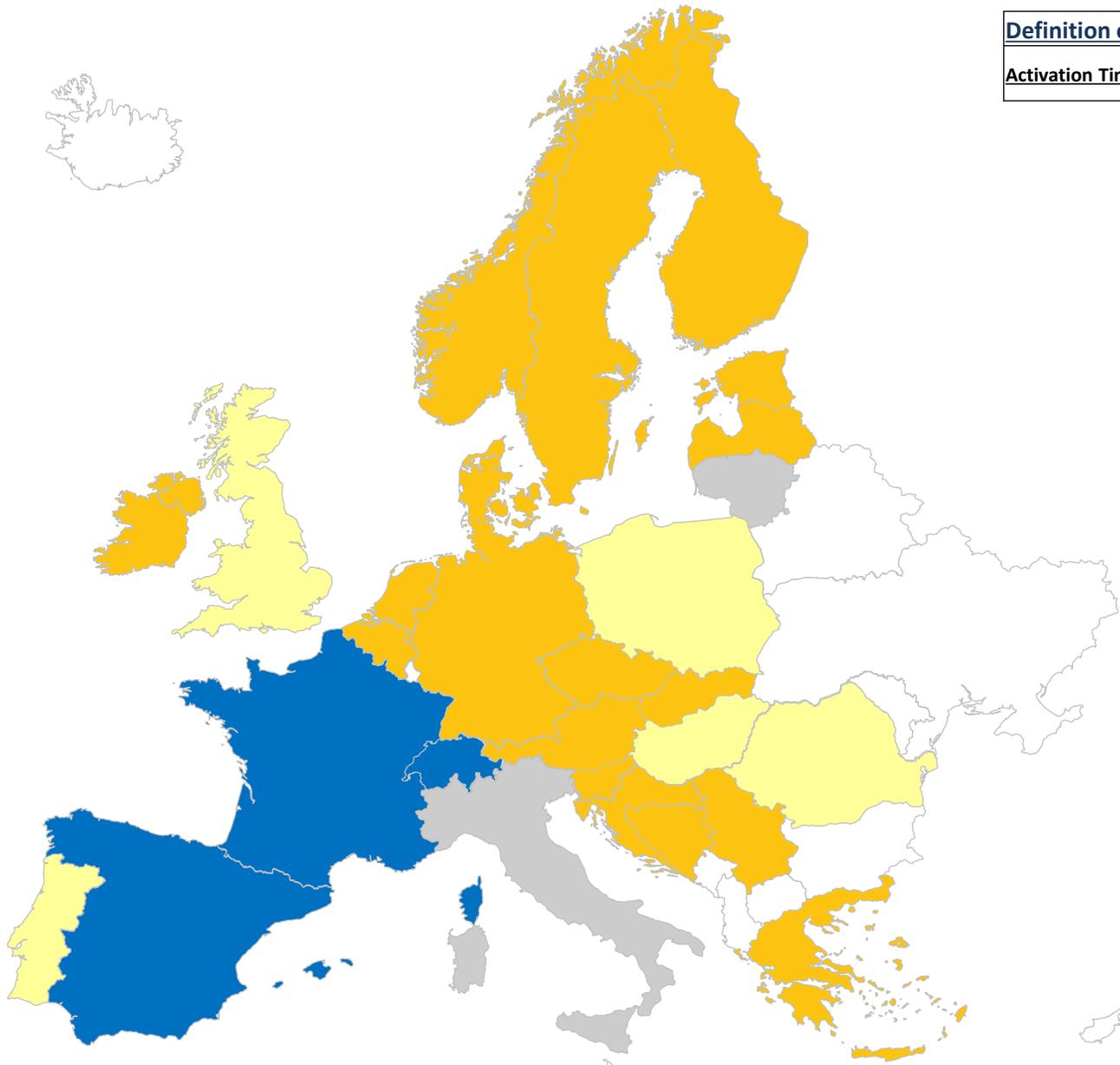
Replacement Reserve - Energy - Partially activated product



Key:

| |
|----------------------------|
| Missing data |
| N/A |
| Yes, in all directions |
| No in none direction |
| Only in upward direction |
| Only in downward direction |

Replacement Reserve - Energy - Activation time of RR from 0 to max



Definition of question

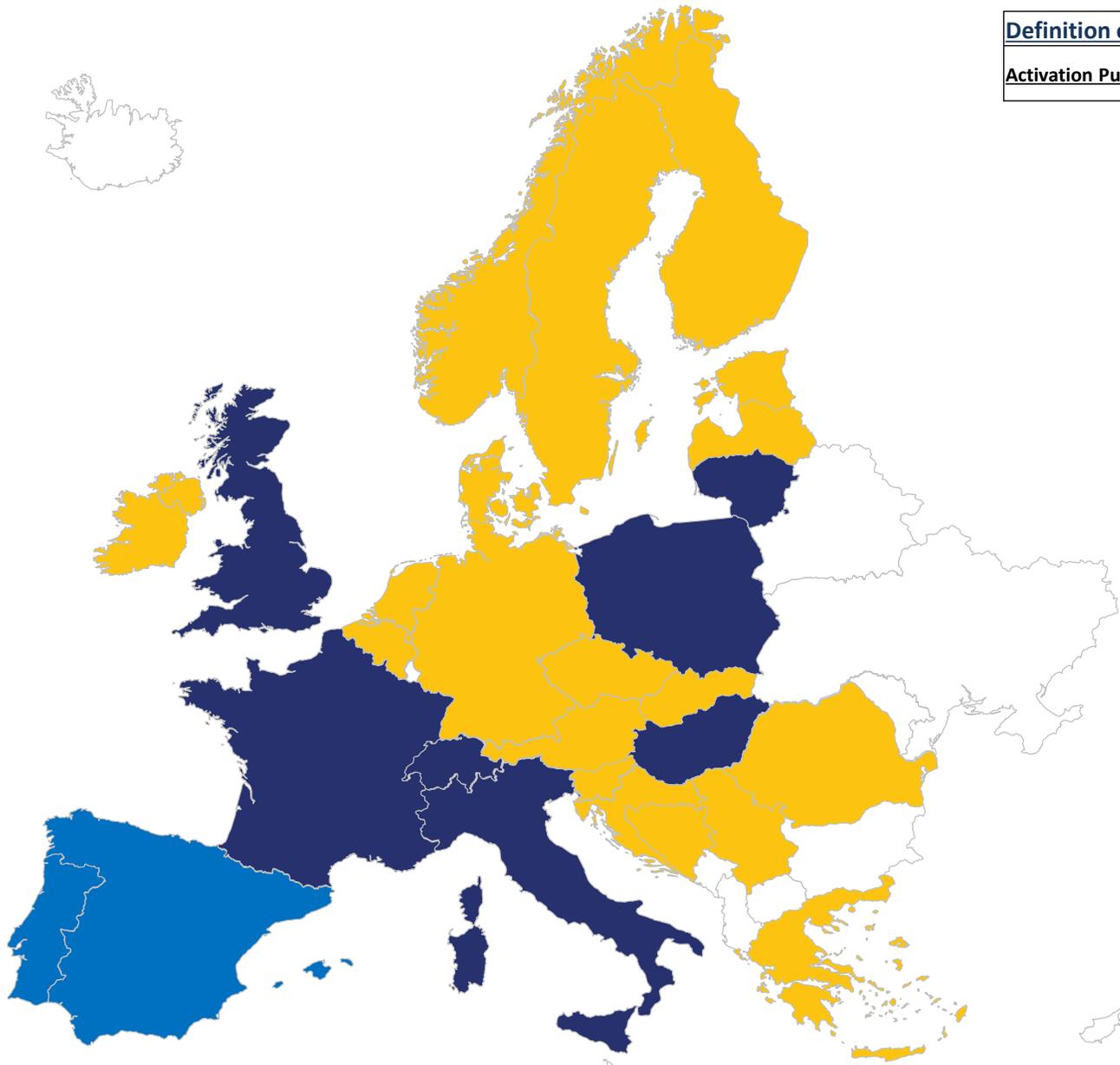
Activation Time

Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.

Key:

| | |
|--|--|
| | Missing data |
| | N/A |
| | $x \leq 15 \text{ min}$ |
| | $15 \text{ min} < x \leq 30 \text{ min}$ |
| | $30 \text{ min} < x \leq 1 \text{ hour}$ |
| | $x > 1 \text{ hour}$ |
| | Depends on the unit |

Replacement Reserve - Energy - Are activations possible for other purposes than for balancing?



Definition of question

Activation Purpose

Are activations for other purposes than Balancing (e.g. congestion management) possible?

Key:

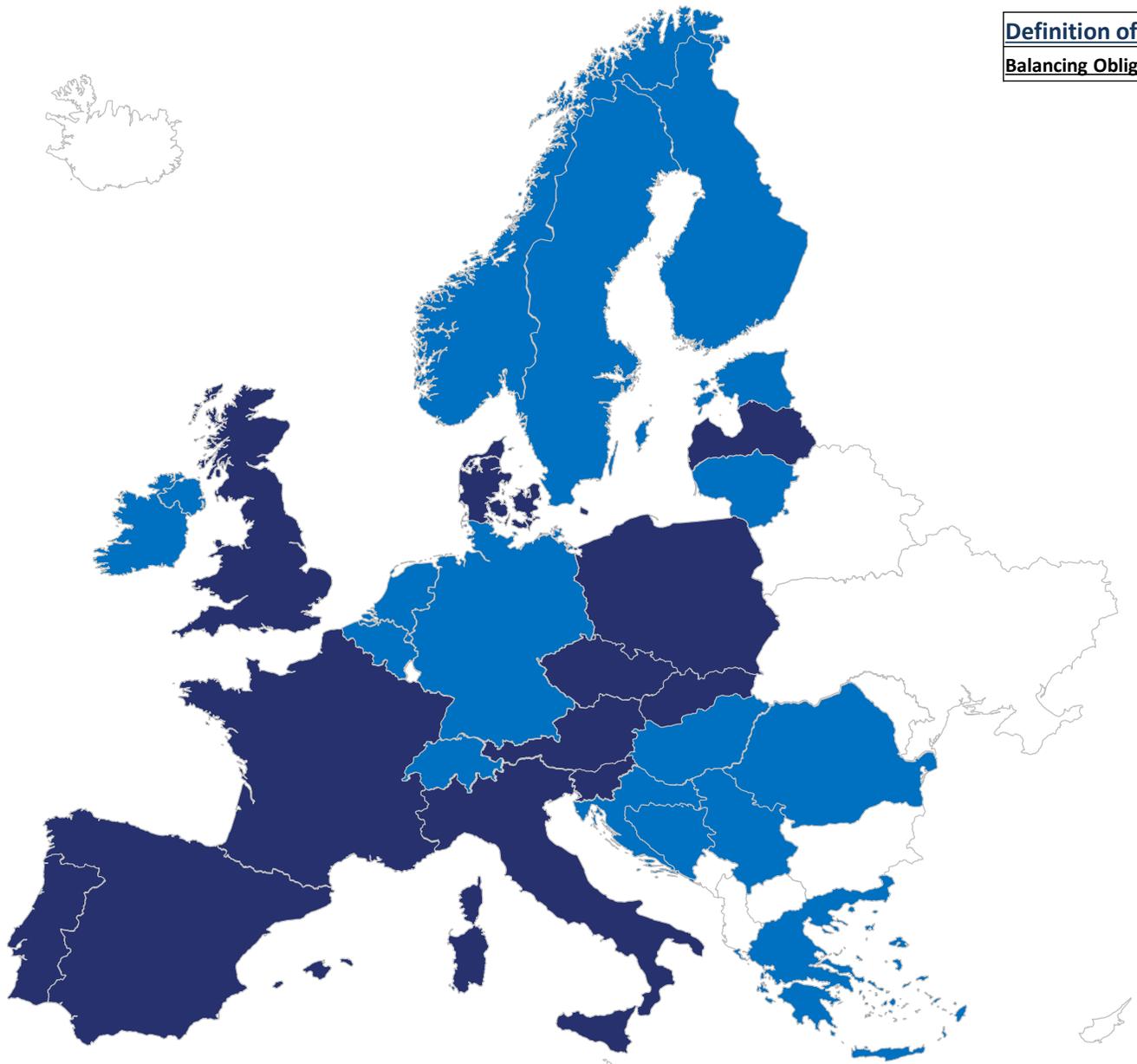
| | |
|--|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Imbalance settlement

(Referring to questions of AS survey from IS1.0 to IS15.0)

Imbalance settlement - Nature of the Balancing Obligation

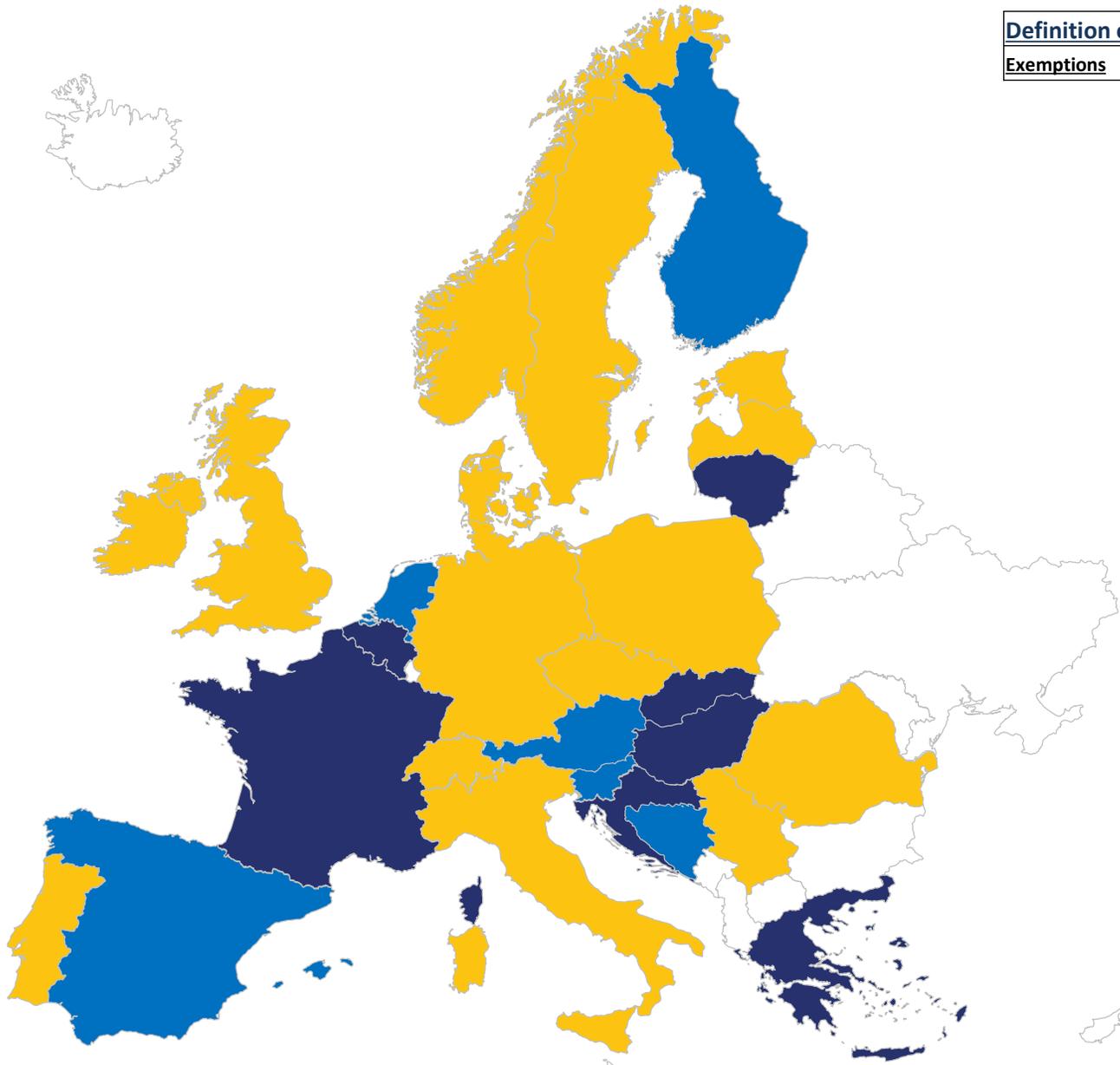
| Definition of question | |
|---------------------------------|---|
| Balancing Obligation Enforcment | Nature of balance responsibility enforcement. |



Key:

| | |
|-------------|-----------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Financial only |
| Medium Blue | Legal+financial |

Imbalance settlement - Exemptions for RES



Definition of question

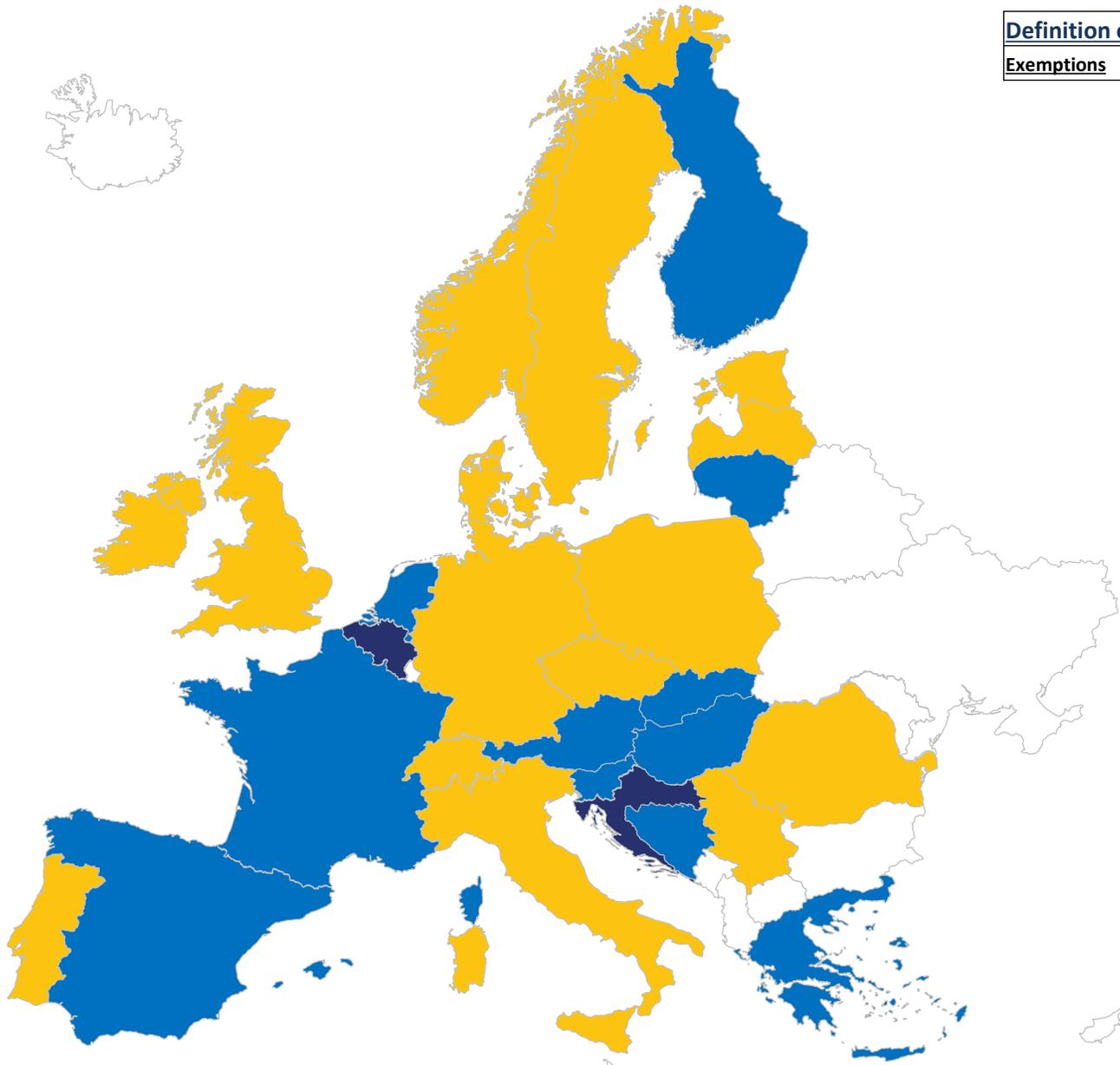
Exemptions

Market participants which do not have obligations to be responsible for its imbalance.

Key:

| | |
|--|--------------|
|  | Missing data |
|  | N/A |
|  | Yes |
|  | No |

Imbalance settlement - Exemptions for Generators licensed for the AS market



Definition of question

Exemptions

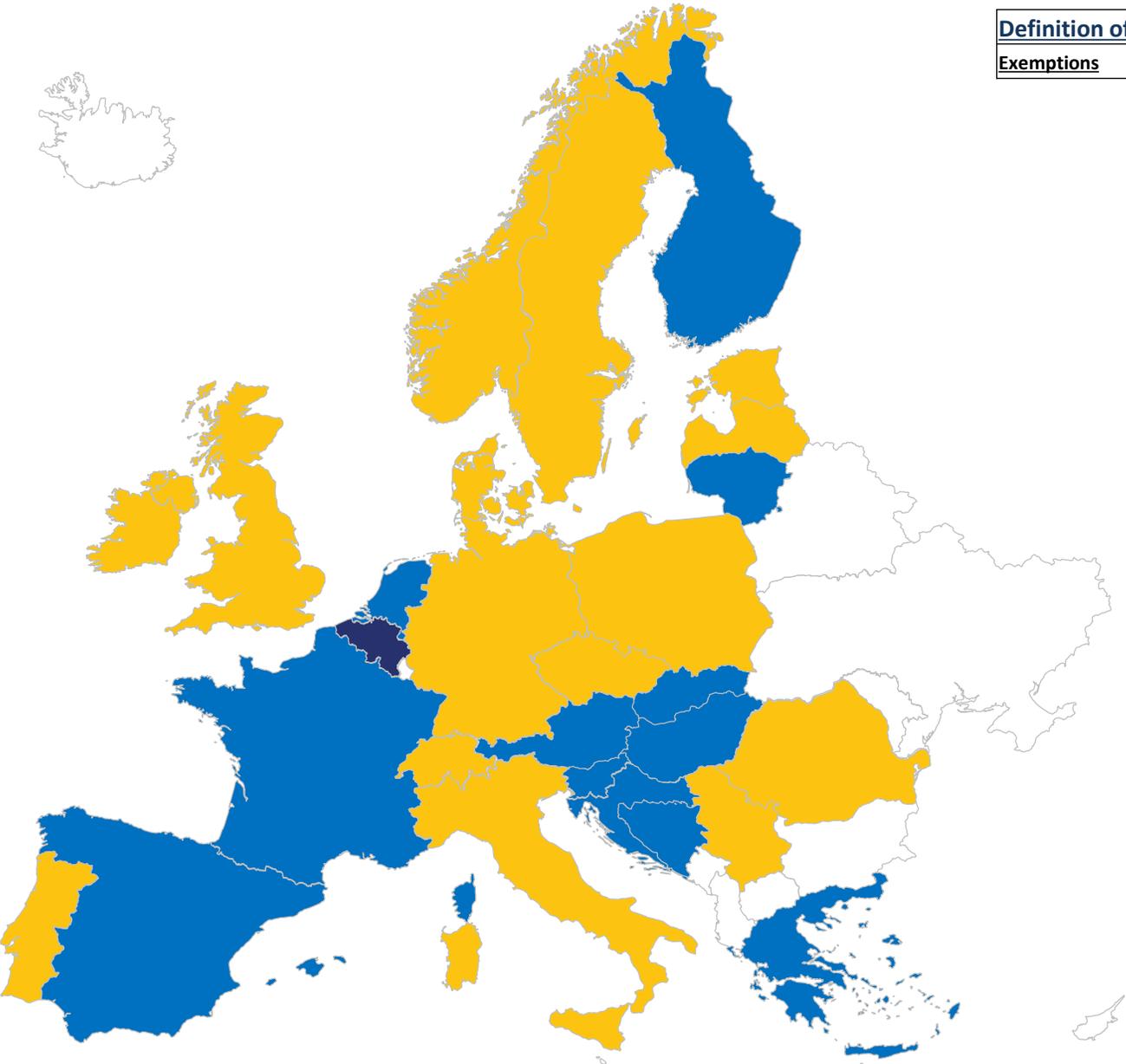
Market participants which do not have obligations to be responsible for its imbalance.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Imbalance settlement - Exemptions for Other

| Definition of question | |
|------------------------|--|
| Exemptions | Market participants which do not have obligations to be responsible for its imbalance. |

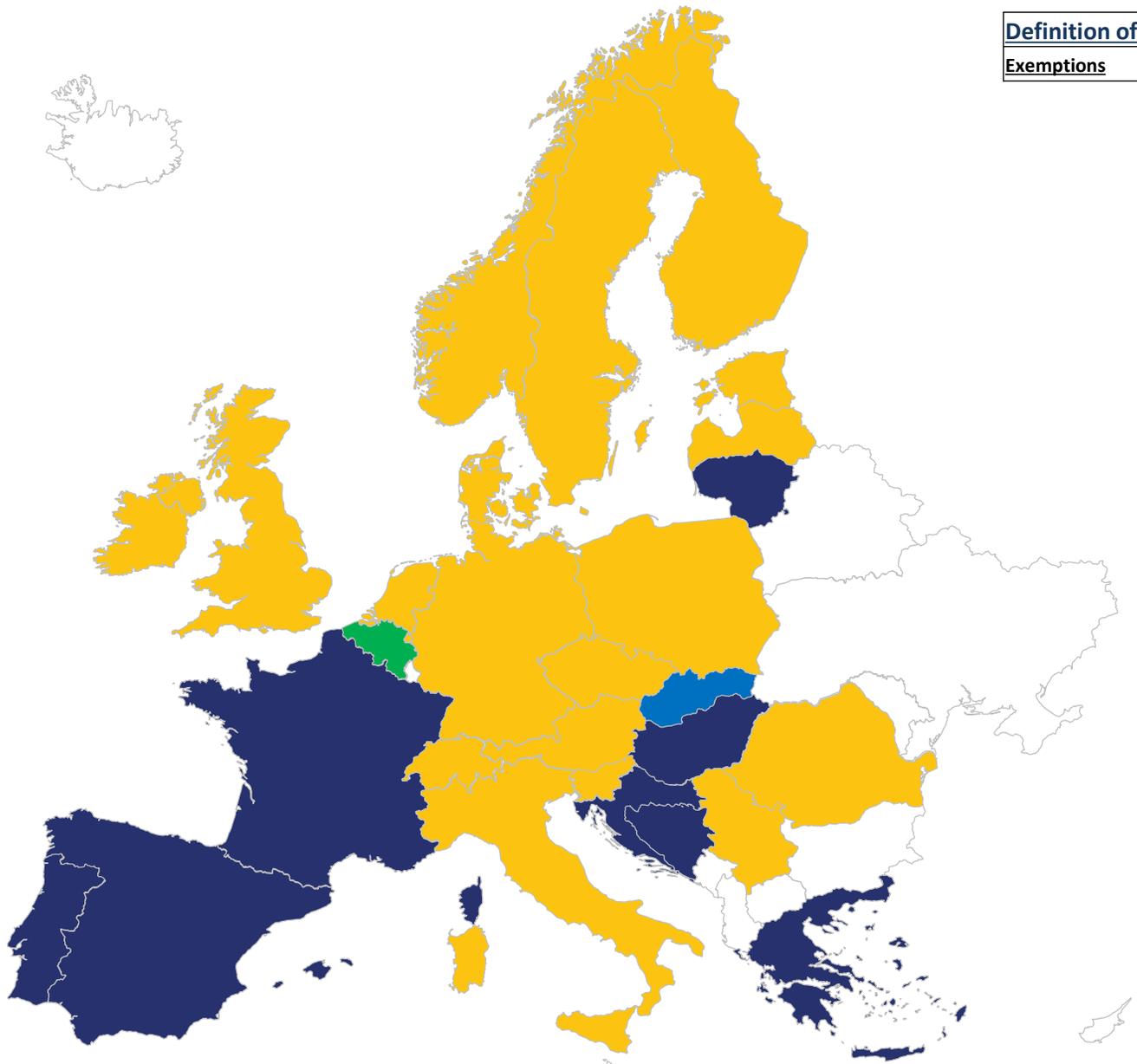


Key:

| | |
|-----------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Blue | No |

Imbalance settlement - Limit to exemption

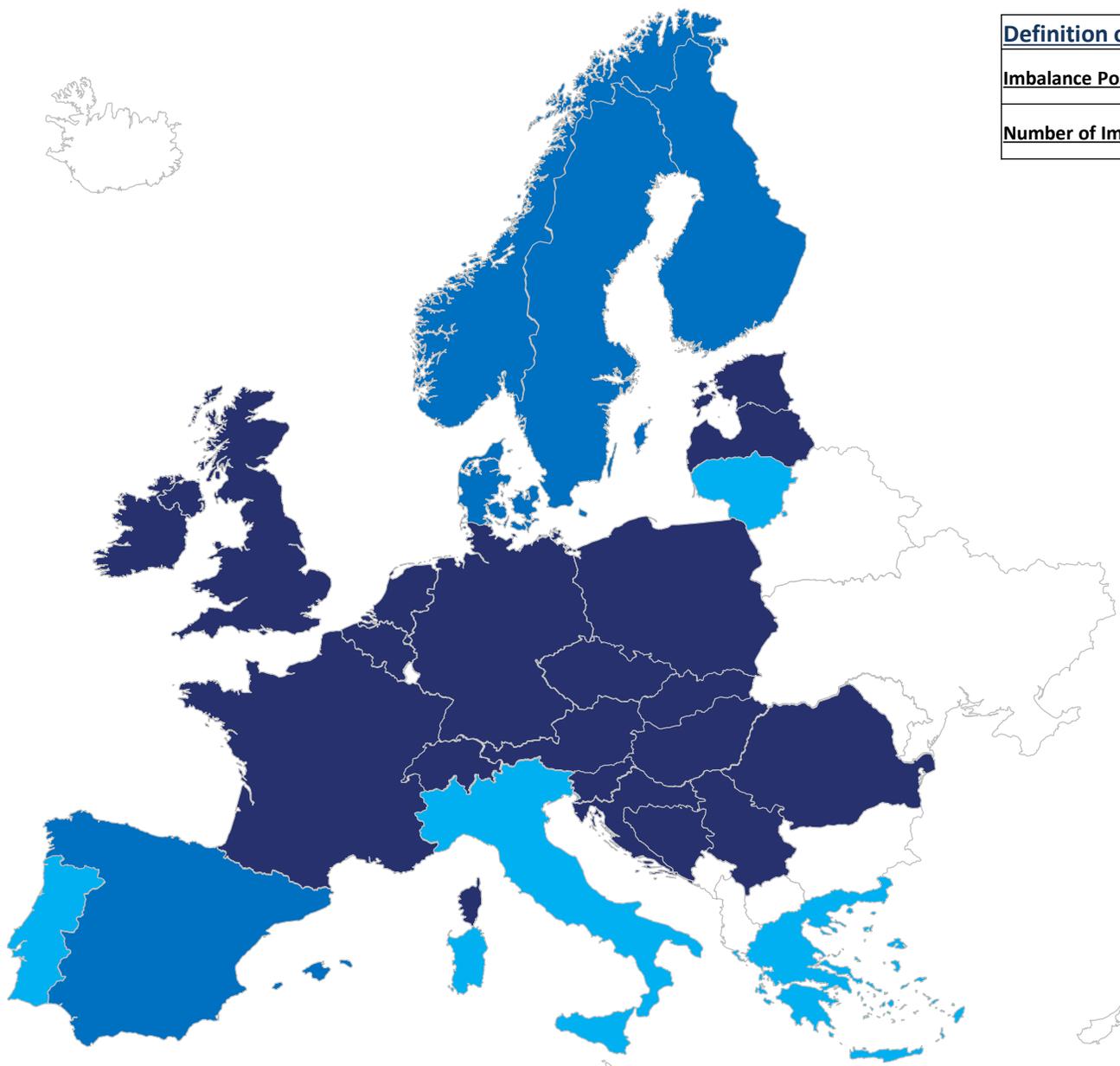
| Definition of question | |
|------------------------|--|
| Exemptions | Those parties that do not have a balancing obligation. |



Key:

| | |
|--------------|-----------------------------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | No limit |
| Blue | $x \leq 1\text{MW}$ |
| Cyan | $1\text{MW} < x \leq 5\text{MW}$ |
| Grey | $5\text{MW} < x \leq 10\text{MW}$ |
| Light Yellow | $x > 10\text{MW}$ |
| Magenta | Other |
| Green | % of nominations |

Imbalance settlement - Number of Imbalance Positions



Definition of question

Imbalance Position

The declared energy volume of a balance responsible party used for the calculation of its imbalance.

Number of Imbalance Position

Number of Imbalance Positions is a property of local market design. For each Imbalance Position Imbalance Volume is calculated.

Key:



Missing data

N/A

1 position

2 positions – separate positions for generation and consumption

> 2 positions

Imbalance Settlement - If there are more than 2 positions, please, clarify!

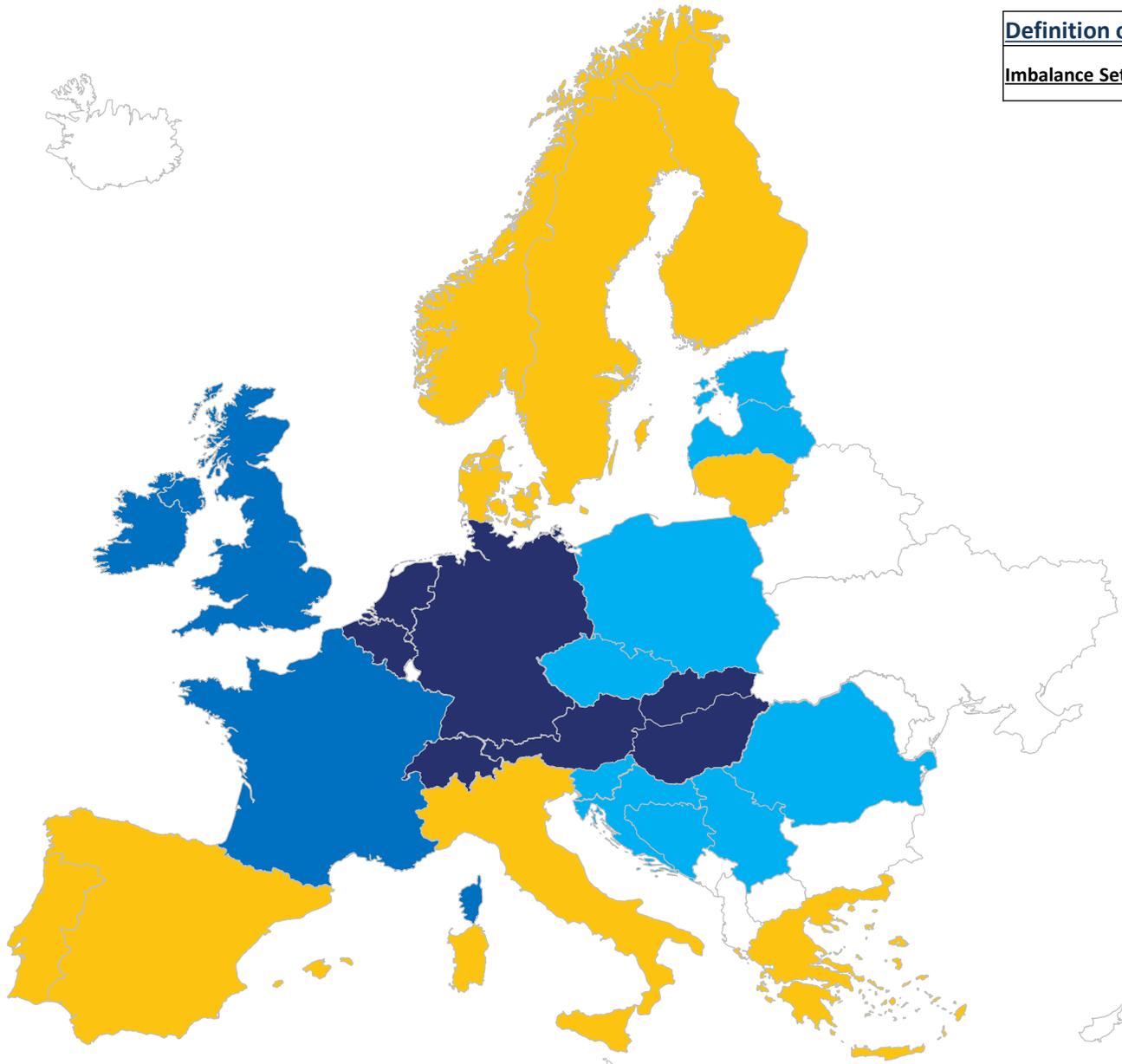
| TSO | Answer |
|---------|---|
| ADMIE | Different portfolios for: <ul style="list-style-type: none">– generation– consumption– imports– exports |
| LITGRID | <ol style="list-style-type: none">1. Consumption portfolio2. Generation portfolio3. Cross border trade with 3rd countries portfolio |
| TERNA | In Italy we calculate an imbalance volume for each production or consumption unit |
| REN | For generators the imbalance is calculated by imbalance area. A market player can have more than one imbalance area. |

Imbalance settlement - Imbalance Settlement Period - If 1 position

Definition of question

Imbalance Settlement Period

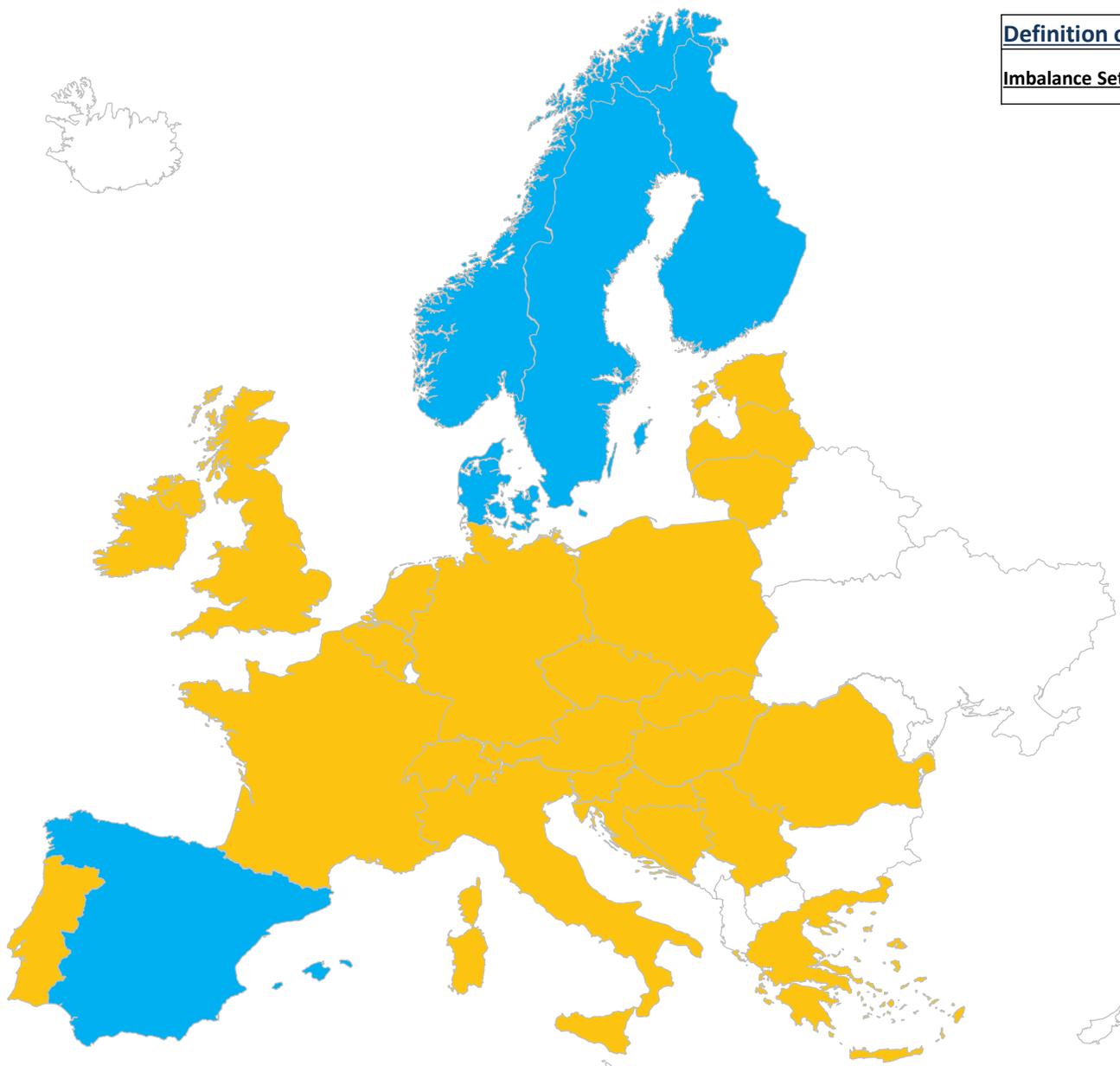
The unit of settlement that is applied to the quantities in which the time series is expressed.



Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | 15 min |
| | 30 min |
| | 1 hour |
| | x > 1 hour |

Imbalance settlement - Imbalance Settlement Period - If 2 positions - Generation



Definition of question

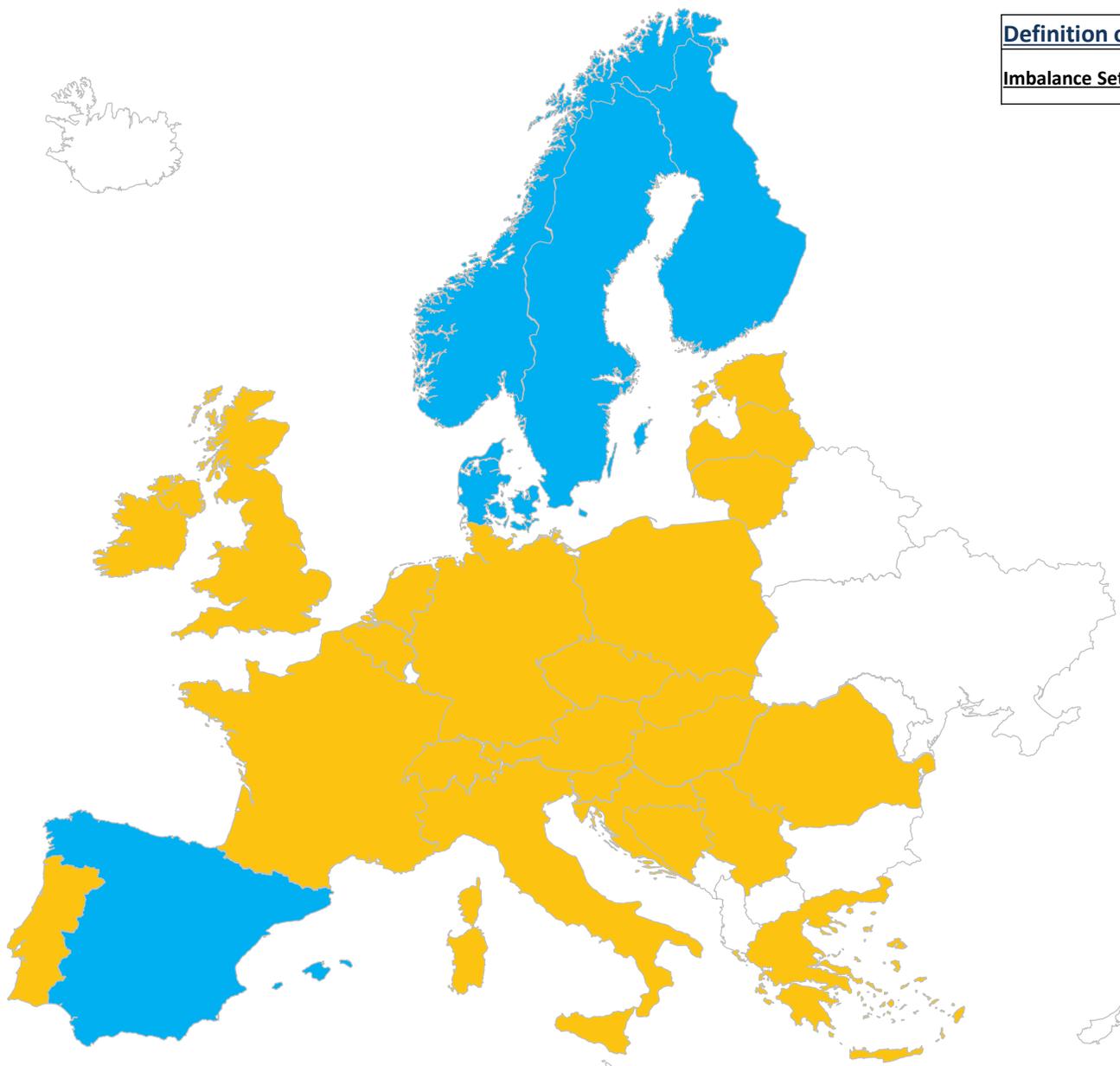
Imbalance Settlement Period

The unit of settlement that is applied to the quantities in which the time series is expressed.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | 15 min |
| | 30 min |
| | 1 hour |
| | x > 1 hour |

Imbalance settlement - Imbalance Settlement Period - If 2 positions - Consumption



Definition of question

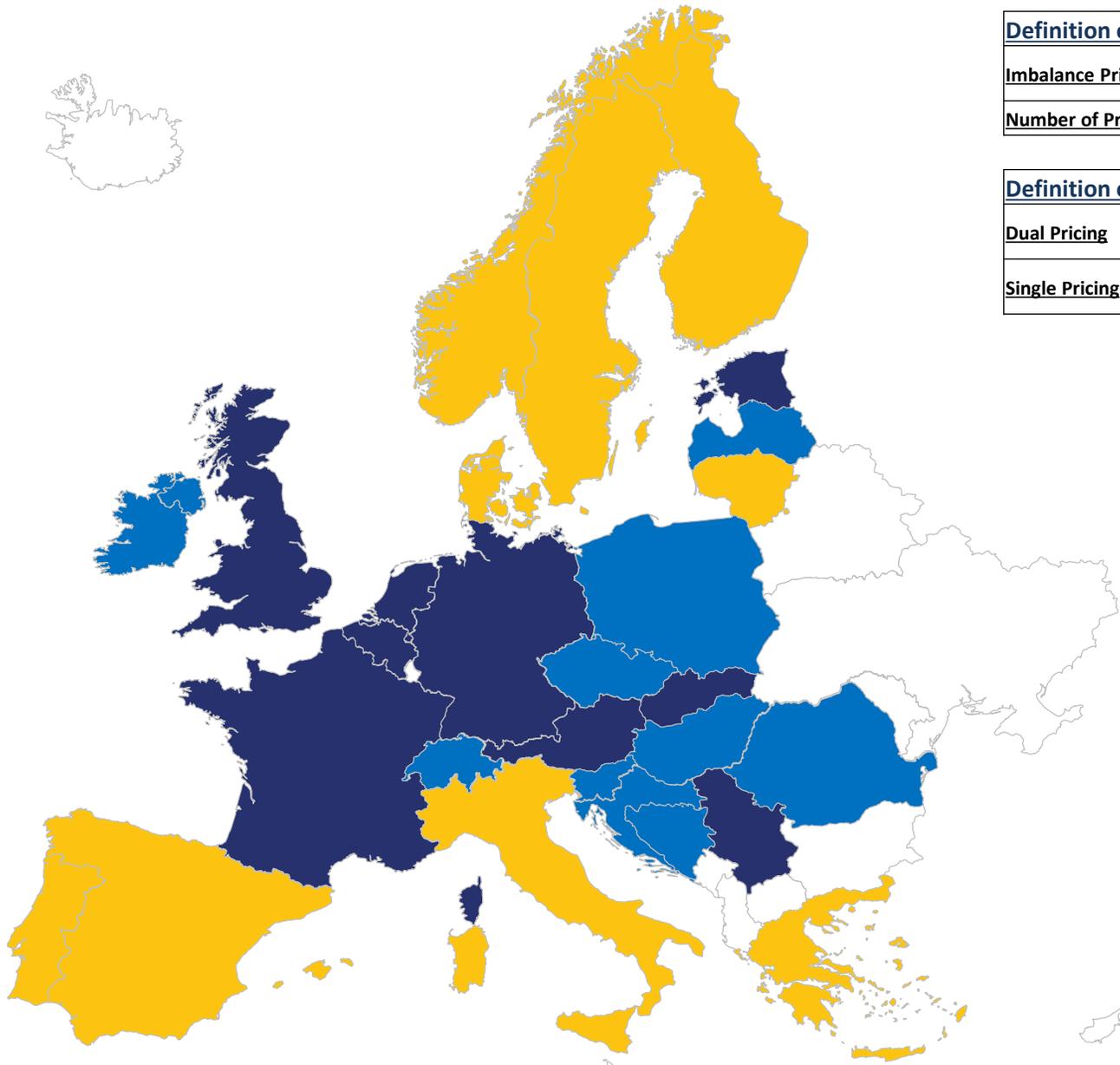
Imbalance Settlement Period

The unit of settlement that is applied to the quantities in which the time series is expressed.

Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | 15 min |
| | 30 min |
| | 1 hour |
| | x > 1 hour |

Imbalance settlement - Number of Prices - If 1 position



Definition of question

| | |
|-------------------------|--|
| Imbalance Price | The price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction. |
| Number of Prices | Number of prices for Imbalance Position. |

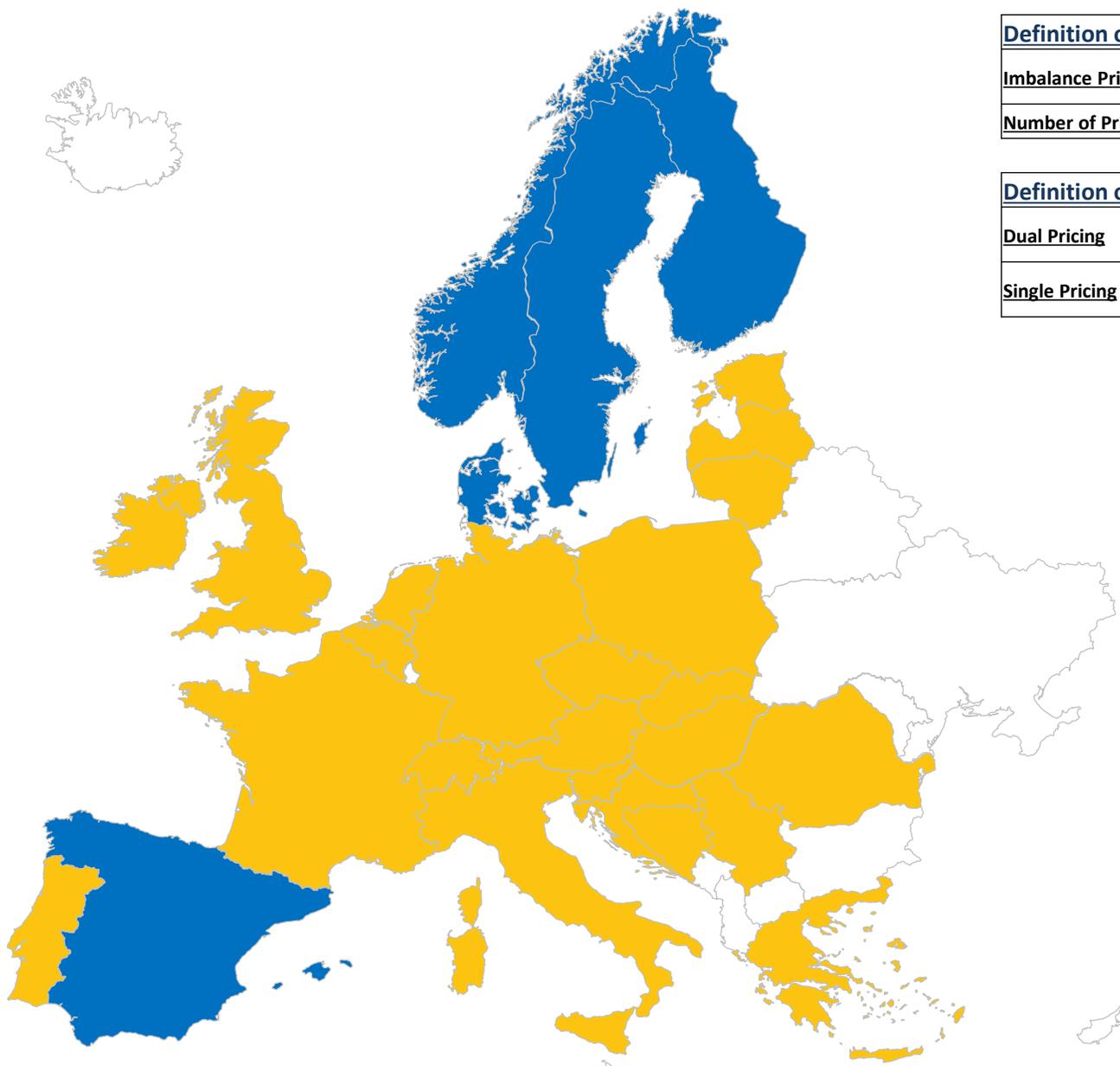
Definition of answer

| | |
|-----------------------|--|
| Dual Pricing | Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance. |
| Single Pricing | Imbalance Price takes system state into account, same price for aggravating and non-aggravating imbalance. |

Key:

| | |
|--|----------------|
|  | Missing data |
|  | N/A |
|  | Single Pricing |
|  | Dual Pricing |

Imbalance settlement - Number of Prices - If 2 positions - Generation



Definition of question

| | |
|-------------------------|--|
| Imbalance Price | The price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction. |
| Number of Prices | Number of prices for Imbalance Position. |

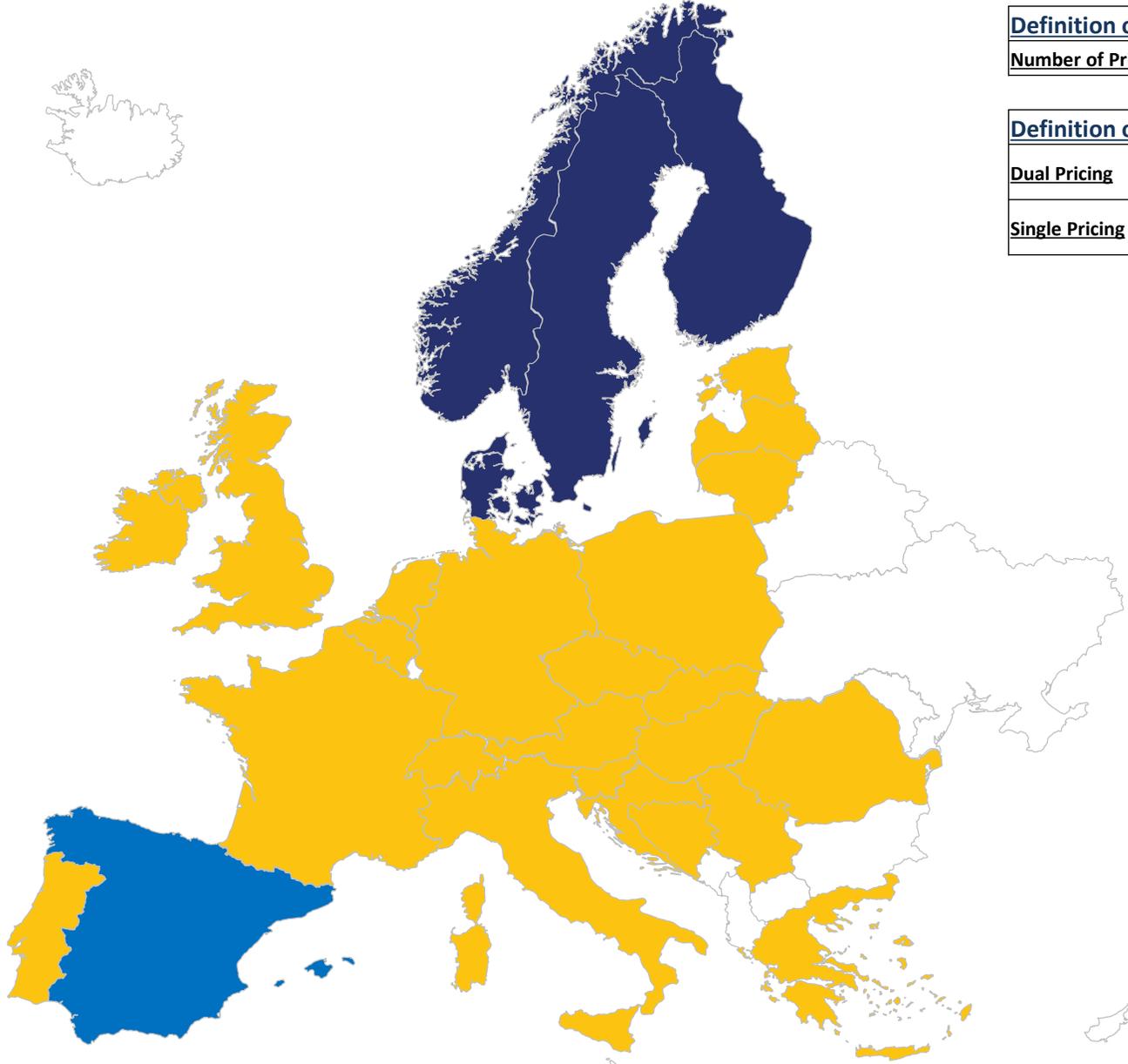
Definition of answer

| | |
|-----------------------|--|
| Dual Pricing | Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance. |
| Single Pricing | Imbalance Price takes system state into account, same price for aggravating and non-aggravating imbalance. |

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Single Pricing |
| | Dual Pricing |
| | Other |

Imbalance settlement - Number of Prices - If 2 positions - Consumption



Definition of question

| | |
|-------------------------|--|
| Number of Prices | Number of prices for Imbalance Position. |
|-------------------------|--|

Definition of answer

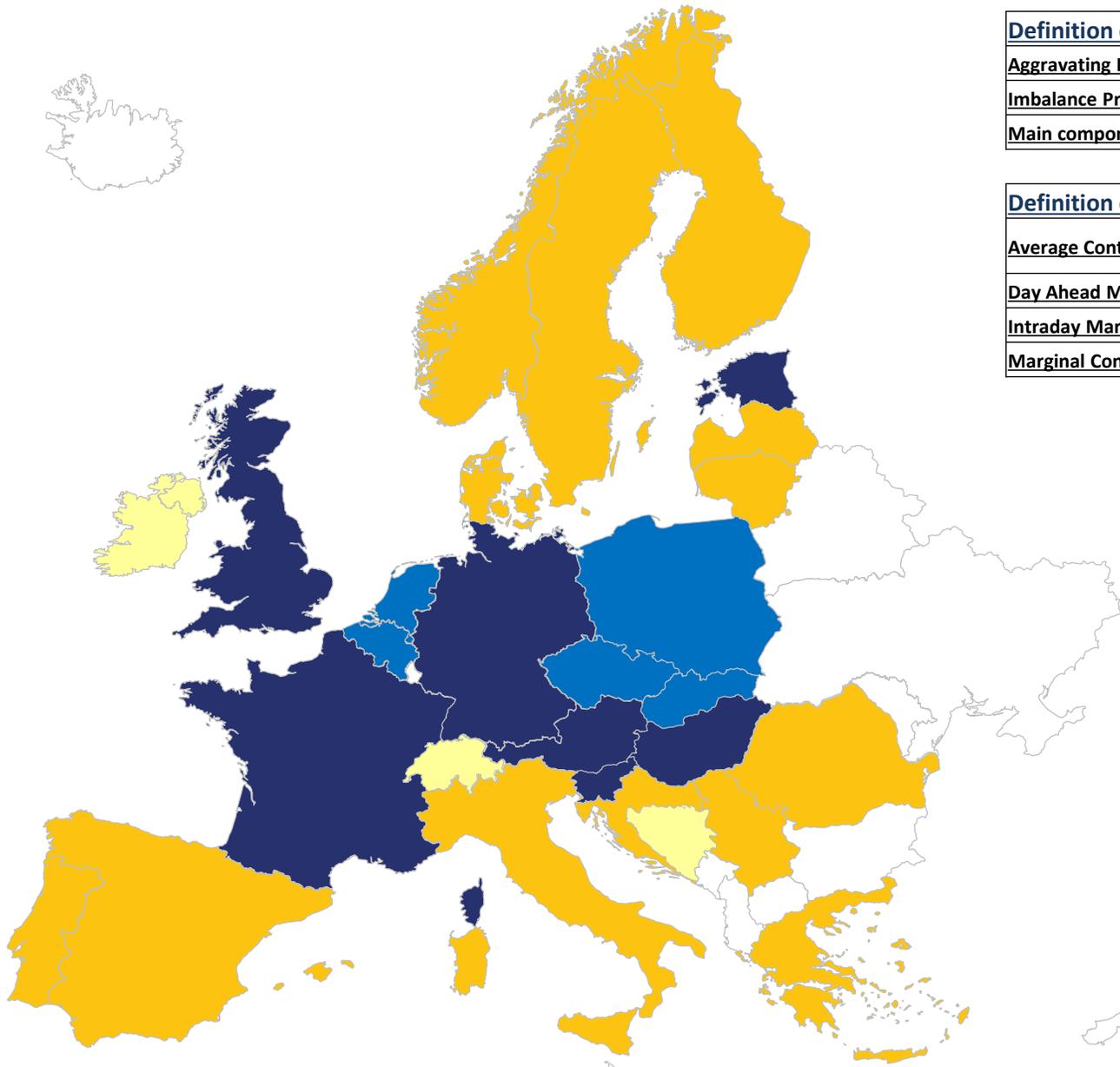
| | |
|---------------------|--|
| Dual Pricing | Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance. |
|---------------------|--|

| | |
|-----------------------|--|
| Single Pricing | Imbalance Price takes system state into account, same price for aggravating and non-aggravating imbalance. |
|-----------------------|--|

Key:

| | |
|--|----------------|
| | Missing data |
| | N/A |
| | Single Pricing |
| | Dual Pricing |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 1 position - Aggravating imb.



Definition of question

| | |
|---|---|
| Aggravating Imbalance | BRP imbalance same direction as Imbalance Price Area imbalance. |
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |

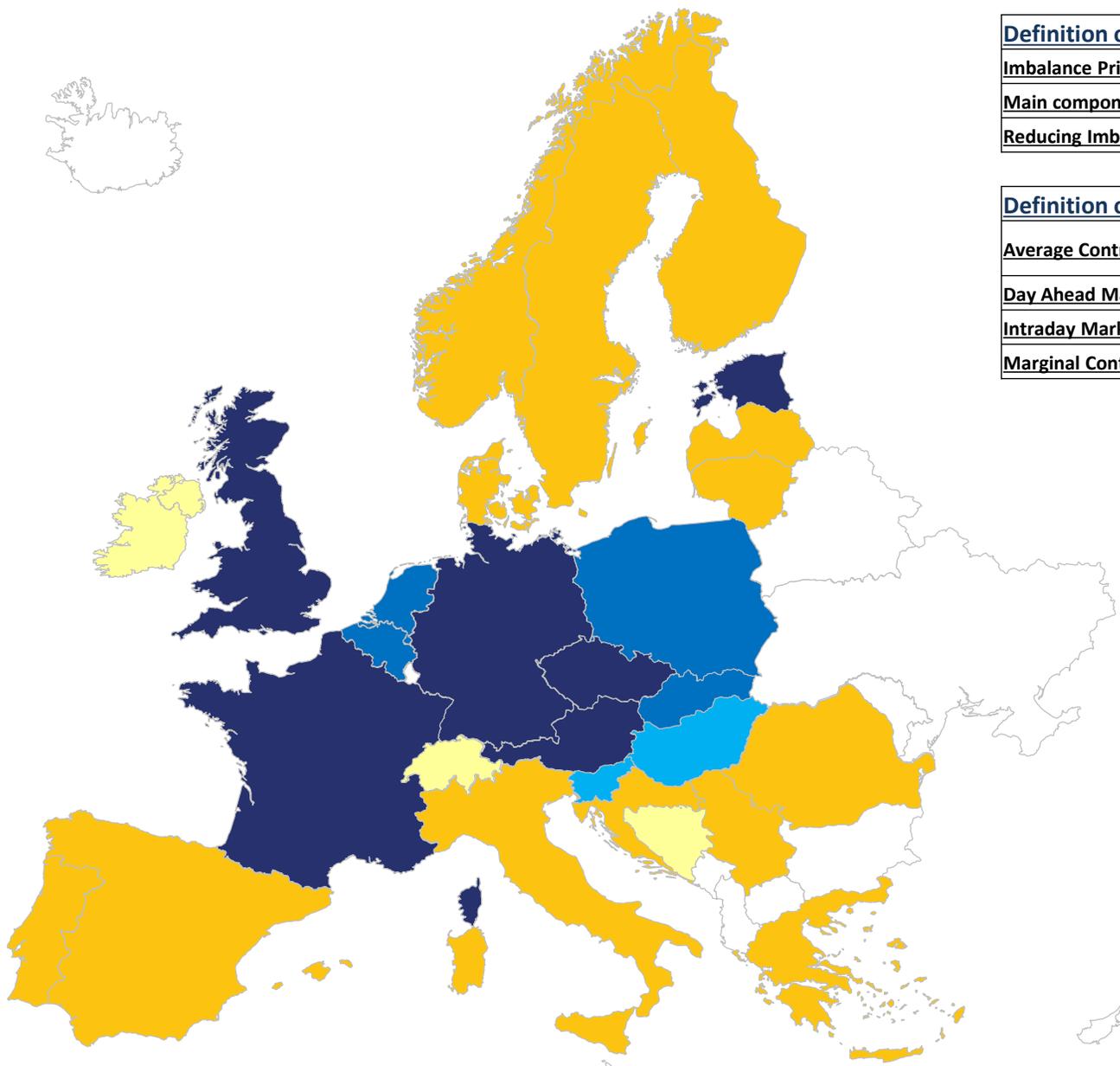
Definition of answer

| | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 1 position - Reducing imb.



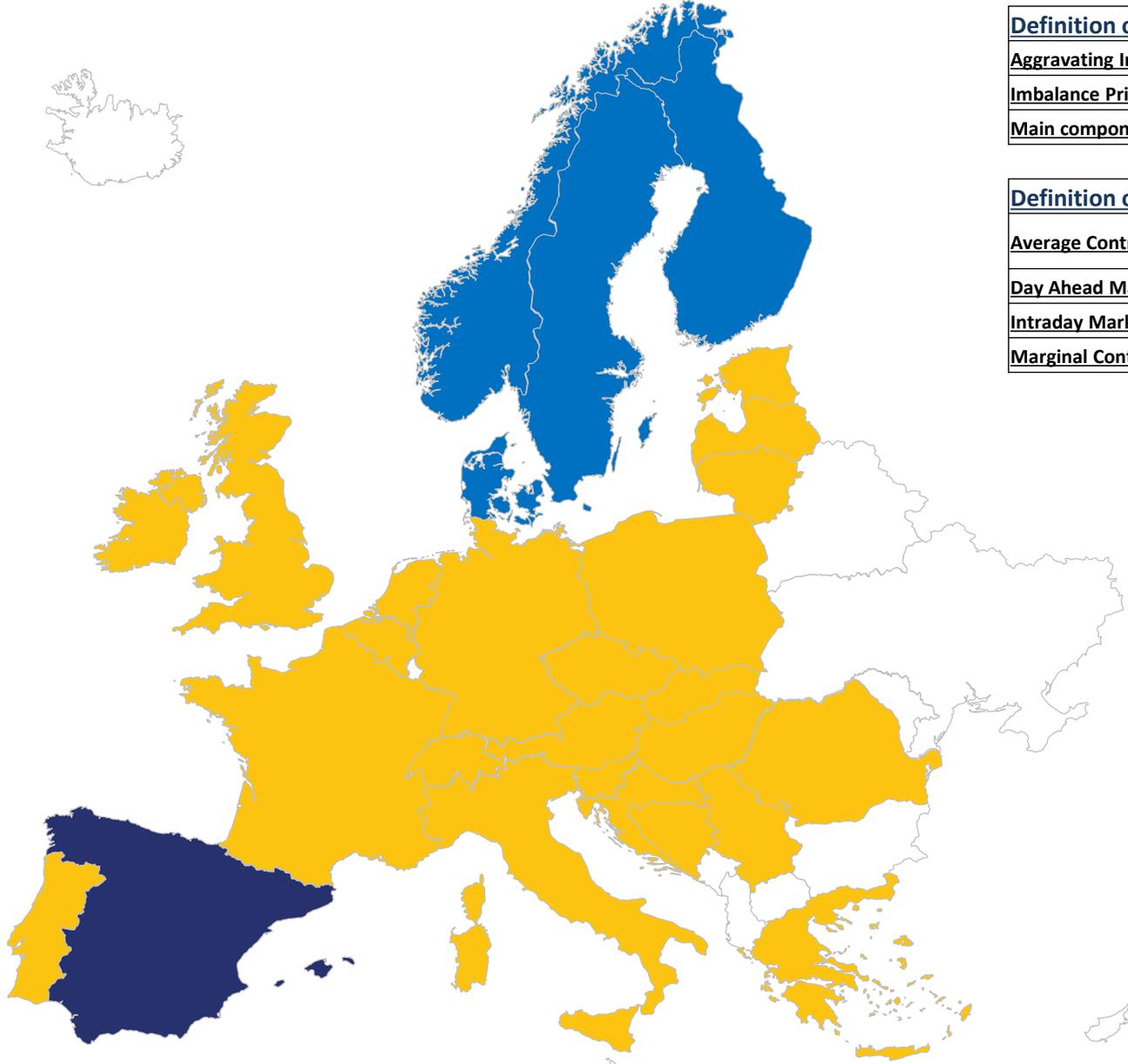
| <u>Definition of question</u> | |
|---|---|
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |
| Reducing Imbalance | BRP imbalance opposite direction as Imbalance Area imbalance. |

| <u>Definition of answer</u> | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For generation "aggravating imb."



Definition of question

| | |
|---|---|
| Aggravating Imbalance | BRP imbalance same direction as Imbalance Price Area imbalance. |
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |

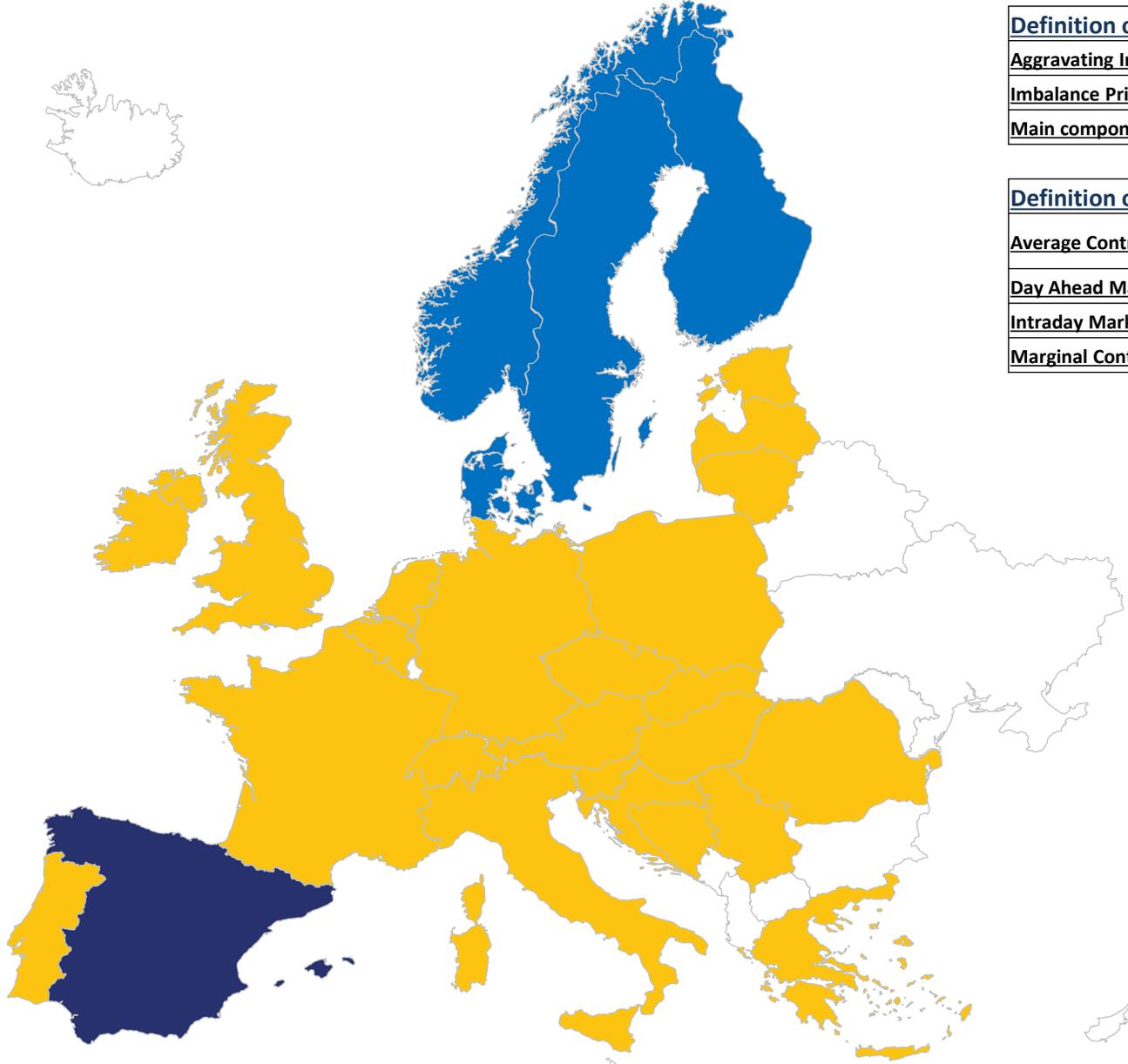
Definition of answer

| | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For consumption "aggravating imb."



Definition of question

| | |
|---|---|
| Aggravating Imbalance | BRP imbalance same direction as Imbalance Price Area imbalance. |
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |

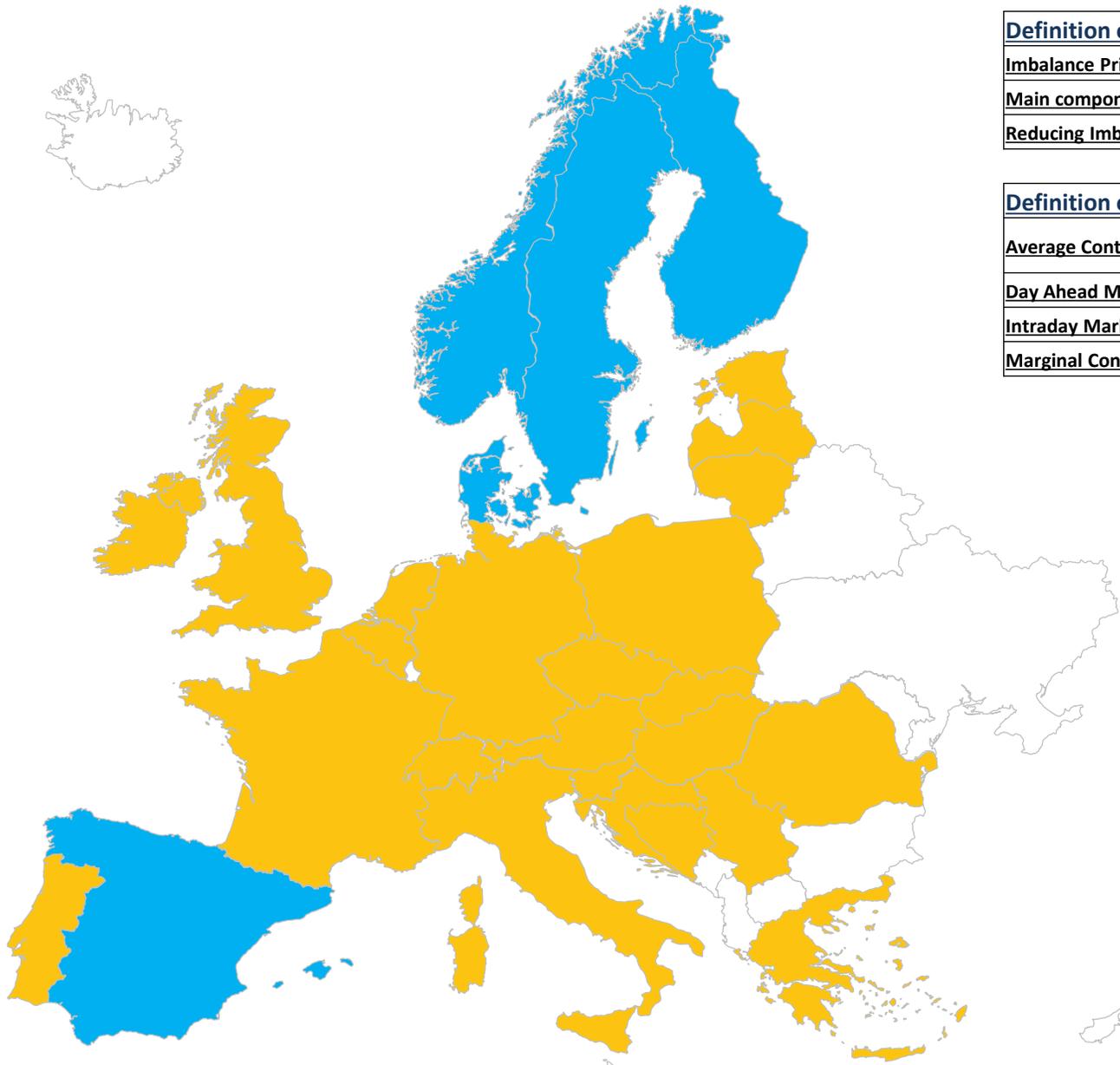
Definition of answer

| | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For generation "reducing imb."



Definition of question

| | |
|---|---|
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |
| Reducing Imbalance | BRP imbalance opposite direction as Imbalance Area imbalance. |

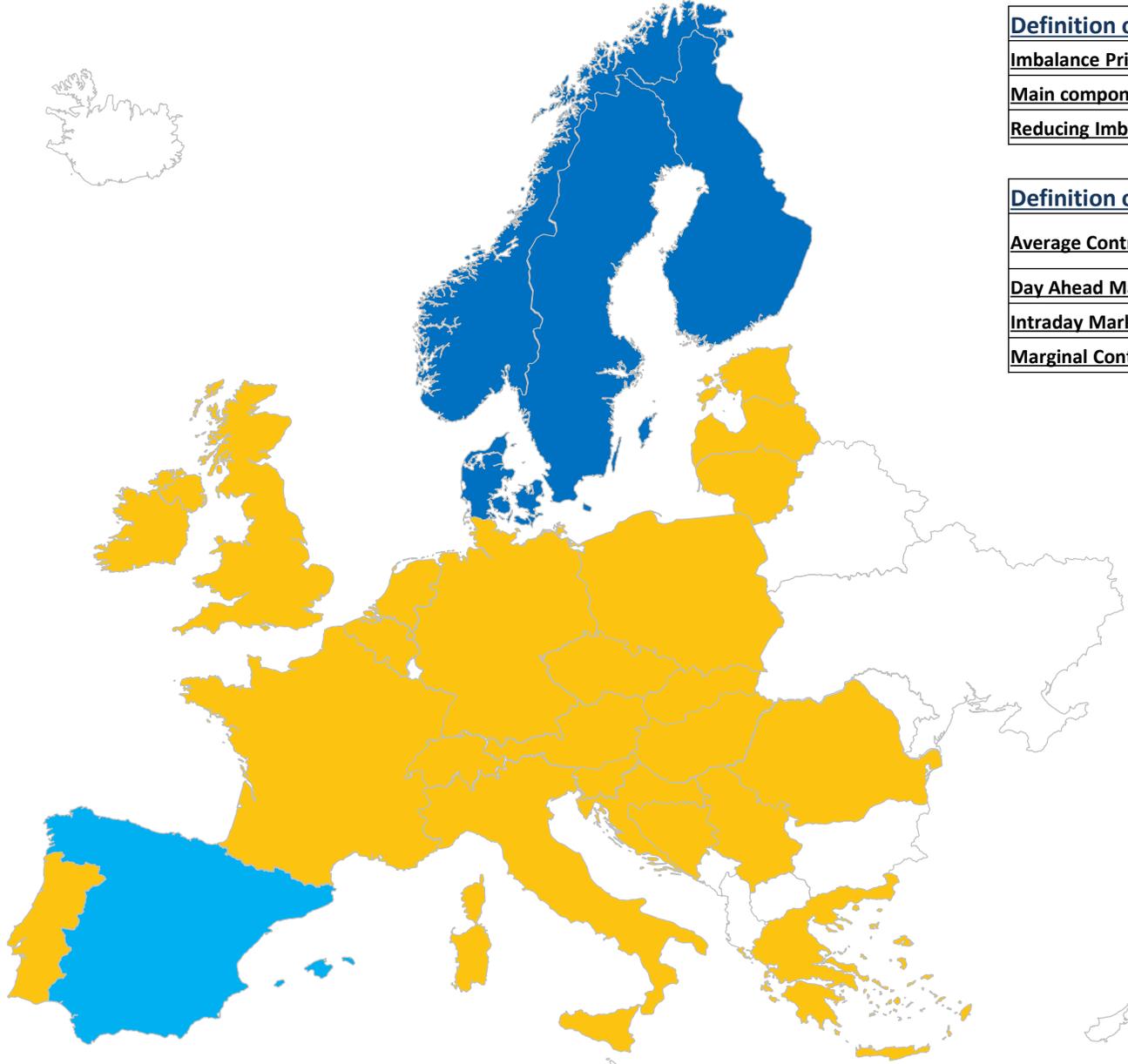
Definition of answer

| | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For consumption "reducing imb."



Definition of question

| | |
|---|---|
| Imbalance Price Area | The area for the calculation of an imbalance price. |
| Main component of Imbalance Prices | The component that determines imbalance charges most of the time. |
| Reducing Imbalance | BRP imbalance opposite direction as Imbalance Area imbalance. |

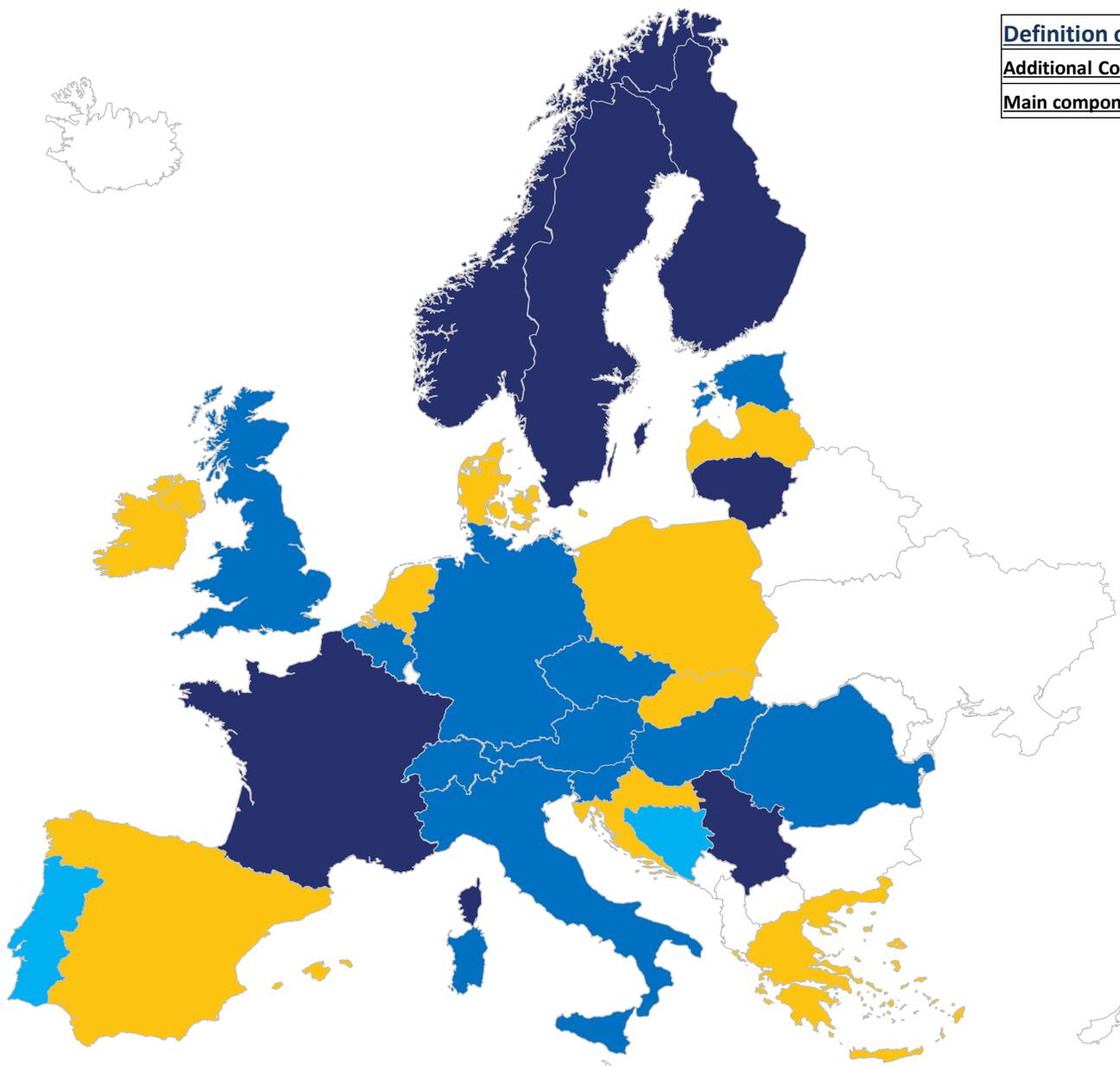
Definition of answer

| | |
|--------------------------------------|---|
| Average Control Energy Price | Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined. |
| Day Ahead Market Price | Price which evolved on the day ahead market. |
| Intraday Market Price | The price of the market within regular business hours, short-term prices. |
| Marginal Control Energy Price | The highest price, which can be acceptable. |

Key:

| | |
|--|-------------------------------|
| | Missing data |
| | N/A |
| | Average Control Energy Price |
| | Marginal Control Energy Price |
| | Day-Ahead Market Price |
| | Intraday Market Price |
| | Other |

Imbalance settlement - Main comp. of Imb. Prices - Additional Components



Definition of question

Additional Components

Other components which determine imbalance charges.

Main component of Imbalance Prices

The component that determines imbalance charges most of the time.

Key:



Missing data

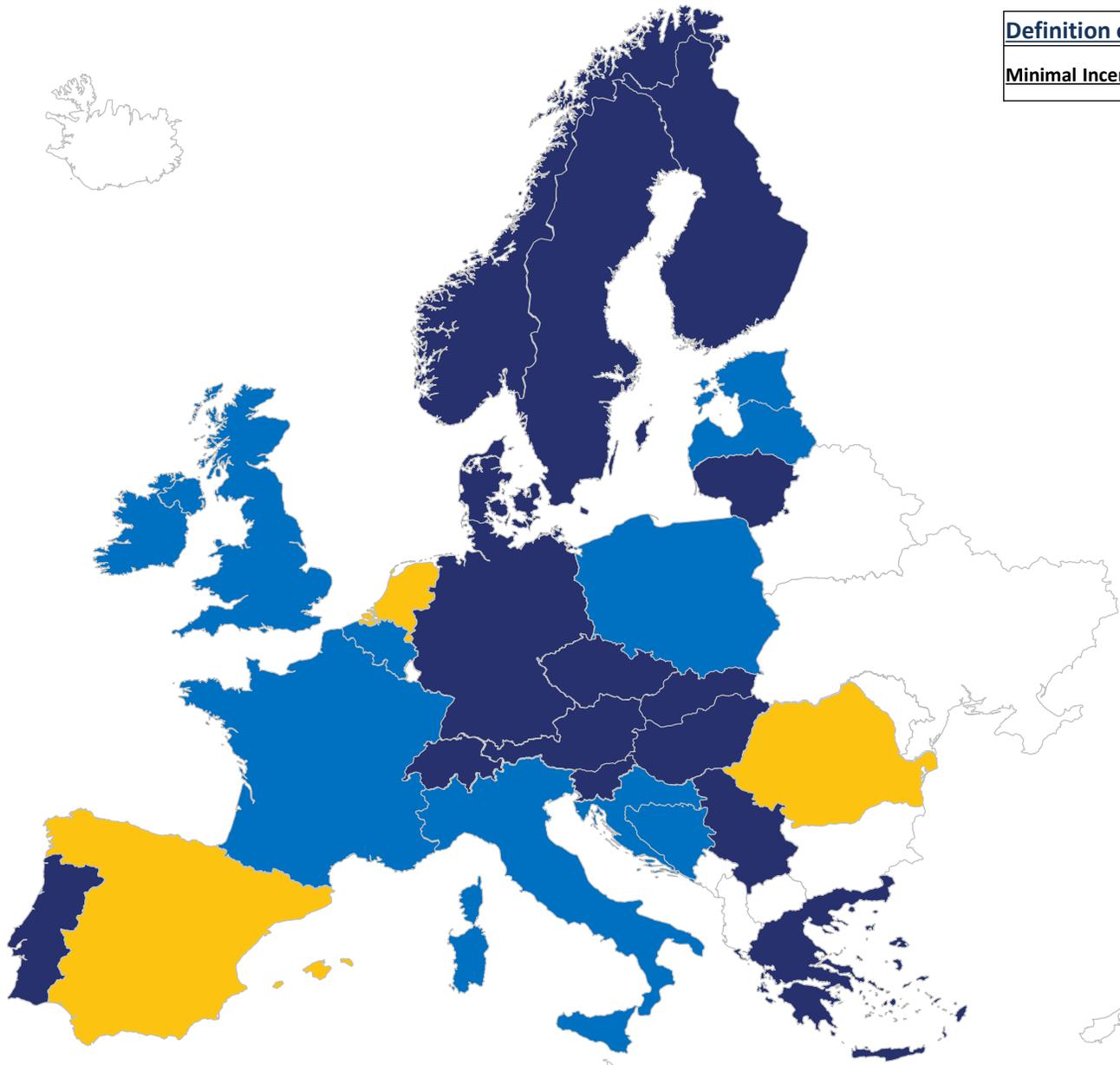
N/A

Constant component

Variable component

Other

Imbalance settlement - Is there a minimal incentive?



Definition of question

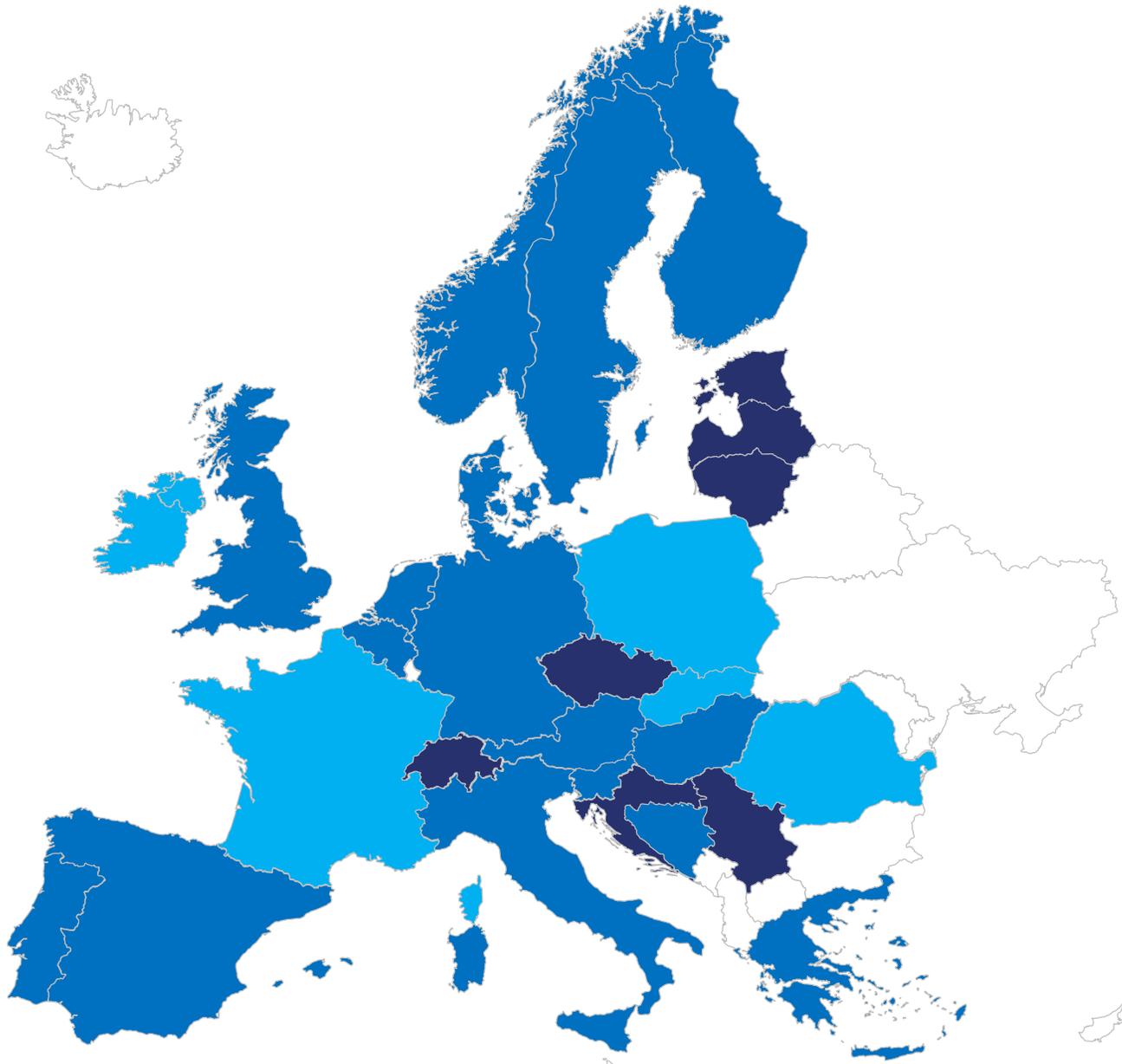
Minimal Incentives

Minimal incentives means that there is some method which leads the BRPs to balance their schedules.

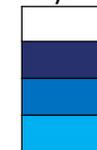
Key:

| | |
|--|--------------|
| | Missing data |
| | N/A |
| | Yes |
| | No |

Imbalance settlement - Control energy prices used - FCR



Key:



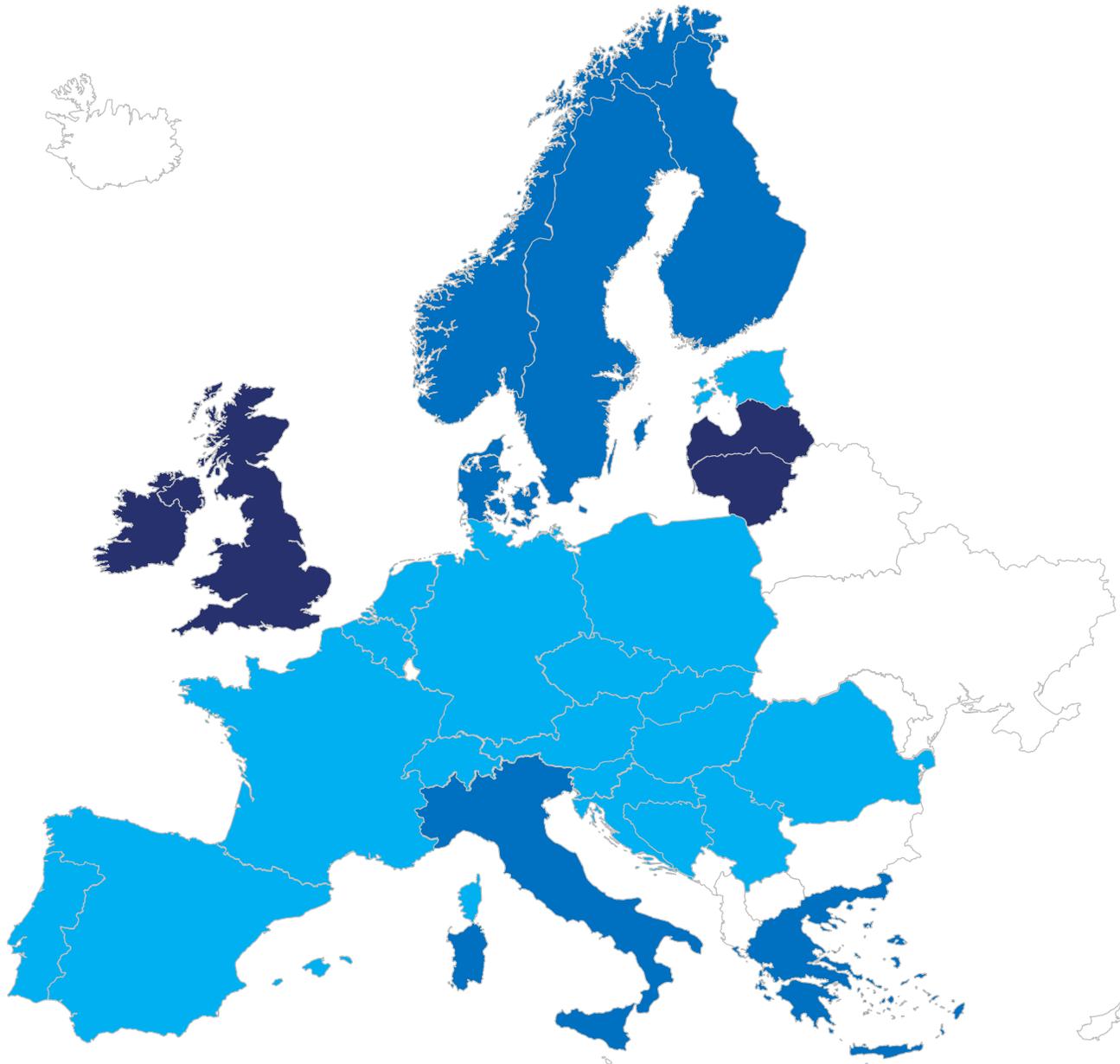
Missing data

TSO is not using this type of product

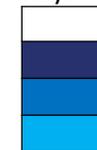
This product is not used in settlement price calculation

This product is used in settlement price calculation

Imbalance settlement - Control energy prices used - aFRR



Key:



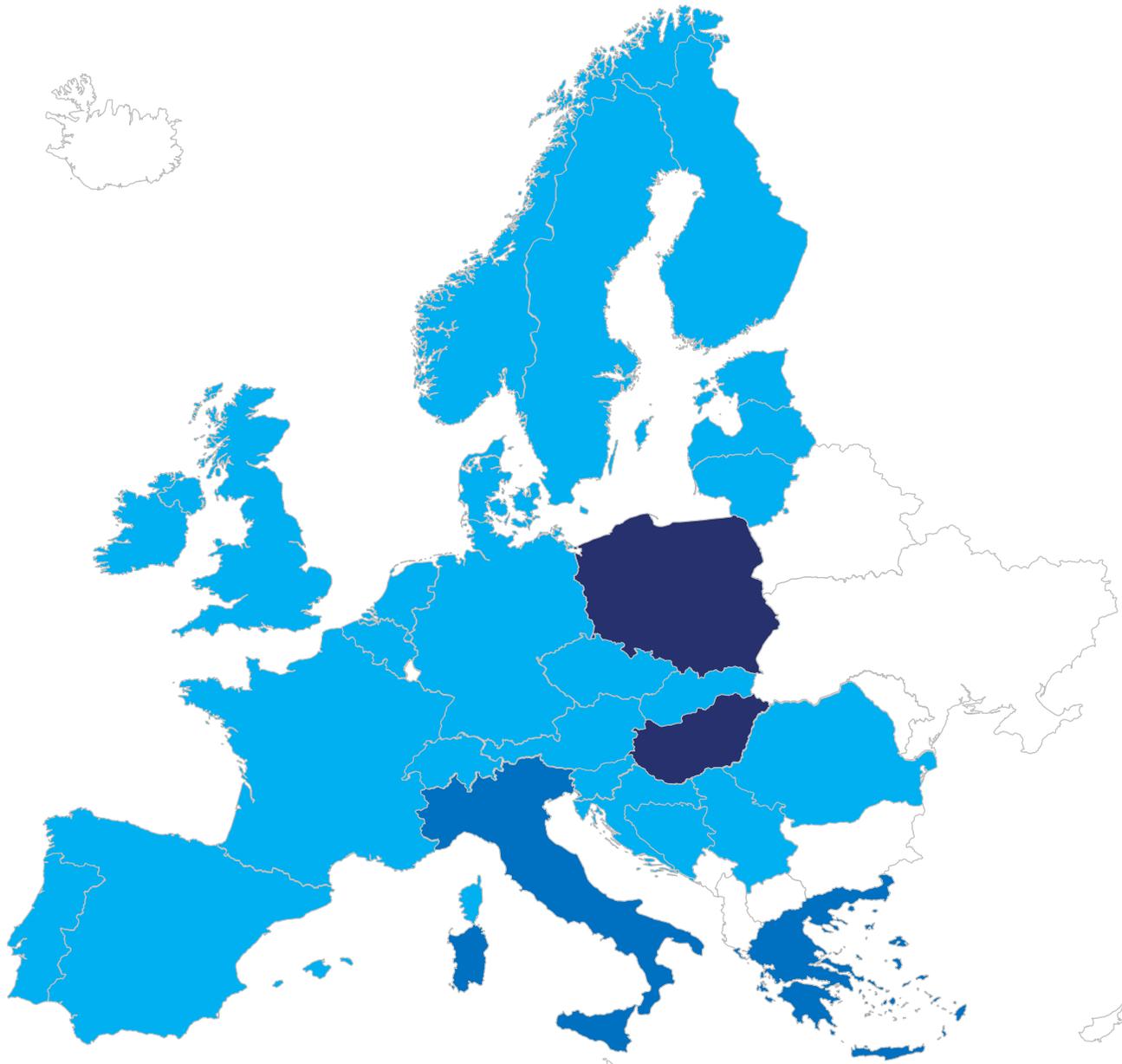
Missing data

TSO is not using this type of product

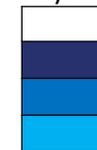
This product is not used in settlement price calculation

This product is used in settlement price calculation

Imbalance settlement - Control energy prices used - mFRR



Key:



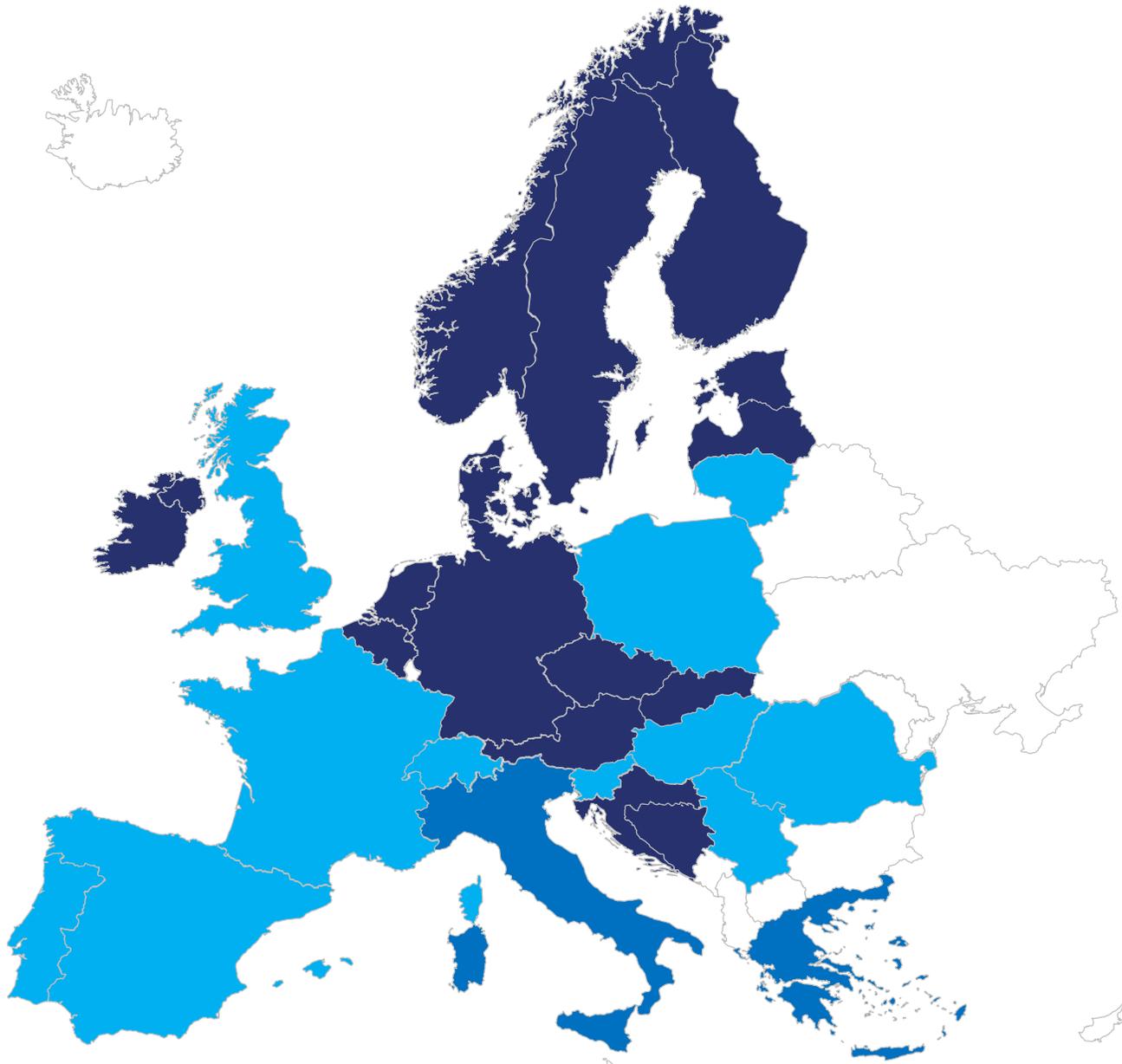
Missing data

TSO is not using this type of product

This product is not used in settlement price calculation

This product is used in settlement price calculation

Imbalance settlement - Control energy prices used - RR



Key:



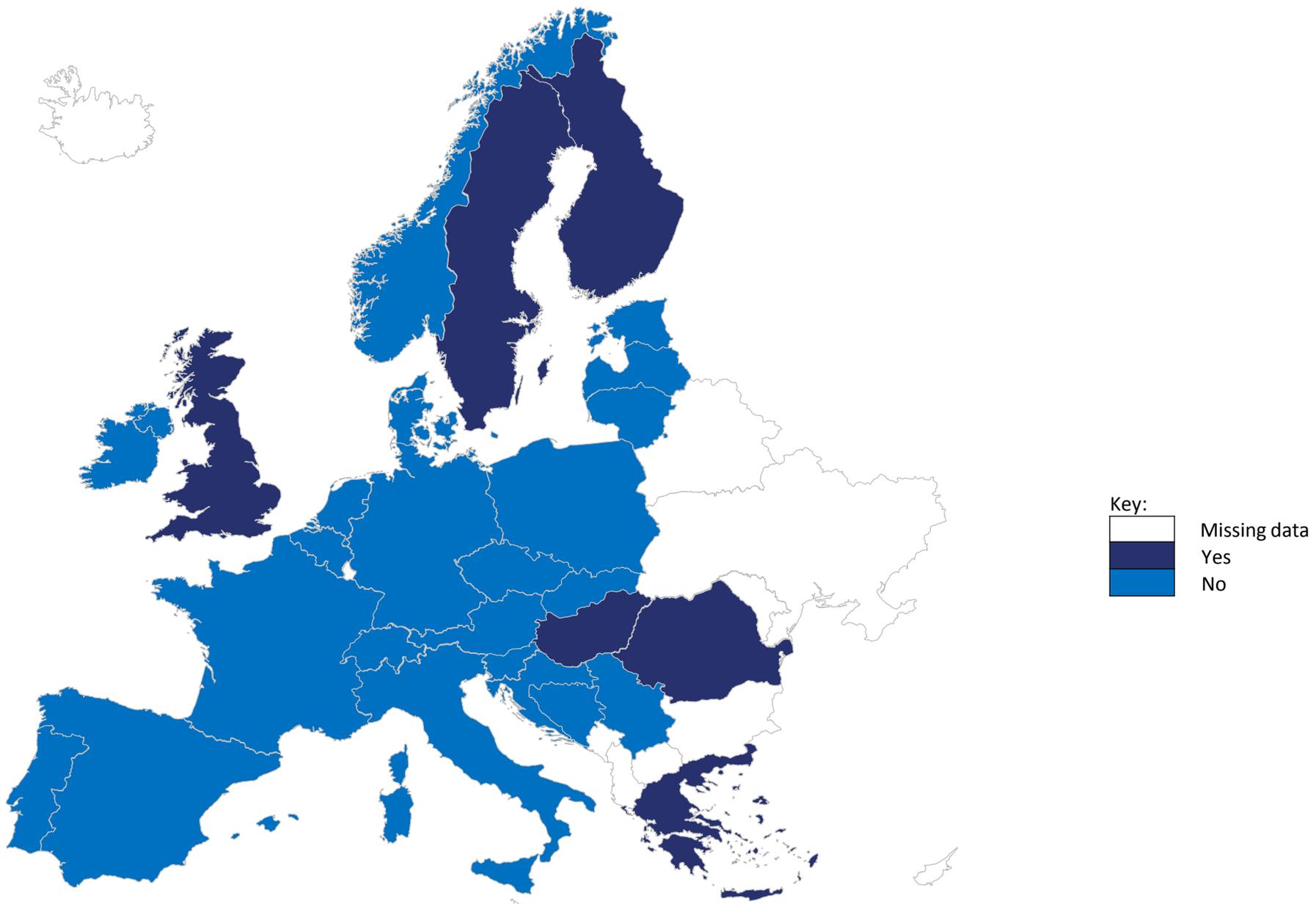
Missing data

TSO is not using this type of product

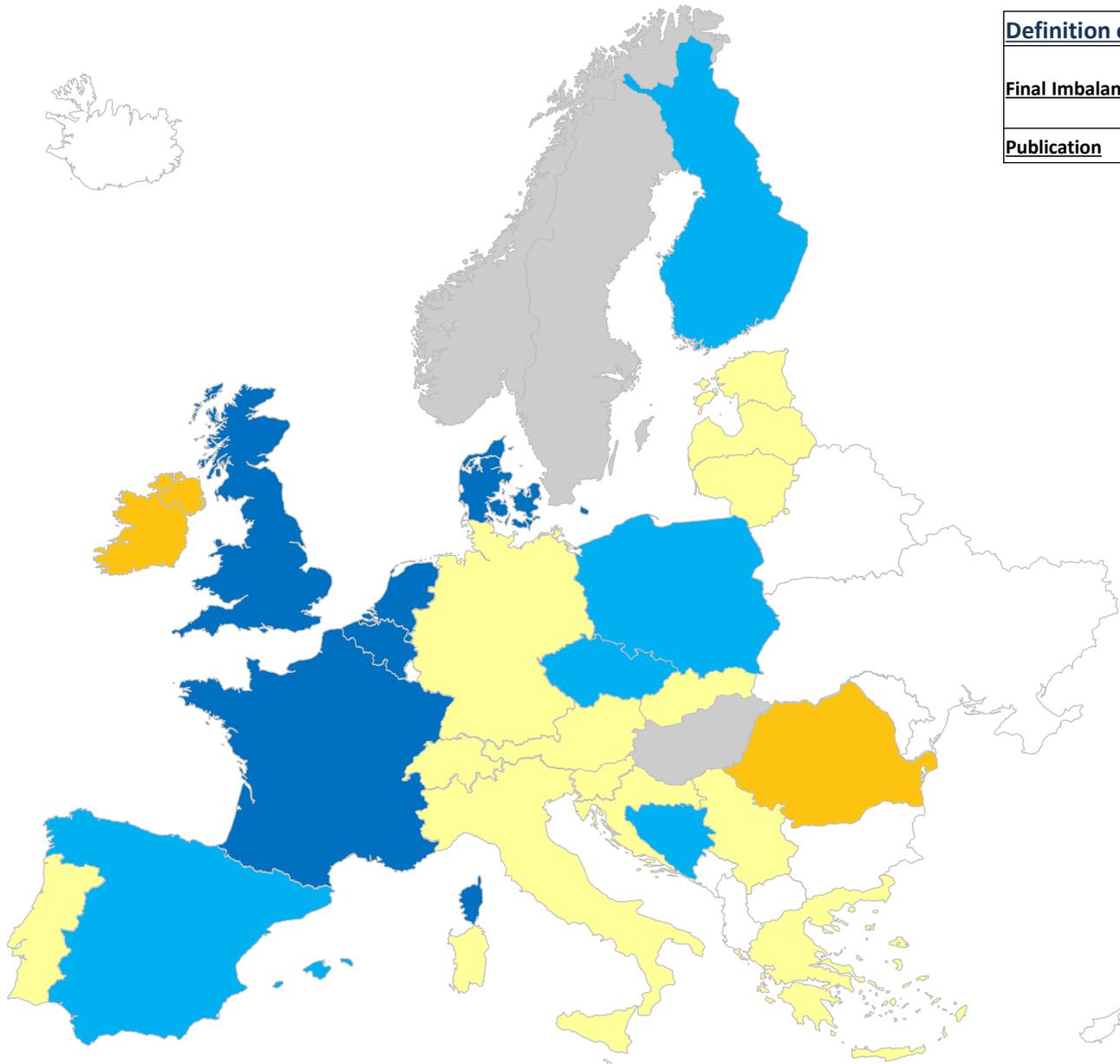
This product is not used in settlement price calculation

This product is used in settlement price calculation

Imbalance settlement - Start/Stop costs in Imbalance Charges



Imbalance settlement - Publication



Definition of question

Final Imbalance Price

Imbalance price means the price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction. Final imbalance price is calculated price for settlement period that cannot be changed anymore.

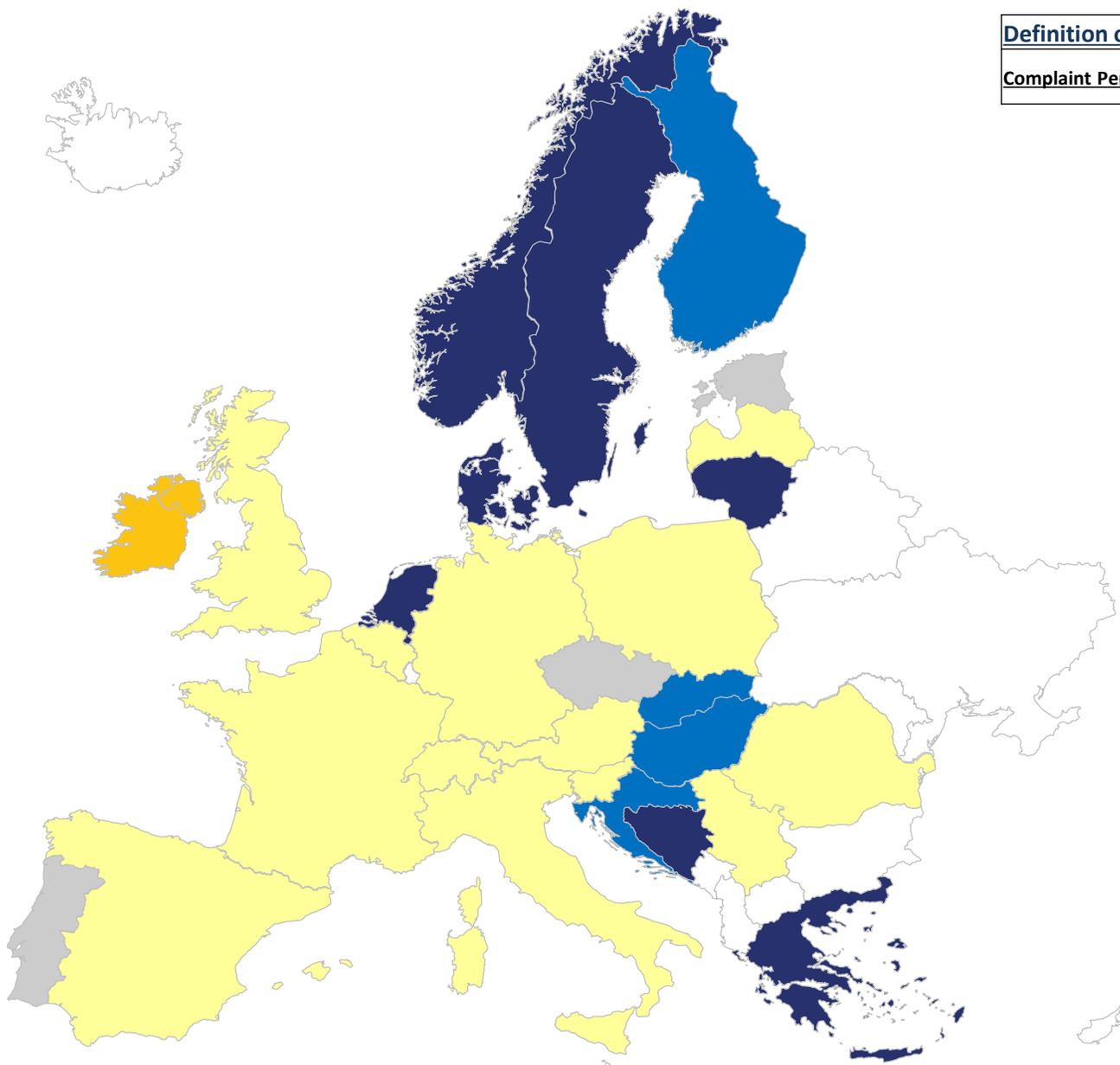
Publication

Publication of final Imbalance Price.

Key:

| | |
|--|--------------------------------|
| | Missing data |
| | N/A |
| | Prior to delivery |
| | $x \leq 1$ hour after delivery |
| | $x \leq 1$ day after delivery |
| | $x \leq 1$ week after delivery |
| | $x > 1$ week after delivery |

Imbalance settlement - Complaint Period



Definition of answer

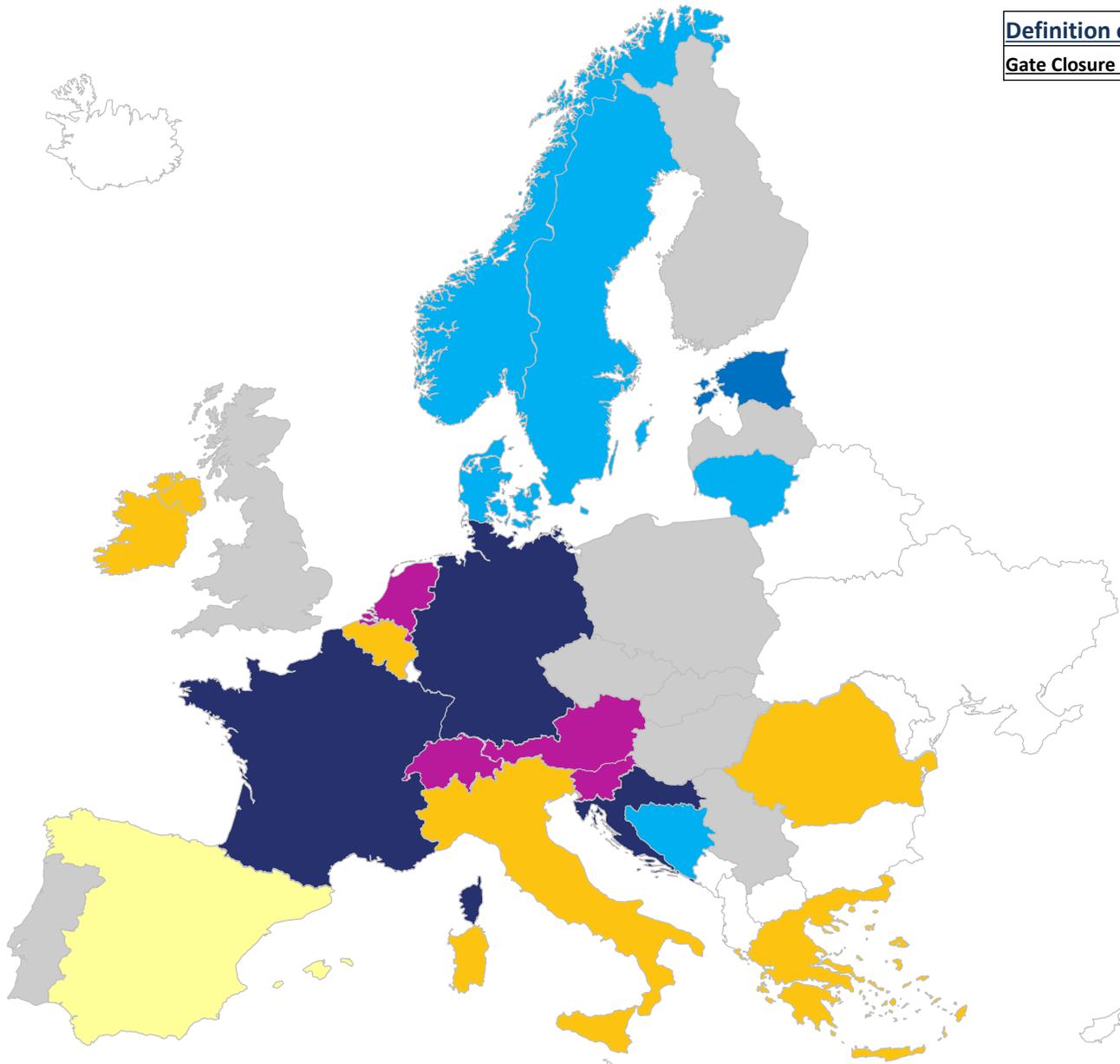
Complaint Period

Length of time for which complaints can be made which will be considered in relation to settlement (after the finalized data are produced).

Key:

| | |
|--|-----------------------|
| | Missing data |
| | N/A |
| | $x \leq 3$ weeks |
| | $3 < x \leq 6$ weeks |
| | $6 < x \leq 9$ weeks |
| | $9 < x \leq 12$ weeks |
| | $x > 12$ weeks |

Imbalance settlement - Gate Closure time for notification of Internal Trade Schedules



Definition of answer

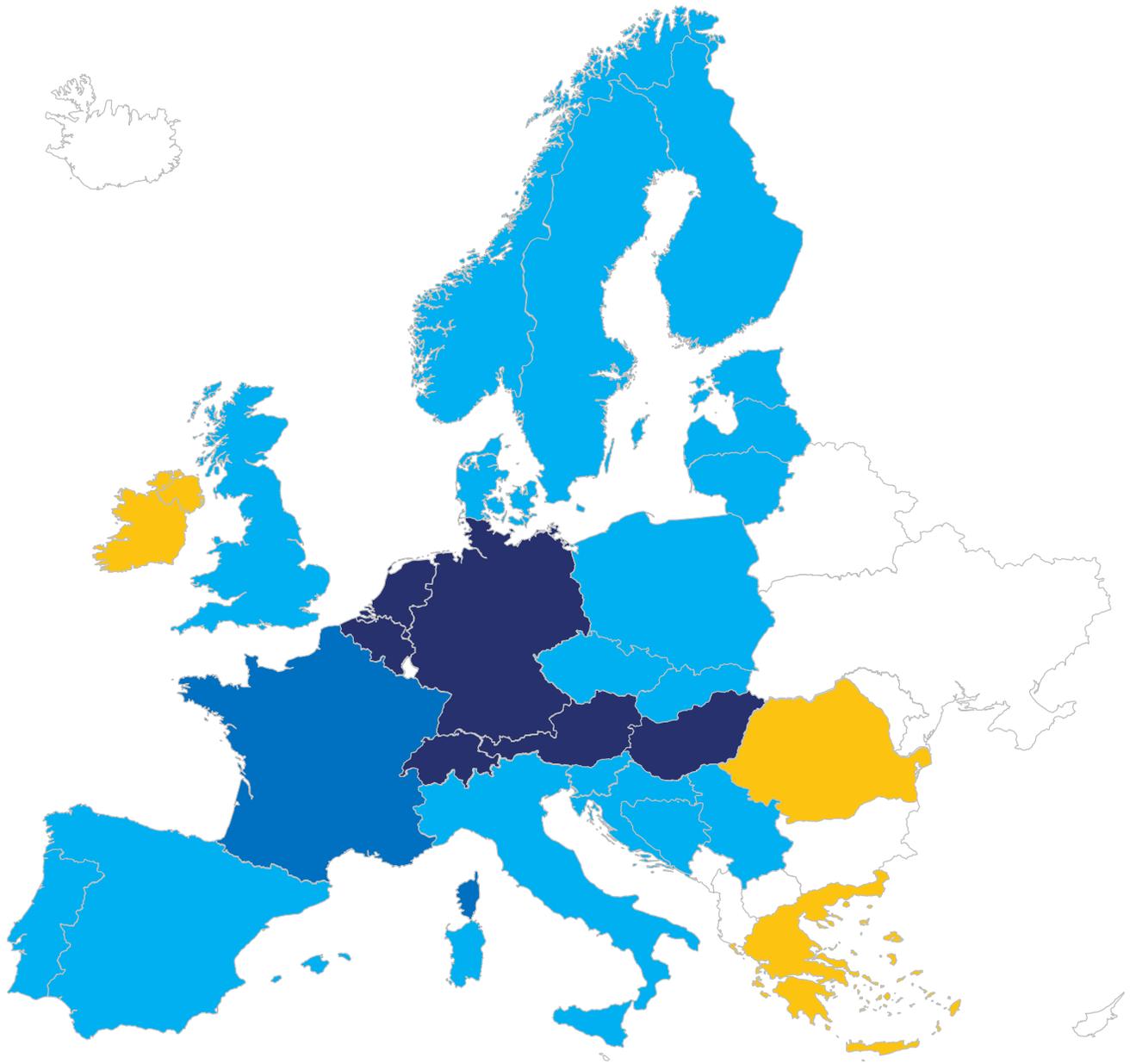
Gate Closure Times (GCT)

Deadline for the participation to a given market or mechanism.

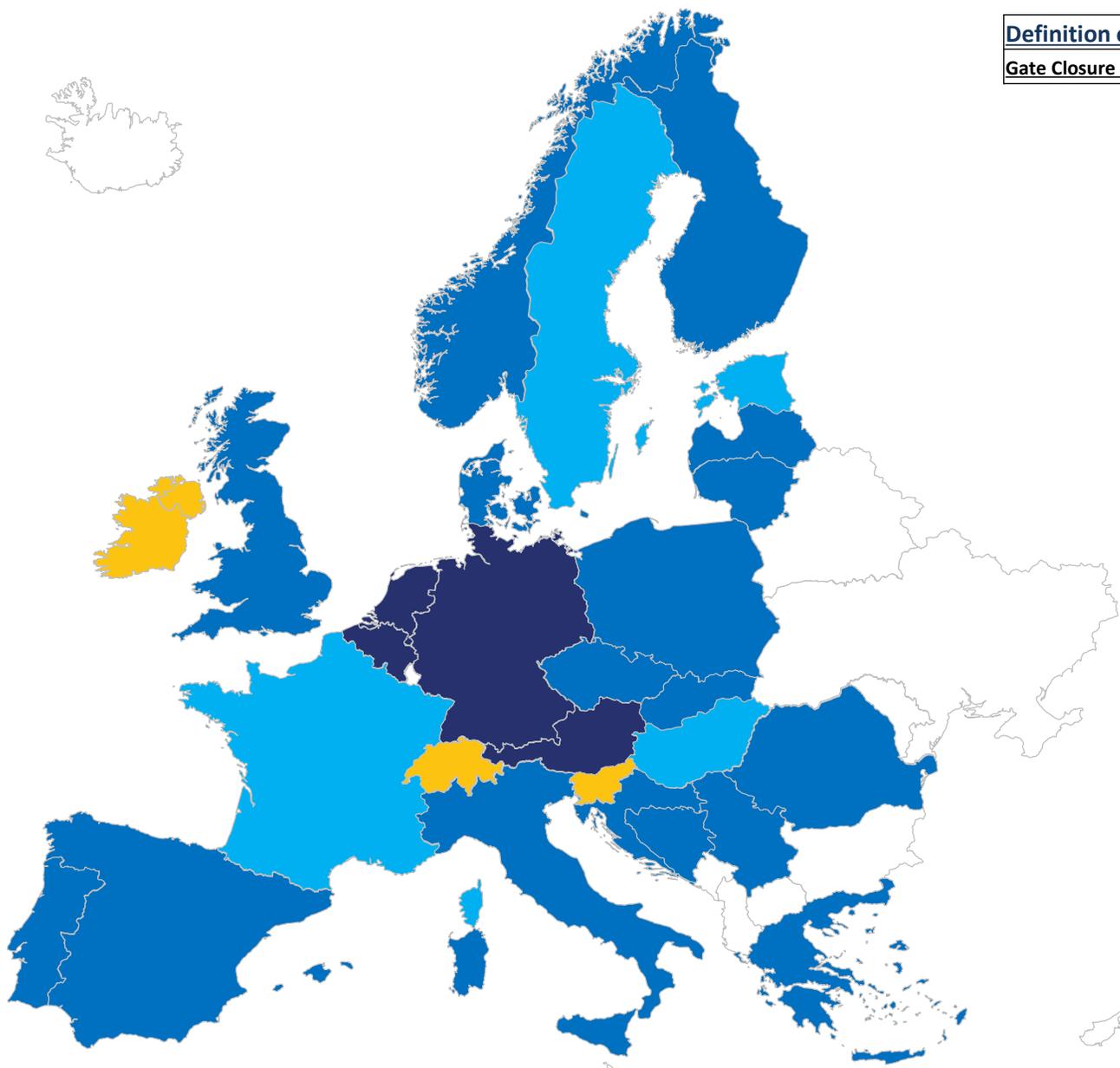
Key:

| | |
|--|------------------------------|
| | Missing data |
| | N/A |
| | 15 min before delivery |
| | 30 min before delivery |
| | 45 min before delivery |
| | 1 hour before delivery |
| | x > 1 hour before delivery |
| | Ex-post notification allowed |

Imbalance settlement - Internal Intra Day Market time period



Imbalance settlement - Can market participants change the approved schedules after Delivery?



Definition of answer

Gate Closure Times (GCT)

Deadline for the participation to a given market or mechanism.

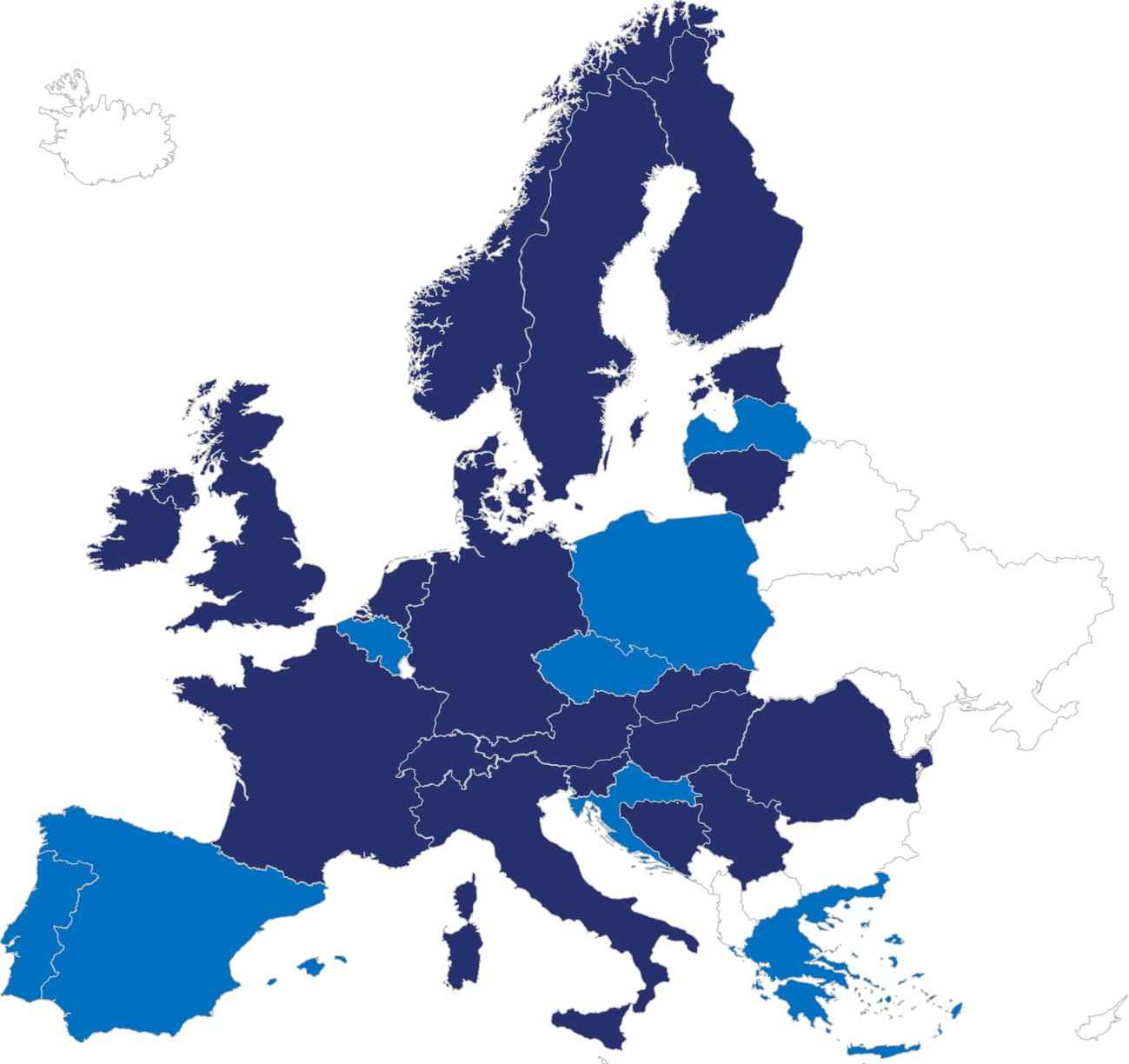
Key:

| | |
|--|---|
| | Missing data |
| | N/A |
| | Always (GCT after delivery) |
| | Never (GCT before delivery) |
| | Only in case of IT or any other problems (TSO approval) |

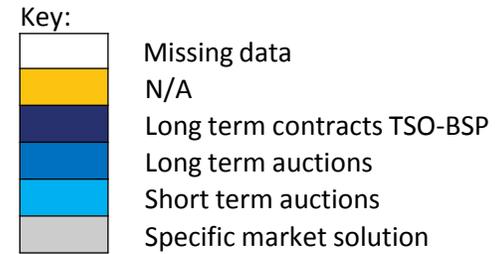
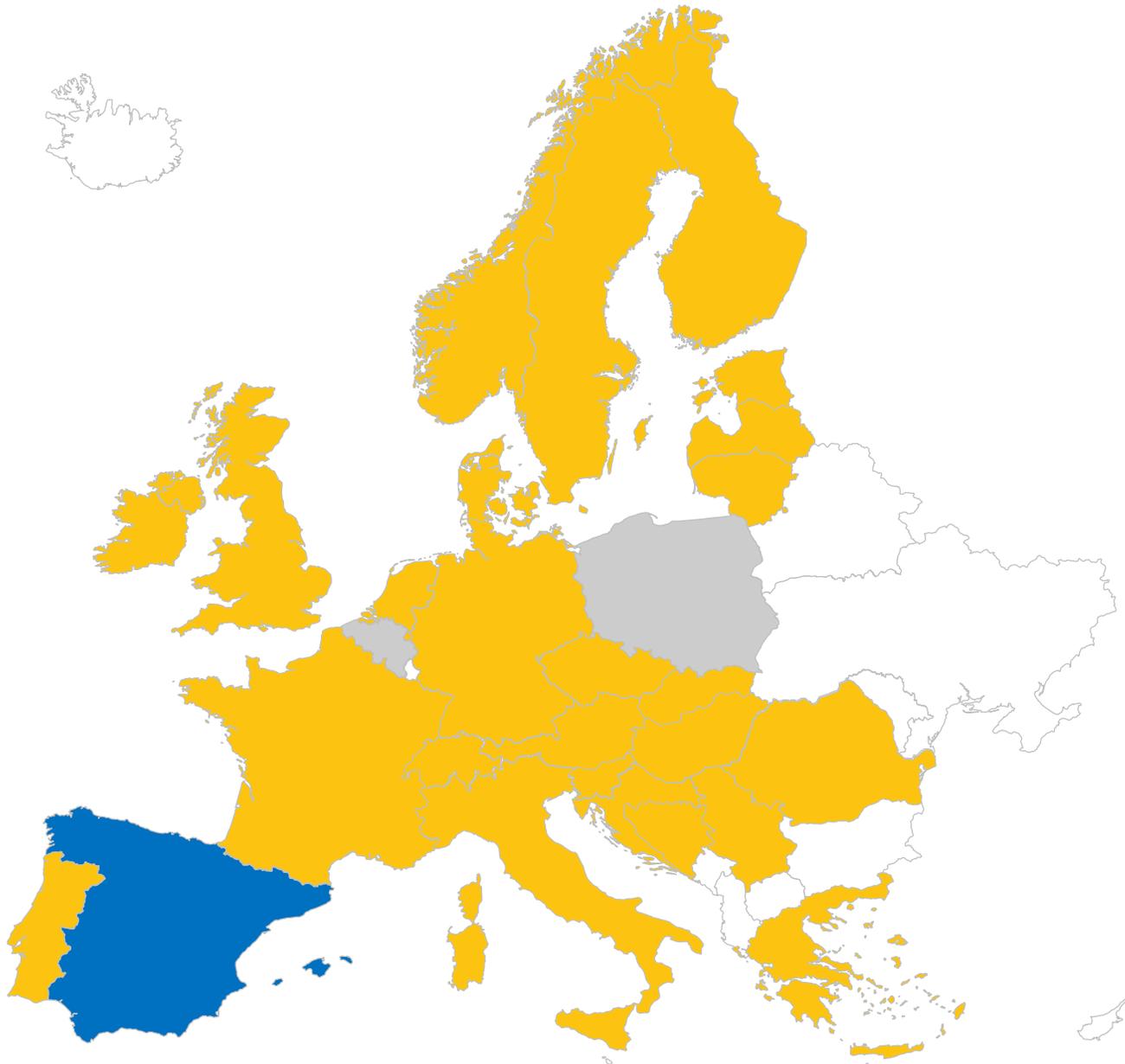
Load participation

(Referring to questions of AS survey from L1.0 to L7.0)

Load participation - Load providers use the same market mech. and act. proc. as generation (cap.&energy)

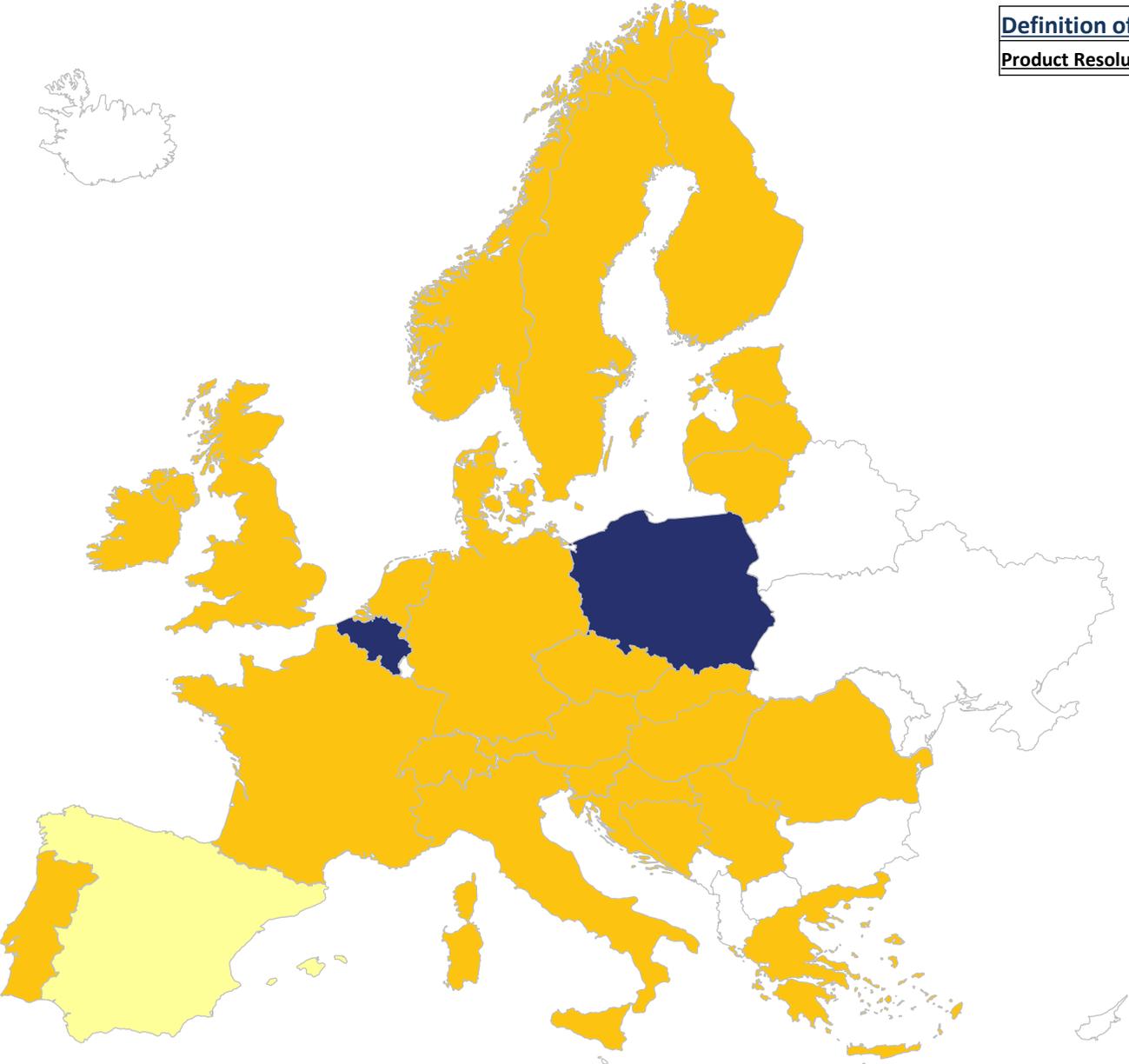


Load participation - Specific market solution use for load providers of balancing services (cap.&energy)



Load participation - Product Resolution (in MW)

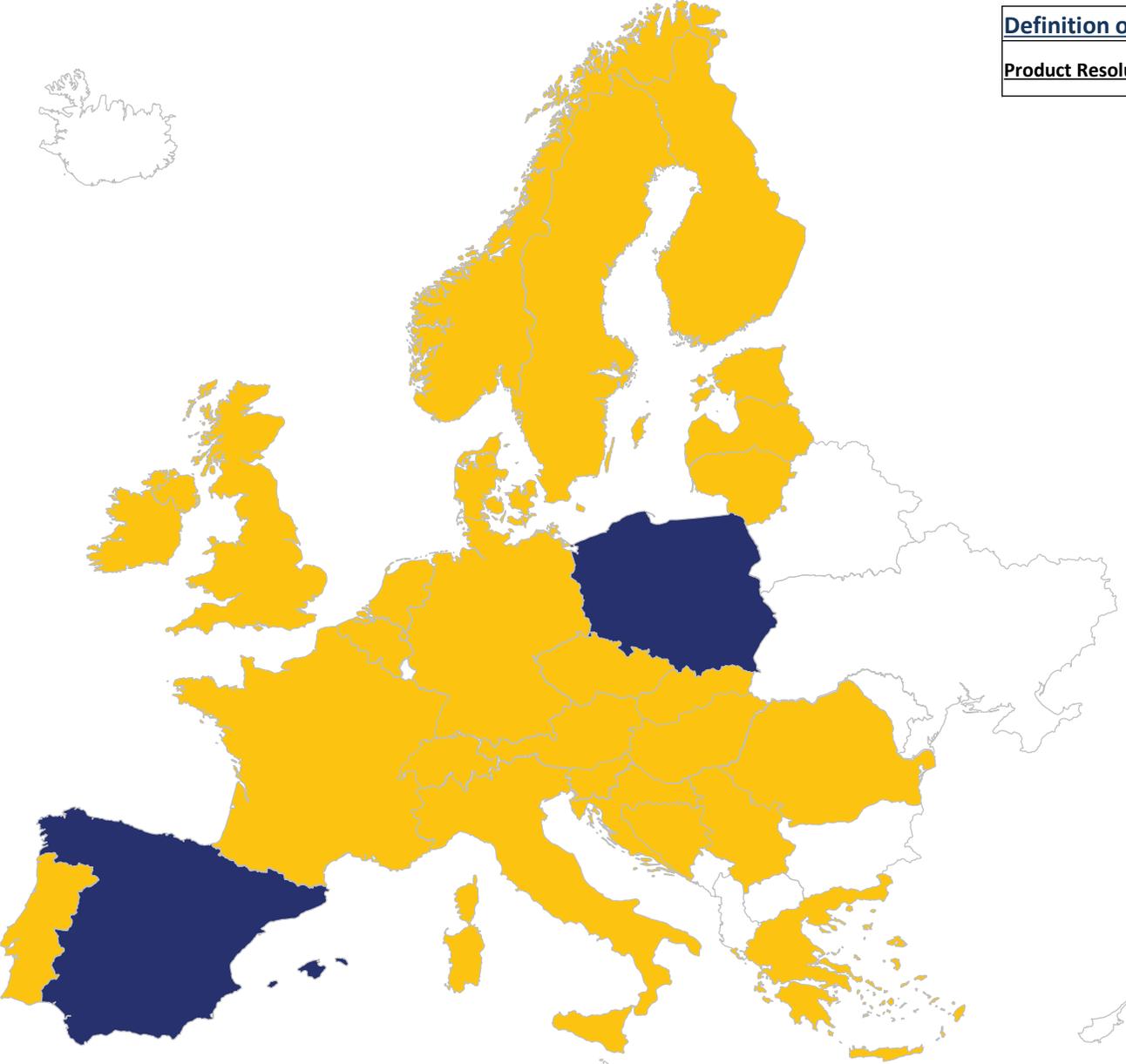
| Definition of question | |
|----------------------------|---|
| Product Resolution (in MW) | The minimum bid size into the balancing market. |



Key:

| | |
|-------------|-----------------------------------|
| White | Missing data |
| Orange | N/A |
| Dark Blue | $x \leq 1\text{MW}$ |
| Medium Blue | $1\text{MW} < x \leq 5\text{MW}$ |
| Light Blue | $5\text{MW} < x \leq 10\text{MW}$ |
| Grey | $x > 10\text{MW}$ |
| Yellow | Other |

Load participation - Product Resolution (in time)

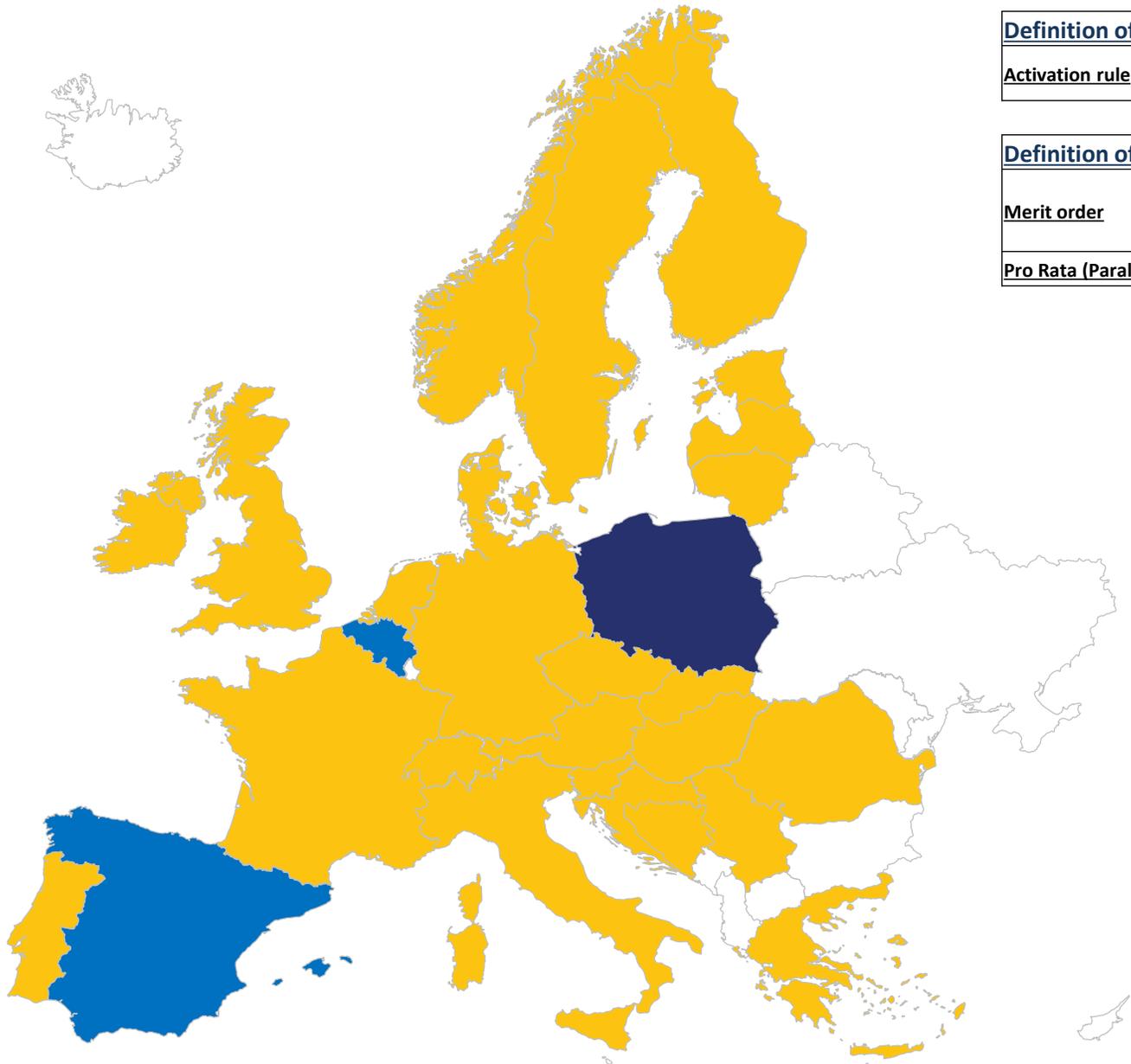


| <u>Definition of question</u> | |
|-------------------------------------|---|
| <u>Product Resolution (in time)</u> | The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision). |

Key:

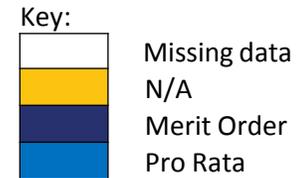
| | |
|-------------|------------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Hour (or blocks) |
| Medium Blue | 30 minutes |
| Light Blue | 15 minutes |

Load participation - What type of specific activation rule do you follow with load type BSP's?

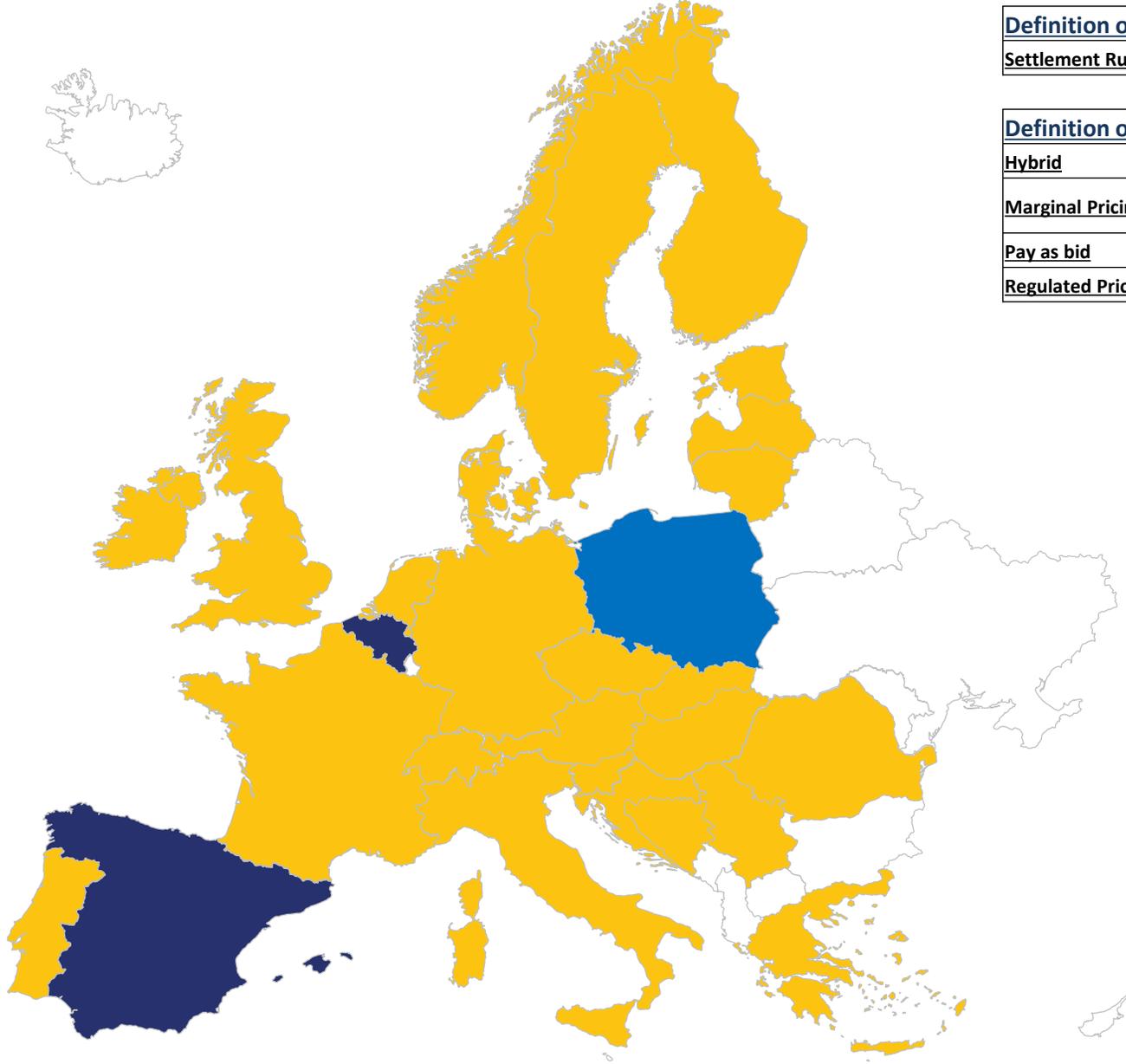


| | |
|-------------------------------|---|
| Definition of question | |
| Activation rule | How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first). |

| | |
|---------------------------------------|--|
| Definition of answer | |
| Merit order | A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand. |
| Pro Rata (Parallel Activation) | All bids always activated in parallel – proportionally. |



Load participation - Settlement Rule



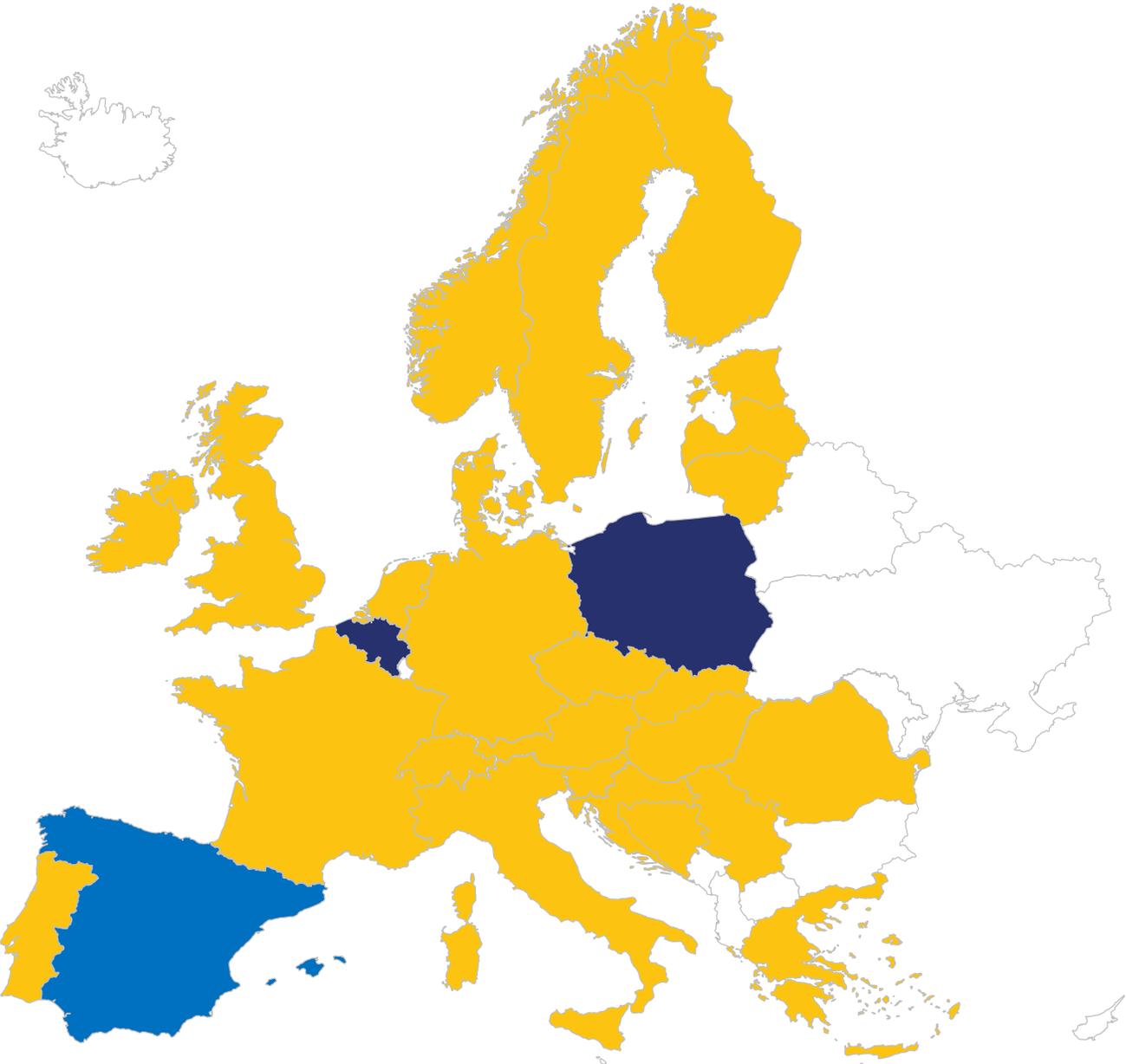
| <u>Definition of question</u> | |
|-------------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |

| <u>Definition of answer</u> | |
|-----------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

- Missing data
- N/A
- Pay as bid
- Marginal Pricing
- Regulated Price
- Hybrid

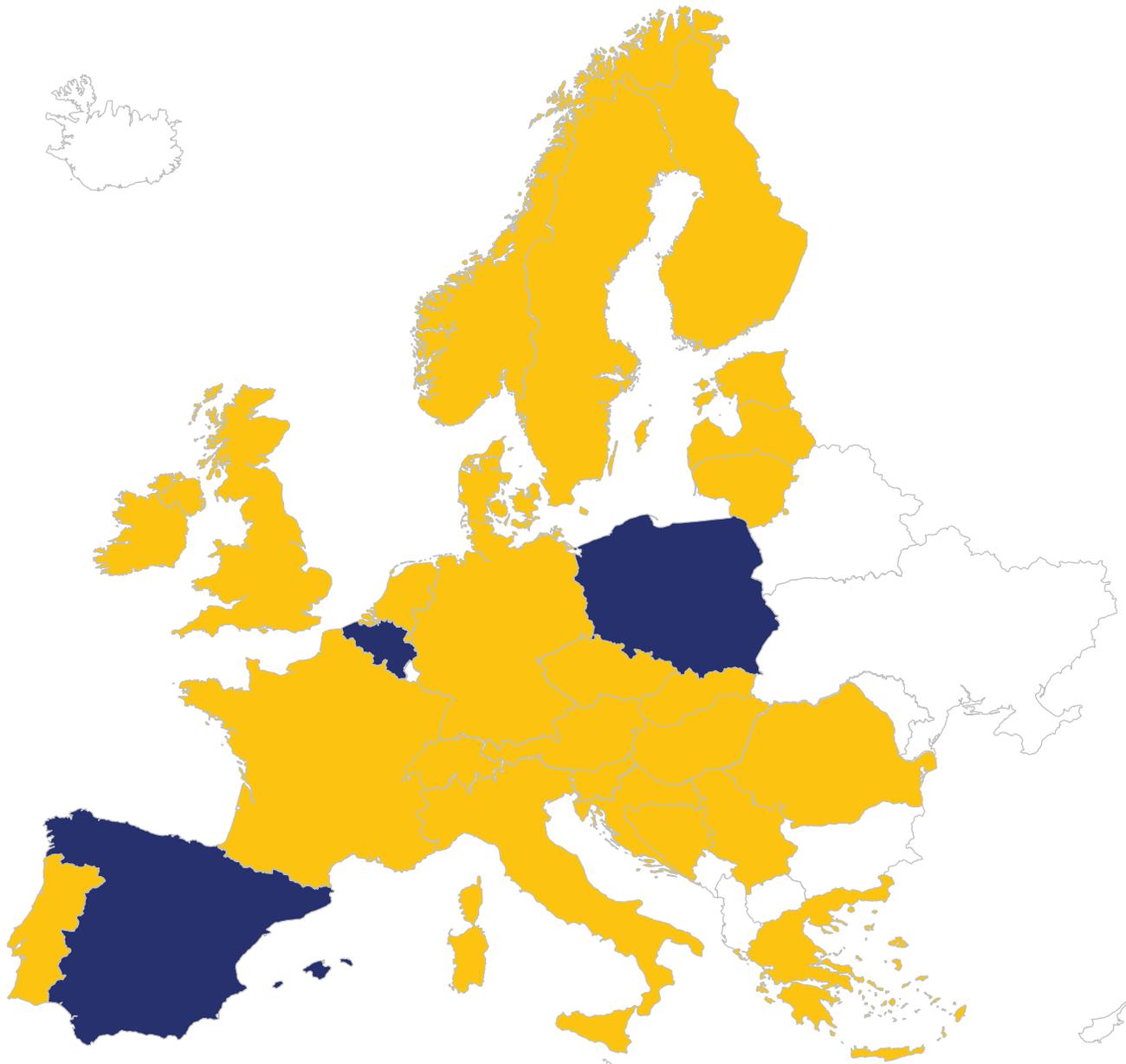
Load participation - Participating in the balancing services - Aggregators



Key:

| | |
|------------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Light Blue | No |

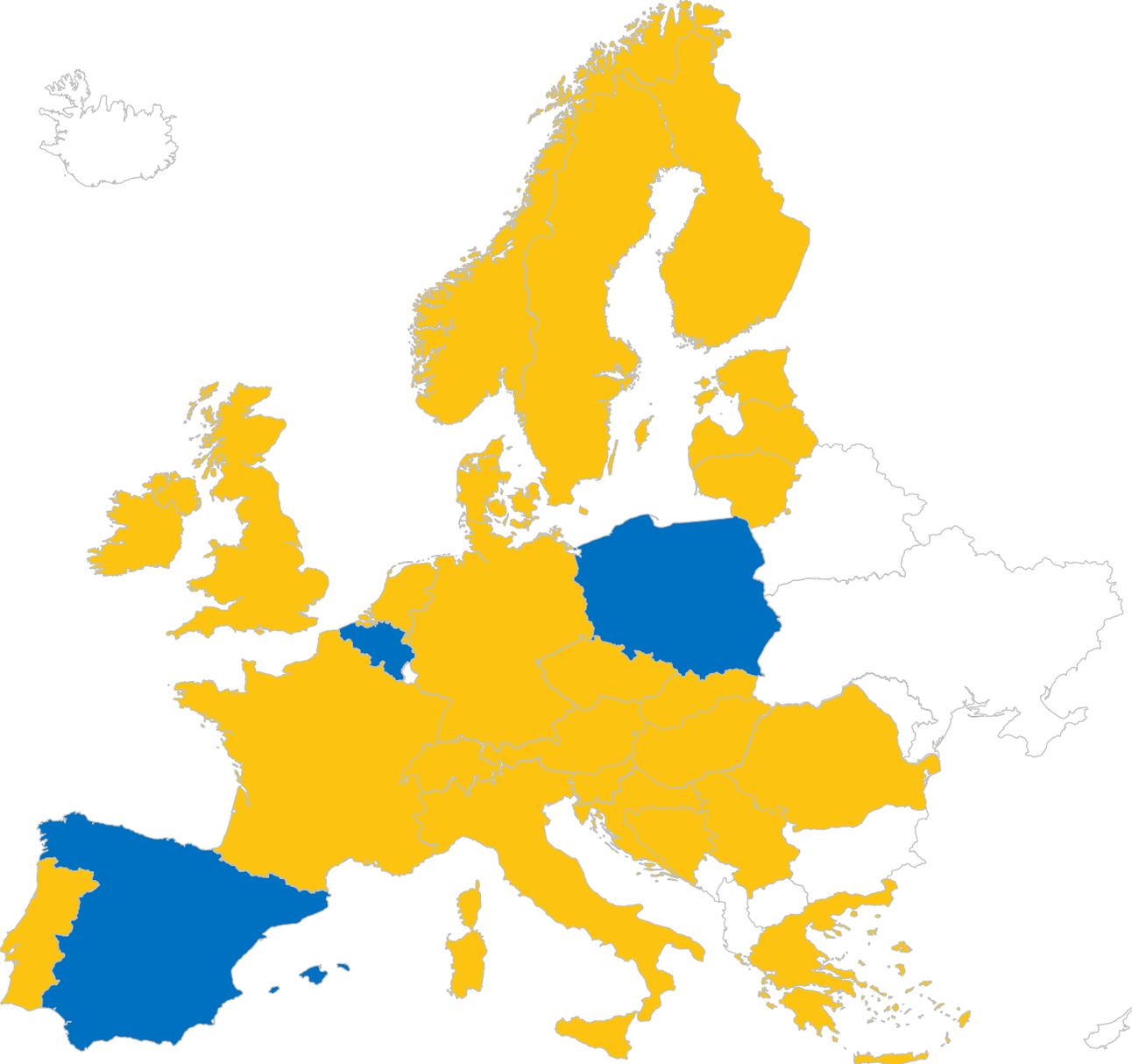
Load participation - Participating in the balancing services - Large consumers



Key:

| | |
|------------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Light Blue | No |

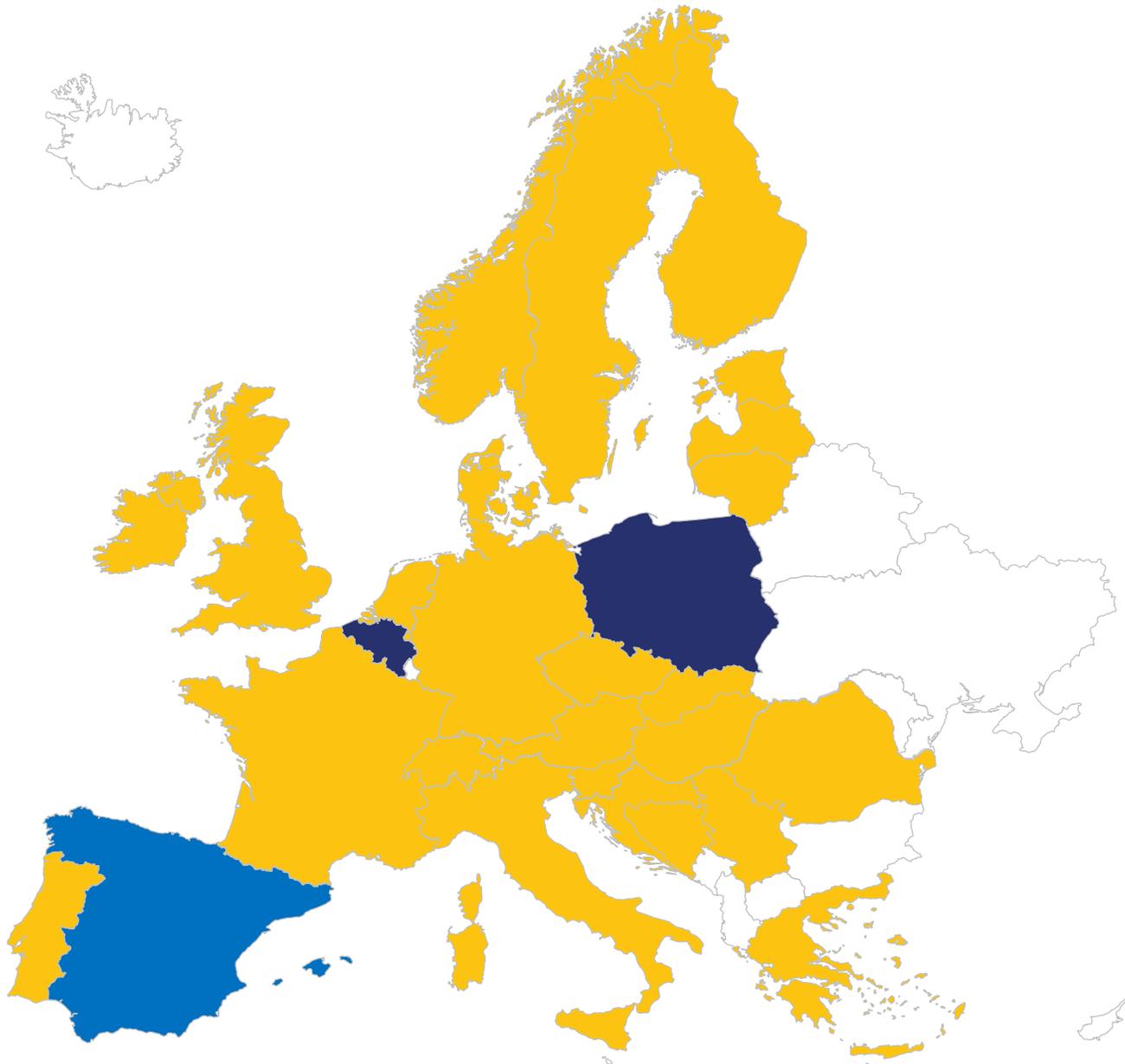
Load participation - Participating in the balancing services - Pump storage units



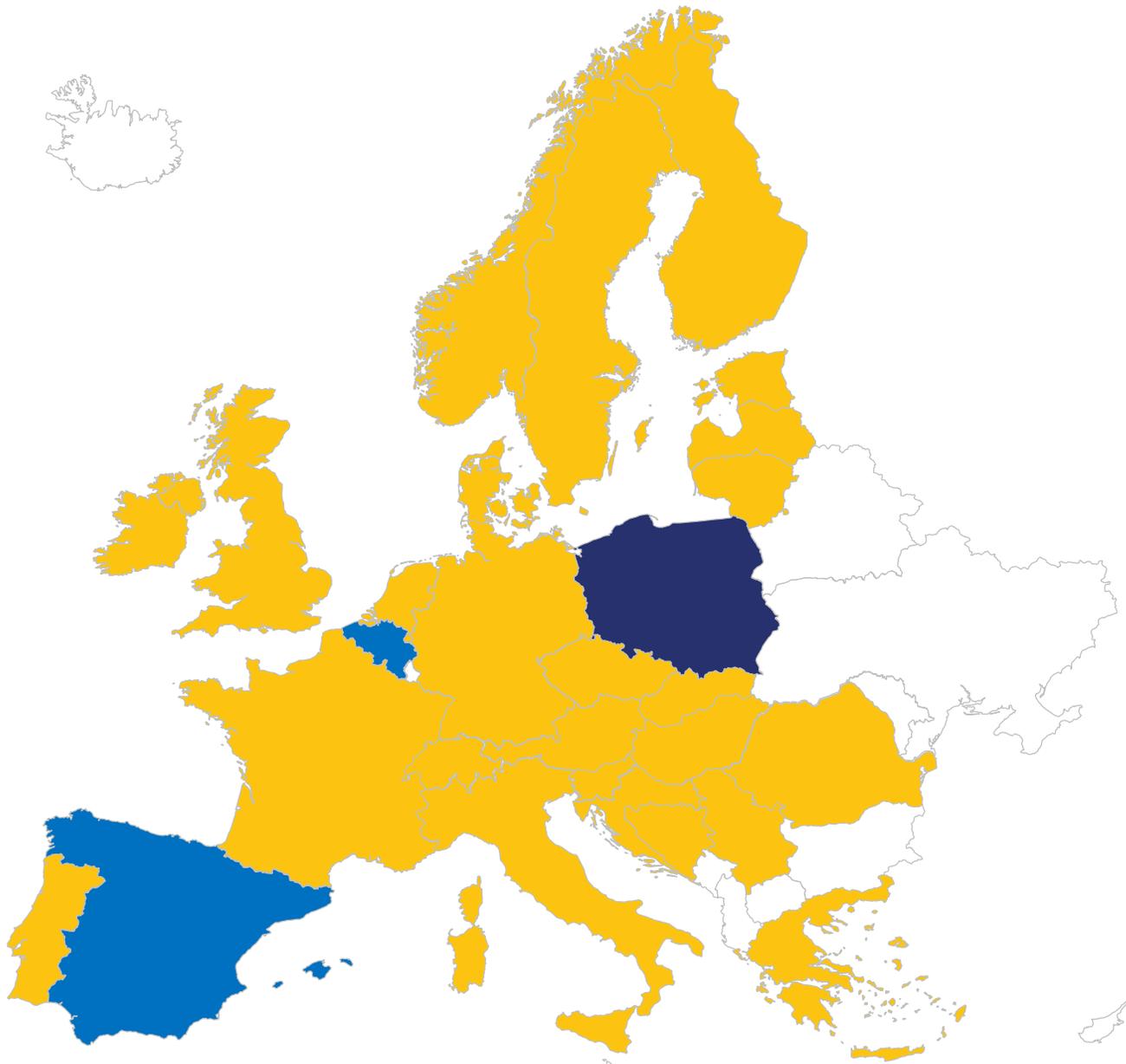
Key:

| | |
|-----------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Blue | No |

Load participation - Participating in the balancing services - Aggregated small size consumers



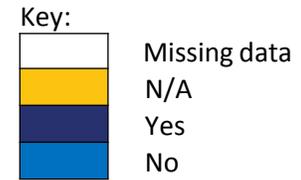
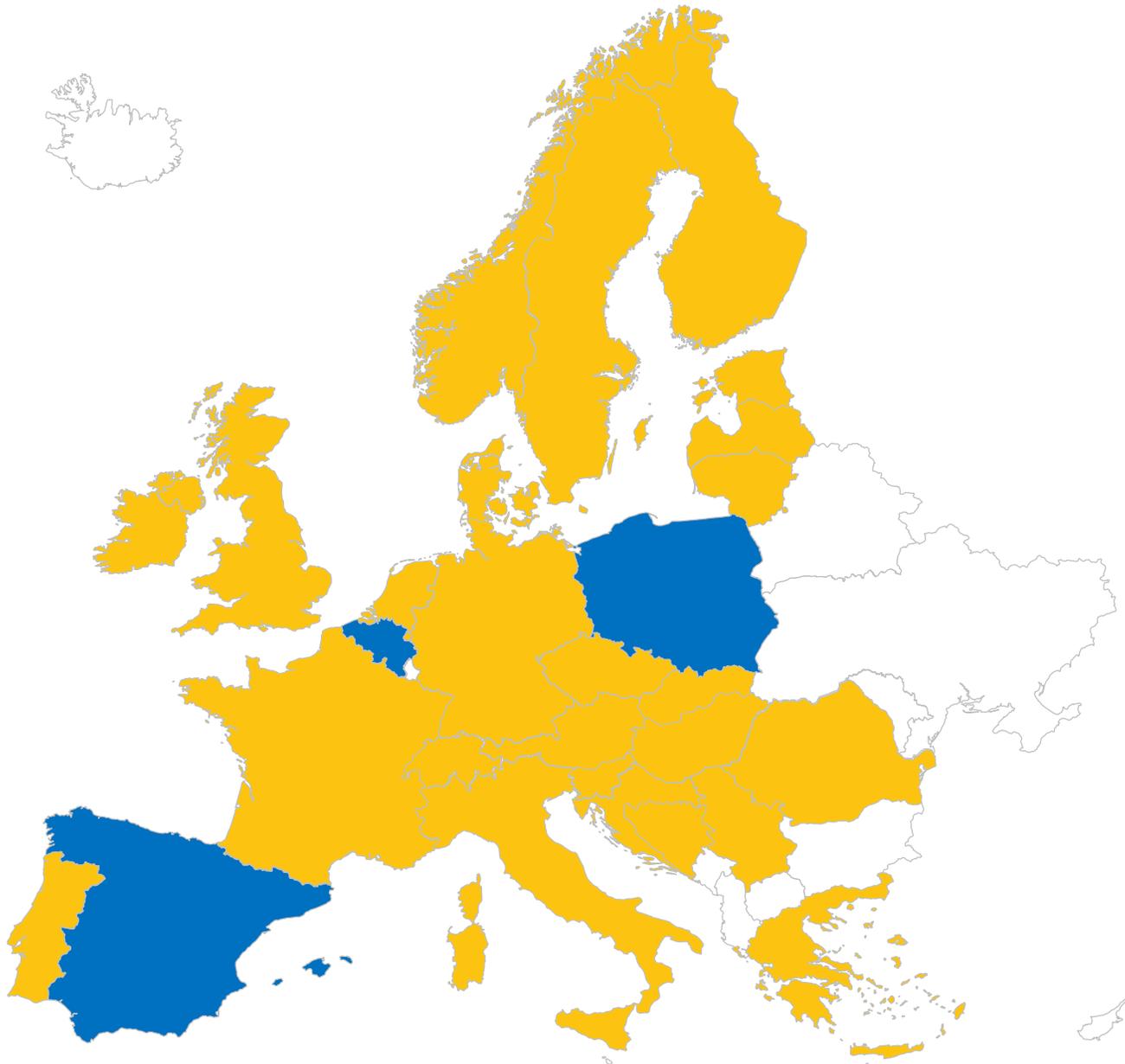
Load participation - Participating in the balancing services - Small consumers



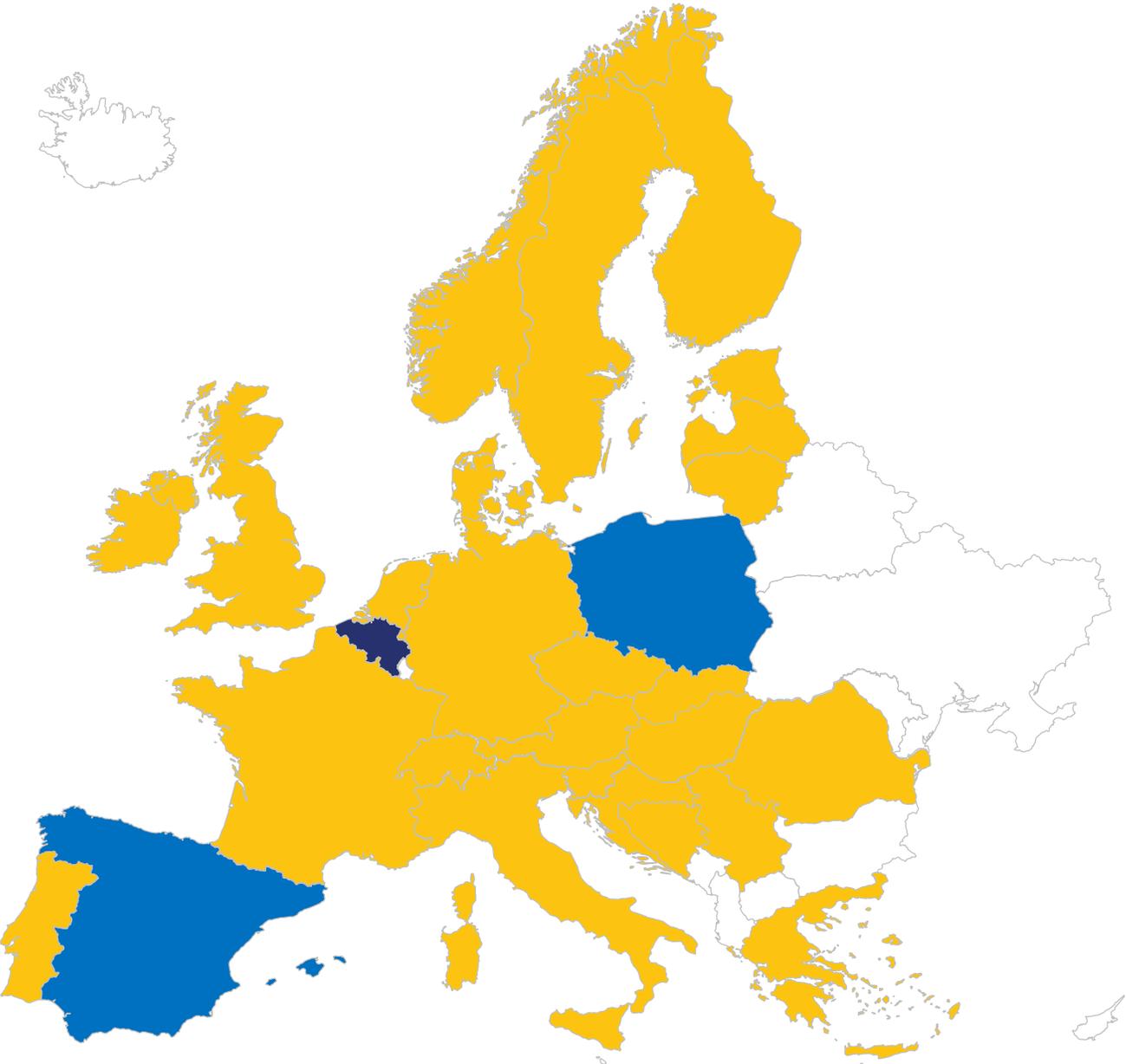
Key:

| | |
|------------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Light Blue | No |

Load participation - Participating in the balancing services - Other storage



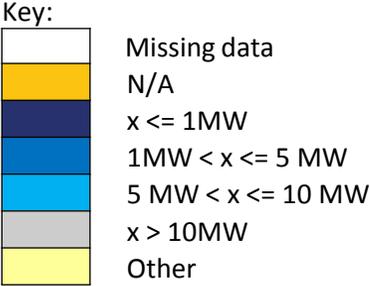
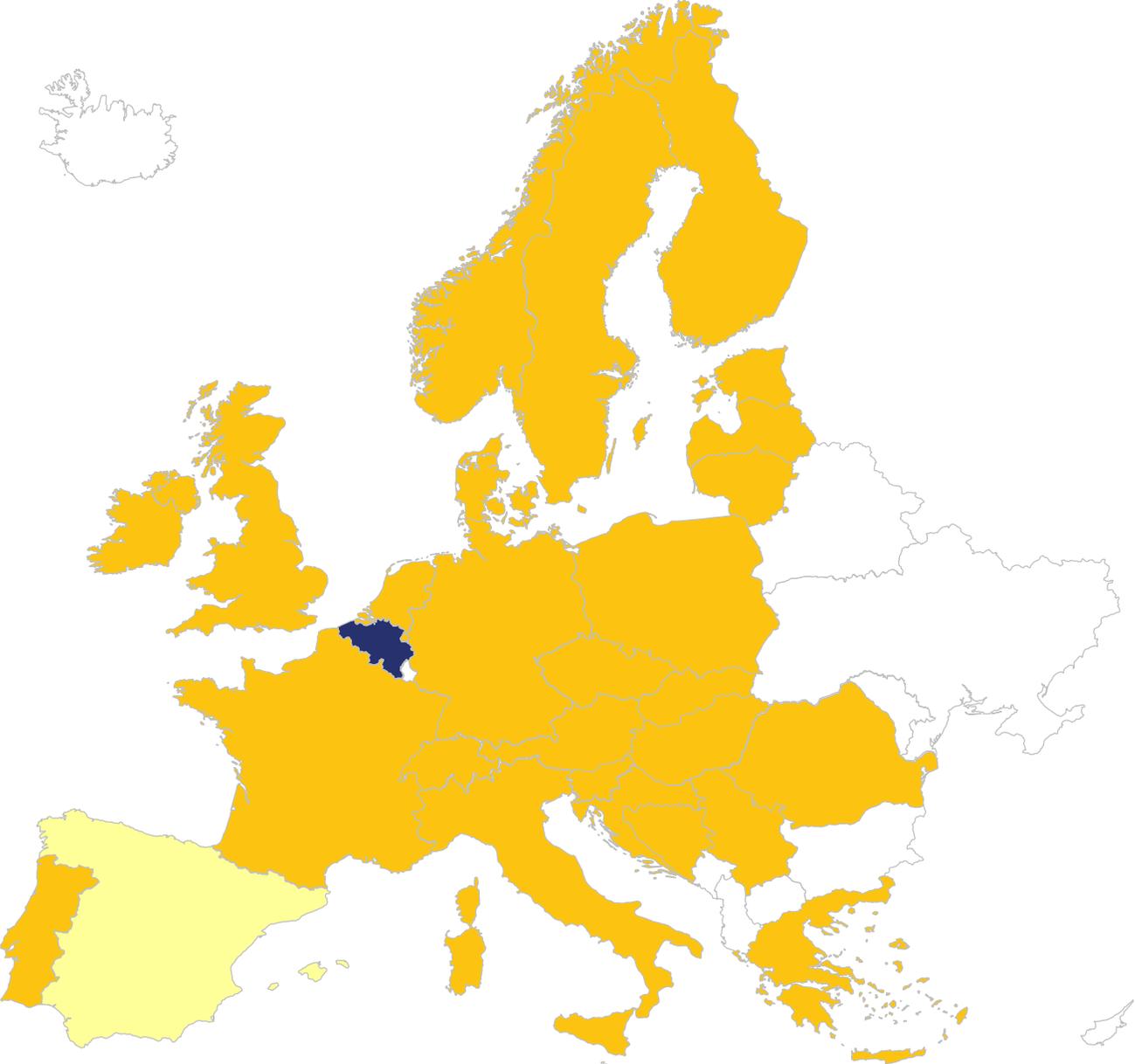
Load participation - Participating in the balancing services - Other



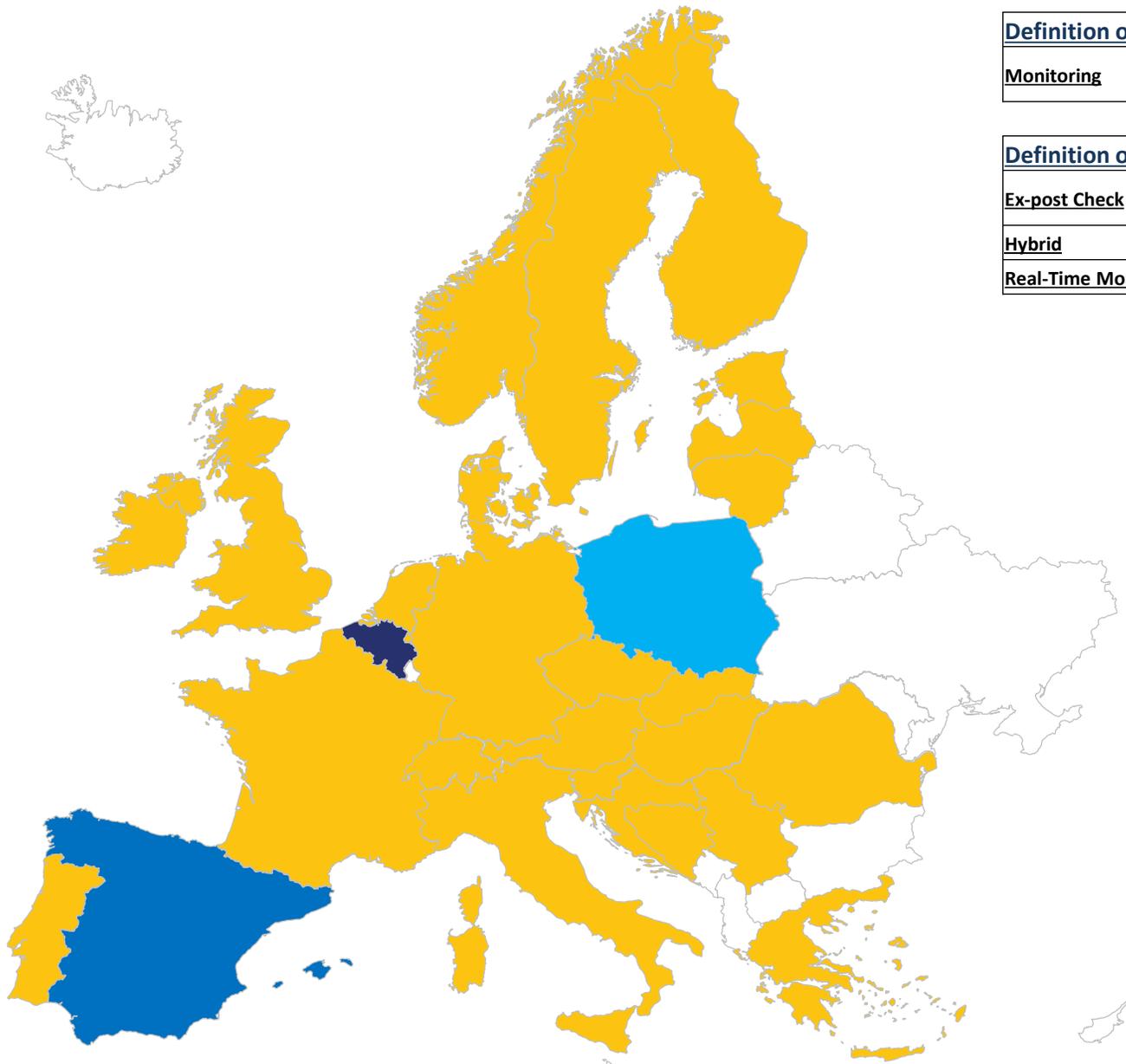
Key:

| | |
|-----------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Blue | No |

Load participation - What is the product resolution for load BSP's to participate at these balancing services?



Load participation - Monitoring



| <u>Definition of question</u> | |
|-------------------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |

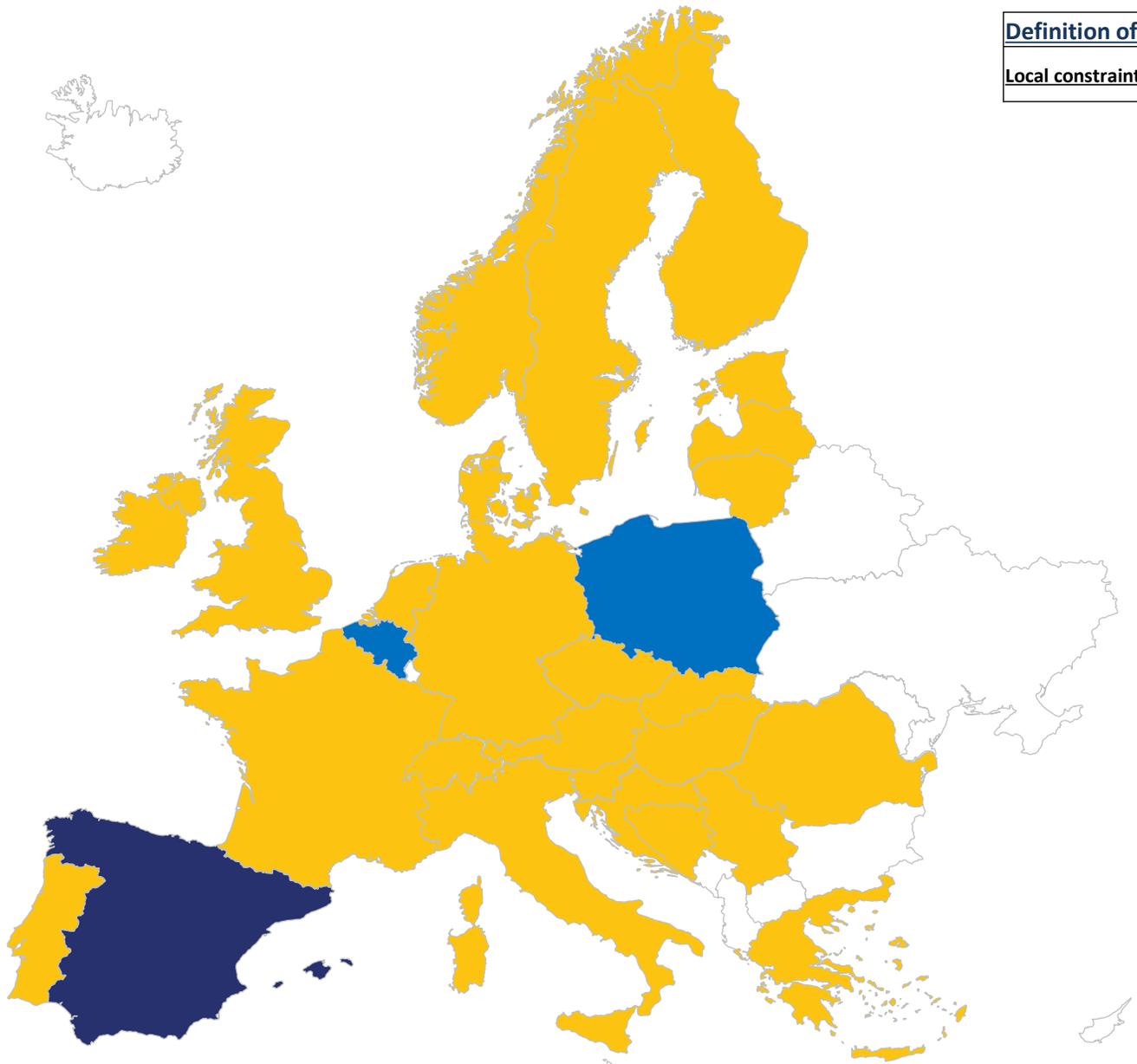
| <u>Definition of answer</u> | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

Key:

- Missing data
- N/A
- Ex-Post Check
- Real-Time Monitoring
- Hybrid

Load participation - Using load BSP's in order to solve local constraints

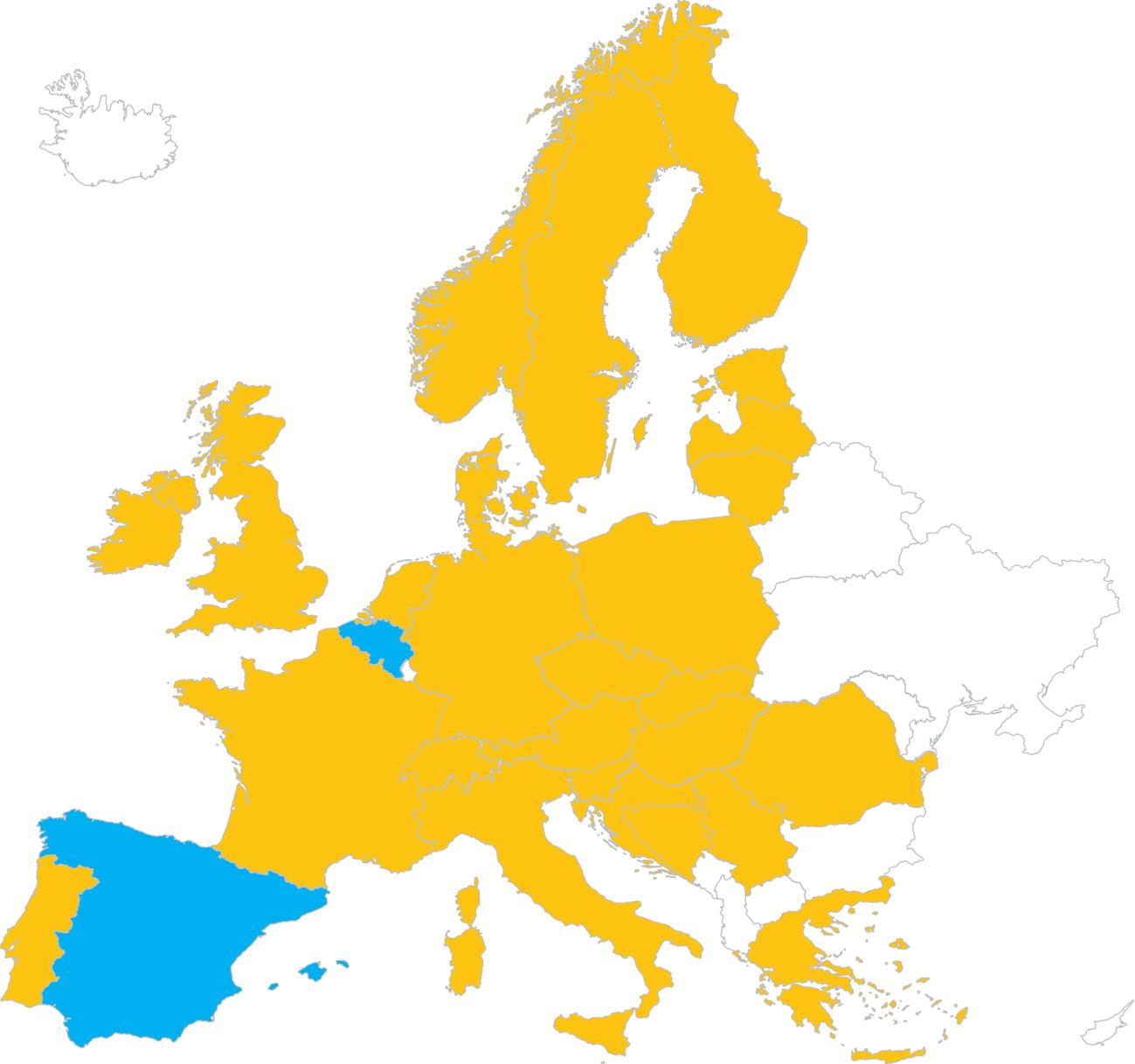
| <u>Definition of question</u> | |
|-------------------------------|---|
| <u>Local constraint</u> | Local constraint means a situation in which there is a need to implement Remedial Action in order to respect Operational Security Limits in the matter of the location. |



Key:

| | |
|------------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Light Blue | No |

Load participation - What level of control of the load does the TSO have?



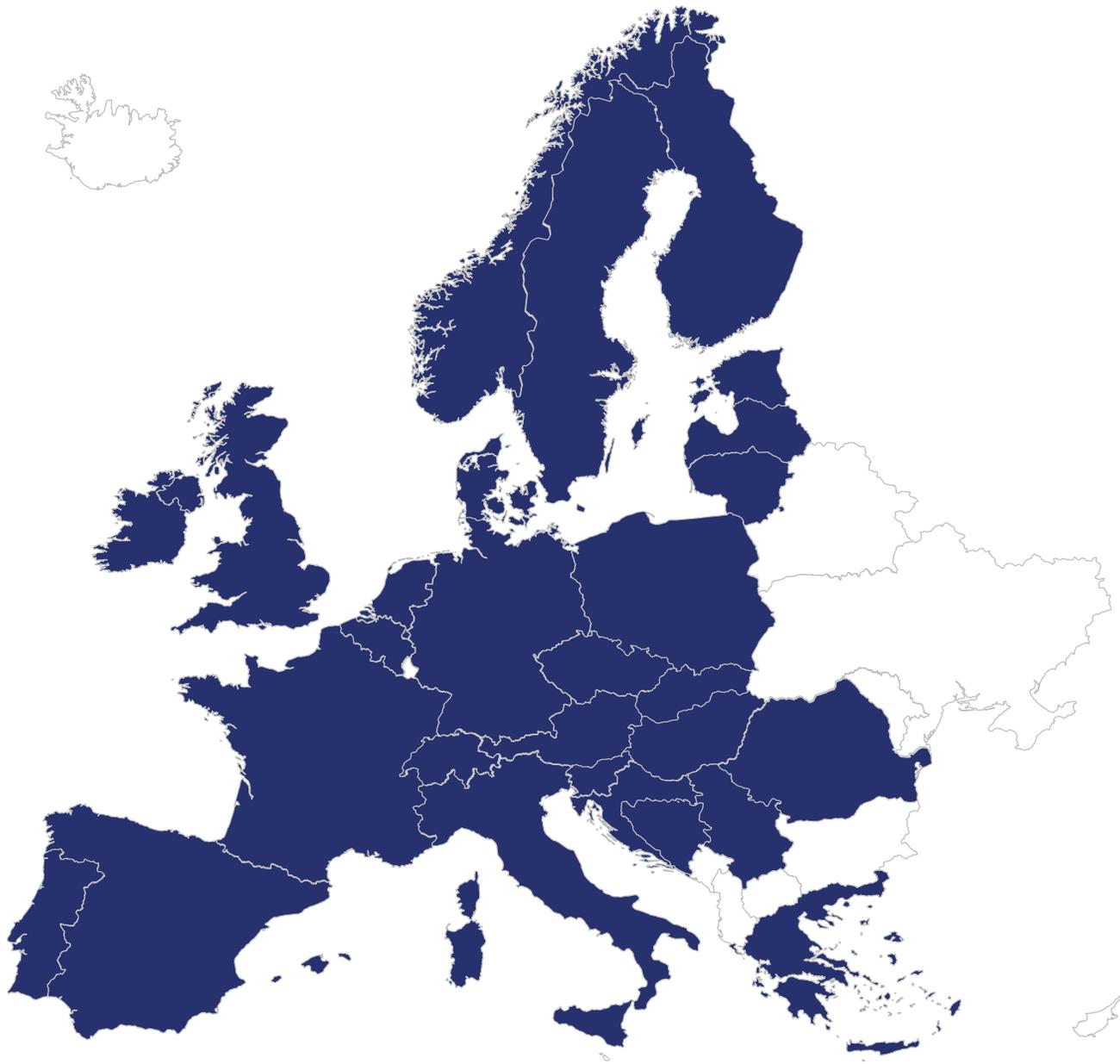
Key:

- Missing data
- N/A
- No Control
- Direct Control (Automatic)
- Direct Control (Manual)
- Relay

Voltage control

(Referring to questions of AS survey from VC1.0 to VCQ12.0)

Voltage control - Voltage support as part of ancillary services



Voltage Control - Which power plants have to provide voltage control? Is it a mandatory service in your country? 1/3

| TSO | Answer |
|---------|---|
| ADMIE | Production units of > 2 MW (RES are exempted) have to comply with technical regulation and have minimum requirements to provide voltage control. |
| APG | Mandatory Service; only power plants connected to the transmission system provide reactive power for the TSO. These power plants have to respect the requirements of the Austrian Grid Code ("TOR"). In the Distribution Grid there are similar requirements based also on individual arrangements between DSOs and generators. |
| AST | All power plants connected to the transmission grid are obliged to provide Voltage Control service. |
| ČEPS | All units connected to the transmission grid (220kV +) must be capable of voltage control. |
| Elering | It is mandatory. All power plants that are connected to the main grid must have voltage control capability. |
| Elia | No, it is not a mandatory service to provide voltage control in Belgium. However, all generating units with an installed power > 25 MVA have to be capable of providing voltage control. |
| Eles | Yes. |

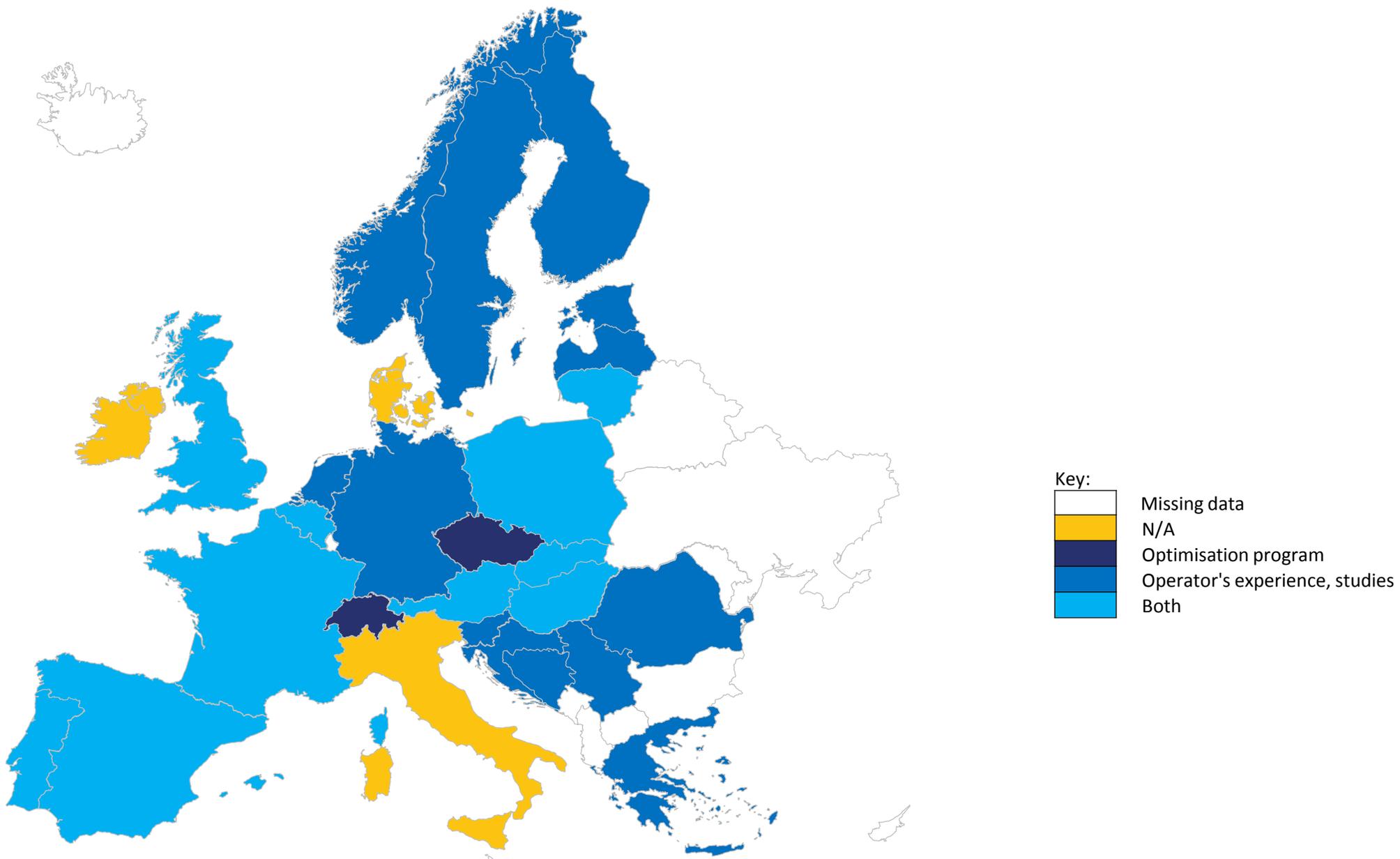
Voltage Control - Which power plants have to provide voltage control? Is it a mandatory service in your country? 2/3

| TSO | Answer |
|---------------|---|
| EMS | All PP connected to transmission system. It is mandatory service. |
| Fingrid | Mandatory service for all power plants. |
| German TSOs | The framework of voltage control requirements for plants connected to the high-voltage grid is provided by the German Transmission Code. Concrete requirements within the given framework are agreed between connecting TSO and power plant operator and included in the grid connection contracts. A similar framework does also exist for medium-voltage grids. |
| HOPS | All. There is a mandatory range. Beside it, it has to be payed. |
| Litgrid | All power plant connected to transmission gird. All running generator shall provide voltage support according technical possibilities from generator. |
| MAVIR | If the installed capacity is more than 50 MW and the power plant is connected to the transmission grid or 132 kV, the service is mandatory. |
| National Grid | Mandatory Service (Grid Code Provision) for Conventional Generators and Windfarms connected to the transmission system. Commercial Service for Conventional Generators and Windfarms connected to the transmission system for provision over and above Mandatory levels. |

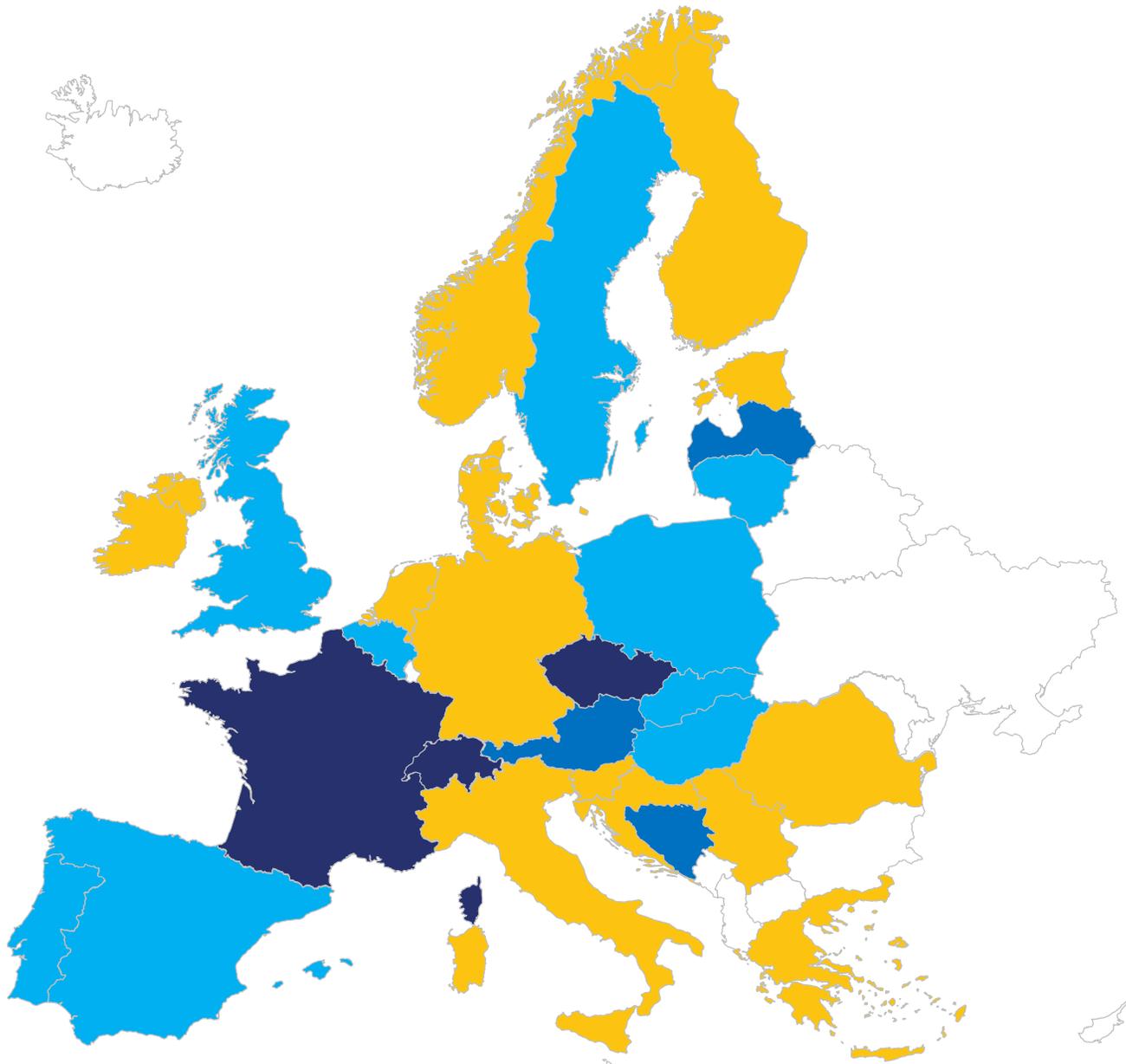
Voltage Control - Which power plants have to provide voltage control? Is it a mandatory service in your country? 3/3

| TSO | Answer |
|------------------|--|
| NOS BiH | Yes. |
| PSE | All generating units according to Grid Code are obliged to control the voltage, centrally dispatched units are contracted for such service |
| REE | Mandatory service; all power plants connected to transmission grid and rated power ≥ 30 MW should provide voltage control service. |
| REN | All conventional generators have to provide. |
| RTE | Primary voltage regulation mandatory for all units connected at transmission level Secondary voltage regulation mandatory for all units connected at voltage higher than 225 kV. |
| SEPS | Primary voltage control is mandatory and secondary voltage control is paid service. We use secondary voltage control just at transmission level (400 kV and 220 kV). |
| Statnett SF | Yes. All powerplants. |
| Swissgrid | All power plants directly connected to the transmission system which are in operation (production, pump mode or synchronous/phase shifting mode), within the scope of their available reactive power that can be exchanged with the transmission system without compromising the active power. |
| TenneT TSO BV NL | Generators > 5 MW mandatory capability, contracted service |
| TERNA | It's mandatory for the power units which have nominal power greater or equal than 10 MVA |

Voltage control - Determination the optimal use of reactive energy



Voltage control - In case of opt.problem - objective function

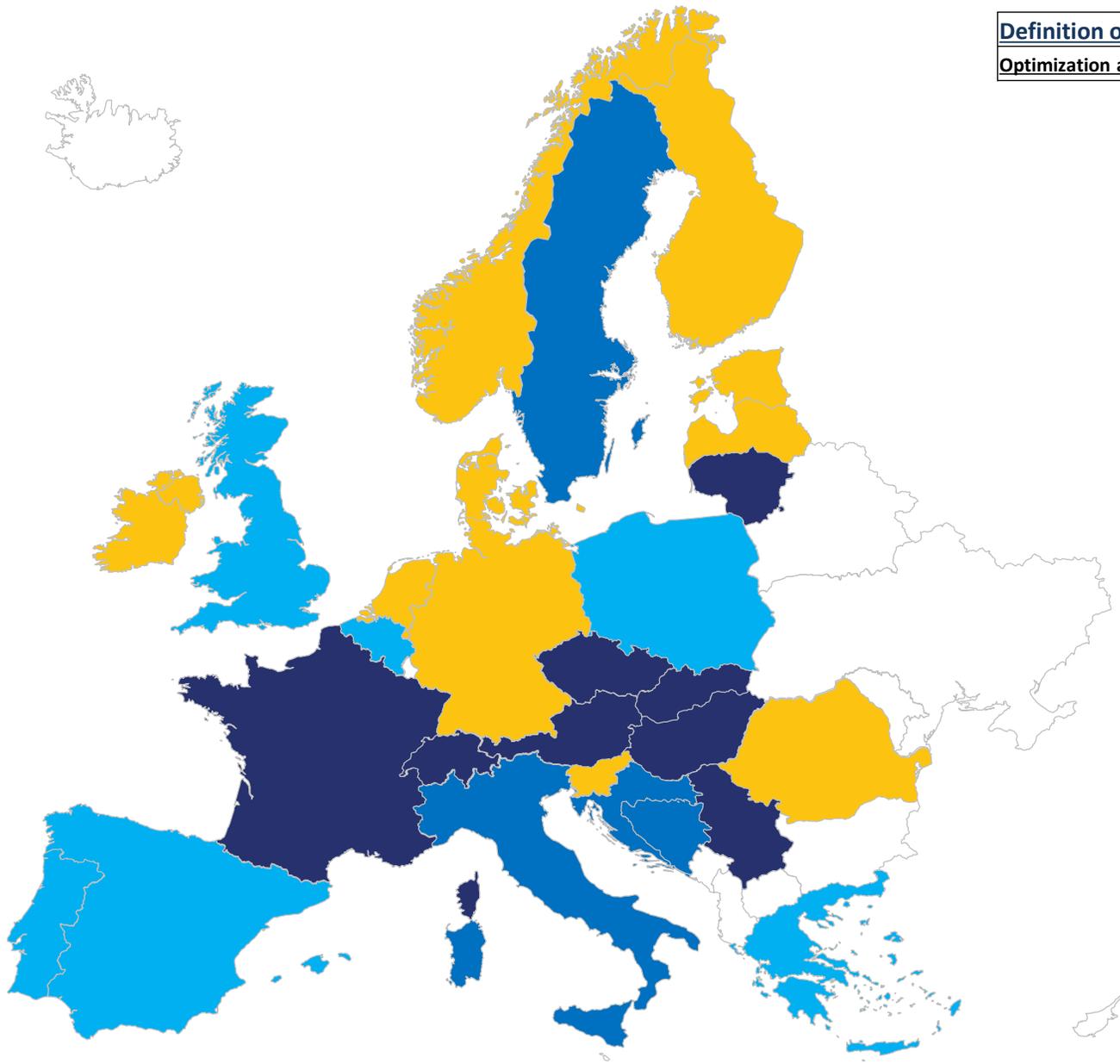


Key:

| | |
|--|-----------------------|
| | Missing data |
| | N/A |
| | Optimisation program |
| | Operator's experience |
| | Both |

Voltage control - Type of optimization approach

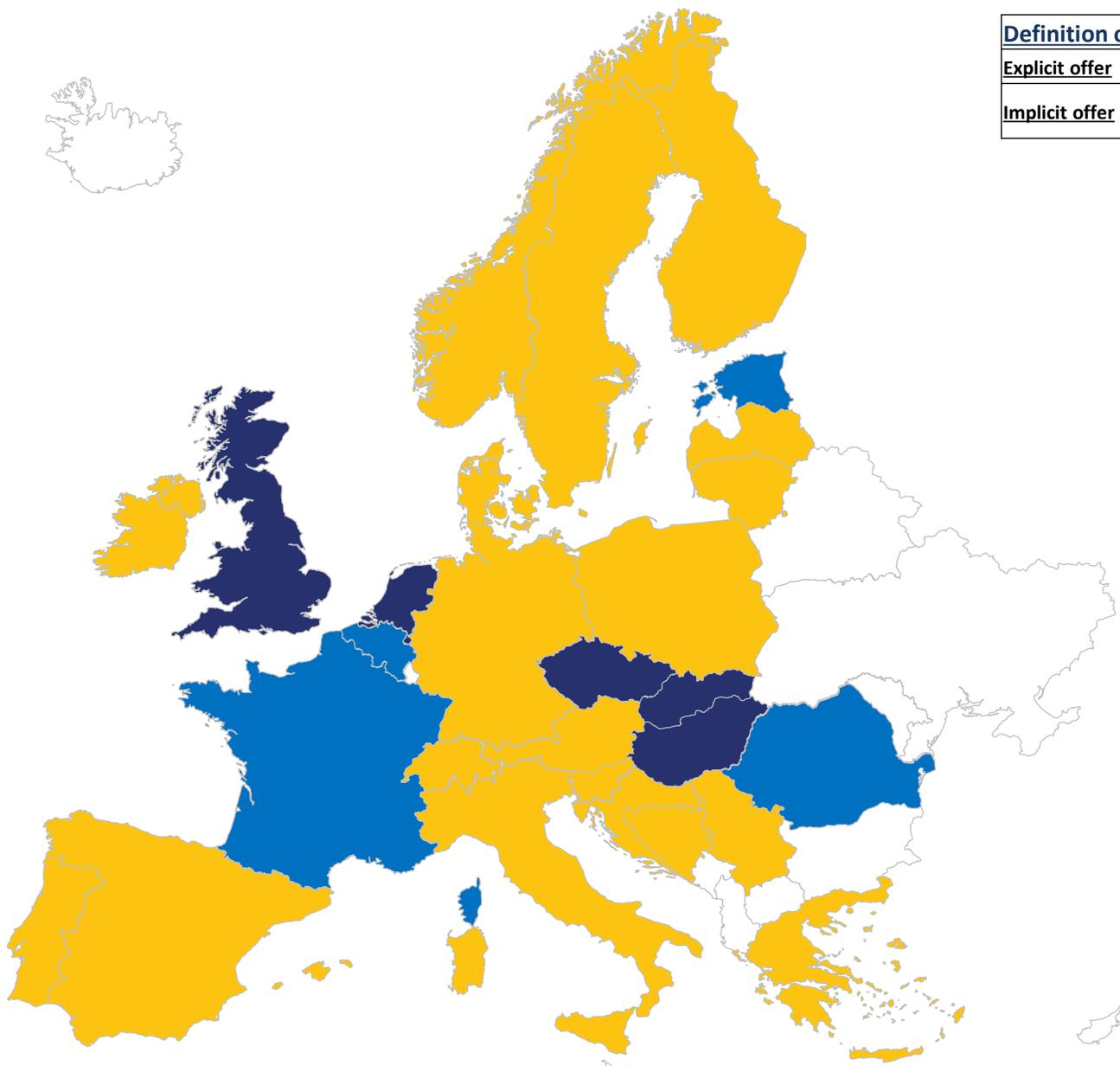
| Definition of question | |
|------------------------|--|
| Optimization approach | What kind of Voltage Control optimization is available in your control area? |



Key:

- Missing data
- N/A
- Centralised optimisation approach
- Regional-oriented approach
- Both

Voltage control - Implicit / explicit offers bids from BSP

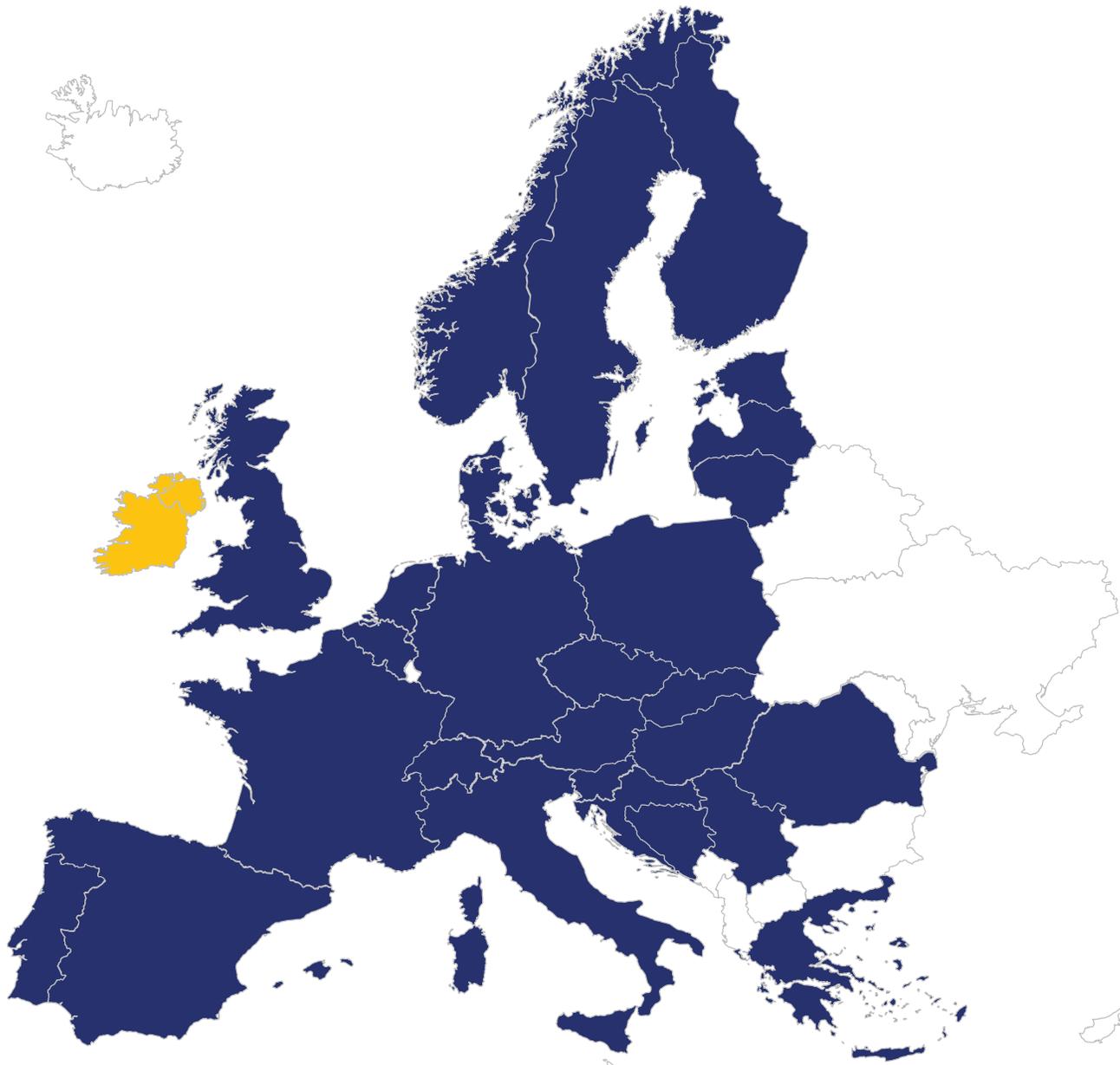


| <u>Definition of question</u> | |
|-------------------------------|---|
| Explicit offer | Specified and limited bids - for Standing unit |
| Implicit offer | If the unit has schedule (it is operate) then automatically must have offer for Voltage Control |

Key:

| | |
|---|--------------|
|  | Missing data |
|  | N/A |
|  | Explicit |
|  | Implicit |
|  | Both |

Voltage control - Provider - Generators



Key:



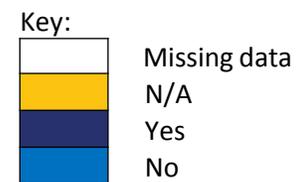
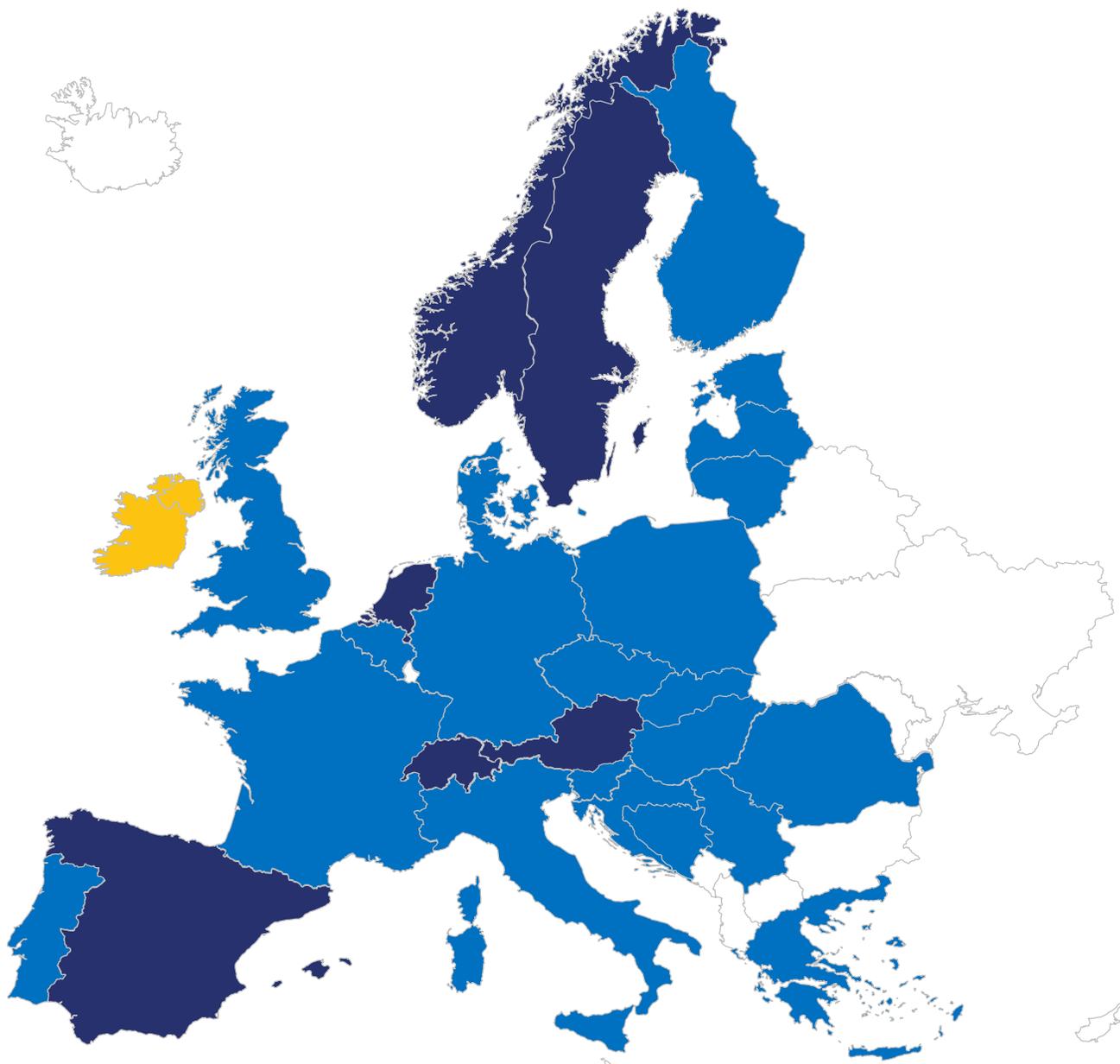
Missing data

N/A

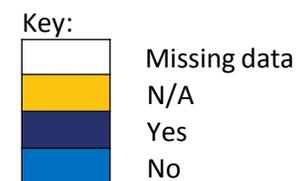
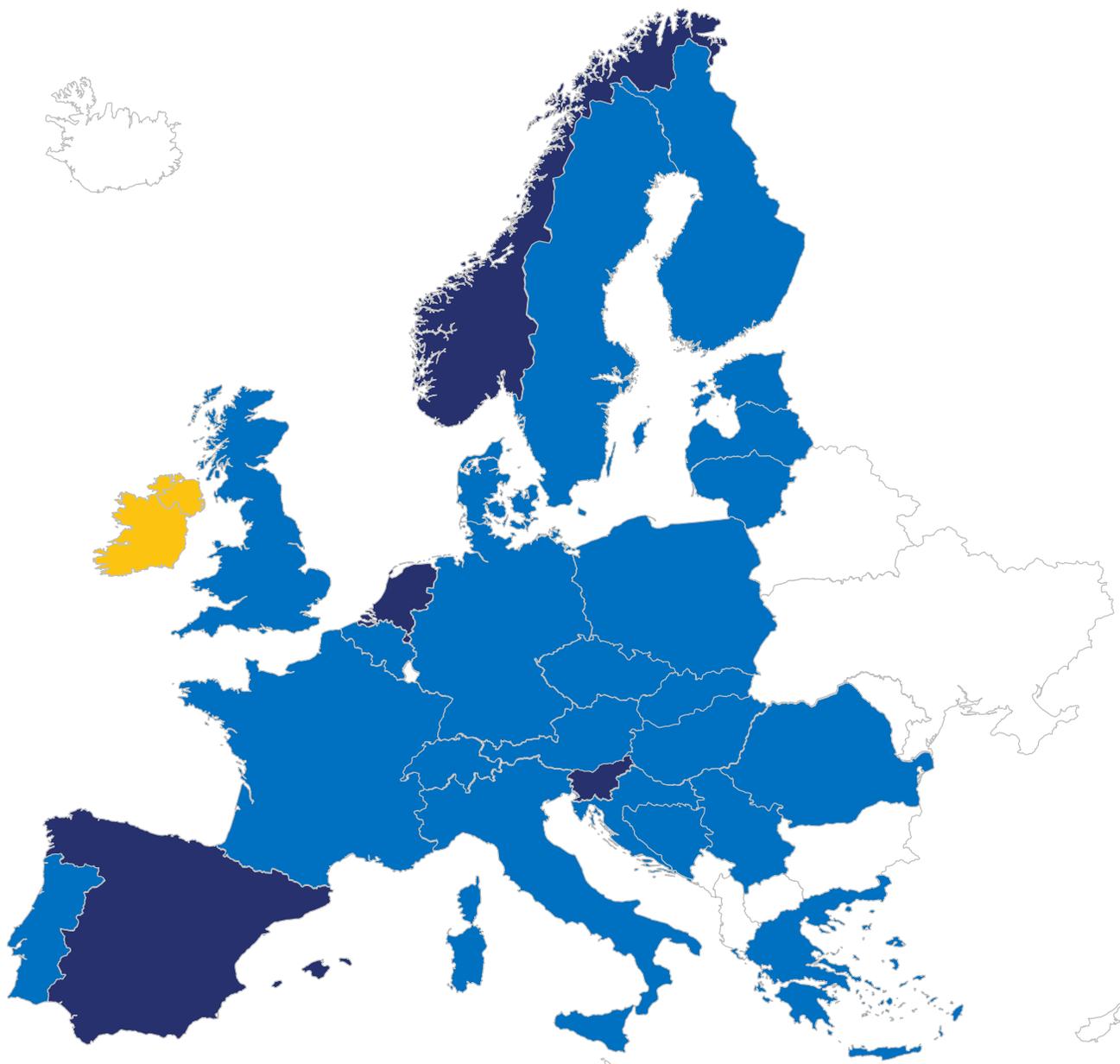
Yes

No

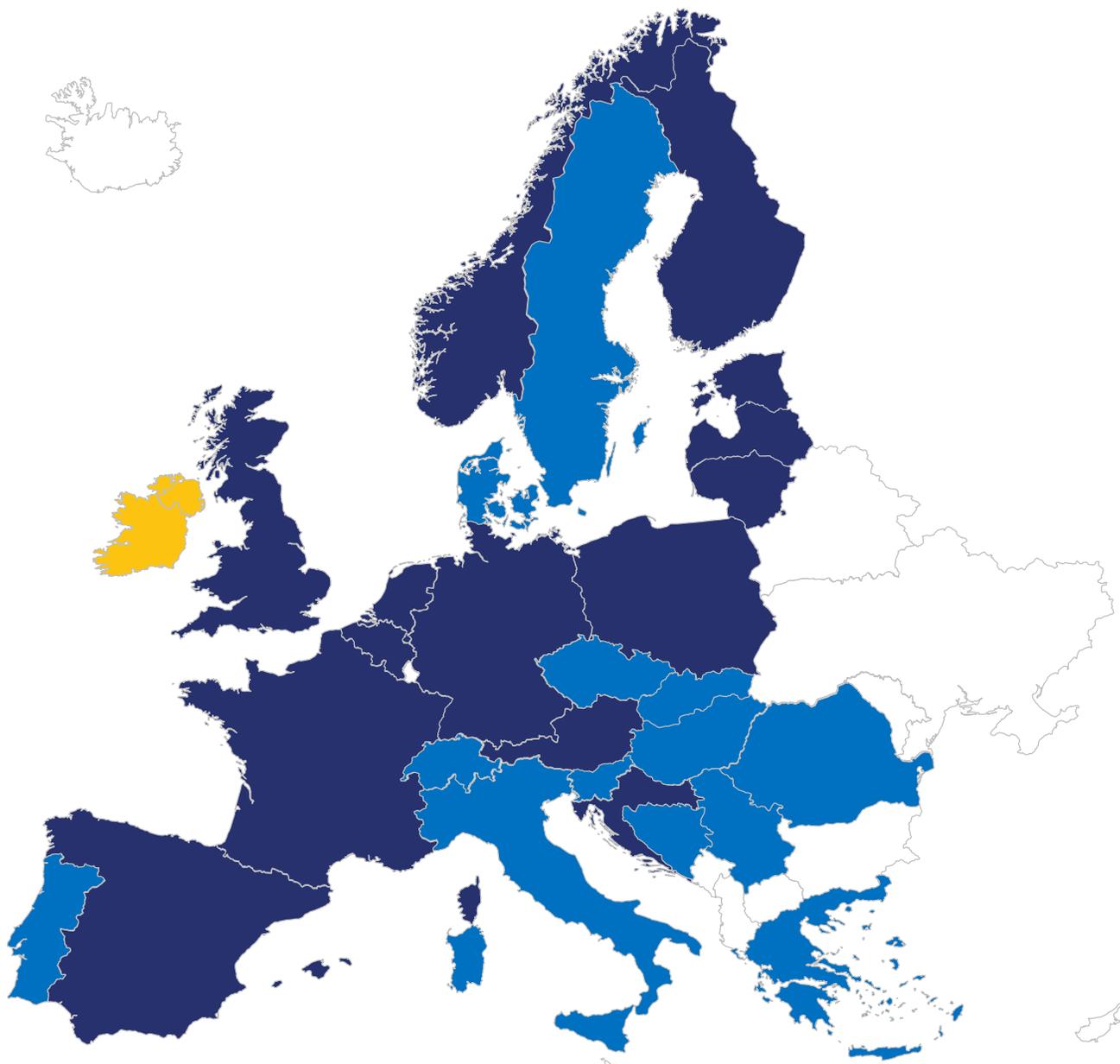
Voltage control - Provider - Distribution system operators



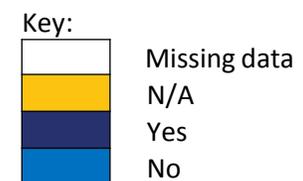
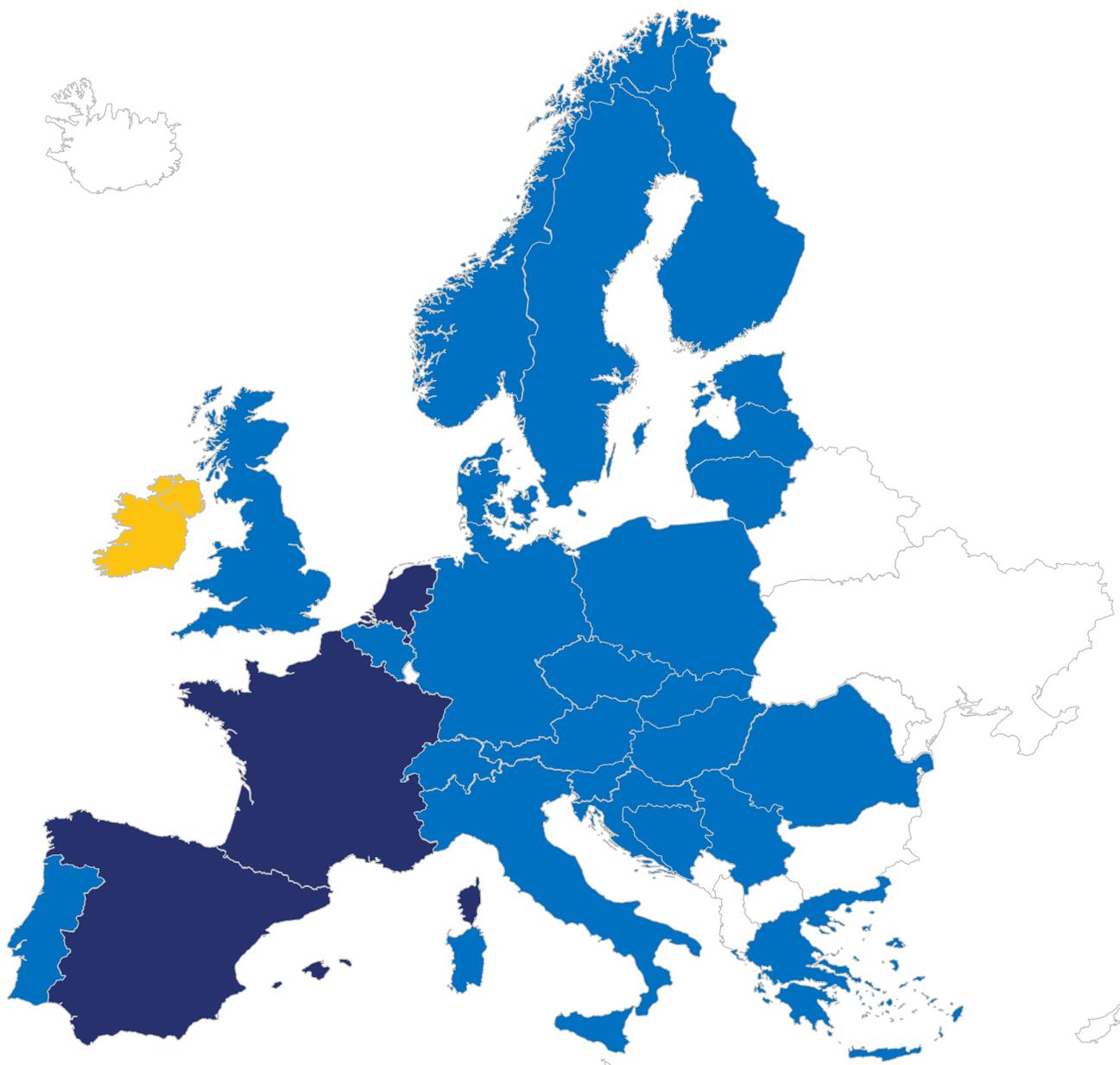
Voltage control - Provider - Industrial consumers



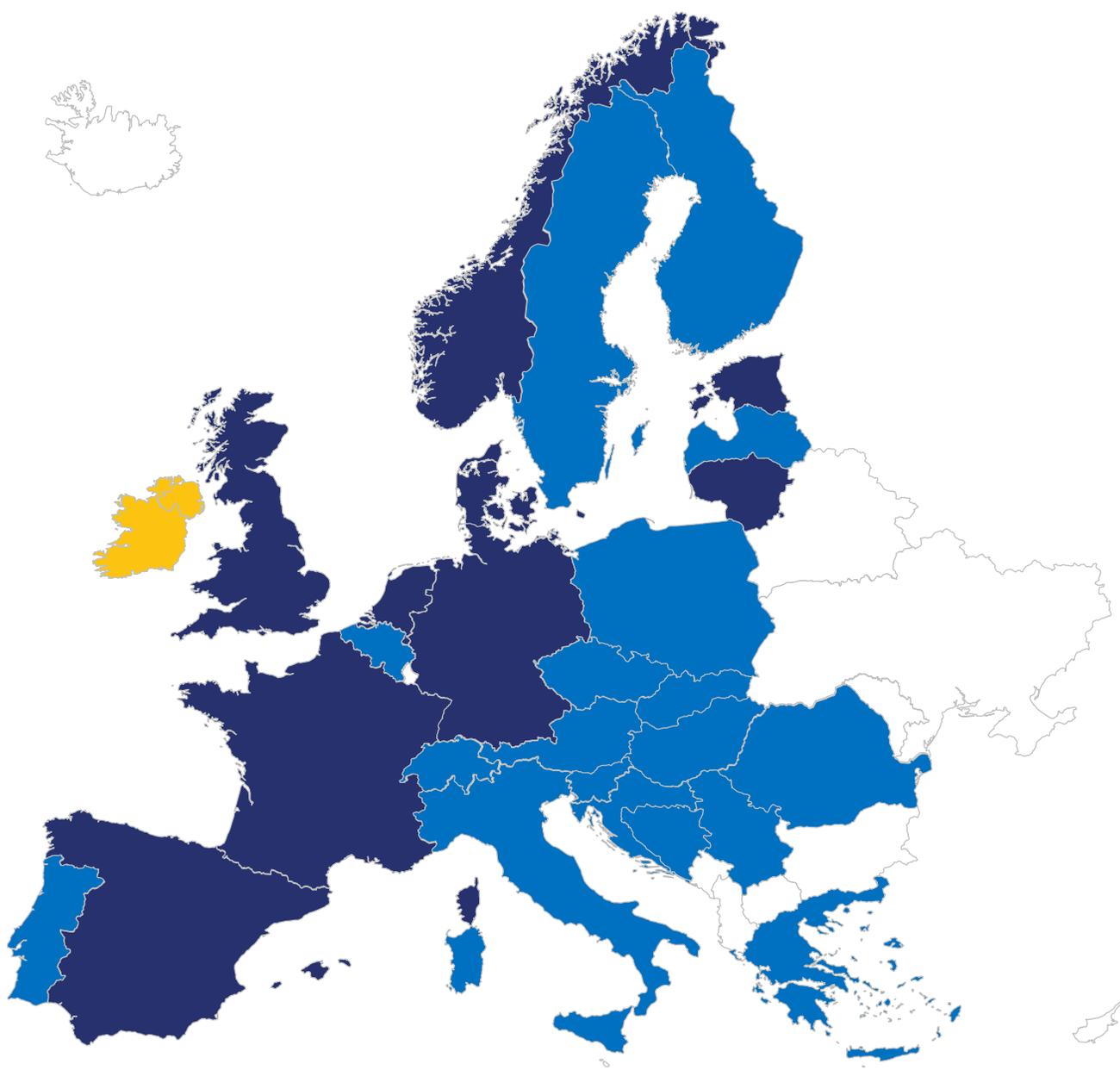
Voltage control - Provider - Windfarm producers



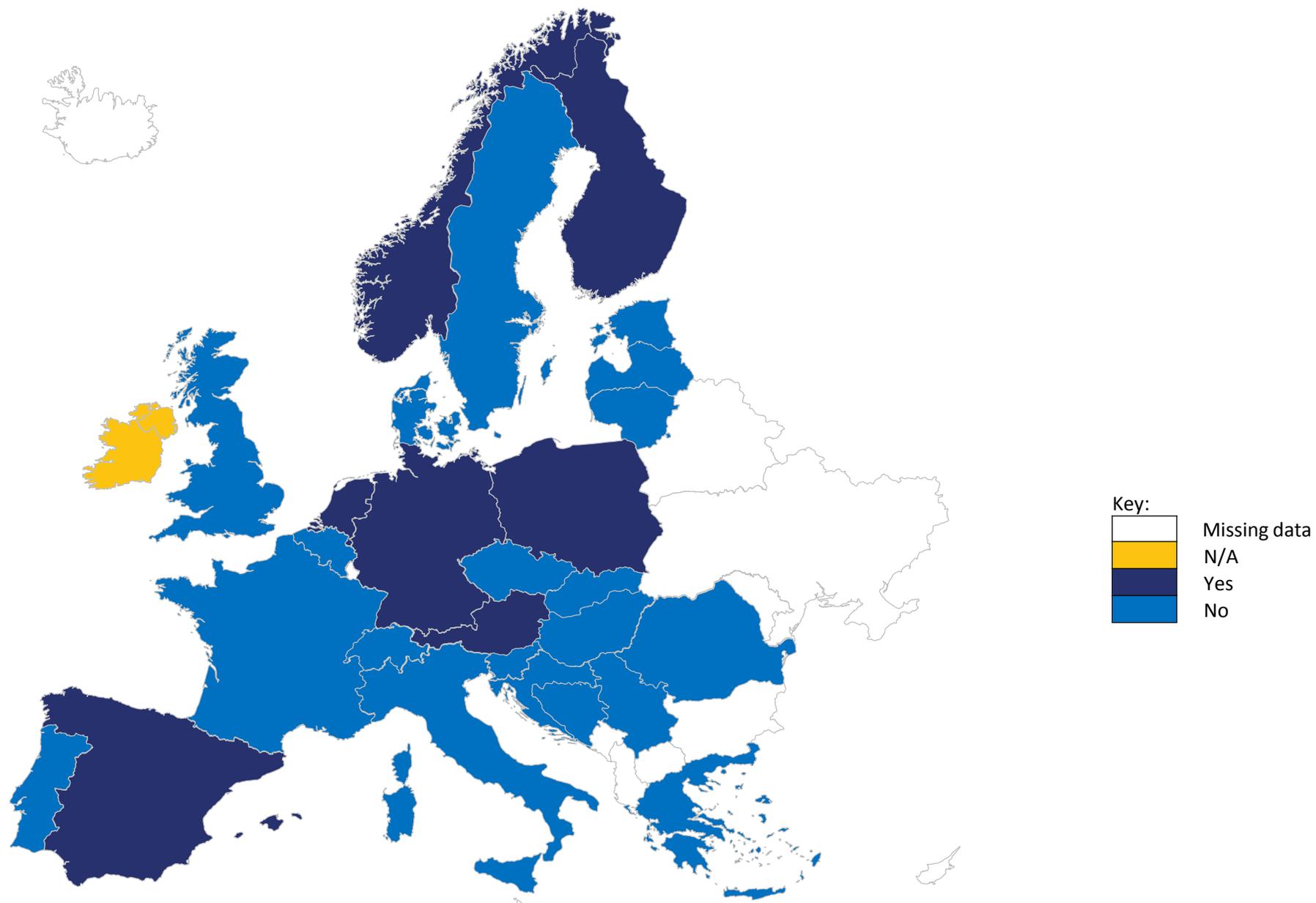
Voltage control - Provider - Photovoltaic systems



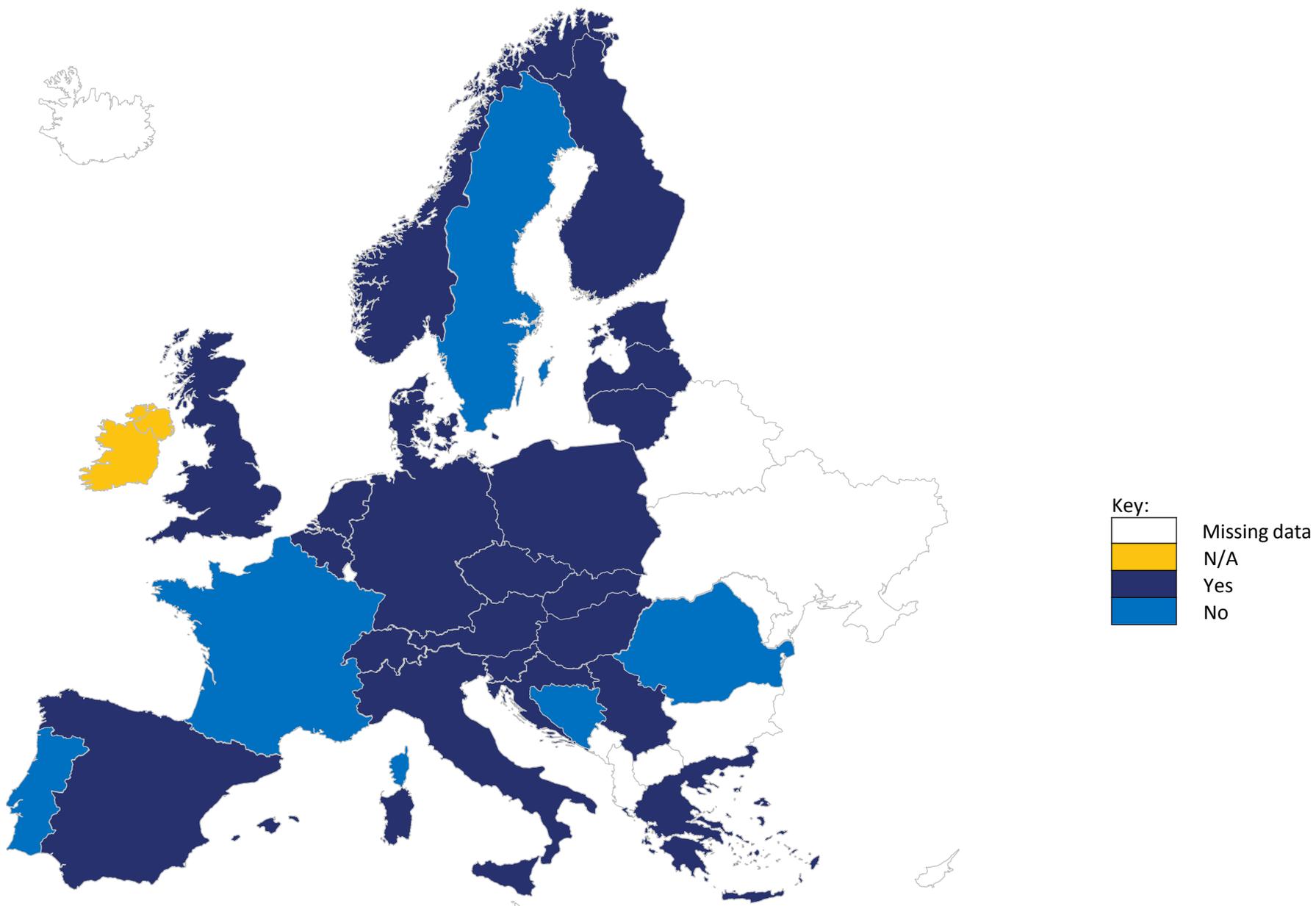
Voltage control - Provider - HVDC links



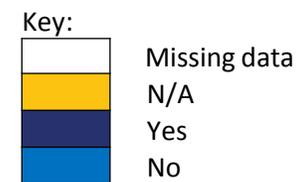
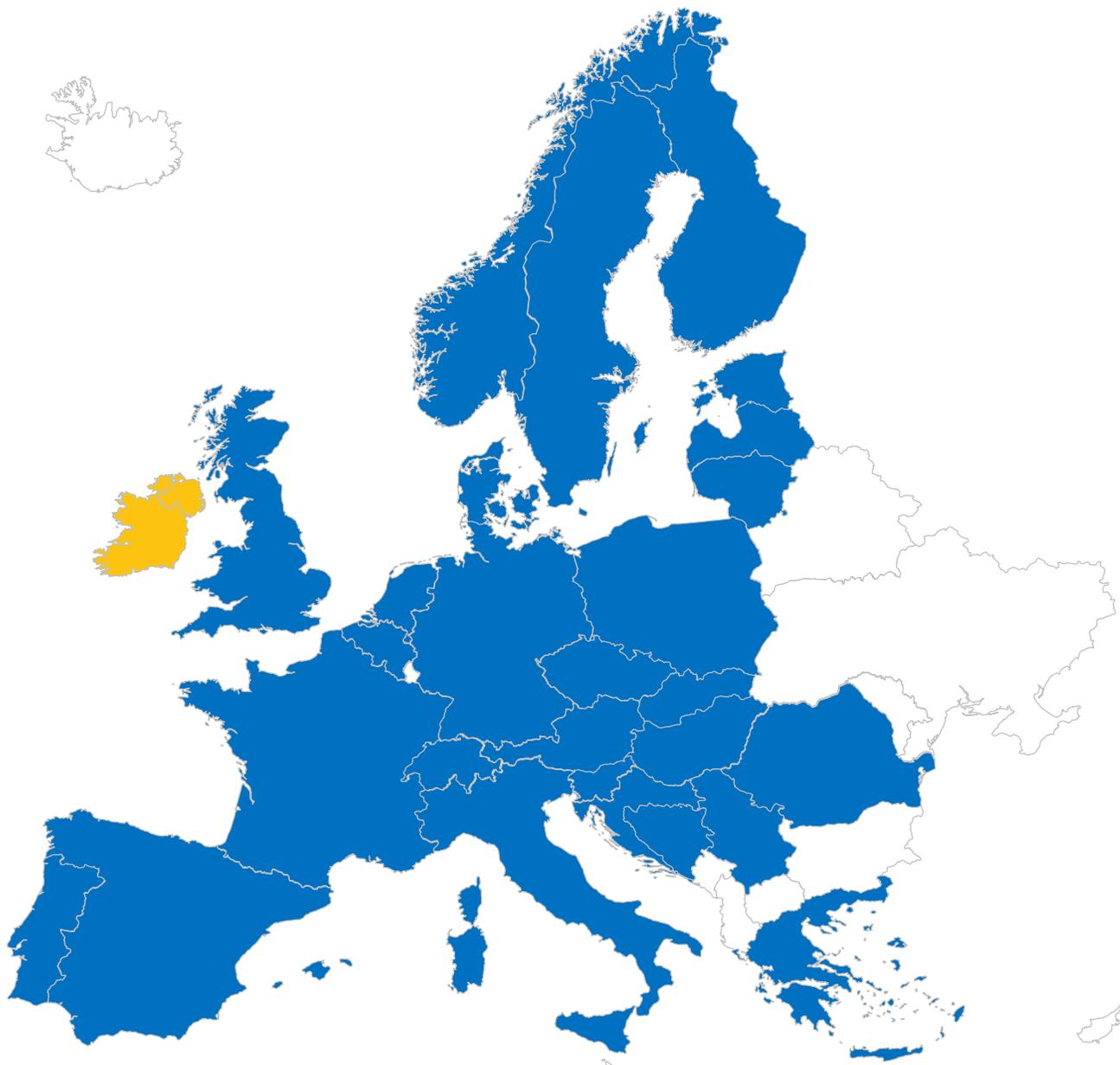
Voltage control - Provider - Windfarm producers or photovoltaic systems connected on the DSO



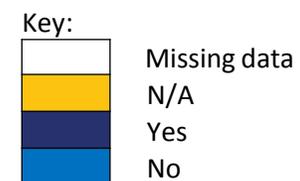
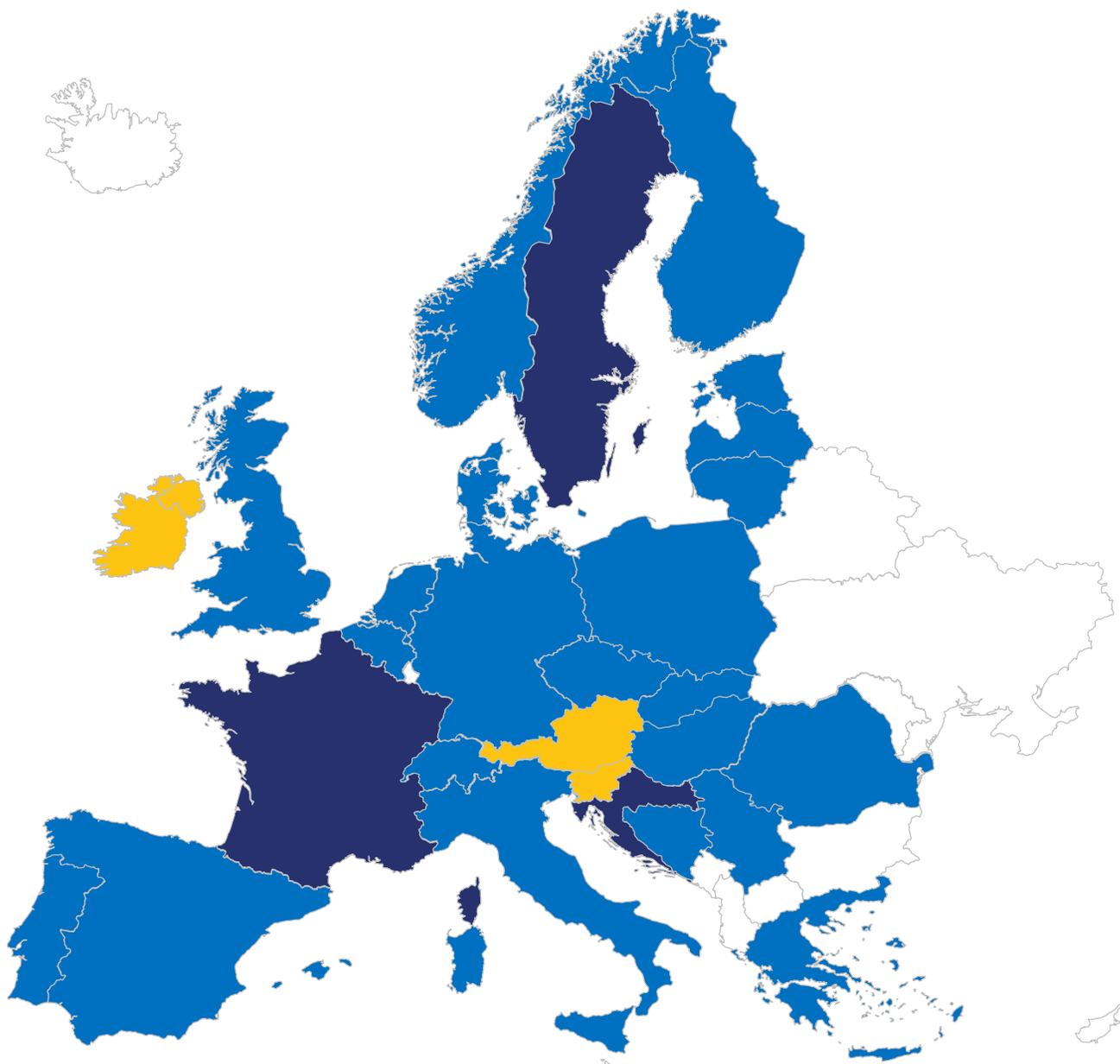
Voltage control - Provider - Transformers of the transmission grid



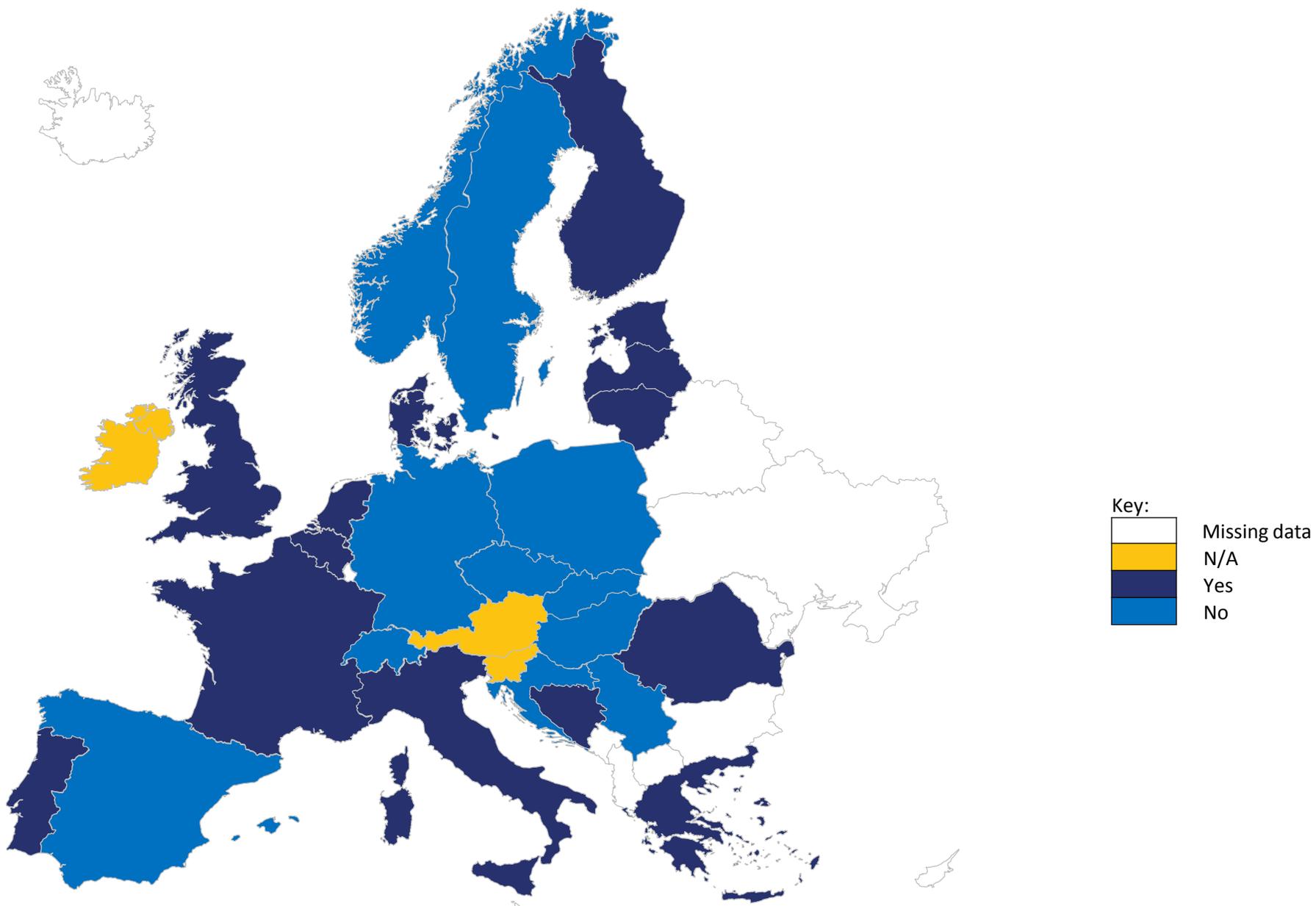
Voltage control - Provider - None



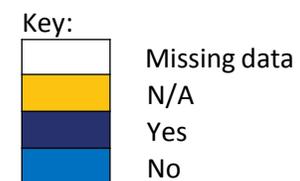
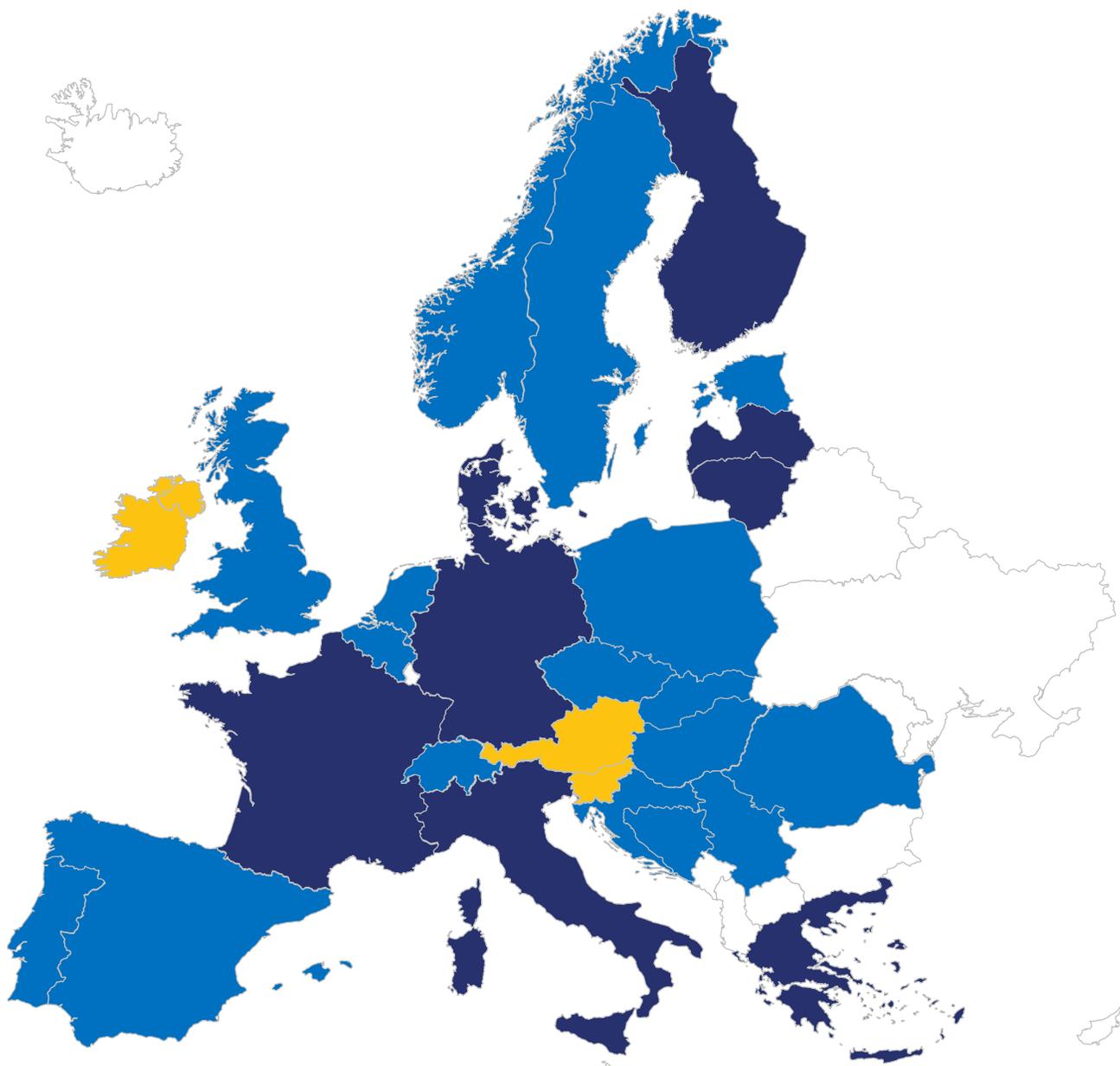
Voltage control - Type of regulations for the voltage control demanded to the power plants - No regulation



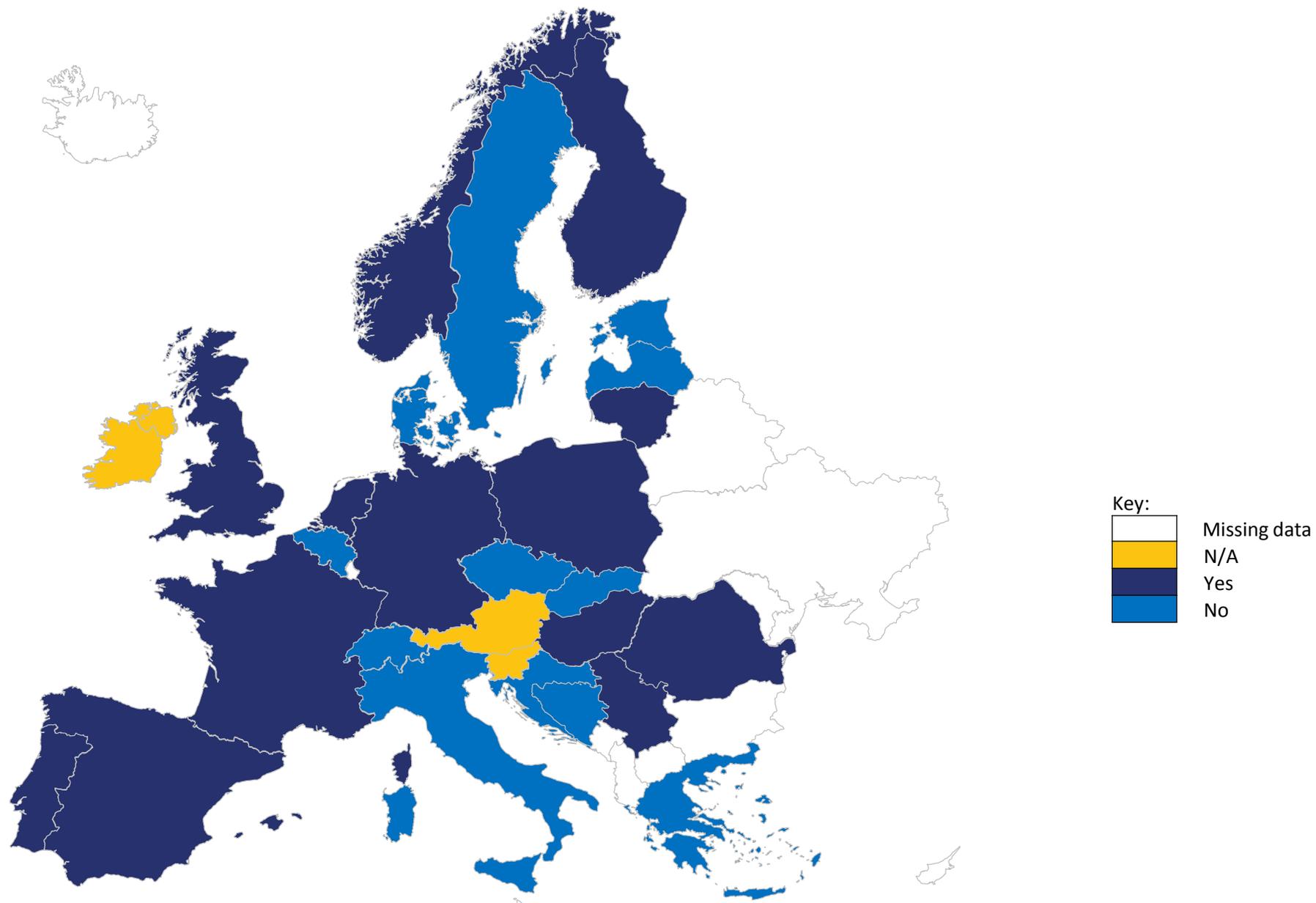
Voltage control - Type of regulations for the voltage control demanded to the power plants - Reactive setpoint



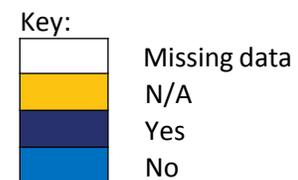
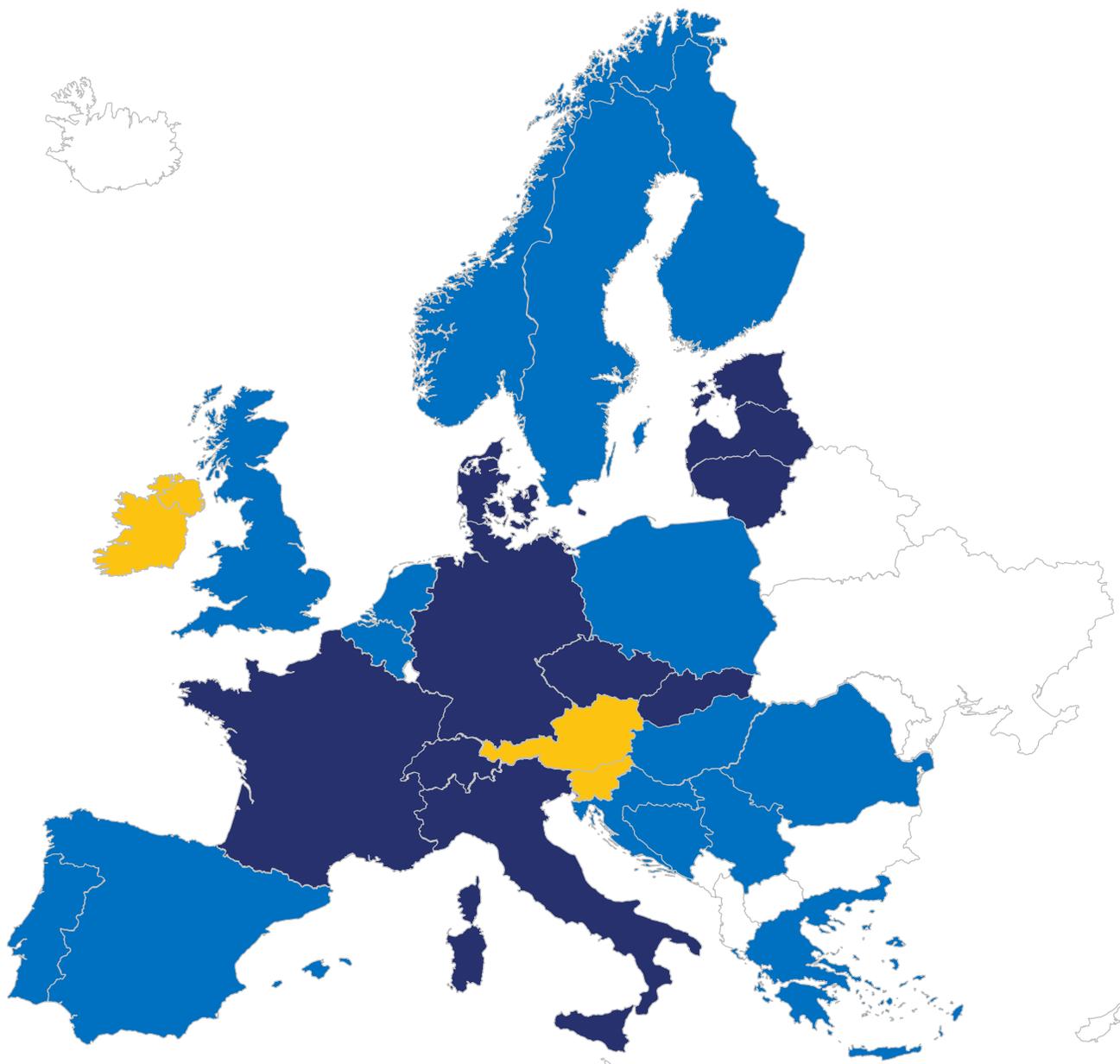
Voltage control - Type of regulations for the voltage control demanded to the power plants - Voltage stator setpoint



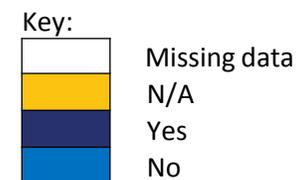
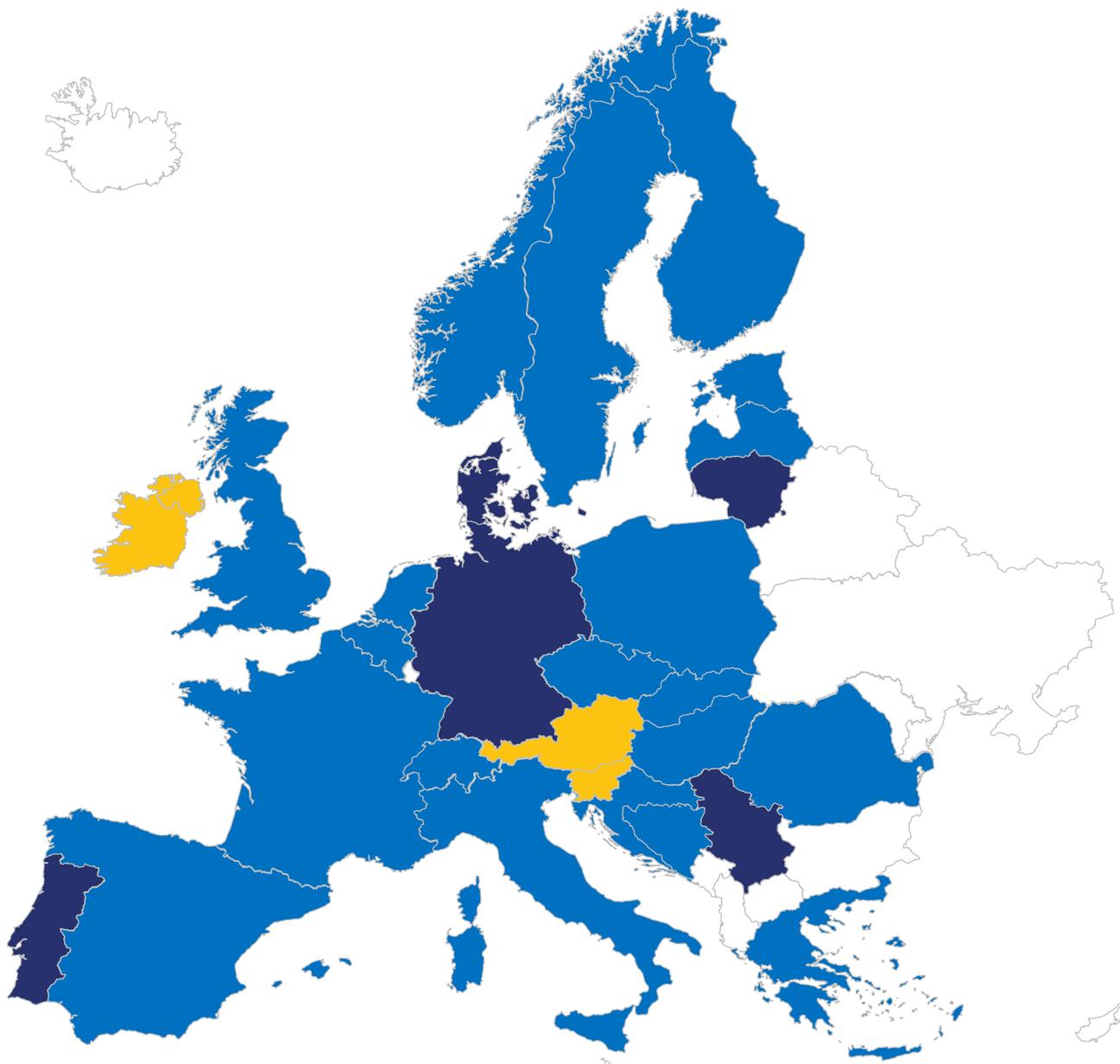
Voltage control - Type of regulations for the voltage control demanded to the power plants - Voltage setpoint at the connexion point (fixed value at EHV point)



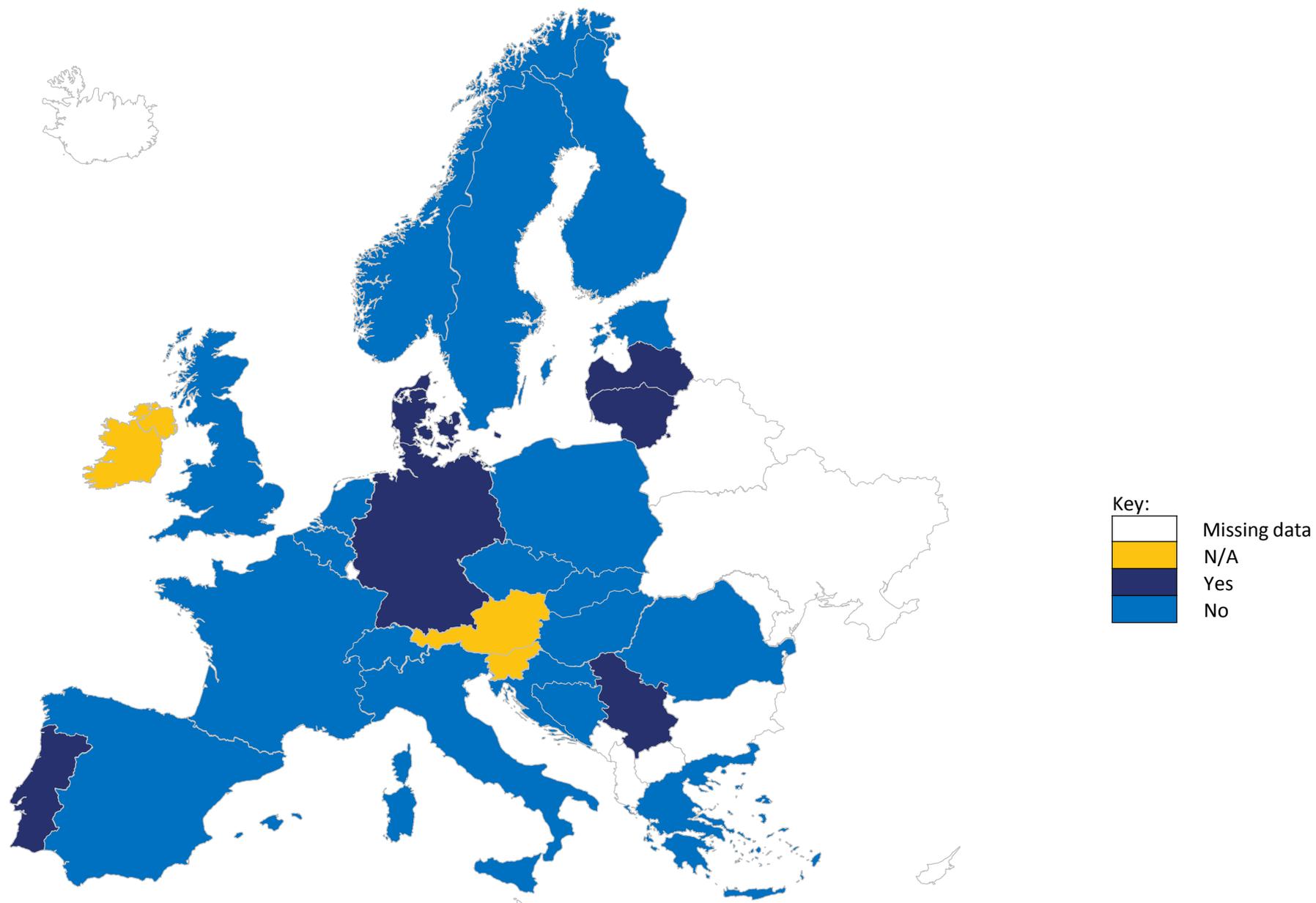
Voltage control - Type of regulations for the voltage control demanded to the power plants - Voltage setpoint at the connexion point function of a signal sent by the TSO (possibility of variation of the EHV setpoint)



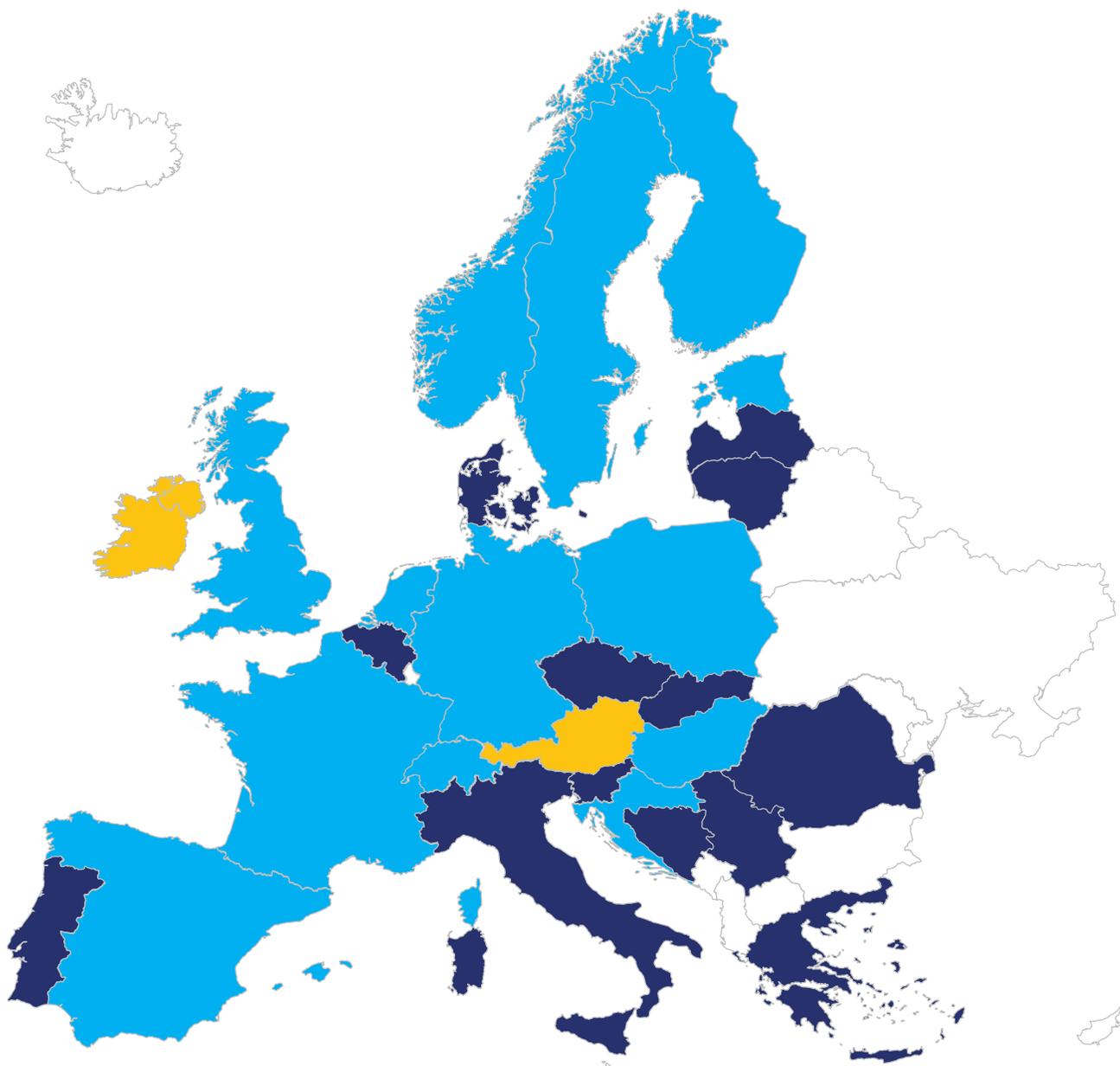
Voltage control - Type of regulations for the voltage control demanded to the power plants - OLTC on the main transformer (manual control)



Voltage control - Type of regulations for the voltage control demanded to the power plants - OLTC on the main transformer (automatic control of the EHV voltage)



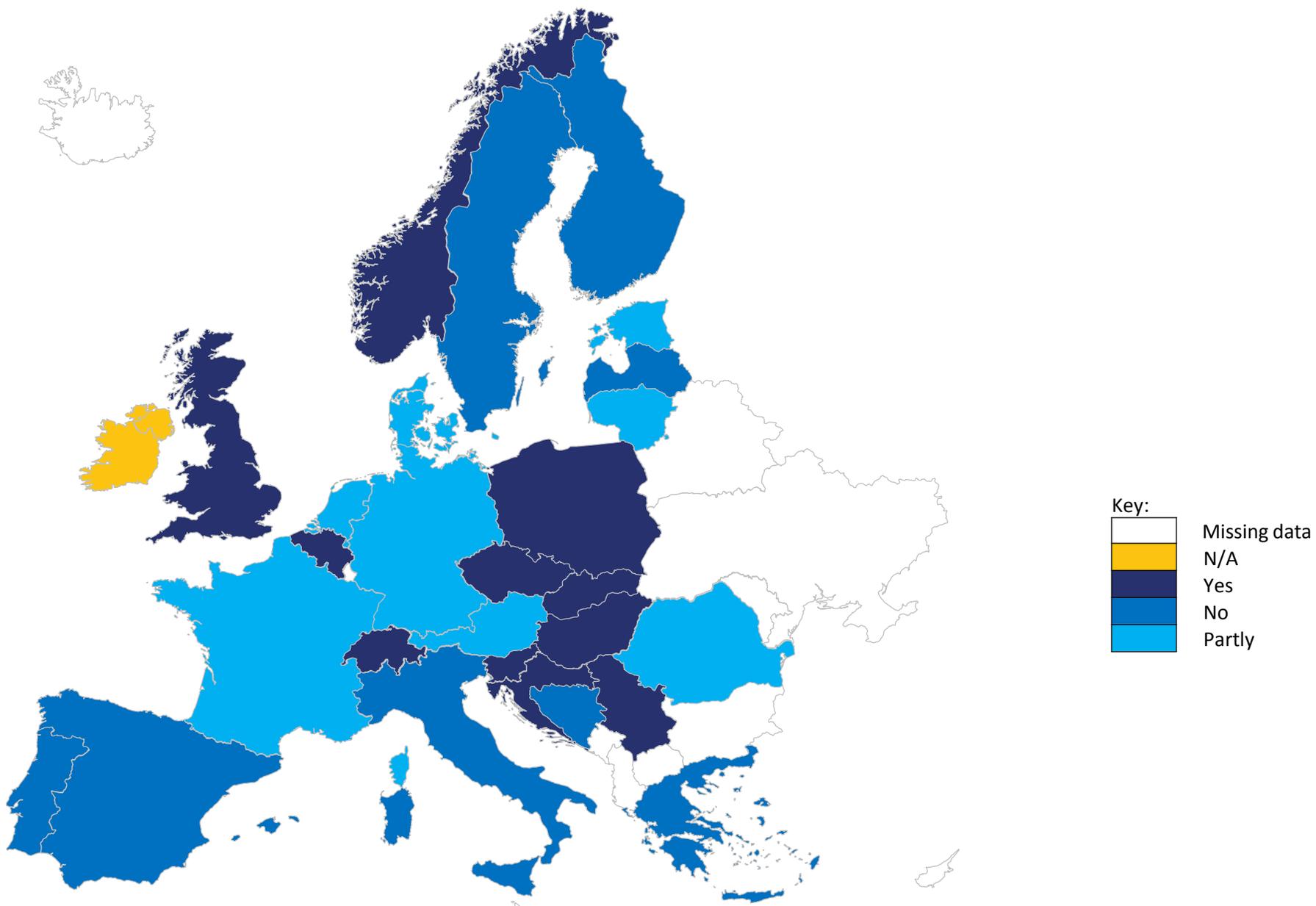
Voltage control - If a power plant is able to provide voltage control, which grid it should be connected to?



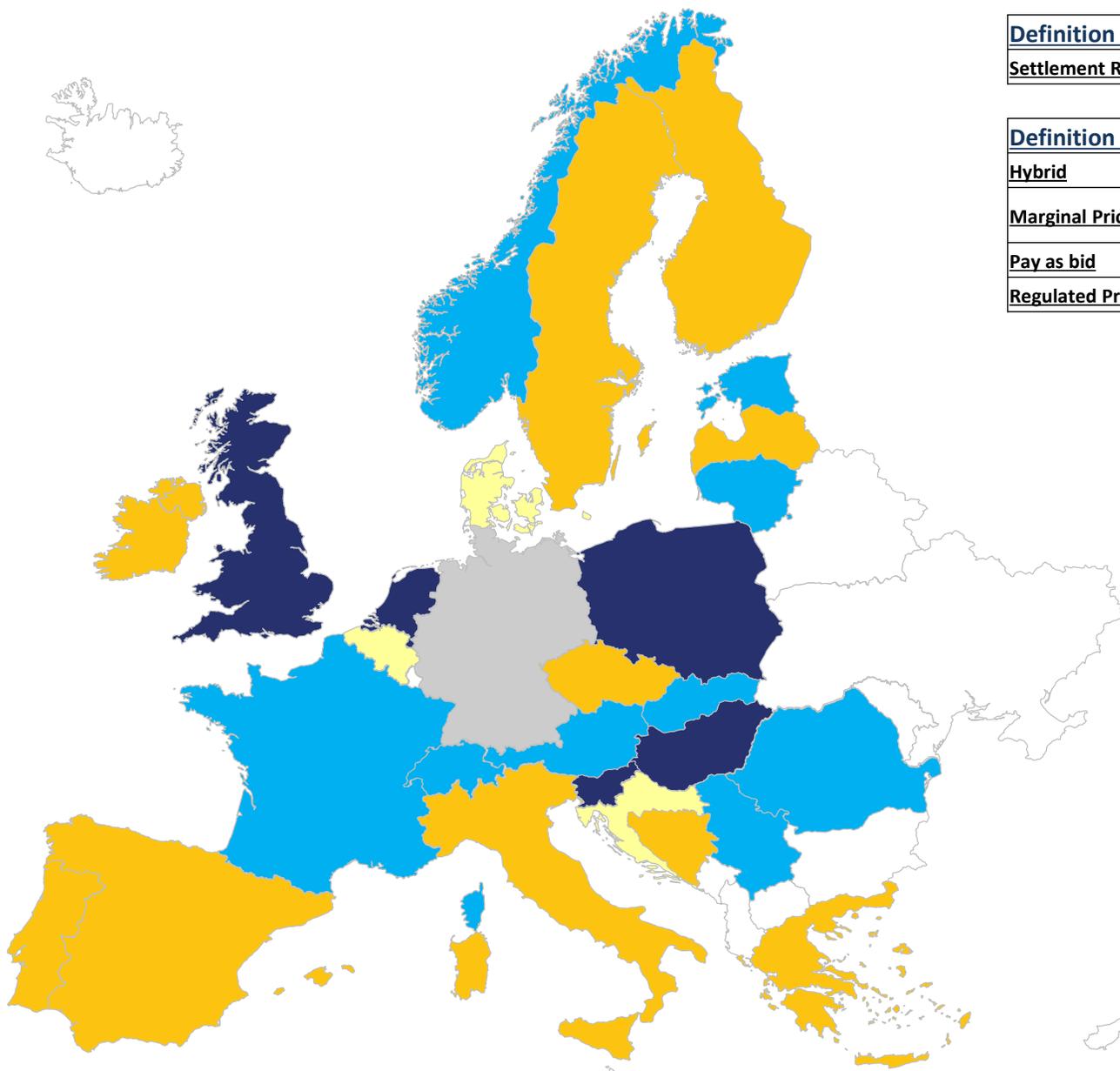
Key:

| |
|-------------------|
| Missing data |
| N/A |
| Transmission grid |
| Distribution grid |
| Both |

Voltage control - Is it a service paid by the TSO?



Voltage control - Settlement Rule



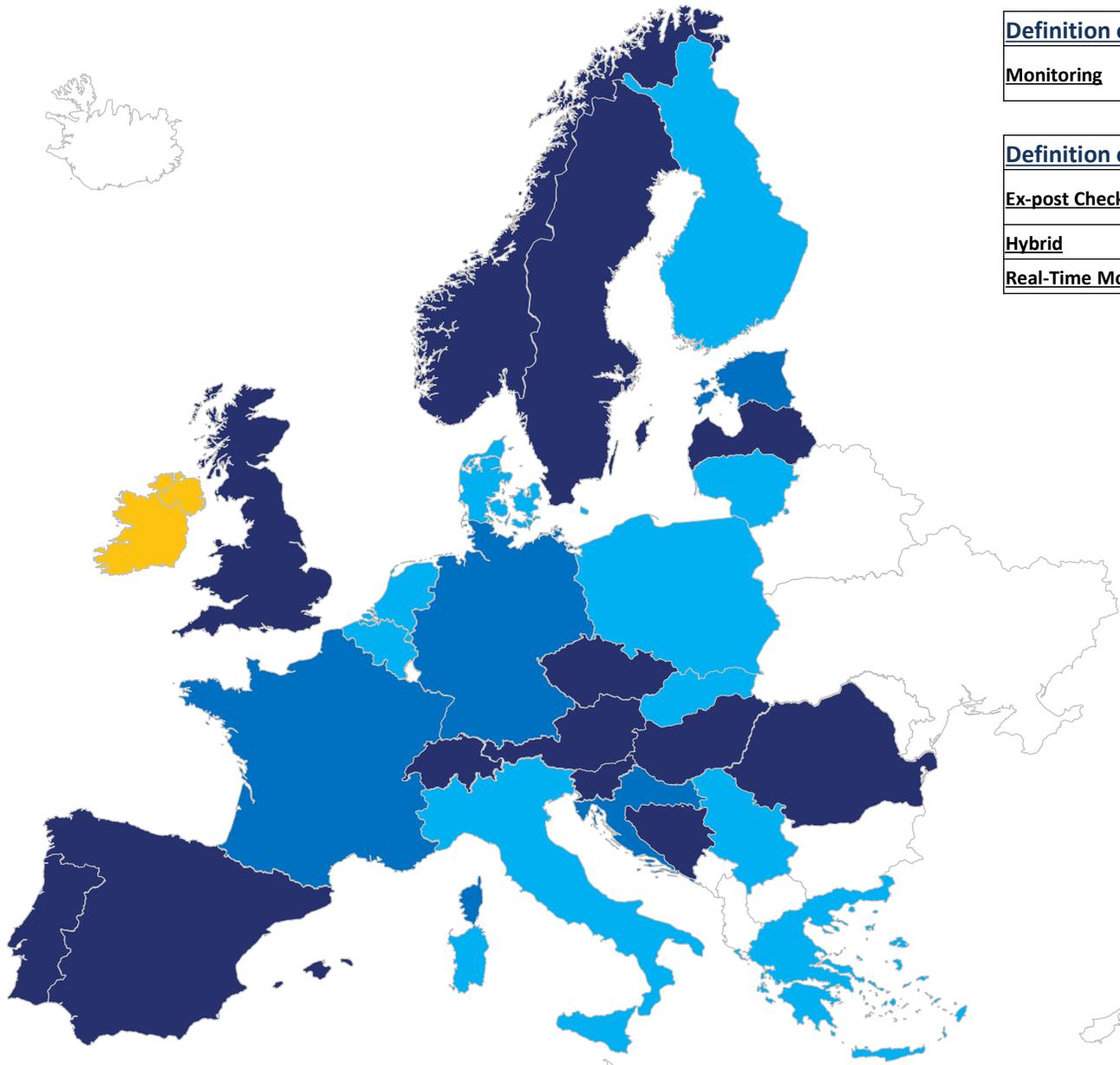
| <u>Definition of question</u> | |
|-------------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |

| <u>Definition of answer</u> | |
|-----------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

- Missing data
- N/A
- Pay as bid
- Marginal pricing
- Regulated price
- Free
- Hybrid

Voltage control - Monitoring



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

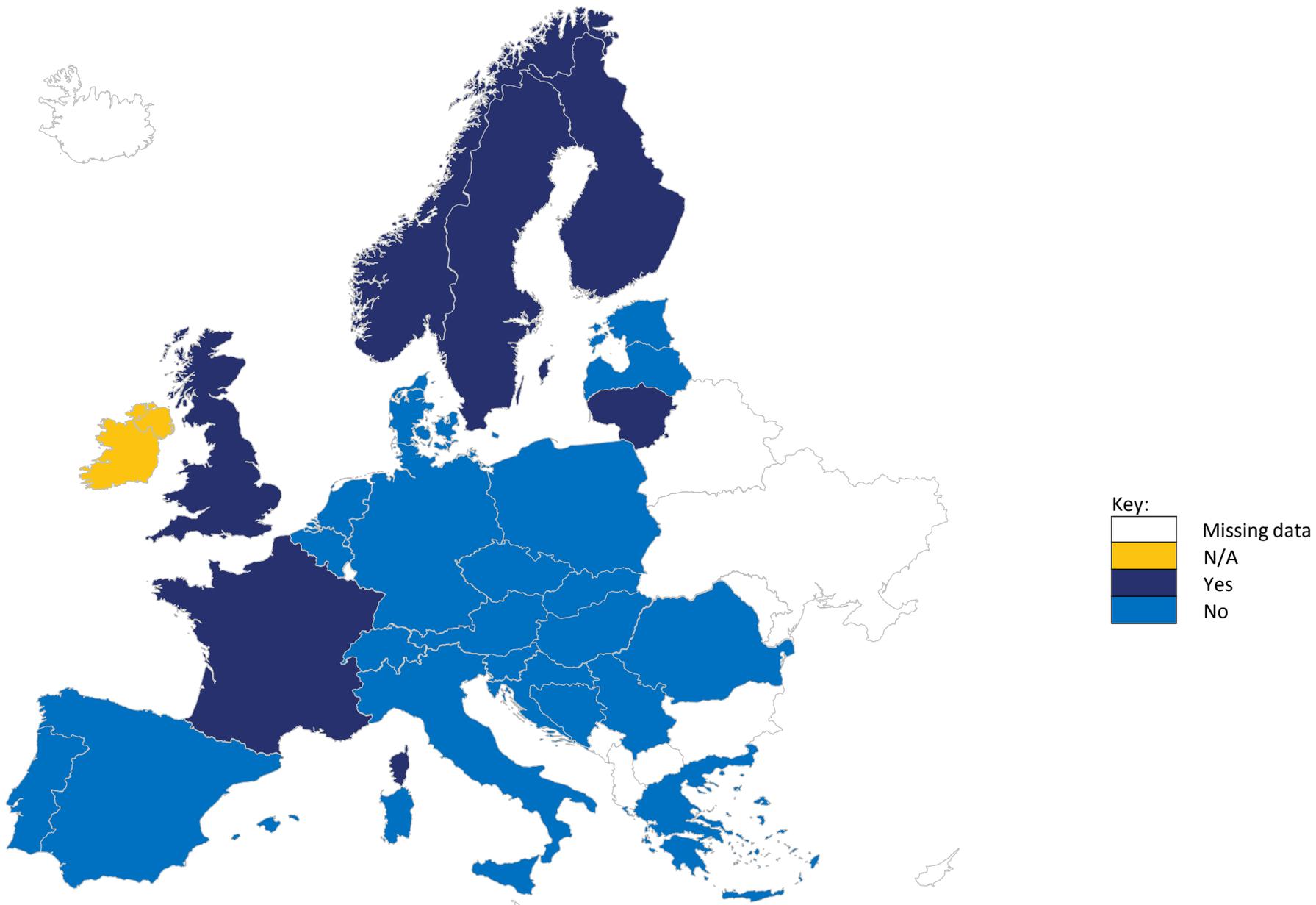
Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

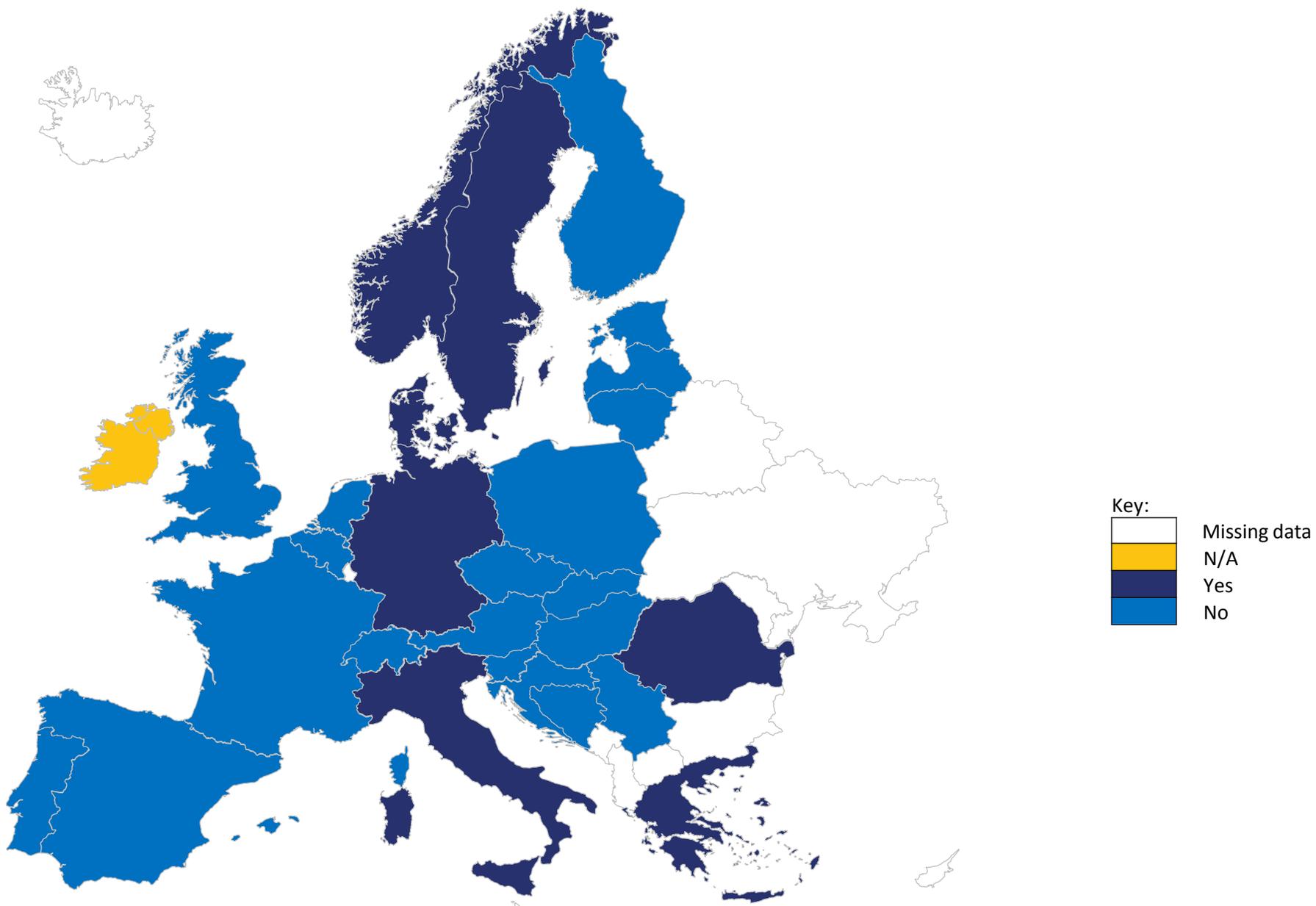
Key:

| | |
|--|----------------------|
| | Missing data |
| | N/A |
| | Real time monitoring |
| | Ex post check |
| | Hybrid |

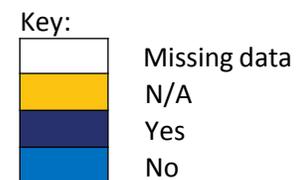
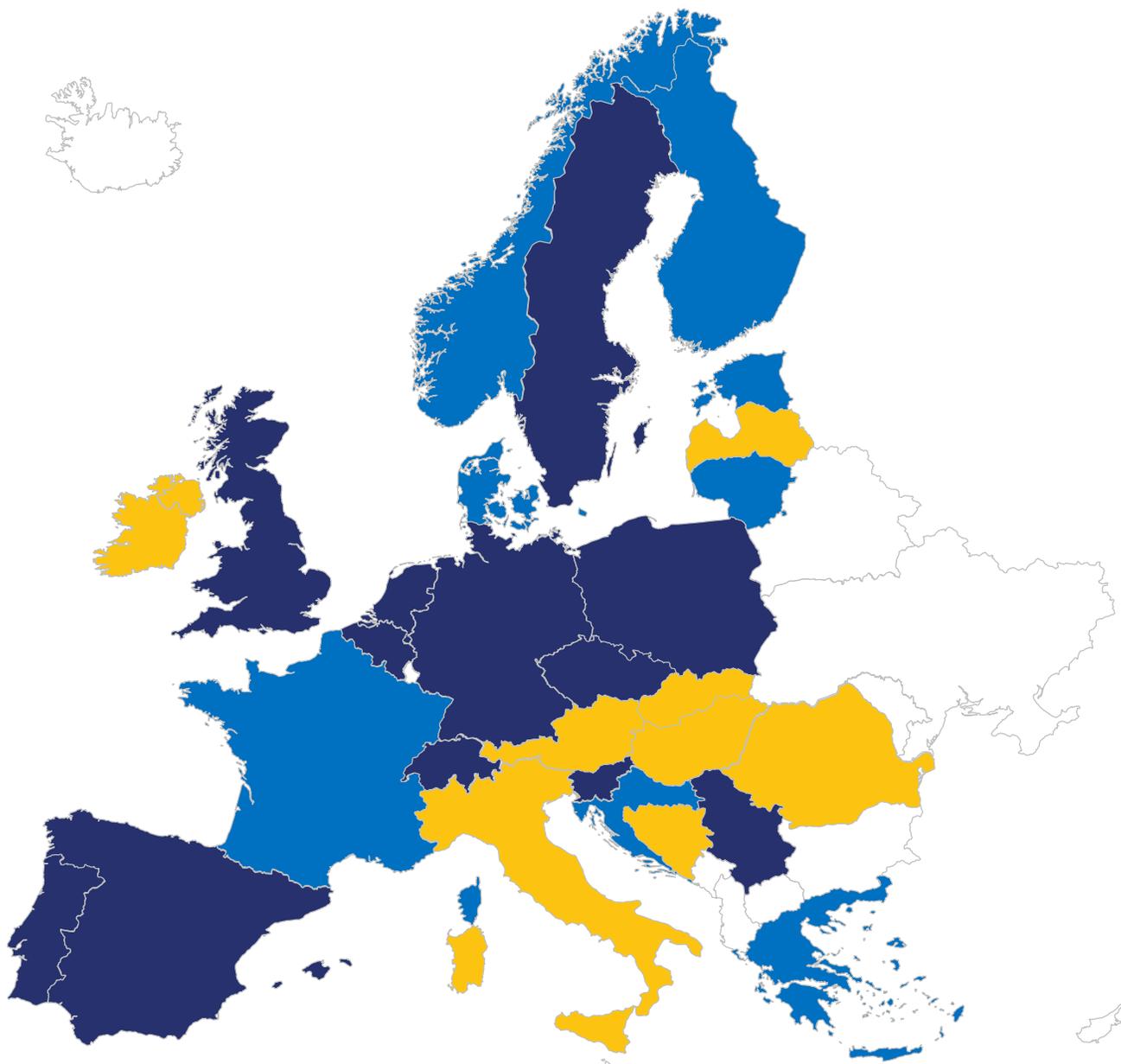
Voltage control - Owning by the TSO the reactive power compensation systems - SVC



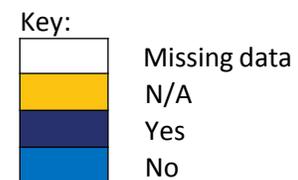
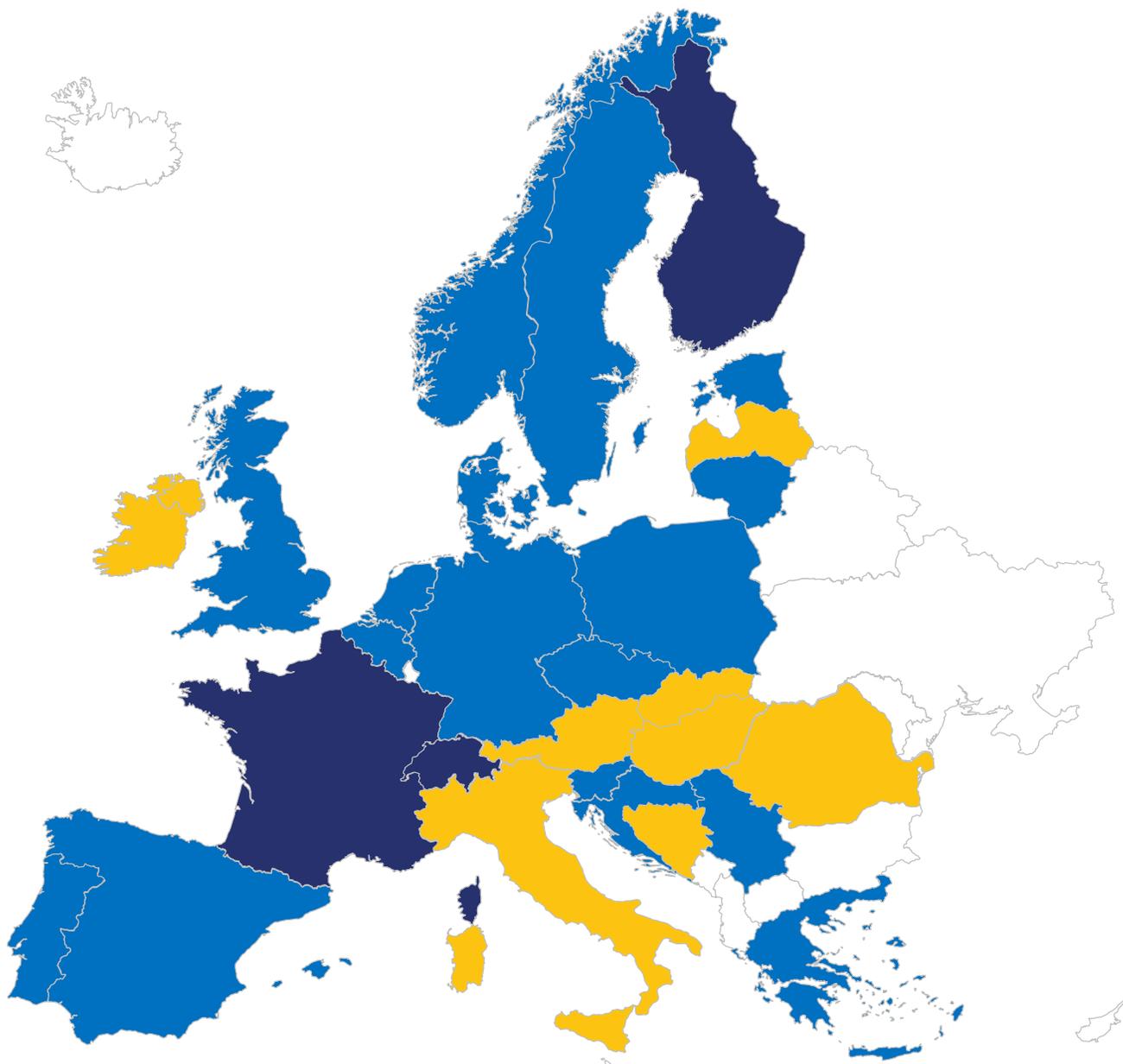
Voltage control - Owning by the TSO the reactive power compensation systems - Synchronous compensator



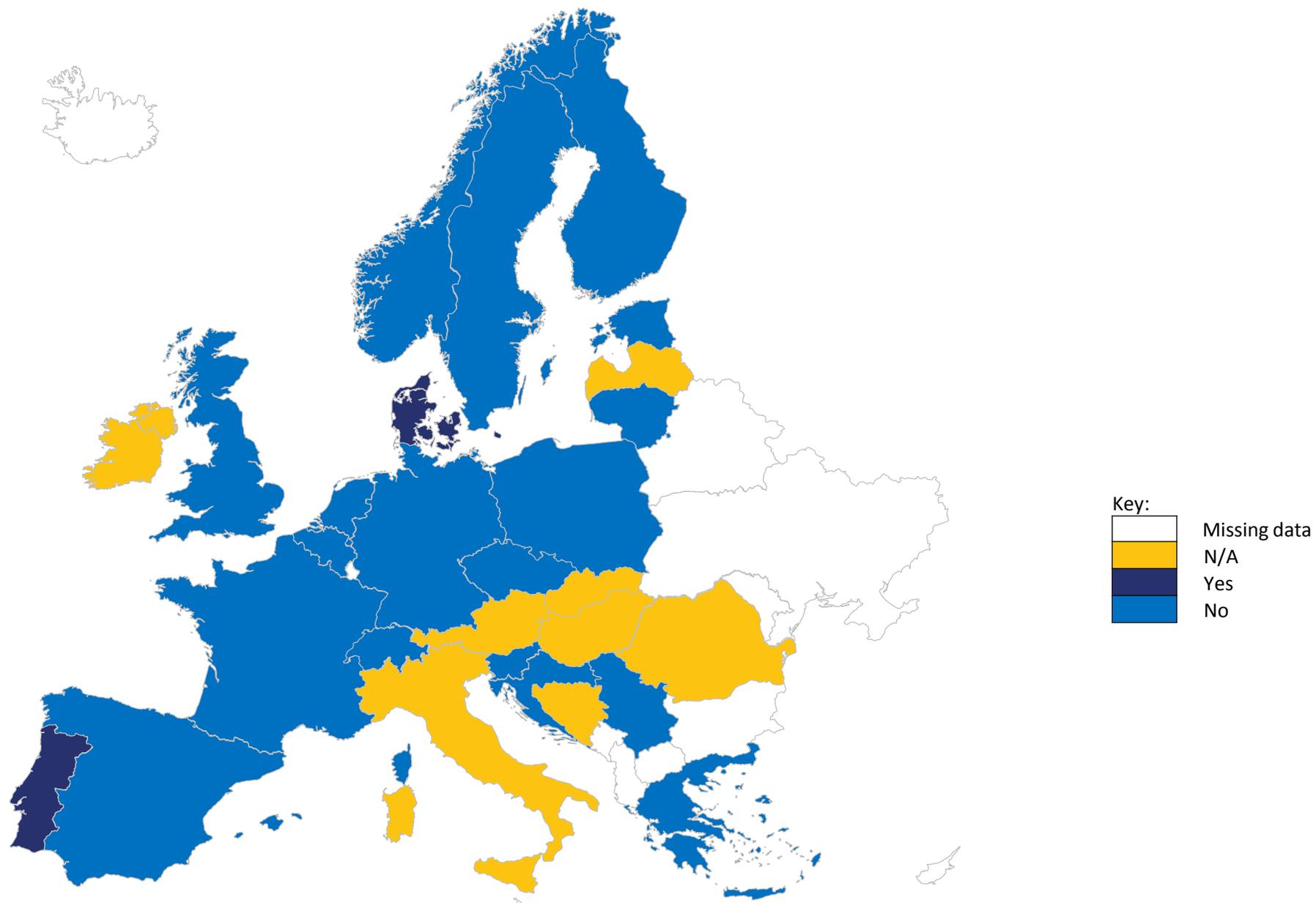
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Respect a Reactive/Active power ratio



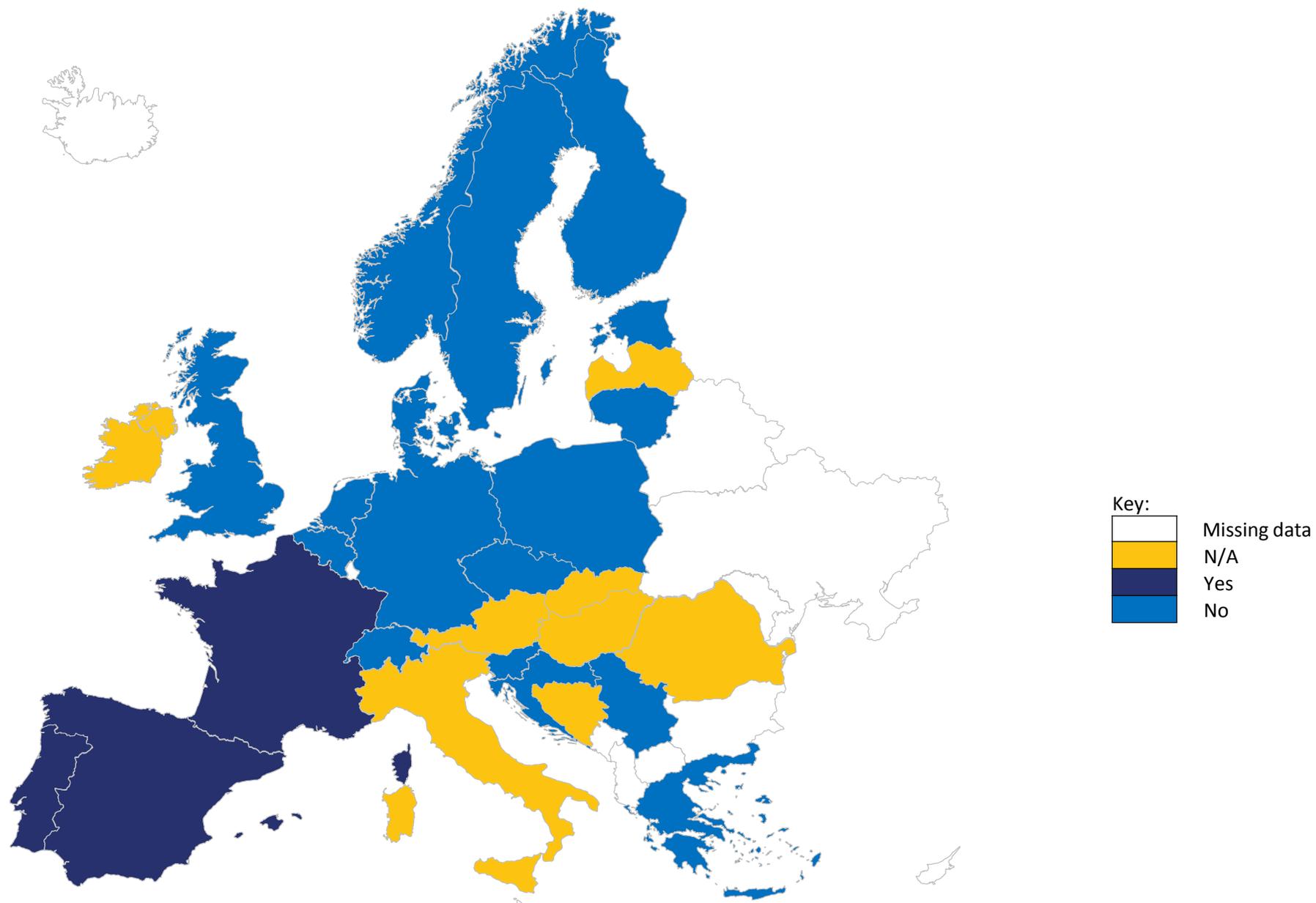
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Respect of an Active/Reactive Power Diagram at the connexion point



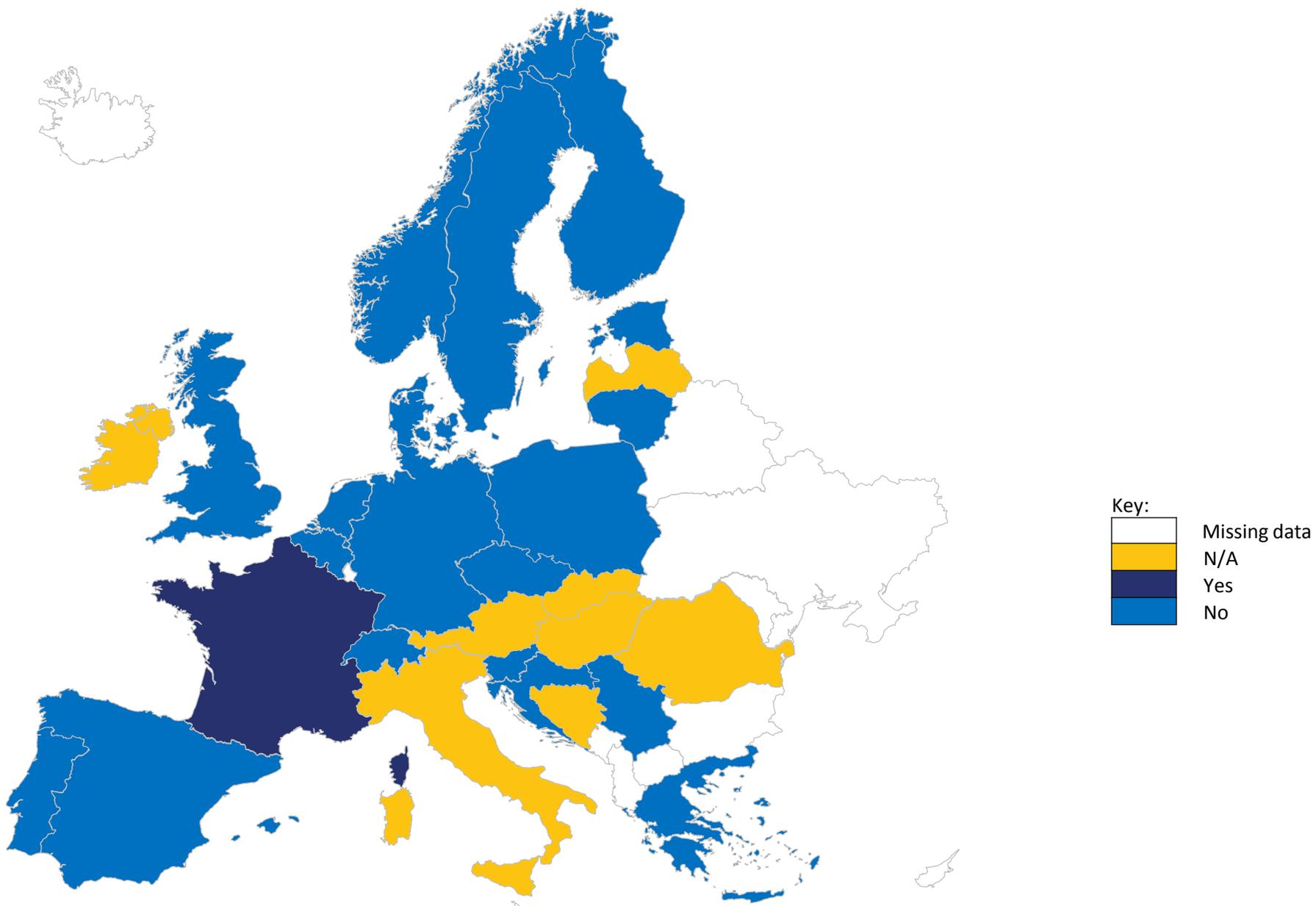
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Min/max fixed value of reactive power



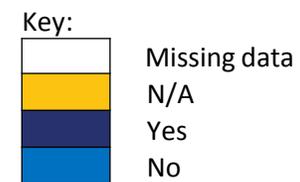
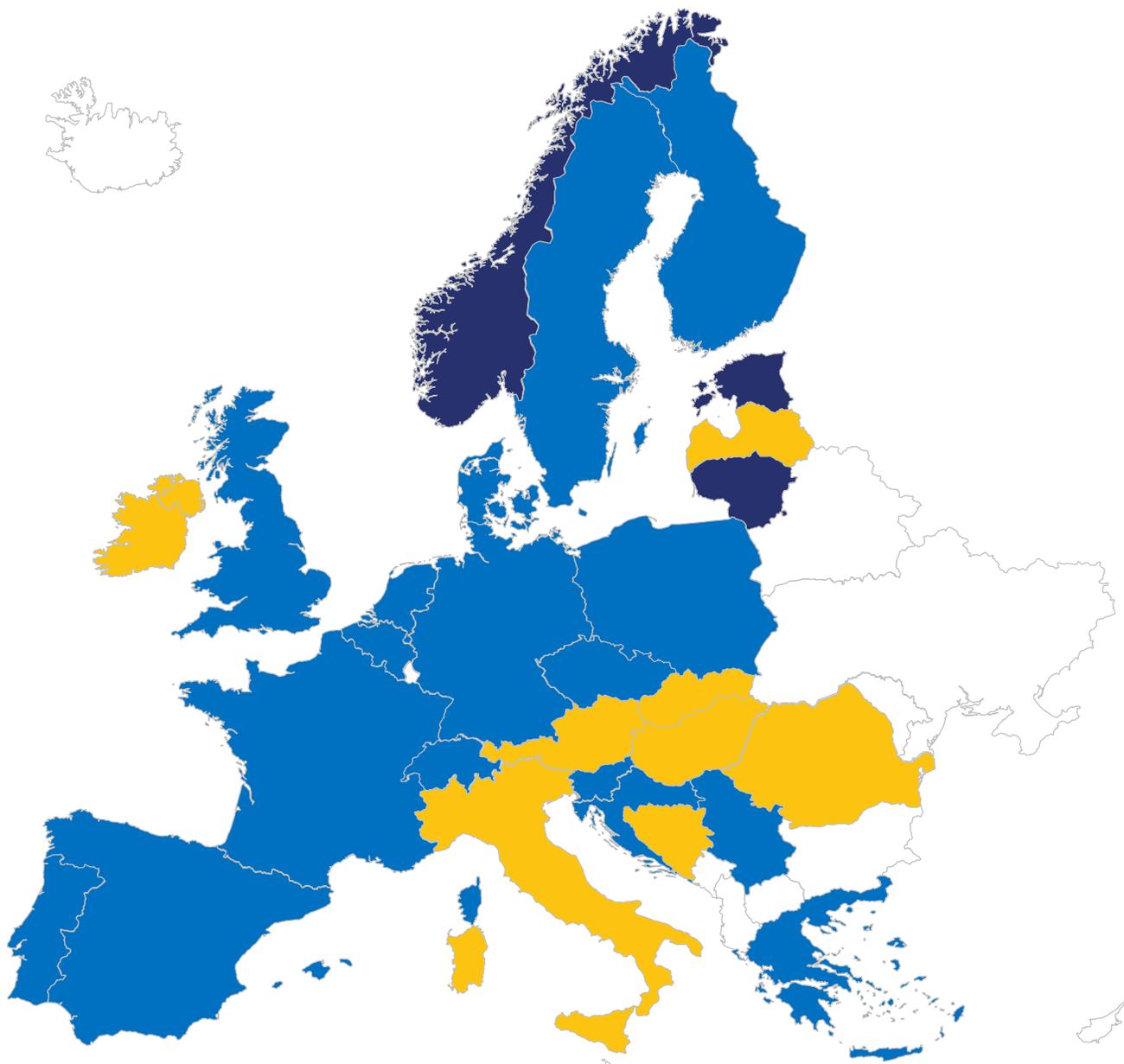
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Depending of the period of the day and/or year



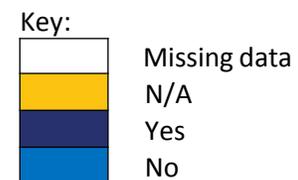
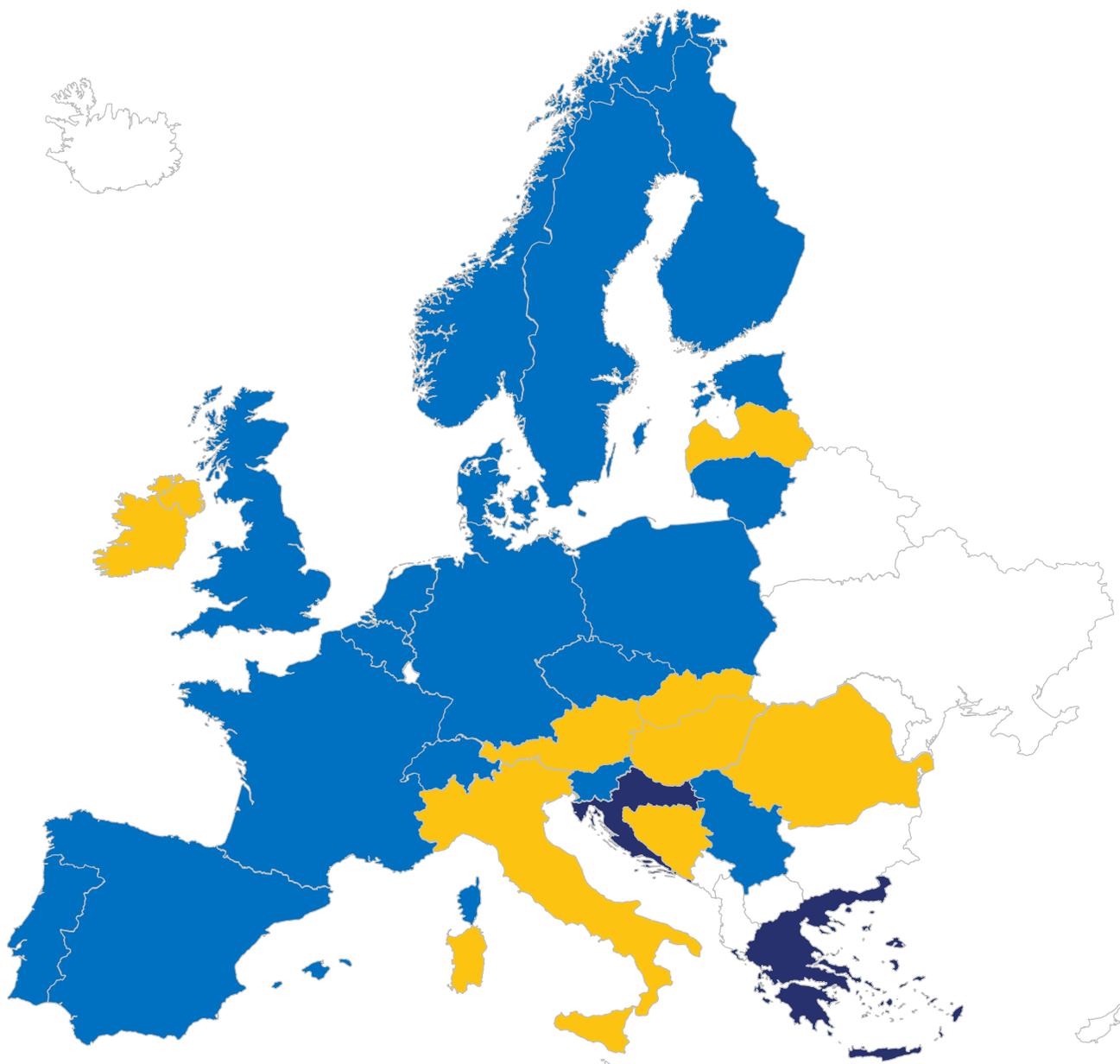
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Depending on the localization of the DSO



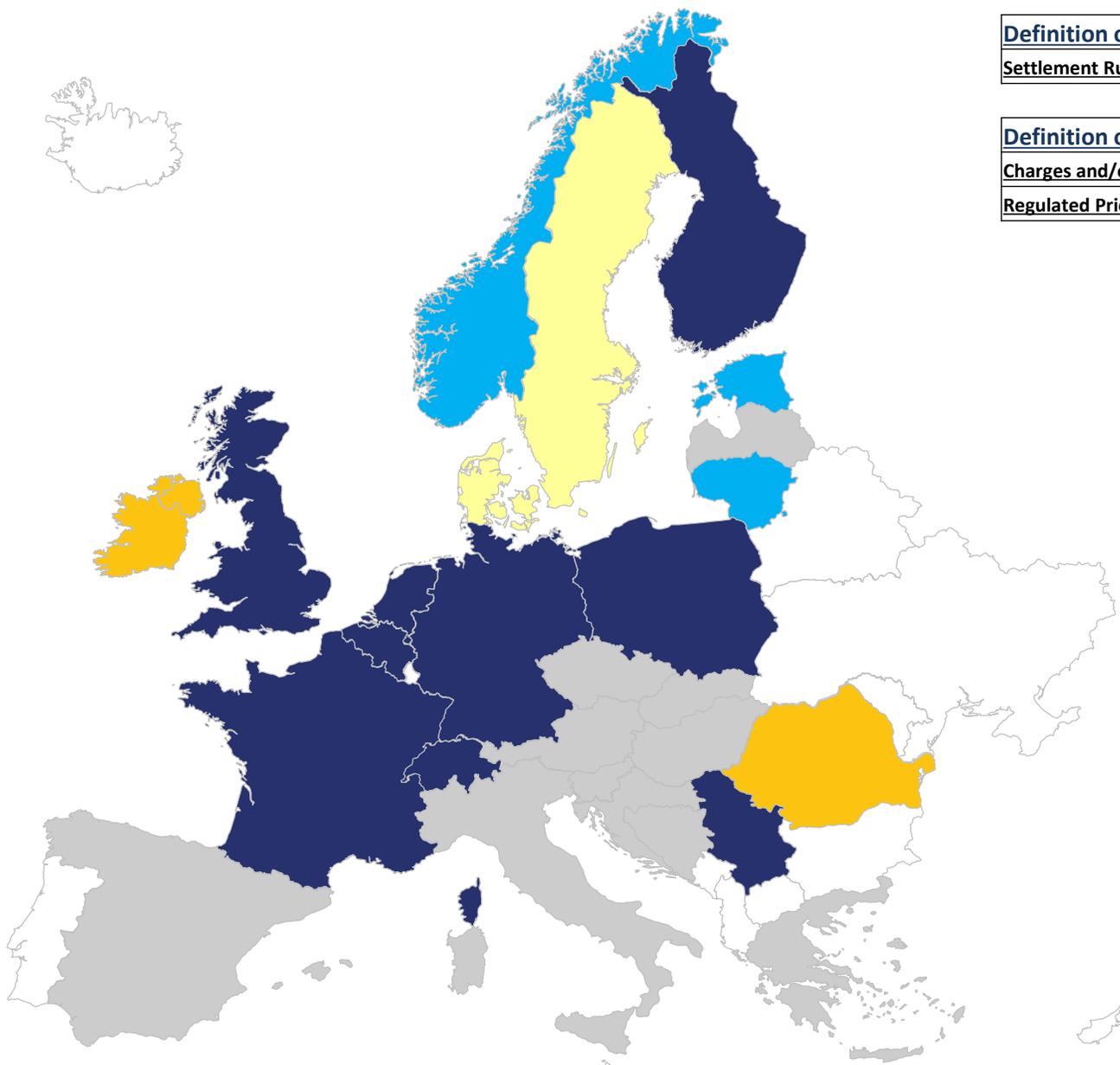
Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - According to the measurement



Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - No rules



Voltage control - What are the settlement rules for the price of reactive power between transmission and distribution grids?



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

Definition of answer

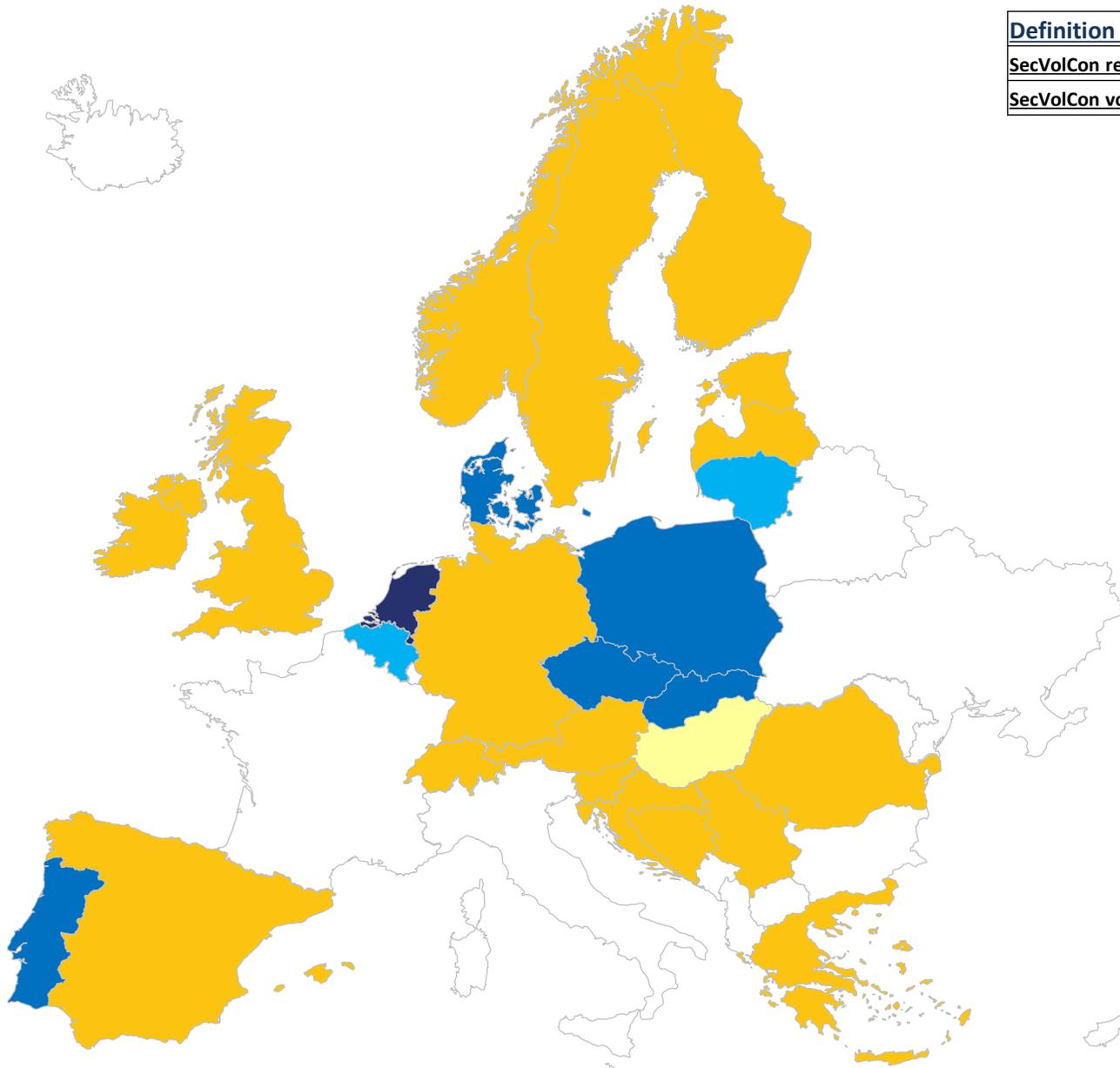
| | |
|----------------------------|--|
| Charges and/or fees | Charges and/or fees if the DSO does not respect the tan Phi and/or the diagram rule. |
|----------------------------|--|

| | |
|------------------------|--|
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |
|------------------------|--|

Key:

| | |
|---|----------------------------------|
|  | Missing data |
|  | N/A |
|  | Charges and/or fees |
|  | Bonus link to a specific diagram |
|  | Regulated price |
|  | No rules |
|  | Free |

Voltage control - Existing of secondary voltage control (SecVolCon) voltage control for the nominated mains?

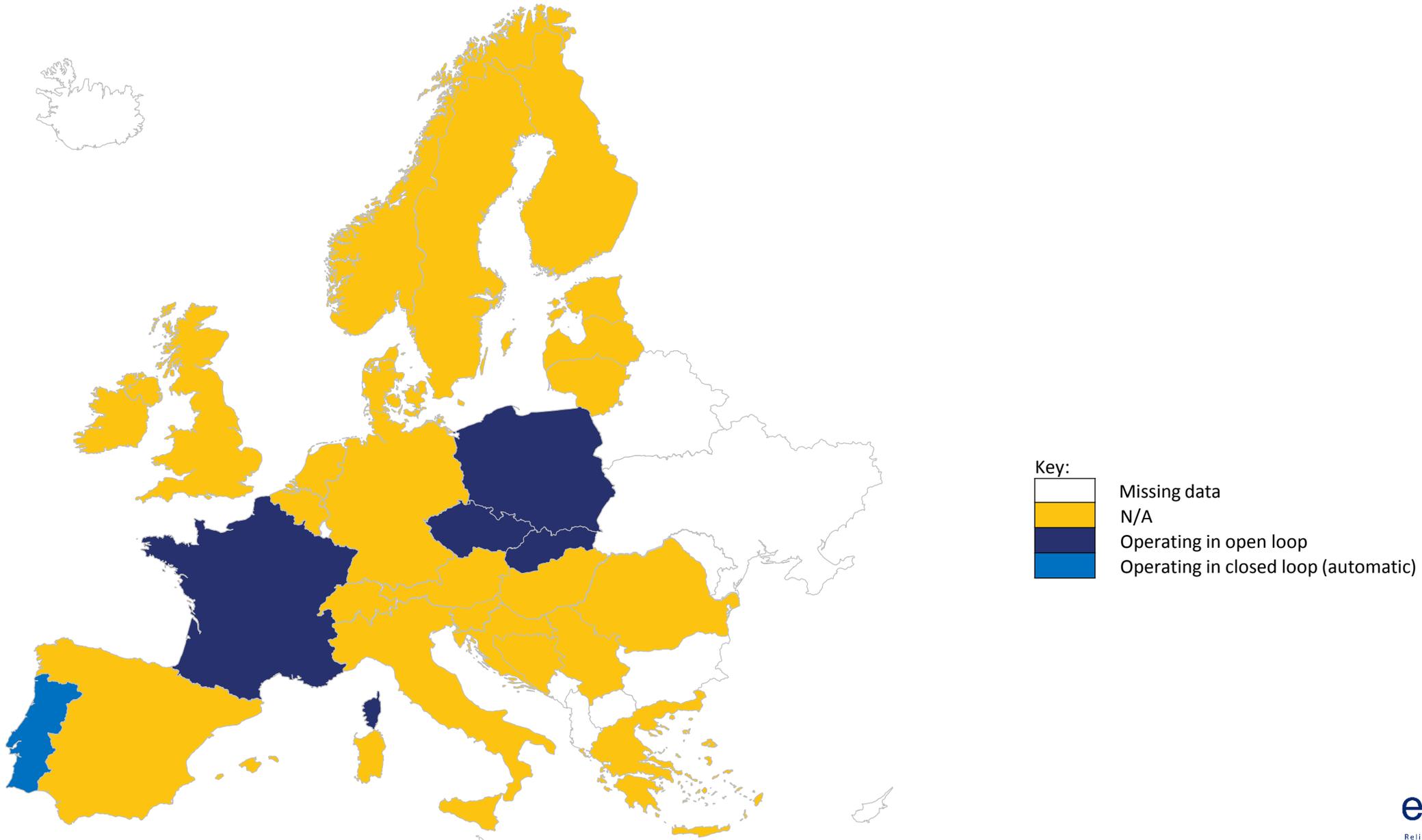


| Definition of answer | |
|---------------------------|--|
| SecVolCon reactive | SecVolCon sending a reactive setpoint to the units (manually or automatically) |
| SecVolCon voltage | SecVolCon sending a voltage setpoint to the units (manually or automatically) |

Key:

- Missing data
- N/A
- Operating in open loop
- Operating in closed loop
- SecVolCon reactive
- SecVolCon voltage
- SecVolCon reactive + SecVolCon voltage
- Operating in closed loop + SecVolCon voltage
- Operating in closed loop + SecVolCon reactive + SecVolCon voltage

Voltage control - Existing of tertiary voltage control



Black start

(Referring to questions of AS survey from BSQ1.0 to BSQ13.0)

Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 1/3

| TSO | Answer |
|--------------|--|
| ADMIE | Predefined power plants have to provide Black Start service. |
| APG | Hydro storage power plants. Not mandatory for power plants. |
| AST | No special rules - agreement with hydro power plant for providing the service. |
| ČEPS | No obligations to provide black start for any unit. |
| EirGrid | It is not mandatory in Ireland but is in Northern Ireland for certain plant types. Technologies currently providing black start across the island: Hydro, Pumped Storage, Interconnectors, Open Cycle Gas Turbines |
| Elering | Black start service is provided by power plants which are included in the restoration plan as black start service providers. It is not a mandatory service. |
| ELES | Yes. |
| Elia | Gas Power plant & Hydraulic power plants (pumped storage). It is not mandatory. |
| EMS | HPPs. It is mandatory according to Grid code. |
| Energinet.dk | No |
| Fingrid | Not mandatory, agreed bilaterally with suitable plants. |
| German TSOs | Black start provision according to respective black-start concepts, based on grid connection and specific contracts. |

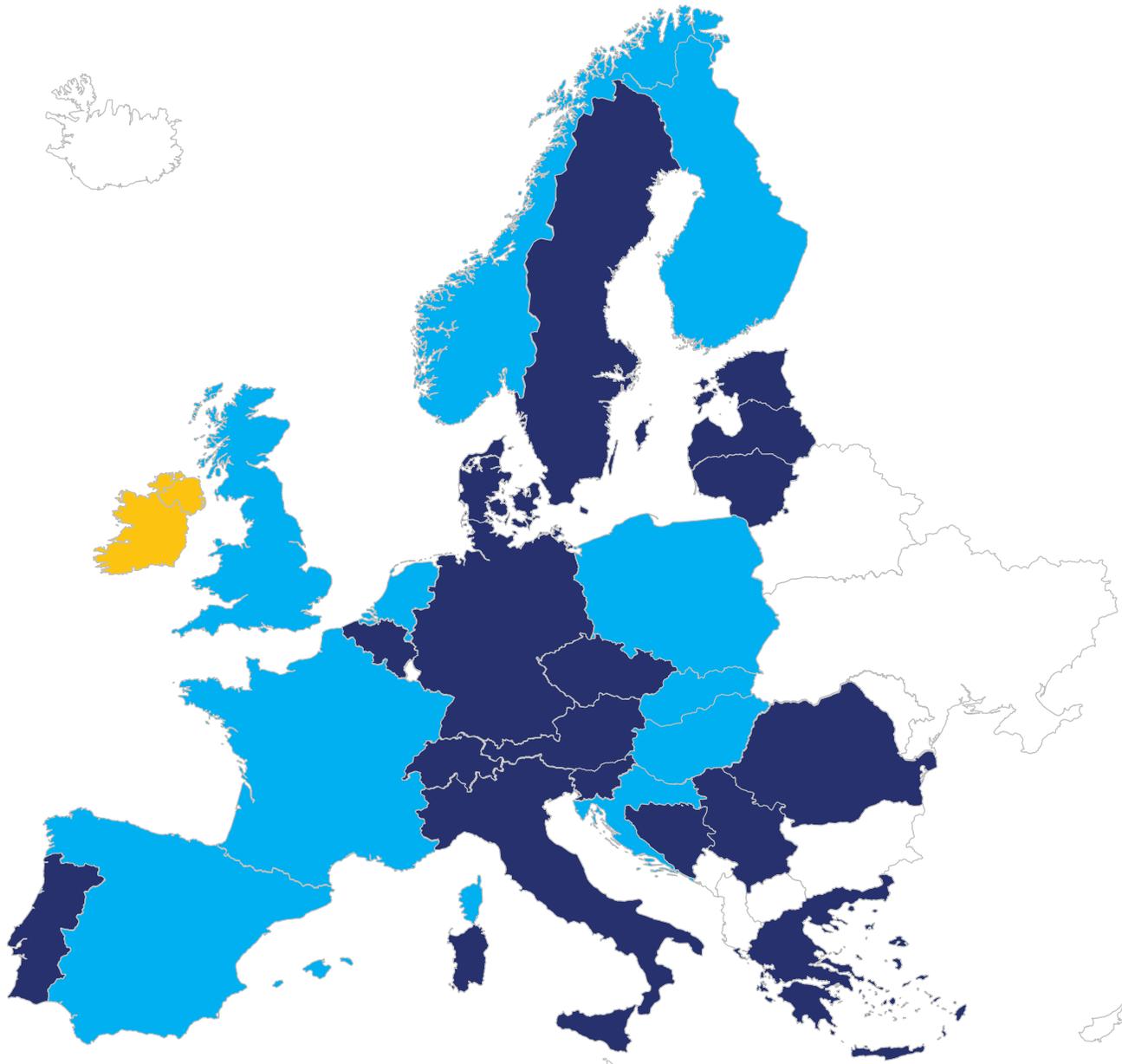
Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 2/3

| TSO | Answer |
|---------------|---|
| HOPS | It is mandatory for plants determined by defense plan. |
| Litgrid | Power plants that are included in the black start plan must provide the black start service (due to technology). |
| MAVIR | If the installed capacity is more than 500 MW and the power plant is connected to the transmission grid, the service is mandatory. But there are some power plants who are able to provide BS capability, but their installed capacites are less than 500 MW. |
| National Grid | Not a mandatory service for generators. However, mandatory for National Grid to maintain black start capability - Grid Code & Transmission Licence requirements. Black start services are procured via bilateral contracts with power stations. |
| NOS BiH | Yes. |
| PSE | It is not a mandatory service in Poland. |
| REE | Mainly hydro units, it is not a mandatory service. |
| REN | BS is not a mandatory service in Portugal. We have a CCGT and a Hydro that provide that service. |
| RTE | BS not mandatory. Nuclear power plants provide VSC w/o BS. |
| SEPS | No, this service is not mandatory. |

Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 3/3

| TSO | Answer |
|------------------|--|
| Statnett | Power plants that have a significance impact on the reconstruction of the network or other critical functions. |
| Svenska kraftnät | We have contracts with some suppliers of blackstart capability. |
| Swissgrid | <p>Swissgrid ensures that for the reestablishment of supply after a major incident an adequate number of powerstations, qualified for black start and island operation consolidated to a buildup-cell, are ready for operation.</p> <p>A buildup-cell is defined as a small subnet, limited in area and electrical network, which consists of one powerstation equipped with black start facilities and one or more powerstations with islanding functionality being able to keep frequency, voltage and power stable in this buildup-cell, with an adequate load at its disposal.</p> <p>The buildup-cell needs:</p> <ul style="list-style-type: none"> - to have a direct connection to the 220kV-level - to be connected to the same or neighboring nodes - Its rotating mass (power output) to be between 200 and 250 MW and a switchable load of 10% |
| TenneT TSO BV NL | It is contracted service. it is not a mandatory service. |
| Terna | It is mandatory for the power plants defined in the restoration plan. |
| Transelectrica | Power plants that are included in the black start plan must provide the black start service - due to technology. |

Black Start - If a power plant is able to provide black start service, which grid it should be connected to?



Key:



Missing data

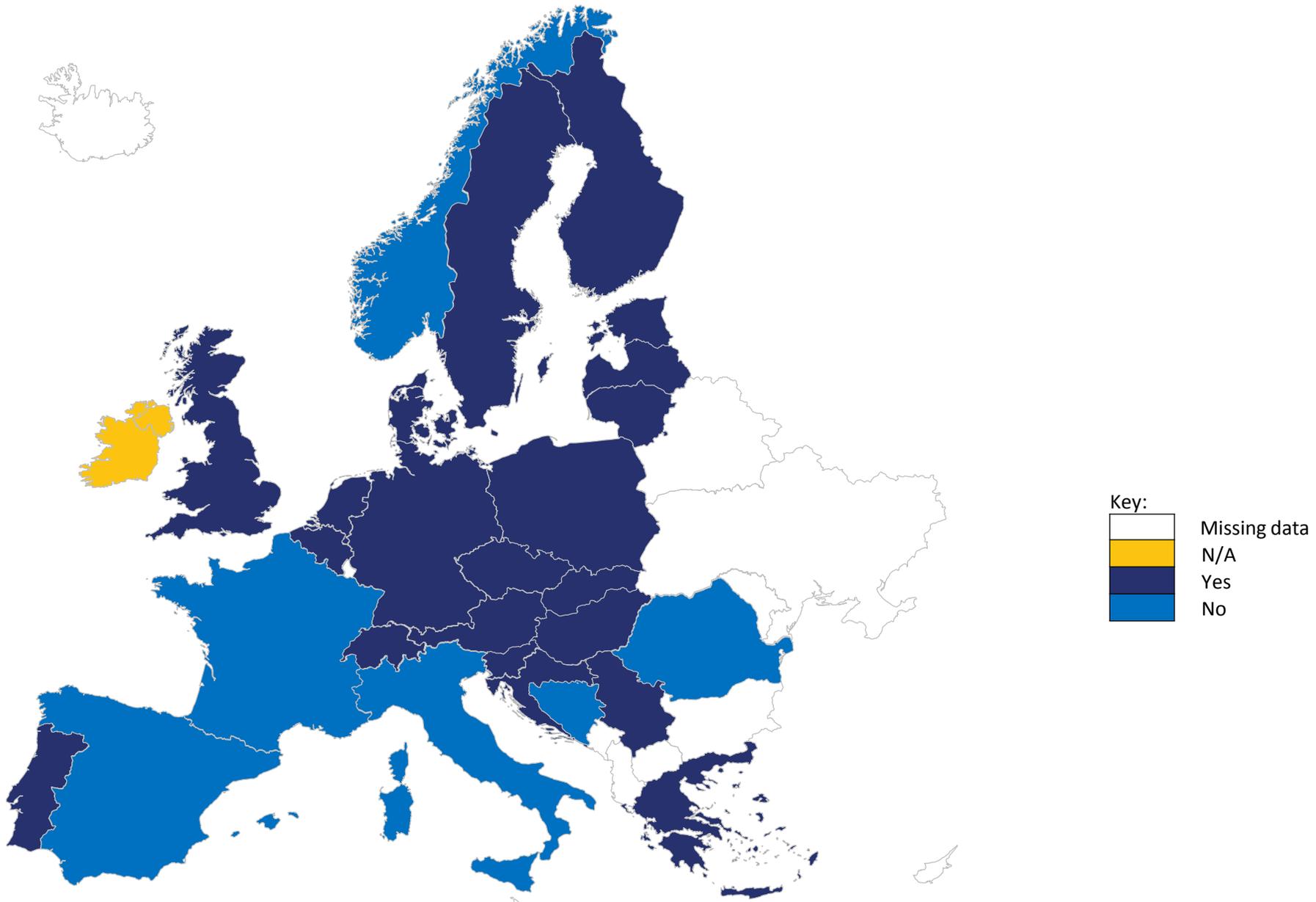
N/A

Transmission grid

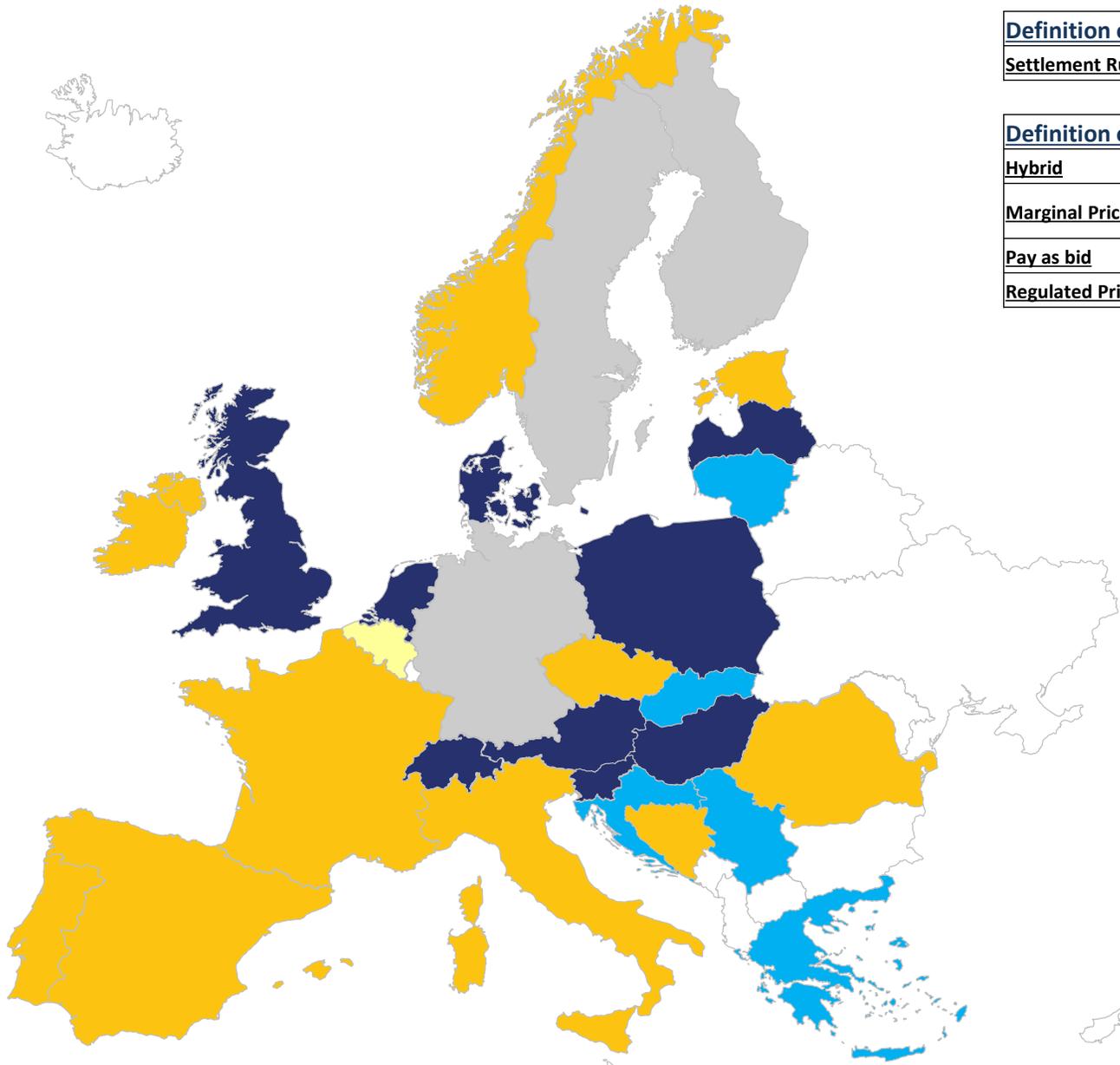
Distribution grid

Both

Black Start - Is it a service paid by the TSO?



Black Start - Settlement Rule



Definition of question

| | |
|------------------------|-----------------------------------|
| Settlement Rule | The pricing rules for settlement. |
|------------------------|-----------------------------------|

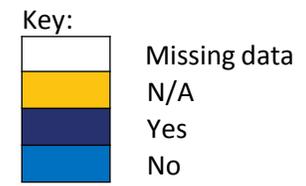
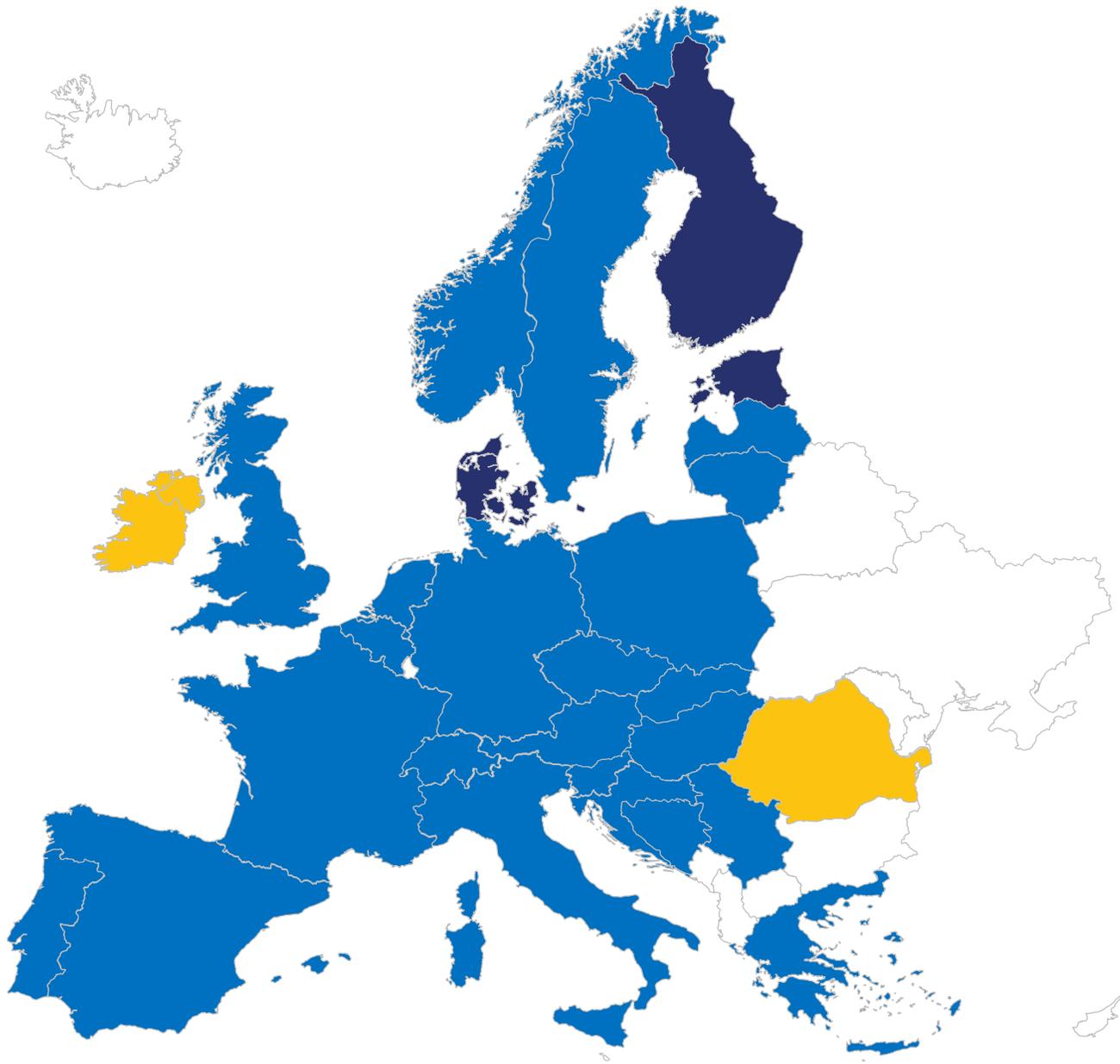
Definition of answer

| | |
|-------------------------|--|
| Hybrid | Combination. |
| Marginal Pricing | All capacity or balancing energy settled at the same price – price of the most expensive capacity bid procured or most expensive balancing energy bid activated. |
| Pay as bid | Contracted parties who provide a service are paid based on their offer price. |
| Regulated Price | Price for this service is based on a price that is set by the relevant regulatory authority. |

Key:

| | |
|---|------------------|
|  | Missing data |
|  | N/A |
|  | Pay as bid |
|  | Marginal pricing |
|  | Regulated price |
|  | Free |
|  | Hybrid |

Black Start - Does the TSO own unit for Black start service?



Black Start - Does the TSO have some special rules for the distribution/location/number etc of black start service units? 1/3

| TSO | Answer |
|--------------|---|
| ADMIE | No rules. |
| APG | Geographical distribution, Redundancy |
| AST | No special rules. |
| EirGrid | Black Start is procured through a tender process. The location of the service provider is one of the factors considered in the tender, so that the system can be divided into subsystems for restoration and each subsystem will have one or more sources of Black Start. |
| Eles | Prescribed amount of BS is area-dependent. |
| Elia | Number of BS production unit is defined at control level (Belgian control area) but Elia defined specific rules for their location (electrical zones within BE control area). |
| EMS | No. |
| Energinet.dk | Yes |
| German TSOs | According to respective black-start concept |
| HOPS | No, exact units are determined by defense plan. |

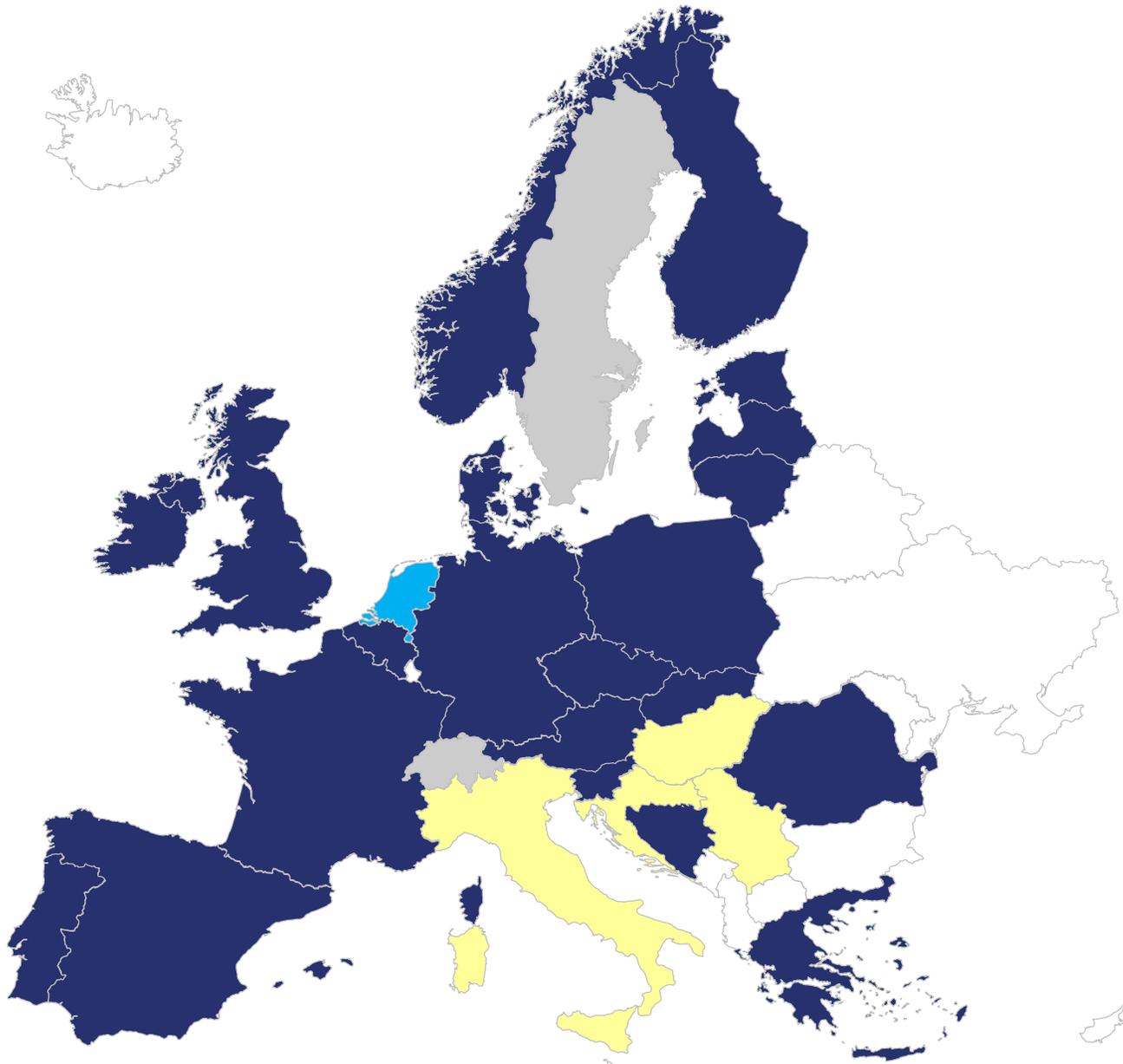
Black Start - Does the TSO have some special rules for the distribution/location/number etc of black start service units? 2/3

| TSO | Answer |
|------------------|--|
| Litgrid | No special rules for distribution, black start service unit shall be located in such a place, where is feasible to restart main generation units. |
| MAVIR | No special rules. |
| National Grid | Restoration strategy is to split GB into 6 geographical zones (Scotland, North West, North East, Midlands, South West & South East) and contract for at least 3 black start power stations from each zone. |
| NOS BiH | No. |
| PSE | TSO is obliged to fullfill standards from OH Policy 5 |
| REE | No special rules. |
| REN | No special rules. |
| RTE | No. |
| SEPS | Yes, we have a set of different rules. Each application for BS providing is assessed separately. |
| Statnett | Power plants that have a significance impact on the reconstruction of the network or other critical functions. |
| Svenska kraftnät | Yes, we have a set of different criterias. |

Black Start - Does the TSO have some special rules for the distribution/location/number etc of black start service units? 3/3

| TSO | Answer |
|------------------|---|
| Swissgrid | Distribution of CH in 4 network restoration regions (West, South, Central and East): Each region must have 1 buildup-cell |
| TenneT TSO BV NL | Minimum 3 locations 2 units per location 200 MW capability per location |
| Terna | We have a fixed number of "restoration path" |
| Transelectrica | Geographical distance according to respective black-start concept |

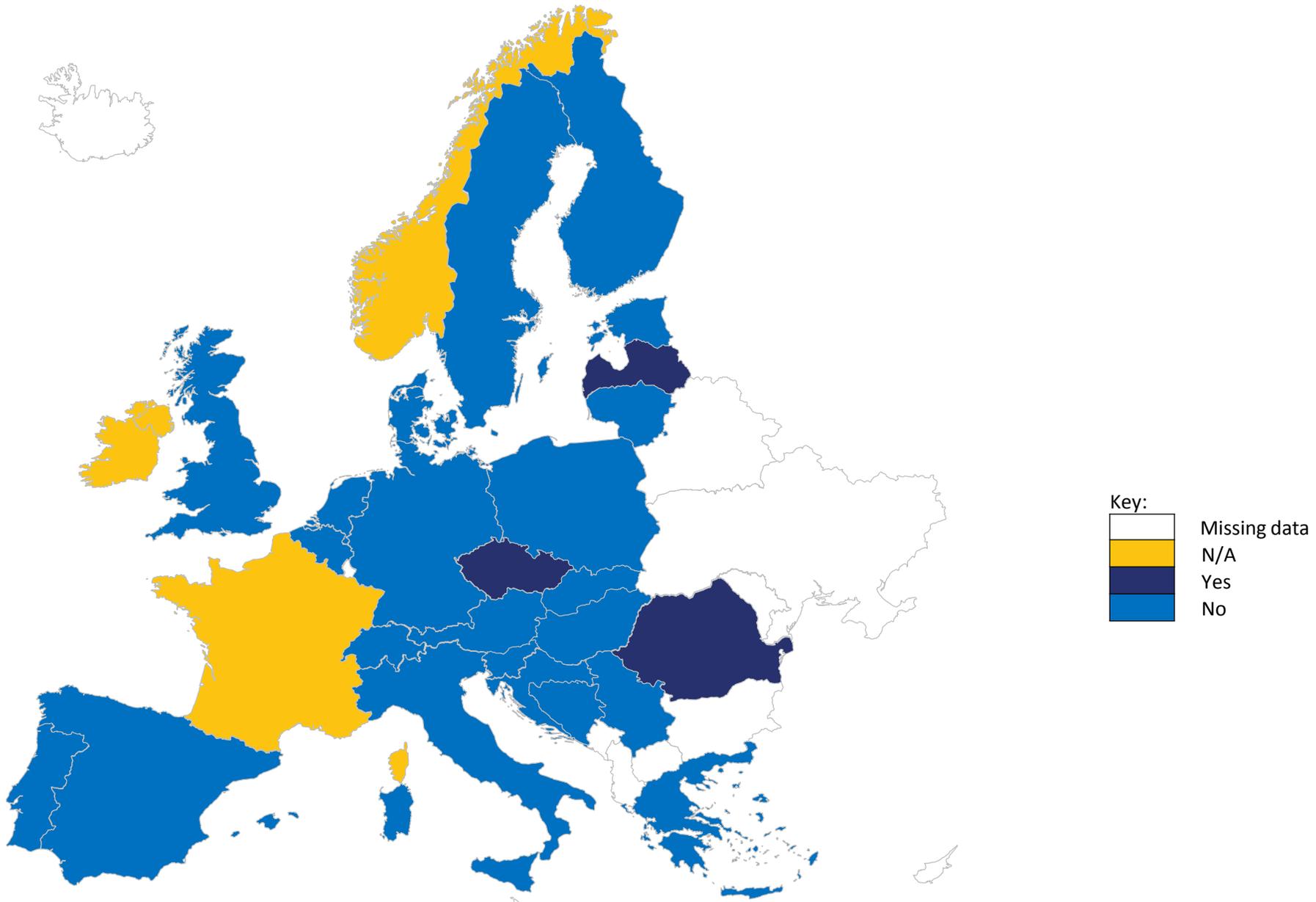
Black Start - Does the TSO have a regulated amount of BS control (regarding the whole control area)?



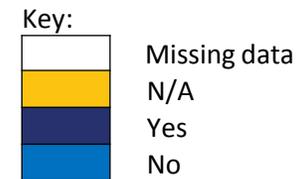
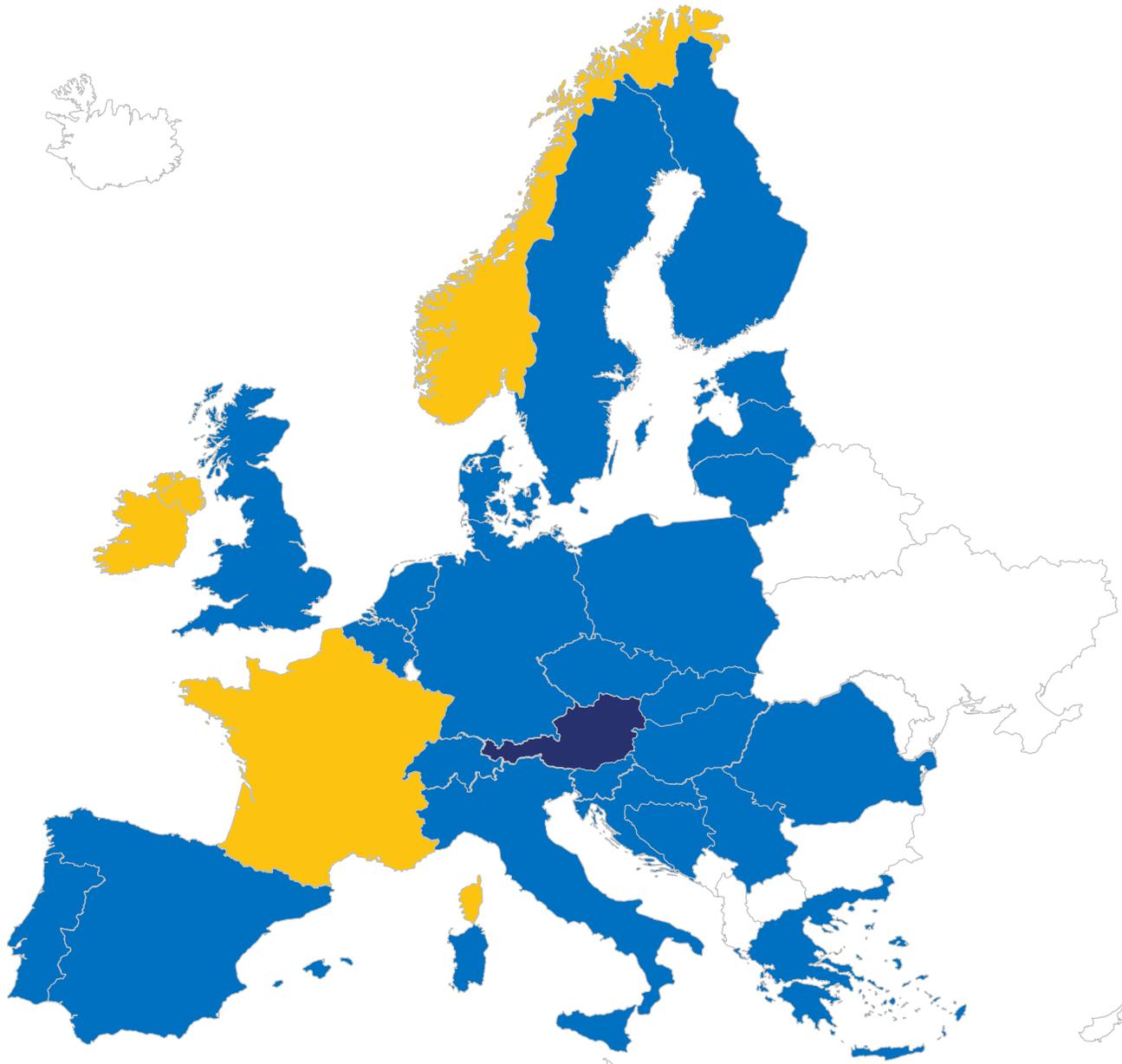
Key:

| | |
|---|---|
|  | Missing data |
|  | N/A |
|  | No |
|  | Yes, 1-500 MW |
|  | Yes, 501-800 MW |
|  | Yes, more than 800 MW |
|  | All the units who are able to provide BS must to provide it |

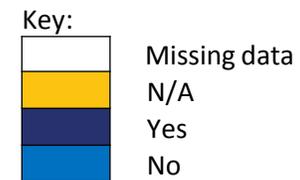
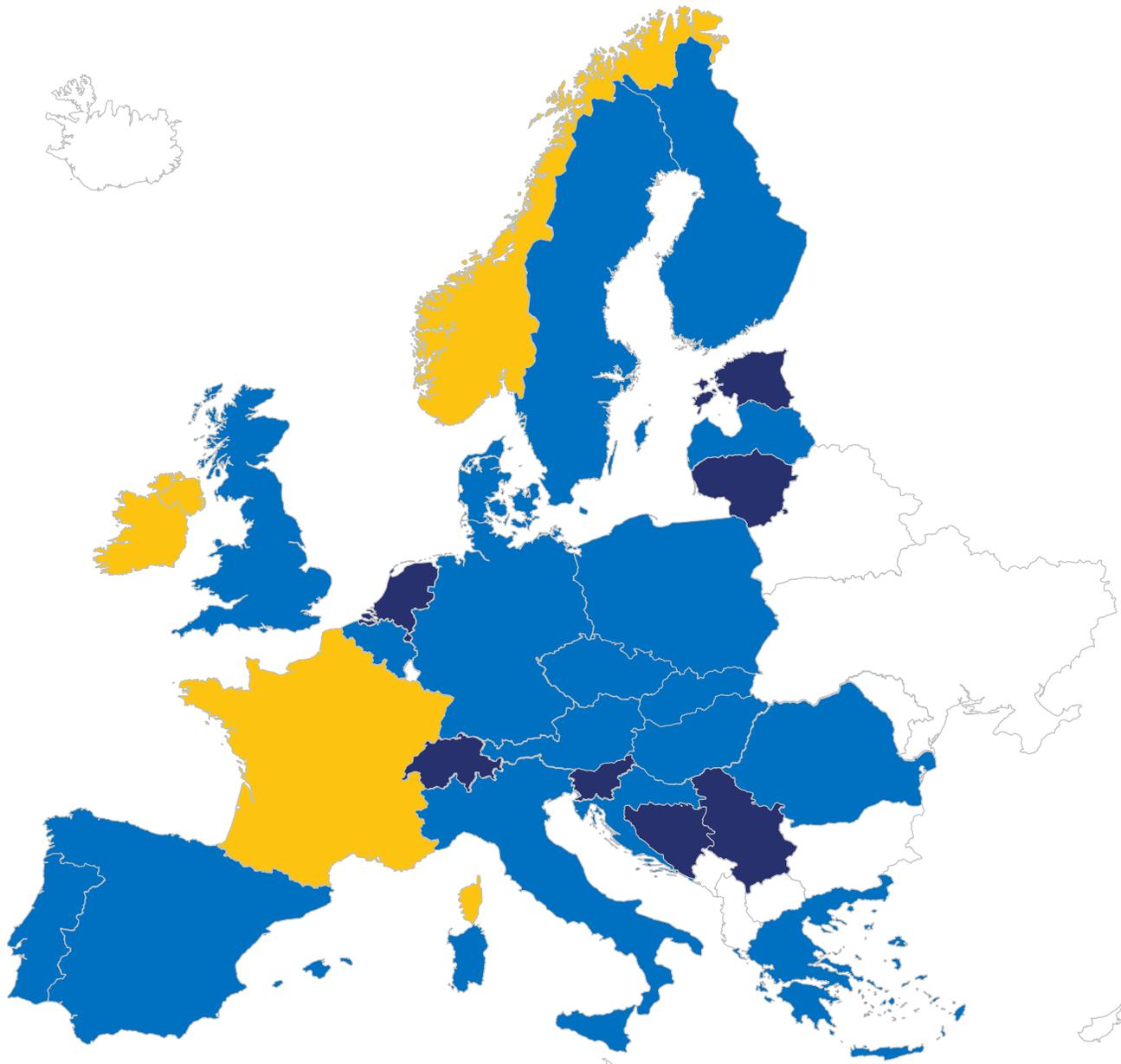
Black Start - Testing the BS ability by the TSO - During the accreditation process only



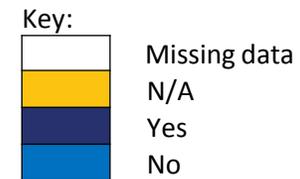
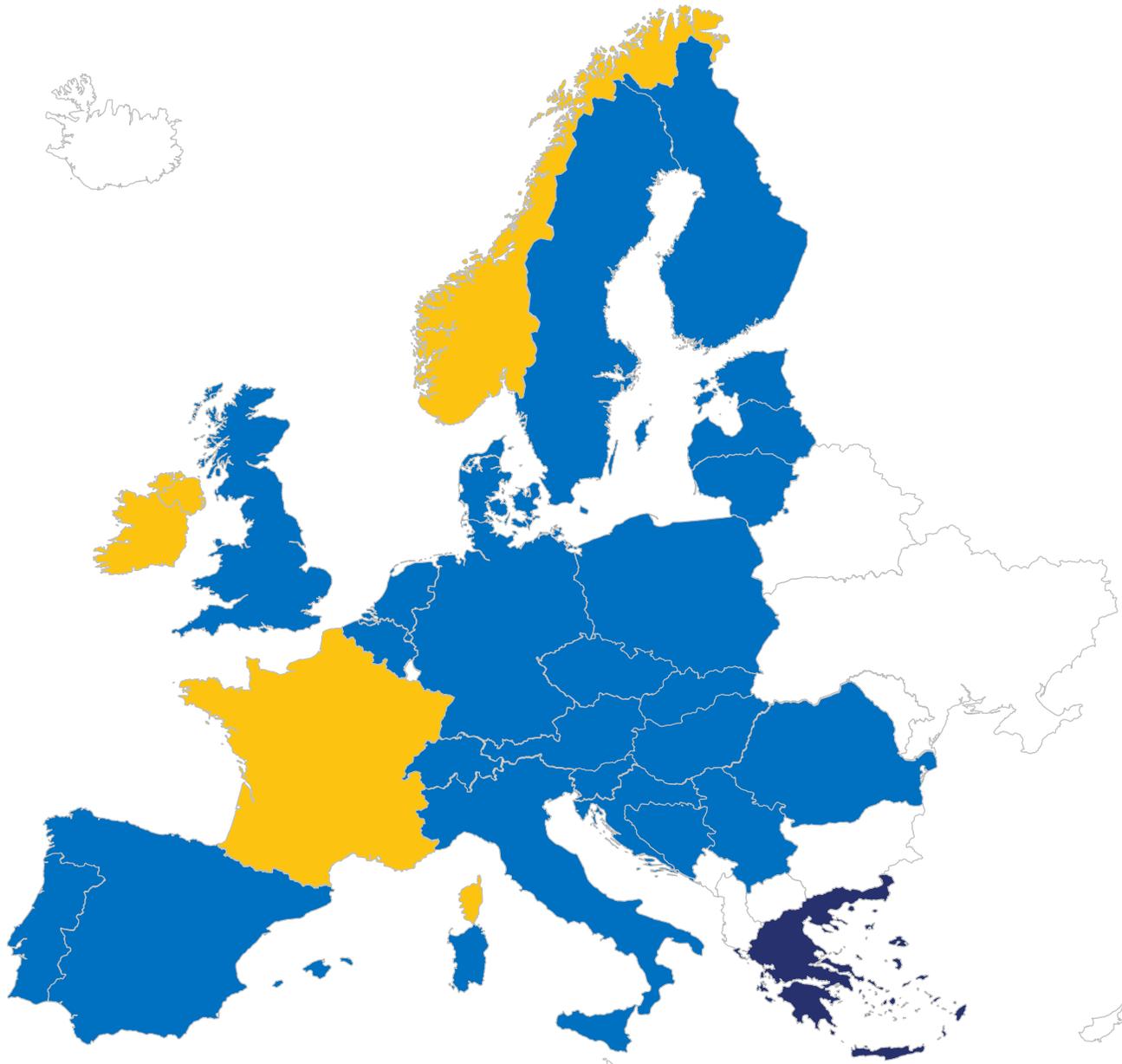
Black Start - Testing the BS ability by the TSO - After the accreditation process/ Only the operational function of the BS unit (unit is working, not connected to the grid)/Once a year



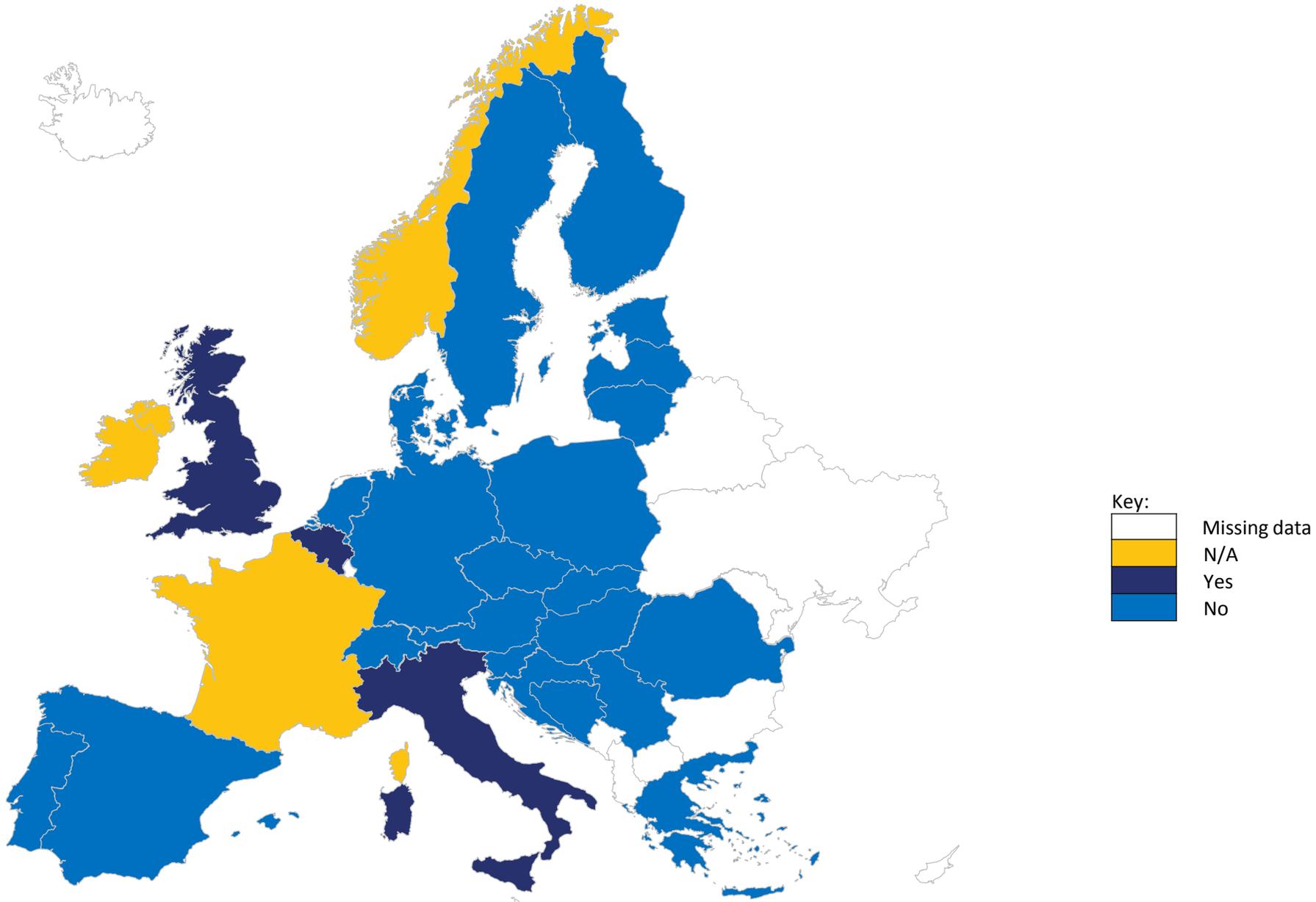
Black Start - Testing the BS ability by the TSO - After the accreditation process/ Only the operational function of the BS unit (unit is working, not connected to the grid)/Occasionally



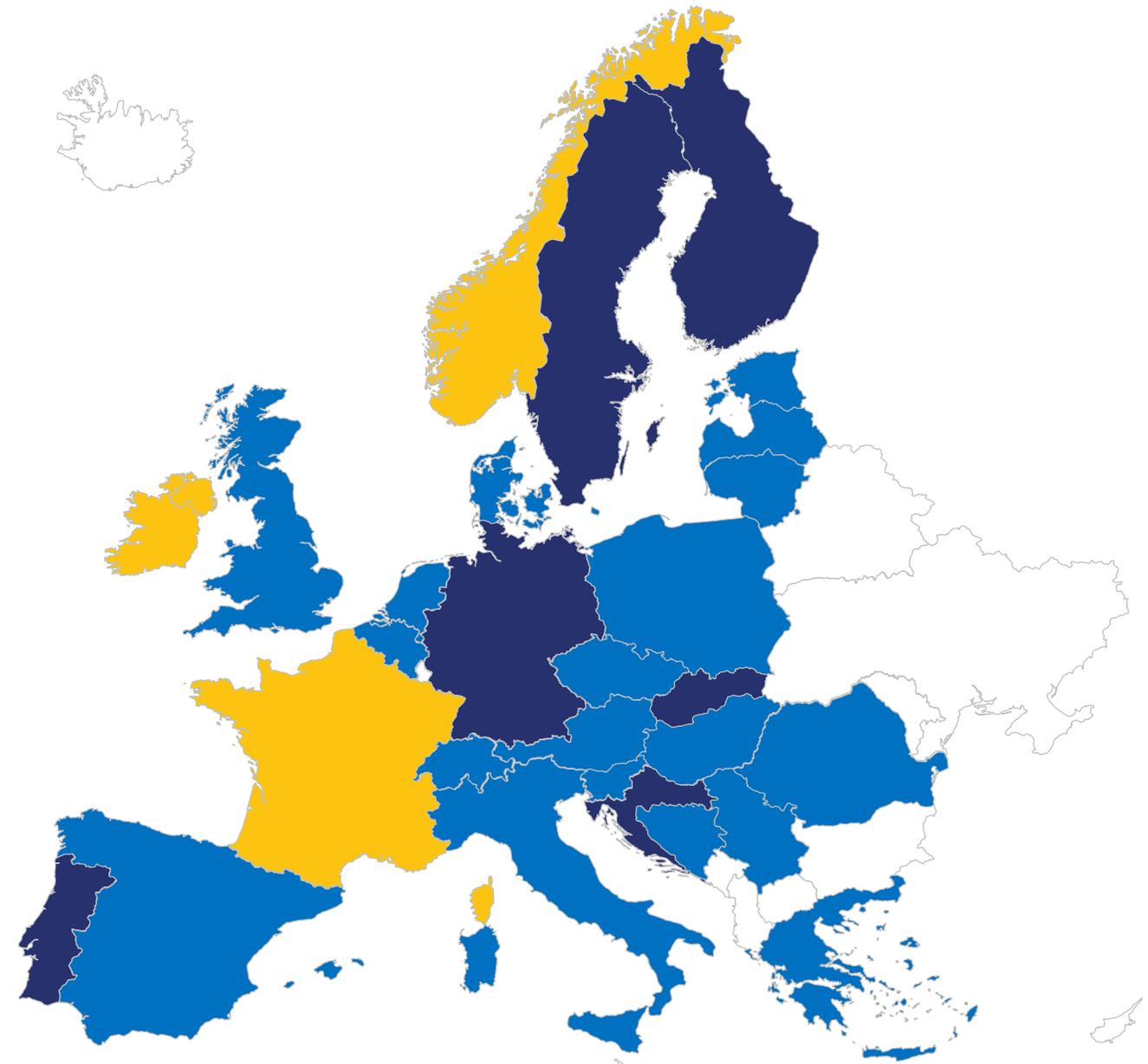
Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to the grid and has to provide some predefined orders)/Once a year



Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to the grid and has to provide some predefined orders)/Several times a year



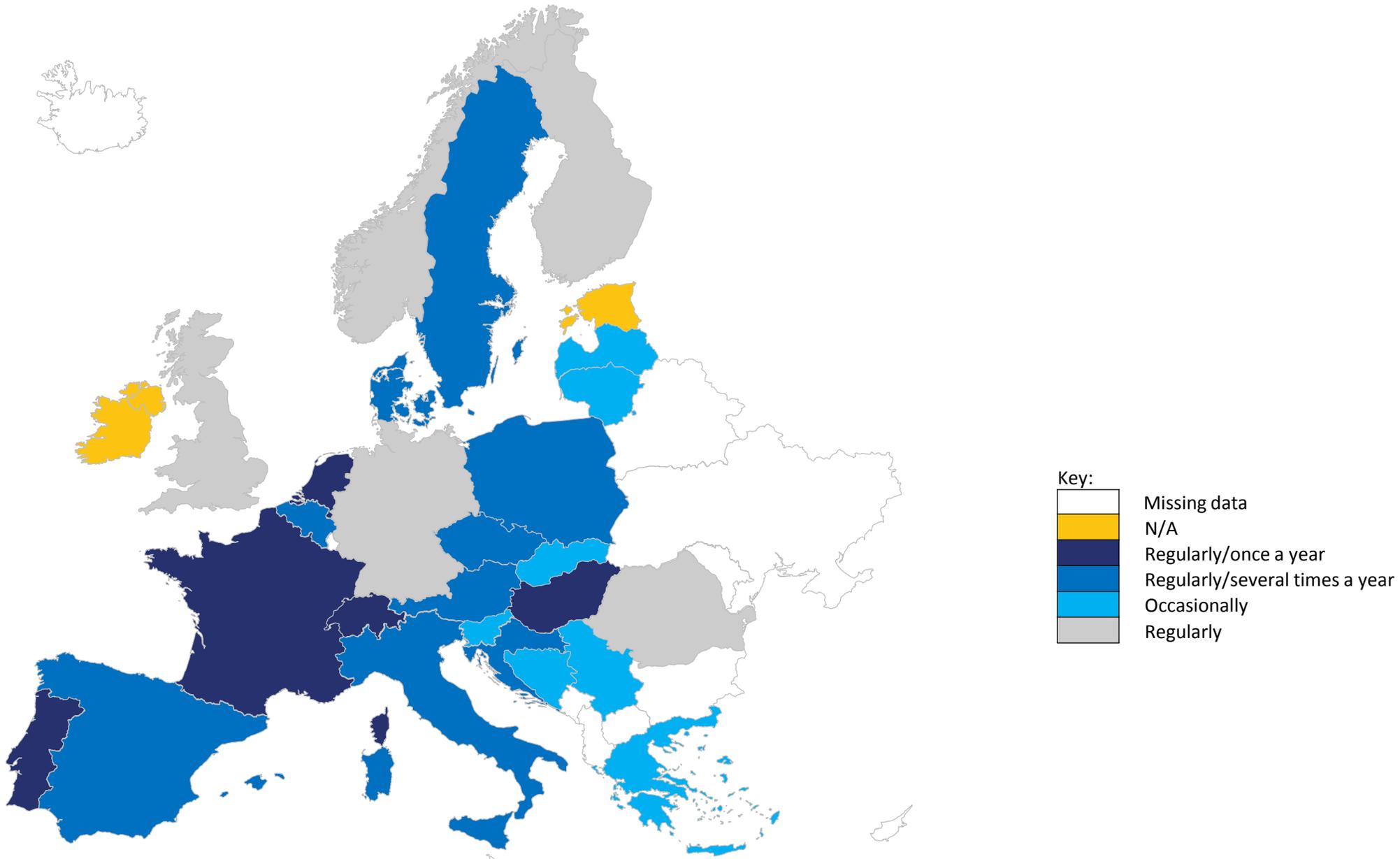
Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to the grid and has to provide some predefined orders)/Occasionally



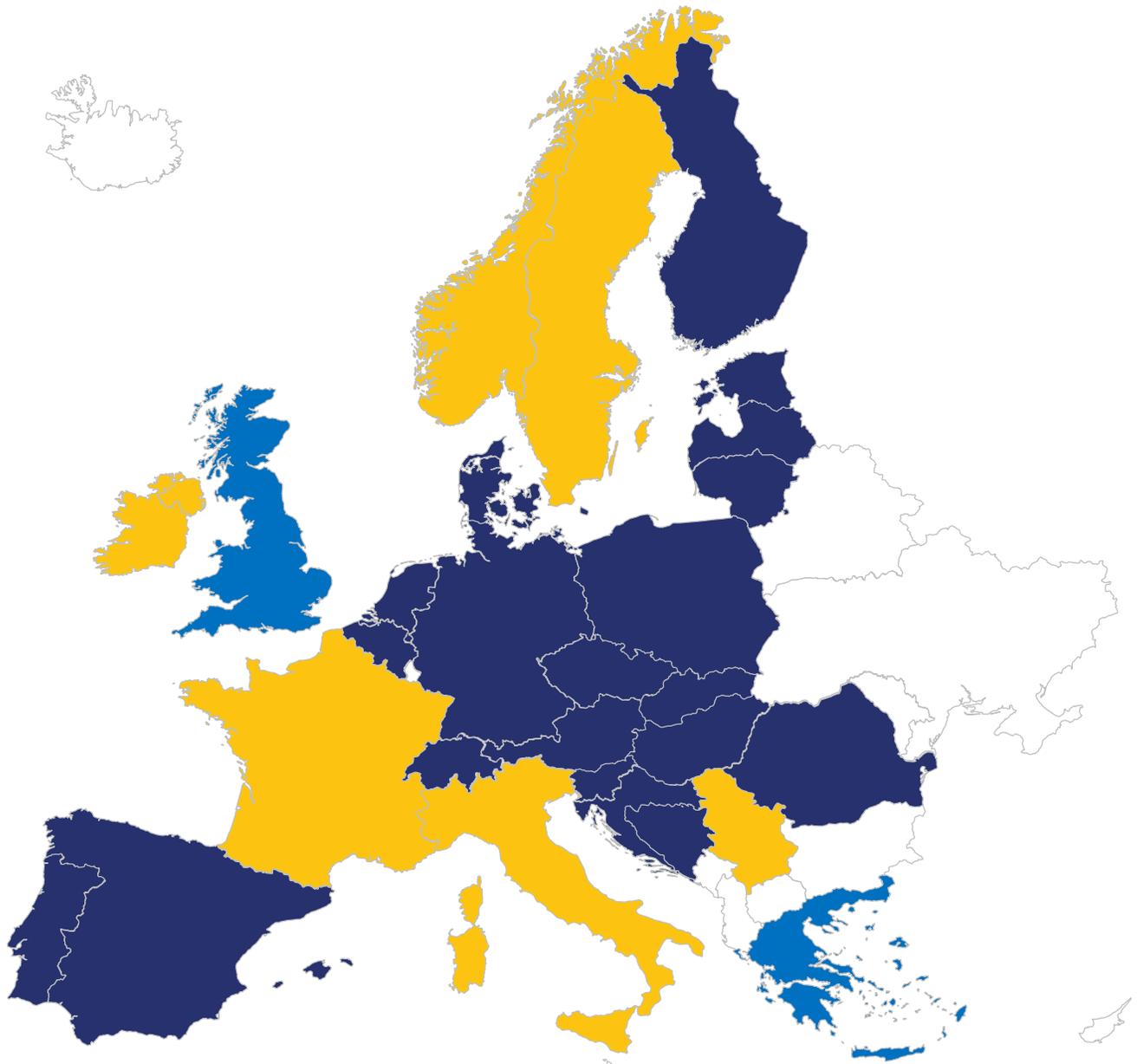
Key:

| | |
|------------|--------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | Yes |
| Light Blue | No |

Black Start - How often does the TSO practise the method of the BS process (for example using a training simulator)?



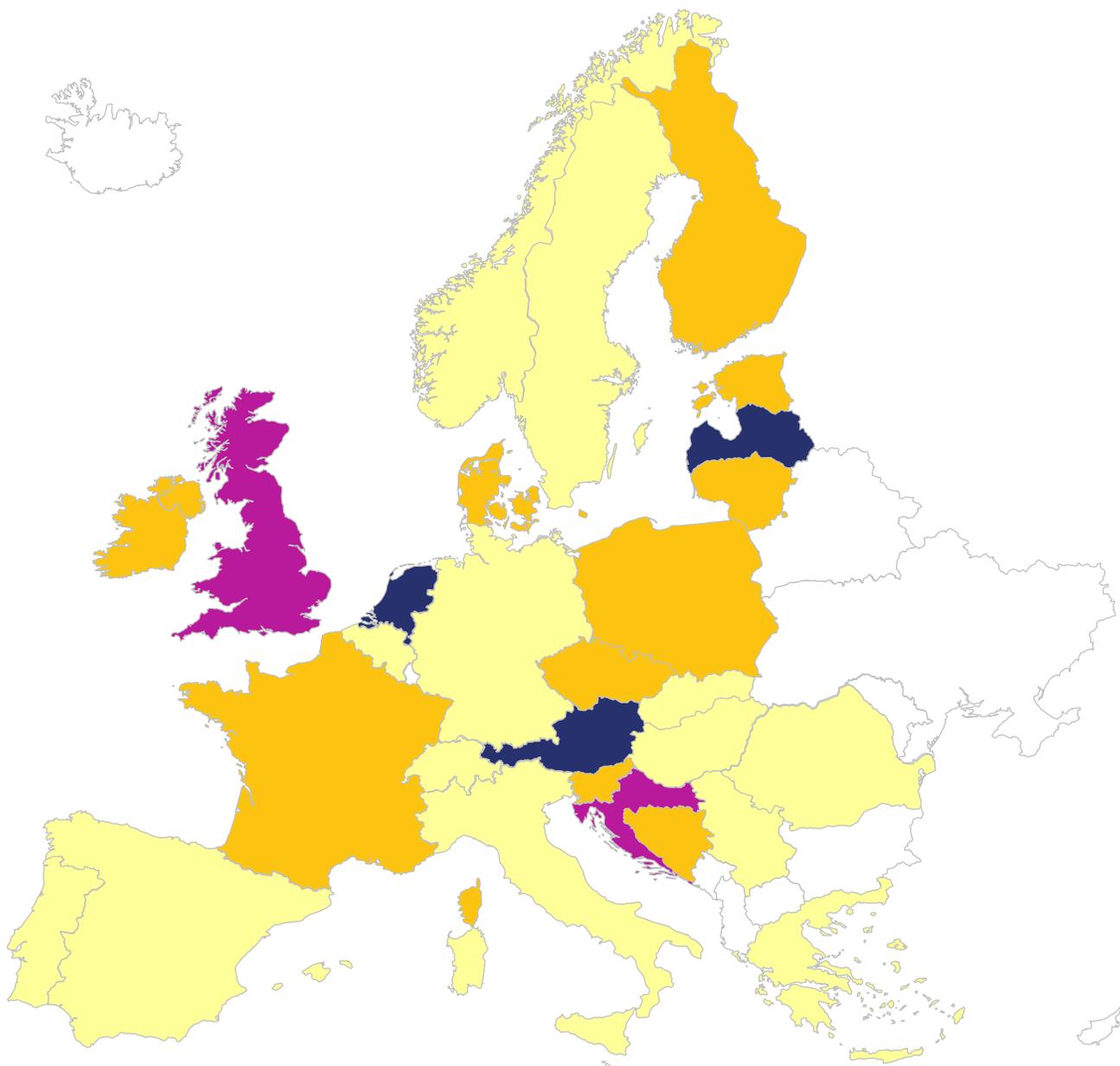
Black Start - Should be the Black start service provided by a single unit or it is allowed to be a part of a power plant?



Key:

- Missing data
- N/A
- Yes, it can be part of the power plant
- No, it has to be a single unit

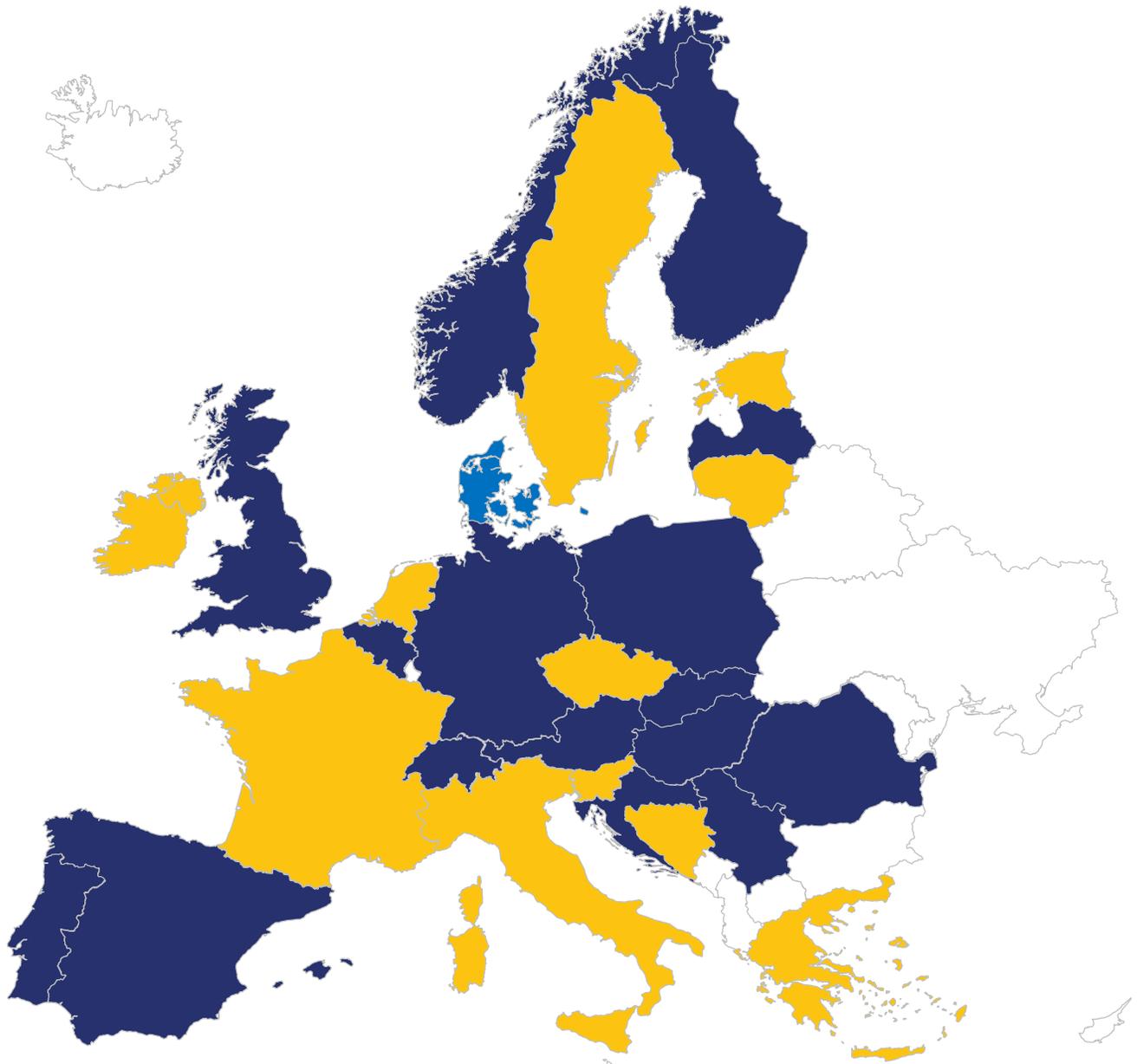
Black Start - How long is the acceptable non-availability period of the BS unit (planned, for example: resurrection & maintenance of the unit)?



Key:

| | |
|------------|---|
| White | Missing data |
| Orange | N/A |
| Dark Blue | It is not allowed |
| Light Blue | Less than one day |
| Blue | Between 1 and 3 days |
| Grey | Between 4 and 7 days |
| Yellow | Depending on the availability of other BS units |
| Purple | More than one week |

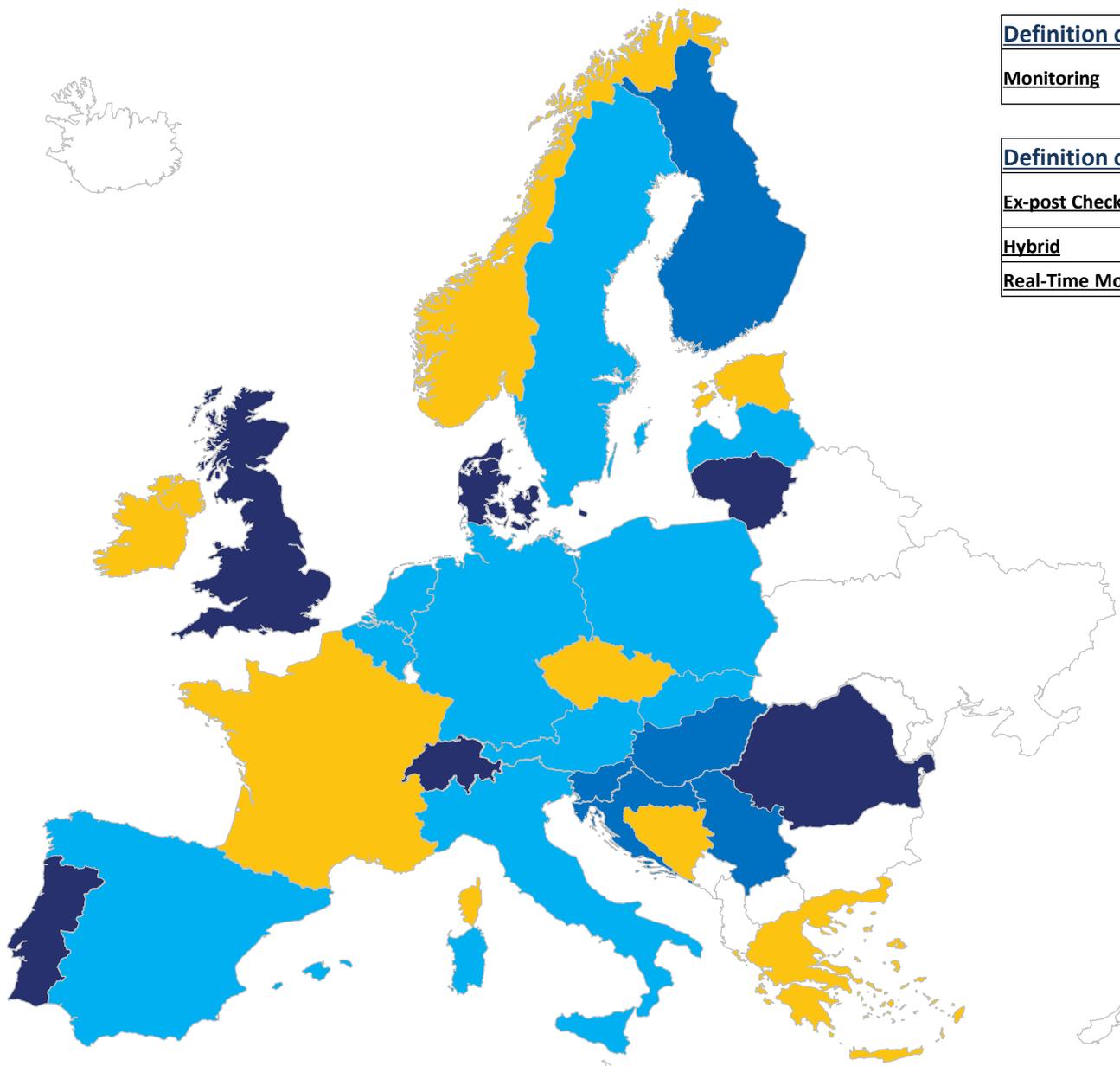
Black Start - Is there a regulated gradient for the BS unit?



Key:

| | |
|-------------|------------------------------|
| White | Missing data |
| Yellow | N/A |
| Dark Blue | No |
| Medium Blue | Yes, 0-100MW/15 min |
| Light Blue | Yes, 101MW-200MW/ 15 min |
| Grey | Yes, more than 200 MW/15 min |

Black Start - Monitoring of the black start service?



Definition of question

| | |
|-------------------|--|
| Monitoring | Refers to the type of monitoring in place by the system operator to ensure performance of plant. |
|-------------------|--|

Definition of answer

| | |
|-----------------------------|---|
| Ex-post Check | When the monitoring of performance of plant carried out 24 hours after the delivery period. |
| Hybrid | Combination. |
| Real-Time Monitoring | Monitoring of delivery of ancillary services in real time. |

Key:

| | |
|---|----------------------------|
|  | Missing data |
|  | N/A |
|  | Real time monitoring/tests |
|  | Ex post check |
|  | Hybrid |