

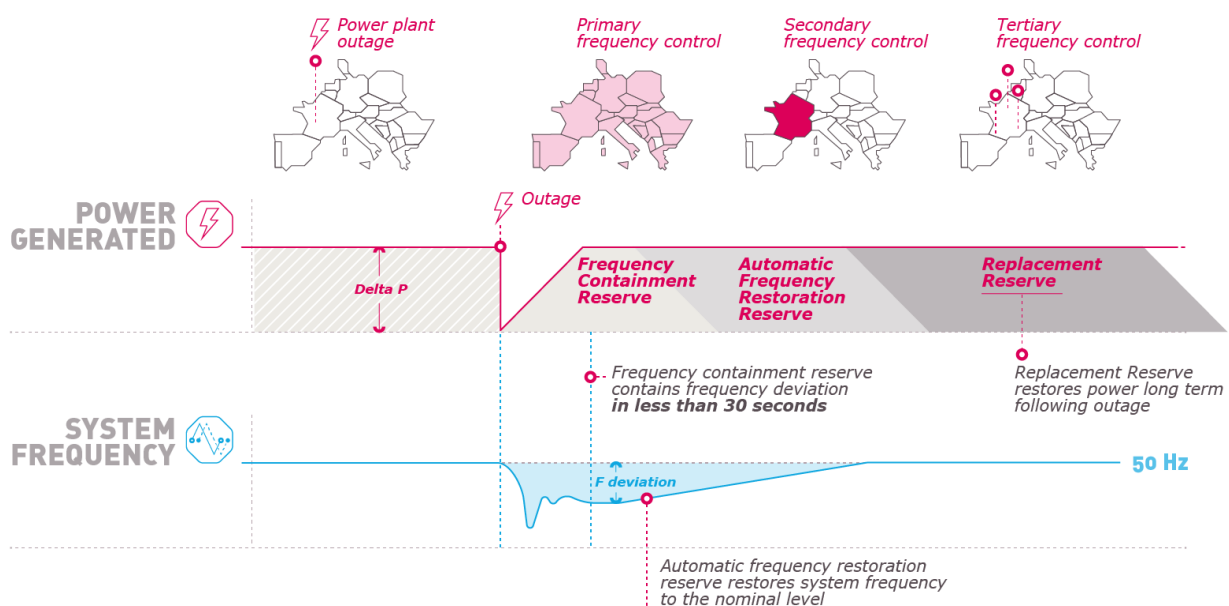
D4.1 Flexibility within the electrical systems through demand side response: introduction to balancing products and markets in Germany, France, and the UK

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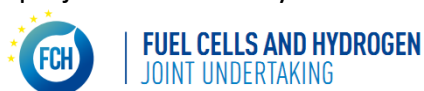
Keywords: balancing market, ancillary services, France, Germany, UK.

In order to ensure the reliability and the quality of supply within electrical systems, the operation of electrical networks requires an exact balancing of electrical flows: the demand has to match the generation at anytime. Balancing markets and ancillary services are the services necessary to support the transmission of electric power from generators to consumers. Traditionally these services have been provided by generators. However, the integration of intermittent generation and the development of smart grid technologies have prompted a shift in the equipment that can be used to provide ancillary services.

In the context of the project H2 Mobility Europe, these contracts are of interest, as buffer storage installed at electrolytic hydrogen refuelling stations can enable flexible operation of electrolyzers for hydrogen supply. Smart operation strategies make it possible to decouple the hydrogen generation profile from the hydrogen end user consumption profile and hence monetize flexibility by providing balancing services to the electrical system. The revenues of such contracts is expected to decrease the net production cost of hydrogen.



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Dissemination Level: Public

Flexibility within the electrical systems through demand side response:

Introduction to balancing products and markets in Germany, France, and the UK



Synthesis of balancing products open to demand response in Germany

| Type of reserve | Activation | | | Access to market | | | Product specifications | | Auctions | | |
|---|--|--|---|------------------|---------------|-----------------|------------------------------------|---|--|--|---|
| | Dynamic | Type | Duration | Minimum lot size | Voltage level | Pooling allowed | Direction | Time slices | Payment | Selection rule | Activation rule |
| PRIMARY CONTROL RESERVE FCR | 50% of required reserve released within 15s & 100% of required reserve released within 30s | Undifferentiated activation. All participating units react proportionally to their contracted capacities and to the observed frequency deviation | For the reference incident, the reserve must be kept activated for 15 minutes minimum | 1 MW | Any | YES | Positive AND Negative | 4 hours long time slices (6 time slices each day) | Payment for capacity (pay as cleared) | Offers are selected in the capacity price merit order until the reserve requirement is fulfilled | All selected offers are activated |
| SECONDARY CONTROL RESERVE aFRR | 100% of the required reserve activated within 5 minutes | Differentiated activation: the TSO sends a (de-)activation order specifically to each participating unit | The possible activation duration is unlimited during the whole duration of the contract | 1 MW | Any | YES | Positive OR Negative | 4 hours long time slices (6 time slices each day) | Payment for capacity & Payment for energy activated (pay as bid) | Offers are selected in the capacity price merit order until the reserve requirement is fulfilled | Selected offers are activated by the TSO following the energy price merit order |
| TERTIARY CONTROL RESERVE mFRR | 100% of the required reserve activated within 15 minutes | Differentiated activation: the TSO sends a (de)activation order specifically to each participating unit | The possible activation duration is unlimited during the whole duration of the contract | 1 MW | Any | YES | Positive OR Negative | 4 hours long time slices (6 time slices each day) | Payment for capacity & Price for energy activated (pay as bid) | Offers are selected in the capacity price merit order until the reserve requirement is fulfilled | Selected offers are activated by the TSO following the energy price merit order |

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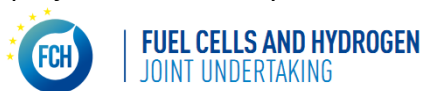
Introduction to balancing products and markets in Germany, France, and the UK



Synthesis of balancing products open to demand response in France

| Type of reserve | Activation | | | Access to market | | | Product specifications | | Auctions | | | |
|--|--|--|--|---|---------------|-----------------|---|---|---|---|--|---|
| | Dynamic | Type | Duration | Minimum lot size | Voltage level | Pooling allowed | Direction | Time slices | Schedule | Payment | Selection rule | Activation rule |
| PRIMARY CONTROL RESERVE | 50% within 15s 100% within 30s | Undifferentiated activation. All participating units react proportionally to the observed frequency deviation | For the reference incident, the reserve must be kept activated for 15 minutes minimum | 1 MW | Any | YES | Positive AND Negative | 1 week from Monday to Sunday Day +2 | Every working days | Payment for capacity (1week) | Financial merit order | All selected offers are activated |
| SECONDARY CONTROL RESERVE | Emergency activation ramp of 133 seconds | Undifferentiated (de-) activation National activation via the N signal | No limitation unless the end of the availability contract | 1 MW | Any | YES | Positive AND Negative | 1 hour | No auction: compulsory reserve mechanism. A secondary market exists | Flat rate of ~18 €/MW/h, activated energy = SPOT price | Compulsory reserve | All participating units reacts to a national undifferentiated activation signal (N) |
| Evolution secondary control reserve | | Differentiated signal activation | | | | | | | | RTE will activate the best offer (merit order device) | | Only participants selected by RTE with a differentiated signal. |
| TERTIARY CONTROL RESERVE | 100% of the required reserve activated within 13 minutes (FR), 30 minutes (CR) or up to 2 hours (AM, IL) | Differentiated activation: the TSO sends an (de-)activation order specifically to each participating unit | The possible activation duration can reach up to 120 min. for FR, 90 min. for CR, variable time slice duration for AM and IL | 10 MW (relaxed to 1 MW for demand response) | Any | YES | Only Positive for FR and CR, IL, Positive OR Negative for AM | Annual contracts for FR, CR, and IL, 6 time slices a day for AM | Annual tender for FR, CR and IL Working day prior to the contract start for AM. | Payment for availability only for FR, CR and IL. Payment for energy activated for all types of products | Financial merit order (availability payment for FR, CR and IL) | Financial merit order (energy payment) |

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Synthesis of balancing products open to demand response in UK

| Service | Volume Requirements | Upward or downward regulation? | Activation Principle | Response Time | Response Duration | Allowed Providers | Aggregation Allowed? | Min. Unit Size | Availability Window? | Availability Payments (£/MW/hr) | Utilisation Payments (£/MWhr) | Market Value (£/MW/yr) | Over delivery acceptable? |
|--------------|---------------------|--------------------------------|----------------------|----------------|-------------------|-------------------|----------------------|----------------|----------------------|---------------------------------|-------------------------------|------------------------|---------------------------|
| BM | | Both | Dispatch | 5m | 1-1.5h | BM Units | In theory | 1MW | Live Market | - | 0-12,500 | | |
| STOR - C | 3000MW | Down | Dispatch | ~15m TP | 2h | All | Yes | 3MW | Defined | 0-10 | 60-250 | | Yes |
| STOR - F | | Down | Dispatch | ~15m TP | 2h | Non-BM | Yes | 3MW | TP | 0-5 | 60-200 | | Yes |
| STOR - PF | | Down | Dispatch | ~15m TP | 2h | Non-BM | Yes | 3MW | TP | 0-2 | 60-200 | | Yes |
| EO STOR | <300MW | Down | Dispatch | <20m | 2h | Non-BM | Yes | | Defined | - | | | Yes |
| Fast Reserve | | Down | Dispatch | 2m | 15m | All | Yes | 50MW | | 6-8* | 100-150 | ~35,000 | Yes |
| DSBR | 500MW | Down | Dispatch | | 2-4h TP | Demand | Yes | | TP | Service withdrawn | | | Yes |
| Dynamic FFR | 1200MW | Both | Automatic | <10s | 30m | All | Yes | 10MW | TP | 10-20* | - | 90-190,000 | Yes |
| MFR | | Both | Automatic | <10s | 30m | BM Units | No | 1MW | Live Market | | | | Yes |
| EFR | | Both (sym) | Automatic | <1s | 15m | All | Yes | 1MW | TP | | - | 30-52,000 | No |
| Static FFR | 800MW | Down | Automatic | 30s | 30m | All | Yes | 10MW | TP | ~3.2 | - | ~28,000 | Yes |
| FCDM | | Down | Automatic | 2s | >30m | Demand | Yes | 3MW | TP | ~2.5 | - | ~22,000 | Yes |
| DTU | 309MW | Up | Dispatch | Flexible | Flexible | Demand | Yes | 1MW | Defined | 1.50 | 60/75 | 10-15,000 | Yes |

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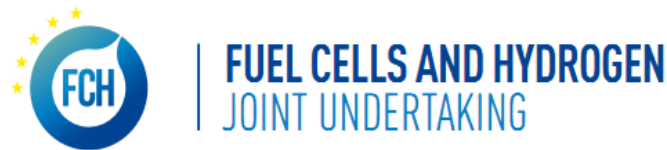


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