






# Reserves (2013)



## Action levels to maintain generation-load balance

	Reserve Capacity	Call time	Involved actors	Participation	Annual costs : who pays ?	
<b>1</b> <b>Frequency Containment Reserve - FCR</b> CONTRACTS (weekly tender)	66 MW 	< 30 s	Austrian generators	Voluntary	Capacity : variable	All generators with capacity >5MW
<b>2</b> <b>Frequency Restoration Reserve - FRR</b> CONTRACTS (weekly tenders/ daily price adjustments)	200 MW  200 MW 	< 5 min	Austrian generators	Voluntary	Capacity : variable Energy : variable	78% generators 22% balance groups (BG)
<b>3</b> <b>Replacement Reserve - RR</b> CONTRACTS (weekly and daily tenders)	280* MW  125 MW 	< 10 min	Austrian generators	Voluntary	Capacity : variable Energy : variable	Pos. Capacity: 78%/22% Energy/neg. Cap.: BG

\*incl. failure reserve

Market based balancing mechanism

 Upward activations

 Downward activations

# Tertiary reserve : design & data (2012)



## 1. Important design variables

### Balance responsibility

Energy program  
Gate closure times

Program time unit: 15 minutes  
DA generation schedule: 14:30

BRP Imbalance definition

Total balance (production & consumption combined)

### Balancing service provision

Procurement mechanisms

Tender  
(Bids based on capacity price)

Reserve requirements

Prequalification required

Timing of BSMs

6 energy prices / day

BSM pricing mechanisms

Pay-as-bid

Bid requirements

First bid: 10 MW – 50 MW  
Following bids: 25 – 50 MW

### Imbalance settlement

Imbalance pricing mechanism

Single (BP<sup>1)</sup>)

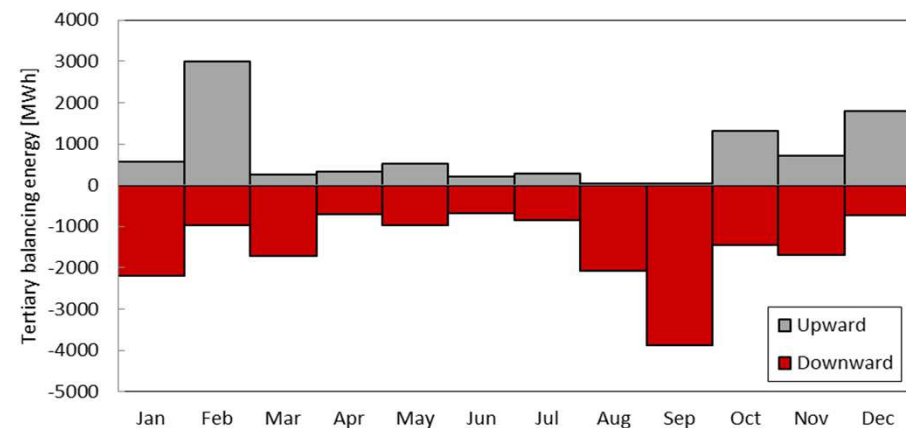
Frequency of settlement

Monthly settlement

## 2. Zoom on cash-out mechanism

BRP	SYSTEM		
	Upward trend Generation > Load	Balanced Generation - Load	Downward trend Generation < Load
Positive imbalances	BRP has to pay BP <sup>1)</sup>	0	BRP gets paid BP
Negative imbalances	BRP gets paid BP	0	BRP has to pay BP

## 3. Activated tertiary volumes 2012



Footnotes:

1) **BP - Balancing Price** includes costs and revenues for Tertiary Control, Secondary Control, Unintentional Deviation and miscellaneous costs/revenues ;

**One price for each quarter of an hour; Ø 2012: 51,20 EUR/MWh**

Tertiary balancing energy		Secondary balancing energy		Commercial exchanges for balancing	
Upward	Downward	Upward	Downward	Import	Export
9,1 GWh (0,013% of consumption)	17,9 GWh (0,026% of consumption)	221,7 GWh (0,32% of consumption)	492,8 GWh (0,71% of consumption)	0 GWh	0 GWh
158,21 EUR/MWh	-6,07 EUR/MWh	120,64 EUR/MWh	-22,36 EUR/MWh	/	/

# Reserve/Balancing needs and opportunities

---



- Needs:
  - Reducing the total costs of balancing market
  - Increasing the level of competition
  
- Opportunities
  - Increase the number of suppliers
    - Enable aggregation (under discussion)
    - Cooperation with other TSOs (deregulation of balancing market for external suppliers,..)
  - Reduce the needed amount of balancing energy
    - Imbalance Netting Cooperation with other TSOs

# Reserves (2012)



Action levels to maintain generation-load balance

		Reserve Capacity	Call time	Involved actors	Participation	Annual costs : who pays ?	
1	Frequency Containment Reserve - FCR	<div>CONTRACTS (weekly) (tender)</div> <div>68 MW</div> <div>↑↓</div>	< 30 s	Swiss and German generators	Voluntary	Capacity : Pay-as-bid	All users via network user tariff
2	Frequency Restoration Reserve - FRR	<div>CONTRACTS (weekly) (tender)</div> <div>400 MW</div> <div>↓↑</div>	< 5 min	Swiss generators	Voluntary	Capacity : Pay-as-bid Energy : SwissIX +/- 20 %	Capacity: All users via network tariff Energy: BRP
3	Replacement Reserve - RR	<div>CONTRACTS (week daily) (tender)</div> <div>450 MW</div> <div>↑</div> <div>390 MW</div> <div>↓</div>	≥ 15 min ≥ 20 -35 min	Swiss generators	Voluntary	Capacity : Pay-as-bid Energy : Pay-as-bid	Capacity: All users via network tariff Energy: BRP

Market based balancing mechanism

↑ Upward activations

↓ Downward activations

# Balancing energy (2012)



## 1. Important design variables

<b>Balance responsibility</b>	
Energy program Gate closure times	Program time unit: 15 minutes
BRP Imbalance definition	DA generation schedule: 14:30 Firm schedule: 45 min to the delivery Start
	Total balance (production & consumption combined)
<b>Balancing service provision</b>	
Procurement mechanisms	Weekly/daily Auctions
Reserve requirements	Prequalification required
Timing of BSMs	Weekly/ 6 Blocks Daily
BSM pricing mechanisms	Pay-as-bid
Bid requirements	5 MW (pooling allowed)
<b>Imbalance settlement</b>	
Imbalance pricing mechanism	Balance Energy Price <sup>2</sup>
Frequency of settlement	Monthly settlement

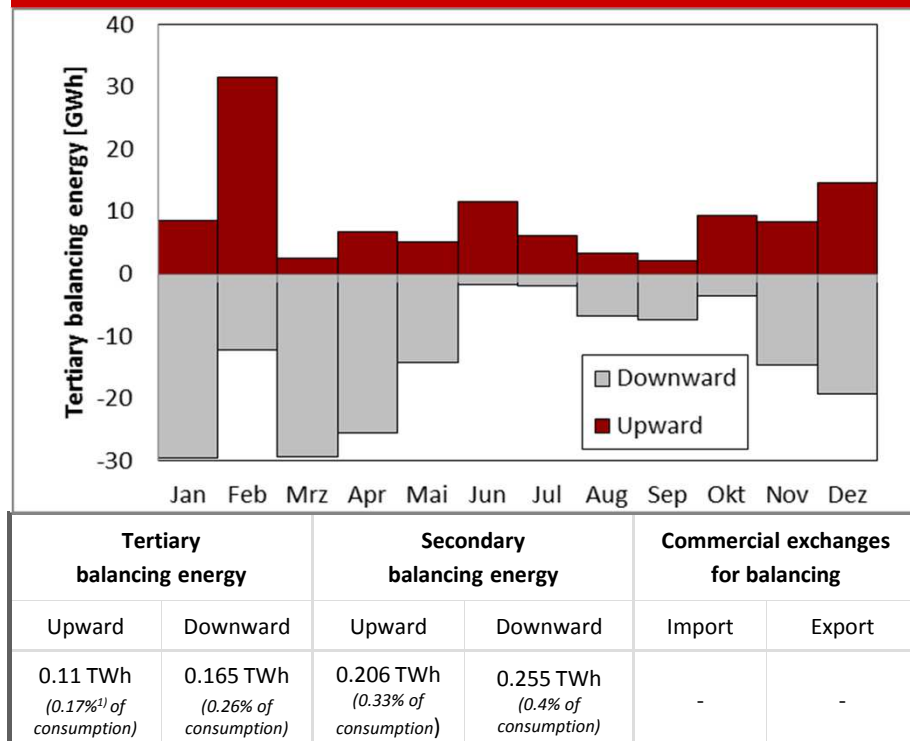
Footnotes:

- Consumption of 63 TWh in 2012
- Two price system according in which the prices for Balance Energy are classified according to the direction of a balance group discrepancy

## 2. Zoom on cash-out mechanism

<b>BRP</b>	
<b>Short (Deficit)</b>	BRP has to pay Balance Energy Price for deficit
<b>Long (Surplus)</b>	BRP gets paid Balance Energy Price for surplus

## 3. Activated tertiary volumes (from January 2012 to December 2012)



## Reserve/Balancing needs and opportunities

---



- Needs
- Opportunities

# Reserve (2012)



## Action levels to maintain generation-load balance

	Reserve Capacity	Call time	Involved actors	Participation	Annual costs : who pays ?	
<b>1</b> Frequency Containment Reserve - FCR	CONTRACTS (bilateral) triennial ~ 700 MW (UCTE 3000 MW)	< 30 s	French generators <sup>(1)</sup>	Compulsory	Capacity : 9 €/MW.h Energy : 0 €/MW.h	All users via the network user tariff
<b>2</b> Frequency Restoration Reserve - FRR	CONTRACTS (bilateral) triennial 500 ~ 1000 MW depending on demand	< 15 min	French generators <sup>(1)</sup>	Compulsory	Capacity : 9 €/MW.h Energy : +/- 17 €/MW.h	All users via the network user tariff
<b>3</b> Replacement Reserve - RR	CONTRACTS (tender) triennial Rapid reserve 1000 MW	13 min	French generators <sup>(1)</sup> and consumers	Compulsory	Contracted Capacity : NA Energy : variable	BRPs: Physical withdrawal fee (0.11 €/MWh) to cover contracted capacity costs  Unbalanced BRPs pay balancing charges
	CONTRACTS (tender) triennial Additional reserve 500 MW	30 min				
	CONTRACTS (annual) Electro-intensives 230 MW	< 2 h	French consumers		Overall reserve charges 500 M€	All network users pay overcosts from ✓ Congestion Management ✓ Reconstitution of automatic control reserves
	OTHERS Unfixed	variable	French generators <sup>(1)</sup>  Consumers Foreign players British TSO	Compulsory  Voluntary		

## Market based balancing mechanism



Upward activations



Downward activations

<sup>(1)</sup> intermittent generation non-included

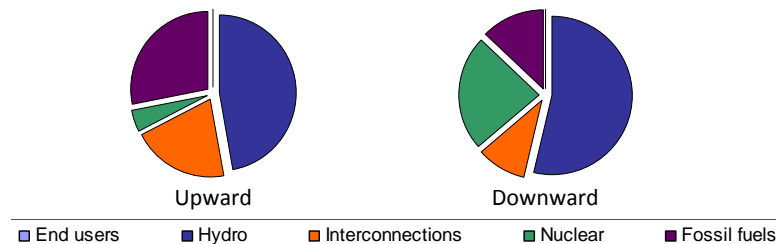
# Tertiary reserve : design & data (2012)



## 1. Important design variables

<b>Balance responsibility</b>	
BRP balancing obligations	Program time unit : 30 minutes
Energy program Gate closure times	No obligation to be balanced (incentives only)
BRP Imbalance definition	Day-ahead generation schedule : 4:30 PM Firm schedule : 1h before delivery
	Total balance (production and consumption combined)
<b>Balancing service provision</b>	
Procurement mechanism	Tertiary : compulsory & voluntary bids with merit order selection
Timing of BSM	Steps of 30 minutes 6 price ranges / day
BSM pricing model	Pay-as-bid
Minimum bid requirement	10 MW
Existing balancing exchange program	BALIT (RTE & National Grid) TSO-TSO model w/o common merit order
<b>Imbalance settlement</b>	
Frequency of settlement	Monthly settlement ; several months after ending of the month
Imbalance pricing mechanism	Dual pricing (EPEX spot based)

## 2. Tertiary reserve activations per technology

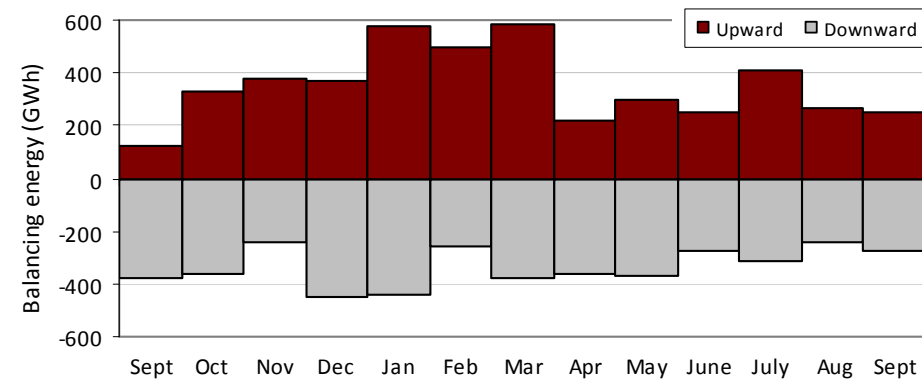


## 3. Zoom on cash-out mechanism

BRP	SYSTEM		
	Upward trend Generation < Load	Balanced Generation - Load	Downward trend Generation > Load
Positive imbalances	EPEX Spot price	EPEX Spot price 2010 average : 46€/MWh	Min (WAPd/1+k), EPEX 2010 average : 36€/MWh
Negative imbalances	Max (WAPu (1+k), EPEX) 2010 average : 67€/MWh	EPEX Spot price	EPEX Spot price

WPA : up/downward weighted average price on the 30 min period  
k : yearly defined factor for global balancing account equilibrium (k = 8%)

## 4. Activated tertiary volumes (from Sept. 2009 to Sept. 2010)



Tertiary balancing energy		Secondary balancing energy		Commercial exchanges for balancing	
Upward	Downward	Upward	Downward	Import	Export
3.4 TWh (0.64% of consumption)	3.7 TWh (0.7% of consumption)	1.5 TWh (0.32% of consumption)	1.5 TWh (0.32% of consumption)	945 GWh	500 GWh



## Reserve/Balancing needs and opportunities

---








- Needs
- Opportunities

# Reserve (2012)



Action levels to maintain generation-load balance

		Reserve Capacity	Call time	Involved actors	Participation	Annual costs : who pays ?	
1	Frequency Containment Reserve - FCR	CONTRACTS (weekly) (tender)					
		551 MW 	< 30 s	German and Swiss generators	Voluntary	Capacity : variable	All users via network user tariff
2	Frequency Restoration Reserve - FRR	CONTRACTS (weekly) (tender)					
		~ 2100 MW  ~ 2100 MW 	< 5 min	German generators	Voluntary	Capacity : variable Energy : variable	Capacity: All users via network tariff Energy: BRP
3	Replacement Reserve - RR	CONTRACTS (daily) (tender)					
		~ 2400MW  ~ 2400MW 	< 15 min	German generators	Voluntary	Capacity : variable Energy : variable	Capacity: All users via network tariff Energy: BRP

 Upward activations

 Downward activations

# Tertiary reserve : design & data (2012)



## 1. Important design variables

<b>Balance responsibility</b>	
Energy program Gate closure times	Program time unit: 15 minutes
BRP Imbalance definition	DA generation schedule: 14:30 Firm schedule: 15 min to the next 1/4 hour <sup>1)</sup>  Total balance (production & consumption combined)
<b>Balancing service provision</b>	
Procurement mechanisms	Tender (Bids with CMO selection based on capacity price)
Reserve requirements	Prequalification required
Timing of BSMs	6 energy prices / day
BSM pricing mechanisms	Pay-as-bid
Bid requirements	5 MW (pooling allowed)
<b>Imbalance settlement</b>	
Imbalance pricing mechanism	Single (WAP <sup>2)</sup> )
Frequency of settlement	Monthly settlement

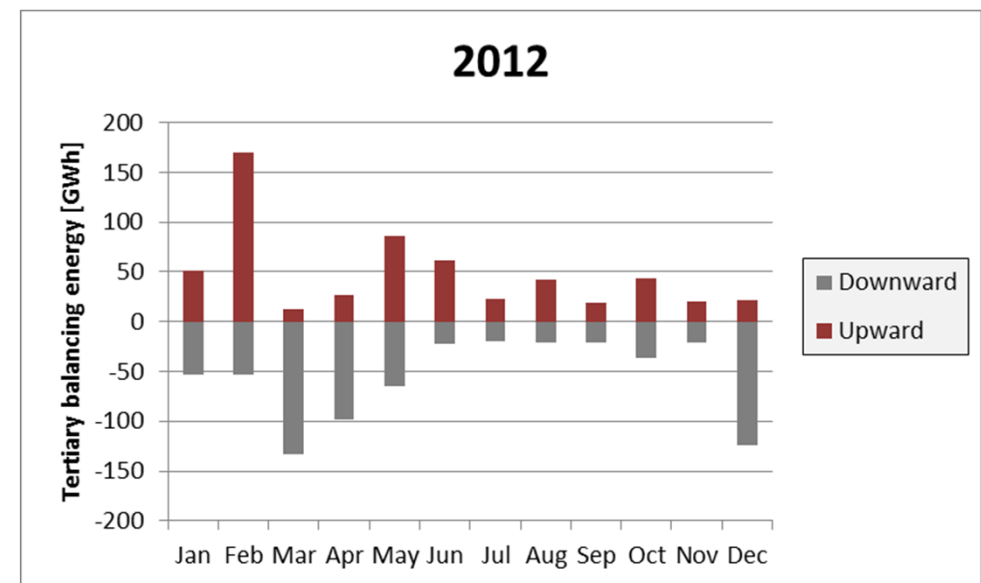
Footnotes:

- 1) Example: The schedule for the ¼ hour starting at 13:15 can be adjusted till 12:59. Additionally the schedule of the BRP can be adjusted ex-post till 16:00 of the next working day (Ex-post netting between BRPs).
- 2) WAP: Weighted average price of secondary and tertiary energy prices + non transferrable costs; intraday spot prices (as thresholds) are also take into account; depending on the usage of the reserved capacity additional fees can be applied

## 2. Zoom on cash-out mechanism

<b>BRP</b>	SYSTEM		
	Upward trend Generation > Load	Balanced Generation - Load	Downward trend Generation < Load
<b>Positive imbalances</b>	BRP has to pay WAP <sup>2)</sup>	0	BRP gets paid WAP
<b>Negative imbalances</b>	BRP gets paid WAP	0	BRP has to pay WAP

## 3. Activated tertiary volumes (from January 2012 to December 2012)



# Reserve/Balancing needs and opportunities

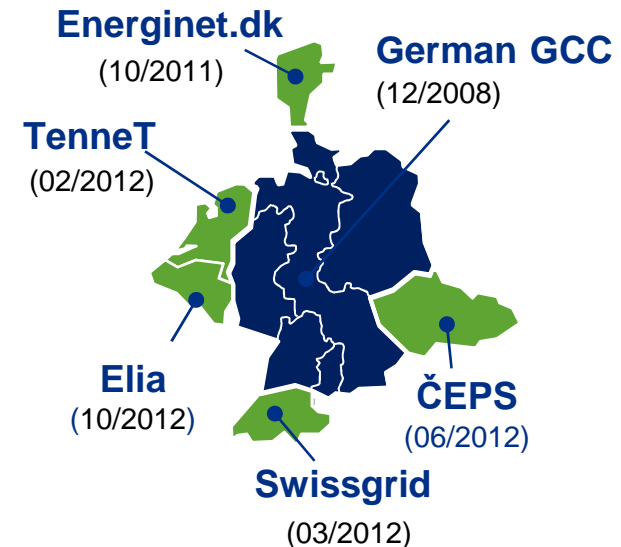


## International Grid Control Cooperation (IGCC)

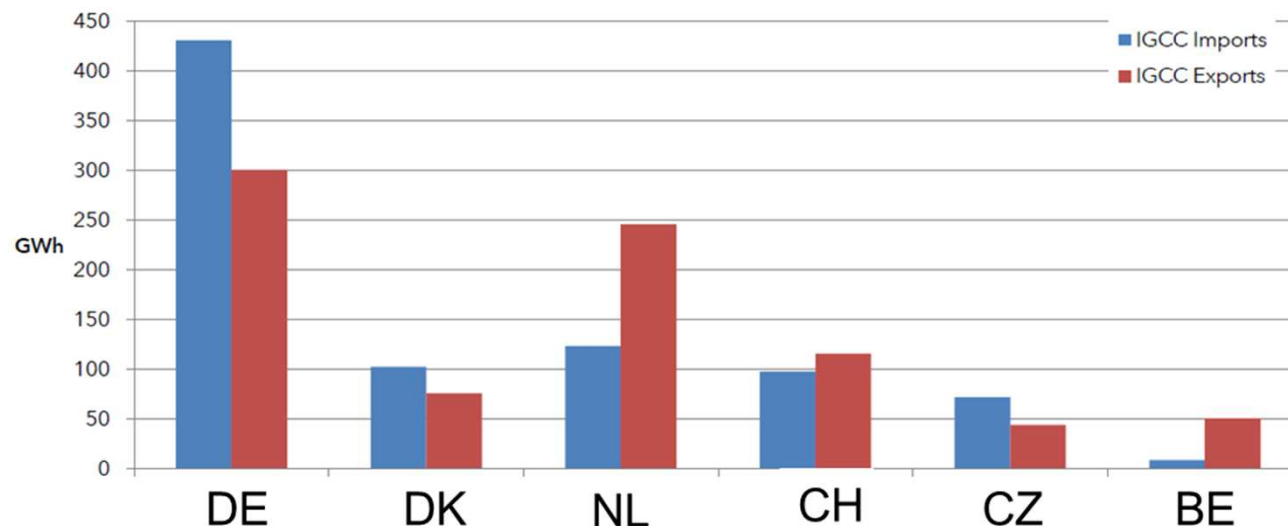
### Key benefits

- IGCC: Utilization of optimization potentials by TSO-TSO cooperation – “Smart Grid on TSO level”
- De-central structure of load-frequency-control with a coordination component
- Real-time IGCC Congestion Management ensures that IGCC exchange does not exceed available transmission capacity
- Significant cost savings, higher control quality, stable and reliable operation

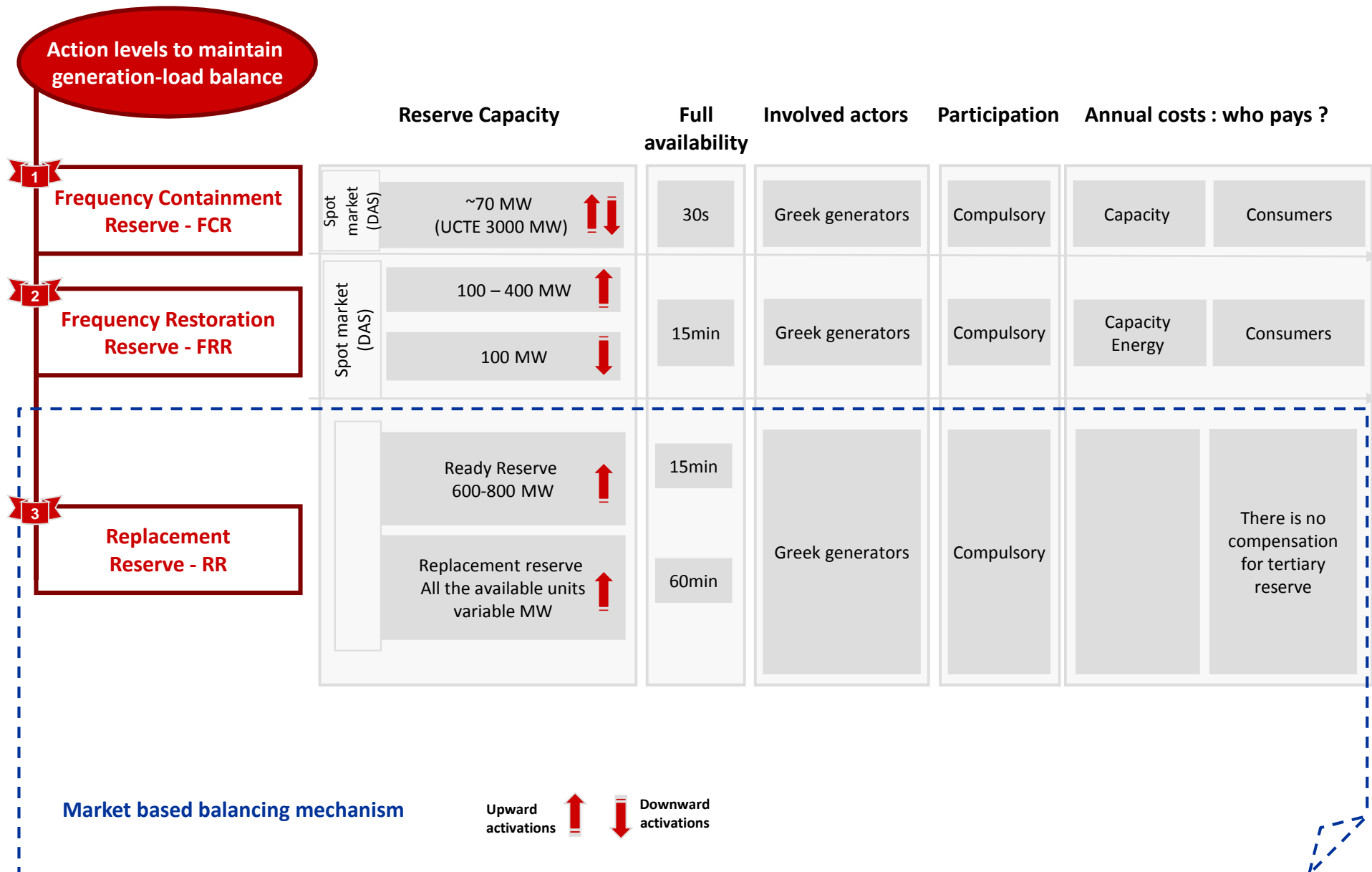
### Participating TSOs



### Saved Energy in 2012 Total IGCC Energy Interchange



# Reserve (2012)



# Balancing energy (2012)



## 1. Important design variables

### Balance responsibility

Energy program  
Gate closure times

BRP Imbalance definition

Program time unit: 60 minutes

Day-ahead generation schedule:  
13:00

Separate for producers and  
suppliers

### Balancing service provision

Procurement mechanisms

Reserve requirements

Timing of BSMs

BSM pricing mechanisms

Bid requirements

Tender/compulsory for primary  
& secondary

Steps of 1 hour for 24 hours

24 h co-optimization/Marginal

N.A.

### Imbalance settlement

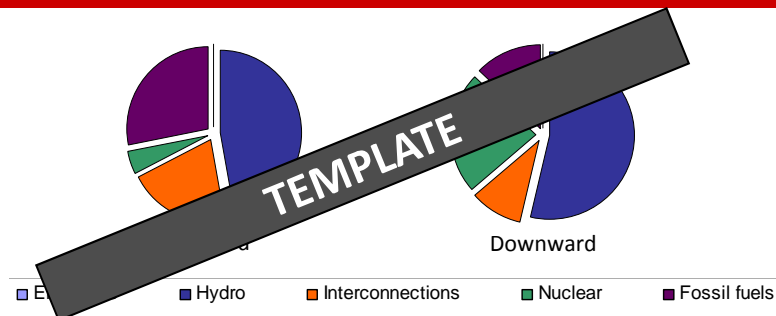
Imbalance pricing mechanism

Frequency of settlement

Dual (based on DAS,EX-POST)

Monthly settlement (M+ 1)

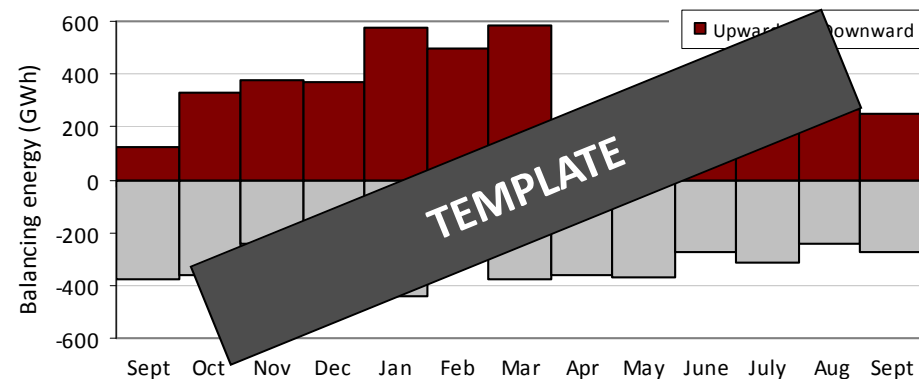
## 2. Tertiary reserve activations per technology : N.A.



## 3. Zoom on cash-out mechanism : N.A.

BRP	SYSTEM		
	Upward trend Generation > Load	Balanced Generation - Load	Downward trend Generation < Load
Positive imbalances	X	X	X
Negative imbalances	X	X	X

## 4. Activated tertiary volumes (from X to X) : N.A.



Tertiary balancing energy		Secondary balancing energy		Commercial exchanges for balancing	
Upward	Downward	Upward	Downward	Import	Export
X TWh (X% of consumption)	X TWh (X% of consumption)	X TWh (X% of consumption)	X TWh (X% of consumption)	X GWh	X GWh
€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh

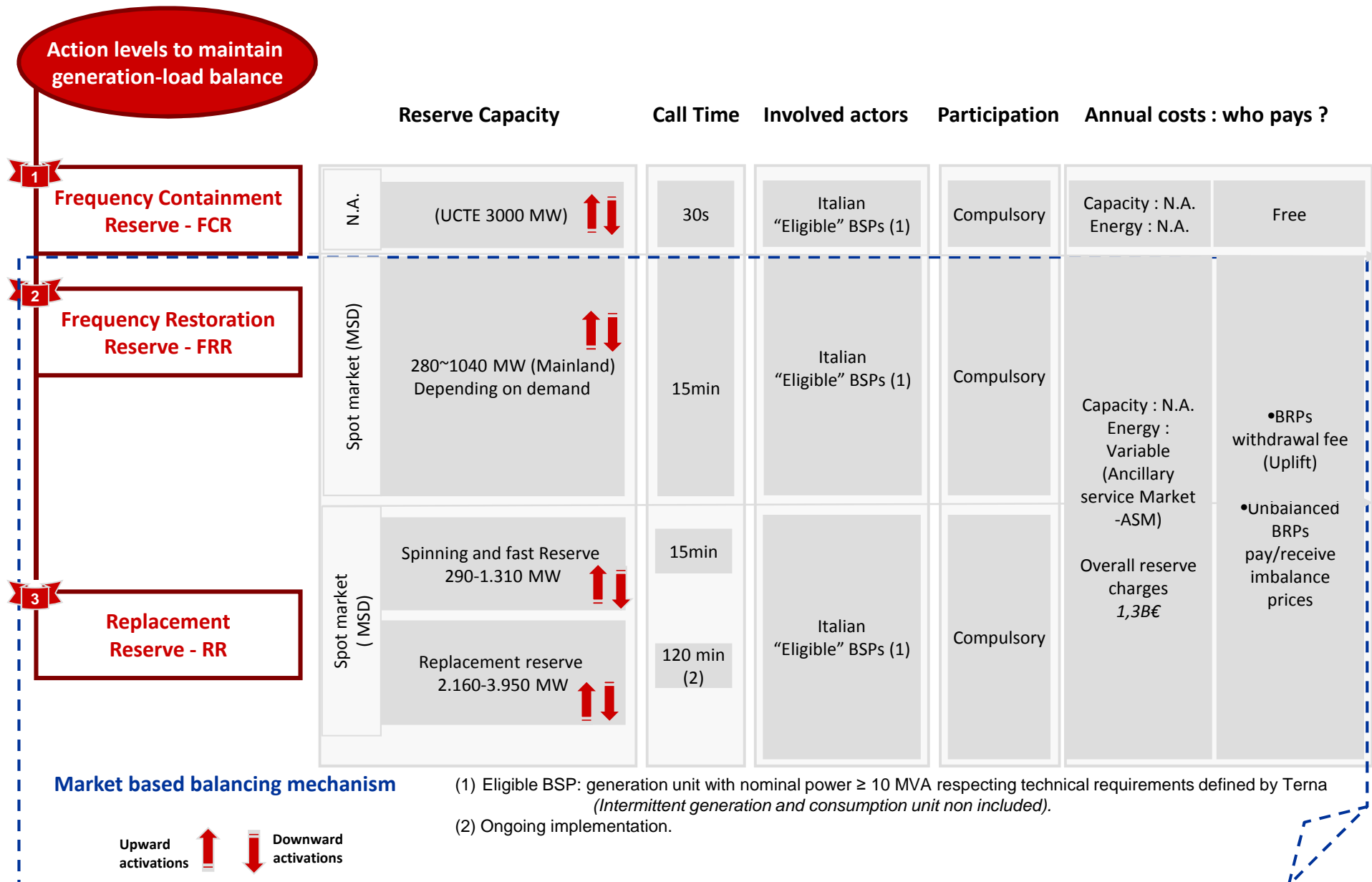
## Reserve/Balancing needs and opportunities

---



- Needs
- Opportunities

# Reserve (2012)





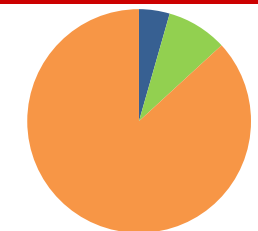
# Balancing energy (2012)



## 1. Important design variables

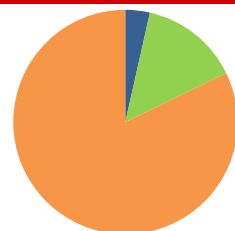
<b>Balance responsibility</b>	
Energy program Gate closure times	Program Time Unit: 60 minutes / 15 minutes (1)
BRP Imbalance definition	Intraday Generation schedule in (D-1): 15:10 Firm schedule: around 4h before delivery
	Separate for injection and withdrawal
<b>Balancing service provision</b>	
Procurement mechanisms	Tertiary and secondary: bids with merit order selection.
Timing of BSMs	Steps of 1 hour in ASM - planning phase; 15 min in ASM - Real time. (2)
BSM pricing mechanisms	8 sessions: 3 ASM-planning phase+5 ASM-Real Time.
Bid requirements	Pay-as-bid
	Secondary and tertiary: min. Bid of 1MW
<b>Imbalance settlement</b>	
Imbalance pricing mechanism	Dual (based on DAM, ASM)
Frequency of settlement	Monthly settlement (M+ 1)

## 2. Tertiary reserve activations per technology (2012)



■ Hydro ■ Pump ■ Thermal

**Upward**



■ Hydro ■ Pump ■ Thermal

**Downward**

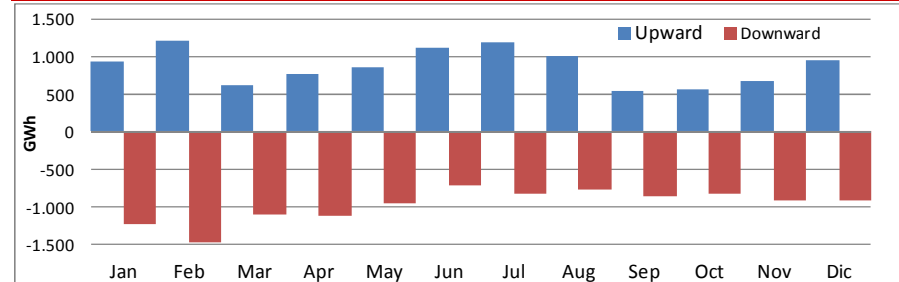
- (1) 15min: generation unit licensed to participate in Ancillary Service Market  
60 min: generation unit not licensed to participate in Ancillary Service Market and Consumption Unit  
(2) Generators bid hourly product but Terna selects bid for each 15 min in ASM-Real Time

## 3. Zoom on cash-out mechanism

	SYSTEM	
	Upward trend Generation > Load	Downward trend Generation < Load
<b>“Eligible” BRPs</b>		
<b>Positive imbalances</b>	$Min(minASM, DAM)$	$DAM$
<b>Negative imbalances</b>	$DAM$	$Max(maxASM, DAM)$
<b>Others (2)</b>		
<b>Pos./Neg. imbalances</b>	$Min(avgASM, DAM)$	$Max(avgASM, DAM)$

ASM= Ancillary service Market; DAM = Day Ahead spot market

## 4. Activated tertiary volumes (2012)



Tertiary Reserve activations		Secondary Reserve activations	
Upward	Downward	Upward	Downward
10,4 TWh	11.6 TWh	0.9 TWh	1.7 TWh
153€/MWh	27€/MWh	105€/MWh	37 €/MWh

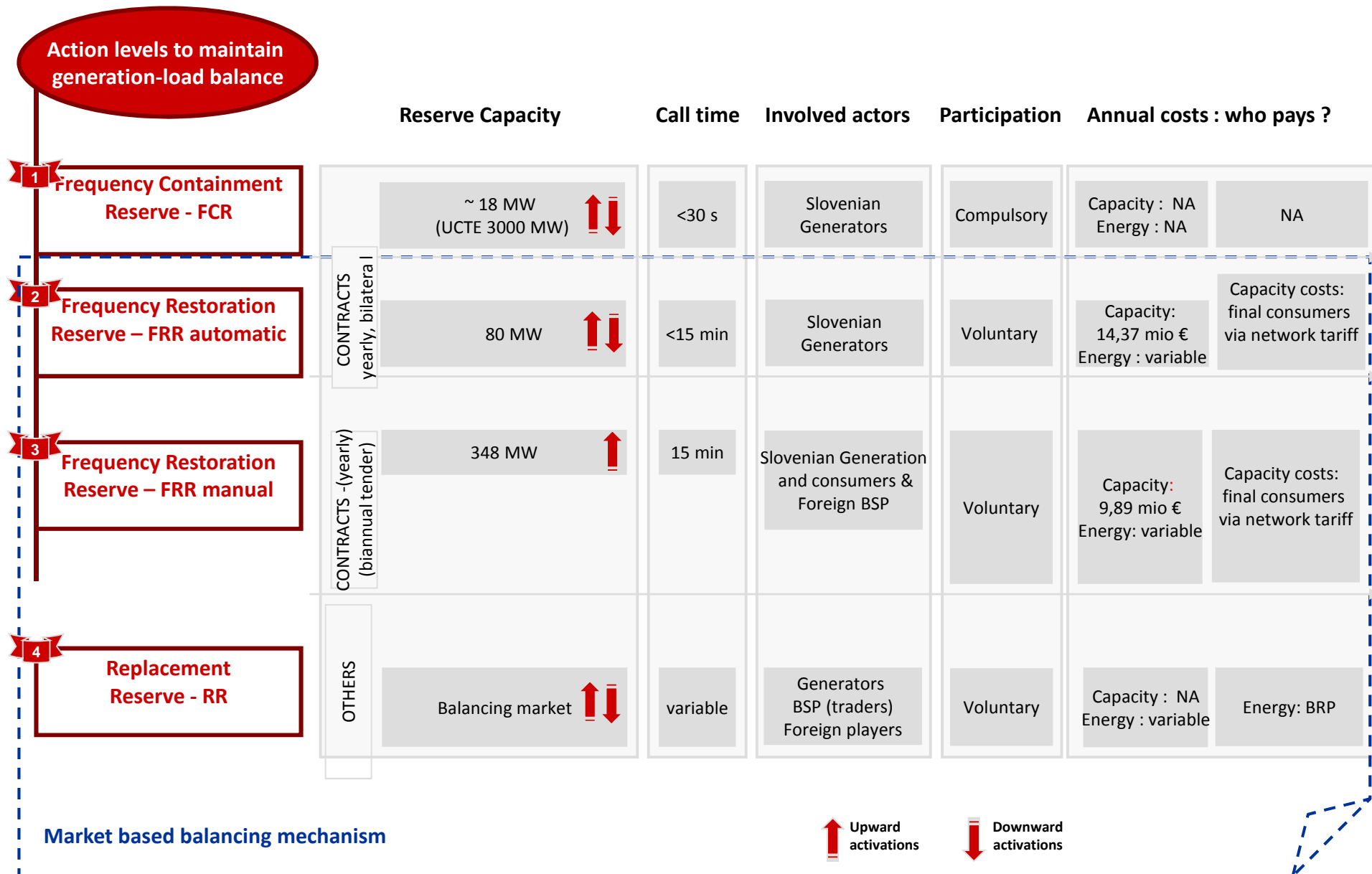
# Reserve/Balancing needs and opportunities

---



- Overall increase of intermittent RES generation in Europe.  
*In Italy is expected to continue to increase even in the short-medium term*
  - *9.600 MW wind*
  - *23.000 MW PV*
- The increasing amount of intermittent RES generation is an important driver from promoting the development of XB balancing solutions.
- Design of the Ancillary Service and balancing Market is dictated by the physical structure of the Italian grid and by the production mix composition
  - *Central Dispatch Model.*

# Reserve (2012)



# Balancing energy (2012)



## 1. Important design variables

### Balance responsibility

Energy program  
Gate closure times

BRP Imbalance definition

Program time unit PTU: 60 min

GCT: from 11am in D-1 to 1 hour before D

Total balance(s)  
for production & consumption

### Balancing service provision

Procurement mechanisms

Reserve requirements

Timing of BSMs

BSM pricing mechanisms

Bid requirements

Primary: mandatory  
Tender, Voluntary

ENTSO-E OH

Final GCT: before D (delivery)  
(continuous bidding)

Pay-as-bid

Volumes, price, grid location,  
Duration, No. of activations

### Imbalance settlement

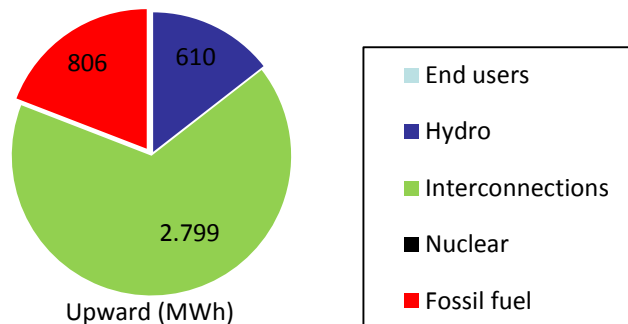
Imbalance pricing mechanism

Frequency of settlement

dual

Monthly settlement; more than  
one month after ending of the month

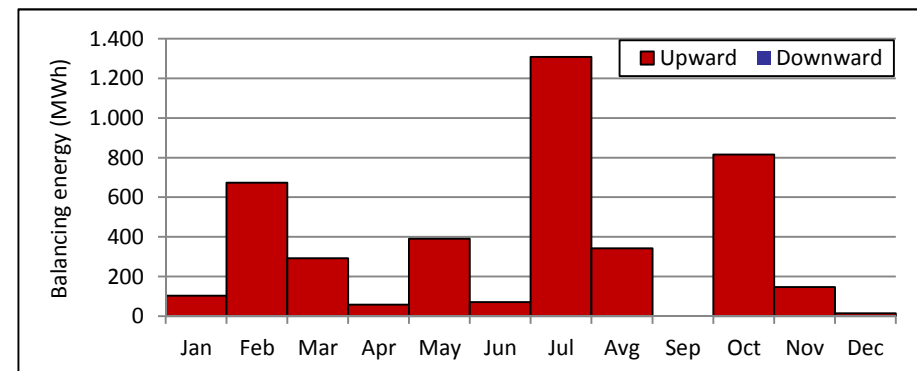
## 2. Tertiary reserve activations per technology



## 3. Zoom on cash-out mechanism

BRP	SYSTEM		
	Upward trend Generation > Load	Balanced Generation - Load	Downward trend Generation < Load
Positive imbalances	BSP Spot price	BSP Spot price 53,15 €/MWh	Average price of balancing energy 44,15 €/MWh
Negative imbalances	Average price of balancing energy 60,47 €/MWh	BSP Spot price	BSP Spot price

## 4. Activated tertiary volumes

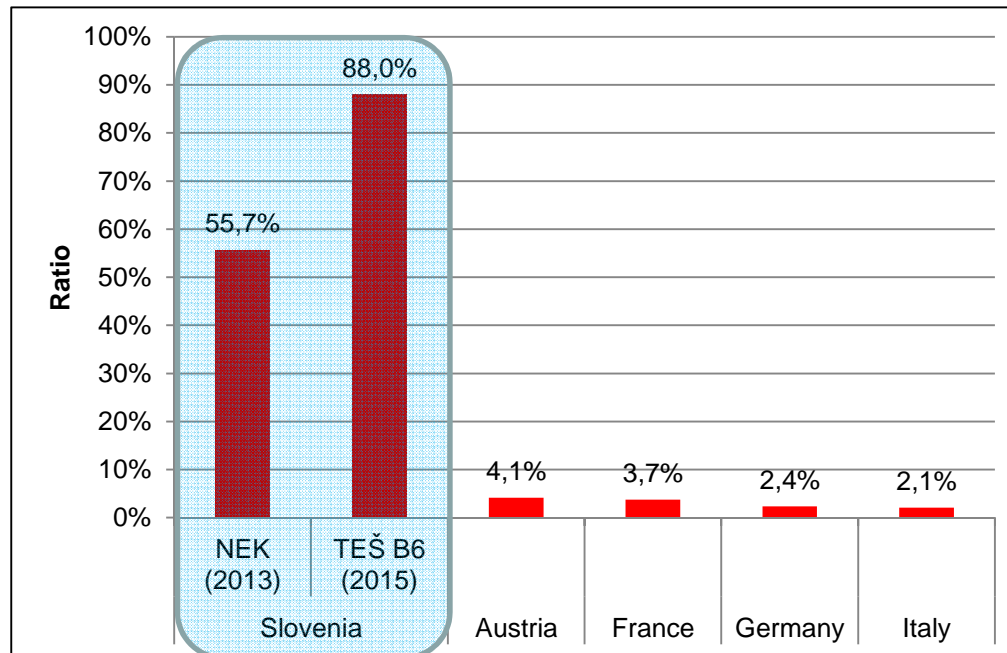


Tertiary balancing energy		Secondary balancing energy		Commercial exchanges for balancing	
Upward	Downward	Upward	Downward	Import	Export
4,2 GWh (0,034% of consumption)	0 GWh (0,0% of consumption)	106,3 GWh (0,85% of consumption)	192,8 GWh (1,54% of consumption)	0 GWh	0 GWh
155,8 €/MWh	/	79,4 €/MWh	33,1 €/MWh	/	/

# Reserve/Balancing needs and opportunities



- Relatively powerful production units in a small power system
- Not sufficient market investments in new generating capacity suitable for providing tertiary reserve to meet the long-term needs of TSO
- Slovenian ratio between required tertiary reserve and the difference between total installed power and peak power demand is the most unfavorable (see figure below)



## Slovenia

- Required tertiary reserve: 348 MW
- Total installed capacity of production: 2.700 MW
- Peak demand: 2.075 MW

## France

- Required tertiary reserve: 1.000 MW
- Total installed capacity of production: 123.510 MW
- Peak demand: 96.710 MW

- Slovenia is facing difficulties assuring sufficient amount of tertiary reserve capacity (NEK: 348 MW, TEŠ B6: 550 MW, increase of 57 %)
- New rules on reserve sharing and reserve exchange seems to be rather promising for our specifics





# Balancing Market Austria

19th IG CSE Meeting

13<sup>th</sup> March 2013



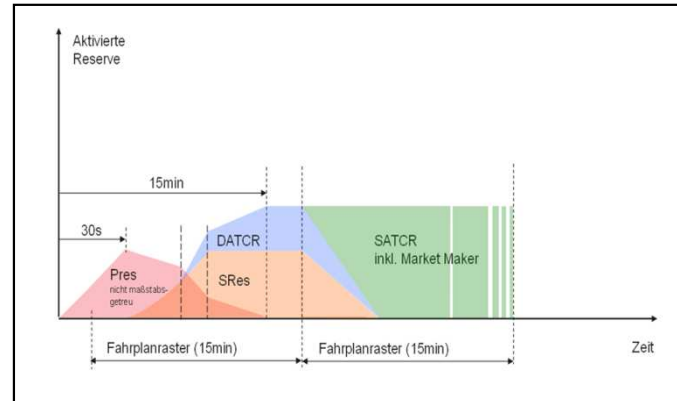
# Why Market based?



- **Primary Control Reserve (PCR/FCR)**
    - ElWOG 2006 (Austrian Electricity Act) defined that PCR procurement shall be market based
  - **Secondary Control Reserve (SCR/FRR)**
    - ElWOG 2010 (Austrian Electricity Act) defined that SCR procurement shall be market based
  - **Tertiary Control Reserve (TCR/RR)**
    - Since beginning of market opening in Austria TCR was procured market based (100% market opening since October 2001)
    - Procurement was performed by APCS (Austrian Power Clearing and Settlement)
- **Since 01.01.2012 all services are procured in a market based manner by APG!**



# Structure of Balancing Market



## Primary Control

**Weekly Tenders by APG  
since 2010-01-01**

Primary control power  
(no energy component)

+/- 66 MW (2013)

## Secondary Control

**Weekly Tenders by APG  
since 2012-01-01**

Capacity and energy price for  
reserves.  
Only energy price for day ahead  
balancing energy market

+/- 200 MW Secondary Control

## Tertiary Control

**Weekly Tenders by APG  
since 2012-01-01**

Capacity and energy price for  
reserves.  
Only energy price for day ahead  
balancing energy market

-125 MW / 280 MW

# Prequalified Reserves in Austria



- In Austria there is quite huge potential of reserves for balancing purposes.
- Nevertheless, APG is also interested to increase competition by enabling foreign market actors to participate in APGs tenders based on a TSO-TSO cooperation model (as foreseen in FG Balancing).
- Currently prequalified amounts:

	Austria
<b>PCR</b>	ca. +/- 550 MW
<b>SCR</b>	ca. +/- 2920 MW
<b>TCR</b>	ca. +/- 8290 MW

# Cross-border Projects of APG



- **Austria-Switzerland**

- Cross-Boarder exchange of Primary Control Power
- TSO-TSO Model

- **Austria – Slovenia – Swissgrid**

- Imbalance Netting of Secondary Control Power (INC – Imbalance Netting Cooperation)

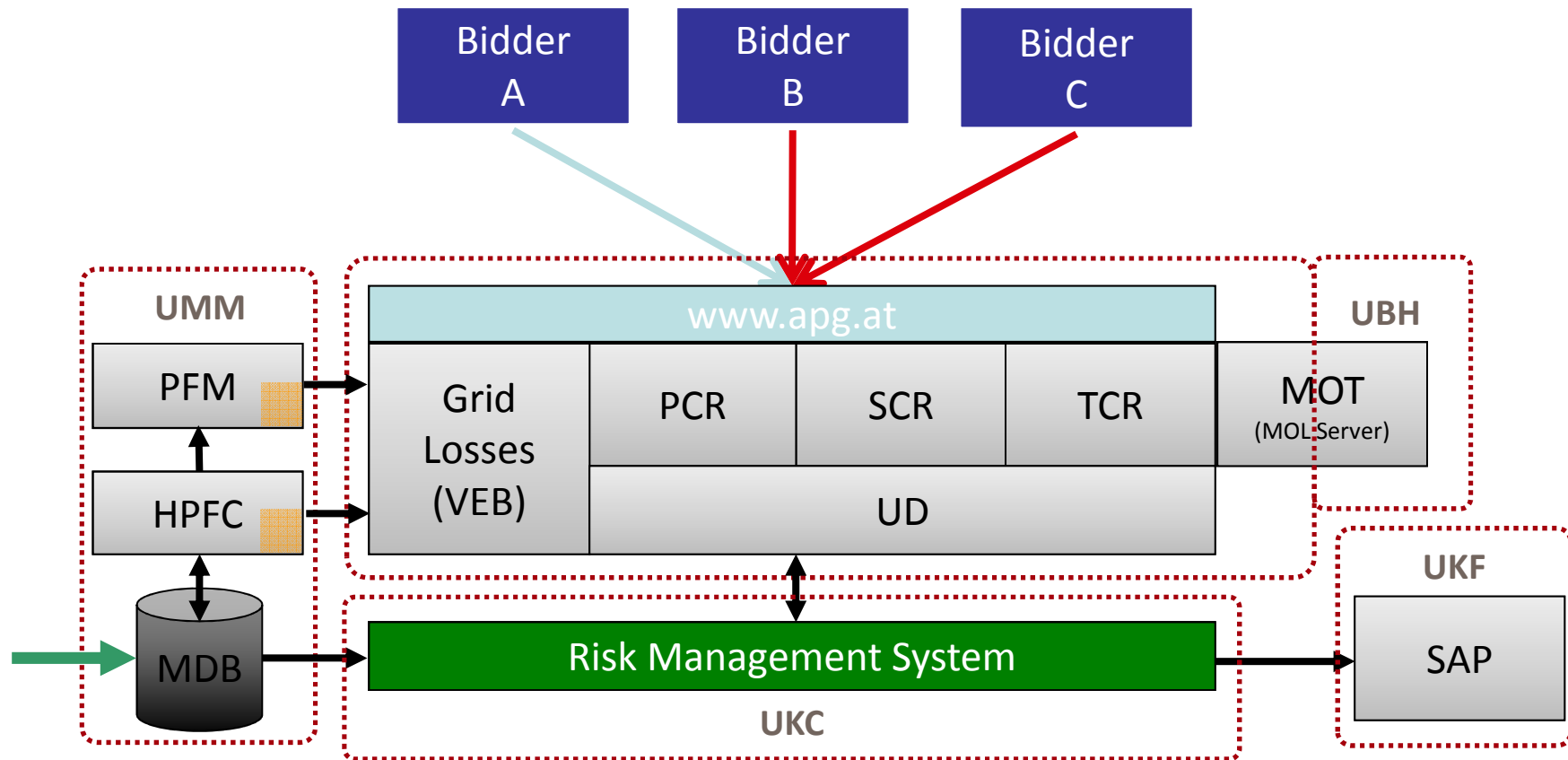
- **Austria – Germany**

- Cross-Boarder exchange of Tertiary Control Power
  - TSO-BSP Model (interim solution)
  - Cooperation with IGCC

# Fully Market Based and Integrated Tendering System



- „One-Stop-Market“ is established by APG!
- All necessary requirements for XB cooperation are fulfilled!



VEB.. Grid Losses PCR... Primary Control SCR.. Secondary Control TCR.. Tertiary Control  
UA.. Unintentional Deviation MOT.. Merit Order Tool PFM.. Portfoliomanagement MDB.. Market data base