E-Control „Capacity Markets“

Vienna, March 29, 2012

German Energy Transformation and Capacity Markets – The Need to Look Beyond National Borders

Prof. Dr. Christian von Hirschhausen, Prof. Dr. Thorsten Beckers,
Albert Hoffrichter, Alexander Weber + Study Project „Germalpina“
Berlin University of Technology, Workgroup for Infrastructure Policy (WIP)

Agenda

1. Introduction: “Capacity Instruments” are a Political Reality
2. Defining the Objectives and Range of Instruments
3. The German Energy Transformation and Already Existing Instruments
4. The Potential Role of Neighbouring Countries: Case of Austria
5. Conclusion

The Discussion about “Capacity Instruments” is a European-wide Reality

UK-EMR

D: Fossil-fuel support program

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Basic Market Architecture for the future Polish market

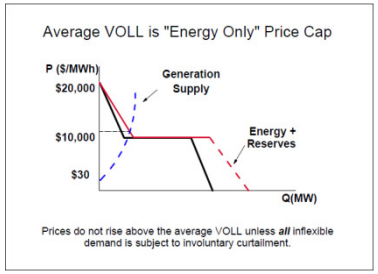
- **Integrated Energy and Ancillary Services Markets**
  - Day-Ahead, Intra-Day and Real-Time Market
  - Energy and reserves compete for access to the transmission grid
  - Coherent incentives for the grid users
  - Consistent rules throughout all market segments
- **Hedging instruments against the risk of congestion**
  - Financial Transmission Right (FTR) Markets
  - FTR allocation and FTR auction
- **Capacity Markets ensuring long-term generation adequacy**
  - Decentralized bilateral market
  - Centralized market run by TSO

LE POINT DE VUE DE **CLAUDE CRAMPES ET THOMAS-OLIVIER LÉAUTIER**

Marché de l’électricité : quand la France donne l’exemple

La création du premier marché de capacité électrique en Europe facilitera le renouvellement du parc nucléaire à partir de 2025.

In Germany, too, the Discussion on Capacity Markets is a Political Reality (08/09 December, 2011, 06-10 February, 2012)



Germany forced to buy Austrian electricity

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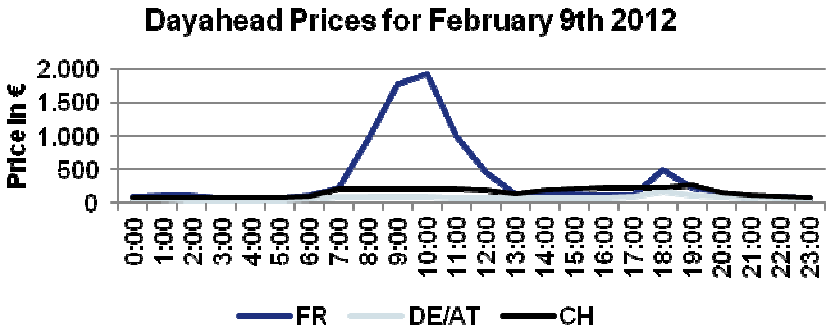
Deutscher Strom ist nicht mehr genug

Die Lage ist kritisch. Die Noteingriffe der Netzbetreiber nehmen zu. Zuletzt mussten sie auf Reserve-Kraftwerke in Österreich zurückgreifen



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Rationality of intervention in „open competition“: Not a question of „if“ but „who“ provides the public good

Supply side

System security / adequacy = public good

“Appropriate” forms of coordination considering long-living investments and dependencies

- Generation ←→ retail: Long-term contractual relationships or even vertical integration feasible and often to find
- Retail ←→ end consumers: Long-term contractual relationships problematical to some extent
- High political / regulatory risks on top of high market risks

→ Some rationales for regulatory intervention exist

Bid Cap

- Relevance compared to other problems should not be overrated

Demand side

System security / adequacy = public good

- Single end customers (or single retailers with access to DSM measures at end customer level) do not reduce their load voluntarily

Weak investment incentives for those measures that are prerequisites for load reductions

- Problem of “appropriate” forms of coordination considering long-living investments and dependencies (see above)
- Though only limited availability at demand side for load reduction measures to cap electricity prices

The Type of Instrument Depends upon Specific Objectives Sought

Type of service:

- Peaking capacity
- System services (e.g. reactive power)
- Certain characteristics
- ...

Time scale:

- Short term
- Medium term
- Long term

Spatial scope:

- European-wide
- Bi-national
- National
- Regional

Effective achievement of objectives

Short- and long-term security of supply

Limiting consumer payments (long-term perspective)

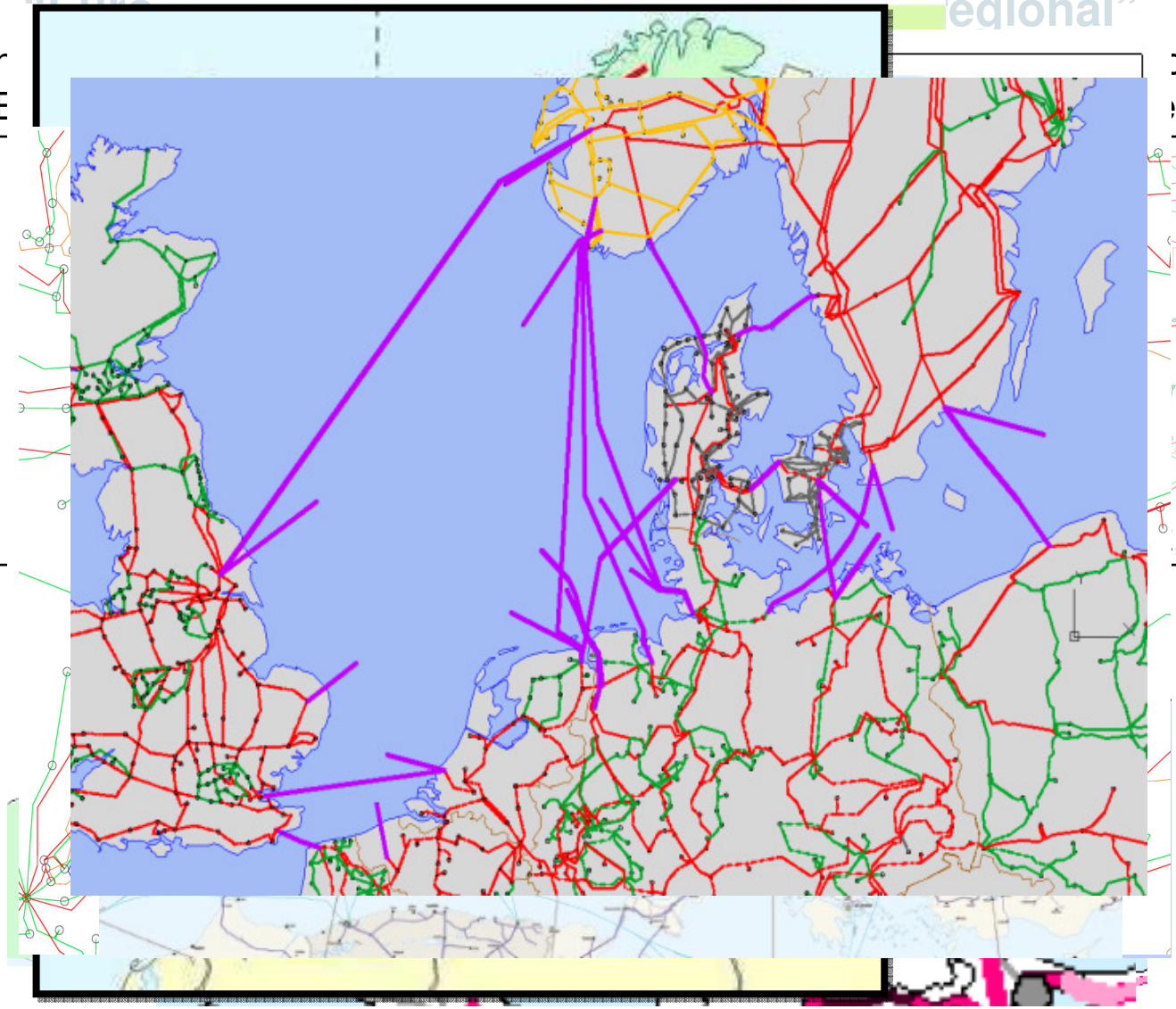
- Welfare effect of instrument choice
  - Risk bearing and risk costs
  - Incentives to efficient investments from system perspective
  - Incentives to efficient dispatch decisions
- Distributive effects
  - Generators - consumers
  - To distinguish: neighbour countries´ consumers and generators

Constraint: Avoid opportunistic behaviour towards sunk investments

Compatibility with environmental objectives

Transmission expansion can take two different forms: pan-European and regional

Electricity		
Natural Gas		



[Lochner, 2011]

Overview of capacity instruments

1) Strategic reserve

2) Operative reserve

3) Capacity payments

4) Capacity certificates

4.1) Capacity tender

4.2) Capacity requirements

5) Capacity options

5.1) Capacity options tenders

5.2) Capacity options requirements

6) Regulatory procurement contracts

7) Vertical integration
regulator – generation

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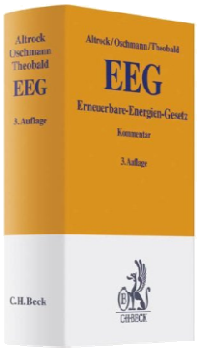
The Energy „Transformation“ in Germany

1991 ➡



Prof. Klaus Töpfer is German Environmental Minister; the German Feed-In Law is Created on 1 Jan., 1001 (StromEinspG)

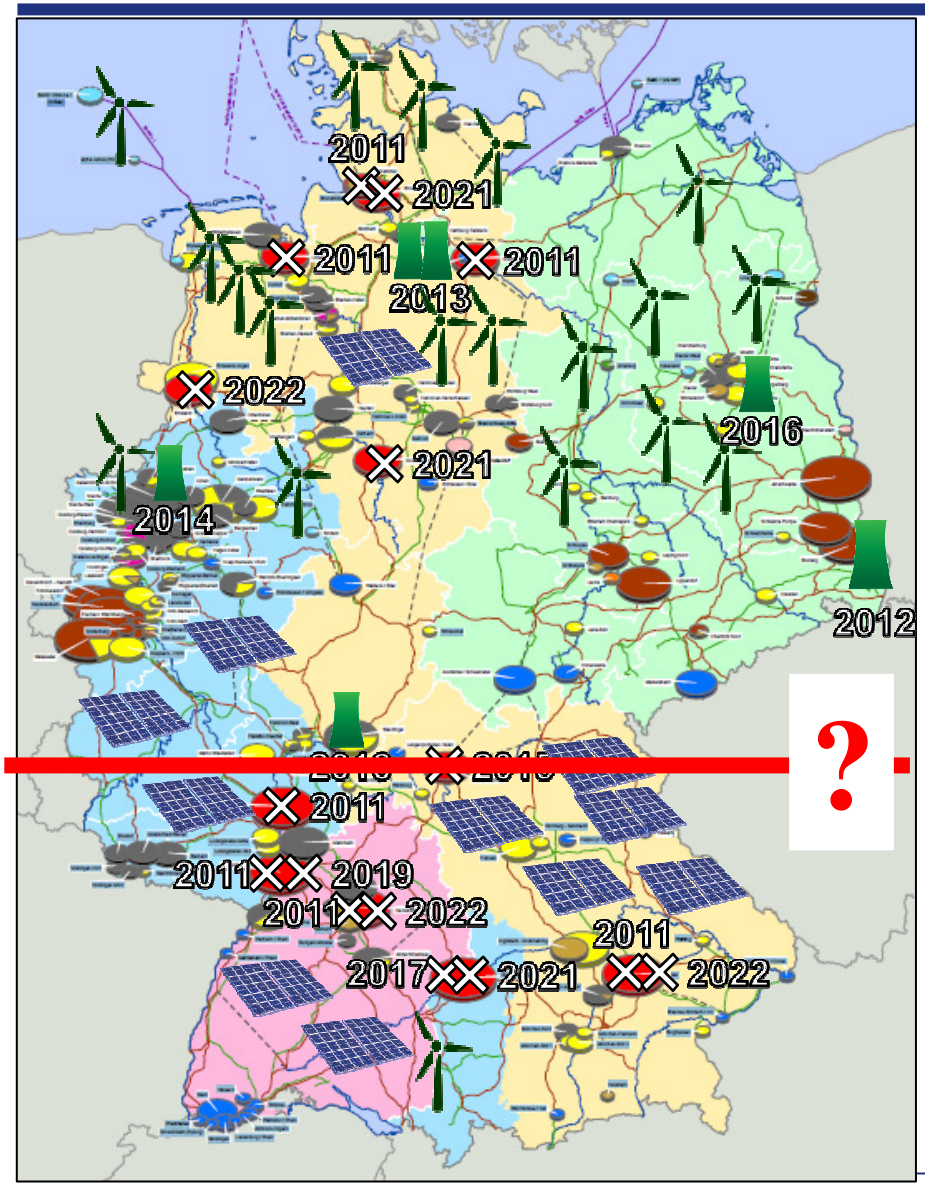
2001 ➡

Chanelleor Gerhard Schröder (SPD) and E.ON CEO Ulrich Hartmann (l.) agree on the end of nuclear power in Germany (11 June, 2001)

2011 ➡

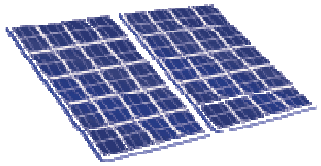
Chancellor Angela Merkel (CDU) announces the moratorium on nuclear power (7+1 plants) and the abandon of life-extension for remaining plants (14 March, 2011)

The German Energy System: Generation to 2020/2022



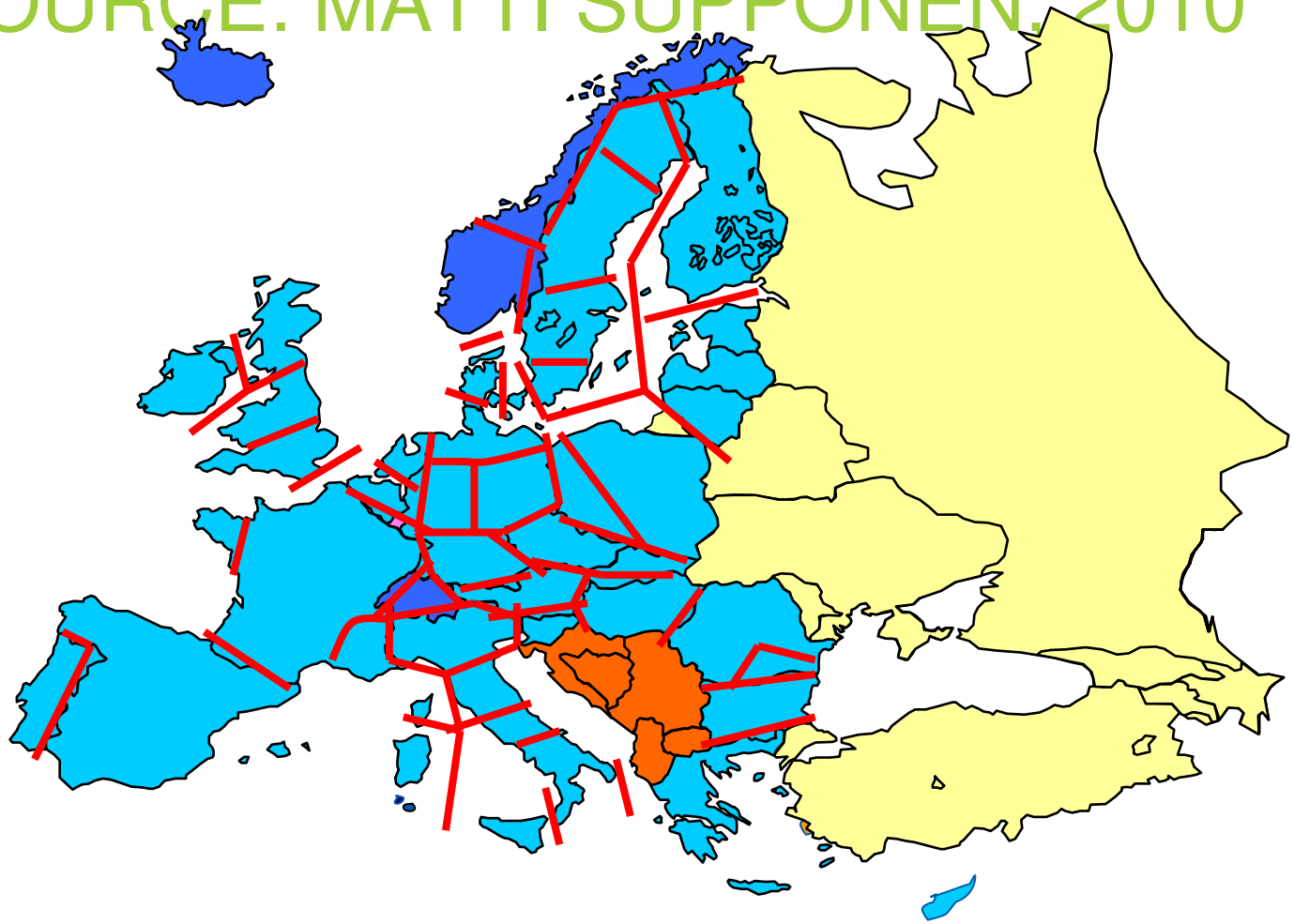
Renewables in Germany 12/2011:

Wind: 27,5 GW



Solar: 19,7 GW

Proposal for price zones in Europe SOURCE: MATTI SUPPONEN, 2010



Transmission Expansion is Well Under Way (though somewhat late); redispatch is limited (2-digit € mn.)

Static Nation-wide Analysis: Despite nuclear phase-out no „power gap“

Results of recent studies: No „power gap“ at least until 2020

- ENTSO-E (2011)
- Consentec, EWI, IAEW (2010, cf. table)

→ Monitoringbericht des BMWi (2011)

Leistung	2008		2010		2015		2020*	
[GW]	installiert	gesichert	installiert	gesichert	installiert	gesichert	installiert	gesichert
Erneuerbare	38,4	4,5	46	5,3	61,4	7	78,4	8,6
Wasserkraft	8	7,2	8	7,3	9	7,5	9	7,5
Kernenergie	20	17,6	19	16,6	13	11,5	7	5,8
Gas	25	21,1	20	17,3	25	21,3	31	26,3
Braunkohle	20	17,4	23	19,6	21	18,3	20	17
Steinkohle	26	22,2	31	26,9	31	27	28	24,3
Summe	137,4	90	147	93	160,4	92,6	173,4	89,5
Last		86,8		86,8		87,5		88,2

Source: Consentec et al. (2010), S. 42/46; generation in 2008, 2010 and 2015 based on known building projects, in 2020 based on cost minimization at given reliability level

Nuclear Phase-out: „Don‘t Worry ...“ (Kunz, Hirschhausen, Möst, Weigt, 2011)

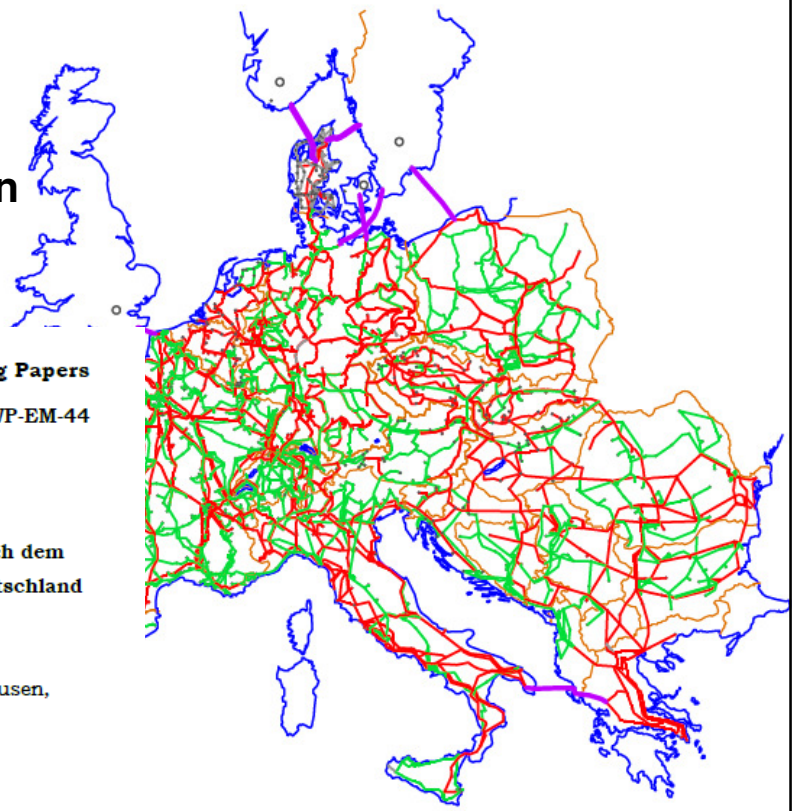
Technical-Economics Analysis of the Nuclear Phase-Out in Germany

Based on model of the German and European electricity market (ELMOD, Leuthold, Weigt and von Hirschhausen, 2011)

Simulation of dispatch and electricity flows

Status Quo and two scenaric

- **Moratorium**
- **Phase-Out**



Electricity Markets Working Papers

WP-EM-44

Nachfragesicherung und Lastflüsse nach dem Abschalten von Kernkraftwerken in Deutschland – Sind Engpässe zu befürchten?

Friedrich Kunz, Christian von Hirschhausen, Dominik Möst und Hannes Weigt

May 2011

TECHNISCHE UNIVERSITÄT DRESDEN — Dresden University of Technology, Chair of Energy Economics

EE²

TU WIP — Berlin University of Technology, Workgroup for Infrastructure Policy (WIP)

European University Institute Florence

Import/Export and Prices (Moratorium)

Total exports drop by appr. 25% and the imports increase by about the same

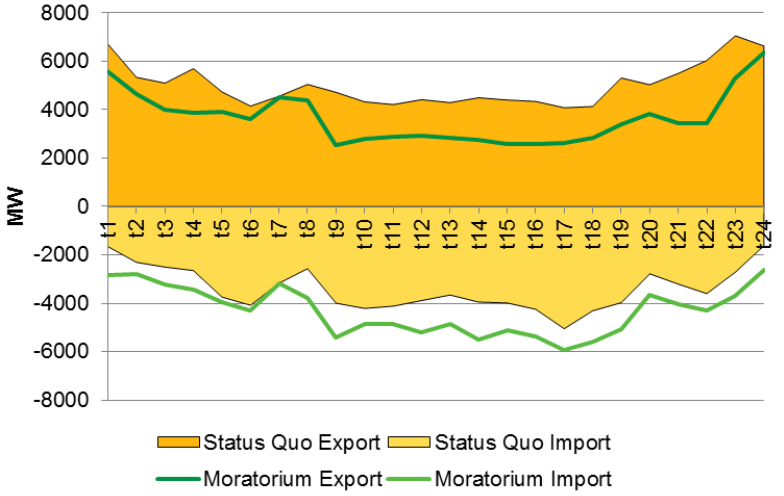
•imports from France and the Czech Republic increase by 20%

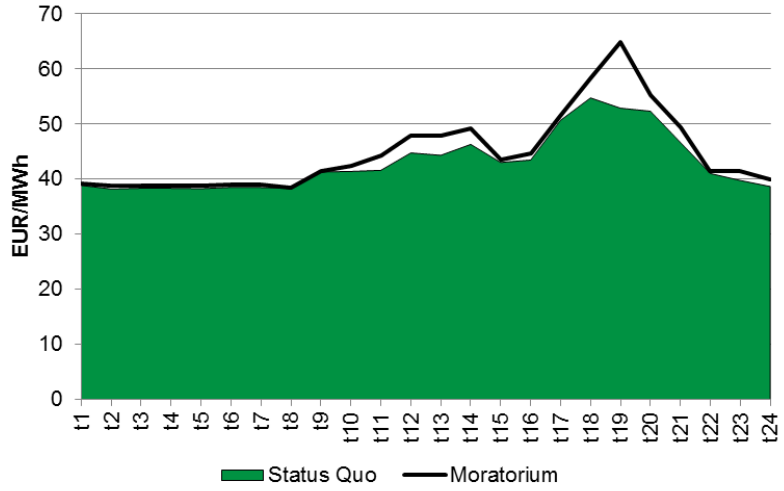
•exports to neighboring countries drop, particularly to the Netherlands and Austria

Trend strengthens in the phase-out scenario

Off-peak prices are on average 1 €/MWh higher in the moratorium scenario.

The average peak price premium in the moratorium scenario is € 3/MWh.



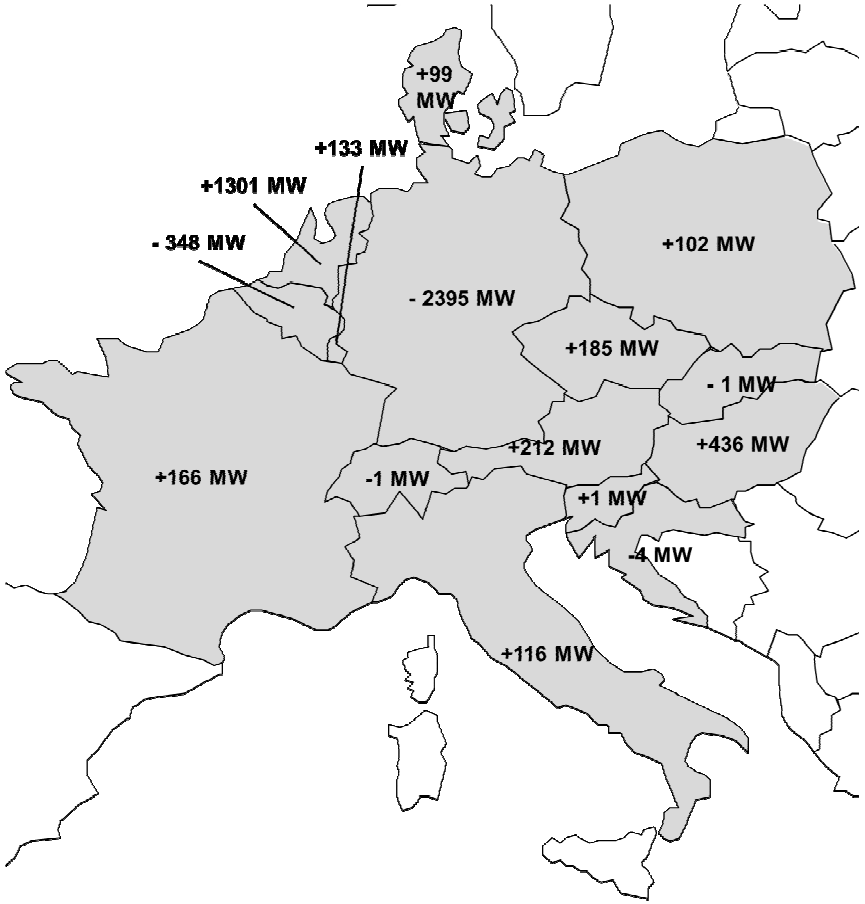


Dispatch (Moratorium)

Higher share of coal and natural gas fired units in Germany

During off-peak hours marginal additional quantities of electricity are generated in the Netherlands, France, Italy, Poland, and Hungary to replace imports from Germany.

In the peak hours when the German coal power plants are already close to maximum capacity utilization, natural gas units supply the additional generation.



Existing and Planned "Capacity Mechanisms" in Germany

There is no generally accepted, clear way to define „capacity mechanisms". The following table gives an overview of German market mechanisms which could be identified as such instruments:

Mechanism	Function	Capacity reward	Status
Control reserve markets	Procure control reserve to equal generation and load in realtime	Pay-as-bid capacity payment for each successful bidder	In place
Thermal reserve power plants	Ensure local/regional voltage stability after partial nuclear phase-out („Moratorium")	Bilaterally negotiated between TSOs and generators	In place since autumn 2011
„Abschalt-verordnung"	Compensate demandside for targeted TSO-load shedding	To be determined; first government proposal highly controversial	To be implemented (§ 13 (4a) EnWG)
„Kraftwerks-förderprogramm"	Stimulate 2013-2016 investment in fossil fired plants of small to medium size marketd participants	Investment grants; latest drafts hardly compatible with recent EC directive	To be implemented
Further capacity instruments	???	???	Currently vividly discussed in political, industrial and academical circles

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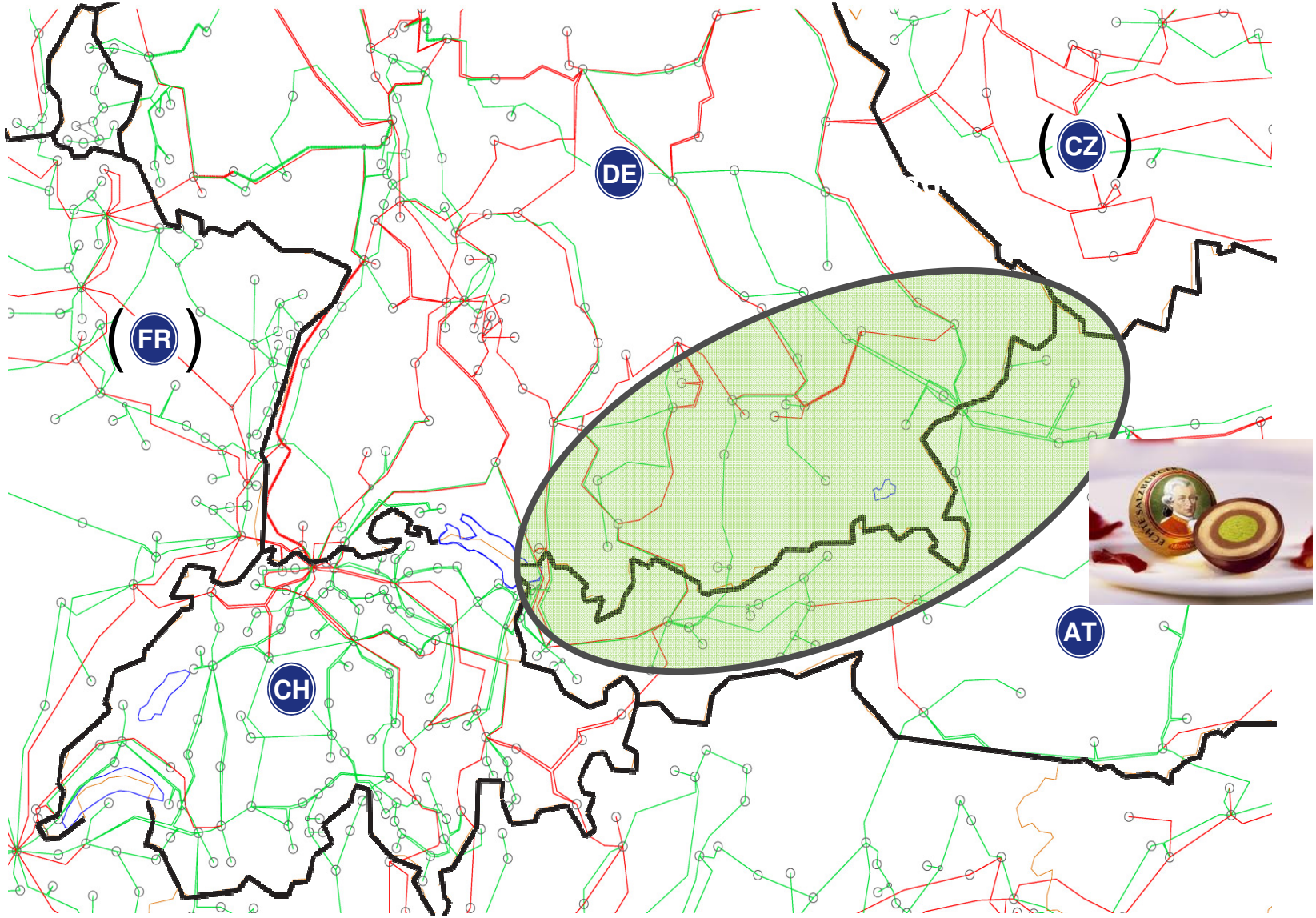
Zooming in on Germalpina, here: Austria



Instruments for Austrian-German Cooperation

Primary reserve (PRL): pre-defined by ENTSO-E „Operation Handbook“

Secondary reserve (SRL): large potential for integration in both directions, „shared order books“, etc.

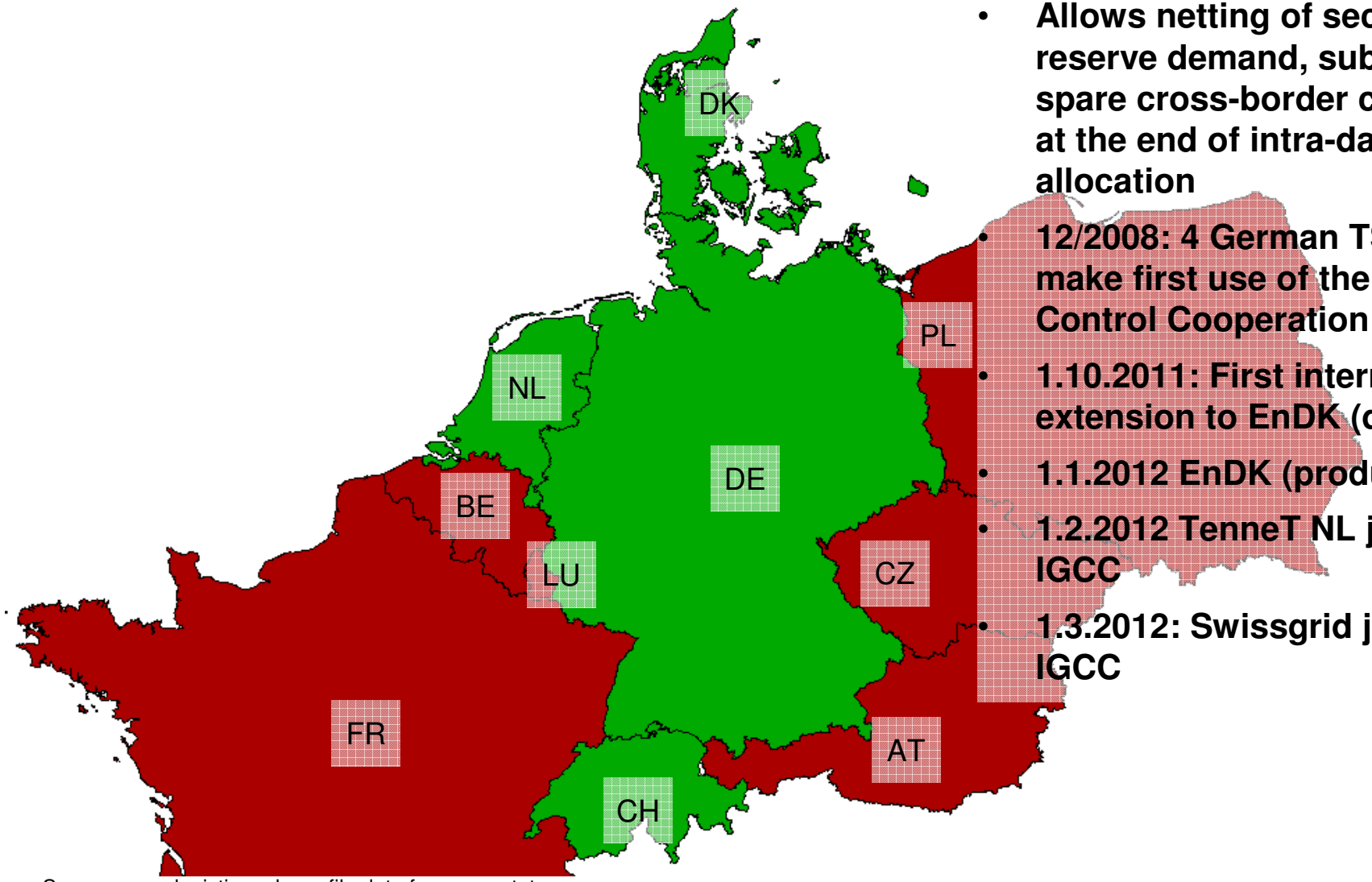
Tertiary reserve (TRL): „direct lines“ by some producers (TIWAG, VKW)

(Bilateral) cold reserve backup contracts („Störfallaushilfsverträge): e.g. already in place, with contracts (EVN)

Ancillary services, e.g. reactive power: already in place, not formalized?

Reserving transmission capacity for balancing services?

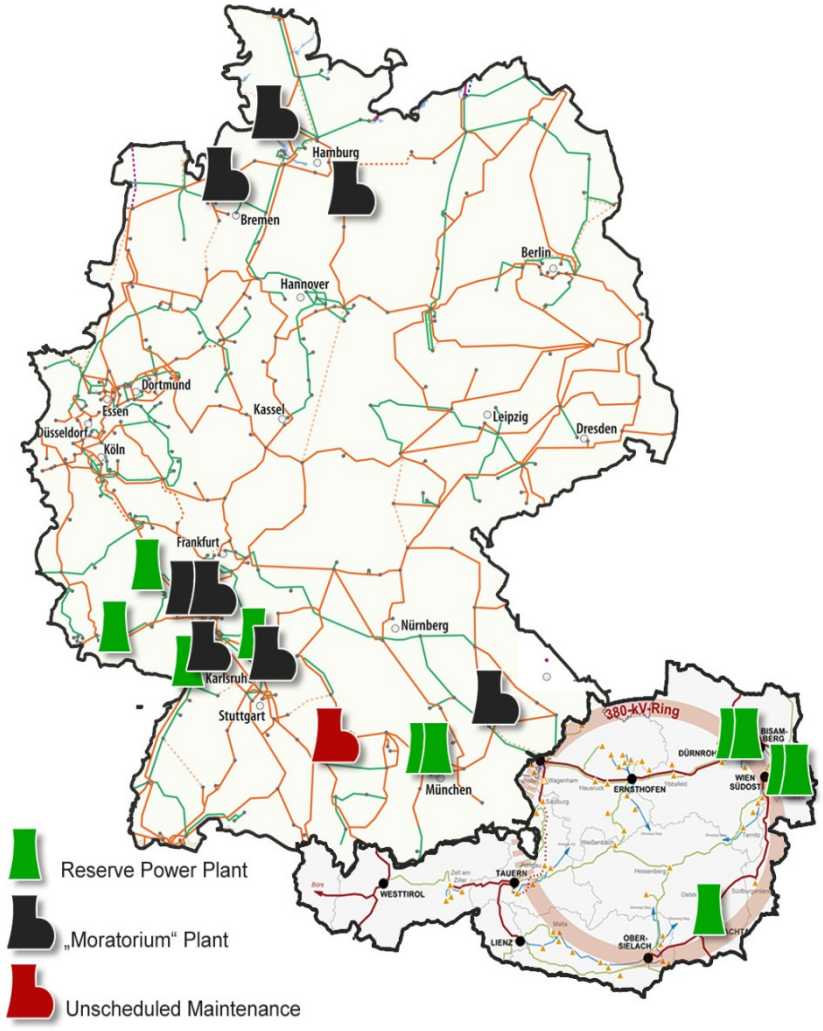
Secondary reserve (SRL): large potential for integration in both directions, „shared order books“, etc., as practiced in the International Grid Control Operation (IGCC)



- Allows netting of secondary reserve demand, subject to spare cross-border capacity at the end of intra-day allocation
- 12/2008: 4 German TSOs make first use of the Grid Control Cooperation (GCC)
- 1.10.2011: First international extension to EnDK (dry run)
- 1.1.2012 EnDK (productive)
- 1.2.2012 TenneT NL joins IGCC
- 1.3.2012: Swissgrid joins IGCC

Source: own depiction, shape file data from eurostat.

(Bilateral) cold reserve backup contracts („Störfallaushilfsverträge): already in place



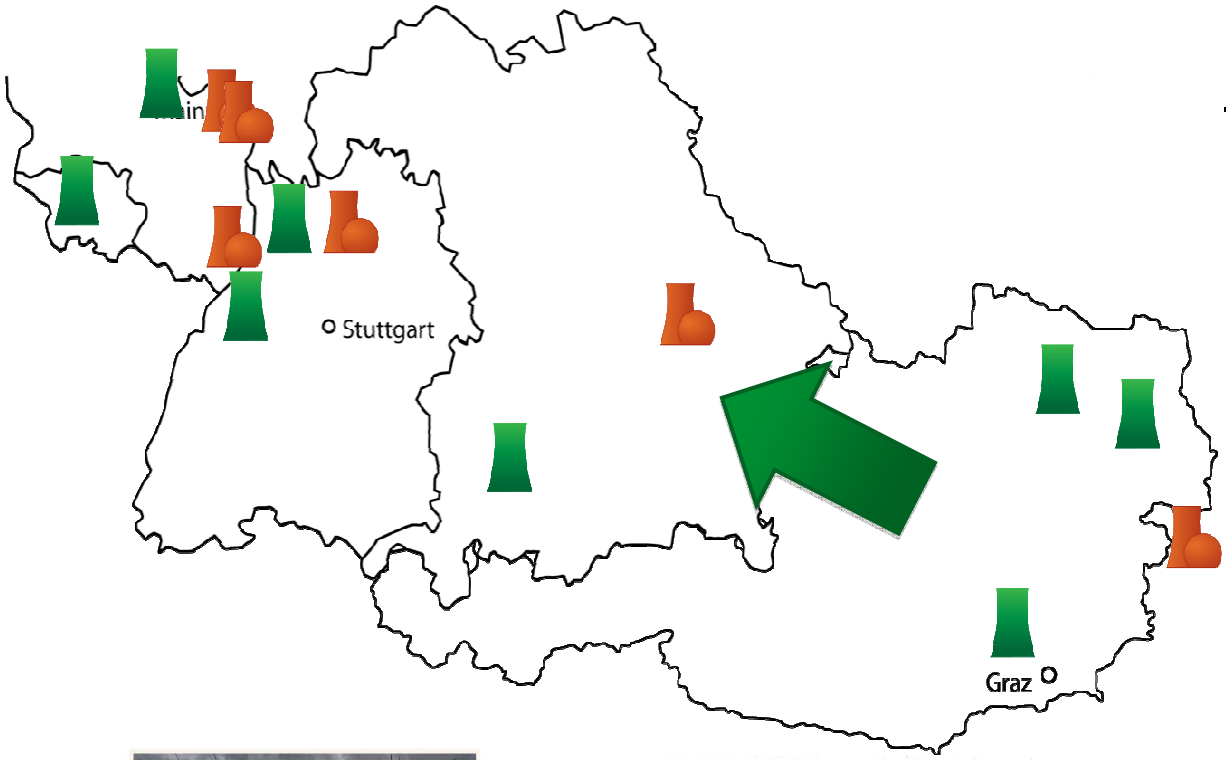
German Reserve Plants

Name	Year	Fuel	Capacity (MW)
Kraftwerk Mainz	1977	Natural Gas	335
Kraftwerk Ensdorf	1971	Hard Coal	283
GKM	1966	Hard Coal	202
MiRO	1995	Fuel Oil	25
HKW Freimann	1975	Natural Gas	80
HKW Freimann	1975	Natural Gas	80
		Subtotal	1005

Austrian Reserve Plants

Name	Year	Fuel	Capacity (MW)
Theiß Kombi	1974-76	Natural Gas	450
Theiß	1974-76	Natural Gas	160
Korneuburg	1958	Fuel Oil/Gas	160
Neudorf-Werndorf	1975	Fuel Oil	150
Donaustadt	1973	Fuel Oil/Gas	140
		Subtotal	1060
		Grand Total	2065

Application: 8/9 December 2011: Bavaria Receives Cold Reserve Capacity from Austria



Chain of events

- March 2011, the Federal Government permanently shuts down five nuclear power plants in Southern Germany
- August 2011, the German Regulator selects twelve fossil power plants in Germany and Austria as emergency backup capacity for the winter
- November 2011, RWE shuts down Grundremmingen nuclear power plant for unscheduled maintenance
- December 2011, Tennet calls on Austrian power plants as storm „Ekkehard“ activates 20GW of wind power in the North

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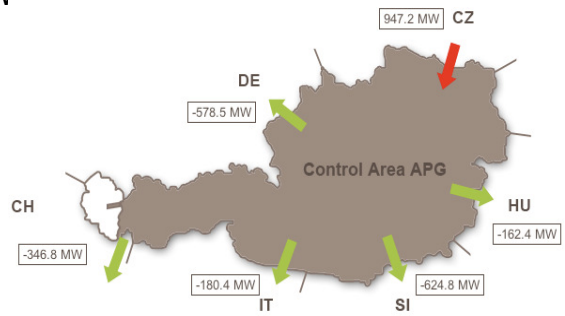
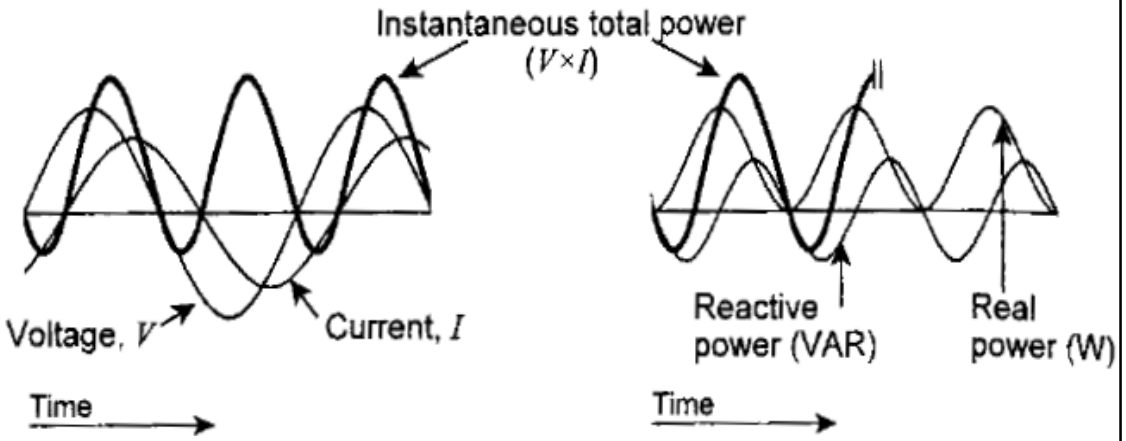


Ancillary services, e.g. reactive power: already in place, not formalized?

Reactive Power

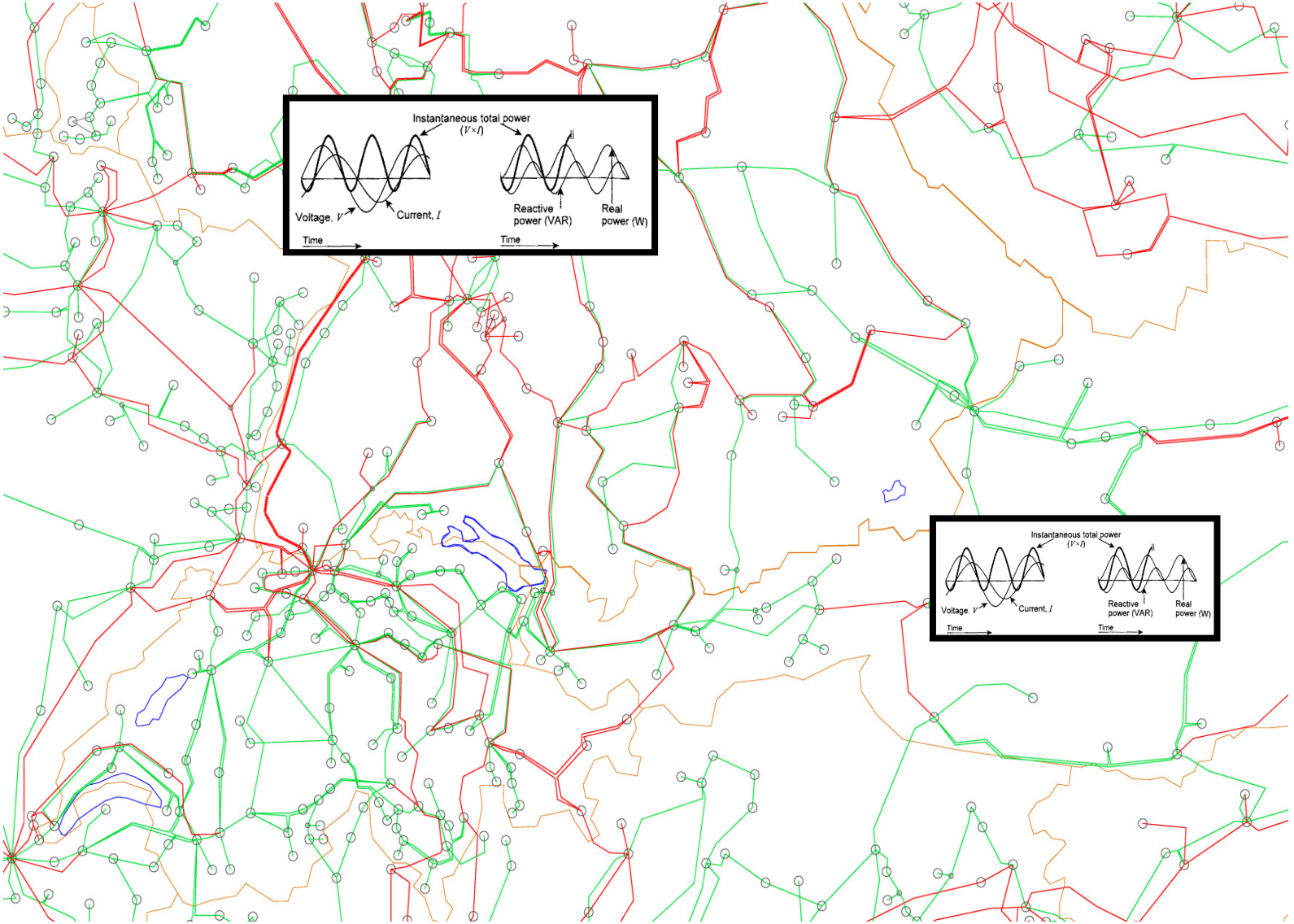
- is a vital ingredient for network stability
- Generators produce real (W) and reactive power (Q)
- Apparent power $|S| = \sqrt{W^2 + Q^2}$



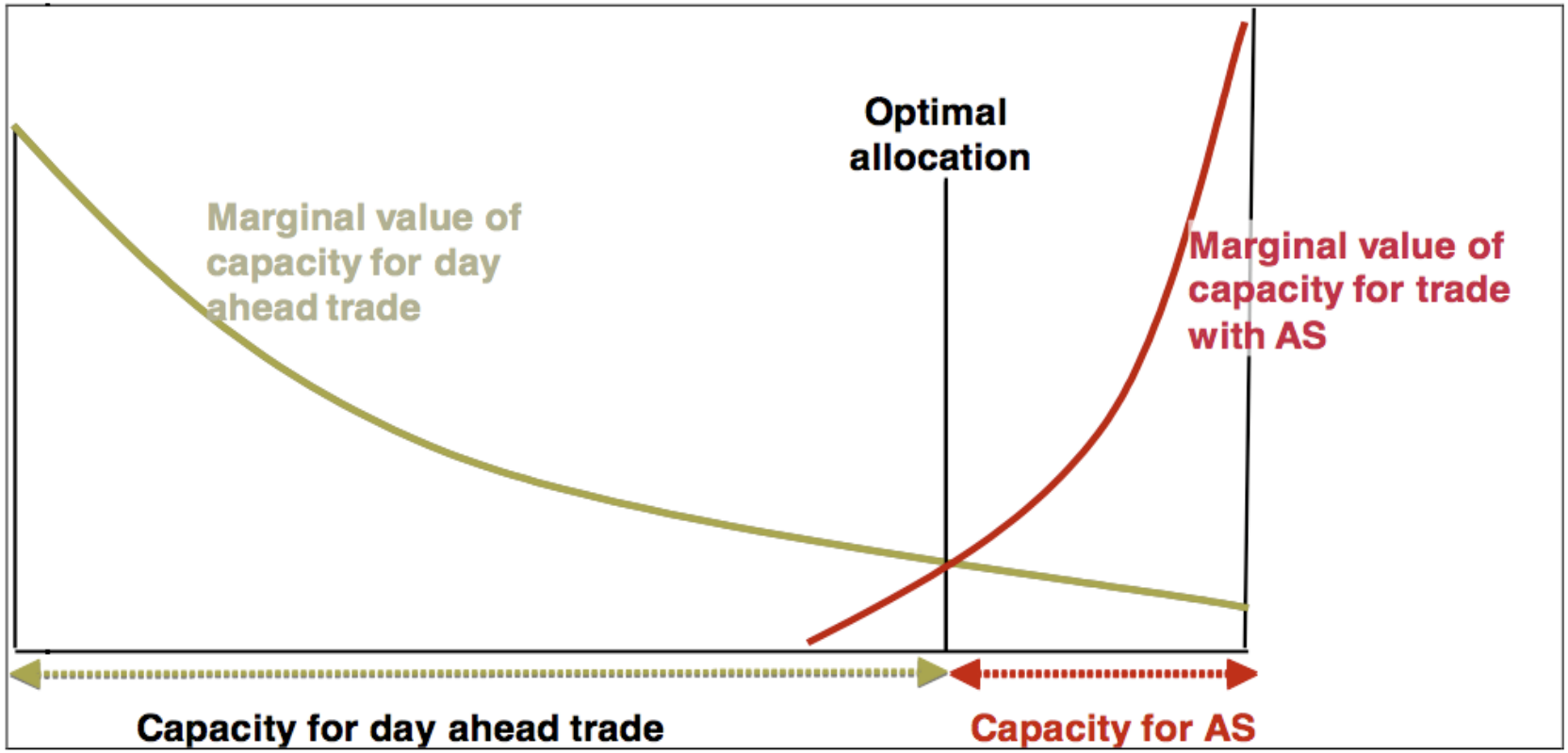
- **By definition a regional issue:**
- Can not be transmitted over great distances due to physical constraints
- Cross-border reactive power markets only possible in areas without much congestion: reactive power trade requires constant availability of transmission capacity to function properly

Source: Stoft (200x) p. 384

Reactive power sources: i) ex-NPP Biblis; ii) Austria
DE-AT border uncongested ➔ reactive power transfer possible



Key Considerations: Reserving Transmission Capacity for Balancing Services



Source: ENTSO-E (07/2011) Position Paper on Balancing Services, TU Wien

- Cross-border balancing trades require the reservation of transmission capacity on already congested interconnectors; what is the optimal allocation given the coexistence of „normal“ power markets?

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Conclusions

1) **The discussion on capacity markets is a political reality**
2) **The instruments have to suit the the concrete situation prevailing – „one size does not fit all“**
3) **In Germany there are indications that the overal capacity is sufficient, but that local deficits may occur**
4) **The German electricity sector design is already moving towards real capacity instruments, which need to be critically assessed**
5) **In the time frame under consideration (2025), cross border cooperation seems to be an appropriate level of discussing capacity instruments**