

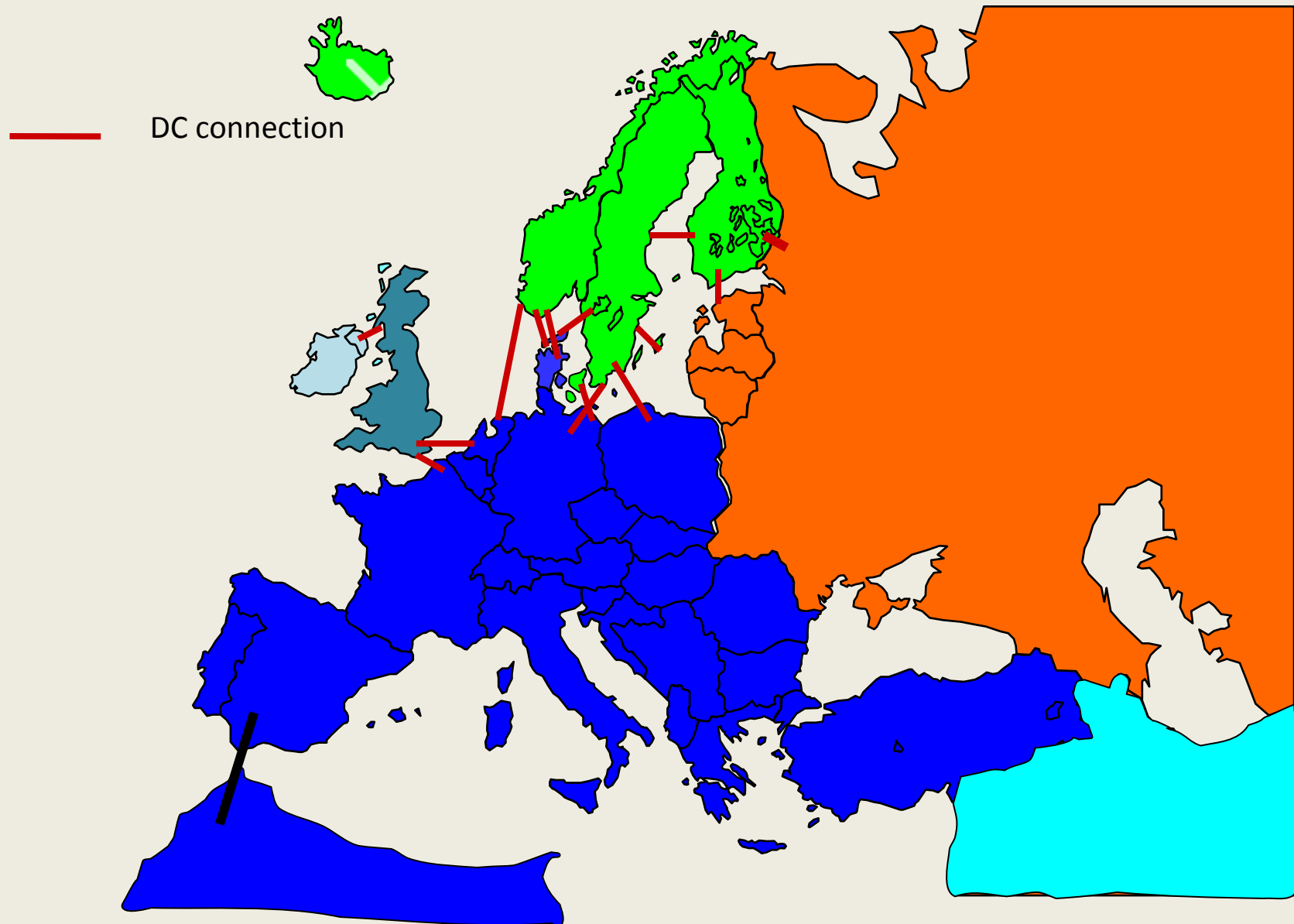
# Information sharing and system security

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# Outline

- Need for information sharing
- Examples of what happens when information is not shared
- How to achieve information sharing

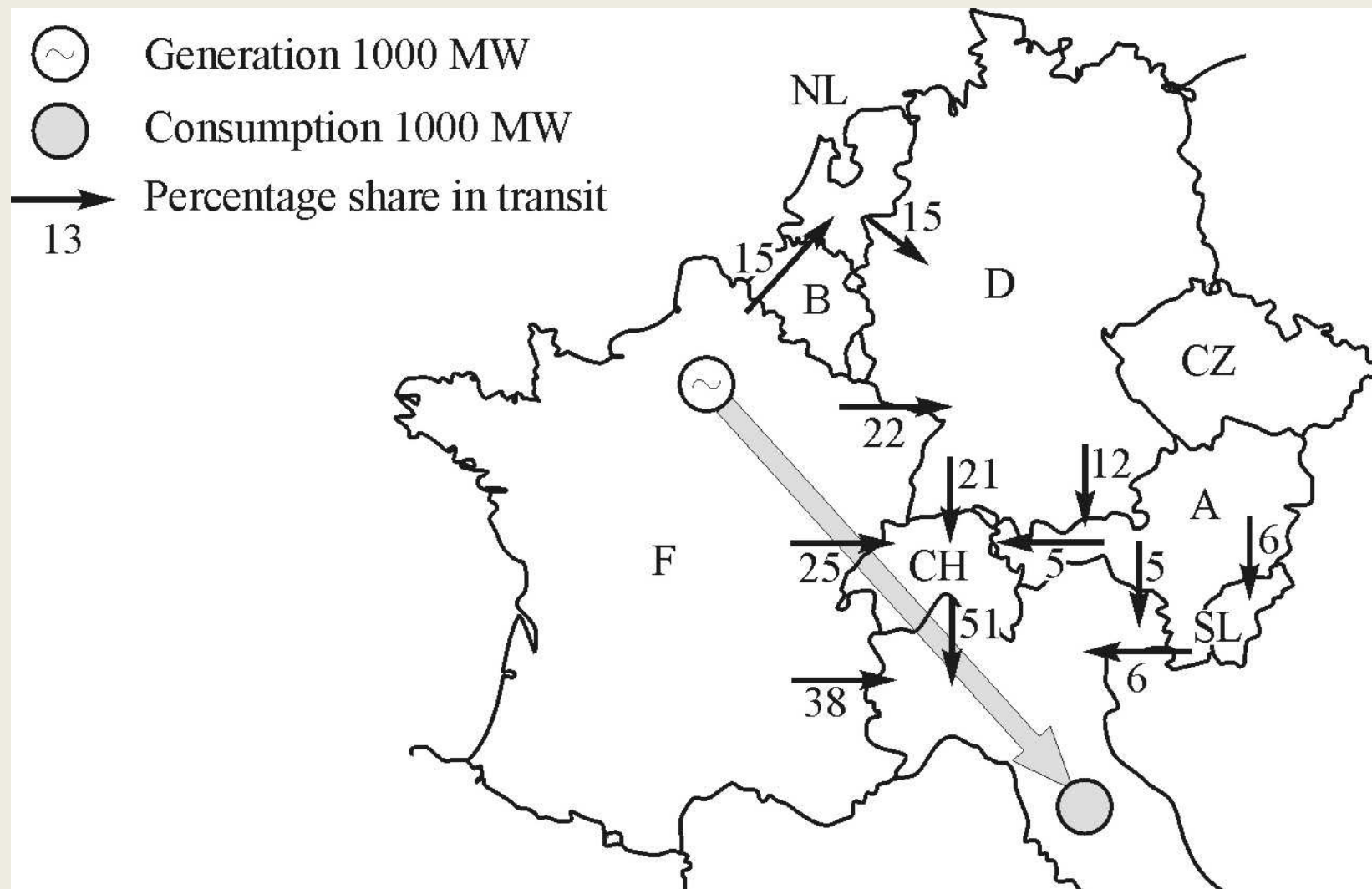
# Europe's synchronous areas



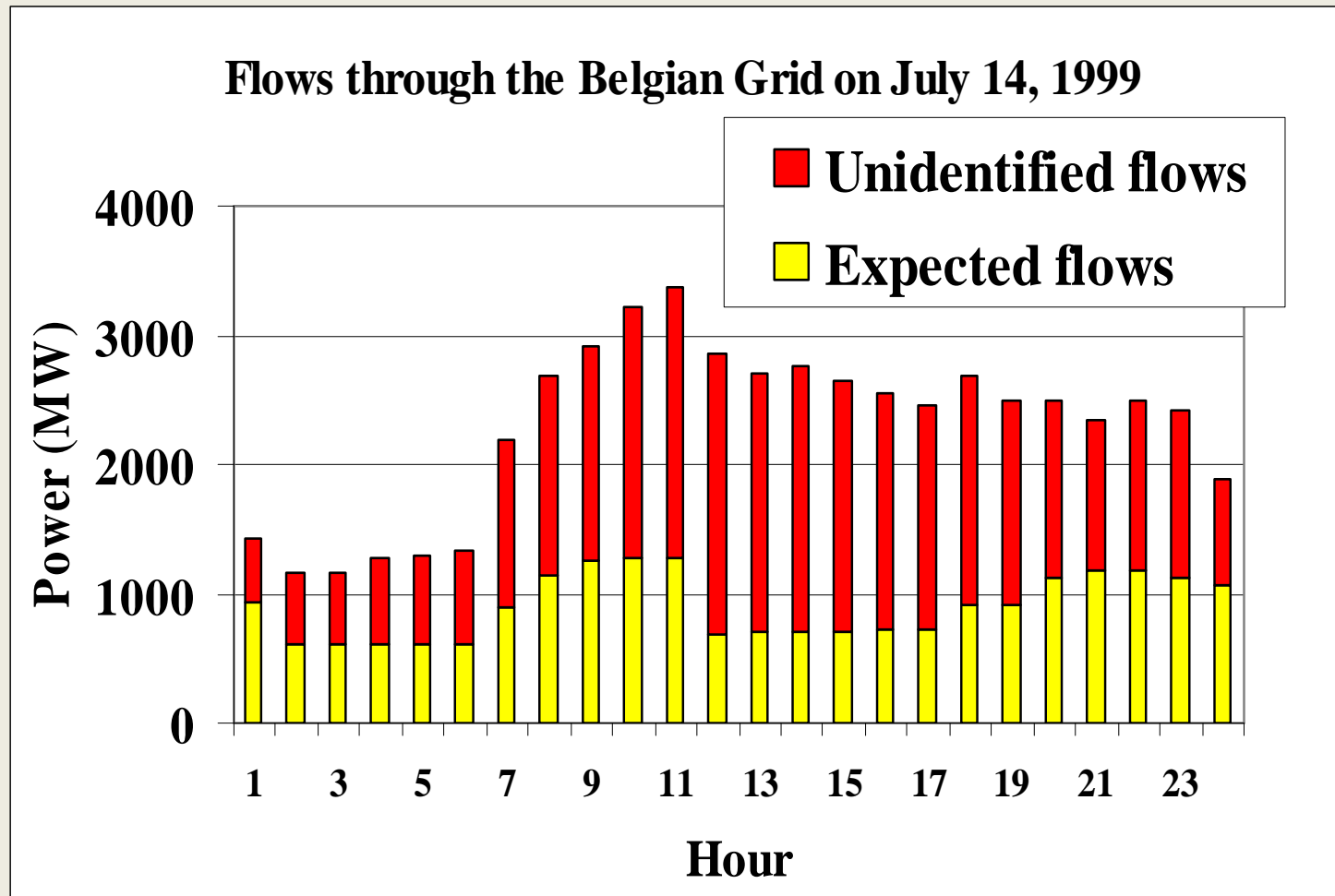
# Facts about power system operation

- The whole AC interconnection operates as one integrated system
- Balance of generation/demand in the whole system must be maintained minute-by-minute
- Any change in any part of the system changes everything everywhere
- Infamous example: loopflows

# System security must be analysed and monitored system-wide



# What happens if it isn't: Belgium



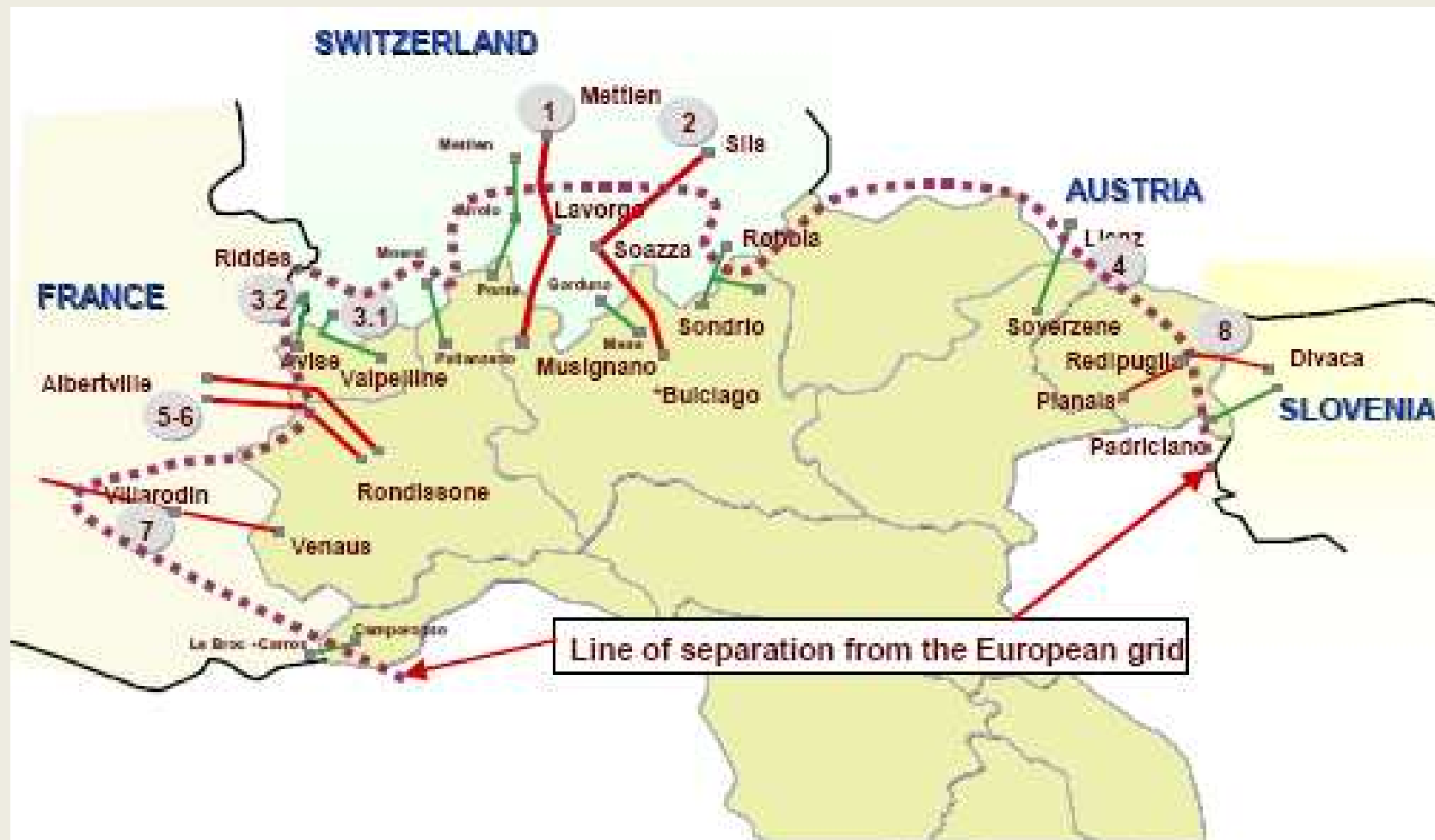
Remedy: phase-shifting transformers installed at the borders

What if everyone does the same?

# What happens if it isn't: US/Canada 2003






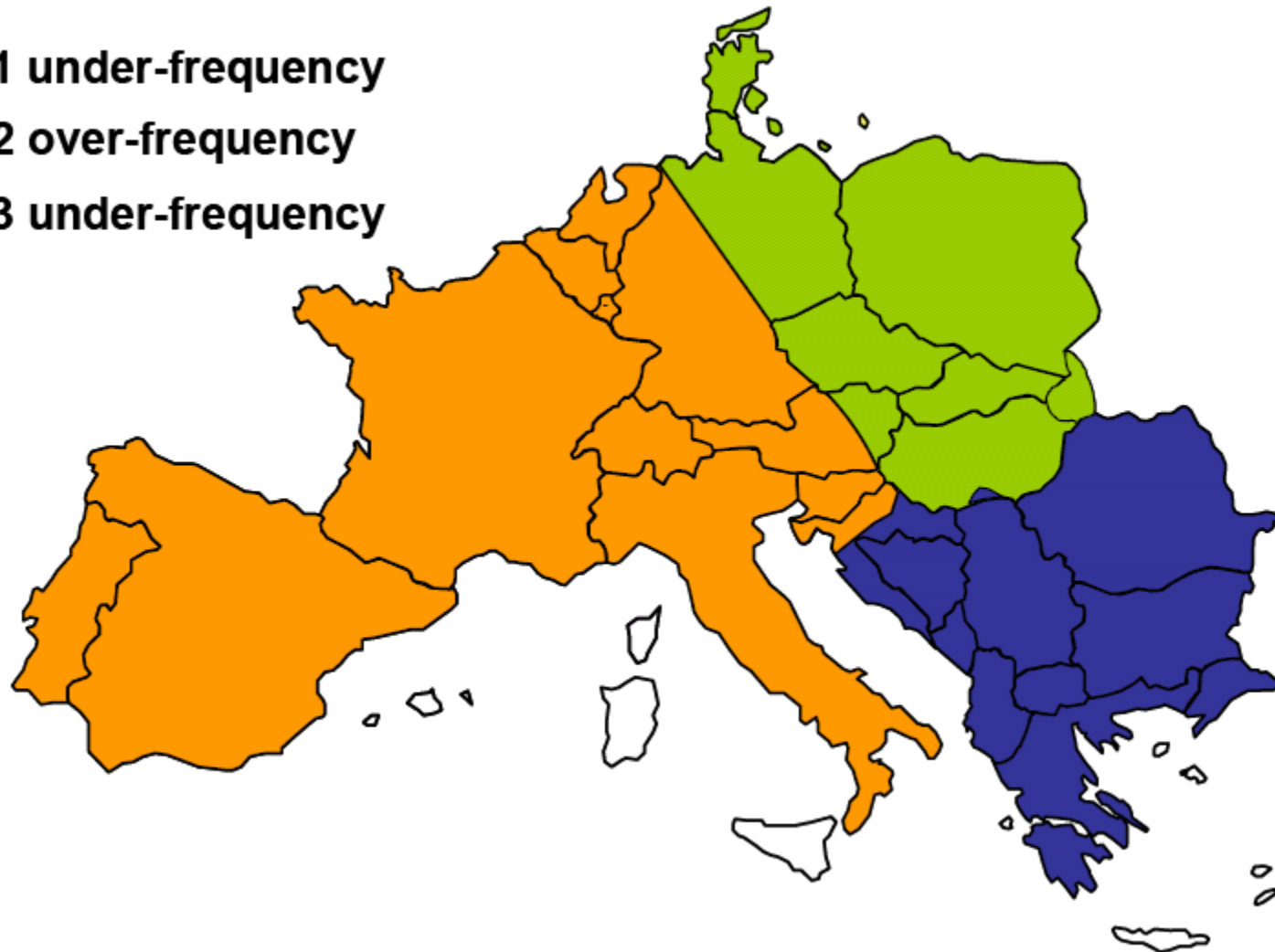
# What happens if it isn't: Italy 2003





# What happens if it isn't: UCTE 2006

-  Area 1 under-frequency
-  Area 2 over-frequency
-  Area 3 under-frequency



*Figure 4: Schematic map of UCTE area split into three areas*

# Information sharing

- ... is a must for power system security assessment
- ... and effective system-wide congestion management (OPF)
- Currently two-stage approach to NTCs:
  - Internal assessment by individual TSOs
  - System-wide processing of NTCs
  - Suboptimal
- Integrated system-wide security assessment and OPF would bring economic benefits and more secure system operation

# What info is needed

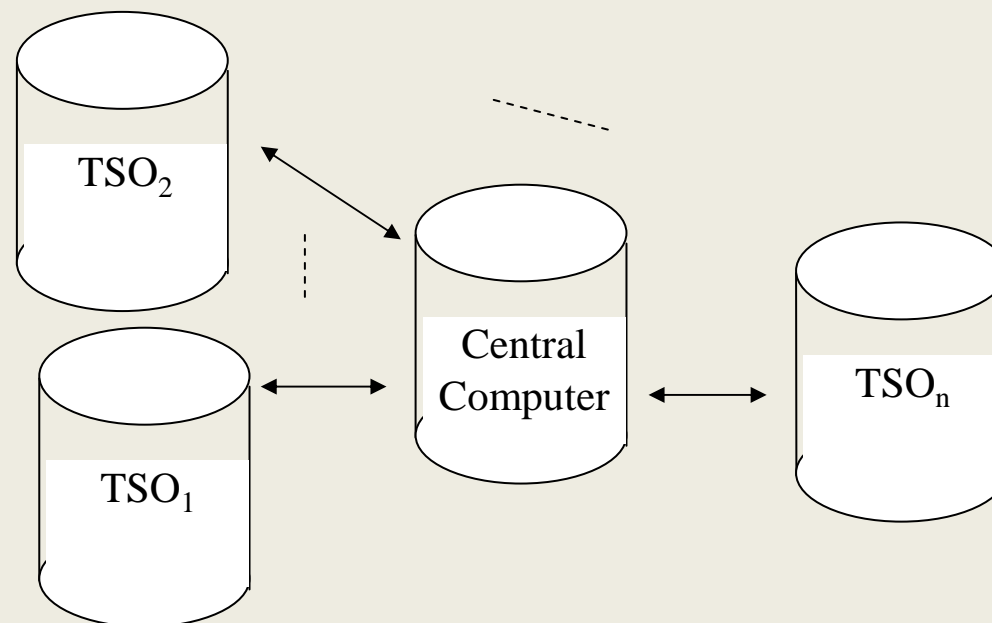
- Sharing information would be technically trivial to achieve but there are significant institutional obstacles
- Detailed model of electrical network
  - Intact ENTSO-E network model is available but real-time changes must be incorporated
- Dispatch (OPF) and security assessment: contracts and nodal generations/demands with prices
  - Optimal (least cost) dispatch
  - System-wide security assessment
  - significant objections on confidentiality and commercial sensitivity grounds
- Real-time operation: monitoring of power flows at main transmission lines (state estimation)

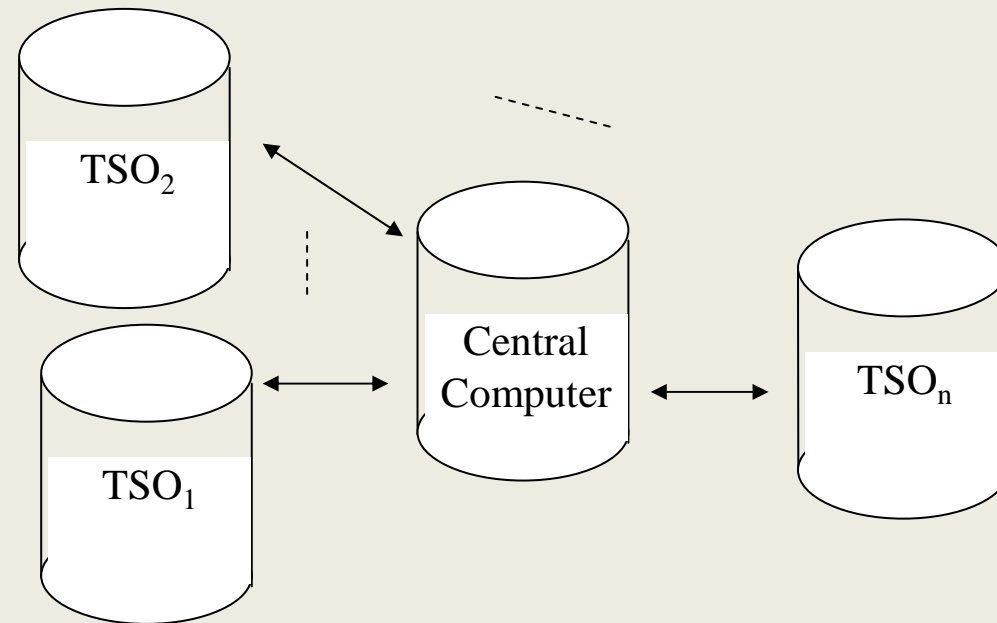
# How to achieve coordinated operation?

- Prodi: a central pan-European TSO is needed
  - doubtful
- “Virtual pan-European TSO”:
  - a computer program fed with data by individual TSO and returning security assessment/margin, power flows, LMPs etc
  - Example: Open Access Same Time Information Systems (OASIS) developed in the USA in the 90s
  - Still may be seen with suspicion whether confidentiality of data will be maintained
- The answer: hierarchical processing of information to calculate power flows, OPF, security assessment etc.

# Hierarchical processing of information

- Initially developed in the 90s for the purposes of parallel computation: Lagrangian relaxation, Internal Point Method etc.





- Each TSO processes their own confidential data and sends “up” aggregated information for further processing
- A central computing engine assesses system-wide security, power flows, redispatch, LMPs etc. and sends “down” to TSOs
- Difference wrt current two-stage approach: it is an integrated system-wide approach split computationally into two stages
- Advantage: it is virtually impossible to “unscramble” the processed info from local TSOs to get/contract info price

# Conclusions

- Sharing accurate real-time information is necessary for security assessment and trading
- If not: blackouts and economically suboptimal operation
- Replace the current hierarchical two-stage approach with an integrated system-wide one
- To alleviate concerns about confidentiality and commercial sensitivity, information can be processed in two stages
- More research needed on hierarchical security assessment (FP7)
  - Innovative tools for the future coordinated and stable operation of the pan-European electricity transmission system
  - Innovative strategies and tools for the reliability assessment of the pan-European electricity transmission network