Workshop on Power Grid Interconnection in Northeast Asia

May 14-16, 2001

INTERNATIONAL PERSPECTIVS ON POWER GRID INTERCONNECTIONS

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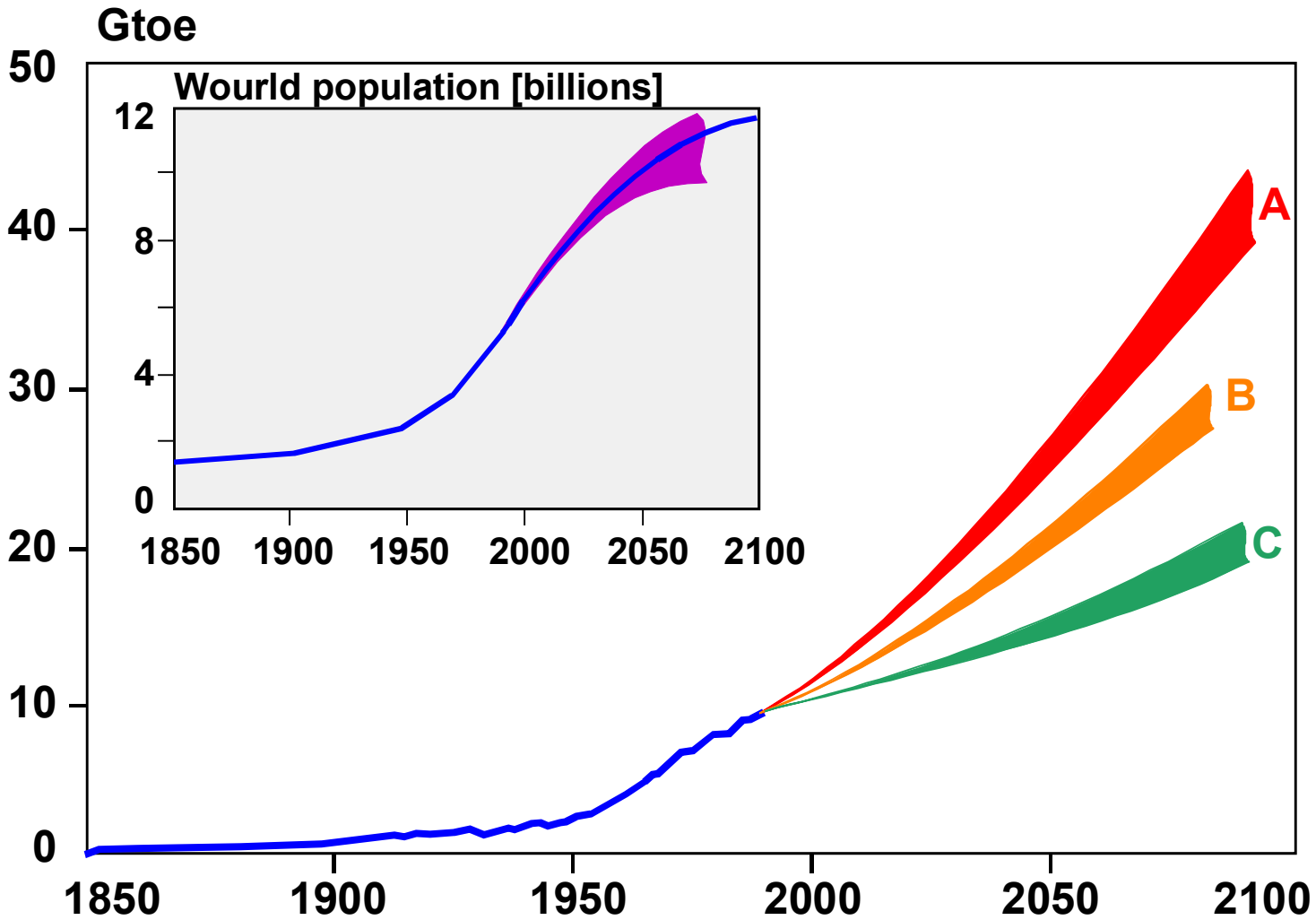
Global primary energy use



Source: IIASA, WEC

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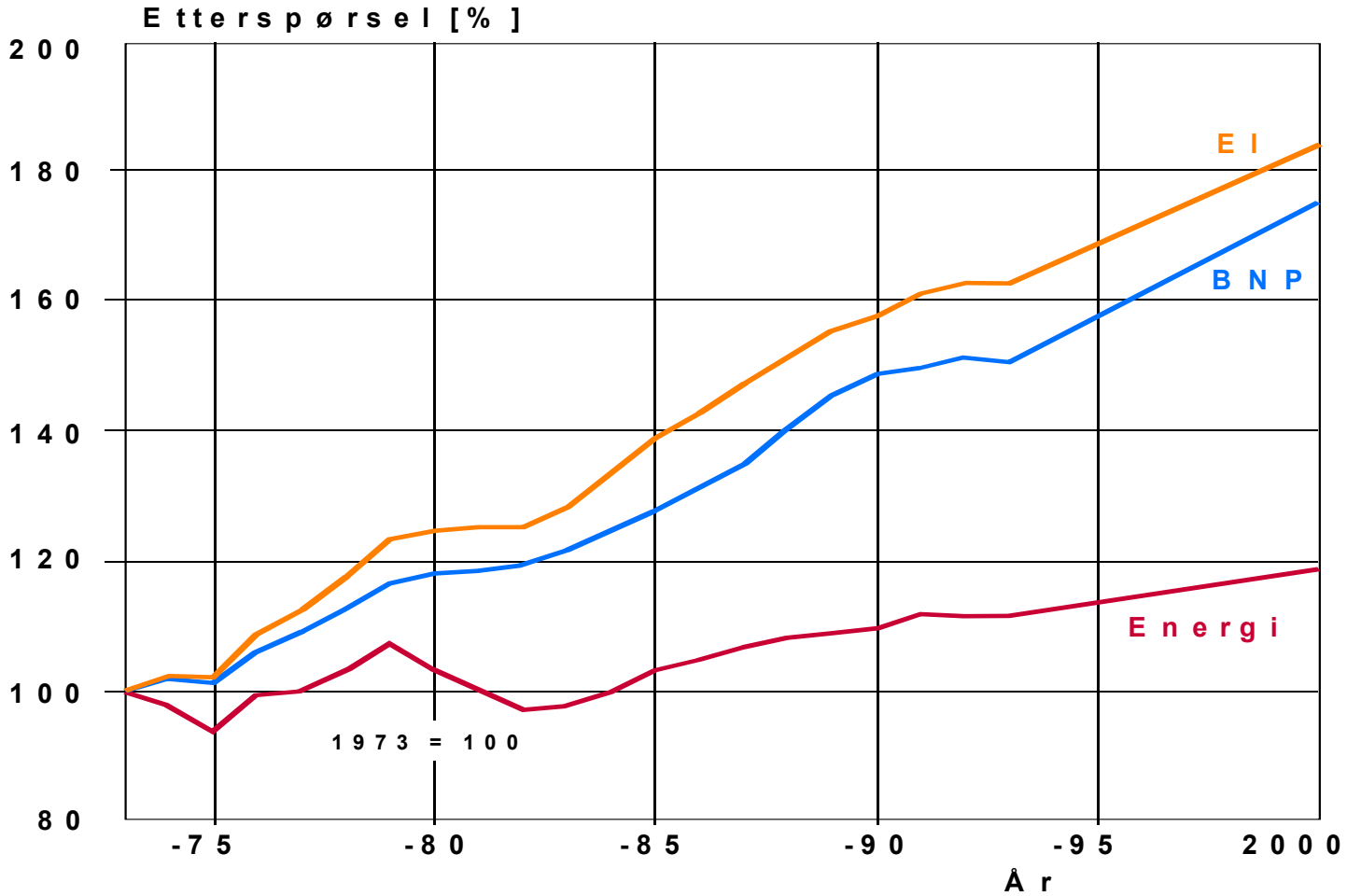
Energy- and elconsumption v.s. BNP (EC 12 - 1973-1993/2000)



Sourcs: unipede; Statistical panorama 1997

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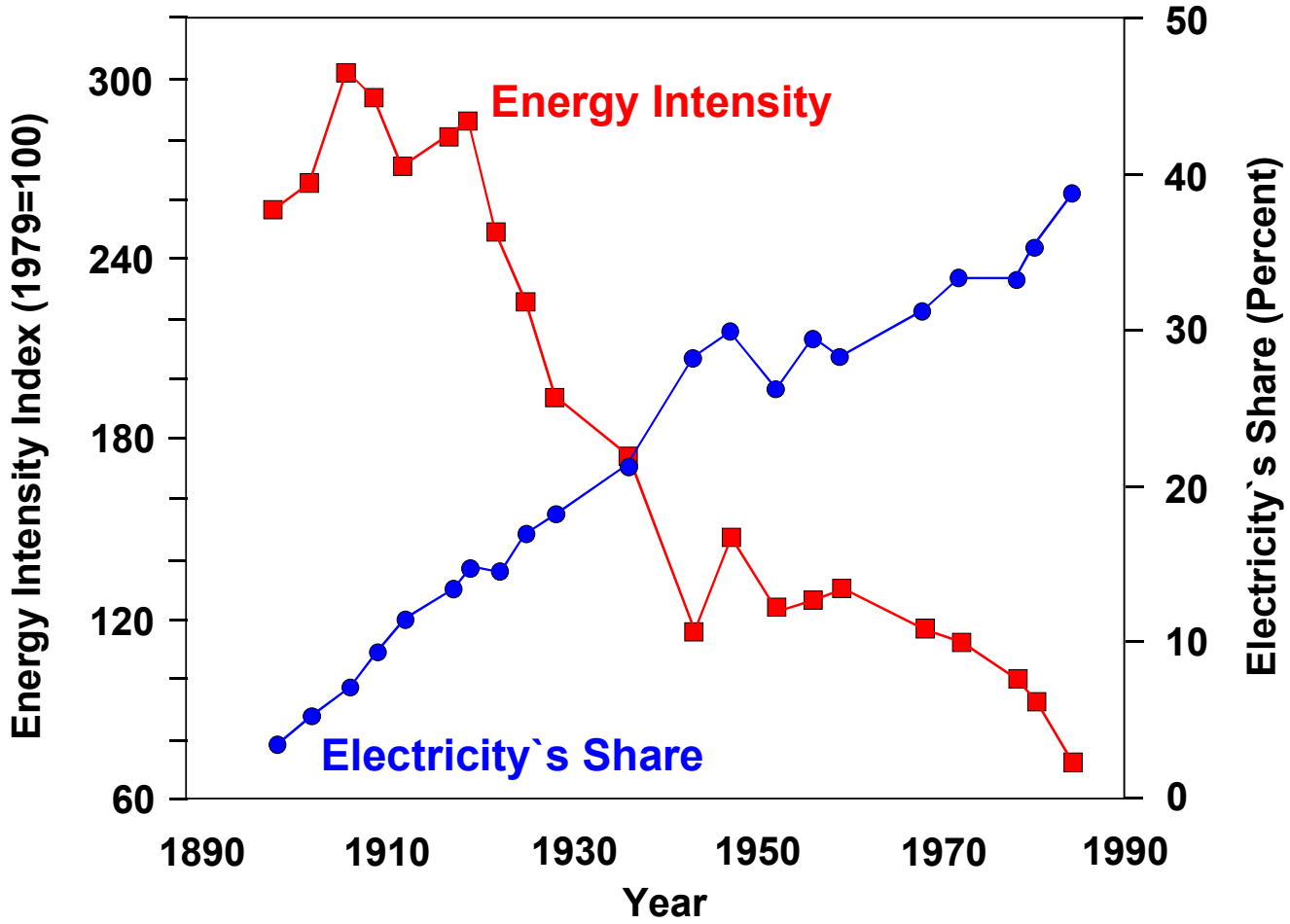
Energi- og elektrisitets intensitet i amerikansk industri



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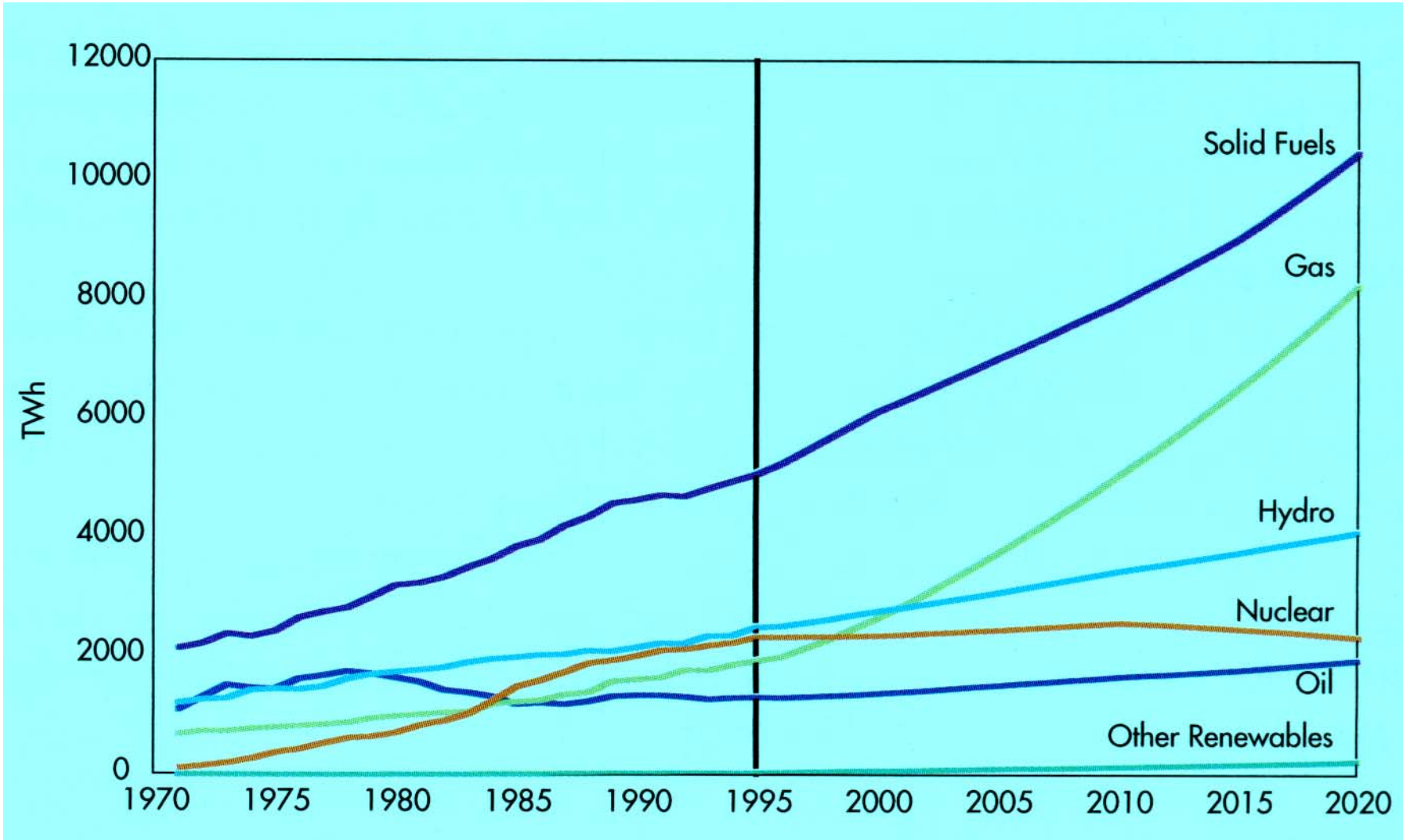
World electricity generation sources



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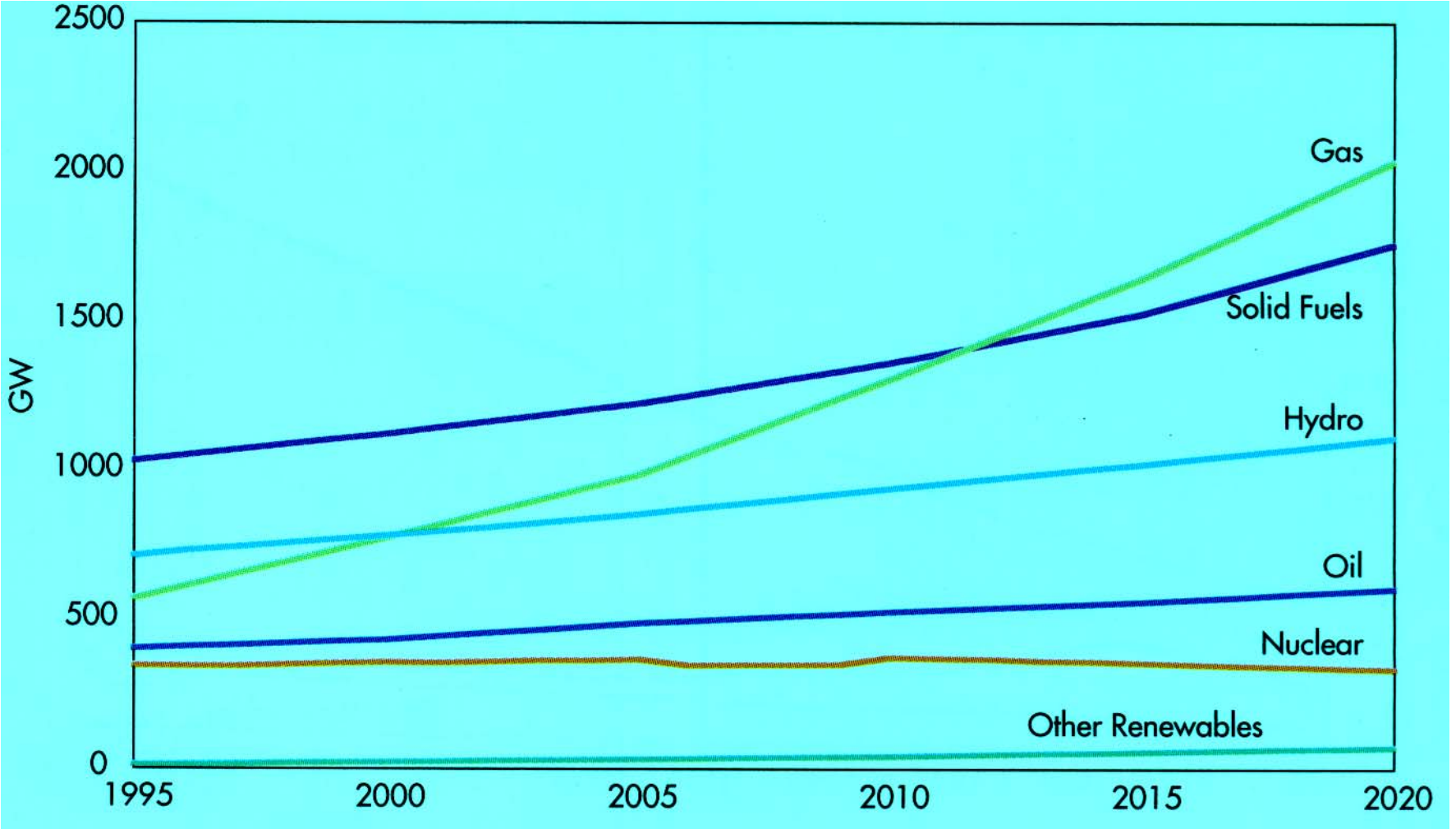
World generation capacity



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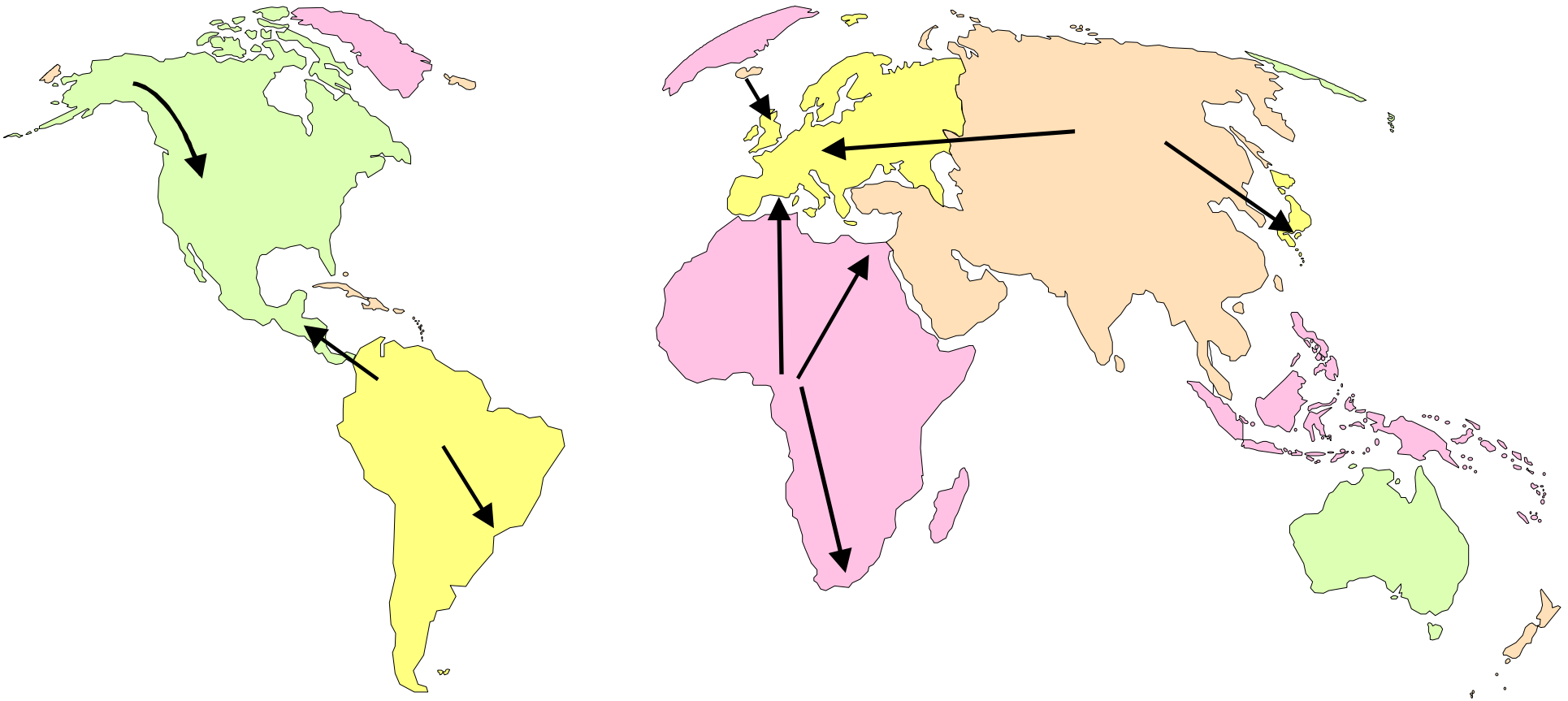
Massive transfer of hydro electricity to population centres (Source ABB)



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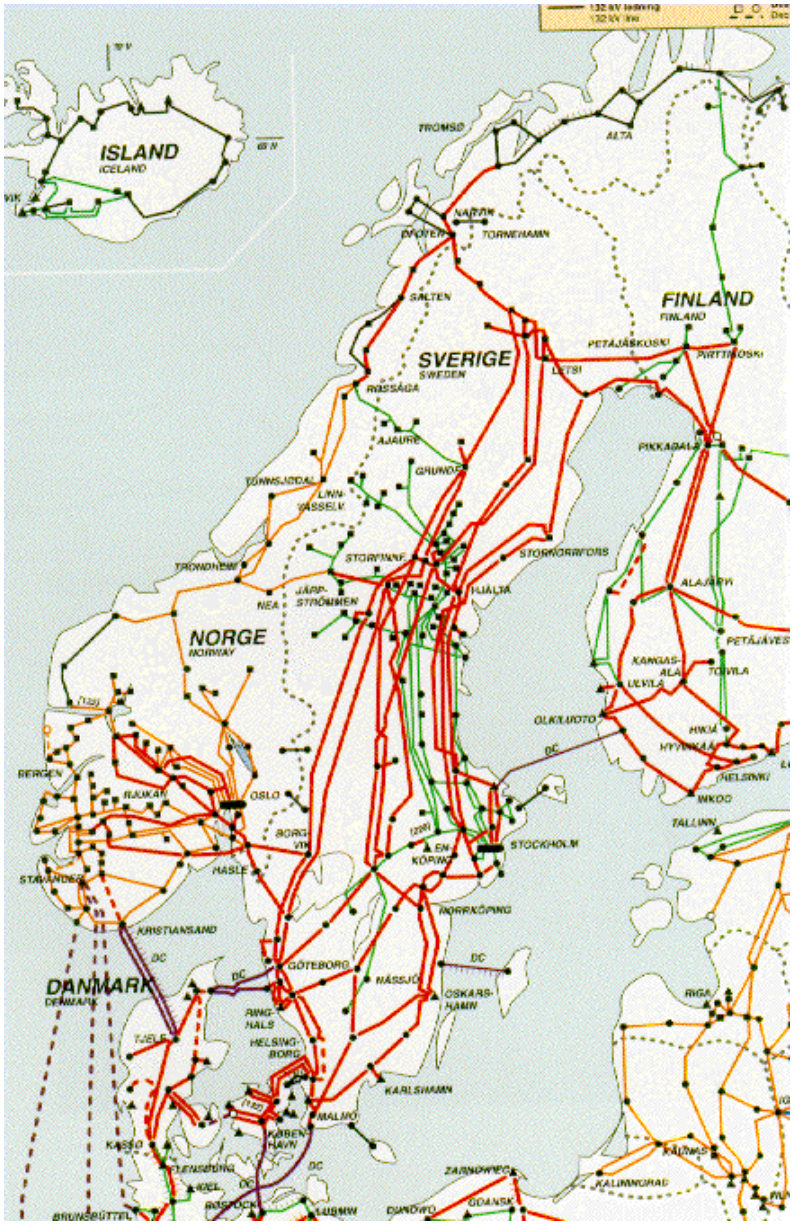

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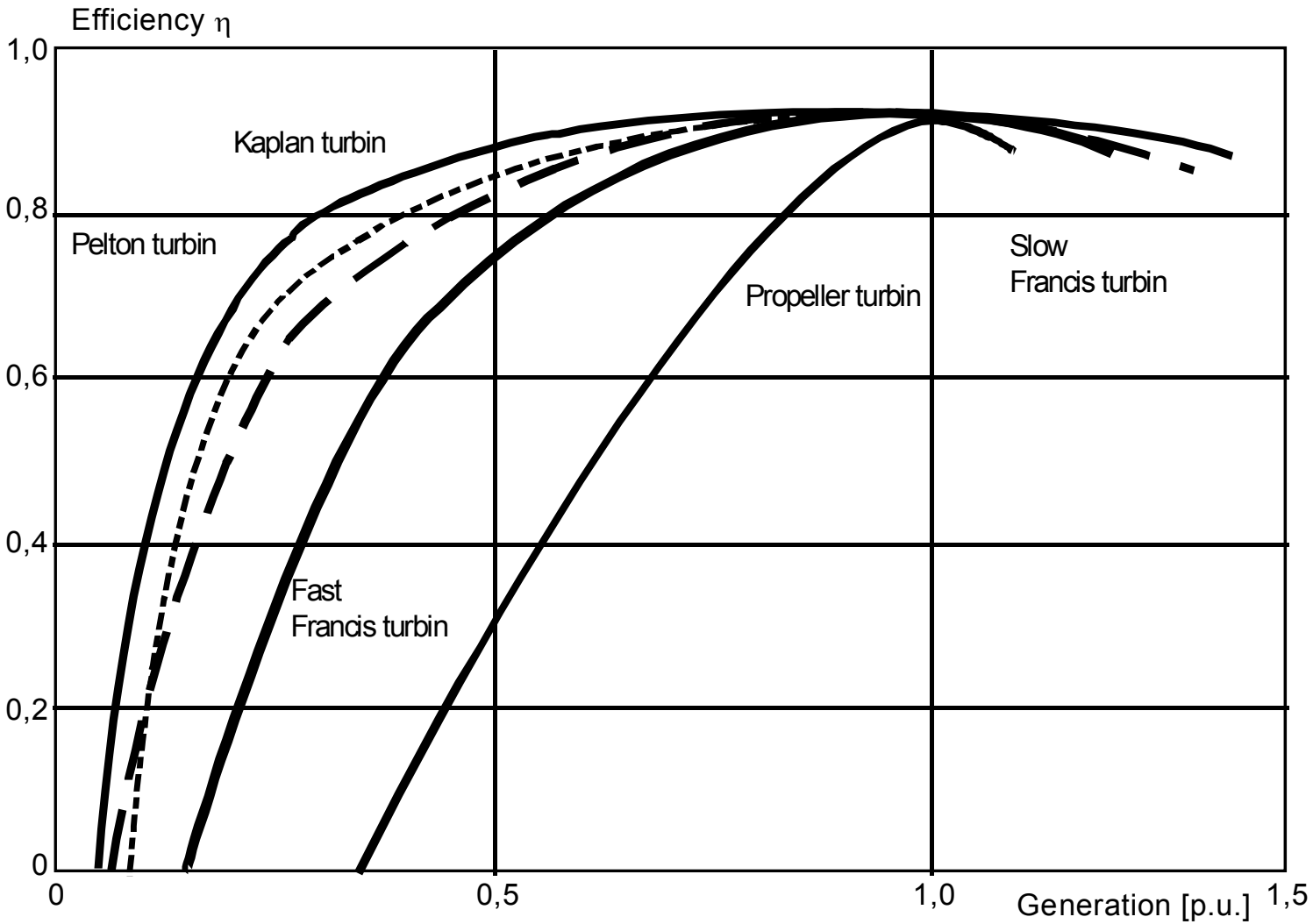
Factors contributing to benefits

- Non coincidental peak load (Example: the England-France interconnection)
- Merit order investments, i.e. the cheapest projects first.
- Scale economy. Large projects have often low unit cost but are too large for the local market.
- Operational benefit (merit order loading)
- Lower total investment.
- Lower total reserve requirement (which contributes to lower investment).
- Use of hydro as a cheap FCR (Frequency Control Reserve).
- Load following.

Benefit of hydro thermal interconnection

- Two categories of hydro generation systems:
  - Capacity constrained systems.
  - Energy constrained systems.
- Thermal systems are always energy constrained.
- There is always a benefit in connecting an energy. constrained system to a capacity constrained.
- The hydro system can provide low cost reserves.
- The same for load following capabilities.
- The hydro system relies on a highly variable and stochastic inflow of water.

Rate of efficiency for different hydro turbines



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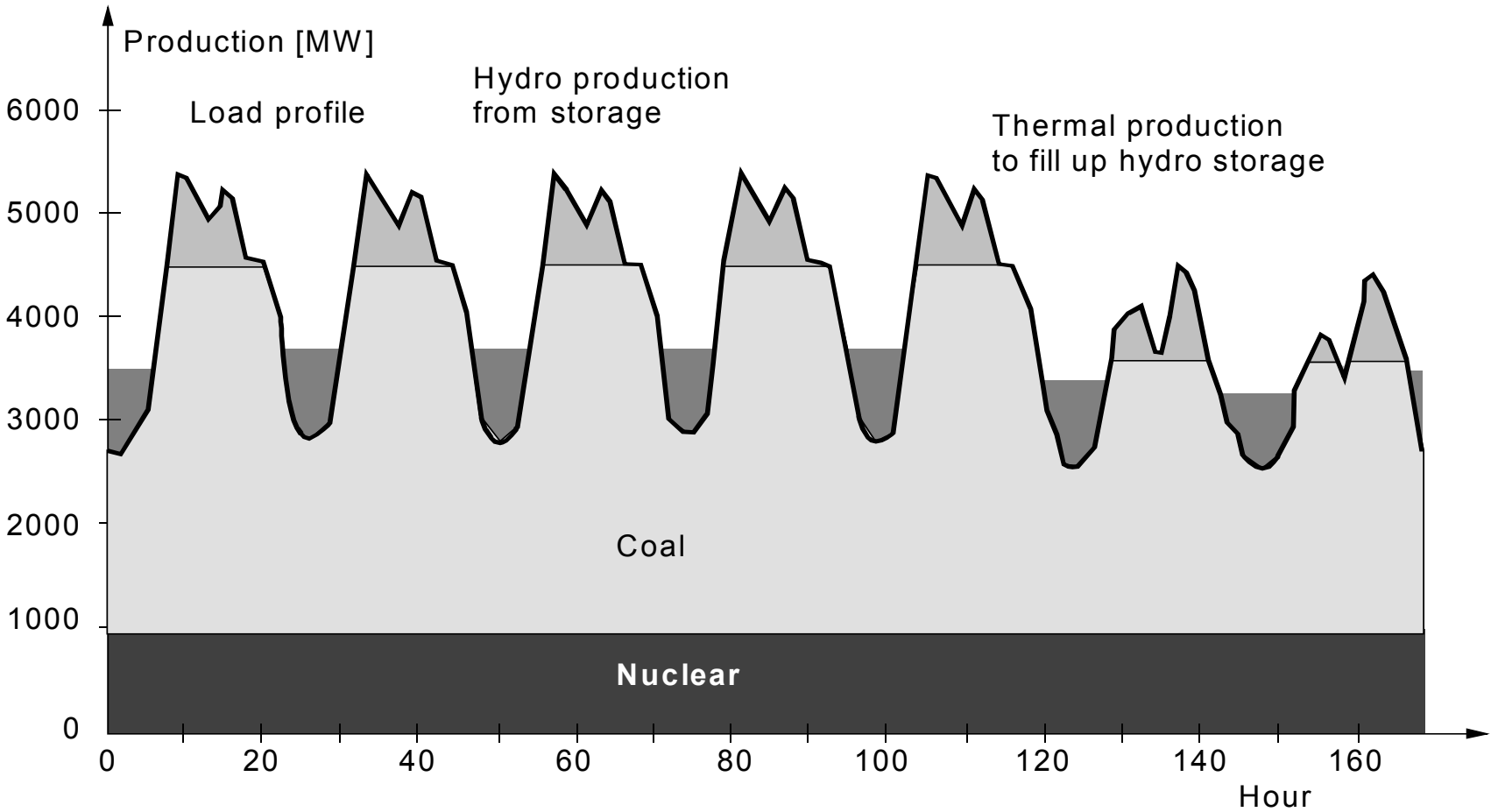
Load profile covered by hydro and thermal generation



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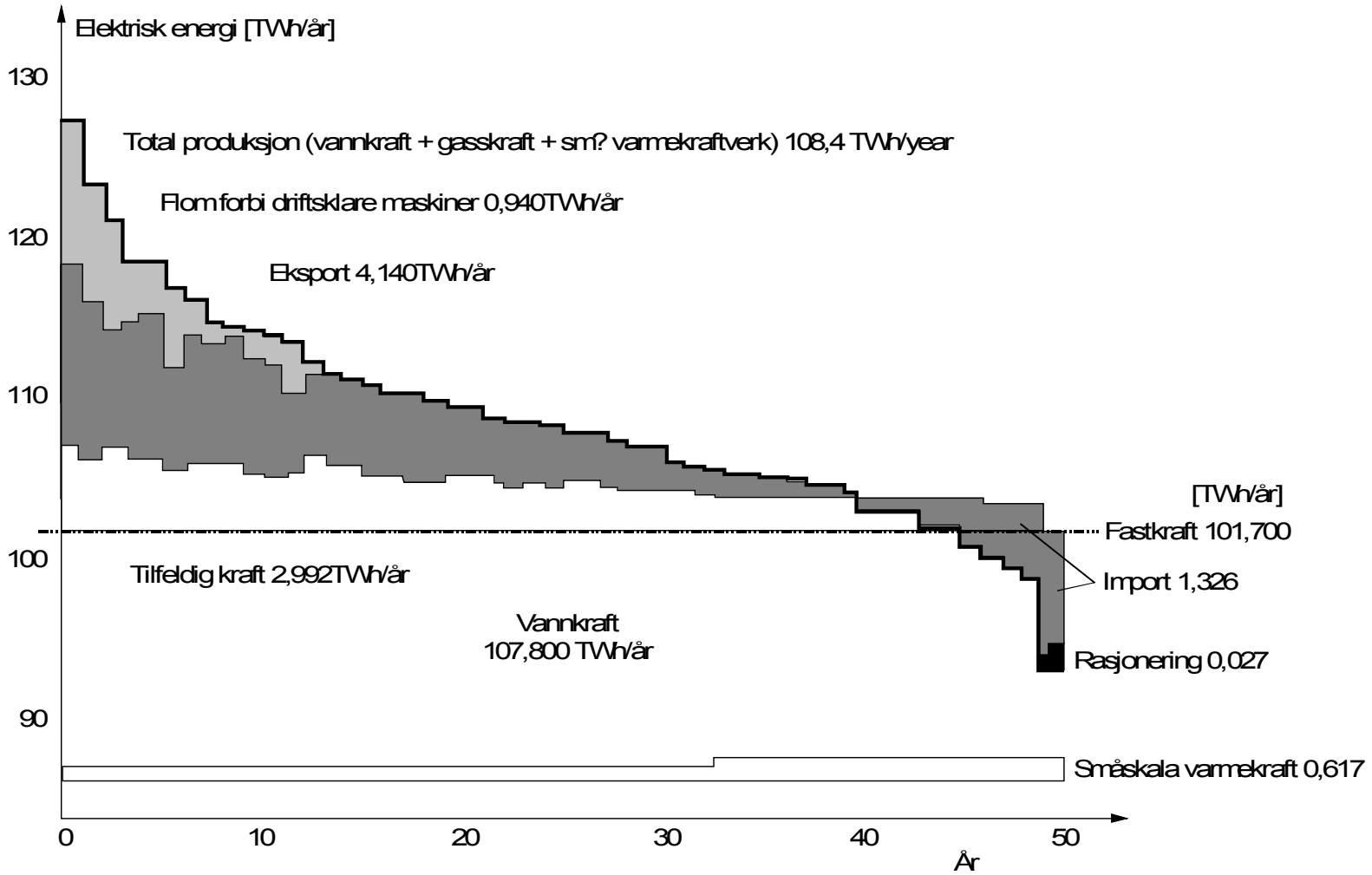
Simulated generation in Norway over 50 hydrological years



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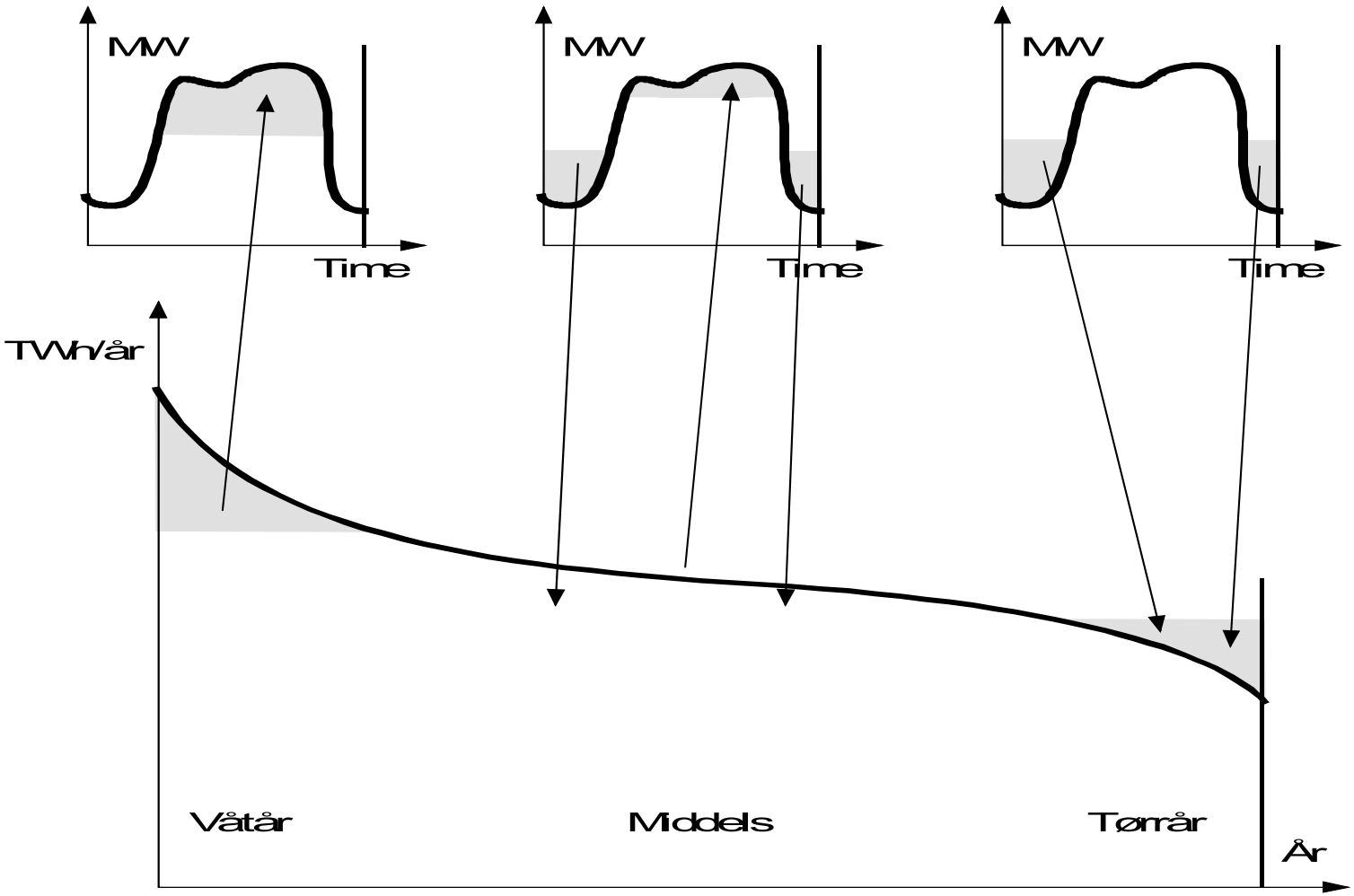
Benefit of hydro–thermal exchange



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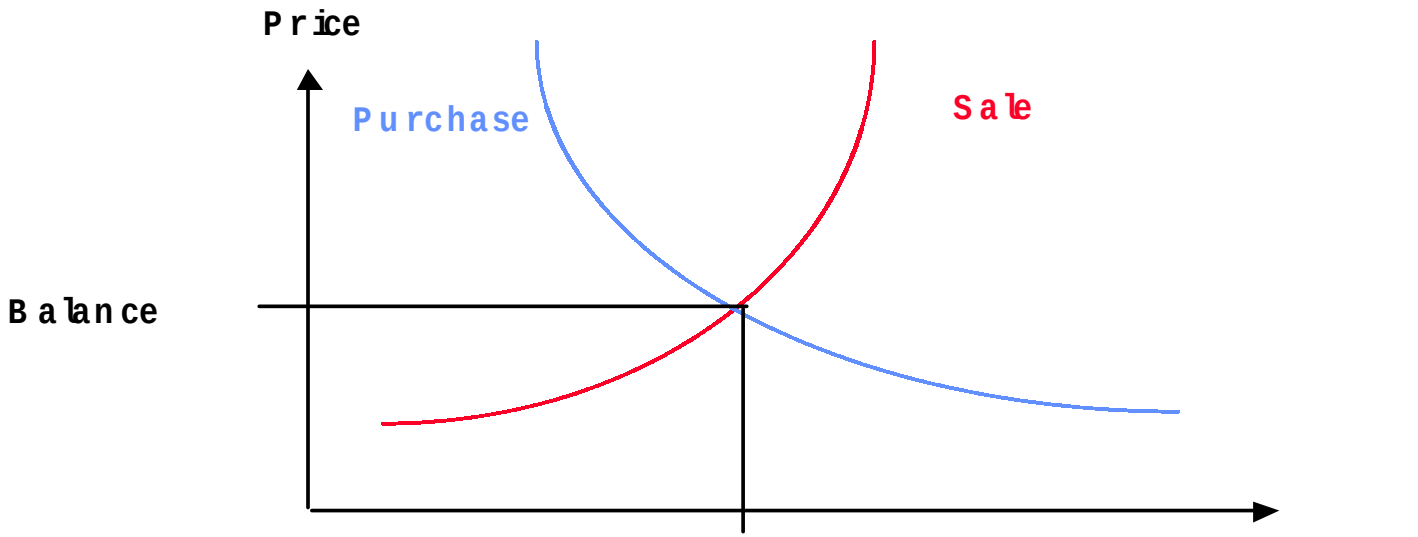
Deregulation has serious impact on regional interconnections

- Interconnections increase the competitive pressure
- Interconnections affect market prices.

Principle for price calculation



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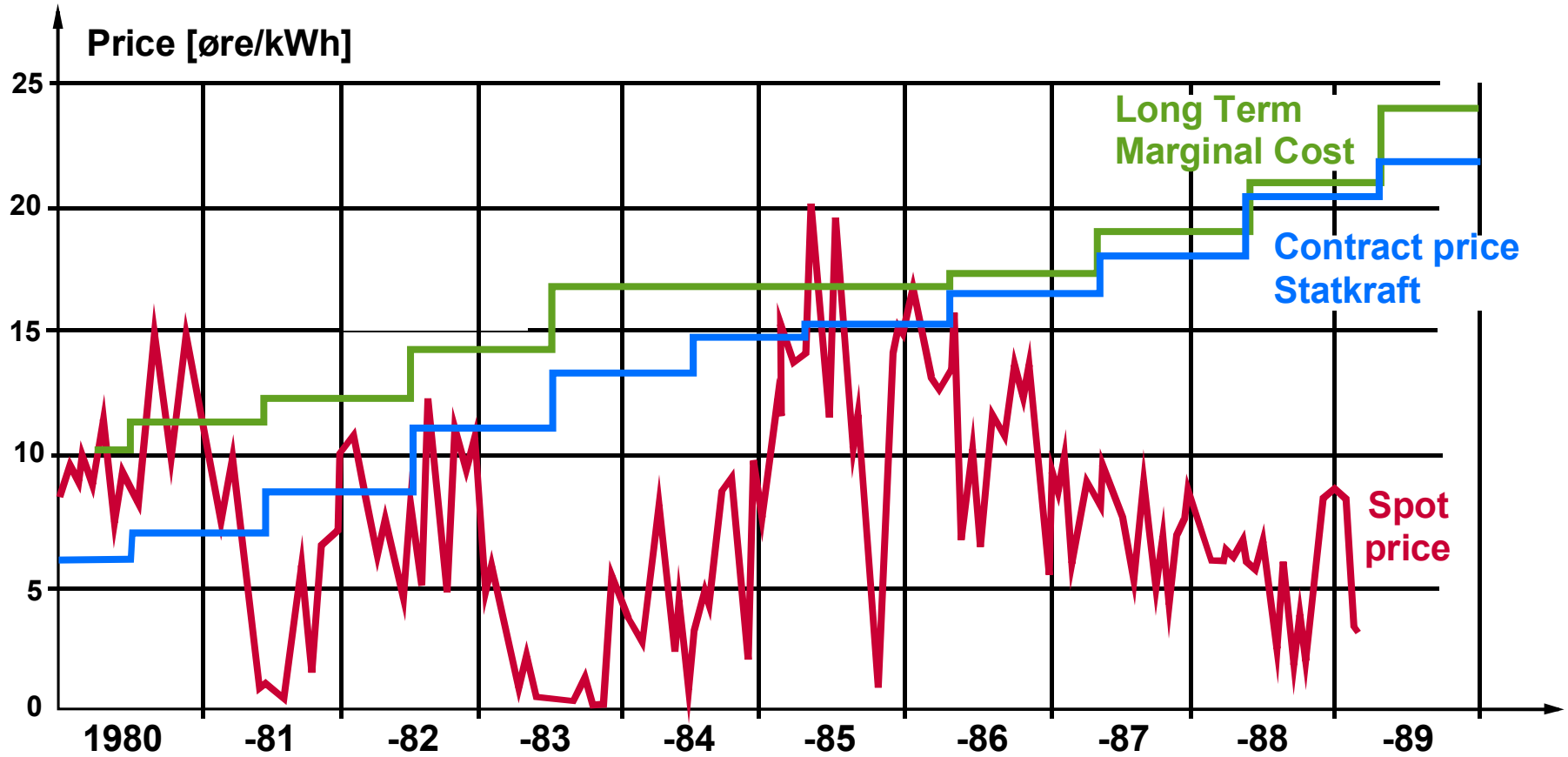
Spot and wholesale contract prices before deregulation



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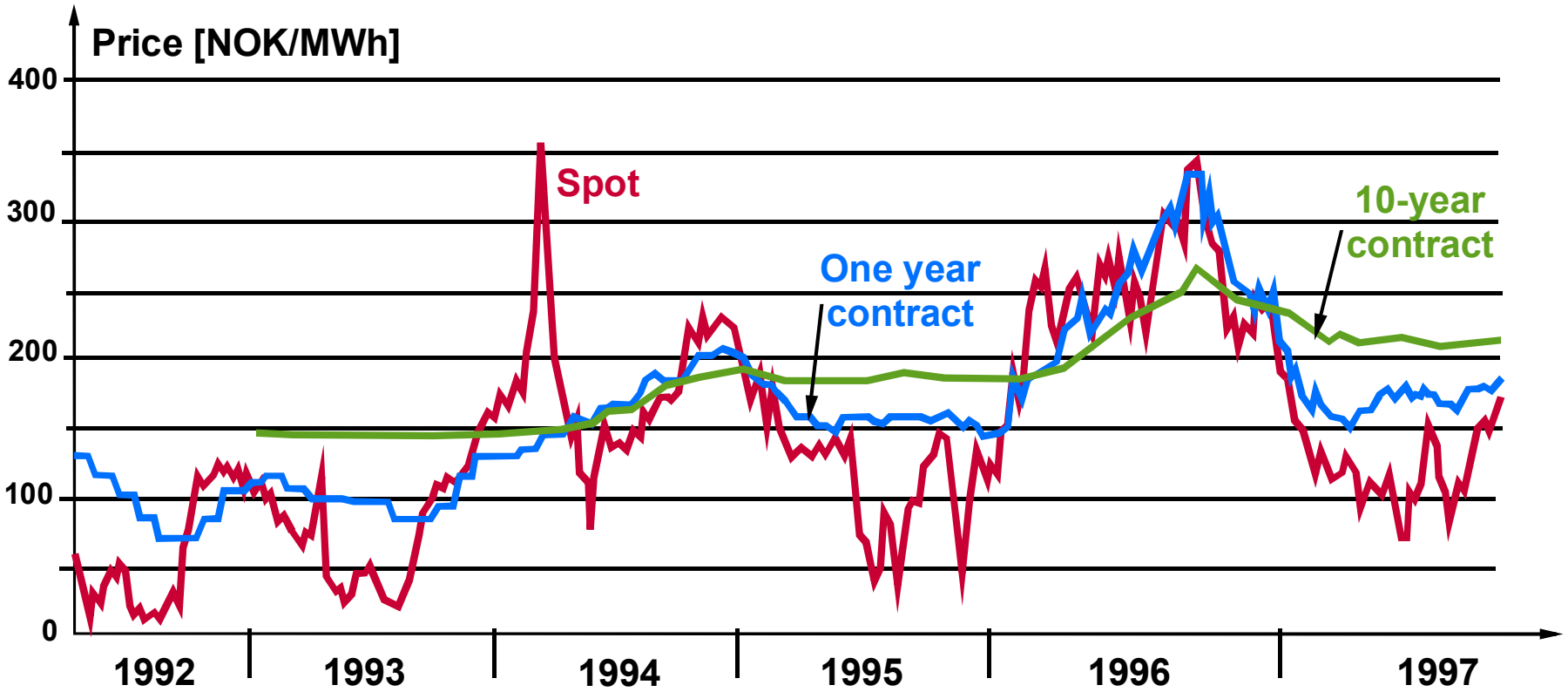

Source: Norsk Kraftmegling

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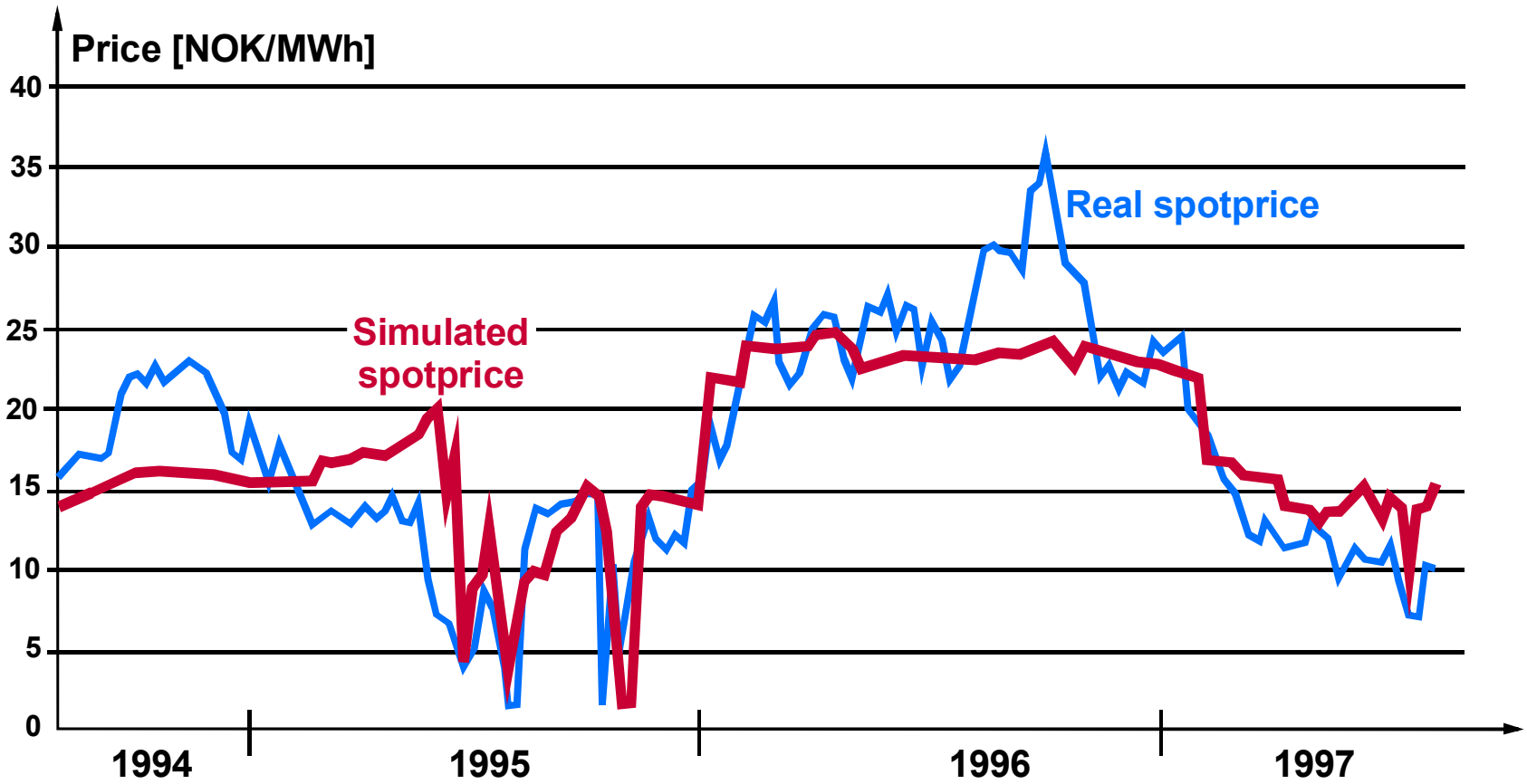
Simulated and observed spot prices in Nord Pool



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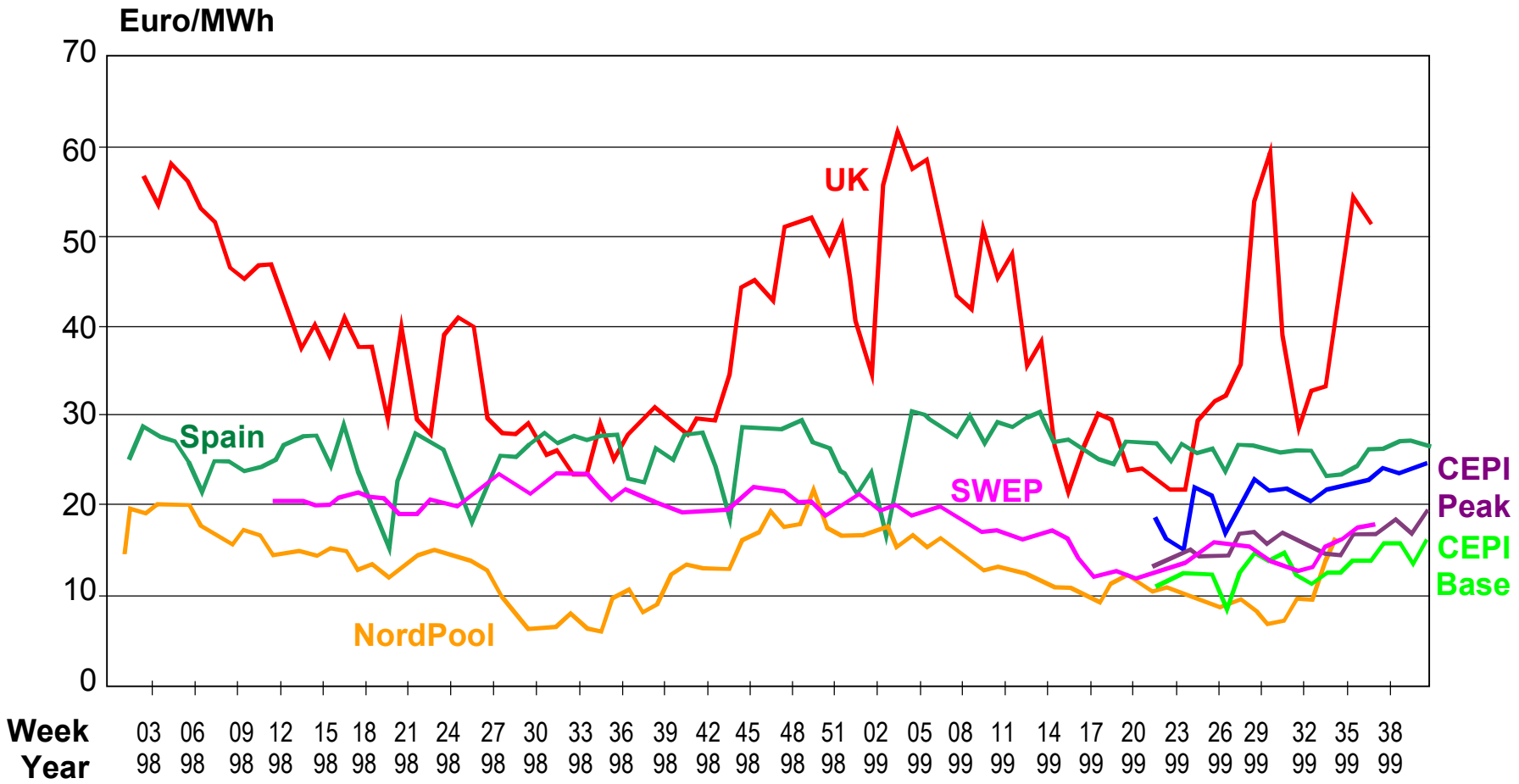
Spotpriser/prisindekser i Europa



APX - Amsterdam Power Exchange
SWEP - Sveitsiste prisindeks
CEPI - Central European Power Index

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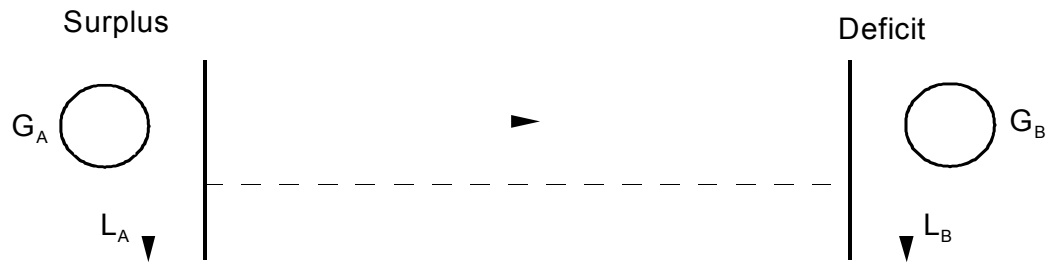
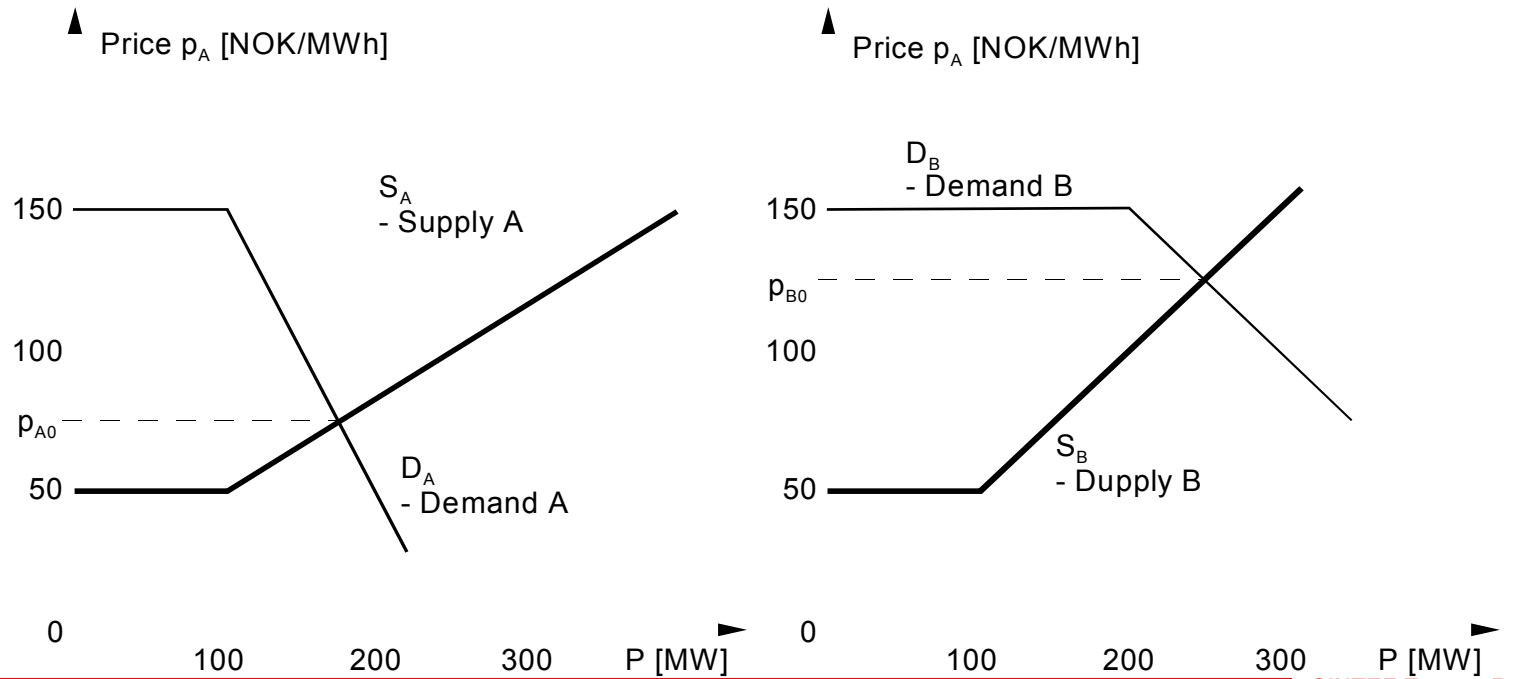
Case: Single transmission line between two areas





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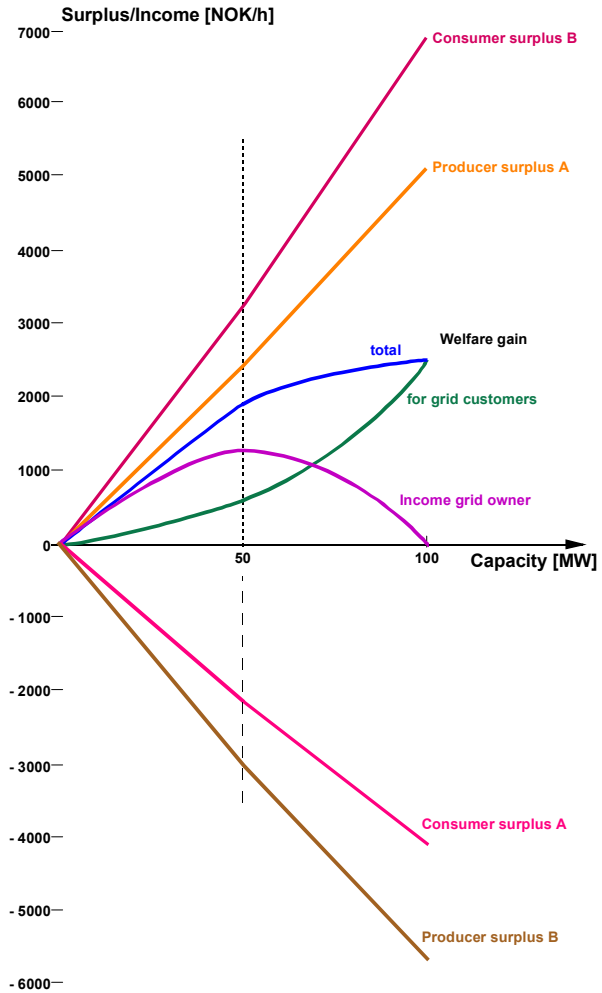
Congestion fee
Consequences for different participants



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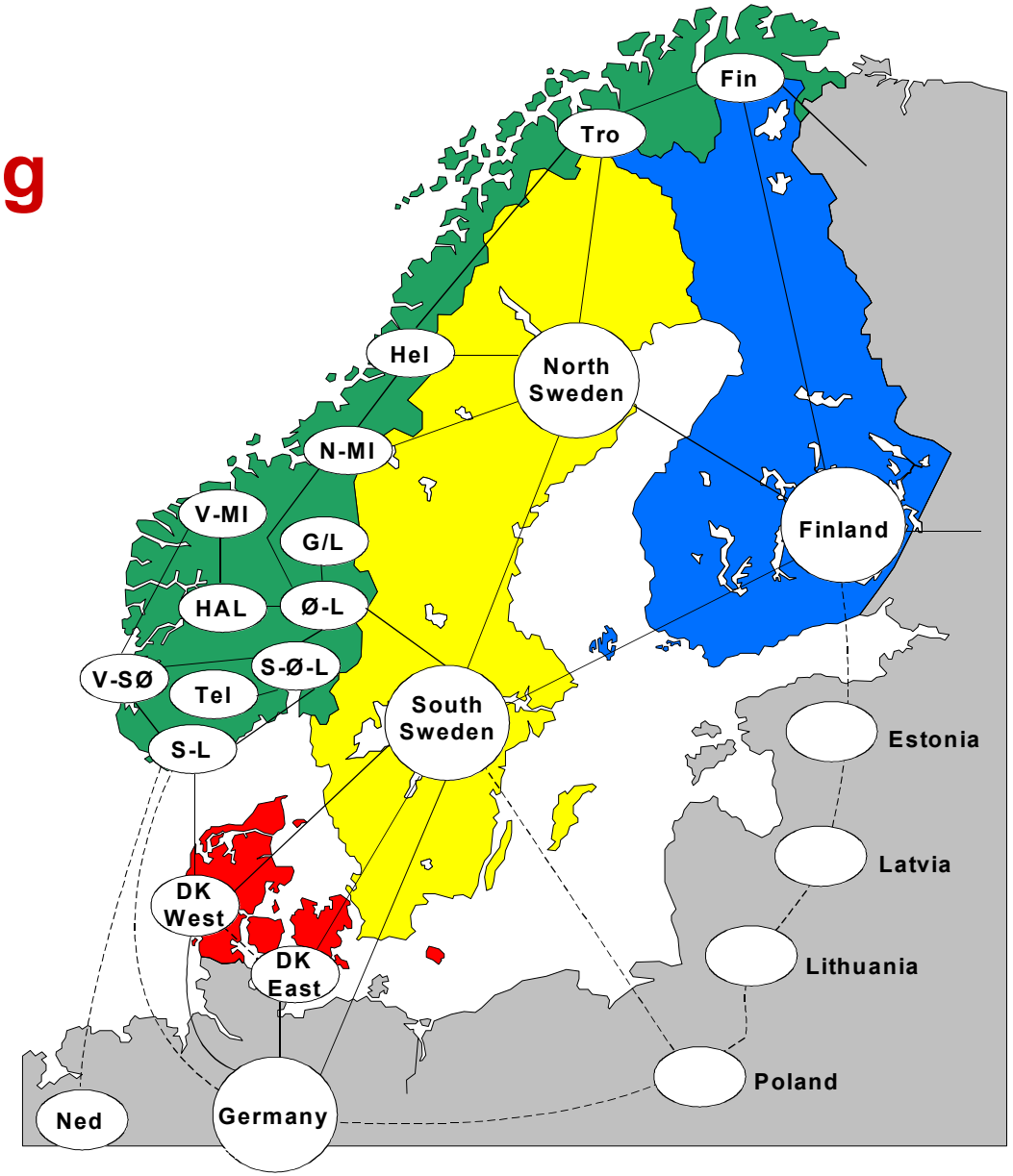
The Baltic Ring Project



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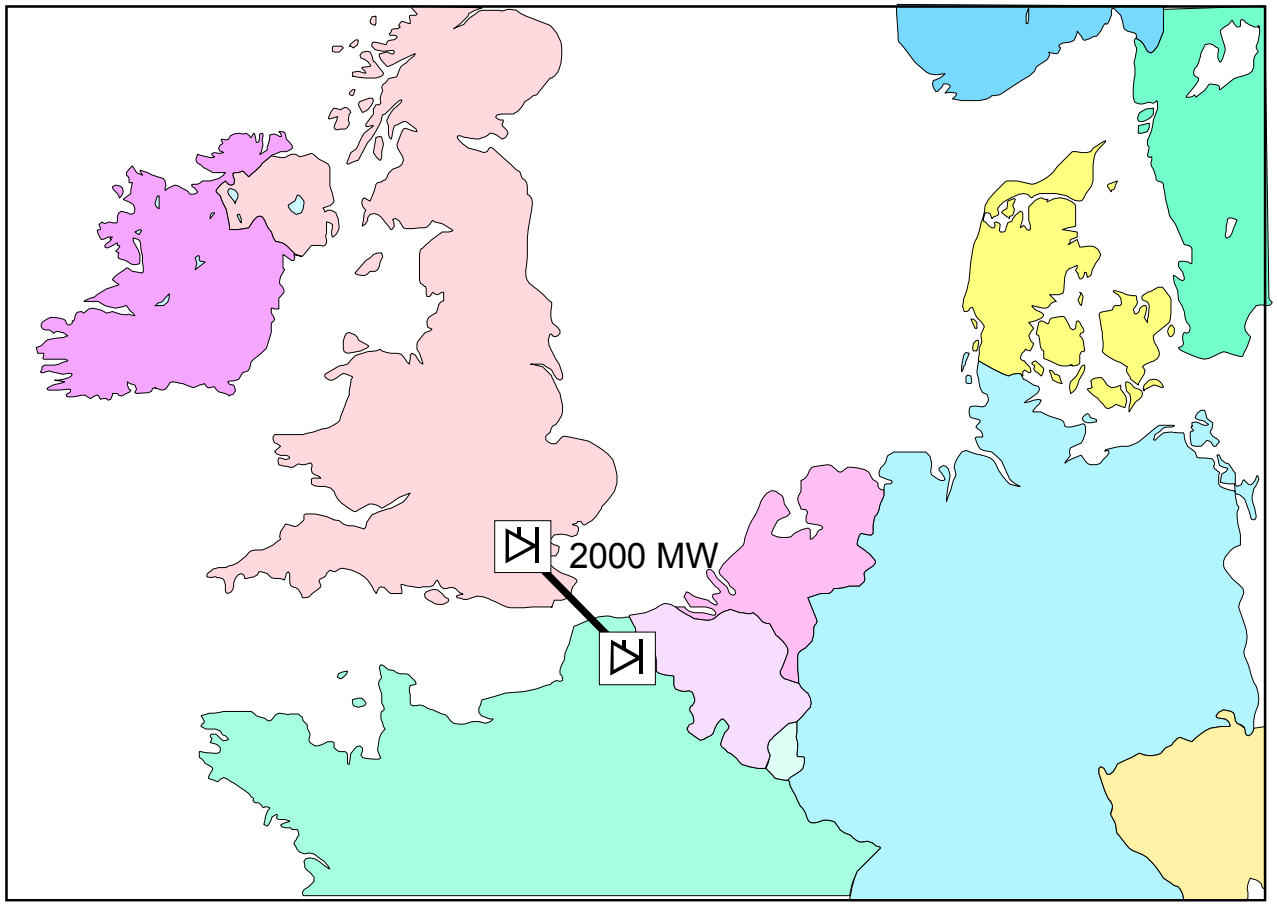
DC connection England - France



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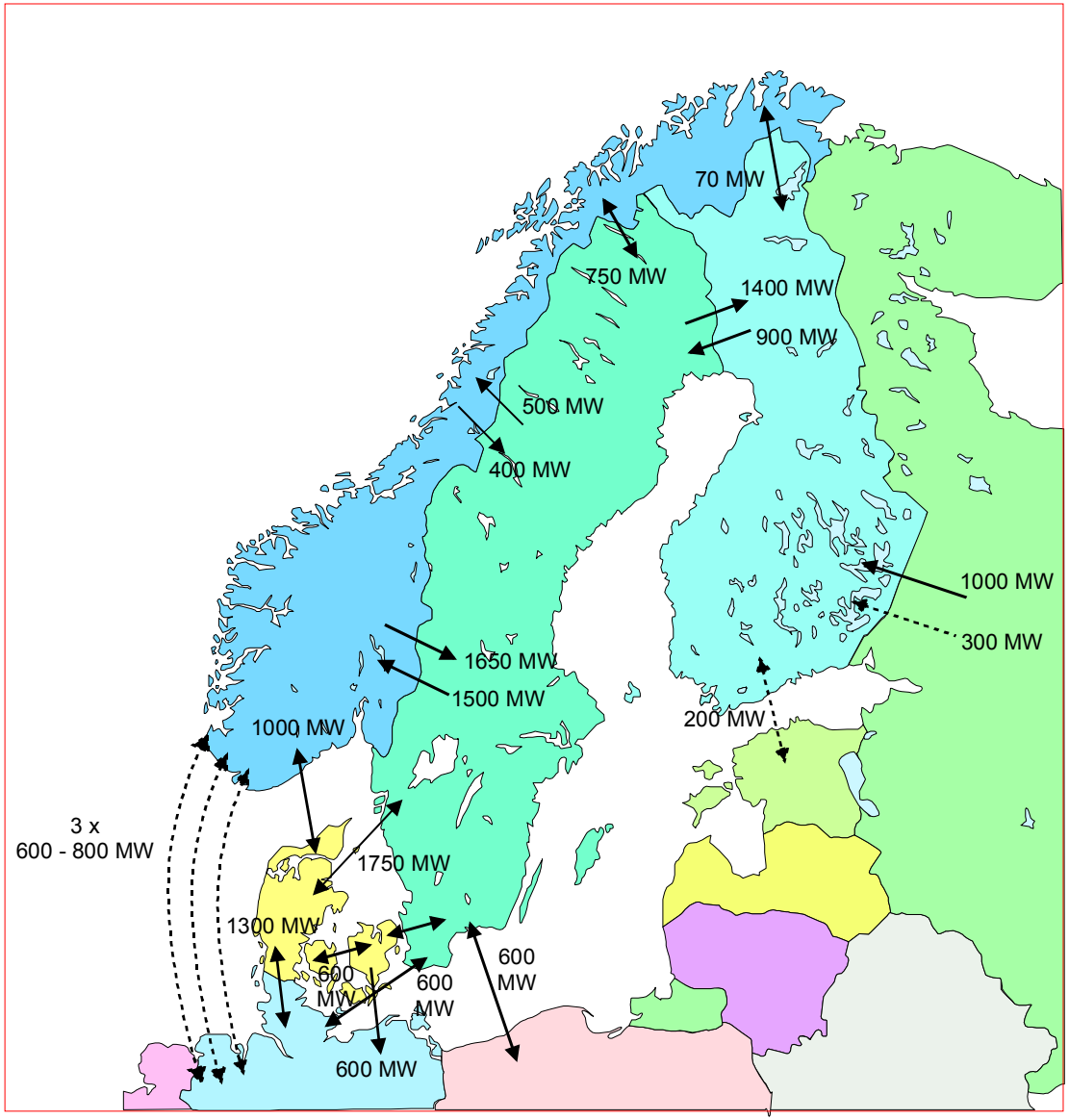
Interchange capacities in Scandinavia



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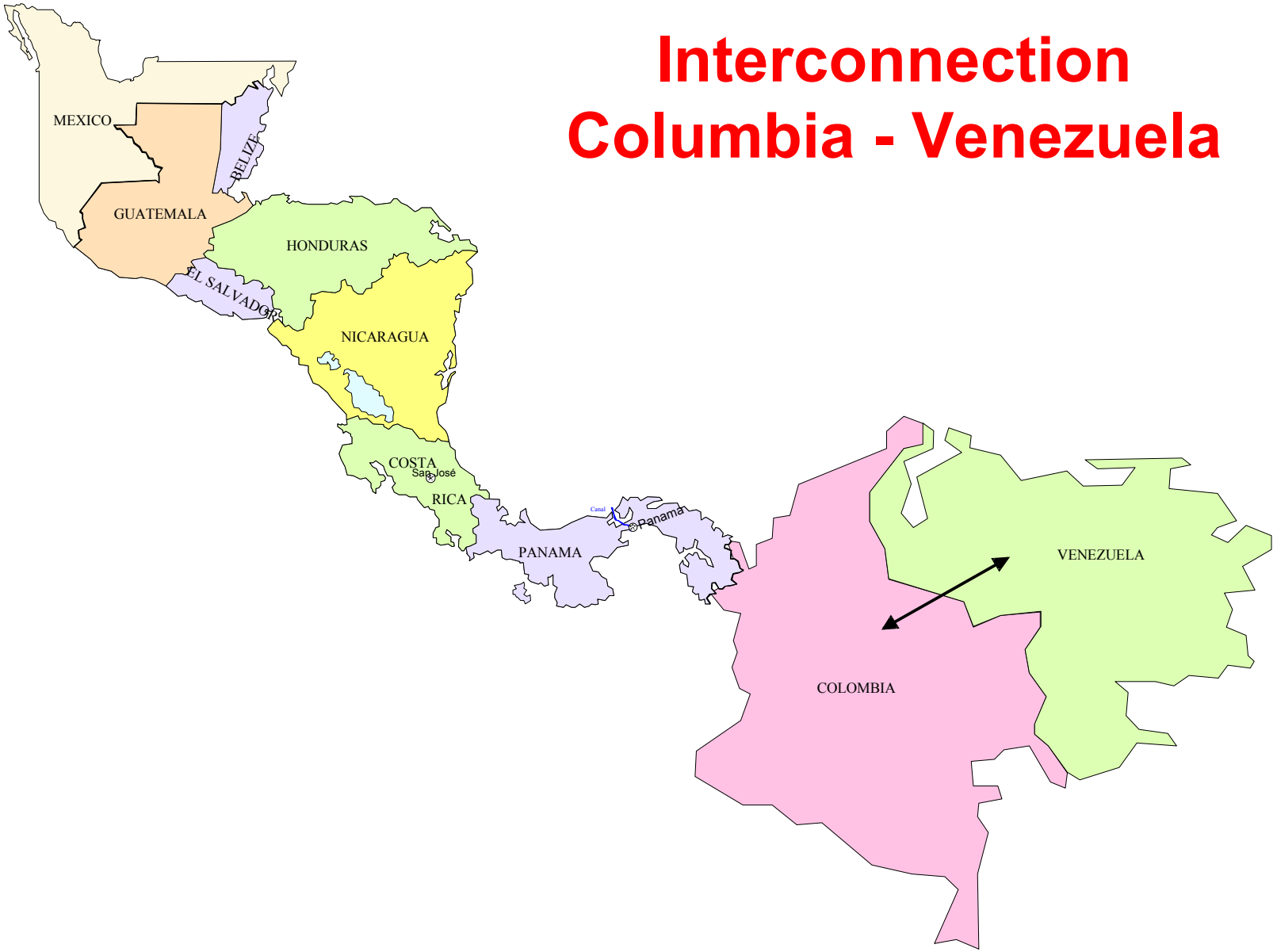
Interconnection Columbia - Venezuela



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Greater Mekong Subregion

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Energy recourses in the GMS region

- Hydro power in Yunnan
- Hydro power in Myanmar
- Hydro power in Lao PDR
- Coal in Yunnan
- Lignite Lao PDR
- Gas in Myanmar and Malaysia