Electricity Policy Research Group

UNIVERSITY OF CAMBRIDGE

Merchant Interconnectors

David Newbery

EPRG Winter Research Seminar

Cambridge 15 December 2006

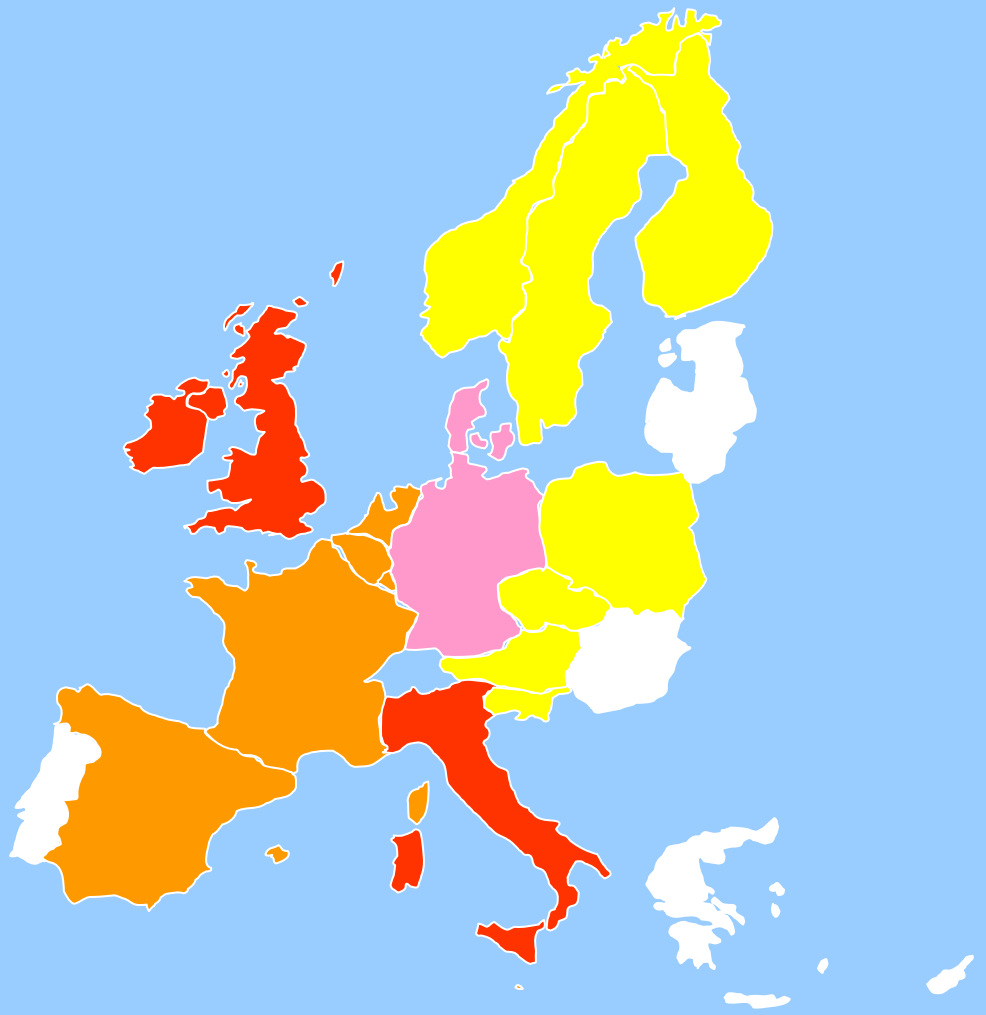
http://www.electricitypolicy.org.uk

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Outline

- Strong pressure from EC to increase interconnection
  - impeded by vertical integration, regulatory delays
- Merchant interconnectors as solution?
  - for HVDC links
  - for transit through e.g. Switzerland
- What are the economics?
- What are the regulatory issues?

Day-ahead price levels 2005



>51 Euros/MWh

41-50 Euros/MWh

31-40 Euros/MWh

< 30 Euros/MWh

n.a.

Merchant Interconnectors

- Receive arbitrage profits and AS income
- Risk borne by private investors
  - avoids regulatory hold-up?
  - In exchange for more relaxed conditions
- Are private profits aligned with social benefit?
  - Interconnecting two jurisdictions?
  - for transit countries?
- An issue for proper inter-TSO compensation?

Regulation EC 1228/2003 of 26 June 2003

for network access to cross-border exchanges

Article 6 on congestion management:

1. to use market based solutions
3. Maximum capacity to be ‘made available’
4. Unused capacity to be ‘reattributed to the market’
5. TSOs to apply netting ‘as far as technically possible’
6. Revenues to be used for increasing IC capacity or taken into account for network charges

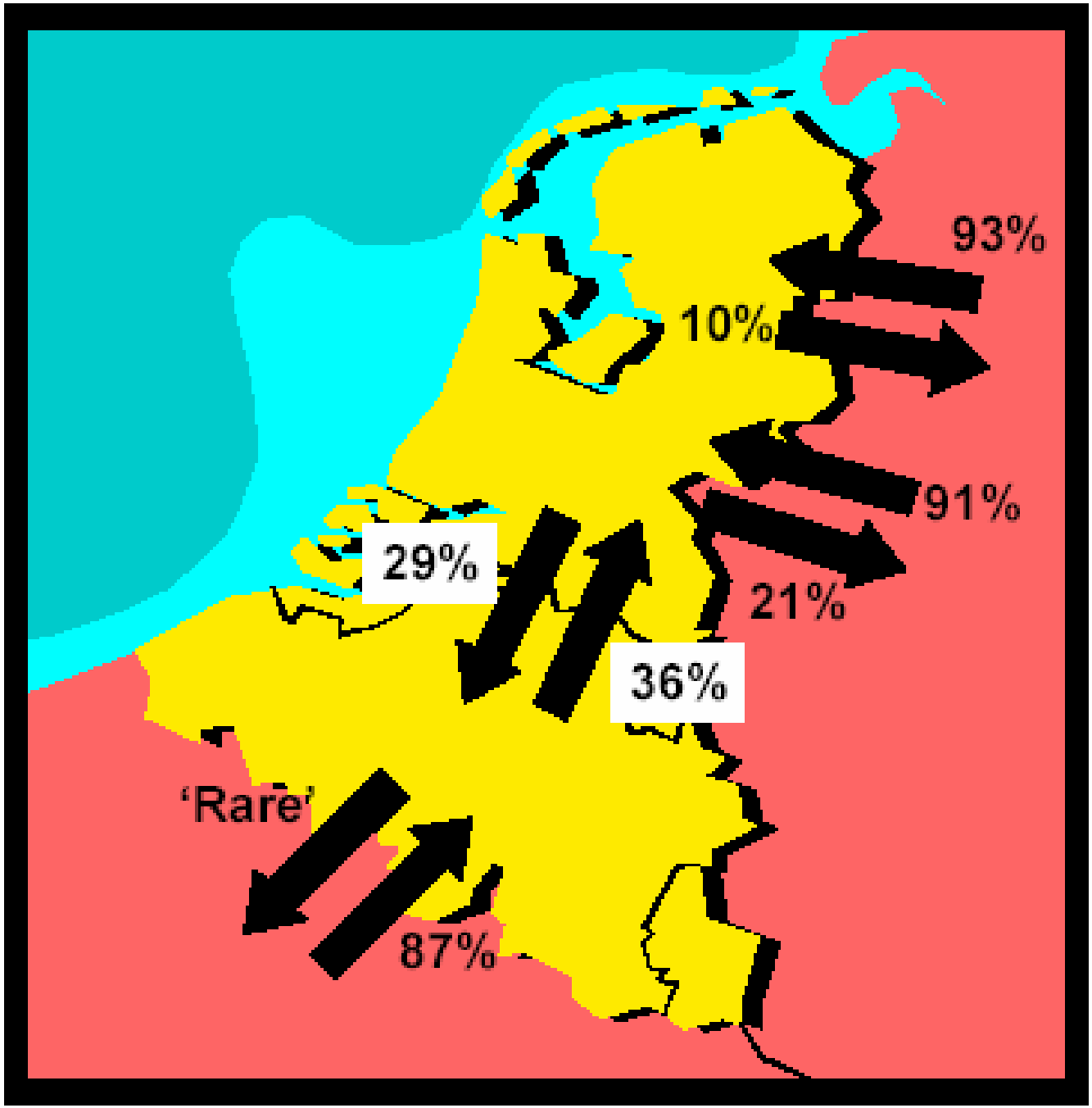
Increasing cross-border capacity

- New investment can be exempted from rTPA
  - if investment enhances competition
  - for maximum of 15 years?
- whether to impose UIOLI up to NRAs?

  $\Rightarrow$ UIOLI could reduce profitability of IC

  $\Rightarrow$ This could determine whether built

Percent of time contractual constraints exist in Benelux (Brattle, 2003)



BritNed

"National Grid and NLink - a subsidiary of TenneT, ... are developing a project for an interconnector between Britain and the Netherlands.

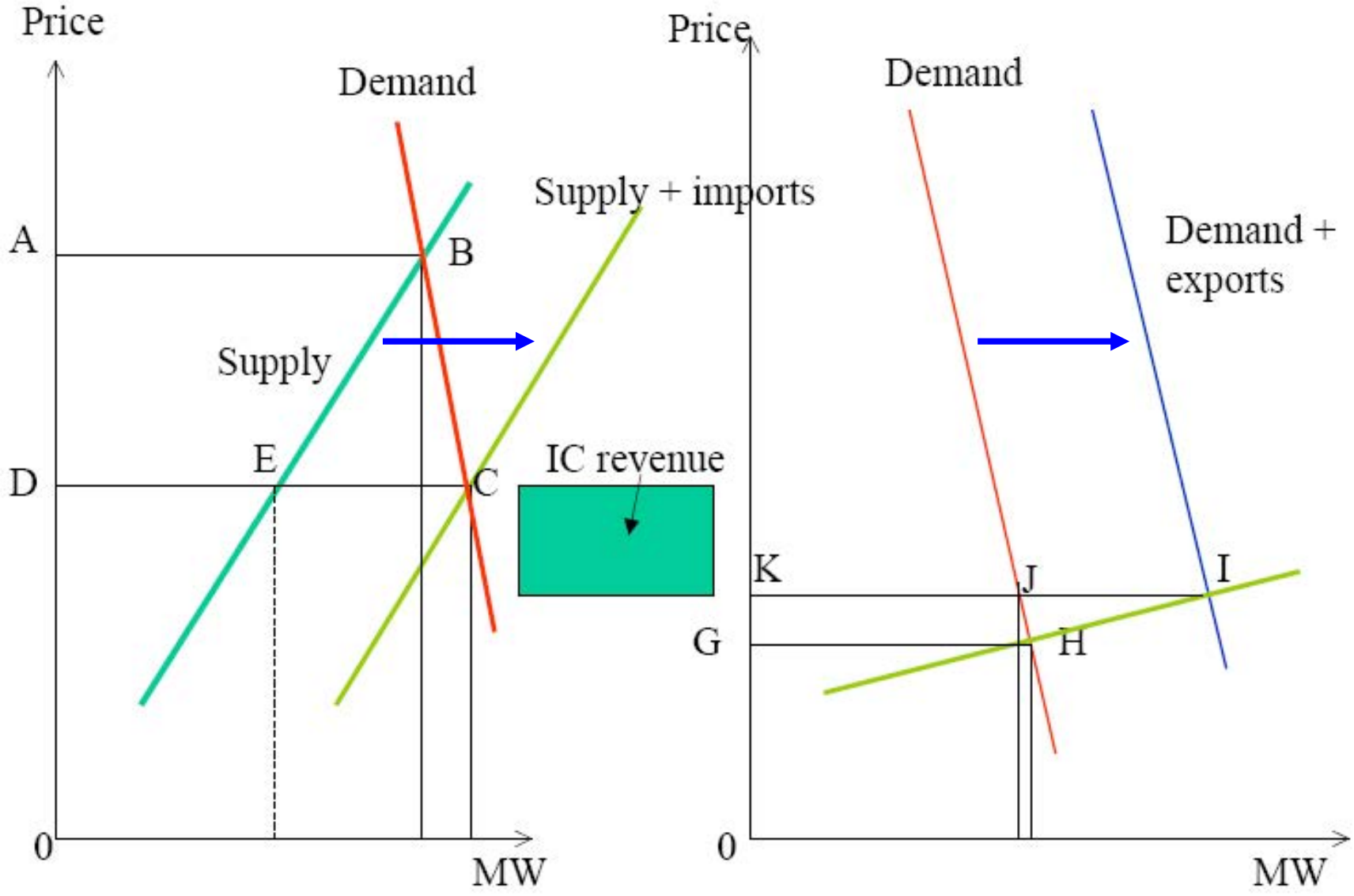
BritNed would have a capacity of between 600-1300MW, be 250km long, and cost between €300 and €400m" (NGC web site)

"We will be effectively connected to relevant markets, much like an 'electricity crossroads'. This is beneficial for the market and good for the security of electricity supplies." (TenneT web site)

Economic analysis

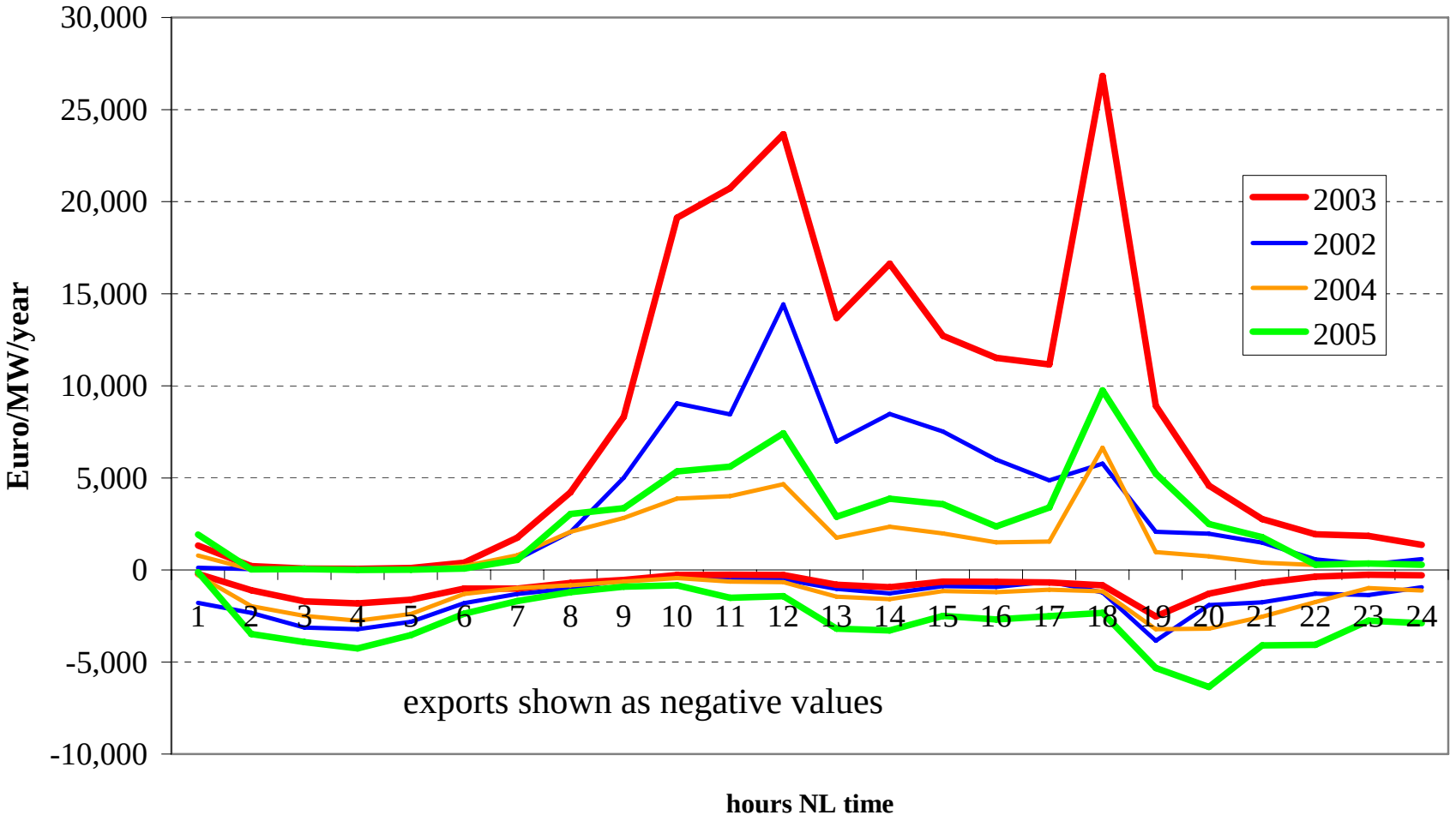
- What is the potential profit?
  - assuming no impact on prices
  - now and in possible futures
- What impact does BritNed have on prices?
  - on the APX and UKPX spot and contract
  - what is the resulting profit?
- What impact does BritNed have on profit of NorNed? On other interconnectors?

Impact on agents of IC

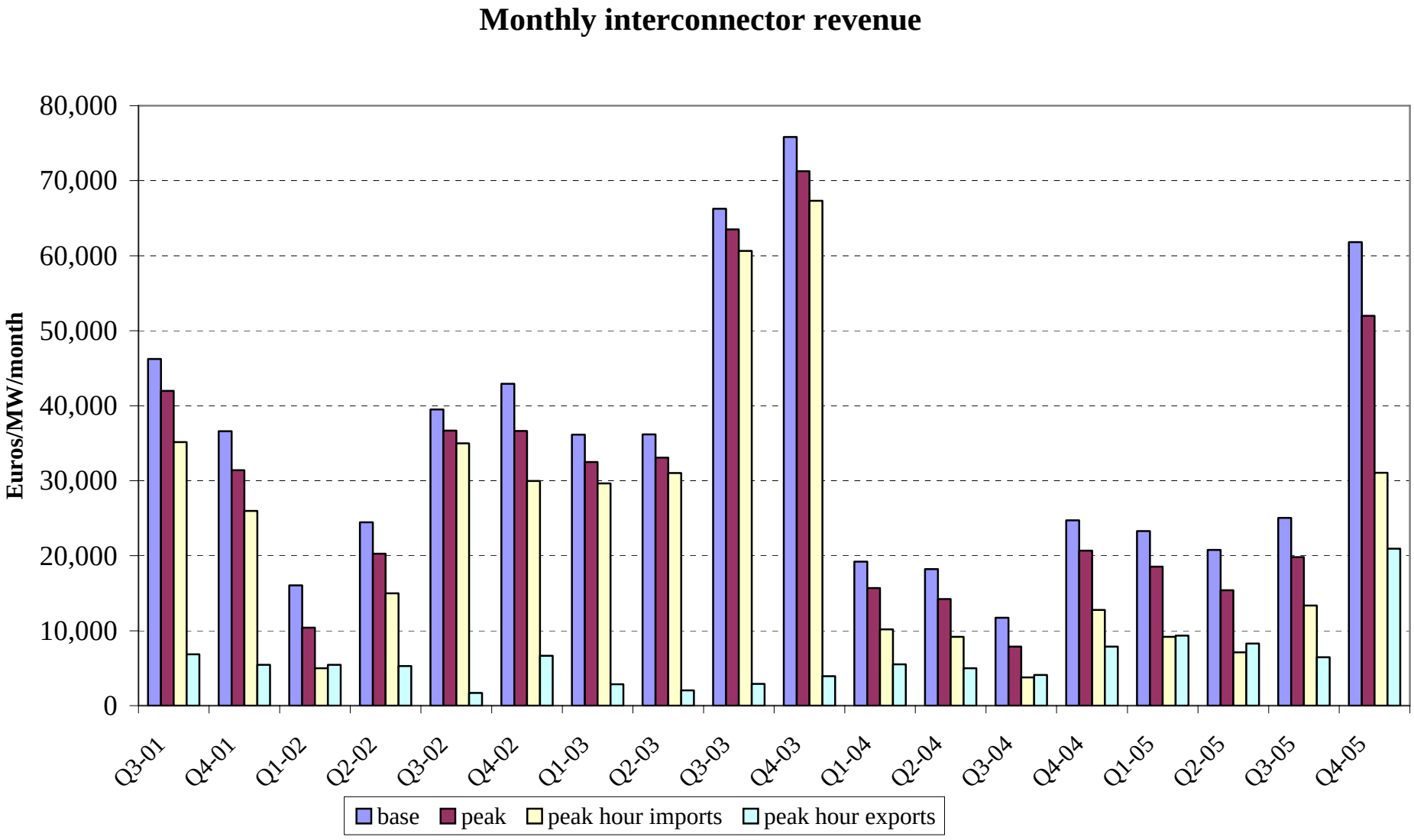


Ignoring price impacts

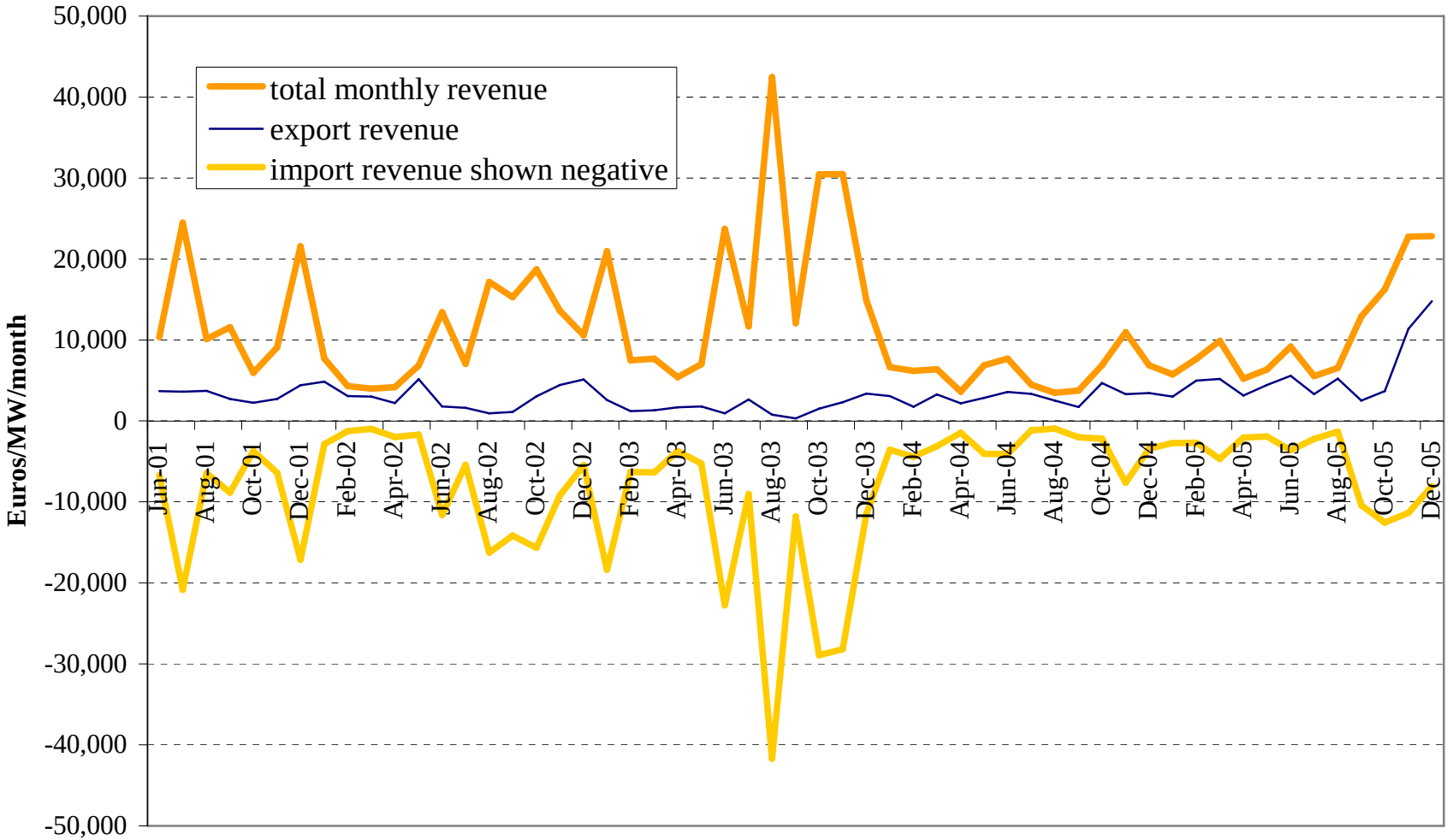
Annual hourly import and export revenue for Britned



Allowing for 2% losses but no impact on prices



Monthly interconnector revenue per MW

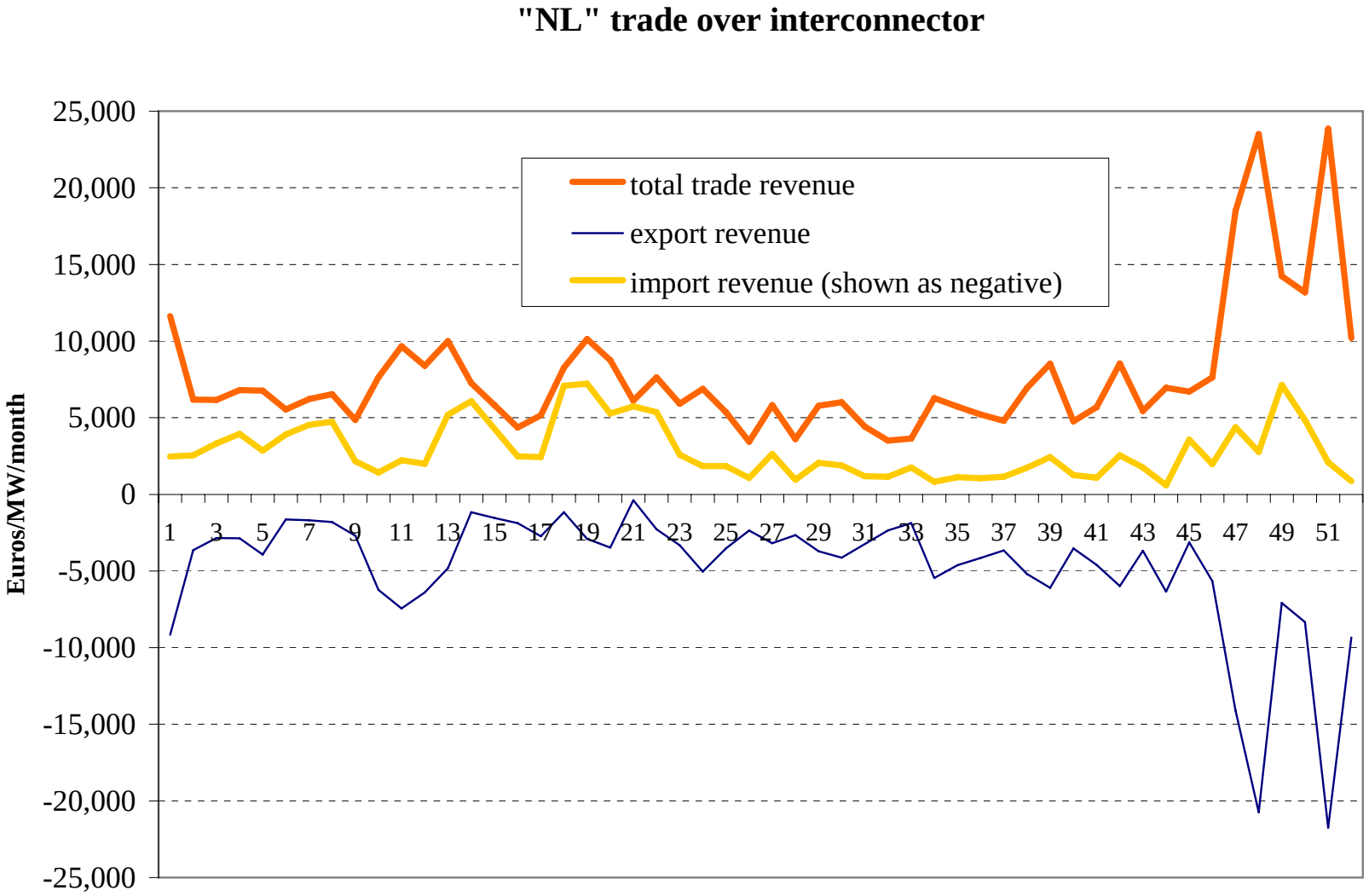


Adjusting APX to average of UKPX prices (1,000 MW)

← *€million/year* → *€/MWh*

	Unad-justed	**Additive adjust-ment**	**Proport-onal adjust-ment**	**Average original APX price**	**Average UKPX price**
2002	123	139	138	30	24
2003	214	266	249	46	26
2004	74	74	74	32	31
2005	131	110	130	52	53
Average	136	147	148	40	34

Simulating the effect of Dutch prices aligning on German prices

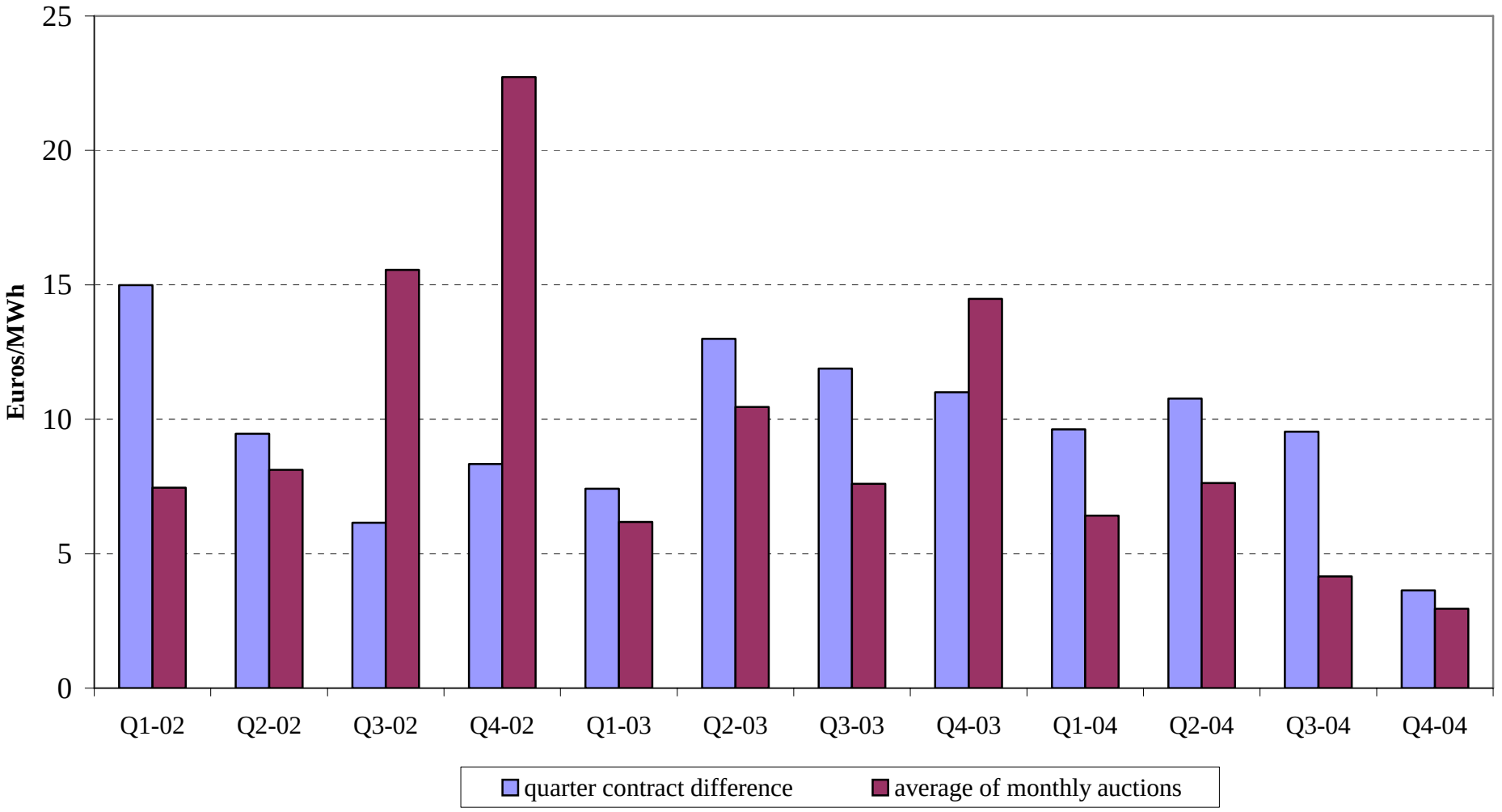


Effect on profits of aligning APX with EEX prices, (1,000 MW) *€ million/yr*

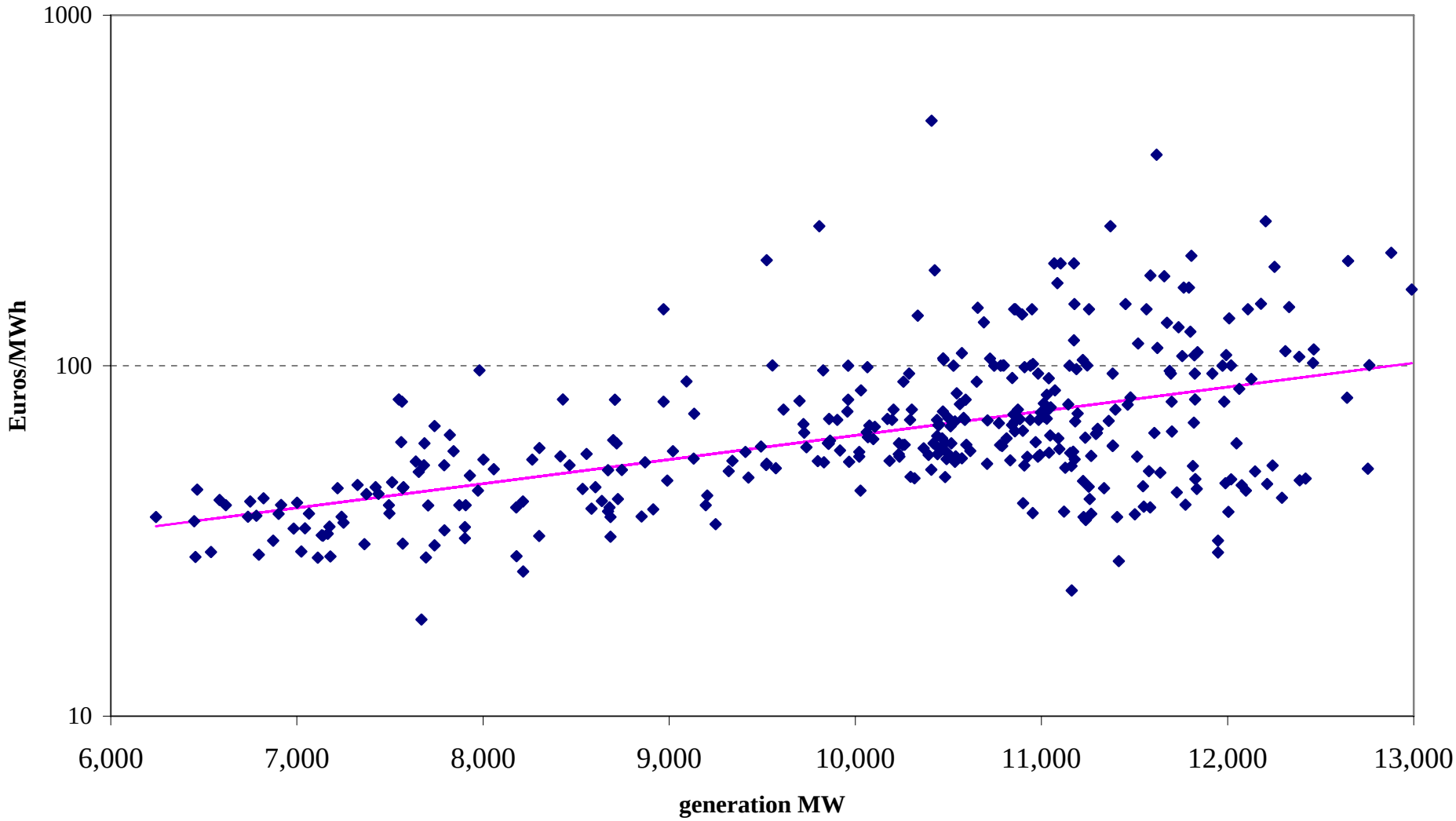
	APX	APX adjusted	EEX
2002	123	138	86
2003	214	249	86
2004	74	74	59
2005	131	130	110
Average	136	148	85

Do auction prices predict IC value? Averages same

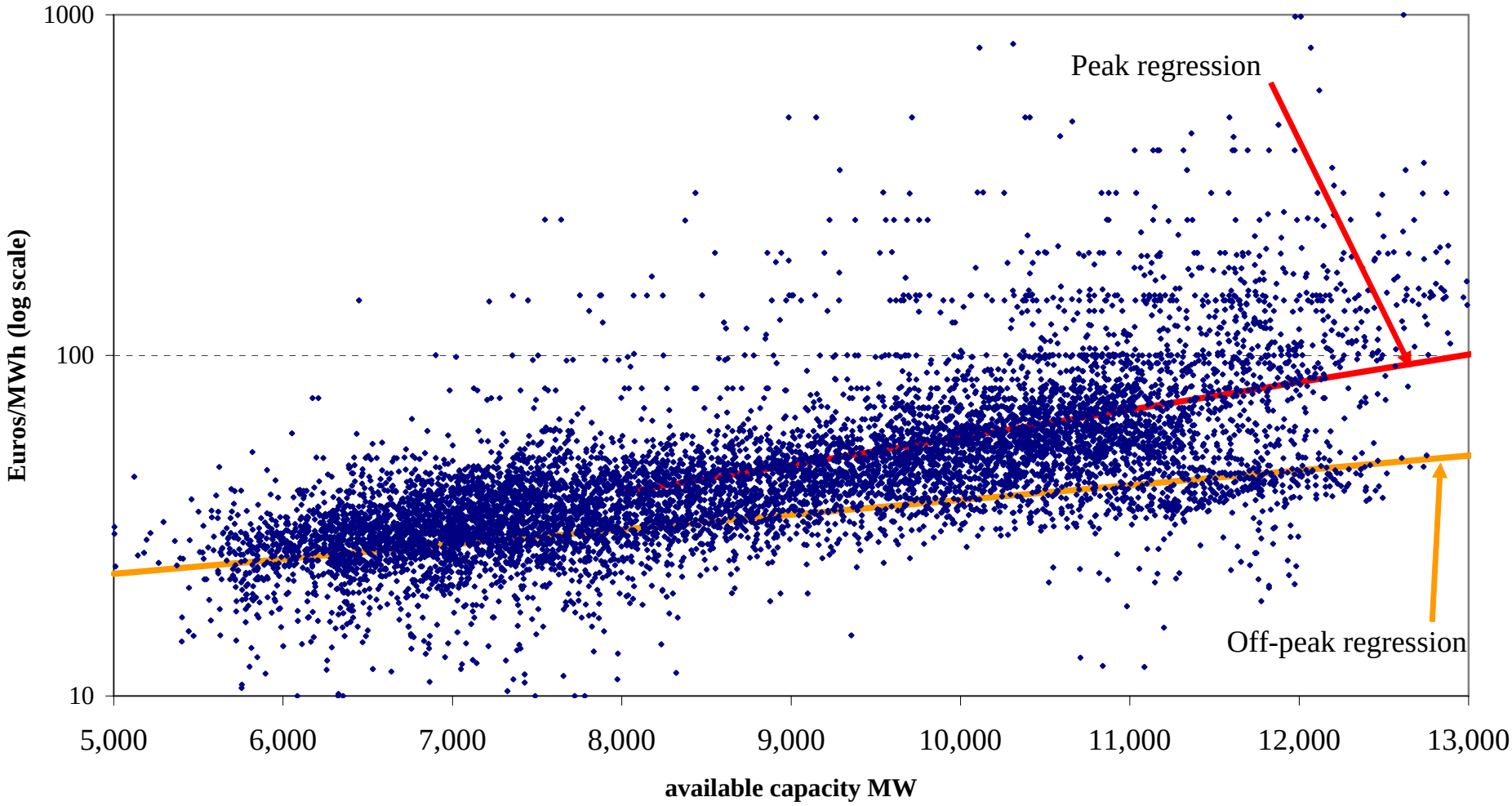
Comparison of auctions and base-load contract differences



Estimating the price impacts



Price vs generation all hours 2005



Total BritNed profits (1,000 MW) in €million /year before and after various price impacts

	No impact on prices	**Pre-BritNed, Post-Norned**	**Post-BritNed, Post-Norned**
2002	130	116	59
2003	218	194	100
2004	77	66	24
Average	142	125	61

Impact of ICs on APX price levels and variability

€/MWh

	Pre-BritNed, Pre-Norned		**Pre-BritNed, Post-Norned**		**Post-BritNed, Post-Norned**	
	Mean	SD	Mean	SD	Mean	SD
Average	33	54	30	39	29	32

Rough estimate of impact of BritNed on NorNed profits

€ million/year

	Revenue from NorNed without BritNed	Revenue from NorNed with BritNed
2002	115	86
2003	178	129
2004	62	44
average	118	86

Conclusion on BritNed

- Profitability depends sensitively on
  - magnitude of price impacts
  - operating and capital costs
  - internal network constraints (Randstadt)
  - impacts on NorNed
- Moderately robust to changes in price levels

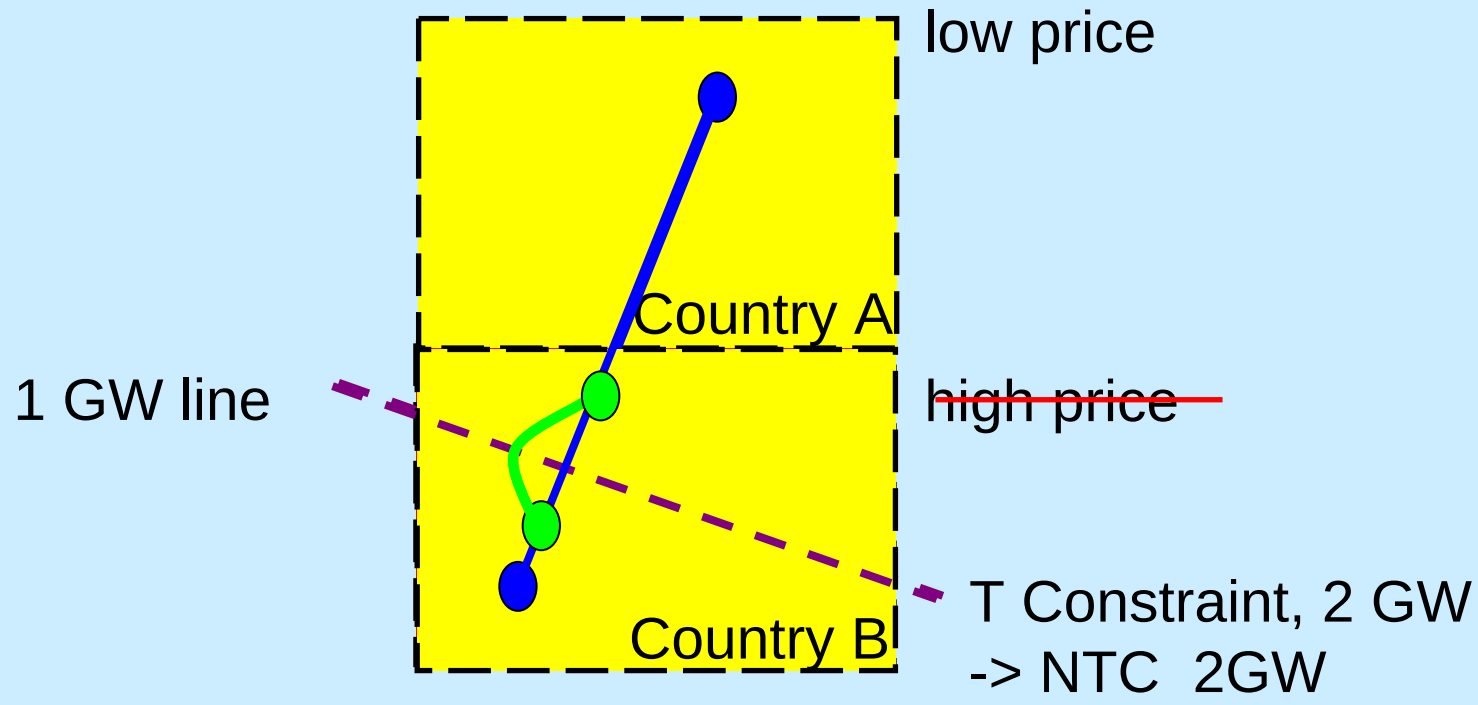
The Swiss case for merchant interconnectors

- Switzerland is a major transit hub
- and also the southern control centre
  - a key member of ETSO
- but is not part of the EU or EEA
- companies are vertically integrated
- Swiss regulation is evolving
- and merchant transit investment is happening

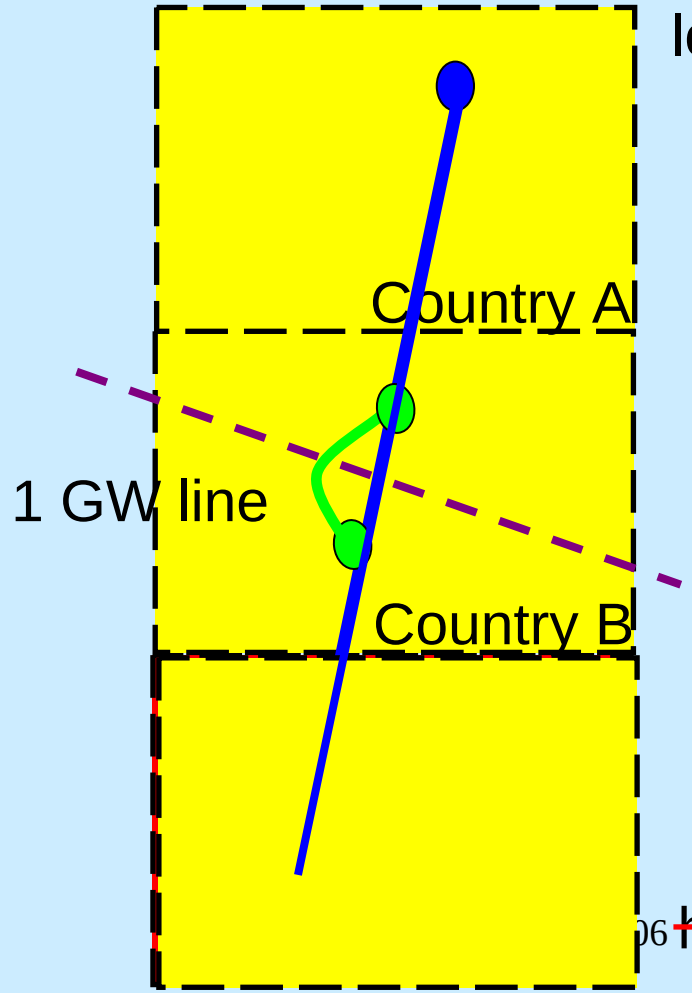
Limitations of regulatory solutions for interconnectors…

- Vertical integrated utilities fail to invest to avoid competition
- Conflict between jurisdictions if benefits & costs have distributional impacts
- Inter-TSO compensation may not be adequate for new line
  - burden placed on transit country

Vertical integrated companies reluctant to build capacity if it lowers prices



Difficulties for regulated investment - transit



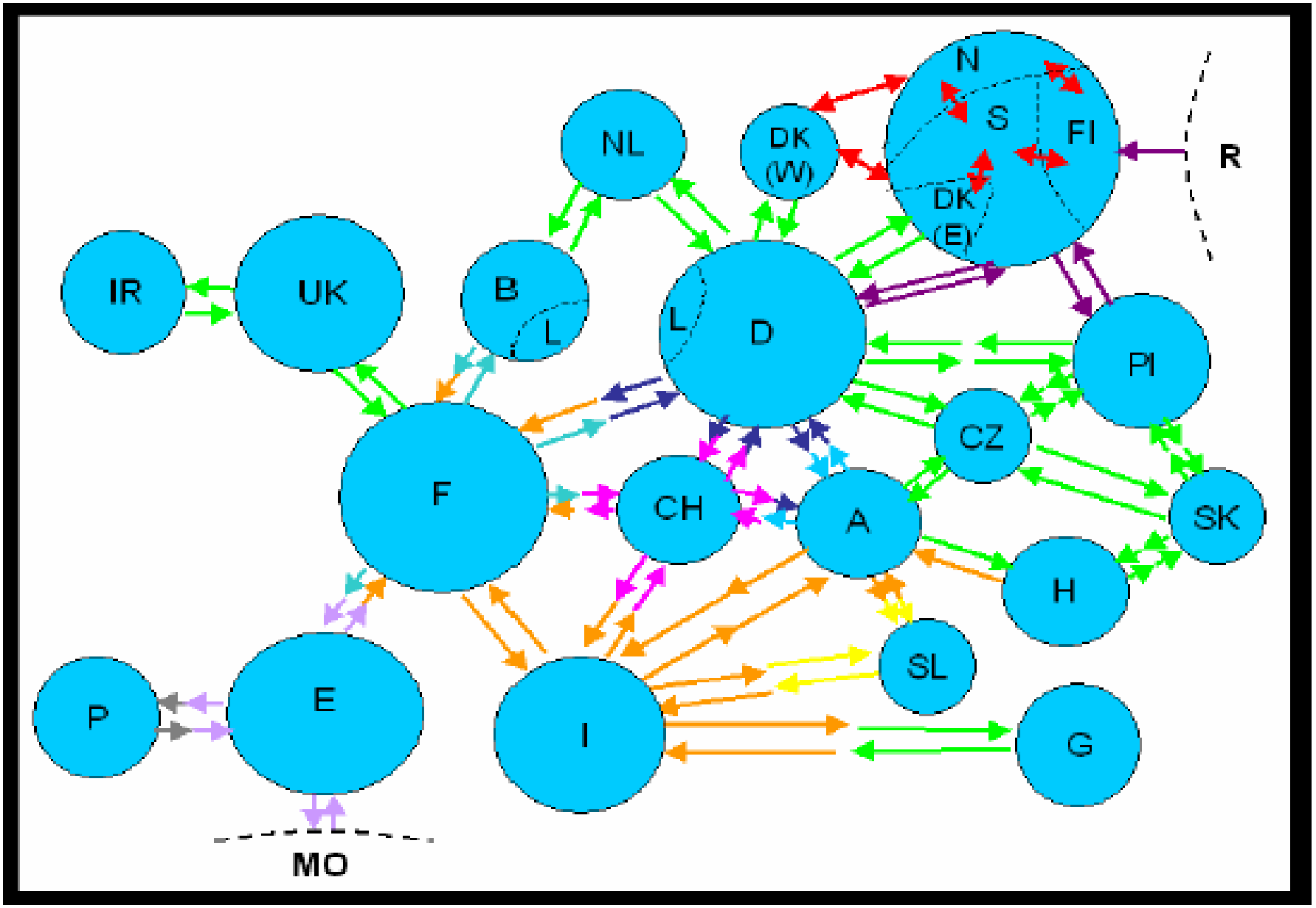
Why would B want to pay for the benefit of A and C?

Does TSO compensation suffice?

Inter-TSO payments

- Current TSOs compensation is provisional: PM
- Florence process to choose replacement
  - ETSO prefers With & Without Transits method: WWT
  - IIT proposes Average Participation method: AP
- Choice will impact CH transmission charges
  - the level via effect on total income
  - possibly structure of charges?
  - returns to cross-border transmission

IIT study for 2002 for DGTren



Payments (Provisional Method) for 2002

Payments to

Payments by countries mill. euros

	A	B	CH	CZ	D	E	F	H	I	NL	P	SLO	SK
A	14.5	0.0	0.0	0.2	0.7	0.0	0.0	0.1	0.0	0.0	0.0	0.5	0.1
B	0.0	22.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
CH	0.0	0.0	21.5	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CZ	1.6	0.0	0.0	10.9	2.7	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4
D	1.2	0.0	2.0	0.7	156.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
E	0.0	0.0	0.0	0.0	0.0	103.6	0.0	0.0	0.0	0.0	1.3	0.0	0.0
F	0.0	1.5	2.7	0.0	3.7	0.8	256.5	0.0	0.0	0.0	0.0	0.0	0.0
H	0.1	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.5
I	1.6	0.0	8.3	0.0	0.6	0.0	0.1	0.0	82.5	0.0	0.0	0.9	0.0
NL	0.0	0.8	0.0	0.0	2.1	0.0	0.0	0.0	0.0	26.6	0.0	0.0	0.0
P	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	22.0	0.0	0.0
SLO	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0
SK	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	6.9
Use of	20.3	24.8	34.6	12.2	167.2	106.6	256.8	8.1	82.5	27.3	23.3	4.3	7.9
Use by	16.1	23.0	22.4	15.7	160.9	104.9	265.3	8.2	94.1	29.6	24.2	3.9	7.8
receipt	4.2	1.9	12.3	-3.5	6.3	1.8	-8.6	-0.1	-11.5	-2.3	-1.0	0.4	0.1
	5.8	2.4	13.1	1.3	10.7	3.0	0.3	0.6	0.0	0.7	1.3	1.5	1.0
	1.6	0.5	0.8	4.8	4.4	1.3	8.8	0.7	11.6	3.0	2.2	1.1	0.9

Total use of CH's network =34.6, use by CH =22.4, so net receipt by CH is 12.3 m Euros

Payments under WWT method

	A	B	CH	CZ	D	E	F	H	I	NL	P	SLO	SK
A	99.0	0.2	1.6	-0.5	1.9	-0.4	0.0	0.7	0.0	0.3	-0.1	0.1	0.2
B	1.4	141.1	2.2	-0.6	2.7	-0.7	0.0	1.0	0.0	0.5	-0.1	0.1	0.2
CH	2.0	0.6	97.8	-1.0	4.3	-1.3	0.1	1.6	0.0	0.8	-0.2	0.2	0.4
CZ	2.2	0.5	3.6	202.3	4.2	-0.8	0.0	1.5	0.0	0.8	-0.4	0.2	0.5
D	1.8	0.7	3.5	-1.3	1261.8	-1.9	0.0	1.7	0.0	0.6	-0.4	0.2	0.6
E	1.4	0.3	2.2	-0.6	2.4	849.9	0.0	0.9	0.0	0.6	-0.1	0.2	0.2
F	15.3	3.3	24.2	-6.9	28.4	-6.2	1198.3	10.4	0.1	5.4	-1.3	1.5	2.7
H	0.7	0.2	1.2	-0.4	1.5	-0.4	0.0	70.8	0.0	0.2	-0.1	0.1	0.2
I	11.3	2.3	17.6	-5.0	20.6	-4.0	0.4	7.4	516.1	4.1	-0.9	1.1	2.0
NL	3.6	0.9	5.7	-1.8	7.8	-1.6	0.1	2.6	0.0	227.8	-0.5	0.3	0.9
P	0.5	0.1	0.7	-0.2	0.8	-0.2	0.0	0.3	0.0	0.2	154.9	0.0	0.1
SLO	0.5	0.1	0.8	-0.2	1.0	-0.2	0.0	0.3	0.0	0.2	-0.1	22.6	0.1
SK	0.9	0.2	1.4	-0.4	1.6	-0.3	0.0	0.6	0.0	0.3	0.0	0.1	74.7
	140.6	150.5	162.4	183.3	1339.0	831.8	1199.1	99.8	516.4	241.9	150.7	26.7	83.0
	103.1	147.8	105.2	214.7	1267.4	857.4	1275.2	73.8	573.0	245.9	157.2	25.2	79.1
	37.5	2.7	57.2	-31.4	71.6	-25.6	-76.0	25.9	-56.6	-4.0	-6.5	1.5	3.8
	41.6	9.3	64.6	-19.0	77.2	-18.1	0.8	29.0	0.3	14.0	-4.2	4.1	8.2
	4.1	6.6	7.4	12.4	5.6	7.5	76.8	3.0	56.9	18.1	2.3	2.6	4.4

CH's network used 162.5, uses others 105.2, receives 57.2

Payments under AP method

	A	B	CH	CZ	D	E	F	H	I	NL	P	SLO	SK
A	86.0	0.0	0.0	7.4	6.5	0.0	0.0	1.5	3.5	0.0	0.0	3.4	1.0
B	0.0	123.1	0.0	0.0	0.5	0.0	7.2	0.0	0.0	11.0	0.0	0.0	0.0
CH	0.8	0.0	93.4	0.0	11.6	0.0	14.5	0.0	12.4	0.0	0.0	0.0	0.0
CZ	14.9	0.0	0.0	146.4	16.7	0.0	0.0	1.2	0.2	0.0	0.0	0.3	3.3
D	13.7	0.8	11.3	7.7	1228.8	0.0	5.8	0.0	2.7	26.9	0.0	0.1	0.0
E	0.0	0.0	0.0	0.0	0.0	791.2	14.6	0.0	0.0	0.0	17.2	0.0	0.0
F	0.0	22.1	20.0	0.0	29.1	11.1	1121.9	0.0	27.4	0.4	0.0	0.0	0.0
H	2.0	0.0	0.0	1.3	0.0	0.0	0.0	68.1	0.0	0.0	0.0	0.0	4.0
I	9.1	0.0	30.8	0.1	5.3	0.0	31.2	0.0	463.6	0.0	0.0	4.9	0.0
NL	0.0	2.5	0.0	0.0	9.9	0.0	0.1	0.0	0.0	195.1	0.0	0.0	0.0
P	0.0	0.0	0.0	0.0	0.0	27.2	0.0	0.0	0.0	0.0	133.3	0.0	0.0
SLO	7.3	0.0	0.0	0.2	0.1	0.0	0.0	0.0	1.9	0.0	0.0	14.2	0.0
SK	1.7	0.0	0.0	5.6	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	58.8
	135.4	148.4	155.6	168.7	1308.5	829.6	1195.2	78.3	511.7	233.4	150.6	23.0	67.1
	109.4	141.8	132.6	183.1	1297.7	823.0	1232.0	75.3	545.0	207.5	160.6	23.6	73.6
	26.0	6.6	22.9	-14.4	10.8	6.6	-36.8	3.0	-33.3	25.8	-10.0	-0.7	-6.5
	49.5	25.3	62.2	22.3	79.7	38.4	73.3	10.2	48.1	38.3	17.2	8.8	8.3
	23.5	18.7	39.2	36.7	68.9	31.8	110.1	7.3	81.4	12.4	27.2	9.5	14.8

CH's network used 155.6, uses others 132.6, receives 22.9

Interconnectors and Inter-TSO payments

- The AP method ignores country boundaries
- This could penalise short interconnectors and reward counter-flow transits
- AP seems more compatible with efficient internal T charging
  - and therefore more credible and durable?
- Marginal methods attractive for incremental investments?
  - i.e. long-term contract for new lines

Why allow MTI at all?

- Ideal vision: RTO optimises regional grid, allocates investments to TSOs with suitable compensation
- Optimistic in short-medium run?
- MTI makes transmission investment contestable
  - forces TSO/regulator to set sensible charges and regulatory test
  - may encourage needed investment otherwise resisted by vertically integrated incumbent
- ideally replicates the optimistic solution
  - failing which may be better than *status quo*
  - *provided regulatory test sound*

Principles for Merchant Lines

- ensure that any costs imposed on system are correctly charged
  - otherwise other users may bear cost
- ensure that benefits delivered to system are rewarded
  - to encourage MTI where in national interest
  - to encourage designs that maximise Swiss benefit
- ensure that MTI does not pre-empt preferable regulated lines
  - through a carefully designed regulatory test

Network charges (e.g. Peru: Perez-Arriaga, 2006)

- Long-term locational signals are important only for new connections and disconnections
- Peru model: transmission pricing by method A and B
  - A: existing lines and users
  - B: for new lines and users
- A charges: can be based on previous methods
- B charges: deep
  - incremental cost of entrant (also as in PJM)
  - liability/credit to significant disconnections (mainly G)

Recommendations

- ETSO (and Swissgrid) need to agree a future cross-border compensation scheme
  - for existing grid - possibly different for expansions?
  - this will form part of charges/payments for MTI
- Regulator will need to define a regulatory test
  - and conditions under which MTI can become regulated
  - conditions under which charges may change
  - and/or offer long-term contract for charges

Conclusions

- Can be hard to make MTI profitable
  - but they may have other benefits: on competition, security, integration
  - CEC/ETSO assistance to support?
- Put pressure on ETSO to devise good cross-border tariffs
  - and to identify socially profitable interconnectors

Electricity Policy Research Group

UNIVERSITY OF CAMBRIDGE

Merchant Interconnectors

David Newbery

EPRG Winter Research Seminar

Cambridge 15 December 2006

http://www.electricitypolicy.org.uk

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL