Regulation and Investment
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Energie
braucht Impulse

The move from cost-based to price-based regulation

Year	Rate of return regulation	Rate case moratoria	Earnings sharing regulation	Price cap regulation	Other
1985	50	0	0	0	0
1986	45	5	0	0	0
1987	36	10	3	0	1
1988	35	10	4	0	1
1989	31	10	8	0	1
1990	25	9	14	1	1
1991	21	8	19	1	1
1992	20	6	20	3	1
1993	19	5	22	3	1
1994	22	2	19	6	1
1995	20	3	17	9	1
1996	15	4	5	25	1
1997	13	4	4	28	1
1998	14	3	2	30	1
1999	12	1	1	35	1
2000	8	1	1	39	1
2001	7	1	1	40	1
2002	8	1	1	38	2

Number of USA states employing the specific regulatory regime.

Source: Sappington, 2003 Dec., RNE, p. 357

Key conclusions

"Regulators are seeking to ensure that there is sufficient long-term investment in networks"

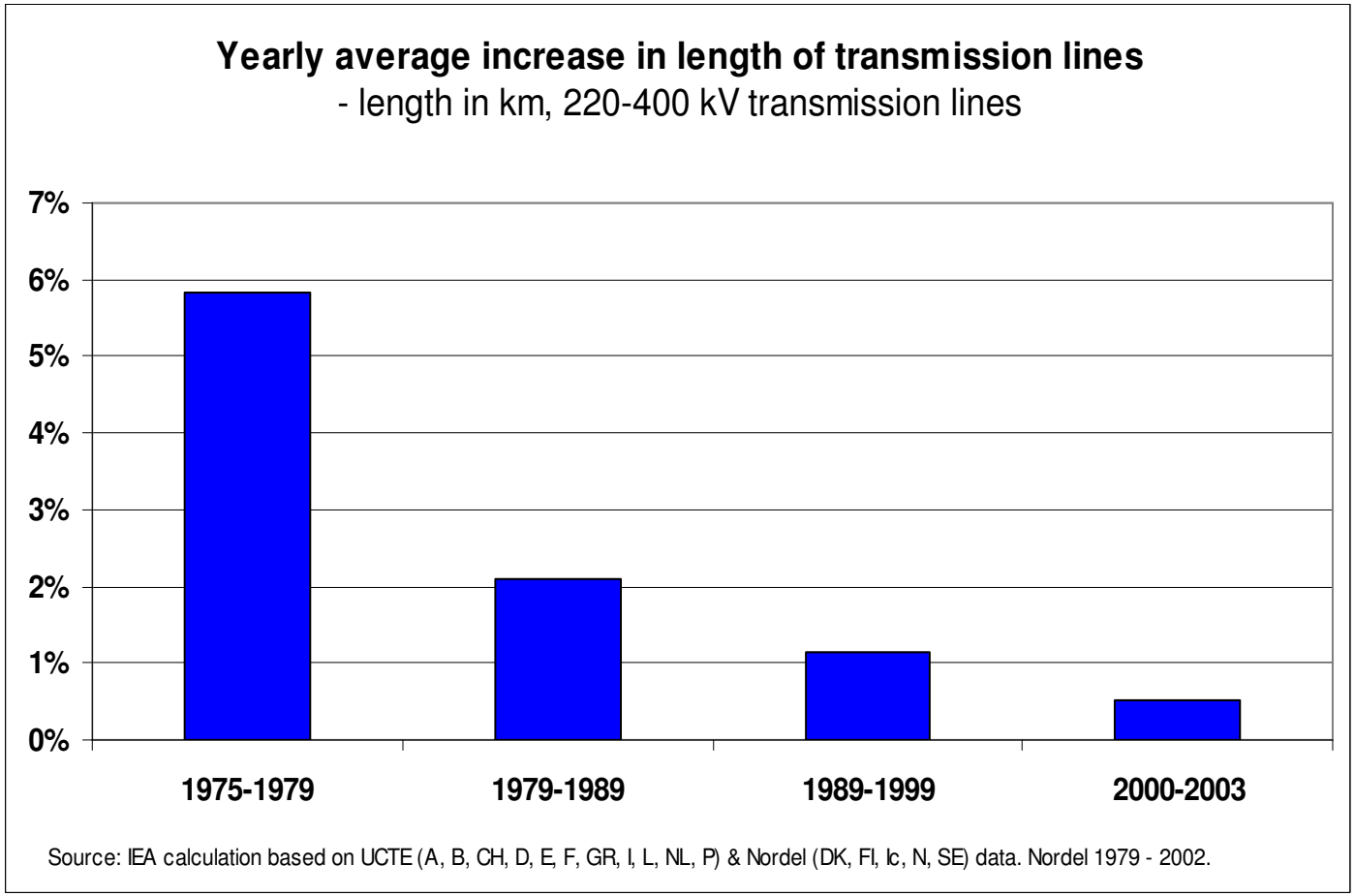
UK NAO, 2002, p. 29

- Price based regulation is good for short term efficiency, but not for long term investment
- As efficiency gains get exhausted, and (lack of) investment gets more urgent, quasi cost-based regulation regains territory
- But … in which dress?
  - OPEX – CAPEX split?
  - Explicit investment allowances?
  - Sliding scales? (aka profit-sharing)
  - UUROR?
  - Regulation holidays?

Overview

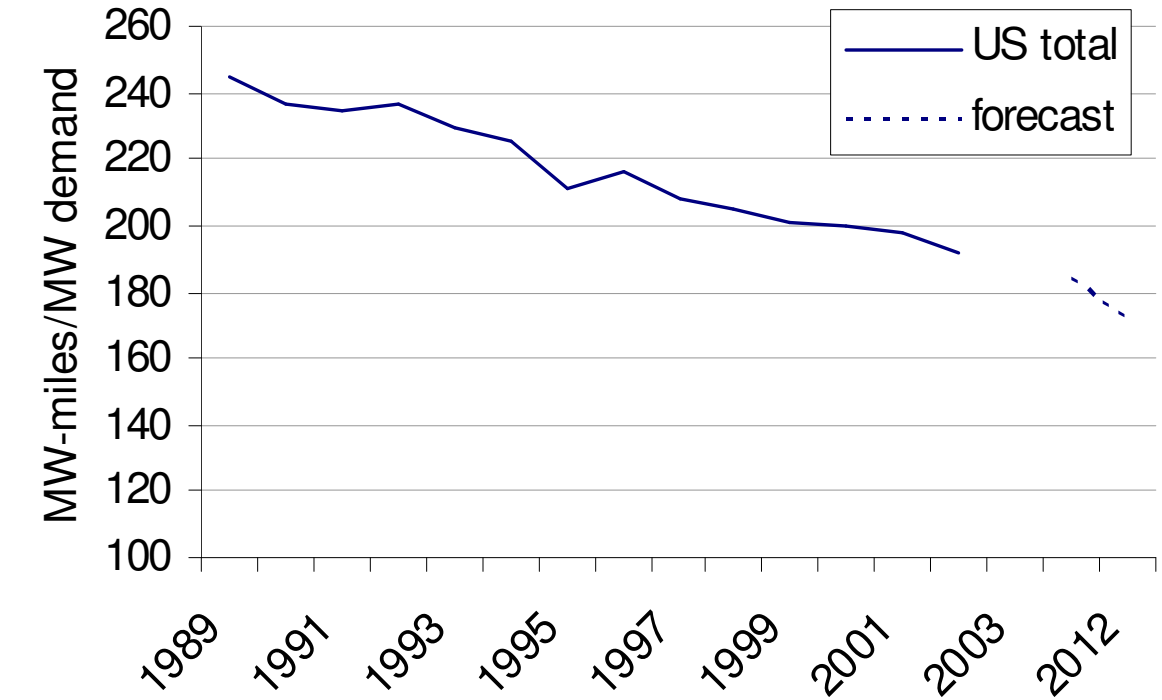
- Some figures
- The issues
  - Price-cap regulation increases risk
  - Price-cap regulation is more vulnerable to regulatory time-inconsistency problem
  - Price-cap regulation impedes quality
  - Price cap repairs gold-plating effect
  - Price cap regulation may delay investment
- Next steps
  - Incentive regulation with menu‘s of sliding scales.

Change of transmission capacity in UCTE



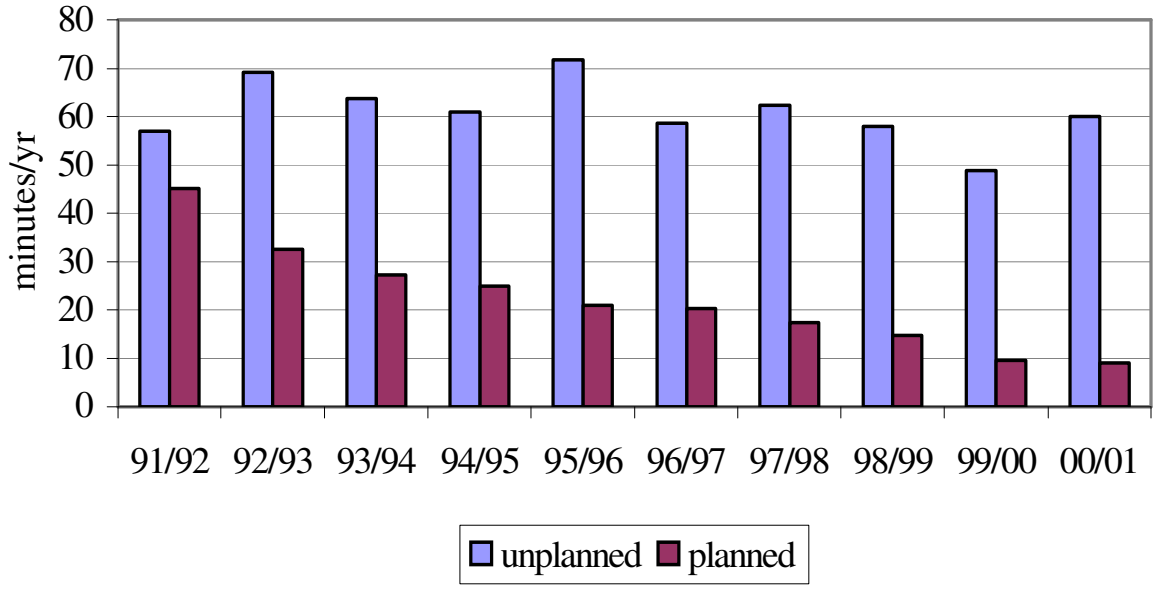
Source: IEA, 2004, World Energy Outlook 2004.

Transmission capacity in the USA



Hirst, June 2004

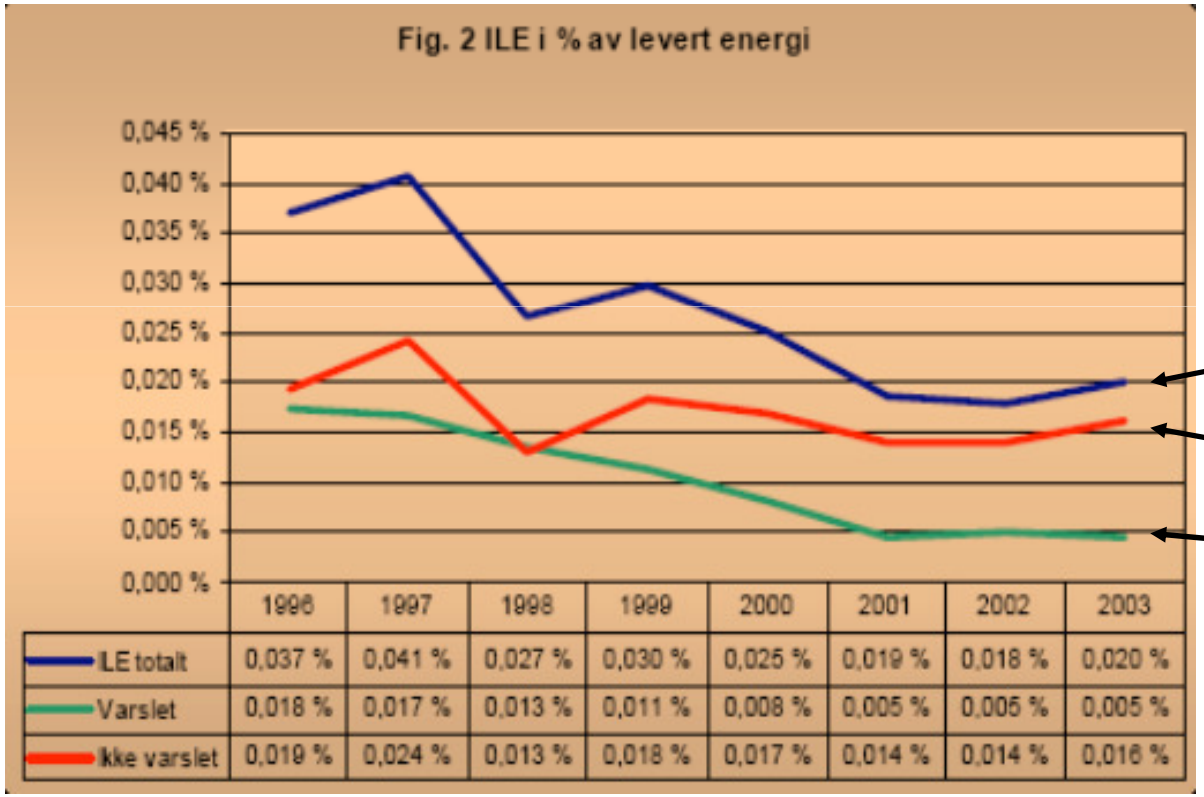
Quality of Supply (QoS) – UK



Duration of Supply Interruption (CML)

Source: CPB, 2004, p.77

Quality of Supply (QoS) – Norway



	1996	1997	1998	1999	2000	2001	2002	2003
ILE totalt	0,037 %	0,041 %	0,027 %	0,030 %	0,025 %	0,019 %	0,018 %	0,020 %
Varslet	0,018 %	0,017 %	0,013 %	0,011 %	0,008 %	0,005 %	0,005 %	0,005 %
Ikke varslet	0,019 %	0,024 %	0,013 %	0,018 %	0,017 %	0,014 %	0,014 %	0,016 %

Energy-Not-Supplied as % of total

ENS total

non-notified

notified

Source: NVE, Norway

Assessment

- These figures are not readily interpreted.
- However:
  - Investment levels have been low
  - Massive new investment is needed
    - networks are old
  - New investment is planned
    - But, is it going to happen, and, is it adequate?
- Ofgem, in the DNO price control 2005-2010 (the 4th round)
  - P_0 = +3,1%, X = 0.
  - Investment allowance is 50% higher than pre-2005 levels
  - Introduction of sliding scales

Regulation – a general formulation

Regulatory options: $R = A(b(\gamma)) + (1 - b(\gamma)) \cdot c$

- R – revenue
- A – a number (revenue cap)
- c – observed cost
- γ – inherent (unobservable) cost
- b - sliding scale parameter

If:

- b = 0: full cost pass through: A will be low (or even zero)
- b = 1: strict price cap: A will be high
- 0 < b < 1: (hybrid form) sliding scale:
  - Additional costs/profits are partially borne/kept by the firm and partially passed through to the end user.

Price capping increases market risk

- Higher risk translates into higher cost of capital und thus affects investment
- Rate of return regulation: “buffering hypothesis” of Peltzman (1976):
  - Rate-of-return restriction lowers risk
  - Profitability is ‘low’ but safe
- Risk under price caps compared to no regulation (Wright et.al, 2003)
  - Price capping increases cost-side risk
  - Price capping lowers demand-side risk
- Empirically, higher sliding scale parameter (i.e. towards price cap) increases risk-β (Grout & Zalewska, 2003)

Revenue Cap versus Tariff Basket

Tariff Basket: $$\sum_{i=1}^{n} p_{i,t} \cdot Q_{i,t-1} \leq \sum_{i=1}^{n} p_{i,t-1} \cdot Q_{i,t-1} \cdot (1 + RPI - X)$$

Revenue Cap: $$\sum_{i=1}^{n} p_{i,t} \cdot Q_{i,t} \leq \sum_{i=1}^{n} p_{i,t-1} \cdot Q_{i,t-1} \cdot (1 + RPI - X)$$

- Assume uncertain demand shocks.
- Revenue cap lowers risk from the demand shock by absorbing the shocks (presuming that prices can be adjusted)
- If prices cannot be adjusted adequately, risk of violating the regulatory constraint
  - Way out: regulatory account

Time inconsistency and regulatory risk

- Price-capping suffers from time-inconsistency problem
  - Pure price-cap: results in either direction can be “unreasonable”
    - Regulator is not legally bound to fair rate-of-return
    - Commitment problem (time inconsistency)
    - A non-credible regulator impedes new investment
- UUROR: Used-and-Useful Rate-of-Return Regulation
  - Investment-pass-through only allowed if used- and-useful
  - UU can be used imprudently by regulator, but also …:
  - Interpretation of UUROR by Gilbert & Newbery (1994):
    - UUROR increases regulator’s credibility and thereby improves investment incentives

Who regulates the regulator?

- Three regulatory principles
  - Regulator should be *independent* from political interference.
    - Politicians have shorter horizon and different agenda
  - Regulator should have *flexible powers* to interprete the law
    - You cannot arrange all regulatory details in law
  - System of *checks & balances*
    - Who regulates the regulator?
    - Important: review on substance
    - Example as in UK with regulators (Ofgem) and Competition Commission.

Price Capping and Quality

- Rate-of-return Regulation: gold plating
  - Hence inefficiently high quality
- Price Capping
  - In ‘reference’ case, unregulated monopolist invests the same in quality as welfare optimizer
  - With fixed prices, price-cap regulated firm invests less in quality than welfare optimizer (given same prices)
    - Add. investment in quality brings add. benefits for all consumers, while for the firm this cannot be recouped by higher prices
- An approach is to adjust regulatory rule for quality component
  - This can be done, albeit not without problem

Investment incentives

- Rate-of-return Regulation
  - Low powered incentives: Not good for short-term efficiency
  - But .. good for long-term investment
    - Even “inefficient” investment can be passed through
      - However, restricted by Used-and-Useful clauses
    - Goldplating / Over-capitalisation
      - Gold plating is empirically controversial
      - Extending the Averch & Johnson approach (1962), Bawa & Sibley (1980) suggest that goldplating effect vanishes for allowed RoR close to cost of capital
        - Then, however, ‘normal’ X-inefficiency increases

Investment incentives (cont'd)

- Timing of investment
  - Assume:
    - Big projects (large fixed construction costs or even lumpy investment): if sufficiently large (and discount factor sufficiently high), then one investment only
    - Growing demand
    - No race for investment
  - Optimize investment timing and capacity
  - Claim: (Brunekreeft & Newbery, 2005):
    - Unregulated profit maximizing firm invests the same capacity as welfare maximizer, however, later in time.
      - Welfare maximizer uses social welfare as criterion
      - Profit maximizer uses profit as criterion

Investment incentives (cont'd)

- Use the same approach and assumptions to assess regulation:
  - (with conditions from previous slide): under quite general assumptions, price-cap regulated firm invests later than unregulated firm and social welfare maximizer.
  - Hence, price-cap regulation may delay replacement or new investment projects.
    - Note 1: the assumptions are important.
    - Note 2: things change with a race for investment.
- If late investment projects (of e.g. DC interconnectors) is a problem, either change type of regulation, or allow regulation holidays, or allow third parties: merchant investors.

Next steps: Incentive Regulation

- New practical development (but known from the literature):
  - ‘Real’ incentive regulation: offer a menu of regulatory options
- Regulation:
  - Price-cap and Rate-of-Return are polar cases
  - Incentive regulation is hybrid form:
    - sliding scale / partial cost pass through
- Examples:
  - Distribution Price Control 2005-2010 in the UK
  - Incentive mechanism for balancing revenues for NGT (currently under design)

Why Incentive Regulation?

- Ofgem (June 2004, p. 88):
  - “Significant differences from the CAPEX for … DNOs”
  - The ‘difference’ and the lack of information thereof are key
- Two goals:
  - Allow CAPEX overspend if this is necessary: thus no strict price cap
  - Avoid automatic cost-pass-through: hence no strict RoR
- With the correct incentive scheme:
  - Low investment firm chooses price cap
    - Cap can be lower while still set incentive to be efficient
  - High investment firm chooses cost pass through
    - Necessary capital overspend not frustrated

Incentive Regulation – A small model

γ – inherent cost, which can be low or high and is unknown to regulator

c – realized cost, which depend on managerial effort, and which can be observed by the regulator

- Firm receives a transfer payment in excess of realized costs (which are also reimbursed):

$$t(\gamma, c) = A(b(\gamma)) - b(\gamma) \cdot c \qquad \text{with} \quad A = a(b) \cdot b(\gamma)$$

- Total allowed revenue $R = t + c$.
- This rewrites into revenue for the firm: $R = A(b(\gamma)) + (1 - b(\gamma)) \cdot c$
  - The menu, $A(b)$, is designed by the regulator
  - The firms choose b and thereby implicitly A.

$$\frac{\partial A}{\partial b} > 0$$

Incentive Regulation – A small model (cont'd)

- Menu of regulatory options: $R = A(b(\gamma)) + (1 - b(\gamma)) \cdot c$
- If the firm chooses:
  - b = 0: full cost pass through: A will be low (or even zero)
  - b = 1: strict price cap: A will be high
  - 0 < b < 1: (hybrid form) sliding scale:
    - Additional costs/profits are partially borne/kept by the firm and partially passed through to the end user.

$$\frac{\partial b^*}{\partial \gamma} < 0$$

"Self selection":

- High-costs firm (γ high) selects low b (cost pass through)
- Low-cost firm (γ low) chooses high b (price cap)

- Note that $A(b)$ should fulfil the incentive compatibility constraint.

DNO:PB Power ratio (%)	100	110	120	130	140
Marginal incentive.	40%	35%	30%	25%	20%
Additional revenue	5	4	2.8	1.5	0
Rewards and penalties:					
Allowed capex (%)	105	107.5	110	112.5	115
Actual capex					
70	19	17.1	14.8	12.1	9
80	15	13.6	11.8	9.6	7
90	11	10.1	8.8	7.1	5
100	7	6.6	5.8	4.6	3
105	5	4.9	4.3	3.4	2
110	3	3.1	2.8	2.1	1
115	1	1.4	1.3	0.9	0
120	-1	-0.4	-0.3	-0.4	-1
130	-5	-3.9	-3.3	-2.9	-3
140	-9	-7.4	-6.3	-5.4	-5

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Ofgem's Distribution Price Control 2005-2010;

June 2004, table 6.9

Ofgem's Distribution Price Control 2005-2010

- In terms of the 'small model' above:
  - Marginal incentive = b
  - Allowed capex = a
  - Marginal incentive * allowed capex = b*a = A
  - Firms choose the "marginal incentive"
  - The "additional revenue" makes the scheme incentive compatible
- Firms have an incentive to tell the truth and act accordingly
- Note: the scheme here is slightly different as it concerns deviations from what is considered and approved as used-and-useful
    - Still possibilities to game the system.

NGC System Operator incentive scheme

- NGC (part of NGT) is system operator in GB
- Energy and System Balancing is incentivized by Ofgem since 1994
- System is sliding scale (with caps and floors) around revenue targets

Table A2.1 – SO external cost incentive parameters since NETA go-live (money of the day)

Parameter	2001/02 scheme[68]	2002/03 scheme	2003/04 scheme	2004/05 scheme
Target	£484.6 million to £514.4 million	£460 million	£416 million	£415 million
Upside sharing factor[69]	40%	60%	50%	40%
Downside sharing factor[70]	12%	50%	50%	40%
Cap	£46.3 million	£60 million	£40 million	£40 million
Floor	-£15.4 million	-£45 million	-£40 million	-£40 million

Ofgem, March 2005.

NGC System Operator incentive scheme

- As from April 2005, Ofgem introduced a menu.
- NGC chose option 2 (which was subsequently revised)

Proposed value[6]	Option 1	Option 2	Option 3
Target	£480 million	£500 million	£515 million
Upside sharing factor	60%	40%	25%
Downside sharing factor	15%	20%	25%
Cap	£50 million	£40 million	£25 million
Floor	-£10 million	-£20 million	-£25 million

Ofgem, March 2005.

Outlook:

The move from cost-plus to price-based …

.. and back to more cost-pass-through?

Year	Rate of return regulation	Rate case moratoria	Earnings sharing regulation	Price cap regulation	Other
1985	50	0	0	0	0
1986	45	5	0	0	0
1987	36	10	3	0	1
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1999	12	1	1	35	1
2000	8	1	1	39	1
2001	7	1	1	40	1
2002	8	1	1	38	2

Sliding Scales

Literature

Brunekreeft, G. & Newbery, D.N., 2005, 'Should merchant transmission investment be subject to a must-offer provision?', forthcoming in *Journal of Regulatory Economics* (also Working Paper EPRG 05-03, University of Cambridge).

Brunekreeft, G. & McDaniel, T.M., 2005, 'Policy uncertainty and supply adequacy in electric power markets', *Oxford Review of Economic Policy*, Vol. 21, No. 1, pp. 111-127.