California's Electricity Crisis – A Warning Sign for Europe?

In the mid-1990s, California was the first U.S. state to fundamentally change the way in which its electricity supply was regulated. In order to achieve competition on the electricity market, production and transportation were separated and electricity exchanges were set up. Following the introduction of the reforms, electricity prices initially fell somewhat for most consumers. This was considered a success of deregulation. In the summer of 2000 and again in the following winter, however, wholesale prices on the electricity exchange rose drastically. In mid-January 2001, electricity demand outstripped available capacities, so that the power supply of many consumers had to be cut.

In addition to the conceptional problems of deregulation, a series of other factors also contributed to this development, such as under-estimating economic growth, the increase in electricity consumption in the second half of the 1990s, the elaborate and time-consuming approval procedures for power stations and insufficient incentives to save electricity. In Europe, the starting position is more advantageous than it was in California, but here, too, deregulation of the electricity supply could contribute to reducing capacity reserves and thereby to endangering the security of the power supply. The suggestion might therefore be made that electricity producers should be obliged to maintain minimum reserves and to create a market for long-term capacity reserves.

Regulation of the electricity supply in California until 1996

Until the mid-1990s, California – like all the other U.S. states – was predominantly supplied with electricity by companies that also produced, transported and distributed it (vertical integration) and, moreover, were in charge of more or less closed supply areas (regional monopoly). The prices these companies were allowed to charge for the power they supplied were set by regulatory authorities at both the federal and state levels on the basis of company operational costs with due consideration for an adequate capital mark up (the 'rate of return' regulation).

In such a system, there can be an incentive for companies to stake as much capital as possible so as to increase the basis for the rate of return.[1] This system of a regulated monopoly was therefore regarded as inefficient and modified as early as 1978 by the federal 'Public Utilities Regulatory Policy Act' (PURPA). PURPA laid down that public utility power companies had to buy electricity from qualified independent electricity producers (e.g., smaller thermal power stations and renewable energy power stations) at avoided costs. In many U.S. states, including California, however, the regulatory authorities set these avoided costs much higher than the marginal cost savings these public utility companies actually received by giving up their own electricity production. In addition, many companies bought electricity at high prices from qualified producers within a framework of long-term contracts, assuming that natural gas prices and therefore the costs of producing electricity would rise in the future. In fact, however, the price of natural gas fell between the late 1970s and early 1980s. The costs of electricity supply also rose due to delays in building, and increased costs in running, power stations. In California, such mistakes seem to have been made particularly frequently, since electricity prices there were noticeably higher than in the neighbouring states.[2]

The new competitive regulatory structure since 1996

In 1994, the California Public Utilities Commission (CPUC) presented a proposal to introduce competition in the area of power supply (the so-called 'blue book'). Competition for consumers was to be opened by means of transmissions through foreign power grids.[3] To gain their support, the public utility companies were assured that they would be able to pass the full costs of earlier decisions, which had shown themselves to be wrong under changed basic conditions (these are known as stranded investments), on to the consumer[4] by charging them so-called Competition Transition Costs (CTC). In 1996, the California Parliament passed the relevant restructuring law unanimously.[5]

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[1] Cf., for example, H. Averach and L. Johnson: 'Behavior of the Firm under Regulatory Constraint'. In: *American Economic Review,* Vol. 52, 1962, pp. 1052–1069.

[2] Cf. Severin Borenstein and James Bushnell: 'Electricity Restructuring: Deregulation or Reregulation?' In: *Regulation,* Vol. 23, 2001, No. 2, pp. 46–52.

[3] Only public utility companies were to be able to enter this spot market as buyers, so that these could continue to hold a monopoly on the supply of consumers.

[4] Cf. Robert J. Michaels: 'Stranded in Sacramento. California tries legislating electrical competition'. (*http://www.cato.org/pubs/regulation/reg20n2i.html)*

This law laid down a reduction of electricity rates by 10% for households and small commercial consumers, while electricity rates for industrial clients and for large commercial users were frozen at existing levels.[6] These maximum prices ('price cap') were to remain valid until the stranded investments had been fully financed by consumers (until 2002 at the latest).

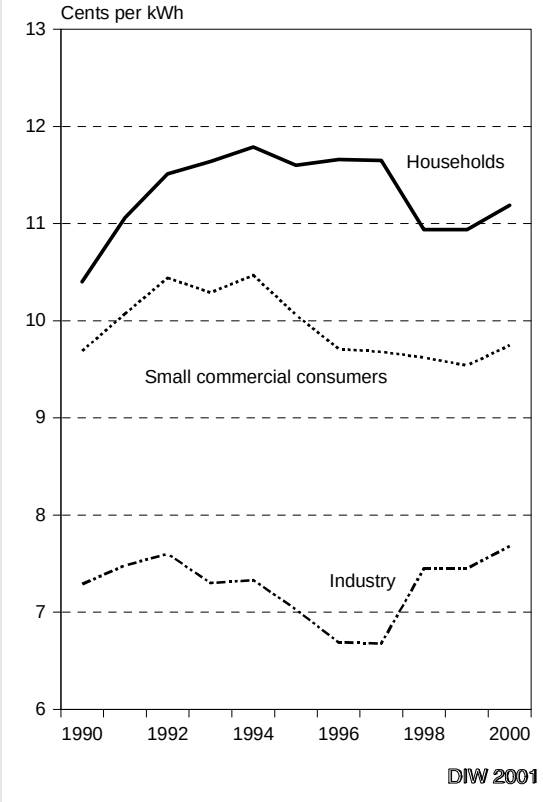
The maximum prices for households and small commercial consumers were set so low that new providers were, on the whole, unable to significantly underbid the prices of established companies and thereby to give consumers an incentive to change supplier. Thus, there was very little incentive for new suppliers to penetrate this market. This could also be a reason for the dampening in building new capacity.

California's private utility companies were forced by this restructuring law to sell at least half of their power station capacity[7] and to buy any additionally needed electricity themselves, and exclusively from the newly established power exchange, the California Power Exchange, or CALPX.[8] In this way, the previously more or less completely vertically integrated utility companies became grid operators, who primarily transport and distribute electricity. They therefore could no longer guarantee security along the entire power supply chain.

Auctions for deliveries of electricity are carried out at CALPX one hour and one day in advance. Moreover, electricity can also be traded between one and three months in advance. Longer-term contracts were not permitted until the onset of the power crisis in the summer of 2000.[9] To prevent those public utility companies with power grids from manipulating the electricity market to their advantage, an Independent System Operator (ISO) was also put in place. Another role of the ISO is to ensure that the transactions desired by electricity suppliers and buyers are also technically feasible. The ISO therefore operates the power grids even if these remain the property of the grid operators. The ISO also operates a real-time market for compensatory and reserve capacities. During periods of high grid utilisation, far greater loads were being traded on this market than initially anticipated, because higher prices could be achieved here than on the CALPX market.

Figure 1

Average Electricity Prices in California, 1990 to 2000



Source: Edison Electric Institute: Statistical Yearbook.

Outbreak of the crisis

Electricity prices for California's consumers, and especially for households, initially fell following the introduction of reforms because of the price cap regulation (cf. figure 1). However, with rising oil and natural gas prices, prices for peak-load electricity began to rise slightly as early as 1999. In mid-2000 they exploded, due to capacity bottlenecks, to about US-$ 400 per megawatt hour (1 MWh = 1 000 kWh), several times the previously normal prices.

To prevent an extensive collapse of the electricity supply, those industry customers whose contracts permitted it were temporarily taken off the grid towards the end of the summer of 2000.[10] In the autumn the price rise continued. In early 2001, the supply situation wors-

[5] David A. Rohy, vice president of the California Energy Commission at the time, complained in a speech in Berlin in late 2000 that their experts had not been adequately consulted.

[6] Cf. Pete du Pont: 'The Banana Republic of California'. In: *Opinion Journal from the Wall Street Journal,* 18 January 2001.

[7] Not including nuclear power stations and power stations using renewable energy sources. In fact, they reduced their share of electricity production even more.

[8] Not included in the spot trade was electricity production based on hydro-electric power and nuclear energy, and power supplies based on old contracts. Electricity from these sources is sold at regulated prices based on past costs.

[9] Bilateral contracts between electricity producers and large-scale consumers were permitted, but not encouraged.

ened to such an extent that households, in turn by supply areas, also saw their electricity cut: on 18 January 2001 alone, a total of 2 million customers had their power supply cut. In April 2001, peak prices briefly rose above US-$ 1 000/MWh.

Until the eruption of the crisis in the summer of 2000, San Diego Gas and Electric (SDG&E) was the only large utility company to have already financed its stranded investments and therefore found itself able to adapt its electricity prices for households and commercial users to the increased cost price on the spot markets. The other grid operators were not permitted to do this and therefore began to experience liquidity problems as early as autumn 2000. Potential suppliers in California and neighbouring states were therefore no longer willing to supply electricity to these companies. In April 2001, Pacific Gas & Electric, California's largest public utility company, had to declare bankruptcy. Since then, the second-largest grid operator, Southern California Edison, has also come under the threat of bankruptcy.

Political reactions to the crisis

To solve the electricity supply crisis in California, the Governor of California introduced a number of measures that – if they should become permanent – could lead to greater regulatory density than before the introduction of competition. The following measures are envisaged:

- The Department of Water Resources was instructed by the government to buy in electricity for those grid operators unable to pay, within a framework of long-term contracts.
- Grid operators are permitted to increase electricity rates for households by almost 27% on average – even if stranded investments have not yet been fully compensated.
- In return, until 2010, grid operators must make the electricity they produce available on the basis of cost-oriented rates[11] and transfer ownership of their high-voltage system to the state of California for a fair price.
- A public authority is to be established to ensure that the electricity supply once again exceeds demand by at least 15% at peak load.
- To achieve this, power stations with a total capacity of 20 gigawatts are to be built over the next three to five years.[12] If the private sector is not in a position to do so, the new authority will build the power stations itself.
- In the short term, power saving programmes are to contribute to easing supply problems.[13]

Causes of the crisis: misjudgement of electricity consumption and supply…

When the regulatory reforms were introduced in the mid-1990s, it was assumed – based, partly, on the success in saving electricity[14] – that, as in the 1980s, electricity consumption and strain on the grid in California would rise only slightly, that imports of electricity from neighbouring states could be increased further and that the capacity of power stations in California would not need to be increased until the new millennium.[15]

In actual fact, however, due to a strong increase both in population and in economic growth, the demand for electricity has risen significantly since the mid-1990s by 34 billion kWh, or 15%, to 264 billion kWh by the year 2000 (cf. table 1); this corresponds to an additional capacity need of at least 6 gigawatts. During the same period, however, power station capacity was not increased by even one gigawatt,[16] and the transport capacity of the high-voltage system was not increased

[10] These were customers who had signed so-called 'switch-off contracts'. Such contracts stipulate that it is permissible to switch off power several times a year for short periods. In return, affected consumers are given price reductions. Until the beginning of the crisis, however, it was very rare for power to actually be switched off.

[11] This assumes that these companies do not sell their own power stations. Until now, the sale of these plants was encouraged, since it made compensation for stranded investments higher.

[12] This corresponds to at least 20 large power stations. In the 12 years before the current Governor, Gray Davis, came to office, not a single power station was built.

[13] Governor Gray Davis: 'State of California, Meeting the Energy Challenge', April 5, 2001.

[14] Savings of a total of 2 large power stations were presumed; however, the electricity supply companies drastically cut their budgets to stimulate electricity savings.

[15] California Energy Commission: 'Critical Changes: California's Energy Future', 1997. The commission's projections for 2000 contained 2.3 gigawatts of electricity imports from the north-west and south-west of the United States; such deliveries, however, were not secured within a framework of long-term contracts. At this time, only lower output was available on the spot markets, and, because of the financial crisis of California's power supply companies, these were delivered only upon the massive intervention of the U.S. Energy Ministry. In 1995, the Federal Energy Regulatory Commission (FERC) strictly prohibited power supply companies from acquiring electricity produced from renewable energy sources within the scope of long-term contracts as long as prices for it were higher than the avoided costs. As a result, contracts worth 1.4 gigawatts, which had already been signed, had to be cancelled.

[16] Between 1996 and 1999, according to the California Public Utilities Commission, required output rose by 5 500 MW, while power station capacity increased by only 672 MW. California Public Utilities Commission: 'California's Electricity Options and Challenges', p. 39 ff (*http://cpuc.ca.gov/published/report/Gov-report.htm)*

Table 1
Development of Power Consumption in California

	Households	Businesses	Agriculture	Industry	Other	Total
			In million kWh			
1990	67 669	74 562	20 849	51 195	13 763	228 038
1991	67 145	74 296	16 345	50 439	14 036	222 261
1992	69 227	77 929	15 483	49 926	14 423	226 988
1993	68 426	79 152	15 918	49 479	14 649	227 624
1994	69 781	78 546	16 957	49 524	15 290	230 098
1995	69 767	80 528	14 321	50 594	15 780	230 990
1996	72 166	83 366	16 898	51 758	15 415	239 603
1997	73 574	87 401	17 733	53 253	15 477	247 438
1998	75 490	87 093	14 661	51 996	15 270	244 510
1999	76 559	89 538	17 840	53 527	15 335	252 799
2000*	79 924	95 018	18 230	55 656	15 601	264 429
			1990 = 100			
1990	100.0	100.0	100.0	100.0	100.0	100.0
1991	99.2	99.6	78.4	98.5	102.0	97.5
1992	102.3	104.5	74.3	97.5	104.8	99.5
1993	101.1	106.2	76.3	96.6	106.4	99.8
1994	103.1	105.3	81.3	96.7	111.1	100.9
1995	103.1	108.0	68.7	98.8	114.7	101.3
1996	106.6	111.8	81.0	101.1	112.0	105.1
1997	108.7	117.2	85.1	104.0	112.5	108.5
1998	111.6	116.8	70.3	101.6	110.9	107.2
1999	113.1	120.1	85.6	104.6	111.4	110.9
2000*	118.1	127.4	87.4	108.7	113.4	116.0

* Preliminary figures.
Source: California Energy Commission Quarterly Fuel and Energy Report Database.

enough to be able to prevent bottlenecks in the national transport of power during periods of intense grid load.

At 7%, available reserve capacity at times of peak grid load in California was already very low at the beginning of the deregulation process in 1996[17]; by 2000, this had shrunk even further, to 3.5%. To prevent further system breakdowns this year, or, rather, to limit these both regionally and in terms of length of time, it would be necessary for new power stations with a capacity of at least 5 gigawatts to begin operating this year.

Almost one-fifth of California's electricity production is currently provided by hydro-electric power (cf. table 2). Furthermore, a large share of electricity imports, which traditionally cover between 20% and 25% of electricity demand, comes from hydro-electric power stations. However, the performance of such installations is heavily dependent on river flows. Given the low levels of precipitation during the last two years, imports from Oregon and Washington in particular have been limited.[18]

It seems that inadequate provision was made for such a fluctuation in output, for example by making available appropriate reserve capacity, or through the extension of the high-voltage grid.

A price hike in natural gas in the past year[19] also had a decisive effect on the power crisis. Reasons given

[17] A level of 15% could be considered normal. This was still attained in 1993.

[18] Cf. Reinhard Haas, Hans Auer and Fereidoon P. Shioshansi: 'Die kalifornische Stromkrise'. In: *Energiewirtschaftliche Tagesfragen,* 51st year (2001), Issue 5, pp. 280–287.

[19] From January to December 2000 gas prices rose from US-$ 2.50 to US-$ 10.00 per MBTU.

Table 2
Electricity Production in California

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					In million kWh					
Hydro-electric power	26.09	23.24	22.37	41.60	25.63	51.67	47.88	41.40	48.76	41.62
Nuclear power	36.59	37.17	38.62	36.58	38.83	36.19	39.75	37.27	41.72	40.42
Coal	21.40	23.44	32.44	22.91	25.10	17.93	25.46	27.11	34.54	36.33
Oil	4.45	0.52	0.11	2.09	1.95	0.49	0.69	0.14	0.12	0.06
Gas	76.08	75.83	87.03	70.72	95.03	78.38	66.71	74.34	82.05	84.70
Geothermal power	16.04	15.57	16.49	15.77	15.57	14.27	13.54	11.95	11.55	13.25
Wind power	2.42	2.67	2.71	2.87	3.29	3.18	3.15	2.74	2.78	3.43
Other	6.65	7.31	7.36	5.76	7.17	5.97	5.91	5.50	5.50	5.66
Total	189.72	185.75	207.13	198.28	212.57	208.06	203.11	200.45	227.01	225.47
					Share as %					
Hydro-electric power	13.8	12.5	10.8	21.0	12.1	24.8	23.6	20.7	21.5	18.5
Nuclear power	19.3	20.0	18.6	18.4	18.3	17.4	19.6	18.6	18.4	17.9
Coal	11.3	12.6	15.7	11.6	11.8	8.6	12.5	13.5	15.2	16.1
Oil	2.3	0.3	0.1	1.1	0.9	0.2	0.3	0.1	0.1	0.0
Gas	40.1	40.8	42.0	35.7	44.7	37.7	32.8	37.1	36.1	37.6
Geothermal power	8.5	8.4	8.0	8.0	7.3	6.9	6.7	6.0	5.1	5.9
Wind power	1.3	1.4	1.3	1.4	1.5	1.5	1.6	1.4	1.2	1.5
Other	3.5	3.9	3.6	2.9	3.4	2.9	2.9	2.7	2.4	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: California Energy Commission.

for this increase in gas prices were a sharp fall in natural gas supplies, weather-related high demand and an explosion in an important transport pipeline (the El Paso Natural Gas Pipeline). Substituting the now more expensive gas with oil or coal was possible only to a limited extent, due to strict environmental regulations, i.e., limited emission rates for most power station operators.

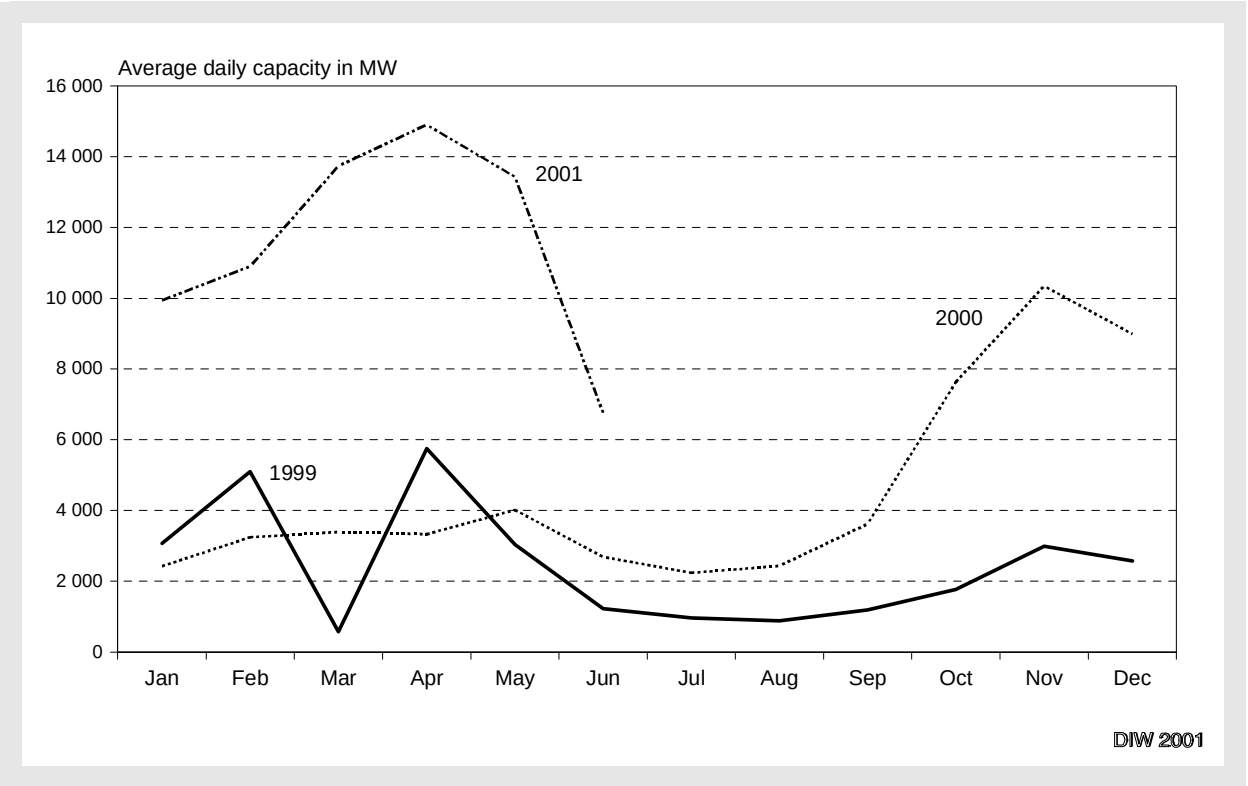
Finally, more than half of California's power stations are over 30 years old.[20] In older plants, the need for maintenance work and for temporary closure periods rises. Insufficient co-ordination of this work has added to the fact that, during times of peak load, vitally needed outputs were not available (cf. figure 2). According to the Californian regulatory commission, however, certain power stations were not removed from the supply system during periods of peak load because of technical problems, but rather in order to further increase prices.

… and deficiencies in the regulatory structure

Mistakes in the way in which the new competition rules were structured and transposed further contributed to the failure of California's electricity reforms (cf. box). For example, the reforms sought to introduce competition by means of one detailed law rather than an organised learning process that would permit the speedy correction of aberrations. The reforms were aimed in particular at cracking open the vertical integration of power supply and directing the allocation of resources primarily via spot markets; long-term electricity delivery contracts were initially forbidden. Inadequate provision,

[20] In 1996, approximately 37% of thermal power stations in Germany were 25 years old or older; some of these may, however, have been closed in the meantime.

Figure 2
Temporarily Closed Power Stations in California



Source: California Energy Commission.

however, was made for the fact that this could lead to new problems:

- In their decisions, electricity producers and distributors were offered no incentives to properly consider long-term cost trends and risks, and to maintain security reserves above the required minimum operational levels.
- Vertical integration can be substituted by horizontal concentration.
- During periods of short supply, electricity suppliers with low market share can, as marginal sellers, strengthen price escalations by temporarily withholding capacity.
- The financial stability of companies focusing exclusively on electricity production or distribution is lower than that of vertically integrated companies, since losses at the individual stages of the chain of value added cannot be compensated for by gains at other stages.
- Problems in coordinating maintenance work during times of peak load times are on the increase.
- Households and small commercial consumers were disconnected from movements in prices on wholesale markets by peak prices. This, however, means that price-dependent changes in consumption no longer apply, that access of new suppliers is reduced, and that the financial stability of grid operators becomes endangered.

Increased security risks due to dominating spot markets

Following the regulatory reforms, electricity in California was traded primarily on spot markets. Dominating spot markets, however, can increase security risks. As long as supply can adequately meet demand, electricity prices on spot markets will correspond to the short-term marginal costs in the respective time intervals; these are, in the main, the fuel costs of the respective last required supplier necessary to cover demand. Under these conditions, power stations with low fuel costs can contribute towards covering fixed costs. In the long term, however, only those plants able to claw back at least their running costs (excluding capital costs) will be able to remain hooked up to the grid.[21] Plants that do not find this possible are shut down or, as far as technically feasible,

Box

Conceptional Weaknesses of Deregulation

Misunderstandings regarding the functioning of efficient markets underlie the failure of deregulation in California. These can be reduced to three basic elements.

First: In addition to the short-term allocation of currently available supply via spot markets, signals must also be exchanged on other markets that lead to the efficient long-term adaptation of both supply (construction of power stations) and demand (purchase of energy-efficient products). This, however, necessarily presupposes the existence of markets on which relevant future expectations can be traded. The absence of such efficient markets leads to inter-temporal incorrect allocations. An allocation oriented exclusively along spot markets will shift the decisions of participants in the short term. The dominance of spot markets may also make it possible for the wrong kind of incentives to be sent out. If, because of price competition, only variable marginal costs can be achieved, even though higher prices are needed for a secure long-term supply, this can lead to a reduction in capacity that is undesirable in the long term.

Second: It is a fact that the future cannot be exactly forecast or planned through economic agents. By evaluating the risks of future market developments, market participants can, in the course of information exchanges, trade their varying expectations by means of appropriate contracts. These markets also create the opportunity for skilled intermediaries to operate an efficient risk management.[1] This market-oriented coordination tendentially reduces the danger of incorrect allocations, since all market participants determine the market outcome.[2] At the same time, the consequences of negative economic events can be reduced for individual participants by pooling risks through insurance contracts. State-level regulation is less able to solve the information problem efficiently if it does not have knowledge of future expectations of market participants.[3]

Third: Since the supply of infrastructure goods such as electricity is not elastic, longer time periods are needed for capacity adaptation in the case of unexpected events – such as, for example, a strong rise or fall in demand. Rationing on the demand side caused by fluctuations in demand can be avoided only through capacity reserves, with which fluctuations in demand can be balanced out in the short term. This risk precaution must, however, be paid for by the electricity consumer as a risk premium. Infrastructure goods markets with long time limits for the provision of additional capacity are therefore not in a position to even come close to the ideal of fully flexible markets. Only if market participants receive the signal of a risk of rationing via appropriate markets will they be prepared to pay a risk premium. In the absence of such transparency and clear separation between markets on the security of provision, the problem of adverse selection on pooled markets can arise.[4] It might therefore be sensible to commit electricity producers to maintaining minimum reserve levels and to create a market for long-term capacity reserves.

This market should, however, also be regulated by a central supervisory institution as regards the consistency of agreed contracts. This is especially important to prevent participants adverse to risk-taking from signing one contract only with a participant willing to take risks, who, however, does not have better information on future market developments and is unwilling to put in place – according to his contractual obligations – the provisions to create the necessary required additional capacity. Such supervision should oblige market participants, within the scope of a regulation on minimum reserve levels, to fulfil the contractual agreements under the available risk assumptions.

[1] Cf. Kenneth J. Arrow: Essays in the Theory of Risk Bearing. Chicago, Markham Publishing Company, 1971.

[2] This, however, presupposes market participants who do not allow themselves to be influenced by irrational market behaviour. On the limits of the premise of rationality of 'homo oeconomicus', based on experimental research, cf. Richard H. Thaler: The Winner's Curse, Paradoxes, and Anomalies of Economic Life. Princeton, New Jersey, Princeton University Press, 1992.

[3] One way out of this dilemma for the regulator, who has no knowledge of efficient future markets, can only be his willingness to learn to adapt flexibly to changed market conditions with re-regulation. This, however, often comes up against limitations because of institutional inertia and opportunism, when regulatory changes create winners and losers.

[4] Adverse selection in modern economic theory is taken to mean the problem of strategic change in behaviour of individual actors when confronted with asymmetrical information between the economic subjects that form part of the economic process. Cf. Daniel F. Spulber: Market Microstructure, Intermediaries and the Theory of the Firm. Cambridge, U.K. Cambridge University Press, 1999, pp. 203–225.

remain operational only during time periods in which particularly high prices can be generated. This can lead to a faster reduction in capacity than would be sensible for the long-term security of provision.

If supply is no longer adequate to meet demand, market clearing prices are common on competitive markets. Price formation is then no longer determined by the marginal costs of suppliers but rather by the con-

sumers' willingness to pay. Under such market conditions, suppliers siphon off significant scarcity rents.

Price increases that are significantly higher than the costs of electricity provision stimulate an extension of capacity and market entry of new suppliers. Nevertheless, several years are usually needed to proceed through the planning, authorisation and construction stages for power stations and power cables. Price signals on spot markets can therefore come too late, be too drastic and lead to an overreaction on the part of market participants.

Under the old regulatory system, the public utility companies were legally bound, and, because of the possibility of passing on costs, also able to guarantee a high degree of security in terms of the power supply. In such a system, there is an incentive to build up safety reserves that are greater than absolutely necessary. Following deregulation, such a commitment no longer existed for the independent electricity producers, and this security gap was not adequately closed by the new market regime.

Consumers definitely have great interest in a secure power supply. However, their willingness to finance adequate security reserves can be reduced by inadequate awareness of the risk and by the 'free ride' syndrome. Habituation to the previously high level of security contributed to the under-estimation of such risks.

Price manipulation by producers?

Since the public utility companies have been obliged, since 1996, to sell at least half of their power station capacity, private companies (including qualified power plants) now control over 60% of California's electricity production capacity.[22] Although the share of even the largest supplier currently only amounts to almost 8% of total electricity production capacity, this share, given the unelastic demand for electricity, is enough to render it able, as a marginal supplier, to influence price trends at certain times of recurring shortages.[23] The same can be effected through uncoordinated maintenance work or unforeseen power station failures. Between May 2000 and May 2001 alone, the ISO estimates that consumers had to pay a total of US-$ 8.9 billion in additional costs due to excessively high electricity prices.[24] A share of the additional profit could have come about as a result of improper use of the power of the market.[25] It would be wrong, however, to suggest that price manipulation by some electricity producers was the main cause of the current power supply crisis.

Small consumers isolated by price signals

When households and small commercial consumers were shielded from the effects of prices on the wholesale markets resulting from the price cap regulation, these consumers had no incentive, when buying domestic appliances with a relatively high electricity consumption (e.g., refrigerating and air conditioning equipment), to select particularly efficient appliances.

Electricity prices would probably have fallen for these consumers in any case after the introduction of competition, even without government-legislated maximum prices, so that, from a medium-term perspective, prices would temporarily have been very low under such conditions as well.

Conclusion: mistakes of deregulation and unfavourable basic conditions are responsible for California's electricity crisis

All in all, conceptional deregulation problems, but also a series of unfavourable basic conditions, contributed to California's electricity crisis. One mistake in the new organisation of the electricity market in particular was the predominance of the spot markets, with the separa-

[21] Capital costs are 'sunk' costs that arise regardless of whether plants are operating or not. They therefore do not influence the use of these plants, on the condition that plant owners can finance the lacking capital rate interest via other means. Cf. J. Sutton: Sunk Costs and Market Structure. Cambridge, MA, MIT-Repress, 1991.

[22] Cf. California Public Utilities Commission: 'California's electricity options and challenges'. Report to Governor Gray Davis (*http://www.cpuc.ca.gov/published/report/GOV-REPORT.htm)* p.5

[23] Cf. Severin Borenstein and James Bushnell, et al., p.49: 'Unfortunately, it is easy to show that in such a situation a firm of more than microscopic size can almost always do better than passively accepting these scarcity rents, attractive as they may be. By withholding a bit of its supply (or offering it to the market at an extremely high price) such a firm can drive the price still higher while losing little demand, and boost its profits.'

[24] San Diego Gas and Electric has demanded an examination and payment refunds. Cf. Department of Market Analysis, California Independent System Operator: 'Potential Overpayment in California's Wholesale Energy Market', June 19, 2001. The extent of legally inadmissible price hikes is, however, disputed. The FERC considers a far lower amount as improperly used than the ISO.

[25] The ISO therefore supports the demands of disadvantaged supply companies that these amounts should be refunded. Furthermore, in April 2001, the ISO proposed a comprehensive market stabilisation plan that would lead to even more drastic re-regulation. To prevent the future exploitation of market power by electricity suppliers, maximum prices are to be set this summer for each individual electricity producer based on the respective marginal costs.

tion of consumers from price trends on wholesale markets. In this way, consumers were not given sufficient incentive to save electricity. That these mistakes triggered a dramatic power crisis is also due to the fact that economic performance and electricity consumption during the second half of the 1990s rose significantly faster than anticipated. To this must be added the inability to react quickly and pragmatically to aberrant developments.

Is the development in California a warning sign for Germany and Europe?

For a long time, the United States was regarded by the European Union as an example in terms of introducing competition in the area of public utilities. In light of the crisis in California, the question as to whether similar problems could develop in Europe inevitably arises.

The starting position of Europe's power supply and its specific reforms are fundamentally different from the situation in California. Europe currently has at its disposal much higher power station reserves than California did at the beginning of liberalisation. Up to now, Europe has also demonstrated a higher degree of maintenance and repairs than the United States. Under the pressure of competition, however, the first alarming changes are now becoming evident. For example, the German *Verbundgesellschaft* reported in October 2000 that a less reliable 'security cushion' was evident in Germany's electricity supply than one year earlier.[26] At the same time, expenditure for maintenance and repairs is said to have fallen quite heavily.[27]

The European Commission's electricity directive is aimed in particular at opening up access to cheaper electricity producers for wholesale consumers.[28] This would oblige grid operators to transmit the electricity of their competitors through their own grid under fair and transparent conditions. While the directive does not call for the entrepreneurial separation between electricity production and transport, it does stipulate separate accounting structures for these areas. Spot markets are not prescribed, and long-term contracts are permissible.

In some EU countries, the power supply reforms go much further than the conditions stipulated by the EU. The United Kingdom[29] and a number of Scandinavian countries, for example, lead in this area. Germany, in 1998, in principle gave all consumer groups free choice of suppliers. But in contrast to other EU countries – and as demanded by the European Commission – the actual organisation in Germany, especially concerning transmission fees, has been reserved for the associations concerned. Electricity spot markets have been created voluntarily, but do not play the dominant part they have in California.

Despite these differences, in the medium term, the supply risks can also increase in Europe in the course of deregulation. Norway and Sweden, for example, depend heavily on hydro-electric power. In unfavourable weather conditions, these countries have to import electricity that has been produced in thermal power stations. And at times of low water levels, France's nuclear power stations cannot use enough coolant to work to maximum capacity. And greater electricity production on the basis of renewable energy sources increases the security of supply only to a limited extent given the fluctuating nature of the most important renewable energy sources (i.e., wind, water, solar energy). If several of these risks become activated simultaneously, considerable regional bottlenecks could result. Within a competitive framework, such risks could be more difficult to overcome.

In Germany, public utility companies, under the pressure of drastically falling wholesale prices for electricity, are taking old power stations off the grid more quickly. Depending on the competitive situation, this will also occur in other European countries. It can also not be ruled out that, in certain growth regions within the EU, the demand for electricity will outstrip supply; such shortages are already becoming evident in Spain. And the excess capacity that still exists in eastern European countries could decline rapidly with their accession to the European Union, as they grow and simultaneously have to adapt the capacity of their power stations to EU environmental demands. Under competitive conditions, the expansion of intra-European high-voltage links will be subject to strict economic criteria, so that it might stagnate in the foreseeable future.

Because of the increasing significance of gas-fired power stations in new buildings in many European countries, price risks are on the increase. Against the backdrop of these developments, the risk of temporary

[26] Deutsche Verbundgesellschaft: 'Leistungsbilanz der allgemeinen Stromversorgung in Deutschland'. Vorschau 2001 bis 2003. Heidelberg, October 2000, p.2.

[27] Cf. Michael F. Schneeberger (Energie AG Oberösterreich, Linz): 'Stromkrise in Kalifornien – Amerikanischer Sonderfall oder auch Gefahr für Europa'. Lecture at the VDEW conference in Berlin, 20 June 2001.

[28] This would reduce the disadvantages of industrial location within the EU, since electricity can be accessed from the cheapest suppliers across Europe.

[29] In the United Kingdom, the strong concentration of electricity supply has led to price hikes on spot markets, but, although regulatory structures are similar to those in California, this has not yet led to a supply crisis.

supply crises caused by the introduction of competition in electricity supply without flanking measures could grow in Europe too.[30]

Conclusions for Germany and for Europe

What conclusions can be drawn? One fundamental lesson from the Californian experience is that reform of the electricity economy should be organised in phases within the framework of a learning process. This is the route the German government has taken so far.

Basically, the introduction of competition in electricity supply is accompanied by a reduction in the safety margins if no adequate markets for long-term capacity reserves are available. Until now, most consumers have paid electricity prices assuming they are guaranteed a high degree of supply security. Based on their experience so far, they are evidently not yet prepared to pay additional risk premiums. It therefore seems necessary to establish certain binding safety margins. To guarantee the efficient provision of security reserves, a market that trades in long-term capacity reserves should be created. It is also fundamentally important for consumers that price formation on electricity markets is not skewed by maximum price regulations. Only under this condition do consumers have an incentive, one that is based on changes in price, to adapt their behaviour accordingly.

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[30] The European Commission is already attaching increased significance to the supply security problem. Cf. European Commission Green Paper: 'Towards a European strategy for the security of energy supply'. Brussels, 2001.