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Energy subsidies in California's electricity market deregulation

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Abstract

Deregulation and re-regulation of California's electricity market not only failed in terms of anticipated cost reductions, improved customer service and higher competition, it also led to the introduction of various additional energy subsidies. This paper analyzes California's electricity market deregulation process from a subsidy viewpoint. Under deregulation in California, investor-owned utilities were not allowed to pass their energy procurement costs fully on to their customers, and therefore subsequently, and inevitably, ran into severe financial problems. Such retail price regulation is an energy subsidy that is both economically and environmentally unfavorable, because it veils true price signals to electricity consumers and, in this way, discourages energy conservation. Other policies implemented in California that represent perverse energy subsidies are the purchase of power by the state of California, the suspension of retail competition, and the potential misuse of money from the recovery of stranded costs. Many interventions implemented by the state to smooth out the impacts of the energy crisis insulated electricity consumers from market realities, supported the existing structure of California's electricity market, which is predominantly based on fossil fuels, and suppressed market incentives to improve energy conservation.

Keywords: Energy subsidies; Electricity market deregulation; California energy crisis

1. Introduction

All over the world, governments are deregulating their electricity markets to increase competition, lower costs and promote innovation. In California, the most important step of deregulation was introduced on March 31, 1998 when all residential customers were allowed to buy competitive retail electric power. Expectations about the benefits were high. Cost reductions were anticipated due to increased production efficiency as a result of wholesale competition, more efficient retail pricing structures, and enhanced technological development. A 1999 study by the US Department of Energy estimated that the average national price of electricity would be 14% lower under competition by 2010 (DOE, 1999). Besides cost reductions, other benefits were also expected, including improved customer services, increased number of new products available, improved levels of service reliability, and added environmental benefits due to customer-driven preferences for the so-called "green" power such as that from biomass, wind and solar energy.

However, wholesale prices in California after deregulation were higher than before, Californian businesses and residents have experienced brown-outs and blackouts, and retail electricity prices have been raised for most consumers. In addition, one of the two major investor owned utilities (IOUs) faced bankruptcy and the Governor had to declare a temporary state of emergency. One year after the introduction of competition into the retail electric power market, of the more than 300 companies that initially expressed interest in marketing electricity directly to customers, all but 33 had pulled out. Up to now, just 1.7% of residential utility customers and 3.5% of commercial and industrial customers have switched their supplier, representing 1.6% and 18.8% of customer load, respectively, (Shioshansi, 2001).

The reasons why deregulation failed so dramatically in California are complex. The most important flaw of California's deregulated electricity market was that the market was more re-regulated than deregulated. What Paul Joskow of MIT has referred to as "...the most complicated electricity market ever created..." was a

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mismatched combination of a deregulated wholesale market with price controls in the retail market for up to 4 years (Joskow, 2001, p. 1). If consumers are insulated from wholesale market prices, they will not adjust their use of energy (e.g. through conservation), and this inevitably results in supply shortages. When demand is very inelastic and supply constrained, wholesale prices soar, giving generators the opportunity to exercise market power by withholding capacity. This is believed to have happened in California (Joskow and Kahn, 2001a, b; Hall, 2002). Another shortcoming of the restructuring process was that the California Public Utilities Commission (CPUC) required California IOUs to divest a substantial portion of their generation assets, while it did not require them to establish long-term power purchase agreements with the new owners. The IOUs, still regulated by the CPUC, hesitated to enter into long-term contracts, because they feared the mandatory review and approval process of these contacts by the CPUC. This led to a complete dependence of the utilities on the highly volatile spot market to procure their customer's unmet electricity needs and drove wholesale prices even higher.

To solve the energy crisis in California, the State of California stepped in to purchase electricity on behalf of retail customers in the IOU's service areas. The Governor of California also introduced financial incentives to hasten the building of new power plants, and to decrease demand for electricity. This allowed the "lights to be kept on" while the IOUs raised their electricity rates less than what was needed to recover their costs. However, the policies to address the crisis veiled true price signals to consumers and are, therefore, not compatible with a fully deregulated and competitive electricity market. Ideally, deregulation should produce a smooth transition to a more competitive, market-based economy with less government intervention and regulation. Many policies introduced in California influenced the electricity market through governmental intervention and not through market-based price signals, and can thus be considered energy subsidies.

This paper analyzes California's electricity market restructuring process to date, and shows that some elements of this process can be regarded as an introduction of additional subsidies, which are likely to lead to greater economic inefficiencies and environmental damage. In the sections that follow, California's deregulation law will be outlined, energy subsidies will be defined, and the main elements of California's deregulation and re-regulation will be discussed in light of a subsidy framework. These policies include retail and wholesale price caps, stranded cost recovery, and state power purchases. Our analysis provides an example for policy makers who wish to implement a more competitive electricity market that benefits the economy and the environment.

2. California's deregulation process

In 1998, California became one of the first states in the US that restructured its electricity supply industry. It followed the British example of electricity market deregulation, which started in 1990 and had already achieved substantial cost reductions a few years after implementation. A cost benefit analysis of the British deregulation experience estimates an overall benefit of £6 to £11.9 billion, which is equivalent to a permanent reduction of electricity prices of 3.2–7.5% from 1990 levels (Newbery and Pollitt, 1997).

The framework of California's restructuring plan was established by the Electric Utility Industry Restructuring Act (AB 1890), which was unanimously enacted in August 1996 by the State Legislature. Before restructuring, each California utility provided its customers with generation, transmission, distribution, metering and billing of electricity. After restructuring, customers were allowed to choose their electric power supplier. Restricted transmission and distribution facilities were opened to all power generators on a fair and equitable basis and were overseen by a new organization, the Independent System Operator (ISO). Electric power was traded at the newly created Power Exchange (PX), where power producers competed to sell their electricity generation in response to bids submitted by buyers.[2] Besides the establishment of a competitive wholesale and retail market for electricity, the deregulation bill authorized the recovery of stranded costs for utilities. Under the old regulatory environment, California's IOUs made mandatory investments in utility infrastructure that became uneconomic in the new competitive marketplace. Assembly Bill 1890 provided an opportunity for the utilities to recover these "stranded costs" by collecting a mandatory charge from virtually all customers and by securitization of parts of their stranded costs. The restructuring legislation also established funding for public interest programs, such as conservation, research and development, and renewable energy resource development.

3. Energy subsidies

An important economic aspect that is often neglected when formulating energy policy is subsidies to energy production and consumption. Historically, the rationale for the introduction of energy subsidies has been to stimulate economic growth and to enhance the security of energy supply (de Moore, 2001). This goal was mainly addressed through reduced electricity retail prices for industrial customers to boost industrial development, or

[2] The PX ceased functioning in January 2001.

through various production incentives for electricity generators.

Undoubtedly, there can be some benefits for society due to energy subsidization. However, one should not overlook possible negative side effects. In order to evaluate the impact of an energy subsidy one has to balance the positive and negative implications to the welfare of the society. In many cases, the often unintended, negative side effects are higher than the benefits. Myers (1998) defines subsidies with an overall adverse effect on the society as "perverse". He estimated annual global energy subsidies to be $145 billion, of which $110 billion are perverse subsidies (Myers, 1998).

Energy subsidies have positive impacts if the subsidies correct market failures. For example, they can stimulate the development of energy technologies with environmental benefits that would not be adequately supported in fully competitive markets. They can also enhance the reliability of the electricity system, provide affordable energy to low-income groups, or guarantee the security of the energy supply system. Some energy subsidies, introduced for environmental reasons, are an obligation to generate a certain amount of electricity using renewable energy technologies (e.g. renewable portfolio standards), or impose minimum energy efficiency requirements. Although clearly environmental beneficial, these obligations may not be the most efficient policy instrument. Fischer and Toman (1998) point out that indirect subsidies, which mandate or protect certain technologies, are almost always a less efficient policy option compared to policies that penalize polluters, e.g. through internalization of external costs.

Many energy subsidies have been constructive at the time of their introduction, but have later become adverse economically or environmentally. Often, energy subsidies were introduced long before the environment was of any real concern to governments. Besides, some negative effects of the combustion of fossil fuels, such as global warming, became evident only recently.

In general, most energy subsidies are detrimental both to the economy and the environment in the long run. Negative effects of energy subsidization are (Bruce, 1990; Myers, 1998):

- Energy subsidies aggravate governments' budget deficits and divert government funds from other programs with possibly higher benefits to the society.
- Subsidies produce economic efficiency costs, because resources are allocated so as to take advantage of subsidies rather than market profitability.
- Subsidies produce equity costs, because they tend to benefit few at the expense of many.
- Most energy subsidies are harmful to the environment, because they support polluting energy technologies, or they encourage increased energy consumption. Globally, only $9 billion are annually spent to subsidize renewable energy technologies and end-use energy efficiency programs, compared to $151 billion per year supporting fossil fuels, and $16 billion per year for nuclear power (Van Beers and de Moore, 2001).

3.1. Defining and measuring energy subsidies

In its 1992 service report, the US Energy Information Administration defined an energy subsidy as "any government action designed to influence energy market outcomes, whether through financial incentives, regulation, research and development (R&D) or public enterprise" (EIA, 1992).

Subsidies can be categorized as either production or consumption subsidies. Energy production subsidies increase the prices received by producers, while consumption subsidies reduce the prices paid by consumers, typically through price controls that set energy prices below their full cost. While both kinds of subsidization take place in most countries, developed countries use energy subsidies primarily to support producers.

The above stated subsidy definition is very broad and includes direct cash disbursements to consumers or producers, tax policies (tax credits, tax exemptions, tax deductions), public provision of infrastructure, public R&D expenditures, implicit subsidies (government loan or liability guarantees, debt forgiveness), price regulations, special government procurement practices, import and export tariffs, and many other forms of direct and indirect governmental interventions in the market.

Most subsidies other than direct subsides, which are recorded in the national budgets, are very hard to measure and can only be estimated. One can find several other, much narrower, definitions of energy subsidies in the literature, which cover only those subsidies that can easily be measured and for which data is readily available. Basically, there is no single correct subsidy definition, and the decision how broadly or narrowly to define a subsidy should be based on practical criteria (Bruce, 1990).

This paper analyzes energy subsidies in California. The analysis will be based on the very broad subsidy definition from the US Energy Administration Information stated above. The aim of this work is to point out the additional energy subsidies that have been introduced in the course of the electricity market deregulation process in California. It is beyond the scope of this paper to measure them exactly. However, rough estimates will be given in those cases where data was currently available.

A crucial point for the measurement of a subsidy is the choice of the baseline. The baseline is the counterfactual environment in which the subsidy does not exist. This hypothetical situation is often assumed to be a fully competitive, undistorted market. However, in the case of energy subsidies, one has to consider that electricity markets, even if they are liberalized, are never perfectly competitive. The usually low number of generators, the very inelastic price elasticity of demand for electricity, and the high cost of electricity storage make it easy for competitors to manipulate the market. To mitigate potential market manipulation, some form of oversight and regulation by an independent authority, such as the Federal Energy Regulatory Commission (FERC) in the US, is necessary. Technical issues, such as network constraints, imperfect registration of demand, and the uneven distribution of suppliers with different production and transmission cost and different ability to adjust the output to the varying demand require the control of the electricity system by an ISO. Both the FERC and the ISO have a regulatory function and, therefore, interfere with the electricity market and make competition imperfect. These considerations suggest that the "ideal" deregulated electricity market requires some regulation, which is an energy subsidy according to our definition, in order to work effectively and produce maximum welfare. In this paper, the reference, against which energy subsidies have to be measured, is an imperfect competitive electricity market with some form of state or governmental regulation.

3.2. Benefits of subsidy removal

Despite the many obvious negative effects of most energy subsidies, in most countries very little progress has yet been achieved in removing them. This is because, in general, many subsidies are hidden and, therefore, unknown or at least very difficult to quantify. On the other hand, once introduced, subsidies create special-interest groups and political lobbies, defending their persistence despite their negative implications for society's overall interests. A comprehensive analysis of the barriers to subsidy removal and a strategy to overcome them can be found in Van Beers and de Moore (2001).

Removal of most energy subsidies will have a beneficial environmental impact. Two independent studies (DFI, 1993; DJA, 1994), using slightly different assumptions, estimated that the environmental gains of reducing energy subsidies in the USA range from 40 to 235 million tonnes of carbon dioxide annually avoided. This would lead to a 0.6–3.7% decrease of total annual US carbon dioxide emissions (EIA, 2001). At a global scale, removal of all coal subsidies would reduce global carbon dioxide emissions by 8% (Anderson and McKibbin, 2000). A study by the International Energy Agency (IEA, 1999) found that removing consumer subsidies in eight large non-OECD countries could cut their carbon dioxide emissions by up to 16%, which would reduce global carbon dioxide emissions by nearly 5%.

Subsidy removal is also likely to benefit a nation's economy in the long run. Burniaux et al. (1992) show that the removal of energy subsidies to consumers in non-OECD countries would increase global welfare by $35 billion. Removing subsidies will lead to greater fairness, meaning that only people who consume a certain good or service pay for it and its affiliated environmental costs. A clear, undistorted pricing of goods and services improves economic efficiency and national welfare. Subsidy removal is also likely to increase flexibility in the energy sector, promote long-term economic growth, benefit employment policies, facilitate international trade, and reduce government spending and help balance the budget (OECD, 1996, 1997, 1998).

To ensure that energy markets facilitate improvements in energy efficiency, environmental protection, and investment in supply infrastructure, the Energy Ministers of the member countries of the Asia-Pacific Economic Cooperation adopted in 1996 the following non-binding energy policy principle: "Consider reducing energy subsidies progressively and promote implementation of pricing practices which reflect the economic cost of supplying and using energy across the full energy cycle, having regard to environmental costs" (APEC, 1999).

California's electricity market restructuring could have been an opportunity to reduce government regulation, reduce energy subsidies and enhance efficient pricing. However, the way California restructured lead in the opposite direction, at least in the short run. In the sections that follow, we will describe and discuss several key aspects of California's deregulation that involve energy subsidies. These include retail price caps, recovery of stranded costs, and public benefit programs. Table 1 summarizes the findings of the present study.

4. Retail price cap

California Assembly Bill 1890 mandated a freeze of electricity rates for each class of customer at their levels on June 10, 1996. The rate freeze period started on January 1, 1998 and was to continue until the date on which utilities' stranded costs have been fully recovered.

Residential rates for electricity generation were frozen at a relatively high level of about 5.4 cents (US) per kWh (PG&E, 2001). This provided an opportunity for the IOUs to recover their stranded costs. In the first years after deregulation when the utility's costs to purchase energy were lower than the capped retail price, utilities could use the difference to recover their stranded costs. The price difference is called the "competition transition charge (CTC)" and is given by the amount of revenues from the monthly bills paid by consumers minus the utility's costs to purchase energy at the PX, the

Table 1
Summary of subsidies introduced in California's electricity market deregulation and re-regulation process

Policy	Subsidy	Perverse subsidy	Comments
Retail price cap	Yes	Yes	Electricity consumers were insulated from market price signals
Stranded cost recovery	Yes	Yes	Unclear legislation of California's deregulation law allowed the potential misuse of the proceedings from the Rate Reduction Bonds by the incumbent utilities
Public benefit programs	Yes	No	Support of energy efficiently, R&D, renewables, and low-income customers
Power purchases	Yes	Yes	Suspension of retail competition
Increase of supply	Yes	No	Support program for the accelerated construction of various new power plants
Reduction of demand	Yes	No	Around 10% reduction in energy use achieved due to various energy conservation programs
Wholesale price cap	No	No	Cost-based price cap imposed by FERC

As defined by the US Energy Information Administration, an energy subsidy is "any government action designed to influence energy market outcomes, whether through financial incentives, regulation, research and development (R&D) or public enterprise" (EIA, 1992). Subsidies with an overall adverse effect on the society are defined as "perverse" (Myers, 1998).

transmission and distribution costs, the costs of public purpose programs, and nuclear decommissioning.

During the first 2 years of the transition period, when PX prices were low, utilities could recover significant parts of their stranded costs by collecting a positive CTC charge. From early summer 2000 onwards, however, PX prices spiked and the utilities' energy procurement costs became higher than the frozen retail cap. Beginning in June 2000, the wholesale price of electric power in California increased to an average cost of 18.16 cents per kWh for the period from June to December 2000, compared to an average cost of 4.23 cents per kWh for the same period in 1999 (PG&E, 2001). Thus, the CTC became negative.

As a consequence, the CPUC allowed the utilities on January 4, 2001 to collect a surcharge of 1 cent per kWh, called the "Electric Emergency Procurement Surcharge". Since this surcharge turned out to be insufficient to reduce the negative CTC, the CPUC adapted an additional, tiered usage surcharge on March 27, 2001, called the "Energy Procurement Surcharge", which is on average about 3.5 cents per kWh.

Despite the addition of the two surcharges to the frozen retail rate, the utilities' costs of energy procurement, delivery, transmission, public purpose programs, and nuclear decommissioning remained higher than the revenues from ratepayers, resulting in a continuously negative CTC from May 2000 until July 2001. The northern California utility "Pacific Gas & Electric Company" reported an under collection of $6.7 billion as of December 31, 2000, the southern California utility "Southern California Edison" reported for the same period an under collection of $4.5 billion (Barrington-Wellesley, 2001; KPMG LLP, 2001). The cost imbalance of one utility is depicted in Fig. 1 for illustration purposes.

The CPUC allowed the southern California utility "Southern California Edison" the full recovery of the undercollected power procurement costs including the interest expenses in a resolution in January 2002 (CPUC, 2002a). The northern California utility "Pacific Gas & Electric Company" filed a plan of reorganization with the Bankruptcy Court on September 20, 2001. Once the plan is confirmed and becomes effective, the plan is expected to allow the utility to restructure and refinance its business. Until then, it is unknown who will finally pay for the past undercollected power procurement costs.

However, even in the case that also the northern California utility will be able to fully recover its past undercollected power procurement costs through future electricity rates paid by its retail customers, the retail price cap can be regarded as a subsidy to consumers. The price cap deferred parts of the electricity costs to be

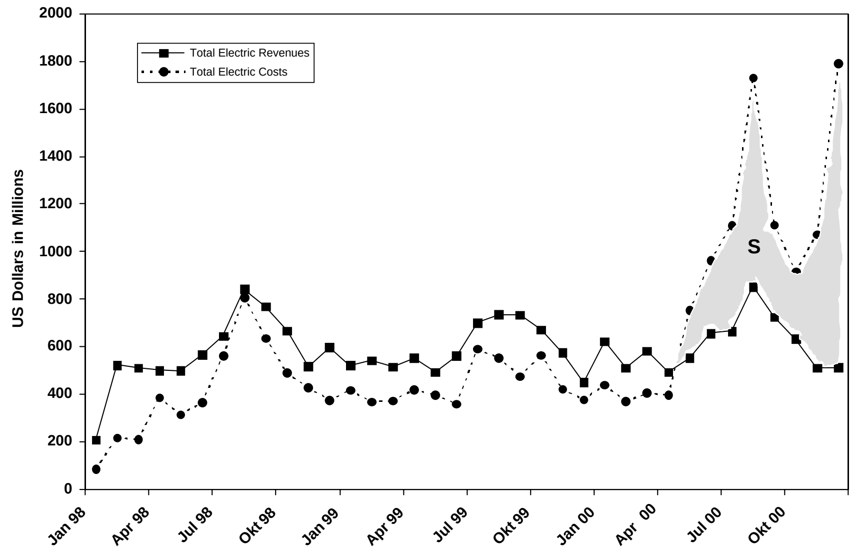

Fig. 1. Comparison of Southern California Edison's electric revenues collected from its customers and the utility's costs of power purchases, including other costs associated with electric industry restructuring, for the time period between January 1998 and December 2000. Area S represents a negative Competition Transition Charge of approximately $4.5 billion (data source: KPMG LLP, 2001).

paid into the future and, thereby, insulated the customers from market price signals that reflect fundamental scarcity. As a result, electricity consumers had little incentive to save energy.

Since the price elasticity of demand for electricity is negative, albeit rather small, one could have expected at least a modest reduction in electricity use, if the price cap had not been in place and prices had risen. The California Energy Commission (CEC, 2002) estimates the short-run residential electricity demand elasticity between −0.06 and −0.49, the commercial short-run elasticity between −0.17 and −0.25, and the industrial short-run elasticity between −0.04 and −0.22.[3] Other studies (Branch, 1993; Hsing, 1994) estimate the short-run residential demand elasticity between −0.20 and −0.27, well within the range stated above.

The price capped electricity service at a rate at, or below, wholesale prices also discourages consumers to switch to alternative retailers and is therefore anti-competitive. In addition, price caps cause producers to look to other markets in the short run, and deters investments in new capacity. The overall effect of retail price caps is therefore that they increase demand and reduce supply. This is exactly the opposite of what a deregulated market is expected to do, and this led to an escalation in the California energy crisis.

[3] A price elasticity of −0.1 describes the fact that the electricity demand falls by 0.1% due to a price rise of 1%. A short-run period describes a period of time, in which consumers response to a price increase is limited to adjusting existing equipment (e.g. changing the thermostat setting) rather than replacing existing appliances with more energy efficient ones.

5. Recovery of stranded costs

One of the main issues in the transition process from a regulated to a competitive electricity market is the recovery of stranded costs. Stranded costs are typically defined as costs of historical investments and contractual obligations, which would be recovered by the incumbent utility under the prior regime of cost-of-service regulation, but which will not be recovered under the reduced price level, which is expected to result from competition. A more detailed definition can be found in California Assembly Bill 1890 (California Public Utilities Code, 1997, Section 840(f)). The California utilities estimated their stranded costs to amount for $27 billion (Hirst, 1999).

There are several critics of stranded cost recovery who claim that it is unfair and produces economic inefficiency (Penn, 1994; Michaels, 1994, 1995; Navarro, 1996). However, we believe that the recovery of stranded costs, as long as these costs are properly measured and defined, does not distort competition and should not necessarily be regarded as a subsidy. Recovery of stranded costs, if done correctly, relieves incumbent utilities from the legacy of sunk cost of the old regulatory regime and creates, therefore, a "level playing field" in the new, competitive marketplace. A comprehensive analysis of this aspect can be found in Tye and Graves (1997), Kahn (1997), Joskow (1996), and Baumol and Sidak (1995).

Stranded cost recovery by itself does not distort competition, if the amount of stranded costs is determined by an appropriate and accurate methodology, and if it is ensured that the proceeds are used without impeding competition or distorting the market. Ideally, the legislation should ensure that utilities use the granted compensation to cover losses associated with the sale of stranded assets or the retiring of uneconomic financial obligations. Without such provisions, there is the danger that utilities will use the granted funds in an anti-competitive or inefficient way.

The California legislature allowed two forms of stranded cost recovery (California Public Utilities Code, Sections 330(s), 330(w), 365, 841(a), 841(e)). The first option is by collection of a mandatory charge, called the CTC on all customer bills during the transition period. The CTC is equal to the difference between the frozen 1996 electricity rate charged to consumers and the utility's costs of purchasing and delivering power. This CTC was discussed previously.

The second option of stranded cost recovery permitted by the California AB 1890 is called "securitization" or "asset-backed financing". It requires a "financing order" by the state's public utilities commission approving parts of a utility's stranded costs to be recovered. This is accomplished by means of a mandatory charge, called the "Fixed Transition Amount", applied to all residential and small commercial customer's energy bills. The ownership to all revenues arising from the fixed transition amount is defined as "transition property". Under securitization, the utility sells this transition property to a special-purpose entity, usually a securitized trust. The special-purpose entity is financed from the issuance of "Rate Reduction Bonds" in the form of notes or certificates to investors. The bonds are amortized and the bondholders are paid by the revenue stream arising from the mandatory charge to the utility's customers. Proceeds from the issuance of the bonds will be transferred back to the utility in form of an up-front "lump sum" payment in return for the transition property.

In California, both stranded cost recovery approaches were used (CTC and securitization). The two major California IOUs issued $5.4 billion in Rate Reduction Bonds through the state's Infrastructure and Development bank in December 1997 (PG&E, 1998; SCE, 1998).

Stranded cost recovery by securitization can be regarded as a subsidy to incumbent utilities, if they can use the proceeds of the issuance of the rate reduction bonds in their generation business without restrictions. This is anti-competitive, because it permits the incumbent utility an undue competitive advantage in the new marketplace. The California legislature defines rate reduction bonds as "bonds, notes, certificates of participation or beneficial interest" ..., "the proceeds of which are used to provide, recover, finance, or refinance transition costs and to acquire transition property" (California Public Utilities Code, Section 840(e)). In the bill's language "transition costs" basically mean stranded costs, and "transition property" stands for the ownership of the stream of payments that collateralizes the rate reduction bonds. Besides this definition, there is no clear restriction on the use of the proceeds of the securitization financing. Deregulation laws in other states are much more restrictive. The Pennsylvania legislation, for example, provides that the Pennsylvania Public Utilities Commission has the oversight of the disposition of the bond proceeds, which are to be used primarily to reduce stranded costs (Pennsylvania House Bill 1509/1995, Section 2812(b)(2)).

There are suspicions that some California IOUs used the proceeds of their issued rate reduction bonds at their holding company level in an anti-competitive manner (TURN, 2000). In 1997, the President of the California utility "San Diego Gas and Electric" noted that cash from stranded cost recovery was opening a billion dollars in new investment opportunities for his company (Brydolf, 1997). Thus, the unclear definition of the legal use of the proceeds of the issuance of the rate reduction bonds in the California Assembly Bill 1890 can be regarded as a subsidy to incumbent utilities.

The advantage of securitization for the utilities and their shareholders is that the recovery of their securitized stranded costs is guaranteed and received immediately. The alternative way of stranded cost recovery through the CTC just provides an opportunity for the utility to retire its stranded costs over the time of the transition period, because the amount of the revenues from the competitive transition charge depends on the utility's unknown cost of energy procurement.

The advantage of stranded cost recovery by securitization for ratepayers is questionable. Advocates of securitization, which are mainly utilities, argue that it can produce savings for ratepayers. This assumption is based on the usually higher credit ranking for the securitized assets than that of the utility. The credit enhancement is possible because of the character of the "financing order" by the state public utilities commission, which defines a property right by statute to receive the proceeds of the fixed transition amount. The interest imposed on the rate reduction bonds will therefore be lower than the utility might otherwise obtain if it had to recover its stranded costs by the issuance of utility bonds and rely on its own bond rating. Some economists, however, point out that securitization does not necessarily lead to economic savings for ratepayers (Michaels, 1998; Awerbuch and Hyman, 1997). In order to accurately compare the two debt financing options, either by the issuance of utility bonds or by securitization, one has to consider the risk differential, the different payback periods, and the discount rate. Securitization is likely to benefit ratepayers only if capital markets have systematically overestimated the utility's risk to default on interest payments.

6. Public benefit programs

One provision of AB 1890 is the creation of various public benefit programs for improvements in energy efficiency, energy-related research and development, support of renewable generation, and support of low-income customers. The public benefit programs are financed through mandatory charges for all retail customers of IOUs based on their electricity usage. The funding level of the programs is around $640 million per year. The public benefit surcharge adds only 2–3% to the price of a kWh, since California's electricity costs about $25 billion per year.

The public benefit programs succeed the former demand-side management (DSM) programs that were carried out by California investor owned utilities (IOUs). The CPUC ordered California IOUs to implement DSM programs with the aim to shape total customer demand to better match system generating requirements and system costs. This helped utilities to improve system performance, reduce load, and cut down costs. The statewide utility spending on DSM programs varied over time. It started with $100 million a year in 1980, grew to $230 million a year in 1984, fell below $100 million a year in 1989, and rose again to about $500 million a year in 1994 (CEC, 1999). With the utility restructuring process starting in the mid-1990s, IOUs were no longer required to continue their DSM programs and the California Assembly Bill 1890, therefore, ordered the implementation of the above mentioned public benefit programs.

The funding for these programs is currently allocated as follows (CEC, 1998; CPUC, 1999):

- About $270 million per year for energy efficiency programs.
- $62.5 million per year for the Public Interest Energy Research (PIER) Program, which supports energy related research, development, and demonstration projects that are not adequately provided by competitive markets and aim to advance science or technology.
- $135 million per year for the Renewable Energy Program, which supports existing, emerging, and new renewable energy technologies.
- About $180 million per year for support of low-income electricity customers through the reduction of their electricity bills, and through improvements in energy-efficiency.

The public benefit programs are direct energy subsidies provided for environmental and social reasons. The programs are in the public interest, because the funded projects are not adequately undertaken in competitive markets due to various impediments and market failures.

In the case of energy efficiency improvements, consumers and businesses often lack the information, tools, or correct incentives to identify and implement energy saving choices that would benefit them. Another important market failure is that the environmental and social costs attributed to electricity generation are not included in the market price for electric power, resulting in artificially reduced prices. If electricity prices do not reflect their full costs to society, consumers cannot make rational economic investments in energy efficiency.

The development of clean energy technologies are impeded by factors that include market, institutional and legislative barriers. Market barriers involve unequal subsidies and tax regulations, while institutional barriers result from a small industrial base for emerging technologies that hinders effective bargaining. Legislative barriers, for example, include unfavorable legal requirements for renewable energy sources.

The public benefit programs are subsidies that are in the best public interest. Energy efficiency programs reduce the energy intensity, make businesses more competitive, and allow consumers to live more comfortably. By reducing the electric system loads, the programs increase the power system reliability, reduce the need for new capacity, improve the environment, and stimulate the economy. Studies show that recent energy efficiency programs in California have been cost-effective and returned at least two dollars in benefits for every program dollar spent (CEC, 1999).

In addition, the PIER program is very likely to show significant economic benefits for the state of California. A benefit evaluation of the PIER program, which was at the time of the writing of this article in its early stages, analyzed 8 out of 506 PIER projects that were expected to result in commercially available products or information in the near future. The analysis estimates the public benefits of the 8 analyzed projects at around $150 million (Jenkins et al., 2002). Considering that not all projects have yet been evaluated and that the PIER program has been in place only 4 years (with a cumulative funding of $250 million), one can reasonably expect that the benefits of the whole PIER program will significantly exceed its costs as additional products and information emerge from ongoing projects. This is in accordance with other R&D programs in the energy sector. For example, R&D expenditures of the Gas Research Institute in Illinois, incurred between 1997 and 2001, produced a benefit to cost ratio of 9.2 to 1 (Bournakis, 2002).

Up to August 2001, the Renewable Energy Program supported approximately 4400 MW of existing renewable capacity and about 1600 MW of new renewable capacity via production-based competitive auctions. It aims to increase the percentage of California's electricity generation from renewables from 12% in 2002 to 17% by 2006 (excluding large hydroelectric power). Renewable energy technologies show high environmental and economic benefits compared to fossil fuel-based electricity generation. A recent study from the Electric Power Research Institute (EPRI, 2001) finds that renewable-energy resources could cost-effectively contribute up to 20% of California's electrical energy demand (excluding large hydro) by 2010. This would create over 18,000 jobs, and reduce electricity generation-related emissions of air pollutants by at least 18%. It would also lead to a 30% reduction in CO_2 emissions and a 44% reduction in NO_x emissions, compared to a scenario where all needs for capacity addition in the next decade will be filled with natural gas. The cumulative value of the avoided emissions would exceed $2.3 billion by 2010.

7. Actions undertaken to fix the energy crisis

The main elements of the plan to manage the crisis in California were (State of California, 2001):

- *Keep the lights on*. The IOUs could not purchase energy to meet their customer's needs. That is the rationale behind why the state stepped in and began purchasing one-third of the total electricity needs in the IOUs' service areas.
- *Increase supply*. The construction schedules of the private sector contractors who were building new power plants were accelerated by providing them with financial incentives to finish the job in time to bring new power on-line for the summer of 2001. That added approximately 5000 MW.
- *Decrease demand*. Through a program of education and demand management programs, the overall demand was reduced about 11% over the previous year.
- *Discipline the wholesale market*. FERC reluctantly placed a temporary price cap on wholesale prices of electricity in the western states.

Each of these actions can be examined in the light of energy subsidies (see Table 1).

7.1. Power purchases by the state of California

Due to the poor financial situation of two major IOUs in California, the state of California stepped in as a power purchaser after January 2001. This allowed the lights to be kept on in California. From January 17, 2001, until December 31, 2002, the state is expected to have spent $10.0 billion through the Department of Water Resources (DWR) for energy on behalf of California's IOUs (CPUC, 2002b).

However, the state's general fund will be fully reimbursed according to a decision of the CPUC in February 2002 (CPUC, 2002b). The Department of Water Resources will collect its revenue requirements through charges remitted from billings to retail customers of the three major California electric utilities.

Although, in the end, no taxpayer's money will have been used to finance the state's power purchases, the mitigation action by the Governor of California can be regarded as an energy subsidy according to the definition stated previously. The power purchases by the state helped to amortize (and smooth) the peaks in the cost of energy during 2001, sparing California's economy from the shock of trying to absorb all of the added cost at one moment. This intervention prevented a scenario, where widespread disruption in electricity supply would have occurred, due to the illiquidity of California's IOUs, which hindered them from purchasing power for their customers.

On September 20, 2001, the CPUC suspended the right of customers to acquire direct access electric service from independent power retailers (CPUC, 2001). The motive for this decision was to provide the three Californian IOUs with a stable customer base in the future, from which to recover the cost of the power the DWR has purchased. With this decision, the CPUC prevented a scenario where customers switch from utility service to independent electric service providers to avoid higher electricity rates due to the charges associated with the repayment of the Department of Water Resources. The most important element of deregulation, namely customer's choice to select their energy service provider, was thereby removed. This action is a subsidy to the IOUs, because it essentially abolishes competition in the electric retail market. The decision provides a large advantage to incumbent utilities, since, under AB1890, state oversight was reduced, and now they can again operate as monopolies. The IOUs and the newly created California Power Authority will be able to pass electricity costs to ratepayers, without having to compete against independent power providers. The decision is also unfavorable from an environmental perspective, because so called "green" service providers, offering renewable energy, are banned from entering the direct market. This prevents customers from choosing cleaner energy products, such as geothermal, wind, biomass, or solar power. Of course, they can enter into contracts with the IOUs.

7.2. Wholesale price cap

Wholesale electricity prices in California have risen more than 10-fold since the spring of 2000. While the wholesale market price for electricity averaged 3.5 (US) cents per kWh in 1999, it skyrocketed to 30 cents per kWh in 2000 with peak prices of $1.50 per kWh (State of California, 2001). There are suspicions that the wholesale price increase was not only due to a supply–demand imbalance, but was also caused by the exercising of market power by generators and marketers (Joskow and Kahn, 2001a, b; Hall, 2002). For this reason, the FERC introduced a price mitigation plan on June 19, 2001 (FERC, 2001). The mitigation seeks to correct dysfunctions in the wholesale power market of California, and the remainder of the Western Systems Coordinating Council (WSCC) that is responsible for the majority of electric generation in the western US. The price mitigation plan consists of two parts that cover every hour of spot market sales of electricity in California and the WSCC.

During reserve deficiency hours, i.e. when reserve levels in the ISO are below 7%, the bids of sellers that own generation are limited to the marginal cost to replace gas used for generation plus variable operation and maintenance costs. During all non-reserve deficiency hours, spot prices are to be capped at 85% of the highest ISO hourly market-clearing price established during the hours of the last stage 1 alert when reserves were below 7%. In both cases, sellers are allowed to justify bids above maximum prices. The price mitigation plan of the FERC introduces cost-based price caps. The price cap is based on the marginal cost of the economically least efficient generating unit dispatched, which is very likely to be fired by natural gas. This price mitigation plan reflects prices in a competitive market, where the market-clearing price is also set by the marginal cost of the last unit of energy produced. For a more detailed analysis of the wholesale price mitigation plan see Shioshansi (2002).

We conclude that such cost-based wholesale price caps should not be considered as subsidy. A price cap will distort the market only if it is set too low, i.e. below the short-run marginal cost of production. In this case the cap will deter production from an existing power generation facility. The maximum price of the FERC price protection plan is, however, based on costs of production of the least efficient generating unit dispatched. Furthermore, justified bids above maximum prices are allowed. Thus, the price cap will not deter production, but will deter the exercising of market power from excess generators since they will lose an incentive to restrict output in order to drive the price higher.

7.3. Programs to increase supply and reduce demand for electricity

One reason for California's electricity market breakdown was the imbalance of power demand and supply. The power reserves dropped several times during summer of 2000 to alarmingly low levels, resulting in very steep wholesale price increases. The reason for the constrained capacity situation was not an unexpected increase in demand. California's electricity consumption has been rising by about 1% annually during the last decade, and this pattern did not change in 2000. The peak demand in summer of 2000 was actually lower than in 1998. The power reserve levels dropped in 2000 mainly due to electricity imports that were suddenly reduced. While California has historically been relying on out-of-state generators for about 20% of its electricity needs, imports fell to 11% in 2000, because the neighboring states had less excess capacity to export (CEC, 2001).

The State of California addressed the supply–demand imbalance by passing new laws to expedite approval of new power plants and introduce aggressive energy conservation programs. The goal was to increase generation capacity by 20,000 MW by July 2004, so that the supply exceeds demand by 15%. The California state program to increase capacity consisted of a rapid certification and construction of new "peaking" power plants, the accelerated construction of already approved base load power plants, and the raising of power output from existing power plants.

It is difficult to assess if the plan to increase capacity should be considered as energy subsidy or not. Although the new peaking power plants are typically small simple cycle gas power units, the program also provides for renewable energy systems to be constructed (Governor of California, 2001). However, emergency power plant projects permitted under this program were exempt from requirements of the California Environmental Quality Act. Additionally, the review process of environmental documents for these projects was allowed to be shortened to 7 days to expedite local permitting. These regulations favor fossil fuel-based power plants compared to renewable energy. On the other hand, as a part of the plan to boost generation capacity, the state of California introduced several additional financial incentives to support the construction of new renewable energy sources, such as tax credits, commercial loan guarantees, and rebates for small renewable energy systems. In addition, the California Air Resources Board established a State Emission Reduction Credit Bank to allow peaking power plants to buy emission reduction credits to compensate for increased emissions of nitrogen oxides and particulate matter. The available emission reduction credits are achieved by cleaning up existing facilities that are more polluting, such as older power plants and diesel machinery. The program to increase power generation may have been balanced between fossil fuel-based and renewable energy sources. Nevertheless, it is an energy subsidy according to the definition stated in Chapter 3.

Apart from the plan to increase capacity, the Governor of California initiated a series of integrated conservation programs in the amount of $828 million that aimed to reduce the demand by 10% during summer of 2001 (State of California, 2001). The conservation programs consist of public education and outreach, improving energy efficiency in State buildings, load shifting, interruptible service, time-of-use metering, demand buyback programs, and the "20/20" rebate program. The latter provides a 20% rebate for electricity customers who cut back their electricity use during the summer of 2001 by 20% over the levels in summer of 2000. These conservation initiatives were very effective, and helped California's electricity consumers to pass the summer of 2001 without any blackouts despite a hotter weather than in summer of 2000. The conservation program influenced the energy market significantly and is therefore an energy subsidy according to the definition given previously. The outcome achieved was beneficial both economically and environmentally. It spared Californians expensive electricity outages and it reduced emissions connected with the generation of electric power. A drawback of the initiative was, however, that all taxpayers had to pay for parts of the conservation program, including those who have already been energy efficient and who produced their own electricity by distributed energy sources, such as solar panels. A fairer approach would have been to influence the energy consumption behavior of Californians not by publicly sponsored media campaigns, but by allowing the utilities to increase their electricity rates. This would have rewarded energy efficient customers and penalized inefficient ones, contrary to a conservation program funded by all taxpayers.

8. Conclusions

California's faulty deregulation plan lead to an electricity market breakdown not often seen in industrialized countries. Many elements of the original restructuring process (AB 1890) were fundamentally flawed and led to additional energy subsidies instead of a more deregulated electricity market.

Regulated retail prices combined with deregulated wholesale prices were a subsidy to electricity consumers that insulated them from market price signals. This discouraged consumers from saving energy or investing in energy efficiency improvements. The result is related to the "tragedy of the commons", where people take excessive advantage of a supposedly free or very inexpensive good thereby depleting, or degrading, it faster. In the case of the California energy situation, high demand, skyrocketing wholesale prices, and electricity shortages were the result. In addition, since utilities could not recover their energy procurement costs, it led to severe financial problems in California's investor owned utilities. The State of California stepped in by purchasing power in form of long-term power contracts to prevent temporary rate increases to electricity consumers. This action falls under the category of an energy subsidy.

Alternatively, by letting retail prices float, electricity consumers would have experienced clear price signals and curtailed their demand accordingly. Utilities would not have faced insolvency problems, rendering the state's interventions superfluous. Generators would have been paid by utilities for their delivered energy and would have had an incentive to invest in new capacity. Higher retail prices would also have stimulated retail competition by facilitating new energy supplier companies to enter into the market. Thus, retail price flexibility would have led to reduced demand and increased supply, solving the energy crisis through market forces and opening up the path for a more competitive electricity market, where investments in energy efficiency and renewable energy are rewarded.

However, the state interventions to smooth out the impacts of the energy crisis insulated electricity consumers from market realities, supported the existing structure of California's electricity market, which is predominantly based on fossil fuels, and prevented incentives to improve energy conservation and a switch to renewable energy systems. The mitigation actions by the state of California can therefore be regarded as energy subsidies with both unfavorable economic and environmental consequences.

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