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The effects of Liberalization and Regulatory Issues on the Development of Renewable Energies

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Abstract

Liberalization is occurring very differently in different member states submitted to the same EU Directives (1996, 2003). The five components of a comprehensive liberalization – competition, harmonization, transparency, unbundling, regulation – are implemented unevenly and linear progress is not evident. The liberalization turmoil brings positive and negative effects on the development of renewable energy in Europe. Most negative is the worshipping of the Golden Calf of low electricity end-use prices, while end-users need the signal of high (tax loaded) end-use prices to foster continuously improving efficiency. Today unseen efficiency performance only makes an almost complete renewable backstop supply affordable.

Keywords: renewable electricity, electricity sector liberalization, local energy utility, backstop supply, efficiency

Introduction

The title points to 'liberalization' and 'regulatory issues' as driving forces for the 'development of renewable energies'. This is a very broad and complex question and all aspects require attention although an extensive coverage is impossible in this brief address. Section I reminds some highlights of the liberalization discussion in Europe, now about 20 years old. A normative model of restructuring is also reminded (section II). In section III, main effects of the liberalization processes on the development of renewable energies, are assessed. The second part of the contribution focuses on the meaning of backstop supply solutions (section IV) and on the role and impact of end-use electricity prices on the intensity (and efficiency) of the electricity use in a panel of wealthy OECD nations. It is shown in section V that the long-run price elasticity of the electric intensity is almost -1. This opens perspectives of increasing the efficiency of electricity use to a level that makes an almost complete renewable backstop supply affordable in the future. A conclusion rounds up the arguments.

I. Liberalization and regulatory issues

Although hundreds of books and articles were written and thousands of experts have gathered on the topic of liberalization of the electricity sectors in Europe and in other parts of the world, there remains a wide variety in models, opinions and practices [see Glachant and Finon, 2003, and Newbery, 2005 for recent reviews]. Let us remind some highlights and apologize immediately that this is but an incomplete coverage of a 20 year history spanning such colorful power landscape as the European one.

First eye catch was the term **competition**, often accompanied by terms as privatization and deregulation. Up to the 1980s competition in the electricity sector was unknown. Progress and benefits in the sector came from cooperation and mutual learning[1] in carefully franchised distribution, transmission and correlated generation sectors. New-lighters came to talk about '*leveled playing fields'* and about '*third party access'* to the neatly franchised playing fields, and about electricity markets and competition.

Most power company CEOs had to go and buy Adam Smith's works. They learned that market exchanges can generate an economic surplus when '*comparative advantages'* between the market parties exist. In fact, the comparative advantages should be *natural* in a sense that they should be due to particular endowments of the country (e.g. large hydro potentials) or due to special skills developed in the country (e.g. mastering particular technologies such as the construction and exploitation of nuclear power stations), or due to exceptional managerial skills of CEOs that could extract more value from the available production factors, etc. When comparative advantages are not drawn from natural assets or form private endeavours, the advantageous position of particular market suppliers is the result of *artificial* factors, i.e. factors that consume in some or another way economic resources without being paid for by the suppliers.
In order to avoid distorted markets with dumping and other evils, artificial factors should be excluded. This is one of the major challenges to every governmental official or regulator, supervising the proper functioning of markets. The boundary between *natural* assets and *artificial* factors providing an advantageous position to a market supplier is often very thin or difficult to identify. Some artificial factors are very obviously created to bias normal market rules in favour of some party, e.g. when subsidies are given. Blunt subsidies are not acceptable, but rooting out hidden subsidies is very difficult. Hidden subsidies take on many forms and flow through many channels (e.g. advantageous tax regimes in private-public partnerships).

Harmonisation was the next step-stone in the debate. All European participants in the electric power play should face the same terms of reference. This lovely idea accords the educational background and feelings of most people in Europe since the French revolution in 1789.

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[1] Because there was no fear of competition most electric utilities were quite open with information and willing to share know-how and experience. European sector institutions and conferences contributed to the mutual learning processes.

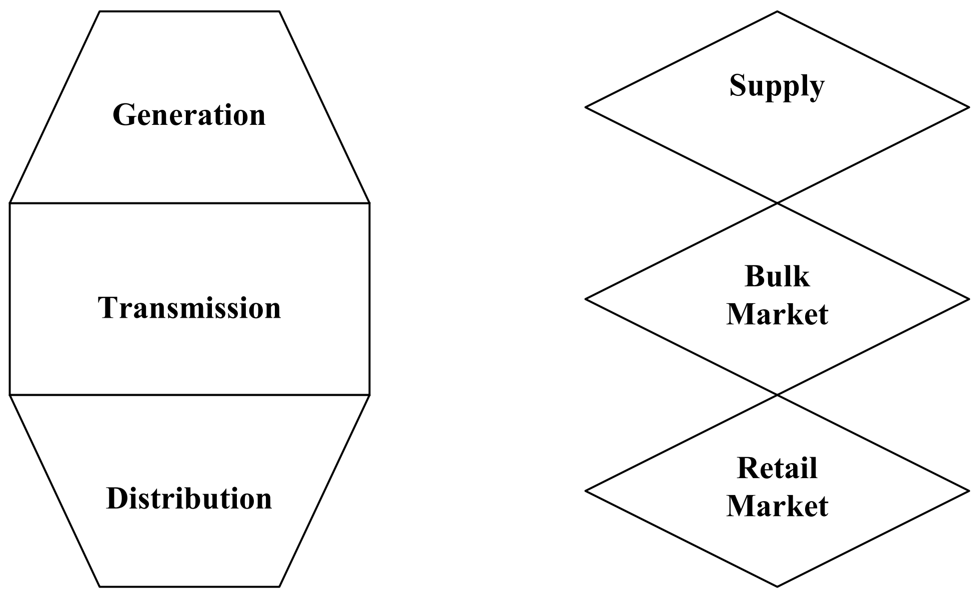
Early in the debate "reciprocity" was advertised as an important standard of harmonisation because it reflected symmetry in the conditions among national champions. In reality one observed some of the absolute monopolies in Europe (EDF, ELECTRABEL) pursuing the strategy of fencing the own market tightly while conquering plants and assets in countries with a more open regime. This all in the absence of any real intervention by public authorities at the EU or at the national levels to prevent such anti internal market moves. In the 2003 Directive article 21 (EU, 2003) reciprocity is confined to eligibility and market opening between trading partners. "Non-discriminatory" is now often used to refer to harmonisation.
Improving harmonisation can be done by e.g. submitting all electricity suppliers to an equal or comparable legislative system (e.g. for obtaining construction licenses, for obeying environmental protection rules, etc…). Even here disagreement arises when the principle is extended to the social sector, because some will argue that cheap labour is a 'natural' asset of some nations while others will argue that all, or a major share of, labour cost difference is due to a lack of harmonisation in the legal and social systems. In a diversified Europe with private and public utilities, some governed top-down and others bottom-up, with different cultural, social, economic, institutional, political histories and customs and with different natural endowments, etc. installing a workable level of harmonization is a long and difficult task. One must strike the precarious balance between on the one hand diversity that enriches a continent and on the other hand uniformity that easies integration and productivity.

Because borders between natural and artificial and optima between diversity and uniformity are difficult to identify, there is a high need for **transparency**. In the electricity supply sectors of Europe one would like to have transparency about the capital supply, working conditions, cost structures, pricing practices, etc.
Transparency increases in case of non-integrated companies operating in a competitive environment. However, the electricity sector in most member states was covered by vertically integrated power companies with franchised monopolies for whole or part of the country. Today vertical *interconnection* is substituted for vertical integration and franchising is limited to the natural monopolies of distribution and transmission of the current. In vertically integrated or interconnected structures, transfers between generation and distribution activities can be hidden, e.g. by manipulated transfer prices, by shifting expertise among the separate entities, etc. Jamasb and Pollitt (2005, p.38) also observe that "there is, for example, a shortage of data on ownership interests of companies, cost information, subsidies, and measures of security of supply" and that "in the post-liberalisation era, some type of data have been deemed commercially sensitive and are not made available even to regulators" (sic!). Maybe they conclude too early that we live in a post-liberalisation era.

Unbundling was one crucial requirement for improving transparency. In the first years of the liberalisation discussion unbundling was the restructuring of the vertical power column into three components: GENCOs, TRANSCOs and DISCOs that had to balance activities through market rules rather than by internal company conventions (Figure 1). Because an important share of the European power suppliers was (and some still are) opposing the idea of such unbundling, the EU first introduced some type of weak unbundling by obliging a separate cost accounting and management for the three main

functions. Further unbundling is the creation of separate companies for generation, transmission and distribution. The 2003 Directive requires legal unbundling but does not impose unbundling in ownership. Important links between such companies often remain in capital and personnel (the formal rules on independency cannot impede personal relationships and rotating job positions).
Within the three levels further unbundling took place. At the power transmission level a separation between the functions of independent system operator (ISO) and of high voltage grid provides advantages, although now transmission system operators (TSO) that cover more services such as expansion and maintenance of the grid are favoured [EU, 2003; Joskow, 2003, p.12; Newbery, 2005, p.4]. At the distribution level the distribution grid activities were separated from the supplier activities in order to offer households and other small customers a freedom of choice in power suppliers.

Figure 1: Vertical integration (left) versus unbundling (right) of main power sector functions



While unbundling of the three main functions (generation, transmission and distribution) and of the system operator (the central broker of the power system) from the high voltage grid are meaningful for installing workable competitive conditions in the electricity markets, I remain [Verbruggen, 1997] convinced that breaking up the distribution utilities was and is a bad move.
Arguments to oppose such move are:

- The **transaction costs are high**. The creation of a multitude of organisations (network companies, suppliers, metering companies, marketing and advertising agents, etc.) costs more than it creates value. The small customers are bombarded with advertisements and commercials and the searching costs for finding out the best offers are much higher than the small differences in prices and conditions they can gain from. Joskow (2003, p.12) states: "Retail competition initiatives have often worked well for large industrial and commercial customers. But the benefits for residential and small commercial customers are yet to be demonstrated compared to alternative procurement arrangements that retain distribution company responsibilities for supplying smaller customers by procuring power in competitive wholesale markets."

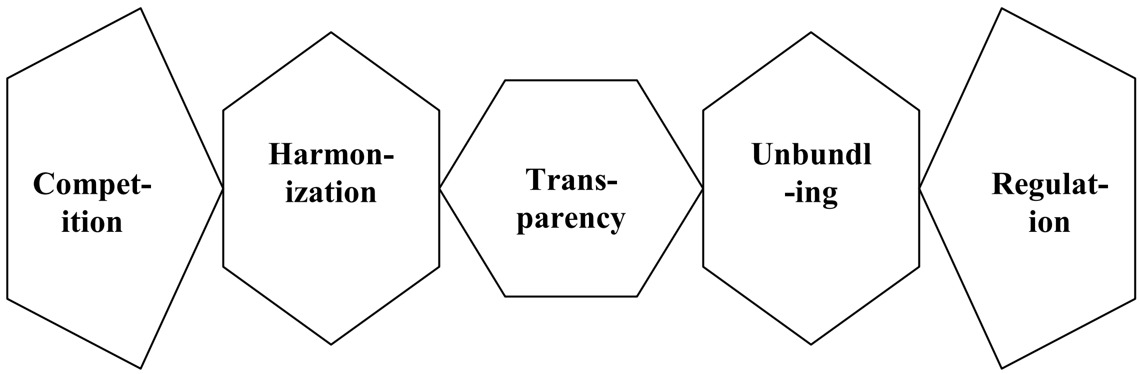
- By disintegrating the distribution utilities **economies of scope are lost**. In particular in some countries the distribution utilities offered a full range of local services such as electricity, gas, district heat, telecom, water, sewerage, and/or were allied with other local services such as public transport, sports facilities, etc. Many of such local companies offered a high level of utility service and of luxury to the constituency, while they also took care of the broader public interest (environment, local distributed resources, cogeneration, renewable energy).
- **Real competition is reduced** by placing small individual customers on the same playing field as large industrial customers. Workable competition requires parties of about equal strength under about equal circumstances. Were the distribution utilities not broken up but regulated to act as *agents* of the small customers, real competition could function at the level of the high voltage transactions. The demand side of such market would consist of large industrial and commercial end-users and of locally franchised and strictly regulated distribution utilities.
- The regulator better can install *diverging objectives and targets for the three main functions* (profit making for the generators, brokerage for the system operator, and *energy service activities for the distribution companies*). Where necessary distribution activities had to be transformed from the sales departments of the vertically integrated monopolies to **public interest utilities** that maximize energy efficiency, realize local renewable electricity generation, redistribute opportunities and results among the customers, etc. Because of their access to capital, know-how, technology on the one hand and because of the close relationship they can build with the inhabitants in an area, such utilities can provide a solid basis for materializing sustainable development. This requires new and clear regulatory models rewarding performance on sustainability indicators rather than on sales volumes.

Regulation is the fifth closing step-stone in restructuring the electricity sectors in Europe. Giving up monopoly control by e.g. vertical unbundling is not a natural drive of power companies. In order to establish and to safeguard real unbundling, firm regulatory intervention is necessary. While submitting proposals of market reform, one also should have presented the main lines of the regulatory system that governs the reforms. Many observers emphasized there was a need for re-regulation not for de-regulation (equalling at the end no-regulation). Regulatory effectiveness and efficiency is important for realising the goals of unbundling, transparency, harmonization and so competition in the power sectors (as in many other markets). Regulation is also a necessity for redirecting our societies towards a sustainable future.

In 1996, the EU (commission, parliament, council) did not come up with a clear blueprint of the regulatory institutions necessary to realize the liberalization ideals. The 2003 Directive (article 23) fills the gap, but still today shortfalls in regulatory capability and independency gives free way for the incumbent power companies to maintain monopoly positions and advantages (Jamasb and Pollitt, 2005, p.37-38).

Figure 2 shows how competition and regulation have to be balanced through the linking components of harmonization, transparency and unbundling. Every next step-stone is a prerequisite of the preceding one, and so it is obvious that regulation is the ultimate prerequisite for competition in the electricity industry.

Figure 2: Competition and regulation balanced

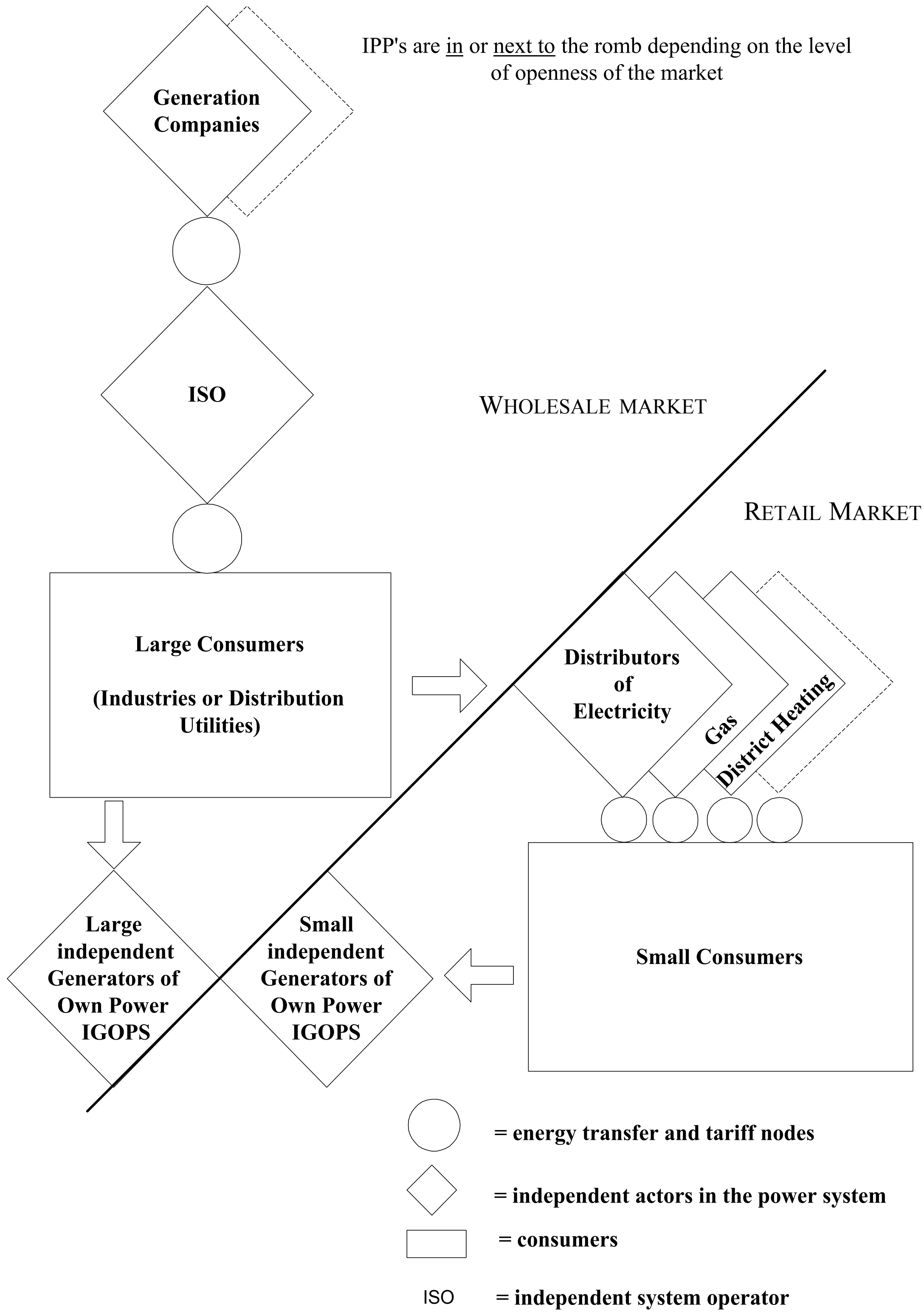


II. Blueprint of a normative structure for the electricity sector

A blueprint of a particular normative open structure for the electricity sector is shown in figure 3 (Verbruggen, 1997). Several attributes of the structure are commonly accepted and realized by now in many countries. There are also important differences between the proposed normative structure and the actual developments in the field. Without a detailed discussion, some of the differences should here be mentioned:

- Figure 3 shows the distinction between 'Generation Companies', being producers of power to sell to third parties, and **'Independent Generators of Own Power'** (IGOPs) that mainly produce power for own needs (cogeneration, local renewable sources). IGOPs may turn up in the electricity market *once as suppliers of power, and once as demanders for power*. Mostly IGOPs cannot guarantee capacity availability, and therefore often refrain from participating in power exchanges. Also IGOPs buy back-up power at the grid when the own units fail, and generally will purchase complementary power from the grid. In a sustainable future IGOPs, as part of distributed generation supplies have to cover an increasing share of electricity consumption. Figure 3 shows that a distinction between large scale and small scale IGOPs is helpful. The EU 2003 Directive does not identify IGOPs as a separate category within the group of distributed generators (definition 31, article 2).
- **Wholesale and retail markets are neatly distinguished**. The blueprint favors the suitable levels of unbundling and competition in both market levels, considered to be a high level in the wholesale markets and a low level in the retail markets. In the wholesale market only large customers deal and small consumers are best represented there by distribution companies regulated to be their agents. Contrary to the actual practices small customers are not loaded with the responsibility and transaction costs of finding the best supplier. In the normative model it is the regulator that takes care of controlling suppliers and of providing the right incentives so that public service levels are high while costs stay low.
- Independent generation of own power, in particular small sized projects (rooftop PV, small biomass converters, small scale wind and hydro, etc.), needs stimuli. Utilities pursuing the public interest can play a crucial role in such development, e.g. by lifting all barriers to a fair network access, by supplying know-how, by offering investment capital, by supplying maintenance contracts, etc. Because high performance in the efficient use of energy is dependent on the height and the stability of the energy end-use prices, significant and steadily increasing energy taxes are necessary. Part of the tax revenues can be invested in the service activities the local utilities have to offer to the customers, in particular the financially less well-of part of the population.

Figure 3: A normative open structure for the electricity industry



III. Effects of the liberalization on the development of RES-E

In a 2005 Special Issue of The Energy Journal on "European Electricity Liberalisation", Jamasb and Pollitt state that it is 'too early to quantify the performance and effects of electricity reforms'. They describe the evolution in market structure. Performance is measured by 1) electricity prices with also reference to consumer switching, 2) investment adequacy, 3) security of supply, 4) environmental impact and 5) social impact. Under the caption "environmental impact" the ½ page text is fully spent on renewable electricity sources. The relationship between liberalization and the development of RES-E is characterized by following statements: 'The long-term effects of liberalization on the choice of low-carbon technologies will depend on the level and predictability of the subsidy they receive', and 'It is clear that liberalization across Europe does not stand in the way of differences of national emphasis on renewable policy' [Jamasb and Pollitt, p.36]. The statements suggest that the link between liberalization and the development of renewable energy has been weak. In addition, as different countries have liberalized their electricity sector differently, the (weak) effects of the liberalization on the development of RES-E were different too. Because liberalization occurred over a long period (the discussion lasts 20 years; in most countries the reforms are undertaken since 10 years) it is difficult to identify the base-line, i.e. how would RES-E have developed without liberalization. When the baseline is fuzzy, hard conclusions on the effects of liberalization are even more difficult to state.

For discussion purpose I identify some generic positive and negative effects of liberalization on the development of RES-E in Europe.
At the positive side:

- *More public awareness about electricity supply affairs*. The liberalization process has raised the public and political interest in the structure and working of the electricity industries in the various member states. By this enhanced interest some countries have found out that the availability of some independent regulatory capability is worthwhile or necessary. Other countries learned that the production mix can be more varied than only the national champion technology. And more countries found that their electricity companies had evolved into lame ducks specialized in gold-plating and wining and dining. Past evolutions and incumbent positions were challenged by other models and by other technologies, and by competitors from abroad.
- *Modest development of independent regulatory capability*. Very few European nations had developed real independent regulatory capacities (as e.g. the US public utility commissions offered). Although the way to go is still long, some countries have set up progressive experiments with an open mind to alternative solutions.
- *Expansion thrift in large-scale coal and nuclear plants checked.* The growth of the power sectors in the 1950-1990s was based on a rushed construction of ever larger base-load plants to meet expansionist forecasts in demand for power. Externalities of all kind were rolled-off on present and future societies. The expansive construction of base-load capacities pre-emptied the balanced development of electricity efficiency, renewable sources and distributed solutions in general. A variety of factors next to liberalization contributed in choking this expansionist

behavior. But also the liberalization process in particular tested nuclear investments on their market congruency, and halted further too blunt state supported projects, e.g. in the use of particular domestic fuels (coal) or technologies (nuclear).

- *Adoption of a specific renewable energy directive*. After the adoption of the 1996 directive on the internal electricity market, the EU commission felt the need to complete the regulatory job with complementary directives on renewable energies, CHP and energy efficiency / services. Although the link among the directives may be weak, the pressure to adopt the latter three directives after the internal market one was published in February 1997 was real. For some countries the renewable energies directive felt short of their expectations and ongoing plans, but for others the statement of the indicative targets has triggered processes to develop renewable resources.

At the negative side:

- *The disintegration of many local public utility companies*. A normative view on the structure of the European electricity sector and on paths to more sustainable futures, assigns local energy utility companies important roles in overcoming or attenuating barriers towards more energy efficiency and more RES-E deployment. The particular roles of local utilities imply locally integrated resource planning with full priority for energy efficiency and distributed generation. From the policy side the utilities have to be regulated tightly, on the one hand by incentive regulation rewarding efficiency and RES-E success and penalizing growth in sales of non-sustainable supplies, on the other hand by conduct regulation. Positive stimuli are also expected from procedures empowering end-users in filing claims and in getting payment for shortcomings in service by the utilities. In most countries the liberalization has worked in the opposite direction. Local utilities are split up, disintegrated, reformed to commercial entities making profit by boosting sales of whatever can be sold.
- *The golden calf of low electricity prices*. Next to assessed levels of monopolistic power in the member states' electricity markets, the height and evolution of electricity prices in the various member states, is the final test of liberalization success (Jamasb and Pollitt, 2005; Joskow, 2003). Such price analyses and comparisons are mostly forgetting about the diversity in natural resource endowments, subsidy regimes, inherited assets, etc. Most importantly there is an almost total neglect of incorporating the full external costs in the kWh price, because the market myopia does not consider global long-term impacts. Because the present unsustainable development is to a large degree the result of low energy prices fueling an ever increasing expansion of production and consumption systems, our argument is that only ever increasing energy end-use prices[2] can pave the way for a sustainable future. This argument is developed in the next sections.

[2] Arguments for high end-use prices are not in conflict with arguments for low generation and delivery costs as a result of improved productive and allocative efficiency. The gap between low costs and high end-use prices must be filled by taxes that express the distance between the actual development of the economy (mostly neglecting externalities in particular the ones with global and long-term impacts) and the targeted sustainable development. Because such taxes will generate significant cash it is necessary to rebound the income back in the economy by reducing taxes on goods and raising R&D and other public good spending.

IV. Electricity Backstop Supply Sources for a Sustainable Future

In the high days of the first oil crisis Nordhaus [1973] introduced the concept of a backstop supply technology. By definition such technology can deliver an unlimited amount of energy at a given high/very high cost. In 1973 all focus was on energy exhaustibility, sustainability being at that time the concern of academic and societal minority groups. Nordhaus described nuclear power with breeders, followed up by fusion, at that time as the evident backstop candidate.

Because today the exhaustibility issue is complemented by the discussion about a sustainable development including next to economic also democratic, environmental and social concerns [WCED, 1987], one adds "globally accessible", "environmental benign" and "low-risk and affordable" to the "unlimited" property of backstop supply solutions. Today, nuclear power fails on the criteria to pass the test as a reliable backstop technology (Turkenburg, 2004), as commented in table 1.

Table 1: Evaluation of nuclear power on the criteria of backstop supply technology

Criteria	*Nuclear power performance*
Unlimited	Nuclear power on earth can be considered as an unlimited resource only when *fusion* will be technically, economically and safely possible. The second best unlimited nuclear source (*breeders*) has failed the demonstration tests. The once-trough use of uranium in fission processes will exhaust the recoverable reserves.
Globally accessible	The huge capital and technology intensity of the nuclear option makes this option inaccessible for developing economies. In addition, *proliferation* of know-how and nuclear capabilities creates a more dangerous world than the containment and reduction of its spreading.
Environmental benign	Nuclear power is almost carbon free, and other emissions in the air are not zero but not as massive and diverse as from fossil fuel combustion. Release of radioactive isotopes is a constant source of contamination, but significant releases only happen by accident.
Low risk	Given the probability of accidents, and given the – from a human perspective – eternal lifetime of radioactive waste, nuclear power is not without risks. Some will consider the risks as minor, some as huge. Risk perception and assessment are very personal matters, and therefore one should call upon societal risk processing institutions and procedures, i.e. the insurance sector. However, given that the risks of nuclear accidents and the eternal horizon of nuclear waste fall out of the range accepted by underwriters, it is difficult to argue that the societal risks of nuclear power are minor, and should be accepted by the present and future generations.
Affordable	Safe nuclear power always will be expensive, but when societies accept particular kinds and levels of risk, large amounts of nuclear power can be generated at affordable resource costs. These costs however neglect the externality costs of major accidents and of the eternal concern for the high-level waste. Even our instruments to assess such costs fall short.

Renewable electricity sources are arguably the only candidate for passing most of the criteria of the sustainable backstop supply technology, except perhaps for the aspect of financial affordability when compared to the present low prices of fossil and nuclear power. E.g. photovoltaic power is unlimited as long as the earth circles the sun but expensive to collect, convert and store, as several other renewable power resources are (wave, tidal, wind, small hydro, biomass).
Let us assume that the cost price of the kWh form the renewable backstop technology equals $0.40/kWh in 1995 prices [UNDP 2000, p.16][3]. This conservative position is the outcome of the interaction of opposite forces. On the one hand *technological progress* will increase the performance and lower the investments in renewable energy appliances (wind turbines, PV cells, hydro stations, etc.). On the other hand the *full phasing out of cheaply priced fossil fuels* will raise the costs to provide goods and services in the economy, also the costs of constructing, placing and operating renewable energy installations. When in addition renewable sources must take care also of ancillary services in a continuous supply of power, the cost of the average kWh delivered by a full or almost complete renewable electricity system will remain at the high end.
The crucial and ultimate question about RES-E remains: **is an almost complete RES-E backstop supply affordable?**

V. Affordability of an almost complete RES-E backstop supply

"Affordable" is a loose concept, depending on people's willingness to pay, itself dependent on income (ability to pay), preferences, customs, etc. Considered from a more societal point of view and limited to the power supply issue, one can define affordable as what consumers are used to pay for the current. Households, industries, organizations and whole countries consider the bills of goods and services acceptable as long as the share of their budget they must spend on continuing their consumption patterns remains about constant.

This is investigated for a panel of *high income* OECD nations. The panel data show no correlation between GDP/capita (indicator of income) and electricity intensity. Also all countries have an equal *access* to electrical technologies, but their different intensities show that they make a different use of this access, i.e. the *adoption and implementation* of the various electrical technologies differs, what is for a minor part (about 1/5) due to structural differences and for the major part (about 4/5) reveals differences in end-use efficiencies. Because next to income and technology, price is the third main determinant of consumption and production optimization, the electricity intensities of 14 OECD countries are regressed on the average end-use prices (year 1997[4]). A hyperbolic function

[3] A capacity cost of $5,000/kW is annualized with a 6% annuity, covered by an average annual production of 750 kWh/kW installed. The assumed constant marginal cost of the non-exhaustible renewable supplies does not entail that there are no large quantities of renewable power available at a lower cost.
[4] This is the most recent year with an acceptable number of wealthy OECD members that provide also sufficient electricity price information. Because price regimes and intensity levels do not vary a lot over time within the given countries, regressions on other years deliver similar results, while a pooling of cross-sectional with time-series data did not bring better results.

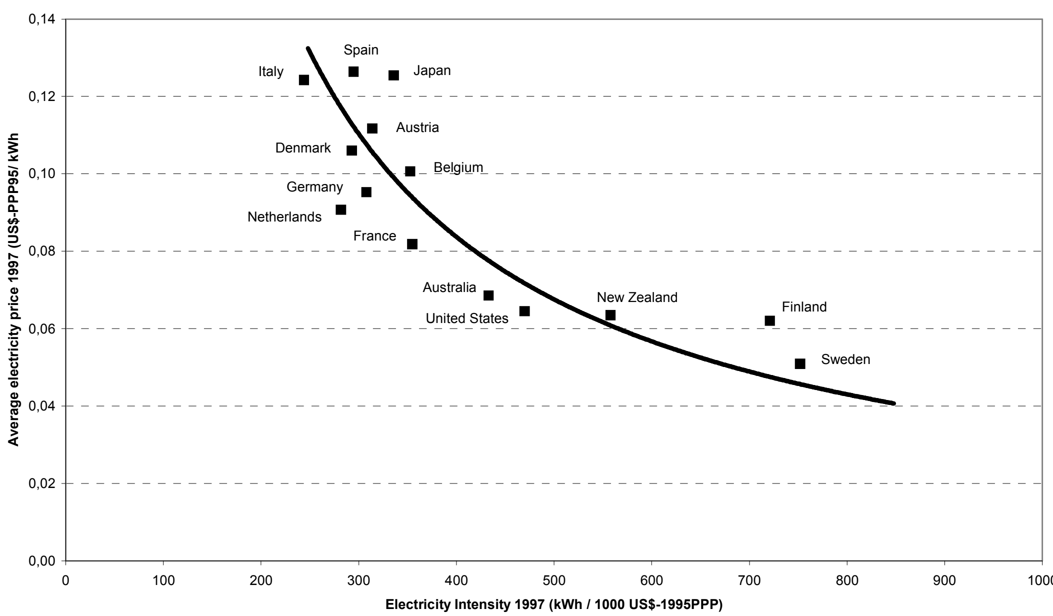
$EI = \alpha.P^{\beta}$ [EI = Electricity Intensity; P = Price] has been estimated, leaving 12 degrees of freedom. Results of the regression are:

Elasticity β		Constant α		R²	Sum Squares of regression
estimate	standard error	estimate	standard error		
-1.04	0.15	3.41	0.37	80	1.28

Figure 4 shows the 1997 observed market equilibriums (squares) in the 14 countries and the fitted curve (solid black line). The statistical results indicate that the assumed hyperbolic relationship between electricity intensity of an economy and the end-use electricity price fits the observed data points well. Deviations from the curve can be seen as the result of e.g. the spread of natural gas distribution in the country, the intensity of government policies in the field of efficiency promotion, etc. The curve approaches the form of an orthogonal hyperbole given the value of parameter β is near to -1.

Given the exclusion of income and of access to technology as explanatory variables, the specification $EI = \alpha.P^{\beta}$ can be interpreted as a *demand curve* where β equals the price elasticity of electricity intensity and the %-share of the GDP that is spent on the electricity bill is given by $\alpha.P^{\beta+1}$. In particular, when $\beta \sim -1$ this 'budget share' is independent of the height of the price and given by the α parameter. With a unitary elasticity countries spend in the long run[5] about equal shares of their GDP on electricity use whatever end-use price levels are adopted.

Figure 4: The 1997 demand curve for electricity intensity (wealthy OECD countries)



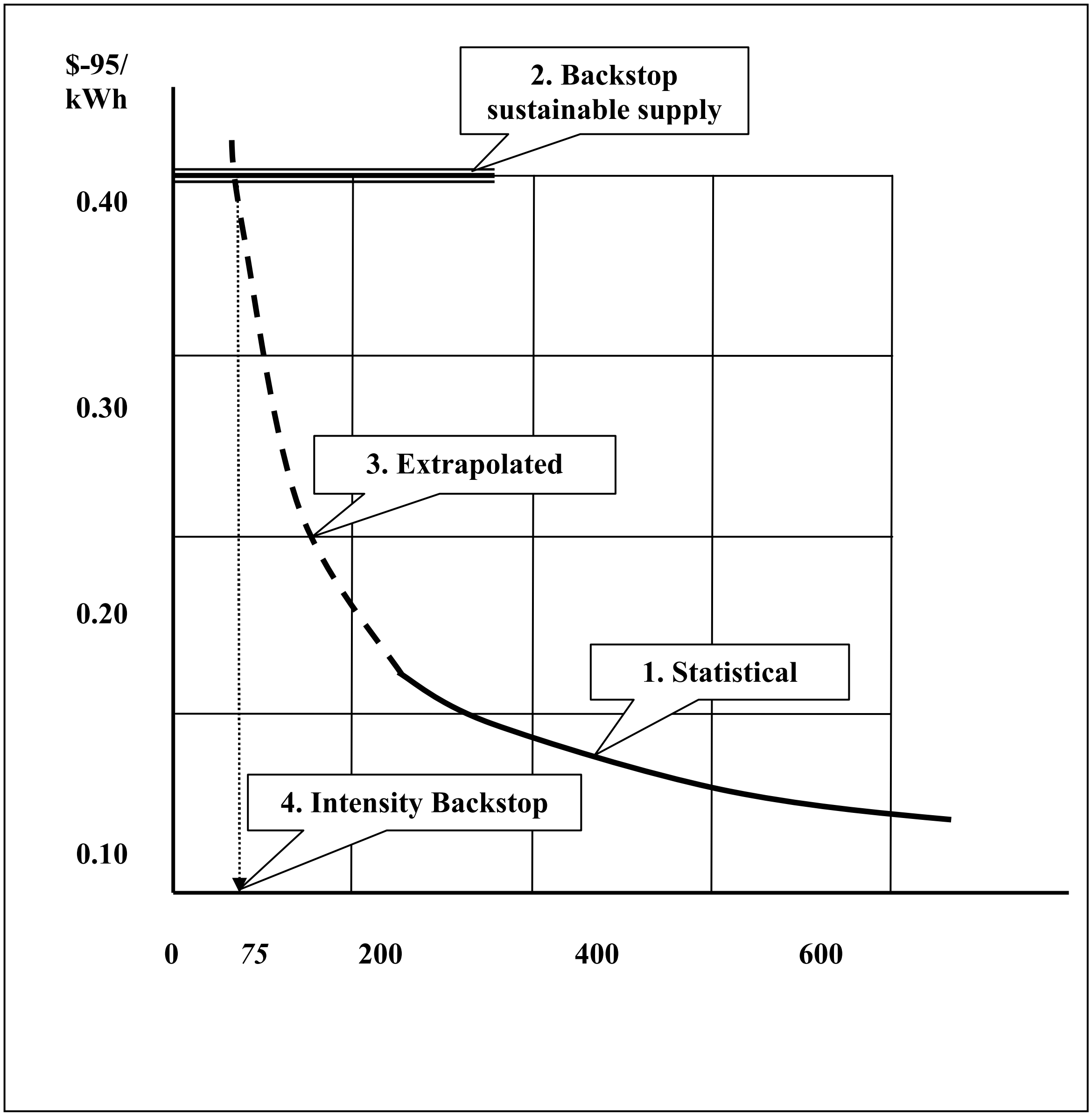
[5] Regression results based on a cross-section sample show long-run effects, i.e. effects after countries have had full time to adapt to the impact of the driving variables.

Analyzing electricity intensity as a "demanded good" is an unusual way of explaining people's real behavior, although this unusual way bridges the gap between on the one hand an inelastic demand for electricity services [light, cooling, entertainment, etc.] and on the other hand obvious indifference of people regarding the physical product kWh [voltage, current, frequency]. While we observe a very inelastic demand for the services providing wealth and comfort, there is no personal interest by people to bother about how many kWhs are consumed by the services [the reality is that the overwhelming majority of the population has not the faintest idea of how much electricity a particular service consumes; even experts don't know well]. While there is no interest in the quantity of kWhs, companies and households are sensible for the height of their electricity bill at the end of the month or of the year. When the bill exceeds expected levels they take measures to lower their consumption of kWh by becoming more efficient. When the bill is low or decreasing they will not care about efficiency because being efficient requires attention, learning, understanding, time and often some specific change in behavior or investment. Mostly the latter efforts and investments are paid back by a decreased electricity bill and several other spill-over benefits (e.g. safer and healthier living climate). The length of the payback period of every efficiency effort depends on the price of the electricity saved, and therefore the demanded intensity depends on this price too. Intensity as a demanded "good" reflects the preference of rational consumers and producers not to bother about efficiency or spillage. Indeed, electricity intensity is a truly neutral variable without passion or personal commitment for the overwhelming majority of people. Here rational behavior prevails and the electricity price balances the rational choice of people between efficiency effort and paying the power supplier.
The rather tight relationship between intensity and price teaches that countries (i.e. their households and companies) will only reach low intensity (high efficiency) if and only if the end-use prices are set at a high level.

Figure 5 brings the backstop supply and demand for electricity intensity together. The statistical demand curve for electricity intensity reveals the long-run behavior of households and companies in high income countries. It shows the likely intensity attained after these had the time to adapt to a given electricity price height.
At the 0.40 $-95/kWh ordinate the constant long-run cost price of a fully renewable electricity supply is shown by the horizontal bar. When this price, well above the market prices we are accustomed to since decades, would be established without time for the economies to adapt, the share of their GDP spending on electricity would more than triple for all economies. This is why at present there is a strong argument against renewable supplies as being economically not affordable. It can also be seen as an argument that our economies are too electric intensive and that the efficiency in using electricity should be increased. However, figure 4 shows that intensity only comes down (or efficiency goes up) when the end-use price stimulates the numerous decision makers – households and companies – to change decisions and behavior.
The statistical demand curve and the backstop supply do not cross, so there is no equilibrium yet. One must extrapolate the statistical demand curve and refer to the literature whether such extrapolation is acceptable. Bottom-up electricity efficiency specialists [Lovins et all, 2002; Hennicke, 2004] argue that the necessary efficiency performance of such extrapolation is feasible, also given the technological development expected. Innovation specialists however also point to the diminishing returns to research in a given

field [Popp, 2002]. In addition the lingering performance of the best practice countries gives food to arguments that some technical ceiling could be hit, i.e. the demand curve cannot be extrapolated far enough because it faces a kink before the backstop level is attained.

Figure 5: Backstop end-use intensity level at given Backstop supply price



A major question remains what attaining the backstop end-use efficiency level costs to the economies of the OECD member states. Will the present situation of countries, companies and households using electricity efficiently not facing (significantly) higher investment costs than the spilling ones, endure into the future? I.e. will technological progress bring timely rescue? Many will argue 'yes, if 50% of the R&D efforts are directed towards efficiency technologies and solutions' [Jochem et all., 2002]. For such redirection to happen an enduring and stepping-up price signal is necessary, one can learn from Popp's analysis [2002].

When the demand curve cannot be extrapolated but is kinked somewhere in the 75 ~ 250 kWh intensity interval, society will face higher electricity budget shares and must transcend the purely technical efficiency discourse. This means also the energy conservation[6] question is addressed when electricity bills are to be ceiled at a constant share of GDP. Physical limits on intensity reduction lift the discussion about energy use to non-energy policies (redirecting social activities and consumption patterns). However, when societies bring up the flexibility to adapt and the technological focus is redirected to efficiency and to the development of environmental benign, low-risk and unlimited supplies, energy and climate doomsday can be removed from the agenda.

Conclusion

"Europe is liberalizing electricity in accordance with the European Commission's Electricity Directives. Different countries have responded differently, notably in the extent of restructuring, treatment of mergers, market power, and vertical unbundling." [Newbery, 2005, p.1]. The actual state is more and more difficult to monitor because more and more relevant information is withhold by the incumbent and powerful players in the field (that looks not really leveled for 'third party access'). Competent energy regulators are still missing in most countries and also at the EU level. Perhaps the prior building up of regulatory capability is a prerequisite for an effective and efficient reform of an activity sector characterized by natural monopolies and public services.

The effects of the liberalization processes on the development of renewable energy in Europe are unequal in various member states. One can identify positive and negative effects. One of the main negative effects is the growing worshipping of the Golden Calf of low electricity prices. This conflicts directly with the necessity of high end-use prices to maintain a sufficient drive for energy efficiency. It is shown that high end-use electricity prices are responded by countries with lower electricity intensities to keep budget shares spent on power bills almost stable. This offers the opportunity to design efficient taxing reforms to improve efficiency and reduce intensity in electricity use so that we can afford an almost complete renewable backstop supply in the future.

[6] Energy or electricity conservation affects the way end use goods and services are delivered or consumed. Conservation eventually requires the reduction of some services. Conservation is not neutral as efficiency is.

References

EU, 2003, Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC, Official Journal of the European Union 15.7.2003, L 176/37-55.
Glachant J-M., Finon D. eds., 2003, Competition in European Electricity Markets. A Cross-country Comparison, Edward Elgar, XXXp.
Hennicke, P., 2004. Scenarios for a robust policy mix: the final report of the German study commission on sustainable energy supply. Energy Policy, Vol. 32, N° 15, 1673-1678.
Jamasb T., Pollitt M., 2005, Electricity Market Reform in the European Union: Review of Progress toward Liberalization & Integration, Special Issue of The Energy Journal edited by Newbery D., pp.11-41.
Jochem, E., et all. 2002. Steps towards a 2000 Watt society. Novatlantis, Forschungs-anstalten im ETH Bereich: PSI, WSL, EMPA, EAWAG.
Joskow P.L., 2003, Electricity Sector Restructuring and Competition: Lessons Learned, Center for Energy and Environmental Policy Research, MIT, 15p.
Lovins, A.B., et all., 2002. Small is profitable. Rocky Mountain Institute, 398p.
Mez L., Thomas S., Schneider M., guest eds. 2006, Energy Policy and Nuclear Power – 20 Years after the Chernobyl Disaster, Special Issue of Energy & Environment, Vol.17, N°3, 208p.
Newbery D. ed., 2005, European Electricity Liberalisation, The Energy Journal, Special Issue, 214p.
Nordhaus, W.H., 1973. The Allocation of Energy Resources. Brookings Papers on Economic Activity, 3, 529-576.
Popp, D., 2002. Induced Innovation and Energy Prices. American Economic Review, March 2002, 160-180.
Turkenburg W.C., 2004, Nuclear Energy and Sustainable Development, International Conference on Innovative Technologies for Nuclear Fuel Cycles and Nuclear Power, IAEA, June 23-26, 2003, proceedings, pp.45-56
UNDP, United Nations Development Programme, 2000, World energy assessment. Joint report with UNDESA-UN Department of Economic and Social Affairs and WEC- World Energy Council, New York, overview, 27p.
Verbruggen A., 1997, A normative structure for the European electricity market, Energy Policy, Vol.25, No 3, pp.281-292
Verbruggen A., 2006, Electricity intensity backstop level to meet sustainable backstop supply technologies, Energy Policy, Vol.34, pp.1310-1317
WCED 1987, Our Common Future, World Commission on Environment and Develop-ment, Oxford University Press.