UNITED NATIONS **E**

Economic and Social Council

Distr.
GENERAL

ECE/ENERGY/2006/4
18 September 2006

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

COMMITTEE ON SUSTAINABLE ENERGY

Fifteenth session
Geneva, 28 – 30 November 2006
Item 7 of the provisional agenda

UNECE PANEL ON REGULATION AND INVESTMENT IN THE ELECTRICITY INDUSTRY

Note by the secretariat

INTRODUCTION

1. Electricity dominates almost all sectors of final energy consumption, with the exception of the transport sector. On the production side, the electricity sector is the main consumer of coal and increasingly a significant consumer of natural gas. Even some quantities of oil are utilized for the production of electricity in a number of countries. Well over 60% of the electricity generated in the UNECE region comes from fossil fuels, the remainder is generated from nuclear power and renewable sources, mainly hydro.

I. PURPOSE OF NOTE

2. Historically, the UNECE has had a region-wide programme on electricity industry issues, which aimed at fostering the development, including the interconnection and integration, of the electricity industries in the UNECE region as well as assisting governments in the development of appropriate government policies and regulation. However, no activities have been undertaken in the field of electricity since the last session of the Ad Hoc Group of Experts on Electric Power held in November 2003 due to the lack of regular staff resources devoted to the programme of work on energy. Even before 2003, work on electricity issues was significantly cut back as a result of the 1997 UNECE Reforms. In view of this and the need to explore all opportunities to

implement the 2005 Work Plan on ECE Reform, the Committee on Sustainable Energy will have to consider whether to restart the programme on electricity and, if so, in what specific areas.

3. With the recent opening up and liberalization of electricity markets and the consequent restructuring of the electricity industries and enterprises in the UNECE region, the complexion and nature of the sector has changed remarkably across the UNECE region. This change has opened up a whole range of issues, which the Committee on Sustainable Energy will need to keep in mind when deciding how to proceed with future work in this area. Those issues, described in more detail in the following paragraphs, include investment, regulation, the use of alternative fuels, competitiveness, the relationship between financial markets and regulation as well as the interaction among various parts of the UNECE electricity market.

4. The short review of selected key electricity industry issues which follows is intended to provide a basis for the UNECE member countries to decide on the mandate and possible future directions of work, if any, of the UNECE in the electricity area. To facilitate that decision, a panel on regulation and investment in the electricity industry will be organized on the occasion of the fifteenth session of the Committee on Sustainable Energy. The Panel session will be held on the morning of 29 November.

II. CURRENT ELECTRICITY ISSUES

5. Unit capital and production costs, the availability and prices of alternative fuels, the evolving market structure, investments and the relationship with financial markets, improvement in cross-border interconnections, CO_2 and SO_2 related emissions, the maintenance or emergence of business-friendly regulatory regimes as well as security of supply are some of the important issues now preoccupying the electricity industry on the supply side. The issues on the demand side, which are equally important for the efficient functioning of the industry, include improvements in energy efficiency, active demand management in particular in the times of consumption peaks, efficient pricing with minimum cross-subsidization, and the creation of conditions for wider consumer choice with low switching cost.

6. Regulation of the electricity industry is one of the most important and complex issues facing power generating, transmission and distribution companies and financial markets. Although most regulatory regimes currently in place are claimed to be efficient and compatible with market mechanisms, these regimes differ widely across the UNECE region.

7. The dissimilar availability of domestic fuels for electricity generation, the different supply/ demand balance outlook and growth prospects across the UNECE region work naturally in favour of different regulatory goals and regimes. This is also the case for countries of the European Union. Some countries such as Germany, the United Kingdom and to some extent France have at least short-term excess generating capacity with relatively low growth prospects, while on the other hand some countries such as Spain and Finland enjoy favourable growth rates leading to the construction of new power plants. Some of the new EU member-countries such as the Czech Republic and Poland are also experiencing significant increases in electricity production and consumption. These differences explain at least in part differences in regulatory goals and practices among EU countries.

8. The significant sub-regional differences regarding the current state and prospects of the electricity industries within the UNECE region are perhaps best seen when comparing the United States and the EU power sectors, two significant and well developed markets. The United States electricity industry, still dominated by coal-fired power plants and characterised by fairly sophisticated federal and state regulation, is by far the biggest electricity market in the UNECE region. Electricity pricing, which is based on a combination of long-term contracts and spot and futures contracts, could be regarded as approximating long-term and short-term marginal pricing which, in theory, should lead to efficient asset allocation and competitive rates of return for invested capital. Generally, both public utilities and privately held electricity operators have been able to maintain acceptable long-term bond ratings which are of paramount importance for the continuous financing of additional power plants as well as additional required infrastructure. But even here in this highly developed and well functioning market, there have been problems as exemplified by the Enron bankruptcy and corporate scandals, involving at least to some extent trading operations in electricity, the 2003 electric power blackout in the eastern part of the United States and Canada and electricity distribution problems in the summer of 2006.

9. On the other hand, the EU electricity sector is much more diverse and under significant structural transformation. EU countries are still adapting, to varying degrees and pace and in different ways, to the opening up and liberalization of electricity markets and to the European Commission's efforts to establish a single efficient internal electricity market, to create conditions for unhindered competition and to find a workable regulatory balance not only between EU-wide regulatory convergence and national regulation but also among the regulatory approaches of individual governments and their regulatory agencies at least on key industry issues.

10. In the rest of the UNECE region, the state of electricity markets, and thus the need for specific regulatory approaches, is even more diverse. It depends to a great extent on the general state of the economy, its growth prospects, the degree of market reforms achieved and the particular historical evolution of each country's electricity industry.

11. In general, the countries of south east Europe suffer from low efficiency in the production, transformation, transmission and distribution of electricity, an outdated stock of power plants, an aging and inefficient transmission and distribution system, inadequate cross-border interconnections and insufficient levels of investment. The current efforts, supported by the European Union, to develop a regional electricity market is a step in the right direction. This needs to be followed up with measures to increase efficiency at all levels of the electricity production, transmission and distribution chain, establishing appropriate economic pricing systems and inducing capital formation and investment. One of the main concerns of the electricity industries in south east Europe are low profit margins and return on investment as well as the relatively difficult overall economic situation in the region.

12. The efforts to create pan-national electricity markets are also under way in Eastern Europe and Central Asia. Two major initiatives, the CIS Electric Power Council, established in 1992, and the Central Asian Coordinating Electric Power Council, set up in June 2005, aim at the creation of regional electricity markets with efficient parallel operation covering almost all of the countries of Eastern Europe and Central Asia, thereby enhancing the potential for increased trade

among the countries. Within that framework, Russian and Kazakh electricity production and consumption grew close to 5-10% in the period 2002-2004 with the expectations that these trends will continue. The expected electricity demand growth in particular in those two countries will require an upgrade of the available electricity infrastructure and the addition of new and more efficient power generating capacity. The large Russian electricity utility, RAO UES, plans to invest more than US$15 billion over the next 10 years in the Russian Federation in anticipation of the continued growth in electricity demand. The recently established Energy Community Treaty for south east Europe will also accelerate the creation of pan-national electricity markets and place both opportunities and burdens on the signatory nations. Related to this is one of the first experiments in multi-national energy regulation since the Treaty contemplates establishing a regional energy regulatory board. The Treaty's functions and powers are being currently developed. This major development will have a significant impact on the formation of electricity markets in the region and on how other major, related issues such as CO_2 emissions, renewable resource development and associated external costs are handled.

13. The most important challenge facing the electricity industries and enterprises in the UNECE region over the last decade has been the opening up and liberalization of electricity markets. Market liberalization has entailed the reorganization of natural gas and electricity markets. On the one hand, governments have had to implement legal and regulatory mechanisms to govern the functioning of markets. On the other hand, the changing nature and character of the marketplace has compelled energy companies to rethink their corporate strategies, operating philosophies and lines of business. In sum, a new set of rules, regulations and norms of behaviour have evolved and, to some extent, are still evolving in the electricity marketplace.

14. This transformation, which is still ongoing, has delivered some of the anticipated benefits of liberalization, namely increased competition and consumer choice. However, other key objectives are still the subject of debate, such as lower electricity costs and prices, the reduction of barriers to entry, full opening of national markets and sustained investment.

15. Market liberalization is also accelerating the race for greater size, and therefore the search by electricity utilities for partnerships, alliances, mergers, acquisitions and/or the creation of national champions. This consolidation trend is being reinforced by the convergence of the gas and electricity sectors, resulting in the emergence of multi-utility companies. In this new competitive environment, the largest operators, capable of spreading risk over a vast and diversified market, seem to be gaining a competitive advantage.

16. While not yet high on the policy agenda of every UNECE member country, the reduction or substantial elimination of CO_2 and other emissions will certainly keep moving up the agenda of UNECE governments, the electricity utilities and energy and electricity regulators. The recent successful introduction of CO_2 trading at the EU level will no doubt encourage its greater use in the future for further emissions reduction. Its introduction has also placed a price on CO_2 emission reductions. The total value of the CO_2 emissions market in EU countries is estimated to have been about seven billion Euros in 2005 with about 360 million tonnes transacted, for an average price of about €19 per tonne of CO_2. It is now clear that under a consistent regulatory framework with much more stringent and significant emissions reductions in the future, that

price could easily reach €50 or more, which ultimately will need to be borne by the final consumer.

17. Finally, consensus on the most suitable regulatory framework and models still needs to emerge from the continuing debate of the cost and benefits of incentive regulation versus traditional cost-of-service regulation.

III. ELECTRICITY PRODUCTION IN THE UNECE REGION

18. The growth of electricity output in the UNECE region averaged about 1.6% per year over the period 2002-2004 with much slower growth in the North America (0.9% per year) than in the European and Euro-Asian parts (2.2% per year). Amongst the largest producers, only Germany (2.2 %) and the Russian Federation (2.2%) recorded growth rates higher than 2% per annum. At the same time, world electricity production rose at an average rate of about 3.8%, more than double the rate of UNECE countries. Of the 9,735 Terawatt hours (TWh) of electricity produced in the UNECE region in 2004, the United States represented 43%, the largest share, the Russian Federation about 10%, and Germany, France and Canada approximately 6% each.

19. Due to the slower growth in electricity output in the UNECE region compared with the rest of the world, its share in total world output fell 2 percentage points over the period 2002-2004, from 58 to 56%. This downward trend is expected to continue for the foreseeable future.

20. The strong growth in electricity demand in emerging economies can best be illustrated with the experience of China. Over the two-year period, 2002-2004, Chinese electricity output rose by almost 540 TWh, which is very close to the total annual production of France (572 TWh in 2004) and Germany (607 TWh in 2004) and 35% higher than the annual electricity output in the United Kingdom (400 TWh in 2004).

IV. ELECTRICITY TRADE IN THE UNECE REGION

21. Following the opening up and liberalization of electricity markets over the last two decades, the importance of electricity trade in particular inside large UNECE countries rose dramatically. National or even regional electricity exchanges were established in a large number of UNECE countries. Typically, the following major products are sold on those exchanges: standardized spot, forward, futures and options as well as clearing for various OTC (over-the-counter) products. While the main purpose of spot contracts is physical delivery a day ahead for both base-load and peak-load, forward, futures and options contracts are almost exclusively used as risk-mitigation and hedging mechanisms with financial settlement where exchanges assume counterparty and financial performance risk.

22. All other trades which do not conform to standard exchange contract specifications are called OTC trades for which selected exchanges provide clearance services. For example, at the Nord Pool exchange, which includes Sweden, Denmark, Finland and Norway in its membership, and is one of the most advanced world power exchanges, the total trading volume tends to exceed annual consumption of electricity by nine times for these four countries. However, because of lack of market confidence and credit concerns, not all exchanges in the UNECE

region are able to handle significant trade volumes such as those handled by the Nord Pool. Another example of the size of the trade in electricity is the power industry in the United States, where the annual trade volume in 2004 was close to 70% of electricity production.

23. The establishment of national electricity exchanges across the UNECE region not only contributed to increasing electricity trade but also to the development and greater use of spot contracts. This may partially be due to the mandatory purchase of renewable and cogeneration electricity or national regulations favourable to exchange sales. In any case, the volume of trade, in particular spot contract sales, at major national European exchanges has increased sharply over the last few years. In terms of trade spot volumes relative to national consumption in 2005, Spain, Italy and the Nord Pool countries had the highest ratio of 95%, 63% and 45%, respectively. Electricity spot trade volumes on exchanges in Germany and the Netherlands were more modest and reached 17 and 14% respectively. The remaining countries still have negligible spot trade volumes on their national power exchanges, including France (4%) and the United Kingdom (3%). At the same time, despite the establishment of, at least, four power exchanges, the exchange-traded electricity volumes in the new EU countries is practically non-existent.

24. Where available, the most sought-after contract on power exchanges in the UNECE region is the futures contract. It is an effective hedging and risk management tool with potential benefits for both electricity sellers and buyers. Once it becomes widely available, including in Spain and Italy where currently only spot contracts are traded, its use is expected to expand quickly. In some countries, such as in Germany and Scandinavia, for historical, regulatory and infrastructural reasons over-the-counter (physical delivery) volumes dominate trading activity.

25. Contrary to the significant trading taking place in natural gas, another industry experiencing market liberalization, electricity trading in the UNECE region has faced a number of obstacles over the last 10 years such as low liquidity, the absence of (significant) formal futures markets and sometimes the lack of a benchmark reference physical price. Regulatory efforts in several countries are under way to address those critical issues.

26. The segmentation of electricity trade has led to sharp differences between the prices for spot and long term sales. This divergence in prices has coincided with the recent large increases in electricity prices following the sharp rise in oil prices. For example, in 2006 retail electricity prices in certain regions of the United States reached unprecedented levels rising to more than 13 cents per kilowatt hour (kWh) for industry and 18 cents per kWh for households compared to the respective national averages of less than 6 cents and 9 cents in 2004 respectively. But on average, electricity prices in the United States have increased only modestly since 1993 when industry and households were paying respectively 4.8 cents and 8.3 cents per kWh.

27. Electricity prices also rose across Europe and Euro-Asia in 2005 in response to rising oil prices. For example, the unweighted exchange spot price in EU countries rose on average 57%

in 2005 while the volume-weighted price climbed 21 per cent.[1] European spot and retail electricity prices continued to rise during the first half of 2006.

V. OPENING UP AND LIBERALIZATION OF UNECE ELECTRICITY MARKETS

28. Many UNECE Governments have been actively working to open up and liberalize their national electricity markets, some for more than 20 years. The common wisdom for a long time was that the electricity and natural gas industries were characterized by significant economies of scale giving rise to entry barriers and monopoly power. Hence, governments were obliged to directly intervene in those industries either through regulation or direct state ownership. Over the past 20 years, there has been a gradual paradigm policy shift to the view that the electric power generating and marketing functions could be liberalized and subject to competition while the transmission and distribution functions had to continue to be regulated, albeit subject to new forms of regulation (e.g., through independent regulatory bodies). While there has been considerable progress in this area, tariff and price regulation has remained a controversial issue despite more light-handed regulatory attitudes either through the introduction of price caps or incentive regulation compared to the more traditional rate-of-return or cost-plus regulation.

29. The main objective for liberalizing energy markets is to promote increased economic efficiency in the marketplace. From a public policy point of view, it is important that resources are efficiently allocated in the economy, that consumers have as much choice as possible in terms of the different fuels and sources of supply, and that consumer prices are stable and "fair", that is, free from undue market power. From the perspective of a supplier of energy, such as a private energy company, it is important that energy prices are sufficient to attract investment for the continued development of new supplies, and that the market penetration rates of the different fuels and supply sources are not hampered by artificial hindrances or barriers to entry.

30. The benefits of opening up and liberalizing electricity markets in the UNECE region are difficult to fully assess at this time. Given the changing trends in international energy markets, including high and volatile energy prices, it is not obvious how market liberalization has affected the evolution of electricity costs and prices. Equally, it is not clear whether the new restructured electricity industry will be in a better position to undertake the significant investments that will be required to either replace the existing, aging power plant stock or bring on stream new additional capacity in a timely fashion. This is particularly important in countries, such as the United States, where power plant construction is financed directly through financial markets by the issuance of bonds and where a predictable business and financial climate is a condition sine-qua-non for a solid credit rating.

31. Due to historical, political and resource endowment and regulatory reasons, the fuel mix for generating electricity in individual countries in the UNECE region varies greatly. In some countries, coal still represents the largest share of generating capacity (United States). In others, it is nuclear (France) or natural gas (Russian Federation). Even oil is used in some countries to

[1] Average for exchanges in Scandinavia, Germany, Spain, Italy, Netherlands, France, United Kingdom and Austria.

generate electricity (Italy). No doubt, the future evolution of regulatory regimes in member countries will continue to influence the choice of fuel mix for new electric generating capacity.

32. Although natural gas-fired power plants currently enjoy a competitive advantage in many UNECE countries, the future fuel-mix for replacement and new capacity is uncertain. Despite the renewed interest in nuclear power, it appears that nuclear power plants still face cost challenges for the generation of electric power because of high up-front capital costs and the long lead times required to obtain regulatory approval. More reliable information on the competitiveness of nuclear power plants will be available once the several plants currently under construction come on stream. Capital costs can run up to US$3,000 per kWh of installed capacity of a nuclear power plant compared to typically US$600-700 per kWh for combined cycle gas-fired power plants.

33. While less expensive in terms of capital investment, conventional coal-fired power plants with efficiency rates in the mid-thirties or low-forties will increasingly become unacceptable for environmental reasons. Efforts to raise efficiency levels above 50% and to internalize in particular the cost of CO_2 emissions, through CO_2 capture and storage for example, will require significant additional capital investments and entail higher operating costs.

34. While gas-fired power plants currently enjoy a clear competitive advantage in terms of initial investment costs, their operating costs tend to be higher than that for nuclear power plants and to some extent coal-fired power plants. The cost of natural gas, which continues to be linked to oil prices, is a significant element of total operating costs. However, for the time being, despite the relatively high fuel cost of natural gas, investors and operators do not seem to be deterred from continuing to commission gas-fired power plants.

35. As noted above, an important factor that is likely to influence the electric power generating fuel mix is environmental compliance. On this score, both coal and nuclear – but for different reasons – are at a disadvantage. The recent introduction of trading (and therefore pricing) of CO_2 emissions in the European Union clearly illustrates the technological and financial challenges, which operators of coal-fired power plants might face. Although the current price for one tonne of CO_2 emissions of about €25 per tonne is considered fairly low and, therefore, could rise perhaps towards €100 per tonne as more stringent emission targets are set, already at the current level it is affecting the profitability of coal-fired power plant operators. As an example, a recent study by the Royal Academy of Engineering from 2004 estimated that the total cost of generating electricity in the United Kingdom in coal-fired pulverised steam plants would double from 2.5 pence/kWh to 5 p/kWh with a total ban on CO_2 emissions at a cost of £30 per tonne of CO_2. With the same CO_2 emission costs per tonne, gas-fired combined cycle turbine power plants, which were identified as the cheapest source of electricity with costs of about 2.2 p/kWh, would remain the most competitive power source, with additional generating costs of 1.1-1.2 p/kWh.[2] However, it is not excluded that selected new technologies such as carbon capture and storage (CSS) and the related Zero Emissions Platform, supported by the European Commission and expected to deliver commercially viable technology by 2020, could improve the competitiveness of coal-fired plants in the electricity market.

[2] Royal Academy of Engineering, The Cost of Generating Electricity, London, 2004

VI. REGULATION AND INVESTMENT IN THE ELECTRICITY SECTOR

36. According to the International Energy Agency (IEA), if present trends continue, US$16 trillion of investment will be needed globally over the next three decades to maintain and expand energy supply. Power generation, transmission and distribution will absorb almost 60% of this or almost US$10 trillion, equally distributed between generation on the one hand and transmission and distribution on the other. IEA estimates also that some US$4 trillion will need to be invested in the UNECE region over the next 30 years, about equally in generation and in transmission and distribution. Financing this investment will be a challenge. The mobilization of the necessary capital resources will require a business-friendly environment, favourable macroeconomic performance and a regulatory environment that is predictable, fair, transparent and efficient.

VII. ADJUSTMENT CAPACITY FOR DEMAND AND SUPPLY SHOCKS

37. While considerable analysis and attention has been paid to the potential evolution of price, investment and technology in the new regulated framework emerging in the UNECE region, much less attention has been paid to strengthening the adjustment capacity of the electricity industry to various demand and supply shocks and major incidents. The electricity sector has been and continues to be exposed to natural gas and crude oil price shocks, the potential large scale decommissioning of nuclear power plants, the potential future internalization of the cost of CO_2 emissions, the introduction of CO_2 trading schemes and possible credit constraints, such as the credit crunch at the beginning of this decade.

38. Such events can shift the electricity industry's supply curve upwards and thereby reduce potential output at any given electricity price. Additionally, they can compound problems related to the availability of reserve capacity and system vulnerability. In the absence of sufficient capacity to adjust to shocks, the only mechanism left is the price mechanism, which usually implies a significant electricity price rise.

VIII. UNECE Panel on Regulation and Investment in the Electricity Industry

39. The purpose of the Panel is to review and discuss with members of the Committee on Sustainable Energy the most pressing regulatory and investment issues in the electricity industry in the UNECE region. A secondary objective is to help delegates decide on the future direction of UNECE's work in the field of electricity.

40. The following senior corporate and government officials will take part in the panel:

- Mr. Paul Bulteel, Secretary General, Eurelectric, Brussels, Belgium
- Mr. John W. Gulliver, Head, Energy, Pierce Atwood LLP, Portland, United States
- Mr. David Halldearn, Director, European Affairs at OFGEM, London, United Kingdom
- Mr. Sergey Novikov, Director, Federal Service on Tariffs, Moscow, Russian Federation

- Mr. Andrew Steel, Managing Director, Head of Energy, Utilities & Project Finance, Fitch Ratings, London, United Kingdom
- Mr. Branko Terzic, Global & US Regulatory Policy Leader, Energy & Resources, Deloitte Services LP, Washington DC, United States, Chair of Panel
- Mr. Yuriy Udaltsov, Director of Regulatory Affairs, RAO UES, Moscow, Russian Federation
- Mr. Jorge Vasconcelos, President, Entidade Reguladora dos Serviços Energéticos/Energy Services Regulatory Authority (ERSE), Portugal (recent former President of the Council of European Energy Regulators)
- Mr. Helmut Warsch, Senior Advisor, Areva, Germany (formerly Framatom and Siemens)

IX. PROGRAMME OF WORK ON EFFICIENT AND CLEAN FOSSIL FUEL-BASED ELECTRICITY

41. Delegates to the upcoming annual session of the Committee on Sustainable Energy will be asked to consider and decide on the future direction and activities of the UNECE's programme of work on electricity as well as on coal on the basis of proposals presented in the document on the "Response by the Committee on Sustainable Energy to the Work Plan on ECE Reform" (ECE/ENERGY/2006/12). The Panel discussion on regulation and investment in the electricity industry, scheduled for the morning of 29 November 2006, should assist Committee members in this task. Delegates need, additionally, to be aware that those decisions will have to be taken in the light of the Work Plan on ECE Reform, adopted by the Commission on 2 December 2005 (E/ECE/1434/Rev.1). The Committee's proposals will then have to be endorsed by the newly established Executive Committee of the UNECE.