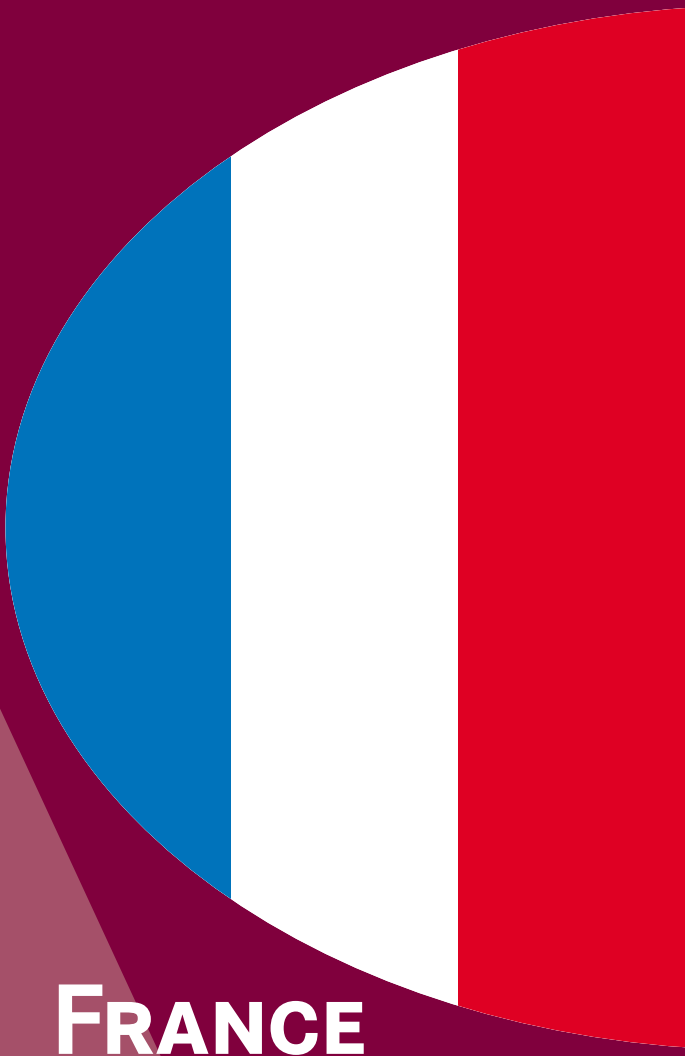
INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries



FRANCE 2000 REVIEW

OECD

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INTERNATIONAL ENERGY AGENCY
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The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-four* of the OECD's twenty-nine Member countries. The basic aims of the IEA are:

- To maintain and improve systems for coping with oil supply disruptions;
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- To operate a permanent information system on the international oil market;
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- To assist in the integration of environmental and energy policies.

** IEA Member countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.*

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- To contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The three main goals of French energy policy are security of energy supply; reduction of environmental impacts, especially mitigation of climate change; and low-cost energy supply. France is poor in energy resources on its national territory and depends to a large degree on energy imports. This has led to an effort to reduce dependence on energy imports and to achieve high levels of security of supply. There is a strong tradition of public service, a notion that encompasses measures taken to counteract market failures in the energy market as well as social, regional and territorial policy objectives.

Under the Kyoto Protocol and the EU burden-sharing mechanism, France is committed to stabilising its greenhouse gas emissions (six gases) at 1990 levels by 2008-2012. This target was set in recognition of the fact that France has low per capita and per-GDP carbon emissions. The country's vast nuclear programme has contributed significantly to this result. With nuclear power providing 40 per cent of Total Primary Energy Supply and 75 to 80 per cent of electricity generation, France has the highest share of nuclear power in the world. The nuclear programme was built up essentially to address the security of supply concerns that were foremost in the national and international debate after the two oil crises. This happened long before climate change became an issue of significant order. Despite the fact that the use of nuclear was not a conscious climate policy decision, nuclear power contributed very significantly to France's favourable position with respect to carbon emissions[1].

The government expects the share of nuclear to decline in future, however, especially since its contribution to the French energy market exceeds the amount considered to be economically efficient. Because of this situation, and even more so because of the continued growth of fossil energy demand, particularly in the transport sector, greenhouse gas emissions will probably have to be reduced by 10 per cent (or 16 million tonnes of carbon equivalent) in 2010. The government has just published a National Programme to Combat Climate Change, setting out a balanced range of measures. These include proposals for significant environmental (carbon) taxation: a first in France. Among the measures are also regulatory instruments and structural measures. The programme would create synergies among the individual measures and allow the stabilisation goal to be met.

Over the last 15 years, France has gradually liberalised its energy markets, beginning with deregulation and privatisation in the oil industry. France's two major oil companies, TotalFina and Elf, both privatised since 1996, merged in Spring 2000 to

1 Nuclear energy of course has environmental implications of its own; these are discussed in the Nuclear chapter.

create the world's fourth-largest oil company. As required by the EU Electricity and Gas Directives, the country is now in the process of opening up its electricity and gas markets to competition.

Implementation of the EU Gas Directive is under way; the government has adopted a draft bill to this effect for submission to Parliament. The degree of gas market opening proposed under the bill is close to the minimum thresholds of market opening set out in the Directive. A number of potential competitors to the state-owned natural gas supply company Gaz de France (GDF) exist, but GDF has a vastly dominant position in the downstream gas industry and enjoys a significant incumbent advantage. Discussions about partial privatisation of GDF were held but called off recently. Despite the scarcity of domestic resources, France's security of supply position in natural gas is rather favourable, due partly to a large amount of storage capacity.

Transposition of the EU Electricity Directive occurred in February 2000. The new Electricity Act liberalises the French electricity market close to the minimum thresholds required by the Directive. The state-owned French power company Electricité de France (EDF) enjoys a very dominant position and a large incumbent advantage, while being very active internationally. It is questionable whether much competition will arise under the Electricity Act. The Act contains a number of trading restrictions and does not address EDF's incumbent advantage. Taking issue with one of the trading restrictions, the European Commission launched a legal procedure against France in June 2000.

The Electricity Act also contains several public service-related provisions, and for the first time provides a legal basis for the policy of geographic uniformity of tariffs. This policy creates distortions in the energy market and it eliminates niche markets for renewables in France's overseas territories where they would be economic.

RECOMMENDATIONS

The government should:

Energy Market and Energy Policy

- ☐ Continue to reform its legislation, procedures and institutions to adapt French energy policy to the challenges of the future, namely competition, energy security and climate change. Solutions to these three issues are complex and far-reaching and require a well-informed, dispassionate public debate. The Government has a key role in ensuring that the public is well informed about the implications of its choices.

- ☐ Pursue its successful strategy of clarifying and defining public service and general interest issues. Extend the strategy to encompass quantification of security and environmental externalities for France.

- ☐ Be prepared to move beyond the minimum thresholds of the EU Gas and Electricity Directives to reinforce the principle of equal treatment.

- ☐ Strive to maintain the momentum in gas market liberalisation, and to achieve transposition of the EU Gas Directive into French law close to the anticipated schedule.

- ☐ Avoid further concentration in the French energy market.

- ☐ Develop fully market-compatible measures to address climate change and energy security concerns, leaving consumers as much choice as possible in how the objectives should be reached.

- ☐ Consider carefully the impacts of geographic uniformity of tariffs. Revise the tariff system to achieve greater economic efficiency and choice for consumers and to facilitate the use of renewables, e.g. by restricting the uniform tariff to network services in existing interconnected distribution grids. Social and regional policy objectives should be pursued through specialised policy instruments.

Energy and the Environment

- ☐ Implement the measures set out in the National Programme to Combat Climate Change swiftly, and according to the anticipated schedule.

- ☐ In particular, implement the measures addressing demand and emissions growth in the transport sector without delay, as these measures will become fully effective only in the long term.

- ☐ Continually monitor the effects of various economic incentives. Adjust and tighten policies in a flexible and market-compatible way if necessary in light of the stabilisation target.

- ☐ Continue to review its energy efficiency and renewables policy with respect to all its main objectives.

- ☐ Continue and reinforce the current priority given to measures, energies and technologies that are effective and low-cost and that have the greatest potential for market uptake.

- ☐ Provide greater continuity and stability to energy efficiency and renewables policies.

☐ Review the biofuels programme with a view to ending tax support as soon as possible.

☐ Review the principle of geographic uniformity of tariffs because it distorts the market and eliminates promising niche markets for renewables in the DOM.

Fossil Fuels

☐ Review its public service approach to the natural gas sector in order to make it compatible with the requirements of a liberalised market and to increase efficiency and flexibility in gas supply.

☐ Ensure that more room is made available for gas supply, transmission and distribution activity by others besides GDF. Abolish GDF's exclusive gas import and export rights. Whereas GDF remains the main actor and instrument for public service in gas, the positive contributions others can bring to the consumer and to the gas supply system should not be disregarded.

☐ Give large gas users or other entities with technical and financial ability the opportunity to build and operate their own gas supply infrastructure and to buy gas via Third Party Access. Greater independence and involvement of the non-GDF-affiliated gas players should be encouraged or made possible.

☐ Be prepared to go beyond the minimum provisions of the EU Gas Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. Allow extensive eligibility for cogeneration. It is important that France keep in step with the European market development, both for France's consumers and for its gas industry.

☐ Retain a role in monitoring and ensuring diversified imports in view of France's gas supply situation. Any measures to this effect should avoid rendering market access for newcomers too difficult.

☐ Make sure storage and other modulation instruments are offered on non-discriminatory and cost-reflective terms. This is vital, given their importance for gas trade and the existing concentration in storage. Part of the existing storage capacity could, however, be reserved for public service purposes like seasonal and operational balancing, safety and strategic storage, in particular for the captive market.

☐ Third Party Access rules for transport and tariffs should be made non-discriminatory and designed to enable access and trade, including secondary trade in commodity and capacity.

☐ Ensure that the regulator is totally independent of the market; the relationship of the regulator with the government should be arm's-length.

☐ Continue the promotion of upstream and downstream integration by pursuing GDF's strategy of acquiring upstream assets and by providing more freedom of action for TotalFinaElf and others in competition with GDF downstream.

Electricity

☐ Actively prepare the way for the French power market to adapt to developments across its borders and world-wide.

☐ Implement the spirit of the Electricity Directive as quickly as possible by putting in place practical arrangements to ensure that suppliers can compete with EDF on fair terms.

☐ Be prepared to go beyond the minimum provisions of the EU Electricity Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. It is important that France keep in step with the European market development – both for France's consumers and for its power industry.

☐ In order to adhere to the principle of equal treatment and to avoid cross subsidies, extend access to the competitive electricity market to all consumers as soon as possible.

☐ Remove uncertainty about the market among potential new entrants by defining and then clarifying by ministerial decree those areas of planning security and transparency which are still obscure.

☐ Work to remove practical and legal barriers to competitors who wish to supply French customers.

☐ Develop and implement pro-competitive mechanisms, through the regulatory structure or otherwise, to address France's public service obligations and aspirations.

☐ Help to remove uncertainty among French consumers and the public at large by informing them fully about the mechanisms available to protect their interests while bringing them the benefits of competition.

☐ Quantify energy security externalities, including those related to the electricity market. In light of the result, review the relative weight given to security of supply externalities on the one hand and competition on the other hand. Review policy measures accordingly.

Nuclear

☐ Maintain nuclear power as an option while continuously observing very high safety standards. Draw upon the experience of other countries concerning nuclear lifetime extensions.

☐ Increase efforts to expose the nuclear generating sector to a competitive environment early and directly.

☐ Maintain safety standards at their current high level and increase their transparency for further improvement.

☐ Work towards developing high-level radioactive waste management, and ensure that this activity is fully funded by nuclear waste producers.

Energy Technology and R&D

☐ Assess the current R&D situation in light of growing competition in the market and new challenges in the energy sector. Study the implications of these developments for the roles of different players in energy R&D and for resource allocation among them.

☐ Establish a three-year national research plan, identifying strategic objectives in the main areas (energy, environment, transport, information technologies). The plan should provide a comprehensive review of all efforts in the field, giving all players an overview of their national strategy and helping to avoid duplication. The research activities of the state-owned industries (EDF, GDF, Cogéma, Framatome) should also be included.

☐ Strengthen the co-ordination among the Ministries of Higher Education and Research, Industry, Environment and Transport in defining and implementing this plan.

☐ Evaluate periodically and systematically the efficiency and effectiveness of government research programmes using independent experts.

RESUME DES CONCLUSIONS ET DES RECOMMANDATIONS

La politique énergétique française vise trois objectifs principaux : la sécurité des approvisionnements énergétiques, la maîtrise des incidences sur l'environnement, et en particulier l'atténuation du changement climatique, ainsi que la fourniture d'énergie à bas coût. La France, très faiblement dotée en ressources énergétiques sur le territoire national, est donc fortement tributaire des importations d'énergie. Aussi s'est-elle évertuée à réduire sa dépendance à l'égard des importations de produits énergétiques et à renforcer considérablement la sécurité des approvisionnements. S'agissant d'un pays où la tradition du service public est solidement ancrée, des mesures sont prises pour amortir les effets des « défaillances du marché » dans le secteur de l'énergie, ainsi que pour servir les objectifs des politiques sociales, régionales et territoriales.

Dans le cadre du protocole de Kyoto et du mécanisme de partage de la charge, la France s'est engagée à stabiliser ses émissions de gaz à effet de serre aux niveaux de 1990 d'ici la période 2008-2012 (cet engagement concerne six gaz), objectif que l'Union Européenne a défini sachant que les émissions de carbone par habitant et par unité de PIB sont faibles en France. Le vaste programme nucléaire français a joué un grand rôle à cet égard. La France, dont 40 pour cent des approvisionnements totaux en énergie primaire et 75 à 80 pour cent de la production d'électricité sont d'origine nucléaire, est le pays où la part du nucléaire est la plus élevée du monde.

Le programme nucléaire avait été conçu essentiellement pour faire face aux préoccupations relatives à la sécurité d'approvisionnement, primordiales dans les débats nationaux et internationaux à la suite des deux crises pétrolières, et ce bien longtemps avant que le changement climatique ne devienne prioritaire. Bien que le choix du nucléaire n'ait pas visé délibérément à appliquer une politique respectueuse du climat, il a été pour beaucoup dans la position favorable où se trouve la France en matière d'émissions de carbone[2].

Le gouvernement escompte néanmoins que la part du nucléaire diminuera à l'avenir, surtout parce qu'elle dépasse, sur le marché énergétique français, le niveau jugé efficient du point de vue économique. Dans ce contexte, et d'autant plus vu que la demande d'énergie fossile ne cesse de croître, en particulier dans le secteur des transports, il faudra probablement réduire de 10 pour cent (soit 16 millions de tonnes d'équivalent carbone) les émissions de gaz à effet de serre à l'horizon 2010. Le gouvernement vient de rendre public un Programme national de lutte contre

2. Bien entendu, l'énergie nucléaire a des répercussions sur l'environnement qui lui sont propres ; celles-ci sont examinées dans le chapitre sur le nucléaire.

le changement climatique exposant un ensemble équilibré de mesures, parmi lesquelles figurent des propositions concernant une écofiscalité (taxe sur le carbone), ce qui est une première en France. D'autres instruments sont prévus dans ce cadre, notamment des mesures réglementaires et structurelles. Ce programme devrait permettre d'atteindre l'objectif de stabilisation grâce aux synergies entre les différentes mesures.

Au cours des 15 dernières années, la France a progressivement libéralisé ses marchés énergétiques, en commençant par la déréglementation et la privatisation de l'industrie du pétrole. Les deux plus grandes compagnies pétrolières françaises, TotalFina et Elf, privatisées l'une comme l'autre depuis 1996, ont fusionné au printemps 2000 pour devenir la quatrième compagnie pétrolière mondiale. En outre, comme l'exigent les directives de l'UE sur le gaz et l'électricité, la France procède actuellement à l'ouverture à la concurrence des marchés électrique et gazier.

La transposition dans la législation nationale de la directive de l'UE sur le gaz est en cours : à cet effet, le gouvernement a adopté un projet de loi dont sera saisi le Parlement. Le taux d'ouverture du marché gazier qui y est proposé avoisine les seuils minimums exigés par la directive. Il existe un certain nombre de concurrents potentiels de l'entreprise nationale Gaz de France (GDF), mais cette dernière jouit d'une position largement dominante en aval de la filière et d'avantages considérables en tant qu'opérateur historique. Des pourparlers avaient été entamés à propos de la privatisation partielle de GDF, mais ils ont été abandonnés récemment. Bien que la France possède peu de ressources gazières nationales, sa position en matière de sécurité d'approvisionnement en gaz naturel est relativement bonne, notamment parce qu'elle dispose d'une grande capacité de stockage.

La transposition de la directive de l'UE sur l'électricité s'est achevée en février 2000. La nouvelle loi électrique opère une ouverture du marché français de l'électricité voisine des seuils minimums requis par la directive. L'entreprise nationale Electricité de France (EDF) occupe une très forte position dominante et elle tire grand avantage de son statut d'opérateur historique, tout en intervenant très activement au niveau international. On peut se demander si la loi électrique laissera s'instaurer une concurrence importante. En fait, elle énonce un certain nombre de restrictions à la libre concurrence et ne s'attaque pas aux avantages dont bénéficie EDF en raison de sa situation d'opérateur historique. Contestant l'une de ces restrictions, la Commission européenne a intenté un recours contre la France en juin 2000.

La loi électrique prévoit également plusieurs dispositions relatives au service public et, pour la première fois, elle jette les bases juridiques de la politique de péréquation géographique nationale des tarifs. Celle-ci crée des distorsions sur le marché de l'énergie et élimine des créneaux spécialisés pour les énergies renouvelables dans les départements d'outre-mer, où ces formes d'énergie seraient rentables.

RECOMMANDATIONS

Le gouvernement devrait s'attacher à :

Marché de l'énergie et politique énergétique

☐ Poursuivre la réforme de la législation, des procédures et des institutions afin d'adapter la politique énergétique française aux enjeux de l'avenir, à savoir l'ouverture à la concurrence, la sécurité énergétique et le changement climatique. Les solutions seront complexes, radicales et appelleront un débat public éclairé et dépassionné. La tâche essentielle du gouvernement est de veiller à bien informer le public sur les conséquences de ses choix.

☐ Continuer à mettre en œuvre sa stratégie de clarification et de définition de la notion du service public (ou de l'intérêt général). L'élargir pour procéder aussi à l'évaluation quantitative des externalités en matière d'environnement et de sécurité.

☐ Se préparer à dépasser les seuils minimums exigés par les directives de l'UE sur le gaz et l'électricité afin d'avancer sur la voie de l'égalité de traitement.

☐ S'efforcer de maintenir le rythme de la libéralisation du marché gazier et accomplir la transposition de la législation communautaire dans des délais proches du calendrier prévu.

☐ Eviter une concentration accrue sur le marché énergétique français.

☐ Mettre au point des mesures parfaitement compatibles avec les mécanismes du marché pour s'attaquer aux problèmes liés au changement climatique et à la sécurité énergétique, en laissant aux consommateurs la plus grande liberté de choix possible en ce qui concerne les moyens à mettre en œuvre pour atteindre les objectifs visés.

☐ Etudier de manière approfondie les incidences de la péréquation géographique nationale des tarifs. Revoir le régime de tarification afin, notamment, d'améliorer l'efficience économique, d'offrir de plus grandes possibilités de choix aux consommateurs et de faciliter l'exploitation des énergies renouvelables, par exemple en limitant la péréquation des tarifs aux services de réseau assurés par les réseaux de distribution interconnectés existants. Pour atteindre des objectifs d'ordre socio-économique, il faudrait plutôt recourir à des instruments d'action spécifiques.

Energie et environnement

☐ Traduire rapidement en actes les mesures décrites dans le Programme national de lutte contre le changement climatique, selon le calendrier prévu.

☐ En particulier, appliquer sans tarder les mesures de modération de la demande et de limitation de la croissance des émissions dans le secteur des transports, qui ne porteront pleinement leurs fruits qu'à long terme.

☐ Assurer un suivi permanent des effets produits par les diverses incitations économiques offertes. Ajuster et renforcer les politiques, en souplesse et de manière compatible avec les lois du marché, si cela s'avère nécessaire pour atteindre l'objectif de stabilisation.

☐ Continuer à réexaminer sa politique en matière d'efficacité énergétique et d'énergies renouvelables en fonction de l'ensemble des principaux objectifs recherchés.

☐ Maintenir et rehausser le rang de priorité accordé aux mesures, aux énergies et aux technologies efficaces et peu coûteuses, qui sont en outre le plus susceptibles d'être utilisées sur le marché.

☐ Veiller à améliorer la continuité et la stabilité des politiques en faveur de l'efficacité énergétique et des énergies renouvelables.

☐ Passer en revue le programme concernant les biocarburants en vue de mettre un terme aux aides fiscales qui y sont associées le plus rapidement possible.

☐ Revoir le principe de la péréquation géographique nationale des tarifs, étant donné qu'il entraîne des distorsions sur le marché et élimine des créneaux prometteurs pour les énergies renouvelables dans les départements d'outre-mer.

Combustibles fossiles

☐ Reconsidérer son approche du service public dans le secteur du gaz naturel pour la rendre compatible avec les exigences d'un marché libéralisé ainsi que pour augmenter l'efficience et la flexibilité des approvisionnements gaziers.

☐ Faire en sorte qu'une plus large place soit concédée à des acteurs autres que GDF dans les activités d'approvisionnement, de transport et de distribution du gaz. Abolir les droits exclusifs d'importation et d'exportation dont jouit GDF. Sachant que GDF reste le principal acteur et instrument de la politique de service public dans le secteur gazier, il conviendrait de ne pas négliger les avantages que d'autres sont en mesure de procurer aux consommateurs et à la filière du gaz dans son ensemble.

☐ Offrir aux gros consommateurs de gaz et à d'autres entités la possibilité technique et financière de construire et d'exploiter leurs propres infrastructures de fourniture de gaz ainsi que d'acheter du gaz acheminé selon le principe de l'accès de tiers au réseau. Il conviendrait d'encourager ou de rendre possibles une plus grande autonomie et une participation accrue des parties prenantes du secteur gazier non affiliées à GDF.

☐ Se montrer prêt à faire plus qu'appliquer les dispositions minimales de la directive de l'UE sur le gaz en ce qui concerne les clients éligibles et l'ouverture

du marché, ce qui profitera tout autant aux gros et aux petits consommateurs. Permettre la reconnaissance d'une large éligibilité dans le secteur de la cogénération. Il importe que la France ne se laisse pas distancer dans la mise en place du marché intérieur – au bénéfice des consommateurs français et de son industrie du gaz.

☐ Continuer à jouer un rôle dans le suivi des importations et à veiller à les diversifier, compte tenu de la situation des approvisionnements gaziers de la France. Toutes les mesures prises dans ce sens doivent permettre d'éviter que l'accès au marché pose de trop grandes difficultés aux nouveaux entrants.

☐ S'assurer que les installations de stockage et d'autres moyens de modulation de la charge soient accessibles dans des conditions de non-discrimination et de vérité des prix. C'est là un facteur décisif, compte tenu de leur importance pour les échanges de gaz et de la concentration actuellement observée dans le secteur du stockage. Une partie de la capacité de stockage pourrait toutefois être réservée pour les besoins du service public, notamment l'équilibrage saisonnier et quotidien de la charge, la sécurité ainsi que le stockage stratégique, surtout pour l'approvisionnement des marchés captifs.

☐ Veiller à ce que les règles régissant le transport et les tarifs dans le cadre de l'accès de tiers au réseau soient non discriminatoires et conçues pour faciliter l'accès et les échanges, y compris dans le cas de transactions sur les marchés secondaires du produit et de la capacité.

☐ Faire en sorte que le régulateur soit totalement indépendant du marché; en outre, le régulateur et les pouvoirs publics devraient entretenir des relations d'égal à égal.

☐ Continuer à favoriser l'intégration en amont et en aval de la filière, en poursuivant la stratégie d'acquisition d'actifs en amont de GDF et en ménageant une plus grande liberté d'action à TotalFina-Elf et à d'autres entreprises qui concurrencent GDF en aval.

Electricité

☐ Lancer les préparatifs qui s'imposent pour que le marché français s'adapte aux situations nouvelles qui se font jour à ses frontières et dans le monde entier.

☐ Faire en sorte que l'esprit de la directive sur l'électricité soit reflété dans la législation française dès que possible, en mettant en place des arrangements pratiques qui permettent à des fournisseurs de rivaliser avec EDF dans des conditions équitables.

☐ Se montrer prêt à faire plus qu'appliquer les dispositions minimales de la directive de l'UE sur l'électricité en ce qui concerne les clients éligibles et

l'ouverture du marché, ce qui profitera tout autant aux gros et aux petits consommateurs. Il importe que la France ne se laisse pas distancer dans la mise en place du marché intérieur – au bénéfice des consommateurs français et de son industrie électrique.

☐ Afin de se conformer au principe de l'égalité de traitement, et d'éviter autant que faire se peut les subventions croisées, étendre à tous les consommateurs l'accès au marché concurrentiel de l'électricité dans les meilleurs délais.

☐ Clarifier la situation sur le marché pour les nouveaux entrants potentiels en définissant, puis en explicitant par décret ministériel, les domaines de programmation dans lesquels la sécurité et la transparence font encore défaut.

☐ S'employer à lever les obstacles pratiques et juridiques que doivent surmonter les concurrents désireux d'approvisionner des clients français.

☐ Elaborer et mettre en œuvre des mécanismes compatibles avec la concurrence pour satisfaire aux obligations et aux aspirations de la France à l'égard du service public.

☐ Contribuer à dissiper l'incertitude chez les consommateurs français, et dans le public en général, par une information complète sur les mécanismes existants pour protéger leurs intérêts et leur permettre de tirer parti des bienfaits de la concurrence.

☐ Chiffrer les externalités liées à la sécurité énergétique, et notamment au marché de l'électricité. A la lumière des résultats obtenus, faire le bilan de l'importance relative accordée aux externalités de la sécurité d'approvisionnement, d'une part, et à la concurrence, de l'autre. Reconsidérer en conséquence les mesures prises par les pouvoirs publics.

Energie nucléaire

☐ Faire en sorte que le nucléaire puisse continuer de faire partie des possibilités énergétiques de la France, tout en respectant en permanence des normes de sûreté très strictes. Tirer profit de l'expérience acquise par d'autre pays qui ont déjà prolongé la durée de vie de leurs centrales nucléaires.

☐ Redoubler d'efforts pour ouvrir, à brève échéance et directement, le secteur de la production électronucléaire à un environnement concurrentiel.

☐ Maintenir la sûreté nucléaire à son excellent niveau actuel et accroître la transparence, condition d'une amélioration supplémentaire.

☐ Œuvrer pour le développement de la gestion des déchets de haute activité et faire en sorte que le système soit intégralement financé par les producteurs de déchets nucléaires.

Recherche et développement

☐ Evaluer la situation actuelle dans le domaine de la R-D compte tenu de la concurrence grandissante sur le marché et des nouveaux défis à relever dans le secteur de l'énergie, pour ensuite en étudier les conséquences du point de vue des rôles que jouent les différents acteurs de la R-D énergétique et de la répartition des ressources.

☐ Elaborer un programme national de recherche d'une durée de trois ans, en définissant des objectifs stratégiques dans les principaux domaines (énergie, environnement, transports, technologies de l'information). Dans le cadre de ce programme, il faudrait procéder à un examen exhaustif des initiatives prises, en brossant à l'intention de tous les acteurs concernés un panorama de la stratégie nationale, ce qui contribuerait à éviter la répétition ou le chevauchement des travaux. Les activités de recherche des entreprises publiques (EDF, GDF, Cogéma, Framatome) devraient être prises en compte également.

☐ Pour définir et mettre en œuvre ce programme, renforcer la coordination entre les ministères de l'Éducation nationale, de la Recherche, de l'Industrie, de l'Aménagement du territoire et de l'Environnement ainsi que de l'Équipement, des Transports et du Logement.

☐ Ce programme devrait faire l'objet d'évaluations périodiques et systématiques par des experts indépendants pour s'assurer de son efficience et de son efficacité.

2

ORGANISATION OF THE REVIEW

An IEA review team visited France in December 1999 to review the country's energy policies. This report was drafted on the basis of information received during, prior to and after the visit, including the French Government's official response to the IEA's 1999 policy questionnaire and the views expressed by various parties during the visit. The main author of the review is Gudrun Lammers. Special thanks are extended to Jochen Hierl, Peter Wilmer and Alicia Mignone for providing decisive input to the natural gas, nuclear and R&D chapters. The team greatly appreciated the openness and co-operation shown by everyone it met.

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The team held discussions with the following organisations:

- The Ministry of Economic Affairs, Finance and Industry
  (Ministère de l'économie, des finances et de l'industrie)

- The Ministry of Physical Planning and the Environment
  (Ministère de l'aménagement du territoire et de l'environnement)

- The Ministry of National Education, Research and Technology
  (Ministère de l'éducation nationale, de la recherche et de la technologie)

- The Ministry of Equipment, Transport and Housing
  (Ministère de l'équipement, des transports et du logement)

- The Parliament (Assemblée Nationale)

- The Interministerial Mission on Climate Change
  (Mission interministérielle sur l'effet de serre, MIES)

- The Regional Directorate for Industry, Research and the Environment
  (Direction régionale de l'industrie, de la recherche et de l'environnement, DRIRE) – Île-de-France

- The Agency for the Environment and Energy Management
  (Agence de l'Environnement et de la Maîtrise de l'Energie, ADEME)

- The French Petroleum Industry Association (Union française des industries pétrolières, UFIP)

- The French Petroleum Institute (Institut français du pétrole, IFP)

- Gaz de France (GDF)

- Electricité de France (EDF)

- The Commissariat à l'Energie Atomique (CEA)

- Cogéma
- The National Agency for Radioactive Waste Management (Agence nationale pour la gestion des déchets radioactifs, ANDRA)
- The Directorate for the Safety of Nuclear Installations (Direction de la sûreté des installations nucléaires, DSIN)
- The Association of Industrial Energy Users (Union des industriels utilisateurs d'énergie, UNIDEN)

3

ENERGY MARKET AND ENERGY POLICY

ENERGY MARKET OVERVIEW

Energy Supply

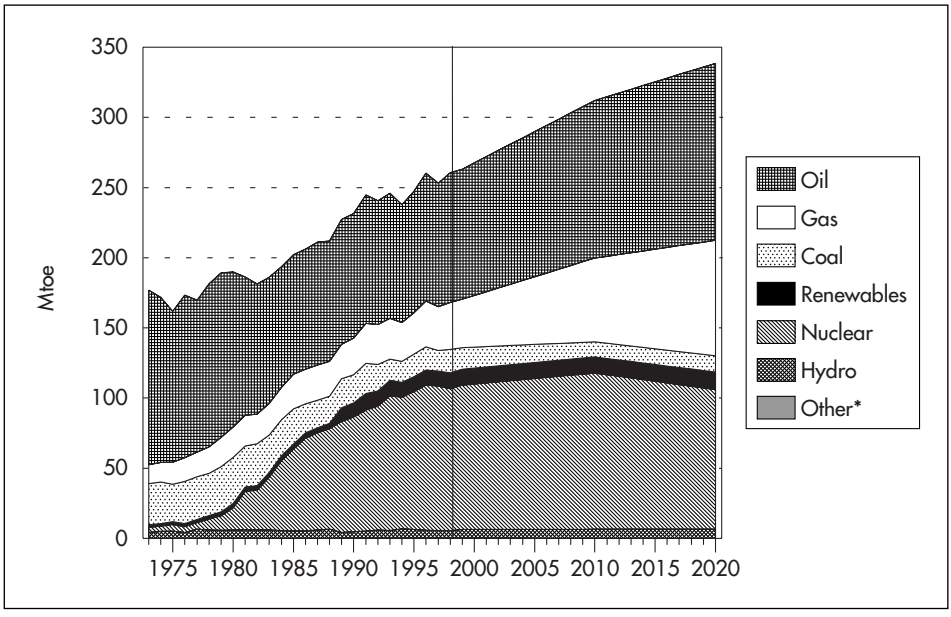
France has few energy resources of its own. All types of fossil resources can be found on French territory, but the quantities are very small. At the end of 1997, remaining resources of oil and gas on French territory were estimated to amount to 13 million tonnes of crude oil, 1.2 million tonnes of natural gas liquids, and 14 billion cubic metres (bcm) of economically viable natural gas. These amounts correspond to 0.01 per cent of world fossil fuel reserves. The only significant resource in France is uranium. France has about one-third of European uranium resources and some 7 per cent of world resources.

France produces about 2.1 per cent of its annual oil consumption, 5.6 per cent of its gas consumption and 22 per cent of its coal use. However, the contribution of indigenous coal is small because coal accounts for only 6.3 per cent of total primary energy supply (TPES). Indigenous production of all three resources has been in decline for at least 10 years, due to depletion and/or unfavourable economics of the resources.

Figure 1 shows total primary energy supply from 1973 to 1998. Primary nuclear energy displaced oil between the mid-1970s and today, bringing nuclear energy's contribution from 2.2 per cent in 1973 to about 40 per cent today and halving the contribution of oil from over 70 per cent to 35-37 per cent. France is the second-largest producer of nuclear power in the world following the United States. The share of nuclear power in power generation stands at 75 to 80 per cent. This is the highest share in the world.

Correspondingly, France reduced its energy import dependence from 81 per cent in 1973 to 50 per cent in 1998. In 1973, the country imported 134.8 million tonnes of oil, 85 per cent of which came from the Middle East and North Africa. Indigenous production was 2.1 million tonnes. By 1998, imports were reduced to 90.5 million tonnes, and indigenous production to 1.7 million tonnes. Significant diversification had occurred with respect to the countries of origin: 51 per cent came from the Middle East and North Africa and 32 per cent from the North Sea. In 1973, coal imports accounted for 16.5 million tonnes, 57.1 per cent of which was imported from Germany. Domestic production was 29.1 million tonnes. By 1998, total imports had increased to 19.4 million tonnes, but domestic production had dropped to 6.1 million tonnes. The import basket was well-diversified with six major and many more minor countries of origin; coal imports from Germany had shrunk to 0.4 per cent.

Figure 1
Total Primary Energy Supply, 1973 to 2020



* Includes geothermal, solar and wind.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

In contrast, natural gas imports quadrupled between 1973 and 1998, reaching 30.1 Mtoe in 1998. Domestic production declined from 6.3 Mtoe to 1.8 Mtoe. Significant diversification of sources occurred: in 1973, almost 82 per cent was imported from the Netherlands, and all of the remainder from Algeria. In 1998, Algeria and Russia both delivered approximately 28 per cent, Norway 30.2 per cent and the Netherlands 13.7 per cent.

Indigenous production and supply of renewables was 16.8 Mtoe in 1998, some 13 per cent of production and 7 per cent of supply, i.e. relatively significant amounts[3]. The largest part (11.3 Mtoe in 1998) came from combustible renewables, especially non-commercial wood combustion, and from hydroelectricity (5.3 Mtoe). Solar, wind and geothermal energy together contributed only 0.2 Mtoe in 1998.

France has 13 refineries and 113 thermal power generating units. More than half of the power plants are nuclear reactors: after the latest reactor, Civaux 4, went on

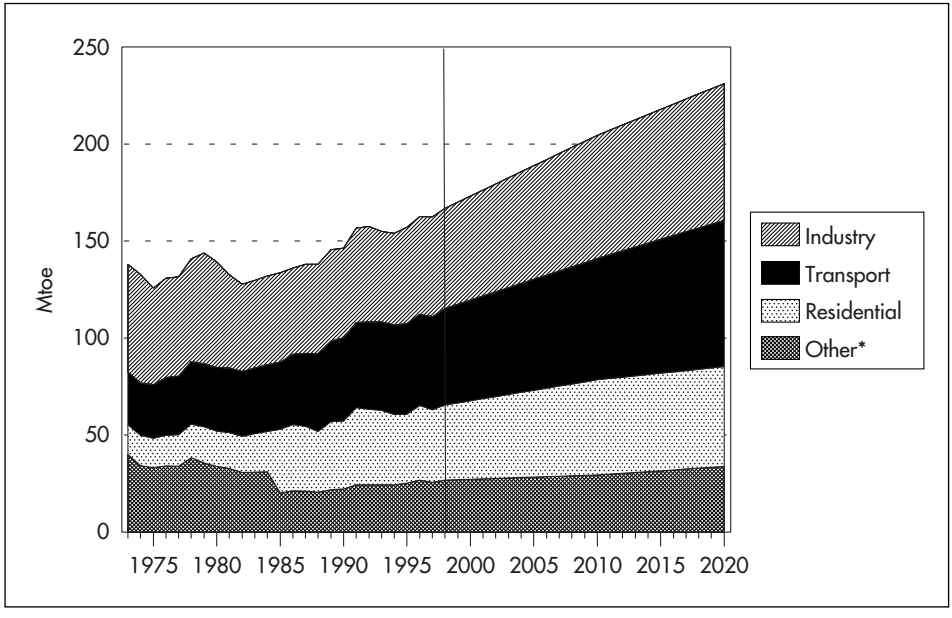
3. These figures would be even larger if it were not for the statistical convention of counting all nuclear heat generation as indigenous. Strictly speaking, this is not entirely true: France imports uranium. However, the ambiguity introduced by this statistical convention is minor, because the entire fuel chain from uranium extraction to fuel fabrication to reprocessing and final storage takes place on French territory.

stream in December 1999, the country had 58 pressurised water reactors (PWRs) in operation at 25 sites. The reactors fall into three groups of almost identical design and capacity: 4 reactors of the N4 series (1,450 MW), 20 reactors of 1,300 MW, and 34 reactors of 900 MW. The other thermal power generating units are 55 fossil-fired plants with capacity between 125 and 700 MW. Coal extraction is currently concentrated in three mines and is scheduled to end in 2005.

Energy Demand

Figure 2 shows Total Final Consumption (TFC) by sector. While industrial energy consumption fell rather dramatically after the two oil crises and has not changed much since, the transport sector has grown rapidly and today accounts for 30 per cent. Transport is responsible for slightly more than half of France's oil consumption, without much scope for substitution.

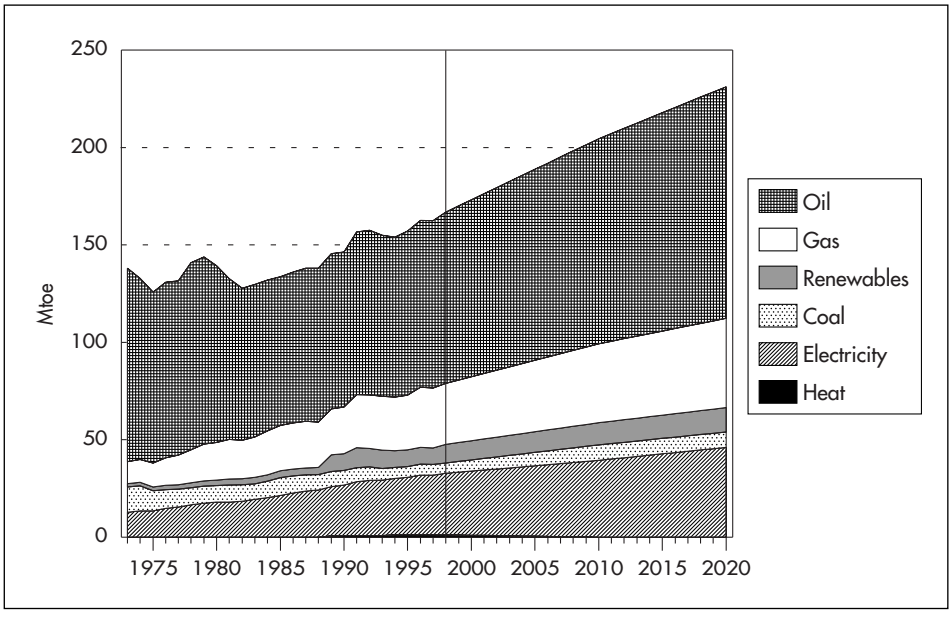
Figure 2
Total Final Consumption by Sector, 1973 to 2020



* Includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

Figure 3 details TFC by energy input between 1973 and 2020. Energy end-use is dominated by oil, which accounted for 52.6 per cent of TFC in 1998. The share of electricity demand in TFC was 18.9 per cent in 1998, slightly above average for IEA Europe (17.8 per cent in 1997).

Figure 3
Total Final Consumption by Fuel, 1973 to 2020



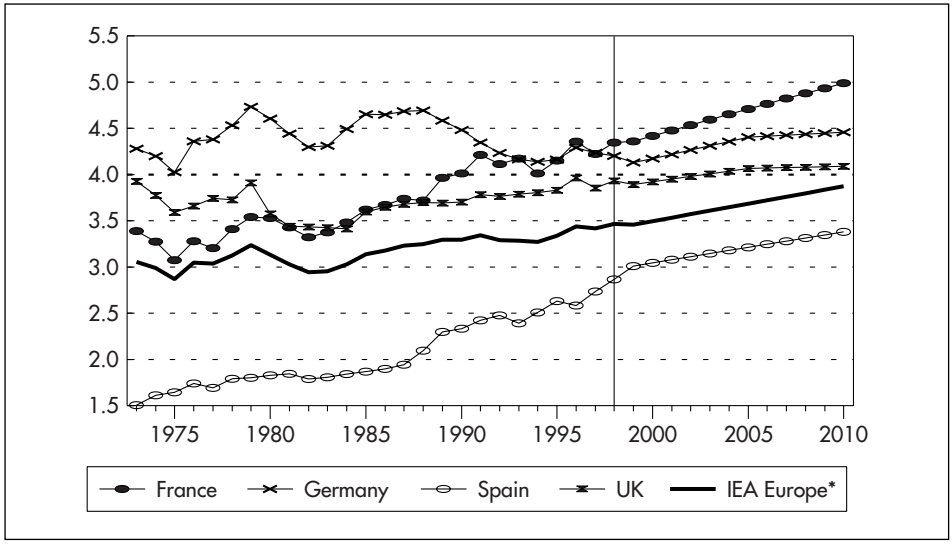
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

Compared to IEA countries as a whole, France has relative low per-capita energy use: in 1997, TPES per capita was 4.22 tonnes of oil equivalent (toe), compared to the 5.1 toe average for IEA countries. However, French TPES was higher than the EU average of 3.4 toe per capita.

At 1.9 toe per thousand US dollars, France's GDP-related energy intensity almost equalled the value for IEA Europe and the IEA as a whole (2.0 toe). As indicated in Figure 5, France's energy intensity has fallen over time, but not as rapidly as in many other IEA countries. The steepest reductions in energy intensity occurred between 1973 and 1982, when TFC fell by 2.2 per cent per annum. From 1982 to 1989, energy intensity reduction slowed to 0.7 per cent per annum. Between 1989 and 1997, energy intensity actually increased by 0.1 per cent per year.

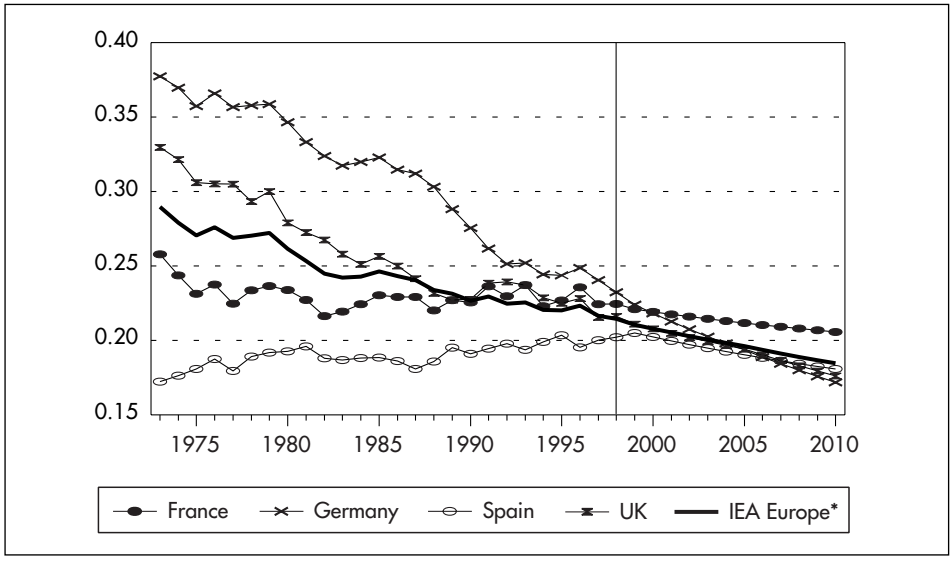
As indicated in Figure 6, energy intensity declined most in the industry sector but only in a very minor way in the residential sector, and it actually grew in the transport sector. While the specific fuel consumption of the overall passenger car fleet declined quite drastically between 1980 and 1992 due to the greater efficiency of newly-registered cars, this effect has levelled off, and has in any case been more than counterbalanced by greater car use. Electricity intensity in France has increased quite substantially, and faster than in other countries, with marked acceleration between 1989 and 1994.

Figure 4
Energy Intensity Per Capita in France and in Other Selected IEA Countries, 1973 to 2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

Figure 5
Energy Intensity Per GDP in France and in Other Selected IEA Countries, 1973-2010
(Toe per thousand US$ at 1990 prices and purchasing power parities)

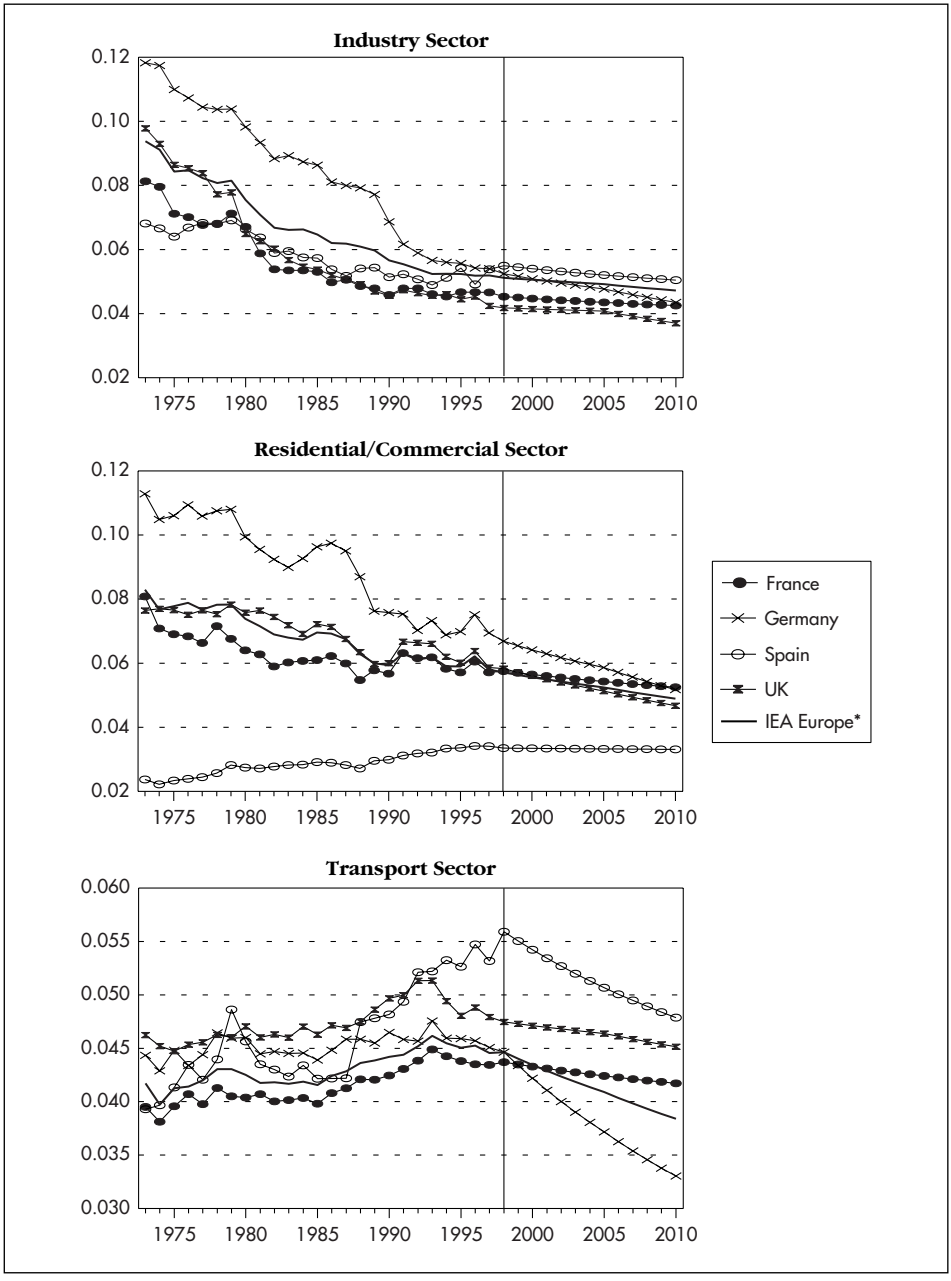


* Excluding Norway from 1999 onwards.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999; *National Accounts of OECD Countries*, OECD Paris, 1999 and country submissions.

Figure 6

Energy Intensity by Sector in France and in Other Selected IEA Countries, 1973-2010

(Toe per thousand US$ at 1990 prices and purchasing power parities)



* Excluding Norway from 1999 onwards.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999; *National Accounts of OECD Countries*, OECD Paris, 1999 and country submissions.

In 1996, the government established a working group called "Energie 2010-2020" to develop a report on long-term energy consumption in France. The group published its report in 1998. This report is not a forecast, given the time horizon to 2020. Instead, it contains three scenarios:

- The market economy (S1). This scenario assumes a reduction of government intervention in the markets and an increase to 12 per cent in the discount rate for investment.
- The industrial state (S2). The underlying assumption for this scenario is policy intervention in the markets with a view to accelerating economic growth and increasing the competitivity of French industry as much as possible within the framework of the EU.
- The state as protector of the environment (S3). In this scenario, the government intervenes rather strongly to protect the local and global environment. S2 and S3 assume an 8 per cent discount rate. Among a host of measures to protect the environment, S3 also assumes CO_2 taxation.

The scenarios were not designed with reference to France's CO_2 commitments under the Kyoto Protocol and the EU burden-sharing mechanism. France is committed to stabilising its greenhouse gas emissions at 1990 levels by the end of the first budget period 2008-2012. Only S3 results in CO_2 emissions stabilisation in 2010.

All three scenarios result in an increase of import dependence, with the most pronounced increase occurring in the S1 scenario. Under the S1 scenario, energy consumption continues unbroken until 2010 the growth trend it has shown since 1983; under S3, growth is almost flat; under S2 growth is between S1 and S3. The use of natural gas and oil products rises significantly under S1 and nuclear generation drops off relatively quickly after 2010, especially if a 30-year lifetime of nuclear reactors is assumed. In all three scenarios, 40 years is the standard assumption for nuclear plant lifetime, with 30 years as a variant. A 40-year lifetime is now the generally accepted hypothesis for the technical and economic lifetime of a nuclear power plant.

In 1999, the government developed a business-as-usual outlook to 2020 to indicate what developments it considers likely assuming no new measures after December 1999 - i.e. only pre-Kyoto policy measures were taken into account. GDP growth is assumed to be 2.3 per cent p.a. on average. The population is expected to increase from 60 million living in 24 million households to 64 million in 27 million households. The average oil price is expected be $17 per barrel until 2010, rising to $25 per barrel in 2015 and remaining stable thereafter. Gas prices continue to be linked to oil prices.

In this forecast, energy demand continues to rise unabated. Nuclear generation declines slowly after 2008, replaced mainly by gas, but still accounts for half of all power generation in 2022. The energy independence ratio drops from its 1998 level of 50 per cent and returns to its 1982 level of 33 per cent in 2022. Annual

CO_2 emissions (expressed in tonnes of carbon) reach 130 million tonnes in 2008 and 140 million tonnes in 2012, 24 per cent and 34 per cent, respectively, above their 1990 levels. In 2022, carbon emissions reach 160 million tonnes.

ENERGY POLICY

Energy Policy Objectives

French energy policy is characterised by three principal objectives. These objectives are set out in numerous legal documents and government policy publications, and have remained virtually unchanged over the last decades. They comprise:

- Security and continuity of energy supply, especially in the long term.
- Economic efficiency and notably low energy prices in order to ensure competitivity of French companies in the world market and employment in France.
- Sustainable and environmentally benign energy supply, especially with respect to climate change. In the context of commitments under the Kyoto Protocol and the EU burden-sharing mechanism, France is required to stabilise its CO_2 equivalent emissions (six gases) by 2008-2012.

Energy policy discussions and energy legislation are often strongly influenced by a fourth policy principle, the public service or general interest principle. The notion of public service has been defined as "any activity the accomplishment of which must be ensured, provided, regulated and controlled by the government because this activity is indispensable to the realisation and development of social interdependence." [4]

This characterisation indicates that the public service principle is open to further definition to make it operational. The government believes that the principle is best defined separately for each market. For electricity, the principle has recently been defined in an operational manner for the first time in the Electricity Act [5]. The Box Public Service - An Operational Definition According to the Electricity Act contains the principles set out in this Act. There are also public service considerations that relate to the natural gas market and the oil market. Balanced regional development, equal treatment of citizens, and universal service play an important part in all public service considerations. In the oil market, for example, public service includes strategic and emergency stockholding and the government's efforts to preserve a minimum number of service stations across the national territory. Public service often also encompasses social policy objectives, such as basic service for the poor (i.e. service despite non-payment).

4. Definition by L. Duguit (1928), quoted from Ministère de l'économie, des finances et de l'industrie: *Énergies et matières premières – regards sur 1998*, Paris, 1999.
5. See the Electricity chapter.

Public Service – An Operational Definition According to the Electricity Act

The notion of public service is defined in Section 1, Article 1 of the "Act Relating to the Modernisation and the Development of the Public Service of Electricity" (Loi de la modernisation et du développement du service public de l'électricité no. 2000-108 of 10 February 2000). According to this definition, the purpose of public service is to guarantee the supply of electricity across the entire French territory, taking into account and furthering the general interest. To this end, public service must contribute to the main objectives of energy policy:

- Independence and security of supply.
- Clean air and the abatement of climage change.
- Optimal development and management of national resources.
- Control of energy demand and the rational use of energy.
- Competitiveness of economic activity.
- Control of future technical choices.

Stricktly speaking, public service is to work towards:

- Social cohesion, ensuring a right to electricity for everybody.
- The fight against social exclusion.
- Balanced regional development, while taking account of environmental protection.
- Research and technological progress.
- Defense and public security.

Electricity is defined as a product of absolute necessity. Implementing everybody's right to electricity, the public service of electricity must take into account the principles of equality, continuity and flexibility (adaptability), under the best possible conditions relating to safety, quality, cost, and price as well as economic, social and energy efficiency. Public service of electricity is to be organised by the government, the communes or their public co-operation organisations, respectively.

In the network industries, public service comprises the principle of geographic uniformity of energy prices (peréquation des tarifs) across the entire national territory, explicitly including the French overseas departments (départements outre-mer, DOM)[6]. Although the geographic uniformity of prices was not provided for in the 1946 Nationalisation Act for electricity and natural gas, this principle ranks high in French electricity policy-making. It is taken to represent the equality of all citizens.

Finally, national sovereignty plays an important role in French energy policy formulation. The country's energy policy-making has always been characterised by a striving to be able to formulate an independent national energy policy. Successive governments have sought to maintain sufficient independence from occurrences in the regional or world energy markets, as well as from, and within, supra-national organisations, to be able to do so.

The optimal response to the combined objectives of low energy prices, energy security and environmental protection has long been seen in France to be the country's vast nuclear programme[7], developed in the context of extensive government ownership in the energy industries and close government surveillance and/or guidance of the markets.

Organisational Structures

Figure 7 provides an overview of the main government bodies involved in energy market shareholding and surveillance in 2000. Despite the large number of organisations involved in energy policy formulation, the main responsibility for government shareholding in the nationalised industries and for control and regulation of the energy markets has traditionally been shared by two different ministries, the Ministry of Industry (before 1998, Ministère de l'Industrie, de la Poste et des Télécommunications) and the Ministry of Finance. In 1998, the two Ministries were merged to form the Ministry of Economic Affairs, Finance and Industry in 1999.

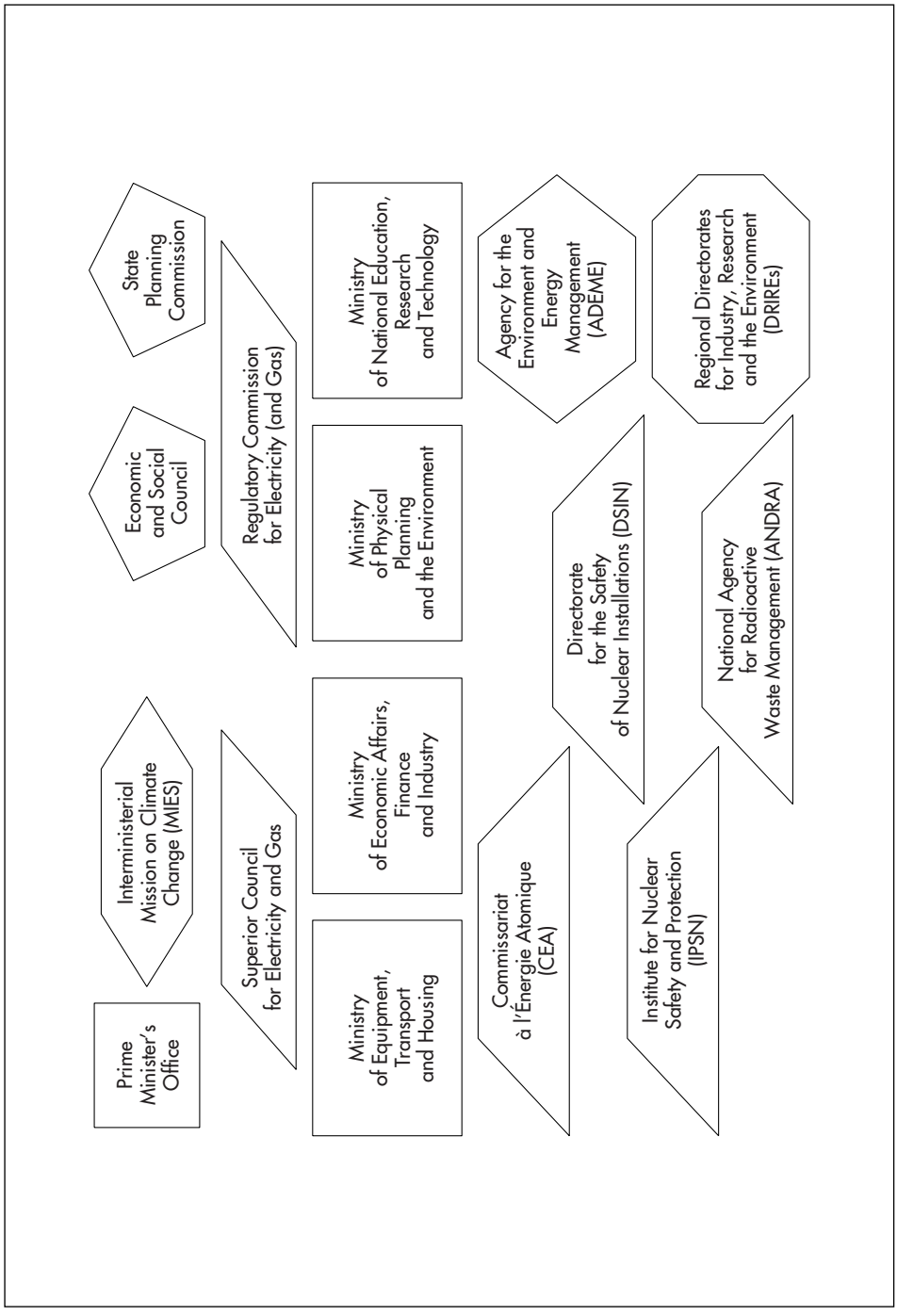
Within the new, merged ministry, the Directorate-General for Energy and Raw Materials (Direction-Générale de l'Energie et des Matières Premières, DGEMP) is responsible for energy policy formulation and supervises other organisations involved in energy. Its present functions are the same as they were in the Ministry of Industry. They include, in particular, surveillance of the nationalised industries. Together with the Environment and Research Ministries, the DGEMP also supervises the Agency for the Environment and Energy Management (Agence de l'Environnement et de la Maîtrise de l'Energie, ADEME) which assists the French government in implementing policies on energy efficiency, renewables and environmental protection.

In particular, the Directorate for Gas, Electricity and Coal (Direction du gaz, de l'électricité et du charbon, DIGEC), and, to a lesser degree, the Directorate for Raw Materials and Hydrocarbons (Direction des matières premières et des

6. France also has overseas territories (territoires outre-mer, TOM), but there the legislation relating to electricity is decided locally.
7. The nuclear programme is described in detail in the Nuclear chapter.

Figure 7

Government Institutions Involved in Energy Policy-Making



Source: IEA.

hydrocarbures, DIMAH), both sub-directorates of the DGEMP, carry out government surveillance of nationalised industries, on whose boards they are represented. The Ministry of Finance was responsible for investment control and price regulation, and its Exchequer Department held the shares of the nationalised industries.

The government organisations mentioned above represent the main channels of government influence, but numerous other institutions are involved in the formulation, implementation and evaluation of energy policy. The Economic and Social Council (Conseil économique et social), a consultative body for economic and social policy established by the French Constitution, has an important role. The State Planning Commission (Commissariat Général du Plan), the body responsible for France's economic planning, and the Superior Council for Electricity and Gas (Conseil supérieur de l'électricité et du gaz), a consultative body which advises the government on its surveillance of the gas and electricity industries, are also involved. The Government Accounting Office (Cour des Comptes) occasionally issues an opinion on the efficient use of state spending for energy projects and organisations as well.

In addition, 22 regional Directorates for Industry, Research and the Environment (Directions régionales de l'industrie, de la recherche et de l'environnement, DRIRE) report to the Ministry of Economic Affairs, Finance and Industry as well as to several other Ministries, and play a role in energy policy implementation. They focus on authorising low-voltage power line construction, technical control of combustion facilities and lending technical support to the implementation of regional energy plans carried out by regional councils. The DRIRE were created through a 1982 law designed to decentralise certain government functions; their role appears to be slowly expanding. Under a 1995 law relating to collective energy services (schémas de services collectifs énergie), the elected representatives of the regions, together with the central government, define for 15 years:

- objectives for the use of local resources.
- forecasts for local energy consumption and production as well as the corresponding infrastructure needs.
- regional policies relating to energy conservation and the use of renewables.

The DRIRE assist in the implementation of these programmes.

Under a law passed in July 1998, the DRIRE establish gas supply plans for those regions which are not yet covered by the gas distribution network. In those municipalities where such a supply plan has been established, GDF must begin laying pipes within three years. All other municipalities are free to contract for the construction of a gas supply network with private companies, which need to be registered with the Ministry. Also based on the regional plans, a national gas supply plan was adopted on 3 April 2000. Based on this plan, the non-nationalised gas distributors must begin laying pipes within three years.

Since the mid-1990s, there has been striving for more transparency, accountability and democratic control in the process of energy policy-making. Among other things,

the 1994 Souviron report, named after its rapporteur, suggested that experts' committees should be established to supervise EDF's activities and that transmission line construction should be subject to review by the regions. The Mandil report, also issued in 1994, focused on the future functioning of EDF and suggested the creation of a regulatory authority and introduction of some competition into the electricity market. Meanwhile, France has transposed the EU Directive on electricity into French law and is developing similar legislation for the gas market. Many of the recommendations of the Mandil report were put into practice. The new Regulatory Commission for Electricity (Commission de régulation de l'électricité, CRE), is about to receive a role in price and investment control in the electricity market. It will, in due course, also perform regulatory functions in the gas industry.

The structure and functions of the government bodies exerting control over the new competitive markets have not yet been fully adapted to the new situation. A large body of secondary legislation is needed to define the functioning of the competitive electricity market. By the end of April 2000, only two Ministerial decrees had been issued, but at the end of September 2000, significant progress had been made with the issuance of more than ten ministerial decrees and decisions laying down rules for the functioning of the regulator and other institutions, criteria for eligibility and modified procedures relating to operating licences for power generation equipment. The members of the regulatory commission and other institutions have also been nominated. Further adaptation of governmental institutions to the new market is necessary.

ENERGY MARKET STRUCTURE

The French oil industry is now completely privatised. Nevertheless, the French energy market overall is still characterised by extensive government ownership. This includes full ownership of the electricity company Electricité de France (EDF), the gas company Gaz de France (GDF), the coal mining company Charbonnages de France (CDF) and the Commissariat à l'énergie atomique (CEA), a research institution that played an extensive role in developing French reactor designs and the nuclear programme in general.

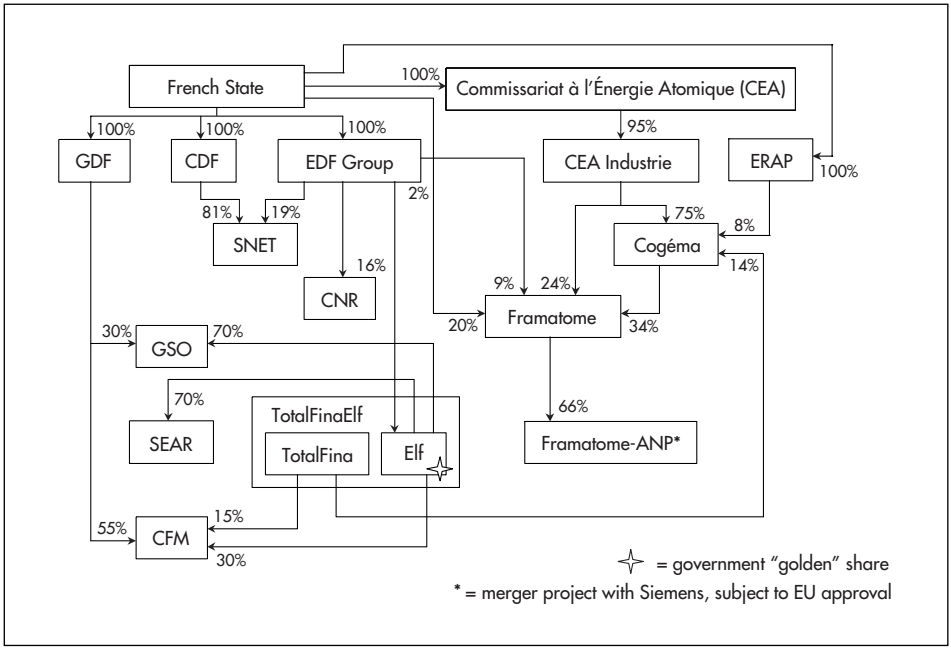
In recent years, the government has taken steps to privatise part of its holdings in the energy sector. Notably, the government has sold its stakes in the French oil industry. In February 1994, the government reduced its shareholding in the oil and chemicals group Elf Aquitaine, France's largest industrial company, from 51 per cent to 10 per cent. The remaining stake in Elf was sold by 1998. In the mid-1990s, the government also reduced its ownership in France's second-largest oil company, Total, from 34 per cent (1991) to 5 per cent in 1995 and 0 per cent in 1996. In November 1998, Total and the oil corporation Petrofina announced their intention to merge. The resulting conglomerate, Totalfina, announced its intended merger with Elf on 13 September 1999. This merger created TotalFinaElf (TFE), the fourth-largest oil company in the world. The merger was examined by the European Commission and was approved in February 2000. The French government does not hold shares in TFE, but maintains a "golden" share in Elf.

The government also holds stakes in the nuclear industry through the CEA and its subsidiary CEA Industries, especially in Cogéma, the company responsible for the nuclear fuel cycle, and Framatome, the nuclear reactor construction company. In 1993, the government had already sold an 11 per cent stake of Cogéma to Total. Now, it has announced its intention to sell 20 per cent of Framatome, to be floated on the Paris stock exchange. Figure 8 illustrates government ownership in the energy market in 2000.

Further changes in the French energy market lie ahead. After transposition of the EU Electricity Directive in February 2000, the government is currently in the process of transposing the EU Gas Directive. Transposition was due in August 2000, but is delayed.

Regarding liberalisation of the gas industry, the Government believes that the future position of GDF in the European market has to be consolidated. GDF is in the process of acquiring upstream interests and expertise and has plans to seek upstream partners abroad. The merged TotalFinaElf group itself holds sizeable assets in the Compagnie Française du Méthane (CFM) and Gaz du Sud-Ouest (GSO), GDF's main potential competitors in the gas supply market, which together supply some 9 per cent of the market.

Figure 8
Government Shareholding in the Energy Sector



Source: IEA.

ENERGY TAXATION

There are currently two main strands of reform in energy taxation in France: one relating to a re-balancing in the taxation of automotive fuels and the other to increasing taxation of environmentally harmful activities in the energy market, including a possible scheme on the European scale.

The background to the re-balancing of oil product taxation, especially automotive fuels, is the following. French taxes on automotive fuels are comparatively high across the board. Beginning in the early 1980s, taxes on gasoline were increased at high rates, whereas taxes on automotive diesel were raised much less in order to protect the competitive position of French road hauliers. The largest increase occurred in an excise tax on oil products named TIPP (taxe intérieure sur les produits pétroliers), which in 1999 was between FF 384.62 and FF 415.60 per 100 litres of gasoline (premium), compared to FF 248.16 per 100 litres of diesel. Overall, pump prices of gasoline contain a tax share of 78% per cent, whereas automotive diesel has a tax share of 72% per cent. As a result, the tax differential between gasoline and diesel is the highest in any IEA country. 1999 tax revenues from the TIPP were FF 160 billion; this is the fourth-largest source of government revenue in France, larger than revenues from income tax.

The tax differential has affected vehicle purchases and since the early 1990s, diesel consumption has exceeded gasoline consumption. This has led to an increasing discrepancy between oil product demand and refinery output in France. In 1999, 25 per cent of France's diesel consumption had to be imported, whereas its excess gasoline production (29 per cent of French gasoline production) had to be exported.

In light of the unfavourable economic impact of the tax differential on French refineries and in response to increasing concerns regarding the health impact of diesel engines, the government decided to reduce the tax differential to the European Union average of FF 93 per 100 litres within seven years. The first step was taken in January 1999, when excise taxes on diesel and on leaded gasoline were increased more than those on unleaded gasoline (premium) which were kept constant: the maximum TIPP on gasoline (premium) was raised to FF 417.68, but the TIPP on diesel rose to FF 255.18. This led to a reduction of the differential by FF 5 per 100 litres.

However, in September 2000, high oil prices led to public protests from farmers and road hauliers who blocked motorways and access to refineries, claiming that the Government was unduly benefiting from high crude oil prices through taxation. As all *ad valorem* taxes, VAT does indeed automatically increase with pre-tax sales prices, and hence the government benefits from rising crude oil prices. In response to the protests, the government decided to compensate for this effect by introducing some flexibility into the TIPP as of 1 October 2000. If crude oil prices rise by more than 10% from one quarter to the next, the TIPP on diesel will automatically be reduced by the same amount as the extra VAT. If on the other hand the crude oil price falls, the TIPP rises again to its original level. The new mechanism is estimated to reduce the pump price of automotive fuels by FF 0.20 per litre in October 2000.

The environmental effects of energy use are reflected in French tax policy insofar as tax rates are higher for leaded gasoline, natural gas for automotive purposes is taxed at the minimum level set by the European Union, and LPG for vehicles has benefited from tax rebates since 1996. Owners of vehicles using cleaner fuels also pay lower vehicle taxes (vignette, abolished in 2000).

On the other hand, coal use is not taxed at all. Natural gas is taxed only for industrial use, and at comparatively low rates (40 per cent below EU average). Coal receives government support. A budgetary subsidy of FF 26.68 per tonne applied in 1995 was abolished in 1996, but other forms of state aid continue[8]. In 1999, VAT on the basic (subscription) charge for gas and electricity was reduced from its full (1995)[9] rate of 20.6 per cent to the reduced rate of 5.5 per cent which applies to goods and services of absolute necessity. A similar reduction had been implemented for fuel wood for residential use in 1997.

The Parliament adopted a new general tax on polluting activities (taxe générale sur les activités polluantes, TGAP). At present, this tax does not apply to energy products and services. The tax replaced five previous taxes designed to raise revenue for the activities of the environmental agency ADEME. In 1999 and 2000, the main purpose of the tax was to counteract local pollution, and especially waste production. However, in May 1999 the government decided to expand the purpose of the tax to include global environmental effects, especially climate change, as of 2001. The concrete shape of this broader environmental tax, which would also be levied on energy, is currently under discussion, but a number of features have already been decided. The tax is to be levied on energy use by companies. The government intends to make the tax revenue-neutral, i.e. it plans to return the tax revenue to the public through reduced social security contributions for employers. A White Paper on the extended version of the TGAP was issued for consultation with the interested public in July 1999.

CRITIQUE

In trying to understand the motivations underlying French energy policy, it is extremely important to keep the country's dependence on imported energy in mind as well as the sense of vulnerability that this dependence has created for decades, especially after the two oil crises. The government has since tried to play a strong role in shielding French citizens from the perceived security threat. Another important factor in energy policy is the notion of public service. So much importance is attached to this notion that there is virtually no official energy policy document or statement which does not make extensive reference to it. Finally, French economic policy has long been characterised by a certain planning element, the *planification indicative*. This type of economic planning does not aim to replace the workings of the market but to make market

8. For more detail on coal support, see the Coal section in the Fossil Fuels chapter.
9. Beginning in April 2000, general VAT was reduced by one percentage point to 19.6 per cent.

predictions and allow the market to be channelled into the politically desired direction if necessary.

The energy policy which emerged from these principles was successful in many respects. After the oil crises made diversification away from oil seem necessary, the government achieved oil substitution in the power industry through its nuclear programme. France went further in this direction than most other IEA countries that were exposed to the same situation. Thus, it was possible to establish an energy sector with relatively low CO_2 emissions[10] compared to other G7 countries, while ensuring electricity prices which are among the lowest in Europe.

Government control and intervention in France has become a lot more light-handed over the past years, especially in the oil market, which was deregulated between the mid-1980s and the early 1990s. Today, new pressures are coming to bear on energy sectors throughout the world, including France: greater drives to reduce emissions, to increase the competitiveness of energy-consuming industries and to introduce competition in the European electricity and gas markets under the EU Directives.

These developments will put pressure on French energy policy to continue moving along the reform path, to introduce greater flexibility and to balance its strategic and public service concerns with market forces. These changes require the reform of the relevant legislation and institutions and, in the grid-bound industries, the establishment of regulatory institutions overseeing the market. Developments in this direction are well under way; for example, the regulatory body for electricity has been created and the posts of the commissioners have been filled. Many details still remain to be determined.

In the process, the government should work towards a less polarised public debate. The greater public awareness and involvement in energy market developments and energy policy processes that are both the result and the pre-condition of open and competitive markets require a fair amount of impartial information for market participants and the general public. Open markets thrive best in the context of a dispassionate debate about the best ways of guaranteeing fair competition and the achievement of the policy objectives subsumed under the public service principle. The government has a key role in ensuring that high-quality, objective information is available as a basis for balanced public debate and sound policy decisions.

The issues that are likely to emerge in France as well as in the wider European context relate to the following questions:

- What is the best response to security of supply concerns? How large is the security threat? What is the best way of responding to it?
- How can the broader objectives of French energy policy and the country's public service concerns be made compatible with liberalisation? How can this be done in a manner that ensures a level playing field?

10. See the Nuclear chapter for a brief discussion of the full environmental implications of nuclear power.

- If there is conflict between the above concerns and principles and free markets, what is the best trade-off – in other words, how much free market should be given up to provide how much security or public service?

Addressing the first issue, it may well emerge that energy security is still a vital concern for France, despite the fact that most other IEA member countries appear to be less concerned, including some which do not have extensive resource endowment. The IEA's own analyses show quite clearly that the current diversity of supply regions and suppliers in the oil market cannot and will not last forever, and that the world's oil-consuming nations may have to find supplies in a market once more characterised by unrestrained market power in 20 to 30 years' time.

The economically most efficient solution to such a situation – in fact, a security externality – is to penalise oil consumption via price signals and let the market respond to the price signals by diversifying away from the expensive input. To ensure an optimal outcome, all significant externalities attached to the consumption of a good or service have to be incorporated into the price signal; for energy, this means security and environmental and health externalities at least.

Internalisation can occur in many ways, most efficiently through taxation or import tariffs. This is done everywhere in oil-consuming nations, especially in France, which has one of the highest oil taxation rates in the IEA. Taxing oil products was not the only response of the French government to the security of supply threat. After the first oil crisis, the government analysed the situation, identified the power industry as the sector with the greatest substitution possibility, and made large-scale use of nuclear power the core of its response strategy.

Subsequently, the nuclear industry was developed. All elements – nuclear power plant manufacturing and technology, the fuel cycle, nuclear plant orders and plant operation – were synchronised in a way that made it possible to exploit the technology's strong economies of scale and the industry's economies of scope. This was helped by administrative procedures that allowed comparatively swift plant construction. The high productive efficiency in power generation thus realised was one of the factors enabling EDF to charge power prices among the lowest in Europe.

However, the nuclear programme has created excess capacity, notably in base load. In the French government's own view, it exceeds the economically efficient contribution of nuclear to the French energy economy today.[11]

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11. The French Secretary of State for Industry, Mr. Christian Pierret, said in his Declaration of the Government on French Energy Policy before the French Parliament (Assemblée Nationale) on 21 January 1999: "Nowadays, an "all nuclear" approach is no longer appropriate either. The share of nuclear in our electricity production is, as you know, close to 80 per cent. This share exceeds the competitive contribution of nuclear as we estimate it today." ("L'heure n'est plus non plus au tout nucléaire dans la production de l'électricité. La part du nucléaire dans notre production d'électricité est, vous le savez, proche de 80%. Cette part excède la plage de competitivité du nucléaire telle que nous pouvons l'estimer aujourd'hui.")
Quoted from Ministère de l'économie, des finances et de l'industrie: *Énergies & Matières Premières*, No. 8, 2e trimestre 1999.

In the 1980s, France began exporting electricity to its European neighbours. This provided an outlet for its nuclear generation and electricity supplies to its neighbours, e.g. to Italy, the biggest net electricity importer in the European Union. Nevertheless, between mid-1986 and mid-1992, the average load factor of French nuclear units lay between 60 per cent and 65 per cent. Between 1987 and 1992, this load factor was the second lowest among IEA countries (above the UK). To be sure, since electricity demand in France grows at a rate of slightly more than 2 per cent p.a., the excess base load capacity will eventually be absorbed. Still, with slightly less than 71 per cent, the 12-month capacity factor of French nuclear power plants was third-to-last among OECD countries in 1999, and last among OECD countries with light water reactors.[12]

This situation has created repercussions throughout the French economy and beyond: in the oil market, refineries had to adapt to rapidly falling demand for heavy fuel oil. Their response was to increase gasoline production – a strategy that was rendered unprofitable due to expanding diesel demand caused by the widening tax gap between gasoline and diesel. This has contributed to the low profitability of the French refining industry today[13]. In the heat market, electrical heating displaced other, more energy-efficient forms of heating (in terms of primary energy input). And in the renewables sector, the expansion of electrical heating eliminated niche markets for wood-based heating, otherwise very popular in France[14].

Today, oil use still accounts for 52 per cent of final demand, mainly in the transport sector, where it continues to grow, causing CO_2 emissions growth that calls into question whether France will be able to meet its stabilisation commitment (environmental externalities), and perpetuating the security threat (security externalities). Substituting nuclear energy for fossil fuels through the nuclear programme was relatively easy insofar as the government needed to address only a small number of companies in the energy market, many of them state-owned. Since the easy substitution possibility has now been used up, the government will need to find means to influence the consumption choices of millions of energy consumers to address the externalities attached to fossil fuels, especially climate change. And these means will have to be adapted to increasingly open markets.

Concern regarding the future of the nuclear programme, together with the concern for public service[15], contributed to a rather hesitant welcome to competition in the electricity and gas markets in France, and to a market design for the new power market that is unlikely to lead to much competition. Another important factor was the

12. *Nuclear Engineering International*, May 2000.
13. See the Fossil Fuels chapter. It should be noted that other factors also contributed to these developments, notably overcapacity in the European refining industry.
14. See the Electricity and Energy and the Environment chapters. If wood-based heating had not been displaced by electrical heating, it would have been displaced by other energies to a certain degree, for reasons of convenience. However, the decline would probably have been less sharp.
15. See, e.g., Batail, Jacques: Towards New French Gas and Electricity Market Structures. Ministry of Economic Affairs, Finance and Industry: *Lettre des Énergies et des Matières Premières*, No. 12, 2e trimestre 2000.

perception that competition was not needed in France as much as it may have been in other countries.

Successful as the French power industry has been in the last decades, it is by no means certain that electricity prices to end users were fully efficient. It is not clear whether the entire supply chain was organised as efficiently as was generation. Monopolies often engage in misallocation or squandering of resources if not prevented from doing so by competitive forces. This is true in theory, and the experience in other countries that have gone through a liberalisation process shows it is also true in practice[16]. Such inefficiencies can be larger than the gain from exploiting economies of scale and scope. Experience in other liberalising markets also shows that the brunt of such inefficiencies tends to be borne by small and medium-sized enterprises in the industrial or services sector, a sector generally recognised to contribute much to creation and more equal distribution of wealth.

The French government should consider ways to reap the benefits from competition while addressing the security and environmental externalities of energy use and public service concerns. The first step could be to assess how large the security (and environmental) externalities are. The next step could be to identify and quantify the market failures that need to be addressed as a public service. The French government has made significant progress in this respect insofar as the new Electricity Act clearly defines public service for the first time in a legal document. This was partly prompted by the EU debate on competition in the electricity and gas markets. This definition is highly commendable, especially since a 1996 government report states that the notion of public service has given rise to misunderstandings[17]. The government should pursue this necessary and successful strategy of clarifying and defining public service.

Insofar as public service is related to social objectives, as the new Electricity Act suggests, the most economically efficient way of tackling them would be through separate policy instruments, not energy prices or the provision of goods and services "of absolute necessity": it is less costly overall for society to support low-

16. For example, all liberalising power markets have increased labour productivity by reducing staffing levels and these reductions were largest in countries with large state-owned monopolies. After the introduction of competition in the UK, the power sector reduced its employment by more than half and the former Electricity Supply Board of Victoria (Australia) even reduced it to less than 1/3 of pre-liberalisation staffing levels. In contrast, EDF is increasing its staff (see Electricité de France Group: *1998 Annual Report*. Paris).
17. The introductory section of the report states: "One of its main findings, after several dozens of interviews with French and foreign personalities from different backgrounds, is that the debate in these last months has suffered from confusion between two types of reasoning: the notion of public service (la doctrine du service public), on the one hand, and the organisational modalities of public network industries (les modalités de l'organisation des services publics en réseaux), on the other hand. Many French people sincerely believed that in reforming the latter, one was attacking the former. Many of our friends in the European Union honestly believed that in brandishing the former, we wanted to perpetuate the latter indefinitely." See Renaud Denoix de Saint Marc: *Le service public. Rapport au Premier ministre*. La documentation française, Paris, 1996.

income groups through direct person-oriented support rather than low prices. This gives consumers the possibility to make efficient choices between their consumption of energy and other inputs, e.g. capital for better insulation.

Supporting needy customers through special, low prices results in misallocation of resources: since the poor get the gas, not the money to buy the gas, they do not get the choice of improving thermal insulation of their dwelling or looking for a better dwelling even if this would be cheaper for society. Thus, they make a suboptimal choice between capital investment and energy use – in other words, they do not undertake energy efficiency efforts that would be economic if they had a choice. This way of addressing social considerations is in conflict with environmental and energy security concerns. This is also the case for the recent reduction of VAT for the basic charge for electricity and gas, although the effect will be minor since the reduction does not apply to the consumption-variable rate[18].

On the other hand, the government's plan to reduce the gap between gasoline and diesel taxation will re-balance the energy taxation system in an efficient and environmentally advantageous way, and should therefore be commended. Extending the general tax on polluting activities to energy products and services would be another commendable achievement.

Another element forming part of public service obligations is the geographic uniformity of tariffs (peréquation tarifaire) in the electricity industry, and to some extent also in the gas industry[19]. This issue is discussed in detail in the critique sections of the Electricity chapter and in the Energy and Environment chapter. Suffice it to say here that the mechanisms used create market distortions throughout and beyond the French market, notably destroying promising niche markets for renewables in the *départements outre-mer*[20]. The usefulness of this policy should be reconsidered. If applied in a more circumscribed, efficient manner, the policy need not be an obstacle to competition. Hence it should not be invoked as one. Note that regional and territorial policies are decisions belonging to sovereign nations and that this report does not suggest doing away with such policies. Instead, it suggests carrying them out in a manner that avoids market distortions.

The compatibility of competition and public service obligations are discussed in the Gas section of the Fossil Fuels chapter and in the Electricity chapter. At the root of

18. It may still encourage some additional consumption, however. This may be explained using an example from the electricity sector. EdF's tariffs are sufficiently complex even for small customers, including residential customers, to contain a basic charge that is differentiated according to the customer's maximum load. The higher the load, the higher the fee. By reducing the end-user price of the basic fee, EdF may encourage customers to take out a subscription at a higher load. This in turn makes it easier (it may lead to the installation of a fuse allowing higher load) and relatively cheaper to consume more electricity, because the per-kWh price remains the same or is slightly lower. Thus, as consumption increases, the average price of a kilowatt-hour falls slightly more steeply than before.
19. Please refer to the Fossil Fuels chapter for a discussion of this issue in the gas market.
20. As also discussed in the Energy and Environment chapter, a special programme, the "electrification gap" programme, was established to limit these distortions.

all public service issues lie valid policy concerns, but for every existing policy instrument, more market-based alternatives exist.

These issues have strongly affected the process of electricity market liberalisation in France in recent years and will probably also have an impact on the reform procedures under way in the gas industry. As far as the proposals for new French legislation are known, gas industry liberalisation appears to be proceeding on a somewhat faster schedule, with greater ease and to a slightly greater extent than electricity market liberalisation. The government should strive to maintain the momentum, and even enhance it.

The recent merger creating TotalFinaElf has created greater concentration in the already highly concentrated French energy market. Further concentration should be avoided.

RECOMMENDATIONS

The government should:

- ☐ Continue to reform its legislation, procedures and institutions to adapt French energy policy to the challenges of the future, namely competition, energy security and climate change. Solutions to these three issues are complex and far-reaching and require a well-informed, dispassionate public debate. The Government has a key role in ensuring that the public is well informed about the implications of its choices.
- ☐ Pursue its successful strategy of clarifying and defining public service and general interest issues. Extend the strategy to encompass quantification of security and environmental externalities for France.
- ☐ Be prepared to move beyond the minimum thresholds of the EU Gas and Electricity Directives to reinforce the principle of equal treatment.
- ☐ Strive to maintain the momentum in gas market liberalisation, and to achieve transposition of the EU Gas Directive into French law close to the anticipated schedule.
- ☐ Avoid further concentration in the French energy market.
- ☐ Develop fully market-compatible measures to address climate change and energy security concerns, leaving consumers as much choice as possible in how the objectives should be reached.
- ☐ Consider carefully the impacts of geographic uniformity of tariffs. Revise the tariff system to achieve greater economic efficiency and choice for consumers and to facilitate the use of renewables, e.g. by restricting the uniform tariff to network services in existing interconnected distribution grids. Social and regional policy objectives should be pursued through specialised policy instruments.

4

ENERGY AND THE ENVIRONMENT

CLIMATE CHANGE

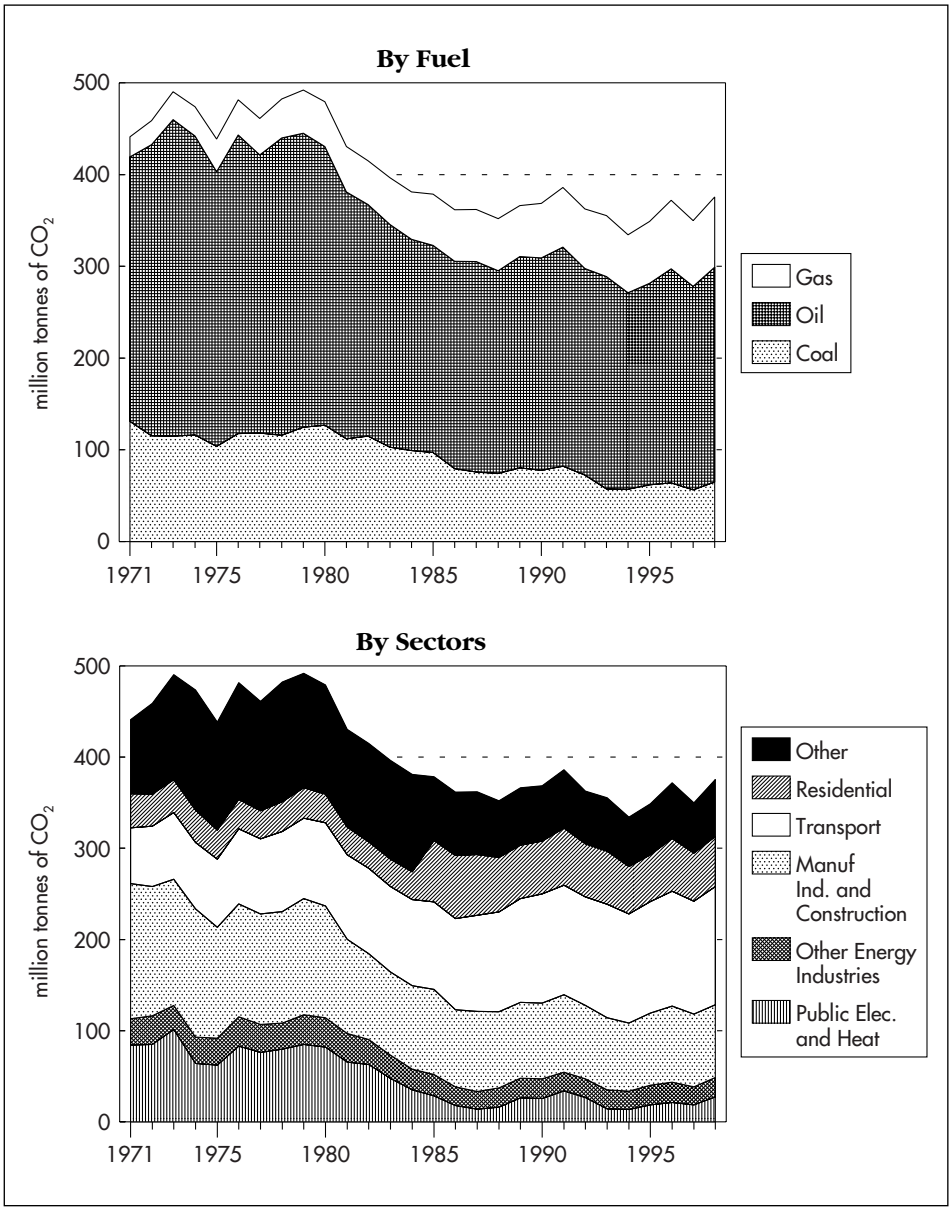
In April 2000, the French Parliament adopted an instrument which will allow it to ratify the Kyoto Protocol to the Framework Convention on Climate Change (FCCC) in due course. According to the Kyoto Protocol, and the EU burden sharing agreement that sets individual targets for EU member countries, France is required to stabilise its greenhouse gas emissions at 1990 levels at the end of the first budget period 2008-2012.

This target was set in recognition of the fact that France has already reduced its CO_2 emissions drastically since 1980. As a consequence, France emits 1.7 tonnes of carbon per capita, compared to a European average of 2.3 tonnes, and an IEA average of about 2.6 tonnes. In terms of carbon intensity per capita, the country has the 5th lowest emissions among IEA countries. In terms of carbon intensity by GDP it ranks third-lowest among those IEA countries which rely almost exclusively on non-fossil electricity generation (by order of increasing emissions: Switzerland, Sweden, France, Norway).

Figure 9 shows the development of total CO_2 emissions since 1971. From 1979 until 1987, emissions dropped sharply. However, in the second half of the 1980s, the pace of nuclear power plant addition began to decline and after the 1986 fall in oil prices, CO_2 emissions began to rise again. Whereas emissions from power plants were reduced by 62 per cent between 1980 and 1998 and industry and agriculture reduced theirs by 26 per cent, the transport sector increased its emissions by 41 per cent in the same time frame and is today the largest emitter of CO_2, accounting for 41.2 million out of 108.5 million tonnes of carbon in 1998 (38 per cent). Electricity generation contributes only 11.1 million tonnes (10 per cent).

France submitted its Second National Communication to the FCCC in November 1997. The next communication is due in 2001. France's climate change response policies involve about ten different ministries, including the Ministry of Economic Affairs, the Ministry of Transport, and the Ministry of the Environment and Spatial Planning. The Environment Ministry leads the French delegations to international climate negotiations. To co-ordinate French policies, an Inter-ministerial Committee on Climate Change was formed. In the mid-1990s, this committee consisted of three officials. In 1998, the committee was transformed into a standing group of the ministers themselves. This group met for the first time in November 1998, under the presidency of the Prime Minister. During this meeting, the Prime Minister initiated the preparation of a national programme to combat climate change, to be finalised and submitted in 2000.

Figure 9
Total Energy–related CO_2 Emissions, 1971 to 1998



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

As early as 1992, the committee established a task force to carry out the detailed work, to prepare the French negotiating positions and to monitor the progress of adopted climate change measures: the Inter-ministerial Mission on Climate Change (Mission interministérielle de l'effet de serre, MIES). The MIES reports to the Inter-

ministerial Committee on Climate Change. It was reinforced considerably in 1998, when it was placed directly under the Prime Minister's authority. Staffing of the MIES was increased from five people in 1995 to 20 in 1999. The current main priorities for the MIES were set by the ministerial meeting in November 1998:

- To prepare for upcoming international events in the field of climate change, especially the 6th Conference of Parties to be held in November 2000 in The Hague and the French Presidency of the EU Council of Ministers in the second half of 2000.
- To develop the national programme to combat climate change.

To achieve its objectives, the MIES co-operates with officials in the ministries concerned, with development organisations such as the French Fund for World Development (Fonds français pour le développement mondial), and with national and international research bodies, industry and NGOs. In the framework of its new national programme, MIES intends to extend its co-operation to the services sector, especially the banking and insurance sector, trade unions, consumer associations, and regional and local authorities. It is also the focal point for contacts with the European Commission and EU member governments.

The National Programme to Combat Climate Change[21] was submitted to the Inter-ministerial Committee on Climate Change in early 2000 and approved by it on 19 January 2000. According to this document, the stabilisation target means, after climate correction and for six gases, that France has to bring its emissions back to 143.5 million tonnes of carbon equivalent around 2010. The report quotes a reference scenario that projects greenhouse gas emissions rising to 175 million tonnes of carbon equivalent in 2010. Taking into account a number of response measures decided later but not incorporated into the projections, emissions in 2010 are estimated at 159.58 million tonnes of carbon equivalent, 16.08 million tonnes above 1990 levels. To reach the stabilisation target, France thus has to reduce emissions at the end of the first budget period by 10 per cent. CO_2 emissions alone are estimated to rise from 103.4 million tonnes in 1990 to 122.8 million tonnes in 2010. The reference scenario is based on the assumption of 2.2 per cent annual GDP growth rate up to 2010. If a 2.8 per cent growth rate is assumed, emissions rise to 171 million tonnes instead of some 160 million tonnes.

Based on an extensive research effort, the document specifies about 100 measures called "first category" measures, which were selected due to their low (or negative) net cost, their effectiveness or their "no regrets" character. These measures consist to a large degree of reinforced efforts in areas that were already targeted by measures adopted before 1997, i.e. regulations, energy efficiency programmes in buildings and electricity-specific uses, and improvements in the transport sector.

21. République Française: *Programme national de lutte contre le changement climatique 2000/2010*. Premier ministre/Mission interministérielle de l'effet de serre et Ministère de l'aménagement du territoire et de l'environnement. Paris, 2000.

Taken together, the first category-measures are estimated to save 7.04 million tonnes of carbon equivalent, including 5.04 million tonnes from CO_2 alone. This amounts to 44 per cent of the reductions target.

To go beyond this result and save the remaining 56 per cent, the government is currently considering the option of using economic instruments, especially carbon taxation. The National Programme to Combat Climate Change specifies that the Government believes a tax rate of FF 500 per tonne of carbon equivalent should be the goal in 2010 and that the starting tax rate should be between FF 150 and FF 200 per tonne. The National Programme also specifies that a tax rate of FF 500 to FF 600 per tonne of carbon would lead to achievement of over half of the reduction target domestically. The remainder could be achieved abroad if flexibility mechanisms were used. Specifically, and as mentioned in the Energy Market and Energy Policy chapter above, the government is currently considering extending the general tax on polluting activities (TGAP) to address climate change; other measures are also being considered. If greenhouse gas taxation were indeed phased in, it is estimated that it could lead to savings of another 6.7 million tonnes of carbon equivalent, including 5.8 million tonnes from CO_2. This would bring the total savings to 13.74 million tonnes or 86 per cent of the target.

The remainder is to come from long-term policies targeting the supply side, such as long-term energy efficiency improvements in buildings, support for the development of renewables, and a development programme for renewables in the DOM/TOM. Most importantly, policy efforts in the transport sector would aim at stabilising emissions growth of greenhouse gases from transport at a level of 40 million tonnes of carbon equivalent between 2010 and 2020. This objective foresees CO_2 emissions peaking in 2010 at a level of 38 million tonnes of carbon equivalent.

ENERGY EFFICIENCY

The objectives for improving energy efficiency and developing renewable energies are the same in France as they are in all IEA countries, namely:

- to avoid the environmental impact of non-renewable energy resources.
- to develop alternatives to non-renewable fuels for the time when non-renewables become scarce.
- To develop domestic energy resources.

French energy efficiency policy is defined by the DGEMP and carried out by numerous organisations. An important body for the implementation of energy efficiency policy in France is ADEME. The box below gives a brief description of the organisation. Likewise, energy efficiency policy is set out in numerous pieces of legislation, notably the 1996 Act on the Air and Rational Use of Energy (Loi n° 96-1236 of 30 December 1996 sur l'air et l'utilisation rationelle de l'énergie). Based on this law, a number of sector-specific measures and programmes were developed, as listed below.

As with the electricity and gas industry, the relationship between ADEME and the supervising Ministries involves contracts, the so-called contrats d'objectif, that set out the objectives for ADEME's policy and spending for several years. The last such contract covered the period 1995 to 1998. A new contract for the period 2000 to 2006 was signed in 2000.

The Agence de l'environnement et de la maîtrise de l'énergie (Agency for the Environment and Energy Efficiency, ADEME)

ADEME was created through legislation passed in 1990 out of three pre-existing government agencies: the Agence française pour la maîtrise de l'énergie (French Agency for Energy Efficiency, AFME), the Agence nationale pour la récupération et l'élimination des déchets (National Agency for Waste Recuperation and Elimination, ANRED), and the Agence pour la qualité de l'air (AQA). ADEME began operating in January 1992. The organisation reports to the Environment Minister, the minister in charge of industry, and the Research Minister. Its main tasks are:

- Saving energy and raw materials.
- Limiting waste production, and especially working towards avoidance of waste and towards re-use or re-cycling of the energy and raw materials contained in wastes.
- Promoting clean technology and renewable energies.
- Combating noise pollution.
- Preventing air pollution and preserving air quality.
- Preventing soil pollution.

ADEME's budget more than doubled between 1992, when it was slightly above FF 1 billion, and 1999, when it reached almost FF 2.5 billion. Most of ADEME's resources are spent on waste, including the clean-up of contaminated soils, which accounted for almost 40 per cent of the budget in 1999. The portion of the budget reserved for energy efficiency and renewables was 22 per cent and a further 14 per cent was spent on transport and clean air. In 1999, ADEME had a staff of 700 in three locations in Paris, Angers and Valbonne, and 26 delegations in the French regions, in three overseas territories, and in Brussels.

In a special effort to re-launch French energy efficiency policy after the Kyoto conference, the government in 1998 decided to allocate FF 500 million per annum for this purpose. This contribution is to be used to help implement the government's climate change policy. The amount forms part of ADEME's FF 2.5 billion budget for 1999 but represents a stable and higher energy-related portion than before.

The detailed sectoral energy efficiency regulations and projects (excluding the "first category" measures to combat climate change) comprise the following:

Industry

- Decree 98-817 of September 1998 sets minimum fuel efficiency standards for boilers between 400 kW and 50 MW.

- Decree 98-833, also of September 1998, requires regular inspections of all installations using thermal energy.

- Companies' spending on energy-efficient equipment can be depreciated on an accelerated schedule.

- A programme launched in 1998 and targeted specifically at small and medium-sized companies provides information and support to decision-making related to energy-efficient equipment. DRIRE and ADEME, together with some regional funds, provide financial support for energy audits and feasibility studies. The exact amount is currently under negotiation with the European Commission.

- Equipment using best available technology can benefit from significant investment support.

- The government intends to conclude voluntary agreements with energy-intensive industries, especially companies in the iron and steel, pulp and paper, chemicals and building materials industries.

Transport

- The government decided in July 1999 to set aside a budget contribution for regional railway transport. Of this, FF 7.6 billion, allocated within the framework of contracts between the state and the regions (contrats de plan état-régions) running from 2000 to 2006, are to be used as support for the refurbishment of the regional railway network. Together with funds from the regions themselves and from the new French railway infrastructure company RFF (Réseau Ferré de France), this programme totals FF 24 billion. Outside of the contrats de plan, the Government contributes FF 1.7 billion for similar projects amounting to a total funding of FF 5 billion.

- The PREDIT 2 programme, aimed at research and development in the transport sector and funded jointly by ADEME, ANVAR[22] and the Ministries of Industry, Environment and Transport, had a total budget of FF 7.3 billion and ran from 1996 to 2000.

22. ANVAR is a government organisation for research and innovation reporting to the ministries responsible for economic affairs, small and medium-sized industries and research and technology.

- Under the 1996 Act on the Air and Rational Use of Energy, municipalities and cities of more than 100,000 inhabitants were to develop urban mobility plans (plans de déplacement urbains) before June 2000. If by that date plans had not been developed, the central government's representative in the region, the Prefect, may develop such a plan. The plans are to be evaluated after five years.

- Under Decree no. 98-701 of 17 August 1998 on the renewal of the road vehicle fleet used by publicly-owned companies and by government institutions, 20 per cent of new vehicles must be "alternative" vehicles, i.e. low-pollution vehicles using electricity, LPG or natural gas.

Residential and services sector

- A tightening of thermal requirements in building standards is scheduled for 2000.

- Two decrees relating to a requirement to declare the specific energy use of buildings (e.g. for rented real estate) and to the possibility of changing a building's energy supply are to be issued in 2000.

- ADEME supports decision-making for energy-efficient equipment in buildings at the same level as for small and medium-sized industries. State-of-the-art equipment can benefit from significant investment support.

- Decree 98-257 of March 1998 sets energy efficiency standards for refrigerators and freezers for household use.

- A set of energy labels exists for a number of household appliances (e.g. for washing machines, issued in June 1998).

- An electricity efficiency programme for the residential sector with a special focus on promoting energy-efficient lighting was launched by the Ministry of Economic Affairs in February 1998. Meanwhile, ADEME aligned its objectives and organisation with this programme.

- Under Decree 99-360 of 5 May 1999 on district heating and cooling networks, new buildings must be connected to existing heating networks if those networks use mainly renewables or waste heat.

RENEWABLES

France's overall supply of renewable energies is very much in the mid-range of IEA member countries; its share of renewables in TPES is below 7 per cent and only slightly above the IEA average of about 6 per cent. The lion's share of renewables supply in IEA countries is from hydroelectricity, a matter of natural endowment. France has a significant hydro resource and exploits it, but its endowment is

nowhere near that of some other IEA countries such as Switzerland, Austria, Sweden and especially Norway.

If only non-hydro renewables are considered, however, France is the second-largest producer and user of renewables among IEA countries after the United States. Almost all of this use (96.5 per cent) is from combustible renewables, such as incineration of municipal and industrial wastes, biogas, and biomass. Biomass, especially non-commercial wood use, accounts for most of the use of combustible renewables.

France has one of the largest forested land areas in Europe and wood is used extensively. Approximately 3 million households use wood as their main heating fuel. An additional 4 million use wood heating to complement other types of heating, especially electrical heating. A further 1.5 million households use wood occasionally for heating and because of the cosy atmosphere it creates.

Besides combustible renewables and hydro, France has geothermal energy, used in 41 facilities around Paris and in 15 in the Aquitaine region, plus solar, wind and tidal power. France is one of two IEA countries with tidal power, from its 240 MW tidal plant at La Rance.

A significant renewables potential also exists in the DOM/TOM, especially where grid electricity is not available. This potential includes solar and wind, as well as geothermal energy. A 4 MW geothermal facility began producing in Bouillante (Guadeloupe) in 1996.

In France, as in other IEA countries, renewables are generally not competitive and benefit from government support programmes and measures, including:

- Requirements for EDF to purchase renewable energies. The purchasing requirements are based on standardised contracts (contrats-types) co-developed and approved by the government between EDF and renewables suppliers. A new set of such contracts was developed in 1997 and 1998. They are based on avoided cost of new investment and run for 15 years. The standard contracts for hydroelectricity, cogeneration, and household waste incineration were approved in 1997, 1998 and 1999. A similar standard contract for photovoltaics was approved in 1999. These contracts are also referred to in the Electricity chapter. Their concrete implementation remains to be defined under the new Electricity Act.

- A programme to install 20,000 solar-thermal water boilers on the French islands (Corsica and DOM), launched by EDF and ADEME in January 1996 and expected to save 10,000 tonnes of oil equivalent per year. Funding is from various national and international institutions.

- The HELIOS 2006 programme for solar-thermal water heaters in metropolitan France, established in May 1999 and carried out by ADEME. Total funding is FF 30 million. Households that equip themselves with solar water heaters can obtain an investment subsidy which can be topped up by support from regional bodies.

- The EOLE 2005 wind energy programme. This programme aims at installing 250 to 500 MW of new wind capacity by 2005. For this purpose, a series of calls for tender was launched in 1996. Successful bidders were given the guarantee that EDF would purchase their entire production. So far, the amount of capacity that was accepted following the bidding rounds has exceeded expectations: a total of 124 MW was accepted, compared to a target of 75 MW. Purchase prices came down from 38 centimes per kWh to 34 centimes per kWh already during the first bidding round in 1997.

- The "electrification gap" programme (Programme électrification des écarts). This programme aims at electrifying isolated areas in France, especially in the DOM, by using renewable energies. The programme was created in 1995 within the Depreciation Fund for Electrification Charges (Fonds d'amortissement des charges d'électrification, FACE), the body responsible for funding electrification in France in the remaining, non- or weakly-electrified areas. It had resources of FF 100 million per year. Its budget for renewables and energy efficiency for 2000 is FF 75 million. At the end of 1998, 1,128 sites (of which 656 are in the DOM) benefited from this programme. 914 kW, two-thirds of which were photovoltaic, had been installed, avoiding the laying of 1,400 km of power lines and expenditure of FF 589 million.

- A programme for Energy Wood and Local Development (bois-énergie et développement local), launched in 1994 together with regional authorities. On 1 January 1999, FF 120 million of subsidies had been spent (of which FF 47 million were from ADEME), yielding total investment of FF 345 million in 188 wood-fired boilers totalling 150 MW with an energy content of 36,000 tonnes of oil equivalent per year. This programme was extended to comprise the Wood Wastes Plan (Plan bois-déchets) announced in February 1998. Under this plan, technical and economic viability studies relating to the use of all kinds of wood wastes as well as the investment cost of installations using wood wastes are significantly subsidised. At present, ADEME spends FF 65 million per annum on these programmes.

- Under Article 20 of the 1997 Finances Law, a reduced VAT rate of 5.5 per cent, instead of 20.6 per cent, applies to commercial heating wood.

- The 1998 biogas programme, designed to equip waste dumps with combustion facilities for the use of methane from waste fermentation. Like the EOLE 2005 programme, it is based on calls for tender. The first tendering round for 10 MW of electricity generating capacity was successfully concluded in May 1999.

- The biomass-electricity programme. This programme is intended to explore the competitivity of power generation from biomass by establishing 10 MW of demonstration plant. EDF is currently preparing a call for tender.

- The biofuels programme. Beginning in 1994, funding of some FF 65 million was made available from a joint government-industry project for the production of methyl-ester, ether and ethanol from sunflowers, rape seed, wheat and beetroot.

Methyl-ester from sunflowers and ether is exempt from taxation. Today, France has become the world's largest producer of biofuels. They are produced in some 22 biofuels plants, from land that would have otherwise been left fallow under EU farm rules, and blended into oil products such as diesel.

- As stated in the preceding section, existing district heating networks must be used following a 1980 Decree that was confirmed by Decree 99-360 of 5 May 1999. New buildings within the area covered by the network must buy the heat if it is produced predominantly from renewable energies.

CRITIQUE

Climate Change

France's carbon dioxide emissions are low, compared to those of other industrialised nations of the same size and wealth. This very positive situation was acknowledged by France's neighbours in the context of the EU burden-sharing mechanism for greenhouse gas emissions reductions. This does not mean that the country does not have to make additional efforts, however. Carbon dioxide emissions, and greenhouse gas emissions generally, are expected to rise and according to government projections, this growth trend will have to be reduced by 10 per cent to reach the stabilisation target in 2010. This is not a trivial task. It requires a clear strategy and a balanced mix of clearly defined, concrete measures.

In its new National Programme to Combat Climate Change, the government sets out such a clear strategy. The mix of measures that the programme contains encompasses reinforcement of existing policies on a large scale, but also an important new element of carbon taxation. Taken together, these measures would bring France close to meeting its target. With the additional (comparatively small) contribution from the envisaged long-term structural measures, the target would be met.

According to the programme, about half of the emissions savings will stem from conventional measures (such as regulation or voluntary agreements), and the other half from economic instruments. The government has sought to generate synergies between the individual measures, and has proposed "first category" measures that enhance the effectiveness of the economic instruments. Hence, the proposed basket of measures appears both balanced and effective, with the tax measures notably contributing to the economic efficiency of the programme.

It is worth mentioning that a sensible approach is particularly visible in the transport sector. Transport is the largest emitter of CO2 and shows the highest emissions growth rates. In this area, developments in France do not differ much from those in other countries. However, transport fuels are already very highly taxed in France. While road freight transport may not yet pay for its full external costs, experience throughout IEA countries and elsewhere shows that the economics and the convenience of road transport, both of freight and persons, are such that a price signal alone is not likely to lead to significant results – unless

attractive alternatives exist. This is even more true since road (and air) transport seems to be a strongly superior service. This means that growth of disposable income causes higher-than-proportional demand for transport. This effect can overcompensate price increases, including those from environmental taxation.

The government has taken these issues into account by abstaining from suggesting immediate large increases in transport fuel taxation, and by targeting the transport sector through the long-term structural programmes that may help create the necessary attractive alternatives. Taxation is to play a role as well, but it appears that the government's intention is to adapt further taxation measures to the progress made in implementing the structural measures. It should be noted that the reduction of the tax gap between diesel and gasoline is expected to contribute to the reduction of carbon emissions from transport in the order of 1 million tonnes of carbon equivalent.

Since a sensible and effective national climate change strategy has now been developed, the Government should strive to implement it. Any great delays could jeopardise the effectiveness of the programme and create a need to resort to more drastic measures later.

Energy Efficiency

In 1993, the Inter-ministerial Committee for the Evaluation of Public Policy (Comité interministériel de l'évaluation des politiques publiques) was given the task of evaluating French policy in the area of energy efficiency and renewables between 1973 and 1993. In January 1998, the task force established by the committee for this purpose published its report, the Yves Martin report[23], an extraordinarily thorough and detailed piece of work. Since then, a number of the recommendations of the report have been implemented by the government.

The report states that French energy efficiency policy followed a very short-term approach over the observed time period, especially if compared to the very long-term strategy that was adopted for the development of nuclear power and the marketing strategies of fossil energy suppliers. The energy efficiency efforts undertaken by the government were found to have been motivated more by short-term concerns such as improvement of the balance of payments through reduction of oil expenses than by striving to establish an appropriate long-term equilibrium based on the full cost of scarce energy resources. In particular, the report states that government spending on energy efficiency and energy taxation varied in a pro-cyclical manner. This means that taxation was lowered and energy efficiency spending was reduced during periods of low oil prices. One example is the reduction of taxation of heavy heating oil after the 1986 fall in world oil prices,

23. Comité interministériel de l'évaluation des politiques publiques, Premier ministre, Commissariat général du plan: *La maîtrise de l'énergie*. Rapport d'évaluation. Paris, 1998. Also known as the "rapport Yves Martin" after the president of the committee. See also L'évaluation de la politique de maîtrise de l'énergie, in: *Énergies et matières premières*. Ministère de l'Economie, des Finances et de l'Industrie, Direction Générale de l'Energie et des Matières Premières, no. 4, 2e trimestre 1998.

when the threat of oil scarcity subsided. On 1 January 1986, heavy fuel oil was taxed at a rate of FF 370 per tonne, whereas two years later the tax rate was reduced to FF 150 per tonne.

It can be added to the report's analysis that such pro-cyclical taxation is, of course, hazardous to the economy from an overall macro-economic point of view, besides discouraging energy efficiency investment at the very moment when the Government's task should be to compensate for market developments and to maintain such investment. Meanwhile, the government decided to give its energy efficiency and renewables policy a new impetus by contributing FF 500 million per year for ADEME's energy activities and by announcing that this budget would be maintained for the foreseeable future.

This may represent a striving to provide more stability and a longer-term outlook. It may also mean that in future, energy efficiency and renewables policy will reflect, in a balanced way, all three reasons why governments are well-advised to support energy efficiency and renewables, and not just the third:

- To avoid the environmental impact of non-renewable energy resources.
- To develop alternatives to non-renewable fuels for the time when non-renewables become scarce.
- To develop domestic energy resources.

Furthermore, the report states that government regulation of the fuel efficiency of boilers was ineffective because it followed developments on the marketplace instead of leading them, and with a large time lag. Although the report found regulations relating to the energy efficiency of buildings to have been successful, it nevertheless criticises the fact that the standards were not updated after 1988. The report also found near to no enforcement and control of thermal efficiency standards for residential buildings and equipment in the services sector. As a result, the report estimates that only 5 per cent of the equipment fully complies with the regulations in force. The absence of a coherent energy efficiency policy for government buildings is also highlighted.

It should be noted that the government has begun to act on some of these criticisms. New boiler efficiency standards were adopted in 1998, and regular technical controls may improve compliance. However, much room for improvement remains and the government may be well-advised to develop the energy efficiency measures suggested in its climate change response programmes based on the findings of the Yves Martin report.

Renewables

The report also analyses French renewables policy. Its main conclusions in this area concern the use of wood, the effect of the public service notion of geographic tariff

uniformity (peréquation des tarifs) on niche markets for renewables, and the French biofuels programme.

Regarding the use of wood, the report states that the government could have made better use of the existing popularity of wood-based heating. The main criticism in the report is that the government favoured wood-based central heating in multifamily dwellings, and that the incentives used encouraged the installation of expensive, oversized boilers. The criticisms expressed in the report were instrumental in bringing about the new policy measures phased in after 1994, such as the Energy Wood programme. The measures adopted in recent years have contributed decisively to re-balancing the situation.

However, the report also states that all renewable energies have suffered from the principle of geographic uniformity of tariffs. As far as wood is concerned, the task force believed that the policy of promoting electric heating led to the necessity of reinforcing electricity networks in isolated rural areas where wood-based heating would otherwise have been competitive. The grid reinforcement receives support from the electrification fund FACE.

However, the report finds even greater negative impacts on solar thermal, photovoltaic and wind energy in the DOM, where electricity is sold at the same price as in densely populated and electrified metropolitan France, regardless of its cost. In addition to imposing a major cost on consumers in metropolitan France, this policy destroys local niche markets for renewable energies in the DOM and imposes on everyone the external cost of electricity generation from fossil sources, often small diesel generating units with significant emissions.

The situation has been improved through the creation in 1995 of the "electrification gap" programme within the electrification fund FACE. This programme appears to be highly profitable – it achieved cost reductions of FF 589 million against an expenditure of FF 400 million in less than four years of operation between 1995 and 1998. The programme acts as an ex post correction of a distortion, whereas it would be more logical and economic to remove the distortion. It should also be noted that new electricity production may well increase greenhouse gas emissions. In this context, the development of electrical heating should be kept under review and should not be favoured by subsidised grid reinforcement.

It is not clear whether geographic uniformity of tariffs leads to the lowest possible prices even in the DOM in all cases – how else could the "electrification gap" programme be profitable? Hence, it is questionable whether geographic uniformity of tariffs achieves its stated policy goals in all instances. Therefore, this principle should be reconsidered with a view to removing market distortions.

The third focal area of the report concerns the French biofuels programme. The report states that the tax rebates for biofuels[24] led to a reduction in tax revenue of

24. Note that the programme relates to biofuels intended for blending with automotive fuels.

FF 1 billion in 1996 alone, amounting to 13 times ADEME's total expenditures on energy efficiency and renewables in the same year.

The biofuels produced using very significant government resources have only minor net energy content – in other words, the energy input to produce one tonne of oil equivalent of biofuels is very high, and much higher than for other renewables such as wood. The scale of the programme goes far beyond what would be required for a mere demonstration programme.

The report concludes that the biofuels programme was motivated more by the desire to provide temporary relief from necessary adaptations in the agricultural sector than by the desire to promote promising renewables and protect the environment. However, by adding new distortions to existing distortions, such policies may achieve little more than the transfer of welfare to small but vocal pressure groups at the expense of society at large and, eventually, of the environment. In light of the increasingly pressing need to find cost-effective ways to limit CO_2 emissions, the government should reconsider its spending and allocate resources where they are most effective. The government has recently begun evaluating productivity gains in the biofuels programme.

RECOMMENDATIONS

The government should:

- ☐ Implement the measures set out in the National Programme to Combat Climate Change swiftly, and according to the anticipated schedule.
- ☐ In particular, implement the measures addressing demand and emissions growth in the transport sector without delay, as these measures will become fully effective only in the long term.
- ☐ Continually monitor the effects of various economic incentives. Adjust and tighten policies in a flexible and market-compatible way if necessary in light of the stabilisation target.
- ☐ Continue to review its energy efficiency and renewables policy with respect to all its main objectives.
- ☐ Continue and reinforce the current priority given to measures, energies and technologies that are effective and low-cost and that have the greatest potential for market uptake.
- ☐ Provide greater continuity and stability to energy efficiency and renewables policies.

- ☐ Review the biofuels programme with a view to ending tax support as soon as possible.

- ☐ Review the principle of geographic uniformity of tariffs because it distorts the market and eliminates promising niche markets for renewables in the DOM.

5

FOSSIL FUELS

COAL

Overview

Hard coal production in France is now concentrated at three underground mines in the Lorraine coal field (Reumaux, Vouters and La Houve), and four opencast sites in central/southwestern France (Aveyron, Gard, Aumance and Blanzy). Production in 1999 amounted to 4.5 million tonnes. In addition lignite mines in the Provence region produced approximately 0.7 million tonnes in 1999.

Hard coal production is concentrated in the hands of the state-owned Charbonnages de France (CDF). Production costs for hard coal are well above market prices: in 1998 extraction costs of coal were estimated at FF 766 per tonne, versus a market value for the coal of only FF 259 per tonne. As a consequence, CDF loses over FF 6 billion per year from its coal mining activities and carries an onerous debt burden (FF 35 billion). These losses are somewhat offset by the profitability of SNET (Société nationale d'électricité et de thermique), which owns and operates coal-fired power stations (including a 250 MW circulating fluidised bed plant at Gardanne) and is involved in other activities (such as engineering).

Under these circumstances, France is planning to phase out its hard coal industry while maintaining state aid for restructuring the sector. Under the terms of the National Pact for Coal (Pacte charbonnier), signed between Charbonnages de France and the trade union organisations in 1995, indigenous coal production is to be progressively reduced and will cease completely by 2005, although the profitable operations of the company (such as power generation) are expected to continue. In line with this agreement, production of hard coal has declined from 7 million tonnes (Mt) in 1995 to 4.5 Mt in 1999, a reduction of 35 per cent. Industry employment has declined to 9,100 people, down about 37 per cent over the past four years.

State Aid

Since 1997, state aid for the coal industry has come in two forms: a contribution for social security costs associated with restructuring the industry (approximately FF 2.8 billion in 1999) and loans and a capital contribution (dotation en capital) applied directly to the company's balance sheet. The European Commission considered this capital contribution to be state aid.

State aid to the coal industry must be authorised by the European Commission. To date the Commission has not authorised the aid for 1997-99, and in a notice issued

in October 1999 stated that it "considers that several elements in the aid notifications submitted by (the government of) France could be contrary to Community law". The European Commission has concluded that the purpose of the capital contribution is to permit CDF to borrow in order to cover operating losses[25].The Commission requested that France provide arguments to show that the aid is compatible with Community legislation. The IEA secretariat's estimates of assistance to the French coal industry from 1990 onwards are given in Table 1.

Despite the plan to phase out domestic mining, the new French electricity law passed in February 2000 permits the Minister of Energy to require up to 10 per cent of domestic power generation to be derived from domestic coal[26]. It should be noted that power generation from domestic coal in France accounted for 7.4 per cent of electricity production in 1998.

OIL

Overview

Remaining French oil reserves are estimated to be around 15 million tonnes. France produces about 2 million tonnes of oil equivalent, amounting to some 2 per cent of its oil consumption. Production is concentrated in the Paris basin (60 per cent) and in the Aquitaine region (40 per cent) and has declined since 1988. However, French oil companies are very active abroad. Nearly all of the oil used in France (92 per cent) is imported from three regions, the middle east (43 per cent), the North Sea (32 per cent) and Africa (17 per cent).

There are 13 refineries in metropolitan France and one small plant in the overseas department of Martinique with a total throughput capacity of 95.5 million tonnes per year. It is currently estimated that Europe has about 60 million tonnes of refining overcapacity per year, and according to the *Union française des industries pétrolières* (French Association of Oil Industries, UFIP), France is one of the regions where the profitability of refining is particularly low.

This low profitability is due in part to the discrepancy between diesel and gasoline taxation described in the Taxation section in the Energy Markets and Energy Policy

25. "The difference between the losses and aid to cover current production costs is covered by loans authorised by the French authorities and issued annually by Charbonnages de France." Commission of the European Communities (CEC): *State Aid. France*. Commission notice pursuant to Article 88 of the ECSC Treaty and Commission Decision No 3632/93/ECSC of 28 December 1993, addressed to the other Member States and other interested parties, concerning aid falling under the Community rules for State aid to the coal industry – N 3/97, 2/98, 1/99 – France. Official Journal of the European Communities (1999/C 280/03) of 2 October 1999.
26. The EU Electricity Directive allows the use of up to 15 per cent.

chapter above[27]. The French refining industry had originally developed its refinery capacity for conversion of heavy fuel oil into gasoline. This was necessary in response to declining heavy fuel oil demand caused by the substitution of oil-fired power generation by nuclear. However, throughout the 1980s the tax gap between diesel and gasoline widened increasingly in favour of diesel. The French oil industry believes that this has led to the loss of part of the export market, estimated at 1.5 million tonnes per year. In 1998, the French oil industry had to import 8.2 million tonnes of diesel fuel from neighbouring countries, while France itself exported 3.5 million tonnes of gasoline at discount prices. The refining industry believes that the share of diesel cars in the entire car fleet would have to be reduced to 25 per cent from the current 41 per cent to re-balance the situation.

In France, as in other IEA countries, the number of service stations has declined since the mid-1970s. This decline is attributed partly to strong competition in the retail market. Between 1994 and the end of 1998, the number of service stations declined from 19,000 to 17,125. In 1985, more than 40,000 service stations existed. The oil refiners and marketers attribute the tend of service station closures in part to unfair competition from supermarkets which are suspected of selling below cost and without respecting safety regulations.

Having found some truth to these claims, the government has strengthened the provisions of the Competition Act of 1996, notably the prohibition against selling at a loss, and has reinforced the 1996 Commerce Act, inserting a provision that allows control of the development of automotive fuels sales by supermarkets.

The government has also had a support policy since the early 1990s for small retailers of automotive fuels. The aim of this policy is to maintain petrol supply in remote areas. The policy is financed by a tax that yielded a total revenue of FF 53 million in 1997. The tax was raised in December 1999 to yield a total revenue of FF 73 million. The Government intends to maintain this higher level of support in 2001.

TotalFinaElf Merger

In 1998, France's largest oil and chemicals company Elf Aquitaine was fully privatised. France's second-largest oil company Total was also privatised down to a government stake of 5 per cent in 1995 and 0 per cent in 1996. In November 1998, Total and the oil corporation Petrofina announced their intention to merge. The resulting conglomerate, TotalFina, announced its intended merger with Elf on 13 September 1999. This merger created the fourth-largest oil company in the world in terms of turnover, and the fifth-largest in terms of oil reserves. Through

27. The effect of taxation is powerful, but other factors are also at work. For example, there is excess production of gasoline (compared to diesel) throughout Europe. Also, France has less catalytic cracking capacity than other European countries. Catalytic cracking, after vacuum distillation, yields increased amounts of diesel and gasoline.

Table 1

IEA Secretariat Estimates of Assistance to French Coal Producers

(FF Million or FF per tonne)

Assistance Category [a]	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999p*
I. ASSISTANCE INCLUDED IN PRODUCER SUBSIDY EQUIVALENT (PSE)										
a) Aid to cover operating losses	1,149	1,153	1,284	1,262	1,962	371	569			
b) Grant associated with write-down of assets	0	0	0	0	44	44	35			
c) Residual charges/depreciation and servicing of loans transferred to the Central Office	814	1,085	843	1,124	0					
d) Capital contribution and loans attributed as aid to current production [b]								2,489	2,578	2,369
Total PSE (FF million)	**1,963**	**2, 238**	**2,127**	**2,386**	**2,006**	**415**	**604**	**2,489**	**2,578**	**2,369**
Total PSE ($ million)	**360**	**397**	**402**	**421**	**361**	**83**	**118**	**426**	**438**	**385**
FF per tonne produced	175	205	208	265	247	49	73	396	530	523
$ per tonne produced	32	36	39	47	45	10	14	68	90	85
Hard coal Production (Million tonnes)	11.199	10.910	10.249	8.990	8.109	8.495	7.755	6.286	4.863	4.532
USD/FF exchange rate (OECD figures)	5.45	5.641	5.294	5.662	5.552	4.991	5.116	5.837	5.892	6.149

p Preliminary data, subject to revision.

[a] Definitions of categories are in Appendix D of Coal Prospects and Policies in IEA Countries: 1987 Review (Paris: OECD, 1988).

[b] From 1997, aid provided by the French government does not include a specific operating aid grant. A portion of the capital contribution (dotation en capital) and loans has been declared as "aid for the reduction of activity" in its filings with European Commission.

Table 1 (Continued)

IEA Secretariat Estimates of Assistance to French Coal Producers

(FF Million or FF per tonne)

Assistance Category [a]	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999p*
II. ASSISTANCE NOT BENEFITING CURRENT PRODUCTION										
d) Conversion costs	660	725	457	445	0	0	0			
e) Early retirement	3,620	3,365	779	728	636	561	516			
f) Exceptional expenditure on workers who lose their jobs	0	0	0	0	252	180	155			
g) Aid towards residual costs resulting from administrative, legal or tax provisions	0	0	0	0	64	74	72			
h) Aid towards additional work resulting from restructuring	300	225	304	185	147	219	189			
i) Aid towards mining damage caused by pits previously in service	0	0	0	0	22	42	22			
j) Research and development aid	80	15	15	15	15	15	15			
k) Assistance to cover social security costs	0	0	2,923	2,930	2,867	2,860	2,842			
l) Capital contribution and other assistance [b]								3,869	4,059	4,135
Total aid not benefiting current production (FF million)	**4,660**	**4,330**	**4,478**	**4,303**	**4,003**	**3,951**	**3,811**	**3,869**	**4,059**	**4,135**

p Preliminary data, subject to revision.

[a] Definitions of categories are in Appendix D of *Coal Prospects and Policies in IEA Countries*: 1987 Review (Paris: OECD, 1988).

[b] From 1997, aid provided by the French government does not include a specific operating aid grant. A portion of the capital contribution (*dotation en capital*) and loans has been declared as "aid for the reduction of activity" in its filings with European Commission.

this move, Total increased its oil and gas production by 30 per cent, its reserves by 20 per cent and the number of its refineries from five to nine. The French government does not hold shares in TotalFinaElf (TFE) but maintains a "golden" share in Elf.

Due to the size of the transaction, this merger required approval by the European Commission. The Commission gave its approval on 9 February 2000. As part of the approval procedure, the new company made a number of commitments regarding four markets examined by the Commission. The commitments are to be applied exclusively in France. Their purpose is to maintain competition in each market while preserving the benefits of the merger. The commitments are:

- 70 service stations on French motorways are to be sold, divided equally between the two groups' trade names.
- Interests held in three oil pipelines (Trapil, SPMR and DMM) and in 17 storage depots for refined products will also be partly or fully divested.
- The logistical assets for LPG in France, currently held by Elf Aquitaine and Elf Antargaz, will be sold.
- Half of the supply infrastructure for the Lyon and Toulouse airports is to be opened to third parties.

NATURAL GAS

Market Overview

Demand

Natural gas has a long history in France, though its share in the country's primary energy consumption of about 13.1 per cent remains significantly below the European average (21 per cent). From 1973 to 1997, the use of natural gas in France has increased by an annual average of 3.6 per cent. Today, France consumes about 34.4 million tonnes of oil equivalent of natural gas per year. Natural gas accounts for about 27 per cent of industrial final energy consumption and 24 per cent of residential final consumption.

The relatively low penetration of natural gas is mainly due to three reasons:

- The large share of electricity in the residential heating market.
- The priority given to nuclear power in power generation.
- The relatively sparse population of France and the relatively high costs of connecting remote communities.

But France expects a strong increase in its gas consumption over the next 15 years, bringing natural gas to over 19 per cent of the country's primary energy consumption in 2010 and reaching almost 25 per cent in 2020.

Table 2
Present and Forecasted Natural Gas Demand
(Mtoe)

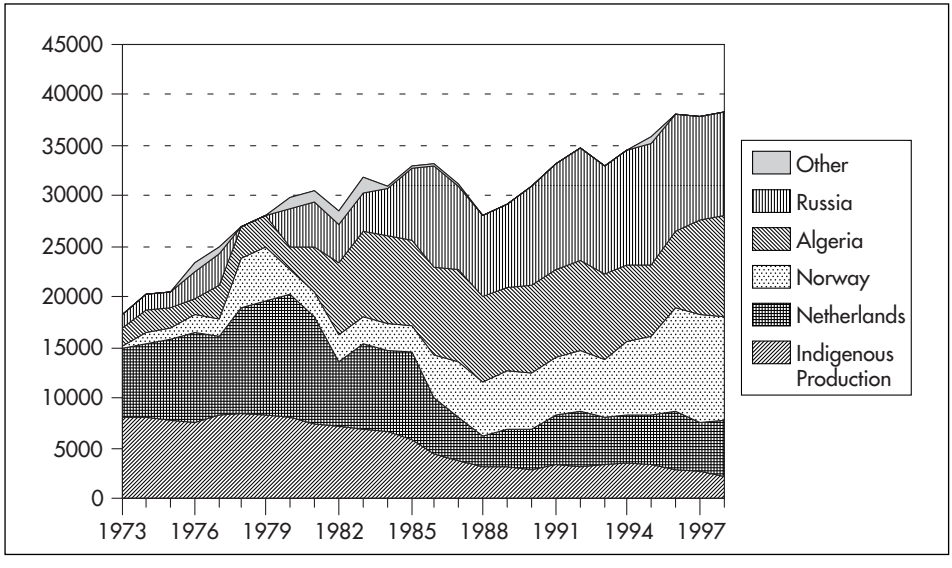
Sector	*1998*	*2010*	*2015*
Residential	9.4	17.1	18.8
Commercial and other	8.9	8.3	10.5
Industrial	14.0	15.1	16.5
Power generation, CHP	1.6	17.4	33.9
Own use	0.5	1.7	2.7
Total	**34.4**	**59.7**	**82.4**

Sources: IEA/OECD Paris, 2000, and country submission

Supply

Virtually all the gas consumed in France is imported. Today, only 5 per cent is produced domestically (mainly from the Lacq field operated by Elf in south-west France) and indigenous production is set to decline over the medium term. Most of the gas imports stem from non-European countries (Russia and Algeria) or countries in which the production and sale of gas are highly concentrated (Russia, Norway, Algeria). Gaz de France (GDF), the wholly state-owned gas supply, transmission and distribution company, is the only importer of natural gas (it holds the exclusive rights to import and export natural gas).

Figure 10
Natural Gas Supply by Source 1973-1998 (million cubic metres)



Source: *Natural Gas Information*. IEA/OECD Paris.

France has an evenly diversified gas supply portfolio: in 1999, 31 per cent of the gas was sourced in Norway, 28 per cent in Russia, 24 per cent in Algeria, 12 per cent in the Netherlands and 4 per cent in France, with other suppliers accounting for 1 per cent (mainly LNG from Qatar and Nigeria).

Imports from Norway, the Netherlands, Algeria and Russia are based on long-term take-or-pay contracts of more or less twenty years, which provide France contractual supply security in compensation for its own lack of resources. The contracts also provide GDF flexibility and time to identify further secure and cost-effective supply options for the future. The duration of GDF's import contract is generally about 20 years. Since GDF concluded these contracts at different times, some of them will reach their term earlier than others.

GDF intends to diversify its sources of supply even further by continuing to expand supplies from its own reserves. For this purpose, GDF wants to invest and own shares in foreign gas fields. GDF's target is to produce 15 per cent of total gas sales from its own reserves within five years. GDF has already formed partnerships, and has invested jointly with Elf in the UK's Elgin-Franklin field and with Total in the UK Murdoch field in 1998. GDF also has additional smaller investments. By 2001, GDF's own production capacity should amount to 1.6 bcm per year.

In this connection, it should be noted that the newly merged group TotalFinaElf is a sizeable producer of natural gas on world scale, with important assets notably in the North Sea, which it could bring to the French market depending on economic incentives.

Transport and Modulation (Storage)

Transport

Thanks to the French gas industry's technical and commercial skills and the large investments into transmission and storage, France enjoys a favourable position for the supply and transit of natural gas in an integrating European market.

France receives pipeline gas at three different inlet points:

- From Russia at Medelsheim at the Franco-German border from the MEGAL system (entitled to 12 bcm per year).
- From the Netherlands, Norway and the UK at Blaregnies at the Franco-Belgian border.
- From Norway at Dunkirk from the NorFra system (15 bcm per year capacity).

In addition, France has two large-capacity LNG receiving terminals at Fos-sur-Mer (Marseille) and Montoir-de-Bretagne with working capacities of 150 thousand cm and 360 thousand cm per year, respectively. Montoir-de-Bretagne is Europe's largest LNG receiving terminal.

Gas transits France to Spain (2 bcm per year of Norwegian gas to Enagas since 1993) and a long-term agreement was signed with Snam of Italy for the transit of 6 bcm per year of Norwegian gas (for this purpose, GDF is constructing an additional pipeline from the Franco-Belgian to the Franco-Swiss border).

In addition, GDF has an important swap agreement with Enel of Italy covering 3.5 bcm per year. Under this agreement, GDF has received at its Montoir-de-Bretagne terminal since 1999 the LNG from Nigeria contracted by Enel. GDF swaps this LNG for LNG supplies from Algeria and piped gas from Russia. This constitutes a complicated and innovative exchange of gas supplies between European players.

GDF also holds shares in transit pipeline systems abroad that are important to its own gas supply: MEGAL (Germany), WAG (Austria) and SEGEO (Belgium).

In 1998, the total French pipeline transmission network extended about 32,012 km. This is comparable in length to the network in Italy and almost double the length of the network in the UK. Italy and the UK are comparable to France in population. The French network is less than 60 per cent as long as the network in Germany, which has a much larger population than France. The gas distribution grids in France totalled about 140,500 km, which is comparable to Italy, but considerably less than the total km of distribution pipelines in Germany and the UK (288,000 and 256,000 km respectively).

Transport (transmission and distribution) is regulated by concessions through which the holder receives authorisation to construct and operate the facilities. Ownership, however, remains in the hands of public authorities (state concessions for transmission and municipal concessions for distribution).

The high-pressure transmission grid connects the larger urban districts - roughly 30 per cent of the country's towns and municipalities. Thus, approximately 75 per cent of the population in metropolitan France is within reach of the gas grid. At the time of this review, 40 per cent of the households in France (about 28 per cent of the population) were connected to the gas grid, but connectivity is growing. In 1998, GDF hooked up 280 municipalities.

Modulation

Gas suppliers in France face particularly high demand seasonality. Demand in August is typically less than 24 per cent of demand in January (seasonality on average seems to be less pronounced in other European countries). This demand seasonality needs to be addressed by modulation.

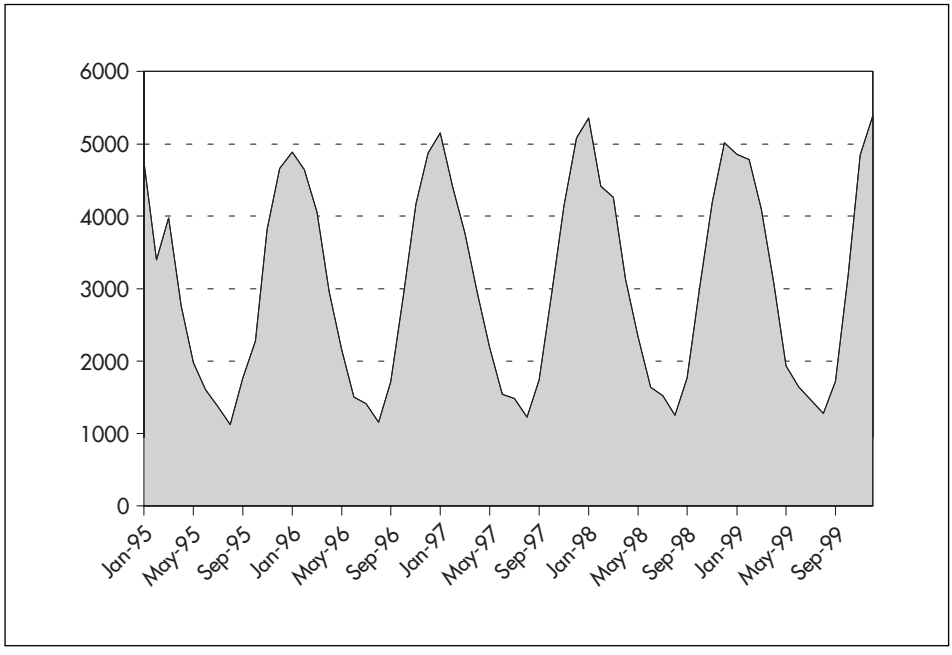
Storage is the prime modulation instrument. With about 10.5 bcm working capacity and 182 mcm peak output per day, France has the largest storage capacity in Western Europe in relation to its annual consumption (third-largest capacity in absolute figures after Germany and Italy). Statistically, total storage working capacity covers more than a quarter of annual consumption. Under normal conditions, storage filling occurs during summer and withdrawal is made in winter.

Figure 11

Natural Gas Pipelines and Facilities Map, France, 1999

Source: *Natural Gas Information 1998*, IEA/OECD Paris 1999.

Figure 12
Monthly Gas Consumption, France, 1995 to 1999
(million cubic metres)



Source: IEA monthly gas statistics.

On extremely cold days in winter, storage withdrawal has accounted for up to 58 per cent of total consumption.

There are 15 storage sites scattered around the main consumption centres in France. They are mostly aquifer storage sites, a minority consisting of salt cavities. GDF operates 12 of the 15 sites (or 80 per cent of total capacity). Internationally, GDF is at the forefront of storage technology development.

There are plans to extend storage capacity in line with demand growth in the foreseeable future. As one example among others, the gas production field of Lacq, operated by Elf, could have some potential to become a significant storage site once the field is depleted.

GDF is also required to maintain storage for strategic security reasons. About one-third of the country's total storage capacity is held in case of a supply disruption. This capacity can, however, also serve to cover peak demand in winters with below average temperatures (none in recent years).

Other modulation instruments include supply swing in the import contracts, modulation of internal production and interruptible gas supply volumes. Supply

swing is expensive and there seems to be an economic advantage in reducing this cost element as far as possible by favouring other modulation tools. Nevertheless, there appears to be considerable swing in Dutch and Algerian supplies and to a lesser extent in supplies from Norway and Russia.

Nominally, 40 per cent of gas supplies to the industrial sector is covered by interruptible supply contracts. In practice, though, the number of customers that can really be interrupted - i.e. those that would be able or prepared to cope with an interruption - is said to be much less. Unfortunately, precise information on the real interruptibility of so-called "interruptible customers" does not seem to be publicly available. Until now, the French gas suppliers gave preference to other means of modulation before making use of the contractual provisions to interrupt at specific times and under specific conditions, even though interruption constitutes a cost-effective way of load balancing.

The French gas supply system is designed to guarantee uninterrupted supply to all firm consumers under circumstances equalling the coldest year in the last 50 years or the highest daily demand peak in the past 50 years, or in the case of a year-long interruption of 30 per cent of its supplies. This constitutes one of the highest supply security standards in the world.

Industry and Institutional Structure

France's natural gas supply sector is highly concentrated and dominated by GDF. Since GDF's creation in 1946 it has enjoyed an exclusive right over import and export, as well as a dominant position in the high-pressure transportation network and the distribution network. GDF is fully state-owned. 90 per cent of the transmission network and 95 per cent of the distribution networks are operated under licence by GDF, which also operates 80 per cent of the storage capacity in France. GDF supplies about 88 per cent of France's gas consumption.

Three other entities operate a transmission system – Gaz du Sud-Ouest (GSO), Compagnie Française du Méthane (CFM) and Société Elf Aquitaine de Réseau (SEAR):

- GSO is owned by Elf (70 per cent) and GDF (30 per cent) and markets in southwestern France gas contracted from GDF or abroad (but swapped with GDF due to the latter's exclusive import right) and gas produced from Elf's field in Lacq.

- CFM is owned by GDF (55 per cent), Elf (30 per cent) and Total (15 per cent). It is located in central France and leases the pipeline grid it uses, which is owned and operated, and was built, by GDF.

- SEAR is owned by Elf (70 per cent) and Caisse de Dépôts et Consignations, and has a limited transport concession in the southwest.

Note that Elf and Total are now part of the recently established group TotalfinaElf.

CFM supplies about 6 per cent of the French gas market and GSO supplies about 3 per cent. Both GSO and CFM sell gas to local distribution companies or directly to large industrial users, but do not distribute gas themselves.

As said earlier, GDF is the dominant gas distribution company (as well as the dominant transmission and supply company). But in the GDF distribution areas, gas distribution and sales to households and small consumers are handled jointly with electricity distribution and sales through a joint arm of GDF and EDF called EDF-GDF-Service (EGS). EDF is the dominant partner in this activity. Separate marketing and provision of services take place for larger customers.

Besides GDF, there are 17 non-nationalised local gas distribution companies, which have been exempted from the nationalisation law of 1946. They account for about 2.7 per cent of sales in France. Depending on their location, they buy their gas from GDF, GSO or CFM. They sell their gas mostly to households, commercial and small industrial consumers though some also sell to larger industrial consumers. The largest among them distribute gas in Bordeaux, Strasbourg, Grenoble, Colmar, Dreux and Guebwiller. GDF and Elf have a 16 per cent stake each in Gaz de Bordeaux; Total and GDF have a 24.9 per cent stake each in Gaz de Strasbourg. The entire industry as described above employs about 28,000 people in France (25,000 of them with GDF).

Table 3
Transport Infrastructure Owners in France

	Transmission (km)	*Distribution (km)*
GDF	21,658	134,525
CFM	6,352	-
GSO	3,930	-
SEAR	72	-
17 LDCs	-	6,031
Total	**32,012**	**140,556**

Source: Ministère de l'Économie des Finances et de l'Industrie, White Paper *Vers la future organisation gazière française*, Paris, June 1999.

Regulation

The gas industry is primarily regulated by the Ministry of Industry. The most important instruments of regulation are concessions, price regulation and the contracts concluded between the government and GDF (contrats d'entreprise). Both the transmission and distribution activities are regulated by concessions.

Transmission concessions

In gas transmission, a distinction can be made at the technical level between the "Grand Réseau de Transport"(GRT) – an integrated system of high-pressure transmission pipelines of bi-directional flows, forming the backbone of France's gas supply system – and the so-called antennas that are local one-directional high-pressure branches connecting the GRT to the distribution areas or end users.

A state concession is needed to build and operate both these types of high pressure pipes and the requirements imposed upon the concessionaire are defined in the terms of reference for such concessions adopted in 1952. The minister responsible for gas may require the concession holder to transport gas beyond what is defined in his concession if it is judged to be in the public interest and if there is spare capacity. Such utilisation may, however, only take place on a temporary basis.

Distribution concessions

By the 1946 Nationalisation Law, GDF in principle holds the concession for gas distribution in almost all areas except those already served by the 17 Régies at the time GDF was created (the 17 non-nationalised distributors).

Until 1982, the terms and conditions of concessions for all gas distribution companies were laid out in a standard contract. Then, with the decentralisation policy, municipalities and urban districts gained the freedom to negotiate their own terms and conditions when concession agreements come up for renewal, though a model concession agreement - drawn up collectively by all interested parties in 1994 – is typically adopted. This model concession agreement imposes upon the concessionaire a number of rules concerning obligation to supply, connection and delivery conditions, tariff setting and investment criteria for network extensions.

The criterion used for extensions is that discounted profits from the project divided by the discounted investment stream of the project over a deemed duration of 20 years should be equal to or larger than 0.3. This means that new investments are required to give a nominal internal rate of return of 12 per cent using a discount rate of 8 per cent. The objective is to avoid allowing local municipalities to develop the grid in an uneconomic fashion, thereby distorting competition. Concessions normally last 30 years. Concession agreements must contain public service obligations as laid down in the 1946 law.

Under all concession agreements, gas distributors are subject to the public service obligation to supply any customer within their concession areas. All distributors (including marketers of gas from the high-pressure transportation grid) must also sell firm gas according to published, non-discriminatory tariffs; i.e. customers within a particular region with identical load characteristics must be charged the same tariff.

The 1946 law prevented the non-GDF distributors from expanding their networks outside their existing supply areas. Thus, any municipalities not already connected to the grid could only be connected by GDF. In practice, this restriction prevented a number of municipalities, which, due to technical or economic constraints would

not be connected by GDF to its system, from being connected to one of the 17 non-GDF distributors or to another supplier. In some instances non-GDF distributors could have connected new supply areas more efficiently than GDF. These distortions led to Parliament's adoption in April 1996 of a change to the 1946 law allowing municipalities situated next to a non-GDF supply area to choose between being connected by GDF (subject to profitability criteria) or by the neighbouring non-GDF distributor. At the beginning of 1998, another change in the law was adopted, requiring GDF to develop a three-year-plan for connecting new municipalities. Municipalities not included in GDF's three-year-plan would be allowed to grant a distribution concession to another company, provided that the latter's capital is at least 30 per cent publicly owned, and that security of deliveries is guaranteed.

It seems, though, that this reform has only a limited practical impact, other than speeding up the extension of GDF's network. Since most of the unconnected municipalities being left out of GDF's plan are small and remote, it is not clear to what extent they can attract a minimum-30 per cent-publicly-owned gas supplier. Municipalities located at the border also cannot count on supplies from a neighbouring foreign supplier. But France numbers about 36,000 municipalities, of which 20 per cent are connected to gas, representing 41 million inhabitants or 70 per cent of the total population. Therefore, it seems that if other suppliers, including the non-nationalised distribution companies, were genuinely allowed to compete with GDF in this area, efficiency could be enhanced in terms of cost and speed of extending supply.

State supervision of GDF

GDF is run as a commercial enterprise, but is under government influence. Government representatives comprise one-third of the board, and a government commissioner and deputy commissioner sit with the board. The Chairman and the Director General are appointed by the Council of Ministers. Since 1991, the government has used planning agreements (contrats d'objectifs) as the principal mechanism for state control and supervision of GDF. The agreements run for three years and set objectives for operational and financial performance.

GDF is subject to the same rules regarding investment as other nationalised French industries: a real discount rate of 8 per cent over 25 years is applied to any new project, including transport system improvements and grid extensions to connect new municipalities. Connecting a new municipality must be profitable to GDF. In the case of insufficient profitability, the municipality or Département was allowed to provide subsidies up to a specified ceiling. This measure was abolished in 1998.

Tariffs and Prices

Gas prices in France are regulated. This applies to gas prices for end users served by the distribution system as well as to gas supplied directly from the high-pressure transportation system (both the GRT and the antennas).

Under the decree regulating gas prices (Decree no. 90-129 of 20 November 1990), all supplying gas companies determine the tariffs and prices they wish to apply, but must obtain approval from the Ministry of Finance. Formally, the suppliers propose and register end-user prices and transport tariffs with the Ministry of Finance, which then examines the tariffs in consultation with the Ministry of Industry (presently, industry and finance come under the single Ministry of Economic Affairs, Finance and Industry). The Minister fixes tariffs based on a pre-established formula contained in the contrat d'entreprise between the Government and GDF (see below). The formula is used to ensure cost-reflective prices. If prices are not cost-reflective, the companies are invited to modify their proposals. The formula can be used in a flexible way, e.g. in case of drastic and sudden changes in supply costs, the Minister may allow cost pass-through with a delay or in a limited way. The Minister has made use of this flexibility in the past.

The companies calculate the gas prices based on a cost-plus approach that takes into account the construction, maintenance and operating costs for storage, transportation and distribution facilities. The 1990 gas pricing decree states that the invoiced price of gas may include a capacity charge and a commodity charge, both of which may take into account the size of the subscribed volumes, the volumes effectively used and other parameters like the load of the customer's off-take over the year.

Within the terms of the decree, retail suppliers are allowed to take the market situation into account when setting tariffs for the various categories of customers. In practice, this means that a large share of the gas sold is priced in relation to the main competing fuels - most often gas oil and heavy fuel oil.

The exceptions to the general rule of price and tariff regulation are prices to large industrial customers with an annual consumption of over 5 GWh. These prices can be negotiated freely with the client, although the gas-supply company still has to submit them to the authorities. In practice, prices for this customer group are set in relation to the price of substituting fuels - mainly distillates or heavy fuel oil. The overwhelming majority of these large customers is supplied directly from the high-pressure transmission systems by GDF, GSO or CFM.

Another way of regulating gas prices is through agreements (contrats d'objectifs) between GDF and the government for distribution customers. Average annual tariff adjustments are calculated according to a price-cap formula defined in the contract. The formula implies that half of all productivity gains realised by GDF are to be reflected in the tariffs. For the period 1997 to 99, GDF was obliged to reduce its annual costs (gas purchase costs excluded) and to reflect 50 per cent of the absolute cost saving in the tariffs, which were supposed to drop on average by at least 1.6 per cent.

Tariffs and prices are set differently for each customer group. For a number of large industrial consumers and distribution companies that take gas directly from the GRT, the tariff comprises a subscription fee, capacity fee and commodity fee. In terms of share of total price, the commodity fee is by far the most important – for a

large industrial customer it typically accounts for 85 to 90 per cent of the total price. The transportation element contained in these tariffs is the same for all buyers. On the GRT everybody pays the same per-equated price regardless of the location of the off-take point (this is not the case for the implicit transportation fee paid on the antennas).

There are two price sections for industrial customers: one for off-takes below 24 million kWh per year and one for off-takes above that volume. Thus the system provides an incentive to increase volumes. The fixed capacity charge is multiplied by the daily off-take per year (kWh/day/year). If the need for load factor is low, i.e. if the off-take is evenly spread over the year, the customer pays a lower unit price than when the off-take is uneven. This means that customers with a high need for load factor pay a higher unit price to contribute to the costs caused by load factor. In this sense there is a link between the cost of load factor and the price paid by the customer.

The tariff also distinguishes between off-take in summer and in winter in that both the capacity charge and the commodity charge are lower in the summer. The commodity price is 1.27 c/kWh lower in summer than in winter, the difference being the same in both volume sections. Paying a higher price for gas delivered in the winter is also one way of contributing to the higher cost associated with winter gas since it has to be stored. The price difference is also an incentive to concentrate off-take in summer. Relatively, this incentive is stronger for the small customers than for large ones.

The majority of the distribution companies and some industrial customers take their gas from one of the antennas. The implicit tariff for transportation on the antennas is in principle calculated in the same way as the implicit tariffs on the GRT, but with one major difference: the tariff is not geographically uniform, but calculated to allow recouping of specific grid investment costs (depending to a large extent on the length of each connection), in accordance with the volumes transmitted. There are six different zones, reflecting distance. One exception to the rule of not per-equating the cost for transportation on the antennas is the Paris region. All buyers in this region pay the same price, which is higher than the price paid for direct off-take from the GRT.

End users in public distribution areas can choose among different sets of tariffs, depending on their consumption. The GDF tariff system is simple. There are different tariff categories to match different consumer types, but each consumption category tariff consists of a fixed subscription charge and a price per kWh. In GDF's tariff system, the different consumption categories are:

- The base tariff (annual consumption of 0 – 1,000 kWh[28] - typically consumers using gas for cooking only).
- The BO tariff (annual consumption of 1,000 – 7,000 kWh[29] - typically for cooking and water heating).

28. High calorific value.
29. High calorific value.

- The B1 tariff (annual consumption of 7,000 – 30,000 kWh[30] - typically for cooking, water and space heating).
- The B2I tariff (annual consumption above 30,000 kWh[31] - typically for collective heating systems, small industry and commercial enterprises).
- The B2S tariff (similar to B2I, for consumption in excess of 150,000 kWh, with a seasonal pricing element – typically for industrial heating).
- A subscription tariff scale, STS, for large consumers with seasonal demand - typically a large collective heating system.

The base and BO tariffs apply to all of GDF's supply areas. Tariffs B2I and above vary according to geographical zone. These tariffs are linked to pricing at the outlet of the antennas: the price paid for gas on the antennas is a function of distance from the GRT system and the size of the pipeline serving the customers on the antenna. The same zone system is used in gas distribution and is reflected in six different price levels. The presumption underlying this arrangement must be that a distribution system far away from the GRT is typically small, thus costly to develop and requiring a higher price.

Table 4
GDF Household Tariffs
(FF, all taxes included)

	1997 *Annual average*	*1998* *Annual average*	*1999* *15 August*
Base Tariff			
Annual subscription	140.04	141.78	115.84
Price/100 kWh (hcv)*	33.98	34.30	32.00
B0 Tariff			
Annual subscription	217.13	218.99	178.76
Price/100 kWh (hcv)	26.92	27.22	25.40
B1 Tariff			
Annual subscription	787.76	796.63	649.71
Price/100 kWh (hcv)	17.75	17.95	16.72
B2I Tariff			
Annual subscription	1,115.02	1,124.93	916.84
Price/100 kWh (hcv)	16.67	16.86	15.71

Source: Ministère de l'Économie et des Finances, http://www.industrie.gouv.fr/energie/statisti/pdf/prix.pdf

* hvc = high calorific value

30. High calorific value.
31. High calorific value.

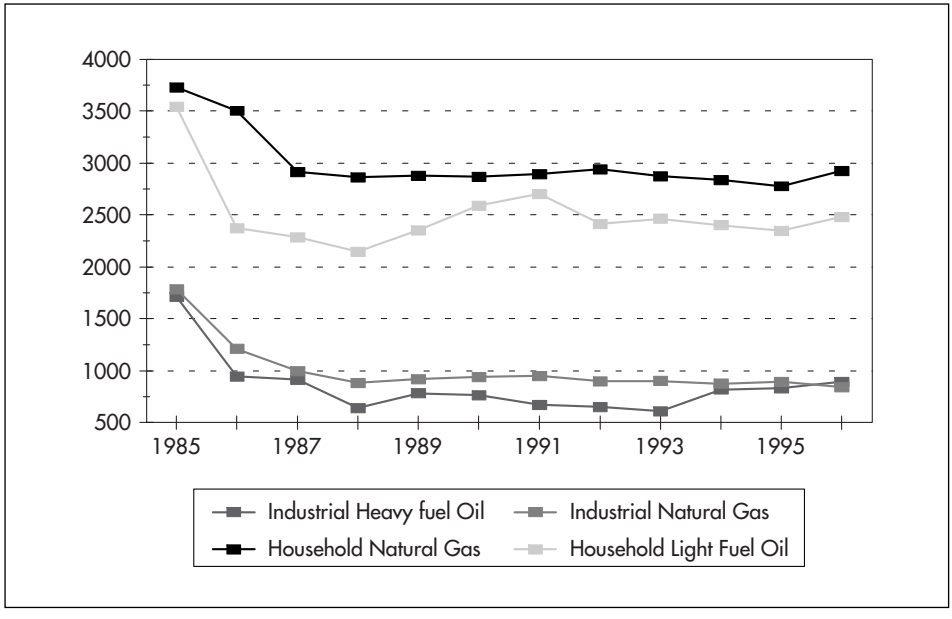
Table 5
GDF Household Tariffs for a Typical Annual Consumption
(FF, all taxes included)

Typical annual consumption tariff		*1997*	*1998*	*1999*
B0	2,326 kWh (hcv)	40.28	40.71	36.76
B1	23,260 kWh (hcv)	23.49	23.74	21.68
B2I	34,890 kWh (hcv)	22.07	22.31	20.38

Source: Ministère de l'Économie et des Finances, http://www.industrie.gouv.fr/energie/statisti/pdf/prix.pdf
hvc = high calorific value.

As in most other IEA countries, gas prices are linked to prices of other fuels. The French gas import contracts are indexed mainly to petroleum product prices. Then a cost plus approach is used for end-user tariff calculation. This method results in a relatively good correlation between end-user gas prices and petroleum product prices.

Figure 13
Industrial and Residential Fuel Prices, 1985-1996
(FF/toe, net calorific value, taxes included)



Source: Ministère de l'Économie et des Finances, DIGEC.

In comparison with other IEA countries, end-user gas prices in France seem to be in the middle of the range of prices at which gas is supplied, based on data collected by the IEA on typical average gas prices. Compared to the larger European countries surrounding France, end-user gas prices in France appear competitive with Italy and Germany, but are consistently higher than in the UK. Reasons for this include the UK's very favourable situation in terms of gas production (indigenous reserves, high share of associated gas production, limited outlet possibility beside the UK for UK offshore production) and the highly competitive gas market in the UK.

The Path of Reform

Since June 1999, the government has engaged in a wide consultation process on the approach to take towards the implementation of the EU Gas Directive, and thus on the reform of France's gas sector. On 17 May 2000, the government adopted a draft Natural Gas Bill for submission to the Parliament.

Several discussion documents and position papers were tabled earlier[32]:

- A white paper by the Ministry of Economy, Finance and Industry[33], 17 June 1999.
- The position of the Gas and Electricity Council[34], 12 October 1999.
- The position of the Economic and Social Council[35], 27 October 1999.
- The report of Mrs. Bricq, Member of Parliament, 27 October 1999.
- The bill proposed by the Ministry of Economy, Finance and Industry, 19 November 1999.

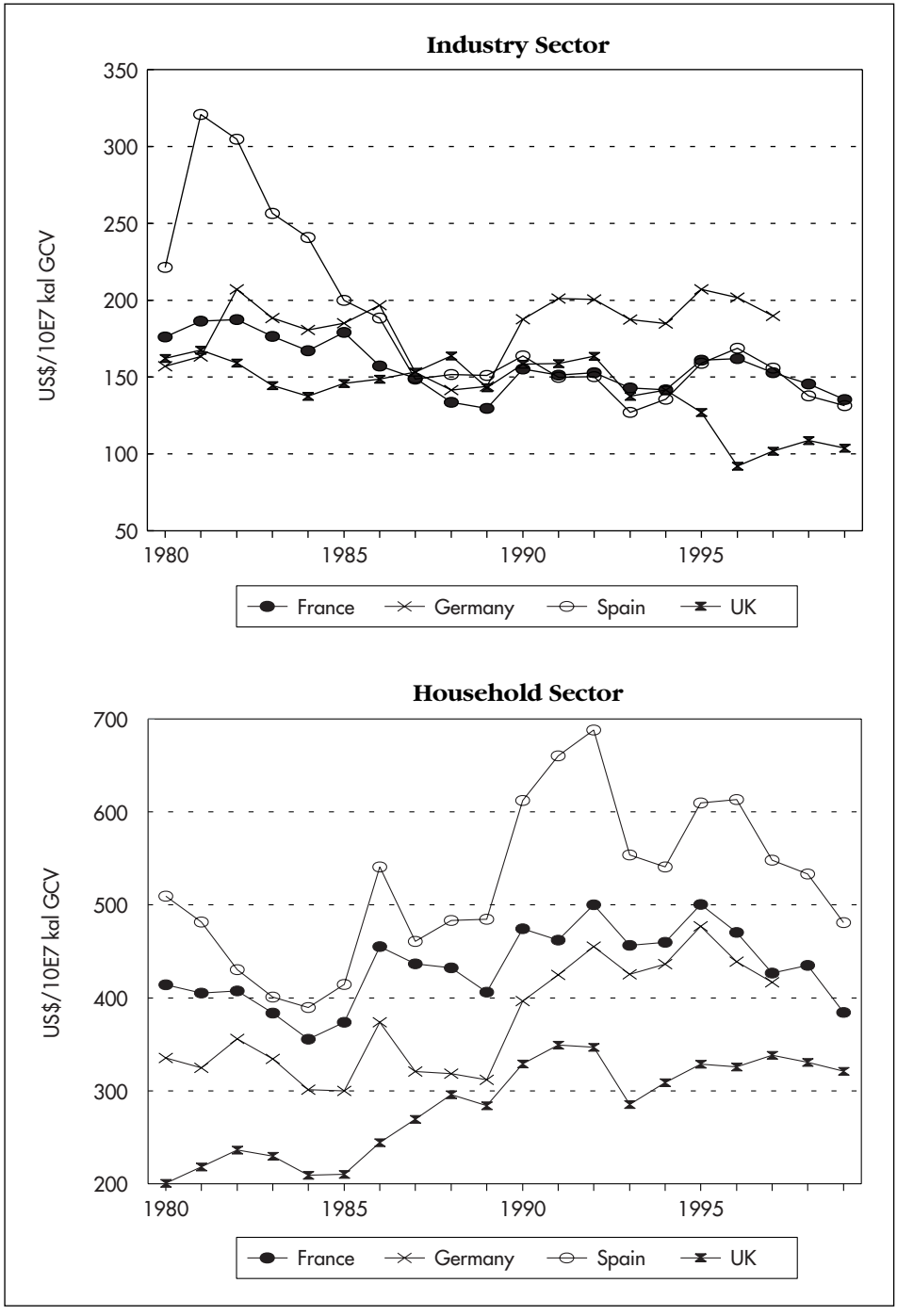
These discussion documents are becoming less relevant as the political discussion progresses. The following relates briefly the main points of the bill presently under discussion:

Public service: the proposed objective is to strengthen the public gas service, in particular to continue lowering the costs for private consumers, to extend the grid and gas supply to more consumers, to diversify supply sources and storage for the sake of security and to guarantee supply at harmonised tariffs for small, captive consumers across France for social cohesion, while progressively introducing

32. Documents in French language can be downloaded from the Economy and Finance Ministry's Web site: http://www.industrie.gouv.fr/cgi-bin/industrie/frame0.pl?url=/energie/sommaire.htm
33. *Vers la future organisation gazière française*, Ministère de l'Économie, de Finances et de l'Industrie, DGEMP, June 1999.
34. Conseil Supérieur de l'Électricité et du Gaz.
35. Conseil Économique et Social.

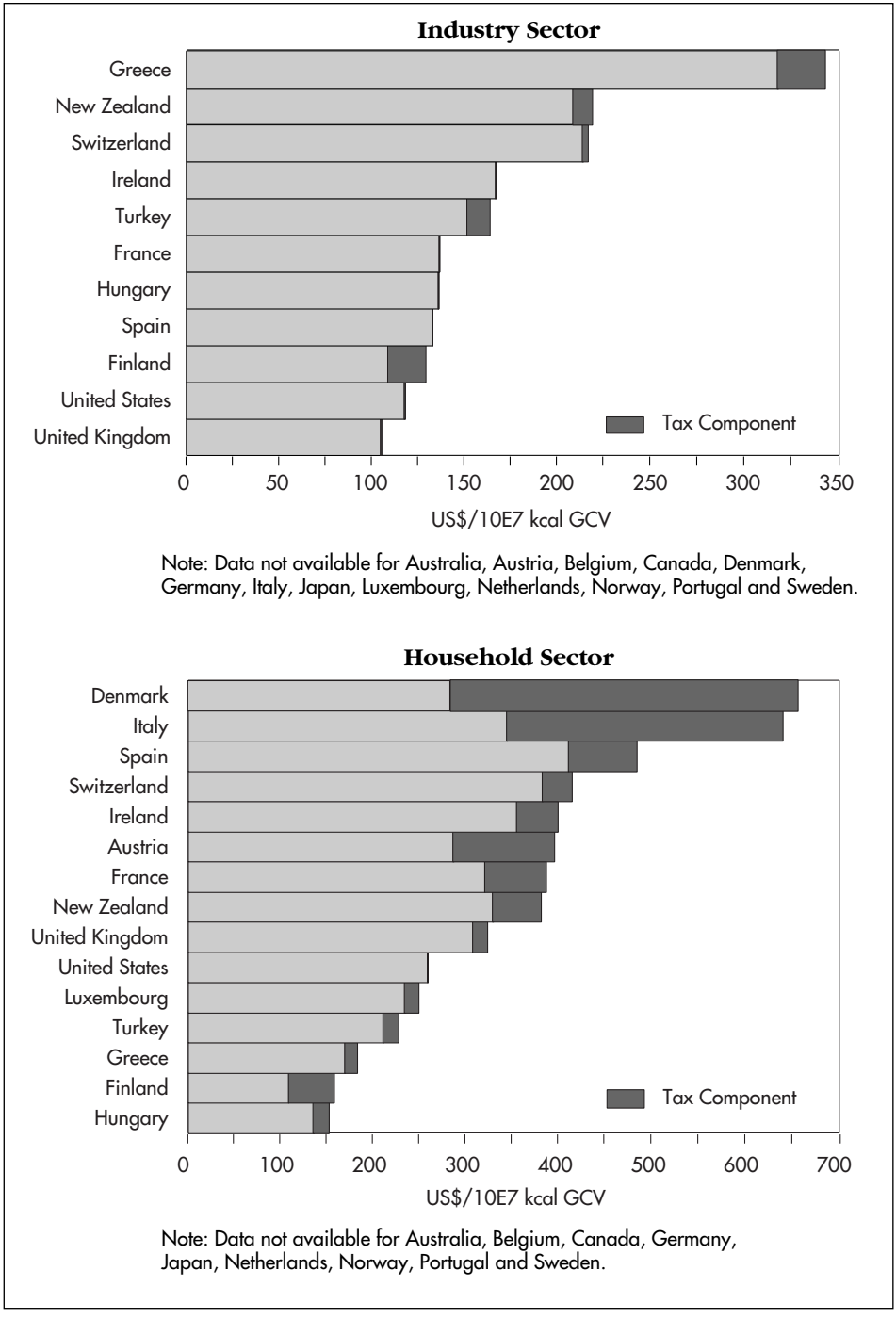
Figure 14

Natural Gas Prices in France and in Other Selected IEA Countries, 1980-1999



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 15
Natural Gas Prices in IEA Countries, 1999



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

competition. All market players, old and new, would be subject to the same public service obligations in a non-discriminatory and transparent way.

Competition: the bill proposes to organise competition and market opening in a way that allows large gas consumers, particularly large industrial gas users, to negotiate their gas purchases and take advantage of the opportunities offered by the liberalising markets in Europe.

Market opening: market opening is proposed to be progressive and in keeping with the minimum eligibility thresholds set in the EU Gas Directive. This means that as of 10 August 2000, final customers and non-nationalised distributors taking at least 25 mcm per year and per site should become eligible – the equivalent of about 20 per cent of the gas market. There will be progressive lowering of the thresholds in order to attain market openings of 28 per cent in 2003 and 33 per cent in 2008.

Third Party Acces (TPA): the proposal stipulates that Third Party Access to the systems should be granted under mutually agreed contracts and non-discriminatory conditions to the extent that the operator can still guarantee fulfilment of the public service obligations, the transit agreements and the long-term take-or-pay commitments, as far as reasonable. Preference is given to regulated TPA.

Unbundling: accounting unbundling is proposed, with installation of Chinese walls.

Regarding security of supply, the gas supply activity should be subject to an authorisation or licence, obtained from the ministry responsible for the industry by fulfilling the following, non-discriminatory conditions: technical, economic and financial viability; compatibility or compliance with the public service obligations; minimum standards of safety and security of supply. The latter criterion includes a sufficiently diversified supply portfolio once the entity in question reaches a specific significance in the market (to be defined). The May 2000 draft of the new Gas Bill proposes to limit the obligation to diversify supply sources to non-eligible customers (distributors) and to those eligible customers whose gas supply is crucial for essential needs of the country (health, security, defence, etc.).

Storage and modulation: the bill does not propose to subject storage to TPA, but to allow storage owners to sell storage services and capacity as well as other means of modulation on the market to an extent that does not conflict with their public service obligations and meeting the grid's balancing needs.

Regulatory authority: the bill proposes the creation of a joint electricity and gas regulator (Commission de régulation de l'électricité et du gaz – CREG), which should work with the existing competition authority.

The draft law proposes to abolish GDF's import and export monopolies through deletion of the relevant clauses in the 1946 Nationalisation Law. It also contains provisions relating to independent investment in gas transportation infrastructure and to the legislation concerning underground storage.

Towards the end of July 2000, it became clear that adoption of the law before 10 August was not possible. The first Parliamentary reading of the bill is expected to occur before the end of 2000, but adoption may only occur during the first half of 2001.

CRITIQUE

The paramount policy change in France regarding the markets for fossil fuels concerns the natural gas industry. Despite the country's heavy dependence on gas imports from Russia and Algeria, France is well-prepared to handle any major supply disruption. It has one of the most diversified import portfolios in Western Europe and the most substantial storage capacity in relation to annual consumption. Its gas supply security standards are among the world's highest.

However, it is possible that France's level of gas supply security is beyond optimum level and it is unclear whether gas security has been achieved at least cost. The seasonality in gas demand has been addressed by a strong reliance on storage with comparatively little weight given to other means, notably interruptible supplies. In this respect, higher gas penetration in power generation – if used as base load, for example in industrial autogeneration and CHP schemes – may help to decrease seasonality.

On the whole, an outsider's impression of how the French gas supply is handled is one of relative rigidity, with the public service policy primarily responsible. The service public is presently organised with a nationalised GDF enjoying exclusive import and export rights and a massively dominant position in gas transportation, distribution and supply. Such organisation has made the industry more transparent to the policy maker and to some extent has allowed exploitation of economies of scale. On the other hand, this system excludes competition as well as synergies and complementarities between gas-supplying entities which could increase overall efficiency and thus provide general economic benefits. Competition would also increase consumer choice.

While the new draft Gas Bill addresses a large number of issues, it is not entirely clear that it will cause GDF's dominant position to subside quickly. This position, as well as GDF's large incumbent advantage, are not tackled directly in the proposal.

For example, the approach to the extension of the grid and the connection of new municipalities and consumers remains concentrated in the hands of GDF. Whereas the three-year plan for GDF agreed by the state and GDF is useful, other options should not be disregarded. Other entities within France, like the non-nationalised distribution companies, CFM or GSO, but also other companies with the technical and financial ability or companies in neighbouring countries may in some instances be able to connect and supply a municipality or an end user more efficiently or under better conditions than GDF.

The concession system for the construction and operation of gas transmission and distribution pipelines seems too restrictive. Large gas users that would have the technical knowledge and potential to build and operate a natural gas pipeline, for example chemical or oil companies, are hindered from doing so, even for supplying their own gas needs. Liberalisation here would be in the general interest and would ultimately introduce competitive pressures that benefit all energy consumers. The May 2000 draft of the Gas Bill proposed a degree of liberalisation in these areas.

The public service objective of regional and social cohesion, which imposes a certain harmonisation in gas tariffs for consumers up to a specific size, also seems too restrictive. There is no regional cohesion in France regarding natural gas in any case, since a large share of French municipalities does not even receive gas. Furthermore, natural gas, unlike electricity, is substitutable in almost all its applications. Thus, people's dependency on gas is not comparable to their dependency on electricity. This characteristic implies that natural gas needs to be priced at competitive terms if it is to be sold to energy consumers, irrespective of their location.

The energy market itself provides gas price ceilings (demonstrated by the strong correlation of end-user gas prices with those of petroleum products). Significant price disparities should therefore be the exception rather than the rule. A more liberal approach to pricing, while maintaining price regulation where necessary, would offer more flexibility in gas supply without endangering social or regional cohesion. Furthermore, the public service approach through GDF and EDF may have contributed in the past to sub-optimal competition between gas and electricity, particularly in the residential sector.

Regarding the future structure and functioning of the gas market, the EU Gas Directive provides an opportunity to review gas sector regulation and its structure in order to make improvements and enhance efficiency. The government appears genuinely committed to make full use of this opportunity. Its proposals on organising the public service in a more competitive market environment in a transparent and non-discriminatory fashion merit commendation.

In the long-term, gas sector liberalisation can bring economic benefits in the form of consumer choice, efficiency and lower end-user prices with better security of supply. The crux is to introduce genuine and widespread competition without weakening the downstream gas industry (this does not necessarily require fortifying GDF's position within France). Regulation should be fully oriented towards the interests of the economy and the public. Public service obligations are perfectly conceivable in a liberalised and competitive market and do not require vertical integration and concentration.

Liberalising the gas sector would not be incompatible with security of supply. The introduction of competition could enhance efficiency while maintaining security of supply because it leads to greater system flexibility. Market pricing of the means by which security is provided – storage, interruptibility, supply swing, back-up – would ensure that the full costs of providing security and modulation are borne by its beneficiaries, and that the degree of security and the way it is provided are

optimised. In view of France's gas supply situation, the government would probably want to keep an active role, for example in monitoring and ensuring diversification of imports. In this respect it is conceivable that market access to gas suppliers could be made conditional on minimum technical and financial standards as well as on guarantees regarding their supplies (such as reserve stocks in storage, back-up contracts or a diversified gas portfolio). But such conditions should not be too restrictive since they might render market access too difficult and hamper the development of short-term trade.

For the purpose of efficiency and supply security, it would be important to set conditions that are conducive to short-term trade and liquidity as quickly as possible. Given the unfavourable location of Europe's supply sources and the concentration in production and supply, it seems likely that initially only large gas users will profit from the consumer choice they will enjoy through Third Party Access. As trade and competition develop, however, other consumers should be able to benefit. It is therefore important for France to keep in step with the market developments occurring elsewhere in Europe. In this respect, the government should go beyond the minimum eligibility and market opening criteria in the Gas Directive. At the same time, greater independence and involvement of the non-GDF affiliated gas players should be encouraged or made possible. For this purpose, all present gas-supplying entities in France should be made fully eligible for TPA. Cogenerators should also be given full eligibility. If exceptions are made, discrimination between eligible and captive cogenerators should be avoided as much as possible.

Furthermore, competitive access to or provision of storage and other modulation services would be important. GDF operates 12 out of 15 storage sites (Elf operated two and Géométhane operates one). Without competitive access to or provision of storage and other modulation services it is hard to imagine development of significant degrees of trade and competition. Without the release of at least some of this capacity on the market at non-discriminatory and cost-reflective terms, storage risks remain effectively monopolised, thereby reinforcing GDF's position in France vis-à-vis the other incumbent gas suppliers. Nevertheless, it is conceivable that a share of the total storage volume or specific storage sites could remain reserved for public service purposes like seasonal and operational balancing, safety and strategic storage, in particular for the captive market.

Furthermore, access rules and tariffs should be non-discriminatory and designed to enable access and trade, including secondary trade in commodity and capacity. If, as proposed, a joint regulatory authority is established for gas and electricity (CREG), the government should ensure that the regulator is totally independent of the market. The relationship of the regulator with the government should be arm's-length.

Further efforts favouring the integration of upstream interests abroad with downstream activity in France deserve encouragement. Considering the future position of GDF in the European market and its status in France, it seems sensible to pursue the present policy and GDF's strategy of acquiring further upstream interests and expertise. Developing partnerships between GDF and foreign gas producers also seems worth pursuing.

But this should not be at the expense of competition within France, including inter-fuel competition. Further concentration within France's energy sector should be avoided. It should be noted that the TotalFinaElf group has sizeable upstream assets and is already involved in the French downstream gas market through various assets, mainly GSO, SEAR and CFM. Providing the group more room and opportunity for manoeuvre in the French gas market in competition with GDF would be a fast and efficient way of promoting upstream and downstream integration and thereby the diversification and security of gas supply. The May 2000 draft of the new Gas Bill takes encouraging steps in the right direction and already takes into account the following recommendations to a certain degree. Nevertheless, the recommendations remain valid since the bill is not yet law.

RECOMMENDATIONS

The government should:

- ☐ Review its public service approach to the natural gas sector in order to make it compatible with the requirements of a liberalised market and to increase efficiency and flexibility in gas supply.
- ☐ Ensure that more room is made available for gas supply, transmission and distribution activity by others besides GDF. Abolish GDF's exclusive gas import and export rights. Whereas GDF remains the main actor and instrument for public service in gas, the positive contributions others can bring to the consumer and to the gas supply system should not be disregarded.
- ☐ Give large gas users or other entities with technical and financial ability the opportunity to build and operate their own gas supply infrastructure and to buy gas via Third Party Access. Greater independence and involvement of the non-GDF-affiliated gas players should be encouraged or made possible.
- ☐ Be prepared to go beyond the minimum provisions of the EU Gas Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. Allow extensive eligibility for cogeneration. It is important that France keep in step with the European market development, both for France's consumers and for its gas industry.
- ☐ Retain a role in monitoring and ensuring diversified imports in view of France's gas supply situation. Any measures to this effect should avoid rendering market access for newcomers too difficult.
- ☐ Make sure storage and other modulation instruments are offered on non-discriminatory and cost-reflective terms. This is vital, given their importance for gas trade and the existing concentration in storage. Part of the existing storage capacity could, however, be reserved for public service purposes like seasonal

and operational balancing, safety and strategic storage, in particular for the captive market.

- ☐ Third Party Access rules for transport and tariffs should be made non-discriminatory and designed to enable access and trade, including secondary trade in commodity and capacity.
- ☐ Ensure that the regulator is totally independent of the market; the relationship of the regulator with the government should be arm's-length.
- ☐ Continue the promotion of upstream and downstream integration by pursuing GDF's strategy of acquiring upstream assets and by providing more freedom of action for TotalFinaElf and others in competition with GDF downstream.

6

ELECTRICITY

THE STATUS QUO BEFORE REFORM

Industry structure

France has the second-largest electricity market in IEA Europe after Germany. Its main power company, the fully vertically integrated, state-owned Electricité de France (EDF), is the largest power company in Europe and dominates the French market[36]. Like its gas industry counterpart Gaz de France, EDF was created through the Nationalisation Act (Loi sur la nationalisation de l'électricité et du gaz) of 8 April 1946. Previously, some 1,300 companies had been active in the power market, including privately-owned and publicly-owned companies, as well as companies with mixed ownership. Some of these companies had been in competition with each other.

EDF enjoys a statutory monopoly in electricity transmission (and, until February 2000, foreign trade)[37] but not in power generation or distribution. The company is not the only generator; nor is it the only distributor in France. Under Articles 8 and 23 of the 1946 Nationalisation Act, certain generating companies and distributors were exempt from nationalisation.

In long-term average, EDF has generated between 85 per cent and 95 per cent of all electricity generated in France. In 1998, EDF generated 94.3 per cent (1997: 91.2 per cent) of all electricity in France. The variation is due to the amount of hydro generation, since the non-EDF generators have a larger share of hydro than EDF itself. EDF's dominant position stems from the terms of the Nationalisation Act and the fact that investment in generating capacity since then has been based on multi-annual government planning with strong EDF involvement, especially in plant siting. The 'non-nationalised' generators are:

- The Compagnie Nationale du Rhône (CNR), which is responsible for managing the Rhône watercourse and also produces electricity from large dams (3 per cent of generation in 1997).
- The nationalised coal company Charbonnages de France (CDF). Generation by CDF accounted for 1.5 per cent of total generation in France in 1998 (1.7 per cent in 1997).

36. EdF's foreign operations are described in the box Electricité de France Group below. This section focuses on the company's position in the French market.
37. This section describes the industry structure prior to the current reform efforts. The reforms are described in the section "The Path of Reform" below.

- The national railway company SNCF (Société nationale des chemins de fer) (0.3 per cent in 1997).
- Municipal and other local public corporations (régies) as well as small-scale private generators with annual production below 12 GWh (1.5 per cent in 1997).
- Industrial autoproducers (2.3 per cent in 1997).

EDF's position in the distribution sector is fixed through concession agreements. Some 5 per cent of the distribution grid is not owned by EDF and on average about 5 per cent of all electricity sold in France was not distributed by EDF. In 1998, 89.2 per cent of all electricity sold in France was distributed by EDF. The exemptions to nationalisation on the distribution side concern some 140 distribution companies from the following categories:

- Municipally-owned distributors or distribution companies with mixed public-private ownership, such as the local utilities of Strasbourg and Grenoble.
- Agricultural and consumer co-operatives.

EDF runs 99 per cent of the high-voltage transmission system on French territory; the French state owns these lines. At intermediate and lower voltage, the non-nationalised distributors still own a small share of the grid. With modernisation, these parts of the grid have become increasingly obsolete and the 'non-nationalised' part of the transmission grid has shrunk.

Even though the aforementioned organisations are separate from EDF, they are not necessarily fully autonomous in the operation of their power plants. For example, CNR manages its plants under an EDF concession on behalf of EDF and according to EDF's organisational needs. On the distribution side, the 'non-nationalised' utilities operate under equivalent constraints.

Originally, the Nationalisation Act provided for a somewhat different industry structure. Article 2 of the Act provides for the creation of a distribution sector consisting of at least partly autonomous regional distribution utilities. Articles 21 and 23 describe the functioning and structure of these distribution companies, with further detail to be defined in ministerial decrees. EDF was to be responsible for the co-ordination of the entire system, as well as for generation and transmission. However, these provisions were never put into practice.

Regulation

Regulatory control of the French electricity supply industry lies to a large degree in the hands of the Minister of Economic Affairs, Finances and Industry. The Minister is responsible for price control in all monopoly parts of the industry. But his powers reach much further, since he has the right to nominate EDF's chief

executive officer[38] and its board of administrators, as well as to determine the company's broad lines of development, including EDF's investments, financing and fuel choices. According to Articles 20, 24 and 27 of the Nationalisation Act, all of EDF's borrowing is subject to approval by the Minister. The Minister's representatives on EDF's board have extensive rights of control and can veto every major decision.

In practice, government control of EDF has taken the form of five multi-annual agreements (contrats de plan, contrats d'entreprise) since 1969. Each of these agreements increased EDF's autonomy from the government to a certain degree in exchange for reaching performance targets, including price reductions. The last such contract was signed on 8 April 1997 for the period 1997 to 2000 with a view to preparing EDF for the competitive European power market. The four preceding agreements had broadly similar features.

One feature in all of these contracts is a commitment by EDF to reduce prices in pre-defined steps. This price control element in the agreements refers to average prices and thus influences price levels, but it also contains differentiated instructions on the development of price structures, including the standard tariffs for different customer groups. The last *contrat d'entreprise* committed EDF to reduce its prices to end users by 13.3 per cent (real) in four incremental steps, three of which were effectively carried out:

- 5.7 per cent (4.6 per cent real) on 18 April 1997
- 2.8 per cent (2.5 per cent real) on 29 April 1998
- 3.2 per cent (2 per cent real) on 1 May 1999.

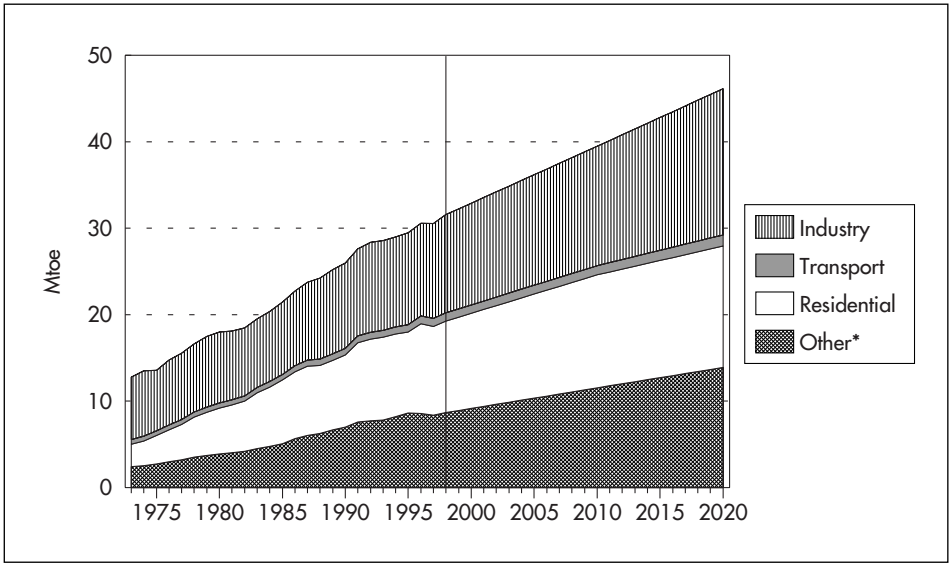
The Electricity Market

Total electricity generation in France amounted to 506.9 TWh in 1998. Of this, 76.5 per cent (79.2 per cent in 1997) was from nuclear, 12.2 per cent from hydro, 7.4 per cent from coal, 2.3 per cent from fuel oil and 1.6 per cent from other sources. 4 TWh or 0.8 per cent were gross imports.

Of this total, 12.6 per cent was exported (14.3 per cent in 1997). Industry consumed some 40.6 per cent, households 31.8 per cent and the services (tertiary) sector 27.6 per cent. Figures 16 and 17 detail electricity consumption by sector and electricity generation by fuel since 1973.

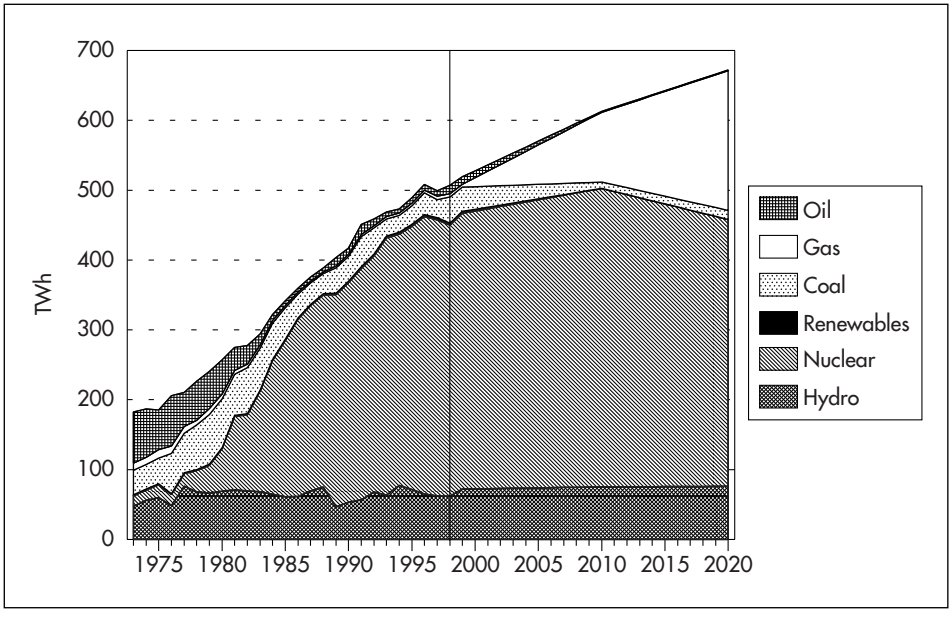
38. Final nomination requires the approval of the Council of Ministers.

Figure 16
Electricity Demand by Sector, 1973-2020



* Includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

Figure 17
Electricity Generation by Fuel, 1973-2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

The French electricity market has two striking features: the predominance of nuclear power and the high share of exports. With almost 80 per cent of power generation from nuclear, France has the highest share of nuclear generation in the world. With more than 50 TWh of annual net exports since the early 1990s, France is the largest net electricity exporter among IEA countries far ahead of Canada (approximately 30 TWh p.a.). Table 6 shows France's power trade with its neighbours.

Table 6
Electricity Exports from France to Neighbouring Countries, 1998
(GWh)

	Exports	*Imports*	*Export Balance*
Andorra	200	-	200
Belgium	4,600	- 1,400	3,200
Germany	13,100	- 600	12,500
Italy	16,600	- 300	16,300
Spain	5,200	- 700	4,500
Switzerland	9,400	- 1,000	8,400
UK	12,900	-	12,900
Total	**62,000** **(1997: 69,634)**	**- 4,000** **(1997: 4,238)**	**58,000** **(1997: 65,396)**

Source: Ministry of Economic Affairs, Finances and Industry.

Both these features have common causes. Perhaps the most important cause is France's relatively poor endowment with energy resources. Although the country has all types of energy resources, including fossil resources and uranium, the amounts found on its national territory are very small. As noted before, the only possible exception is uranium. Consequently, the country was hard-hit by the first oil crisis in 1973, especially since it had just lost easy access to oil resources in its colonies.

Also, the low oil prices of the 1960s had led to a programme of replacing old coal-fired capacity with new oil-fired capacity. The high degree of vertical and horizontal integration of EDF may have played an important role, allowing the company to switch rapidly to the supply source that was seen as the most economic at the time. Based on orders made throughout the 1960s, new capacity coming on stream after 1969 was almost exclusively oil-fired. When the first oil crisis struck in 1973/74, the share of coal generation had fallen to 9.4 per cent from 27 per cent in 1965 (33 per cent in 1950), whereas the share of oil-based generation was almost 43 per cent.

Following the first oil crisis, the government and EDF decided to speed up the nuclear energy programme that had been created almost immediately after World War II[39], and that had been expected to contribute increasingly to electricity generation in any case. One of the reasons for this decision was that nuclear was clearly economic even in the light of the low, pre-1973 oil prices, especially after the 1969 decision to abandon the gas-cooled reactor types developed domestically in favour of a pressurised water reactor (PWR) design.

After 1973, the government's objective was to reduce the use of oil as much as possible throughout the entire energy market and to replace it by nuclear. This policy found its clearest expression in the slogan coined by EDF "tout électrique – tout nucléaire" (all electric – all nuclear). EDF's and the Government's strategy led to a much expanded use of electricity, notably in the heat market. On a lesser scale, a policy favouring the increased use of coal was adopted.

After 1970, and on an accelerated schedule following the first oil crisis, EDF brought on stream 58 pressurised water reactor units, which are still in service today. 37 of them went into service between 1973 and the end of 1980; the remaining 21 followed after 1980. These reactors fall into three series of standardised reactor units of about 900 MW (34 units in service), 1,300 MW (20 units in service) and 1,450 MW (4 units in service). This policy of cost reduction through standardisation of units was not new: EDF had already used it successfully for its large-scale orders of oil capacity. The policy also allowed economically optimal use of the complete supply chain which had been built up in France for the nuclear fuel cycle as well as for reactor construction[40].

By the late 1980s, electricity had begun to penetrate residential space heating on a significant scale: whereas 1.6 per cent of new dwellings were equipped with electrical heaters in 1970s, this figure had risen to 72.2 per cent in 1987. In industry, also, efforts were made to substitute electricity (and gas) for oil for process heat, beyond the existing trend towards electrification. As a consequence, electricity accounts for more than half of industrial energy demand today, compared to slightly less than one-third in 1973.

Despite these developments, however, there were limits to the substitution of oil-fired capacity by nuclear electricity. Power demand began to lag behind the forecasts upon which the schedule of reactor orders was based, partly due to the recessions triggered by the oil crises. It also became clear throughout the 1980s that the fuel mix was beginning to be out of balance with the demand structure. Nuclear is cheapest and best run in base load. Due to the logic and constraints of the nuclear programme, EDF was overbuilding base load capacity.

The other side of the "all electric" strategy, and especially the expansion of electricity use in the heat market, was leading to increased "peakiness" of

39. For further detail on nuclear power in France see the Nuclear chapter.
40. See the Nuclear chapter.

demand: whereas in 1952, winter peak demand lay slightly less than 30 per cent above summer peak demand, winter peak demand in 1992 was about double summer peak demand. This situation was in marked contrast to developments in many other countries, where the summer "load valleys" tended to fill up to some degree due to the increasing use of air conditioning, while their winter peak grew less rapidly than in France[41]. In some countries, such as the US, there are now two peaks, a summer and a winter peak, with the summer peak higher than the winter peak.

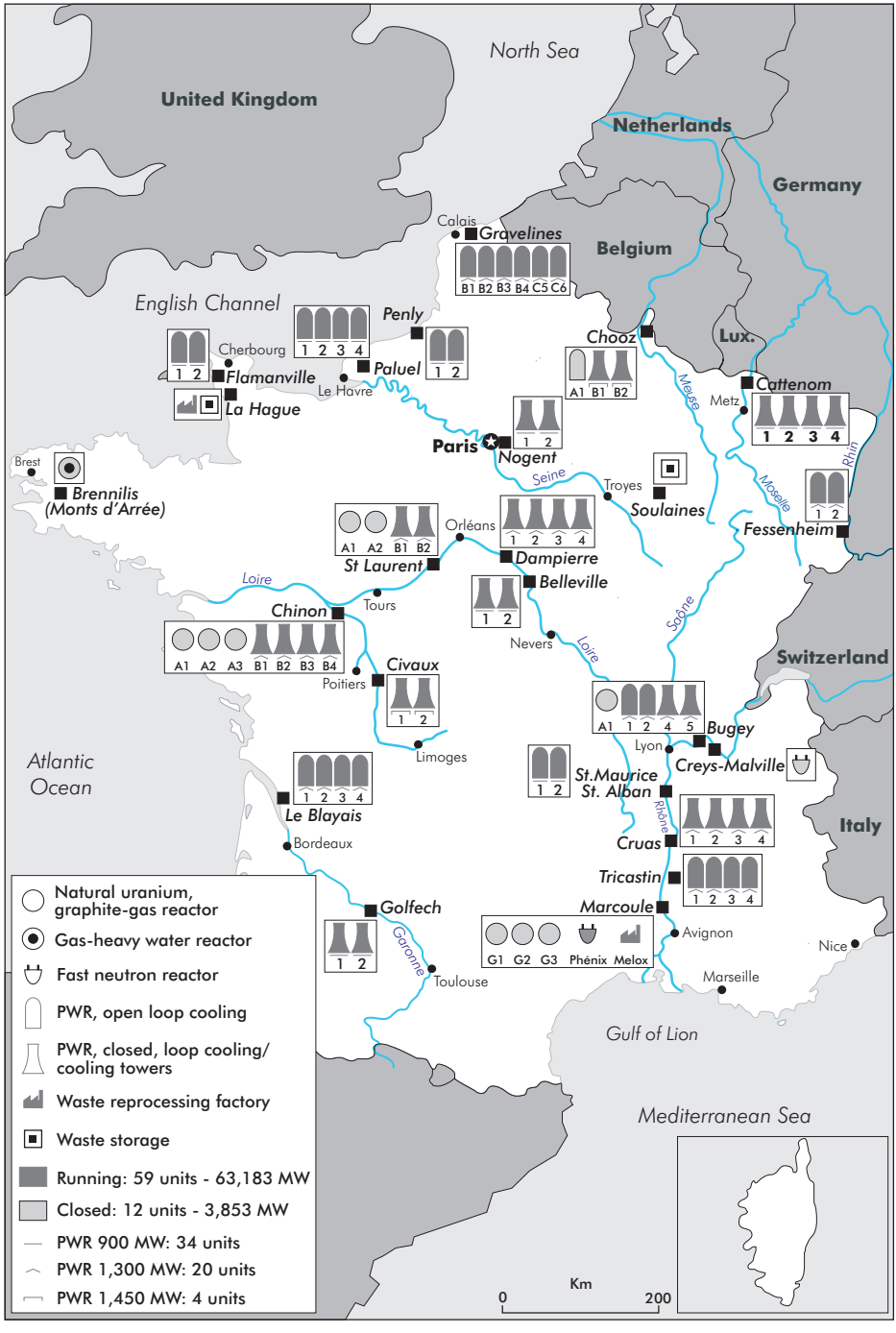
In addition, France had early on begun using highly efficient peak load (time-of-use) pricing structures in its end-user electricity prices[42]. These prices were differentiated according to (time-dependent) marginal cost to a much higher degree than in any other power market in the world and were made accessible to a much wider group of customers than anywhere else. They even include residential customers. These pricing structures give incentives to limit electricity use during peak periods and to consume freely during off-peak periods. The increasing peakiness of demand occurred in spite of these incentives.

EDF responded to this disequilibrium in two ways: it pioneered the technological development of using nuclear plants in load-following mode – something nuclear plants had not been designed for, either from a technical or an economic point of view – and it sought to shed the excess capacity by exporting electricity to the surrounding countries[43]. The latter strategy was helped by the fact that the nuclear programme began to yield comparatively low electricity prices, especially in comparison to some neighbouring countries which had had more difficulty adapting to the high oil prices of the period 1973 to 1986. Figure 19 shows the development of electricity prices in France compared to other selected IEA countries.

These are the main trends that have shaped EDF into the power company it is today. Apart from its solid base in its home market, EDF is very active internationally, with some 12.4 per cent of its generation exported to neighbouring countries in 1999. The company began buying stakes in foreign power companies a decade ago and presently holds shares in power companies in 19 countries (including France), of which eight are European Union countries. The box Electricité de France Group provides a brief overview of the EDF conglomerate.

41. One of the few countries where this effect cannot be observed is Norway, where the low cost of hydro power has made electric heating wide-spread and where air conditioning is rarely necessary.
42. In fact, EdF's Director-General (1967 to 1979), Marcel Boiteux, had contributed decisively to the development of the economic theory of peak load pricing in a ground-breaking 1949 article. See Boiteux, Marcel: La tarification de la demande en pointe: application de la théorie de la vente au coût marginal. *Revue Générale de l'Electricité*. No. 58, 8/1949.
43. A small part of France's electricity exports occurred because some nuclear power plants were constructed jointly by EdF and foreign companies, e.g. the Fessenheim plant.

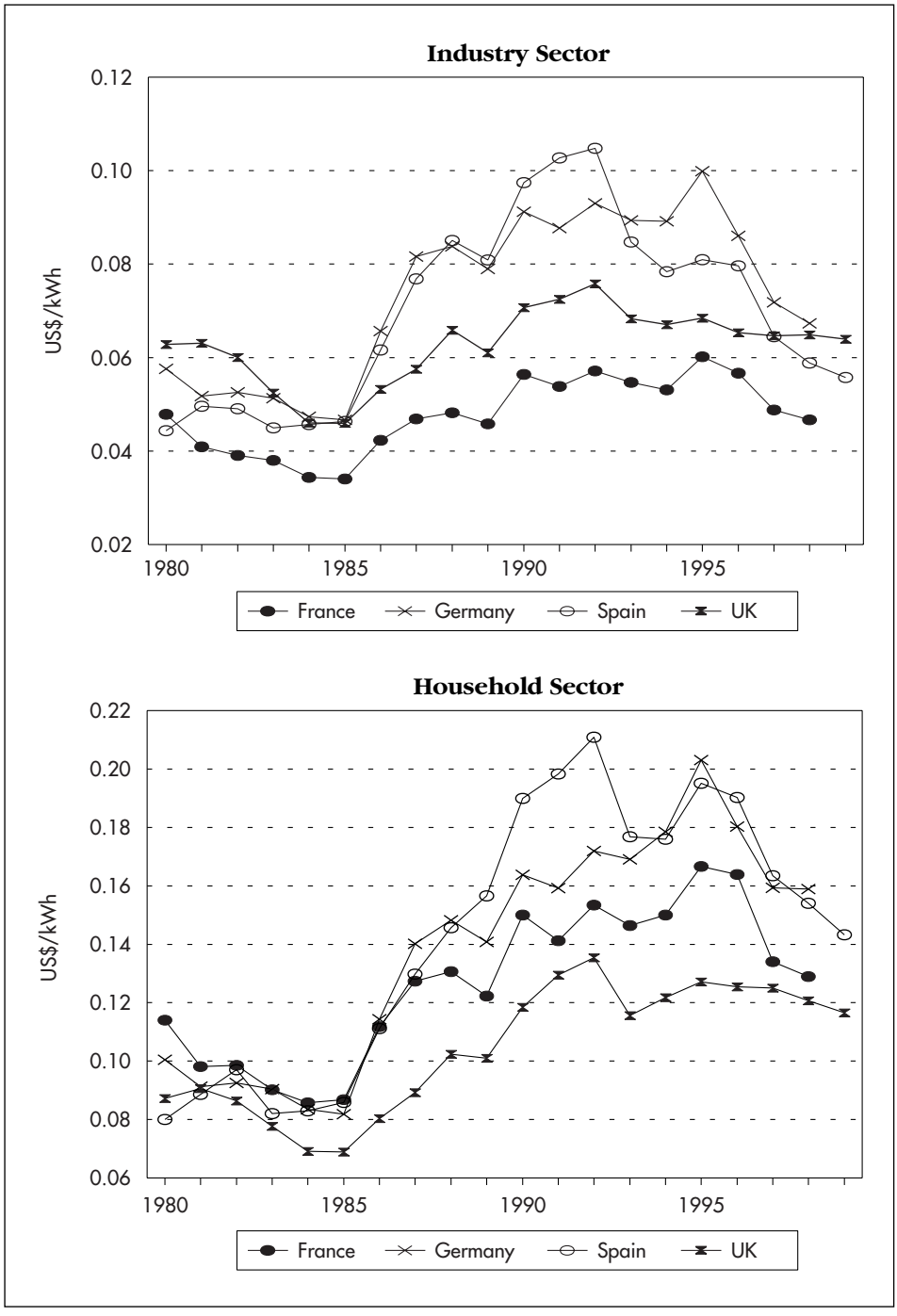
Figure 18
Nuclear Power Plants in France, 1999



Source: Ministry of Economic Affairs, Finance and Industry.

Figure 19

Electricity Prices in France and Other Selected IEA Countries, 1973 to 1999



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 1999, and country submission.

Electricité de France Group

The EDF Group encompasses the domestic parent company Electricité de France S.A. and its 100 per cent-owned holding company EDF International as well as 12 subsidiaries. EDF S.A. owns 88 per cent of the group's assets. EDF International participates in serving more than 15 million customers in 18 countries and owns shares in more than 14.5 GW of power generating capacity outside of France.

EDF's installed capacity on French soil was 102 GW in 1998. This comprised 57 nuclear units with a total capacity of 61.5 GW, 23 fossil-fired thermal plants with a total capacity of 17.7 GW and 23 GW of hydro capacity. According to EDF's own figures, domestic generation was 460 TWh out of a national total of 489.7 TWh. Of EDF's generation, 80 per cent was nuclear, 13 per cent hydro and 7 per cent fossil-fuelled. Of this generation, 57.4 TWh were net exports. EDF served 30 million French customers and had 114,380 employees.

In 1998, EDF Group's consolidated turnover amounted to € 29.5 billion, of which 94 per cent was in the parent company and 6 per cent in the subsidiaries. Net profits were € 1.12 billion, 67 per cent from the parent company and about 33 per cent from the subsidiaries. 88.4 per cent of the 1998 turnover originated in France, 7 per cent in EU countries, 3.2 per cent in non-EU European countries and 1.5 per cent outside of Europe. EDF's profits go to its only shareholder, the French Republic, and have consistently been above € 1 billion since 1996. Beforehand, they were in the range of € 700 million.

In 1999, EDF made further investments abroad, bringing its total capacity outside France to 17 GW and the number of customers to 16 million. Among its acquisitions was a controlling stake in the southwest German power utility Energie Baden-Württemberg (EnBW). Its holdings abroad now amount to € 4.34 billion or FF 28.5 billion, 80 per cent of which are in Europe. Meanwhile, EnBW has made an offer for the Spanish electricity retailer Cantábrica. Some of EDF's investments were made in countries with very competitive power markets, i.e. Argentina, Germany, Spain, Sweden and the UK.

The challenge now facing EDF and the government is to be (and to be seen to be) a fair player in the competitive European electricity market[44] as well as in the world. While nuclear power will still play a large role in the French energy market, EDF and the government need to take a position on market trends, such as the success of the combined-cycle gas turbine (CCGT). There are signs that an adaptation is under way.

44. The adaptation of the French power market to competition is described in the next section,The Path of Reform.

Table 7
EDF Group's Foreign Assets, 31 December 1998

Company (country)	*Generating Capacity (MW)*	*Number of Customers (million)*
ESTAG (Austria)	1,141	0.5
ISE (Italy)	1,291	-
Tejo Energia (Portugal)	600	-
Elcogas (Spain)	335	-
Graninge (Sweden)	590	0.2
Motor Columbus AG (Switzerland)	2,000	0.1
London Electricity (UK)	-	2
Édasz, Démasz (Hungary)	-	1.612
ECK-SA (Poland)	1,000	-
Edenor, Edemsa, Distrocuyo/ Los Nihuiles/ Diamante (Argentina)	660	2.242
Light, Metropolitana (Brazil)	907	7.275
Shandong, Laibin B (China)	3,720	-
SOGEL (Guinea)	97	0.047
Azito, CIE, CIPREL (Ivory Coast)	1,829	0.6
Rio Bravo (Mexico)	495	-
Lydec, Koudia al Baida (Morocco)	50	0.47
Phambili Nombane (South Africa)	-	0.043
Total	**14,655**	**13.089**

Source: EDF.

The government prepares cost estimates for new capacity every three years. Since the mid-1990s, these cost estimates have shown increasing competitiveness of combined-cycle gas turbines in the French market in intermediate load and the government expects that CCGTs will play a significant role in future.

For base load, the calculations show a continued cost advantage for new nuclear at discount rates of 5 per cent and 8 per cent. The IEA's own calculations[45] confirm this result for discount rates of 5 per cent and 10 per cent; France is in fact the only IEA country where nuclear is cheaper than gas in base load at a 10 per cent discount rate.

45. The results are highly sensitive to the underlying assumptions. For these, please refer to International Energy Agency (IEA)/Nuclear Energy Agency (NEA): *Projected Cost of Generating Electricity. Update 1998*. Paris (OECD), 1998.

The French government's 1997 cost estimate also shows that decentralised power production, especially combined heat and power production (CHP) above 10 MW, has economic potential and represents an interesting means to diversify the supply mix. To date, CHP has played only a very minor role in France, compared to other European countries. The economics depend crucially on the possibility of making use of the heat and so far, no major CHP development has occurred.

THE PATH OF REFORM

The Reform Process

The reforms currently under way in the French electricity market are very closely linked to the European Union's efforts in this respect. The Single European Act of 1986 stipulated that "The Community shall adopt measures with the aim of progressively establishing the internal market over a period expiring on 31 December 1992 .... The internal market shall comprise an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured ...." This article was later repeated as Article 7 A of the European Union Treaty and is thus part of the foundations upon which the European Union is built.

As far as the internal market for electricity was concerned, two directives were adopted in 1990, the "Transit Directive"[46] that liberalised transboundary electricity trade and the "Price Transparency Directive"[47] that made it mandatory to report industrial electricity contract prices and other relevant information to the European Commission.

To ensure workable competition in the European power market, a further step had to be taken: extending the opening achieved under the Transit Directive beyond transboundary trade. This was eventually accomplished with the adoption of Council and Parliament Directive 96/92/EC of 19 December 1996 *concerning common rules for the internal market in electricity*, in short, the "Electricity Directive".

This directive had been under negotiation since 1987, starting with a working document that suggested very far-reaching liberalisation including vertical separation, in which the grid would act as a "common carrier"[48]. The "common carrier" regime pre-supposed vertical separation of the power grid from generation and supply. However, many EU member governments were not ready to accept such far-reaching proposals and had no legal means of interfering with private ownership rights to the extent necessary to comply with these plans.

46. Council Directive 90/547/EEC of 29 October 1990 *on the transit of electricity through transmission grids*.
47. Council Directive 90/377/EEC of 29 June 1990 *concerning a Community procedure to improve the transparency of gas and electricity prices charged to industrial end users*.
48. Commission of the European Communities (CEC): *The Internal Electricity Market*. Commission Working Document. COM 238 final of 2 May 1988.

Consequently, the proposals were altered to a grid access regime (Third Party Access, TPA) that does not make any attempt to stipulate vertical separation in ownership between generation, transmission and supply, and that establishes rules for competition compatible with both vertically integrated and vertically unbundled utilities. Different types of Third Party Access rules were discussed, including mandatory, regulated, negotiated and voluntary Third Party Access. Mandatory TPA would have compelled the incumbent utility to transmit power for its competitors under any circumstances. Regulated TPA obliges the incumbent to transmit according to rules supervised and regulated by a regulatory or government authority. Negotiated TPA subjects these rules to negotiations between the parties concerned, with the possibility of referral to regulatory institutions or the courts. Voluntary TPA gives discretion to the incumbent utility whether or not to transmit its competitors' power.

In 1994, France proposed an alternative proposal to the Third Party Access regimes then being discussed: the "Single Buyer" model. This proposal was motivated by concerns relating to the public service principle, also enshrined in the founding Treaties of the EU. In the Single Buyer model, the vertically integrated incumbent utility was to retain the role of power wholesaler who procured electricity from competing generators, whether they were existing generators or new entrants who proposed to construct and/or run new generating capacity. This model also foresaw opening a share of retail supply to competition. For the part of the market that was not opened, the model introduced a competitive element in generation, potentially leading to cost and price reductions for ultimate consumers. For the part of the market that was opened, the model introduced competition, including the possibility of switching suppliers, but it aimed at retaining somewhat more involvement of the incumbent in transactions among third parties than some of the TPA regimes.

The European Union decided to investigate whether the two models could co-exist and decided that they could, given some additional clarification of details of the rules. The Electricity Directive as it was adopted in 1996 enshrines both systems. It requires opening the power market in EU member countries in three steps. These are defined by the EU-wide market share of customers consuming more than

- 40 GWh per annum. Opening was due on 19 February 1999. The minimum degree of market opening was 26.48 per cent of total power sales in each EU country. All customers consuming 100 GWh per year or more were to be made eligible for competition on that date, regardless of their share of the market.

- 20 GWh per annum. Opening is due in 2000. The minimum market share to be opened to competition is estimated at approximately 30 per cent.

- 9 GWh per annum, with opening due in 2003. The minimum competitive market share is estimated to amount to about 35 per cent.

Following the adoption of the Directive by the European Union Council of Ministers and by the European Parliament and its publication in the Official Journal, member

countries had two years to transpose the Directive into their national legal systems. The transposition period expired on 19 February 1999.

The legislation transposing the Electricity Directive into French law is the "Act relating to the Modernisation and the Development of the Public Service of Electricity" (Loi de la modernisation et du développement du service public de l'électricité no. 2000-108 of 10 February 2000). This act had been under discussion since 1998. It was adopted by the Council of Ministers in December 1998 and subsequently submitted to the Parliament. In February 1999, several amendments were made to the bill by the current Government, especially relating to Articles 4, 22, 45, 47, 49 and 50[49]. The bill was adopted by the Lower House of the French Parliament on 2 March 1999 and referred to the Upper House (Senate) in October 1999. The Senate introduced further modifications. In November 1999, the European Commission began launching legal action against France for not transposing the Directive into French law.

On 1 February 2000, the Act was adopted by the Lower House of Parliament and it came into force upon its publication in the Official Journal on 11 February 2000, approximately one year after the transposition of the Directive into French Law was due. The Act contains numerous provisions that require further clarification through Ministerial Decree in future.

In February 1999, the market for eligible customers consuming 100 GWh or more was opened to ensure a minimum degree of compliance with EU legislation during the period when transposition was due but not yet accomplished. EDF took temporary steps to accommodate this market opening in the absence of clear legislation and began to develop interim measures, such as a temporary transmission tariff. This tariff is to remain in force until the required secondary legislation is in place. On 28 March 2000, implementation of the Act was greatly advanced through the creation of the Regulatory Commission for Electricity (Commission de régulation de l'électricité, CRE) and the nomination of its six commissioners. The Regulatory Commission for Electricity is also to become responsible for the regulation of the competitive gas market, once competitive trading is introduced. Meanwhile, more secondary legislation including a decree defining eligibility has been enacted. This decree fixes the current threshold for eligibility at 16 GWh per annum.

The Electricity Act 2000

The French Electricity Act is based not on the Single Buyer model but on regulated Third Party Access. It contains numerous detailed provisions, many of which require further clarification by ministerial decrees[50]. The most important provisions are the following:

49. See the following section for details.
50. At the end of April 2000, only two decrees had been issued: one relating to a technical committee and the other setting up the regulatory authority. By September 2000, more than ten additional decrees and decisions were published, but significant areas remain open to further definition.

Articles 1 and 2 state that electricity supply has to promote the objectives of public service and these articles define the notion of public service. The public service obligations relating to electricity are:

- Independence and security of electricity and energy supply, as well as any long-term planning and government influence required to ensure that this objective is met.
- Abatement of climate change and air pollution.
- Optimal utilisation of national resources.
- Energy efficiency and technological progress, including the development of renewable energies.
- Economic efficiency and competitiveness of economic activity.
- Social cohesion and balanced development of the regions, including the French overseas territories. This includes the principle of geographic uniformity of supply tariffs across all French territory, which is considered one of the most important public service obligations.
- Minimum service even in case of non-payment since electricity is a product of absolute necessity.

To supervise the application of these objectives, Article 3 provides for the creation of one national and 22 regional supervisory bodies (Observatoires du service public) with consultative functions. Article 4 establishes electricity as a "product of absolute necessity" and stipulates a right to electricity for all. This includes a social tariff: low-income families can obtain a certain amount of electricity (3 kW) at reduced rates. The article includes measures for the poor in cases of non-payment, essentially continued delivery of power while social security procedures are under way, and financial support for payment of the power bill.

The costs of all public service obligations, including those of above-market contracts for renewable energies and geographic uniformity of tariffs, are to be covered from a national public service fund for electricity (Article 5). Article 6 stipulates that the Government must pass a law before the end of 2002 defining how long-term energy planning is to be carried out in the context of the liberalised market, and provides for the suspension of competitive trading in crisis situations in the energy markets.

Articles 7 to 9 describe the procedures to be followed for new capacity construction and operation, either by new entrants, who need to obtain an operating licence from the Minister responsible for energy, or by the incumbent EDF. If the market provides insufficient production capacity, a competitive tendering procedure is launched by the regulatory commission CRE on behalf of the minister responsible for energy.

Article 10 lays down priority purchasing requirements on EDF and the non-nationalised distributors for electricity produced from renewables, CHP, and from indigenous coal (up to 10 per cent of total primary fuel input to electricity generation). Renewables and CHP are subject to an absolute purchasing requirement, but coal is not. Cost compensation is to come from the national public service fund for electricity.

Articles 12 to 16 describe the independent system operator for the transmission grid (ISO, gestionnaire du réseau public de transport) and its functions. This is a core entity required under the Electricity Directive. The ISO is to be a subsidiary to EDF, but independent of EDF's other functions. Its director is to be nominated by the Minister responsible for energy from three candidates suggested by EDF, for a term of six years. The electricity regulator supervises the ISO, including its non-discriminatory behaviour and its efforts to maintain and extend the grid, and is consulted both on recruitment and on dismissal of its director.

The ISO develops dispatch schedules one day ahead of deliveries, carries out re-dispatch in the most economic way given grid constraints, compensates generators for re-dispatch and contracts for ancillary services. Article 16 stipulates confidentiality of the ISO and establishes a fine of FF 100,000 for disclosure of commercially sensitive information. Articles 17 to 20 describe the tasks of distributors and distribution system operators.

Articles 22 and 23 set the rules for grid access and determine which customers are eligible for competition. For the definition of eligibility, they refer explicitly to the Electricity Directive and add all producers with a valid operating license, the state railway company, and the non-nationalised distributors. However, the latter are only eligible to the extent needed to source electricity competitively for their own eligible customers.

Article 22 contains two important trading restrictions which were inserted into the Act as part of the amendments referred to in the preceding section:

- No supply contract in the competitive French power market can have a duration shorter than three years. This refers to the duration of the contractual framework and not the length of individual deliveries. Within this framework, the time periods for deliveries, the duration of individual deliveries, the quantities supplied and their seasonal variations are free to be determined by the contracting parties.

- Electricity trading is subject to an authorisation by the minister responsible for energy, delivered after consultation with the regulatory commission. This authorisation is issued only if the party wishing to trade electricity can prove that it has generating capacity available, and only up to a ceiling. This ceiling is to be a percentage share of the party's available capacity. The exact percentage is to be fixed by Ministerial Decree. The authorisation can be withdrawn if it is in conflict with the public service obligations.

Article 24 authorises direct line construction and defines the conditions for such construction. Articles 25 to 27 stipulate separation of accounts between generation, transmission, distribution/supply and any other activities and define information disclosure rights of the regulatory commission.

Articles 28 to 40 outline the structure, rights and financing of the Regulatory Commission for Electricity CRE. The CRE has six commissioners. Three of them, including the president, are nominated by ministerial decree. The other three are nominated by the presidents of the Lower House of Parliament (Assemblée Nationale), the Upper House of Parliament, and the Economic and Social Committee. They serve rolling, non-renewable terms of six years, can exert no other public function and cannot be removed from office except for major offences. They enjoy comprehensive information disclosure rights and are subject to confidentiality requirements. The government can nominate a liaison officer to the commission. The regulator has the following rights and duties:

- It carries out calls for tender for new capacity according to the guidelines set by the minister responsible for energy.

- It supervises the ISO's operation and the dispatch criteria used by the ISO.

- It approves the accounting standards and rules used by all organisations active in the power market, the ISO's plans for investment in the transmission grid, the ISO's conditions for grid connection and access, its contracts for ancillary services and its methods for establishing dispatch and re-dispatch schedules, including its methods of financial compensation for re-dispatch.

- It proposes network tariffs, the amount of cost compensation to be paid from the national public service fund and grid reliability rules and procedures.

- It is consulted on supply rates to non-eligible customers and EDF's sales prices to non-nationalised distributors. The tariffs are set by the minister responsible for energy. It is also notified of and consulted on the nomination and removal of the head of the ISO, the ISO's grid development plans, the ceilings for electricity trading referred to above, any refusal to authorise direct line construction, new legislative projects relating to grid access, selection of power plant projects following a call for tender and purchase obligations related to electricity generated from renewable energies, CHP or indigenous coal.

- It is informed of the ISO's budget, accounts, grid access contracts and grid access protocols and any refusal to conclude a grid access contract.

- Its has access to the accounts of all companies active in the power market and can initiate investigations.

In all these areas, the CRE can make pronouncements, especially if called upon in a complaint. Within this framework, the CRE can develop further rules relating to issues requiring detailed regulation, such as grid access protocols. It can take emergency measures to protect grid stability and reliability. Its decisions are subject

to appeal before the Paris Appeals Court. If anti-competitive behaviour is detected, the electricity regulator can call upon the Competition Council (Conseil de la concurrence). This can also occur as an emergency procedure.

Articles 45 and 46 contain so-called social provisions. They relate to agreements between workers in the gas and electricity industries and EDF and GDF concerning working conditions and remuneration, the *statut des industries électriques et gazières*, which are more favourable than in other comparable industries in France. This special status has been applied in all enterprises in the gas and electricity sectors since 1946. The new Act extends this status insofar as it previously applied only to a small number of state-owned companies. The status may now also apply in the competitive industry, and cover potential new entrants, as Article 45 states that a government Decree is to determine a list of measures necessary for the application of the special status to all employees in the electricity and gas industry. The minister is authorised to take these measures, if necessary, in lieu of a potential future industry-wide labour agreement. Article 47 provides for monitoring of the impact of the Act on employment in the electricity sector.

Articles 48 to 50 make general provisions for stranded cost recovery. Only above-market costs incurred before 19 February 1997 can be recovered. Assessment and reimbursement of these costs are to occur in the same manner and through the same institutions as above-market costs from public service obligations (Article 5). Article 50 states that power generators can terminate supply contracts concluded prior to the publication of the Electricity Act with EDF or the non-nationalised distributors if three months' notice is given.

CRITIQUE

Through its tradition of public service and strategic planning, France has established a very successful energy sector with relatively low air emissions compared to other G7 countries. New pressures are coming to bear on energy sectors world-wide: greater drives to reduce emissions, the drive for ever more competitiveness for energy consuming industries and the introduction of competition throughout Europe. French energy policy is under pressure to become more flexible and in particular to balance its strategic and public service needs, including energy security and environmental protection, with market forces.

The French electricity supply industry highlights, more than most other industries, the goals and concerns of the French people and policy-makers and the potential conflicts between these goals. On the one hand, there is the quest for economic efficiency, i.e. the striving for the least-cost generating option. The standardisation programme for oil-fired power plants and the even more pronounced similar efforts in the nuclear programme clearly demonstrate this quest for efficiency. There is no doubt that EDF reaped economies of scale (including "economies of learning") and economies of vertical integration to a degree rarely found in any other power market. These factors contributed significantly to the success of the nuclear

programme[51] and to the low energy prices that French customers are currently enjoying – prices which are among the lowest in Europe for large industrial and for residential customers.

On the other hand, there is a set of concerns that are discussed in France as forming part of the "public service". These concerns crystallise around four major areas:

- Energy security.
- Environmental protection.
- Balanced regional development.
- Social equity.

These issues are not specific to France; all IEA member countries share these concerns. However, the French public is more sensitive to them, especially to energy security, and the proposed solutions vary in some cases from solutions discussed and proposed in other countries. Competition especially has for a long time been seen to be in conflict with these issues. However, this is not necessarily true. Many highly competitive electricity markets are now in operation around the world, ranging from the resource-rich, economically highly developed United States to resource-poor Finland and economically middling, at best, Argentina. These countries have not signalled any major conflict between competition and wider policy objectives.

At the core of the first two issues lie generally acknowledged "market failures", in other words, external costs. Energy security in the electricity industry has two dimensions. The first is a purely electricity-related, "short-term" concern: reliability of transformation of primary energy resources into electricity, which requires adequate and reliable power generating capacity and reliable transportation of the electricity to ultimate consumers, which in turn requires an adequate and reliably-run transmission network. This concern is labelled "short term" because supply failures often occur during load peaks when the transformation and transportation equipment operates near to capacity, clearly exposing inadequacy of this equipment. While it may take a while to repair damaged equipment after a power outage and while it may take even longer (up to 15 years) to ensure the full reliability of the system, the problem generally subsides (at least temporarily) when demand falls naturally to off-peak levels.

In contrast, "long-term" security of supply goes beyond the electricity market. Policies aiming at "long-term" security of supply attempt to address prolonged shortages of primary energy resources. Such shortages can occur if important primary energy resource markets are highly concentrated and if producers manage to co-operate to drive up prices or curtail supply in order to extract monopoly rent

51. See the Nuclear chapter for a more detailed discussion.

from consumers. Such behaviour can, of course, also be motivated by other, notably political intentions, particularly if production companies are state-owned monopolies. The obvious examples of both situations are OPEC market power and the two oil crises.

It should be noted that both types of behaviour also put a strain on producers. In the first case, there is the need to enforce cartel discipline, i.e. to oblige individual members to forgo revenues which they could realise by selling more than the quota allocated to them by the cartel. As long as the cartel manages to keep prices above marginal production costs, quota busting is a temptation for cartel members and a very real threat to cartel discipline, the overall production target, and the resulting price. In the second case, governments curtailing supplies forgo all or significant parts of revenue from the resource, for which they generally need very good reasons. In both cases, the behaviour drives up resource prices, which prompts consumers to look for substitutes and sooner or later draws competing producers into the market.

However, the lesson governments of consuming countries have learnt from the two oil crises is that "sooner or later" may well be too long and impose a major cost on their economies, especially if the price increases are drastic and sudden and then persist. This is also the reason why the issue is labelled "long term": the supply crisis persists and does not subside rapidly due to natural demand fluctuations. Exacerbated by structural problems, such as labour market rigidities[52] in many OECD countries, this cost took the form of two major recessions and sluggish economic growth for more than a decade from the mid-1970s to the mid-1980s. The "short-term" and the "long-term" issues are addressed below.

- "Short-term" energy security: throughout the last decade, competitive power markets have shown that they can supply the first, electricity-specific type of security. There were incidents of spectacular black-outs in the competitive power markets of New Zealand and the United States in 1998. The New Zealand incident involved a major power outage in Auckland's central business district and the statement by the distribution and retailing company of Auckland that it could no longer supply electricity to that area. Emergency services had to be mobilised and the loss of business had major financial implications for companies in the area. The crisis lasted more than one month. In the US, a wave of rolling black-outs affected large parts of the country, especially the Western Interconnection, during the summer peak period.

  However, both incidents originated in the distribution system, as does the vast majority of actual black-out incidents. Yet distribution is not part of the competitive market segment and continues to be operated by monopoly utilities under government regulation. Moreover, investigation into the Auckland power failure showed that the cable failures which lay at the root of

52. The resulting macro-economic phenomenon was discussed as "stagflation" at the time.

the outages were caused by many years of sub-optimal management and were thus the consequence of decisions taken before the industry was liberalised[53].

The electricity industries in a number of other countries have successfully combined competitive markets with enhanced quality and reliability of service. Overall, the record of competitive power markets to date is no worse and in fact is even slightly better than that of the non-competitive markets that preceded them. The government should establish a regulatory regime that permits the benefits of competition to be applied while protecting those elements of public service required by the state. Legislators and regulators in other countries recognised the importance of reliability and made necessary provisions. Adequate provisions were also made in the French Electricity Act.

- "Long-term" security: in order to respond to a threat in the most economically efficient way, Governments first need to assess how large it is. This assessment will yield the security externality carried by each unit of primary energy consumption. The least-cost way of signalling this external cost to consumers is by incorporating this externality into energy prices at the point where the resource enters the economy. The least-cost way of doing this is through import tariffs and/or primary fuel taxation. This method gives consumers along the entire supply chain[54] the possibility of substituting while letting them determine whether their preference for high-price fossil fuel is so strong that they want to continue consuming it or whether they would prefer using something else.

  In many IEA countries, and especially in France, taxation of fossil fuels, particularly oil, is already high. The end-user price for gasoline is already almost 80 per cent tax[55]. It is therefore likely that the French government has already internalised part of the security externality. Emergency stock holding under IEA rules further contributes to internalisation of the security externality. It would be useful to determine how much is left to internalise. It may well be that consumers are already paying the full security externality. The unabated growth of oil demand for road transport may simply signal that consumers' preference to use their cars is so high that they do not wish to restrict their demand even in the face of the externality.

  The electricity industry, of course, offers large substitution possibilities. If the security externalities are internalised in fuel prices and large enough, appropriate substitution would occur. Like other governments, the French government reacted to the oil crises by short-cutting this process and picking the power industry as one of the main targets for substitution. This approach is

53. For further (extensive) detail see e.g.: Ministry of Commerce of New Zealand: *Inquiry into the Auckland Power Supply Failure*. Wellington, July 1998.
54. A rough example of the supply chain that gives rise to substitution possibilities at each stage starts with crude oil import and then goes on to refining to oil product use in boilers, car engines, etc., and from feedstock use to the production and use of organic chemicals to the production and purchase of plastic toys, etc.
55. See the Taxation section in chapter 3.

economically less efficient, at least in theory. In practice, it is unclear whether the French economy as it existed then suffered any drawbacks from this. What is clear is that the desire to protect and preserve long-term investments such as the nuclear programme has led to a hesitant approach to competition in the power industry, which limits eligibility to industrial consumers and leaves in place a large incumbent advantage for EDF (see this section, below).

The government would be well-advised to study these issues in depth. An overview of the issues and a brief analysis of this sort for the United States was carried out in the framework of the latest NEA/IEA generating cost study, comparing oil and gas with nuclear generation on economic and security grounds[56]. In the US, new nuclear power is not economic, but the country has its own coal, oil and gas resources. The result of the analysis was that in the US it is inefficient to subsidise or require the construction of nuclear power plants, both from an economic and a security of supply perspective.

In France, the situation may well be different. New nuclear power is economic, which in principle reduces the need for the government to interfere in the market or restrict competition to protect it. However, France does not have its own oil and gas resources. As in the US, *new* nuclear power in France would not substitute for oil-fired power plants, and therefore would *not* contribute to oil security, because oil is used in peaking plants, where nuclear is absolutely not competitive. The 1995 IEA gas security study[57] analysed France's current supply security situation and concluded that the country would be able to withstand a disruption from one of its suppliers (about 30 per cent of gas imports) for about one year before having to cut supplies to customers with firm (non-interruptible) customers. This good result is due to the fact that France has Western Europe's largest gas storage capacity relative to annual consumption and that interruptible contracts, concluded especially as insurance against supply disruptions, cover about half of industrial demand. GDF now systematically verifies that interruptible customers really have alternative facilities (often using heavy fuel oil), which appears to be the case. The discussion in the Natural Gas section of the Fossil Fuels chapter reinforces the favourable security outlook for the French gas market at present.

This favourable picture is of course itself partly due to the nuclear programme, but the relatively significant resilience in France highlights the question how large the gas security externality really is and how large it would become if more competition were allowed. In exploring these issues, it should also be taken into account that the threat of a real supply disruption would in all likelihood not be limited to France but would occur on a Europe-wide scale and might best be tackled in a European context. It may well turn out that fossil fuels still carry a security externality high enough to justify diversification away from them or that fossil energy security externalities will again grow significantly as non-OPEC

56. Nuclear Energy Agency (NEA) and International Energy Agency (IEA): *Projected Costs of Generating Electricity – Update 1998*, pp. 219-235. Paris, (OECD), 1998.
57. *The IEA Natural Gas Security Study*, IEA/OECD Paris, 1995.

oil supplies are depleted. However, at present, the French Government's policy towards competition in the power industry appears to be built upon a set of traditions and assumptions that could well use an overhaul based on thorough, quantified analysis to prove that the French consumer is not worse off on balance than he would be with more competition. It should also be noted that the French generating mix relies so heavily on nuclear today that it lacks diversity, which is itself a means of addressing security of supply, although of the more "short-term" type.

The government should analyse the ways and means in which the security of supply concern is reflected in approaches to the energy market, especially the electricity market. It should undertake to provide a quantified estimate of the externality. In the light of these results, the government should determine how high energy security can reasonably be thought to rank - higher than competition? - and should consider ways of adapting its approach to the functioning of a competitive market.

Environmental protection is an equally important issue and also an external cost of energy use. As for security externalities, the most economically efficient way to address this issue would be to internalise the external cost into energy prices and let the market adjust and choose the least-cost response option. Nuclear electricity carries environmental external costs which should also be internalised. The French government and Parliament believe that the fuel cycle costs of nuclear have been fully internalised[58].

The security externality was one of the main motivations for building up the nuclear programme. Climate change was unheard of at the time the nuclear programme was set in motion. When the threat of climate change was first discovered and subsequently when it was taken more and more seriously in the late 1980s and early 1990s, it contributed an additional ex-post argument in favour of nuclear. The French nuclear programme has contributed to comparatively low air pollution and has limited national carbon dioxide emissions. In such circumstances, fossil generation, and especially a "dash for gas", potentially following liberalisation, are seen as detrimental.

However, existing nuclear power is economic, especially when technically well-performing units are approaching the end of their depreciation period, which is the case in France (see this section, below). Extending the lifetime of existing nuclear power plants beyond the anticipated 30 years to the now internationally-accepted 40 or more years, while maintaining high safety standards, can be a low-cost way of preventing increased national CO_2 emissions from current electricity demand. The issue that then needs to be addressed is incremental CO_2 emissions from load growth.

58 See Bataille, Christian, et Galley, Robert: *L'aval du cycle nucléaire. Tome II: Les coûts de production de l'électricité.* Office parlementaire d'évaluation des choix scientifiques et technologiques no. 1359. Paris, 3 février 1999.

The French government does not maintain that incremental CO_2 emissions growth from power consumption must be addressed by more nuclear power. As with the security externalities, such an approach would amount to short-cutting the decisions the market might take in the light of high and internalised externalities and replacing them by a government decision to place the entire burden for CO_2 emissions reductions on the power industry, regardless of the cost to society. Instead of focusing solely on substitution possibilities, it might be better to address areas of strong emissions growth, such as transport. And it should be noted, once more, that new nuclear power is expected to be competitive in France. Private companies throughout IEA Member countries invested in nuclear power plants in the past, in some cases very successfully, although for obvious economic reasons no private investment in new nuclear capacity has been made in recent years. Should a more substantial security threat arise or should fossil fuel prices increase substantially, such investment could well occur.

The next issue relates to regional development and territorial policy. Its main relevance in the electricity industry is the public service obligation for geographic uniformity of tariffs throughout the entire national territory, even including the French overseas *départements*, where power supply can cost more than twice what it costs in metropolitan France. Geographic uniformity of tariffs for network industries is not based on the 1946 nationalisation law, nor is it fixed as a legal principle anywhere else. It was established progressively throughout the 1960s in metropolitan France and was extended to the DOM in 1975 as part of French territorial policy and received a legal basis only very recently in the context of the new Electricity Act. Today, it constitutes a transfer of wealth from metropolitan France to these areas in the order of FF 2 billion per year.

Geographic uniformity of tariffs is taken to represent equal treatment of customers. To be sure, equal treatment of citizens before the Law is a basic prerequisite for democracy. It basically means that for similar crimes, everybody gets the same punishment.

To assume that the equivalent in markets simply means that everybody gets the same price is fundamentally flawed. Customers ought to be charged the cost they cause society for delivery of goods and services they demand and this cost can differ widely. This fact is, of course, implicitly acknowledged in EDF's and GDF's pricing mechanisms: industrial customers tend to pay much lower prices than others. The lower prices are justified because supplying industrial customers costs less, since they have much better load factors, take electricity at higher voltages causing less line losses, etc.

If geographic uniformity of tariffs were interpreted very simply, it would indeed be an obstacle to competition. Competition is pointless unless certain customers – those who make use of the opportunity of looking for a cheaper supplier - are allowed in principle to be supplied at lower prices than others. In practice, the interpretation of public service relating to *peréquation des tarifs* is more sophisticated: it no longer means the very same prices for all customers of any one customer group. The question must then be how equal the prices are required to be.

It appears that France has chosen a mixed path in this respect. On the one hand, it is certain that some of the consumers who are eligible under the new Electricity Act will pay prices that are different from, and probably lower than those they paid before. This appears to be accepted in principle. On the other hand, the intention seems to be to maintain full geographic uniformity of end-user prices for certain (non-eligible?) consumer groups in metropolitan France and the DOM. It is hard to see any economic benefit in this system. In addition, the system also destroys profitable niche markets for renewable energies, as discussed in the chapter Energy and the Environment.

The idea of competition is that producers should try to out-compete each other, leading to a price that equals marginal cost. Such a price entails zero profit for the marginal supplier. However, supply cost in some of the DOM island states is a multiple of prices in metropolitan France. Maintaining the same prices as in metropolitan France requires very substantial cross subsidies and restrictions of competition in the regions providing the cross subsidies. These cross subsidies are made possible by prices above marginal cost.

It should be noted that such a situation has nothing to do with equal treatment. Consumers in the regions that are financing the subsidies are suffering welfare reductions due to higher prices, whereas consumers on the receiving end benefit from a massive welfare transfer. If those who pay more than their fair share do so out of their own free will, following democratic decision-making and based on adequate information and transparent procedures, there is nothing to be criticised. This appears to be the case. Nevertheless, the government must take great care to ensure that voters and consumers are well informed about the financial burden they bear and to ensure that the wealth transfer is carried out in the most economic and efficient way. If a transfer of wealth is desired, it should be carried out as a regional support programme unrelated to electricity consumption.

Moreover, if the transfer, or the mechanisms used for it, have significant implications for fair competition and free trade in the European Union, the government should take all necessary steps to eliminate any possible distortions.

In any case, it may not be possible to maintain this system for much longer. As more and more consumers become eligible for competition in France, the customer base from whom the cross subsidy can be financed becomes smaller and smaller. Eventually, only small- and medium-sized companies and residential customers will be left to provide the subsidy. Probably those customers who have to bear an increasingly heavy burden will demand more transparent procedures or abolition of the measure. At present, the concrete way in which the transfer is carried out is not entirely clear yet. It appears that the government intends to finance it through a mechanism resembling a wires fee. The wires fee would be less harmful than an outright cross subsidy since it would not affect competition, but it would still depress electricity demand in France.

The distortions created through the *peréquation tarifaire* are in some way an extreme form of cross subsidisation that may occur anyway as long as customers are

separated into eligible and non-eligible consumers. Opting for less-than total market opening to competition automatically introduces a certain inequality of treatment. Eligible consumers can "shop around" for the cheapest energy, whereas non-eligible customers are barred by law from doing the same. But a utility that serves both a competitive and a non-competitive market always has an incentive to reduce prices where it is under competitive pressure, and to finance potential losses through cross subsidies from the non-competitive segment. This can lead to a situation where the non-eligible customers end up with higher prices and are worse off than before competition, whereas eligible consumers benefit from their freedom of choice.

Whether, in addition to the *incentive*, the utility also has the *ability* to cross subsidise is not a simple question. It depends upon the effectiveness of the regulatory and other surveillance authorities (such as the competition authorities). The complexity of the network industries is such that marginal cost has multiple dimensions, such as level of the supply chain, time and space, capacity/energy supply, reliability/interruptibility, voltage level, calorific value, etc. Estimating cost at this level of complexity is very difficult. The best even a sophisticated regulatory authority can probably achieve is to establish limits to abuses, not prevent them. This means that smaller infringements will probably go undetected and non-eligible customers can never be sure their service is as good as it is in the eligible market. If the government is really interested in equal treatment, it should open the market rapidly to all consumers.

A milder form of geographic uniformity of tariffs is used by some IEA member countries with vast land surfaces and low population density, like Australia or the US. In that system, only the grid services, especially distribution, are provided at uniform prices. The system is fully compatible with competition in generation and supply, because the grid is in any case generally still considered and organised as a (regional) natural monopoly. This makes it possible to maintain a certain amount of cross subsidisation for the grid service[59].

On the distribution side, customers located in remote areas impose much higher distribution costs than those situated in or near a cluster of concentrated demand. The cost differences can be such that economically efficient prices for remote customers can be multiples of those for city-dwellers. In the past, electricity (and gas) utilities equalised prices across regions through cross subsidies between customers, creating a certain geographic pattern of housing, businesses and small industry, which can reveal itself to be sub-optimal when the cross subsidy is removed. Once a network industry is opened to competition, the question arises how the system can be adapted to the changed circumstances. When designing their distribution markets, some liberalising governments have thus chosen to

59. Cross subsidies involving the entire electricity end-user price generally do not work well in competitive markets because the areas where prices are much higher than marginal costs are likely to be targeted by "cherry pickers" sooner or later, i.e. by suppliers who can supply at prices below those of the incumbent utility and still make a profit.

equalise only the price for network services because they did not want to place a sudden burden on consumers who had chosen a remote location years (or decades) ago when prices were cheap.

In the simplest version of this system, one uniform distribution tariff is set at average distribution system cost. Lower-cost distributors have to contribute part of their profit to a compensation fund, which re-distributes it to higher-cost distributors. Economic efficiency is ensured through normal price regulation.

The more sophisticated versions of the system allow fine tuning of regional pricing: in the competitive Australian national power market, the cost differential between electricity supply to urban agglomerations and electricity supply to the outback was found to be 1:50 or more. The government decided to signal to remote customers that they were imposing a higher cost on society than city-dwellers, but to reduce the cost differential to 1:3 through a combination of the above system with a zoning mechanism.

In this system, new customers who need grid connection can be confronted with the full, unsubsidised price, because they can still choose their location. This system can be used to ease the transition towards fully cost-based prices for the grid-based energy industries.

This system could work in France as well, especially since the government has created a public service fund to cover the extra cost of public service obligations (Article 5 of the Electricity Act). Currently, all electricity suppliers above a certain size are required to contribute to this fund an amount based on their annual deliveries to consumers in France (or, if applicable, on autogeneration). The electricity regulator supervises the operation of the fund. This system is not far from a wires tax and could well be used to allow geographic uniformity for grid services.

Hence, a well-understood version of geographic uniformity of tariffs is fully compatible with competition and could make it possible to maintain full geographic uniformity of prices for *grid services* across the entire territory of metropolitan France, even if the electricity market underwent full vertical separation.

The fourth area of public service concerns relates to social equity. Social equity is a difficult concept because equity is in the eye of the beholder. The Electricity Act goes beyond the previous legal regime in France in that it establishes a right to electricity and a consumption level that cannot be curtailed even in cases of prolonged non-payment. If French voters feel that the poor need protection, they are certainly entitled to see protection enshrined in the law. In principle, it would be preferable to support the poor through direct, person-oriented subsidies. But if this is not possible, minimum service is an option that is fully compatible with competition, using a compensation fund in the same manner as for the geographic uniformity of tariffs, as already enshrined in the Act for other public service obligations. Minimum service is not an obstacle to competition.

In France, the four public service concerns are discussed in a way that intermingles them and stays too close to choices and interpretations made in the past, thus

creating conflict between competition and policy in areas where there is little or none, while missing opportunities to liberalise and contribute to policy goals. The Government should attempt to support and inform the debate with thorough, publicised analysis.

The primary objective of the Electricity Act is to improve economic efficiency for the benefit of French and European consumers. The above discussion suggests that this can be done without harming the special policy concerns of the public. Therefore, the Act is a welcome development. It is also welcome that the government opted for a regulated Third Party Access regime which allows greater predictability and transparency than negotiated Third Party Access. The establishment of a regulatory authority is also a necessity for a well-functioning market.

Yet in many areas the legislation is slow or hesitant and it is questionable whether much competition will arise. First of all, the amendments to the Act during its first reading in Parliament limit electricity trading. While the Act may allow a variety of interpretations, it is hard to see how a minimum contractual duration of three years can be reconciled with the creation of an electricity exchange of sufficient liquidity and depth to enable its participants to reap the full benefits of competition. Taking issue with this provision, the European Commission took legal action against France on 13 June 2000 for not opening its electricity market to competition as required under the Electricity Directive. Meanwhile, the Minister of Economic Affairs has responded to the Commission's action, pointing out that the three years apply only to the contactual framework, not individual deliveries. The issue is under consideration at present. The crucial point is whether short-term, one-off deliveries will be authorised or not.

Moreover, EDF enjoys a very large incumbent advantage that any newcomer will find almost impossible to compete against. EDF has extensive information on most, if not all generating units in the industry, including its potential competitors on French soil, from having dispatched the plants. In addition, some 37 of EDF's nuclear plants came on stream between 1975 and 1980. Given the expected plant lifetime and depreciation periods used at the time and the much longer technical lifetime of the plants expected now (40 years or more), this means that within five years from now 37 of EDF's nuclear reactors will reach their "golden end", where their cost is reduced to the very low running cost of nuclear plants. This means that EDF can out-compete virtually any new entrant and practically precludes new entry except at the margin.

Work is under way to set up simple and transparent arrangements for network access including top-up and stand-by, but more has to be done. Adequate regulatory oversight and functioning market structures are essential to ensure a level playing field. The Act also requires further clarification of detailed regulation through numerous ministerial decrees. A certain number of decrees have already been issued, but a significant number is still missing. They should be enacted as soon as possible.

In France, the system operator is under the umbrella of EDF. Although the legal provisions foresee "Chinese Walls" to shield commercially sensitive information,

practical implementation of these provisions may be difficult. Also, leaking of such information is liable to a fine of FF 100,000 – a sum that may be dwarfed by the value of some of the power transactions that may occur in the future competitive market. It is very questionable whether a fine of this size will discourage abuses. Special care should be taken by the regulator, the competition council and all other institutions involved to ensure that the system operator works in a non-discriminatory manner.

It should be noted that EDF is no newcomer to competitive markets. It is involved in some of the world's most fiercely competitive power markets and is clearly doing very well in those markets. EDF has indicated more than once that it sees Europe as its home market. The company is clearly more than well-equipped to face a more strongly competitive market than what can be expected in France.

France occupies a central place in the European Union in all respects and its electricity network is a key part of the European energy infrastructure. It is important therefore, both for those competing with EDF within Europe and for electricity consumers within France, that France have an effective competitive electricity market as soon as practical. The progress made to date towards this objective is welcome, but important barriers remain. Further work will be needed before a fully competitive market is achieved.

RECOMMENDATIONS

The government should:

- ☐ Actively prepare the way for the French power market to adapt to developments across its borders and world-wide.

- ☐ Implement the spirit of the Electricity Directive as quickly as possible by putting in place practical arrangements to ensure that suppliers can compete with EDF on fair terms.

- ☐ Be prepared to go beyond the minimum provisions of the EU Electricity Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. It is important that France keep in step with the European market development – both for France's consumers and for its power industry.

- ☐ In order to adhere to the principle of equal treatment and to avoid cross subsidies, extend access to the competitive electricity market to all consumers as soon as possible.

- ☐ Remove uncertainty about the market among potential new entrants by defining and then clarifying by ministerial decree those areas of planning security and transparency which are still obscure.

- ☐ Work to remove practical and legal barriers to competitors who wish to supply French customers.

- ☐ Develop and implement pro-competitive mechanisms, through the regulatory structure or otherwise, to address France's public service obligations and aspirations.

- ☐ Help to remove uncertainty among French consumers and the public at large by informing them fully about the mechanisms available to protect their interests while bringing them the benefits of competition.

- ☐ Quantify energy security externalities, including those related to the electricity market. In light of the result, review the relative weight given to security of supply externalities on the one hand and competition on the other hand. Review policy measures accordingly.

7

NUCLEAR

OVERVIEW

General Overview

France has the largest fully integrated system of nuclear power plants in the world. It currently has 58 operational production units, all of which are of the same generic design, the pressurised water reactor. Nuclear electricity accounted for 76.5 per cent of all electricity generated in France in 1998. Table 8 details nuclear capacity in France.

Table 8
Nuclear Power Generating Capacity in France

Number of Reactor Units	*Capacity*
34	900 MW_e
20	1,300 MW_e
4	1,450 MW_e
Sum: 58	**62,400 MW_e**

Source: IEA.

The most recent plant was connected to the national grid in December 1999. Plant capacity is currently well in excess of domestic need. 58 TWh (equivalent to the production of nine "average" nuclear plants) were exported to neighbouring countries in Europe in 1998.

France has responded to its electricity policy objectives, i.e. security of supply, minimum environmental impact and minimum costs, by developing an independent nuclear capacity. This has resulted in a strong capability to design, construct and operate nuclear power plants and to conduct the nuclear fuel cycle activities necessary to support them. Having now reached a stage at which there is no immediate need to install new nuclear capacity in France, current policy is to maintain the indigeneous capability to pursue nuclear development as an option for the future when the existing plants reach the end of their life span.

Key Nuclear Organisations

France's key nuclear organisations are

- Electricité de France, the national electricity monopoly utility: owner and operator of all commercial nuclear power plants.

- Framatome: the nuclear reactor supplier. The company also has fuel supply interests.
- Cogéma: the provider of nuclear fuel cycle services.
- The Commissariat à l'Énergie Atomique (CEA): the country's national nuclear research and development organisation. The CEA played a crucial role in designing French nuclear reactors.
- The Agence nationale pour la gestion des déchets radioactifs (ANDRA): the national organisation for the disposal of all radioactive waste.
- The Direction de la sûreté des installations nucléaires (DSIN): the main regulatory institution responsible for reactor safety.
- The Institut de protection et de sûreté nucléaire (IPSN), which provides technical support to the DSIN. The IPSN is currently associated with the CEA.

Plant Construction

No nuclear power plant is currently under construction in France and there is limited demand in the world for new nuclear plants. Among OECD countries, nuclear plant construction is being pursued in Asia, principally in Japan and the Republic of Korea by their domestic suppliers. One plant is being completed in the Czech Republic. Other plants are being constructed in non-OECD countries. Recent IAEA data indicate a world total of 38 units under construction at the end of 1999; French industry is involved in these to a limited extent.

However, there could be limited or little opportunity for French designers and constructors to exercise their skills even if the government seeks to maintain the nuclear construction option. Whereas operational capabilities will continue to be needed to support existing plants and R&D support might be perpetuated by funding appropriate projects, the situation for practical engineering and project management is less clear. Retaining staff and skills at a time of inactivity could be problematical.

Jointly with Germany, France has actively supported the development of an evolutionary successor to the current generation of plant, the European Pressurised Water Reactor (EPR). To develop the plant, a prototype is probably necessary. However, there is little need for more than one such plant and generation from the prototype is not needed in the French market. The prototype is unlikely to be built in Germany in the current political climate. The recent merger of Framatome and Siemens, the two principal industrial partners in the EPR project, is an indication of the poor prospects for future orders and the consequent need for rationalisation. (Framatome is also associated with General Atomics and other companies in the US for the development of a High Temperature Gas-cooled Reactor). France probably will need to make some strategic decisions, including:

- How to maintain practical nuclear engineering skills beyond the year 2000 in the absence of new plant orders.
- Whether or not a new plant design will be warranted in approximately ten years. If so, should a prototype be constructed?

Financing will be a key issue in both cases.

Economic Performance of Nuclear Power

As outlined in the electricity chapter, new nuclear power plant construction is expected to be economic in France. The IEA/NEA generating cost study shows that at both a 5 per cent and a 10 per cent discount rate, nuclear is cheaper in France than coal or natural gas. In fact, according to that study, France is the only IEA country where nuclear is cheapest in base load at a 10 per cent discount rate[60].

The study confirms the results of the French government's own cost estimates for new capacity that are prepared every three years. For base load, the calculations showed a continued cost advantage for new nuclear at discount rates of 5 per cent and 8 per cent. In fact, these cost estimates showed that nuclear had favourable economics even in the lower parts of intermediate load. Since the mid-1990s, these cost estimates show increasing competitiveness of combined-cycle gas turbines in the French market in intermediate load and the government expects CCGTs to play a significant role in future.

The economic outlook for nuclear is more positive still for existing nuclear plants. The electricity industry and particularly the nuclear industry have evolved as state-owned monopolistic entities in France. This allowed establishment of the nuclear industry, including the whole supply chain for plant equipment as well as for the fuel cycle, in a co-ordinated manner, thus allowing the exploitation of economies of scale and economies of scope to a large degree.

As a large number of reactors will soon reach the end of their depreciation period, this picture will improve. The capital costs of EDF plants are currently amortised over a period of 30 years. Plants of the same genus are frequently licensed at the outset for 40 years and prospects exist for extending operating lives to 50 years and possibly beyond. French plants, where average age is around 20 years, have similar prospects. Whereas capital charges currently represent 28 per cent of EDF's nuclear production costs, this share will fall to practically zero in 2010.

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60. At a 5 per cent discount rate, nuclear is cheapest in Canada, France and Spain.
See Nuclear Energy Agency (NEA) and International Energy Agency (IEA): *Projected Costs of Generating Electricity – Update* 1998, pp. 66-69. Paris, (OECD), 1998.
For a brief summary of the findings please refer to: John A. Paffenbarger (IEA) and Evelyne Bertel (NEA): *Results from the OECD Report on International Projections of Electricity Generating Costs*. Proceedings of the International Joint Power Generation Conference and Exhibition, 24-26 August 1998, Baltimore, MD, USA.

The high capital intensity of nuclear technology is complemented by low operating costs, mainly plant operation, maintenance and fuel – with the result that increasing generation from an existing plant is economically very attractive. The specific options are to enhance plant capacity factor, extend plant life or increase plant capacity. The first two are particularly pertinent in France.

The standardisation of the nuclear plants in almost identical series is one of the factors that has led to the favourable economics of nuclear power in France. As a consequence, however, there is a lack of technical diversity in the French generation portfolio. Type faults (e.g. vessel head cracking) or systematic failures have the potential to seriously threaten the security of electricity supply in France and can have a major economic impact as well. This concern appears to be well recognised, however, and actions to mitigate the danger have been taken in two areas:

- Considerable technical expertise and infrastructure have been retained to support all nuclear operations.
- Considerable capacity of alternative, mainly fossil, generation plant is retained but little used in the course of normal operations (c. 40,000 MW).

As noted in the Energy Market and Energy Policy chapter, nuclear experienced comparatively low capacity factors as a consequence of the rapid build-up of the vast nuclear programme in the 1980s. Presently, EDF is specifically seeking improvements in plant availability and plant capacity factor. A target of 85 per cent availability in 2000 has been set, compared with 81.2 per cent in 1998 (excluding the 1,450 MW, N4 plants).

Nuclear generation currently exceeds its economically efficient contribution to the French electricity market and the Government expects the share of nuclear power in French power generation to fall from 80 per cent currently to slightly under 70 per cent in 2010 and slightly above 57 per cent in 2020. However, taking a long-term view, the French government intends to retain strategic choice when deciding on the construction of new generating plants in the competitive electricity market.

To facilitate retaining this choice, efforts are being made to introduce competitive forces within the supply chain needed to support the operations of existing nuclear power plants, notably the procurement of "front-end" nuclear fuel cycle materials and services (i.e. prior to irradiation), such as uranium ore, enrichment and fabrication. More can be done to introduce competition, although such action could affect the currently indigenous nature of many of these activities.

The Nuclear Fuel Cycle

Services to support nuclear power plant operations are currently mainly indigenous in France. The exception is the supply of the primary fuel, uranium ore, which is not sufficiently or economically available in France; it is procured on world markets

where supplies are well diversified and controlled by French interests. The uranium market is depressed at present and has been for more than ten years. The security stocks of uranium held in France are sufficient to cover three years of generation.

France had previously chosen a route for the development of its nuclear programme which included fast breeder reactors and involved reprocessing of irradiated fuel for use in those reactors. This programme was abandoned, but reprocessing continues for both French and foreign nuclear power plants. Separated plutonium is produced, as well as uranium and radioactive waste (for possible further treatment, vitrification and final disposal). Other reasons for reprocessing include reducing the volume of waste needing storage, reducing the amounts of plutonium needing storage and recycling fissile materials. Due to low prices on the markets for uranium and enrichment, the latter reason has become economically less relevant.

In the absence of a programme of fast breeder reactors fuelled by the separated plutonium from pressurised water reactors, a decision has been taken to recycle the separated plutonium in existing plants as mixed oxide fuel (MOX). Currently up to one-third of the fuel load of 20 reactors in France is MOX. As a result, stocks of separated civil plutonium will be maintained in France at a lower level than would otherwise be the case.

Using this type of fuel furthers nuclear non-proliferation goals, since plutonium from military purposes can produce electricity. It is anticipated that France (along with Belgium and the United Kingdom which also have the technology) will benefit commercially and politically from this decision.

ENVIRONMENTAL AND HEALTH IMPACTS

Carbon Emissions

Nuclear power has had a large impact on the environment in France, much of it beneficial. France's carbon dioxide emissions are low compared to those of other industrialised nations of the same size and wealth and the country's nuclear power programme has undeniably contributed greatly to that result. The rapid phase-in of new nuclear units led to drastic reductions in CO_2 emissions after 1980. A rough estimate[61] of the CO_2 emissions that nuclear power helped avoid yields the following results for the period 1981 to 1997:

61. Provided by the DGEMP. This estimate probably underestimates the carbon emission savings of nuclear, since the estimate was based on 1997 technologies and fuel efficiencies for the fossil fuels. Also, it does not take the earlier use of nuclear (1960 to 1980) into account and it does not incorporate other factors, such as methane leaking from coal beds and gas transportation.

- If gas-fired power plants had been used instead of nuclear plants, carbon emissions would have been higher by about 500 million tonnes.
- If coal-fired power plants had been used, the figure could have been as high as 1,500 million tonnes of carbon.

In addition to these savings, by reducing fossil fuel use, the nuclear programme has also reduced emissions of air pollutants. These are much harder to quantify, since they depend on the combustion and abatement technologies used. Therefore no attempt was made to provide estimates. Because France is the biggest net power exporter in Europe, a part of these carbon and air pollutant savings may have occurred outside of France.

However, nuclear energy gives rise to its own environmental, health and security concerns, namely the generation of significant amounts of nuclear waste and the risk of accidents and nuclear proliferation. Much has been written on the relative weight of the environmental and health impacts of nuclear versus fossil fuels, and many attempts have been made to estimate their respective external costs - without yielding any clear guidance. No consensus has emerged, either among IEA countries or in any other group of countries, as to whether nuclear is more or less harmful than fossil fuels[62].

Hence, governments have had to rely on their voters' acceptance of nuclear power in deciding whether to begin, continue or end their nuclear programmes. In France, public opinion is in favour of nuclear by a slight majority. The *Observatoire de l'Energie*, which is part of the Ministry of Economic Affairs, Finance and Industry, commissions annual opinion polls. The 1999 poll shows that 51 per cent of those questioned believe the current 75 per cent share[63] of nuclear power in French electricity generation is advantageous, 35 per cent believe it is disadvantageous and 14 per cent have no opinion. In 1994, 52 per cent of those asked accepted nuclear power, but in all the intermediate years the figure was 48 per cent. The relatively favourable stance of the French population contributed significantly to the large-scale development of nuclear in France.

It is clear that the large amount of savings in air pollutants and CO_2 emissions that occurred in the 1980s was due to the rapid phase-in of nuclear, displacing fossil generation. Not only will there not be another such period of substitution; the government expects the share of nuclear to decline because the economics of gas-based generation in combined cycle gas turbines are improving. This shift will, of course, contribute to increased CO_2 emissions. This reality is fully acknowledged by the government and is reflected in its new national programme to combat climate change.

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62. The French government and Parliament believe that all key nuclear costs, such as radioactive waste disposal, plant decommissioning and the potential cost of a major nuclear accident are internalised (the latter by insurance). See Bataille, Christian, et Galley, Robert: *L'aval du cycle nucléaire. Tome II: Les coûts de production de l'électricité*. Office parlementaire d'évaluation des choix scientifiques et technologiques no. 1359. Paris, 3 février 1999.
63. The exact share of nuclear varies, but has been between 75 per cent and 80 per cent in recent years.

Radioactive Waste Disposal

France currently operates a repository at Centre de l'Aube for the disposal of short-lived low-level and intermediate-level waste. Volumes of the three categories of waste - long-lived, intermediate-level and high-level - are small, solid and chemically stable and are therefore considered to be stored satisfactorily.

Under a government decision of 9 December 1998, three areas of research and development are being pursued for the management of the waste currently stored:

- Research on partitioning and transmutation, supported by operation of the fast reactor, Phénix.
- Research on extended storage and conditioning of waste.
- Study of deep retrievable or non-retrievable geological repository facilities, using underground research laboratories.
  - A site in clay at Meuse has been accepted for construction of an underground laboratory.
  - A second site in granite has yet to be identified.

The first two areas are the responsibility of the CEA;ANDRA is responsible for the third area. The French Parliament is committed to making a decision in 2006 on disposal of currently stored categories of waste 15 years after the research programme was initiated.

Nuclear Safety and Regulation

Nuclear safety is of paramount important in France. Events during the Christmas holiday storm of 1999 illustrate the importance of a strong safety culture. One nuclear plant at Blayais on the banks of the estuary of the Gironde River became flooded to the extent that some safety systems were disabled. In its report on the flooding of Blayais, IPSN indicated that flood protection measures at 16 of EDF's 19 sites need to be reviewed. The report distinguishes four different categories of reactor sites that require different degrees of review.

The Y2K transition took place satisfactorily without any safety problems in France, as elsewhere. Overall, the safety record of commercial nuclear power in France has been very good.

The French government is currently seeking to introduce new institutional and legal arrangements to improve transparency and accountability for safety regulation. In particular, the government is seeking greater independence for the safety authorities. However, proposals to this end, submitted to the National Assembly by the Minister of Regional Development and Environment in December 1999, were not accepted, and new proposals are not expected until the end of 2000.

CRITIQUE

The proportion of nuclear in power generation in France is very high (about 80 per cent) and has grown rapidly (by 5,000 MW) in the period since the last review. Diversity in terms of primary fuel for electricity production and technology is weak, but this is well recognised by the government, and France rightly acts cautiously.

Plant life assumptions of 30 years appear modest. The financial implications and possibilities to reduce carbon emissions from plant life extension are large and work should be maintained in this area. However, plant safety must remain the paramount priority. France can take advantage of the experience of other countries with older plants than its own.

Competition in the electricity market has become a reality in Europe. Nuclear power plants will have to compete against other generating options. The earlier the industry begins to adapt to these new challenges, the better it will be prepared to face them. It may be beneficial to increase efforts in this area. Eventually, the competitive European electricity market will become the main factor determining the level of nuclear generating capacity in France and in the rest of the EU.

Government policy to retain the nuclear option until currently operating plants reach the end of their life spans appears sound. If engineering and project skills are to be maintained in the longer term, however, more efforts may have to be made.

Safety remains of paramount importance. The high nuclear safety standards under the control of DSIN are commendable. New institutional arrangements to improve the transparency and accountability of regulatory activities would improve the picture even more.

The development of high-level radioactive waste management in France is of strategic importance. Waste producers should continue to fund these activities.

RECOMMENDATIONS

The government should:

- ☐ Maintain nuclear power as an option while continuously observing very high safety standards. Draw upon the experience of other countries concerning nuclear lifetime extensions.

- ☐ Increase efforts to expose the nuclear generating sector to a competitive environment early and directly.
- ☐ Maintain safety standards at their current high level and increase their transparency for further improvement.
- ☐ Work towards developing high-level radioactive waste management, and ensure that this activity is fully funded by nuclear waste producers.

8

ENERGY TECHNOLOGY AND R&D

OVERVIEW

French R&D policy is characterised by heavy concentration on nuclear and the involvement of many research entities in the government and industry.

Research in the energy sector ranks fourth in the government's priority after knowledge advancement, space, and life sciences, respectively. In terms of budget, FF 4,150 million were devoted to energy R&D in 1999, representing 7.6 per cent of the civil research budget (BCRD, Budget civil de recherche et développement technologique), compared with 8.1 per cent in 1998. An additional FF 542 million have been assigned to R&D on surface transport, with part of this sum devoted to the inter-ministerial PREDIT programme (see Table 9). Nuclear-related research has the lion's share of the energy R&D budget.

Table 9
Government Funding (BCRD) Assigned to the Main Objectives
(FF Million)

	Per cent of total 1998 budget	*1999*	*Per cent of total 1999 budget*
Total BCRD		54,391	
Knowledge Advancement	36.3	21,145	38.9
Space	17.3	9,296	17.1
Health	8.8	4,657	8.6
Energy	**8.1**	**4,150**	**7.6**
Environment	3.5	1,349	2.5
Surface transport	0.6	542	1.0

Source: IEA.

The major actors in energy R&D are the following:

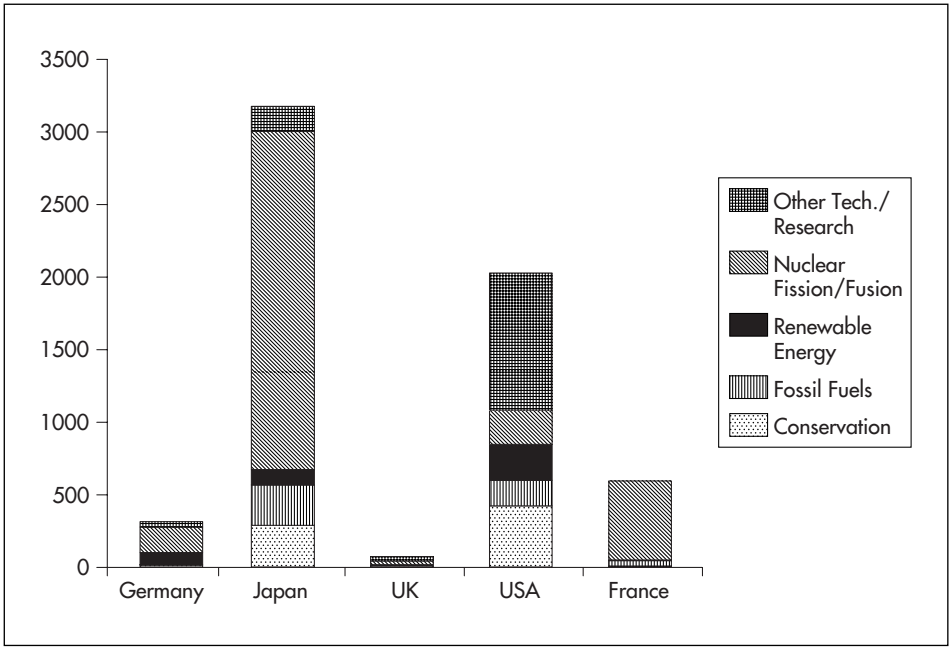
- CEA, *Commissariat à l'Énergie Atomique*: deals mainly with nuclear energy in both civilian and defence fields. The CEA comprises IPSN, which is responsible for nuclear safety and radiation and carries out research in those areas. It is worth noting that the CEA receives more than FF 6,000 million from the government, i.e. 60 per cent of the institution's civilian budget. The difference between this figure and the FF 4,150 million included in Table 9 is explained by

the fact that the CEA uses about 30 per cent of its budget on research in areas other than nuclear, e.g. biology, materials and electronics.

- CNRS, *Centre National de la Recherche Scientifique*: basic research in the energy field.
- IFP, *Institut Français du Pétrole*: oil and gas, especially upstream oil and innovative motors.
- ADEME, *Agence de l'environnement et de la maitrise de l'énergie*: R&D financing and promotional measures for energy efficiency, deployment of renewables and climate-friendly technologies.
- ANDRA, *Agence nationale pour la gestion des déchets radioactifs*: radioactive waste management.

Other public players involved in related R&D are BRGM for geology and mining, CSTB for building and habitat and IFREMER for exploitation of sea resources.

Figure 20
Public Spending on Different R&D Sectors in Major IEA Countries in 1998
(million US$)



Source: ADEME.

The state-owned industries EDF, GDF and Cogéma are very important players in energy R&D. EDF employs 2,628 people in R&D - almost 2.2 per cent of its staff -

and spent FF 3,100 million on R&D in 1999, representing 1.7 per cent of its turnover. GDF has one of the world's leading research centres on natural gas, employs 400 researchers and spent FF 634 million on research in 1990. GDF has increased its R&D budget compared to the FF 400 million R&D budget reported in the 1996 Review.

Cogéma spent 4 per cent of its turnover on R&D in 1998, i.e. FF 1,251 million; Framatome dedicated 4.3 per cent of its turnover to R&D: FF 119 million. In contrast with the decreasing international trend in R&D funding observed in the energy sector, French industries have maintained the same efforts as in 1995.

The French government attaches great importance to European collaboration in R&D, in particular the EU's 5th Framework Research Programme and the EURATOM agreement.

Concerning the post-Kyoto initiatives in R&D, the most important developments are:

- The third phase (1996-2000) of the PREDIT programme for transport, launched with five-year funding of FF 2,125 million.
- The ECODEV programme for interdisciplinary research on sustainable development, approved in 1997 with a four-year budget of FF 142 million.
- A network for R&D on Fuel cells, constituted with an annual budget of FF 50 million.
- A FF 500 million supplement granted to ADEME to strengthen energy efficiency activities.
- The launching of the HELIOS 2006 and EOLE 2005 programmes for the deployment of solar and wind energy systems in Corsica and in the DOM/TOM.

Nuclear R&D

Many organisations carry out nuclear R&D in France. The CEA performs studies and research on reactors and on the nuclear fuel cycle. Framatome deals with the design, development and engineering of nuclear power plants. EDF is involved with the production of electricity and plant construction, operation and maintenance. Cogéma deals with the fuel cycle: ore extraction, isotopic separation, conversion, enrichment, reprocessing and MOX manufacturing. ANDRA is devoted to long-term radioactive waste management.

The different partners carry out research in the nuclear field in close co-operation. Following are some of the most important lines of research:

- Maintaining support to the competitiveness of existing reactors (plant lifetime, fuel use, etc.).

- Preparation for future nuclear generations: the new generation (EPR) and other reactor types (rapid neutron reactors, high temperature reactors).
- Conceptual and technological development of innovative reactors (hybrid systems, fusion).
- Fuel cycle (enrichment, re-processing): support to existing facilities and preparation for future activities.
- Waste management of the three main types specified in the Law of 30 December 1991: 1) separation and transmutation, 2) reversible or irreversible geological disposal, 3) conditioning and long-term interim storage.
- Dismantling of facilities and re-transformation to green-field sites.
- Nuclear safety.

Oil and Gas

R&D policy in oil and gas aims to maintain the know-how and competitiveness of French enterprises in the exploration and production of oil and natural gas, in the face of increasing international competition as a consequence of energy market opening.

The research and development activities are carried out mostly by the *Institut Français du Pétrole*, the national (TotalfinaElf) and foreign (Shell, Mobil, Esso) oil companies and the parapétrolière sector. The CNRS, IFREMER and the mining schools are preferential partners in work financed by the government through the budget assigned to IFP or directly by the oil support fund (FSH, Fonds de soutien aux hydrocarbures) dedicated to the industry and research laboratories. The budget assigned to FSH is of the order of FF 240 million per year.

The Ministry of Industry has set up a plan for technological research in the oil and gas area to promote and co-ordinate the R&D efforts of French companies in exploration and production. The technological programme carried out jointly by the *Comité d'Études Pétrolieres et Marines* and the *Comité des Programmes Exploration Production* had funding of FF 8,603 million for the period 1994 to 1998, i.e. approximately FF 1,700 million per year, and covered four geological domains: reservoirs (51 per cent), wells (8 per cent), marine exploration (29 per cent) and natural gas (12 per cent). The funding was divided among the gas and oil companies (40 per cent), the research centres (30 per cent) and IFP (30 per cent).

Research in the field of gas is performed mainly by industry, more specifically by IFP and Gaz de France. IFP focuses on security of supply and economic utilisation of natural gas and is conducting research on exploration technologies, more cost-effective technologies for production, processing, transportation and conversion, and technologies for underground storage.

IFP shares information with as many as 200 partners, including most of the international oil and gas companies. Gaz de France has one of the world's leading research centres on natural gas, with more than 400 researchers. Its 1999 budget for research was FF 634 million (about 1.2 per cent of its total budget)[64] compared with FF 400 million in 1994. The centre's role is to contribute to the GDF Group's growth and performance objectives: making GDF products more competitive; making installations safer and improving natural gas utilisation and services while protecting the environment.

In the Liquefied Natural Gas (LNG) sector, studies are being conducted through partnerships. Two were formed in 1998: with Total and the *Institut Français du Pétrole* to build a pilot mixed refrigerant cascade unit to reduce liquefaction costs by 20 per cent; and with *Gaz Transport* and *Technigaz* for studies on re-liquefaction.

R&D is being carried out to reduce costs by using new materials and new techniques to lay pipelines and to cut maintenance costs by developing very accurate measurement tools to evaluate the condition of pipeline systems in order to facilitate repairs.

In storage, new horizontal drilling techniques, expected to lead to significant gains in productivity, are being investigated. In co-operation with international industrial firms, new projects are being carried out for the optimisation of natural gas vehicles (NGVs) and their fuel distribution infrastructure.

Coal

Because coal accounts for only 6 per cent of total energy consumption in France, little R&D takes place in this field. Funding was FF 31 million in 1998, the same as for 1996 and 1997 in nominal values. EDF is developing new clean coal combustion technologies such as the circulating fluidised bed introduced at the Gardanne power plant in Southern France.

Renewable Energies and other fuels

R&D on renewable sources of energy is performed by ADEME, EDF, universities, CNRS and the CEA. EDF devotes 1.1 per cent of its R&D budget to renewable sources of energy (FF 31 million in 1999). ADEME spent FF 82 million in 1999, compared with FF 25 million in 1998. The ECODEV Programme was attributed FF 2 million in 1998 out of FF 3.32 million devoted to energy systems and a total budget of FF 11 million.

64. Gaz de France, *Annual Report 1998*.

Regarding rural electrification, it is worth mentioning the development of a set of standardised products and services to offer to developing countries. These products and services are tailored to take into account regional needs and characteristics. EDF's total R&D funding for photovoltaic research in the year 2000 will reach FF 16.6 million (including FF 2.7 million from ADEME and the European Commission). At the end of 1998, more than 3,000 sites were equipped with photovoltaic systems with a total installed power of more than 6 MW in France and in the DOM/TOM as a result of FACE and de-taxation programmes. Moreover, ADEME is conducting multi-annual R&D and diffusion programmes with industrial operators like Photowatt, Total Energie, Apex and Transenergie.

In 1996, the Ministry of Industry, Post and Telecommunications launched the EOLE 2005 Programme aiming to set up a wind power system capable of generating 250 to 500 MW by 2005. The installed wind power capacity was 8 MW at the end of 1998. R&D in this area is carried out by EDF.

Geothermal R&D activities are carried out by ADEME, the BRGM (Bureau de Recherche Géologique et Minière), CNRS through the ECODEV Programme and EDF. These activities include maintenance or refurbishment of the installations (338 MW from the heat network and 182 MW from heat pumps) and R&D in deep geothermal energy. The second phase foresees the drilling of three more wells at 5,000 meters to provide power on the order of 50 MW during the period 2001-2007 and the evaluation of favourable zones for the installation of heat pumps using sub surface heat. At the moment two areas, *Île-de-France* (Paris region) and the *Bassin Aquitain* (Aquitaine region), have been identified.

ADEME is conducting some R&D projects in the field of the electricity production from biomass. Through the ECODEV Programme the CNRS is carrying out studies on the socio-economic valorisation of biomass. A new programme has been launched by CSTB (Centre Scientifique et Technique du Bâtiment) and ADEME for chemical characterisation of the fumes from wood combustion for domestic heating and methods for their elimination. The programme *Bois énergie et développement local* (Energy Wood and Local Development), launched in 1994 in order to improve plants in terms of energy efficiency and environmental impact, achieved good results in 1998 through the installation of approximately 40 heating systems in public buildings.

Biofuels projects are carried out in the framework of the AGRICE Programme involving the oil industry, ADEME and the INRA (Institut National de la Recherche Agronomique). The research follows two major lines: obtaining ethanol and ETBE from glucidic plants and methyl esters from lipidic plants. The projects concern cellulose hydrolysis, pentose fermentation, utilisation of beetroot and the use of mixtures of ethanol and gasoline or ethanol and diesel in appropriate vehicles.

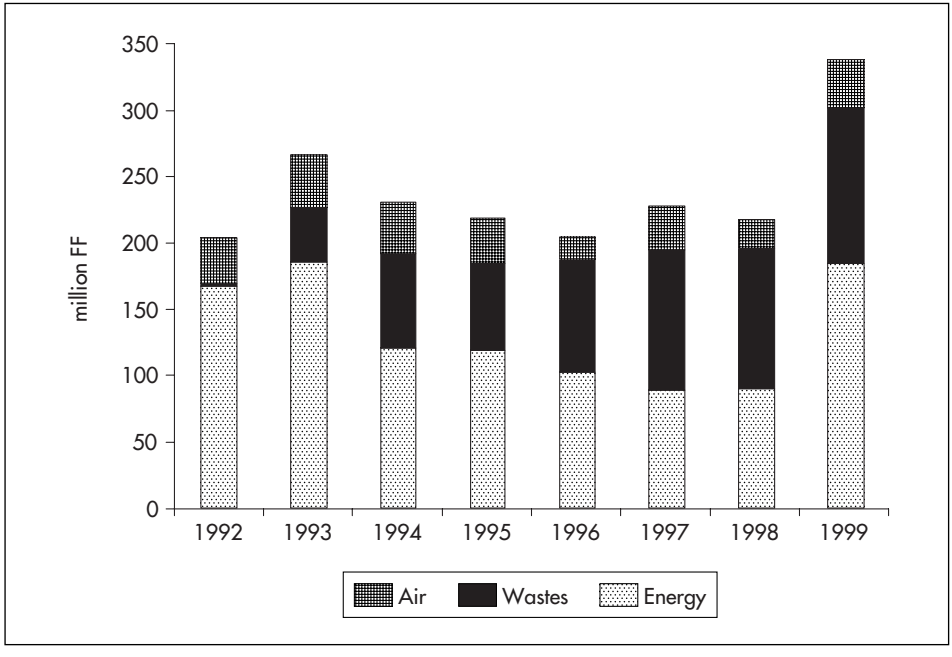
In June 1999, the Ministers of Research and Industry decided to reinforce studies on fuel cells by setting up a technological network, run jointly by the CEA and ADEME, to bring together parties in industry and the scientific community interested in the development of stationary and mobile fuel cells. Annual funding is FF 50 million.

Energy Efficiency

The main organisation involved in energy management is ADEME, created by the Law of 29 December 1990 and operative since January 1992. ADEME is a public body with an industrial and commercial character, under the control of three ministries: environment, research and industry. ADEME is closely associated with the implementation of government policies in the areas of environment and energy. Other players are the Ministry of Transport, EDF, IFP and CNRS (ECODEV programme).

ADEME's efforts seem to be concentrated in the building, transportation and industry sectors. ADEME spent FF 37 million in 1999 on the rational use of energy, out of a total budget of FF 321.2 million. Figure 21 shows the evolution of ADEME's budget from 1992 to 1999 and how it is allocated. It is worth noting that starting in 1999 ADEME received an additional FF 500 million per year to reinforce energy efficiency activities.

Figure 21
ADEME's R&D Budget



Source: ADEME.

Several studies are being conducted by ADEME using the additional funding, specifically an evaluation of energy savings in industry as well as an international comparison of policies and energy efficiency indicators. In the field of transport, the most important initiative is the PREDIT programme sponsored by the ministries

of research, industry, transport and environment. PREDIT's second four-year phase was launched in 1996. The total budget is FF 7,300 million, including FF 2,500 million from public funding. The breakdown by different areas is: energy and environment FF 450 million; clean and safe vehicles FF 1,700 million; materials for railway transport FF 400 million; materials for urban transport FF 600 million; urban transport management FF 400 million; intelligent routing FF 500 million; freight transport FF 300 million, train control FF 600 million. Through the ECODEV programme, the CNRS is working on clean and economic automobile engines as well as on new fuels and vehicles. CNRS had a 1998 budget of FF 1.59 million for this purpose.

CRITIQUE

France may be coming to a turning point in R&D policy making. Traditionally, the government focused on nuclear-related research, leaving other energy research to industry. It makes sense, theoretically, to be efficient in allocating resources so that new technology will be deployed effectively in the market. However, research activities of fairly basic and fundamental nature have been done by state owned enterprises, enjoying monopolistic control over the market, since they were not necessarily under the strong pressure of short-term investment returns.

As the energy market becomes more competitive, industry will probably focus more on short term R&D. The government needs to monitor and adjust national R&D activities to ensure that they are consistent and effective in relation to the national energy policy objectives.

A comparatively high percentage of GDP (2.26 per cent) is spent on research, and research budgets are stable in contrast with the trend observed in most other IEA countries. The percentage of energy R&D within the overall public research budget (7.6 per cent) is substantial. However, the allocation of the R&D budget may need to be modified to support non-nuclear R&D activities. This may be necessary to meet national energy objectives in light of growing competition and the prospect of a declining role for nuclear energy in the future.

The same thing can be said for co-ordination among different R&D players. The roles of the ministries, their subsidiaries and the industries are changing as competition develops. In addition, Kyoto targets cannot be met solely by the efforts of the energy ministry and the energy industry. The broad involvement of different industrial sectors and relevant ministries is necessary. Given the already complex organisation of R&D, it is essential to develop a good co-ordination mechanism to develop and implement policies.

Having an effective means to assess the performance of R&D activities is important in this respect. Currently, the scientific activities of governmental research institutions are reviewed by scientific and technical councils. These reviews concern the quality and relevance of the research conducted in the establishments

and are performed by external experts. However, no monitoring or evaluation of the adequacy and effectiveness of government investments in technology development and deployment is regularly performed.

RECOMMENDATIONS

The government should:

- ☐ Assess the current R&D situation in light of growing competition in the market and new challenges in the energy sector. Study the implications of these developments for the roles of different players in energy R&D and for resource allocation among them.
- ☐ Establish a three-year national research plan, identifying strategic objectives in the main areas (energy, environment, transport, information technologies). The plan should provide a comprehensive review of all efforts in the field, giving all players an overview of their national strategy and helping to avoid duplication. The research activities of the state-owned industries (EDF, GDF, Cogéma, Framatome) should also be included.
- ☐ Strengthen the co-ordination among the Ministries of Higher Education and Research, Industry, Environment and Transport in defining and implementing this plan.
- ☐ Evaluate periodically and systematically the efficiency and effectiveness of government research programmes using independent experts.

A

ANNEX

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2020
TOTAL PRODUCTION		**36.1**	**110.8**	**127.8**	**125.5**	**..**	**129.3**	**118.6**
Coal[1]		18.0	8.2	4.4	3.7	..	–	–
Oil		2.1	3.6	2.2	2.0	..	–	–
Gas		6.3	2.5	2.1	1.8	..	–	–
Comb. Renewables & Wastes[2]		1.7	9.8	10.5	11.3	..	11.4	12.5
Nuclear		3.8	81.9	103.1	101.1	..	111.4	99.5
Hydro		4.1	4.6	5.4	5.3	..	6.5	6.5
Geothermal		–	0.1	0.1	0.1	..	..	..
Solar/Wind/Other[3]		0.0	0.1	0.1	0.1	..	..	..
TOTAL NET IMPORTS[4]		**142.8**	**118.6**	**120.2**	**129.1**	**..**	**178.5**	**215.7**
Coal[1]	Exports	1.3	0.6	0.4	0.4	..	–	–
	Imports	10.8	13.7	10.2	12.8	..	10.8	11.5
	Net Imports	9.5	13.0	9.8	12.4	..	10.8	11.5
Oil	Exports	13.7	14.8	20.1	21.5	..	6.3	5.6
	Imports	145.1	102.4	109.7	115.9	..	121.3	135.1
	Bunkers	5.3	2.5	3.0	2.9	..	2.7	3.4
	Net Imports	126.0	85.1	86.6	91.5	..	112.3	126.1
Gas	Exports	0.1	0.3	1.2	0.7	..	–	–
	Imports	7.6	24.7	30.5	30.8	..	59.7	82.4
	Net Imports	7.6	24.4	29.3	30.1	..	59.7	82.4
Electricity	Exports	0.6	4.5	6.0	5.3	..	4.3	4.3
	Imports	0.4	0.6	0.4	0.4	..	–	–
	Net Imports	–0.2	–3.9	–5.6	–5.0	..	–4.3	–4.3
TOTAL STOCK CHANGES		**–2.4**	**–1.7**	**–0.5**	**1.1**	**..**	**–**	**–**
TOTAL SUPPLY (TPES)		**176.6**	**227.6**	**247.6**	**255.7**	**..**	**307.8**	**334.2**
Coal[1]		29.2	20.2	14.7	16.8	..	10.8	11.5
Oil		124.3	88.8	88.0	92.4	..	112.3	126.1
Gas		13.6	26.0	31.3	33.4	..	59.7	82.4
Comb. Renewables & Wastes[2]		1.7	9.8	10.6	11.3	..	11.4	12.5
Nuclear		3.8	81.9	103.1	101.1	..	111.4	99.5
Hydro		4.1	4.6	5.4	5.3	..	6.5	6.5
Geothermal		–	0.1	0.1	0.1	..	..	..
Solar/Wind/Other[3]		0.0	0.1	0.1	0.1	..	..	..
Electricity Trade[5]		–0.2	–3.9	–5.6	–5.0	..	–4.3	–4.3
Shares (%)								
Coal		*16.6*	*8.9*	*5.9*	*6.6*	*..*	*3.5*	*3.4*
Oil		*70.4*	*39.0*	*35.6*	*36.2*	*..*	*36.5*	*37.7*
Gas		*7.7*	*11.4*	*12.7*	*13.1*	*..*	*19.4*	*24.7*
Comb. Renewables & Wastes		*1.0*	*4.3*	*4.3*	*4.4*	*..*	*3.7*	*3.7*
Nuclear		*2.2*	*36.0*	*41.6*	*39.5*	*..*	*36.2*	*29.8*
Hydro		*2.3*	*2.0*	*2.2*	*2.1*	*..*	*2.1*	*2.0*
Geothermal		*–*	*0.1*	*–*	*0.1*	*..*	*..*	*..*
Solar/Wind/Other		*–*	*–*	*–*	*–*	*..*	*..*	*..*
Electricity Trade		*–0.1*	*–1.7*	*–2.3*	*–1.9*	*..*	*–1.4*	*–1.3*

0 is negligible, – is nil, .. is not available.

Please note: Forecast data for combustible renewables and waste include final consumption of solar. Forecasts do not include inputs and outputs from geothermal. solar. wind and combustible renewables and waste to electricity and heat generation.

Data on renewable fuels have been substantially revised to more accurately represent the use of such fuels in France.

Revisions have been based on data submitted by the French Administration (for 1994) and from the report.

Distribution: 4/3/00.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2020
TFC	**138.1**	**146.3**	**162.4**	**166.9**	**..**	**204.5**	**231.2**
Coal[1]	13.1	7.5	5.5	5.3	..	7.9	7.9
Oil	99.4	79.5	85.9	87.8	..	105.2	118.8
Gas	11.2	23.9	30.6	31.4	..	40.5	45.8
Comb. Renewables & Wastes[2]	1.7	8.5	8.6	9.6	..	11.4	12.5
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	0.0	0.0	0.0	..	..	..
Electricity	12.8	26.0	30.5	31.6	..	39.5	46.1
Heat	–	0.8	1.3	1.2	..	..	..
Shares (%)							
Coal	*9.5*	*5.1*	*3.4*	*3.2*	..	*3.9*	*3.4*
Oil	*72.0*	*54.3*	*52.9*	*52.6*	..	*51.5*	*51.4*
Gas	*8.1*	*16.4*	*18.9*	*18.8*	..	*19.8*	*19.8*
Comb. Renewables & Wastes	*1.2*	*5.8*	*5.3*	*5.7*	..	*5.6*	*5.4*
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*9.3*	*17.7*	*18.8*	*18.9*	..	*19.3*	*20.0*
Heat	–	*0.6*	*0.8*	*0.7*	..	..	..
TOTAL INDUSTRY[6]	**55.7**	**46.2**	**51.5**	**51.6**	**..**	**63.6**	**70.5**
Coal[1]	7.2	5.9	4.6	4.5	..	6.3	5.6
Oil	35.3	18.0	21.0	20.0	..	26.3	28.9
Gas	5.8	11.1	13.5	14.1	..	15.1	16.5
Comb. Renewables & Wastes[2]	0.2	1.4	1.4	1.7	..	2.0	2.6
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	7.2	9.9	11.0	11.4	..	13.8	16.9
Heat	–	–	–	–	..	..	..
Shares (%)							
Coal	*12.9*	*12.7*	*8.9*	*8.6*	..	*10.0*	*8.0*
Oil	*63.4*	*38.9*	*40.8*	*38.8*	..	*41.4*	*41.0*
Gas	*10.4*	*24.0*	*26.2*	*27.3*	..	*23.8*	*23.4*
Comb. Renewables & Wastes	*0.4*	*3.1*	*2.8*	*3.3*	..	*3.1*	*3.7*
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	*13.0*	*21.3*	*21.3*	*22.0*	..	*21.7*	*24.0*
Heat	–	–	–	–	..	..	..
TRANSPORT[7]	**27.1**	**42.8**	**47.9**	**49.8**	**..**	**62.4**	**75.4**
TOTAL OTHER SECTORS[8]	**55.4**	**57.2**	**63.0**	**65.5**	**..**	**78.5**	**85.2**
Coal[1]	5.8	1.7	0.9	0.8	..	1.6	2.3
Oil	37.6	19.5	17.9	19.0	..	17.9	16.1
Gas	5.4	12.8	17.1	17.3	..	25.4	29.3
Comb. Renewables & Wastes[2]	1.5	7.1	7.2	7.9	..	9.1	9.6
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	0.0	0.0	0.0	..	..	..
Electricity	5.0	15.3	18.6	19.3	..	24.6	27.9
Heat	–	0.8	1.3	1.2	..	..	..
Shares (%)							
Coal	*10.5*	*2.9*	*1.4*	*1.2*	..	*2.0*	*2.7*
Oil	*68.0*	*34.0*	*28.4*	*29.0*	..	*22.7*	*18.9*
Gas	*9.7*	*22.4*	*27.2*	*26.4*	..	*32.3*	*34.4*
Comb. Renewables & Wastes	*2.7*	*12.4*	*11.3*	*12.0*	..	*11.6*	*11.3*
Geothermal	–	–	–	–	..	–	–
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*9.0*	*26.8*	*29.6*	*29.4*	..	*31.3*	*32.8*
Heat	–	*1.5*	*2.0*	*1.9*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2020
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**35.9**	**98.5**	**118.5**	**120.1**	**..**	**137.6**	**85.7**
OUTPUT (Mtoe)	**15.7**	**35.8**	**42.9**	**43.6**	**..**	**52.7**	**57.8**
(TWh gross)	182.5	416.8	499.2	506.9	..	612.7	672.1
Output Shares (%)							
Coal	*19.4*	*8.5*	*5.2*	*7.4*	..	*1.5*	*1.9*
Oil	*40.2*	*2.1*	*1.5*	*2.3*	..	*0.2*	*0.1*
Gas	*5.5*	*0.7*	*1.0*	*1.0*	..	*16.3*	*29.8*
Comb. Renewables & Wastes	*0.4*	*0.4*	*0.5*	*0.5*	..	..	..
Nuclear	*8.1*	*75.4*	*79.2*	*76.5*	..	*69.8*	*56.8*
Hydro	*26.1*	*12.8*	*12.5*	*12.2*	..	*12.3*	*11.3*
Geothermal	–	*0.0*	–	–	..	–	–
Solar/Wind/Other	*0.3*	*0.1*	*0.1*	*0.1*	..	..	..
TOTAL LOSSES	**37.6**	**76.7**	**89.5**	**91.2**	**..**	**103.2**	**103.1**
of which:							
Electricity and Heat Generation[10]	20.2	61.8	74.3	75.2	..	86.4	85.7
Other Transformation	5.4	3.2	1.9	2.3	..	..	..
Own Use and Losses[11]	12.0	11.8	13.3	13.7	..	16.9	17.4
Statistical Differences	**0.9**	**4.6**	**–4.4**	**–2.4**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2020
GDP (billion 1990 US$)	811.43	1195.43	1307.35	1349.20	1582.00	1772.49	2225.06
Population (millions)	52.12	56.74	58.61	58.85	60.80	61.70	63.50
TPES/GDP[12]	0.22	0.19	0.19	0.19	..	0.17	0.15
Energy Production/TPES	0.20	0.49	0.52	0.49	..	0.42	0.35
Per Capita TPES[13]	3.39	4.01	4.22	4.34	..	4.99	5.26
Oil Supply/GDP[12]	0.15	0.07	0.07	0.07	..	0.06	0.06
TFC/GDP[12]	0.17	0.12	0.12	0.12	..	0.12	0.10
Per Capita TFC[13]	2.65	2.58	2.77	2.84	..	3.31	3.64
Energy–related CO_2 Emissions (Mt CO_2)[14]	496.1	378.3	362.8	389.4	..	480.8	573.1
CO_2 Emissions from Bunkers (Mt CO_2)	17.0	8.0	9.4	9.1	..	8.5	10.7

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–20
TPES	1.2	1.7	1.2	3.3	–	–	0.8
Coal	1.7	–4.2	–4.5	14.7	–	–	0.6
Oil	–1.0	–2.5	–0.1	5.0	–	–	1.2
Gas	7.4	2.0	2.7	6.6	–	–	3.3
Comb. Renewables & Wastes	7.6	12.7	1.1	7.1	–	–	0.9
Nuclear	18.1	20.6	3.3	–1.9	–	–	–1.1
Hydro	5.7	–2.0	2.2	–0.2	–	–	0.1
Geothermal	–	–	–1.4	19.0	–	–	–
Solar/Wind/Other	–1.8	3.2	1.3	4.5	–	–	–
TFC	0.7	0.2	1.5	2.7	–	–	1.2
Electricity Consumption	5.4	3.7	2.3	3.4	–	–	1.6
Energy Production	2.2	9.4	2.1	–1.8	–	–	–0.9
Net Oil Imports	–1.0	–3.0	0.3	5.6	–	–	1.2
GDP	2.7	2.1	1.3	3.2	2.3	2.3	2.3
Growth in the TPES/GDP Ratio	–1.4	–0.4	–0.1	0.1	–	–	–1.4
Growth in the TFC/GDP Ratio	–1.9	–1.9	0.2	–0.5	–	–	–1.0

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to Energy Balances and Key Statistical Data

1. Includes lignite and peat, except for Finland, Ireland and Sweden. In these three cases, peat is shown separately.
2. Comprises solid biomass and animal products, gas/liquids from biomass, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
3. Other includes tide, wave and ambient heat used in heat pumps.
4. Total net imports include combustible renewables and waste.
5. Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.
6. Includes non-energy use.
7. Includes less than 1% non-oil fuels.
8. Includes residential, commercial, public service and agricultural sectors.
9. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
10. Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.
11. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
12. Toe per thousand US dollars at 1990 prices and exchange rates.
13. Toe per person.
14. "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e. coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (i.e. electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. TPES, by definition, excludes international marine bunkers. INC-IX decided in February 1994 that emissions from international marine and aviation bunkers should not be included in national totals but should be reported separately, as far as possible. CO_2 emissions from bunkers are those quantities of fuels delivered for international *marine* bunkers and the emissions arising from their use. Data for deliveries of fuel to international *aviation* bunkers are not generally available to the IEA and, as a result, these emissions have not been deducted from the national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 1998 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1 **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2 Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3 **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4 **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of

* Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5 **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6 **Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7 **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8 **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9 **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

C

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

AC	alternating current.
ADEME	Agence de l'environnement et de la maîtrise de l'énergie (Agency for the Environment and Energy Management).
ANDRA	Agence nationale pour la gestion des déchets radioactifs (National Agency for Radioactive Waste Management).
bcm	billion cubic metres.
b/d	barrels per day.
cal	calorie.
CCGT	combined-cycle gas turbine.
CDF	Charbonnages de France.
CEA	Commissariat à l'Énergie Atomique.
CERT	Committee on Energy Research and Technology of the IEA.
CFCs	chlorofluorocarbons.
CFM	Compagnie Française de Méthane.
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co-generation" is used.
cm	cubic metre.
CNG	compressed natural gas.
CNR	Compagnie Nationale du Rhône.
CO	carbon monoxide.
CO_2	carbon dioxide.
CRE	Commission de régulation de l'électricité (Regulatory Commission for Electricity).
CREG	Commission de régulation de l'électricité et du gaz (proposed regulatory commission for electricity and natural gas).
DC	direct current.
DGEMP	Direction générale de l'énergie et des matières premières (Directorate-General for Energy and Raw Materials).
DH	district heating.

DIGEC	Direction du gaz, de l'électricité et du charbon (Directorate for Gas, Electricity and Coal).
DIMAH	Direction des matières premières et des hydrocarbures (Directorate for RawMaterials and Hydrocarbons).
DOM	Départements d'outre-mer (French overseas territories enjoying the same administrative status as regions in metropolitan France).
DRIRE	Regional Directorate for Industry, Research and the Environment (Direction régionale de l'industrie, de la recherche et de l'environnement).
DSIN	Direction de la sûreté des installations nucléaires (Directorate for the Safety of Nuclear Installations).
DSO	distribution system operator.
ECU	European Currency Unit.
EDF	Electricité de France.
EFTA	Europe Free Trade Association: Iceland, Norway, Switzerland and Liechtenstein.
EIA	environmental impact assessment.
EPR	European Pressurised Water Reactor.
ETSO	Association of European Transmission System Operators.
EU	The European Union, whose members are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
Euro	European currency (€).
FACE	Fonds d'amortissement des charges d'électrification (Depreciation Fund for Electrification Expenses).
FCCC	Framework Convention on Climate Change.
FF	French currency. One French Frank was the equivalent of US$ 0.164 and € 0.1524 in 1999.
FSU	Former Soviet Union.
GDF	Gaz de France.
GDP	gross domestic product.
GNP	gross national product.
GEF	Global Environmental Facility.
GJ	gigajoule, or 1 joule $\times 10^9$.
GSO	Gaz du Sud-Ouest.
GW	gigawatt, or 1 watt $\times 10^9$.
GWh	gigawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^9$.
IAEA	International Atomic Energy Agency.

IEA	International Energy Agency whose Members are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
IEP	International Energy Programme, one of the founding documents of the IEA.
IGCC	integrated coal gasification combined cycle plant.
IPCC	International Panel on Climate Change.
IPSN	Institut de protection et de sûreté nucléaire (Institute for Nuclear Protection and Safety).
ISO	independent system operator.
J	joule; a joule is the work done when the point of application of a force of one newton is displaced through a distance of one metre in the direction of the force (a newton is defined as the force needed to accelerate a kilogram by one metre per second). In electrical units, it is the energy dissipated by one watt in a second.
kV	kilo-Volt, or one Volt $\times 10^3$.
kWh	kilowatt-hour, or one kilowatt $\times$ one hour, or one watt $\times$ one hour $\times 10^3$.
LNG	liquefied natural gas.
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature.
mcm	million cubic metres.
MIES	Mission interministérielle sur l'effet de serre (Interministerial Mission on Climate Change).
Mt	million tonnes.
Mtoe	millions of tonnes of oil equivalent; see toe.
MW	megawatt of electricity, or 1 Watt $\times 10^6$.
MWh	megawatt-hour = one megawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^6$.
NATO	the North Atlantic Treaty Organisation.
NEA	the Nuclear Energy Agency of the OECD.
negTPA	negotiated Third Party Access.
NGV	natural gas vehicles.
NO_x	nitrogen oxides.
OECD	Organisation for Economic Co-operation and Development.
PJ	Petajoule, or 1 Joule $\times 10^{15}$.

ppm	parts per million.
PPP	Purchasing power parity: the rate of currency conversion that equalises the purchasing power of different currencies, i.e. estimates the differences in price levels between different countries.
PWR	Pressurised Water Reactor.
regTPA	regulated Third Party Access.
RFF	Réseau Ferré de France (French railway network company).
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
SB	Single Buyer.
SEAR	Société Elf-Aquitaine de Réseau.
SLT	Standing Group on Long-Term Co-operation of the IEA.
SNCF	Société Nationale des Chemins de Fer.
SNET	Société Nationale d'Électricité et de Thermique.
SO_2	sulphur dioxide.
TFC	total final consumption of energy; the difference between TPES and TFC consists of net energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses.
TFE	TotalFinaElf.
TGAP	Taxe générale sur les activités polluantes (General Tax on Polluting Activities).
TIPP	Taxe intérieure sur les produits pétroliers (tax on petroleum products).
toe	tonne of oil equivalent, defined as 10^7 kcal.
TOM	Territoires d'outre-mer (French overseas territories).
TOP	take-or-pay contract.
TPA	Third Party Access.
TPES	total primary energy supply.
TSO	transmission system operator.
TW	terawatt, or 1 watt $\times 10^{12}$.
TWh	terawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^{12}$.
UFIP	Union française des industries pétrolières (French Petroleum Industry Association).
UGS	underground storage (of natural gas).
UN	the United Nations Organisation.
VAT	Value Added Tax.
VOCs	volatile organic compounds.
WANO	World Association of Nuclear Operators.

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