



Office of the Comptroller and Auditor General
Report on Value for Money Examination

Department of Transport,
Energy and Communications

Gas Interconnector Project

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Report of the Comptroller and Auditor General

Department of Transport, Energy and Communications Gas Interconnector Project

I have, in accordance with the provisions of Section 9 of the Comptroller and Auditor General (Amendment) Act, 1993, carried out a value for money examination of the project to connect the Irish and United Kingdom gas grids.

I hereby submit my report of the above examination for presentation to Dáil Éireann pursuant to Section 11 of the said Act.

A handwritten signature in black ink, appearing to read 'John Purcell', with a large, stylized initial 'J'.

**John Purcell
Comptroller and Auditor General**

9 August 1995

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Glossary

bar	1 bar is a pressure of 14.504 pounds per square inch
BCM	Billions of cubic metres
BGE	Bord Gáis Éireann
ESB	Electricity Supply Board
EU	European Union
IRR	Internal rate of return
LNG	Liquefied natural gas
NET	Nitrigin Éireann Teoranta
REGEN	EU initiative on energy infrastructure, established under Article 11 of Council Regulation (EEC) No. 4253/88
TPER	Total primary energy requirement
UK	United Kingdom

Summary of Findings

Background

- 1 Ireland's reserves of natural gas, extracted from two sub-sea fields off the south coast, are being progressively depleted. It is estimated that, at current rates of extraction, remaining reserves will be insufficient to supply peak demand by the winter of 1996.
- 2 The Government decided in December 1991 that Bord Gáis Éireann (BGE) should undertake construction of an undersea pipeline connecting the Irish and UK natural gas grids (the interconnector). The capital cost was then estimated at £238m, with a further provision against contingencies of £33m, and the project was scheduled for completion on 1 October 1993. *(Paragraphs 2.14 to 2.18)*
- 3 The funding for the project was to be provided by BGE from retained earnings and borrowings. The EU agreed to provide grant assistance of 35 per cent of the capital cost under its REGEN initiative for the energy sector. *(Paragraphs 2.16 and 2.17)*
- 4 This review focused on the procedures employed in the planning and execution of the project with particular reference to the role of the Department of Transport, Energy and Communications (the Department) in ensuring that mechanisms were in place to provide for its cost effective completion. *(Paragraphs 1.14 to 1.16)*

Project Appraisal

- 5 Appraisal was carried out in two stages. The Department and BGE prepared a feasibility study which examined the economics of the main supply options after Kinsale/Ballycotton gas is exhausted. Subsequently, an independent economic analysis of the interconnector project was conducted by consultants engaged at the request of the EU.
- 6 The appraisal concluded that the only real alternative to the gas interconnector project was the importation of LNG but this was ruled out on grounds of cost and security of supply. In these circumstances, it was recommended that the gas interconnector project should proceed and this was duly approved by the Government. *(Paragraphs 3.3 to 3.8 and 3.15)*

Economic Returns

- 7 The proposal seeking Government approval for construction of the interconnector presented estimates of economic returns for the project based on the assumptions that bulk importation of gas would commence in 1994 and that capital costs of the project would be around £200m (1990 prices). However, the proposal also recognised that, due to changes in circumstances, bulk importation of gas would not commence

until the winter of 1996 and that the capital costs of the project would be around £240m in 1991 prices. *(Paragraph 3.16)*

8 Neither the feasibility study nor the consultants included a provision for the costs up to the year 2000 of ongoing development and up-grading of the natural gas infrastructure. These are estimated at around £160m (1994 prices) for the period 1993 to 1998 alone. *(Paragraphs 3.17 to 3.20)*

9 A more complete appraisal at the time of Government approval of the project, taking account of the higher capital cost, the effect of deferred importation of gas and the costs of extending and upgrading the grid, would have estimated the return to the national economy to be of the order of 11 per cent a year over a 25 year period and the return to BGE to be in the range 2.7 to 5.7 per cent a year (before EU assistance). When EU funding is taken into account, the estimated return to BGE is increased by about 2 per cent a year. *(Paragraphs 3.21 to 3.24)*

10 Accordingly, the project would have a positive return to the national economy and EU funding would contribute to its viability from the viewpoint of BGE.

Project Timing

11 A key decision which had to be made concerned the timing of the project. Increases in UK gas prices in 1991 caused the Department to review the economics of the project. Although in pure economic terms there was a good case for postponing the project for one or two years, the Department concluded that when everything was taken into account, the balance of advantage lay with commencing construction of the pipeline in 1993 and delaying importation of gas until winter 1996. The principal factor underlying the Department's decision was that REGEN funding would be available for the project if it went ahead in 1993 — the project would be very difficult for BGE to finance at a later stage without REGEN or other grant assistance. Furthermore, the Department was advised that construction costs were likely to be higher in 1994 and 1995. *(Paragraphs 3.9 to 3.13)*

Project Monitoring

12 The project was managed by a project management team. Progress on the project was monitored by a project task force which provided co-ordination between BGE, the Department and the project management team and by a Monitoring Committee set up under EU funding rules. This approach was appropriate to a project of this size and complexity. *(Paragraphs 3.27 to 3.33)*

Project Outturn

- 13 The current scheduled completion date for the interconnector is December 1995.
- 14 The estimated final cost of the project is £249m — about 4.6 per cent over budget. At this cost, it represents a good performance bearing in mind the scale and complexity of the project and the fact that some additional work had to be undertaken over and above that envisaged. *(Paragraph 3.38)*
- 15 Within the overall expenditure on the project, there were cost overruns on elements of the project, including the construction of the gas compressor station in Scotland and the gas pressure reduction station in Ireland. These overruns were the result of delays due to replacement of project contractors from the Kentz Group of companies because of its financial difficulties, additional work and faults in the compressor station in Scotland. *(Paragraphs 3.42 and 3.45)*
- 16 BGE estimates that the net increase in costs of construction and overheads for the pressure stations due to the change in contractors and some additional work will be of the order of £10m. Extra interest charges of £2.6m will also accrue. *(Paragraphs 3.40 and 3.41)*

Project Administration

- 17 Project administration and design costs are now expected to be £27.5m — an overrun of £8.5m (about 45 per cent). Remuneration of the project management team was originally set on a reimburseable fee basis but was capped at £18.6m in January 1993. This arrangement was altered in September 1994 from a fixed fee to a reimburseable fee basis with the approval of the Board of BGE to reflect the extra work arising from the change of contractor on major elements of the project. *(Paragraphs 3.47 to 3.49)*

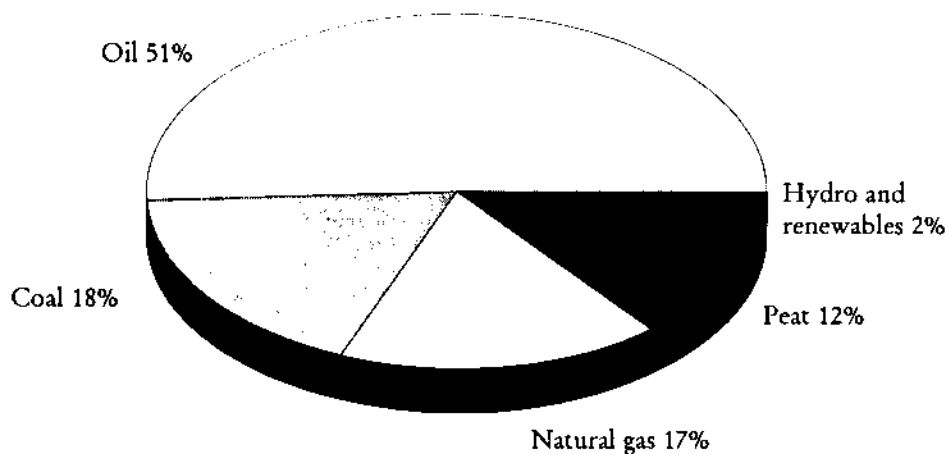
Evaluation

- 18 While some preliminary work has been done by the Department on evaluating the economic impact of the project, its long term achievement is dependent on successful commissioning and its future operation to design standards. The contribution of the project in terms of its economic, security and environmental objectives should be monitored and evaluated following commissioning, taking into account the changes that have occurred in the energy sector since the adoption of those objectives. *(Paragraphs 3.60 to 3.69)*

Part 1 : Introduction

- 1.1 Natural gas is an important source of energy in Ireland, supplying over one sixth of the total primary energy requirement (see Figure 1.1). It is also strategically important in maintaining the diversity of energy sources, thereby reducing the degree of dependence on any single energy source. It is the least polluting of the major fossil energy sources.

Figure 1.1
Total primary energy requirement in Ireland by energy type, 1994

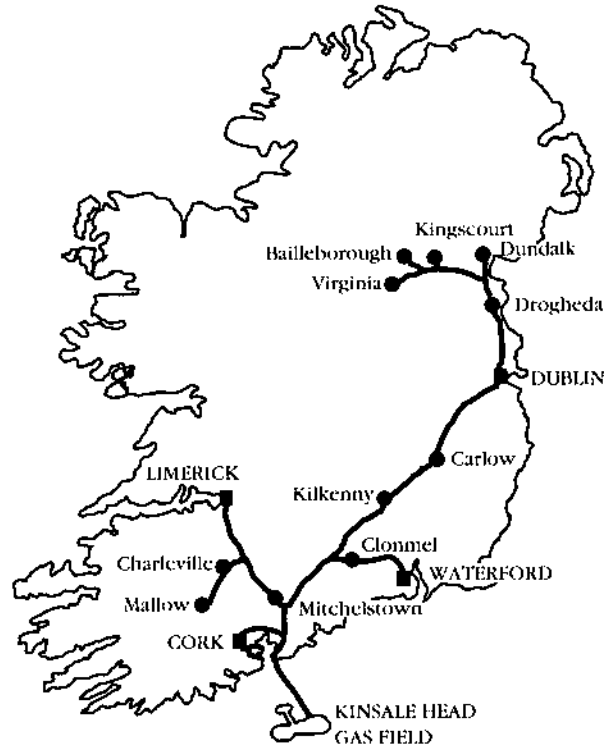


Source : Department of Transport, Energy and Communications — provisional estimate

Market for Natural Gas

- 1.2 The natural gas transmission and distribution system in Ireland is managed by Bord Gáis Éireann (BGE). The system was developed to allow exploitation of indigenous supplies of natural gas from the Kinsale Head gas field. The initial customers for gas supplies were Nitrigin Éireann Teoranta which buys gas for use as a raw material in the manufacture of fertiliser and the Electricity Supply Board (ESB) which uses gas as an electricity generation fuel.
- 1.3 The transmission and distribution system has been expanded gradually to permit the supply of natural gas to an increasing number of industrial, commercial and domestic consumers in the South and East of the country (see Figure 1.2). By the end of December 1994, BGE was serving 222,600 domestic customers and about 8,000 industrial and commercial customers. The ESB was the largest single customer, receiving 42 per cent of all gas delivered. About 26 per cent of the fuel used in electricity generation in 1994 was indigenous natural gas.

Figure 1.2
Irish natural gas transmission system



- 1.4 BGE's 'core' market consist of its industrial/commercial customers (who consume 24 per cent of all gas delivered) and domestic customers (who consume 11 per cent). Together they contribute around 61 per cent of BGE's turnover of £217m. (See Table 1.1.)

Table 1.1
BGE turnover and gas deliveries by market sector, 1994

Market sector	Gas delivered %	Turnover %
Electricity Supply Board	42	31
Nitrigin Éireann Teoranta	23	8
Core market	35	61
Total	100	100

Source: BGE Annual Report 1994

Irish Natural Gas Reserves

- 1.5 The indigenous supply of natural gas is limited. Only two commercially exploitable gas fields have so far been found - the Kinsale Head field and the smaller Ballycotton field. Both are undersea fields located to the south of Kinsale Head in County Cork and within the area designated under Section 2 of the Continental Shelf Act, 1968. The fields are managed by Marathon Petroleum Ireland Limited. Exploration for further supplies of natural gas is continuing.
- 1.6 About 72 per cent of the known indigenous reserves of exploitable natural gas were extracted between 1978 and 1994. The current rate of extraction is around 6 per cent of known reserves each year.
- 1.7 Supplies of indigenous natural gas are delivered onshore and transmitted throughout the grid through a single pipeline. Because there is only a single source of gas, there is a risk of accidental interruption of supply.
- 1.8 In November 1989, the Minister for Energy sought Government approval in principle to explore the possibilities for gas importation because of fears that recoverable gas reserves would be exhausted within three to five years. The Department¹ and BGE began to assess the feasibility of importing additional supplies of natural gas to Ireland in order to:
 - replace indigenous supplies from the Kinsale Head/Ballycotton fields when they became exhausted
 - meet current and projected increased demand for supplies during the course of depletion of indigenous gas
 - provide security against accidental or other interruption of indigenous gas.

REGEN Initiative

- 1.9 While the joint Department/BGE feasibility study was underway, an EU sponsored initiative for the energy sector (called REGEN) was also being developed.
- 1.10 A large, partially integrated network of energy infrastructures had been developed within the EU by 1990, but a number of shortcomings and inadequacies were

¹ *References to the Department include the present Department of Transport, Energy and Communications and those Departments which at all material times have been assigned responsibility for energy matters under the Ministers and Secretaries Acts.*

apparent, particularly in peripheral regions. The main deficiencies were perceived to be in terms of primary natural gas grids and the interconnection of gas grids.

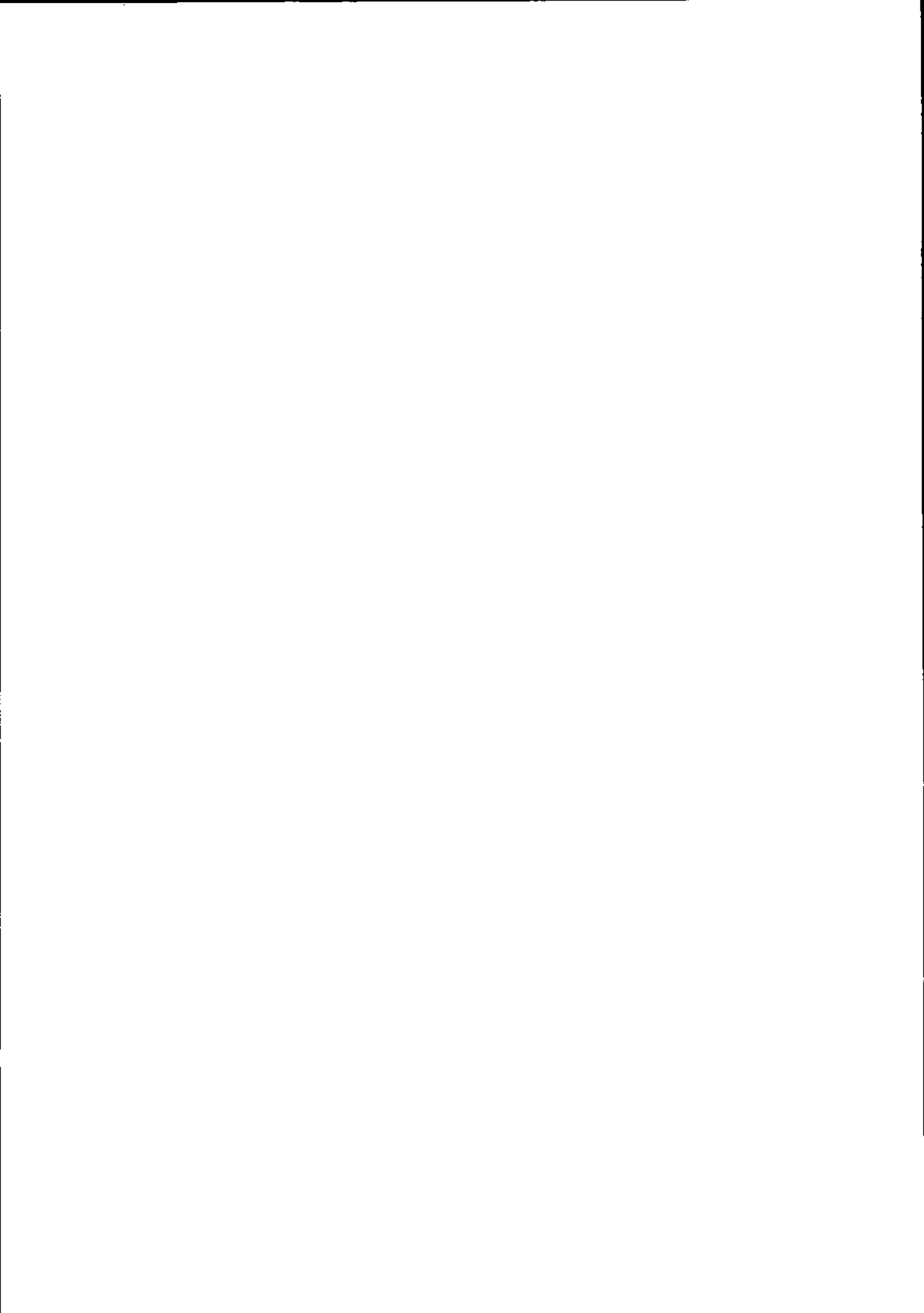
- 1.11 In December 1990, the EU introduced the REGEN initiative which was designed to promote the integration of the energy infrastructures of certain peripheral regions of the EU, to help them derive benefit from the creation of the internal market.
- 1.12 The initiative was accordingly designed to speed up the establishment of trans-European energy networks. It was felt that investment under the initiative, in combination with other structural funding, would:
- help industry in the peripheral regions to become more competitive
 - make it possible to reduce the proportion of total energy supplies accounted for by coal and oil, and thus help improve the environment
 - reduce the degree of dependence on imported oil
 - strengthen the security of energy supplies.
- 1.13 On the basis of the feasibility study findings, the Government applied in 1991 for assistance at a rate of 35 per cent towards the cost of construction of an under-sea pipeline to connect the Irish and UK natural gas grids.

Purpose and Scope of Examination

- 1.14 It was considered appropriate to undertake an examination of the gas interconnector pipeline project because:
- a very considerable amount of public resources have been applied to the project in a short period
 - the project has significant implications for the national economy and for the energy sector.
- 1.15 The specific objective of this review was to examine whether the systems, procedures and practices which were established were adequate to enable the Department of Transport, Energy and Communications to discharge its responsibilities in relation to the project and to achieve value for the public money involved.
- 1.16 The following criteria were used in assessing whether value for money had been achieved in respect of this project:
-

- whether the appraisal had adequately assessed the economic returns of the project
- whether the project was delivered to cost and time targets
- whether project objectives have been achieved or are the subject of appropriate reviews.

1.17 The methodology adopted in undertaking this review is outlined in Appendix A.



Part 2 : The Elements of the Interconnector Pipeline Project

- 2.1 Although gas pipeline laying is a well established procedure, the Ireland-UK gas interconnector project was relatively complex. Apart from being a large budget capital project, it involved many agencies, many separate technical elements and the negotiation of major contracts and agreements, including an intergovernmental agreement on which construction and operation of the interconnector depended.

Implementing Agencies

- 2.2 The final decision to build a gas interconnector was made by the Government on 19 December 1991 in response to a proposal put forward by the Minister for Energy, following EU approval of REGEN funding for the project. A Government decision was required because of the scale of the project and because of its potential importance to the national economy.

Intergovernmental Agreement

- 2.3 The Department, which was advised by the Attorney General, took the lead in negotiating an intergovernmental agreement with the UK authorities concerning such matters as safety and environmental protection, pipeline security, jurisdiction, permissions and authorisations for construction, operation and ownership of the pipeline, reservation of capacity in the pipeline for possible supplies to Northern Ireland and the Isle of Man and co-operation in the event of disruption of supplies. The agreement was signed on 30 April 1993.

Construction of Interconnector

- 2.4 The Department and BGE operated jointly in assessing the options and in monitoring the project. A project management team had day-to-day responsibility for planning and construction of the interconnector.
- 2.5 Finance for the project under the REGEN initiative was channelled from the EU through the Department of Finance and the Department of Transport, Energy and Communications to BGE. The balance of funding was provided by BGE from retained earnings and borrowings.

Gas Supplies Contracts

- 2.6 BGE negotiated to secure a one-off supply of gas to use in the commissioning of the interconnector on its completion. In addition, while the pipeline was being planned and built under the control of the project management team, the Department, BGE and the ESB were in negotiation with a number of UK-based gas suppliers to secure

access to a supply of gas which could be drawn in the event of an interruption in indigenous supplies and bulk supplies of gas for importation in the years up to 2015.

2.7 No bulk supply contract had been concluded by 31 May 1995.

Structure of the Interconnector

2.8 The project consisted of the following main elements:

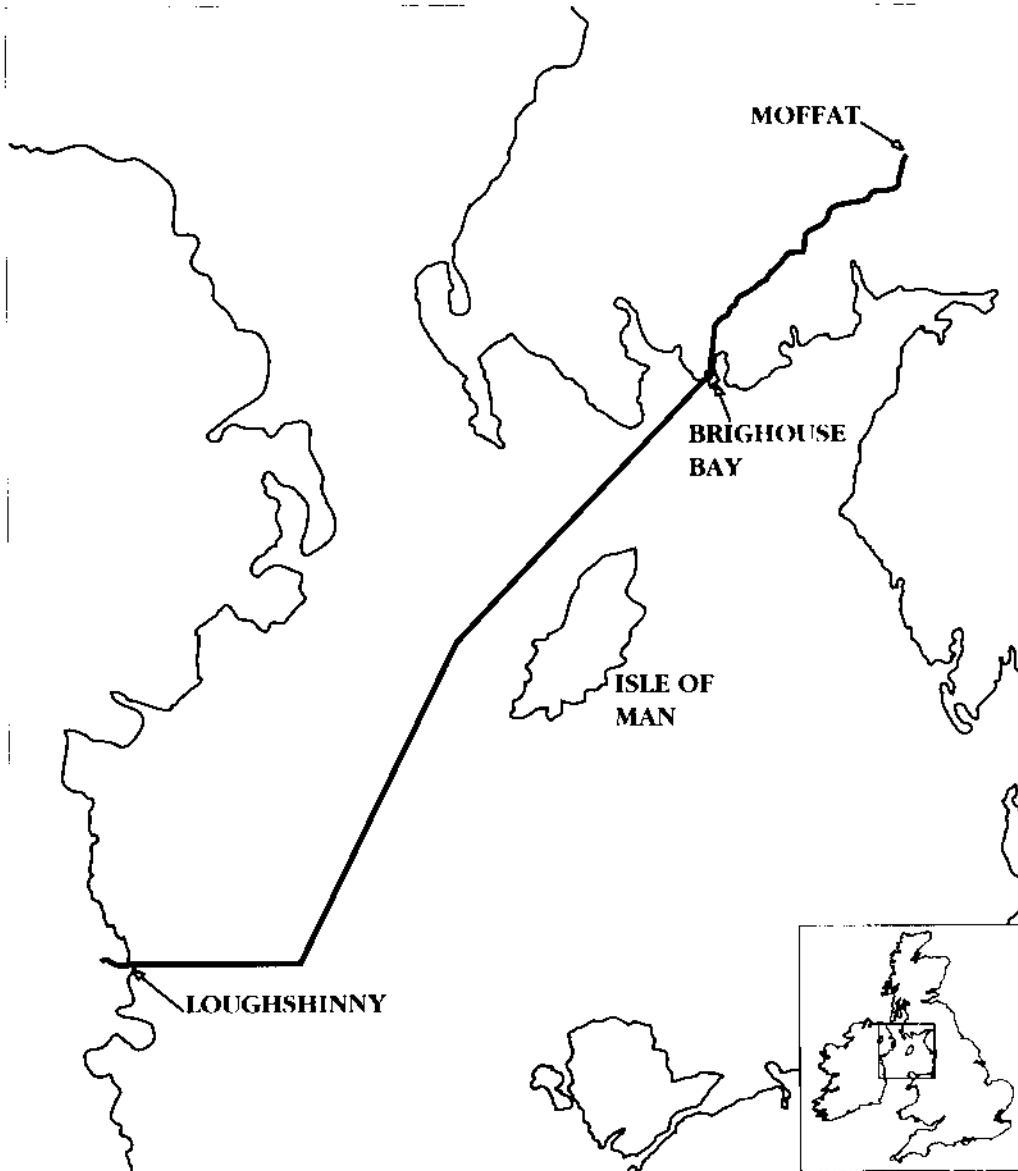
- A 9 km pipeline, with a diameter of 30 inches, to connect the existing gas grid to a new pressure reduction station at Loughshinny, on the north County Dublin coast, where the sub-sea pipeline comes ashore.
- A 205 km sub-sea pipeline, with a diameter of 24 inches, from Loughshinny to Brighthouse Bay on the Scottish coast.
- A compressor station located on the Scottish coast to compress the gas for onward transmission to Ireland.
- An 80 km pipeline, with a diameter of 30 inches, from Brighthouse Bay to a gas off-take station located at the UK high pressure grid at Moffat in Scotland.

Gas Compression

2.9 The variation in pipeline size and the pressure change stations are required because:

- Gas loses pressure while being transmitted through a pipeline. Pressure is brought back up to required levels in compressor stations at suitable points on a pipeline's land route.
- In general, the higher the pressure, the smaller (and cheaper) is the pipe required to carry a given volume of gas. However, there is a balance to be struck between the costs of compression and the cost of the pipeline.
- The maximum pressure to which a pipeline can be safely operated is limited by the strength of the pipe and by concerns for public safety. These concerns generally limit land pipelines transporting natural gas to pressures not in excess of 75 bar (0.5 tonnes per square inch). There are fewer restrictions on the operating pressures of sub-sea pipelines, which can operate at 150 bar or more.

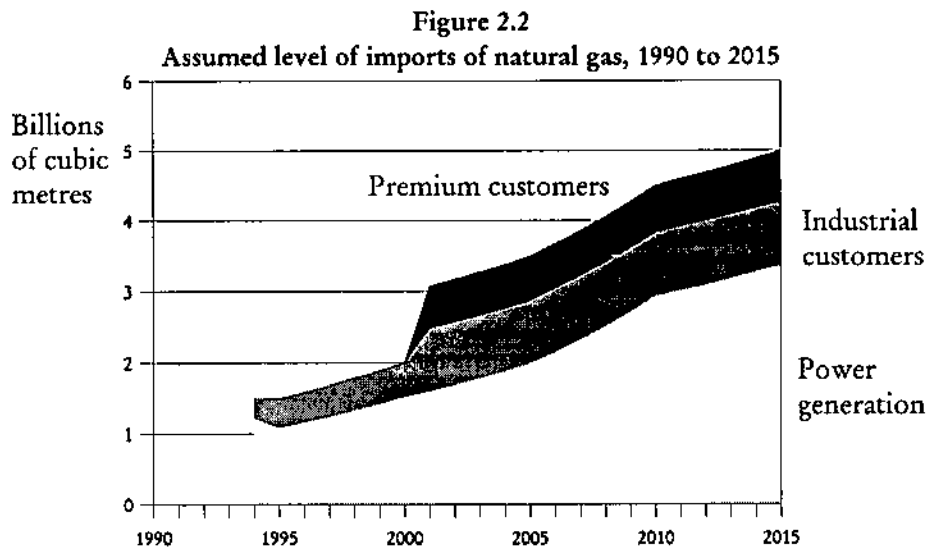
Figure 2.1
Gas interconnector pipeline route



2.10 The compressor station at Brighthouse Bay in Scotland is designed, when gas flow is at its maximum, to operate using five compressor units working in parallel. At present three compressor units have been provided.

Design Service Level

- 2.11 The pipeline was designed to be capable of delivering a flow of 5.35 billion cubic metres (BCM) of natural gas a year, or 610,000 cubic metres/hour. It was also required to be able to accommodate peak flows 25 per cent above this level (i.e. up to 760,000 cubic metres/hour), to meet seasonal and daily fluctuations in demand.
- 2.12 It was anticipated during planning that the flow of natural gas would be built up on a phased basis, reaching almost full capacity in 2015. It was assumed in appraising the project that the average flow of gas over the period 1994 to 2015 would be 3.3 BCM per year.



Source: Department of Transport, Energy and Communications

- 2.13 There is an option under the intergovernmental agreement for the off-take of gas from the interconnector for supply to Northern Ireland and to the Isle of Man. The Northern Ireland option has been taken up and a pipeline between Belfast and Twynholm in Scotland is currently under construction.

Project Timetable

- 2.14 The original project timetable envisaged that all elements of the pipeline would be completed and fully commissioned by 1 October 1993. To meet this ambitious deadline, major construction, machinery and components contracts were placed during the first half of 1992. The bulk of the construction work was planned to take place in the period February to October 1993.

Project Budget

- 2.15 The budgeted capital cost approved for the project totalled £238m and was based on estimated costs before tenders were issued. The individual elements of the budget are shown in Table 2.1.

Table 2.1
Approved budget for gas interconnector project

	Total £m
Ireland on-shore pipeline and pressure reduction station	6
Under-sea pipeline	158
UK on-shore pipeline	36
Station to take gas from the UK grid	4
Compressor station at Brighthouse Bay, Scotland	15
Total construction costs	219
Design and project management fees and administration expenses ^a	19
Total direct project costs	238

Note: ^a Includes £300,000 in respect of the feasibility study and seabed surveys.

Funding of the Interconnector

- 2.16 BGE provided 65 per cent of the funding for the project from accumulated retained earnings and by borrowing to be repaid out of future earnings. The need to commit earnings to debt servicing and repayment, so as to reduce the BGE debt to a level which will be manageable when higher priced imports begin in 1996, reduces the amount of dividends payable by BGE to the Exchequer.
- 2.17 External funding to cover the remaining 35 per cent of the cost of the project was provided by way of assistance to BGE from the REGEN initiative.

BGE Funding

- 2.18 BGE adopted a project budget of £287m. This amount included the capital cost of £238m shown in Table 2.1 and a further amount of £49m consisting of a provision of £16m in respect of interest charges which it was estimated would accrue during the construction of the interconnector and a contingency provision of £33m.

- 2.19 It is BGE's accounting policy that interest incurred on borrowing used to finance expenditure on major capital projects is capitalised during the period of construction, and is then treated as part of the cost of the assets.²
- 2.20 The Gas (Amendment) Act, 1993 provided for an increase in BGE's limit for borrowing for capital purposes from £170m to £350m to permit the company to borrow for the interconnector project. In addition, the limit on the portion of BGE's borrowing which may be guaranteed by the State was raised from £80m to £190m.
- 2.21 By end-December 1994, BGE had borrowed £141m net for the interconnector project, of which £105m was provided by the European Investment Bank and guaranteed by the State.

REGEN Funding

- 2.22 REGEN funding of £91.3m was allocated by the EU for the project. Such moneys were required to be matched with other funds in the ratio 35:65. On this basis, the EU commitment would support total expenditure up to £261m.
- 2.23 At present the final date for discharge of all commitments is 31 December 1995.

Development and Upgrading of the National Grid

- 2.24 The decision to build an interconnector involved a long-term commitment for the Irish gas industry. In that context, and particularly to ensure that the premium market for natural gas grows, BGE are undertaking a major programme of development and upgrading of the national grid. Work on this scale would not have been required or economically worthwhile in the event of the industry being closed down when known indigenous reserves of gas expired.
- 2.25 The types of associated development necessitated by the decision to import natural gas include:
- upgrading and reinforcement of the gas distribution system designed to facilitate safe and reliable delivery of gas in existing markets
 - development of premium market business by extending the gas network to service new domestic, industrial and commercial customers.

² *Accrued interest was not eligible for grant assistance and so was not included in the budget submitted to the EU seeking grant assistance for the project.*

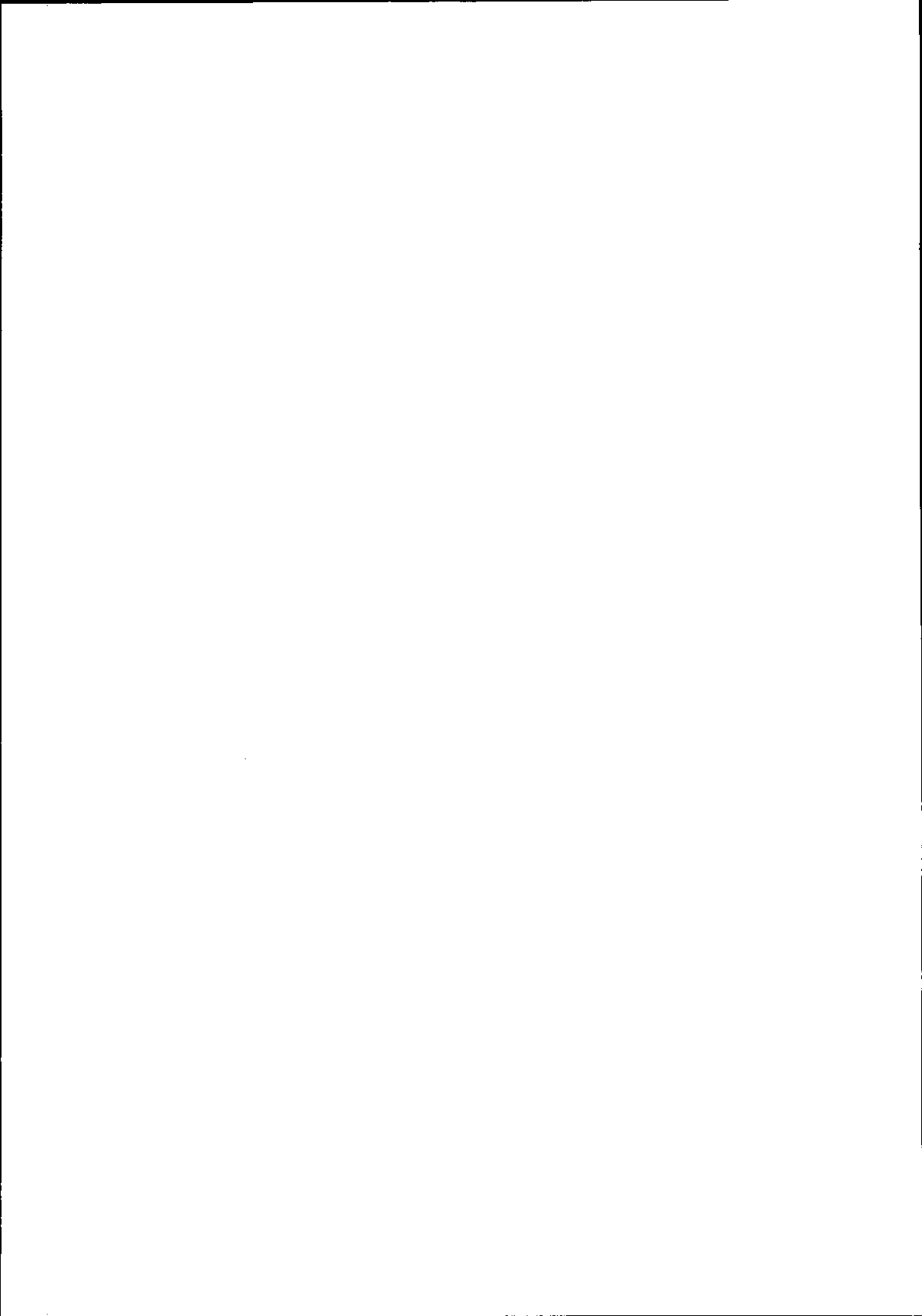
2.26 The estimated costs of these associated developments over the period 1993 to 1998 are shown in Table 2.2.

Table 2.2
Estimated cost of national grid development and upgrading,
1993 to 1998 (at constant 1994 prices)

	System reinforcement and upgrading	New business development	Total
	£m	£m	£m
1993*	12	14	26
1994	14	18	32
1995	19	17	36
1996	12	15	27
1997	11	9	20
1998	11	8	19
1993 to 1998	79	81	160

Source: Department of Transport, Energy and Communications

*Note: * For 1993, expenditure is shown in 1993 prices.*



Part 3 : Administration of the Project

- 3.1 The Department's main responsibility in relation to the interconnector project was to establish mechanisms to enable it to discharge its monitoring and overseeing functions, the most important of which are to:
- ensure that the project is appraised effectively
 - oversee the efficient execution and control of the project
 - ensure that adequate steps have been taken to enable the effectiveness of the project to be evaluated.

Appraisal of the Interconnector Project

- 3.2 In November 1989, the Minister for Energy informed the Government that there were fears that indigenous gas reserves would be exhausted in the period 1992-94. The Government approved in principle a request by the Minister to explore the possibilities for gas importation, on the understanding that no decisions would be taken without a fully evaluated proposal being submitted to it.

Feasibility Study

- 3.3 Following this approval in principle, the Department and BGE jointly undertook a feasibility study of the potential for importation of natural gas from 1994 onwards. The feasibility study was completed in November 1990.

Terms of Reference

- 3.4 The terms of reference for the feasibility study were agreed with the EU. They involved:
- analysing and forecasting the likely demand for natural gas in Ireland over the period to 2020 at foreseeable market prices
 - identifying potential sources of natural gas for importation into Ireland
 - identifying and costing feasible options for transmission of gas to Ireland
 - economic and technical assessments of the more feasible supply options
 - conclusions ranking the feasible options according to stated criteria, together with a recommendation in favour of one option.

Study Conclusions

- 3.5 The main conclusions of the feasibility study were:
- Ireland's energy requirement was likely to increase by around 50 per cent between 1990 and 2015 (i.e. around 1.65 per cent a year).
 - The only practical sources of gas for importation in the short-term would be North Sea gas piped to Ireland and liquefied natural gas (LNG) shipped to Ireland.
 - LNG importation was likely to be significantly more expensive than pipeline importation.
 - Of three possible pipeline routes linking the Irish and UK gas grids, a route between North County Dublin and South West Scotland was likely to involve the lowest unit cost of transportation of gas. None of the routes considered involved supply via Northern Ireland.
 - Importation of gas by pipeline would be viable in the long term if the overall demand for natural gas increased, especially that of the ESB and premium domestic and commercial consumers.
 - It would not be advisable to defer the project because the ESB, in the absence of additional gas supplies, would probably invest in additional electricity generation plant using other fuels. This would eliminate a substantial proportion of the potential future market for gas in Ireland.
- 3.6 Due to security risks at that time, detailed consideration was not given to importation through Northern Ireland which would have involved a shorter under-sea route. The Department also contends that preliminary costings indicated that this option would be less favourable economically.
- 3.7 The feasibility study pointed out that the interconnector project would have very high initial costs. Because of the need to build a pipeline to cater for projected gas flows which will not be reached until well into the life of the project, financial benefits would be low in the early years of operation and grow slowly as the volume of gas carried through the pipeline increased.
- 3.8 One of the primary objectives in considering gas importation was security of energy supply. However, other options which would contribute to security of energy supply (for example, increased oil storage capacity) do not appear to have been formally explored in the appraisal process. The Department has explained that its general

policy has been towards diversification of supply and in particular a reduction in oil dependency.

Changes in Gas Prices

- 3.9 During 1991, plans for expansion of gas-fired electricity generation capacity in the UK increased the demand for gas due for delivery in 1993-94, with the result that UK forward prices for gas rose to levels above those at which the feasibility study concluded it would be economically viable to import gas.
- 3.10 As a result of the price changes, the Department and BGE reconsidered the options for the interconnector project in October 1991. Market analysts advised the Department and BGE that it was likely that forward prices would ease in the succeeding 6 to 18 months and that supplies of gas for delivery around 1995-96 should then be available at prices within the range assumed in the feasibility study. On that basis, the main options identified were:
- proceed as planned i.e. build the interconnector in 1993 and contract for imports of gas for delivery in 1994
 - build the interconnector as planned in 1993 but delay bulk gas purchase until better terms were available
 - delay construction of the pipeline by one to three years
 - delay the whole project indefinitely.
- 3.11 The Department concluded that the best option was to proceed with construction in 1993 but that BGE should not enter into a long-term contract for gas supplies until forward prices had settled down (expected to be in the second half of 1992, or early 1993). In the meantime, BGE should negotiate an option to draw gas through the interconnector to secure continued supply in the event of any interruption of indigenous gas.
- 3.12 It was estimated that delaying both the construction of the pipeline and of bulk gas importation for three years would improve the rate of return on the project. However, the Department argued against delaying construction for three reasons:
- If the pipeline was built in 1993, security of supply could be achieved for 1994 and 1995.

- REGEN funding would be available for the project if it went ahead in 1993. Without REGEN funding, the project would be very difficult financially for BGE to undertake.
- Their advice was that construction costs were likely to rise in 1994 and 1995.

3.13 Indefinite delay in construction of an interconnector was not considered as a serious alternative by the Department because it would be "tantamount to a reversal of energy and gas policy in Ireland, and of Community policy". It was felt that indefinite delay would reinforce Ireland's peripheral status and impede access to the advantages of a single European energy market. It also felt that it would deny Ireland the opportunity to develop a countervailing balance to the national dependence on imported oil and coal.

Estimates of Economic Returns

3.14 The feasibility study concluded that there was a strong case from the national economic point of view for proceeding with interconnection. It estimated that the rate of return to the national economy would be in the range 23 to 39 per cent a year, depending on the assumptions used. It also concluded that from BGE's point of view, the interconnector project was likely to yield a return in the range 7 to 22 per cent a year.

3.15 The EU required that independent economic consultants be engaged to assess the feasibility study. The consultants concluded that while the appraisal was generally sound, they would take a less optimistic view on certain key assumptions including:

- the market value of gas for electricity generation
- BGE's operating costs
- the impact of closure of the industry
- the cost of infrastructure to guarantee security of supply after 2000.

They concluded that the national economic rate of return would be around 15 per cent a year and that the return to BGE would be in the range 6 to 9 per cent a year.

Government Approval

3.16 The Government approved the construction of the interconnector in December 1991. Although the proposal submitted to the Government presented estimates of project returns which had been calculated on the assumption that bulk importation of gas would commence in 1994 and that the capital costs of the project would be around

£200m (1990 prices), it also recognised that due to changed circumstances³, bulk importation of gas would be delayed until the winter of 1996 and that capital costs would be around £240m in 1991 prices.

Costs of System Development and Upgrading

- 3.17 Neither the feasibility study nor the consultants included a provision for the costs up to the year 2000 of system development and up-grading. These are estimated at around £160m (1994 prices) for the period 1993 to 1998 alone.
- 3.18 The Department has informed us that the consultants took the view, and BGE concurred, that all revenues and costs connected with the Kinsale/Ballycotton based business prior to 2000 should be excluded. It also stated that much of the development and upgrading work would have been necessary for safety reasons and that the extension of the network introduced more premium customers thereby enhancing revenue flows before the year 2000.
- 3.19 However, the Department has itself contended that the upgrading and development would not have taken place in the absence of the interconnector and sought EU funding for the work on that basis.
- 3.20 Accordingly, while acknowledging that it will have some impact in enhancing revenue from indigenous gas sources, we believe it would have been appropriate to include upgrading and development costs in the calculations since such development work was necessary for the achievement of the revenues projected from the project.

Revised Estimates of Economic Returns

- 3.21 Since the factors mentioned above have implications for the economic return on the project, the rates of return were re-estimated in the course of this examination to take account of:
- deferring importation of bulk supplies of gas until winter 1996
 - the higher capital cost approved by Government
 - expenditure on associated measures.
- 3.22 On this basis, a more complete appraisal of the interconnector project at the time of Government approval would have estimated the national economic rate of return at around 11 per cent a year over a 25 year period, while the estimated rate of return to BGE would be in the range 2.7 to 5.7 per cent a year.

³ See paragraphs 3.9 to 3.13.

Impact of REGEN Funding

- 3.23 All these estimates of economic return on the interconnector were calculated without taking into account the effect that EU grant aid would have. By subsidising the capital cost of constructing the interconnector, REGEN funding improved the rate of return to BGE. Whether the national economic return would be similarly improved depends on whether REGEN funding for Ireland is regarded as specific additional funding or merely displaced a similar amount of ERDF funding which would have been available for other Irish projects.
- 3.24 In the course of this examination, it was estimated that the availability of 35 per cent REGEN funding for the capital cost of the interconnector would raise BGE's rate of return by up to 2 per cent.

Selection of Alternative Options

- 3.25 The Department's appraisal focused mainly on the economics of pipeline importation and on the timing of pipeline construction with the result that:
- The option of transshipping LNG was not considered after the feasibility study was completed, despite the increase in the estimated cost of the interconnector.
 - Alternatives regarding how best to manage the exploitation of the remaining indigenous gas reserves do not appear to have been formally evaluated as an input to decision-making about optimum timing of the construction of the interconnector.
- 3.26 The Department has assured us that it continued to monitor LNG developments until the commencement of construction to ensure that such developments had not made the pipeline a less attractive option. In regard to the management of reserves, the Department has explained that the best advice available to it at the time of the appraisal was that the gas reserves in the Kinsale Head field were much less than previously estimated. Also, because of the characteristics of the gas field, the advice was that the gas should be drawn down as quickly as possible.

Management of the Project

Project Management Team

- 3.27 A project management team was engaged by BGE on a contract basis to manage the day-to-day operation of the project. The project management team was selected after an evaluation of tenders received. The evaluation took into account the quality of the project manager nominated, the strength of technical support available to him and the fee rates. A consortium of two Irish consulting engineering companies in joint venture with French consultants was appointed. The management team set up its headquarters in Dublin in March 1991.
- 3.28 The management team was led by a Project Manager. The responsibilities of the team included:
- detailed design of all elements of the project
 - tendering, selection of contractors and negotiation of contracts
 - preparation of applications for construction authorisations and planning permissions
 - overseeing the testing and commissioning of all elements of the interconnector
 - provision of weekly progress reports to the Department and to BGE
 - provision of monthly financial reports to the Board of BGE.

Project Monitoring

- 3.29 The project was monitored and overseen by a Project Task Force and a Monitoring Committee set up under EU funding rules.

Project Task Force

- 3.30 The Project Task Force was established to meet throughout the duration of the project under the chairmanship of a Project Director appointed on a full-time basis by BGE. Membership of the Task Force comprised the Project Manager and representatives of the Department and of BGE. It met on 93 occasions up to the end of July 1995.
- 3.31 The purpose of the Project Task Force was to ensure maximum co-ordination and communication between the main stakeholders in the project (the Department and BGE) and the project management team.

Monitoring Committee

- 3.32 A Monitoring Committee was established in March 1992 under the chairmanship of a representative of the Department. Its membership included representatives of the Department, the European Commission, BGE and the Department of Finance, together with the Project Director and Project Manager. It adopted as its function the responsibility to ensure that the project, its expenditure and funding should proceed as planned.
- 3.33 In total, seven meetings of the Monitoring Committee were held up to November 1993. A further meeting was held in July 1995.

Tendering

- 3.34 The interconnector project involved five major construction contracts and four large contracts for the supply of pipeline and equipment. Advance notices to potential tenderers were published in August 1991 in the supplement to the Official Journal of the European Union. Invitations to tender appeared in the supplement between September 1991 and May 1992. Appendix B lists the major contractors for construction and supply on the project.

Efficiency of Project Administration

Budget Outturn

- 3.35 In June 1995, the estimated expenditure outturn for the gas interconnector project, excluding associated measures, was £249m. (See Table 3.1.)

Expenditure on Grid Development and Upgrading

- 3.36 Commitment to assist works costing up to £261m had been approved by the EU but the estimated final costs of the interconnector were projected to be less than this sum. The Monitoring Committee agreed at its meeting of 23 July 1993 to widen the scope of the measures to include some expenditure on the 'associated measures' of developing and upgrading the national transmission and distribution system.
- 3.37 The total cost of national grid development and upgrading in the period 1993 to 1998 is estimated at some £160m (see Table 2.2). Qualifying expenditure on such measures up to a level sufficient to absorb the total commitment prior to 31 December 1995 will be subvented at a rate of 35 per cent from EU funds.

Table 3.1
Estimated expenditure outturn on gas interconnector project

	Budget ^a	Estimated final cost ^b	Savings / (Overruns)
	£m	£m	£m
Ireland on-shore pipeline and pressure reduction station	6	8	(2)
Under-sea pipeline	158	150	8
UK on-shore pipeline	36	31 ^c	5
Station to take gas from the UK grid at Moffat	4	4	—
Compressor station at Brighthouse Bay, Scotland	15	24	(9)
Other miscellaneous contracts	—	5	(5)
Total construction cost	219	222	(3)
Project management, fees and administration ^d	19	27	(8)
Total direct project costs	238	249	(11)

Notes: ^a Budget figures were estimated in 1991. ^b Cost incurred estimated at June 1995.

^c No account has been taken of contingent liabilities arising out of claims by the main contractor. (See paragraph 3.44.)

^d Includes £300,000 in respect of the feasibility study and sub-sea surveys.

Budget Variances

- 3.38 The current estimated final cost for the interconnector project itself (£249m) is about 4.6 per cent higher than the original budgeted amount (£238m). The outturn is, however, inclusive of the cost of a number of items not provided for in the original budget. These are outlined in the paragraphs that follow.
- 3.39 Variances between budget and estimated outturn are significant for individual elements of the project and range from an outturn of 17 per cent less than budgeted for the UK on-shore pipeline to an outturn 65 per cent greater than budgeted for the Brighthouse Bay compressor station.

Termination of Contracts

- 3.40 Separate contracts for the Ireland on-shore (including the pressure reduction station) and compressor station elements of the project were awarded to companies in the Kentz Group. Because of financial difficulties in the Group, which resulted in companies within it being placed under administrative receivership or examinership, it became clear that the contractors were not in a position to complete the contracts to time. The contracts were terminated and replacement contractors appointed to complete the work.
- 3.41 BGE estimate that the total additional costs of construction and overheads on these elements of the project will be £10m net of liquidated damages and retention payments forgone. This includes increased costs attributable to the change of contractors, remedial works and some additional works. Extra interest charges of £2.6m will also accrue.

Irish On-shore Works

- 3.42 It is estimated that the Irish on-shore pipeline and pressure reduction station cost £8.2m by completion, compared to a budgeted cost of £6.2m. The increased costs of £2m were due to:
- completion of outstanding works at Loughshinny following termination of the contract, remedial works and additional facilities (£1.1m)
 - alteration of planned pressure reduction facilities at Loughshinny (estimated at £0.8m)
 - operating spares not budgeted for (£0.1m).

Under-sea pipeline

- 3.43 Overall this element of the project came in £9m under budget. This was achieved despite absorbing additional costs of almost £10m for items not originally contemplated:
- consideration for lease of easement and foreshore licences paid to Irish and Isle of Man authorities (£2.4m)
 - costs in connection with crossing a sub-sea communications cable (£1.9m)

- an increase of 10 km in pipeline length due to alteration of the planned route to avoid jurisdictional complications which could lead to delays in finalising intergovernmental legal arrangements (£5.4m).

UK On-shore Pipeline

- 3.44 The estimated final cost of the UK on-shore pipeline is £30.6m — £5.2m less than the original budget amount. However, extensive repairs of pipe-coating faults were necessary at an additional cost of £2m which BGE are advised can be recovered from the contractor who completed the work. The main contractor on the sub-project has submitted a claim for additional payments because of alleged changes in the contract scope of work and because of extensions of time. The original contract amount for the element in dispute was £11.5m. It is not possible to quantify the extent of the liability, if any, arising out of the claim.

Compressor Station

- 3.45 The cost of construction of the compressor station increased from a budgeted £14.8m to an estimated £24.4m because:
- It was decided in March 1992 that three compressor units should be installed instead of the two units planned originally, at an additional cost of around £2.8m.
 - Construction of the compressor station was 45 per cent completed on termination of the construction contract. Delays resulted in some items of plant being on site for over 12 months which in turn necessitated a level of commissioning work more extensive than originally anticipated. The incremental cost of completing the outstanding work and the cost of remedial and additional work not included in the scope of the original contracts was £6.1m.
 - A further £0.71m was expended on operating spares.

Miscellaneous Contracts

- 3.46 No direct provision was made in the original budget for a number of items which, by the time the project is completed, will have cost an estimated £5m. These comprise:
- control and monitoring system (£1.3m)
 - commissioning gas (£2.0m)
 - road works in Scotland (£1.3m)
 - perimeter security (£0.4m).

Project Management, Design and Administration

- 3.47 The cost of project management fees, engineering and design fees and office administration increased from a budgeted figure of £19m to an expected outturn of £27.5m. The original project management agreement of June 1991 provided for a reimbursable fee basis of remuneration, using an agreed schedule of rates for calculation of fees. The agreement also set a limit on the maximum fees which could be earned in any one calendar year by the Project Manager and other senior personnel. At that stage, the project management team submitted an overall estimate of fees of £18.6m with £0.4m for project office costs. The agreement was varied twice thereafter, as follows:
- In January 1993, an overall limit of £18.6m for fees was agreed but the restrictions in the original agreement limiting the annual remuneration of individuals within the team were removed.
 - In September 1994, the calculation of remuneration was altered to a reimburseable basis for the remainder of the project.
- 3.48 Despite their strict legal right to hold the management team to the original agreement, BGE, having consulted the Department, took a number of commercial considerations into account before agreeing to alter the basis of payment, including:
- the delays caused by termination of contracts
 - their dependence on the project management team for engineering advice and evidence in connection with claims by contractors
 - the refusal or inability of the project management team to provide an all-in cost.
- 3.49 The project management team indicated that an insistence on maintaining a fixed fee basis would, in the light of the additional input required of it following the disruption of the project, have forced it into liquidation.

Project Timing

- 3.50 The full interconnector project was scheduled for completion by 1 October 1993. Given the scale and complexity of the project, this was a very ambitious target. While some elements of the project were completed soon after that date, there were substantial delays in construction of the gas pressure reduction station at Loughshinny and of the gas compressor station at Brighthouse Bay.

Progress on Commissioning

3.51 Table 3.2 shows the date of commissioning of each of the main elements of the project. The full interconnector system cannot be finally commissioned until all individual elements have been completed and commissioned.

**Table 3.2
Completion of interconnector project elements**

	Month of commissioning	Delay (months)
Ireland on-shore pipeline	December 1993	2
Pressure reduction station (Loughshinny)	September 1994	11
Under-sea pipeline	November 1993	2
UK on-shore pipeline	October 1993	2
Station to take gas from UK grid at Moffat	October 1993	2
Compressor station at Brighthouse Bay	December 1995 [*]	26

*Note: * Estimated.*

3.52 The estimated completion date for the project is now December 1995. This delay is largely due to difficulties discovered during the commissioning of the compressors in the UK.

3.53 To permit safe shutdown in an emergency, compressors are fitted with a by-pass to facilitate circulation of gas around the compressor until such time as it can be slowly brought to a halt. During commissioning, the compressor manufacturers discovered that a by-pass system did not deliver gas in sufficient quantities soon enough to the compressor inlet. This deficiency had caused one of the compressors to surge.⁴ The problem was attributed to one or more of the following:

- the by-pass control valves did not open quickly enough
- guidance vanes in the compressor were restricting flow and/or
- some of the pipework was too long and had too small a diameter.

⁴ *On the restriction of gas entering the compressor, a surge can be created whereby already compressed gas flows back into the compressor only to be recompressed and discharged again. Unless corrected, surge conditions can continue indefinitely and result in damage to the compressor.*

3.54 The following action is in hand:

- The control valves in question, which have a response time (fully closed to fully open) of 1 second, are being replaced with new valves which have a 0.4 second response time.
- The guidance vanes are being re-machined to reduce their flow resistance.
- New pipework has been designed but its fabrication and installation have been deferred while the contribution of the other two measures is assessed.

Extension of EU Deadlines

3.55 The initial EU Commission decision in December 1991 set a deadline for the agreement of all legally binding contracts for the interconnector project at 31 December 1993. The date set for the completion of payments to BGE in respect of vouched expenditure on the project was fixed at 31 December 1994.

3.56 Because of the delays encountered on the project, the Department subsequently sought two extensions to these deadline dates. In December 1993, the EU approved the extension of the deadline dates to 30 June 1994 and 30 June 1995, respectively. In June 1994, a second extension was approved to 31 December 1994 and 31 December 1995, respectively.

3.57 All the necessary contracts had been entered into by 31 December 1994. The Department expects that all expenditure related to the project will be completed soon after the interconnector is finally commissioned in late 1995.

Service Level

3.58 The pipeline interconnector, as a system, will not be operational to its design specification until the compressor station has been fully commissioned. However, BGE has contracted for gas for security of supply in the event of an interruption in indigenous gas. The agreement provides for the supply of 1.2m therms per day for 150 days.

3.59 The price has been set at 34 pence per therm which represents a premium of about 15 pence per therm for security gas drawn. In addition, a consideration of £0.9m a year has to be paid irrespective of drawdown.

Effectiveness of the Project

- 3.60 The success of this major project can only be determined in the light of its future operation. This depends on a range of factors including:
- the successful commissioning of the compressor station, now scheduled for December 1995
 - the capacity of BGE to fund the borrowings out of retained earnings which will largely be generated from the sale of remaining indigenous gas to premium customers
 - the increase in Ireland's total primary energy requirement (TPER) at least to the extent projected in the feasibility study
 - an increase in the gas content of the TPER and the continued expansion of BGE's customer base
 - increased use of gas for electricity generation
 - the future price of gas relative to that of other energy prices.
 - the timing and nature of environmental legislation.
- 3.61 While some preliminary work has been done by the Department in reassessing the projected economic benefits of the interconnector, it is desirable that a comprehensive review be carried out taking account of changes which have occurred since initial appraisal of the project, including:
- the decision to build a new peat fired station for electricity generation
 - the final costs of construction of the interconnector
 - changes in international oil and gas prices
 - the decision to connect the Northern Ireland and UK grids
 - obligations under international agreements covering sulphur dioxide emissions.
- 3.62 In order to monitor and evaluate the project's effectiveness, the Department should give consideration to assessing its achievement in terms of:
- the contribution of the interconnector to the economy and to BGE's commercial operation, as projected at the appraisal stage
 - the specific economic, environmental and security objectives set for the project, that is:
-

- to improve the competitiveness of Irish industry
- to reduce the harmful environmental impacts of energy consumption by use of cleaner natural gas instead of other, more polluting fuels
- to ensure security of energy supply by maintaining diversity of energy sources over the long term
- to ensure security of supply of natural gas by providing an alternative source of supply, in the event of accidental disruption in supply from the Irish gas fields.

3.63 Targets for achievement of each of these objectives were not set explicitly but may be derived from relevant forecasts used in the feasibility study.

Environmental Impact

3.64 The feasibility study outlined the likely implications of non-importation of natural gas when indigenous reserves are exhausted. Essentially, this would result in increased dependence on coal and oil imports. National commitments under international agreements on reducing sulphur dioxide emissions were made on the basis of increased use of coal and heavy fuel oil with low sulphur content together with increased use of natural gas. Some cost increases are expected arising from these commitments.

3.65 Appraisal of the economic return on the interconnector project assumed that, in order to meet environmental emission criteria, the alternative to using imported natural gas for the industrial and power generation sectors would be to use low-pollution coal and oils. This implicitly put a monetary value on a significant part of the environmental benefit of using imported natural gas.

Import Volume Targets

3.66 The feasibility study contained forecasts of both TPER and volume of gas imports at five yearly intervals to 2015. (See Table 3.3.)

3.67 The feasibility study assumed that Ireland's TPER would increase to 11,200 TOE by 1995 and that gas consumption would be 2.9 BCM. Gas consumption at 2.1 BCM in 1994 does not appear to be set to achieve the projected level. However, a recent evaluation by the Department has indicated that BGE's gas sales to premium customers are ahead of the feasibility study target.

Table 3.3
Forecasts of Irish total primary energy requirement
and demand for gas^a, 1995 to 2015

	Actual	Feasibility Study Forecast				
	1994	1995	2000	2005	2010	2015
Total Primary Energy Requirement (TPER) ('000TOE ^b)	10,458	11,200	11,800	12,700	13,800	14,900
Natural gas as % of TPER	17%	24%	24%	25%	29%	30%
Natural gas consumption (BCM ^c)	2.1	2.9	3.1	3.5	4.5	5.0
Imports of natural gas as % of consumption	1%	50%	65%	100%	100%	100%

Source: Department of Transport, Energy and Communications (1994); feasibility study (1995 to 2015)

Note: ^a Neither Total Primary Energy Requirement nor gas consumption include gas feedstock for the fertiliser industry.

^b TOE = Tonnes of oil equivalent

^c BCM = Billion cubic metres

Security Objectives

- 3.68 A shorter term objective — security of supply in the event of accidental interruption of gas from the sole existing source — can be assessed now. The aim was to provide security of supply from 1 October 1993. In the event, the service was available from 12 December 1993, and should such a supply be needed, gas can be drawn for 150 consecutive days.
- 3.69 A second security objective was that of increasing diversification of the supply of energy in terms of fuels used. The forecast levels for gas as a percentage of the TPER are shown in Table 3.3. It is too early yet to assess whether the diversification objective will be reached.

Appendices

Appendix A

Audit Methodology

The examination was conducted partly by staff of the Office of the Comptroller and Auditor General and partly by consultants (Coopers and Lybrand, and Goodbody Economic Consultants Ltd).

In the course of the examination, the audit team reviewed the administration of the project by the Department. The fieldwork consisted of interviews and correspondence with relevant administrative personnel and examination of departmental records. The audit also examined the following:

- Feasibility Study of Importation of Natural Gas to Ireland (November 1990)
- Minutes of Monitoring Committee meetings
- Minutes of Task Force meetings
- Monitoring Committee Progress Reports
- BGE Annual Reports 1991 to 1994
- BGE Corporate Plan 1993 to 1997 (January 1993)
- Agreement between the Government of Ireland and the Government of the United Kingdom relating to the transmission of natural gas by pipeline between Ireland and the United Kingdom (Treaty Series, 1994, No. 1).

BGE assisted in the preparation of this report by providing information and documentation requested and by facilitating the participation of BGE staff in a number of meetings.

Estimates of Economic Return

In the course of the examination, the economic returns on the interconnector project were re-estimated to take account of variations in costs and other factors which occurred after the original appraisal work by the Department was completed.

Table A.1 sets out the estimated internal rate of return (IRR) to the national economy and to BGE over the period 1990 to 2015, based on the assumptions used in the feasibility study and those proposed by independent consultants. The results of re-estimation of economic returns undertaken during this study are also presented.

Table A.1
Estimates of internal rates of return on the interconnector project
over the period 1990 - 2015

	National Economy IRR	IRR for BGE when premium customers sales price is discounted by:	
		20%	30%
Feasibility study	26.0%	15.2%	13.8%
Independent consultants	15.5%	9.1%	6.0%
VFM study assumptions	11.0%	5.7%	2.7%

Internal Rate of Return

The results of economic appraisal of the interconnector project are presented in the form of internal rates of return (IRR). The IRR method is one of a range of methods used to assess investment proposals.

Investors normally seek to be compensated for the amount of time they must wait for revenues or other benefits (the returns on the investment) to arise. The IRR method identifies the discount rate which, when applied to the stream of future net benefits of an investment, reduces them until their sum equals the value of the initial investment required. This discount rate, called the IRR, is then compared with a minimum desired rate of return, usually based on an appropriate market rate of interest. Where the IRR is greater than this minimum, the investment is usually considered to be worth proceeding with on economic grounds.

Appendix B

Principal Contractors on Interconnector Pipeline Project

Contracts (in order of value)	Contractor
<i>Construction</i>	
Sub-sea pipeline construction	McDermott – ETPM
UK on-shore pipeline	Press Construction Ltd
Ireland on-shore pipeline/station	MF Kent & Co Ltd
Compressor station	MF Kent Services Ltd with R O'Rourke & Sons Ltd
Moffat off-take	British Gas plc
<i>Equipment/Pipe</i>	
Line pipe	British Steel plc
Pipe coating	Wood-Bredero (Irl) Ltd
Compressors	Thermodyne/Framatome
Anodes for sub-sea pipeline	Wilson-Walton Ltd
