GREENPEACE

and

Australian Conservation Foundation

submission

to the

Senate Economics References Committee Inquiry

on

Proposed Eastlink High Voltage Powerline between Armidale, New South Wales, and Springdale, Queensland.

EASTLINK

July 1995

Prepared for Greenpeace and the Australian Conservation Foundation
by

MARK ELLIS
ENERGY CONSULTANT

31 Russell Street,
Lilyfield, NSW 2040, Australia.

Tel: (02) 569 2031   Fax: (02) 569 2114

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A. Introduction

The terms of reference for the Senate Economics References Committee on the Proposed Eastlink High Voltage Powerline which Greenpeace will concentrate on in this submission are:

(c) *the likely impact of the powerline on overall levels of electricity consumption, with reference to Australia's obligations and commitment to reduce greenhouse gas emissions;*

and

(d) *the viability of the use of renewable energy sources including hydro-electricity to provide electricity to Queensland consumers.*

Our assessment of the Eastlink interconnection between Queensland and NSW raises a considerable number of questions about the proposal. Not least, these result from the lack of detailed, publicly available, information regarding the proposal. It is hoped that the process of this Senate Inquiry will help to clarify some of these issues.

In undertaking this submission we have examined the potential for alternative options for the supply of energy services to meet Queensland's foreseeable demands. From this assessment, we conclude that there is a wide range of options that could adequately substitute for Eastlink Stage 1. It is also highly probable that a similar range of options exist for Stage 2.

Further, the majority of customer benefits resulting from participation in the competitive electricity market will occur without physical interconnection. While access to the competitive wholesale market requires Eastlink Stage 2, it is questionable whether the long-term export of electricity at low cost from NSW will increase the opportunity for the competitive sourcing of energy supplies.

In order to compare the likely economic and greenhouse impact of Eastlink with alternative options, we have constructed a graph which plots the capacity of different resources to reduce carbon dioxide (CO_2) emissions and the costs associated with these savings. In this case we have plotted the costs of increasing or reducing CO_2 by 1kg (x axis) against the amount of CO_2 reduced or increased per kWh of electricity generated, or saved (y axis), for each resource.

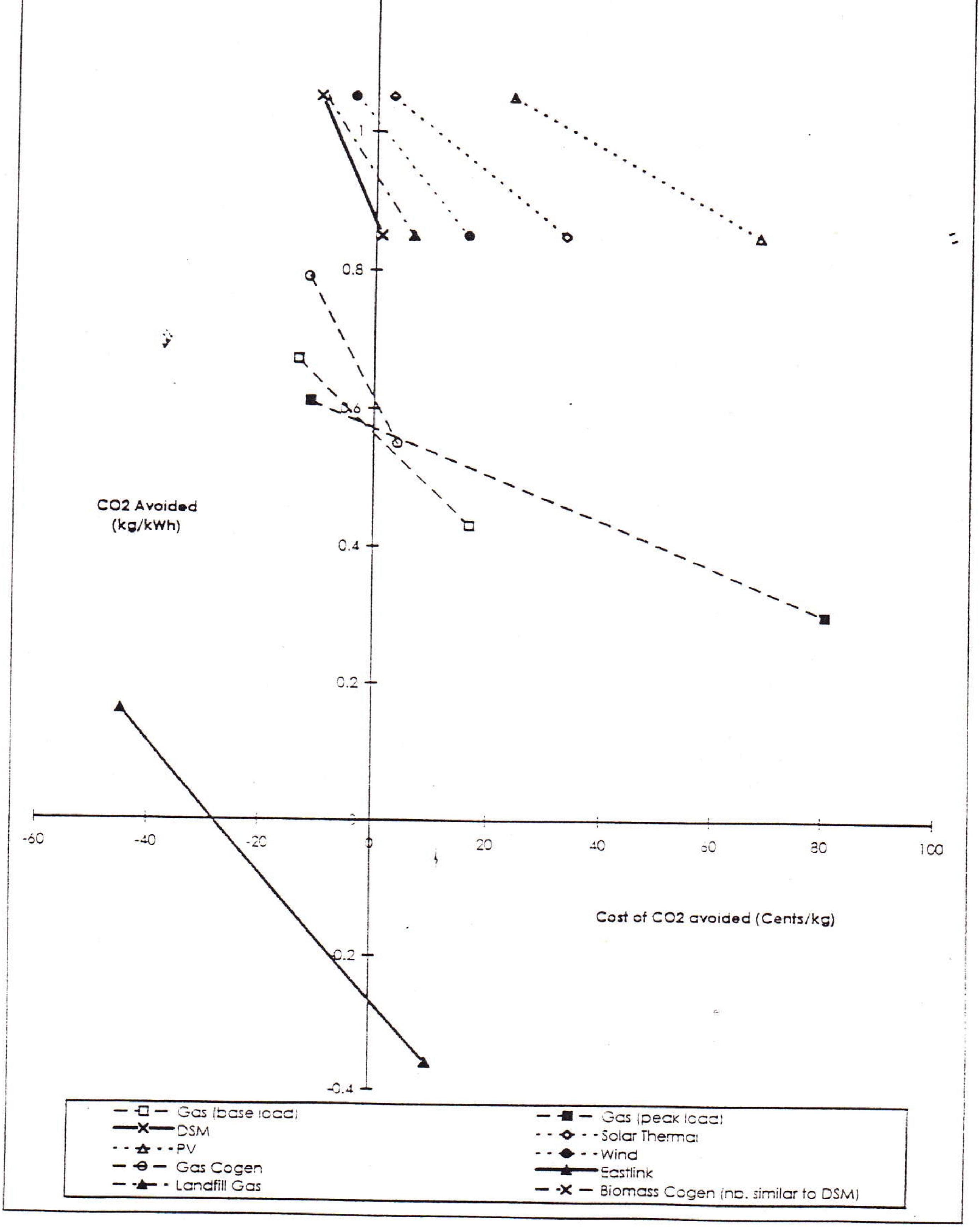
As a reference we have used typical values for a conventional coal-fired power station. The resultant graph has four quadrants since there are both negative and positive values for each axis. These are to be interpreted as follows:

Fig. 1

CO_2 reduced Net economic benefit (*"No Regrets"*)	CO_2 reduced Net economic cost
0 CO_2 increased Net economic benefit	CO_2 increased Net economic cost

The following graph shows the range of predicted impacts and costs for a range of resources:

Fig. 2



As the above greenhouse abatement graph clearly demonstrates, our assessment of a range of resources concludes that many of these are likely to be more cost-effective and more effective in reducing greenhouse emissions than Eastlink.

In the light of relevant Commonwealth and State policies to reduce greenhouse emissions, and the significance of emissions from the electricity generating sector, it is Greenpeace's view that major investments in this sector must contribute to a reduction of emissions.

Not only will Eastlink Stage 1 be, at best, neutral to the reduction of greenhouse emissions, it will also reduce the opportunity for providing energy services by other means at lower emission levels. The effect of proceeding with large investments which do not offer greenhouse benefits is to commit Australia into 'business as usual' rates of emissions for their lifetime, and decrease the possibility for 'no regrets' strategies to cut emissions.

This effect, of course, will be even more significant for Eastlink Stage 2.

B. What Are the Aims and Objectives of Eastlink?

The aim of Eastlink is to provide an interconnection between the Queensland electricity network and the eastern Australian network through NSW. The stated benefits of this [3] are:

- to give Queensland access to electricity via competitive trading in the new market;
- to share NSW reserve plant and thereby reduce the combined size of RPM in QLD & NSW;
- to allow new generating capacity to be located in optimal positions in Eastern States.

THE PROPOSAL

As we understand it, there are two distinct elements to the proposals:

Stage 1: a 330 kV line providing an interconnection of 500 MW (equivalent to 400MW new capacity in QLD) spanning a distance of 350km, costing approx $400m..

Stage 2: upgrading to two 500kV lines with a capacity of between 1000-2000 MW and extensive upgrading of lines in QLD, in all covering about 1,110 km. Probable cost in the region of $1.5 billion.

Stage 1 would only allow one-way transmission of up to 400MW capacity, from NSW to QLD and therefore would only meet the aim of sharing reserve plant and providing electricity in the short term. Since QLD Government estimate that it will need to find an extra 200-300 MW each year from 1998, Eastlink will only be a solution for approximately 1-2 years. [1]

To meet all the aims of the project, Stage 2 has to be completed in full although a thorough costed proposal has not yet been drawn up.

C. What Are Queensland's Foreseeable Electricity Needs?

In order to undertake this assessment, the Queensland electricity system has been modelled using demand and supply data from the 1994 NGMC Review of Opportunities [1] and the 1995 Queensland Government Energy Policy Statement [2]. These also appear to be the primary sources of demand and supply information for the Project Concept document, issued in October 1994 [3, Figs 3, 4], and used as justification for the Eastlink project.

Details of the model is provided in Tables 3a and 3b, together with an explanation of assumptions. The model runs between 1995 and 2006 and uses three scenarios for growth in peak demand. Existing levels of capacity, planned additional plant, demand side measures and retirements are all accounted for together with a reserve plant margin (RPM). From these factors, the *'net additional capacity requirements'* are calculated for each growth scenario in each year. In Table 3a, a RPM of 24% used, which is the level suggested as appropriate by the Queensland Government [2, p7], however in Table 3b, a RPM of 20% is used.

In Tables 3a and 3b, we have also accounted for those future projects which have already been through a tender process or we regard as firm commitments [2, p2,17]. These are labelled 'proposed new capacity'.

The final set of columns, the *'net additional capacity requirements after proposed new capacity'* represent the estimated peak capacity requirements for the Queensland electricity system. (Note that a negative figure here means that there is no net requirement).

Like all projections, the outcomes are sensitive to assumptions made on the supply and demand side and should be treated with some caution. The current nature of Queensland electricity demand, with very 'peaky' winter loads [4, p25], means that new capacity requirements are particularly sensitive to peak demand forecasts. The Queensland Energy Statement states [2, p12]:

> *"As a demand forecast can only be regarded as an estimate of the likely future outcome, a range of future forecasts is made (corresponding to low, medium and high rates of demand growth). The greatest emphasis in supply planning is placed on the medium forecasts so that a flexible plan may be developed, capable of meeting any of the outcomes and providing the greatest economy or supply at or about the medium demand forecast."*

Presumably using this methodology, the Queensland Government has stated that [2, p3]:

> *"After allowing for the effects of DSM and increased use of renewables, there remains a requirement for 200-300 MW per year of new conventional generating capacity from 1988."*

However, in our model (Table 3a), it would appear that, after taking into account the alterations to plant availability, DSM and existing plans for new capacity, there is no further estimated requirement before about the year 2000 in the medium growth scenario.

The overall capacity situation may be further improved by altering the assumptions made about the level of RPM required. A comparison of the implications for net capacity of adopting a RPM of 20%, as opposed to 24% is summarised in Tables 1 and 2 below.

Table 1: Net Additional Capacity Requirements - RPM - 24% [MW]

Growth	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
High			65	834	1024	1283	1525	1800	2631	2975
Medium				227	304	502	633	907	1515	1747
Low									238	408

Table 2: Net Additional Capacity Requirements - RPM = 20% [MW]

Growth	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
High				581	758	1006	1237	1499	2316	2645
Medium					62	250	373	635	1236	1457
Low										161

The Queensland Government paper suggests that 24% RPM is appropriate for the Queensland electricity system. However, over the past five years the availability levels of generating plant in Queensland have been between 84-90% and there have apparently been very few outages [4, p70]. This suggests that a reserve plant margin of 20% may be acceptable[1], which would have the effect of reducing the requirement for new capacity by at least one year. Outhred [20, p14], amongst others, have made similar recommendations.

Conclusion:

Assuming that the purpose of Stage 1 of Eastlink is to defer the short-term need for new capacity (on the basis of a requirement for 200-300MW per year [2, p3], Eastlink would provide a stop-gap for 1-2 years), then we believe that the current set of assumptions used in modeling demand and supply warrant further investigation.

Even a brief examination of the Queensland electricity system indicates that some of the assumptions which have been used to justify a requirement for further capacity from 1988 are open to question, on the evidence that we have seen to date. Given that new capacity requirements are highly sensitive to peak demand assumptions in this system, this is particularly important and suggest a range of solutions which may achieve similar end results at lower cost and environmental impact.

1 See *1989 Strategic Plan*, Electricity Commission of NSW, Appendix A. This document states: "it is estimated that a 1% improvement in system-wide availability would reduce the reserves required by approximately 2%".

TABLE 3

QUEENSLAND ELECTRICITY FORECAST 1995-2006

TABLE 3a (rpm =24%)	WINTER PEAK DEMAND			TOTAL CAPACITY REQUIREMENTS			FIRM CAPACITY CHANGES		TOTAL CAPACITY AVAILABLE	DSM PROG	NET ADDITIONAL CAPACITY REQUIREMENTS			PROPOSED NEW CAPACITY	NET ADDITIONAL CAPACITY REQUIREMENTS AFTER PROPOSED NEW CAPACITY		
	HIGH	MED	LOW	HIGH	MED	LOW	INCREMENTS	NOTES			HIGH	MED	LOW	INCREMENTS	HIGH	MED	LOW
1989	3610	3610	3610														
1990	3780	3780	3780														
1991	3860	3860	3860														
1992	3980	3980	3980														
1993	4120	4120	4120														
1994	4410	4340	4300						6640								
1995	4650	4580	4450	5766	5679	5518	115	(A)	6655		-889	-976	-1137	0	-889	-976	-1137
1996	4890	4760	4600	6064	5902	5704	0		6655	-5	-596	-758	-956	0	-596	-758	-956
1997	5470	4950	4740	6783	6138	5878	275	(B)	6930	-15	-162	-807	-1067	0	-162	-807	-1067
1998	5750	5370	4870	7130	6659	6039	50	(C)	6980	-30	120	-351	-971	300	-180	-651	-1271
1999	6020	5640	4980	7465	6994	6175	0		6980	-70	415	-56	-875	50	65	-406	-1225
2000	6330	5840	5110	7849	7242	6336	-500	(D)	6480	-135	1234	627	-279	50	834	227	-679
2001	6640	6060	5250	8234	7514	6510	60	(E)	6540	-220	1474	754	-250	50	1024	304	-700
2002	6930	6300	5390	8593	7812	6684	0		6540	-320	1733	952	-176	0	1283	502	-626
2003	7210	6490	5530	8940	8048	6857	0		6540	-425	1975	1083	-108	0	1525	633	-558
2004	7520	6800	5730	9325	8432	7105	0		6540	-535	2250	1357	30	0	1800	907	-420
2005	7880	6980	5950	9771	8655	7378	-500	(F)	6040	-650	3081	1965	688	0	2631	1515	238
2006	8250	7260	6180	10230	9002	7663	0		6040	-765	3425	2197	858	0	2975	1747	408
NOTES	(i)	(i)	(i)	(ii)	(ii)	(ii)		(iii)	(iv)	(v)	(vi)	(vi)	(vi)	(vii)	(viii)	(viii)	(viii)

TABLE 3

QUEENSLAND ELECTRICITY FORECAST 1995-2006

TABLE 3b (rpm =20%)

	WINTER PEAK DEMAND			TOTAL CAPACITY REQUIREMENTS			FIRM CAPACITY CHANGES		TOTAL CAPACITY AVAILABLE	DSM PROG	NET ADDITIONAL CAPACITY REQUIREMENTS			PROPOSED NEW CAPACITY	NET ADDITIONAL CAPACITY REQUIREMENTS AFTER PROPOSED NEW CAPACITY		
YEAR	HIGH	MED	LOW	HIGH	MED	LOW	INCREMENTS	NOTES			HIGH	MED	LOW	INCREMENTS	HIGH	MED	LOW
1989	3610	3610	3610														
1990	3780	3780	3780														
1991	3860	3860	3860														
1992	3980	3980	3980														
1993	4120	4120	4120														
1994	4410	4340	4300						6540								
1995	4650	4580	4450	5580	5496	5340	115	(A)	6655		-1075	-1159	-1315	0	-1075	-1159	-1315
1996	4890	4760	4600	5868	5712	5520	0		6655	-5	-792	-948	-1140	0	-792	-948	-1140
1997	5470	4950	4740	6564	5940	5688	275	(B)	6930	-15	-381	-1005	-1257	0	-381	-1005	-1257
1998	5750	5370	4870	6900	6444	5844	50	(C)	6980	-30	-110	-566	-1166	300	-410	-866	-1466
1999	6020	5640	4980	7224	6768	5976	0		6980	-70	174	-282	-1074	50	-176	-632	-1424
2000	6330	5840	5110	7596	7008	6132	-500	(D)	6480	-135	981	393	-483	50	581	-7	-883
2001	6640	6060	5250	7968	7272	6300	60	(E)	6540	-220	1208	512	-460	50	758	62	-910
2002	6930	6300	5390	8316	7560	6468	0		6540	-320	1456	700	-392	0	1006	250	-842
2003	7210	6490	5530	8652	7788	6636	0		6540	-425	1687	823	-329	0	1237	373	-779
2004	7520	6800	5730	9024	8160	6876	0		6540	-535	1949	1085	-199	0	1499	635	-649
2005	7880	6980	5950	9456	8376	7140	-500	(F)	6040	-650	2766	1686	450	0	2316	1236	0
2006	8250	7260	6180	9900	8712	7416	0		6040	-765	3095	1907	611	0	2645	1457	161
NOTES	(i)	(i)	(i)	(ii)	(ii)	(ii)		(iii)	(iv)	(v)	(vi)	(vi)	(vi)	(vii)	(viii)	(viii)	(viii)

TABLE 3

QUEENSLAND ELECTRICITY FORECAST 1995-2006

NOTES			
	All values in MW		
(i)	From NGMC 1994 - Review of Statement of Opportunities [1]. It is assumed that 750 MW of DSM is included in these figures		
(ii)	Capacity requirements = winter peak demand + reserve plant margin.		
(iii)	Firm Capacity Changes include plant additions and retirements, as indicated in the NGMC Review of Statement of Opportinites [1] and Queensland Government		
	These are as follows:	(A)	Barcaldine & Stanwell 4 on line [+390MW]; Gladstone partially closed for refurbishment [-275MW]
		(B)	Gladstone back on line [+275MW]
		(C)	Bagasse contract [+50MW]
		(D)	Swanbank A retired [-500MW]
		(E)	Renewable Energy Acquisition Plan [+60MW]
		(F)	Swanbank B retired [-500MW]
(iv)	Total Capacity Available = total capacity as of 6540MW (from(2)) + Firm Capacity Changes		
(v)	The DSM program announced in Feb 1995 is predicted to reduce peak demand by 650MW over a 10 year period, if funding is continued for this period.		
(vi)	The Net Capacity Requirement is equivalent to (Total Capacity Requirements - the impact of the DSM Program) - Total Capacity Available.		
	Note that a negative value denotes a capacity surplus and a positive value denotes a capacity shortfall.		
(vii)	Proposed New Capacity include those projects which are identified as in [2] which we interpret to be commitments. These include:		
			The recommisioning of Collinsville [180MW] and Callide A [120MW]
			The proposed extension of Bagasse contract to supply 200MW by 2001; ie. 150MW in addition to (iii) C, above.
(viii)	Net Capacity Requirements after Proposed New Capacity is equivalent to columns (vi) - (vii).		
	Note that a negative value denotes a capacity surplus and a positive value denotes a shortfall.		

D. Could the aims of Eastlink be achieved through energy efficiency and renewables?

IN RELATION TO STAGE 1

The primary aim of Eastlink Stage 1 is to enable Queensland to gain access to NSW supply capacity. This may either be used to provide backup capacity (ie. reduce the reserve plant margin in the QLD system) [3, p2], or to transmit electricity supplies. In the latter case, some existing QLD generators would be relegated to reserve plant.

Whether Eastlink Stage 1 will be used to provide spare capacity or electricity will be dependent upon contractual arrangements, including the price, and transmission constraints within the NSW and QLD systems.

The introduction of further demand side management (DSM) measures would have a similar effect. Initiatives to reduce peak demand or shift loads could release existing generators for use as reserve plant, while energy efficiency programs would have an equivalent impact as the supply of electricity from NSW.

Most renewable energy projects would also be used to supply base load, for the reason that they have negligible variable operation costs and their is little opportunity to vary or store their output (ie. 'non-dispatchable). As a result, renewable energy supplies would be dispatched in advance of other generators in the system, therefore their contribution would displace other generators.

There appears little doubt that, assuming equivalent quantities of DSM and renewable energy sources are available in Queensland, both these options are feasible alternatives to Stage 1 of Eastlink.

Is there potential for 400MW of DSM or Renewable Energy in Queensland?

The Queensland Government has indicated that there is already potential to supply at least 400 MW from **renewable energy sources** [2, p3]:

> *"In respect of renewable energy, there will be an increased supply from the State's sugar mills, commencing at 49MW in 1998 and possibly rising to 200MW in the future.*
>
> *The electricity industry will implement a program for the purchase of renewable-based energy with a target, beyond the contribution from the sugar mills, of 60MW by 2001 and possibly 200MW by 2010."*

Of these, 140MW have not been included in Tables 1-3 and therefore could further reduce capacity requirements. These comprise relatively small acquisitions and it highly likely that they could be timed to coincide with capacity shortfalls in order to maximise their impact.

Further, the above document mentions a number of new renewable energy sources which may be available [2, p16] including:

- Biomass Cogeneration
- Solar Thermal
- Wind
- Tidal and Wave Power
- Geothermal
- Landfill Gas
- Industrial Waste Incineration
- Other Biomass projects.

While there is little information regarding the potential for these resources, the Queensland Transmission and Supply Corporation is undertaking a detailed evaluation. However, in advance of this information, there are indications that the potential for renewable energy supplies is at least equal in size to the contribution of the proposed Eastlink 1 project.

- The Victorian 'Cogeneration and Renewable Energy Incentives Package", which the SECV operated between 1987 and 1992, stimulated the development of projects exceeding 150MW [21].

- In investigating the potential for wind energy, the DASETT report [5, p29] states:

  "It is likely that detailed surveys of such a large state (Queensland) with such a long coastline will find numerous pockets of abnormally high windspeeds suitable for siting groups of wind generators."

- The ERDC Biomass Report [6], contains several examples of projects which have potential for application in Queensland.

It is of particular concern to Greenpeace that the Queensland Government Energy Policy Statement [2, p16] appears to view renewable energy technologies as either too small or not sufficiently developed to warrant serious consideration. It is worth noting the comments recorded in 'Queensland's Future Power' [7, p65] from a QEC staff member with experience in wind power:

> *"A report by myself and Dean Perkins (of QEC) is available, and describes 19 possible sites along the Queensland coast, for wind turbine generators. It was recommended that 7 sites be monitored for wind energy for 12 months. Only 3 of these are being currently monitored by QEC, and one by SEQEB."*

In fact, the benefits of sourcing small increments of electricity supply to match demand growth are considerable and represent an opportunity for substantial economic efficiency gains over larger supply projects (see Section E).

In addition, while some members of the Queensland Government and utilities may have little experience of these technologies, they can no longer be regarded as in their infancy and the majority are now fully mature. Australia has an excellent indigenous renewable energy industry with the capability to support the development of practical projects, of which their are numerous examples around the country.

> *"...our renewable industries and the research and innovation upon which they are based have already gained a sound international reputation"* [8, piii]

In the field of **demand-side management**, the Queensland Government estimate that previous and current activities have reduced peak demand by about 750MW [2, p12]. In addition, the latest Queensland energy efficiency program [11 & 2] estimates that additional demand reductions of 650MW will be achieved by 2005.

It is claimed that the impact of Queensland's participation in Commonwealth Government national initiatives to promote energy efficiency has been mostly accounted for in programs announced by the Queensland Government in February 1995 [11, p15-16].

These national programs include:

- The mandatory application of Minimum Energy Performance Standards (MEPS) for refrigerators, freezers, electric storage water heaters;
- The possible extension of MEPS to include lighting ballasts, HVAC systems and industrial motors;
- The Domestic Appliance Labelling Program and the addition of a new program to include office equipment, industrial motors and HVAC systems;
- The commitment to a Commercial Building Energy Code (CBEC);
  The mandatory application of the CBEC in Queensland is estimated to have a cumulative impact over 30 years of reducing total electricity demand by 12,940 GWh and total gas demand by 10,803 TJ [10, p6-3]. See Table 5.

Table 5: Electricity Savings due to Implementation of CBEC in Queensland Cumulative over 30 years (GWh)

Queensland	Electricity	
	New	Refurb
Accommodation	1,552	122
Education	1,411	78
Large Office	1,763	91
Small Office	807	568
Large Retail	1,289	686
Small Retail	1,054	627
Health	949	280
Warehouse	1,483	181
Total	**10,308**	**2,632**

- The National Home Energy Rating Scheme;

However, it is unclear to us to what extent recent developments in these national programs, such as those announced in March 1995 in the Greenhouse 21C plan [9], a month after the release of the new Queensland energy efficiency program, have been fully accounted for. Decisions to widen the scope of some programs and to proceed with mandatory implementation of some initiatives, are likely to significantly increase the estimated impact of these measures and should therefore be factored into calculations for Queensland's demand forecasts.

In itself, this may further reduce the need for capacity additions, however we also believe that there will be scope to expand the number and range of activities under the energy efficiency program. For example, Lowe [22] has estimated that the $400 million which would have been spent on Eastlink Stage 1, could instead be invested on the following projects which would provide greenhouse benefits:

- $1000 subsidy for 350,000 domestic solar water heaters, saving up to 1000MW; or
- domestic thermal insulation for every home in QLD, saving at least 500MW; or
- providing 20 million compact fluorescent lights, saving at least 500MW.

In addition, the proceedings of the Second National Demand Management and Energy Efficiency Conference 1994, provide numerous examples of successful and cost effective utility programs from around Australia.

IN RELATION TO STAGE 2

There are three main aims of Stage 2, being:

a) to give Queensland access to electricity via competitive trading in the new market;

b) to share NSW reserve plant and thereby reduce the combined size of RPM in QLD & NSW;

c) to allow new generating capacity to be located in optimal positions in Eastern States.

The arguments concerning item (b) are the same as those in the preceding section. We consider that, in this respect, Stage 2 is fully substitutable by investment in renewables and energy efficiency over the proposed timespan.

Without Eastlink Stage 2, access to the competitive interstate wholesale market will be foregone (item (a) above). That is the trade in the supply of electricity between states which requires a physical transmission network.

However, a major objective of the current process of industry restructuring is to increase competitive forces at all levels, in order to provide consumers with greater choice between suppliers of electricity and between a range of energy services. To achieve this, competition policy will gradually increase the numbers of contestable customers over the next five years.

The result will be that energy service retailers will no longer be restricted to franchise areas and will offer services directly to customers wherever they are located. For example, NSW retailers will be able to operate in Queensland by initiating purchase agreements with QLD generators and supply contracts with customers; and vice versa. This important aspect of competitive trading which is likely to have the most impact on consumers, does not require Eastlink.

Secondly, the new market arrangements only facilitate competition between supply-side providers. The response to the Future Supply Consultative Electricity Task Force [7] suggests that a significant number of consumers wish to be able to choose between supply and demand-side investments. Queensland consumers, asked what they thought were the most suitable power sources for Queensland, responded as follows: [12]

Table 6: Queensland consumers preferences for new supply options

Efficiency Gains	96%
Solar	90%
Cogeneration	83%
Hydro	71%
Interconnection	67%
Wind	60%
Wave	57%
Coal	51%
Gas Turbine	49%

Therefore, investment in energy efficiency as an alternative to Eastlink would increase customer choice and could be the beginning of a competitive market in Queensland that treated demand and supply side investments as interchangeable.

The final point to made regarding competition concerns the proposed contract between the QEC and Pacific Power. While the details of this agreement are not available, we understand that it includes the commitment to supply electricity through Eastlink at a low cost. Indeed, the Queensland Energy Policy Statement alludes to this [2, p21]. To the extent that the price quoted by Pacific Power represents an attempt to increase utilisation of excess capacity due to poor previous investment decisions in NSW, it is questionable that this activity can be described as pro-competitive. It is certainly the type of process designed to gain market share and to lock clients into a long term commitment which should be examined in detail to determine whether it is anti-competitive.

It is unclear to us the extent to which Eastlink Stage 2 will facilitate the optimum siting of new generation capacity in the Eastern States (item (c) above), or indeed whether this is a major benefit worthy of the costs associated.

The 'Project Concept' report [3, p2] is vague on this issue, however in so far as it suggests that Stage 2 will greatly expand the opportunities for the location of new electricity generating plant, it is misleading. Even with a 1000-2000MW interconnection, the degree to which electricity can be transmitted through the whole eastern system will be constrained by 'weak links' in the system and losses sustained over long distances. While there is little information available on the direct costs of Stage 2, or the associated costs of network enhancement, it would be unlikely to be less than $1.5 billion.

In an established and extended electricity system such as that in NSW and Queensland, the key to greater efficiency is the location of relatively small supply or demand-side measures close to the point of use.

E. Would investment in renewables and energy efficiency be as cost effective as Eastlink?

A series of estimates for the levelised costs of generating electricity have been calculated in Table 8, at the end of this section, and summarised below in Table 7.

Table 7: Levelised cost of Electricity Generation (10% discount rate)

Technology	Levelised Cost cents/kWh	
	Low	*High*
Coal Generation	3.96	12.09
Gas-Fired Generation		
Base-load	3.11	11.16
Peak-load	5.19	28.20
Gas Cogeneration	2.84	6.34
Grid Connected Photovoltaics	37.19	62.13
Wind Farms	8.00	17.69
Solar Thermal	15.14	32.28
Biomass Cogeneration	3.20	4.58
Landfill Gas	2.17	9.62
Eastlink		
Eastlink (Stage 1)	2.39	5.49
plus electricity purchase cost of 2c kWh	4.39	7.49
Eastlink (Stage 2)	2.39	8.23
plus electricity purchase cost of 2c kWh	4.39	10.23
Demand-Side Management	1.6	4.8

However, these are only a part of the cost-effectiveness equation. Other relevant factors that will effect overall costs include:

- the timeliness of investment; ie. whether the capacity is required at the time that the new plant is commissioned.
- the effect on network costs; ie. whether the technology selected will reduce or increase network costs.

A thorough assessment of which technology is most cost-effectiveness must take these three factors into account.

EASTLINK

The levelised cost of transmitting electricity through Eastlink Stages 1 and 2 is dependent upon a number of factors, including:

- the capital investment costs;
- electricity supply costs;
- losses within the transmission system;
- utilisation of the asset.

As the following graph illustrates (Fig. 3), the cost effectiveness of investment in Eastlink is highly sensitive to the quantity of electricity that is transmitted (ie. the 'capacity factor').

Fig. 3: Levelised Cost of Electricity Supplied by Eastlink vs Capacity Factors

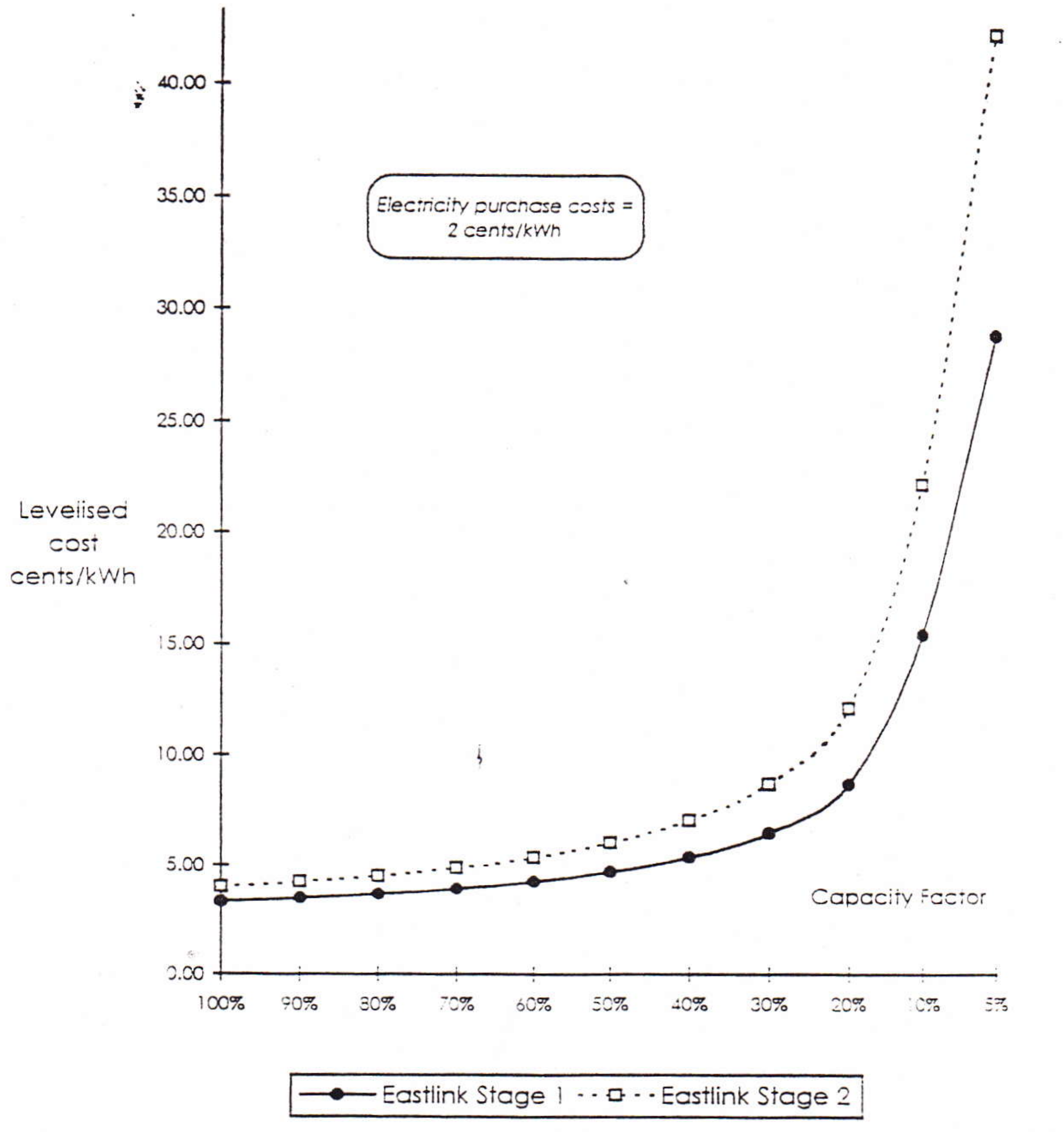
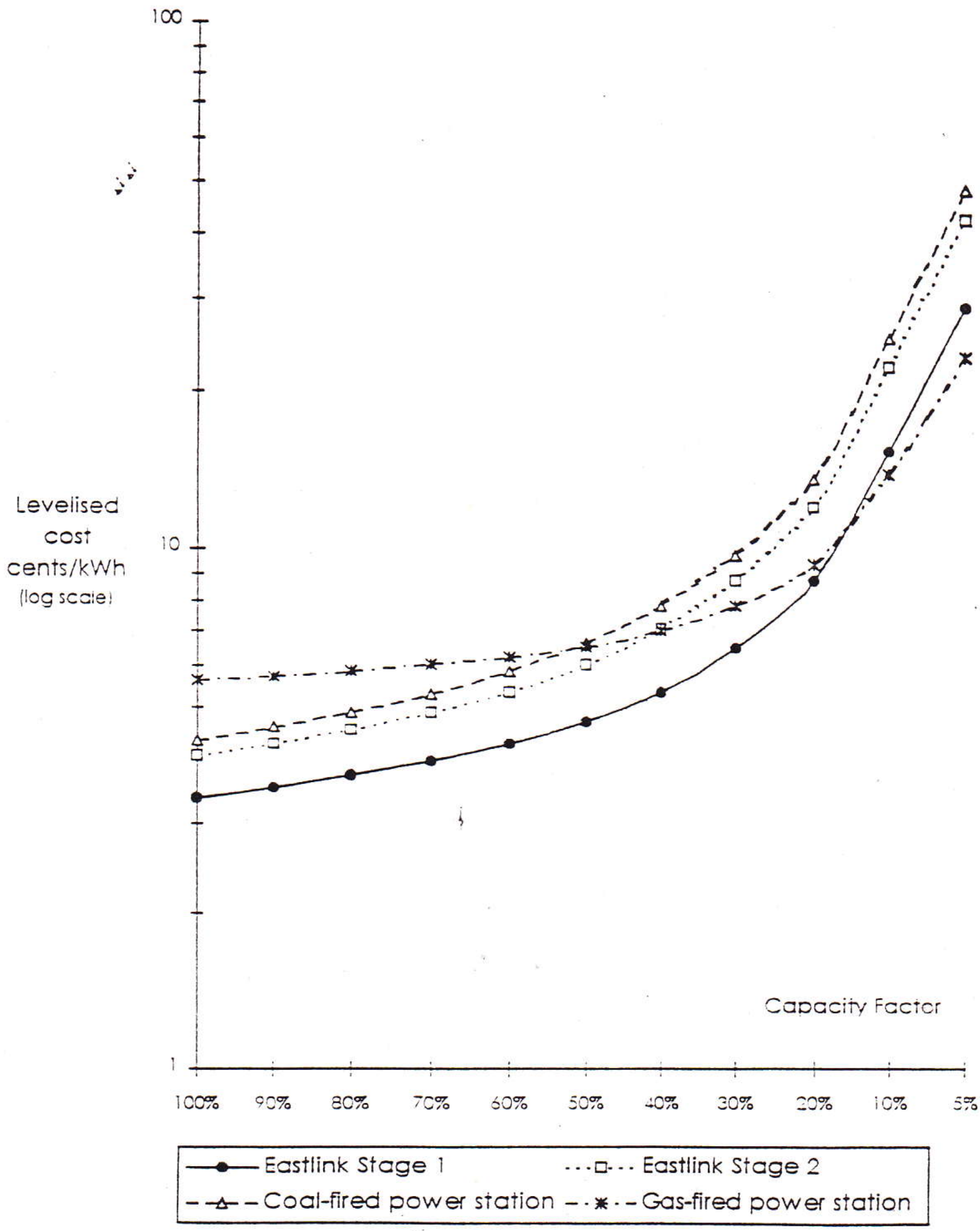


Fig. 4, (below) includes values for typical coal and gas fired generation options and illustrates how at any point the lowest-cost technology will vary depending upon the amount of electricity that is required. While we have no accurate information on the likely utilisation level of Eastlink, this is obviously a crucial issue which warrants further investigation. As a guide, it would be prudent to examine the utilisation levels of similar transmission links, such as those between NSW and Victoria, and Victoria and South Australia.

Fig. 4: Levelised Cost of Electricity vs Capacity Factors



As a major transmission project, the electricity supply costs of Eastlink will also vary depending upon the purchase costs of electricity. Normally, it would not be expected that the costs of investment in transmission plus electricity purchase costs could compete with generation options. However, in this instance it appears that low purchase costs from NSW make this a possibility in some circumstances (see Figs. 3 & 4).

However, this 'opportunity' arises only because of poor previous investment decisions in the NSW system which have led to extremely high levels of overcapacity. (See Greenpeace submission to the NSW Government Pricing Tribunal [24]). In order to recoup some of the resultant sunk costs, Pacific Power now appears willing to sell power at low cost. This in itself raises several questions about Eastlink, such as:

- How long does the commitment to provide Queensland with a low purchase price last?
- What will happen to the costs of electricity supplies via Eastlink after this commitment expires?
- Should such a major investment of public funds be used to alleviate problems due to previous poor investment decisions?

RENEWABLE ENERGY TECHNOLOGIES:

In general, renewable energy technologies currently appear the most costly option. However, these costs could be reduced substantially with the establishment of a market in Australia, such as the commitment by Queensland to a major renewables acquisition program. Similar initiatives in the United States and Europe over the last ten years have demonstrated the effectiveness of this approach. (See Fig. 5).

Further, renewable energy projects generally allow for scaled development appropriate to actual demand. This is because they each involve small increases in capacity and have relatively short lead times[2]. As a result, the risk of commissioning plant in advance of demand and incurring large costs can be substantially avoided. As the Queensland Government notes:

> *"Building a major power station like Stanwell a year earlier than necessary would result in additional costs of over $150 million."* [2, p15]

Finally, as small generation plant, renewable projects have the capacity to be strategically located within the electricity grid ('distributed generation") to minimise or reduce network costs and transmission losses.

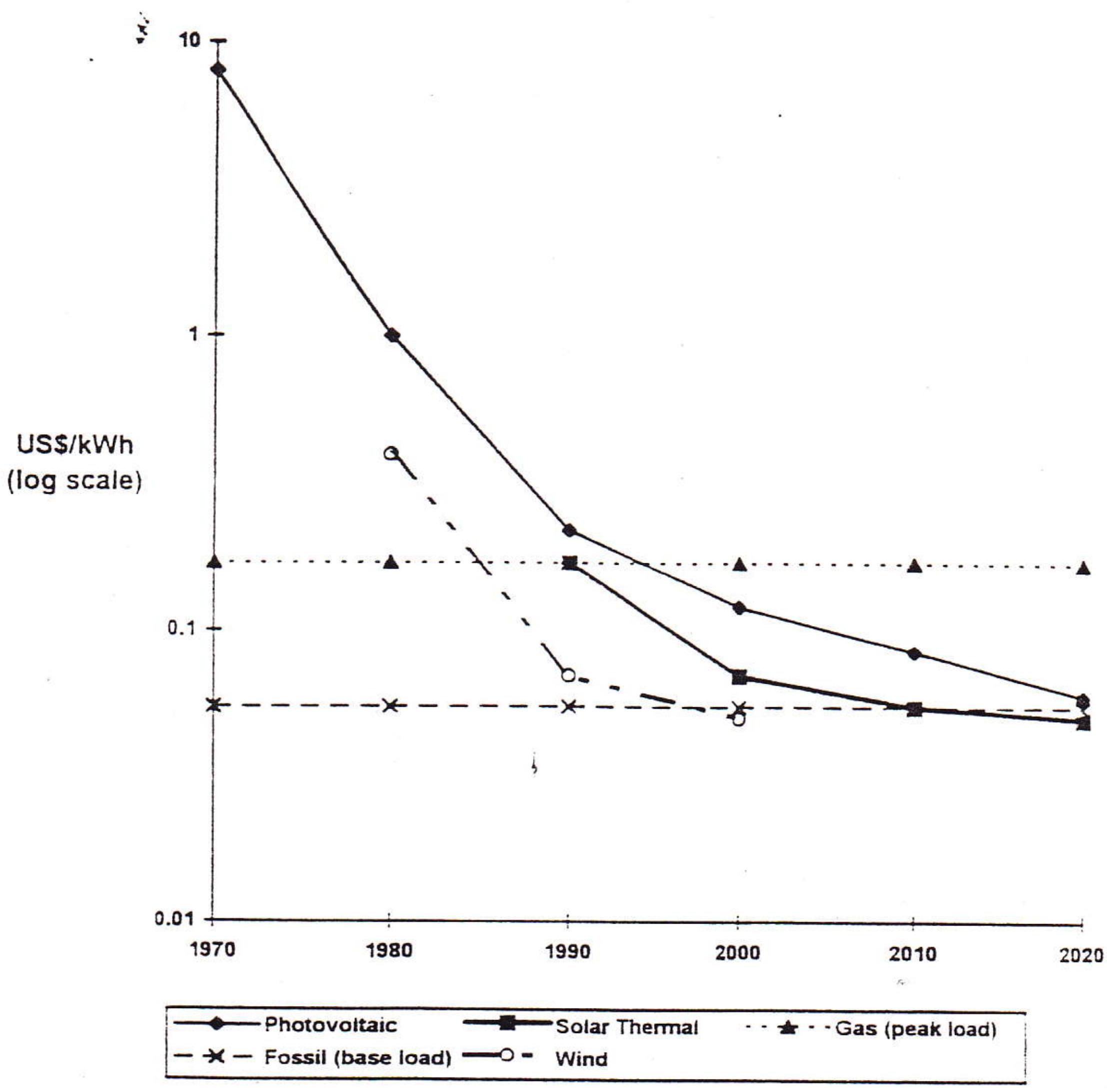
This is most clearly demonstrated in the case of electricity supplies to remote areas, however, as the costs of maintaining and augmenting the general network become increasingly transparent, it is evident that the real cost of supplying electricity to many areas will be substantially influenced by costs associated with the network.

---

2 Within a framework that supports the development of renewable energy potential.

"Being embedded in the T & D network, distributed resources can defer or substitute for additional network investment. Such T & D benefits can tip the scales in favour of distributed generation even if generation costs are higher than those of large scale generation. Thus the value of distributed resources derives not only from the displacement of conventional generation, but also from T & D specific savings such as improved asset utilisation, lower losses, improved local reliability, deferral of distribution investment (which tends to be lumpy and uncertain) and better management of investment risk." [15]

Fig 5: Cost of alternative means of generating electric power in high-insolation areas, 1970-2020, [13] and US wind power costs [14]



CONVENTIONAL ELECTRICITY GENERATION:

The levelised costs for electricity supply from central generation plant. ie. coal-fired or gas-fired, are low and largely depend upon whether they are used to supply base or peak loads. Clearly, as described in the previous section, there will however, be associated network costs with each of these options and the risk of untimely investment.

In addition, the costs of these projects do not represent all the social and environmental costs which flow from their development. It is now widely acknowledged that the lack of inclusion of these 'externalities' is a flaw which causes a distortion in planning decisions.

For instance, the NGMC states in the National Grid Protocol [16]:

> *"The objective 'to achieve the lowest cost for electricity while recognising environmental factors' must focus on the full cost of the energy service provided by electricity at the point of use".*

To date there has been little work to evaluate monetised values for environmental externalities in Australia, although utilities in the United States and Europe have been estimating values and using them to make planning decisions, for some time. Hagen and Kaneff provides several examples of these, citing the value 1.68 US cents to 10.3 US cents per kWh adopted by the Massachusetts Dept of Public Utilities, equivalent to 160% of conventional costs of production. [17]

The best known evaluation of pollution costs in Australia, undertaken by Stocker, Harman and Topham for Western Australia, recommend externality values of 2c/kWh for gas-fired electricity generation and 4c/kWh for electricity generated from coal. [18] A recent European study [26] provides a summary of researched values for externalities.

Therefore, while doubt exists concerning the exact values of environmental externalities, they are likely to substantially add to the cost of electricity generated from conventional sources. Renewable energy projects and energy efficiency measures emit zero or very low levels of pollutants and therefore the impact of these externalities on their overall cost will be small.

ENERGY EFFICIENCY:

Energy Efficiency programs such as those already commissioned in Queensland are amongst the lowest cost means of meeting demand for electricity services. We estimate that the Queensland energy efficiency program will cost between 2.2 and 1.6 cents per kWh of electricity saved (see notes to Table 10).

This compares favourably with the costs of the SECV program which averaged 4.8 cents per kWh saved (see Table 9 below). The difference may be explained by the contribution made to the Queensland program from initiatives funded by the Commonwealth Government and the fact that the SECV figures represent a Total Resource Cost (ie. they include the contribution of participants).

Table 9: SECV Demand Management Program [10]

Program Area	Energy Saved (GWh)	Total Resource Cost (cents/kWh)
Business Lighting Efficiency Program	13	3.6
Industrial Energy Efficiency Program	59.7	4.4
Commercial Energy Efficiency Program	13.9	4.5
Office Lighting	4.4	8.0
Business Lighting Efficiency	2.9	5.8
Higher Efficiency Motors	0.6	8.6
Residential Lighting	7.5	7.7
Total Energy Saved	**102**	
Average resource cost		**4.8**

As with distributed generation projects, end-use energy efficiency has considerable potential to provide network benefits and therefore reduce supply costs.

Most efficiency measures are modular and can be expanded in small increments, and within an overall energy efficiency program culture can be acquired relatively quickly.

It should be recognised, however, that although energy efficiency measures may represent the lowest cost option from society's point of view, under the current regulatory framework they are not necessarily advantageous for electricity supply utilities. Where utility revenues are linked to sales, capital expenditure and reduced consumption will be a cost to utilities which can only be recouped by network savings, reduced purchases and better asset utilisation.

Currently only a small proportion of the full potential of energy efficiency projects can meet these onerous criteria. Only if the utilities were able to 'sell' energy efficiency in the same way as they currently sell kilowatt hours, would it then be possible for the utilities to evaluate all options equally.

The acquisition of future energy supplies, however, is a matter of crucial importance to society, and not just the utilities. While it should be recognised that utilities currently face a disincentive to invest in energy efficiency, this should not influence the choice of which technologies offer most advantages but is a matter which should be addressed through regulatory controls and other means.

The NSW Government Pricing Tribunal, which has studied utility investment in demand management extensively [19], notes that:

> *"Regulation which focuses on prices will reward increases in sales and may discourage the ESI from marketing energy management services on a commercial basis. The problem may not the failure of the market in energy management services, but rather that the regulatory framework has prevented its development."*

Conclusion:

We have indicated a number of factors which need to be better understood before the exact costs of Eastlink can be calculated. We have also identified some of the factors which need to be taken into account when calculating the cost-benefits of energy efficiency and renewable energy options. However, on the basis of reasonable assumptions it would appear almost certain that, in the short-term, investment in demand management and some renewable energy options would be at least as cost-effective as Eastlink Stage 1. Over the longer term, it is highly likely that there are a wide range of alternatives which will be more cost-effective than Eastlink Stage 2.

Perhaps the only way in which Eastlink can be made to look cost-effective in comparison with other options is if the full costs are not met by the industry. A statement by the Queensland Government [2, p21] may indicate that this is the case:

> *"The Eastlink interconnection has been selected as part of Queensland's supply plan on the basis of providing the lowest total cost* ***for the electricity industry*** *and hence electricity consumers throughout Queensland."*
>
> [emphasis added]

If it is intended that State and/or Commonwealth Governments directly finance Eastlink, then it should be asked whether this is a prudent and proper use of public money when cheaper alternatives exist.

TABLE 8 — COSTS OF ENERGY GENERATION OPTIONS

Technology	Options	Discount Rate	Typical Capacity	Capacity Factor	Capital Investment Costs			Overheads & Maintenance Costs		Fuel Costs	Total Cost of electricity supply
			[kW]		Capital Costs [$/kW]	Life of system [yrs]	levelised costs [cents/kWh]	Annual costs [% of capital]	levelised cost [cents/kWh]	Levelised cost [cents/kWh]	Levelised costs [$/kWh]
Grid Connected PV [1]	Option 1 - High	10%	100	18%	8000	20	59 59	0 50%	2 54	0 00	62.13
	Option 2 -Low	10%	100	22%	6000	20	36 57	0 20%	0 62	0 00	37.19
Wind Farms [2]	Option 1 - High	10%	2000	21%	2500	25	14 97	2%	2.72	0 00	17.69
	Option 2 - Low	10%	2000	36%	2100	25	7.34	1%	0 67	0 00	8.00
Solar Thermal [3]	Option 1 - High	10%	1000	16%	3600	30	27.25	2%	5.14	0.00	32.38
	Option 2 - Low	10%	1000	21%	2400	30	13 84	1%	1.30	0 00	16.14
Coal Generation [4]	Option 1 - High	10%	500000	40%	2000	30	6 05	3%	1.71	4 32	12.09
	Option 2 -Low	10%	500000	80%	1500	30	2 27	2%	0 43	1 26	3.96
Gas Fired Generators [5]											
Gas Thermal	Option 1 - High	10%	250000	30%	800	25	3 35	2 00%	0 61	7.20	11.16
	Option 2 - Low	10%	250000	70%	500	25	0.90	1 00%	0 08	2 25	3.23
Gas Turbine	Option 1 - High	10%	50000	5%	700	25	17.61	1.00%	1 60	9 00	28.20
	Option 2 - Low	10%	50000	25%	400	25	2 01	0 50%	0 09	3 09	5.19
Gas Combined Cycle	Option 1 - High	10%	250000	50%	1000	25	2.52	1.00%	0 23	5 04	7.78
	Option 2 - Low	10%	250000	80%	700	25	1.10	0.50%	0.05	1.96	3.11
Gas Cogeneration [6]	Option 1 - High	10%	100000	70%	1200	25	2.16	3%	0.59	3.60	6.34
	Option 2 - Low	10%	100000	80%	800	25	1.26	2%	0.23	1.35	2.84
Biomass Cogen [7]	Option 1 - High	10%	10000	70%	2300	25	4.13	1.20%	0.45	0.00	4.58
	Option 2 - Low	10%	10000	80%	1900	25	2.99	0 80%	0.22	0 00	3.20
Landfill Gas [8]	Option 1 - High	10%	5000	40%	1500	20	5.03	4%	1.71	2.88	9.62
	Option 2 - Low	10%	5000	65%	900	20	1.86	2%	0.32	0.00	2.17
Eastlink - Stage 1 [9]	Option 1 - High	10%	400000	25%	1000	25	5.03	1%	0.46	0.00	5.49
	Option 2 - Low	10%	400000	55%	1000	25	2.29	0.50%	0.10	0.00	2.39
Eastlink - Stage 2 [10]	Option 1 - High	10%	1000000	25%	1500	25	7.55	1%	0.68	0.00	8.23
	Option 2 - Low	10%	1000000	55%	1000	25	2.29	0 50%	0.10	0.00	2.39

TABLE 8

COSTS OF ENERGY GENERATION OPTIONS

Notes:

[1] PV capital costs do not include land costs

[2] For Wind Farms: Option 1 is for wind speeds of 5.5 m/s; and Option 2 is for wind speeds of 7 m/s.

[3] This technology is currently at the lowest state of development of all alternatives modelled here.

[4] Typical values for black coal used. Coal costs used = \$1.3/GJ (low) and \$3/GJ (high)
Note that the NSW Government Pricing Tribunal [19] estimated generation costs to be:
1992/3 cost per unit sold = (NSW) 4.41 c/kWh, (QLD) 3.19 c/kWh. 1992/3 LRMC (NSW) =5.3 to 6.1 c/kWh.

[5] Costs of Gas used = \$3/GJ (low) and \$7/Gj (high).

[6] Assumes a large thermal in addition to electricity output. Costs of Gas used = \$3/GJ (low) and \$7/Gj (high).

[7] Assumes a large thermal load in addition to electricity output. Cost of biomass is assumed to be zero

[8] Some commercial landfill plant may be required to purchase fuel

[9] These costs are for the transmission infrastructure and do not include the purchase cost of electricity.

[10] It has been assumed that the full interconnection would provide 1000MW firm capacity.
These costs are for the transmission infrastructure and do not include the purchase cost of electricity.

Sources:

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F. Would Eastlink inhibit the development of future cost-effective investments in NSW and Queensland?

If Eastlink Stage 1 goes ahead, there will be limited period (1-2 years) where future capacity is not required in Queensland. To the extent that one viable alternative to Eastlink Stage 1 is Demand Management, including energy efficiency, investment in Eastlink will have inhibited the implementation of energy efficiency measures. If the options for future capacity beyond this period remain open, then energy efficiency must be one of these.

However, if Stage 1 is only a precursor to Stage 2, then the impact of Eastlink on demand management initiatives is likely to be even greater. The benefits of a substantial supply-side investment in interconnection will only be realised if it is utilised, which, over the next ten years, is likely to mean the export of low cost electricity from NSW. The result will be that Queensland utilities will no longer feel constrained and under pressure to restrict demand, and that the range of cost-effective demand-side investments will be reduced.

On the other hand, with access to Queensland markets, the excess capacity of NSW generators is likely to be reduced at a faster rate. In other words, given that current excess capacity in NSW is a major disincentive to utility investment in energy efficiency in NSW, as the excess is progressively removed so demand management in that State may become more attractive.

However, in the current electricity industry restructuring process, there is little certainty about the forces and mechanisms that will be in place to influence future acquisitions. In reality, it may be that, in the face of capacity constraints, NSW will build more power stations (or some other alternative) rather than invest in demand management. We therefore consider it unwise to assume that Eastlink will necessarily promote the implementation of cost-effective energy efficiency in NSW.

In conclusion, it is difficult to see either Stage 1 or 2 of Eastlink having anything but a detrimental effect on alternative means of meeting the demand for energy services in Queensland. An investment in supply-side assets, particularly of the size envisaged for Eastlink, will necessarily place restrictions on the funds available to Governments and utilities for other projects. In addition, the motivation to maximise use of existing assets and to manage demand will be replaced by a financial requirement to maximise utilisation of Eastlink.

G. What is the extent of greenhouse gains from sharing Reserve Plant Margin?

The 400MW interconnection involved in Eastlink Stage 1 is intended to provide Queensland with access to NSW generators for use as reserve plant and to supply spinning reserve. As identified in Section D, another possible scenario is that existing Queensland generators could be used as reserve plant and to provide the spinning reserve, while electricity is imported from NSW. Given the quantity of excess capacity in NSW, it is considered unlikely that there would be substantial demand in NSW to receive similar services from Queensland in the near future.

The greenhouse emissions from coal-fired plant in the NSW and Queensland systems which would be used to provide RPM, spinning reserve or incremental increases in electricity supply, are very similar. Any alteration in greenhouse emissions would therefore be the result of losses occurring in the NSW-Queensland interconnection. While these losses may be considerable, the proportion of energy involved in the sharing of RPM between the States is small in comparison with total electricity generation in Queensland.

In Appendix A we have included an approximate calculation of greenhouse emissions due to Eastlink Stage 1 compared to the supply of RPM from Queensland generators. Because of the factors identified above, there is potential for a very small increase in greenhouse emissions attributable to Eastlink Stage 1.

This assessment would, however, need to revised if losses in the interconnection are greater than those modelled in Appendix A. It should also be noted that this analysis does not take any account of the impact of any deforestation which may be associated with the Eastlink project. 'South East Queensland Against Eastlink' estimate that 1,000,000 trees will be cleared if Eastlink goes ahead, which would have a significant negative impact on carbon sequestration in Australia. [23]

In the light of relevant Commonwealth and State policies to reduce greenhouse emissions, and the significance of emissions from the electricity generating sector [25], it is Greenpeace's view that major investments in this sector must contribute to a reduction of emissions.

Not only will Eastlink Stage 1 be, at best, neutral to the reduction of greenhouse emissions, it will also reduce the opportunity for providing energy services by other means at lower emission levels. The effect of proceeding with large investments which do not offer greenhouse benefits is to commit Australia into 'business as usual' rates of emissions for their lifetime, and decrease the possibility for 'no regrets' strategies to cut emissions.

This effect, of course, will be even more significant for Eastlink Stage 2.

H. What are the most cost-effective ways of meeting Queensland's Electricity needs and reducing Greenhouse emissions?

Regarding the acquisition of new supply or demand-side resources to meet Queensland's electricity demand, the Queensland Government states [2, p15]:

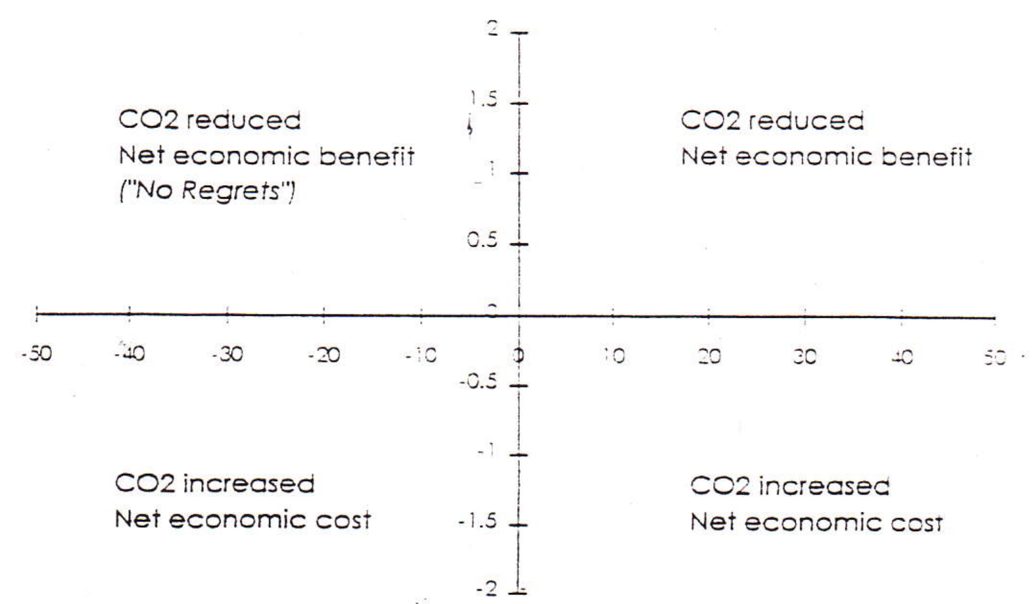
> *"the selection process needs to have regard to Queensland's obligations under the National Greenhouse Response Strategy and the policies outlined in the Queensland Greenhouse Response Strategy released by the State Government in March 1995. In particular, they need to give effect to the "no regrets" principle whereby:*
>
> - *actions which are economic in their own right and reduce greenhouse emissions will be taken; and*
> - *if two options are equally economic, the one with the lower emissions will be selected."*

A means of undertaking this type of assessment is by reference to a greenhouse abatement graph which compares the capacity of different resources to reduce CO_2 emissions and the costs associated with these savings.

In this case we have plotted the costs of avoiding 1 kg of CO_2 (x axis) against the amount of CO_2 avoided per kWh of electricity generated, or saved (y axis), for each resource (Fig 7). As a reference we have used typical values for a conventional coal-fired power station.

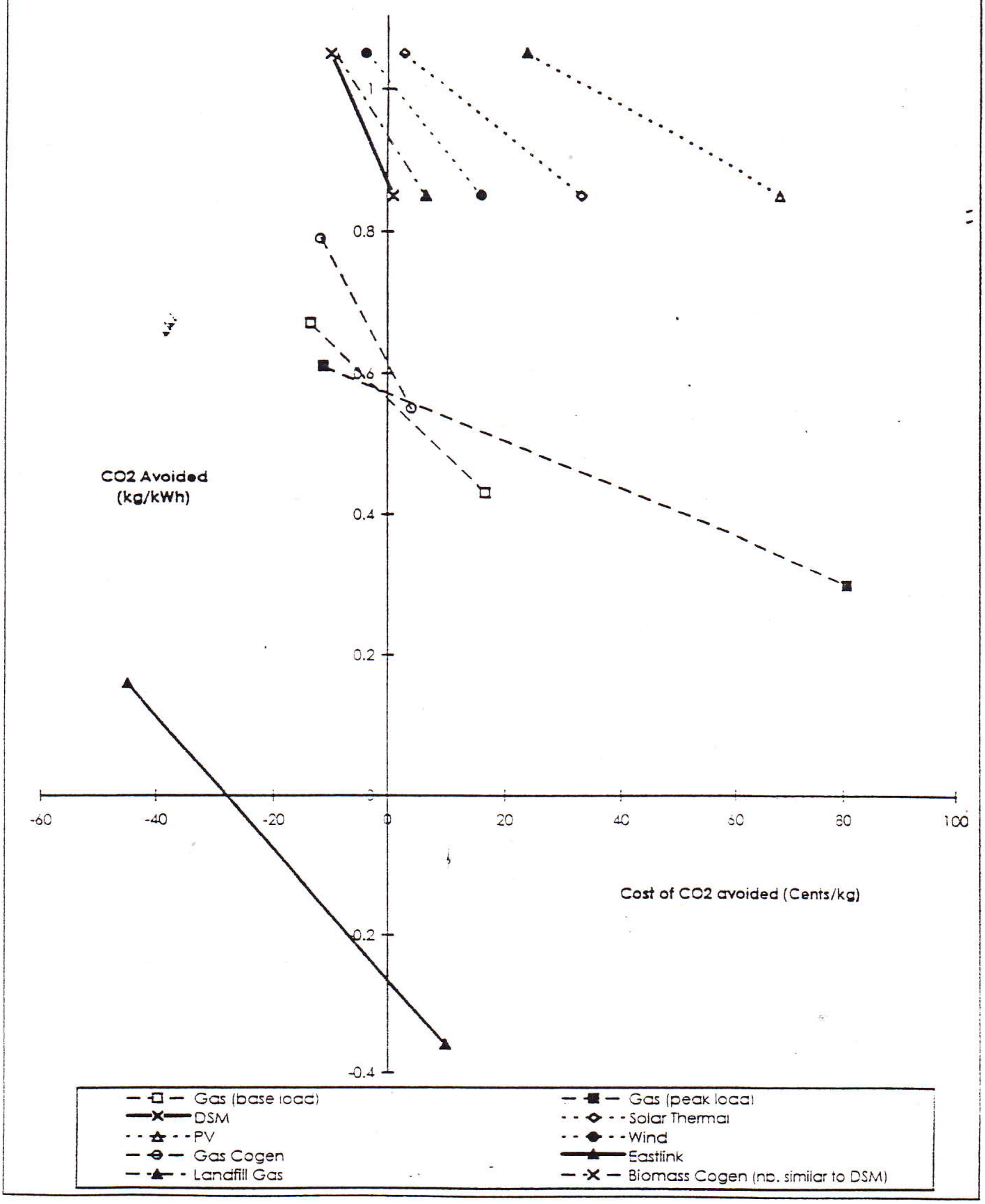
The resultant graph has four quadrants since there are both negative and positive values for each axis. Fig 6 is included to demonstrate how the results can be interpreted.

Fig 6: Interpretation of Greenhouse Abatement graph.



The information and assumptions used to construct a greenhouse abatement graph are contained in Table 10. For each resource a range of maximum and minimum values have been used for costs and greenhouse emissions, which is reflected by the upper and lower points on the graph.

Fig 7: Greenhouse Abatement graph



Conclusion:

On the basis of this appraisal, it appears that Eastlink is highly unlikely to satisfy the criteria for resource acquisition established by the Queensland Government.

In comparison with the alternatives modelled, it is least likely to result in greenhouse savings. In addition, there are a number of alternatives, including natural gas, gas and biomass cogeneration, demand management and landfill gas, which have a higher probability of providing CO_2 savings at lower cost than Eastlink.

TABLE 10 GREENHOUSE ABATEMENT POTENTIAL

	Levelised Cost		Conversion Efficiency		CO2 Emissions Coefficients		Potential to Avoid CO2 Emissions		Net Economic Cost		Cost of CO2 reduced or (increased)	
	LOW	*HIGH*	*LOW*	*HIGH*	*LOW*	*HIGH*	*LOW*	*HIGH*	*LOW*	*HIGH*	*LOW*	*HIGH*
	cents/kWh	cents/kWh	%	%	kg CO2/kWh	kg CO2/kWh	kg CO2/kWh	kg CO2/kWh	c/kWh	c/kWh	cents/kg	cents/kg
Coal Fired Generation [1]	4	12.1	25%	37%	0.85	1.05	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Gas Fired Generation [2]												
Peak load operation	5.2	28.2	28%	35%	0.44	0.55	0.30	0.61	-6.90	24.20	**-11.31**	**80.67**
Base load operation	3.1	11.2	50%	55%	0.38	0.42	0.43	0.67	-9.00	7.20	**-13.43**	**16.74**
Gas Cogeneration [3]	2.8	6.3	70%	80%	0.26	0.3	0.55	0.79	-9.30	2.30	**-11.77**	**4.18**
Eastlink Stage 1 plus supply [4]	4.4	7.5	85%	95%	0.89	1.21	-0.36	0.16	-7.70	3.50	**-48.89**	**(9.79)**
Solar Thermal [5]	15.1	32.4	100%	100%	0	0	0.85	1.05	3.00	28.40	**2.86**	**33.41**
Wind Farms [6]	8	17.7	100%	100%	0	0	0.85	1.05	-4.10	13.70	**-3.90**	**16.12**
Grid Connected PV [7]	37.2	62.1	100%	100%	0	0	0.85	1.05	25.10	58.10	**23.90**	**68.35**
Landfill Gas [8]	2.2	9.6	25%	35%	0	0	0.85	1.05	-9.90	5.60	**-9.43**	**6.59**
Biomass Cogeneration [9]	3.2	4.6	70%	80%	0	0	0.85	1.05	-8.90	0.60	**-8.48**	**0.71**
Demand Side Management [10]	1.6	4.8	100%	100%	0	0	0.85	1.05	-10.5	0.8	**-10.00**	**0.94**

TABLE 10

GREENHOUSE ABATEMENT POTENTIAL

Notes:	
General:	Levelised cost data taken from Table 8.
	High and Low values are respectively the largest increase and the largest reduction possible, compared to the base case.
Greenhouse Coefficients:	Only Carbon Dioxide is considered. Does not include emissions due to energy used in manufacture.
Potential to Avoid CO2 emissions:	A negative value denotes that CO2 emissions will increase in comparison with the base case.
Economic cost:	This is calculated as the cost of the resource in comparison to the base case. A negative value indicates that it is a cheaper option
Cost of CO2 avoided:	The low value is the lowest economic cost, divided by the highest potential CO2 saving. The high value is the highest cost divided by the lowest reduction in CO2.
[1]	Assumes base or intermediate use of coal generation. This is used as the base case.
[2]	These include Gas Thermal, Gas Turbine and Gas Combined Cycle options, as in Table 8.
[3]	Assumes a high thermal load in addition to electricity output.
[4]	Includes an electricity purchase cost of 2 cents/kWh. Note that the value of (9.79) in the final column refers to a negative potential to achieve CO2 savings,
	not to negative cost. It therefore has the opposite meaning to the other negative values in this column.
[5] [6] [7]	The net greenhouse emissions from renewables are likely be negative if these resources displace fossil fuel generation options.
[8]	The net greenhouse emissions from landfill may also be negative if methane that would otherwise be emitted to the atmosphere in burnt to generate electricity.
[9]	Assumes a high thermal load in addition to electricity output and zero fuel costs. Zero CO2 emissions are based upon sustainable cultivation practices.
[10]	The cost of DM programs has been taken from the cost of the Queensland program (Low) and the SECV program (High).
	The Queensland program is estimated to cost $63 million over ten years and reduce demand by a cumulative total of 650MW.
	It is assumed that an average of $6.3 m will be spent to yeild average savings of 65MW each year.
	At a capacity factor of 70%, the levelised cost is therefore $1.58 cents/kWh.

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Appendix A:

Greenhouse Implications of Sharing Reserve Plant Margins.

Notes to Table:

We have considered two scenarios for the sharing of RPM, and compared the greenhouse emissions resulting from these with a base case. The base case is assumed to be the conventional supply of electricity to meet predicted Queensland demand, from Queensland generators over the period 1997/8 to 1999/2000.

In Scenario 1, NSW plant is used to provide the Reserve Plant Margin, and spinning reserve, for the Queensland system. Queensland generators are 'freed up' to meet electricity demand.

In Scenario 2, Queensland generators continue to provide the Reserve Plant Margin, and electricity demand is met by increasing imports from NSW up to the limit of the interconnection (400MW). Since it is unlikely that the interconnection will be fully utilised, we have considered two options: 40% and 60% of capacity.

The same general CO_2 emission coefficient for the electricity supplied by NSW and Queensland generators has been used, since any incremental supply will use similar coal-fired technologies. These coefficients already take account of losses within each state, however further losses would occur in transmission via Eastlink, and we have considered two options for line losses.

Since plant used for RPM are on operational standby and do not need to be generating, no greenhouse emissions can be associated with this function. However, the requirements of the spinning reserve are that it must be equivalent to the output of the largest single element within the system (ie. 350MW in Qld) and be available at very short notice. Spinning reserve is therefore run at reduced load, here assumed at either 5% or 30% of capacity[3].

The results contained in the following Table show that there may be a very small increase in emissions resulting from both scenarios.

[3] In reality, NSW RPM and spinning reserve is met by a variety of mechanisms, including the use of capacity from the Snowy Mountain Hydro-Electric Authority and interuptable load arrangements with major customers. If RPM and spinning reserve for the QLD system were provided by these mechanisms within the NSW system, there would be a reduction in greenhouse emissions compared to the base case. However, since there is a corresponding opportunity for interuptable load arrangements within the QLD system which would have a similar greenhouse effect, these alternatives have not been modelled here

APPENDIX A

QUEENSLAND ELECTRICITY SUPPLY OPTIONS - GREENHOUSE EMISSIONS

				Total for existing system	Scenario I			Scenario 2			
	General Assumptions			For a 3 Year period	For a 3 Year period		Cumulative Total CO2 emissions (Mtonnes)		For a 3 Year period		Cumulative Total CO2 emissions (Mtonnes)
	Year 1997/8	***1998/9***	***1999/0***	***QLD***	***NSW***	***QLD***			***NSW***	***QLD***	
Queensland Electricity Demand - medium growth (MWh)	30470000	33650000	35080000	99200000							
Queensland Spinning Reserve requirement (MW)	350	350	350								
Electricity output from operating Spinning Reserve											
Option 1 - 5% of potential output (MWh)	153300	153300	153300		459900	98740100		NSW Capacity Factor =40% (MWh)	1401600	97798400	
Option 2 - 30% of potential output (MWh)	919800	919800	919800		2759400	96440600		NSW Capacity Factor =60% (MWh)	2102400	97097600	
Greenhouse Coefficient [t CO2/MWh delivered]											
Queensland (t CO2/MWh)	0.950	0.950	0.950	**94.24**							
NSW (t CO2/MWh)	0.950	0.950	0.950	Mtonnes CO2							
Assumed tranmission losses due to Eastlink											
Option 1	5%	5%	5%								
Option 2	10%	10%	10%					**CO2 Emissions**			
CO2 emissions - 5% output, 5% losses (tonnes CO2)					458750	93803095	**94.26**	5% losses; 40% capacity factor	1398096	92908480	**94.31**
CO2 emissions - 5% output; 10% losses (tonnes CO2)					480596	93803095	**94.28**	10% losses; 60% capacity factor	2197008	92242720	**94.44**
CO2 emissions - 30% output; 5% losses (tonnes CO2)					2752502	91618570	**94.37**	5% losses; 60% capacity factor	2097144	92242720	**94.34**
CO2 emissions - 30% output; 10% losses (tonnes CO2)					2883573	91618570	**94.50**	10% losses; 60% capacity factor	1464672	92908480	**94.37**