INDUSTRY CASE STUDIES

The benefits of LNG use to replace diesel fuel in the Australian economy.

To quantify the level of cost benefit and environmental benefit available to industry sectors through the use of Australian liquefied natural gas (LNG) as a substitute to imported diesel fuels, 6 Case Studies have been undertaken using client supplied data, and a synopsis of the outcomes is enclosed.

The Case Studies conducted are:

Case Study 1: THE BENEFIT OF MLNG'S REGIONAL LNG PRODUCTION HUBS

Case Study 2: LNG USE IN POWER GENERATION

Case Study 3: LNG USE IN THE IRON ORE MINING INDUSTRY

Case Study 4: LNG USE IN AN URBAN BUS FLEET

Case Study 5: LNG USE IN URBAN RAIL OPERATIONS

Case Study 6: LNG USE IN FREIGHT RAIL OPERATIONS

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The information contained in the following series of case studies has been reviewed, and restructured to reflect:

1. Change in world oil prices, Brent Crude from $US 120 bbl to $US 80 BBL;
2. Change in exchange rate $AUD/$USD from 1.00 to 0.75; and,
3. Change in resultant fuel prices in Australia, typically Terminal Gate Price for diesel fuel down to $0.904.

THE BENEFITS OF LNG FUEL USE TO REPLACE DIESEL FUEL IN THE AUSTRALIAN ECONOMY.

CASE STUDIES SYNOPSIS

To illustrate the real opportunities LNG fuel use can deliver to Australia and Australian Industry, six case studies have been conducted across different Australian industries, using current information and accredited scientific data sources.

For ease of direct comparison LNG references have been converted to diesel litre equivalents (DLE) based upon relative energy content.

The beneficial outcomes in reducing fuel operating costs and achieving environmental gains are shown in each instance.

KEY FACTORS USED

The following values are used in the financial modelling for each of the case studies, and the summary outcome position of each case is provided on the accompanying pages

1. Macro Position References

NATURE	UNITS	DIESEL Use Case	LNG Use Case	SOURCE
Australia's Total Annual Diesel Fuel Consumption	Millions litres / annum	22,600.0		Australian Petroleum Statistics June 2014, BREE
National Carbon Abatement Contract Rate	$ / Tonne	$13.95		Rate as per 1st Release, April 2015 for CO2 reductions
Relative CO2 Emissions	%	1.000	0.725	www.eia.gov/tools/faqs

2. Energy Conversion Factors Used

NATURE	UNITS	DIESEL Use Case	LNG Use Case	SOURCE
Energy Conversion Volume	Mega joules / Litre	38.6	25.0	Energy in Australia 2014, Bureau of Resources and Energy Economics
Energy Conversion Weight	Giga joules / Tonne	45.6	54.4	
Energy Conversion Specific Volume	Litres / Tonne	1,182.0	2,174.0	
Brent Crude Price	USD / bbl	$80.00		Averaged Price over recent months
Exchange Rate	AUD/USD	$0.75		Average rate over the period of Case Studies
Fuel Prices In Diesel litre equivalents	$ / Litre	$0.904	$0.695	Terminal Gate Price Net of GST & Fuel Excise
SA Bus Fleet Study Fuel Prices applicable for On Road Use In Diesel litre equivalents	$ / Litre	$1.165	$0.846	Terminal Gate Price Net of GST & Net of part Fuel Excise, due to Road use Tax component

3. Pricing Factors Used

- The financial outcomes in these case studies reflect a price delivered by an average Brent Crude Price of $80.00 USD/bbl and an average exchange rate of AUD/USD of $0.75 over the case study periods.

  This results in a Terminal Gate Price for Diesel Fuel of $0.904 per litre (net of excise & GST); and an LNG supply price of $0.695 in equivalent diesel litre equivalents (net of excise & GST) is used for the same period.

- The comparable Energy Cost of each fuels is summarily ($ per gigajoule): DIESEL = $23.414 and LNG = $18.000.

- In the instance of the South Australian Metropolitan Bus case study, the resulting fuel cost for both diesel and LNG is higher than the other case studies because of inclusion of a road use tax component.

  The resulting comparable Energy Cost in this instance is ($ per gigajoule): DIESEL = $30.184 and LNG = $21.915.

To show the relationship to diesel price, a sensitivity table has been run on the financial benefits outcomes for each case study, and is represented by a graph showing variations of +/- 25% in diesel fuel pricing compared to the LNG alternative

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CASE STUDY 1: THE BENEFIT OF MLNG'S REGIONAL LNG PRODUCTION HUBS

OBJECTIVE: To examine at the macro-scale, the magnitude of operational and recurrent financial and environmental benefits available nationally from substituting the use of imported diesel fuels, with the use of Australia's own LNG.

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS: The following table demonstrates the incremental benefit of MLNG's domestic LNG production hub objectives, by showing the results achieved from 1 – 400 tonne per day LNG Production Plant, then the beneficial impact of "MLNG's Stage One" where 4 - 400 tonne per day LNG production plants will be in place.

Finally, the scenario where 27 identical production plants are operative, a situation that would displace 25% of Australia's annual need to import diesel fuel.

The calculation of the Annual Carbon Abatement Claim, is an indicative assessment that uses the currently contracted rate from round one announcements in April 2015 of $13.95 per ton per annum

		SINGULAR PER PRODUCTION PLANT	STAGE ONE: 4 PRODUCTION PLANTS OPERATING	REPLACING 25%; OF AUSTRALIA'S ANNUAL DIESEL CONSUMPTION
MEASURE	**UNITS**	**1 X LNG PRODUCTION PLANT**	**4 X LNG PRODUCTION PLANTS**	**27 X LNG PRODUCTION PLANTS**
LNG PRODUCTION QUANTITY	Tonnes / day	**400**	**1,600**	**10,800**
	Tonnes / annum	**146,000**	**584,000**	**3,942,000**
DIESEL QUANTITY DISPLACED	Kilo litres / annum	**205,875**	**823,500**	**5,559,000**

SYNOPSIS:

BENEFITS DELIVERED BY LNG USE	UNITS	1 X LNG PRODUCTION PLANT	4 X LNG PRODUCTION PLANTS	27 X LNG PRODUCTION PLANTS
ANNUAL FUEL COST SAVINGS TO INDIVIDUAL CONSUMERS	Millions $ / annum	**$43.0**	**$172.0**	**$1,162.0**
REDUCTION IN AUSTRALIA'S ANNUAL DIESEL FUEL IMPORTS	Millions $ / annum	**$186.0**	**$744.0**	**$5,025.0**
REDUCTION IN ANNUAL CO2 EMISSIONS	Tonnes CO2 e / annum	**149,900**	**599,600**	**4,047,300**
EST. ANNUAL CARBON ABATEMENT CLAIM AVAIL.	Millions $ / annum	**$2.1**	**$8.4**	**$56.5**

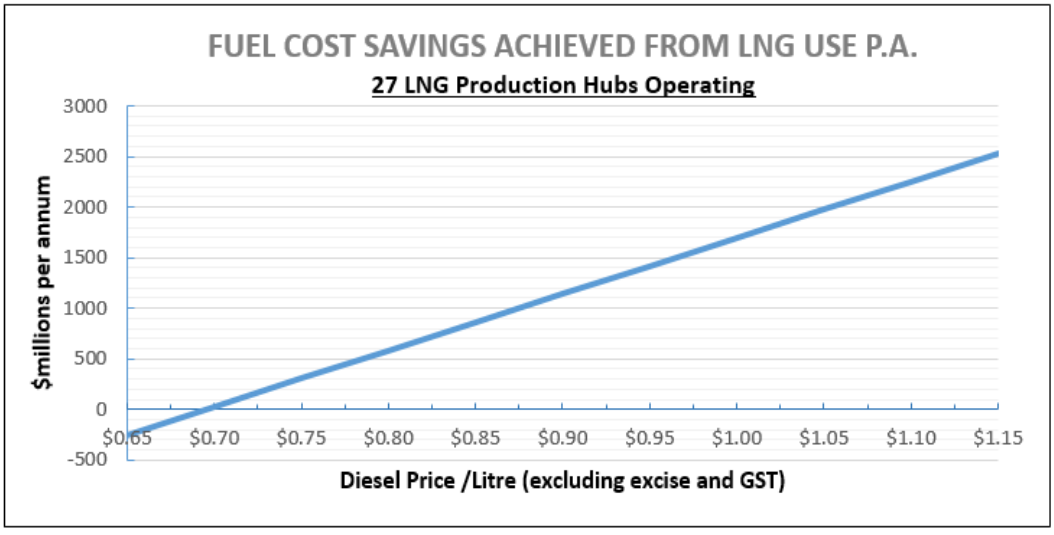
SENSITIVITY:

The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel of $0.904 per litre (net of excise & GST); a price delivered by a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75

Against this LNG supply is $0.695 in equivalent diesel litre equivalents and also net of excise & GST.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $23.414 and LNG = $18.000

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.



CASE STUDY 2: THE BENEFIT OF LNG USE IN POWER GENERATION

OBJECTIVE: To examine the magnitude of operational benefits and recurrent savings available from the use of Australia's own LNG as a substitute to the use of imported diesel fuels, in various sizes power generation scenarios around Western Australia.

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS: These tables are based on actual record keeping across different models, types and situations of use.

Although there are many factors that can influence fuel consumption and the efficiency of electricity generation these calculation are considered to be accurate for situations of proper use, and typically for a 65-100% load.

Over or under use of a generator can vastly affect the efficiency of its fuel consumption.

These tables show the relative savings achieved from reduced FUEL COSTS. They do not include the additional benefits provided with LNG and natural gas use that come from the reduced emissions, environmental advantages, OHS gains etc.

DIESEL FUEL USE CASE

Typical Diesel Fuel Consumption Costs and Rates in Annual Power Generation					
Plant Size	**Generation Type**	**Litres / Kilowatt hour**	**Litres / Day**	**Daily Fuel Cost $**	**Annual Fuel Cost $**
0.5 MW	High Speed	0.256	3,076	$2,781	$1,015,072
5 MW	High Speed	0.249	29,902	$27,032	$9,866,504
25 MW	High Speed	0.244	146,434	$132,377	$48,317,448
100 MW	Medium Speed	0.226	541,438	$489,460	$178,652,750

LNG FUEL USE CASE

Typical Gas Fuel Consumption Costs and Rates in Annual Power Generation					
Plant Size	**Generation Type**	**Kilojoules / Kilowatt hour**	**Litres / Day**	**Daily Fuel Cost $**	**Annual Fuel Cost $**
0.5 MW	High Speed	9,500	4,556	$2,052	$748,980
5 MW	High Speed	9,250	44,357	$19,980	$7,292,700
25 MW	High Speed	8,800	210,997	$95,040	$34,689,600
100 MW	Medium Speed	7,900	757,673	$341,280	$124,567,200

SYNOPSIS:

LEVEL OF BENEFIT DELIVERED THROUGH LNG USE					
Plant Size	**Cost Savings** As % Diesel Costs	**Daily Fuel Cost Savings $**	**Cost Benefit $ Per Annum**	**Reduction in CO2 Emissions** (tonnes p.a.)	**Est. Value of Annual Emissions Claim Avail.**
0.5 MW	**26%**	$729	$266,092	817	$11,400
5 MW	**26%**	$7,052	$2,573,804	7,945	$110,830
25 MW	**28%**	$37,337	$13,627,848	38,908	$542,770
100 MW	**30%**	$148,180	$54,085,550	143,862	$2,006,870

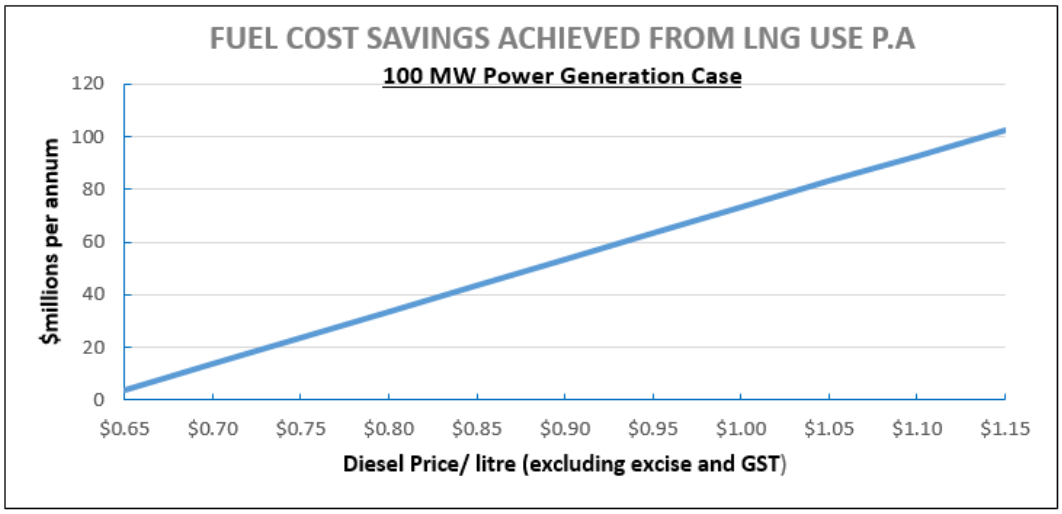
SENSITIVITY:

The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel of $0.904 per litre (net of excise & GST); a price delivered by the confluence of a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75

Against this LNG supply is $0.695 in equivalent diesel litre equivalents and also net of excise & GST.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $23.414 and LNG = $18.000

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.



Case Study 3: THE BENEFIT OF LNG USE IN THE IRON ORE MINING INDUSTRY

OBJECTIVE: To examine across a variety of functional areas, and uses, the magnitude of Financial and Environmental savings available to a mid-tier iron ore mining operation in WA.

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS: The following operational consumption figures are based upon a client provided profile of a 150 million tonne per annum Iron Ore mining operation in the Pilbara, Western Australia:

- Power Generation – 240 MW installed Power Plant running at 80% capacity (as IPP);
- The total fuel consumption of Mine Haulage Vehicles, Heavy Duty Vehicles and Light Vehicle is typically equivalent to the annual Power Generation component;
- Typical Rail Network consumption averages at being 30% of the Power Generation component; and,
- Rounding of larger values has been employed for client confidentiality purposes.

OPERATIONS AREA: POWER GENERATION

Fuel Use Comparison of Options	Quantity Litres	Quantity Tonnes	Total Fuel Cost	CO2 Emissions [Tonnes]
Annual DIESEL Consumption	430,000,000	363,790	$388,720,000	1,139,500
Annual LNG Consumption	n/a	304,942	$298,598,985	826,479
Comparative Benefit / Savings Achieved through LNG use:			**$90,121,015**	**313,021**

OPERATIONS AREA: MOBILE PLANT & EQUIPMENT

Fuel Use Comparison of Options	Quantity Litres	Quantity Tonnes	Total Fuel Cost	CO2 Emissions [Tonnes]
Annual DIESEL Consumption	430,000,000	363,790	$388,720,000	1,139,500
Annual LNG Consumption	n/a	304,942	$298,598,985	826,479
Comparative Benefit / Savings Achieved through LNG use:			**$90,121,015**	**311,750**

OPERATIONS AREA: RAIL TRANSFER TO PORT

Fuel Use Comparison of Options	Quantity Litres	Quantity Tonnes	Total Fuel Cost	CO2 Emissions [Tonnes]
Annual DIESEL Consumption	30,000,000	109,983	$117,520,000	344,500
Annual LNG Consumption	n/a	92,192	$90,274,112	249,866
Comparative Benefit / Savings Achieved through LNG use:			**$27,245,888**	**94,634**

TOTAL ALL MINING OPERATIONS AREAS

Fuel Use Comparison of Options	Quantity Litres	Quantity Tonnes	Total Fuel Cost	CO2 Emissions [Tonnes]
Annual DIESEL Consumption	990,000,000	837,5630	$921,463,917	2,623,500
Annual LNG Consumption	n/a	702,075	$687,472,081	1,902,824
Comparative Benefit / Savings Achieved through LNG use:			**$ 207,487,919**	**720,675**

SYNOPSIS:

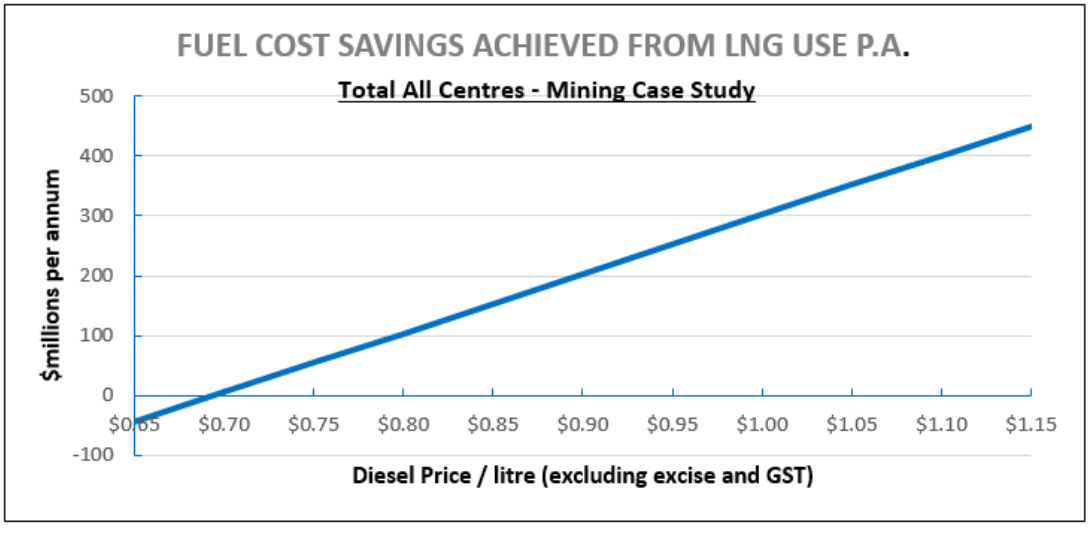
BENEFITS DELIVERED BY LNG USE TO THE MINING INDUSTRY			
Savings in Fuel Costs	per annum	**$ 207,487,919**	23.5% reduction
Reduction in CO2 Emissions	Tonnes per annum	**720,675**	27.5% reduction
Est. Annual Emissions Claim Available Carbon Abatement Contract Claim	$ per annum	**$10,100,000**	

SENSITIVITY: The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel of $0.904 per litre (net of excise & GST); a price delivered by a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75.

An LNG supply price of $0.695 in equivalent diesel litre equivalents and also net of excise & GST is used.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $23.414 and LNG = $18.000.

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.



Case Study 4: THE BENEFIT OF LNG USE IN AN URBAN BUS FLEET

OBJECTIVE: To examine the magnitude of annual Financial and Environmental savings available to bus fleet management operations, through the use of LNG as a source fuel substitute for diesel In SA

Of particular interest is the impact of road use tax implications on both fuel types, and how this may affect the outcomes achieved.

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS:

Client/ Regional Input factors	Quantity	Units
Fleet Size	800	Buses
Weekly travel per bus (Av)	3,400	Kilometres per week per bus
Current diesel fuel use (Av)	1,003	Litres per week per bus
Economic Life of Bus (Av)	11	Years, (Bus Industry Confederation. Aust 2014)

DIESEL FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Vehicle	Fleet Wide	Fleet Wide	Notes
Diesel Consumption	Litres	1,003	802,400	41,724,800	Averaged
Total Cost of Diesel Fuel	$	$1,169	$935,117	$48,626,082	

LNG FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Vehicle	Fleet Wide	Fleet Wide	Notes
Total Cost of LNG Fuel	$	$849	$678,956	$35,305,691	

SYNOPSIS:

BENEFITS DELIVERED BY LNG USE FOR BUS FLEET OPERATIONS				
AREA	Units	Operational Savings Achieved	Units	Reduced CO2 Emissions Achieved
Total Bus Fleet Operations	$ / year	**$13,320,400**	Tonnes/ year	**30,374**
Over average Economic Life of the Fleet	Total $	**$146,524,400**	Total Tonnes	**334,112**
Savings as % Diesel Fuel Use Case	**27%** reduction in Operational Fuel costs		**27%** Reduction in CO2 Emissions	
Est. Value of Annual Emissions Claim Avail	**$423,710 per annum,** based upon current claim rate.			

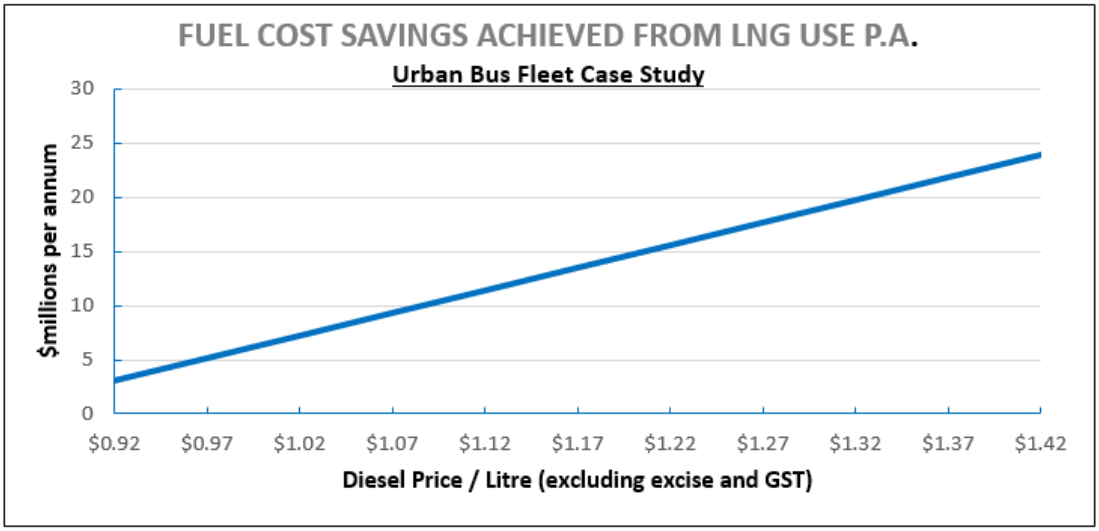
SENSITIVITY: The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel in South Australia of $1.17 per litre (net of excise & GST); a price delivered by a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75.

A full fuel claim back of excise is not permitted under ATO ruling for this function/use, hence a higher price relative to other case studies for both the diesel fuel price and LNG fuel price as they retain a tax component not able to be off set.

An LNG supply price of $0.85 in equivalent diesel litre terms results.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $30.184 and LNG = $22.015

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.



Case Study 5: THE BENEFIT OF LNG USE IN URBAN RAIL OPERATIONS

OBJECTIVE: To examine the magnitude of annual savings both Financial and Environmental, available to an urban passenger rail service and operations, through the use of LNG as a source fuel substitute for diesel In SA

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS:

Client / Regional Input factors	Quantity	Units
Rail Stock	99	Urban Passenger Trains
Current average diesel fuel consumption	14,000	Litres per week per Train Advice from SA Rail
Average Economic Life of Urban Train	25	Years (Australasian Railway Association Inc 2014)

DIESEL FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Train	All Trains	All Trains	Notes
Diesel Consumption	Litres	14,000	1,386,000	72,072,000	Averaged
Total Cost of Diesel Fuel	$	$12,656	$1,252,944	$65,153,088	

LNG FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Train	All Trains	All Trains	Notes
Total Cost of LNG Fuel	$	$9,730	$963,243	$50,088,649	

SYNOPSIS:

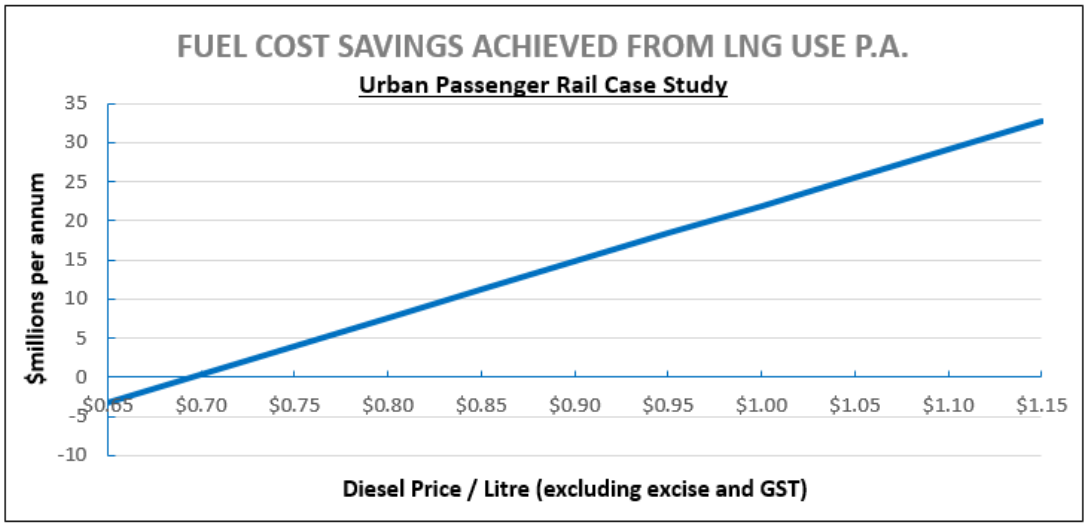
BENEFITS DELIVERED BY LNG USE FOR URBAN RAIL OPERATIONS				
AREA	**Units**	**Operational Savings Achieved**	**Units**	**Reduced CO2 Emissions Achieved**
Total Fuel Costs Passenger Rail Stock	$ / year	$15,064,439	Tonnes/ year	52,465
Over average Economic Life of the Fleet	Total $	$376,610,984	Total Tonnes	731,889
Savings as % Diesel Fuel Use Case	**24% R**eduction in Operational Fuel costs		**27%** Reduction in CO2 Emissions	
Est. Value of Annual Emissions Claim Avail	**$731,889 per annum,** based upon current claim rate.			

SENSITIVITY: The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel in South Australia of $0.904 per litre (net of excise & GST); a price delivered by a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75.

An LNG supply price of $0.695 in equivalent diesel litre measure results.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $23.414 and LNG = $18.000

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.



Case Study 6: THE BENEFIT OF LNG USE IN FREIGHT RAIL OPERATIONS

OBJECTIVE: To examine the magnitude of annual Financial and Environmental savings available to Freight Rail operations in South Australia, through the use of LNG as a source fuel substitute for diesel.

CONVERSIONS: Refer to Synopsis – Key factors and inputs used.

ANALYSIS:

Client / Regional Input factors	Quantity	Units
Rail Stock	10	Freight Locomotives
Current average diesel fuel consumption	10,000	Litres per week per Train Advice from SA Rail
Average Economic Life of Urban Train	45	Years (Australasian Railway Association Inc 2014)

DIESEL FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Loco.	All Locos.	All Locos.	Notes
Diesel Consumption	Litres	10,000	100,000	5,200,000	Averaged
Total Cost of Diesel Fuel	$	$9,040	$90,400	$4,700,800	

LNG FUEL USE CASE

		Per Week		Per Annum	
	Units	Per Loco.	All Locos.	All Locos.	Notes
Total Cost of LNG Fuel	$	$6,950	$69,500	$3,613,900	

SYNOPSIS:

BENEFITS DELIVERED BY LNG USE FOR FREIGHT RAIL OPERATIONS				
AREA	**Units**	**Operational Savings Achieved**	**Units**	**Reduced CO2 Emissions Achieved**
Total Fuel Costs Freight Locomotive Rail Stock	$ / year	$1,086,900	Tonnes/ year	3,785
Over average Economic Life of the Fleet	Total $	$48,910,517	Total Tonnes	170,342
Savings as % Diesel Fuel Use Case	**24% R**eduction in Operational Fuel costs		**28%** Reduction in CO2 Emissions	
Est. Value of Annual Emissions Claim Avail	**$52,805 per annum,** based upon current claim rate.			

SENSITIVITY: The financial outcomes in this assessment reflected a Terminal Gate Price for Diesel Fuel in South Australia of $0.904 per litre (net of excise & GST); a price delivered by a Brent Crude Price of USD/bbl of $80.00 and an exchange rate of AUD/USD of $0.75.

An LNG supply price of $0.695 in equivalent diesel litre measure results.

The resulting comparable Energy Cost ($ per gigajoule) of each fuels is: DIESEL = $23.414 and LNG = $18.000

To assess sensitivity to diesel price, a sensitivity table has been run for variations of up to a further 25% drop in diesel fuel prices, and is shown below.