LEGISLATIVE ASSEMBLY OF THE NORTHERN TERRITORY

Sessional Committee on the Northern Territory's Energy Future

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Key Challenges and Opportunities
Issues Paper

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Chair's Preface

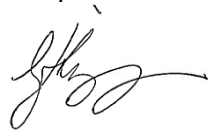
In bringing forward the motion to establish a Committee on the Northern Territory's Energy Future, Attorney-General, the Hon John Elferink MLA, noted that access to secure, reliable and affordable energy is a critical component of strategic planning and development of an economy that has the capacity to unlock the potential of our regions. As a preliminary inquiry, the Committee was concerned to gain a clear understanding of the Territory's energy market, electricity supply industry, potential energy sources for electricity generation, and identify the key challenges and opportunities associated with meeting the Territory's future energy needs.

The Northern Territory has access to a significant pool of proven and potential offshore and onshore energy producing resources. In addition to its considerable reserves of natural gas, the Territory is well placed to take advantage of technological developments in bioenergy, tidal power, low wind turbines, micro hydro systems and geothermal power, and build on its already highly successful deployment of a range of solar technologies. Ensuring the NT's legislative, regulatory and policy frameworks facilitate investment in, and development of, these resources, while maintaining the integrity of the Territory's fragile environment and the amenity of its people was widely acknowledged as a particularly important consideration.

In positioning the Territory for the future, the key challenges will be the implementation of a more decentralised energy supply system and development of an effective electricity market. The distribution network and market mechanisms are the core of energy provision. We need a network and market that will allow for the most effective and efficient electricity supply across the diverse circumstances throughout the Territory: a network that can distribute power from the mix of resources and technologies available to the Territory, and a market that allows these power sources to fairly compete so the sources that are best for the Territory can thrive.

Gas will clearly be the primary source of our electricity for some time to come, but greater energy security and efficiency can be achieved if we provide the conditions for a diversity of power sources. For example, the Territory has a wealth of both gas and solar. If the world price of gas goes up and the cost of accessing solar goes down, we may get a greater return for the Territory by exporting the gas and increasingly use solar for local energy needs.

Having established where we are now and where we need to be, the Committee notes that there are a range of exciting prospects and opportunities on the horizon. Over the coming months, the Committee looks forward to considering in more depth options and strategies for the Territory's long term energy security. On behalf of the Committee I would like to thank all those that provided submissions, attended hearings and indicated their willingness to work with the Committee as it progresses its inquiries further.



Mr Gary Higgins MLA
Chair

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On 18 September 2013 Member for Stuart, Mrs Bess Price, was discharged from the Committee and replaced by Member for Arafura, Mr Francis Kurrupuwu. On 3 April 2014 Member for Arnhem, Ms Larisa Lee, and Member for Arafura, Mr Francis Kurrupuwu, were discharged from the Committee and replaced by Member for Drysdale, Ms Lia Finocchiaro, and Member for Blain, Mr Nathan Barrett, on 15 April 2014.

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Acronyms and Abbreviations

AACL	ACIL Allen Consulting Pty Ltd
AACo	Australian Agricultural Company
ABF	Aboriginal Freehold (NT category of land tenure)
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ALEC	Arid Lands Environment Centre Inc
ALRA	Aboriginal Land Rights (Northern Territory) Act
AMA	African Mahogany (Australia) Pty Ltd
AMEC	Association of Mining Exploration Companies Inc
APPEA	Australian Petroleum Production and Exploration Association Ltd
ARENA	Australian Renewable Energy Association
ASIM	Mini-grid power system modelling tool (PWC)
BCF	Billion cubic feet (of natural gas)
BBL	Barrel (of oil)
CAESI	Connecting Australian European Science and Innovatin
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CDU	Charles Darwin University
COAG	Council of Australian Governments
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
Commission	Utilities Commission of the Northern Territory
CPF	Central Processing Facility
CPV	Concentrated Photovoltaic
CSO	Community Service Obligation
CSP	Concentrated Solar Power
DGR	Domestic Gas Reservation
DME	Department of Mines and Energy
DRA	Demand Response Aggregator
DRM	Demand Response Mechanism
DSM	Demand-side Management
ECNT	Environment Centre of the Northern Territory

EDL	Energy Developments Ltd
EGS	Enhanced Geothermal System
EP	Exploration Permit
ERA	Energy Resources Australia Ltd
ERM	ERM Power Retail Pty Ltd
ESAA	Energy Supply Association of Australia
EUA	Environmental Upgrade Agreement
ETS	Emissions Trading Scheme
ETU	Electrical Trades Union
FEED	Front End Engineering and Design
FID	Final Investment Decision
FIT	Feed in Tariff
FLNG	Floating Liquefied Natural Gas plant
FPSO	Floating Production, Storage and Offloading (facility)
FRC	Full Retail Contestability
GEMCO	Groote Eylandt Mining Company Pty Ltd
GEP	Gas Export Pipeline
GJ	Gigajoule – 10^9 joules
GOC	Government Owned Corporation
GW	Gigawatt – 10^9 watts
HSA	Hot Sedimentary Aquifers
IES	Indigenous Essential Services Pty Ltd
IMO	Independent Market Operator
IPP	Independent Power Producer
ISCS	Integrated Solar Combined Cycle
JA	Joint Authority
JPDA	Joint Petroleum Development Area – Timor Sea
kW	Kilowatt
kWh	Kilowatt-hours – 10^3 watt-hours
LCOE	Levelised cost of energy/Levelised cost of electricity – used interchangeably
LGC	Large-scale Generating Certificates
LIEEP	Low Income Energy Efficiency Program
LNG	Liquefied natural gas
MADD	Mereenie Appraisal and Development Drilling
MOU	Memorandum of Understanding
MW	Megawatt

MWh	Megawatt-hours – 10^6 watt-hours
MTPA	Million tonnes per annum
m/sec	Metres per second
NCP	National Competition Policy
NEM	National Electricity Market
NEL	National Electricity Laws
NER	National Electricity Rules
NPARIH	National Partnership Agreement on Remote Indigenous Housing
NT	Northern Territory
NTCA	Northern Territory Cattlemen's Association
NTDME	Northern Territory Department of Mines and Energy
NTEM	Northern Territory Electricity Market (proposed market design)
NTMEU	Northern Territory Major Energy Users
OCGT	Open Cycle Gas Turbine
OL	Operating Lease
O&M	Operations and Maintenance
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OTEC	Ocean Thermal Energy Conversion
PAC	Public Accounts Committee
PAWA	Power and Water Authority
PPA	Power Purchase Agreement
PV	Photovoltaic
PWC	Power and Water Corporation
PJ	Petajoule – 10^{15} joules
QEnergy	QEnergy Limited
QLD	Queensland
RET	Renewable Energy Target
Review	Review of Wholesale Electricity Generation Market Arrangements for the Northern Territory
RL	Retention Lease
SA	South Australia
SCADA	Supervisory Control and Data Acquisition
SCI	Statement of Corporate Intent
SIHIP	Strategic Indigenous Housing and Infrastructure Program
SLA	Service Level Agreement
SMR	Small Modular Reactors
SSM	Supply-side Management

STC	Small-scale technology certificate
SWIS	South West Interconnected System (of Western Australia)
T3C	Tropical Tidal Testing Centre
TCF	Trillion cubic feet (of natural gas)
TJ	Terajoule – 10^{12} joules
TKLN	Ti Tree, Kalkarindji, Lake Nash (also known as Alpurrurulam) Solar Project
TOR	Terms of Reference
TPA Code	Electricity Networks (Third Party Access) Code
TWh	Terawatt hours – 10^{12} watt-hours
WA	Western Australia
WA WEM	Western Australia Wholesale Electricity Market

Glossary of Terms

Australian Energy Market Commission	Responsible for rule-making and energy market development at a national level, including in respect of the National Electricity Rules, the National Gas Rules and the National Energy Retail Rules.
Australian Energy Market Operator	Responsible for day-to-day operation and administration of both the power system and electricity wholesale market in the NEM, the retail electricity markets, the retail and wholesale gas markets and other support activities.
Australian Energy Regulator	Responsible for regulation and compliance at a national level, including in respect of the Australian Energy Market Legislation.
Bioenergy	Denotes the use of organic material (biomass) as source of energy for power generation and direct source heat applications as well as the production of liquid fuels for transport.
Biomass	Vegetable and animal derived organic materials which are grown, collected or harvested for energy.
Biogas	Composed principally of methane and CO_2 produced by anaerobic digestion of biomass generally captured from landfill sites, sewage treatment plants, livestock feedlots and agricultural wastes.
Biofuels	Liquid fuels produced from biomass by chemical conversion processes that result in the production of ethanol and biodiesel.
CO_2e	Carbon dioxide equivalent is internationally recognised measure of greenhouse emissions.
CO_2 Emissions	Carbon dioxide (CO_2) emissions refer primarily to carbon dioxide released into the atmosphere from burning oil, coal and natural gas for energy use. CO_2 makes up the largest share of man-made greenhouse gases.
Coal Seam Gas	Prevalent in the eastern states of Australia coal seam gas is methane gas that is present within coal seams. The methane is stored in the matrix of the coal as well as the fracture spaces of the rock (cleats) and is held there by water pressure.
Cogeneration	The generation of electricity as a by-product of another process in the industry – involving the recovery of heat or primary energy that would otherwise be wasted.
Contingent Resources (1C, 2C & 3C)	Resources that are not yet considered commercially recoverable. 1C: low estimate of contingent resources. 2C: best estimate of contingent resource. 3C: high estimate of contingent resource.
Conventional Gas	Gas that is produced using conventional or traditional oil and gas industry practices.
Condensate	Hydrocarbons which are in a gaseous state under reservoir conditions and which become liquid when temperature or pressure is reduced during production.
Curtailable Load	The amount of electric demand (kW), that a facility is able to reduce at will.
Demand-Side Management	Activities or programs (education, financial incentives) undertaken by the load-serving entity or its customers to influence the amount or timing of electricity they use – also referred to as load management.
Demand Response Mechanism	Changes in electricity usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized

Dry Gas	Dry gas is almost pure methane and occurs in the absence of liquid hydrocarbons or by processing natural gas to remove liquid hydrocarbons and impurities.
Farm-in	The acquisition of part or all of an oil, natural gas or mineral interest from a third party.
Final Investment Decision	Decision made by an LNG project developer to go ahead and build the project. This step typically occurs after detailed design and engineering is finalised, financing has been arranged and long-term buyers for most of the gas have been secured.
Feed in Tariff	Price received by customers for selling energy into the main electricity grid that they generate on their property from solar panels for example.
Floating Liquefied Natural Gas	A form of LNG production where the plant is offshore rather than onshore. FLNG vessels produce, liquefy and store the gas and offload it onto tankers for delivery to customers.
Fracking	A slang term for hydraulic fracturing, fracking refers to the process of drilling down into the earth and injecting a mixture of water, sand and chemicals at high pressure to create fractures or force open fractures in rocks and rock formations to allow oil and gas to flow out and into the well bore for extraction.
Full Retail Contestability	Electricity market where customers have the capacity to choose between electricity retailers who may tailor different products to different customers that may provide price and non-price benefits.
Gen-tailer	Companies that both generate and retail electricity to consumers.
Greenhouse Gases	Gases that trap heat in the Earth's atmosphere such as water vapour, ozone, carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, and sulphur hexafluoride. The addition of man-made greenhouse gases (in particular C02 emissions) to the atmosphere disturbs the earth's radiative balance (*i.e*. the balance between the solar energy that the earth absorbs and radiates back into space) leading to an increase in the earth's surface temperature and related effects on climate and sea levels.
Hydrocarbon	A compound containing only the elements of hydrogen and carbon which may exist as a solid, a liquid or a gas. Term is primarily used in a catch-all sense for oil, gas and condensate.
Levelised Cost of Energy	Widely used to define a characteristic unit cost of electricity generation (in $/ MWh) over the life (typically 20 years) of a power plant. The LCOE reflects all costs needed to build and operate a power plant over its economic life, normalized over the total net electricity generated.
Linepack	The pressurised volume of gas stored in a pipeline system.
LNG Train	An LNG (gas purification and liquefaction) production unit at an export terminal.
Market Systems	Darwin-Katherine Interconnected Network, Tennant Creek Network and Alice Springs Network
Mini-grid	Isolated power system which operates autonomously in that it manages and controls line voltage and frequency, real and reactive power follow and balances power supply with power consumption.
Natural Gas	Naturally occurring mixture of combustible hydrocarbons and inert non-hydrocarbons, existing as vapours or as solution in crude oil, inside underground reservoirs. The main hydrocarbon typically present is methane, but ethane, butane, propane and pentane can also be present in smaller volumes. The non-hydrocarbon molecules can include carbon dioxide, hydrogen sulphide, nitrogen and helium.
Negawatt	A negawatt is a negative megawatt: a megawatt of power saved by increasing efficiency or reducing consumption.

N-X	Electricity supply planning criteria allowing for full supply to be maintained to an area supplied by N independent supply sources, with X number of those sources out of service.
Penetration	Solar penetration is typically classified as energy penetration or power penetration. Energy penetration (average penetration, [kWH/kWH]) is the fraction of total energy solar provides to the system, usually assessed on a per annum basis. Power penetration (instantaneous penetration, [kW/KW]) is the fraction of power solar provides instantaneously to the power system. For example, a solar system may reach 80 percent instantaneous power penetration at times and provide 30 percent annual energy penetration overall.
Petajoule	A measure of energy consumption equivalent to one thousand terajoules; 1 million gigajoules; one thousand trillion joules - approximately 30,000 megawatt-hours or 1 BCF of natural gas
Power Purchase Agreement	Contract between PWC and independent third parties regarding the supply and purchase of electricity.
Prospective Reserves	Gas volumes estimated to be recoverable from a prospective reservoir that has not yet been drilled. These estimates are therefore based on less direct evidence.
Proved Reserves (1P, 2P & 3P)	Estimated quantities of gas that are reasonably certain to be recoverable in future under existing economic and operating conditions. 1P: low side estimate. 2P: the sum of proved plus probable estimates of gas reserves – the best estimate of commercially recoverable reserves. 3P: high side estimate – the sum of proved, probable and possible estimates of gas reserves.
Regasification Plant	Plant at an LNG receiving terminal that retrieves LNG from storage tanks and warms it back into a vapour for delivery to a pipeline system.
Renewable Energy	Energy that comes from naturally replenishing sources such as the sun, waves, hydro and geothermal.
Reserves	Gas resources that are considered to be commercially recoverable and have been approved or justified for commercial development.
Ring Fencing	The internal separation of business functions within an enterprise for management and accounting purposes.
Shale Gas	Gas found in shale layers – organically rich, very fine grained sedimentary rocks generally of low permeability due to their laminated nature. Shale gas is the most commonly known unconventional gas accumulation in the Northern Territory.
Spinning Reserves	Refers to the amount of spare generator capacity that is online and available to immediately and automatically increase generation or reduce demand in response to a fall in frequency.
Solar Grid-Parity	Where solar power, without subsidies, costs the same as conventional grid electricity.
Supervisory Control and Data Acquisition	System used to remotely monitor and control essential service infrastructure.
Supply-side Management	Refers to actions taken to ensure the generation, transmission and distribution of energy are conducted efficiently.
Tight Gas	Gas that is held in low permeability and low porosity sandstones and limestones.
Unconventional Gas	Gas found in coal seams, shale layers or tightly compacted sandstone that cannot be economically produced using conventional oil and gas industry techniques.
Vertical	The division of a vertically integrated enterprise into commercially autonomous

separation	operations – in the case of electricity utilities this involves separating the generation, transmission, distribution and retail supply. Also referred to as disaggregation.
Virtual Pipeline	Alternative method of transporting (via road, rail or water) natural gas to places where there are no pipeline networks available. It is based on a modular system of compression or liquefaction, transport and decompression and/or regasification of natural gas

Committee's Terms of Reference

On 21 August 2013 the Assembly resolved that:

1. A Sessional Committee to be known as the Committee on the Northern Territory's Energy Future be appointed.
2. The Committee's membership to comprise three Government Members, two Opposition Members and one Independent Member.
3. The Committee shall elect a Government Member as Chair.
4. The Committee may elect a Deputy Chair of the Committee, who may act as the Chair when the Chair is absent from a meeting or there is no Chair of the Committee.
5. A quorum of the Committee shall be three members of the Committee.
6. The Committee shall inquire into, report from time to time and make recommendations regarding:
    i) the Territory's current energy capability;
    ii) the Territory's probable and proven energy capability;
    iii) the prospect for additional energy resources;
    iv) the future energy needs of the Territory and the continuity of supply;
    v) the most cost effective means of meeting the Territory's energy needs;
    vi) regulatory impacts on the cost of energy insofar as these can be reasonably ascertained.
    vii) alternative sources of energy supply available to the Territory, including oil, gas, coal, uranium, and the renewable energy sources such as hot rock, solar, biofuels, wind and tidal energy;
    viii) emerging technologies and their applicability to the Northern Territory.
7. The Committee will give priority to its terms of reference insofar as they apply to onshore energy resources.
8. The Committee may appoint subcommittees comprising two or more of its members and refer to any such subcommittee any matter which the committee may examine, and the quorum of a subcommittee shall be two.
9. The provisions of this resolution, insofar as they are inconsistent with the Standing Orders, have effect notwithstanding anything contained in the Standing Orders.

1 Introduction

Establishment of Committee

1.1 The Legislative Assembly resolved to establish the Sessional Committee on the Northern Territory's Energy Future on 21 August 2013.

1.2 In bringing forward the motion seeking to establish the Committee the Attorney-General, Hon John Elferink MLA, noted that development of "an economy that unlocks the potential of our regions…and provides critical infrastructure"[1] is a key objective of the Government's *Framing the Future* blueprint.[2] Since access to secure, reliable and affordable energy is an essential component of strategic planning for the future, it was further noted that the Territory's "template for growth **must** encompass:

- Energy needs and reserves;
- Capacity required for the coming decades;
- All the options for secure energy supply;
- Delivery methodology; and
- Considerations for the most efficient, effective, and responsible use of our energy."[3]

1.3 Given the above, the Committee's Terms of Reference (TOR) are necessarily wide-ranging. However, while providing significant latitude with regards to how the Committee progresses its inquiries, TOR 7 requires that priority be given to assessing the opportunities and issues associated with the Territory's onshore energy resources. In speaking on the motion to establish the Committee, the Attorney-General also advised that it was anticipated the Committee would table a preliminary report on its work during 2014.[4]

Preliminary Inquiry

1.4 The Committee first met on 29 August 2013 and resolved to conduct a preliminary inquiry to establish baseline data regarding:

- the NT's current and potential energy capability;
- anticipated future energy requirements; and

[1] Hon John Elferink, Attorney-General, *Motion to Establish Sessional Committee on the Northern Territory's Energy Future,* Parliamentary Record No. 7, 21 August 2013, p. 2
[2] Northern Territory Government, *Framing the Future*, Northern Territory Government, Darwin, 2013, p. 5
[3] Hon John Elferink, Attorney-General, *Motion to Establish Sessional Committee on the Northern Territory's Energy Future,* p. 3
[4] Hon John Elferink, Attorney-General, *Motion to Establish Sessional Committee on the Northern Territory's Energy Future,* p. 18

- key factors associated with continuity of supply and energy security over the longer term.

1.5 Acknowledging the technical nature of much of the inquiry and the high level of public interest in the issues it raises, the Committee determined that this approach had the capacity to both provide the Assembly and the wider community with an understanding of the context and various facets of the matters under investigation and assist in determining the focus and priority of the Committee's subsequent investigations.

Inquiry Terms of Reference

1.6 At its meeting of 19 September 2013, the Committee adopted the following terms of reference:

That the Committee inquire into and report on key challenges and opportunities associated with meeting the Northern Territory's future energy needs including:

1. Impact of cultural, economic, environmental, geographic, regulatory or other factors on:
   - the exploration, development and production of energy producing resources; and
   - availability of developed resources for the domestic energy market.
2. Demand and supply-side management strategies and incentive initiatives to improve productivity, cost effectiveness, energy efficiency, consumer and supplier participation in the energy market.
3. Off-grid power generation alternatives for commercial and remote applications, including funding and investment options for the development of emergent and enabling technologies, infrastructure, and commercial scale demonstration projects.

Conduct of the Inquiry

1.7 Following adoption of the inquiry terms of reference the Committee called for submissions to be received by 8 November 2013. The call for submissions was advertised in the *NT News, Katherine Times, Centralian Advocate, Tennant & District Times, Arafura Times, Territory Regional Weekly, Eylandt Echo, The Australian,* and the *Financial Review,* and placed on the Committee's website. The Committee also directly contacted a number of key stakeholders to advise them of the call for submissions.

1.8 The Committee received a total of 24 submissions – see Appendix A.

1.9 As highlighted in Appendix B, over the course of the inquiry the Committee held two public briefings and two public hearings in Darwin with a total of 13 organisations appearing. The Committee also travelled to Perth for two days of private briefings with a further six stakeholders.

Report Structure

1.10 Given the preliminary nature of this inquiry, this report provides background information regarding the nature of the Northern Territory's energy market and operation of its electricity supply industry; an overview of proven and potential energy producing resources available for electricity generation; and identifies key issues that need to be taken into consideration with regards to positioning the Territory for the future.

1.11 Chapter two aims to provide the reader with an understanding of the somewhat unique nature of the Northern Territory energy market and the current legislative and regulatory framework. Having established the context, Chapter three considers the operation of the Territory's electricity supply industry including power generation capacity, anticipated future demand and associated operational constraints within the regulated and unregulated components of the Territory's energy market. Aspects of the proposed industry reform package are also considered.

1.12 Chapter four provides an overview of the proven and potential non-renewable and renewable energy producing resources available to the Territory. Factors impacting on the development and accessibility of resources for the domestic energy market are also canvassed.

1.13 Finally, Chapter five identifies the key issues the Committee considers warrant further investigation if the Territory is to position itself for the future and take full advantage of the mix of resources and technologies that have the capacity to deliver the most cost effective, efficient and sustainable access to energy by all Territorians over the longer term.

2 Overview of the Northern Territory Energy Market

Background

2.1 In 1991 the Commonwealth, State and Territory governments "reached agreement on the need for a national competition policy."[5] In the same year the Industry Commission published the findings of its inquiry into *Energy Generation and Distribution.*[6] These two events created the impetus for microeconomic reform of Australia's energy industry; including the subsequent development of the *National Electricity Market* (NEM) and adoption of wholesale trading arrangements by the interconnected eastern and southern states.[7]

2.2 Noting that both governments and energy utilities agreed that there was considerable scope to improve the efficiency of the industry through competitive reform measures, the Industry Commission concluded that:

> The potential gains are large – in the order of $2.4 billion a year…the Commission recommends significant changes to the structure of the electricity and natural gas supply industries. This involves separating ownership of key functions in each industry and progressively selling much of the publicly owned generation and distribution assets. It would result in a considerable diminution in the dominant role traditionally played in Australia by publicly owned vertically integrated energy utilities…The Commission considers that the process of structural reform needs to start now. This will require immediate action by governments.[8]

2.3 Following introduction of the *National Competition Policy* (NCP) in 1994, the Council of Australian Governments (COAG) was responsible for driving the electricity reform process; in particular, implementation of the structural, governance and institutional reforms required to achieve the framework for the NEM.[9] As a consequence, over the past twenty years the electricity industry has undergone a significant transformation as government owned monopolies have been rationalised, disaggregated, corporatised and, to a lesser extent, privatised in an effort to increase efficiency and lower prices.[10]

2.4 However, the Committee notes that the pace and extent of industry reform in the Northern Territory (NT) has been constrained by the somewhat unique nature of its energy market. As highlighted in Figures 1 and 2 below, with a relatively small (approximately 235,000) and widely dispersed population, the Territory's energy market is characterised by a large number of isolated grids and remote power systems.

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[5] KPMG, *National Electricity Market: A case study in successful microeconomic reform*, KPMG, Sydney, 2013, p. 15

[6] Industry Commission, *Energy Generation and Distribution,* (Vols I – III), Australian Government Publishing Service, Canberra, 17 May 1991 – referred by Commonwealth Treasurer Paul Keating in May 1990

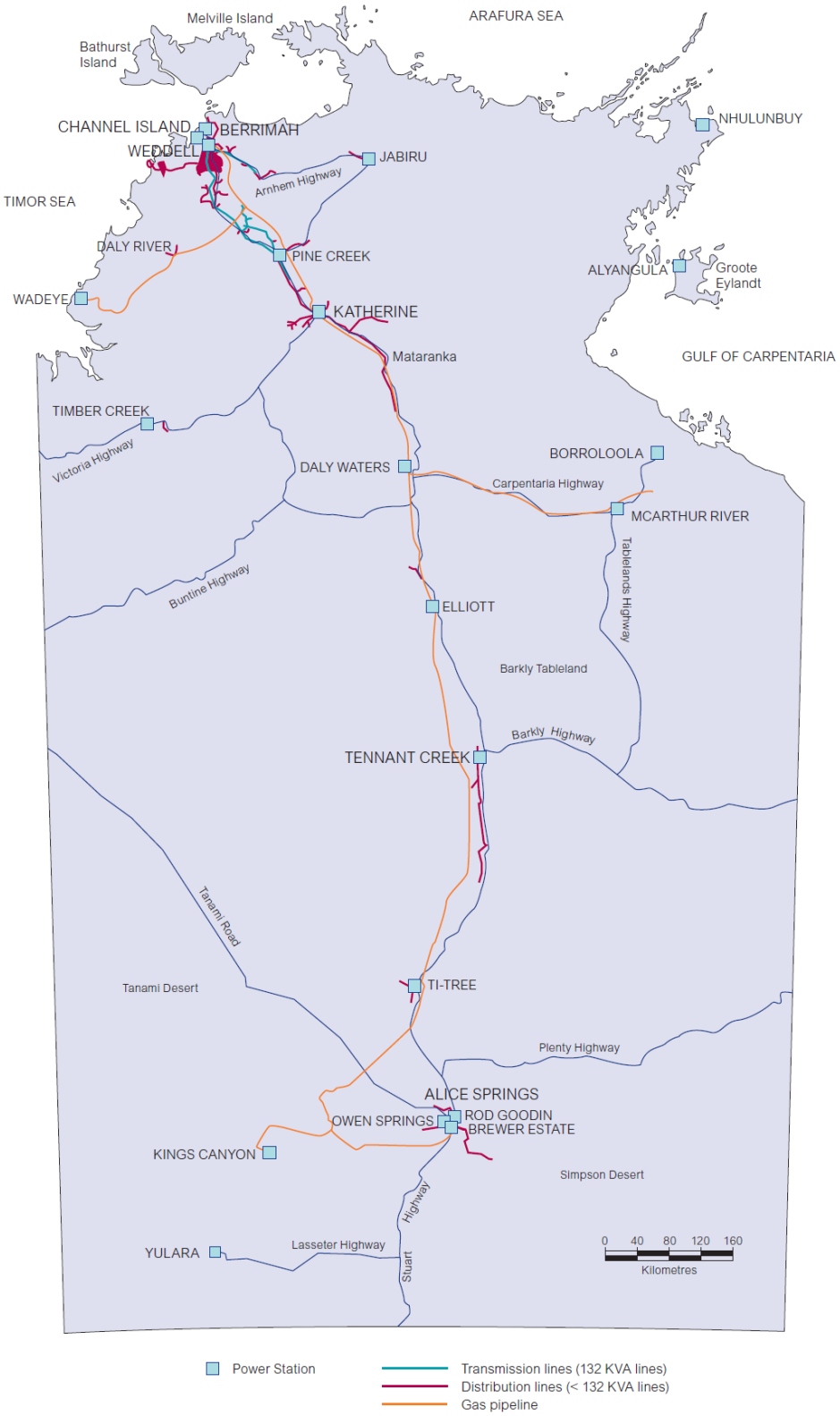
[7] M. Roarty, *Electricity Industry Restructuring: The State of Play*, (Research Paper No. 14 1997-98), Department of the Parliamentary Library, Canberra, 2012, pp.1-3

[8] Industry Commission, *Energy Generation and Distribution,* (Vol I), preface

[9] KPMG, *National Electricity Market*, pp. 19-21

[10] M. Roarty, *Electricity Industry Restructuring: The State of Play*, p.1

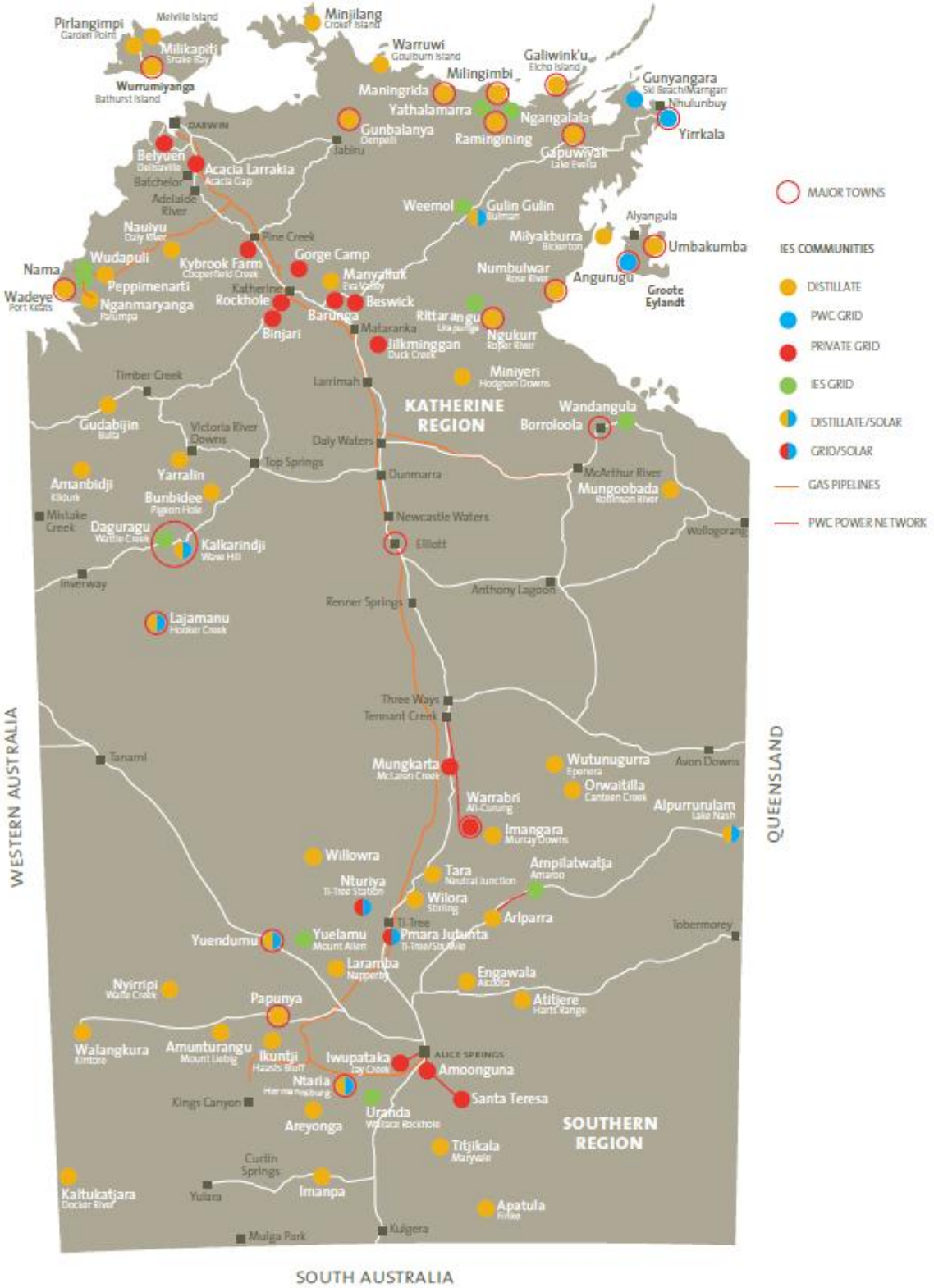
Figure 1: Northern Territory Energy Supply Infrastructure



Source: Power and Water Corporation[11]

[11] Power and Water Corporation, *Northern Territory Energy Supply Infrastructure,* cited in Utilities Commission NT, *Power System Review 2011-12,* Utilities Commission NT, Darwin, April 2013, p. 18

Figure 2: Northern Territory Remote Power Systems



Note: Error in Legend: PWC Grid Communities are shown in red; Private Grids are shown in blue.

Source: Power and Water Corporation[12]

[12] Power and Water Corporation, *Solar/Diesel Mini-Grid Handbook,* Power and Water Corporation, Darwin, 2014, p. 63

2.5 Given the potential customer base, the Territory's regulated market is limited to the gazetted townships associated with the Darwin-Katherine interconnected network, the Alice Springs network and the Tennant Creek network – the market systems. As such, the unregulated component of the Territory's energy market, approximately 50 percent of the NT's total energy consumption, is disproportionately high compared to elsewhere in Australia.[13] While the composition of the NT's energy market is similar to that of Western Australia (WA), the regulated component is significantly smaller catering to approximately 78,000 customers compared to 852,000 in the WA Wholesale Energy Market (WA WEM).[14]

2.6 The Committee understands that, in accordance with its obligations as a signatory to the *National Competition Principles Agreement*[15], the NT Government introduced electricity market reforms in April 2000. Key reform initiatives included:

- Abolition of the statutory monopoly over electricity supply held by the Territory Government owned Power and Water Authority;
- Implementation of a third party access regime for specified electricity networks, certified for the purposes of the *Trade Practices Act;*
- Instigation of a timetable for phased introduction of full retail competition; and
- Establishment of an independent economic regulator, the [Utilities] Commission.[16]

Legislative, Regulatory and Policy Framework

2.7 Given the above, the Territory's electricity industry currently operates within a regulatory framework established by the *Electricity Reform Act 2000*; *Utilities Commission Act 2001;* the *Power and Water Corporation Act 2002; and Electricity Networks (Third Party Access) Act 2002*.[17] A diagrammatic representation of the regulatory architecture is provided at Appendix 3.

Electricity Reform Act

2.8 The *Electricity Reform* Act, and associated *Electricity Reform (Administration) Regulations,* provides the legislative framework for the administration and operation of the Territory's electricity supply industry.[18] In accordance with the

[13] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT, including Geo-Thermal, Solar, Biomass and Tidal: Report 2*, Northern Territory Government, Darwin, 2011, p. 13-14

[14] Energy Supply Association of Australia, *Review of Wholesale Electricity Generation Market,* (Submission), Energy Supply Association of Australia, Melbourne, 4 February 2014, p. 2

[15] Committee Hansard, Dr Patrick Walsh, Commissioner: Utilities Commission NT, Public Hearing: Darwin, 4 December 2013, p. 3; see also National Competition Policy, *Competition Principles Agreement,* viewed 16 January 2014, http://ncp.ncc.gov.au/pages/overview

[16] Utilities Commission NT, *Review of Full Retail Contestability: Final Report,* Utilities Commission NT, Darwin, December 2009, pp. 22-3

[17] Utilities Commission NT, *Power System Review 2011-12,* p. 14

[18] *Electricity Reform Act* (NT); *Electricity Reform (Administration) Regulations.*

Administrative Arrangements Order (effective 3 February 2014), the Treasurer is assigned the role of Regulatory Minister and is responsible for the *Electricity Reform Act* as far as it relates to economic regulation.[19] The Minister for Essential Services is assigned the role of Portfolio Minister and is responsible for the *Electricity Reform Act* as far as it relates to supply and service provision under licence, and policy and service standards relating to the electricity industry.[20]

Utilities Commission Act

2.9 The *Utilities Commission Act,* and associated *Utilities Commission Regulations,* establishes the Utilities Commission (the Commission) as the economic regulator in respect of the electricity supply industry, water supply and sewerage services industries. The object of the Act being to establish an economic regulatory framework that:

> promotes and safeguards competition and fair and efficient market conduct, or, in the absence of a competitive market, that promotes the simulation of competitive market conduct and the prevention of the misuse of monopoly power. [21]

The Commission is an independent body corporate with the Commissioner appointed by the Administrator. Although Associate Commissioners are appointed by the Regulatory Minister, the Committee notes that the Commission is not subject to Ministerial direction in the performance of its statutory functions.[22]

2.10 The Commission's key regulatory functions in respect of the electricity supply industry are to:

- perform licensing functions, granting licences to firms to undertake electricity generation, electricity networks, system control and retail operations in the Territory;
- develop standards of service and supply, and to make codes and rules relating to the conduct or operations of the electricity supply industry or individual licensed entities;
- monitor and promote improvement in, standards and conditions of service and supply and the operations of the electricity supply industry and licensed entities;
- regulate prices charged by PWC Networks for the provision of electricity network services (transport of electricity across the network) and charges imposed by the System Controller relating to the operations of system control;
- monitor and enforce compliance with standards and conditions of service and supply, and to monitor the operation of, and enforce

[19] Northern Territory Government, *Administrative Arrangements Order,* Northern Territory Government, Darwin, 3 February 2014, p. 5; Utilities Commission NT, *Role of the Commission, Regulatory Minister and Portfolio Minister,* Tabled Paper No 5: Public Hearing, 4 December 2013, pp.2-3

[20] Northern Territory Government, *Administrative Arrangements Order,* pp. 19; Utilities Commission NT, *Role of the Commission,* p. 4

[21] *Utilities Commission Act* (NT) 2001 s2; *Utilities Commission Regulations*

[22] *Utilities Commission Act* (NT) ss 5(3), 8,10 and 12.

compliance with, codes and rules relating to the conduct or operations of the electricity industry or licensed entities;

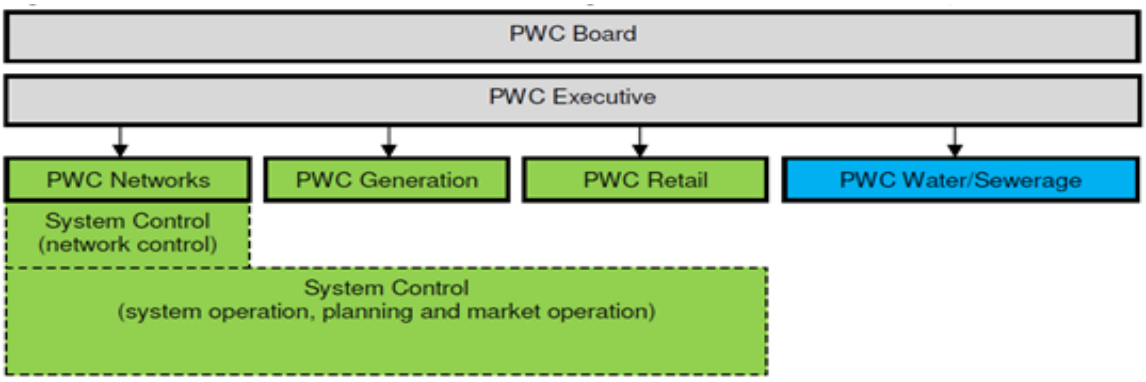
- advise the Treasurer on any matter referred by the Treasurer; and
- assist consumers and others with information on the market and regulatory framework.[23]

2.11 With regards to the Commission's licensing function, the Committee notes that, with the exception of installations defined as small scale renewable energy operations, licences are required for electricity generation; owning or operating an electricity network; selling electricity; and system control over a power station.[24] In addition to granting licences and monitoring compliance with licence conditions, the Committee understands that the Commission is also empowered to 'customise' licences.[25] As highlighted in the overview of the licensing framework provided at Appendix 4, the Commission has developed "subcategories of licences and combined licences to suit [the] particular circumstances" of the Territory's electricity supply industry.[26]

Power and Water Corporation Act

2.12 The *Power and Water Corporation Act* effectively corporatised the pre-existing NT Power and Water Authority and established the Power and Water Corporation (PWC) to generate, trade, distribute and supply electricity in the Northern Territory.[27] As illustrated in Figure 3 below, PWC is a vertically and horizontally integrated, multi-utility Government owned corporation (GOC).

Figure 3: Structure of Power and Water Corporation



Source: Utilities Commission of the Northern Territory[28]

2.13 As noted in PWC's *Statement of Corporate Intent 2013-14*, in accordance with s4 of the *Government Owned Corporations Act*, PWC's objectives are to:

[23] Utilities Commission NT, *Annual Report 2012-13,* p. 19; *Utilities Commission Act* s6
[24] *Electricity Reform Act* 2000 s14; Utilities Commission NT, *Annual Report 2012-13,* p. 21
[25] Utilities Commission NT, *Role of the Commission,* p.1; Utilities Commission NT, *Annual Report 2012-13,* p. 20
[26] Utilities Commission NT, *Annual Report 2012-13,* p. 20
[27] *Power and Water Corporation Act* (NT) 2002
[28] Utilities Commission NT, *Review of Electricity System Planning and Market Operation Roles and Structures: Final Report,* Utilities Commission NT, Darwin, December 2011, p. 34

- Deliver electricity, water and sewerage services to the Northern Territory, safely, reliably and efficiently; and
- In doing so:
    - Operate at least as efficiently as any comparable business; and
    - Maximise the sustainable return to the Northern Territory on its investment in Power and Water.[29]

2.14 PWC is subject to regulation by the Commission, Regulatory and Portfolio Ministers pursuant to the provisions of the *Electricity Reform Act* and *Utilities Commission Act*. In addition, PWC's operational and financial performance is subject to oversight by the Shareholding Minister (Treasurer). The Shareholding Minister's primary responsibilities include:

- agreeing on the *Statement of Corporate Intent* (SCI) with the PWC Board and monitoring of PWC's performance against agreed activities;
- negotiating Community Service Obligations and payments with PWC; and
- agreeing on the annual dividend payable by PWC and PWC's capital structure.[30]

2.15 Noting the potential conflict between the Treasurer's roles as both Regulatory Minister and Shareholder Minister for PWC, the Commission advised that while the Regulatory Minister is responsible for regulatory policy and establishing the broad regulatory principles and framework to be implemented, the Commission is responsible for the administration of such.[31]

Northern Territory Electricity Ring-Fencing Code

2.16 Given that PWC has been retained as a vertically integrated entity, the Committee understands that, consistent with industry reform objectives, ring-fencing of PWC's business units to ensure it "does not use its vertically integrated structure and dominant market position in an anti-competitive manner"[32] is a key requirement of the Territory's regulatory framework.

2.17 Under the *Electricity Ring-Fencing Code* the Commission advised that PWC is required to ring-fence its non-contestable monopoly network and system control businesses from its contestable generation and retail activities by:

- establishing and maintaining separate accounting and information systems to preclude cross subsidising;
- ensuring activities performed by the non-contestable and related contestable businesses are undertaken at arm's length from each other;

[29] Power and Water Corporation, *Statement of Corporate Intent 2013-14,* Power and Water Corporation, Darwin, 2013, p. 4; *Government Owned Corporations Act* (NT) s4
[30] Utilities Commission NT, *Role of the Commission,* pp.3-4
[31] Utilities Commission NT, *Role of the Commission,* p. 3
[32] Utilities Commission NT, *Northern Territory Electricity Ring-fencing Code,* Utilities Commission NT, Darwin, 1 January 2009, p.2; Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, pp. 16-17

- treating third-party competitors on a non-discriminatory basis; and
- ensuring physical separation of PWC staff employed in marketing and sales activities associated with the non-contestable and related contestable businesses.[33]

2.18 The Committee notes that structural reform of government owned utilities within the NEM and the WA WEM has favoured the ownership separation model. In contrast to ring-fencing, regulated activities (networks and systems control) and competitive elements (generation and retail) are established as separate entities in their own right. Apart from removing the incentive for individual business units to engage in anti-competitive conduct, ownership separation:

> reflects industry and financial market recognition that the clear differences between network activities (i.e. focused on asset management and cost control) and generation/retail activities (i.e. focused on customers) warrants specific management and Board expertise.[34]

2.19 In the Australian Capital Territory (ACT), however, contestable and non-contestable activities are subject to legal separation, with separate legal entities established under a common owner. As is the case with ring-fencing, while creating clear boundaries between the separate businesses and reinforcing accounting separation, it does not prevent collaboration between businesses:

> there being strong commercial incentives for legally separate entities within the same organisation to continue to preference their related entities through information sharing transfer pricing and distortions in cost allocation.[35]

This risk is mitigated in the ACT since the ACT Electricity and Water Corporation does not have generating capabilities and buys all its power in the NEM wholesale electricity market.[36]

Electricity Networks (Third Party Access) Act

2.20 Since transmission and distribution networks – the poles, wires, substations, transformers, switching, monitoring and signalling equipment used to transport bulk electricity from the transmission network to customers – cannot be economically duplicated and are fundamental to the provision of an essential service, they are generally acknowledged to be a natural monopoly function of Governments.[37]

2.21 Power system management and control is also considered to be a monopoly function "essential to the safe, efficient and secure operation of the integrated electricity system."[38] With the exception of the Groote Eylandt Mining Company

[33] Utilities Commission NT, *Role of the Commission,* p. 7; Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 17
[34] Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 17
[35] Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 17
[36] M. Roarty, *Electricity Industry Restructuring: The State of Play*, p.11
[37] Utilities Commission NT, *Review of Electricity System Planning, Monitoring and Reporting,* p. 36; Utilities Commission NT, *Role of the Commission,* p. 10
[38] Utilities Commission NT, *Role of the Commission,* p. 5

Pty Ltd (GEMCO) which holds a *Special Licence – Isolated System Operations,* and Pacific Aluminium Pty Ltd which is exempt from holding a licence for its electricity operations in the township of Nhulunbuy and the Gove bauxite refinery, PWC is the Territory's only licensed network service provider and system controller.[39]

2.22 In order to achieve effective competition in upstream (generation) and downstream (retail) markets, the *Electricity Networks (Third Party Access) Act* and associated code (TPA Code), specifies the access regime for persons wishing to access PWC electricity networks within the three regulated market systems.[40] As such, PWC is required to:

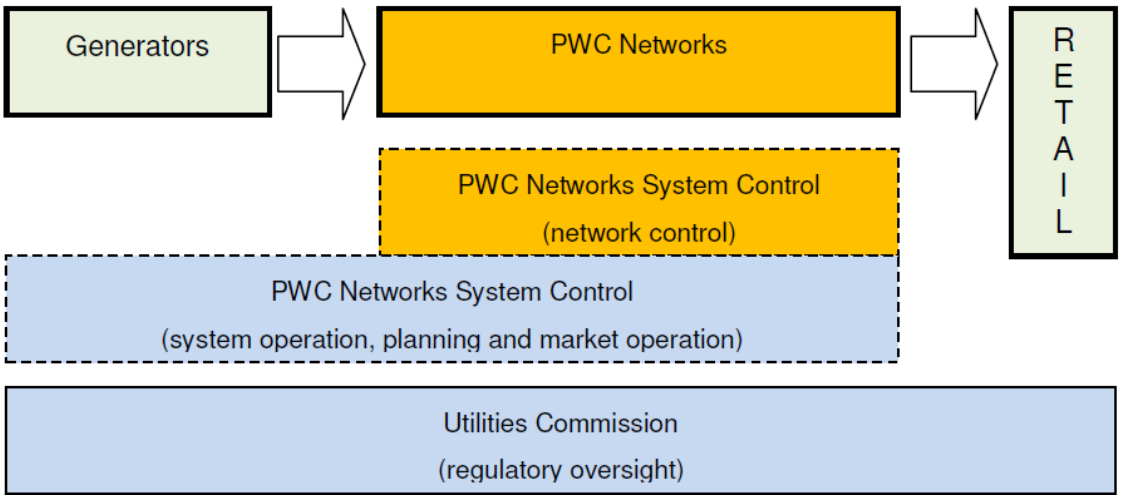
> use all reasonable endeavours to accommodate the requirements of those seeking access to the electricity network and to provide access on a non-discriminatory basis between various network users and potential users.[41]

2.23 However, despite these provisions, in its 2011 *Review of Electricity System Planning and Market Operation Roles and Structures* the Commission noted that PWC's structure is not necessarily the most conducive when it comes to attracting competitive generators into the market:

> there is a credible risk that System Control supervisory functions may be influenced by the interest of related PWC business units…A perception that system and market operation are not independent represents a barrier to entry by potentially deterring investment by competing generators.[42]

2.24 As illustrated in Figure 4, system operation, planning and market operation functions are currently located within the PWC Networks business unit.

Figure 4: Roles and Responsibilities in the NT



Note: contestable activities are green; regulated monopoly activities are orange; and supervisory activities are blue.

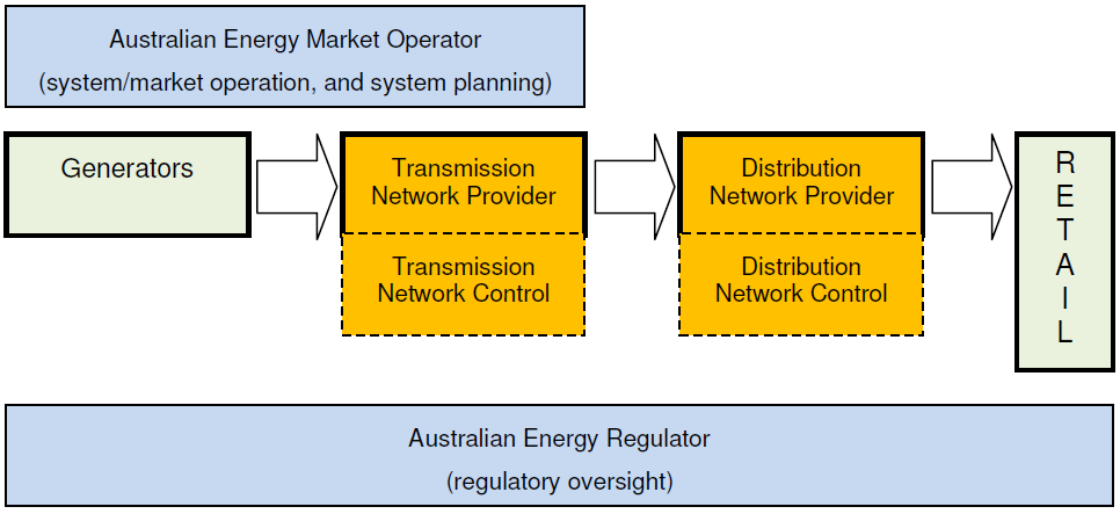
Source: Utilities Commission of the Northern Territory[43]

[39] Utilities Commission NT, *Annual Report 2012-13,* p. 21; see also Appendix 4.
[40] Utilities Commission NT, *Power System Review 2011-12,* p. 14; see also *Electricity Networks (Third Party Access) Act* (NT)
[41] Utilities Commission NT, *Role of the Commission,* p.6
[42] Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 34
[43] Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 24

2.25 The Committee understands that this is not inconsistent with good governance practice where the electricity supply chain involves a single network operator, as is the case in the NT regulated market system, so long as there is "appropriate separation or ring-fencing between the regulated network and supervisory activities, and with related entities."[44] However, while system control supervisory functions are clearly ring-fenced from PWC's generation and retail activities, the separation from network control is assumed rather than explicit. The Committee also notes that unlike other jurisdictions, the Territory's regulatory framework does not make any distinction between the transmission and distribution networks; rather, both services are bundled together to form PWC Networks. [45]

2.26 By way of comparison, Figure 5 illustrates the allocation of roles and responsibilities across the electricity supply chain in the NEM. Widely recognised as an example of good industry practice, this model avoids actual or perceived conflicts of interest by the clear separation of policy making, regulating and rule administration from service delivery and profit making entities, and ensures appropriate levels of accountability and transparency.[46]

Figure 5: Roles and Responsibilities in the NEM



Note: contestable activities are green; regulated monopoly activities are orange; and supervisory activities are blue.

Source: Utilities Commission of the Northern Territory[47]

Full Retail Contestability

2.27 The Committee understands that in order to obtain certification of the *Third Party Access* regime under what was then the *Trades Practices Act,* in 2000 the

[44] Utilities Commission NT, *Review of Electricity System Planning and Market Operation,* p. 33
[45] Australian Energy Market Commission, *2013 Electricity Price Trends Report,* Australian Energy Market Commission, Sydney, 13 December 2013, p.161
[46] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements for the Northern Territory,* Utilities Commission NT, Darwin, February 2014, p. 7
[47] Utilities Commission NT, *Review of Electricity System Planning and Market Operation*, p. 15

National Competition Council required the Government to implement a staged introduction of *Full Retail Contestability* (FRC).[48] The Committee notes that, in light of NT Power Generation's successful s46 claim against the NT Power and Water Authority, certification was considered advantageous since it establishes "a legal avenue for third parties to access network infrastructure and avoids costly legal disputes."[49] The Government is also required to maintain certified energy access regimes as a signatory to the *Australian Energy Market Agreement*.[50]

2.28 As highlighted in the Commission's 2009 *Review of Full Retail Contestability,* the primary objectives of FRC are generally considered to include:

> ensuring that the benefits of competition in wholesale markets are transferred to customers, and that customers might receive the benefits of retail competition through improved customer service and the offer of cost-reflective services that better meet customer needs.[51]

Unlike the Territory, elsewhere in Australia and overseas the introduction of FRC has usually been preceded by both the disaggregation of government owned monopoly utilities and the adoption of wholesale electricity trading arrangements; thus ensuring the prior development of "functioning, transparent and in some cases highly competitive wholesale electricity markets."[52]

2.29 In the Northern Territory, commercial customers using more than 750MWh per annum became progressively contestable over the two year period from 1 April 2000 to 1 April 2002. As such they are required to negotiate an electricity supply contract with a licensed electricity retailer. Apart from PWC Retail, QEnergy Ltd (QEnergy) and ERM Power Retail Pty Ltd (ERM) are the only other retailers currently licensed to operate in the NT.[53]

2.30 While larger customers, using more than 2,000 MWh per annum, pay tariffs determined by commercial negotiation, many of the smaller commercial customers using between 750MWh and 2000MWh per annum have elected to remain with PWC Retail as the default supplier. Similarly, although all customers became contestable as of 1 April 2010, there is currently no competition to PWC Retail when it comes to electricity supply for domestic and small commercial customers using less than 750MWh per annum. Consequently, these customers pay retail tariffs set by the Government though

[48] Utilities Commission NT, *Review of Full Retail Contestability for Northern Territory Electricity Consumers: Final Report,* Utilities Commission NT, Darwin, December 2009, p. 9
[49] Utilities Commission NT, *Review of Full Retail Contestability*, p. 9; Australian Competition Law, *NT Power Generation v Power and Water Authority,* viewed 26 February 2014, http://www.austrliancompetitionlaw.org/cases/ntpower.html
[50] Standing Council on Energy and Resources, *Australian Energy Market Agreement 2004 as amended 9 December 2013,* viewed 30 January 2014, http://www.scer.gov.au/governance/agreements/
[51] Utilities Commission NT, *Review of Full Retail Contestability*, p. 2
[52] Utilities Commission NT, *Review of Full Retail Contestability*, p. 24
[53] Utilities Commission NT, *Role of the Commission,* p. 6; *Electricity Reform Act* s44

Electricity Pricing Orders which are capped; thereby determining the maximum amount PWC can charge.[54]

Uniform Tariffs and Community Service Obligation Policy

2.31 The Committee notes that where a Government owned corporation is required to carry out activities that it would not ordinarily elect to do on commercial grounds, or would only undertake commercially at higher prices, such functions are designated as a Community Service Obligation (CSO); thereby allowing Government "to achieve identifiable community or social objectives that would not be achieved if left to economic or market forces."[55]

2.32 Provision of essential services at a uniform tariff to all Territorians irrespective of where they live is one such example. As the Committee heard, given the reliance on gas and diesel, the wholesale energy component of 66 percent of the regulated retail price of electricity in the NT is almost double the national average of 35 percent.[56] Similarly, while the distribution component in the regulated market systems is on a par with other parts of Australia, costs are significantly higher in the more remote areas of the Territory.[57]

2.33 In accordance with Government policy, the 2013-14 budget incorporates $64.31 million in CSO funding to PWC in respect of utilities service provision in urban areas for:

- electricity supply to domestic customers, and small businesses and other organisations across the Territory at uniform tariffs;
- electricity supply services to tranche 4 electricity customers (primarily medium-sized businesses and other organisations) at a subsidised tariff; and
- water and sewerage services to all customers at uniform tariffs.[58]

2.34 Utilities services in remote areas are subsidised through a $71.28 million Indigenous Essential Services grant. PWC also receives $22.54 million in CSO payments from the Department of Health to fund subsidised utilities services provided under the *Pensioner Concession Scheme*.[59]

Feed in Tariffs

2.35 PWC advised the Committee that, unlike other Australian governments, the Northern Territory Government does not have a policy regarding feed in tariff's

[54] Utilities Commission NT, *Review of Full Retail Contestability*, p. 9; *Electricity Reform Act* s44; Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p. 7

[55] Northern Territory Government, *The Budget 2013-14: Budget Paper No. 3,* Northern Territory Government, Darwin, 2013, 331; *Government Owned Corporations Act* (NT) s28

[56] Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p. 14; Australian Energy Market Commission, *Electricity Price Trends Report: Possible Future Retail Electricity Price Movements 1 July 2012 to 30 June 2015*, Australian Energy Market Commission, Sydney, 22 March 2013.

[57] Committee Hansard, Ms Megan Jolley, Manager Energy & SCADA Strategy: Indigenous Essential Services Pty Ltd, Public Hearing: Darwin, 11 October 2013, p. 2-3; AEMC, *Electricity Price Trends Report*

[58] Northern Territory Government, *The Budget 2013-14: Budget Paper No. 3,* p. 332

[59] Northern Territory Government, *The Budget 2013-14: Budget Paper No. 3*p. 332-3

(FIT) for power fed into the electricity grid from domestic or commercial rooftop solar photovoltaic (PV) installations. Rather, buy-back rates are currently subject to a PWC Retail policy.[60]

2.36 As is the case in the ACT and NSW, PWC offers a FIT based on a *gross* model which provides a 1:1 payment for all electricity generated. Other States offer feed in tariffs based on a *net* model, also known as export metering, where the system owner only receives a FIT for the surplus energy they produce and export to the grid; that is, over and above what the house or business consumes.[61]

2.37 As of 1 January 2014 FIT rates for domestic customers were set at the standard domestic tariff of 27.13 c/kWh. While a flat rate of 29.68 c/kWh is applicable to small commercial customers using less that 750MWh per annum, a customised rate is negotiated for solar PV systems greater than 30kVA and for customers consuming 750MWh or more per annum.[62]

2.38 The Committee was further advised that under the current arrangements, PWC is not required to offer a buy-back rate for customers who contract with other retailers. Moreover, in the absence of an overarching buy-back policy, purchase of any excess solar PV generated by non PWC customers is at the discretion of the individual retailer.[63]

[60] Power and Water Corporation, *Responses to Questions,* Tabled Paper No. 7, Public Hearing, 20 March 2014, Q 4 and 5

[61] Energy Matters, *Feed-in Tariff for Grid-connected Solar Power Systems,* viewed 21 March 2014, http://www.energymatters.com.au/government-rebates/feedintariff.php

[62] Power and Water Corporation, *Responses to Questions*, Q 4 and 5; see also Power and Water Corporation, *Photovoltaic (PV) Solar Systems,* viewed 21 March 2014, http://www.powerwater.com.au/sustainability_and_environment/photovoltaic_pv_solar_systems

[63] Power and Water Corporation, *Responses to Questions*, Q 4 and 5

3 Operation of the NT's Electricity Supply Industry

Regulated Electricity Market

3.1 PWC is responsible for electricity supply operations within the regulated market systems: Darwin-Katherine interconnected network, Alice Springs network and Tennant Creek network. These three market systems provide power to approximately 83 percent of the Territory's electricity customers: 63,102 in the Darwin-Katherine system, 1,527 in the Tennant Creek system and 11,724 in the Alice Springs system.[64]

3.2 In addition to its role as the network service provider and system controller, PWC is the primary electricity generator within the regulated market with 94 percent of the generation capacity. With the exception of a small number of commercial customers, PWC is also the principal electricity retailer.[65] The Committee understands that the regulated market currently represents approximately 92 percent of PWC's territory wide customer base of 82,545.[66]

Power Generation Capacity and Future Demand

3.3 As highlighted in Table 1 below, there is currently 615 Megawatts (MW) of generation capacity available across the three market systems. In addition to PWC Generation, four privately owned generators operate in the Darwin-Katherine and Alice Springs systems. Licensed as *Independent Power Producers* (IPP's) the Committee notes that these privately owned generators do not fully participate in the electricity supply market and, as such, do not operate in competition with PWC. Instead they:

> generate electricity under contract for PWC Generation rather than selling directly to an electricity retailer. PWC Generation provides the fuel used for electricity generation and takes all the electricity generated. [67]

Table 1: Generation Capacity

Darwin-Katherine	**Operator**	**MW**	**Fuel**
Channel Island	PWC	322	Natural Gas/Liquid Fuel
Weddell	PWC	128	Natural Gas
LMS Shoal Bay	LMS Generation	1	Landfill Gas
Darwin-Katherine	**Operator**	**MW**	**Fuel**
Berrimah (back up only)	PWC	10	Liquid Fuel
Katherine	PWC	33	Natural Gas/Liquid Fuel
Pine Creek	EDL NGD (NT) Pty Ltd Cosmo Power Pty Ltd	19	Natural Gas/Liquid Fuel
Total		**513**	

[64] Utilities Commission NT, *Power System Review 2011-12,* p. 17
[65] Committee Hansard, Dr Patrick Walsh, Utilities Commissioner, p.3; Utilities Commission NT, *Annual Report 2012-13,* p. 19
[66] Power and Water Corporation, *Annual Report 2013*, Power and Water Corporation, Darwin, 2013, p.40
[67] Utilities Commission NT, *Annual Report 2012-13,* p. 19-21; see also Appendix 4

Tennant Creek	**Operator**	**MW**	**Fuel**
Tennant Creek	PWC	17	Natural Gas/Liquid Fuel
Total		**17**	
Alice Springs	**Operator**	**MW**	**Fuel**
Ron Goodin	PWC	40	Natural Gas/Liquid Fuel
Owen Springs	PWC	36	Natural Gas/Liquid Fuel
Brewer Estate	Central Energy Power Pty Ltd	8	Natural Gas/Liquid Fuel
Uterne	Epuron Pty Ltd	1	Solar PV
Total		**85**	
Total Capacity		**615**	

Source: Utilities Commission of the Northern Territory[68]

3.4 While the current legislative and regulatory framework does not preclude competitive new entrants in the power generation market, the Committee heard that it is not anticipated that additional generation capacity will be required within the regulated market systems in the short to medium term.[69] The Commission advised that due to inefficient investment decisions there was currently an over-supply of generation plant in all three systems:

> The Darwin-Katherine system is expected to have sufficient generation capacity to maintain supply under any credible electricity demand scenario despite the loss of the two largest generation units in the system (an N-2 event) through to the summer of 2019-20…The Alice Springs system is expected to have sufficient generation capacity to meet forecast peak demand under any credible electricity demand growth scenario...to 2021-22…The generation supply-demand balance in the Tennant Creek system is adequate for the period to 2021-22.[70]

3.5 Nevertheless, the Committee notes that the Northern Power Group is proposing to build a 60MW power station near Weddell and enter the market as a gen-tailer in direct competition with PWC Generation and PWC Retail as early as mid-2015.[71] In the absence of additional demand, PWC Board Chairman, Mr Ken Clarke, admitted that "this does mean power [PWC Generation] may well have some redundant assets."[72]

3.6 The Commission advised that assessments regarding the adequacy of operating and reserve generation capacity, maintenance programs, and network investment needs are informed by maximum or 'peak' demand forecasts as determined by an analysis of electricity consumption patterns.[73] Since consumption patterns are influenced by a range of factors such as weather, population growth, household type, and economic activity, system demand

[68] Utilities Commission NT, *Power System Review 2009-10,* Utilities Commission NT, Darwin, March 2011, pp. 14-16; Utilities Commission NT, *Power System Review 2011-12,* pp. 31-3; Committee Hansard, Mr Martin Poole, Executive Director Epuron Pty Ltd, Public Hearing: Darwin, 14 February 2014, p. 2

[69] Committee Hansard, Dr Patrick Walsh, Utilities Commissioner, p.9

[70] Utilities Commission NT, *Power System Review 2011-12,* pp. 3-5

[71] Committee Hansard, Power and Water Corporation, Public Hearing, Darwin, 20 March 2014, pp. 10-12; see also Australian Financial Review, *Generator to Lift NT Gas Demand,* 14 January 2013, p. 1, viewed 11 February 2014, http://www.icapenergy.com.au/pop.market_news.php?id=1868

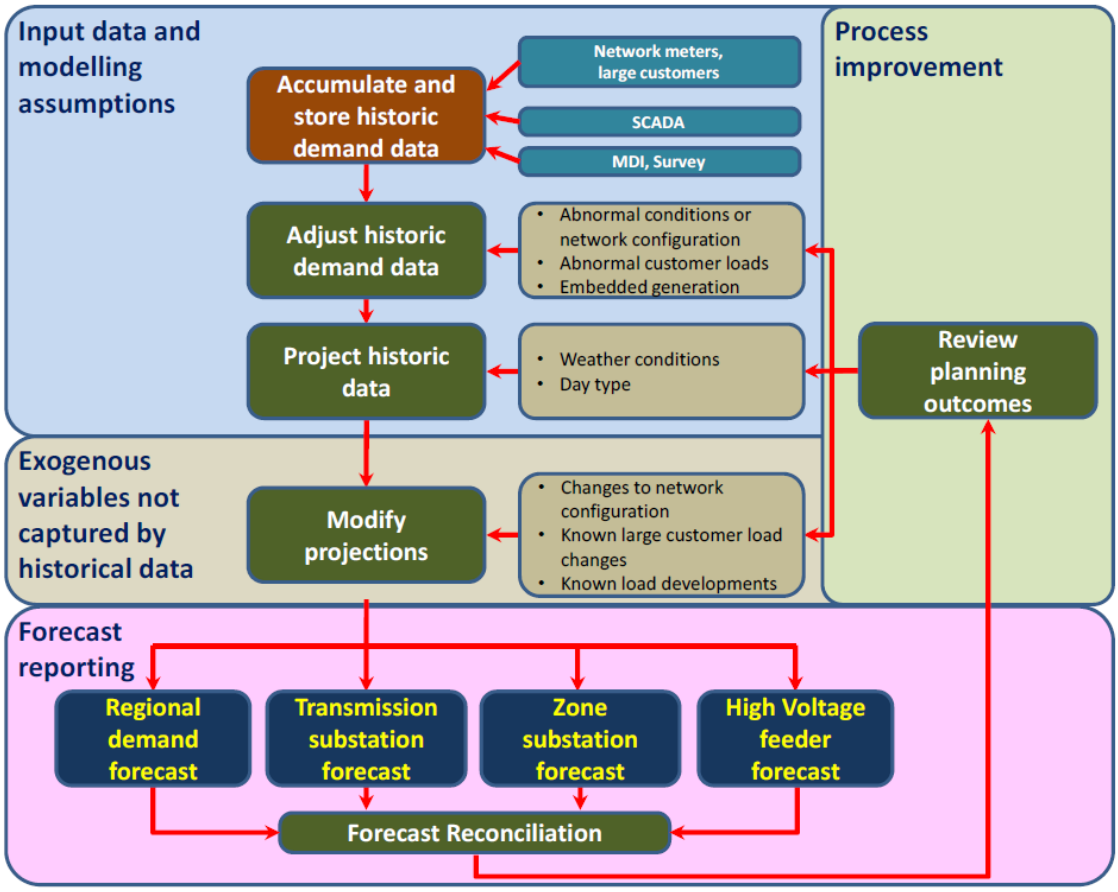
[72] Committee Hansard, Mr Ken Clarke, Board Chairman: Power and Water Corporation, Public Hearing, Darwin, 20 March 2014, p. 13

[73] Committee Hansard, Dr Patrick Walsh, Utilities Commissioner, pp. 8-9

forecasts incorporate a 'bottom up' and a 'top down' analysis and review process.[74]

3.7 As summarised in Figure 6, the 'bottom up' forecasting process involves an examination of available network data regarding loads at the feeder and substation level. These forecasts are then subject to a 'top down' review which takes into consideration region specific factors – population forecasts; trends in building approvals which are a leading indicator of new connections; projections of economic growth and PWC's knowledge of large loads that are expected to connect to the network; and consumer behaviour including uptake of rooftop solar PV and increased energy conservation in response to electricity price increases – to produce consolidated regional forecasts for each of the regulated market systems. [75]

Figure 6: PWC Networks' 'Bottom Up' Forecasting Process



Source: Power and Water Corporation[76]

3.8 The Committee heard that while projected growth in demand is subject to a year by year analysis, over the ten year forecast period 2012-13 to 2021-22 the average growth in maximum demand for the Darwin-Katherine system is

[74] Utilities Commission NT *Power System Review 2011-12,* pp. 21-24
[75] Utilities Commission NT *Power System Review 2011-12,* pp. 24-5
[76] Power and Water Corporation, *Draft Network Management Plan,* cited in Utilities Commission NT *Power System Review 2011-12,* p. 24

expected to be in the region of 2.7 percent per annum. The Tennant Creek system is not expected to experience any growth with maximum demand to remain flat. The Commission noted that there had been virtually no growth in maximum demand in Alice Springs over the past five years, with a significant reduction in the last two years due to an increased uptake of rooftop solar PV systems. Consequently, the average growth in maximum demand for the forecast period was not expected to exceed 0.5 percent per annum.[77]

3.9 The Commission also advised that an analysis of the generation supply-demand balance over the forecast period indicates a significant reserve margin in generation capacity for each of the market systems.[78] Moreover, as highlighted by the Energy Supply Association of Australia (ESAA), "if the uptake of distributed generation such as rooftop PV continues … reserve capacity could rise further."[79] The Commission advised the Committee that the impact of renewable energy, both off-grid and grid-connected, on demand is to be considered in its forthcoming 2012-13 Power Review.[80]

3.10 However, as pointed out in Oakley Greenwood's 2014 *Wholesale Electricity Generation Market Review,* reliance on generation supply-demand balance forecasts needs to be tempered by the fact that the Northern Territory is still very much a developing economy. Citing the impact of changing resource development activity on supply and demand forecasts in the much larger WA WEM, it is noted that:

> electricity demand in the Territory…has the potential to grow rapidly in potentially large steps…due to policy initiatives, resource developments and if the network is extended to currently isolated townships.[81]

Network Capacity and Constraints

3.11 The Committee understands that every five years Engineers Australia prepares an *Infrastructure Report Card* for each state and territory. Based on available data, in 2005 the state of existing transmission and distribution infrastructure was considered to be adequate and the Territory's overall electricity rating was assessed as B-. However, given the findings of the Davies inquiry into the 2008 failure of the Casuarina substation regarding the quality of the distribution infrastructure, maintenance and asset management practices, by 2010 it had fallen to C-.[82]

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[77] Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, pp. 8-9; see also Utilities Commission NT *Power System Review 2011-12,* pp. 25-8

[78] Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p. 9; see also Utilities Commission NT *Power System Review 2011-12,* pp. 34-41

[79] EASA, *Review of Wholesale Electricity Generation Market,* (Submission), p. 3

[80] Utilities Commission NT, *Role of the Commission,* p. 15

[81] Oakley Greenwood Pty Ltd, *Wholesale Electricity Generation Market Review,* Oakley Greenwood Pty Ltd, Brisbane, February 2014, p. 13

[82] Engineers Australia, *Infrastructure Report Card 2010: Northern Territory,* Engineers Australia: Northern Division, Darwin, November 2010, p. 114; see also Mervyn Davies, *Independent Enquiry into Casuarina Substation Events and Substation Maintenance across Darwin,* Power and Water Corporation, Darwin, 4 February 2009

3.12 Prior to the Casuarina substation incident, the Committee understands that the Commission's capacity to assess the adequacy of PWC's networks was hampered by the fact that, unlike other jurisdictions, the Territory's regulatory framework does not require PWC to provide regular reports on network capability and future reliability performance.[83] While substantial improvements have since been made with the introduction of condition based monitoring of network assets and the production of regular network planning and reliability reports, the Commission noted that implementation of these measures revealed the condition of assets to be considerably worse than anticipated.[84]

3.13 The Commission provided the Committee with the following summary of immediate issues:

- All high voltage transmission lines operate within their ratings under normal conditions. However, under first contingency conditions (an N-1 event where one line is out of service) a number of lines may exceed their normal ratings, therefore requiring careful planning of maintenance outages outside of peak load periods.
- Although it is anticipated that all zone substations should have sufficient capacity to meet forecast load with all transformers in service, under contingency conditions (an N-1 event where one transformer is out of service) six substations face capacity constraints.
- Of the 177 distribution (low voltage) feeders within the three power systems, seven currently exceed their rating. By 2016-17 this is expected to reach 13. Having identified these, the Commission noted that it is expected that PWC would implement plans to reduce feeder loading to within normal ratings as a matter of urgency.
- While generation reliability performance has improved in Darwin, it has generally deteriorated in Katherine, Alice Springs and Tennant Creek; despite significant capital investment in both the Darwin-Katherine and Alice Springs systems.
- A review of power system incidents has highlighted a lack of adequate generation reserves (spinning reserve) available at the time of major incidents, resulting in a greater loss of supply to customers than might have been anticipated. The Commission advised that PWC has since initiated a review of operating policy to identify appropriate levels of spinning reserve.
- Although overall network reliability performance, with regards to average outage times in particular, is continuing to show improvements, reliability for customers on long rural feeders continues to be significantly worse than

[83] Utilities Commission NT, *Review of Electricity System Planning, Monitoring and Reporting,* p. 37
[84] Utilities Commission NT, *Review of Electricity System Planning, Monitoring and Reporting,* p. 42

similar areas in Queensland. The Commission noted that it considers this performance to be unacceptable and requiring attention by PWC.[85]

3.14 Given the above, and as further highlighted by the *Darwin-Katherine 'System Black' of 12 March 2014*[86], the transmission and distribution components of PWC Networks would appear to be the Achilles' heel of the Territory's regulated electricity system. In addition to conducting an inquiry into the 'System Black' incident (see Appendix 5 for inquiry terms of reference), the Committee was advised that the Commission's 2012-13 *Power System Review* will "place particular attention on the actual availability of generation and network assets to assess the security and reliability of the system."[87]

3.15 With regards to the latter, PWC Board Chairman, Mr Ken Clarke, acknowledged that despite recent substation upgrades, PWC Networks incorporates a lot of aging infrastructure; including the Hudson Creek substation which was at the centre of the recent 'System Black' event:

> it is a big issue…There has been quite a lot of money spent, as you would know, on the network but we still need to spend more…a lot of our gear is 30 years old…The fact the circuit breakers zapped is a sure sign they are old. They are old and were due for replacement, so it is something we have to be constantly aware of.[88]

3.16 It was further acknowledged that while events as severe as 'System Black' are very rare, the overall condition and reliability of the existing network infrastructure may well deter potential competitors from entering the Territory's electricity supply industry:

> You are dead right. That would be an impediment to a competitor. They would ask, "How reliable is this?" Will I have to put additional security into my system to cater for a situation?" However, at the same time, competitors will also understand we have supply obligation standards we try to achieve.[89]

Electricity Retail Sector

3.17 As noted previously, at present PWC is the dominant electricity retailer. Although QEnergy and ERM also hold retail licenses, the Committee notes that QEnergy is currently the only active market participant. Specialising in the provision of retail electricity to the business sector, the Committee understands that QEnergy has been successful in acquiring a number of medium-to-large customers.[90] However, in its recent submission to the Commission's review of the NT's wholesale electricity generation market, it was noted that while QEnergy:

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[85] Utilities Commission NT, *Role of the Commission,* p.15; see also Utilities Commission NT *Power System Review 2011-12,* pp. 43-54

[86] Power and Water Corporation, *Darwin-Katherine Power System: System Black 12 March 2014,* Power and Water Corporation, Darwin, 18 March 2014

[87] Utilities Commission NT, *Role of the Commission,* p.15

[88] Committee Hansard, Mr Ken Clarke, Board Chairman: Power and Water Corporation, p. 22

[89] Committee Hansard, Mr Ken Clarke, Board Chairman: Power and Water Corporation, p. 21

[90] Department of Treasury and Finance, *Northern Territory Electricity Market Reform: Information Paper,* Northern Territory Government, Darwin, February 2014, p. 6

> entered the market in response to significant customer demand [it] has been unable to satisfactorily fulfil that demand largely owing to the current market design, and the structure and practices of the Power and Water Corporation…given their market dominance. [91]

3.18 As the Committee heard, in the absence of a transparent, centrally coordinated wholesale electricity spot market, such as that operating in the NEM or the WA WEM, licensed retailers are required to enter into bilateral contracts (power purchase agreements) with PWC with prices established between the contracting parties.[92] However, as noted by both the Utilities Commission and the Australian Energy Market Commission (AEMC), not only is there "no wholesale reference price and limited information available on the cost of wholesale electricity in the Territory"[93], PWC has considerable market power given its virtual monopoly status.[94]

3.19 The Northern Territory Major Energy Users (NTMEU) also advised the Committee that there was an over-riding concern amongst its members that the ring fencing of PWC operations had failed to inhibit cross-subsidisation:

> The ability of PWC Networks to support its retail arm so that there was no 'level playing field' for new retail entrants is most concerning, as is the fact that a new energy retailer has to source generation from its dominant competitor. [95]

3.20 In light of the above, the Committee understands that the bulk of the 350,000 MWh per annum of power that is anticipated to be generated by Northern Power Group's proposed Darwin power station is to be sold to QEnergy. As noted by QEnergy's Managing Director, Kate Farrar,

> switching electricity purchasing from Power and Water to Northern Power would cut costs and help win more customers. Because generation is such a large component of the electricity bill in the Northern Territory, it became very clear to us that real savings to customers arising from competition would only occur if we could support competitive generation being put in, and that's what Northern Power has been working on.[96]

3.21 In addition to the aforementioned issues, the Committee notes that the Commission has previously raised the "the absence of cost-reflective tariffs with adequate provision for a retail margin [and] lack of active market trading and settlement systems"[97] as other significant impediments to retail competition. While acknowledging that there was certainly potential to address these issues by means of further industry reforms, the Commission's 2009 *Review of Full Retail Contestability* concluded that:

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[91] QEnergy Limited, *Review of Wholesale Electricity Generation Market,* (Submission), QEnergy Limited, Brisbane, 2014, p.1
[92] Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p. 6
[93] Australian Energy Market Commission, *2013 Electricity Price Trends Report,* pp. 161-2; Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p.p. 5- 6
[94] Utilities Commission NT, *Role of the Commission,* p. 7
[95] Northern Territory Major Energy Users, *Submission 2,* 31 October 2013, pp. 2-3
[96] Australian Financial Review, *Generator to Lift NT Gas Demand,* 14 January 2013, p. 1, viewed 11 February 2014, http://www.icapenergy.com.au/pop.market_news.php?id=1868
[97] Utilities Commission NT, *Review of Full Retail Contestability,* p. 15

> the small size of the Territory market was likely to remain an issue for prospective new entrants. It is therefore debatable whether the cost of undertaking extensive reforms would be justified.[98]

3.22 However, the Committee heard that the need for a concerted industry reform program has become increasingly apparent in recent years given growing concerns regarding PWC's on-going financial sustainability, its infrastructure maintenance practices and the subsequent reliability of electricity supply.[99] In calling for a renewed and strengthened approach to the implementation of the principles inherent in the Territory's legislative framework, Utilities Commissioner, Dr Patrick Walsh, pointed out that:

> The commitment to commercial sustainability for Power and Water requires that prices for electricity services reflect the economically efficient cost of providing those services, leading to a more efficient allocation of resources in the production and consumption of electricity. It, thus, becomes essential to maximise efforts to enhance efficiency in the electricity industry in the Territory. Such efforts would include exposing those industries to the forces of competition where feasible, and driving efficiency improvements in natural monopoly segments of the industries, while also ensuring that services that are appropriate in reliability and quality are provided to consumers.[100]

3.23 Moreover, as highlighted by the Australian Energy Market Commission despite industry reforms designed to open up the market to competition, PWC's dominance in the generation and retail sectors means that the NT's regulated market essentially "continues to operate under a monopoly structure." [101]

Proposed Electricity Market Reform

3.24 On 27 September 2013 the Treasurer announced that the Government had approved the introduction of an electricity industry reform package to address:

- concerns around the financial sustainability of PWC;
- the lack of competition in the Territory's electricity supply market; and
- the reliance on government to fund electricity supply infrastructure to ensure reliability of supply.[102]

As detailed in the *Northern Territory Electricity Market Reform Information Paper,* the package incorporates structural and market reform initiatives to be implemented over the next 18 months to two years; the over-riding objective being the provision of electricity that is safe, reliable and at least cost to consumers.[103]

3.25 The proposed structural reform involves the disaggregation or vertical separation of "PWC's monopoly and contestable businesses into stand-alone

[98] Utilities Commission NT, *Review of Full Retail Contestability,* p. 15
[99] Committee Hansard, Dr Patrick Walsh: Utilities Commissioner, p. 4
[100] Committee Hansard, Dr Patrick Walsh, Utilities Commissioner, p. 4
[101] Australian Energy Market Commission, *2013 Electricity Price Trends Report,* p. 162
[102] Hon David Tollner MLA, Treasurer, *New Structure to Fix Labor's Mess,* (Media Release), Northern Territory Government, 27 September 2013, pp. 1-2
[103] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* p. 2

government owned corporations (GOC) with separate boards."[104] The market reform component seeks to align the operation of the Territory's three electricity market systems with the *Australian Energy Market Agreement*[105], through the introduction of relevant provisions of the laws and rules of the NEM, and transfer of regulatory functions from the Utilities Commission NT to the Australian Energy Regulator (AER) and the Australian Energy Market Commission (AEMC).[106]

3.26 As is the case in the NEM and WA WEM, development of a Northern Territory wholesale electricity market (NTEM) that has the capacity to replace the existing reliance on bilateral contracting and actively promote competition is a key component of the overall reform package. To this end, in October 2013 the Treasurer directed the Utilities Commission to "conduct a review into wholesale electricity market arrangements that are appropriate for the Territory" [107] The review's full terms of reference are provided at Appendix 6.

3.27 With regards to the restructure of PWC, the Committee understands that the existing Power and Water Corporation will be retained with responsibility for non-contestable or monopoly functions:

- Power networks and associated network control operations
- Power system control and gas purchasing functions will be retained until such time as the wholesale electricity market is open to third-party retailers and generators, at which time they will be separated from the monopoly GOC. Transition to wholesale market arrangements is currently scheduled to commence no later than 1 January 2015.
- Indigenous Essential Services
- Water and sewerage and associated retail functions
- Shared Corporate Services unit including provision of transitional or longer-term services to the Power Generation and Power Retail GOCs under formal service level agreements.[108]

3.28 The functions of the Power Retail Corporation will be essentially the same as those currently performed by PWC Retail. As the retailer of last resort, it will continue to have responsibility for associated retail activities in the Darwin-Katherine, Tennant Creek and Alice Springs market systems and the minor centres of Yulara, Borroloola, Ti Tree, Timber Creek, Kings Canyon, Daly Waters and Elliot. Similarly, as the generator of last resort, the Power

[104] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* p. 2
[105] Standing Council on Energy and Resources, *Australian Energy Market Agreement*
[106] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* p. 3
[107] Utilities Commission NT, *Independent Review of the Wholesale Generation Market: Terms of Reference,* viewed 23 October 2013, http://www.utilicom.nt.gov.au/Newsroom/Lists/Posts/Post.aspx?ID=168; see also Appendix 5
[108] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* pp. 14-15

Generation Corporation will continue to have responsibility for generation activities in the three market systems and minor centres. [109]

3.29 Importantly, in order to establish a more transparent, competitive market environment and remove the current reliance on bilateral contracting, following establishment the Power Generation Corporation "will not be permitted to sell electricity directly to end-use customers or enter into exclusive arrangements with a retailer for a period of five years."[110] Under the wholesale market arrangements all generators will be required to sell their output into an electricity exchange or pool with retailers, including the new Power Retail Corporation, purchasing their requirements from that pool accordingly. Initially, wholesale market arrangements will only apply in the Darwin-Katherine market system.[111]

3.30 Although the Government's reform agenda is consistent with its obligations as a signatory to the *National Competition Principles Agreement* and reflects industry reforms implemented elsewhere in Australia, the potential impact on the cost of energy has been raised as a matter of concern. As a consequence, on 26 March 2014 the Public Accounts Committee (PAC) resolved to inquire into the fiscal and economic impact of the proposed structural reform of PWC and the provisions of associated amendment legislation, and report to the Assembly prior to the passage of the Bills through the House.[112] Full terms of reference are provided at Appendix 7.

Positioning the NT's Electricity Supply Industry for the Future

3.31 The Committee notes that the aforementioned reform package represents a major undertaking for the electricity industry and its stakeholders. It is therefore critical that it takes into account industry and consumer trends and has the capacity to position the Territory for the future. As pointed out by the Environment Centre NT (ECNT), it also provides an opportunity for the Territory to benefit from lessons learnt elsewhere and "as the last cab off the Australian Energy Rank to….play a leadership role in adopting cutting edge best practice regulation."[113] Nevertheless, the Australian Energy Market Operator (AEMO) notes that:

> the government should be aware that the change could be costly and disruptive, and if the exercise is to be worthwhile, there must be a clear view of the government's longer term objectives.[114]

3.32 As discussed in Chapter 2, disaggregation of vertically integrated government owned utilities is widely accepted as a necessary prerequisite to wholesale market competition. Similarly, the ownership (or structural) separation model as

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[109] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* pp. 13-14
[110] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* p. 13
[111] Department of Treasury and Finance, *Northern Territory Electricity Market Reform,* p. 12
[112] Public Accounts Committee, *Inquiry into Splitting the Power and Water Corporation: Terms of Reference,* Legislative Assembly of the Northern Territory, March 2014 – see Appendix 7.
[113] Environment Centre NT, *Review of Wholesale Electricity Generation Market,* (Submission), Environment Centre NT, Darwin, 23 January 2014, p. 3
[114] Australian Energy Market Operator, *Review of Wholesale Electricity Generation Market,* (Submission), Australian Energy Market Operator, Adelaide, 28 January 2014, p. 6

proposed by the Government is recognised as having significant advantages over legal separation or functional separation via ring-fencing, as currently applies to PWC, when it comes to establishing a level playing field and encouraging transparency and competition in the energy market. Consequently, the proposed NTEM is based on the following assumptions:

- Structural separation of PWC Generation from PWC Retail;
- Legal separation of PWC Gas from PWC Generation; and
- Functional independence of System Control from PWC Networks.[115]

3.33 Although submissions to the *Review* supported both the introduction of a greater level of transparency and competition in the Territory's energy market and the disaggregation of PWC, a number of issues were raised regarding the economic and operational viability of a wholesale electricity market in the Territory given its nature and size.[116] Significantly, half of the respondents to the *Review* called for a detailed cost-benefit analysis to be undertaken to more accurately assess the applicability of a Territory wholesale electricity market.[117]

3.34 In cautioning against underestimating the time, skill and cost required to establish, let alone operate, the proposed market, the AEMO pointed out that "given the limited scope for competition, one needs to be realistic as to a market's potential benefits."[118] The Committee notes that a high-level comparison of relative costs and benefits (expressed as minimal, moderate or high) regarding the status quo arrangements, NEM, WA WEM and NTEM was subsequently included in the Commission's final report.[119]

3.35 While there was 'in principle' support for the broad strategic direction proposed by Oakley Greenwood, several submissions put forward alternative suggestions for establishing wholesale electricity market arrangements for the Territory.[120] ACIL Allen Consulting Pty Ltd (AACL) noted that they "would have expected a number of potential designs to have been identified for evaluation."[121] Others suggested that a comparative analysis should be undertaken to determine that "the selected framework is the optimal one for the Northern Territory Market."[122]

3.36 The extent to which the proposed model is suitable for implementation in the Tennant Creek and Alice Springs systems is also unclear.[123] Although other

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[115] Utilities Commission of the Northern Territory, *Review of Wholesale Electricity Generation Market Arrangements for the Northern Territory: Final Report,* Utilities Commission of the Northern Territory, February 2014, p. 1

[116] Utilities Commission NT, *Wholesale Electricity Generation Market Review: Submissions,* viewed 24 February 2014, http://www.utilicom.nt.gov.au/Newsroom/Lists/Posts/Post.aspx?ID=178

[117] Utilities Commission NT, *Wholesale Electricity Generation Market Review: Submissions* – see for example submissions from PWC, EDL, AEMO, DME, and ETU.

[118] Australian Energy Market Operator, *Review of Wholesale Electricity Generation Market,* p. 5

[119] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, pp. 25-8

[120] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, p. 16

[121] ACIL Allen Consulting Pty Ltd, *Review of Wholesale Electricity Generation Market,* (Submission), ACIL Allen Consulting Pty Ltd, Brisbane, 23 January 2014, p. 3

[122] Power and Water Corporation, *Review of Wholesale Electricity Generation Market*, (Submission), Power and Water Corporation, Darwin, February 2014, p. 3 – see also submissions from EDL, ETU

[123] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, p.20

market designs were addressed, the Commission noted that "to explore the alternatives fully would require significantly more time than was allowed for the review."[124]

3.37 Many of the submissions raised a range of issues regarding the operational and economic viability of key aspects of the proposed design; in particular the reliability assurance mechanism (RAM) and energy trading mechanism.[125] AEMO, and others, indicated that considerably more detail was required to determine whether the stated benefits could be delivered in practice.[126] Energy Developments Ltd (EDL) recommended that "the Commission consider a process to review how [these] mechanisms are tested to ensure they deliver economically efficient, safe and reliable production and supply of electricity."[127] In recommending the model the Commission acknowledged that:

> implementation of a market with these characteristics will require the resolution of many issues of detail concerning both the proposed RAM and energy trading approaches [and] will need to be further analysed as part of the NTEM design and implementation phase.[128]

3.38 Given the increasing trend towards distributed generation, whether rooftop solar PV or other technologies, a number of submissions highlighted the need to take into consideration the role of renewable generation technologies. For example, ESAA noted the importance of ensuring "an appropriate framework for alternatives to centralised generation."[129] The Department of Mines and Energy (DME) called for "more detailed consideration of the opportunities for renewable energy to compete in the wholesale generation market as either a generator or gen-tailer"[130], while ACIL expressed concern that "the recommended arrangements seem to favour gas-fired generation."[131]

3.39 While the Commission indicated that the proposed model was intended to be 'indifferent' to generation technologies, it was acknowledged that:

> the simple design for the proposed energy trading mechanism might need to change in response to the more widespread use of alternative fuels and technologies, especially in the longer term. However, the Commission notes that, given current costs of possible alternatives, gas will be the predominant source into the future.[132]

Although this may well prove to be the case, as discussed in the section on *Solar Energy* in Chapter 4, the uptake of domestic and large scale commercial solar PV has increased dramatically since July 2012. Furthermore, the Committee notes that the Government is actively seeking proposals from

[124] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, p. 9
[125] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, pp. 12-18
[126] AEMO, *Review of Wholesale Electricity Generation Market,* pp. 2-4
[127] Energy Developments Ltd, *Review of Wholesale Electricity Generation Market,* (Submission), Energy Developments Ltd, Eight Mile Plains, Qld, 28 February 2014, p. 2
[128] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, p. 2
[129] ESAA, *Review of Wholesale Electricity Generation Market,* p.4
[130] Department of Mines and Energy, *Review of Wholesale Electricity Generation Market,* (Submission), Northern Territory Government, Darwin, 29 January 2014, p. 1
[131] ACIL, *Review of Wholesale Electricity Generation Market,* p. 6
[132] Utilities Commission NT, *Review of Wholesale Electricity Generation Market Arrangements*, p. 2

investors to establish utility-scale solar farms to be connected into the Darwin-Katherine system.[133]

3.40 Taking into account recent regulatory developments in both the NEM and WA WEM, the Committee considers it essential that the Territory's overall regulatory framework has the capacity to accommodate demand side participation options, demand response mechanisms and appropriately designed Feed-in-Tariffs.[134] As ESAA points out:

> giving due attention to such issues alongside wholesale market reform will help to prevent unwelcome policy corrections in the future when investment decisions have been made on the basis of the existing framework.[135]

3.41 With regard to positioning the Territory's electricity supply industry for the future, ECNT noted the importance of acknowledging the inherent limitations of commodity based models of the 1990's, such as the NEM, when it comes to their capacity to readily adapt to modern technology trends including:

- The introduction of price signals for energy efficient technologies as both an energy security as well as a means to be able to reduce electricity and energy prices.
- The inclusion of curtailable loads in a Negawatt market alongside the Megawatt market.
- The increased uptake of distributed generation.
- The increase of large scale and utility scale solar PV seeking to participate in the wholesale market as an option to off market hedge or power purchase agreement arrangements.[136]

3.42 While not disputing the need for industry and market reform, the Committee notes its concern that the *Review's* Terms of Reference limited the potential to engage key stakeholders in a more robust debate regarding possible options for wholesale electricity trading arrangements for the Territory. In view of the preceding discussion, the Committee considers the Commission's recommendation that the Government adopt the model as currently proposed to be somewhat premature. Moreover, to proceed to the design and implementation stage without a clear indication of the costs associated with establishment and subsequent operation of the wholesale market, runs the risk that it will suffer the same fate as the Asset Management System project.[137]

3.43 In determining the most appropriate way forward for the NT, the AEMO noted that, at the end of the day, it was important to acknowledge that:

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[133] Office of Asian Engagement, Trade and Investment, *Directory of Investment Opportunities: Energy Investment Opportunities,* Northern Territory Government, Darwin, October 2013, p. 28

[134] See for example: Australian Energy Market Commission, *Power of Choice Review – Giving Consumers Options in the way they use Electricity. Final Report,* Australian Energy Market Commission, Sydney, November 2012; Australian Energy Market Operator, *Demand Response Mechanism ad Ancillary Services Unbundling – High Level Market Design, Australian Energy Market Operator,* Adelaide, 30 July 2013

[135] ESAA, *Review of Wholesale Electricity Generation Market,* p.4

[136] ECNT, *Review of Wholesale Electricity Generation Market,* p. 2

[137] Hon David. Tollner MLA, Treasurer, *Ministerial Statement: Asset Management System,* Parliamentary Record: Debates, 25 March 2014, pp. 10-13

> A market can provide the incentives to drive efficiencies going forward, but it cannot change history and resolve or hide legacy issues. Examples of such legacies could be:
>
> - Inefficient previous capital investment in plant.
> - Political difficulty in implementing cost-reflective customer prices.
>
> A market cannot resolve such issues, and indeed the integrity of some markets have been undermined where design compromises have been made in order to avoid facing and resolving these issues directly. Where these issues exist AEMO recommends they are resolved directly, prior to the introduction of any NTEM.[138]

Unregulated Electricity Market

3.44 As mentioned previously, the Territory's unregulated electricity market accounts for approximately 50 percent of the Territory's total energy consumption. As illustrated in Figure 2 (p. 22), in addition to a number of privately owned and operated power generation systems on pastoral properties and mine sites, the unregulated market incorporates:

- Mining Towns: Nhulunbuy, Alyangula and Jabiru;
- Gazetted Minor Towns: Borroloola, Elliott, Daly Waters, Timber Creek, Ti Tree;
- Remote Tourist facilities: Yulara, Kings Canyon;
- Indigenous Essential Services (IES) Communities: 72 major Indigenous communities and 57 outstation communities.

Mining Towns

3.45 The Committee heard that where towns are established specifically to support mining operations, the general principle is that the mine provides power to the whole community. Where practical they may also supply power to Indigenous communities located nearby. The terms and conditions under which power is supplied to mine employees, which may include support businesses, are determined by the individual mining company. Non-mining employees pay the uniform gazetted tariff subject to agreements negotiated between PWC and the mining company as outlined below.[139]

Nhulunbuy

3.46 Pursuant to section 14(2) of the *Electricity Reform Act 2000,* operators of the Gove bauxite mine and alumina refinery have always been exempt from the need to hold a licence with respect to electricity supply services to Nhulunbuy

[138] AEMO, *Review of Wholesale Electricity Generation Market,* p.6
[139] Committee Hansard, Mr Ken Clarke: Board Chairman, Power and Water Corporation, Public Hearing, 20 March 2014, p. 3

and associated IES communities of Yirrkala and Gunyangara.[140] As such, Rio Tinto is both a gen-tailer and owner/operator of the network infrastructure.

3.47 PWC advised the Committee that it has a retail purchase agreement with Rio Tinto whereby it acts as a billing agent, billing NT Government housing customers and the two IES communities and paying Rio Tinto for the electricity consumed. As with customers in urban areas, the normal application process applies and they are charged the uniform gazetted tariff. Under the current agreement PWC pays Rio Tinto the full cost to generate, based on the market rate for distillate. Although greater than the revenue received from customers based on the uniform tariff, the Committee heard that it is still more cost effective than if PWC were to run their own generator in Gove.[141]

3.48 Of the estimated 180 GWh the power station generates annually, PWC currently purchases and bills customers for approximately 6 GWh per annum. The Committee heard that closure of the mine's refinery operation is not anticipated to impact on PWC's access to electricity for resale given that it will still be a relatively small part of the total generated by Rio Tinto. However, whether or not it will affect the price of electricity to PWC is, as yet, unclear.[142]

Alyangula

3.49 The Groote Eylandt Mining Company (GEMCO) generates electricity for the township of Alyangula and the nearby IES community of Angurugu. GEMCO holds a Special Licence – Isolated Systems Operations which is a combination generation, retail and network licence. Under the conditions of its licence, GEMCO is allowed to:

- generate electricity at its 44MW maximum demand diesel power station;
- sell electricity to customers within the township of Alyangula or other electricity entities holding a generation or retail licence, such as PWC; and
- own and operate an electricity network within Alyangula and connect that network to the PWC network at Angurugu.[143]

3.50 As is the case in Gove, PWC has a retail agreement with the mine and purchases electricity for resale at the full cost to generate, based on market rates for distillate. PWC bills customers in Alyangula and Angurugu not associated with the mine at the standard uniform tariff, and pays GEMCO for the

[140] Utilities Commission NT, *Register of Electricity Licences and Exemptions: Alcan Gove Pty Ltd,* viewed 4 February 2014, http://www.utilicom.nt.gov.au/Publications/Registers/Pages/Registry-of-Electricity-Licences-and-Exemptions.aspx#elec_current_exemptions

[141] Power and Water Corporation, *Responses to Questions,* Q 2

[142] Committee Hansard, Mr Ken Clarke: Board Chairman, Power and Water Corporation, Public Hearing, 20 March 2014, pp. 8-9

[143] Utilities Commission NT, *Isolated System Licence Issued to Groote Eylandt Mining Company Pty Ltd,* viewed 4 February 2014, http://www.utilicom.nt.gov.au/Publications/Registers/Pages/Registry-of-Electricity-Licences-and-Exemptions.aspx#elec_current_exemptions

electricity consumed. Current consumption for these customers is approximately 4 GWh per annum.[144]

3.51 The Committee understands that the Anindilyakwa Land Council (ALC) has been exploring alternative power options, such as large-scale solar farms, to facilitate economic development and decrease dependence on non-renewable energy.[145] Ensuring the island's long term energy security is also a matter of concern given that the life span of GEMCO's current mine is less than 15 years. As the ALC points out in its *2012-2027 Strategic Plan*, in the absence of further mine expansions, "the issue of power on Groote Eylandt will be particularly critical once the GEMCO mine closes."[146]

Jabiru

3.52 Energy Resources Australia Ltd (ERA) owns and operates the Ranger Power Station at the Ranger Uranium Mine. Licensed as an *Independent Power Producer* ERA supplies electricity to the township of Jabiru.[147] PWC's normal application process applies to non-mining residential and commercial customers who are charged the standard uniform tariff, with PWC responsible for all billing and associated credit management actions.[148]

3.53 As per the agreement established between the NT Government and PWC when the Jabiru township was originally formed,

> all billing revenue is then returned to ERA on a quarterly basis…Power and Water also bill ERA installations at a zero dollar tariff and provide this information annually to ERA as a courtesy. These installations include residential, commercial and some mine sites. Some internal use of electricity by the mine and associated work places are not metered.[149]

3.54 Unlike Nhulunbuy and Alyangula, the network is not owned by the mine. Indeed, the Committee heard that it is not entirely clear who actually does own the network infrastructure.[150] Pursuant to the *Jabiru Town Development Act 1978*, the Jabiru Town Development Authority, which has a head lease agreement with the Commonwealth through to 2021, has overall responsibility for maintenance and development of the town.[151] In 1985 a cost sharing agreement was negotiated between the Commonwealth Government, the NT Government, ERA and the Authority which:

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[144] Power and Water Corporation, *Responses to Questions,* Q 1
[145] Anindilyakwa Land Council, *ALC 15 Year Strategic Plan (2012-2027),* Anindilyakwa Land Council, Groote Eylandt, November 2012, p. 72
[146] Anindilyakwa Land Council, *ALC 15 Year Strategic Plan (2012-2027),* p. 72
[147] Utilities Commission NT, *Special Licence (Independent Power Producer) issued to Energy Resources Australia,* viewed 4 February 2014, http://www.utilicom.nt.gov.au/Publications/Registers/Pages/Registry-of-Electricity-Licences-and-Exemptions.aspx#elec_current_exemptions
[148] Power and Water Corporation, *Responses to Questions,* Q 3
[149] Power and Water Corporation, *Responses to Questions,* Q 3
[150] Committee Hansard, Mr Ken Clarke: Board Chairman, Power and Water Corporation, Public Hearing, 20 March 2014, p. 5
[151] Auditor-General for the Northern Territory, *March 2012 Report to the Legislative Assembly,* Northern Territory Auditor-General's Office, Darwin, 29 March 2012, p.52

> set out the principles for the allocation between participating parties of expenditure required for the town development…The NT Government provided loan funds of $8.4 million for construction of water supply, sewerage and associated infrastructure assets. Those assets were constructed to facilitate expansion of the town to its final estimated population.[152]

3.55 Given the above ERA claim that the NT Government owns the network infrastructure but PWC believes that responsibility for such lies with ERA. Consequently, at present, PWC has a networks division which operates and services the network under a Service Level Agreement (SLA).[153] Needless to say, under the current arrangements determining responsibility for infrastructure upgrades is problematic. The Committee heard that the Department of Community Services was currently chairing a working group with representatives from PWC, ERA, JTDA, West Arnhem Shire and relevant Aboriginal organisations, in an attempt to resolve some of the issues associated with responsibility for a range of assets within the township.[154]

3.56 PWC noted that, given the age of the Ranger Power Station, potential alternatives for the supply of electricity to both the mine and the township are currently under consideration. For example, given the spare generation capacity within the Darwin-Katherine system building a transmission line between Darwin and Jabiru is one option. As PWC Board Chairman, Ken Clarke, pointed out this would be a win/win situation, "They will be happy to buy power from us and will not have to replace their plant, and we will be able to use our plant to its optimum capacity."[155]

Indigenous Essential Services

3.57 Electricity supply to 9,179 customers[156] in 72 remote communities and 57 outstations (see Appendix 8) is funded and managed by the Northern Territory Government and provided under an SLA by Indigenous Essential Services Pty Ltd (IES); a not for profit subsidiary of PWC.[157] Of the 72 major Indigenous communities 20 are designated 'major remote towns' or 'growth towns'; 15 of which are classified as 'remote service delivery' communities.[158] The Minister for Community Services is responsible for oversight of the IES program, including coordination of funding and service delivery.[159]

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[152] Auditor-General for the Northern Territory, *March 2012 Report to the Legislative Assembly,* p.52
[153] Committee Hansard, Mr Jim Bamber: General Manager Remote Operations, Power and Water Corporation, Public Hearing, 20 March 2014, p. 7
[154] Committee Hansard, Ms Djuna Pollard: Senior Executive Manager Strategy, Economics and Regulation, Power and Water Corporation, Public Hearing, 20 March 2014, p. 7
[155] Committee Hansard, Mr Ken Clarke, p. 3
[156] Power and Water Corporation, *Annual Report 2013*, p. 41
[157] Committee Hansard, Mr Mike Burgess: Board Chairman, Indigenous Essential Services Pty Ltd, Public Briefing, 11 October 2013, p. 12
[158] Indigenous Essential Services Pty Ltd, *Indigenous Essential Services: Key Points,* Tabled Paper No:3, Public Hearing, 11 October 2013, p.1
[159] Northern Territory Government, *Administrative Arrangements Order*, p. 22

3.58 The Committee heard that under its SLA with the NT Government for the *Provision of Essential Services to Nominated Indigenous Communities 2013-16*, IES receives a 'fee for service' for:

- electricity generation, distribution and retail services;
- strategic asset and service delivery planning;
- water and energy efficiency;
- development assessments;
- asset management;
- operational budget management; and
- data collection and reporting.[160]

The associated service level guidelines require that IES supply electricity at defined quality and reliability standards whereby:

> the number and length of outages is not significantly different from other similarly sized rural communities [with] planned outages limited to 6 hours.[161]

3.59 IES operations are funded from revenue collected from the sale of electricity at the uniform tariff, as is the case elsewhere in the Territory, and an annual IES grant from the NT Government as noted under the previous section in Chapter Two on *Community Service Obligations*. In addition, IES has obtained grant funding from other sources, such as the Australian Renewable Energy Association (ARENA), to implement major projects that fall outside of its requirements under the SLA.[162]

3.60 While PWC is responsible for the supply of electricity in the aforementioned gazetted minor towns and remote tourist facilities, on a day to day basis IES operate the power stations in these localities as an agent for PWC mainstream generation.[163] IES advised that essential services in a further 400 homeland communities is funded by the Australian Government, through the Department of Families, Housing, Community Services and Indigenous Affairs, and provided under the *Bushlight Program;* part of the Centre for Appropriate Technology, a national Indigenous science and technology not-for-profit organisation.[164]

Power Generation

3.61 As summarised in Table 2 below, the Committee heard that IES owns, operates and maintains:

- 52 diesel-fired power stations across the Territory with a total capacity of 76 MW;
- approximately 1320 km of high and low voltage power distribution lines;
- four solar power stations with a total capacity of 820 kW located at Hermannsburg, Lajamanu, Bulman and Yuendumu; and

[160] Indigenous Essential Services Pty Ltd, *Indigenous Essential Services: Key Points,* Tabled Paper No:3, Public Hearing, 11 October 2013, p.1
[161] Indigenous Essential Services Pty Ltd, *Indigenous Essential Services: Key Points*, pp. 1-2
[162] Committee Hansard, Mr Mike Burgess, p. 13
[163] Committee Hansard, Mr Jim Bamber, 20 March 2014, p. 5
[164] Committee Hansard, Mr Jim Bamber: General Manager Remote Operations, Indigenous Essential Services Pty Ltd, Public Briefing, 11 October 2013, p. 13

- three 15kW wind turbines at Alpurrulam.[165]

3.62 Eleven IES communities are connected to PWC urban gas-fired electricity grids: six on the Darwin-Katherine system, two on the Tennant Creek system, and three on the Alice Springs system – see Figure 2 (p. 22) As noted previously power to Yirrkala, Gunyangara and Angurugu is purchased from Rio Tinto-Alcan and GEMCO respectively. Similarly, 1 MW of solar power at Ti Tree, Kalkarindji and Alpurrurulam (Lake Nash) is sourced from Epuron under a twenty year PPA. Electricity supply assets at six outstations are privately owned with services provided on a cost recovery basis.[166]

Table 2: Power Supply IES Communities

Current Supply	Major Remote Towns	Other IES Communities	Outstations
Diesel Only (IES)	12	44	34
Diesel Only (Mines)	2	1	N/A
Solar-diesel	5	6	19
Solar-wind-diesel	N/A	1	N/A
Gas	1	9	4
Grid Connected: gas, diesel, or solar diesel	4	16	57

Source: Indigenous Essential Services Pty Ltd[167]

Remote Energy Supply Strategy

3.63 The Committee heard that the *Remote Energy Supply Strategy* incorporates three primary objectives:

> replacing diesel fuel as the primary source of power generation in remote towns and communities, minimising long-term service delivery costs and meeting community demand growth in an economic and environmentally sustainable manner.[168]

The strategy was initially established in 2009 in response to the volatility in diesel prices and the subsequent financial impost on service delivery in remote communities.[169] The Committee understands that at that time, over 31 million litres of diesel fuel was used per annum to generate electricity in the major remote communities alone, with "demand across these locations…expected to increase by a further 25% over the next three (3) years."[170]

[165] Committee Hansard, Mr Mike Burgess, p. 13; see also Power and Water Corporation, *Renewable Energy,* viewed 28 February 2014, http://www.powerwater.com.au/sustainability_and_environment/renewable_energy
[166] Committee Hansard, Mr Mike Burgess, p. 13
[167] Indigenous Essential Services Pty Ltd, *Indigenous Essential Services: Key Points*, p. 2
[168] Power and Water Corporation, *Indigenous Essential Services Annual Report 2012,* Power and Water Corporation, Darwin, 2012, p. 18
[169] Committee Hansard, Ms Megan Jolley: Manager Energy & SCADA Strategy, Indigenous Essential Services Pty Ltd, Public Briefing, 11 October 2013, p. 2
[170] Green Energy Taskforce, *Roadmap to Renewable and Low Emission Energy in Remote Communities,* Northern Territory Government, Darwin, 2011, p.6

3.64 Around the same time the Government of the day commissioned the *Green Energy Taskforce* to:

- Develop by 30 June 2010 a detailed proposal for substituting a large component of diesel generation with renewable and low emissions energy in remote communities, including financing and funding options; and
- Prepare by 31 December 2010 an evaluation of the relative merits, feasibility and likely costs of the potentially available renewable technologies to be used in the NT, including geothermal, solar, bio-fuel and tidal.[171]

These two reports provided invaluable data regarding the economic and technical assessment of options available for remote power generation at each of the 72 major Indigenous communities which underpins the *Remote Energy Supply Strategy*.[172]

3.65 Mr Jim Bamber, General Manager Remote Operations noted that IES is continually scanning for cost effective alternatives to running diesel power stations. For example, a number of communities have been connected to each other enabling IES to retire five diesel power stations in recent times. The diesel power station at Hermannsburg will also be retired in the very near future following construction of a 120km transmission line from the Brewer power station in Alice Springs.

3.66 The proximity of Wadeye to ENI's *Yelcherr* onshore gas plant has facilitated replacement of the diesel power station with gas generation which is expected to "save 57,000 tonnes of carbon over the life of the project and reduce diesel fuel consumption by over 2.5 million litres per annum."[173] Here again, the Committee was advised that there is the potential to run transmission lines to Palumpa and Peppimenarti.[174] The viability of running a transmission line from Jabiru to Oenpelli is also under consideration. [175]

3.67 Given recent advancements in virtual pipeline technology, transporting gas to communities in liquid or compressed gas forms and converting existing diesel power stations over to natural gas is under consideration.[176] As noted by Professor Peter Hartley, given the high costs associated with installing pipelines, transporting CNG from the main pipeline via trucks is a supply side management strategy widely employed in South America to provide gas for electricity generation in small towns.[177] IES advised that there was also significant potential for biofuels to replace diesel. While a successful trial has been undertaken at the Daly Waters power station where one of the generators

[171] Green Energy Taskforce, *Roadmap to Renewable and Low Emission Energy in Remote Communities,* p.12
[172] Committee Hansard, Ms Megan Jolley, p. 2
[173] Power and Water Corporation, *Annual Report 2013,* p.14
[174] Committee Hansard, Mr Jim Bamber, 11 October 2013, p. 8
[175] Committee Hansard, Mr Jim Bamber, 20 March 2014, p. 4
[176] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Indigenous Essential Services Pty Ltd, Public Briefing, 11 October 2013, p. 11
[177] Record of Meeting: Industry Stakeholders, Professor Peter Hartley: BHP Billiton Chair of Economics, University of Western Australia, 7 November 2013, p. 4

was run on 100 percent biodiesel, to date maintaining continuity of supply has proven problematic.[178]

3.68 Of the potential renewable energy resources, solar is currently deemed to be the most viable. In the absence of affordable storage technologies, the integration of solar power into existing diesel fired systems has been identified as the most cost effective option while still ensuring reliability of supply. As an example of potential savings from hybrid systems, the solar-wind-diesel system at Alpurrurulam commenced commercial operation at the beginning of 2013, as of October 2013 this system had delivered:

> 318 MWh of renewable energy and…saved 88,000 litres of diesel. For limited periods, the system delivers up to 85% of instantaneous power demand by the community, and, over the course of the day, up to 30%.[179]

3.69 The Committee heard that IES is currently seeking $60m from ARENA for its *Northern Territory Solar Energy Transformation Program* to establish solar-diesel hybrid mini-grid systems across of the Territory's remote communities.[180] IES noted that it also supports the installation of rooftop solar PV by customers with approximately 450 kW of privately owned solar currently installed across remote communities.[181] Although solar hot water systems represent a cost saving to customers and a fuel saving for utilities, the Committee heard that uptake in remote communities is limited due to the water quality.[182]

Generation Supply-Demand Balance

3.70 The Committee was advised that there has been a significant increase in electricity demand over recent years driven by population growth and Australian and Northern Territory Government investment in housing and infrastructure under the *National Partnership Agreement on Remote Indigenous Housing* (NPARIH), which also incorporates the *Strategic Indigenous Housing and Infrastructure Program* (SIHIP).[183] In housing alone, this program was scheduled to deliver 934 new builds across the 72 major Indigenous communities by the end of 2013. As such, the SIHIP program necessarily incorporated a number of power station upgrades across the major towns. [184]

3.71 With regards to the overall generation supply-demand balance, IES advised:

> for the foreseeable future, by and large, there is sufficient capacity to meet forecast demand in remote communities provided there are not significant

[178] Power and Water Corporation, *Renewable Energy,* viewed 28 February 2014, http://www.powerwater.com.au/sustainability_and_environment/renewable_energy; see also Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* pp. 33-4
[179] Committee Hansard, Ms Megan Jolley, p. 8
[180] Committee Hansard, Mr Jim Bamber, 11 October 2013, p. 12
[181] Committee Hansard, Ms Megan Jolley, p. 3
[182] Committee Hansard, Mr Trevor Horman, p. 11
[183] Committee Hansard, Ms Megan Jolley, p. 3
[184] Remote Housing NT, *About NPARIH,* Northern Territory Government, Darwin, 2012, p.1

> developments we are not aware of that come online in the immediate future.[185]

Noting that population trends in the smaller communities are less easy to predict, the Committee heard that one of the advantages of solar-diesel hybrid systems is the modular nature of the solar component; "if a community grows you can quickly add the capacity, or you can transport the capacity away if the community diminishes."[186]

3.72 Another issue impacting on the supply-demand balance in remote communities is the prevalence of customers that purchase power via power cards. IES noted that they experience significant fluctuations in demand over the course of the day and from season to season.[187] Consequently, matching the capacity and configuration of individual power stations to ensure that they can respond to changes in demand is particularly critical in the remote context. As is the case with all power stations, the remote systems incorporate three or four different sized engines that are:

> connected together with a smart control system, so that they respond to the demand by putting on a bigger or smaller engine, or even running two sets in parallel to cover demand.[188]

3.73 In addition to supply side management strategies through smart control systems, demand side participation plays an important role when it comes to maintaining the demand-supply balance, limiting the need for costly upgrades to generation facilities, and assisting customers to take control of their own costs. IES has a dedicated demand management team which has been implementing energy efficiency programs in remote communities for a number of years.[189]

3.74 The Committee heard that they were recently successful in obtaining a $9.4m grant from the Australian Government to implement a *Low Income Energy Efficiency Program* (LIEPP) in partnership with the Department of Housing, East Arnhem Shire, Charles Darwin University and Bushlight.[190] In the first instance the *Manymak (Good) Power Use* project will seek to identify barriers to energy efficiency in low income Indigenous households in the East Arnhem communities of Galiwin'ku, Gapuwiyak, Millingimbi, Yirrkala and Gunyangara. The project will then use this data to:

> develop and trial best-practice engagement and technology approaches to address identified barriers and present a best practice model for achieving improved energy efficiency with families in remote Indigenous communities.[191]

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[185] Committee Hansard, Ms Megan Jolley, p. 3
[186] Committee Hansard, Mr Trevor Horman, p. 11
[187] Committee Hansard, Ms Megan Jolley, p. 4
[188] Committee Hansard, Mr Jim Bamber, 11 October 2013, p. 4
[189] Committee Hansard, Ms Megan Jolley, pp. 4-5
[190] Committee Hansard, Ms Megan Jolley, p. 5
[191] Charles Darwin University, *Manymak (Good) Power Use!;* Australian Government, Department of Industry, *Low Income Energy Efficiency Program Round One Projects 2012,* viewed 10 March 2014,

Energy Mix and Adequacy of Fuel Supply

3.75 As highlighted in Table 3, 96 percent of the Territory's electricity is generated from natural gas and diesel fired power stations. Although the first gas turbine was installed in Darwin in 1974, it was not until the early 1980's that natural gas became the Territory's fuel of choice for electricity generation in the regional centres. [192] Following assurances that the gas fields in the Amadeus Basin south west of Alice Springs held sufficient reserves to supply Darwin, and subsequent sign off on construction of a 1500 km pipeline through to Darwin, in 1984 the Government of the day deferred its decision to build a coal-fired power station at Channel Island opting instead for a gas-fired plant.[193] By 1987 gas turbines had been commissioned in Alice Springs, Tennant Creek, and Katherine along with the new Channel Island Power Station.[194]

Table 3: Electricity Generation by Fuel Source

Fuel Source	Percentage of Total Electricity Generated
Natural Gas	64%
Diesel	26%
Combination of Natural Gas and Diesel	6%
Heavy Fuel Oil: distillate/diesel	3%
Renewable Energy: Solar, Wind, Biomass	0.91%
Kerosene and Avgas	0.09%

Source: Power and Water Corporation[195]

3.76 In 2006 PWC entered into a 25 year contract with ENI for the supply of 740 petajoules (PJ) of gas from its Blacktip field in the Bonaparte Gulf.[196] As noted by the Commission, the Blacktip field was specifically developed to "supply gas to PWC for electricity generation to replace the Amadeus Basin fields, from which the last gas was delivered in January 2012."[197] Gas from the Blacktip field comes ashore near Wadeye and is processed at ENI's *Yelcherr* gas processing facility. It is then transported via the 275 km Bonaparte Gulf pipeline entering the Amadeus pipeline at Ban Ban Springs near Adelaide River, at which point it flows both north to Darwin and south towards Alice Springs.[198]

3.77 As the first gas from Blacktip was not supplied until 2009, the Committee notes that the ENI contract does not expire until 2034. The current agreement also

[192] Power and Water Corporation, *A Brief History,* viewed 28 February 2014, https://www.powerwater.com.au/about_power_and_water/about_our_business/a_brief_history_of_power_and_water_corporation
[193] Pipeliner, *Building the Amadeus Basin to Darwin Pipeline,* viewed 10 March 2014, http://pipeliner.com.au/news/building_the_amadeus_basin_to_darwin_pipeline/000619/
[194] Power and Water Corporation, *A Brief History,* viewed 28 February 2014, https://www.powerwater.com.au/about_power_and_water/about_our_business/a_brief_history_of_power_and_water_corporation
[195] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, Public Hearing, 11 October 2013, pp. 9-11
[196] Utilities Commission NT *Power System Review 2011-12,* p.78
[197] Utilities Commission NT *Power System Review 2011-12,* p.78
[198] Committee Hansard, Mr Charles Staples: Gas Marketing Manager, Power and Water Corporation, Public Briefing, 11 October 2013, p. 8

incorporates a clause regarding the possibility of accessing additional gas if required and available. PWC advised the Committee that ENI conducts regular reviews of the gas field's reservoir capacity:

> as the reservoir is drawn down it is possible to predict how it will behave over a longer period of time. We are very early into that…[ENI] have not officially upgraded capacity estimates, and we are still operating on the estimates we contracted.[199]

3.78 In the event of a pipeline rupture or some other type of emergency, the Committee heard that PWC has a contingency gas supply arrangement with ConocoPhillips whereby gas can be supplied from its Darwin LNG facility at Wickham Point. In the case of very short term outages PWC advised that it can operate for a number of days on 'line pack' gas which is the retained pressure in the pipeline.[200] As a number of generators have a dual fuel capability some of the required capacity can also be run on liquid fuel.

3.79 PWC advised that over the past few years the overall demand for gas (domestic and industrial) has been increasing by about 2 percent per annum. Approximately 63.5 terajoules (TJ) is currently required to meet the average daily demand. At a little over 23 PJ per annum the Committee heard that this falls well within the contracted annual allowance under the terms of the ENI contract.[201] Apart from gas for electricity generation, PWC markets gas to a range of other customers including mining, manufacturing and pastoral industries. The NT also incorporates a limited natural gas distribution network supplying commercial and residential customers. [202]

3.80 Alice Springs and Darwin both have small reticulated natural gas networks. Envestra's gas distribution network in Alice Springs comprises 39 kms of gas main supplies 1100 customers, 90 percent of whom are residential customers, with a total of 3.3 PJ per annum. [203] The Darwin network services the Berrimah Gaol along with customers in the East Arm industrial village and a galvanising plant at Berrimah. A small LPG reticulated network also supplies hotels along the Esplanade in Darwin city. [204]

3.81 PWC has recently entered into a contract with Magellan Petroleum Corporation, now Central Petroleum[205], to purchase an additional 15 PJ of gas over 10 years from its Dingo gas field south of Alice Springs for the Brewer Estate power station. While not required to meet any anticipated shortfalls in gas, the Committee was advised that the Brewer Estate gas turbines are reciprocating

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[199] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 6
[200] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, pp. 3-4
[201] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 3
[202] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 56
[203] Envestra Ltd, *Gas Network Information and Statistics,* viewed 17 April 2014 http://www.envestra.com.au/our-business/operational-structure/gas-network-information-and-statistics/
[204] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 56
[205] A Bevege, "Central Petroleum Gas Coup*",* in NT News, 4 March 2014, p. 19 – *the Committee notes that Central Petroleum bought both the Palm Valley and Dingo fields from Magellan Petroleum Corporation.*

machines which require a very high quality of gas (methane with nothing else in it) to operate effectively. However, the gas currently available to Brewer comes from the Mereenie gas field which, in addition to methane, contains butane and propane which lowers the methane count. As such the Committee heard that:

> another pipeline [is] planned to come up from the Dingo field…connecting into the Brewer Estate lateral…[which] comes off the Alice Springs to Palm Valley pipeline. We will join the Dingo pipeline to that lateral so gas can either flow into Ron Goodin or Brewer Estate.[206]

3.82 With regards to diesel, the total annual consumption across PWC and IES assets is currently around 31 million litres.[207] As noted previously, prior to the implementation of the *Remote Energy Supply Strategy* this amount of diesel was required for electricity generation just in the major Indigenous communities let alone anywhere else. The Committee notes that PWC has significant diesel fuel storage capability at each of its dual-fuel facilities: Channel Island, Katherine, Tennant Creek, Ron Goodin and Owen Springs:

> The contingency quantity caters for several hours to several days, depending on the location of the stations, with higher inventories maintained at Alice Springs and Tennant Creek power stations, on account of more alternative gas supply options for Channel Island and Weddell power stations.[208]

3.83 As highlighted above, less than one percent of the Territory's electricity needs are currently met from renewable energy. In addition to the solar facilities operating in IES communities, the 1 MW grid connected Uterne Solar Power Station at Alice Springs has the capacity to provide electricity for approximately 288 average sized homes. Accounting for three percent of the generation capacity in Alice Springs, this facility is currently being expanded and will provide up to six percent of the centre's electricity requirements by mid-2014. [209]

3.84 The 1 MW grid connected LMS biogas power plant at the Shoal Bay Waste Management facility produces approximately 9000 MWh of electricity per annum from methane gas harvested from the landfill.[210] Operational since 2005 it generates sufficient electricity to power 1,200 homes:

> the equivalent in greenhouse gas emission savings of approximately 9,000 cars or planting 3,900 trees…and since its opening has been responsible for preventing approximately 46,000 tonnes CO_2 e per annum from entering the atmosphere.[211]

Apart from the obvious benefits associated with greenhouse gas emission savings, as noted in Figure 7 below, electricity generated from landfill gas is currently one of the most competitive forms of power generation.

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[206] Committee Hansard, Mr Charles Staples, p. 7
[207] Committee Hansard, Mr Mike Burgess Board Chairman, Power and Water Corporation, p. 4
[208] Utilities Commission, *Power System Review*, p. 79
[209] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 10
[210] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Indigenous Essential Services, p. 11
[211] Darwin City Council, *Shoal Bay Renewable Energy Facility,* viewed 12 March 2014, http://www.darwin.nt.gov.au/live/recycling-and-waste-management/shoal-bay-renewable-energy-facility

3.85 While noting that gas provides a stable, base load generating capacity and is presently more cost effective than renewable technologies, PWC acknowledged that there is significant potential for a greater range of renewable energy sources to contribute to the NT's overall power generation mix:

> there is going to be a sweet spot that we are going to hit, maybe in a decade's time, where these things can be truly competitive in their own right. At that point, the community might be more than willing to bear that slightly marginal extra cost that it will take to actually introduce these things on a wide scale…I believe what we will see in the future is a blend of technology supporting any one grid to manage reliability…There will always be a need to have stable generating capacity and gas is not a bad one for that.[212]

3.86 With the future in mind, PWC is currently sponsoring a study into the feasibility of a establishing a solar thermal facility in Alice Springs.[213] PWC also recently entered into a memorandum of understanding with Tenax Energy Pty Ltd regarding the development of a 2MW tidal energy demonstration project in the Clarence Strait.[214] The Committee heard that a number of major studies have also been conducted into the viability of hydroelectricity in the NT.[215] In March of this year PWC commissioned a micro hydro-electric plant in Manton Dam:

> The micro-hydro generator will be registered with the Clean Energy Regulator as an accredited renewable energy power station. It will be NT's first grid-connected hydro power station. The generator will produce enough energy to power four average-sized homes.[216]

3.87 The Committee notes that the Bureau of Energy Resource Economics regularly conducts a comprehensive assessment of 40 electricity generation technologies to provide a cost estimate for each technology type under Australian conditions. As detailed in Figure 7, the cost differential between generating electricity from fossil fuels and renewable resources is fast diminishing. For example, over the past two to three years the cost of solar PV has dropped dramatically due to a rapid increase in global production.[217]

3.88 By 2030 it is expected that solar photovoltaic and onshore wind will have the lowest levelised cost of electricity (LCOE) of all 40 technologies evaluated. Moreover, the Bureau advises that:

> over the coming decades, the Australian electricity sector will need to adjust to unprecedented changes in the relative cost of electricity generation technologies from technological innovation, movements in the fuel prices and climate change policies.[218] ATEA cost estimates suggest that Australia's electricity generation mix out to 2050 is likely to be very different to the current technology mix.[219]

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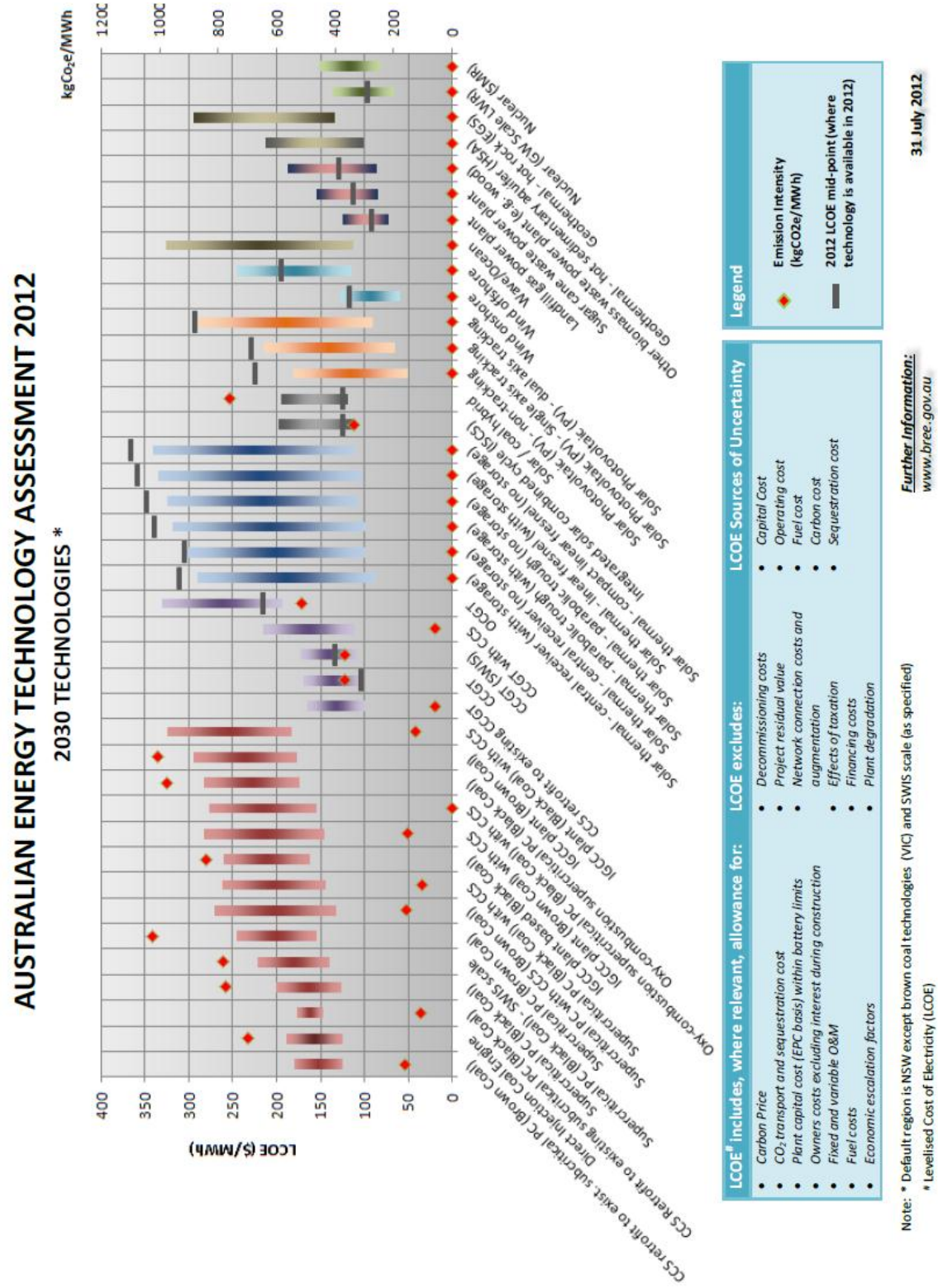
[212] Committee Hansard, Mr Mike Burgess: Board Chairman, Indigenous Essential Services, p.17
[213] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Indigenous Essential Services, p. 11
[214] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.16
[215] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.17
[216] NT News Ltd, *Hydro power switch flicked on,* NT News Ltd, Darwin, 8 March 2014, p. 3
[217] Bureau of Resource Energy Economics, *Australian Energy Technology Assessment 2012,* Commonwealth of Australia, Canberra, 2012, p. 96
[218] Bureau of Resource Energy Economics, *Australian Energy Technology Assessment 2012,* p. 96
[219] Bureau of Resource Energy Economics, *Australian Energy Technology Assessment 2012*, p.iv

Figure 7: Levelised Cost of Electricity by Energy Source



Source: Bureau of Resources and Energy Economics[220]

[220] Bureau of Resources and Energy Economics, *Australian Energy Technology Assessment LCOE Comparison Chart,* Commonwealth of Australia, Canberra, 2012

Industry Energy Requirements

3.89 The Territory's capacity to accommodate the energy requirements of major industrial developments has often been cited as an issue of concern. However, with the exception of particularly large projects such as the Gove refinery, which required 300 PJ of gas and construction of a pipeline, the evidence suggests that this concern is somewhat unfounded.

3.90 The Committee understands that major projects are considered on a "case by case 'contingent' project basis until they become certain." [221] As highlighted by the Commission, the impact of any given project can vary quite considerably depending on factors such as energy intensity, location, potential multiplier effects in the local community, and whether or not the project has its own generating capacity. Given that there is invariably considerable uncertainty regarding the timing of projects, they are not generally included in the gas and generation supply-demand forecasts referred to previously.[222]

3.91 With regards to the availability of gas for industrial projects, PWC Board Chairman Mr Mike Burgess advised the Committee that:

> There is gas available. The way the Blacktip contract was constructed there was gas at a take or pay level and then there was gas above that amount to provide to industrial customers.[223]

The Committee also notes that PWC is not the sole source of gas for industrial projects. For example, McArthur River Mine sources its gas from the Santos owned Mereenie gas field.[224] Moreover, as the Australian Petroleum Production and Exploration Association (APPEA) pointed out, the Santos owned Mereenie gas fields are not currently producing at full capacity "because they do not have markets. Mereenie has gas but it does not have any customers."[225]

3.92 Arafura Resources Ltd advised the Committee that it was currently executing a study for its Nolan Project; to develop its Nolan Bore Resource located approximately 135 kms north of Alice Springs. The gross power load for the plant for power and steam generation is 18.5 MW. During normal operations this demand will be met through the co-generation capability of its sulphuric acid plant without any additional power generation capacity required. Power and steam demand for plant start-ups, during the ramp up period when acid will be imported, and for acid plant maintenance outages will be provided via natural gas boilers and natural gas fired engines. The total peak natural gas consumption for power generation and process heating is expected to be between .8 and 1.1 PJ per annum. John Ganser, General Manager – Projects,

[221] Utilities Commission, *Power System Review*, p. 22
[222] Utilities Commission, *Power System Review*, p. 22
[223] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 16
[224] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 13
[225] Committee Hansard, Mr Steven Gerhardy: Director – NT, Australian Petroleum Production & Exploration Association, Public Hearing, 14 February 2014, p. 9

noted that "natural gas supply is assumed, and currently available from the Amadeus Basin gas pipeline which runs adjacent to our proposed site."[226]

3.93 As highlighted previously, there is sufficient generating capacity to meet forecast demand out to at least 2020 with a comfortable reserve margin. However, the Committee heard that if a single large consumer of generation entered the market and required more than the residual capacity in the system, they could negotiate an upgrade of PWC's generation capacity or purchase gas and provide their own generation capacity.[227] In the case of the abattoir currently under construction at Livingstone, for example, the Committee understands that the Australian Agricultural Company (AACo) is installing its own cogeneration plant, purchasing its gas from Santos with a spur line to be constructed from the Amadeus pipeline to the site.[228]

3.94 In the absence of a Territory wide gas pipeline network, major projects such as mines tend to be reliant upon diesel for generation given their remote location. While renewable technologies represent a viable alternative as a generation source, they are not yet cost competitive enough given the way in which mining companies treat their investments. For example, the Committee heard that Tanami Gold has considered solar on several occasions[229], however given that projects of this nature are generally looking at a five-year investment horizon:

> mining companies have been reluctant to get into the area of renewable simply because it takes a long time to pay off the upfront investment because they are capital intensive…There are probably technology solutions where you could do a combination of renewable plus traditional energy forms, but it is how it is financed that becomes difficult for the companies.[230]

3.95 With regards to the latter, the Committee notes that Tellus Holdings Ltd is considering just such a combination for its proposed Chandler Salt Mine. If the project goes ahead it will be developed on pastoral leases approximately 120 kms south of Alice Springs and about 15 km by road to the community of Titjikala. In a recent interview Tellus Managing Director, Mr Duncan van der Merwe, stated that:

> Tellus is…exploring a hybrid diesel/solar salt batter power station. Salt batteries are ideal for generating solar energy and could meet the mine's own base load power as well as meeting the needs of neighbouring communities.[231]

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[226] John Ganser (General Manager – Projects: Arafura Resources), *Arafura Resources – Energy Demands,* Email to Committee, 20 February 2014

[227] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 13

[228] AIRAH (Australian Institute of Refrigeration, Air conditioning and Heating) Industry Briefing, 26 February 2014; see also ABC News, *AACo secures gas for Darwin Abattoir,* viewed 16 April 2014, https://au.news.yahoo.com/a/22227730/aaco-secures-gas-for-darwin-abattoir/; APA Group, *APA delivering natural gas to AACo meat processing facility,* (Media Release), APA Group, Sydney, 28 March 2014, p. 1

[229] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 17

[230] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 17

[231] Alice Online, *Salt Mine: Tell us more,* viewed 16 March 2014, http://aliceonline.com.au/2012/03/18/salt-mine-tellus-more/

Furthermore, the Committee notes that ARENA received 30 expressions of interest for its 2013 round of renewable energy production grants from the mining sector, with a number having since been asked to submit full applications.[232]

Energy Efficiency

3.96 The Committee heard that supply and demand side energy efficiency strategies have significant benefits for consumers, utilities and the environment. With regards to supply side management strategies, the Committee understands that in accordance with the provisions of the *Energy Efficiency Opportunities Act 2006,* large energy using businesses, including electricity generators, are required to:

- undertake an assessment of their energy efficiency opportunities to a minimum standard in order to improve the way in which opportunities are identified and evaluated.
- report publicly on the outcomes of that assessment in order to demonstrate to the community that those businesses are effectively managing their energy.[233]

3.97 To date PWC has undertaken formal energy efficiency assessments at each of its power stations which "resulted in the identification of an annual total reduction of 690 376 GJ with an approximate net saving of $2.9 million."[234] Retro-fitting equipment and utilising new technology has also improved efficiency. Mr Trevor Horman, Manager Sustainable Energy, noted that technological advancements in recent years have had a dramatic impact on the efficiency of conventional generating plant; for example, "the efficiency…of new diesel engines is well over 42%."[235] As highlighted in PWC's *Energy Efficiency Opportunities Public Report 2013:*

> PWC has achieved a two percent improvement in energy efficiency across its three largest power stations between the baseline year 2011/12 and the reporting year 2012/13.[236]

3.98 The Committee understands that PWC is currently in the process of implementing dispatch model software that has the capacity to determine the optimum unit configuration for each power station to further minimise fuel consumption:

> The model utilises the daily load forecast, based on half hourly forecast figures, and the actual marginal fuel consumption figures for each type of plant available from our internal operational database as inputs. It considers system spinning reserve requirements and suggests dispatch for each half hour section of the day. It chooses the units to be dispatched as well as the individual loading for each unit at each point of the forecasted

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[232] B. Hagemann, 'Renewable Mining Future?', *Australian Mining,* April 2014, pp. 28-29

[233] Australian Government Department of Industry, *Energy Efficiency Opportunities Act 2006,* viewed 29 April 2014, http://energyefficiencyopportunities.gov.au/about-the-eeo-program/about-the-program/legislation-regulations/

[234] Power and Water Corporation, *Energy Efficiency Opportunities Public Report 2013,* Power and Water Corporation, Darwin, 11 February 2014, p. 1

[235] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 21

[236] Power and Water Corporation, *Energy Efficiency Opportunities Public Report 2013,* p. 1

> load. It is estimated the energy savings associated with this initiative will be 103 415 GJ with a $512,000 net annual financial saving and less than one year payback period.[237]

3.99 On the demand side, the Committee heard that there are a wide range of energy efficiency resources and products available which encourage consumers to reduce their power consumption. For example, the PWC website includes:

- a *Virtual Energy Audit* program designed to assist customers to determine how much electricity their household uses and how much energy and money can be saved by changing their power usage habits;
- a *Green Guide* which provides energy efficiency tips and general information about choosing appliances;
- Guides on residential and business appliance costing, energy efficient air conditioners, washing machines, dishwashers, refrigerators and freezers; and
- a link to helpsavetheplanet.com.au, an interactive online education resource for students and teachers.[238]

As noted by COOLmob Program Manager, Ms Nina Bailey, "by targeting what is called the low hanging, easy things you can do to save energy…you can cut your household's energy consumption by approximately 30%."[239]

3.100 However, as PWC noted, demand side management is not simply a matter of reducing consumption. Given that rising peak demand is a key driver of investment in generation and network capacity nationally, the ability to "influence demand characteristics and the load profiles to move load away from peak periods"[240] is a critical aspect of effective demand management. As such, strategies that provide consumers with an incentive to change their usage habits, such as time of use tariffs, have proven to be an effective means of reducing fuel supplies required for generation and decreasing the need for investment in generation and network infrastructure.

3.101 While time of use tariffs are currently only available to commercial customers in the NT[241], PWC advised that it participated in a five year trial (from 2008 to 2013) of cost reflective tariff pricing for domestic customers in Alice Springs as part of the solar cities program.[242] As noted in the final report on this trial "the extremes of climate in Alice Springs (eg. very hot summer afternoons, cold winter mornings) contribute to peak demands on the PWC electricity network that are more than twice the annual average load."[243] The Committee

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[237] Power and Water Corporation, *Energy Efficiency Opportunities Public Report 2013,* p. 1
[238] Power and Water Corporation, *Save on Power*
[239] Committee Hansard, Ms Nina Bailey: COOLmob Program Manager, Environment Centre NT, Public Hearing, 14 February 2014, p. 4
[240] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 22
[241] Power and Water Corporation, *Pricing and Tariffs,* viewed 10 April 2014, http://www.powerwater.com.au/customers/my_account/pricing
[242] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.22
[243] Alice Solar City Energy Champions, *Cost Reflective Tariff Pricing Trial,* Alice Springs Town Council, Alice Springs, July 2013, p. 1

understands that this trial proved quite successful and clearly indicated that "customers are very driven by the hip-pocket and will change their behaviour" when they are exposed to clear price signals.[244]

3.102 Other mechanisms to reduce peak network load include demand response enabled devices which, with the agreement of the customer, allow household appliances to be controlled remotely by utilities.[245] For example, the Committee heard that as of July 2013 all air conditioners sold in Australia must be fitted with load management terminals. This technology allows the air conditioning compressor to be interrupted for a short period when the electricity network reaches peak demand without affecting the air handling system or compromising comfort.[246]

3.103 To date, direct load control trials undertaken by network businesses have focussed on air conditioners and pool pumps, and have found "significant reductions in critical peak demand."[247] As the Productivity Commission points out, direct load control has a number of advantages for utilities:

> Network businesses can implement direct load control without the need to install smart meters (although smart meters and critical peak pricing can still be useful in providing a signal for consumers to take up direct load control)…the capacity to control load at critical peaks provides reasonable certainty over the timing, quantum and location. Reliable demand forecasts at the localised level are necessary for a network business to reduce its investments in capacity.[248]

3.104 Given that air conditioners are the single largest contributor to critical peak demand, the Committee heard that more consideration needs to be given to the storage of coolth.[249] For example, PWC noted that the Charles Darwin University (CDU) building incorporates a 13 million litre tank of water that is chilled to 1^{o}C each night and is then used to air condition the building the next day; "they have peak electricity consumption during the night, and not much during the day, and that helps with our peak demand issues."[250]

3.105 PWC advised that it had been contributing to the development of the Darwin CBD master plan in an effort to encourage the incorporation of these sorts of concepts.[251] As Dr Francis Clark pointed out in his submission:

> There are a number of facilities that could reasonably implement chilled water storage along the lines of the CDU system, especially if they can be assured of obtaining the financial benefit their infrastructure would bring to

[244] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.22
[245] Committee Hansard, Mr Rob Law: Manager Policy and Climate, Environment Centre NT, Public Hearing, 14 February 2014, p. 6
[246] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.22
[247] Productivity Commission, *Electricity Network Regulatory Frameworks Supplement to Inquiry Report: The costs and benefits of demand management for households,* No 62, 9 April 2013, Commonwealth of Australia, Canberra, 2013, p. 15
[248] Productivity Commission, *Electricity Network Regulatory Frameworks, p. 15*
[249] Submission No 23, Dr Francis Clark: Centre for Renewable Energy Charles Darwin University, 10 February 2014, pp.5-6
[250] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.22
[251] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p.22

> the system overall. This is an example of capital expenditure shifting from the central utility to players in the network.[252]

3.106 The Environment Centre NT (ECNT) noted that greater attention also needs to be given to residential building designs that are more appropriate to the tropical climate and less reliant upon air conditioning. As ECNT highlighted in their submission, households in the NT consume approximately 25kWh per day compared to 18kWh for the southern states:

> the building boom in Greater Darwin is leading to the construction of hundreds of 'hot box' houses that are poorly designed for the hot humid tropics. They are designed to be air conditioned for most of the year, have poor passive airflow, and will require owners and renters to pay ever increasing power bills.[253]

3.107 Similar concerns regarding the impact of inappropriate house designs on energy consumption were raised by PWC Board Chairman, Mr Mike Burgess:

> our early observations are that, as a trend, domestic consumption is probably increasing per residential unit. Some of that, we believe, is probably related to house design. We would be very keen for the Northern Territory to be able to take a position where it did not need to be aligned to some building codes that, honestly, do not work in our climate, because we think everyone would be better off.[254]

3.108 In recommending that the NT Government enforce national building standards for energy efficient design and construction, the Arid Lands Environment Centre Inc (ALEC) also mentioned a number of other strategies that have the capacity to improve the energy efficiency of existing buildings.[255] For example, the introduction of *Environmental Upgrade Agreements* (EUA's) in the Northern Territory:

> EUA's are innovative financing mechanisms that provide a low risk option for financing upgrades and retrofits for energy productivity. EUA's are financial agreements between building owners, financial institutions and local councils to fund environmental upgrades to existing buildings...EUA's provide a mechanism to overcome one of the largest barriers to investment in energy efficiency upgrades – up-front costs to the building owner and split incentives for owners and tenants.[256]

3.109 Based on the United States *Property Assessed Clean Energy (PACE)* financing scheme, the Committee heard that unlike conventional financial products, EUA's are tied to the property rather than the property owner. ALEC advised that EUA's for commercial buildings exist in the City of Melbourne and New South Wales and are currently being considered in South Australia.[257] The Committee notes that in February of this year the South Australian Government introduced the *Building Upgrade Finance Bill* modelled on the City of Melbourne and NSW legislation whereby:

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[252] Submission No 23, Dr Francis Clark: Centre for Renewable Energy Charles Darwin University, p. 6
[253] Submission No 16, Environment Centre NT, 22 November 2013, p. 14
[254] Committee Hansard, Mr Mike Burgess: Board Chairman, Power and Water Corporation, p. 18
[255] Submission No 12, Arid Lands Environment Centre Inc, 15 November 2013, pp. 5-6
[256] Submission No 12, Arid Lands Environment Centre Inc, 15 November 2013, p. 5
[257] Committee Hansard, Mr Jimmy Cocking: Director, Arid Lands Environment Centre Inc, Public Hearing 14 February 2014, p. 5

> The building owner is advanced funds for the upgrade by the financier in exchange for having a new council charge levied on the building by the local council. The council then collects this charge and passes it back to the financier. Because the charge is tied to the building, and not the building's owner it is considered less risky.[258]

3.110 ALEC noted that while the Government's ecoBiz NT initiative, which provides one for one funding for energy efficiency upgrades to commercial buildings, has proven to be quite successful, EUA's have the advantage of being a market based mechanism which do not require government funding. Rather, the Government's role is one of "facilitating changes in the marketplace to ensure that the market can provide incentive for energy and water efficiency."[259]

3.111 In noting that energy efficiency policies represent one of the most cost effective and immediate measures the Government can implement to reduce energy demand, ALEC advised the Committee that the International Energy Agency has developed 25 energy efficiency policy recommendations regarding buildings, appliances and equipment, lighting, transport, industry and energy utilities:

> based on this, ALEC recommends that the NT Government establish an Energy Productivity unit within the Department of the Chief Minister to work across all sectors to rapidly improve energy efficiency in the Northern Territory.[260]

ALEC further notes that, as the Territory's largest employer, the NT Government is well placed to play a key role in the move towards a more energy conscious and energy efficient jurisdiction by 'setting energy efficiency targets for all of its operations particularly building performance and vehicle fuel efficiency."[261]

[258] The Sustainability Report, *South Australia Introduces Building Upgrade Finance Bill,* viewed 12 March 2014, http://www.thesustainabilityreport.com.au/south-australia-introduces-building-upgrade-finance-bill/
[259] Committee Hansard, Mr Jimmy Cocking: Director, Arid Lands Environment Centre Inc, p. 5
[260] Submission No 12, Arid Lands Environment Centre Inc, 15 November 2013, p. 6
[261] Submission No 12, Arid Lands Environment Centre Inc, 15 November 2013, p. 6

4 Proven and Potential Energy Producing Resources

Non-Renewable Energy Resources

4.1 As highlighted in the submissions received from the petroleum industry, and as illustrated in Figures 8 and 9 below, "the NT has significant potential oil and gas resources located in both onshore and offshore basins."[262] In considering the Territory's non-renewable energy resources the Committee's inquiry focussed on the availability of natural gas for the domestic market, since it is both the primary source of fuel for electricity generation in the three market systems and, given recent technological developments, has the potential to displace diesel fired generators in the unregulated market. While noting potential sources of supply for the NT, the following discussion considers the factors impacting on resource development and the availability of gas for domestic use.

Offshore Gas Resources

4.2 As indicated in Figure 8, the NT Government is responsible for allocating petroleum rights, administering petroleum operations and collecting royalties on petroleum produced within its coastal or *Territorial Waters* (Area 2), which extend seaward for the first three nautical miles around the NT coast.[263] Representing approximately 15,000 km^2, the Committee understands that this area was first released for applications in 2009. A coastal waters exploration permit was subsequently granted to Territory Oil and Gas Pty Ltd and Beach Petroleum (NT) Pty Ltd in March 2013, "with a work program valued at approximately $6.65M over a 6 year permit term."[264]

4.3 Petroleum rights beyond the coastal waters (Area 3) to the outer limits of Australia's continental shelf, around 0.501 million km^2, are held by the Commonwealth Government. Under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGSA), "the Australian Government and the states/NT jointly grant petroleum titles and exercise resource development functions through a Joint Authority (JA) arrangement."[265] Area 5, Greater Sunrise, is jointly administered by the Commonwealth and Timor-Leste and Area 6, the Joint Petroleum Development Area (JPDA), is governed by the Timor Sea Treaty which came into force in April 2003 with "offshore petroleum acreage…released and administered by the Timor-Leste National Petroleum Authority on behalf of both countries."[266]

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[262] Submission No 21, Australian Petroleum Production and Exploration Association Ltd, 2 December 2013, p. 9

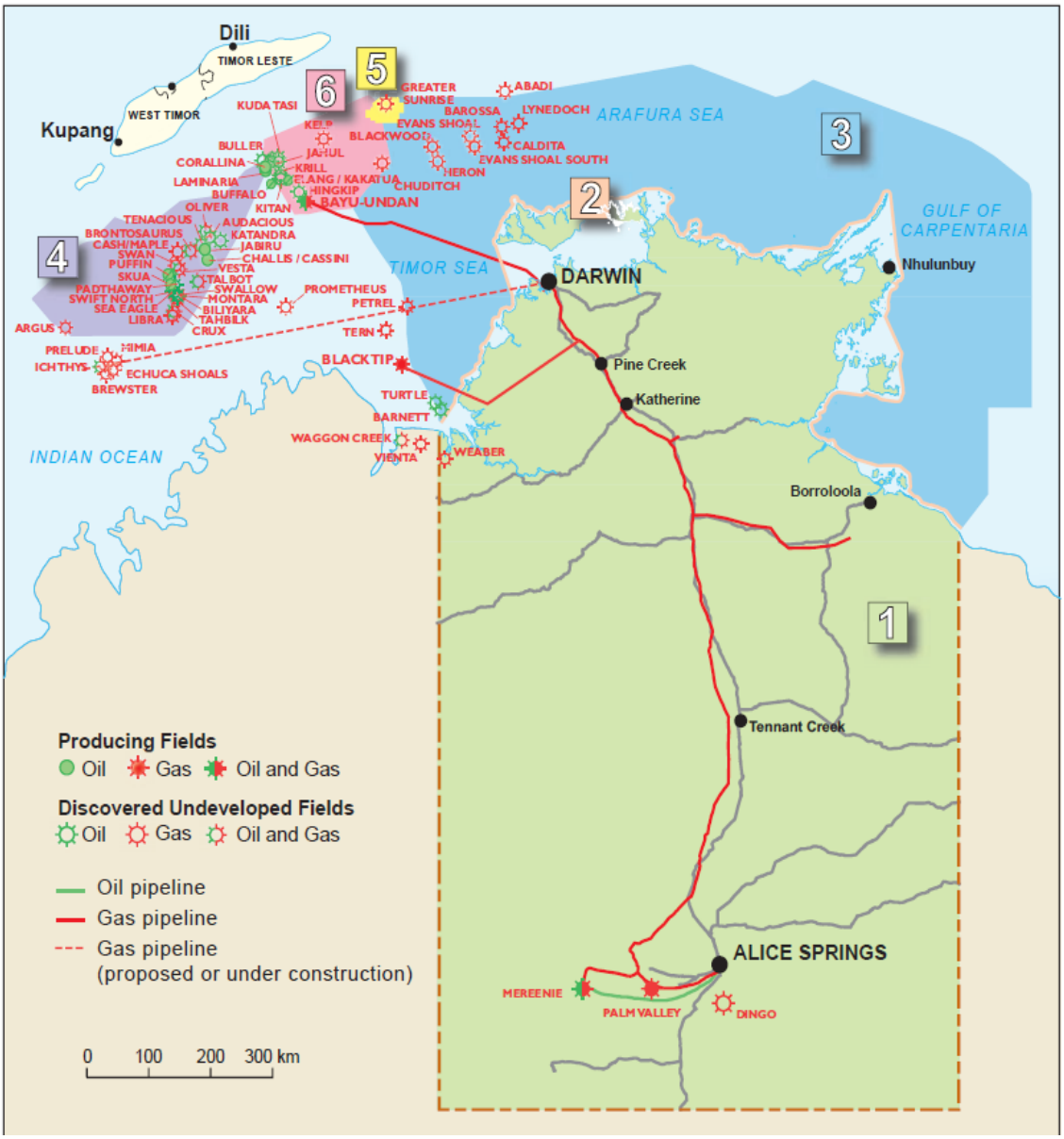
[263] Department of Resources, Energy and Tourism, "Petroleum Law and Government" in *Australia 2013: Offshore Petroleum Exploration Acreage Release,* Commonwealth of Australia, Canberra, 2013, p. 1

[264] Department of Mines and Energy: Energy Directorate, *energyNT 2013,* Northern Territory Government, Darwin, January 2014, p. 3

[265] Department of Resources, Energy and Tourism, "Petroleum Law and Government", p. 2

[266] Department of Resources, Energy and Tourism, "Petroleum Law and Government", p. 2

Figure 8: Administration of Petroleum Exploration Acreage



1 Onshore Area: 1.35 million km^2

2 Territorial Waters: 3 nautical miles around the NT coastline

3 Principal NT Offshore Area: 0.501 million km^2 between the Territorial Waters line and the International borders – administered by the Commonwealth

4 Territory of Ashmore and Cartier Islands (77,187 km^2) within the WA Offshore Area – administered by the Commonwealth

5 Greater Sunrise: made up of two adjacent but separate gas-condensate fields: Sunrise and Troubadour. The field is jointly administered by the Commonwealth and Timor-Leste

6 Joint Petroleum Development Area (JPDA) is administered by the Timor-Leste *National Petroleum Authority* on behalf of Timor Leste and Australia.

Source: Department of Resources, Minerals and Energy Group; Department of Resources, Energy and Tourism: Geoscience Australia[267]

[267] Department of Resources, Minerals and Energy Group, *energyNT 2011,* Northern Territory Government, Darwin, May 2011, p.1; and Department of Resources, Energy and Tourism: Geoscience Australia, "Petroleum Law and Government", p. 2

4.4 As indicated, area 3 incorporates a number of, as yet, undeveloped gas fields. Santos, which holds a 25 percent interest in the ConoccoPhillips operated Caldita and Barossa gas fields, advised the Committee that:

> Planning for a three well appraisal program is well advanced, following entry into the joint venture by Korean diversified group SK in June 2012. Assuming a success case at the end of the appraisal program, which gets under way in 2014, development options include expansion of Darwin LNG.[268]

4.5 The Committee further notes that in November 2013, ENI completed drilling of an appraisal well at the Evans Shoal gas field, also located in Area 3, which revealed that the field contains at least 8 TCF (trillion cubic feet) of raw gas, of which 3 to 4 TCF is expected to be recoverable for processing.[269] As the Chief Minister noted when announcing the results of the Evans Shoal appraisal:

> to put the Evans Shoal find in context, the Bayu-Undan field, which currently feeds the Darwin LNG Plant at Wickham Point, was developed on the basis of 3.4 TCF of gas. Evans Shoal is of a similar scale and could be the next big gas project for the Territory.[270]

4.6 Santos, which has an 11.5 percent interest in the Bayu-Undan oil and gas fields, located in the JPDA, advised the Committee that:

> A Final Investment Decision (FID) was recently taken on the Bayu-Undan Phase 3 project which will deliver incremental liquids recovery and higher offshore well capacity through the development of two subsea wells tied back into the existing platform.[271]

4.7 In addition, the Committee heard that Santos holds a 40 percent interest in the Petrel, Tern and Frigate (not shown in Figure 8, Frigate lies to the north west of Tern and to south west of Petrel) fields located approximately 250 km west of Darwin in the Joseph Bonaparte Gulf. While the Petrel and Tern fields were discovered in 1969 and 1971 respectively, the Committee heard that it has not been economically viable to develop them utilising conventional technology and infrastructure. Given recent technological developments, in 2009 Santos advised that it formed the Bonaparte LNG joint venture with French company GDF SUEZ to develop these fields using floating LNG (FLNG) technology:

> The project is in pre-FEED (Front End Engineering and Design) and is expected to enter FEED in early 2014, with FID scheduled for 2015 and first LNG in 2019. The facility will produce around 2.4 million tonnes per annum (Mtpa) of LNG.[272]

4.8 The Australian Petroleum Production and Exploration Association Ltd (APPEA) advised the Committee that Shell Prelude, located to the north west of the Ichthys field, incorporates the relatively small Prelude and Concerto fields with a combined resource of approximately 3TCF of gas. As such, APPEA notes that:

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[268] Submission No 22, Santos Ltd, 3 December 2013, p. 4
[269] Hon Adam Giles MLA, *New Timor Sea Gas Province,* (Media Release), Northern Territory Government, Darwin, 3 November 2013, p. 1
[270] Hon Adam Giles MLA, *New Timor Sea Gas Province,* p.1
[271] Submission No 22, Santos Ltd, p. 3
[272] Submission No 22, Santos Ltd, p. 3

> They are prefect candidates for the first implementation of Floating LNG anywhere in the world. The deployment of this leading-edge technology will result in significant flow-on benefits through employment, research and development. The Prelude FLNG facility will process 3.6 million tonnes per annum of LNG, as well as condensate and LPG, on a floating facility positioned directly over the gas field. Products will then be loaded at sea and exported direct to customers. Shell has identified Darwin as the supply base for Prelude to support the maintenance requirements of the offshore FLNG facility.[273]

The Committee understands that while the first gas is not anticipated from Prelude until 2016, construction of the supply base located at the East Arm wharf commenced in June 2013 and is expected to be completed by the middle of this year.[274]

4.9 The Ichthys Project, operated by INPEX in joint venture with the TOTAL group of companies and the Australian subsidiaries of Tokyo Gas, Osaka Gas, Chubu Electric Power and Toho Gas, is located in the Browse Basin in the offshore waters of WA.[275] The Committee heard that it consists of two reservoirs:

> one in the Brewster Member and a lower reservoir in the Plover Formation which is the major petroleum system to Australia's North. The Ichthys field is estimated to contain, on a proved and probable (2P) basis, around 12 trillion cubic feet of gas and some 500 barrels of condensate or light oil. This makes it the largest liquids discovery in Australian waters since Kingfish-1 in Bass Strait in the 1960s.[276]

4.10 Given the above, the Ichthys Project is a particularly significant "with an associated capital expenditure of US$34 billion for its development."[277] The project has an estimated lifespan of 40 years and incorporates construction of key facilities including:

- The world's largest semi-submersible platform on which a world-scale central processing facility (CPF) will be built;
- A 1.2 million barrel-capacity floating production, storage and offloading (FPSO) facility permanently moored adjacent to the CPF;
- An 889-kilometre, 42 inch diameter gas export pipeline (GEP) linking the offshore facilities to Darwin;
- An onshore gas processing plant at Blaydin Point on Middle Arm Peninsula, Darwin, designed to produce 8.4 million tonnes of LNG a year from two production trains and 1.6 million tonnes a year of LPG.[278]

4.11 In addition to the aforementioned projects, APPEA advised that other potential offshore developments include the:

- Woodside operated Sunrise Project – discovered in 1974 the Sunrise and Troubadour gas and condensate fields (Greater Sunrise) hold a total

[273] Submission No 21, Australian Petroleum Production and Exploration Association Ltd, p. 11
[274] Hon Adam Giles (Chief Minister), *Darwin Port Open for Business,* (Media Release), Northern Territory Government, Darwin, 14 June 2013, p.1
[275] Submission No 14, INPEX, 15 November 2013, p. 3
[276] Submission No 14, INPEX, 15 November 2013, p. 3
[277] Submission No 21, Australian Petroleum Production and Exploration Association Ltd, p. 10
[278] Submission No 14, INPEX, 15 November 2013, pp. 3-4

contingent resource of 5.13 TCF of dry gas and 225.9 million barrels of condensate; and the

- Tassie Shoal LNG – this project offers a commercialisation option for the remote and currently stranded gas fields in the region. Owned by MEO Australia, this plant is adjacent to the Herron and Blackwood discoveries. ENI and MEO are currently undertaking a drilling program to appraise these discoveries prior to considering development options. The Committee understands that there may be an opportunity for Herron and Blackwood to be developed in conjunction with Evans Shoal.[279]

4.12 APPEA further noted that in 2013 the Commonwealth awarded new exploration permits in both the offshore Browse and Bonaparte basins. Acreage open for bidding in the 2013 offshore release, including four areas in the Ashmore-Cartier, five in NT offshore and three in WA Browse, were "strongly supported by industry nominations indicating the high level of interest in northern Australia territorial waters. [280] While there are considerable gas reserves available in the offshore areas to the north and north-west of the Territory, and a significant level of interest in developing them, the Committee notes that by and large they are destined for the export market.

4.13 With regards to the availability of offshore gas for domestic use, INPEX noted that it needs to be acknowledged that the costs associated with tapping into these reserves are extremely high. Consequently, as was the case in the Ichthys Project, obtaining the capital to develop projects is generally contingent upon the majority, if not all, of the gas being pre-sold or committed for sale. The Committee heard that it is common for customers to become stakeholders (joint venture partners) in the project, thereby facilitating development and ensuring access to the gas they require. It was suggested that this might be a future option for the NT Government in order to secure gas for the domestic market. Farming-in to an existing project is another option.[281] However, the Committee notes that the feasibility of these types of options is questionable given the size of the Territory's domestic market.

INPEX also advised that the GEP incorporates a number of tie-in points to allow for additional gas from other fields (such as ENI's Prometheus/Rubicon gas field which lies adjacent to the GEP), and cater for future expansion of the Blaydin Point processing facility. As such, the Committee heard there is potential capacity for the Ichthys Project to supply gas to the NT domestic market when trains three to six come on line. [282]

4.14 The Committee was also advised to bear in mind that, given this infrastructure, the NT is connected to the international market. Despite the fact that gas from the Bayu-Undan and Ichthys fields has been presold and is destined for Asia,

[279] Submission No 21, Australian Petroleum Production and Exploration Association Ltd, pp. 11-12
[280] Submission No 21, Australian Petroleum Production and Exploration Association Ltd, p. 12
[281] Record of Meeting: Industry Stakeholders, Perth, 8 November 2013, p. 2
[282] Record of Meeting: Industry Stakeholders, INPEX, Perth, 8 November 2013, p. 2

there is still potential for the NT to access offshore gas processed in Darwin for domestic use via gas swaps. For example, the NT could purchase uncontracted gas from overseas LNG projects, then a gas swap with a Darwin based LNG operator could be arranged so that the overseas LNG project would ensure LNG deliveries to Asia while the Darwin based operator would feed the equivalent gas into the NT market. Noting that gas swaps are also applicable in the onshore context, Armour Energy Ltd noted that it is a common industry practice, "it is done all over the world where you have gas swaps and you make sure the pipeline takes the molecules and where they end up is all part of a commercial arrangement."[283]

4.15 Irrespective of whether or not offshore gas is available for the domestic market, the Committee notes that development of associated infrastructure has the capacity to play an important role in the NT's future energy security. For example, while the Darwin LNG was designed specifically to process gas from Bayu-Undan for export it has:

> a key role in assisting Power and Water Corporation's Channel Island electricity facility, providing back-up gas supply during maintenance shutdowns and emergencies. [284]

4.16 Moreover, as ConocoPhillips pointed out, given the high costs associated with the construction of LNG plants,:

> the appropriateness of a development option will always be considered on a project by project basis. However, in certain circumstances, existing processing infrastructure (brownfield) can be more competitive than a new development option (greenfield). In this regard, Darwin is well placed to offer a development option that can assist a project to overcome its cost challenges.
>
> In the case of Darwin LNG, this could mean backfilling the declining gas supply form Bayu-Undan with gas from another project. Another potential cost saving measure is increasing the capacity of Darwin LNG to process gas from additional sources. At present, the constructed capacity of Darwin LNG is 3.7 MTPA, but the site is licensed for up to 10 MTPA, thus providing the potential for an expanded brownfields project.[285]

4.17 The increased interest in offshore exploration has also resulted in other infrastructure developments, such as the INPEX workers village at Howard Springs. It has also facilitated the establishment of the North Australian Centre for Oil and Gas at the Charles Darwin University and other industry specific support services. As APPEA noted, with these types of developments, "there is no doubt the Territory is well positioned to take advantage of the emerging opportunities created by increasing global demand for energy, in particular Asia."[286]

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[283] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, Public Hearing, 14 February 2014, p.5
[284] Submission No 20, ConocoPhillips Australia Pty Ltd, p.1
[285] Submission No 20, ConocoPhillips Australia Pty Ltd, 29 November 2013, p. 3
[286] Committee Hansard, Mr Stedman Ellis: Chief Operating Officer-Western Region, Australian Petroleum Production and Exploration Association Ltd, Public Hearing, 14 February 2014, p. 2

Onshore Gas Resources

4.18 APPEA advised that the Territory's potential onshore conventional and unconventional gas reserves are attracting a significant level of interest from both domestic and international investors. The Committee heard that "the US Energy Information Administration has estimated the Territory contains more than 260 trillion cubic feet of gas, or enough gas to power a city of one million people for more than 5000 years.[287] As noted in the Department of Mines and Energy's *energyNT 2013* report:

> since our 2012 energyNT Report, confidence in the oil and gas potential of the Territory continues to build. On the back of results from recent on ground efforts, companies are keen to pursue further exploration opportunities in their pursuit for new oil and gas discoveries.[288]

4.19 As highlighted in Figure 9, as of December 2013 there were 55 active exploration permits (EP), four retention leases (RL) and three operating licences (OL) spread across the Territory's onshore area. The Committee understands that this represents a significant investment in the Territory's onshore petroleum industry:

> the total nominated exploration expenditure work program for onshore titles for the period 2013-2018 is estimated at $168M for petroleum exploration. The work commitment for the period includes the drilling of 30 wells and the acquisition of 5734 line km of 2D seismic data.[289]

In addition, one coastal waters exploration permit was granted "with a work program valued at approximately $6.65M over a 6–year permit term."[290] A full list of NT Onshore and Coastal Waters Petroleum Titles is provided at Appendix 9. A summary of the drilling activity in 2013 is provided at Appendix 10. As Department of Mines and Energy CEO, Mr Scott Perkins, noted:

> Onshore we have seen an incredible acceleration of activity in the past three years, with almost all of the available land given over to petroleum exploration leases. Of these 141 are applications only, and 52 are granted.[291]

4.20 With regards to current onshore exploration activities, the Committee notes that Santos has long held major interests in onshore oil and gas assets in the NT. One of Australia's largest producers of gas for the domestic market, "in the past 12 months the company has committed to spend up to $320 million in onshore exploration in the NT over the next four years."[292] Santos owns and operates the Mereenie oil and gas field located in the Amadeus Basin approximately 250 kms

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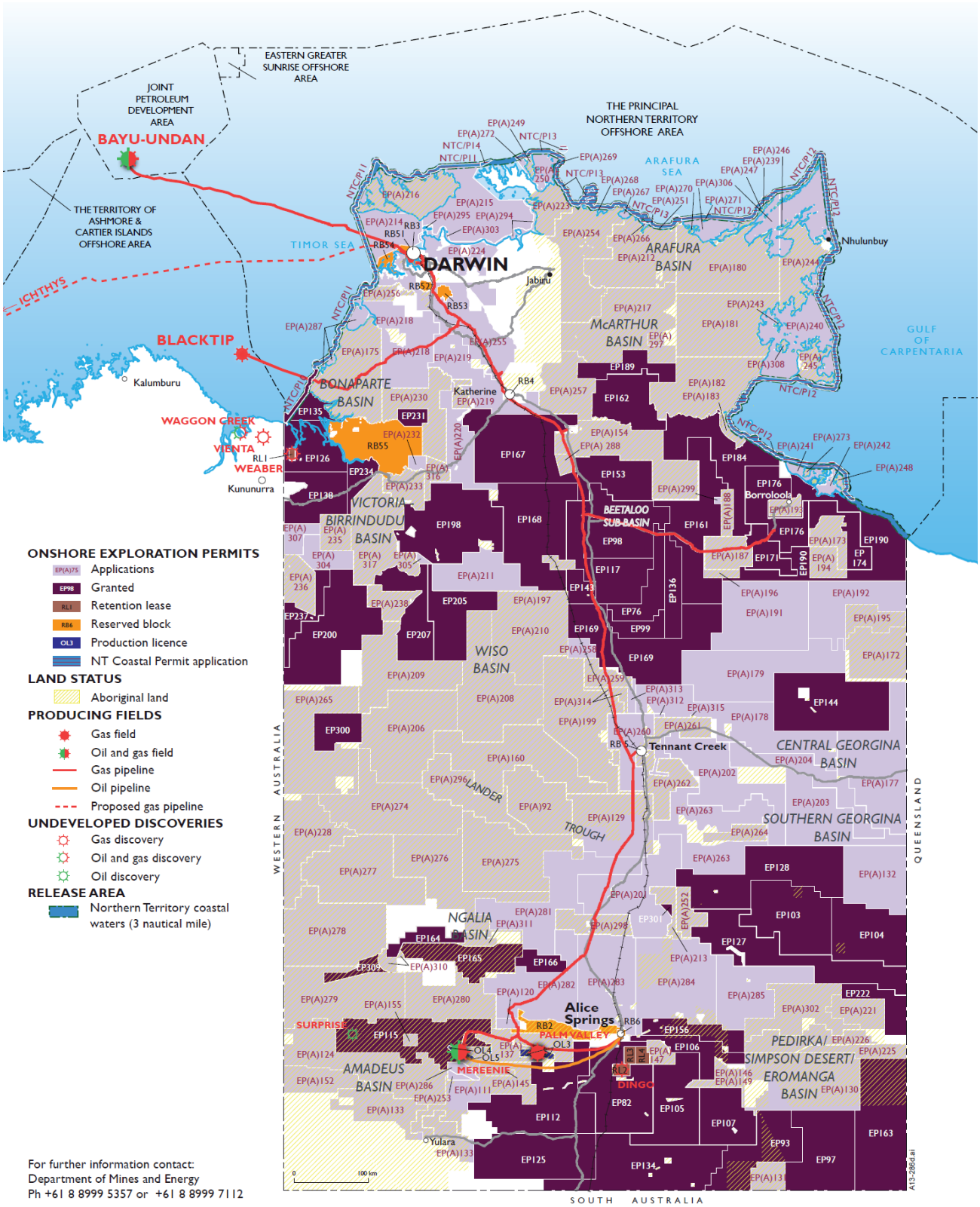
[287] Committee Hansard, Mr Stedman Ellis: Chief Operating Officer-Western Region, Australian Petroleum Production and Exploration Association Ltd, p. 2
[288] Department of Mines and Energy, *energyNT 2013,* Northern Territory Government, Darwin, January 2014, p. iv
[289] Department of Mines and Energy, *energyNT 2013*, p. 3
[290] Department of Mines and Energy, *energyNT 2013,* p. 3
[291] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, Public Briefing, 11 October 2013, p. 3; The Committee notes that between October and December 2013 a further 3 exploration permits were granted bringing the total to 55 as noted in the Department's *energyNT 2013* report.
[292] Submission No 22, Santos Ltd, p. 2

Figure 9: Petroleum Operations and Developments in 2013



Source: Department of Mines and Energy[293]

[293] Department of Mines and Energy, *energyNT 2013,* Northern Territory Government, Darwin, January 2014, p.4

west of Alice Springs. Discovered in 1963, oil production commenced in 1984 followed by gas production in 1987. The Committee notes that up until 2009 when PWC started taking gas from ENI's offshore Blacktip field, Mereenie was the primary source for the NT's domestic gas supply.

4.21 The Committee heard that Santos is currently in the process of appraising and developing further reserves in the Mereenie field. Targeting oil and evaluating natural gas, the $100 million Mereenie Appraisal and Development Drilling (MADD) project is focused on the sparsely drilled western and central areas of the field. As has been the case on half of the 63 existing wells in the Mereenie field, fracture stimulation will be incorporated as part of MADD; "dependent on the outcome of the eight well drilling program, Santos will consider drilling a further 15 wells in the field." [294]

4.22 The Committee understands that Santos has also applied for "EP 288 within the Gorrie sub-basin, an area of about 780 square kilometres, 130 kilometres south-east of Katherine.[295] The Committee was further advised that in 2012 Santos farmed-in to a four year, three phase exploration program regarding 13 exploration permits, exploration permit applications and retention leases held by Central Petroleum in the Amadeus and Pedirka Basins:

> The first phase, seismic survey program commenced in June 2013 with 200 kilometres of seismic EP 115 NM, followed by 1,500 kilometres of seismic in EPs 82, 105, 106, 107, 112 and RLs 3 and 4, as well as one exploration well, known as Mount Kitty, in WP 125. The second phase may include up to 1,300 kilometres of seismic and up to three exploration wells and the third phase may include up to five exploration wells.[296]

4.23 In the same year Santos also farmed-in to three EPs held by Tamboran Resources in the Beetaloo sub-basin of the McArthur Basin and is now the operator of these permits. The Committee heard that Santos has also agreed to farm-in to a fourth title (EP 299) that Tamboran is in the process of applying for.[297] A private, international unconventional oil and gas exploration and development company, Tamboran advised the Committee that Santos is the company's largest shareholder with a 14 percent interest. Tamboran noted that the exploration drilling in the McArthur basin in partnership with Santos represents an investment of approximately A$71 million over a three year period. In addition, Tamboran' upcoming activities include exploration drilling on its tenements in the Ngalia Basin which are wholly owned by the company.[298]

4.24 Falcon Oil & Gas Australia holds four exploration permits (76, 98, 99 and177) on pastoral leasehold land in the Beetaloo Basin. The Committee heard that geological data indicates there is potentially a large volume of both oil and gas available for recovery. In January 2013 Falcon announced that:

[294] Submission No 22, Santos Ltd, pp. 2-3
[295] Submission No 22, Santos Ltd, p. 3
[296] Submission No 22, Santos Ltd, p. 3
[297] Submission No 22, Santos Ltd, p. 3
[298] Submission No 17, Tamboran Resources, 27 November 2013, p. 1

> a report by independent resource analysis company RPS Energy, which considered the potential of the whole of the on-block basin, estimated recoverable resource volumes of 162 TCF of gas and 21 billion barrels of oil.[299]

4.25 The Committee heard that Falcon is currently in advanced negotiations with a number of potential partners regarding the next stage of exploration which will involve the drilling of a number of wells to "locate the 'sweet spots' for further appraisal work and where the geology and science support it, the appraisal of wells for production."[300] With regards to the latter Falcon noted that the appraisal process will require a significant amount of additional scientific analysis and a large amount of expenditure over the next five years since:

> successful transition to production will depend on a number of factors including establishing that there are sufficient hydrocarbons, the shale is able to produce at sufficient flow rates to justify commercial development and the cost of producing any oil and gas will produce an economic return….It is important to note that there is no ***Eureka!*** Moment in unconventional oil and gas exploration as sometimes occurs during conventional exploration…To be commercially successful, the Beetaloo Basin will need to produce very large volumes of hydrocarbons and it could be expected to have an extended life of potentially 100 or more years.[301]

4.26 Advent Energy Ltd is undertaking exploration work in the onshore component of the Bonaparte Basin which straddles the WA/NT border. Through its wholly owned subsidiary, Onshore Energy Pty Ltd, Advent holds a 100 percent interest in EP 386 which is located in WA and RL1 on the NT side of the border. The Committee understands that despite the confirmation of a proven hydrocarbon system for both oil and gas, to date there has been little exploration of the onshore portion of the Bonaparte Basin. RL1 is approximately 166 km^2 and incorporates the Weaber Gas Field. An independent assessment was completed by RISC Pty Ltd in 2011 which indicated a 3C contingent resource of 45.8 BCF of conventional gas.[302]

4.27 The Committee heard that the Bonaparte Basin also incorporates significant levels of unconventional (shale) gas. However, it was noted that extraction is more difficult and more expensive than conventional gas; a major initial cost associated with fracking is access to the water required – approximately 15 mega litres per fracture well. Advent further noted that, while gas is more prevalent, the company had also identified significant amounts of oil which are estimated to be in the order of 56 million barrels in its Bonaparte Basin acreage.[303]

4.28 As one of the smaller exploration companies, Advent noted that their primary focus is the supply of gas to the domestic WA and NT markets. The Committee understands that, to date, development of the Weaber gas field has been constrained by its remoteness and associated lack of infrastructure including

[299] Submission No 18, Falcon Oil & Gas Australia Ltd, 28 November 2013, p. 2
[300] Submission No 18, Falcon Oil & Gas Australia Ltd, p. 3
[301] Submission No 18, Falcon Oil & Gas Australia Ltd, p. 3
[302] Record of Meeting: Industry Stakeholders, Advent Energy, Perth, 7 November 2013, p. 1
[303] Record of Meeting: Industry Stakeholders, Advent Energy, p. 1

lack of all-weather access, gas processing facilities and pipelines connecting the gas field to distribution centres. While there is future potential for a pipeline between the Weaber field and Blacktip to assist gas supply to PWC, whether this would be an economically viable option is questionable.

4.29 Given recent technological developments, the use of transportable micro LNG/CNG processing plants and virtual pipeline technology to move gas from onshore exploration sites that are not necessarily within reach of an existing pipeline to remote communities, mine sites and pastoral properties has considerable potential in the Northern Territory context. Advent advised that on the basis of initial assessments, it had identified 12 customers within a 500 km diameter of its Bonaparte Basin resources that it could potentially supply with CNG via micro technology solutions including six Northern Territory remote communities – Bulla, Manyalluk, Amanbidjii, Timber Creek, Yarralin and Pigeon Hole.[304]

4.30 The Committee also heard from Armour Energy Ltd. A relatively small ASX-listed oil and gas exploration company, Armour Energy holds tenements in the McArthur, South Nicholson and Georgina Basins in the Northern Territory and Queensland. The Committee notes that over the last couple of years, Armour Energy has been one of the Territory's more active exploration companies. Like Advent, the Committee heard that Armour is "very much about domestic use of gas, but if there are opportunities to export gas we are open to that as well."[305]

4.31 Targeting both conventional and unconventional resources, Armour noted that:

> Typically the unconventional play is much larger. For the Northern Territory we are looking a roughly 18 trillion cubic feet of what we call prospective resource. It takes a lot longer to develop but, over and above, we are looking at more conventional plays that are smaller but easier and quicker to develop.[306]

4.32 Armour advised that they have drilled five wells in the NT, all of which have given good indications of the presence of hydrocarbons, with a significant gas discovery made during the drilling of its Glyde 1 well in EP 171:

> with gas flows and flares during drilling and a subsequent flow test confirming a flow of up to 3.3 million standard cubic feet per day…the gas was high in methane with negligible carbon dioxide, an important factor towards confirming an economic gas resource due to the lower processing costs required to remove carbon dioxide.[307]

Table 4 below provides a summary of Armour Energy's conventional and unconventional resource position in relation to its NT exploration permits as of November 2013. While noting its operations are still in the exploration stage, results thus far "indicate the potential for a very large gas resource which Armour Energy hopes will result in gas production in the region of 300

[304] Record of Meeting: Industry Stakeholders, Advent Energy, p. 2
[305] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, p. 3
[306] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, p. 3
[307] Submission No 8, Armour Energy Ltd, 11 November 2013, p. 2

petajoules per annum in the future."[308] To put this in perspective, PWC currently utilises less than 30PJ per annum.

Table 4: Armour Energy's Resource Position NT Exploration Permits 2013

Conventional	Contingent Resource	Coxco Dolomite	2.4 Bcf 1C; 6.0 Bcf 2C; 10.3 Bcf 3C
Conventional	Prospective Resource	Coxco Dolomite	Mean 264.4 Bcf
Unconventional	Prospective Resource	Barney Creek Shale	Mean 18.8 Tcf 2.0bn bbl condensate

Source: Armour Energy[309]

4.33 With regards to gas for the NT domestic market, Armour Energy identified the following gas supply opportunities that its projects could service in the future:

(a) gas for power generation to supply the local electricity market;

(b) gas for the existing mines of Gove and McArthur River;

(c) gas for a number of potential new mines in the Northern Territory (via a direct pipeline connected to the AGP) for onsite power generation; and

(d) due to the lack of existing pipeline and electricity network infrastructure, a small scale Northern Territory CNG/LNG project could be an option for supply to a few major mines.[310]

4.34 Armour Energy further noted that there was potential for a Greenfield LNG project using micro technology in the Gulf of Carpentaria:

> One of the things we have been looking at for some time is potential LNG-type projects around the Gulf of Carpentaria. Bing Bong is an opportunity. There is a range now-the technologies around LNG run from micro-LNG plants up to the majors like they are building at Gladstone on Curtis Island. It is possible to get LNG processing plants built on barges and they can be beached or moored and you can then tranship LNG to larger vessels if you want to. There is a range of possibilities to get LNG. Bing Bong…isn't far from our field, and in Queensland Mornington Island is close, and there is some deep water access so it is possible we could do something there. Also it is possible you could go across to Karumba.[311]

4.35 While certainly not an exhaustive overview of the offshore and onshore gas explorations underway in the Northern Territory, the preceding discussion clearly illustrates that if only a small percentage of these projects comes to fruition there is likely to be significant reserves of gas potentially available for the domestic market. As PANGAEA Resources pointed out, "if the potential and expected production projections hold up there will be a massive surplus of gas for domestic use."[312] However, the Committee understands that given production scale-up times, this may not be realised for another five to ten years. As Santos points out:

[308] Submission No 8, Armour Energy Ltd, 11 November 2013, p. 4
[309] Submission No 8, Armour Energy Ltd, p. 3
[310] Submission No 8, Armour Energy Ltd, p. 5
[311] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, p. 7
[312] Submission No 6, PANGAEA Resources Pty Ltd, 8 November 2013, p. 2

> gas projects typically take three to five years to develop once FID has been taken (timeframes may involve two to three years before drilling exploration wells, then discoveries have to be appraised over two or more years, then an economic development has to be worked up over two or more years, then the project has to built over $2^1/_2$ years or more).[313]

Then too, as discussed below, there are a range of factors that impact on final investment decisions.

Key Challenges

4.36 The Committee notes that there was a significant degree of agreement amongst stakeholders as to the factors which impact on both the development of energy producing resources and the availability of such for domestic use. While not necessarily capturing the specifics of all of the issues raised with the Committee, the following summary seeks to highlight the key challenges facing the Territory's burgeoning oil and gas industry and, as a consequence, the NT's future energy security in so far as it relates to non-renewable energy resources.

4.37 Fiscal stability, provision of a competitive economic environment, supportive regulatory and policy frameworks, and a commitment to a transparent, market-based approach were identified as being of fundamental importance when it comes to easing industry concerns about investment and sovereign risk, and facilitating the Northern Territory's ability to maximise its potential. With regards to accessing gas for domestic use, the Committee heard that the size of the Territory market was

4.38 INPEX noted the capacity for Australia to maintain its international competitiveness as one of the more significant challenges. The Committee heard that, by international standards, Australia is a high-cost location with relatively high labour costs (both direct and indirect); time consuming and costly regulatory compliance frameworks; a lack of infrastructure, and in many cases skilled labour, required to facilitate large scale projects; and a carbon tax which has added another line item to project overheads. Given the investment opportunities arising elsewhere in the world, it was noted while Australia has significant offshore and onshore natural gas and oil reserves, ensuring that the economic setting encourages the exploration and development of these reserves is critical.[314]

4.39 Acknowledging that the NT is well positioned to develop into a major oil and gas hub, ConocoPhillips noted that:

> the single most important element of the Northern Territory's energy future lies in continuing to ensure a stable, consistent and supportive regulatory regime for exploration, investment and innovation. As a developing jurisdiction in an increasingly competitive global energy marketplace, the Northern Territory should take every step to protect its natural advantages of existing infrastructure, location, policy stability and forward looking pro-investment environment. Furthermore, the Northern Territory should avoid

[313] Submission No 22, Santos Ltd, p. 4
[314] Record of Meeting: Industry Stakeholders, INPEX, Perth, 8 November 2013, p. 1

> policy setting seeking to impose artificial constraints on energy pricing or supply.[315]

4.40 With regards to the latter point, Professor Peter Hartley advised the Committee that while domestic gas reservation (DGR) may well have the capacity to ensure on-going access to gas for domestic use, as a form of trade restriction or export control they diminish the value that can be obtained from a country's resource endowment.[316] As noted by Deloitte Access Economics Pty Ltd:

> The impact of a DGR is to – in effect – place a simultaneous tax on domestic gas production and subsidy on domestic gas consumption. Like all taxes and subsidies, the DGR distorts economic decisions and generates an unequivocal economic loss – one which compounds over time as future investment decisions are affected.[317]

As Professor Peter Hartley pointed out in respect of Western Australia's DGR, subsidising the domestic gas market inevitably encourages other industries to develop based on that subsidy. This then makes it difficult to remove at a later date. While good for the end consumer, lower prices achieved through reservation policies discourage exploration and can ultimately lead to limited competition and supply constraints.[318] ConocoPhillips also noted that "numerous studies have been conducted that definitively conclude that these policies achieve an outcome inverse to their goal of energy security."[319]

4.41 Although INPEX advised that the Committee a DGR would not necessarily deter the company from future investment in the NT, it would likely affect its investment framework. As INPEX pointed out, domestic gas reservation policies are necessarily of concern to the financial institutions providing the capital for projects, as essentially it means that there is a certain amount of gas sitting there that no-one knows if or when it will be sold and at what price.[320] Hence, as Santos pointed out, exploration investment is more likely to be "directed to those prospective areas, in Australia and overseas, where a proper commercial return would be obtained."[321]

4.42 With regards to the Territory's regulatory framework the Committee understands that the NT Government recently commissioned an independent review of the *Petroleum Act* and associated regulations, and t*he Petroleum (Submerged Lands) Act* and regulations.[322] As acknowledged by Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy:

> There is a major precursor to developing good outcomes in the energy sector in that we must ensure that our regulatory environment supports development while ensuring that risks to the NT are mitigated through sensible development parameters. To that end and building on the Hunter

[315] Submission No 20, ConocoPhillips Australia Pty Ltd, 29 November 2013, pp. 4-5
[316] Record of Meeting: Industry Stakeholders, Professor Peter Hartley, Perth, 7 November 2013, p. 3
[317] Deloitte Access Economics Pty Ltd, *The economic impacts of a domestic gas reservation,* Deloitte Access Economics Pty Ltd, Adelaide, p. ii
[318] Record of Meeting: Industry Stakeholders, Professor Peter Hartley, Perth, 7 November 2013, p. 3
[319] Submission No 20, ConocoPhillips Australia Pty Ltd, p. 4
[320] Record of Meeting: Industry Stakeholders, INPEX, Perth, 8 November 2013, p. 1
[321] Submission No 22, Santos Ltd, p. 4
[322] Submission No 22, Santos Ltd, p. 6

> review of our petroleum regulations, we are in the process of reviewing our three petroleum acts. The review will be completed by 30 June 2014 with any changes to be consulted and debated in the 2014-15 financial year.
>
> In preparation for this, several initiatives are now implemented or are in the process of being implemented. For instance, all the recommendations of the Hunter report are in place and published on the department's website. This has led to the development of good contemporary management and environmental regulations based on those operating in Western Australia and aligned with the federal government's offshore regulatory framework.[323]

4.43 While submissions to the inquiry supported this review initiative, a number of them raised concerns regarding the overly prescriptive nature of the NT's regulatory framework. As the Association of Mining and Exploration Companies (AMEC) noted:

> The most obvious impact that currently does and will affect the growth of the Northern Territory's energy industry is the current trend toward greater levels of regulation…It is imperative that the competitive advantage that the Territory has possessed is not eroded under the weight of regulatory burden for no additional benefit.
>
> AMEC recommends that all legislation be assessed against a framework of outcome focussed and risk-based regulation…The Territory needs to concentrate further on compliance measure to ensure proponents are operating in a responsible manner, rather than blocking entrants with lengthy and expensive approval, compliance and regulatory processes.[324]

PANGAEA Resources also noted that "increased regulatory burden compliance, enforcement and monitoring might slow down the approval process and delay projects."[325]

4.44 Falcon Oil and Gas noted that in reviewing and updating regulatory frameworks, it was important that the Government bears in mind that:

> As the industry's technology is developing at a rapid pace and becoming more sophisticated, the regulatory framework must be sufficiently flexible to accommodate developments when they occur. The management of the regulatory framework requires departmental staff with the requisite knowledge and skills in sufficient numbers to enable the industry to obtain its approvals and be supervised in a timely manner.[326]

4.45 However, Armour Energy noted that while they had found the Department of Mines and Energy (NTDME) to be extremely helpful, in comparison to Queensland and South Australia, for example, the Territory's regulatory environment was both considerably less flexible and, given its overly prescriptive nature, ran the risk of becoming very difficult to manage from the department's perspective as exploration activity ramps up across the Territory.[327]

> Most difficulties have occurred in real time when informing the NTDME of minor variations to approved field programs. This has proved challenging

[323] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, p. 3
[324] Submission No 19, Association of Mining and Exploration Companies Inc, 28 November 2013, pp. 1-2
[325] Submission No 6, PANGAEA Resources Pty Ltd, p. 1
[326] Submission No 18, Falcon Oil & Gas Australia Ltd, p. 4
[327] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, p. 5

> and has created unnecessary operating inefficiencies and delays without tangible benefits (and often unavoidable costs associated with same).[328]

4.46 In noting the ability for experienced operators to manage their operations in accordance with good oilfield practice, Armour Energy recommended that:

> the Northern Territory develop models which take into consideration the practical considerations of the onshore oil and gas industry, which is quite different to offshore, and create obligations for the operator to remain compliant within the boundaries of their own rigorous assessment processes or suffer serious consequences for the lack of compliance….a good example of this can be seen in Queensland, where some of the toughest regulations, frameworks and approval conditions for resource projects have been imposed. Such regulations ensure that Operators deliver safe operations, high standards of environmental protection, protection of water supplies and farming land and providing fair conditions for landholders. These regulations have been imposed whilst facilitating rapid growth in the onshore petroleum industry.
>
> We recommend the Northern Territory Government seriously consider a similar framework…Companies such as Armour Energy continuously evaluate and prioritise where capital is to be spent. In this context it is important that the Northern Territory provides an attractive regulatory environment that incentivises investment and minimizes red and green tape, whilst ensuring proper controls are in place to protect the environment, cultural heritage and concerns of other key stakeholders.
>
> The regulatory environment for the gas industry in the Northern Territory must set a framework that facilitates the achievement of these goals or risk a failure for the industry to develop to its full potential or at all. The Northern Territory Government must focus on getting the balance right between growing a world-class gas industry, protecting the environment and delivering opportunities to Northern Territory residents, through an attractive regulatory environment.[329]

4.47 Concerns were also raised regarding the extent to which the NT's regulatory framework has the capacity to mitigate the potential environmental impacts associated with unconventional gas exploration. As highlighted previously, while it is a little known fact, hydraulic fracturing was first used in the Territory over thirty years ago with 50 percent of the wells in the Mereenie gas field, which at the time was the mainstay of the Territory's gas supply for electricity generation, subject to vertical fracking practices. While Tamboran Resources notes that the "surrounding and underlying Mereenie aquifer has been unaffected by these activities"[330], ALEC pointed out that:

> something which is not so much on the record is in the late 1960s or 1970s there was a significant leak there. That is not well publicised on the APPEA or Santos websites…What needs to happen with this industry is there needs to be stronger regulation to ensure we do not have the risk of contamination. If there is to be fracking we need to be sure the aquifer is

[328] Submission No 8, Armour Energy Ltd, p. 6; see also Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer and Mr Roger Cressey: General Manager Operations and Projects, Armour Energy Ltd, pp. 4-5 for additional information.
[329] Submission No 8, Armour Energy Ltd, pp. 6-7
[330] Submission No 17, Tamboran Resources, 27 November 2013, p. 3

> safe and it is not just an industry proponent or authority who will seek to profit from that venture telling us it will be okay.[331]

4.48 Quite apart from concerns regarding potential for contamination of aquifers, the impact of the chemicals used in the process and issues associated with fugitive emissions, as noted previously fracking requires access to considerable amounts of water. As Professor Peter Hartley pointed out,

> Issues associated with the volume of water required for fracking will be a significant factor in the development of the NT's unconventional gas resources. Whilst much of the water used can be cleaned and reused in the fracking process, accessing the not inconsiderable amount of water required for fracking will be an issue in many parts of the NT. Disposing of the treated, but still contaminated water, will be another issue and will require suitable underground sites; it is noted that it would generally be inadvisable to dispose of remaining contaminated water through surface streams etc. even if flooding is not an issue. The potential to deplete available water supplies is also a very real concern when it comes to fracking in the NT.[332]

4.49 While noting that hydraulic fracturing has the potential to unlock significant economic benefits for the NT oil and gas industry, Minister for Lands, Planning and Environment, Hon Peter Chandler, acknowledged that public concern regarding the potential environmental impacts was necessarily causing some angst. As such, on 20 February 2014 the Minister announced that he had recommended the Government commission an inquiry into the potential environmental impacts of hydraulic fracturing in the Northern Territory.[333] To be conducted by the Environmental Protection Agency, as per the inquiry terms of reference provided at Appendix 11, the Minister noted that:

> It is my intention that the inquiry will look at assessment of environmental risks, actual environmental impacts and the effectiveness of mitigation measures…The inquiry aims to separate the actual environmental risks from the perceived risks and clear up some of the claims about hydraulic fracturing that have caused significant public concern. Recommendations of effective methods for mitigating actual environmental impacts will come from the inquiry. I want this inquiry to provide Territorians with accurate information so they can have the upmost confidence in our regulatory framework.[334]

4.50 Noting the public's lack of understanding regarding the difference between hydraulic fracturing practices required for coal seam gas, as is the case in NSW and Queensland, and tight gas or shale gas, as is the case in the Territory, the Department of Mines and Energy noted:

> We currently have a program of public meetings being rolled out across the Territory…They are being done in conjunction with APPEA, the industry body, and the industry itself…We have also spoken at two meetings of the Northern Land Council and given them presentations.[335]

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[331] Committee Hansard, Mr Jim Cocking: Director, Arid Lands Environment Centre Inc, p. 8
[332] Record of Meeting: Industry Stakeholders, Professor Peter Hartley, p. 3
[333] Hon Peter Chandler MLA (Minister for Lands, Planning and the Environment), *Inquiry into Fracking,* (Media Release), Northern Territory Government, Darwin, 20 February 2014, p. 1
[334] Hon Peter Chandler MLA (Minister for Lands, Planning and the Environment), *Inquiry into Fracking,* (Media Release), Northern Territory Government, Darwin, 20 February 2014, p. 1
[335] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, p. 7

Tamboran Resources noted that "the industry is already working in a cooperative manner with the NTCA [Northern Territory Cattlemen's Association], which represents the Pastoralists in the Northern Territory."[336]

4.51 However, taking ALEC's point into consideration regarding the need for such presentations to incorporate the views of independent bodies that do not have a vested interest in the industry, the Committee notes that Queensland incorporates a *GasFields Commission* for this purpose. The Commission is an independent statutory body established under the *Gasfields Commission Act 2013*. Established to manage and improve sustainable co-existence of landholders, regional communities and the onshore gas industry, the GasFields Commission is "part of the Queensland Government's commitment to give local communities a more direct say on the responsible development of the CSG-LNG industry.[337]

4.52 Chaired by John Cotter, former chairperson of the Surat Basin CSG Engagement Group and past AgForce president, the Committee notes that GasFields commissioners are drawn from a wide range of backgrounds. For example, Cabinet recently approved the appointment of six new GasField Commissioners including:

- Mr Don Stiller – a landholder and former Mayor of Taroom
- Mr Ian Hayllor – a cotton farmer and irrigator who has a long involvement in managing co-existence through his role as chair of the Basin Sustainability Alliance
- Councillor Ray Brown, - Mayor of Western Downs Regional Council
- Mr Rick Wilkinson – Chief Technical Officer of the Australian Petroleum Production and Exploration Association
- Professor Steven Raine – a leading academic, soil scientist and Executive Director of the University of Southern Queensland's Institute for Agriculture and the Environment
- Mr Shane Charles – Chief Executive Officer of Toowoomba and Surat Basin Enterprise, with more than 20 years experience as a lawyer.[338]

4.53 With regards to the potential for something similar to be established in the Northern Territory, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy, noted:

> I think it is very effective. We believe the Gas Commissioner can provide a very effective bridge between the industry, local communities and government. It will always be an independent voice. If the Territory is considering something similar I would certainly support it.[339]

[336] Submission No 17, Tamboran Resources, p. 2
[337] Queensland Government Business and Industry Portal, *GasFields Commission,* viewed 14 April 2014, http://www.business.qld.gov.au/industry/csg-lng-industry/gasfields-commission; see also http://www.gasfieldscommissionqld.org.au/gasfields/
[338] Queensland Government Business and Industry Portal, *GasFields Commission*
[339] Committee Hansard, Mr Robbert de Weijer: Chief Executive Officer, Armour Energy Ltd, p. 7

The Committee notes that, given the increase in onshore exploration, an NT GasFields Commission could potentially expedite negotiations regarding access to land.

4.54 Access to land was identified as an issue of concern in a number of the submissions provided to the Committee. As Advent Energy noted, the compliance process is further complicated where exploration involves obtaining access to land that comes under the *Native Title Act* or the *Aboriginal Land Rights (Northern Territory) Act* and, as such, is subject to the *NT Aboriginal Sacred Sites* Act, the *Heritage Act* (NT) and associated regulations.[340]

4.55 The Committee understands that, excluding townships, there are two main categories of land tenure in the NT – Aboriginal Freehold (ABF) and Pastoral Lease. While noting that the Government does not regulate contact between mining companies and Pastoralists, it was noted that in some instances exploration applications on Pastoral Leases may be subject to the *Native Title Act* which is administered by the Commonwealth. Where this is not the case, Department of Mines and Energy Chief Executive Officer, Mr Scott Perkins, noted that negotiating access to Pastoral Lease land is:

> up to the two parties to get together and work out a mutually satisfactory solution. That has ended up with some advantage to some people with new roads and so forth. By and large, my sense is that is working relatively well. We are of the opinion that we would not regulate that unless we had to.[341]

4.56 As indicated in Figure 9 (p. 74) a significant proportion of land in the Territory is classified as Aboriginal Freehold with mining exploration applications subject to the provisions of the *Aboriginal Land Rights (Northern Territory) Act* 1976 (ALRA). Under ALRA, mining companies are required to negotiate land access with the relevant Land Council (Northern Land Council, Central Land Council, Tiwi Land Council or Anindilyakwa Land Council) who are recognised as the landowner under the Act and responsible for representing the views of the Traditional Owners.[342] The Committee understands that on receipt of an application to explore on Aboriginal Freehold land the Department of Mines and Energy:

> ensures legislative compliance, and public notification process is undertaken. On completion of this process the NT Minister for Mines and Energy, may issue *consent to negotiate. This consent then activates processes under Part IV of ALRA.*[343]

4.57 As highlighted in the ALRA flowchart provided at Appendix 11, once *consent to negotiate* has been obtained there is a clear pathway that mining companies are required to follow in negotiating land access. However, as AMEC pointed out:

> whilst there are stated pathways to address…ALRA negotiations the experience of explorers and potential investors into the Territory is that the

[340] Record of Meeting: Industry Stakeholders, Advent Energy Ltd, p. 2
[341] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, p. 12
[342] Department of Mines and Energy, *Exploration on Aboriginal Freehold Land,* Northern Territory Government, Darwin, July 2013, p. 1
[343] Department of Mines and Energy, *Exploration on Aboriginal Freehold Land,* p. 1

> outcomes are uncertain, opaque and lack clarity due to the vagaries of the process…There is a strong belief amongst industry members that the process needs reforming to ensure that Traditional Owners have direct input into negotiations determining their future. It is acknowledged that this may not necessarily reduce negotiating time, but would remove variables from this process.[344]

PANGAEA Resources also note that there was a "marked difference…in the duration of securing agreements and signing depending on which Land Council you are dealing with."[345]

4.58 As Mr Perkins noted, unlike negotiations associated with mineral titles, petroleum titles are far more inclined to involve much larger tracts of land which often poses problems for Land Councils:

> The difficulty land councils have under the existing legislation is getting consent from many clans at the same time. Our solution to that is to examine whether or not we can divide those tenements down into smaller chunks in order to make them more manageable under the current land rights legislation.[346]

4.59 Given the increase in exploration activity, the capacity for Land Councils to process applications and cultural heritage clearances was also noted as a concern. As Armour Energy pointed out:

> we will need more sites cleared every year we go forward as we are able to do more wells…The fact the traditional owner group [Land Council] covers a large area – not just our tenements, but other companies' tenements – is perhaps going to put some excess load on the available time and ability of the NLC, for example, with the native title proponents to do the cultural heritage clearances. We are keen to make sure we advise, as early as possible every year, the NLC what we are looking to achieve and work with them to get those clearances done. So far we have not had any issues, but we are cautious about how it is going to work out going forward.[347]

Advent Energy also noted that, unlike Western Australia, the NT legislation incorporates a requirement for heritage sites to be reassessed every five years which is expensive, time consuming and of some concern when it comes to being assured of on-going tenure over exploration acreage.[348] However, the Committee notes that pursuant to Division 6 of the *Heritage Act 2011* (NT), reassessment is only required where the Minister makes a *provisional* declaration that a place or object is *likely* to be of heritage significance as against making a *permanent* declaration that a place or object is deemed to be of heritage significant.[349]

4.60 Given that much of the mining exploration activity in the NT occurs in remote to very remote parts of the Territory, a number of submissions received from industry stakeholders highlighted the lack of infrastructure as an issue of particular concern. As Santos observed:

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[344] Submission No 19, Association of Mining and Exploration Companies Inc, p. 2
[345] Submission No 6, PANGAEA Resources Pty Ltd, p. 1
[346] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, p. 12
[347] Committee Hansard, Mr Roger Cressey: General Manager Operations and Projects, Armour Energy Ltd, p. 2
[348] Record of Meeting: Industry Stakeholders, Advent Energy Ltd, p. 2
[349] *Heritage Act (NT)* 2011, Division 6

> The development of a shale oil and gas industry in the NT will require significant future infrastructure investment, particularly for roads and an expanded gas pipeline network. Santos notes the critical role that available infrastructure played in the rapid development of the shale oil and gas industry in the United States.

4.61 As noted previously, during the course of this inquiry it was mentioned on a number of occasions that one of the biggest challenges for the NT when it comes to accessing gas for domestic use is the size of the NT market. At the same time, the Committee notes that growing the market is, in many respects, a *catch 22* situation. As highlighted by the recent debate over *Gas for Gove*, while providing gas to Rio Tinto would have certainly served to dramatically increase the size of the Territory's market, in the absence of a readily identifiable alternate source of gas, and taking into consideration the lead times for gas production, it had the potential to impact on gas reserves required for domestic power generation. However, as Professor Peter Hartley pointed out, growing the Territory's gas market need not impact on its current or future reserves required for power generation:

> As a small customer, developing the infrastructure necessary to connect the NT to the eastern market in Australia would be particularly advantageous as it would allow the NT to enter the competitive market and tie NT pricing to those prevailing in the much larger and more liquid eastern Australian market.[350]

4.62 As Armour Energy noted, while in the first instance it would be looking at supplying the NT domestic market, the volumes its fields could potentially produce will necessarily require access to larger markets in the longer term. In addition to the possibility of developing an LNG export project, linking its projects to pipelines in Queensland is another option under consideration:

> In June 2013, Armour Energy signed a Heads of Agreement with APA Group that includes new infrastructure and/or pipeline expansions from Armour Energy's Northern Territory permits to deliver gas to end markets in Queensland and elsewhere on the East Coast.[351]

4.63 The Committee notes that in February of this year pipeline operator APA Group announced that, following strong interest from Governments, gas buyers and gas sellers, they would spend $2 million on a feasibility study regarding construction of a pipeline to connect the Northern Territory and eastern Australian gas markets.[352] As highlighted in Figure 10 below, the feasibility study will consider two potential routes:

> One option is an 899km pipeline from Tennant Creek to Mt Isa, which would cost about $900m. The other is from Alice Springs to the big Santos operated Moomba gas plant in SA, which would be about 1000km long and cost about $1.3bn.[353]

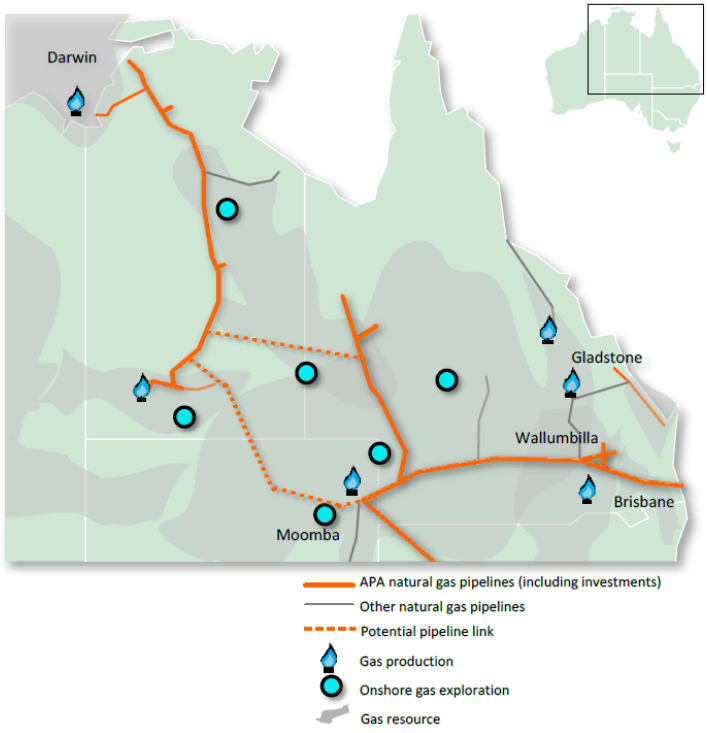
In respect of other pipeline infrastructure within the Northern Territory, the Committee notes that given the costs associated with the development of such,

[350] Record of Meeting: Industry Stakeholders, Professor Peter Hartley, p. 3
[351] Submission No 8, Armour Energy Ltd, p. 4
[352] Matt Chambers, "APA plans to link nation's gas markets" in *The Australian,* 20 February 2014, p. 18
[353] Matt Chambers, "APA plans to link nation's gas markets", p. 18

deployment of virtual pipeline technology might prove to be a more economically viable option and one that needs to be explored more fully.

Figure 10: Connecting Eastern and Northern Regions

- Strategic initiative to connect the Northern Territory and the east coast
  - Pipeline linking APA's east coast grid and Northern Territory pipelines
- Benefits and rationale
  - Linking existing APA pipeline infrastructure
  - Connecting regions to new and existing alternative gas sources
  - Seamless, cost effective end-to-end gas transportation service
  - Flexibility and service options across multiple injection and withdrawal points
- Feasibility study to commence in FY14
  - Route selection
  - Engineering
  - Commercial viability



Source: APA Group[354]

4.64 AMEC suggested that since remotely located projects are invariably required to be self-sufficient when it comes to energy, linear infrastructure and transport, there is potential for the "establishment of collaborative infrastructure between geographically aligned projects."[355] Noting that this would improve the cost-effectiveness and productivity of projects in remote areas, AMEC further suggested that the NT Government should promote a more collaborative approach to infrastructure development through the provision of incentives such as "taxation relief, regulatory assistance or access guarantees."[356]

4.65 Moreover, as Santos points out, irrespective of how infrastructure is funded, it is critical that the Government work with the industry to determine where, what and when infrastructure is required and plan ahead accordingly:

> The investment decisions required and the identification of locations for infrastructure to meet the needs of the shale oil and gas industry are some years away. However, in order to provide a strong incentive for exploration activities, the NT Government is encouraged to acknowledge those likely future needs sooner rather than later, and express a firm resolve to make and/or facilitate the required investments at the appropriate time.[357]

[354] APA Group, *APA Investor Information and 1H14 result highlights,* APA Group, Sydney, April 2014, p. 22
[355] Submission No 19, Association of Mining and Exploration Companies Inc, 28 November 2013, p. 4
[356] Submission No 19, Association of Mining and Exploration Companies Inc, 28 November 2013, p. 4
[357] Submission No 22, Santos Ltd, p. 2

Renewable Energy Resources

4.66 The evidence provided to the Committee clearly indicates that by global standards the Northern Territory has access to "a large pool of energy potential, particularly from renewable resources."[358] While not intended to provide a technical or in-depth consideration of renewable energy technologies, the following sections summarise the range of proven and potential renewable energy resources available to the Northern Territory. As such, the discussion focuses on the key challenges and opportunities associated with the deployment of bioenergy, hydro energy, solar energy, ocean energy, wind energy, and geothermal energy in the Northern Territory.

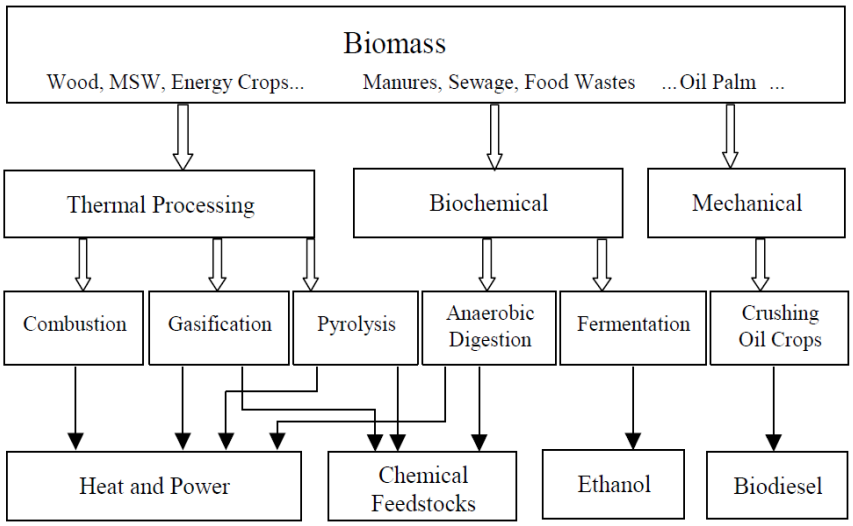
Bioenergy

4.67 *Bioenergy* refers to the use of organic material (biomass) as a source of energy for the generation of electricity and the production of liquid fuels:

> The potential bioenergy resources in Australia are large and diverse. Unused biomass residues and wastes are a significant under-exploited resource. Bioenergy offers the potential for considerable environmental benefits. At the same time, good management of the resource is needed to ensure that problems associated with use of land and water resources are avoided.[359]

The Committee heard that bioenergy is one of the more mature renewable energy technologies utilising a range of methods to convert biomass into energy, liquid fuels and chemical feedstocks; as summarised in Figure 10.[360]

Figure 11: Bioenergy Conversion Routes

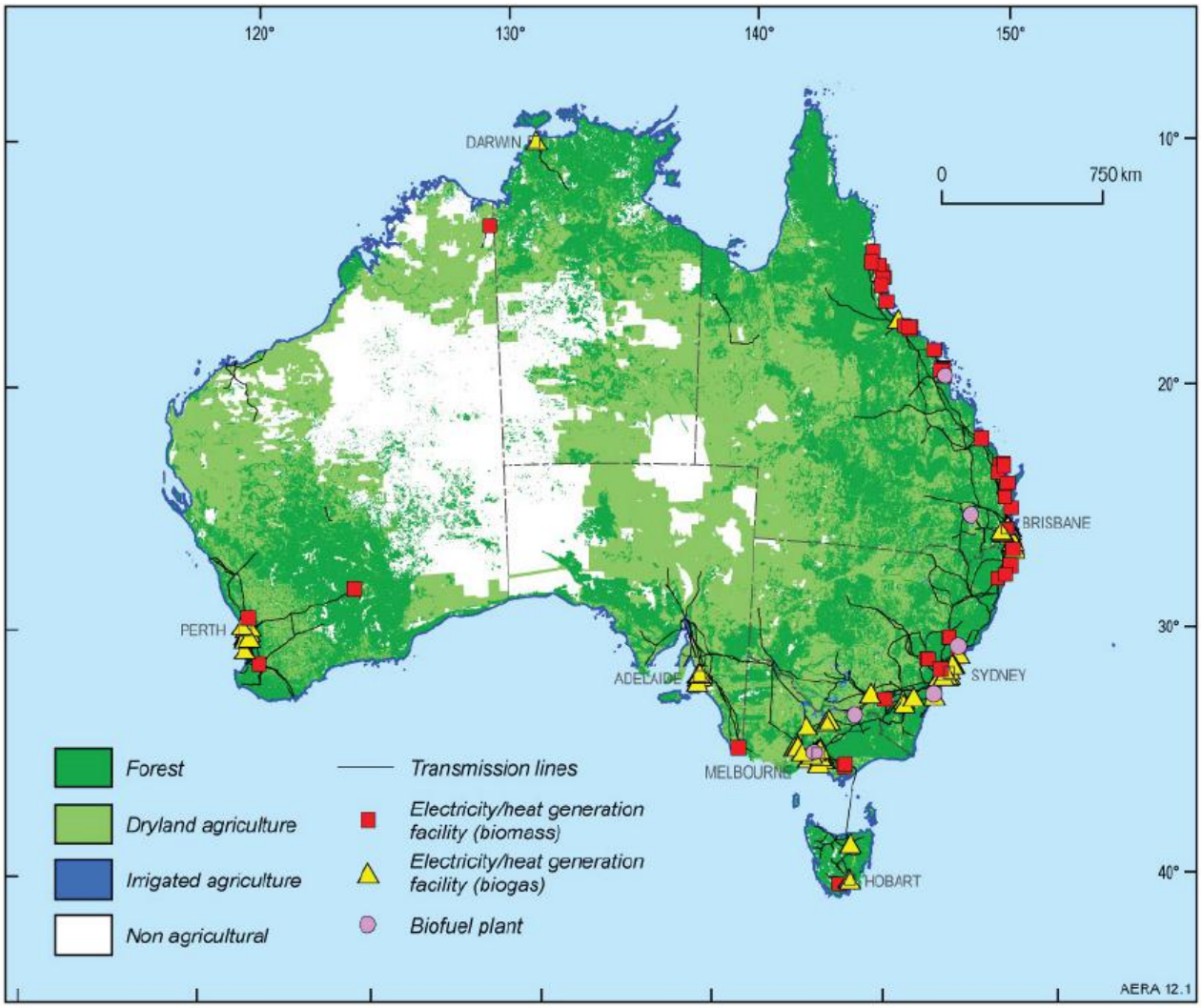


Source: Bioenergy Australia[361]

[358] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, Public Hearing, 14 February 2014, p. 3
[359] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* Commonwealth of Australia, Canberra, 2010, p.309
[360] Committee Hansard, Dr Stephen Schuck: Manager, Bioenergy Australia, Public Hearing, 14 February 2014, pp. 2-3
[361] Submission No 3, Bioenergy Australia, 5 November 2013, p. 6

4.68 As noted previously in Figure 7 (p. 59), electricity generation from bioenergy, in particular landfill gas power plants, is the most cost competitive energy resource currently available. Moreover, by 2030 it is expected to be significantly more cost effective than natural gas especially when carbon capture is taken in consideration. However, despite this fact, as indicated in Figure 11, compared to elsewhere in Australia the Northern Territory's uptake of bioenergy technologies is extremely limited.

Figure 12: Land Use and Bioenergy Facilities in Australia



Note: Areas depicted as under irrigation are exaggerated for presentation. The Committee notes that this graphic does not include the Fryer Fuels Recycled Biodiesel facility or the Territory Biofuels facility which is expected to resume operation during the course of 2014.

Source: Geoscience Australia[362]

4.69 Bioenergy Australia advised the Committee that the concentration of biomass facilities on the eastern seaboard reflects the fact that approximately 53 percent of electricity generated from biomass in Australia is produced from readily available bagasse (sugar cane residues); with a further 11 percent produced

[362] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.310

from a range of other vegetable and plant matter. Biogas produced from methane harvested from landfill, animal manure and sewage facilities accounts for around 26 percent of bioenergy electricity, with the remaining 9 percent produced from wood waste.[363] The Committee notes that data is not currently available regarding the amount of electricity generated using biodiesel as the fuel source.

4.70 In the absence of a sugar cane industry, access to adequate feedstock supplies significantly limits the potential for the development of biomass facilities in the NT given that 10,000 tonnes of fresh weight biomass is required per annum to support the operation of a 1 MW power plant.[364] However, the Committee notes that the NT's burgeoning forestry industry may well have the capacity to provide the necessary feedstocks in the near future. It is noted that Syngas recently signed a *Heads of Agreement* with African Mahogany (Australia) Pty Ltd (AMA) which currently manages African Mahogany plantations in the Douglas Daly area. The agreement covers the supply of plantation trimmings suitable to support the development of a biomass power plant up to 3 MW in size in the Douglas Daly area which has the capacity to offset the current reliance on diesel fired generators.[365]

4.71 As noted in Chapter 3, the Shoal Bay Waste Management facility incorporates a 1 MW grid connected biogas facility that has been in operation since 2005. PWC advised that the methane gas harvested from this facility provides approximately 9000 MWh of electricity per annum.[366] However, Tersum Energy indicated that there was potential for this facility to be upgraded to incorporate an *Energy-From-Waste* Gasification plant that has the capacity to process a far wider range of materials including clinical and pharmaceutical waste, heavy oils, biomass and agricultural wastes:

> The Northern Territory, like many other places in Australia is currently stockpiling, but wasting a valuable asset that can go a long way to be used to generate reliable base-load power generation namely Rubbish. The *'Shoal Bay Landfill'* currently receives in excess of 165,000 tonnes of waste annually (data 2010) and whilst some of the potential energy is captured by way of methane capture, the bulk is lost. The introduction of Energy-From-Waste as a base-load substitute to both diesel and natural gas will provide a secure energy source, whilst having the additional environmental benefit of eliminating landfill.[367]

4.72 The extent to which biogas facilities might prove to be a viable option in other regional centres is unclear. As noted by ALEC, consideration was given to such during the development of their recently released *DesertSMART Roadmap* and

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[363] Submission No 3, Bioenergy Australia, p. 4
[364] Committee Hansard, Dr Stephen Schuck: Manager, Bioenergy Australia, p. 5
[365] BioSyngas, *Heads of Agreement Power Off-Take Signed by African Mahogany (Australia) Pty Ltd,* viewed 16 April 2014, http://www.biosyngas.com.au/attachments/article/25/130305%20HOA%20power%20offtake%20signed%20with%20AMA%20v%201%20Final.pdf
[366] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Indigenous Essential Services, p. 11
[367] Submission No 7, Tersum Energy Pty Ltd, 8 November 2013, pp. 4-5; see also Submission No 3, Bioenergy Australia, p. 9; see also Submission No 9, Mr Geoff Casey, 11 November 2013

while it was acknowledged that there was some scope for both sewage and landfill biogas facilities in Alice Springs:

> the problem is the volumes are always going to be small…It does not mean it is not an option, it just means it is always going to be a very small part of the mix here, particularly when you consider how much of a resource we have in solar here.[368]

4.73 Bioenergy Australia advised that methane capture is also common in many sewage treatment plants across the country, with all of the larger plants servicing the southern cities incorporating captured biogas.[369] It was further noted that there have been a number of technological developments in recent years focussing on systems that are more suited to smaller scale sewage plants that might be more appropriate for the Northern Territory. For example, there are a wide range of small biogas digesters that can be used in conjunction with micro-turbines which are a common means of generating electricity at the community level in a number of countries including Vietnam, Nepal, India and China.[370]

4.74 With regards to biofuel, it is noted that the Territory currently imports approximately 500 million litres of diesel per annum for use in the domestic market.[371] Quite apart from the transport industry, there is considerable potential for biofuel to replace the 31 million litres of diesel PWC currently requires for electricity generation; let alone the diesel utilised for power generation by mine sites and pastoralists. At present there is only one licensed biodiesel manufacturer in the Territory, Fryerfuels Pty Ltd, which recycles waste cooking oil to produce biodiesel.[372] However, the Committee notes that the Territory has had a relatively long association with biofuels, "with PWC having operated its generators on biofuel and biofuel blends at various times within the recent past."[373]

4.75 In 2008 Territory Biofuels Ltd commissioned a large scale bio-refining facility adjacent to the Vopak fuel terminal at the East Arm Wharf to produce both biodiesel and ethanol. The biodiesel plant is the largest in Australia with a rated capacity of 140 million litres per annum. Originally developed to run on palm oil and food grade vegetable oil, the plant was mothballed in 2009 due to technical difficulties and the inability to source an adequate supply of feedstock at a viable price level.[374] In January of this year the Canadian company Lignol Energy Corporation took over the facility and has since entered a joint venture agreement with Dubai investment company Millio International to support the

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[368] Committee Hansard, Mr Jimmy Cocking: Director, Arid Lands Environment Centre Inc, p. 6
[369] Committee Hansard, Dr Stephen Schuck: Manager, Bioenergy Australia, p. 5
[370] Committee Hansard, Dr Stephen Schuck: Manager, Bioenergy Australia, p. 5
[371] Office of Asian Engagement, Trade and Investment, *Directory of Investment Opportunities,* p. 42
[372] Fryerfuels Pty Ltd, *Fryerfuels, Biodiesel and the Northern Territory Environment,* viewed 16 April 2014, http://fryerfuels.com.au/fryerfuels-nt
[373] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 33
[374] Lignol Energy Corporation, *LEC announces completion of its secured note investment in Territory Biofuels Limited,* viewed 16 April 2014, http://www.lignol.ca

restart of production at the plant later this year.[375] The extent to which subsequent products will be available to the domestic market is, however, as yet unknown.

4.76 To further facilitate the development of a biofuel industry in the Territory, PWC advised that that the Government is currently exploring the prospect of producing biofuel from the seeds of the Indian Beech tree *(Pongamia pinnata)* with two trial plantations at Middle Point and Katherine. Given that the seeds from the tree can produce 30 – 40 percent oil it may well prove to be a viable fuel source and an emerging industry in remote communities.[376] Bioenergy Australia also noted that invasive weeds such as *Mimosa pigra* and *Acacia nilotica*, both of which are prevalent in the Northern Territory, are another potential feedstock source for biofuel industries. Moreover, it was noted that:

> Such industries, besides contributing to our future fuel mix and energy security, would stimulate rural economies and provide permanent jobs through the production of the biomass and the supply logistics.[377]

Hydro Energy

4.77 Hydro energy is the most mature renewable energy technology and the largest source of renewable electricity generation; currently accounting for approximately 16 percent of global electricity production.[378] While the potential for additional large scale hydroelectricity facilities in Australia is limited due to issues such as water availability and environmental factors, the Committee understands that there is, nevertheless, scope for small scale developments. For example, both mini hydro schemes of less than 10 MW and micro hydro of less than 100 kW can be deployed as run-of-river systems which rely on the natural fall (head) and flow of the river to generate electricity, or in existing dams.[379]

4.78 As mentioned previously, PWC has conducted a number of major studies into the feasibility of hydroelectricity and recently commissioned a micro-hydro generation plant in Manton Dam. The Committee notes that while mini and micro hydro schemes typically have limited infrastructure, low construction costs and a smaller environmental 'footprint' than larger systems:

> small scale hydro has had high relative costs ($ per MW) but is being considered both for rural electrification in less developed countries and further hydro developments in OECD countries, often supported by environmental policies and favourable tariffs for renewable energy.[380]

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[375] Energy Business News, *Dubai partner held Darwin biodiesel restart; Lignol,* viewed 16 April 2014, http://www.energybusinessnews.com.au/energy/bio-energy/
[376] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Indigenous Essential Services, p. 11
[377] Submission No 3, Bioenergy Australia, p. 14
[378] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* pp. 225
[379] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* pp. 225-7
[380] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.227

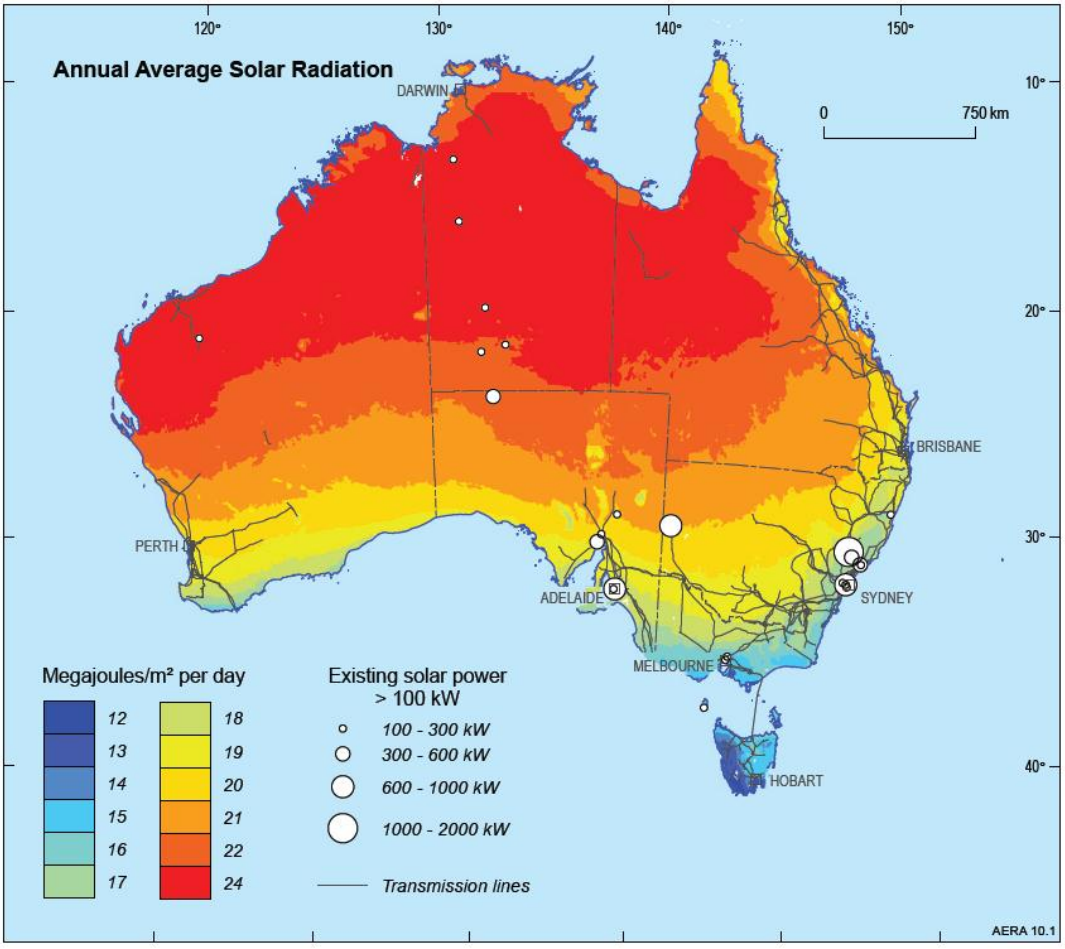
Given that a number of remote communities are located in the vicinity of reliable river or stream flows, PWC advised that they are currently looking at incorporating micro run-of-river systems into the energy mix.[381]

Solar Energy

4.79 As illustrated in Figure 12, Australia's annual average solar radiation per square metre, which is the highest of any continent in the world, is particularly conducive to the deployment of solar technologies.[382] Moreover, as Epuron pointed out in their submission, solar energy is:

> a significant resource in the Northern Territory. Unlike traditional resources it does not need to be mined or extracted, transported or processed prior to use. It provides a useful hedge against fuel prices along with local community development opportunities. It is ubiquitously available where it already has value – in commercial and off-grid applications across the Territory.[383]

Figure 13: Annual Average Solar Radiation



Source: Bureau of Meteorology 2009; Geoscience Australia[384]

[381] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 17
[382] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.268
[383] Submission No 5, Epuron Pty Ltd, 8 November 2013, p. 2
[384] Cited in: Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.262

4.80 The Committee notes that, nationally, electricity generated from solar energy is "currently almost entirely sourced from PV installations, primarily from small off-grid systems."[385] The advantages of solar PV as an adjunct to fossil fuel fired generators in remote locations have already been clearly demonstrated in the Northern Territory. PWC and its subsidiary IES have owned and operated solar/diesel hybrid systems, incorporating a range of solar technologies, in remote Indigenous communities for over 20 years.

4.81 Moreover, a key outcome of PWC's recently completed *Daly River Solar Research Project,* a preliminary assessment of the feasibility of integrating solar into the existing Daly River diesel power station funded by ARENA, was the publication earlier this year of the *Solar/diesel Mini-Grid Handbook* and associated mini-grid power system modelling tool (ASIM):

> The Handbook is intended to inform the broader solar industry, academia and the general public about the remote community power supply context and the challenges associated with implementing solar into an existing diesel mini-grid to achieve fuel savings whilst maintaining a reliable, utility grade electricity service. ASIM is a flexible open-source modelling tool that has been developed to simulate solar/diesel power system operation and evaluate its technical and financial performance.[386]

4.82 As mentioned previously, through its *Northern Territory Solar Energy Transformation Program, "PWC is pursuing a step-change in its remote generation portfolio, with the hybridisation of the entire diesel mini-grid fleet to include solar."*[387] As Epuron advised the Committee, while there is approximately 2 MW of solar PV currently installed in the off-grid remote areas of the Territory, there is:

> at least 10 MW of opportunity in the near future in remote Northern Territory communities…We estimate that building 10 MW off-grid remote solar…could reduce Indigenous Essential Services' current fuel budget by around 15%. Appropriate roll-out of this scale would encourage the private sector to fund and own such projects, and supply power back to IES at a rate which results in immediate operating cost savings.[388]

4.83 It was further noted that the benefits of remote solar PV systems can be enhanced quite significantly through the incorporation of energy storage systems. Irrespective of whether the storage element is conventional lead-acid batteries, state-of the-art battery technology such as fuel cells, or something else, the Committee heard that it is important to ensure that the charging and discharging of the storage device is appropriately controlled so that it integrates with other generators:

> We found at TKLN that having a modest amount of electrical storage really enables us to get a high penetration of solar energy into the system. Then,

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[385] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.273

[386] Australian Renewable Energy Agency, *Daly River Solar Research Project,* viewed 3 March 2014, http://arena.gov.au/project/daly-river-solar-research-project/ ; see also Committee Hansard, Ms Megan Jolley: Manager Energy & SCADA Strategy, Indigenous Essential Services, Public Briefing, 11 October 2013, p. 6

[387] Power and Water Corporation, *Solar/Diesel Mini-Grid Handbook,* p. 3

[388] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, Public Hearing, 14 February 2014, p. 3

> overall, if you look at the whole power supply in remote communities, most of the storage remains where it is now, which is in diesel tanks. Electrical energy storage is an enabling thing, but storing large quantities of electrical energy is much more expensive than storing large volumes of diesel fuel.[389]

4.84 As highlighted in Chapter 3, the 1 MW Uterne facility connected to the Alice Springs network is the Territory's only utility scale solar PV power station. Owned and operated by Epuron the Committee understands this facility is to be expanded to 3.6 MW.[390] Epuron advised that it is anticipated that "the Uterne Two solar power station…will be constructed in Alice next to Uterne One later this year."[391] The Committee notes that development of "additional utility-scale solar farms utilising solar photovoltaic (PV) technology generating a minimum of 1 Megawatt capacity, connecting into the Darwin-Katherine interconnected system" is listed as an immediate opportunity in the *Northern Territory Directory of Investment Opportunities.*[392]

4.85 The Committee heard that the onset of solar PV grid-parity (where the levelised cost of solar electricity is the same as conventional grid electricity) has had a significant impact on uptake rates of residential and commercial solar PV in Australia. Over the past four years almost one million residential systems have been installed in the on-grid regions of Qld, NSW, VIC, SA and WA where solar PV grid-parity has been reached.[393] Given the historically low cost of conventional grid electricity and comparatively high cost of goods and services, uptake rates in the NT have been extremely modest by comparison. However, as indicated by the 75 percent increase in the NT's solar PV uptake rate over the past two years,[394] the combination of rising electricity prices and the downward trend in solar costs suggests that the grid connected areas are beginning to experience solar grid-parity.

4.86 PWC noted that they had experienced a significant increase in the number of applications for roof top PV in recent months; to the point where they have had to increase resources in the customer service area to handle the additional workload; "we are currently processing about 70 applications per week, so it is quite dramatic the uptake of solar PV."[395] The Committee heard that there are approximately 3,000 domestic customers in the grid-connected areas of the NT that have roof top solar PV systems installed: 2090 in Darwin; 100 in Katherine; 10 in Tennant Creek; and 800 in Alice Springs. A further 200 solar PV installations are owned by commercial customers in the NT. [396]

4.87 To streamline the application process, in 2012 a pre-approved limit of 4.5kW was put in place. The Committee understands that a system of this size has the

[389] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p.4
[390] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 20
[391] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p.7
[392] Office of Asian Engagement, Trade and Investment, *Directory of Investment Opportunities,* Northern Territory Government, October 2013, p. 30
[393] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 6
[394] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 5
[395] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, Public Hearing, 20 March 2014, p.9
[396] Power and Water Corporation, *Responses to Questions,* Q's 4 & 5

capacity to offset approximately 75 per cent of the energy consumption of the average residential customer. An application is required for customers wishing to install larger systems to allow PWC to review the potential impact on the network, taking into consideration "load profiles, system integration matters and site characteristics."[397] Since August 2012 PWC have reviewed 215 applications for residential systems over the 4.5kW limit in the Darwin region with 139 subsequently approved. With regards to commercial customers, the Committee was advised that in recent months a number of applications and enquiries had been received for systems in excess of 300kW. PWC has reviewed 123 applications for larger systems in the Darwin region since July 2013. Of these 119 have since been approved. The largest system approved to date is 700kW.[398]

4.88 While acknowledging the value of solar PV, PWC Board Chairman, Mr Ken Clarke, noted that it was important to understand the issues associated with it. As the Committee heard, while electricity networks have the capacity to accept additional loads from solar PV, or for that matter wind energy, it is not an uncapped capability:

> Renewable generation naturally produces a supply of electricity with fluctuating frequency, owing to the variable intensity of sun or wind over short periods of time. If renewable penetration is high enough, this variation can start to strongly influence the overall frequency across the entire grid, reducing power quality. In simple electrical loads such as lighting, this poor quality power can cause flickering or the occasional blown fuse. In more complex electronic loads it can result in permanent damage. There are also risks to frequency stability when distributed power generators connect in the lower capacity sections of the electricity network, and feed back into the grid. [399]

4.89 As PWC noted due to differences in inertia characteristics, the generation plant on the major networks are less able to cope with the intermittency of renewable energy sources than the diesel generators in remote communities.[400] While incorporation of storage via batteries has the capacity to alleviate issues associated with intermittency, as noted previously they are an expensive option. As PWC observed:

> Storage has been the bane of this industry forever. You probably know your own car battery does not last very long these days, and they have been making them for 150 years. With new lithium iron technology and other chemistries in batteries, dramatic improvements are occurring. We are seriously looking at supplementing the Uterne solar farm with a megawatt of storage just see if that makes a big difference and gets rid of some intermittency we experience during the day.[401]

4.90 The Committee heard that New Zealand electricity distributor Vector Ltd is gaining global attention for its innovative approach to network issues associated with the uptake of solar PV by offering customers a hybrid solar and battery

[397] Power and Water Corporation, *Responses to Questions,* Q 5
[398] Power and Water Corporation, *Responses to Questions,* Q 5
[399] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 5
[400] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 21
[401] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 21

system.[402] Under Vector's *SunGenie* initiative, customers enter into a contract and pay a fixed monthly cost for a system which Vector owns and maintains that incorporates solar panels, a smart control unit, battery storage and an online dashboard to assist customers to make the most of their solar power. As is the case with privately owned systems, customers can still enter into power buyback deals with their retailer for any power that is exported from the system. Importantly the addition of storage to residential systems assists Vector in balancing load across the network by enabling it to both draw from and charge *SunGenie's* batteries as required.[403] As noted in the submission from Tenax Energy Pty Ltd:

> In combining solar with batteries there are network benefits for the distribution company, in terms of being able to time shift the solar output to coincide with peak demand, and it also provides buffering on the network which can facilitate high penetration of PV on houses.[404]

4.91 As mentioned previously, PWC is currently sponsoring research into the feasibility of establishing a solar thermal power station in the Alice Springs region. The Committee notes that a national study undertaken in 2008 identified a number of sites across Australia as locations of high potential for solar thermal power including the Darwin-Katherine interconnected system and the area from Tennant Creek to Alice Springs.[405] While solar thermal energy, also known as concentrating solar, has been used extensively for hot water systems across Australia for many years, "electricity generated from solar thermal systems is currently limited to small pilot projects."[406]

4.92 Typically designed for large scale power generation, Epuron advised the Committee that while it is certainly a potential option for the NT, the costs associated with solar thermal have not decreased at the same rate as solar PV, consequently "solar thermal is now struggling to meet the same sort of construction time lines and energy price…and that is at the 50 MW or 100 MW scale."[407] The Committee understands that thermal storage is a key advantage of solar thermal power systems. Recently commissioned systems, in Spain and the United States for example, have 24 hour power generation capability which enables them to dispatch power at peak demand times and creates the potential for intermediate or base-load power generation. In addition, they are well suited to hybrid operation with fossil fuel plants.[408]

Ocean Energy

4.93 Ocean energy, incorporating wave, tidal energy and ocean thermal technologies, is a relatively underdeveloped yet potentially substantial renewable energy source. Globally, ocean energy represents the smallest

[402] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 9
[403] Vector Ltd, *Vector SunGenie,* viewed 23 April 2014, http://vector.co.nz/sungenie
[404] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 7
[405] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.269
[406] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.273
[407] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p.7
[408] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.279

contributor to electricity generation and, to date, has been limited to "tidal barrage power plants in…France (240 MW) and Canada (20 MW)."[409] The Committee understands that:

> currently, 25 countries are participating in the development of ocean power, with the United Kingdom leading the development effort, followed by the United States, Canada, Norway, Australia and Denmark….current ocean power development efforts have focussed on tidal and wave energy.[410]

4.94 Of the three ocean energy technologies, ocean thermal energy conversion (OTEC), which is created by the temperature differential between the ocean's surface water and deep water, is the least developed. However, the Committee notes that a 1- 1.2 MW demonstration plant is under construction in Hawaii with plans for a 10 and 25 MW plant under consideration. Given the capacity for OTEC plants to be used to generate liquid hydrogen and operate in combination with other deep water applications, such as potable water production, interest in this technology is increasing.[411] Given that OTEC is best suited to tropical waters with warm surface temperatures and a deep water temperature differential of at least 20^{o}C, the Committee understands that this may prove to be a potential future energy resource for the Northern Territory.[412]

4.95 Although Australia has access to some of the world's best wave energy resources, the most suitable sites given are located along its western and southern coastlines. The Committee understands that ARENA recently provided funding to support the development of the *Perth Wave Energy Project* which will be "the world's first commercial-scale wave energy array that is connected to the grid and has the ability to produce desalinated water."[413] While the northern half of the Australian continental shelf is deemed to have limited wave energy resources, given currently available wave energy technologies, as highlighted in Figure 13 there is, however:

> sufficient tidal energy resources for local electricity production in many areas, particularly the Northwest Shelf, Darwin, Torres Strait and the southern Great Barrier Reef.[414]

4.96 As noted previously, PWC has entered into a memorandum of understanding (MOU) with Tenax Energy Pty Ltd regarding the development of a 2 MW pilot tidal energy project in the Clarence Strait which is located 45 Km north of Darwin. The Committee heard that Tenax Energy is a local Darwin based company:

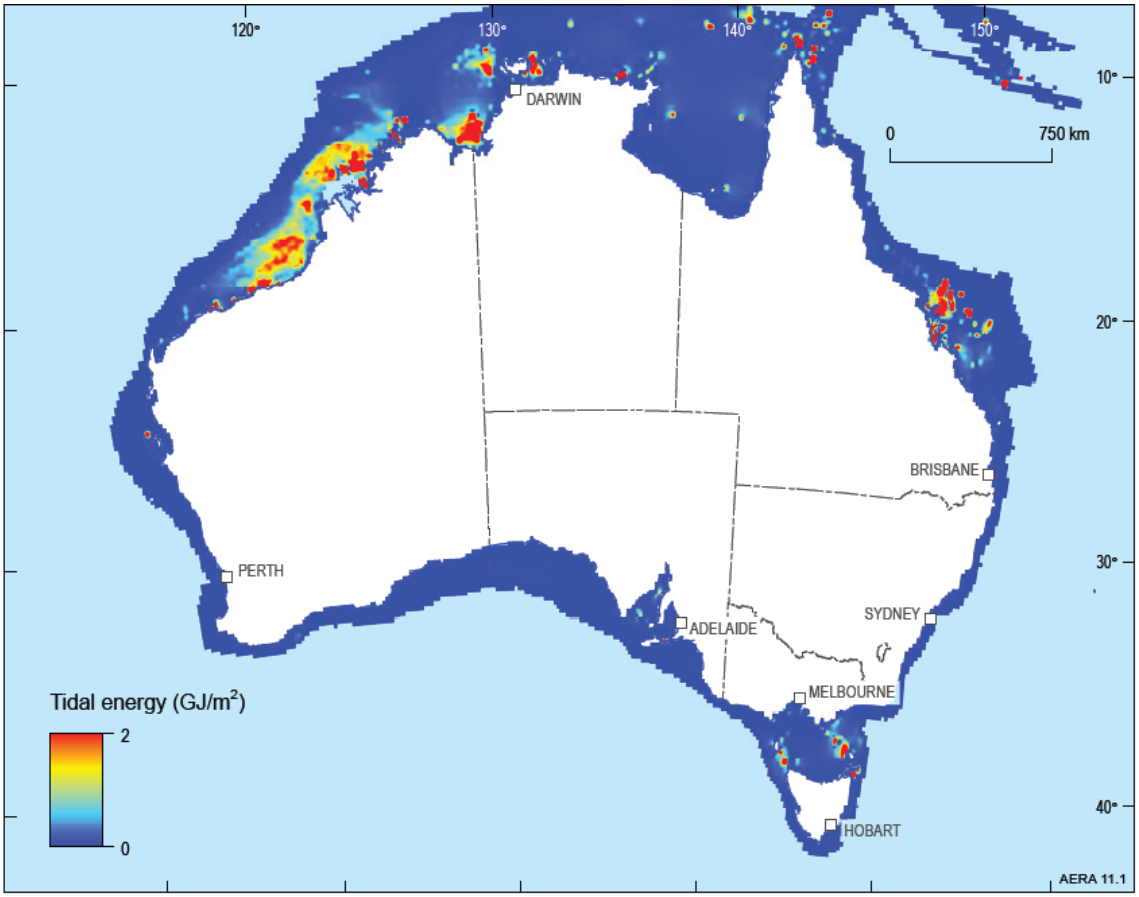
> established to be actively involved in initiating new renewable energy generation systems, to ensure there is a cheaper and more sustainable solution to meeting the long term energy needs of the community. The

[409] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 285
[410] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 300
[411] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* pp. 301/7
[412] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 289
[413] Australian Renewable Energy Agency, *Perth Wave Energy Project,* viewed 16 April 2014, http://arena.gov.au/project/perth-wave-energy-project/
[414] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 285

> company is identifying, packaging and developing tidal energy generation projects across Australia and in the Asia-Pacific region.[415]

4.97 Tenax Energy Managing Director, Mr Alan Major, advised the Committee that not only is the Clarence Strait project the first of its kind in Australia, but globally it will be the first tidal energy facility to be developed for use in a tropical environment.[416]

Figure 14: Total Annual Tide Kinetic Energy on the Australian Continental Shelf



Source: Geoscience Australia[417]

4.98 Given that existing tidal energy technology has been designed for cooler more temperate climates, this project will be seeking to investigate the extent to which equipment is affected by warm water organic growth including fouling my marine organisms such as barnacles and algae; high densities of marine life such as dugongs, crocodiles or turtles that may impact or be impacted by the infrastructure.[418]

4.99 The Committee heard that Tenax has secured a licence to occupy 16.8 km^2 within the Clarence Strait:

> There are three channels – the South, the Howard Channel and the North Channel. Within those three areas we are looking at around six discrete

[415] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 2
[416] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 4
[417] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 286
[418] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 4

> sites which are deeper than 20 m and have velocities in excess of 2 m per second. The initial proposal was to connect into the infrastructure corridor proposed for Glyde Point and, on a shorter term prospect, the intention is to look at the existing power line Power and Water has out to Gunn Point, which is 7 km from shore.[419]

4.100 To support the pilot phase, Tenax advised that they also have an MOU with the CDU's Research Institute for the Environment and Livelihoods regarding establishment of a:

> world class, commercially oriented tidal energy research and testing facility, to be known as the Tropical Tidal Testing Centre ("T3C"), with an aim to stimulate collaboration across research institutions, device manufacturers, project developers, renewable energy markets and ancillary services. The T3C has also entered into an MOU with the European Marine Energy Center (EMEC). EMEC is the preeminent ocean energy research centre, based in the Orkneys Scotland. The T3C offers a unique opportunity for device developers and researchers to develop a coherent and consistent research program focused on the testing of devices and arrays and operating in a tropical environment.[420]

4.101 The Committee heard that tidal energy technology is essentially analogous to that of wind energy in that both require a passing current to drive a rotating turbine; "if you imagine a wind turbine sitting 20-40 m below the sea – you cannot see it but you can still traverse through the channel."[421] If the entire area under licence was developed, Tenax advised that a conservative estimate of the electricity generation capacity of the Clarence Strait project is approximately 450 MW. However, based on European studies, which are currently proposing that 1 km^2 has the potential to yield 200 MW, Tenax noted that "there is a huge surplus within the Clarence Strait for potential future energy."[422]

4.102 Tenax advised that should the pilot project prove successful, it is anticipated that at full production the Clarence Strait facility will have the capacity to provide around 100 MW into the grid. It was further noted that consideration is also being given to the possibility of utilising the Clarence Strait facility to produce hydrogen given the current level of global investment and the fact that "in Europe they are rolling out hydrogen refilling stations for hydrogen cars."[423]

4.103 Although tidal energy is very predictable it is not generally possible to generate electricity at consistent levels on a constant basis since, in most places, the tidal current speed and, as such, electricity generation capability falls to zero twice in every 24 hour period. However, the Committee heard that the advantage of the Clarence Strait is that:

> at one end you have the Beagle Gulf and at the other you have the Van Diemen Gulf, and there is a variance in the tides between the two. While one is at full tide, the other is not quite there, and it pushes and amplifies the currents going through there.[424]

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[419] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 4
[420] Submission No 4, Tenax Energy Pty Ltd, 8 November 2013, p 2
[421] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 4
[422] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 5
[423] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 6
[424] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 5

4.104 Tenax advised that they had received a primary grant from Connecting Australian European Science and Innovation Excellence (CAESI) to "support meetings in Europe to garner interest and establish relationships with researchers."[425] The Committee heard that two Australian companies have already committed to trial commercial scale technology in the Clarence Strait once the pilot project is operational.[426] Tenax Energy noted that the company has already been approached to look at potential projects in WA and Papua New Guinea.[427]

4.105 The Committee notes that prior to the development of the Clarence Strait project, in 2011 the Green Energy Taskforce concluded that:

> Sea-based technologies remain a promising area of renewable generation…Investment flows for project development will increasingly look to regions or locations where there exist both the sea-based resource as well as the industrial and professional skills and capacity to implement the projects…The proximity of mature industry, marine support services and research facilities (through Charles Darwin University) to areas of significant energy potential north of Darwin, could position Darwin as a research hub for warm water energy technologies.[428]

Wind Energy

4.106 As highlighted in Figure 7 (p. 59), of the alternative energy resources, on-shore wind energy is one of the more cost competitive means of electricity generation when compared to traditional sources such as coal, oil and gas. As such, it is the fastest growing energy source worldwide, "increasing at an average annual rate of nearly 30 per cent between 2000 and 2008."[429] However, as illustrated in Figure 14 below, while the south-western, southern and south-eastern areas of Australia incorporate some of the world's best wind resources, average wind speeds in the NT tend to be considerably lower.

4.107 The Committee heard that the large wind farms in the southern states rely on average wind speeds of around 8 metres per second (m/sec). However, monitoring of eight sites across the Barkly Tablelands indicates that average wind speeds are significantly lower in the NT at around 5.2 m/sec.[430] While the terrain of the Territory might not be suitable for large scale wind turbines (>500kW), the Committee was advised that there is, nevertheless, significant potential for smaller scale, low wind turbines.[431]

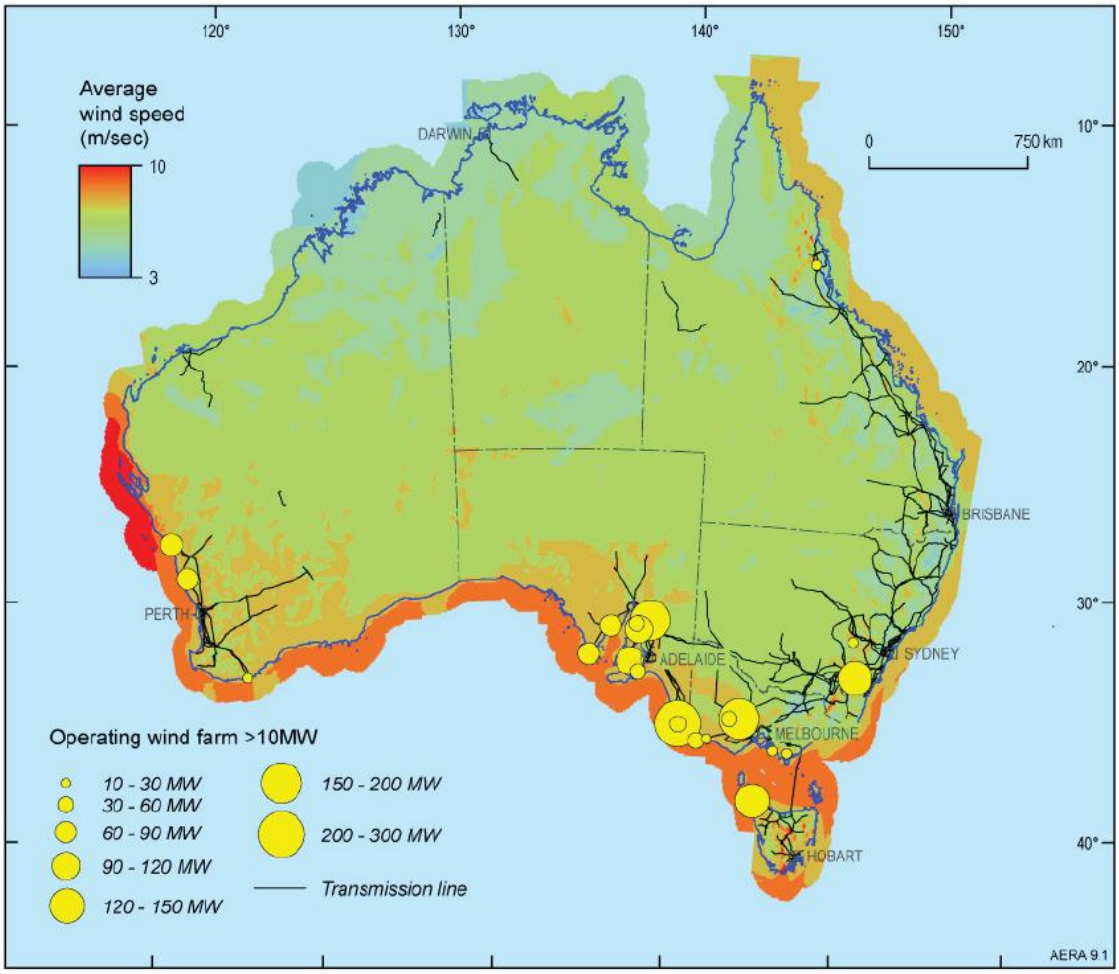
4.108 The Committee notes that, in addition to the three IES 15 kW wind turbines located at Lake Nash mentioned previously, low voltage, wind turbines have

[425] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 2
[426] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 2
[427] Committee Hansard, Mr Alan Major: Managing Director, Tenax Energy Pty Ltd, p. 6
[428] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 32
[429] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 239
[430] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 12
[431] Committee Hansard, Mr Martin Poole: Executive Director, p. 4

been used on many NT pastoral stations for a number of years. Other demonstration and prototype wind turbines include:

- Installation of a hybrid 10kW wind turbine/diesel generator demonstration project with battery storage at Battery Hill, Tennant Creek in 1985; which operated successfully for a number of years;[432]
- Darwin City Council's trial of a hybrid wind/solar streetlight located at East Point Reserve, which incorporates a 600 watt wind turbine and a 150 watt solar panel powering a 77 watt LED street light;[433] and
- NT Christian Schools Association's 75kW wind turbine installed at the GAWA Christian school on Elcho Island in 2009.[434]

Figure 15: Australia's Wind Resources



Source: Windlab Systems Pty Ltd; DEWHA Renewable Energy Atlas (wind map data); Geoscience Australia[435]

[432] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 28

[433] Darwin City Council, *Darwin City Council installs new hybrid street lamp,* viewed 24 March 2014, http://www.darwin.nt.gov.au/media-centre/news/darwin-city-council-installs-new-hybrid-street-lamp

[434] Renewable Energy Focus.com, *Wind for Australian Aboriginal Community,* viewed 24 March 2014, http://www.renewableenergyfocus.com/view/7669/wind-for-australian-aboriginal-community/

[435] Cited in: Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p.240

4.109 Epuron advised that since small wind turbines (i.e. less than 1 or 2 MW utility scale turbines) are less commonly manufactured around the world, "per unit of power, the cost of small wind turbines has not come down anything as much in recent years as the cost of solar photovoltaics."[436] However, the Committee understands that this may well change in the not too distant future given that:

> the trend for development of low wind sites has gathered pace in the past couple of years…The principal factor that has encouraged manufacturers and developers to investigate this market is that many countries are saturated with wind farms, with the best sites already developed. [437]

4.110 Development of economically viable low wind turbines is also being driven by countries such as China and India which have a large number of sites with low wind resources. In the case of China, for example, where almost 70 percent of the country experiences low wind conditions:

> the government is specifically targeting low wind to mitigate the transmission problems the industry has faced in more remote areas. Low-wind sites are typically closer to the higher population densities…and therefore suffer less from curtailment…In 2011, the government…set a target for 20GW to come from such sites, out of a total of 100GW wind it wanted to see developed.[438]

4.111 With regards to the Territory, Epuron noted that, based on their experience operating the Lake Nash wind/solar/diesel hybrid power plant, integrating more wind turbines with existing solar/diesel hybrid systems in remote communities would be advantageous. Quite apart from the fact that the wind turbines can operate at night in lieu of the solar, "in some weather conditions wind or solar will be doing better."[439] It was further noted that there was significant scope for wind farms from 10 MW's to 30 or 40 MW's per installation to be integrated into the Darwin-Katherine interconnected system:

> with the wind resources we believe are available in the vicinity of the Darwin/Katherine system, I expect wind power could be generated in the region of $110 per megawatt hour.[440]

Geothermal Energy

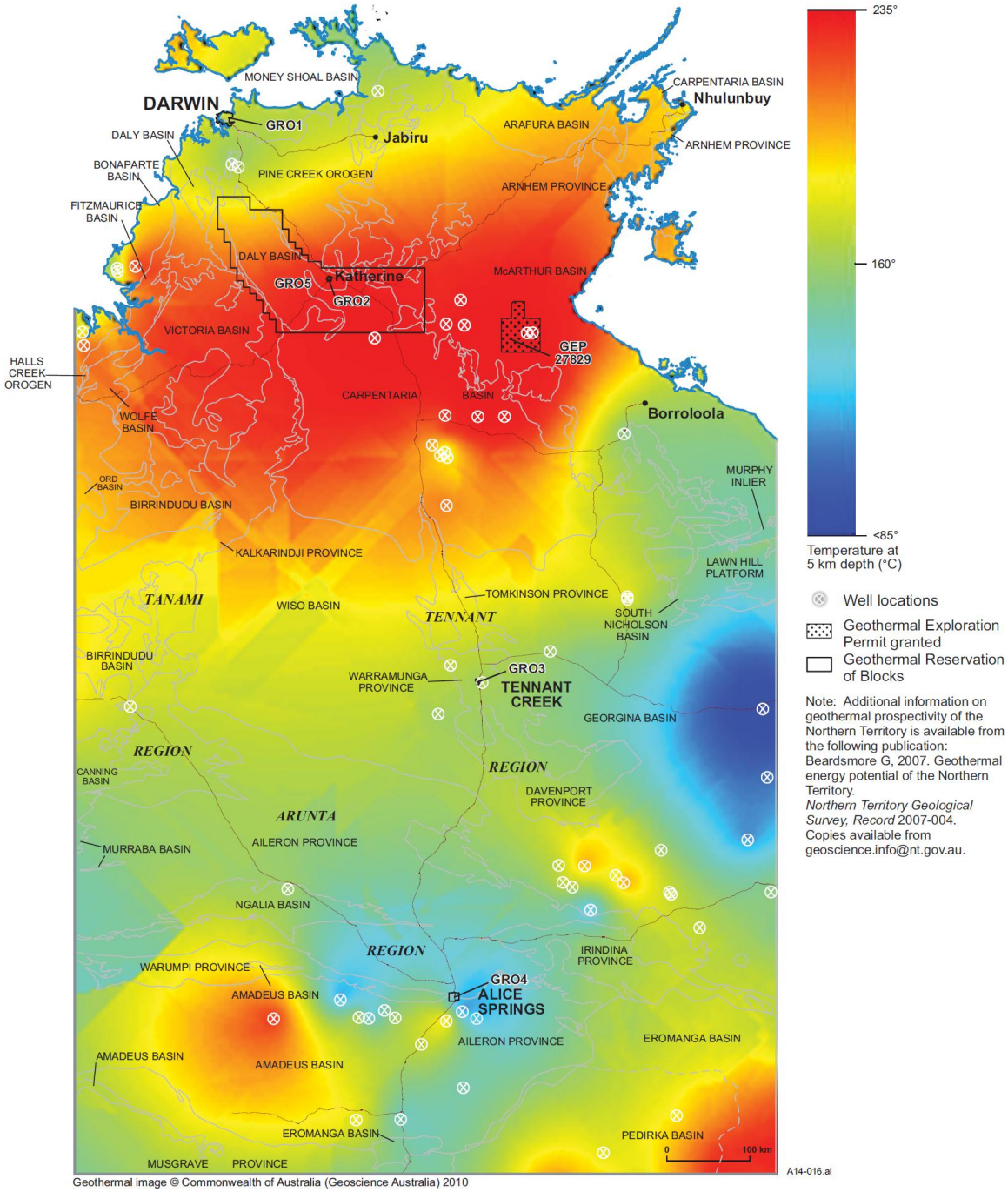
4.112 Geothermal energy is still very much an emerging industry in Australia and while there is, as yet, no commercial production of geothermal energy there is significant potential for this resource across Australia including the Northern Territory. The Committee notes that it has been estimated that:

> if just 1 per cent of the geothermal energy shallower with a minimum temperature of 150^{o}C and at a maximum depth of 5 km were accessible, the total resource is of the order of 190 million PJ, which is roughly 25 000 times Australia's primary energy use…This calculation ignores the renewable nature of the resource, that it can be utilised at temperatures of

[436] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p. 4
[437] Windpowermonthly.com, *Low Wind Sites: Wind Power Special Report July 2013,* viewed 24 March 2014, http://www.windpowermonthly.com/article/1187893/low-wind-sites---special-report, p. 4
[438] Windpowermonthly.com, *Low Wind Sites: Wind Power Special Report July 2013,* p. 4
[439] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p. 4
[440] Committee Hansard, Mr Martin Poole: Executive Director, Epuron Pty Ltd, p. 4

less than 150°C, and that improvements in drilling technology will mean that depths greater than 5 km will be accessible,[441]

Figure 16: Geothermal Potential, Exploration Permits and Applications



Source: Department of Mines and Energy[442]

4.113 As indicated in Figure 15, given that electricity can be generated using temperatures as low as 100°C, geothermal resource mapping based on satellite

[441] Geoscience Australia and ABARE, *Australian Energy Resource Assessment*, p. 213
[442] Department of Mines and Energy, *energyNT 2013,* p.17

imaging and ground-based penetrations indicates a high level of geothermal activity across large parts of the Territory:

> Geological evidence suggests that all the fundamental requirements for geothermal systems exist within the Northern Territory. In particular, the nature of the basement beneath most of the NT's basins suggests that many areas should have high surface heat flow. The sedimentary basins in the NT include many fine-grained formations capable of providing thermal insulation. High heat flow and adequate thermal insulation are the necessary requirements for high temperature heat sources. [443]

4.114 Moreover, the Committee notes that geothermal activity is focussed in the Territory's northern and southern basins which are relatively close to population centres and the Darwin-Katherine and Alice Springs electricity networks.[444] While no technological breakthroughs are required for the commercial development of geothermal resources, "advances in technologies that reduce costs will potentially lead to greater market penetration by geothermal energy."[445] Then too, as PWC pointed out, while the technology is extremely promising, geothermal resources are relatively deep; "we are talking holes that are 5 km deep. There are about two rigs in Australia that will do it, none of them in the Territory at the moment."[446]

4.115 As noted in the *energyNT 2013* report, there is currently only one active geothermal permit (GEP27829) in the Territory, located in the McArthur Basin and operated by Western Desert Resources Ltd. The Committee understands that in accordance with its approved work commitment, it is expected that the project will reach the stage of drilling and testing a deep geothermal well over the next twelve months.[447]

4.116 Despite the fact that geothermal projects in Australia are still at the proof-of-concept or early commercial demonstration stage, "geothermal energy is projected to be the fastest growing source of electricity to 2030."[448] Long-term energy projections, which incorporate the Renewable Energy Target (RET) and a five percent emissions reduction target, indicate that by 2029-30 geothermal energy will produce around 6 terawatt-hours (TWh) of power nationally, "this represents around 1.5 per cent of Australia's projected electricity generation in that year."[449]

4.117 Given that geothermal power plants have the ability to "provide base-load capacity 24 hours a day and have very high long-term capacity and availability factors"[450], the Green Energy Taskforce concluded that geothermal energy

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[443] Graeme Beardsmore, *Geothermal energy potential of the Northern Territory: Northern Territory Geological Survey, Record 2007-004*, Northern Territory Government, Darwin, 2007, p. 15
[444] Graeme Beardsmore, *Geothermal energy potential of the Northern Territory,* p. 15
[445] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* pp. 222-3
[446] Committee Hansard, Mr Trevor Horman: Manager Sustainable Energy, Power and Water Corporation, p. 16
[447] Department of Mines and Energy, Energy Directorate, *energyNT 20134,* Northern Territory Government, Darwin, January 2014, p. 18
[448] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 223
[449] Geoscience Australia and ABARE, *Australian Energy Resource Assessment,* p. 223
[450] Geoscience Australia and ABARE, *Australian Energy Resource Assessment*, p. 206

represents a particularly attractive alternative to existing fossil fuel plants that has significant long-term potential for the NT:

> Indeed, if the technology progresses as forecast by its proponents, and the resource is proven to be as extensive as predicted, the potential remains for the NT to develop a significant comparative advantage in energy production compared with other Australian localities.[451]

Key Challenges

4.118 In many respects the key challenges facing the Territory's renewable energy sector are not dissimilar to those cited above in relation to the Territory's oil and gas industry. As noted in the preceding discussion, the Northern Territory is well endowed with proven and potential renewable energy resources. However, development of such is contingent upon the provision of an effective and attractive investment environment, and implementation of supportive regulatory and policy frameworks that recognise both the value and inevitability of renewable energy resources as an integral aspect of the Territory's overall energy mix.

4.119 Although the cost competitiveness of renewable energy technologies is improving, the Committee notes that cost remains a sticking point in the NT's uptake of renewable energy. Similarly, excess generation capacity, in conjunction with the current and projected levelised cost of gas fired electricity generation out to 2030, is a limiting factor when it comes to investment in renewable energy resource development. As highlighted by Tenax Energy:

> The cost of deploying viable renewable energy projects in the Northern Territory is currently higher than the avoided cost of natural gas fired generation. The result is the liable RET entities such as Power and Water Corporation sourcing 85% of its Renewable Certificates from the national market, a disincentive to project development.[452]

4.120 The Committee understands that under the *Renewable Energy (Electricity) Act 2000,* PWC Retail is classified as a liable entity subject to a renewable energy target (RET) of 20 percent of demand by 2020; approximately 300 GWh. PWC can meet its obligations through the generation of renewable energy, buying renewable energy from other parties, or by purchasing Large-scale Generating Certificates (LGC's) from the national market. While PWC's RET obligation only applies in respect of the Darwin-Katherine interconnected system, as previously noted, electricity generation from renewable sources currently accounts for a mere 9,000 MWh per annum.[453]

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[451] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 30

[452] Submission No 4, Tenax Energy Pty Ltd, p. 6

[453] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 1

4.121 In 2011 it was estimated that by 2020 "the direct cost of meeting this obligation will be between $12M and $21M annually", [454] a cost that, subject to regulatory approval, will ultimately be passed on to consumers.[455] Moreover, the Committee notes that with less than six years to go, in the absence of some form of market intervention by the NT Government, it is highly unlikely that LGC's will be met from NT based renewable power stations by 2020. As ECNT pointed out:

> Rather than investing the $10-$20M p.a. mandated by the RET law in renewable energy generated in the Territory, Power and Water Corporation instead creates jobs and builds a renewable energy industry in other states – mainly south Australian wind generators – by buying large-scale generation certificates elsewhere.
>
> Territorians lose out because the Territory Government fails to require Power and Water Corporation to purchase the large-scale generation certificates locally. To illustrate the opportunity cost of this policy, Territory renewable energy generation businesses will forgo investment by an NT Government corporation of an estimated $100M-$200M between 2010 and 2020; sufficient funds to construct and operate several utility scale solar PV power plants in the Territory.[456]

4.122 Then too, under Australia's *Emissions Trading Scheme* (ETS), as of July 2012 liable businesses, including generation utilities reliant on fossil fuels, have an obligation to purchase emissions permits (currently capped at $24.50 per tonne CO^2e). Effectively increasing electricity generation costs, this cost increase has already been passed through to consumers. Under current legislation, as of 1 July 2015 the price will be set by businesses and the market (a flexible or floating price) and will be linked to the European Union ETS. The Committee notes that:

> over time as international action accelerates and the caps [limits on emissions that can be released by liable entities] in Europe, Australia and elsewhere are tightened, there will be fewer permits available…this means the carbon price paid by Australian businesses is expected to rise over time. This provides strong incentive for businesses to start implementing long-term strategies for cutting emissions.[457]

4.123 The Committee notes that "the electricity sector is Australia's largest source of greenhouse gas emissions, accounting for 36 percent of national emissions." [458] While electricity generated from natural gas is often cited as being 'clean and green', this only holds true when compared to electricity produced from coal for example. Similarly, in the context of the Northern Territory, it fails to take into account the not inconsiderable amount of electricity generated utilising diesel as the primary fuel source. As ECNT noted in their submission,

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[454] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT*, p. 1 and pp. 20-1

[455] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT*, p. 1 and pp. 20-1

[456] Submission No 16, Environment Centre NT, p. 6

[457] World Wildlife Fund, *Australia's Emissions Trading Scheme: Implications of an Early Move to a Flexible Price,* World Wildlife Fund, Sydney, July 2013 pp. 1-2

[458] Institute for Sustainable Futures, *Think Small: The Australian Decentralised Energy Roadmap,* University of Technology Sydney, Sydney, December 2011, p. 7

> Greenhouse gas emissions from stationery energy contributed one quarter of the Territory's greenhouse accounts in 2010/11 (or almost 4Mt CO2-e p.a. of a total 14.7Mt CO_2-e p.a.), the most recent year for which annual accounts are available through the National Greenhouse Emissions Reporting System.[459]

Given the above, and taking into consideration recent debate regarding the financial sustainability of PWC, the absence of a formalised energy policy specifically addressing the stationary energy sector and management of the Territory's obligations with regards to Renewable Energy Targets and Carbon Emissions is of particular concern to the Committee.

4.124 In moving to establish the Committee on the Northern Territory's Energy Future, the Attorney-General noted that "to confidently Frame the Future of the Northern Territory, we must identify and understand our limitations and opportunities…It is why we have invested in a separate Energy Directorate within the Department of Mines and Energy."[460] As Mr Scott Pekins: Chief Executive Officer, Department of Mines and Energy, advised the Committee:

> The Energy Directorate will develop and coordinate the whole-of-government energy policy advice and provide industry support and regulation of upstream energy sources and downstream energy activities including for the generation of electricity.
>
> This encompasses renewable energy resources and gas for consumption both within the Territory and for export. The abundance of gas production potential and the natural advantage of sunlight in the NT make it easy to envisage a policy set that is based on these two commodities and the Energy Directorate is being structured along these lines. We have a clear view of securing future energy security bearing in mind the need to plan for future industrial and domestic development, and ensuring that the price of energy remains competitive with the rest of Australia.
>
> In developing the gas and solar themes, we also recognise the need to contribute to an overall cleaner energy platform using the NT's natural resource advantages and the directorate will be mindful of this context as it develops policy frameworks and actions.[461]

4.125 However, the Committee notes that to date there is little evidence that the Energy Directorate has undertaken any consideration of the aforementioned issues or developed any policies associated with renewable energy resources for the generation of electricity. Indeed, the Committee notes that the Energy Directorate does not even rate a mention on the Department's website and the only reference to Energy is limited to information regarding legislation and titles associated with pipelines, oil, gas and geothermal.[462]

4.126 While PWC has been proactive in the development of renewable energy projects in remote communities, as highlighted elsewhere in this report, the Committee notes that development of such is currently reliant upon the capacity

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[459] Submission No 16, Environment Centre NT, p. 5
[460] Hon John Elferink, Attorney-General, *Motion to Establish Sessional Committee on the Northern Territory's Energy Future,* pp. 7-8
[461] Committee Hansard, Mr Scott Perkins: Chief Executive Officer, Department of Mines and Energy, p. 2
[462] Department of Mines and Energy, *Energy – Oil, Gas, Geothermal,* visited 10 April 2014, http://www.nt.gov.au/d/Minerals_Energy/

for PWC and/or its subsidiary IES to attract funding from the Commonwealth Government. As ALEC noted:

> currently the fueling of [diesel] generators in remote communities across the NT forces certain sections of Power and Water Corporation to consistently – and potentially always – run at a loss…Previously available reports by the Green Energy Task Force…comprehensively detailed steps towards a renewable energy roll-out across the Northern Territory. ALEC recommends that the Northern Territory Government dust off these reports and seek to build on them.[463]

4.127 The Committee notes that the lack of NT Government funding available to implement PWC's *Northern Territory Solar Energy Transformation Program* would seem to be somewhat short sighted given the capacity of this program to significantly reduce on-going costs to Government associated with the IES Service Delivery Grant. Similarly, it is noted that with regards to the Territory more generally:

> The NT has high generation costs already and a substantial Community Service Obligation (CSO) budget commitment thus providing significant incentive to explore opportunities for reduction in energy consumption and pursuit of alternative generation sources.[464]

4.128 The Green Energy Taskforce noted that the Territory's "regulatory and resource environment is not specifically restrictive to the uptake of renewable energy, nor is it specifically attractive for renewable energy proponents." [465] To date, renewable energy projects, such as those owned and operated by Epuron, have been developed within the framework of power purchase agreements where a fair and competitive price has been negotiated. However, as highlighted previously in relation to PPA's:

> A general barrier to determining a fair and competitive price by renewable energy technology proponents and developers is the limited understanding of the real marginal costs of generation within the NT energy markets.[466]

The extent to which this situation will be resolved as a consequence of the Government's recent decision to separate PWC Generation from PWC Retail is yet to be seen.

4.129 As mentioned previously, concerns have also been raised regarding the proposed NTEM and the extent to which the regulatory and operating framework allows for fair competition across technologies. If the Territory is to position itself for the future it is critical that the NTEM provides the opportunity for renewable energy to compete in the wholesale generation market, and that any barriers to entry into the market by new technologies and/or market participants are removed. For example, unlike other jurisdictions, the NT Government does not currently have a policy on Feed-In Tariffs (FIT). Rather,

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[463] Submission No. 12, Arid Lands Environment Centre Inc, pp. 3-4

[464] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 2

[465] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 2

[466] Green Energy Taskforce, *An Evaluation of the Relative Merits, Feasibility, and Likely Costs of the Potentially Available Renewable Energy Technologies to be Used in the NT,* p. 2

as noted in Chapter 2, current FIT arrangements are subject to an internal PWC policy. As such, there is no requirement for other retailers to enter into buy back arrangements with customers for power produced via rooftop solar PV systems.

4.130 The Committee notes that this may well impact on the uptake of residential and commercial solar PV systems. Similarly, it may inhibit customers from moving to other retailers entering the market which will likely impact on the potential benefits of opening the market up to competition. Similarly, retailers that may be considering entry into the NT market need to be aware of what obligations they may incur regarding power buy back arrangements. Given the intention of the Federal Government to encourage "a doubling of the use of household rooftop solar PV systems"[467], the Committee considers that it is an issue that needs to be resolved as part of the overall review of electricity generation wholesale market arrangements.

4.131 As noted previously, while it is generally acknowledged that gas will be required to provide a stable generating capacity within the regulated network systems for the foreseeable future, and may also provide an alternative to diesel generation in remote communities, it is also the case that:

> The NT is vulnerable to increasing price pressure on domestic energy that comes from network costs and upward pressure due to the global demand for gas. In the longer term we do not know for sure what the cost of gas will be, but it would be brave to bet on significant price reductions. By contrast, it is fairly safe to say the cost of renewable technologies will continue to fall. The cost of solar PV alone has fallen dramatically in the past few years, in fact 29% since 2011. In the Territory, the cost of solar PV is already at parity with gas in the retail market and will soon be in the wholesale market. It is an important opportunity and even a responsibility to put some effort into enabling the integration of our enormous renewable resources. In time this will reduce the overall cost of electricity to consumers. [468]

[467] Keith Orchison AM, *On Power yearbook 2014; Power and Uncertainty,* ArmstrongQ, Sydney, 2014, p. 12
[468] Committee Hansard, Mr Rob Law: Manager Policy and Climate, Environment Centre NT, pp. 2-3

5 Positioning the Territory for the Future – the Key Issues

5.1 The Committee notes that the security of the Territory's energy future is not simply a matter of ensuring access to a reliable fuel source. In recent times the on-going viability of the traditional, centralised network business model that currently dominates the Australian electricity market has been brought into question as the NEM struggles to accommodate a rapidly changing electricity supply environment:

> The role of the consumer is changing from being largely passive and disengaged to increasingly driving the evolution of the electricity supply system.[469]

5.2 A steady decline in overall demand for electricity in the eastern states, due in part to the uptake of rooftop solar PV systems, has led to an oversupply of generation capacity and an increasing number of redundant assets. At the same time, peak demand continues to grow necessitating capital expenditure on network infrastructure.[470] Needless to say, this has caused something of a *catch 22* situation: as investment in infrastructure places continued upward pressure on electricity prices more customers are responding by opting to offset costs through the uptake of rooftop solar PV systems which are becoming increasingly affordable.

5.3 As the Energy Networks Association recently noted with regards to the NEM:

> Our energy system is grappling with uncertain demand trends while facilitating seismic shifts in technology, with the potential for solar PV's on the grid to increase by 300 per cent over the next 10 years and for there to be another six million air-conditioning units. It is important that the energy debate move away from unproductive rhetoric to recognising the need to deliver outstanding reform that will benefit consumers in a changed environment.[471]

Then too, as noted by the Queensland Department of Energy and Water Supply, the impact of substantial electricity price rises on the cost of living and broader economic growth as network providers attempt to recoup costs is also cause for concern:

> Unsustainable electricity price rises have the potential to undermine Queensland's four pillar economy of agriculture, tourism, construction and mining. Reduced investment or business closure as a result of high electricity costs would jeopardise jobs and economic growth.[472]

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[469] Department of Energy and Water Supply, The 30-year electricity strategy Discussion paper, p. 6

[470] Institute for Sustainable Futures, *Think Small: The Australian Decentralised Energy Roadmap,* University of Technology Sydney, Sydney, December 2011, p. 27

[471] The Energy Network Association cited in Keith Orchison AM, *On Power yearbook 2014; Power and Uncertainty,* p. 17

[472] Department of Energy and Water Supply, The 30-year electricity strategy Discussion paper: Powering Queensland's future, State of Queensland, Brisbane, 2013, p. 6

5.4 If the Northern Territory is to avoid the not insignificant issues currently impacting on the electricity supply industry and consumers within the NEM, implementation of a more decentralised energy supply system and development of an effective electricity market that has the flexibility to take full advantage of a mix of resources and technologies; accommodate the trend towards customer independence from the grid; and maintain the capacity to deliver the most cost effective, efficient and sustainable access to energy by all Territorians over the longer term is of paramount importance.

5.5 The Northern Territory is in the enviable position of having access to a significant pool of proven and potential non-renewable and renewable energy producing resources. However, as discussed previously, it is anticipated that gas will continue to be the Territory's primary source of electricity in the foreseeable future. It is important to acknowledge that irrespective of availability, the price of gas, as is the case with oil, is largely determined by the vagaries of supply and demand in the world market:

> the development of Liquefied Natural Gas (LNG) export facilities has seen gas producers change their approach to managing gas reserves and supply arrangements as they lock in export contracts. Local gas users, including gas-fired power generators, are finding it difficult to access low priced gas supplies in this environment as demand from the export LNG sector places increasing pressure on prices.[473]

5.6 While domestic gas reservation has the potential to ensure on-going access to gas at a reasonable price, as discussed previously, the preference of both the industry and the Government is to avoid directly intervening in the market through prescriptive regulatory mechanisms. Similarly, given the volatility in world gas prices, locking the Territory into another long term supply contract runs the risk that the Territory will end up paying significantly more for its gas than might otherwise be the case.

5.7 As mentioned by a number of industry stakeholders, development of the Territory's domestic gas market, and as such its bargaining power, would be a more appropriate means of accessing gas for domestic use at a reasonable price. However, over the longer term, having recourse to a range of fuel sources will be the most effective and sustainable hedge against gas availability and price concerns.

5.8 Just as the *Remote Energy Supply Strategy* was developed in response to the volatility in diesel prices and the subsequent financial impost on service delivery in remote communities, consideration of a similar strategy designed to offset reliance on gas within the mainstream electricity sector has potential as a step in transitioning to a more flexible energy supply system.

5.9 As highlighted in Chapter 4, the key challenges associated with the development of the Territory's renewable energy sector are not dissimilar to those of the Territory's oil and gas industry. Development of both sectors is

[473] Department of Energy and Water Supply, The 30-year electricity strategy Discussion paper: Powering Queensland's future, State of Queensland, Brisbane, 2013, p.13

contingent upon the provision of an effective and attractive investment environment, and implementation of supportive regulatory and policy frameworks.

Appendix 1: Submissions and Tabled Papers

Submissions

1. Mr Turner, 30 October 2013
2. Northern Territory Major Energy Users, 31 October 2013
3. Bioenergy Australia, 5 November 2013
4. Tenax Energy Pty Ltd, 8 November 2013
5. Epuron Pty Ltd, 8 November 2013
6. PANGAEA Resources Pty Ltd, 8 November 2013
7. Tersum Energy Pty Ltd, 8 November 2013
8. Armour Energy Limited, 11 November 2013
9. Mr Geoff Casey, 11 November 2013
10. Balance Resources, 11 November 2013
11. Australian Oil and Electric Ltd, 15 November 2013
12. Arid Lands Environment Centre Inc, 15 November 2013
13. Beyond Nuclear Initiative, 15 November 2013
14. INPEX, 15 November 2013
15. Tri-Star Energy Company, 21 November 2013
16. Environment Centre NT, 22 November 2013
17. Tamboran Resources, 27 November 2013
18. Falcon Oil and Gas Australia Ltd, 28 November 2013
19. Association of Mining and Exploration Companies Inc (AMEC), 28 November 2013
20. ConocoPhillips Australia Pty Ltd, 29 November 2013
21. Australian Petroleum Production and Exploration Association Ltd (APPEA), 2 December 2013
22. SANTOS Ltd, 3 December 2013
23. Centre for Renewable Energy Charles Darwin University, 10 February 2014
24. NT Build, 21 February 2014

Tabled Papers

TP1: Growth Towns and Indigenous Communities Energy Source Map 2012
TP2: Levelised Cost of Energy for Various Energy Sources within the NT
TP3: Indigenous Essential Services Overview
TP4: Proposed Work Commitments NT Onshore Exploration
TP5: Role of the Utilities Commission, Regulatory Minister and Portfolio Minister
TP6: ECNT Energy Futures NT Survey
TP7: Power and Water Corporation, Responses to Questions

Note: Copies of Submissions and Tabled Papers are available at:
http://www.nt.gov.au/lant/parliamentary-business/committees/future%20energy/Inquiries.shtml

Appendix 2: Briefings and Hearings

Public Briefings – Darwin, 11 October 2013

- Department of the Chief Minister: Office of Asian Engagement, Trade and Investment
- Power and Water Corporation
- Indigenous Essential Services Pty Ltd
- Northern Territory Department of Mines and Energy
- Minerals Council of Australia NT Division

Private Briefings – Perth, 6 November 2013

- Advent Energy Ltd
- Professor Peter Hartley: BHP Billiton Chair of Economics, University of Western Australia
- Australian Petroleum Production and Exploration Association (APPEA)

Private Briefings – Perth, 7 November 2013

- INPEX
- Association of Mining and Exploration Companies Inc (AMEC)
- ENI Australia

Public Briefing – Darwin, 4 December 2013

- Utilities Commission of the Northern Territory

Public Hearing – Darwin, 14 February 2014

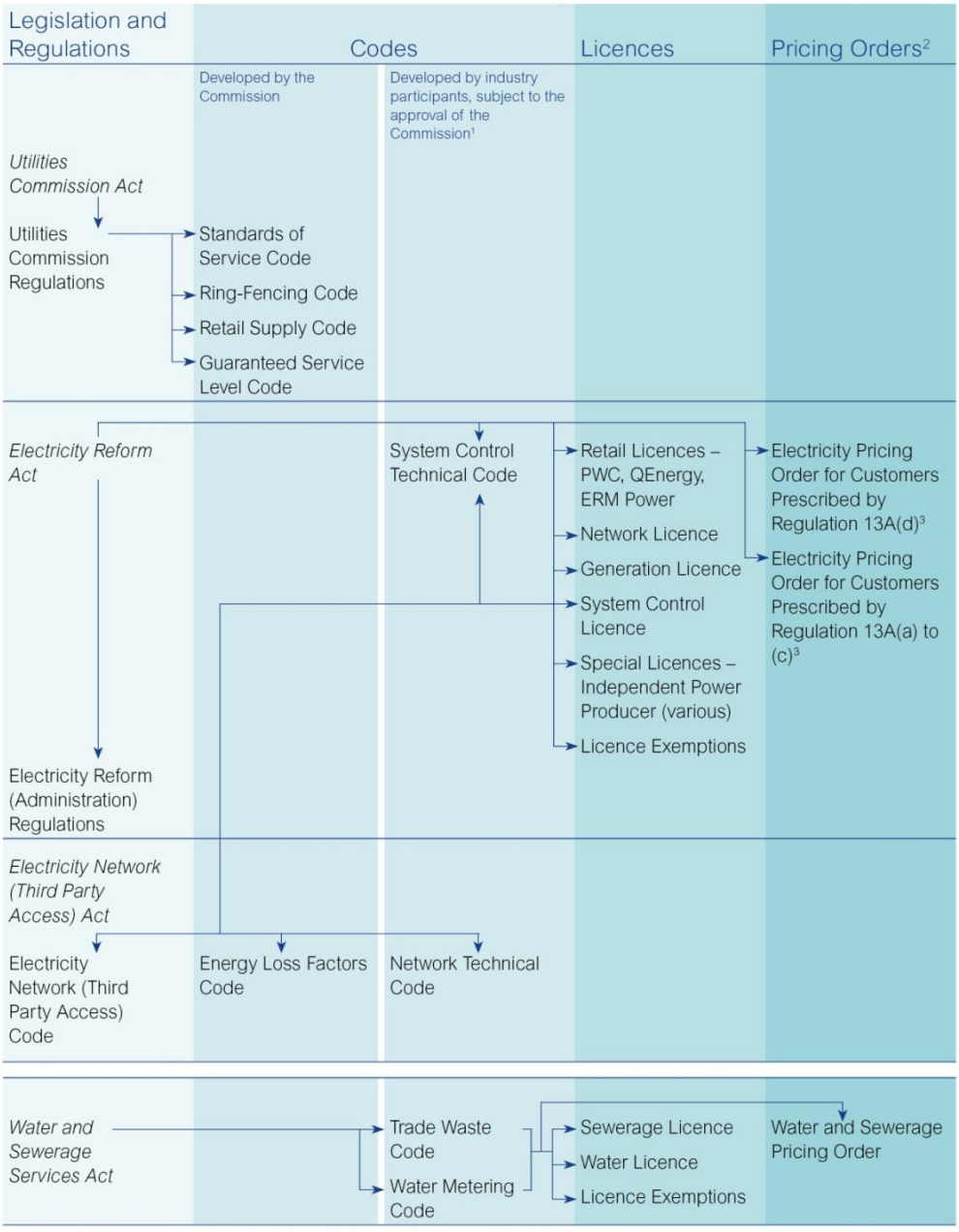
- Australian Petroleum Production and Exploration Association (APPEA)
- Tenax Energy Pty Ltd
- Bioenergy Australia
- Environment Centre NT
- Arid Lands Environment Centre Inc
- Epuron Pty Ltd
- Armour Energy Ltd

Public Hearing – Darwin, 20 March 2014

- Power and Water Corporation

Note: Copies of transcripts are available at: http://www.nt.gov.au/lant/parliamentary-business/committees/future%20energy/Inquiries.shtml

Appendix 3: Northern Territory Regulatory Architecture



Source: Utilities Commission of the Northern Territory[474]

[474] Utilities Commission NT, *Annual Report 2012-13,* p. 12

Appendix 4: Northern Territory Licensing Framework

Licence Type	Scope	Issued To
Standard Generation Licence	• to generate electricity for sale; and • to sell electricity to electricity entities holding generation or retail licences (or as otherwise stated in the licence).	• PWC
Special Generation Licence – Independent Power Producers[1]	• to generate electricity for sale; and • to sell electricity only to electricity entities holding a standard generation licence (or as otherwise stated in the licence).	• EDL NGD (NT) Pty Ltd: Pine Creek A power station and McArthur River power station – McArthur River. • Cosmo Power Pty Ltd: Pine Creek B power station. • Central Energy Power Pty Ltd Brewer Estate power station - Alice Springs • LMS Energy Pty Ltd: Shoal Bay power station - Darwin • Uterne Power Plant Pty Ltd: photovoltaic system at Alice Springs • TKLN Solar Pty Ltd: photovoltaic systems - Ti Tree, Kalkarindji and Lake Nash (Alpurrurulam) • Energy Resources of Australia Ltd: Ranger power station - Jabiru
Network Licence	• to operate the electricity network in the geographical area stated in the licence; and • if stated in the licence – to connect the electricity network to another electricity network.	• PWC
Retail Licence	• to trade in electricity (where 'trade' means buying and selling of electricity other than to final consumers); and • to retail electricity to customers who own or occupy premises anywhere in the Territory (where 'retail' means selling of electricity to specified groups of final consumers).	• PWC • QEnergy Ltd • ERM Retail

Licence Type	Scope	Issued To
Special Licence – Isolated System Operations[2]	• to generate electricity at specified generating plants; • to sell electricity to electricity entities holding a generation licence or a retail licence; • to sell electricity to customers, but only in respect of electrical installations or premises which are situated within specified locations; and • to own and operate an electricity network within specified geographic areas and connect that network to another specified electricity network.	• Groote Eylandt Mining Company Pty Ltd
System Control Licence[3]	• to monitor and control the operation of the power system with a view to ensuring that the system operates safely and securely, including by issuing directions to electricity entities that are engaged in the operation of the power system, or contribute electricity to, or take electricity from, the power system.	• PWC

[1] An Independent Power Producer licence is a 'cut down' version of a generation licence for those parties who do not wish to participate fully in the electricity supply market and instead generate electricity under contract for another generator.

[2] An isolated system operations licence is a combination generation, network and retail licence for entities operating in remote locations, for example where a mining company supplies electricity to a nearby town that predominantly houses workers associated with the mine.

[3] A system control licence is only issued where the power system is of sufficient size and complexity to warrant monitoring and control by an arm's length system controller. In isolated communities with a single generator of electricity, management of system loads and frequency control is undertaken by the generator. Coordination of generation with third-party interconnected networks would be a matter for normal commercial contractual arrangements.

Current Exemptions

Exemption Type	Issued To
Electricity Supply Services	Pacific Aluminium Pty Ltd, Nhulunbuy township and mine
Generation and Retail	Small Scale Renewable Operations (e.g. domestic and commercial roof top PV systems)

Source: Utilities Commission of the Northern Territory[475]

[475] Utilities Commission NT, *Annual Report 2012-13*, p.p. 20-1

Appendix 5: Inquiry into Darwin-Katherine System Black

INDEPENDENT INVESTIGATION INTO THE 12 MARCH 2014 DARWIN-KATHERINE SYSTEM BLACK

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TERMS OF REFERENCE

Background

On Wednesday 12 March 2014, at approximately 1.19am, a fault occurred which resulted in an extended System Black power outage from Darwin to Katherine.

Power and Water Corporation's (PWC) preliminary assessment of the situation is that a fault with a circuit breaker at Hudson Creek substation in Darwin was activated shutting down transmission from Channel Island Power Station resulting in a widespread power outage extending from Darwin to Katherine affecting some 65 000 customers.

PWC are undertaking a full investigation into the course of the incident.

Referral

Pursuant to section 6(1)(g) of the *Utilities Commission Act*, the Commission is to conduct an independent investigation into the system black incident that occurred on 12 March 2014.

Scope of Investigation

The independent investigation is to address the following matters:

1. description of the power system situation that existed prior to the system black incident, the sequence of events leading to the incident and the state of the power system after the incident, plus any related subsequent incidents;
2. identifying root causes of the incident from a technical standpoint including any operational and maintenance activities;
3. history of the performance of Hudson Creek substation and any other transmission and distribution infrastructure involved in the incident;
4. the response of generators to the disturbance and their protection systems;
5. standards and procedures followed by System Control to mitigate the risk of system insecurity and their performance against these standards during this event;
6. assessment of any other the causal factors and factors contributing to both the occurrence and severity of the incident;
7. assessment of the adequacy and speed of the response to the incident, including external communication;
8. assessment of the time taken to restore the system and power system restoration activities including prioritisation and assessment of restoration needs;
9. recommendations for actions that may be required to prevent a recurrence of such an incident including the design of the power system and related power system operation and maintenance practices;
10. what impacts, if any, did gas supply have on the incident;
11. if the above matters are unable to be addressed within the specified timeframe, recommendations for subsequent investigations and appropriate timing.

All results from PWC's internal investigation will made available to the Commission.

The Commission is to draw on external technical resources as it considers appropriate, including consultation with the Australian Energy Market Operator.

Timing

The Commission is to provide a report to the Minister by 27 March 2014.

Appendix 6: Review of Wholesale Electricity Generation Market

Terms of Reference

Background

The electricity supply industry in the Northern Territory is dominated by the Power and Water Corporation (PWC). The Territory Government wishes to provide greater impetus to the application of competitive forces in the generation and retail sectors of the industry. These sectors are already contestable in the sense that legal impediments to the entry of new participants have been removed, with the Utilities Commission (Commission) being responsible for the licensing of new entrants. At the present time, however, there are no competitors to PWC in the generation sector, while in the retail sector two licensees may compete with PWC to sell electricity to all customers. However, PWC continues to be the primary retailer for smaller customers, including households and small business, as the current tariff structures and community service obligations in respect of these customers render them commercially unattractive.

A significant impediment to competition in the generation and retail sectors is the lack of operational wholesale market arrangements in the Territory, such as exists in the National Electricity Market (NEM) and in the South West Interconnected System of Western Australia (SWIS). At present, competing retailers in the Territory contract bilaterally with PWC Generation for the supply of electricity to meet customers' requirements. It is acknowledged that the current reliance in the Territory on direct (bilateral) contracting between generators and retailer, and the associated regulatory arrangements, is by far the most significant regulatory barrier to private sector investment in and entry into the Territory's generation market.

Referral

Pursuant to section 31 of the *Utilities Commission Act* 2000, the Commission is to conduct a review into wholesale electricity market arrangements that are appropriate for the Territory, and to recommend preferred arrangements.

Review Objective

The preferred wholesale market arrangements recommended by the Commission should be based on the achievement of the following market objectives:

(a) to promote the economically efficient, safe and reliable production and supply of electricity and electricity related services of the Territory;

(b) to facilitate competition among generators and retailers in the Territory's electricity system, including by enabling efficient entry of new competitors;

(c) to minimise the long-term cost of electricity supplied to customers from the Territory's electricity system; and

(d) to encourage the use of measures that more efficiently manage the volume of electricity used including the variations between peak and average loads.

It is recognised that the NEM is an established best practice regulatory framework which has been developed over a decade and provides a reference point for the Territory's future regulatory framework.

2

Review Scope

The Commission should consider the applicability of the NEM and SWIS models. In its consideration of appropriate wholesale market design, the Commission should have consideration for the Government's package of electricity supply industry reforms, including greater alignment of the Territory's regulatory framework with the NEM, transfer of network regulation to the Australian Energy Regulator and adoption of the National Electricity Rules. Any proposed market design arrangements would need to be compatible with these reforms.

The Commission is to consider wholesale market arrangements that are suitable to the Territory's circumstances and capable of cost effectively replacing sole reliance on bilateral contracting.

The Commission is to provide recommendations regarding the design and rules that could be adopted initially in the Darwin-Katherine generation market.

In recommending the appropriate wholesale market arrangements, the Commission is to develop the proposed rules in consultation with relevant stakeholders

Timing

In accordance with section 34 of the *Utilities Commission Act*, the Commission is to provide its final report to the Minister by 28 February 2014.

Review Process

The Commission is to undertake the review in the manner it considers appropriate, including consultation with key stakeholders.

Consultation should include, but not be limited to:

- Australian Energy Market Operator
- Australian Energy Market Commission
- Western Australian Independent Market Operator
- Economic Regulation Authority of Western Australia
- Power and Water Corporation
- Department of Treasury and Finance
- Other industry participants (or potential participants)

In accordance with section 32 of the *Utilities Commission Act*, the Commission will publish a notice of the review, including the Terms of Reference in the newspaper and send a copy to licensed entities.

Source: Utilities Commission of the Northern Territory[476]

[476] Utilities Commission NT, *Independent Review of the Wholesale Generation Market: Terms of Reference,* viewed 23 October 2013, http://www.utilicom.nt.gov.au/Newsroom/Lists/Posts/Post.aspx?ID=168

Appendix 7: Inquiry into Splitting the Power and Water Corporation

LEGISLATIVE ASSEMBLY OF THE NORTHERN TERRITORY

12th Assembly

Public Accounts Committee

Inquiry into Splitting the Power and Water Corporation

Terms of Reference

On 26 March 2014, the Public Accounts Committee resolved:

That the Public Accounts Committee inquire into and report on the Government's proposals to split up the Power and Water Corporation into three separate entities, including:

a) The provisions of the Power and Water Corporation Legislation Amendment Bill 2014 serial 63, the Power Generation Corporation Bill 2014 serial 64, and the Power Retail Corporation Bill 2014 serial 65;

b) The fiscal and economic impact of the Power and Water Corporation being split into three separate entities; and

c) Any other matters in relation to the proposed split up of the Power and Water Corporation.

Source: Legislative Assembly of the Northern Territory[477]

[477] Legislative Assembly of the Northern Territory, *Terms of Reference: Inquiry into Splitting the Power and Water Corporation,* viewed 27 March 2014, http://www.nt.gov.au/lant/parliamentary-business/committees/public%20accounts/PWC%20Submissions/Terms_of_Reference_PWC_split.pdf

Appendix 8: Indigenous Essential Services Communities

Northern Territory funded Indigenous Communities and Outstations serviced through the Indigenous Essential Services Program

Ref	ID#	IES Community (Remote Service Delivery communities in bold)	Population 2011 Census	Comments
1	279	Acacia Larrakia[2]	90	Commercial electricity grid - Darwin
2	202	Ali Curung	622	Commercial electricity grid - Tennant Creek CED sewerage scheme.
3	203	Alpurrurulam	514	Solar system owned/managed by others
4	622	Amanbidji (Kildurk)	101	
5	9	Amoonguna	322	Commercial electricity and water grid - Alice Springs CED sewerage scheme
6	10	Ampilatwatja	427	Septic sewerage service provided by others
7	451	**Angurugu**	963	Commercial electricity grid - BHP mine Majority is CED sewerage scheme
8	20	Areyonga	276	
9	42	Atitjere (Hart Range)	217	Septic sewerage service provided by others
10	580	Barunga	361	Commercial electricity grid - Katherine
11	294	Belyuen[2]	181	Commercial electricity grid - Darwin
12	581	Beswick	588	Commercial electricity grid - Katherine
13	582	Binjari	270	Commercial electricity grid - Katherine
14	586	Bulla	153	
15	587	Bulman[2]	335	
16	219	Canteen Creek (Owaitilla)	254	Septic sewerage service provided by others
17	591	Daguragu	223	
18	33	Engawala	165	
19	36	Finke (Apatula)	184	
20	492	**Galiwinku (Elcho Island**)	2470	
21	500	**Gapuwiyak (Lake Evella)**	1018	
22	329	**Gunbalanya (Oenpelli)**	1371	
23	514	Gunyangara (Ski Beach)	183	Commercial electricity and water grid – Rio Tinto
24	41	Haasts Bluff (Ikuntji)	175	Septic sewerage service provided by others
25	43	**Hermannsburg**	725	
26	250	Imangara (Murray Downs)	108	Commercial electricity grid – Tennant Creek Septic sewerage service provided by others
27	51	Imanpa	203	
28	593	Jilkminggan (Duck Creek)	322	
29	603	Kalkarindji (Wave Hill)	400	Solar system owned/managed by others
30	66	Kaltukatjara (Docker River)	331	
31	72	Kintore	527	

Ref	ID#	IES Community (Remote Service Delivery communities in bold)	Population 2011 Census	Comments
32	608	Kybrook Farm[2]	74	Commercial electricity – Darwin, water grid – Pine Ck
33	609	**Lajamanu**	757	
34	86	Laramba	289	Septic sewerage service provided by others
35	362	**Maningrida**	2680	
36	595	Manyallaluk (Eva Valley)	121	CED sewerage scheme to part of the community, Septic sewerage service provided by others
37	374	Milikapiti (Snake Bay)	521	
38	531	**Milingimbi**	1259	
39	532	Milyakburra (Bickerton Is)	201	
40	375	Minjilang (Croker Island)	359	
41	624	Minyerri	562	
42	112	Mt Liebig	180	Septic sewerage service provided by others
43	397	Nauiyu (Daly River)	522	Electricity services also includes Wooliana Road
44	404	Nganmarriyanga (Palumpa)	434	CED sewerage scheme
45	633	**Ngukurr**	1225	
46	127	Nturiya	122	Commercial electricity grid-Ti Tree Septic sewerage service provided by others
47	549	**Numbulwar**	796	
48	128	Nyirripi	243	
49	131	Papunya	484	CED sewerage scheme
50	410	Peppimenarti	215	CED sewerage scheme
51	639	Pigeon Hole	145	
52	411	Pirlangimpi	434	
53	138	Pmara Jutunta (Ti Tree 6 Mile)	224	Commercial electricity grid-Ti Tree
54	550	Ramingining	971	
55	641	Rittarangu	115	
56	258	Robinson River	300	Septic sewerage service provided by others
57	145	Santa Teresa	650	Commercial electricity grid - Alice Springs
58	264	Tara	66	Septic sewerage service provided by others
59	148	Titjikala	235	Septic sewerage service provided by others
60	555	**Umbakumba**	510	
61	426	**Wadeye**	2461	
62	174	Wallace Rockhole	79	Septic sewerage service provided by others
63	429	Warruwi	494	
64	654	Weemol[2]	82	Septic sewerage service provided by others
65	186	Willowra	253	CED sewerage scheme
66	187	Wilora	128	Septic sewerage service provided by others

Ref	ID#	IES Community (Remote Service Delivery communities in bold)	Population 2011 Census	Comments
67	400	**Wurrumiyanga (Nguiu)**	1779	
68	227	Wutunugurra (Epenarra)	238	Septic sewerage service provided by others
69	658	Yarralin	304	
70	576	**Yirrkala**	982	Commercial electricity grid – Rio Tinto Mine
71	197	Yuelamu	235	
72	198	**Yuendumu**	789	
Total Community Population			**36720**	

Location	ID#	Outstation Name[1]	Population 2010	Services Supplied
Northern Region Outstations				
Nguiu	1006	4 Mile Camp	**30**	Electricity - HV, access to water grid
Demed	391	Kungarrewarl (Clancy's Camp)	**5**	Electricity - HV
Palumpa	1026	Nama *	**5**	Electricity (HV & LV) Water and sewerage*
Palumpa	435	Wudapuli *	**10**	Electricity (HV & LV) Water and sewerage*
Ramingining	542	Ngangalala	**40**	Electricity - HV
Ramingining	838	Wulkabimirri	**30**	Electricity - HV
Ramingining	571	Yathalamarra	**70**	Electricity - HV
Katherine	598	Jodetluk (Gorge Camp)	**45**	Electricity – HV, Water
Katherine	642	Rockhole	**5**	Electricity – HV
Timber Creek	597	Gilwi	**30**	Electricity - HV
Timber Creek	648	Muruning (Darby's Camp)	**21**	Electricity - HV
Timber Creek	678	Myatt	**81**	Electricity - HV
Borroloola	256	Wandangula (Police Lagoon)	**20**	Electricity - HV
Southern Region Outstations				
Tennant Creek	244	Mungkarta (McLaren Ck)	**80**	Electricity - HV
Papunya	25	Blackwater *	**12**	Electricity (HV & LV)*
Papunya	760	Ulambara *	**5**	Electricity (HV & LV)*
Papunya	180	3 mile *	**3**	Electricity (HV & LV)*
Papunya	759	5 mile *	**20**	Electricity (HV & LV)*
Tjuwanpa	79	Armstrong's	**10**	Electricity (HV & LV)
Tjuwanpa	21	Arrkapa Bore	**26**	Electricity (HV & LV)
Tjuwanpa	52	Importna	**8**	Electricity (HV & LV)
Tjuwanpa	56	Injartnama	**25**	Electricity (HV & LV)
Tjuwanpa	n/a	Injartnama Bore	**n/a**	Electricity (HV & LV)
Tjuwanpa	771	Ipalala	**5**	Electricity (HV & LV)
Tjuwanpa	n/a	Ipalala Bore	**n/a**	Electricity (HV & LV)
Tjuwanpa	67	Kaporilya	**20**	Electricity (HV & LV), access to water grid
Tjuwanpa	92	Ltira	**10**	Electricity (HV & LV)
Tjuwanpa Outstations	n/a	Ltira Bore		Electricity (HV & LV)
Tjuwanpa	94	Lyilyalanama	**4**	Electricity (HV & LV), access to water grid Hermannsburg

Location	ID#	Outstation Name[1]	Population 2010	Services Supplied
Tjuwanpa	872	Merral Ntarrakala	**8**	Electricity (HV & LV)
Tjuwanpa	106	Motna's	**6**	Electricity (HV & LV)
Tjuwanpa	770	Ntakarra	**10**	Electricity (HV & LV)
Tjuwanpa	700	Old Station	**n/a**	Electricity (HV & LV)
Tjuwanpa	n/a	Old Station Bore	**n/a**	Electricity (HV & LV)
Tjuwanpa	5	Red Sandhill	**20**	Electricity (HV & LV)
Tjuwanpa	n/a	Red Sandhill Bore	**n/a**	Electricity (HV & LV)
Tjuwanpa	861	Rutjingka	**6**	Electricity (HV & LV)
Tjuwanpa	149	Tjamangkurra	**12**	Electricity (HV & LV)
Tjuwanpa Outstations	n/a	Tjamangkurra Bore	**n/a**	Electricity (HV & LV)
Tjuwanpa	-	Tjuwanpa (Resource Centre)	**n/a**	Electricity (HV & LV), access to water grid Hermannsburg
Tjuwanpa	154	Tnawurta Bore	**4**	Electricity (HV & LV)
Tjuwanpa	155	Tnyimipurta	**10**	Electricity (HV & LV)
Tjuwanpa Outstations	n/a	Tnyimipurta Tanks	**n/a**	Electricity (HV & LV)
Tjuwanpa	772	Ulpunda	**12**	Electricity (HV & LV), access to water grid Hermannsburg
Tjuwanpa	984	Yakala	**2**	Electricity (HV & LV)
Utopia	104	Amengernterneah (Clinic)	**35**	Electricity (HV & LV)
Utopia	170	Ankerrapw (Utopia Homestead)	**1**	Electricity (HV & LV)
Utopia	147	Arawerr	**60**	Electricity (HV & LV)
Utopia	7	Arlparra	**70**	Electricity (HV & LV)
Utopia	168	Arlparra (Utopia Store)	**90**	Electricity (HV & LV)
Utopia	22	Artekerr (3 Bores)	**4**	Electricity (HV & LV)
Utopia	729	Atheley	**30**	Electricity (HV & LV)
Utopia	27	Atneltyey (Boundary Bore)	**80**	Electricity (HV & LV)
Utopia	728	Camel Camp	**20**	Electricity (HV & LV)
Utopia	15	Indaringinya (Antarrengeny)	**20**	Electricity (HV & LV)
Utopia	726	Inkawenyerre (New Camp)	**80**	Electricity (HV & LV)
Utopia	82	Inkwelaye (Kurrajong Bore)	**40**	Electricity (HV & LV)
Utopia	63	Irrultja	**96**	Electricity (HV & LV)
Utopia	727	Iylentye (Mosquito Bore)	**4**	Electricity (HV & LV)
Utopia	126	Ngkwarlerlanem	**18**	Electricity (HV & LV)
Utopia	730	Pungalindum	**70**	Electricity (HV & LV)
Utopia	23	QuartPot	**12**	Electricity (HV & LV)
Utopia	146	Soakage Bore (Atnarara)	**12**	Electricity (HV & LV)
Utopia	970	Tommyhawk Swamp	**2**	Electricity (HV & LV)
Alice Springs	65	Iwupataka (Jay Creek)	**20**	Electricity – HV & LV
Total Outstation Population			**1494**	

[1]***Services on outstations marked *, are carried out on a cost recovery basis because these assets are not vested in IES Pty Ltd***

Source: Indigenous Essential Services Pty Ltd[478]

[478] Indigenous Essential Services Pty Ltd, *Northern Territory funded Indigenous Communities and Outstations serviced through the Indigenous Essential Services Program,* Answer to Question Taken on Notice, Public Briefing, 11 October 2013: available at http://www.nt.gov.au/lant/parliamentary-business/committees/future%20energy/Inquiries.shtml

Appendix 9: NT Onshore and Coastal Waters Petroleum Titles

NT Onshore Title	Title Holder/Operator	Date Awarded
EP76	Falcon Oil & Gas Australia Limited	8-Mar-01
EP82	Helium Australia Pty Ltd	2-Sep-05
EP93	Merlin Energy Pty Ltd	30-Jan-13
EP97	Merlin Energy Pty Ltd	23-May-11
EP98	Falcon Oil & Gas Australia Pty Ltd	4-Feb-04
EP99	Falcon Oil & Gas Australia Pty Ltd	4-Feb-04
EP103	Statoil Australia Theta B.V	21-Nov-06
	Texalta Australia Pty Ltd	
	Petrofrontier (Australia) Pty Ltd	
EP104	Statoil Australia Theta B.V	21-Nov-06
	Texalta Australia Pty Ltd	
	Petrofrontier (Australia) Pty Ltd	
EP105	Merlin Energy Pty Ltd	28-Sep-07
	Santos QNT Pty Ltd	
EP106	Merlin Energy Pty Ltd	28-Sep-07
	Santos QNT Pty Ltd	
EP107	Merlin Energy Pty Ltd	28-Sep-07
	Santos QNT Pty Ltd	
EP112	Frontier Oil & Gas Pty Ltd	21-Jul-05
	Santos QNT Pty Ltd	
EP115	Frontier Oil & Gas Pty Ltd	17-Aug-07
EP117	Falcon Oil & Gas Australia Pty Ltd	14-Mar-06
EP125	Ordiv Petroleum Pty Ltd	7-Dec-05
	Santos QNT Pty Ltd	
EP126	Territory Oil and Gas Pty Limited	15-Jun-11
	Beach Petroleum (NT) Pty Ltd	
EP127	Statoil Australia Theta B.V	14-Dec-07
	Baraka Petroleum Limited	
	Petrofrontier (Australia) Pty Ltd	
EP128	Statoil Australia Theta B.V	14-Dec-07
	Baraka Petroleum Limited	
	Petrofrontier (Australia) Pty Ltd	
EP134	Tri-star Energy Company	26-Feb-08
EP135	Territory Oil and Gas Pty Limited	23-Aug-12
	Beach Petroleum (NT) Pty Ltd	
EP136	Sweetpea Petroleum Pty Ltd	28-Aug-12
	Paltar Petroleum Limited	
EP138	Territory Oil and Gas Pty Limited	23-Aug-12
	Beach Petroleum (NT) Pty Ltd	
EP143	Sweetpea Petroleum Pty Ltd	28-Aug-12
	Paltar Petroleum Limited	
EP144	Conarco Minerals Pty Ltd	21-May-13
EP153	Mineral Australia Pty Ltd	1-Jul-13
	Jacaranda Minerals Limited	
EP156	Oilco Pty Ltd	7-Nov-11

NT Onshore Title	Title Holder/Operator	Date Awarded
EP161	Tamboran Resources Pty Ltd and Santos QNT Pty Ltd	21-May-12
EP162	Tamboran Resources Pty Ltd	21-Aug-12
	Santos QNT Pty Ltd	
EP163	Tamboran Resources Pty Ltd	14-May-10
EP164	Tamboran Resources Pty Ltd	23-Aug-13
EP165	Tamboran Resources Pty Ltd	15-Jul-13
EP166	Tamboran Resources Pty Ltd	28-Aug-13
EP167	Pangaea (NT) Pty Ltd	10-Jan-13
EP168	Pangaea (NT) Pty Ltd	10-Jan-13
EP169	Pangaea (NT) Pty Ltd	4-Apr-13
EP171	Armour Energy Pty Ltd	29-Jun-11
EP174	Armour Energy Pty Ltd	11-Dec-12
EP176	Amour Energy Pty Ltd	29-Jun-11
EP184	Imperial Oil & Gas Pty Ltd	21-Aug-13
EP189	Tamboran Resources Pty Ltd	21-Aug-12
	Santos QNT Pty Ltd	
EP190	Armour Energy Pty Ltd	11-Dec-12
EP191	Armour Energy Pty Ltd	3-Oct-13
EP192	Armour Energy Pty Ltd	3-Oct-13
EP198	Pangaea (NT) Pty Ltd	10-Jan-13
EP200	Wiso Oil Pty Ltd	16-Feb-12
EP205	Wiso Oil Pty Ltd	16-Feb-12
EP207	Wiso Oil Pty Ltd	16-Feb-12
EP222	Wiso Oil Pty Ltd	22-Aug-12
EP231	Paltar Petroleum Limited	5-Sep-12
EP232	Paltar Petroleum Limited	3-Oct-13
EP234	Paltar Petroleum Limited	5-Sep-12
EP237	Paltar Petroleum Limited	5-Sep-12
EP300	Tom Oates	17-Apr-13
EP301	Tom Oates	15-May-13
EP309	Tamboran Resources Pty Ltd	15-Jul-13
RL1	Onshore Energy Pty Ltd	9-Jul-13
RL2	Magellan Petroleum (NT) Pty Ltd	4-Feb-09
RL3	Helium Australia Pty Ltd	6-Mar-13
	Santos QNT Pty Ltd	
RL4	Helium Australia Pty Ltd	6-Mar-13
	Santos QNT Pty Ltd	
OL3	Magellan Petroleum (NT) Pty Ltd	6-Nov-03
OL4	Santos QNT Pty Ltd	6-Nov-02
	Santos Limited	
OL5	Santos QNT Pty Ltd	6-Nov-02
	Santos Limited	
NT Coastal Waters Title	**Title Holder/Operator**	**Date Awarded**
NTC/P10	Territory Oil and Gas Pty Limited	8-Mar-13
	Beach Petroleum (NT) Pty Ltd	

Source: Northern Territory Department of Mines and Energy[479]

[479] Department of Mines and Energy, *energyNT 2013,* p.2

Appendix 10: NT Drilling 2013

Well Name	Operations	Operator	Permit	Operations Summary	Drill Rig	Well Spud Date	Rig Release Date	Total Depth (m-MD)	Comments
East Mereenie 44 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL5	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	2/09/13	10/09/13	578	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
East Mereenie 45 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL5	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	20/08/13	1/09/13	723	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
Lamont Pass 3	**Exploration** - *(focusing on Conventional and Unconventional Hydrocarbons)*	Armour Energy Ltd	EP190	Drilled; Cored; abandoned	Nitro # 1 - DE 880	5/10/13	30/11/13	1275	Gas shows and Oil discovered. Well plugged and abandoned.
Mt Kitty Gas WC-A Surface Hole	**Exploration** - *(focusing on Conventional Hydrocarbons)*	Santos Ltd	EP125	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	13/09/13	2/10/13	788	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
Myrtle Basin 1	**Exploration** - *(focusing on Conventional and Unconventional Hydrocarbons)*	Armour Energy Ltd	EP176	Drilled; Suspended.	Nitro # 1 - DE 880	13/09/13	2/10/13	861.42	Well drilled and suspended.
West Mereenie 19	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section; Ensign Rig 918 - drilled the Production Hole section	1/07/13	11/12/13	1511	Well drilled in 2 phases. Surface Hole section drilled, suspended and then well re-entered and Production Hole section drilled. Well suspended after drilling of the Production Hole section. Well encountered minor gas flow.
West Mereenie 20 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	10/08/13	19/08/13	551	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
West Mereenie 21 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	12/07/13	18/07/13	557	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
West Mereenie 22 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	19/07/13	25/07/13	567	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.
West Mereenie 23	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Production Hole section drilling in-progress as of 31/12/13	WW07 Schramm T130XD - drilled the Surface Hole section; Ensign Rig 918 - drilled the Production Hole section	2/08/13	Production Hole section drilling in-progress as of 31/12/13	Production Hole drilling in-progress as of 31/12/13	Well drilled in 2 phases. Surface Hole section drilled, suspended and then well re-entered and Production Hole section drilled. Drilling of the Production Hole section in progress as of 31/12/13.
West Mereenie 24 Surface Hole	**Appraisal -** *(focusing on Conventional and Unconventional Hydrocarbons)*	Santos Ltd	OL4	Drilled; Suspended.	WW07 Schramm T130XD - drilled the Surface Hole section	26/07/13	1/08/13	530	Surface Hole section drilled and well suspended. Production Hole section to be drilled in 2014.

Source: Department of Mines and Energy [480]

[480] Department of Mines and Energy, *energyNT 2013,* p. 12

Appendix 11: Inquiry into Hydraulic Fracturing

Terms of Reference

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Hydraulic fracturing for hydrocarbon deposits in the Territory, including the assessment of the environmental risks and actual environmental impacts of hydraulic fracturing and the effectiveness of mitigation measures, and more particularly the matters mentioned in the following clauses.

1. Historical and proposed use of hydraulic fracturing (exploration, appraisal and production) for hydrocarbon deposits in the Territory (number of wells; locations; timeline).

2. Environmental outcomes of each hydraulic fracturing activity for hydrocarbon deposits in the Territory (number of wells; frequency of types of known environmental impacts).

3. Frequency of types and causes of environmental impacts from hydraulic fracturing for hydrocarbon deposits in the Territory and for similar deposits in other parts of the world.

4. The potential for multiple well pads to reduce or enhance the risks of environmental impacts.

5. The relationship between environmental outcomes of hydraulic fracturing for shale petroleum deposits with geology, hydrogeology and hydrology.

6. The potential for regional and area variations within the Territory of the risks of environmental impacts from hydraulic fracturing.

7. Effective methods for mitigating potential environmental impacts before, during and after hydraulic fracturing, with reference to the following:

   (a) the selection of sites for wells;

   (b) well design, construction, standards, control and operational safety;

   (c) well integrity ratings;

   (d) water use;

   (e) chemical use;

   (e) disposal and treatment of waste water and drilling muds;

   (f) fugitive emissions;

   (g) noise;

(h) monitoring requirements;

(i) the use of single or multiple well pads;

(j) rehabilitation and closure of exploratory and production wells, including issues associated with corrosion and long term post-closure issues;

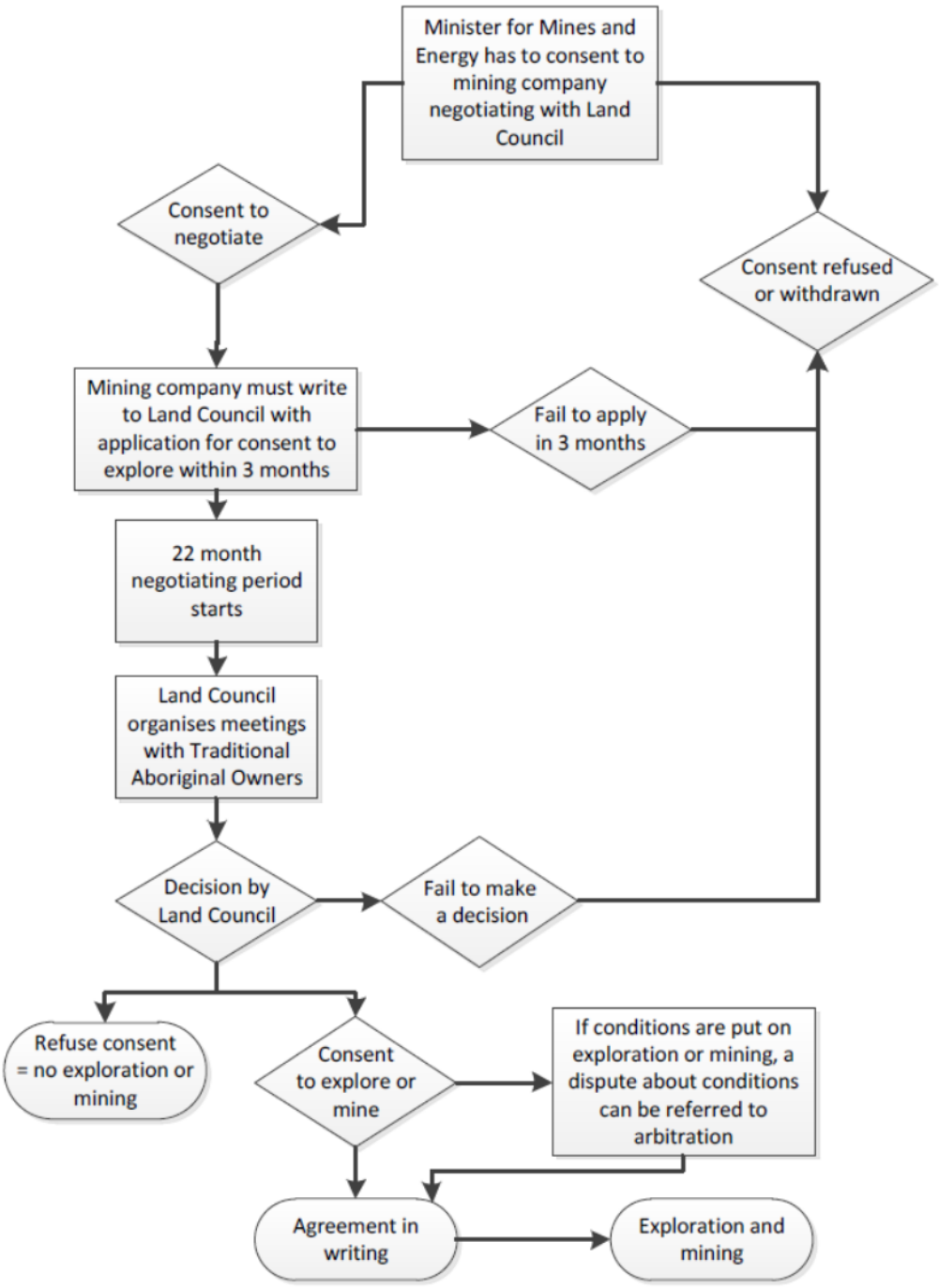
(k) site rehabilitation for areas where hydraulic fracturing activities have occurred.

Source: Legislative Assembly of the Northern Territory[481]

[481] Legislative Assembly of the Northern Territory, *Inquiry in Hydraulic Fracturing: Terms of Reference,* Tabled Paper No. 761, 20 March 2014

Appendix 12: Mining on Aboriginal Land

Mining Application Process under Aboriginal Land Rights (Northern Territory) Act



Source: Environmental Defenders office (NT) Inc[482]

[482] Environmental Defenders Office (NT) Inc, *Mining Process under Aboriginal Land Rights (Northern Territory) Act,* viewed 13 November 2013, http://edont.org.au/wp-content/uploads/2012/10/ALRA-diagram.pdf

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