

A circular inset image on the left side of the slide. It shows a landscape with a rainbow in the sky over a field. The rainbow is positioned in the upper left quadrant of the circle. The field is a mix of brown and green, suggesting a dry or semi-arid environment. In the distance, there are some small structures or buildings.

petratherm

Renewable Energy 2007

Impetus for Economic Energy Market Transformation

REGA Forum

Economic Challenges for Geothermal Energy in Australia

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Managing Director

Explorer and Developer of Geothermal Energy

Presentation Outline

- Key Messages
- Petratherm Overview
- Economics of Geothermal Energy Generation
- Geothermal Energy & Electricity Markets
- SA Electricity Market & Project Optimization Considerations
- SA Geothermal Energy Projects
- Geothermal Energy Project Economics
- Market & Network Issues
- Paralana Commercialization Plans
- Summary

Key Messages

- Geothermal Energy Projects have the potential to provide very cost competitive electricity generation
- The Australian NEM is competitive market but it is characterized by loosely interconnected regional markets – many constraints
- Economics of Geothermal can be clearly assessed but are very project specific – resource and location
- Project optimization process needed to deliver competitively priced product to market – LRAC c.f. New Entrant Price
- Costs include the cost of production, delivery (transmission) and sale to competitive market – “need to understand the market”
- Near term horizon – Geothermal requires a form of carbon pricing mechanism to be viable.

Petratherm Overview

- Established in 2003 and listed on the ASX in July 2004
- Major shareholder is Minotaur Exploration – 35%
- Shares on issue – 49,5000,000 & current price of 85 cents
- Market Capitalization – approx. \$ 42 million
- Mission – *“to explore and develop, emission free, geothermal energy projects that are commercially sustainable”*
- Strategy – *“shallow hot rocks close to market”*

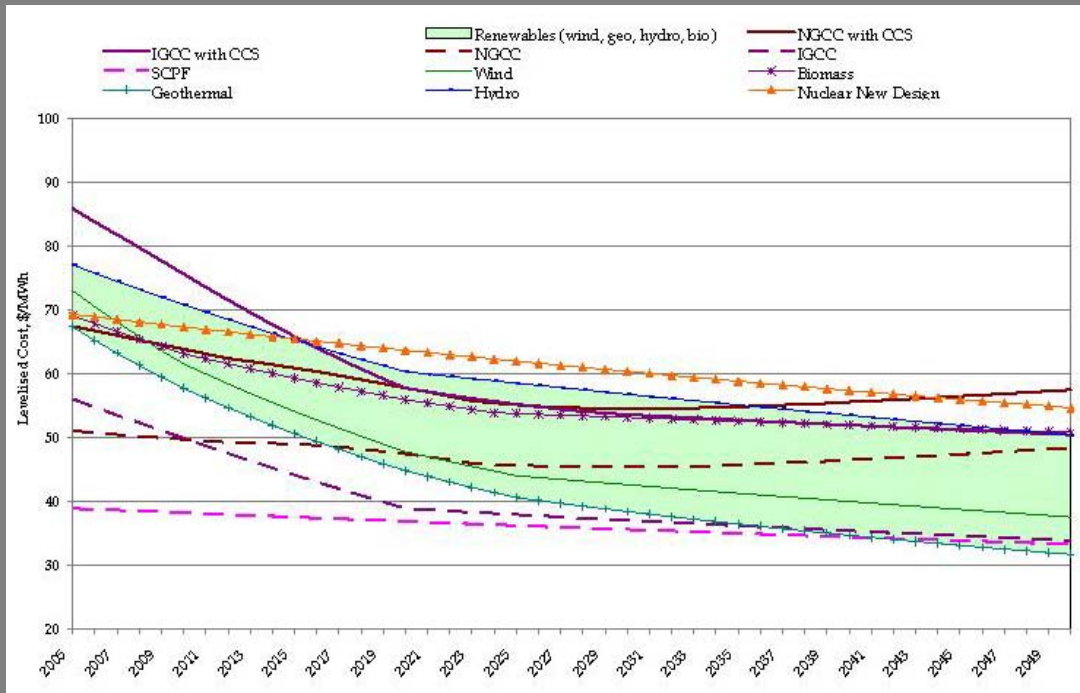
Petratherm - Key Achievements

- Discovery of world-class heat resource at Paralana, South Australia.
- Established an MOU with Heathgate Resources to provide their Beverley Uranium Mine with electricity to meet their growing needs.
- \$30 million dollar Joint Venture with Beach Petroleum to test and build Phase-1 commercial plant at the Paralana Hot Rock Resource
- \$5 million dollar Federal Government grant to support development of a new lower risk heat extraction process (HEWI Model)
- Secured approval to investigate China's Hot Rock potential through Asia Pacific Partnership on Climate and Clean Development (AP6)
- New Hot Rock Projects announced near Madrid and Barcelona, Spain (more to come)

Photo: Callabonna Project Area, South Australia

Economics of Geothermal Energy Generation

- Advantages of Geothermal Energy include:
 - Large scale base load
 - Large resources and reserves
 - Expected to be lowest cost renewable energy source

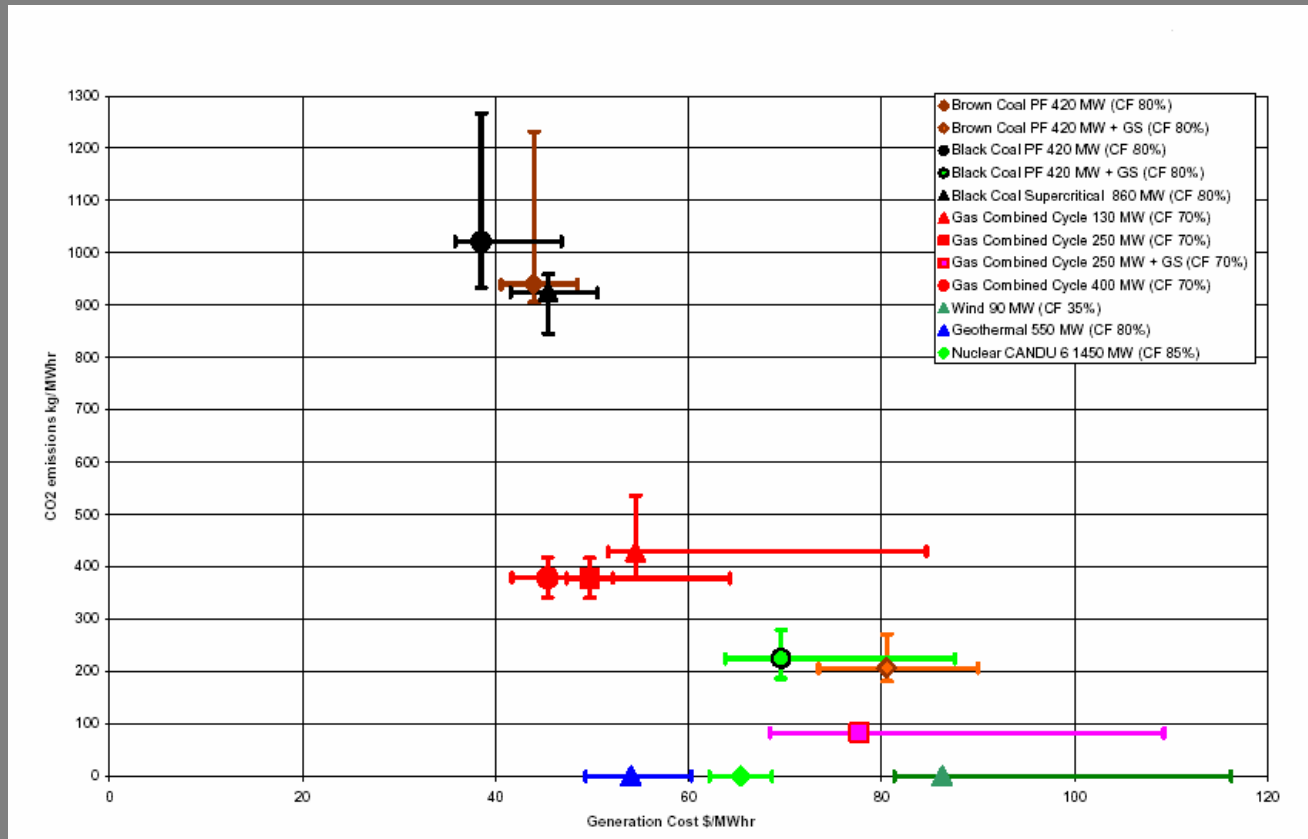


Extract from **McLennan Magasanik Associates independent report** “Renewable Energy – A Contribution to Australia’s Environmental and Economic Sustainability”.

Total renewable cost envelope v’s coal, gas and nuclear cost.

Economics of Geothermal Energy Generation

The SA Electricity Supply Industry Planning Council (ESIPC) Annual Planning Report assesses geothermal energy as the current lowest cost renewable energy source of electricity production.



New Entrant Generation and Clean Coal Technologies v's Emissions.

Geothermal Energy and Electricity Markets

International

- The global renewable energy market (all forms) represents only 4% of electricity production but is growing at 25% per annum.
- Geothermal energy has largest technical potential of all renewable **SOURCES** (source: World Energy Assessment UNPD 2000).
- Renewable energy policies with favourable targets and “in-feed tariffs” some over \$120 per MWh
 - European Union target of 20% by 2020
 - China target of 10% by 2020
 - India target of 10% by 2020
 - California target of 20% by 2017

Geothermal Energy and Electricity Markets

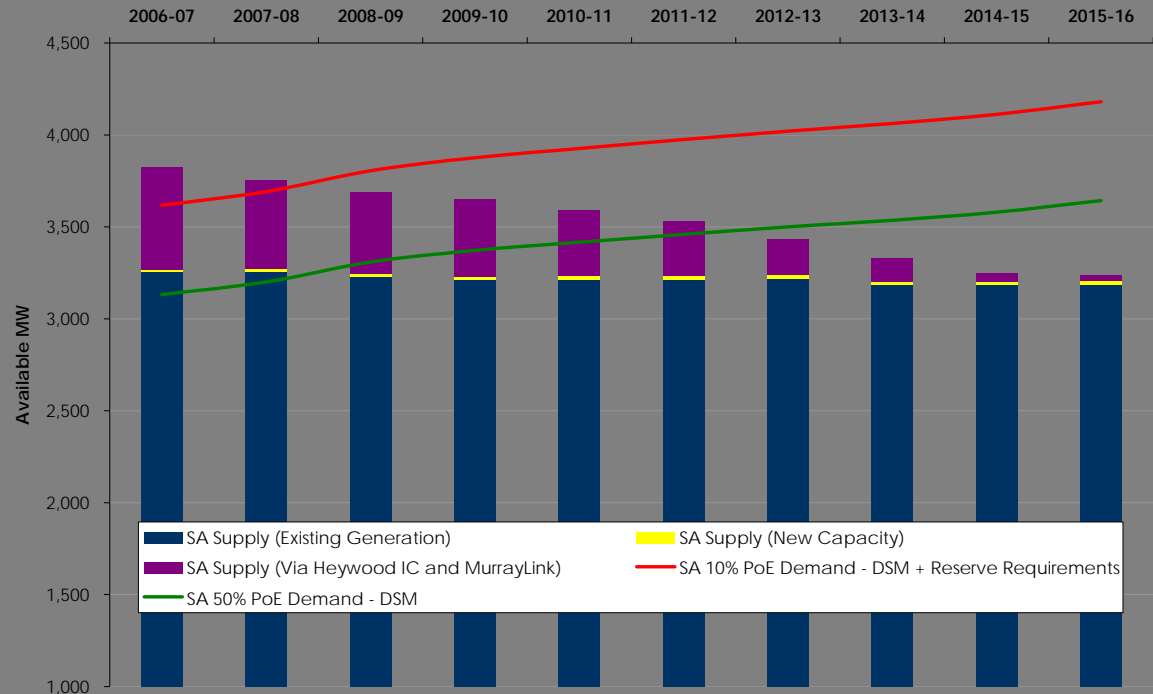
Australia

- Review of the Energy White Paper and current policy on renewable and low emission energy technologies.
- Strong support for geothermal energy due to competitive, large scale, base load potential.
- The Ministerial Council on Energy considering the Energy Reform Implementation Group review of the National Electricity Market (NEM).
- The interconnected NEM in Australia is projected to require 5,000MW of new capacity over the next 10 years (source: NEMMCO Statement of Opportunities).

SA Electricity Market

- SA NEM region electricity demand to require at least 600MW of new capacity
- Does not include the potential increase of 420MW from Olympic Dam.
- Nor the effect of depleting Leigh Creek coal.
- Demand requirements will be between 600 – 1,500MW.

Forecast Supply
Demand Balance for
South Australia (source
SA ESIPC APR 2006)



Geothermal Energy Cost Considerations

Petratherm's Exploration Model

"Shallow Hot Rocks close to Market"

Prime Cost Drivers

- Temperature Differential
- Drilling Depth
- Flow Rate
- Network Connection
- Generation Plant



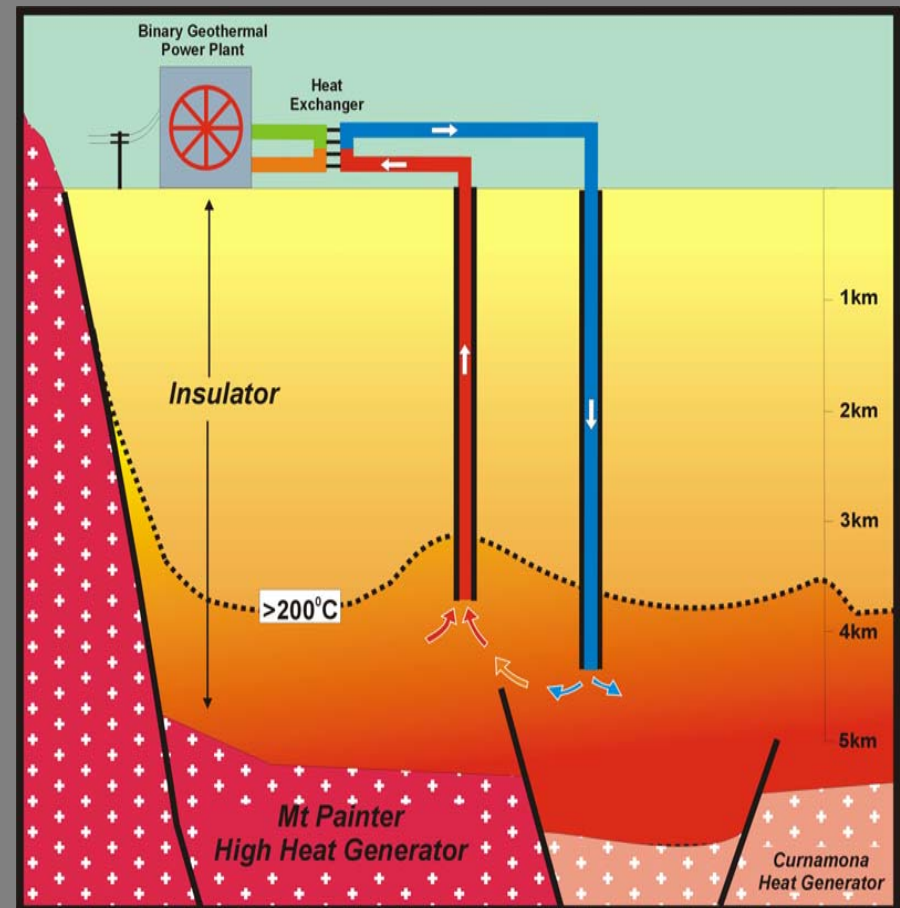
Petratherm is seeking to optimize the key drivers to achieve the lowest long run average cost electricity delivered while minimizing project risks.

Optimization of Key Parameters

Heat Exchanger Within Insulator (HEWI) Model

- Higher Permeability
- Chemically Stable
- No Potential Radon build up
- Lower Risk

= Cheaper Power!



SA Geothermal Projects

- Many players
- Large resources
- Exploiting different geothermal resources
 - Hot Rock plays
 - “Hot Water” plays
- Different market / connection plays



Geothermal Energy Project Economics

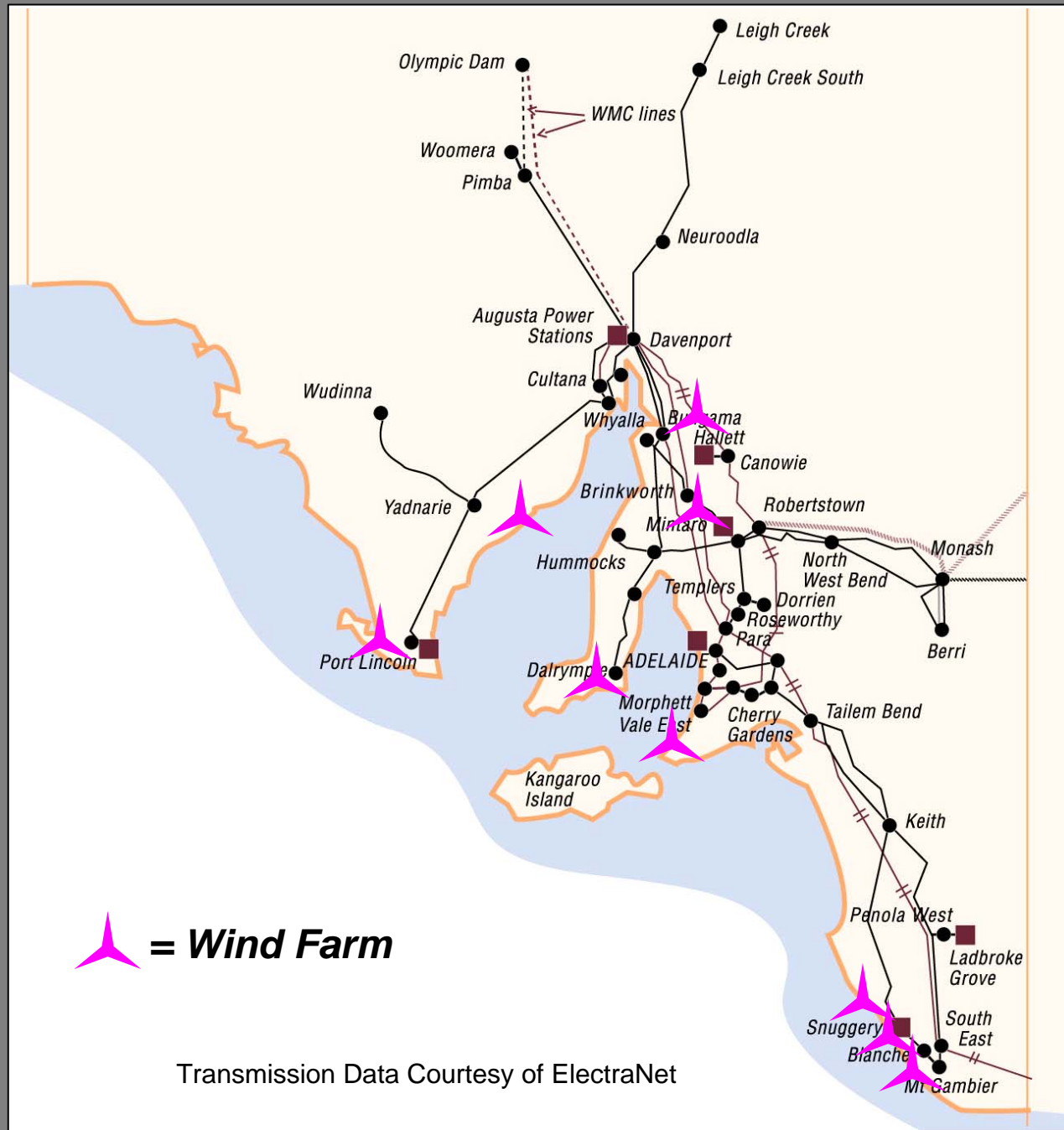
- Temperature (quality and type of resource)
- Drilling Costs (depth, size)
- Energy Flow Rates (energy transfer)
- Plant Capital Costs and related efficiencies
- Connection and Access to markets
- Operating Costs
- Economies of Scale/Production
- Product Pricing in a Competitive Market
- Regulatory Regime – carbon pricing

Geothermal Energy Project Assessment Process

- Key Assessment Areas to include:
 - Thermal Resource potential and accessibility
 - Reservoir & Heat Exchanger
 - Tenement & Land Owner matters
 - Geothermal Electricity Generation technology
 - Network Access & Connection
 - Development Approvals (Production Site and Network Connection)
 - Stakeholder Issues
 - Electricity Market and Regulatory Regime
 - Financial and Risk Assessments

Network Access & Connection

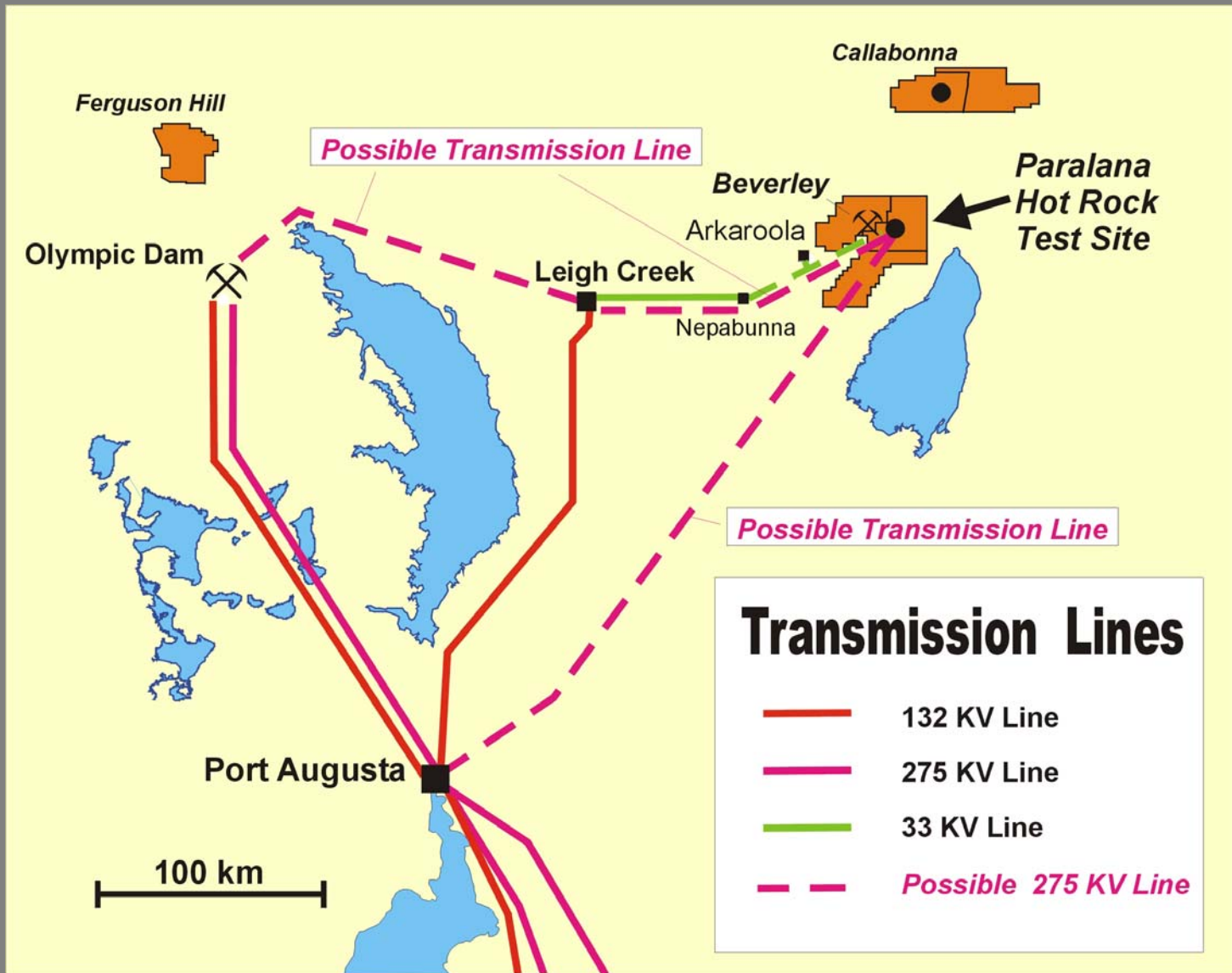
- Transmission Costs
- Transportation losses
- Margin Loss Factor
- System Stability
- Development Approvals, Licensing, Easements and Permits
- Network Capacity at connection point



Market & Network Issues

- Proximity to market – network connection costs – 132kV or 275kV for large scale and/or distant locations
- Network Capital Costs – target around 10% to 15% of total project capital costs.
- Market constraints – local, regional, interstate transmission and market operations
- Marginal Loss Factors and Revenue
- Market – on-grid or off-grid pricing
- Development & Scaling Up
- New Entrant Pricing – SA combined cycle gas

Paralana Commercialization Plan



Petratherm Paralana Commercialization

- Staged local expansion from 7.5 MW to 30 MW – network capital costs range between 8% and 10% of total capital costs
- Continue to refine large-scale Generation development options – current long term plan is for 520 MW (2 x 260 MW) power plant using standard sized plant increments
- Connection to the SA power system at Port Augusta and Olympic Dam, via a “meshed” 275 kV transmission network or individual double circuit 275 kV transmission lines
- Network capital connection costs range between 10% and 13% of total project costs

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Thank you



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