Energy Resilience Capability in Australia

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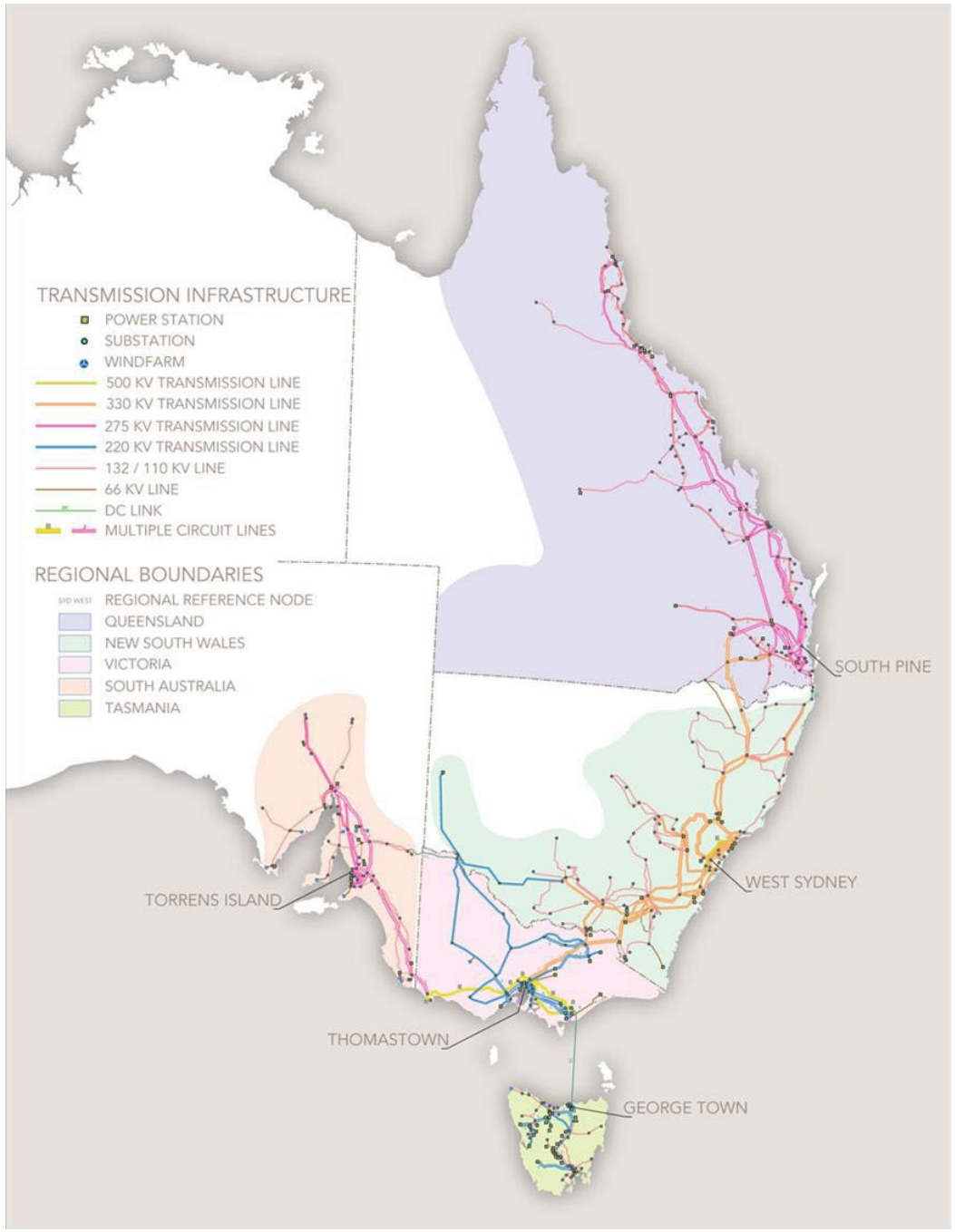
CONTEXT MATTERS

Maps from thertruesize.com

National Electricity Market Interconnected System



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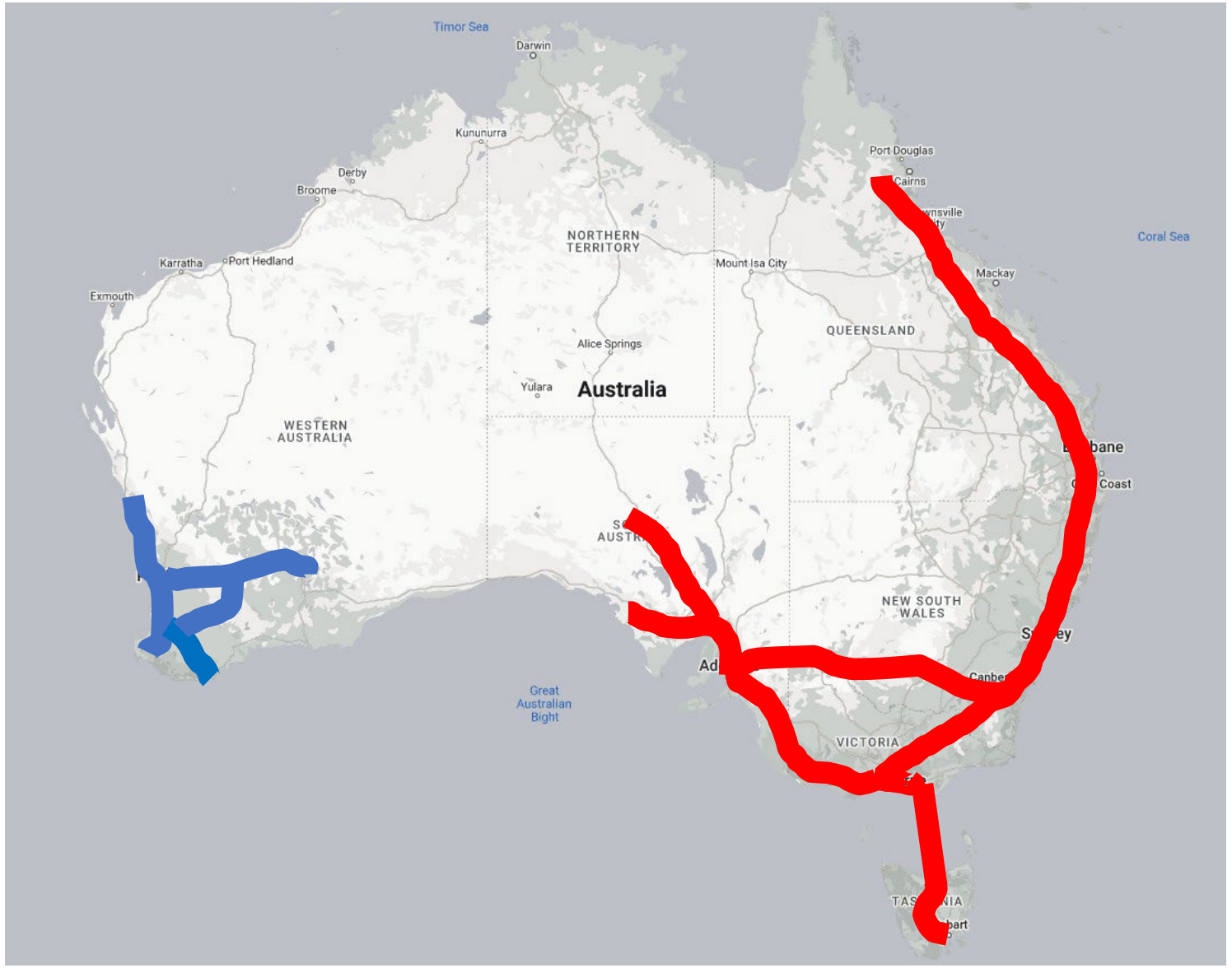


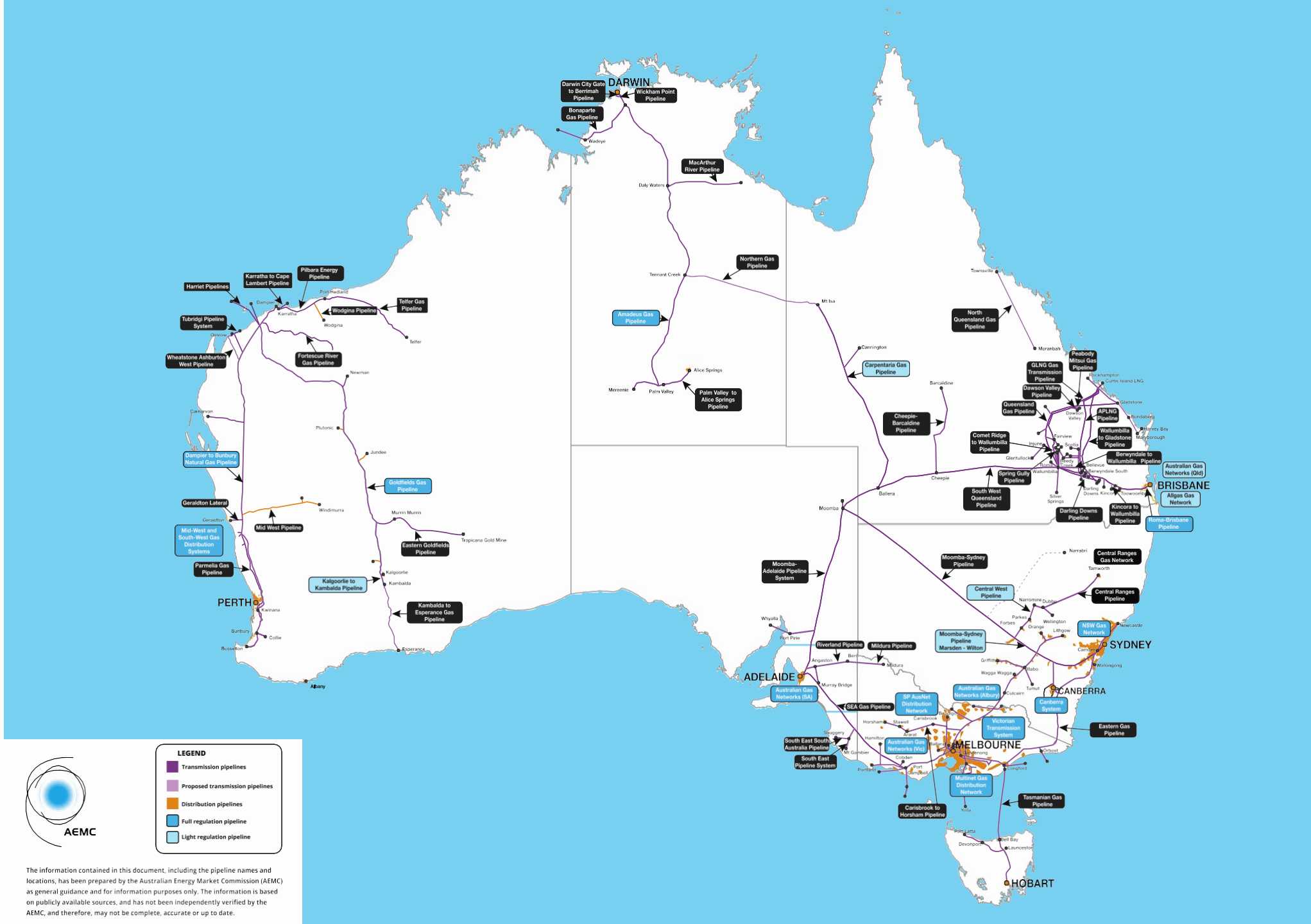
Map from thertruesize.com

National Electricity Interconnected System

South-West Electricity Interconnected System

The gap between the two main grids is about 1330km (830 miles).

Map from Australian Energy Market Commission



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Australian Energy Statistics 2022

Australia exported 16,000 PJ of energy

- 65% was black coal
- 30% was natural gas

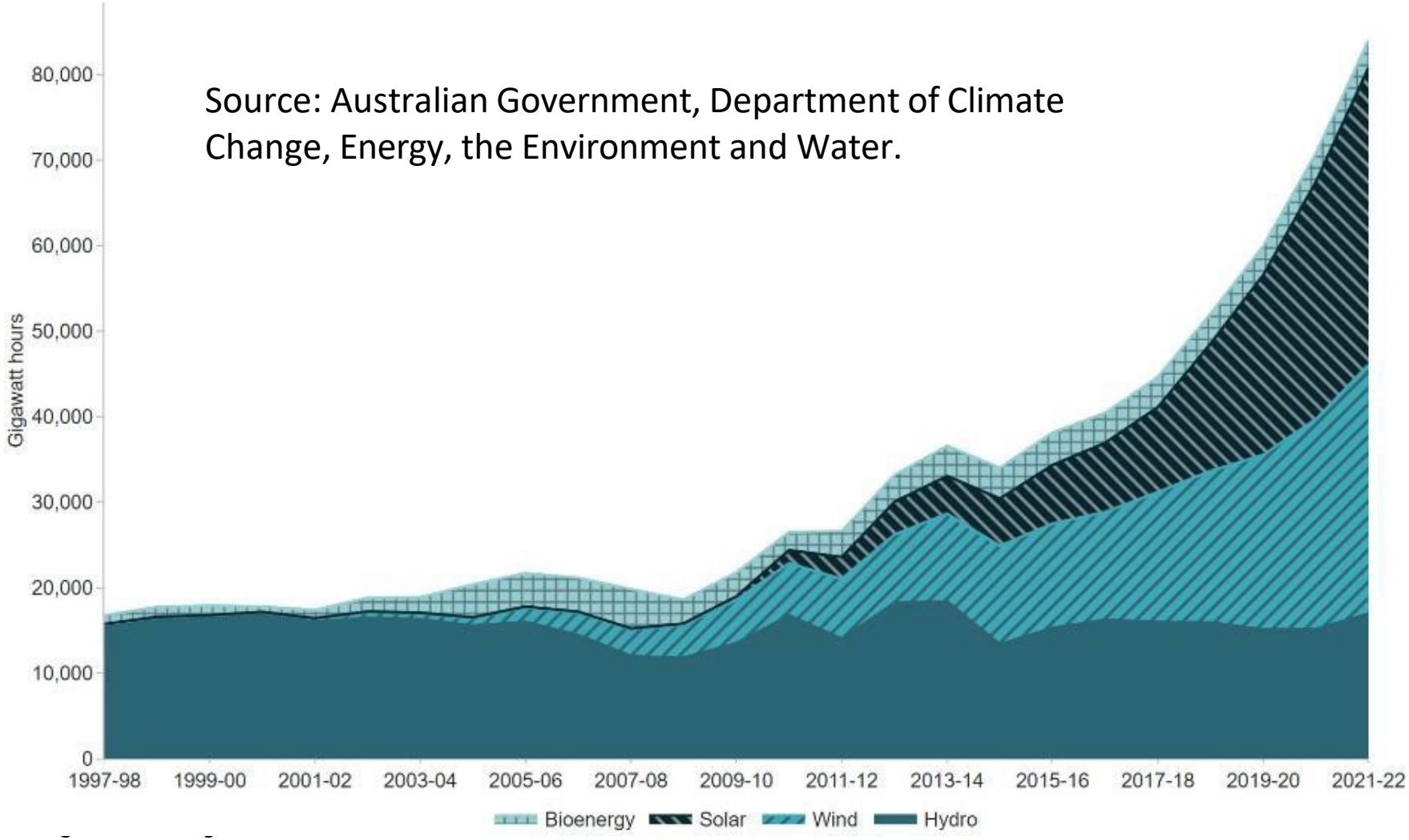
Energy consumed in Australia 6,000 PJ

- 36.5% Oil
- 27.5% Coal
- 27.1% Natural Gas
- 8.9% Renewables

Source: Australian Government, Department of Climate Change, Energy, the Environment and Water.

Renewable energy production rapidly rising: in 2022 it was 32% of total electricity production

Source: Australian Government, Department of Climate Change, Energy, the Environment and Water.



Australian Energy Statistics 2022: Electricity

Electricity generated:

- 47% from coal
- 19% from natural gas
- 32% from renewables
  - small scale solar 8%
  - large scale solar 6%
  - Wind 11%
  - Hydro 6.4%

- 19% of Australia's electricity was generated outside the electricity sector by industry and households

Source: Australian Government, Department of Climate Change, Energy, the Environment and Water.

Lithium statistics 2022

- Australia supplied 53% of the global lithium demand including
- 79% of the world’s hard rock lithium.

COLLABORATIVE LEARNING
and
MANAGE CONNECTIVITY

Collectively understand the threats, hazards and risks in the energy supply chain

Trusted information sharing network (TISN)

- One TISN for each of 14 critical industry sectors.

Banking and Finance	**Communications**	**Data**	**Education and research**	**Electricity**
Food and Grocery	**Gas**	**Health**	**Liquid Fuels**	**Mining**
Transport	**Space**	**Water services**		

- TISN sectors enable critical infrastructure owners and operators to share information on threats and vulnerabilities and collaborate on appropriate measures to mitigate risk and boost resilience.
- Each sector group is supported by an Australian Government agency - usually the agency that has portfolio responsibility for that sector.

Physical security threats: reasonably well understood

- Terrorism
- Theft
- Vandalism

- Generally, sharing of information about threats and counter-measures is good

Security: Cyber threats not always understood by all stakeholders

Unsecured ’operational technology’ connected to the internet could be vulnerable

- For example: hackers might have the capability to turn off, or change settings in inverters for roof-top solar across a whole city or region: the energy supply to that area could be seriously disrupted!

Reliance on solar *’a risk to nation’s security’*

Australian Cyber Security Magazine, 14 August 2023.

Bushfires and grass fires

Hazelwood Mine fire, February 2014

- **Loss of infrastructure; or**
- **Loss of access to infrastructure**
- **Disruption to the supply chain**

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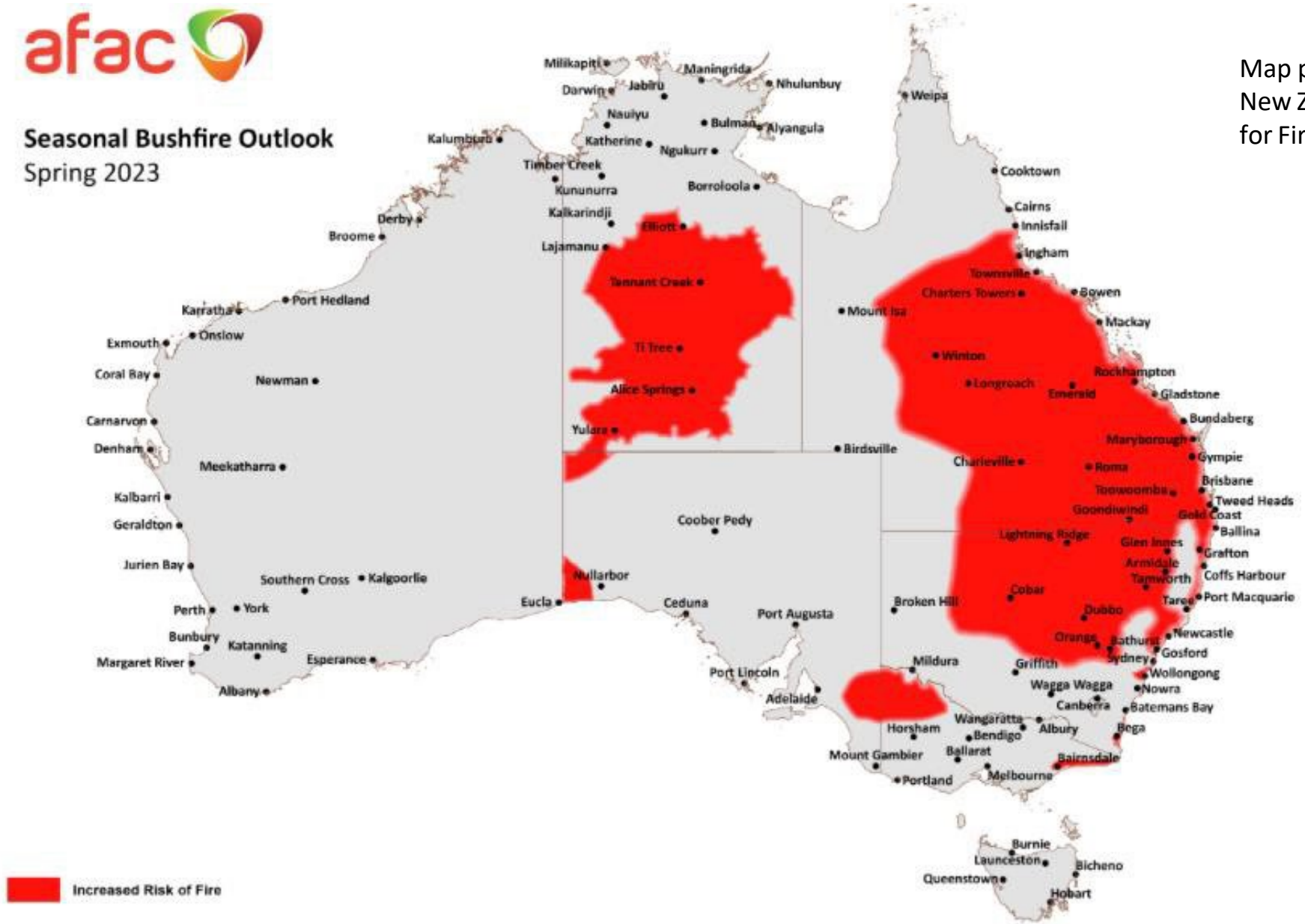
Seasonal Bushfire Outlook

Spring 2023



Map produced by Australian and New Zealand National Council for Fire and Emergency Services

Severe Tropical Cyclones

Always been a threat north of the Tropic of Capricorn. However, towns south of the Tropic are occasionally vulnerable.

Photo from Western Power, Western Australia

Floods

Photo of Yallourn from the Age Newspaper

- Any low lying energy infrastructure is vulnerable to floods
- E.g. a coal mine

Coastal Erosion

Photo from Canberra Times

Thermal Power Station cooling water dams can run out of water – after a long drought

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Other Threats and Risks to Energy Supply

- **Coal mines closing earlier than originally planned.**
- **Thermal power stations taken off-line earlier than expected.**
- **Delays to large-scale ‘cleaner’ energy projects, including the Snowy Mountains 2 GW pumped hydro scheme and the 750 MW Kurri Kurri Natural Gas/green hydrogen power station could cause an energy reliability gap from 2025.**
- **Conflicting regulations can delay large energy projects including the AUD16bn Woodside Scarborough gas project.**

Skills Shortage

Australia in worst skills shortage in 60 years

The West Australian Newspaper 5 October 2023

Not enough engineers and skilled technical workers.

GOVERNANCE AND CONTROL

Current National Governance Framework for Critical Infrastructure Resilience

- Critical Infrastructure Resilience Strategy and Plan
- Security of Critical Infrastructure Act 2018 (Cth) (as amended in 2022)
- Trusted Information Sharing Network

Security of Critical Infrastructure Act 2018 (Cth) (as amended in 2022)

The object of this Act is to provide a framework for managing risks relating to critical infrastructure, including by:

a) improving the transparency of the ownership and operational control of critical infrastructure in Australia in order to better understand those risks ; and

b) facilitating cooperation and collaboration between all levels of government, and regulators, owners and operators of critical infrastructure, in order to identify and manage those risks; and

c) requiring responsible entities for critical infrastructure assets to identify and manage risks relating to those assets; and

d) imposing enhanced cyber security obligations on relevant entities for systems of national significance in order to improve their preparedness for, and ability to respond to, cyber security incidents; and

e) providing a regime for the Commonwealth [of Australia] to respond to serious cyber security incidents.

Energy Market Regulation

- Governance arrangements through federal and state legislation to manage energy markets.

Resilience Principles Used by Infrastructure Australia – to facilitate government decisions about infrastructure investments

Australian Government | Infrastructure Australia

Resilience principles

Infrastructure Australia's approach to resilience

Infrastructure Australia: Definition of Resilience

“Resilient communities have the ability to resist, absorb, accommodate, recover, transform and thrive in a timely, effective manner in response to the effects of shocks and stresses to enable positive economic, social, environmental and governance outcomes.”

Infrastructure Australia resilience principles for assessing investment value of proposed infrastructure projects (summary)

- **Resist:** Robust, fail safe and safe-to-fail
- **Absorb:** Prepared and ready to respond
- **Accommodate:** Spare capacity, variety and sufficient reserves
- **Recover:** Restoration and response
- **Transform:** Future focussed, foresight and reflective
- **Thrive:** Integrated, flexible, innovative and inclusive
- **Effective:** Production of desired or intended result, place-based planning and engagement
- **Timely:** Accountability, transparency and promptness

Energy Resilience Capability in Australia: What Should Happen Next?

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What should happen next?

- Resilient energy supply chains should not be limited to nationally prioritised energy infrastructure. Every community, no matter how small or how remote, relies on the availability of energy.
- Central government level and local level Policies need to improve energy resilience for all communities.
- Private energy providers need incentives to achieve energy resilience for communities reliant on energy services.
- Risk information sharing arrangements in energy supply chains need to be more comprehensive, better connected and more transparent where practicable.

What should happen next?

- The development and completion of draft international standard ISO 22366 Energy Resilience is important and should continue to be supported.
- The design of institutional arrangements needs to fit the scale or nature of the energy resilience problem: central government level problems are not necessarily the same as local community problems.
- Energy resilience principles need to be globally standardised and harmonised, and in my view should be based on socio-technical systems thinking.
- The principles need to be suitable for all contexts and all scales of systems, and all elements of systems.

Examples of broad-based resilience principles

Resilience engineering principles proposed by Yu, Schoon, Hawes et al. 2020	UNDRR infrastructure resilience principles. 2022
P1 **Recognise that system context matters** Dynamically-changing social, ecological and technological contexts	**Environmentally integrated.** Work in a +ve integrated way with the natural environment
P2 **Foster social capital in the socio-technical system** Includes group-shared assets: trust and collaboration that promote self-organising responses	**Socially engaged.** Develop active engagement & participation across society
P3 **Maintain diversity** Both redundancy and functional diversity in physical systems are important	**Proactively protected.** Plan, design, build & operate for current & future hazards
P4 **Manage connectivity** Exchange of knowledge and resources in collaborative networks are crucial	
P5 **Encourage collaborative learning by doing** Implemented throughout the entire energy supply chain and user networks	**Continuously learning**. Develop & update understanding & insight
P6 **Embrace polycentric governance and control** Decisions by risk owners at various locations and times in the energy network	**Shared responsibility.** Share information and expertise for coordinated benefits
P7 **Address the problem of fit** Structure of a collaborative decision network must align with the energy infrastructure system	**Adaptively transforming.** Adapt and transform to changing needs
P8 **Manage for complexity** a. Consider multiple scales and levels and their linkages. b. Understand robustness-vulnerability trade-offs. c. Pay attention to interdependencies or coupling of multiple infrastructure networks.	

References

- Yu, D.J., Schoon, M., Hawes, J.K., et al. 2020, Toward General Principles for Resilience Engineering, in Risk Analysis: An International Journal, Vol. 40, Number 8. pp. 1509-1537.
- United Nations Office for Disaster Risk Reduction. 2022. Principles for Resilient Infrastructure.

Thank you

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