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CENTRE FOR ENERGY AND NATURAL RESOURCES INNOVATION AND TRANSFORMATION

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Activating Agriculture's Net Zero Revolution:

Regulating Innovative Decarbonisation Solutions in the Australian Agricultural Sector

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CENRIT Blue Sky Seminar

May 29th 2024

Presentation Outline

1. Australian Energy Transition and Agricultural Emissions: A Stocktake
2. Agriculture and Large-Scale Solar Co-Location
3. Renewable Hydrogen
4. Biomethane

1. Australian Energy Transition and Agricultural Emissions: A Stocktake

A Snapshot of Australia's Electricity Generation Mix

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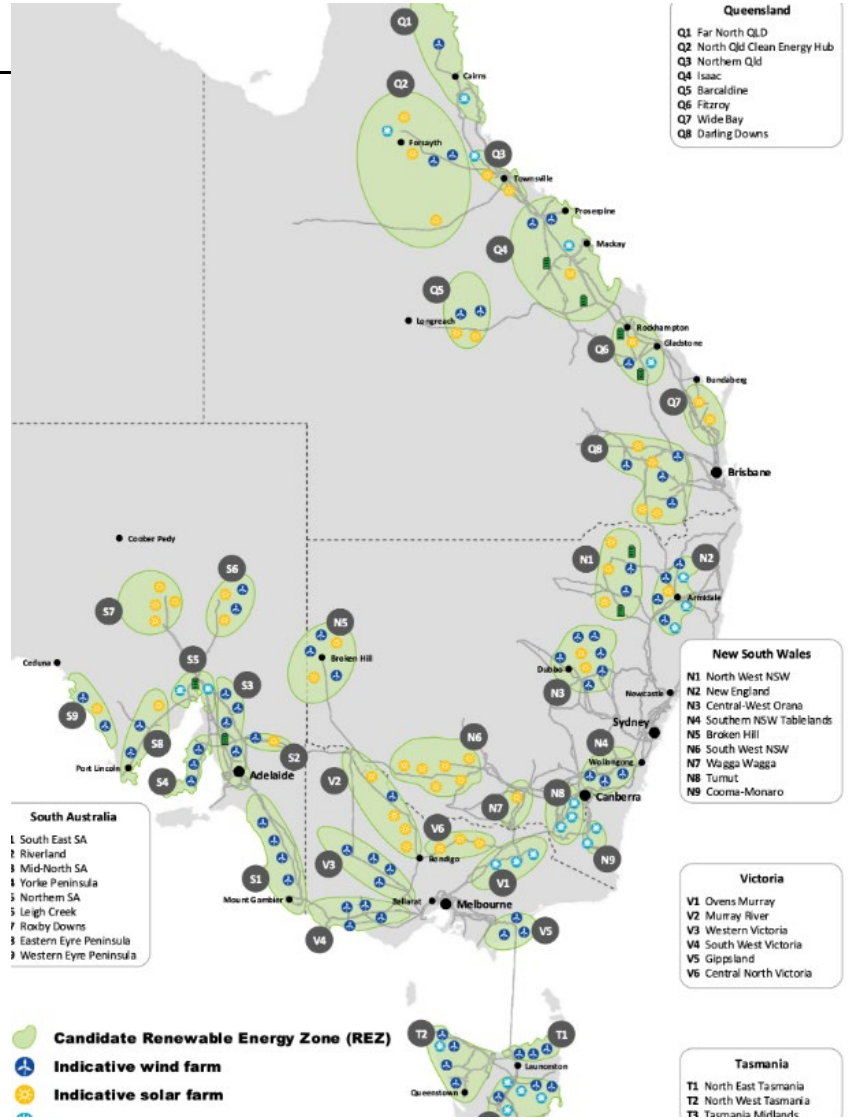
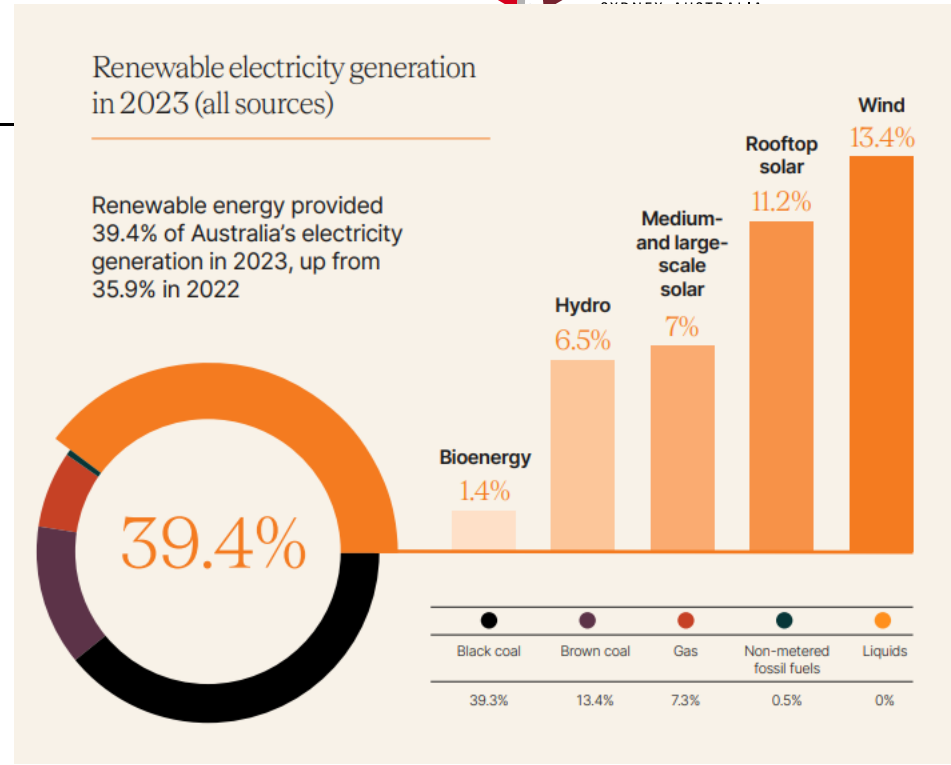
Renewable Energy Zone Candidates





82% renewable energy by 2030

Recent Australian Net Zero Policy Shifts – Rural and Regional Focus

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1

2

Community Engagement Review

Report to the Minister for Climate Change and Energy

December 2023

3

2024 – 2025 Federal Budget:

- **$63.8 million** to reduce emissions in the agriculture and land sector
- **$6.7bn Hydrogen Production Tax Incentive** and $1.3bn of additional Hydrogen Headstart funding
- **Fast-tracking the initial phase of the Guarantee of Origin Scheme** to measure and certify emissions intensity across the supply chain of key products, and providing an additional $32.3 million to support the expansion of the program to green metals and low-carbon liquid fuels and consultation on additional incentives to support the production in these industries
- **$168m** to prioritise approval decisions for **renewable projects of national significance**
- **$1.3 million to develop and release best practice guidance for net zero transition plans**

Australian Agricultural Sector Emissions Profile

- Agriculture made up **16.8% of national greenhouse gas emissions in 2020-21**
  - Australia's red meat industry aims to be carbon neutral by 2030
  - The national grain industry supports a net zero emissions goal for agriculture by 2050
  - NFF aims to be net zero by 2050

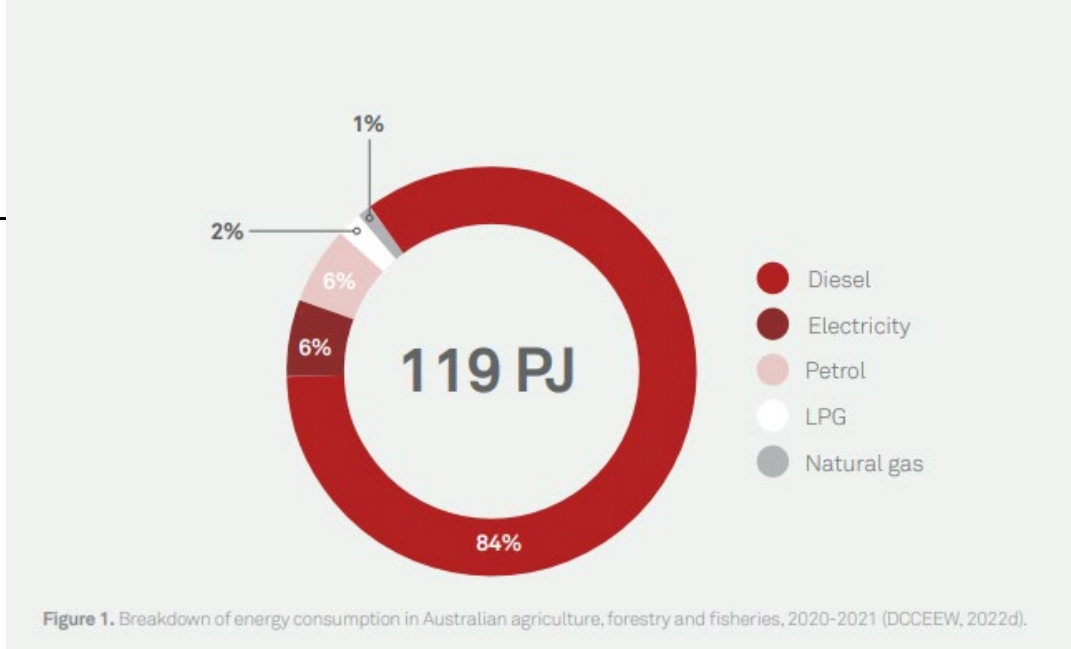
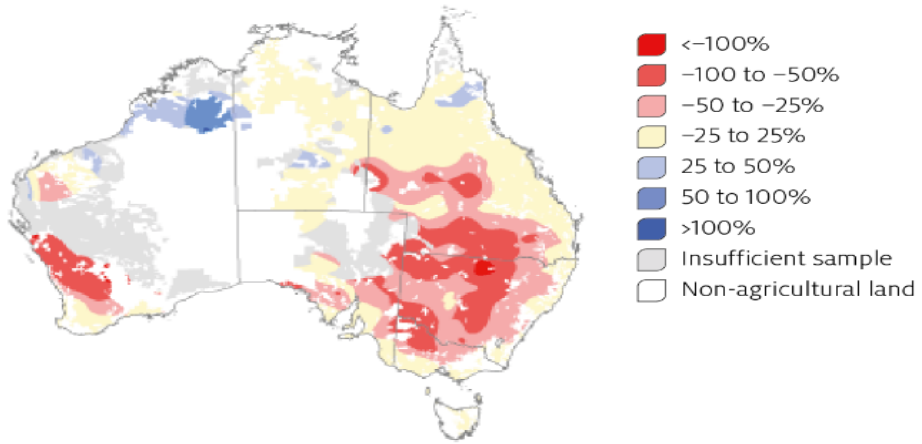


Figure 1. Breakdown of energy consumption in Australian agriculture, forestry and fisheries, 2020-2021 (DCCEEW, 2022d).

- **Agricultural Emissions**
  - Methane– **63%**
  - Fertiliser – **6%**
  - Manure management – **8%**
  - Fuel use on farms **– 7%**

- Changes in seasonal conditions over the period 2001 to 2020 (relative to 1950 to 2000) have reduced annual average broadacre farm profits by **23%, or around $29,200 per farm**

Figure 14 Effect of recent (2001 to 2020) seasonal conditions on farm profit



Source: ABARES farmpredict (Hughes et al. 2022a)

Australian Agricultural Emissions Projection

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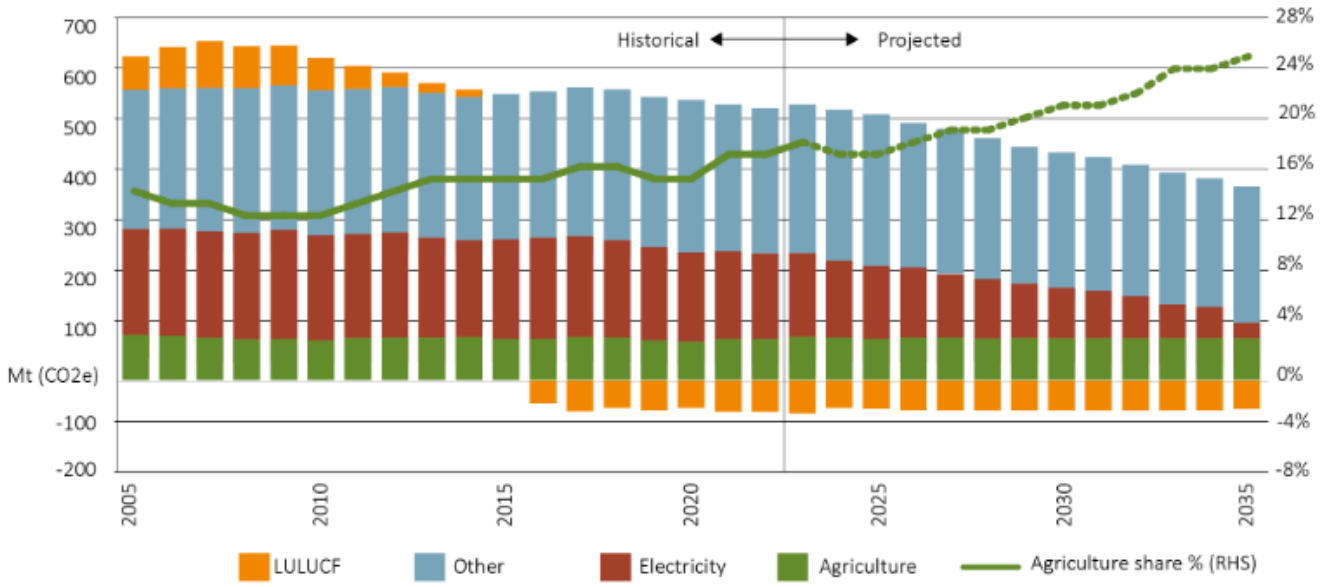
Figure 17 Australian emissions projections



Source: DCCEEW 2023b

"As the rest of the Australian economy decarbonises, agriculture's share of emissions is expected to increase from **17% in 2022 to over 25% in 2035".** (DCCEEW 2023b).

Table 3 Fuel and energy technologies and practices

Established and scalable technologies and practices	Emerging technologies and practices
• On-farm renewable energy generation and integration with agricultural production systems, including solar grazing	• Other agrisolar applications, including with horticulture and apiculture
• Bioenergy generation, including manure bio-digestion and bagasse and wood cogeneration	• Battery electric and hydrogen fuel cells for on-farm machinery and vehicles
• Increased energy efficiency	• Greater utilisation of agricultural feedstocks for bioenergy and biofuel production
–	• Low or zero carbon fuel and gas production and use

Recent Agricultural Decarbonisation Policy Shifts

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1

2

Australian Government

Agriculture, land and emissions
Discussion paper

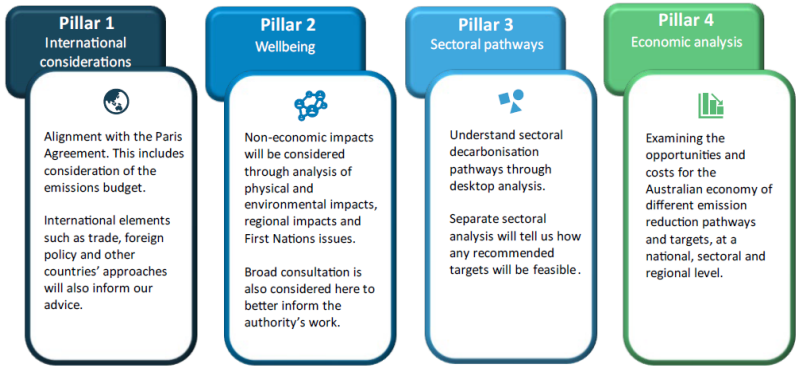
1. What are the opportunities to reduce emissions and build carbon stores in agriculture an land? What are the main barriers to action?
2. How can we progress emission reduction efforts whilst also building resilience and adapt climate change?

3

CLIMATE CHANGE AUTHORITY

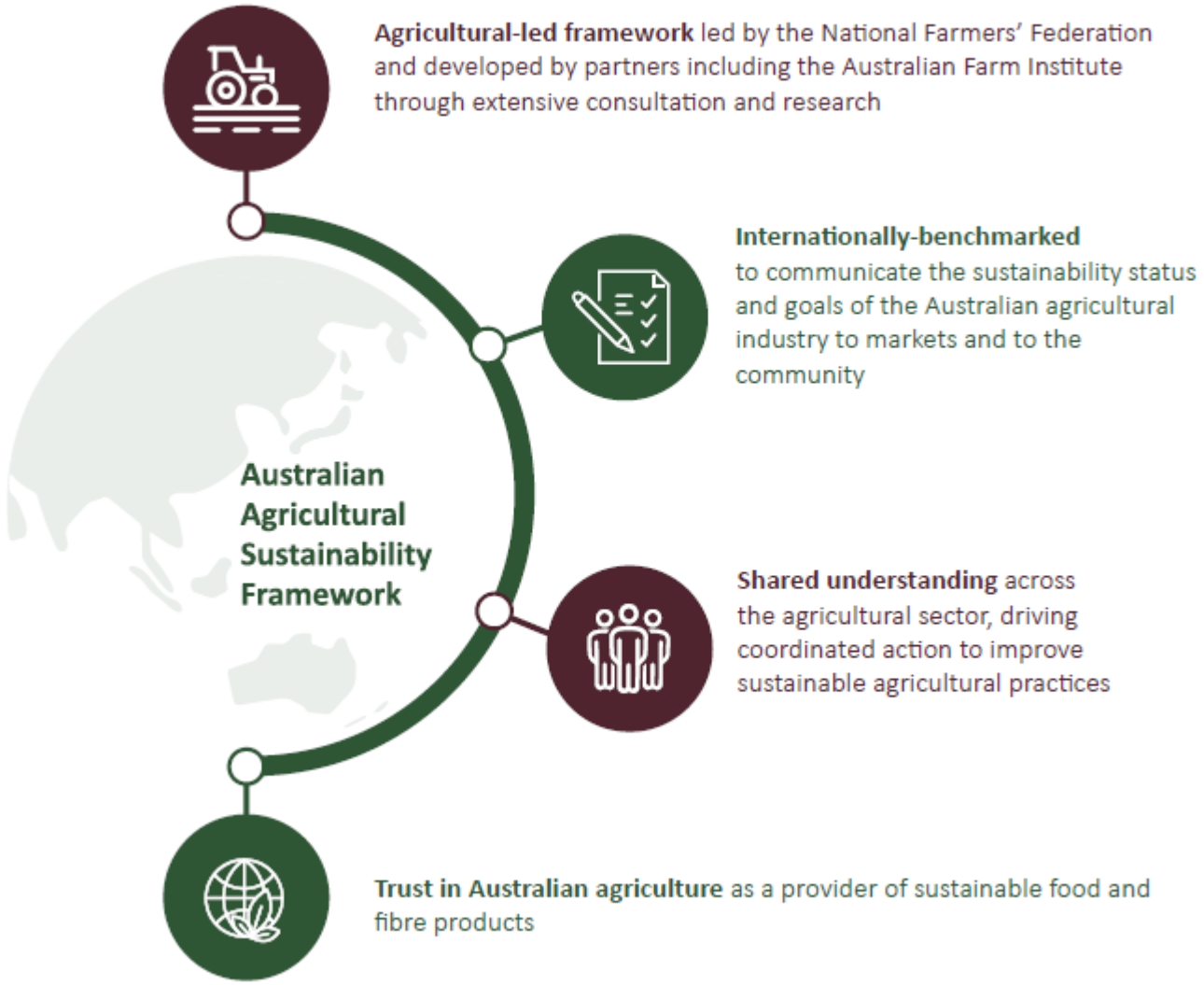
2024 ISSUES PAPER

TARGETS, PATHWAYS and PROGRESS



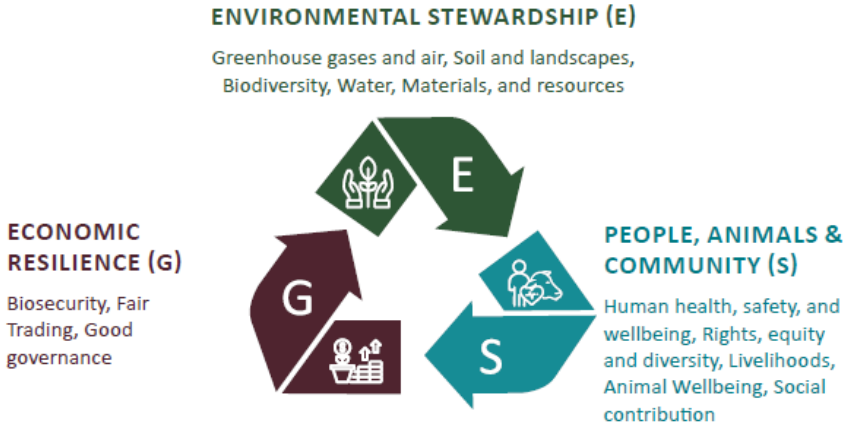
Australian Agricultural Sustainability Framework in Development

FIGURE 4: AUSTRALIAN AGRICULTURAL SUSTAINABILITY FRAMEWORK



Australian agriculture sector vision to become a **$100 billion** industry by 2030

72% of total production exported



Barriers to decarbonising the Australian Agricultural Sector

Australian agriculture accounts for:

- **55% of Australian land use** (426 million hectares as at December 2023);
- **74% of water consumption** (9,981 gigalitres used by agriculture in 2021–22);
- **13.6% of goods and services exports** in 2022–23;
- **2.7%** of value added (GDP (ABS, 2024)

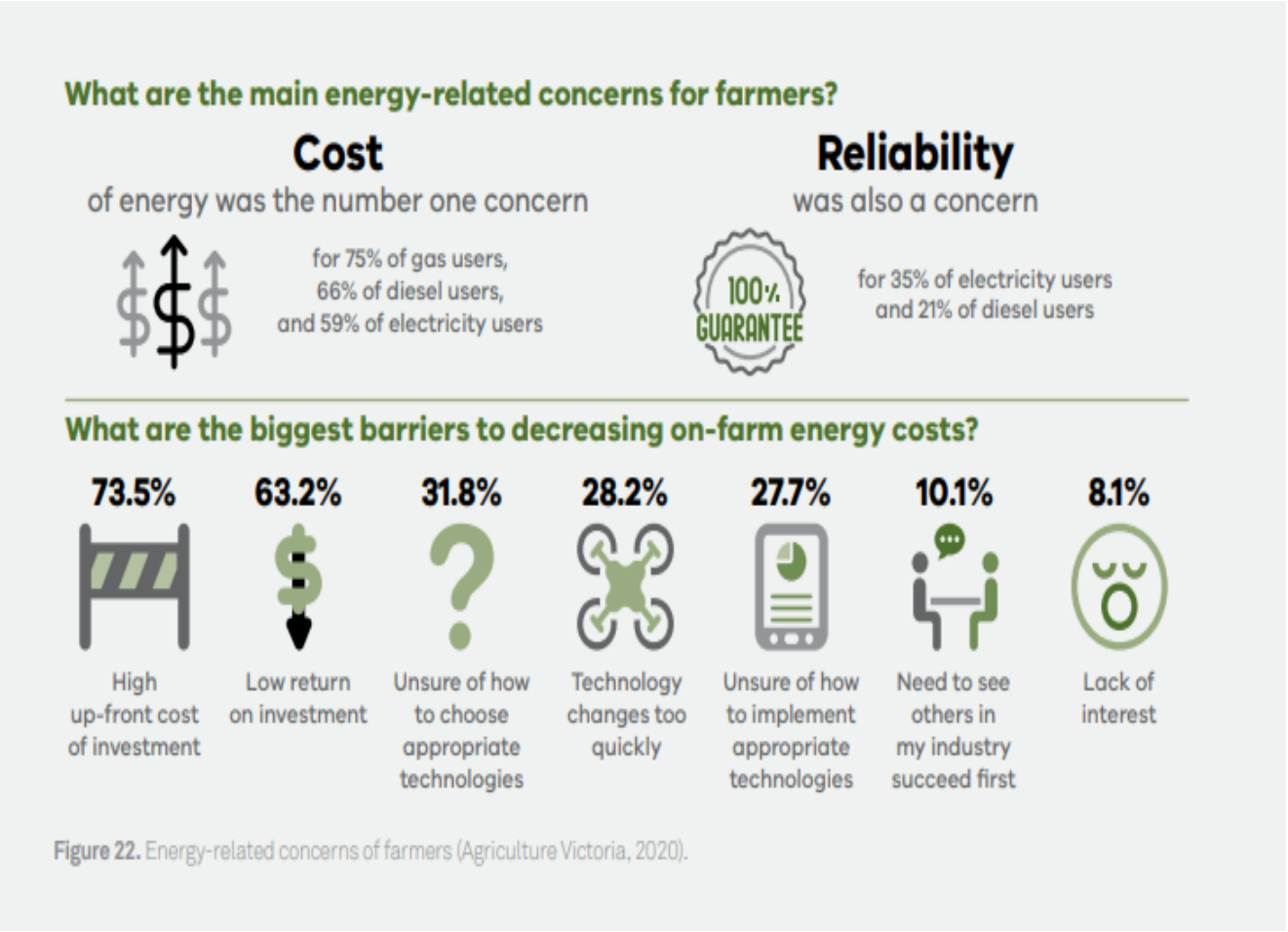
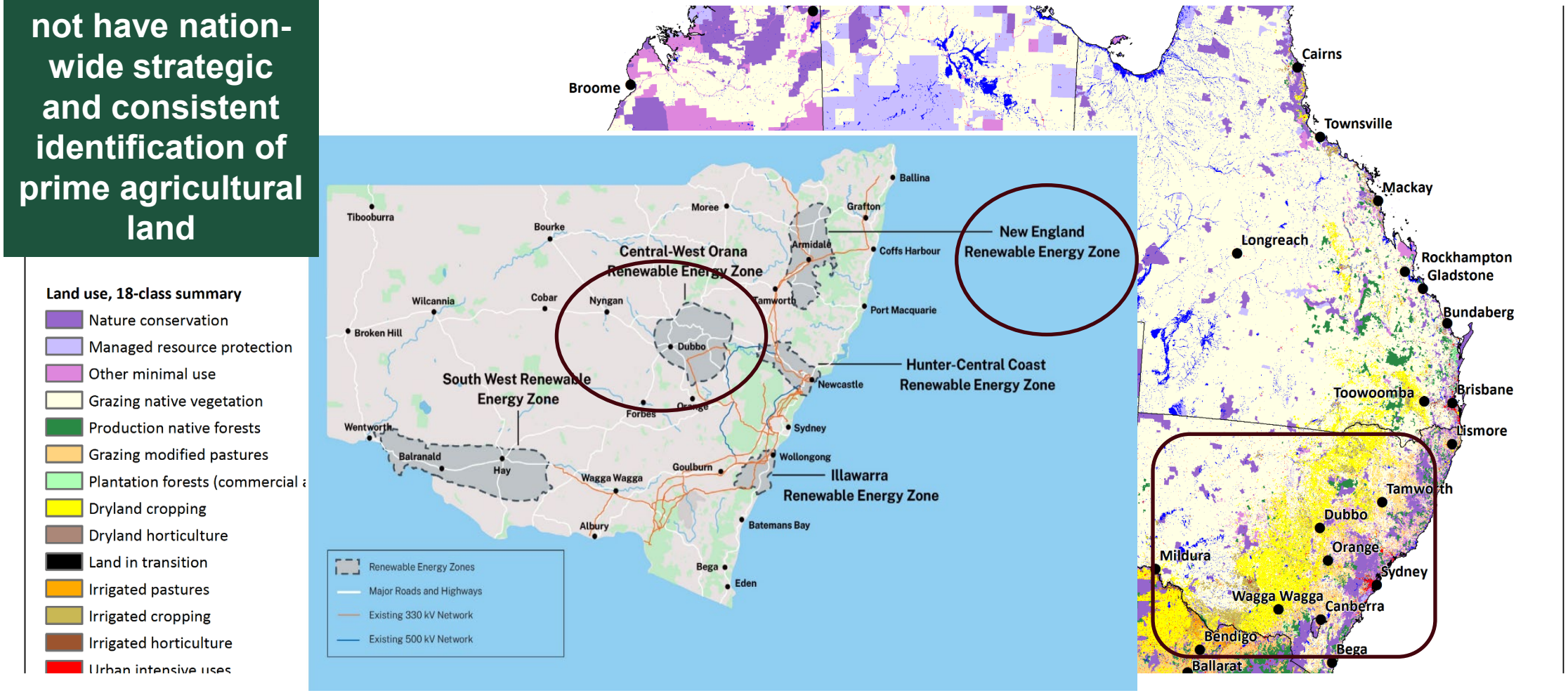


Figure 22. Energy-related concerns of farmers (Agriculture Victoria, 2020).

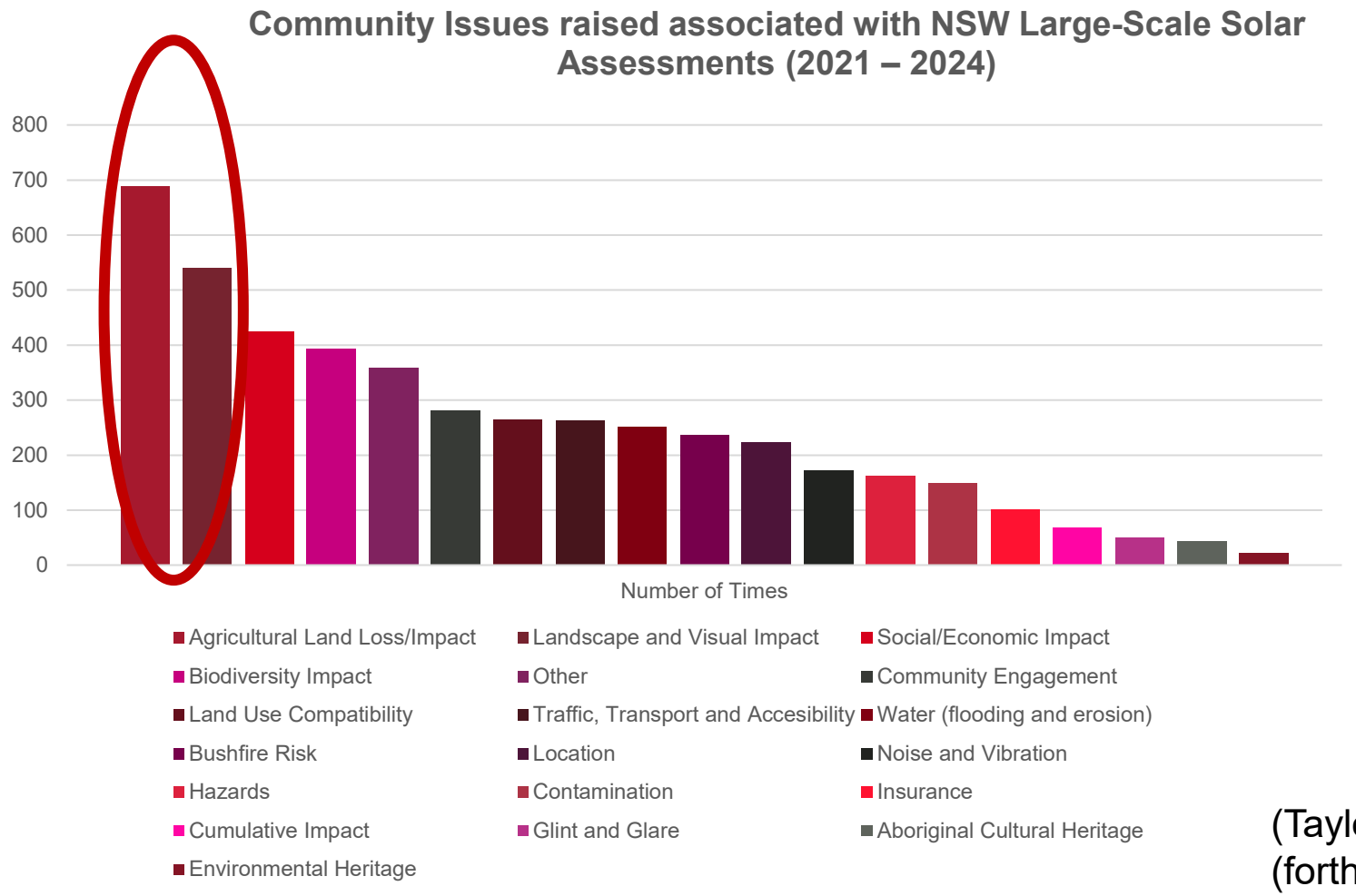
2. *Large-Scale Solar and Agricultural Co-Location*

Agricultural land uses and Renewable Energy Zones in New South Wales

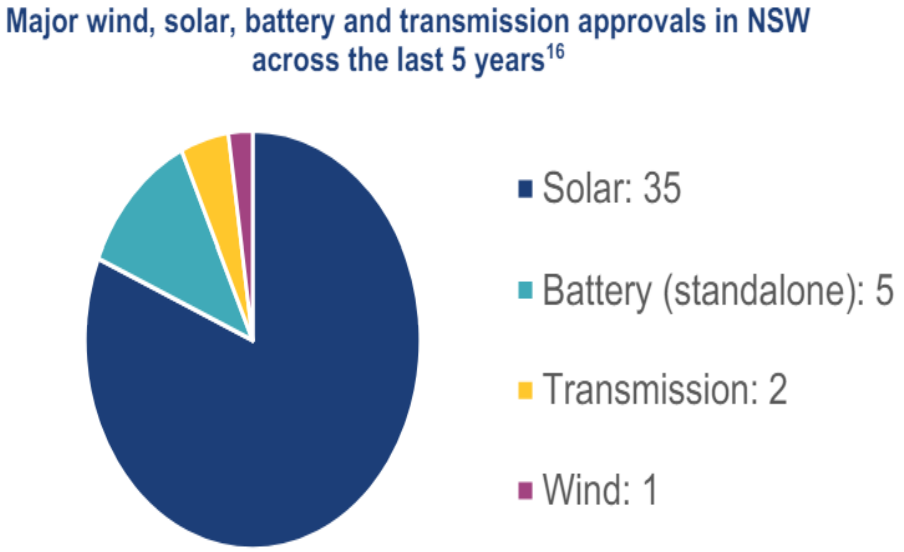
Australia does not have nation-wide strategic and consistent identification of prime agricultural land



Large-scale solar energy projects objections in NSW



(Taylor et al. (forthcoming), 2024)



(HSF, 2024)

Large-Scale Solar Agricultural Impact Assessments

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Existing Framework

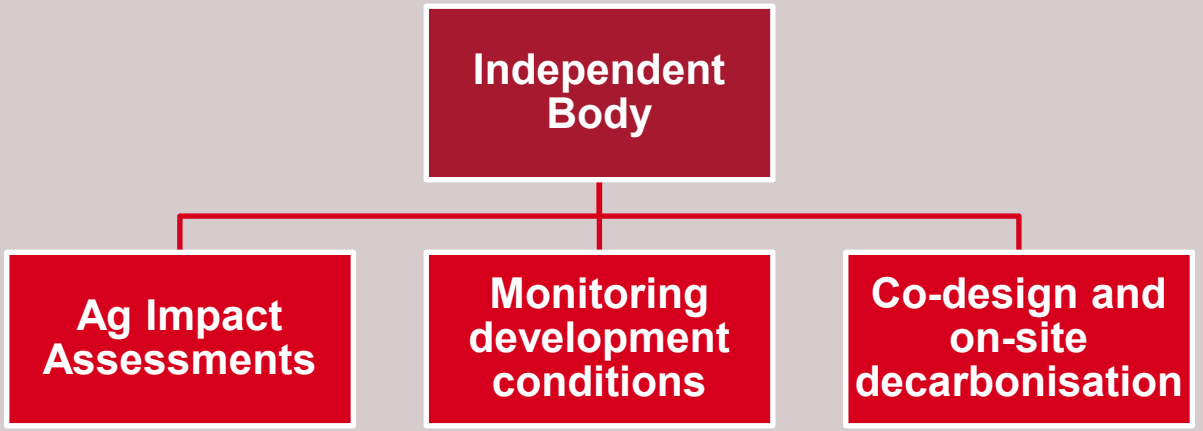
- Detailed **Agricultural Impact Assessment** only required for Class 1 -4 and BSAL Agricultural Land
- Agricultural Impact Assessments for Large-Scale Solar Energy Projects
  - a detailed assessment of whether the project would **significantly impact the local or regional agricultural industry,** including production and supply chains
  - **Decarbonisation** potential?

Legal Gaps

- **No consistent definition** of agricultural land
- **NSW Agriculture Commissioner** report
  - 'An improved evidence base is a prerequisite for more effective rural land use planning and regulation'. (pg 2)
- No body at the intersection of **ag and energy** with formal mediation roles or legal powers

Independent Body at the intersection of agriculture and renewables

- **Independent Body focused on Agricultural Land Zoning and Agricultural Impact Assessments needed** in NSW related to renewables, and solar energy in particular (NSW Ag Commissioner, 2022)



Landholder Solar and Agriculture Co-location

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Existing Framework	Legal Gap	Solar and Energy Co-location Technology - Agrivoltaics
• **Section 1.3 of the EP&A Act** • 'To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's **natural and other resources'.** • "Commercial sheep grazing will continue… which will also help to **control grass and weed growth** around the solar arrays for operational life of the solar farm". (EIS Example, 2023)	• Agricultural land is **not** considered a 'natural' or other 'resource' • No **agrivoltaics specific** planning guidelines • **No binding definition** nor mandatory guidelines to consider agrivoltaics solar and agriculture co-location	

On-Farm Electrification and co-location

- NSW DPI implemented **7 pilot projects across 8 sites**
- Pecora Dairy - **45 kW solar photovoltaic and 60 kWh flow battery system**
- Power bills reduced to about a **third** of what they were previously and elimination of gas costs

Pecora Dairy photovoltaic array (battery container bottom right of buildings)

Agrivoltaics Agreements Legal Gaps

Renewable and Sustainable Energy Reviews 188 (2023) 113815

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Justice-driven agrivoltaics: Facilitating agrivoltaics embedded in energy justice

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- Grazing Licences **most common in NSW**
- **Option to Lease** followed by Solar energy leases in some cases
- **Maintenance and Overgrazing issues**

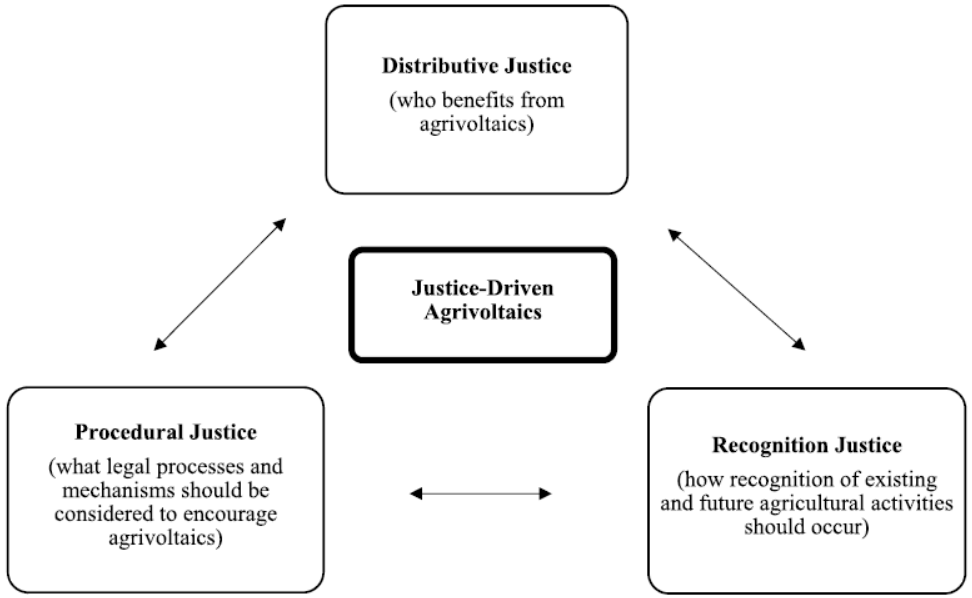
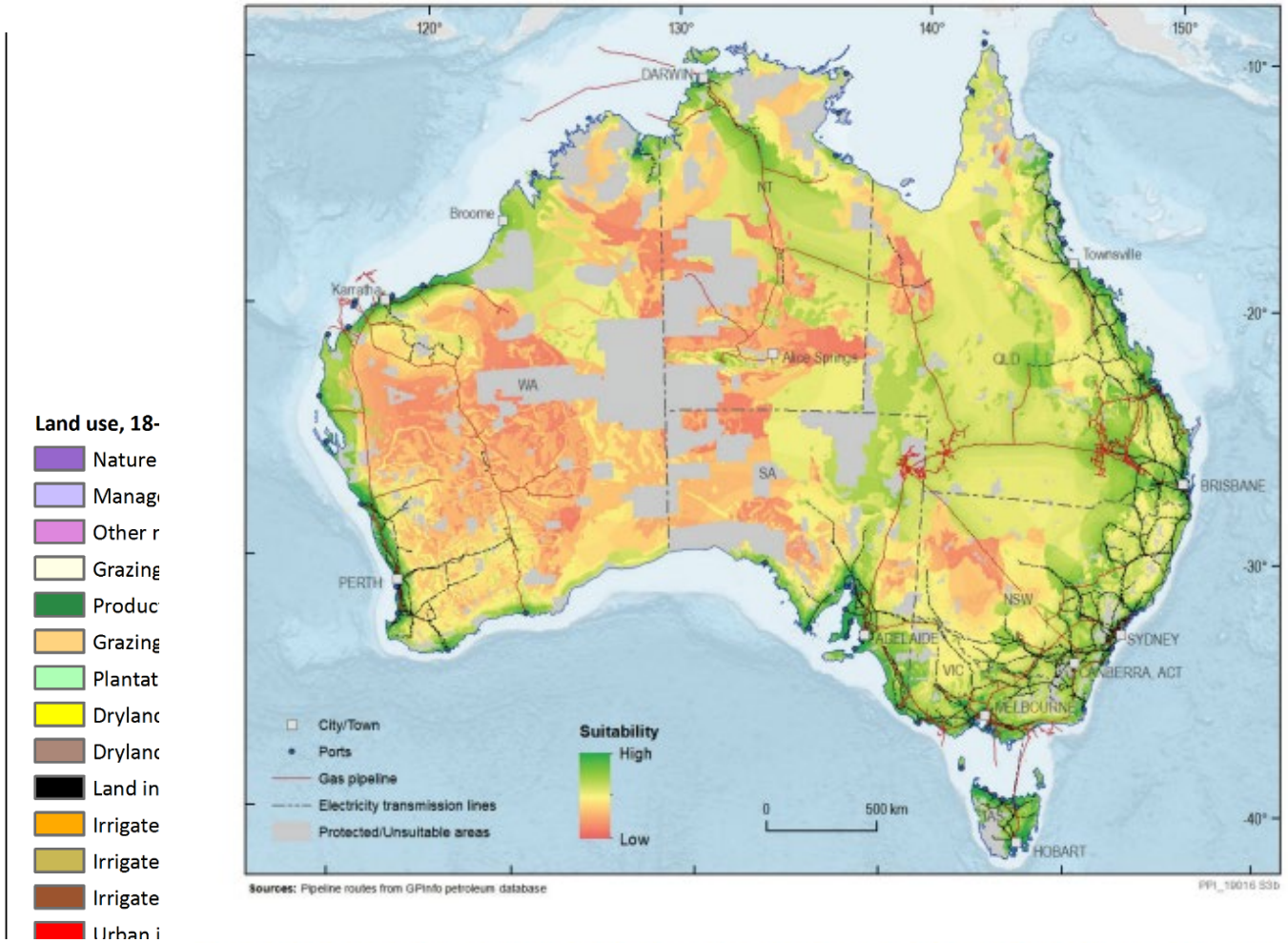


Fig. 1. Justice-driven agrivoltaics framework.
Source: Compiled by authors

3. Renewable Hydrogen

Australia's Renewable Hydrogen Potential



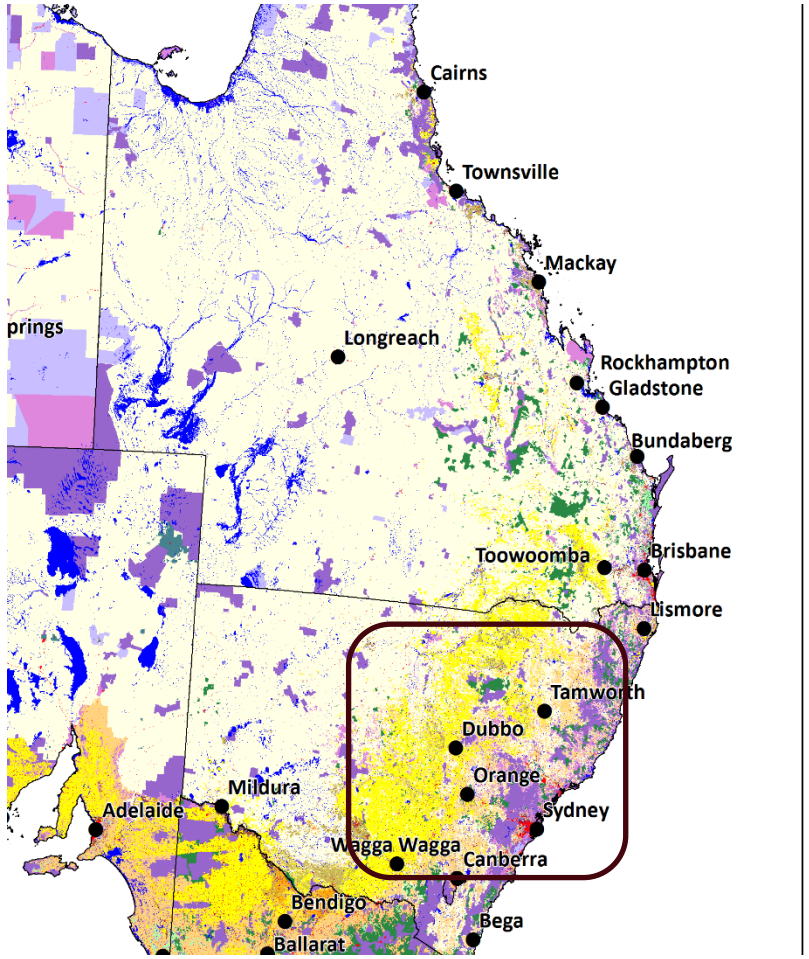


Figure 3. National Hydrogen prospectivity heat map based on Scenario 3: Renewable hydrogen – Coastal or inland production, hydrogen transported via pipeline, and constrained by existing infrastructure.

Hydrogen Production

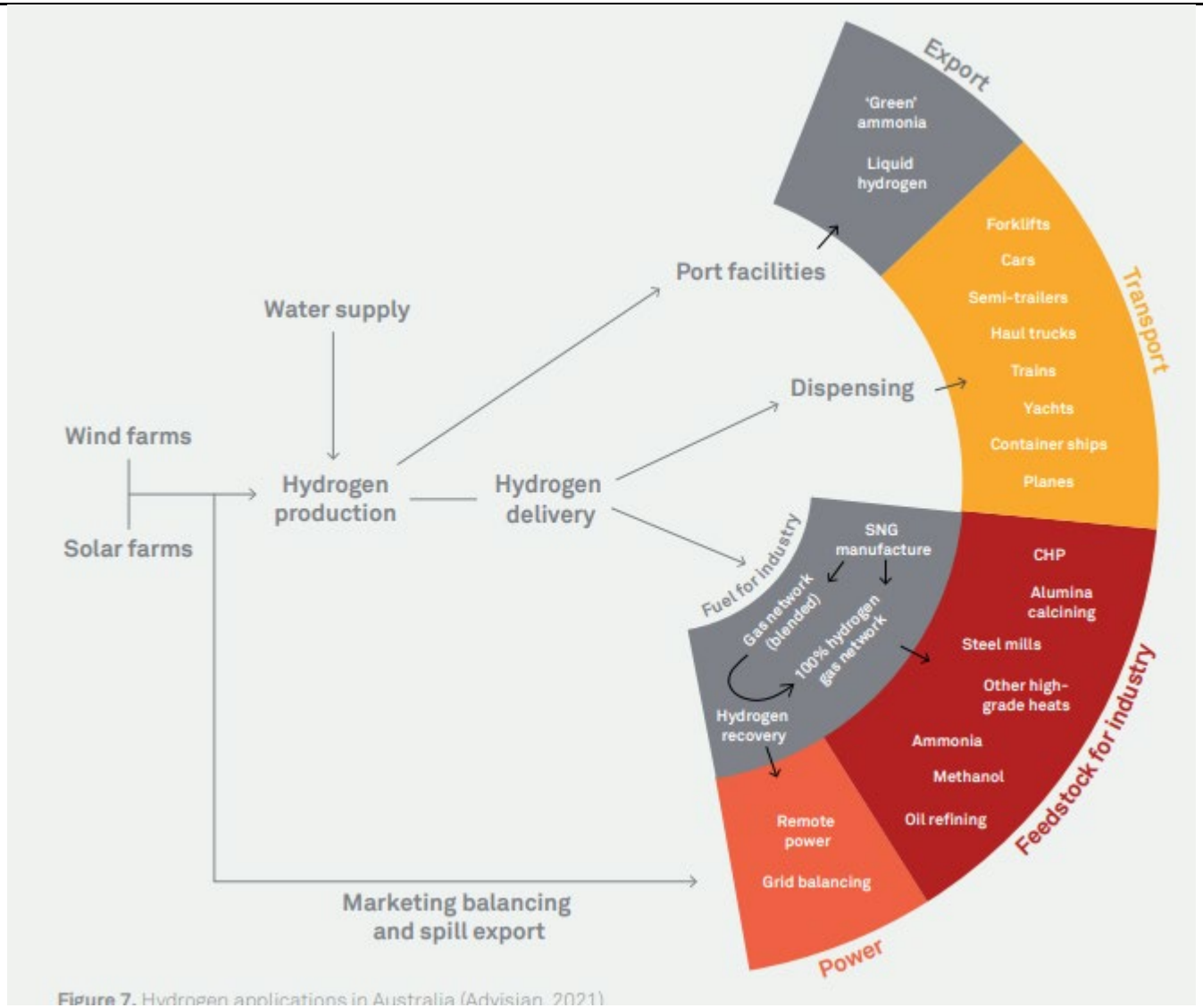
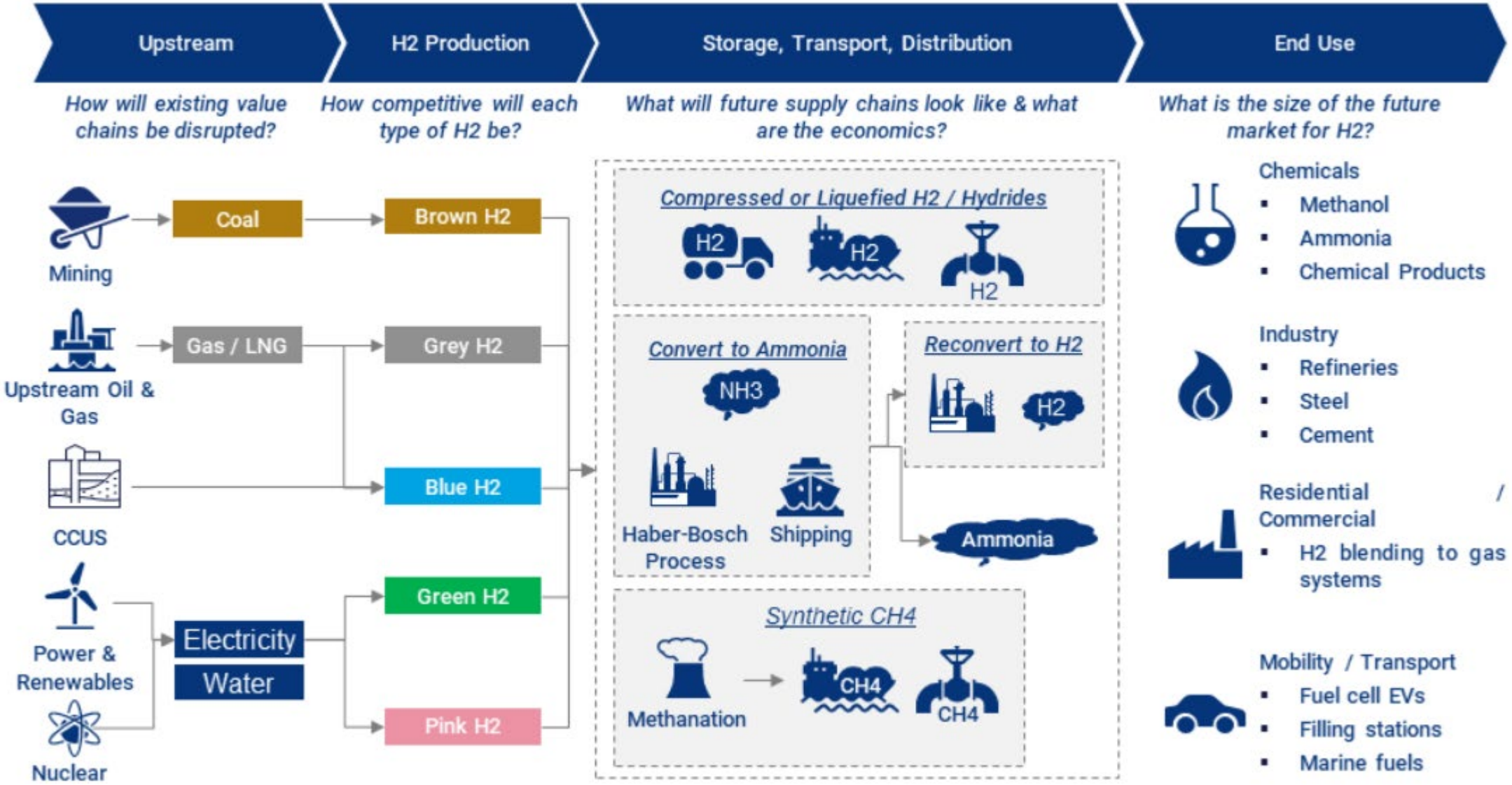


Figure 7. Hydrogen applications in Australia (Advisian, 2021)

Hydrogen Value Chains: Green Ammonia



Source: Wood Mackenzie

Renewable Hydrogen for Diesel Substitution

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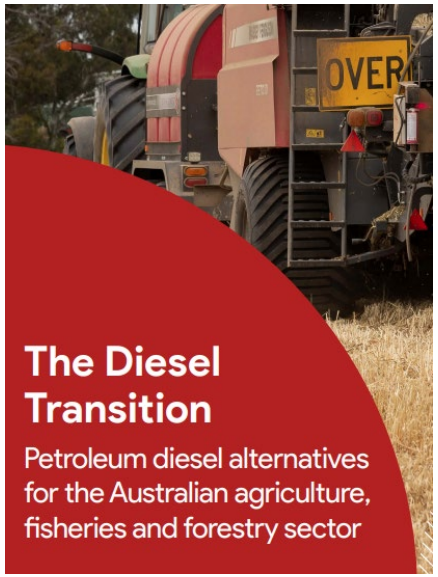
- **84% of total energy consumption for agriculture comes from diesel** (DCCEW, 2022)
- **90%** of Australia liquid fuels are imported
- Heavy agricultural machinery with long-life asset base **needed**
    - A prototype hydrogen-fuelled tractor (New Holland) worked for 3 hours on 8.2 kgs of hydrogen

Table 1 - Fertiliser and fuel costs as a percentage of total farm cash costs, 2018-19 to 2022-23

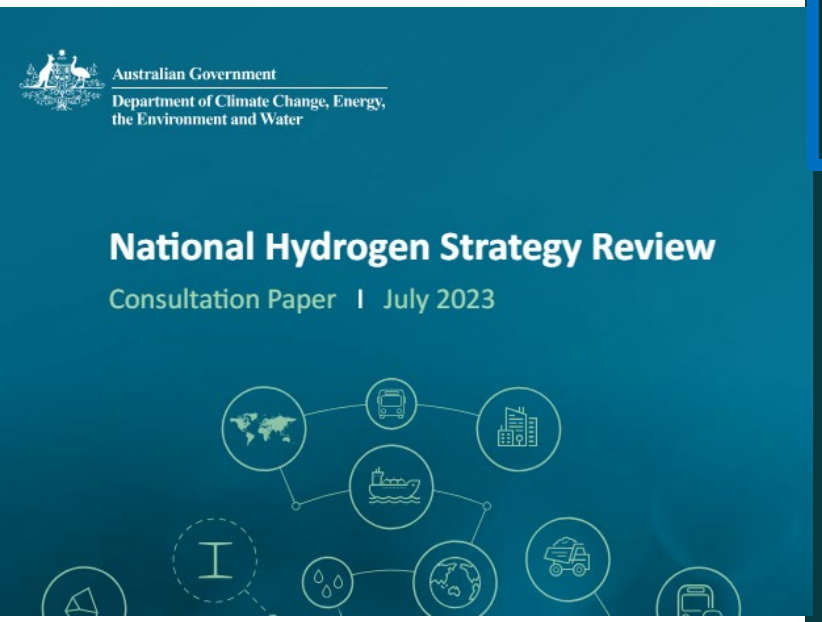
Commodity	2018-19	2019-20	2020-21	2021-22	2022-23[f]
Beef	8.6%	8.0%	8.0%	8.3%	9.8%
Cropping	24.6%	26.4%	24.0%	27.7%	34.0%
Dairy	9.3%	8.9%	9.6%	10.3%	na
Sheep	11.3%	11.5%	11.5%	12.2%	16.2%

f. ABARES forecast. Data is based on an average farm in the industry.

Source: ABARES 2023



International Hydrogen Policy Measures



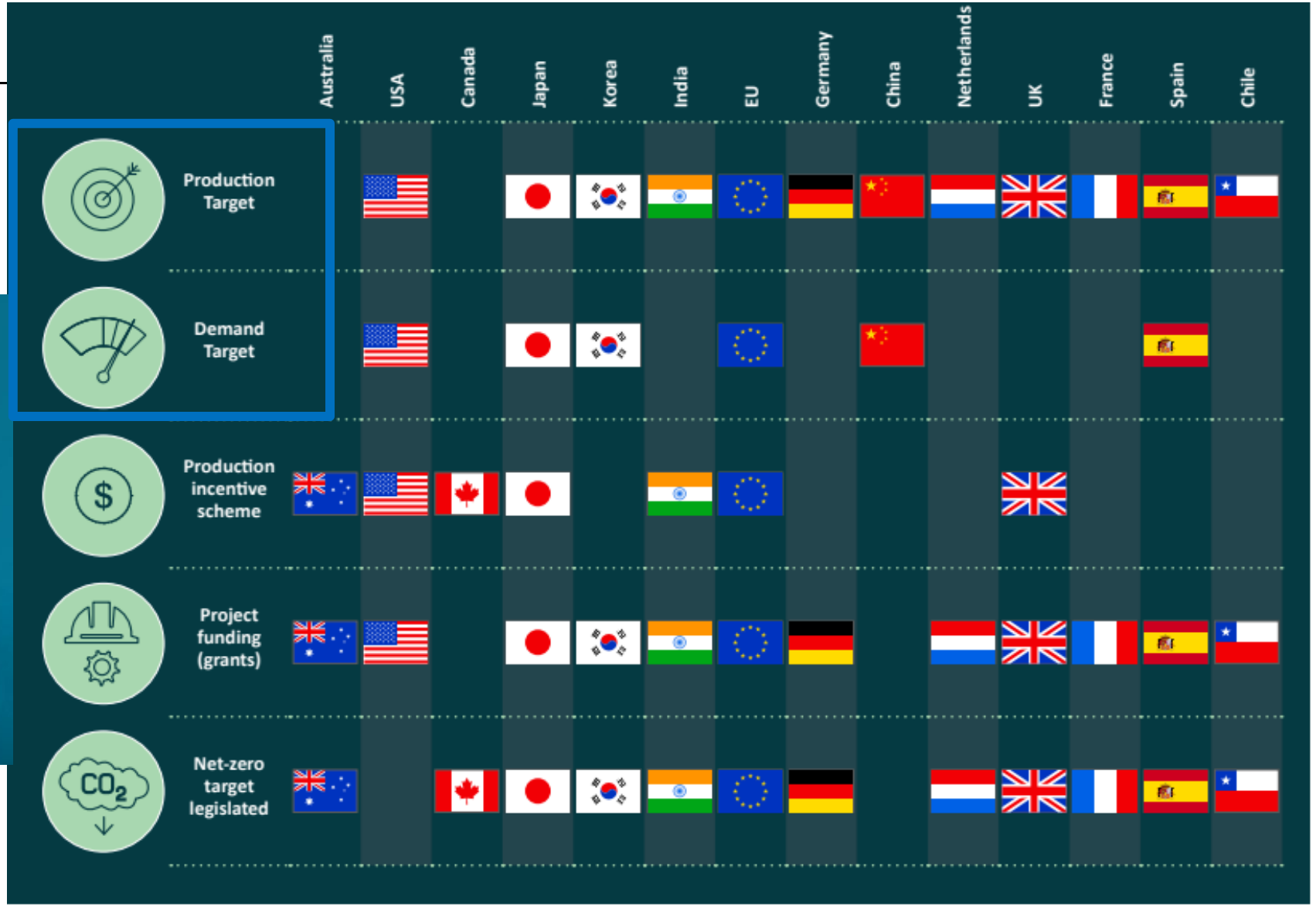
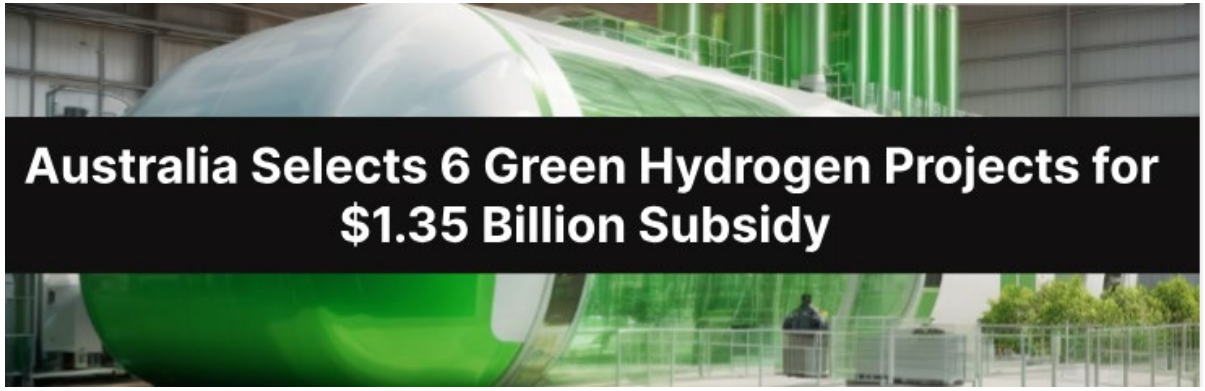


Figure 5: Summary of international hydrogen policy measures

First federal regulatory amendments for Hydrogen and our 'hydrogen bank'

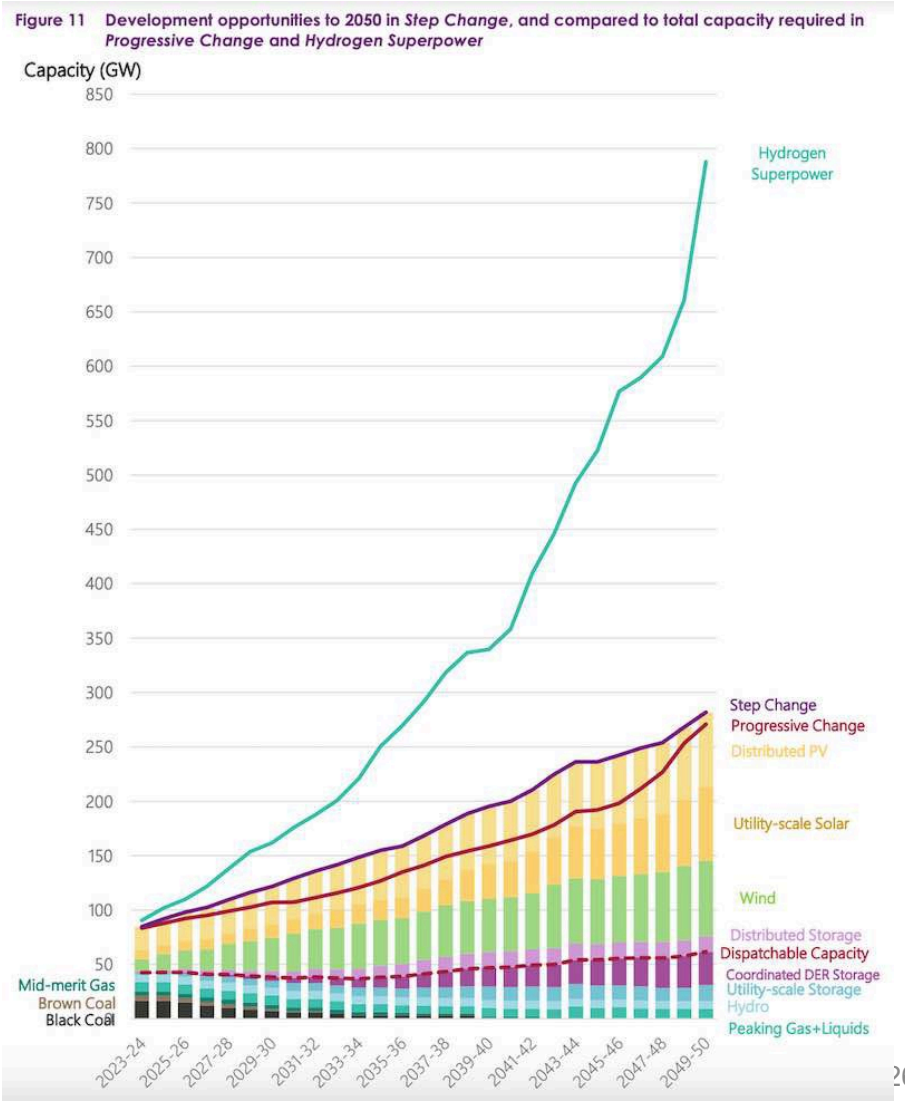
- **Statutes Amendment (National Energy Laws) (Other Gases) Act 2023**
  - Up to 10% of hydrogen blending is permitted
- Previously, the National Gas Law (NGL) and the National Energy Retail Law (NERL) referred only to **'natural gas'**
  - defined as a substance in 'a gaseous state at standard temperature and pressure; and consists of **naturally occurring** hydrocarbons, or a **naturally occurring** mixture of hydrocarbons and non-hydrocarbons, the principal constituent of which is methane': s 23
- NGL will now refer to '**covered gases**' (which specifically lists hydrogen)
  - 'natural gas equivalents' (NGEs)
    - **gases that can be used in gas appliances, such as natural gas, biomethane, synthetic methane and low-level blends of hydrogen with these gases.**
  - 'prescribed covered gases' (PCGs)
    - 100% hydrogen



(Blackridge, 2023)

How much renewable energy is needed to support renewable hydrogen production?

- The generation capacity of the NEM would need to increase from **180 TWh to 220 TWh by 2030**
- Then almost **double in size by 2050 (320 TWh)**
- **AEMO 'Hydrogen Superpower'**– more than **eight-fold increase** in generating capacity **(almost 1,000 TWh)** by 2050.
- **Parliamentary Inquiry** into *Australia's transition to a green energy superpower*
- It takes **54kWh and 9 - 10 litres of water** to produce 1kg of Hydrogen



Guarantee of Origin Scheme Design

- **Well-to-gate boundary** is proposed as a starting point
- **ACCUs** could be used to reduce the emissions from hydrogen production, effectively creating carbon neutral hydrogen
- A **certificate** is proposed to relate to a tonne of hydrogen and include:
  - Emissions
  - Production facility and location
  - Production technology
  - Primary fuel source
- **Biomethane is not covered under the GO**
  - "The Department proposes that RGGOs for **biomethane** will not be recognised initially in the GO scheme. However, there may be an opportunity to recognise these RGGOs in the GO scheme once a domestic market- based approach to recognising these claims has been developed".

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

Australia's Guarantee of Origin Scheme Design

Policy paper

20 September 2023

Renewable Hydrogen: Key Issues for Agriculture

MACQUARIE University
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- **Energy efficiency:**
  - A half to two thirds of the energy will be lost during the process **(~30% during electrolysis, 20-40% on conversion** to derivative or storable form)
- **Water use**
  - 1 KG of hydrogen using electrolysis = **9-10 Litres of water**
  - A 50 MW electrolyser operating at 60% capacity factor will require around **700 ML per year**
- **Land Use**
  - Proposed Infinite **Green Energy Northam hydrogen hub (WA)** rejected for planning approval to produce 42 tonnes of green hydrogen due to the facility not consistent with renewable energy facility land use definition
  - Hydrogen **planning assessment guidelines** needed
  - **Ownership? Cooperatives?**
- **Cost**
  - **AU$ 2/kg** (US$1.38/kg) production target
  - Currently AU**$4-6/kg** (US$2.76-4.14/kg)

WA's green hydrogen plans hit roadblock after proposed Northam plant rejected for planning approval

ABC Midwest & Wheatbelt / By Eliza Bidstrup

Posted Tue 26 Mar 2024 at 8:55am, updated Mon 22 Apr 2024 at 8:26am

Regulatory Gaps: Renewable Hydrogen

- ‘Keytah’ cotton producing property, producing up to 78,000 bales per annum
- Moree Plains, NSW, Good Earth Green Hydrogen and Ammonia Project
- 12 MW Electrolyser Capacity
- 936.5 green hydrogen tonnes and 3,800 tonnes of ammonia per annum
- $35.8 million in funding

Further Regulatory Gaps

- **Feedstock for renewable hydrogen beyond renewable energy?**
- **Concurrent land uses?**
  - ***Land Administration Act 1997* (WA)** Crown Land and Pastoral Leases
    - **‘Diversification Leases’**
      - renewable energy
      - carbon farming
      - aboriginal economic development and land management
      - conservation purposes
      - grazing livestock, horticulture or agriculture
      - multiple concurrent uses
- **Guarantee of Origin Traceability?**

Renewable gas emerges as key piece in emissions reduction puzzle

May 29, 2024 – 1.07pm

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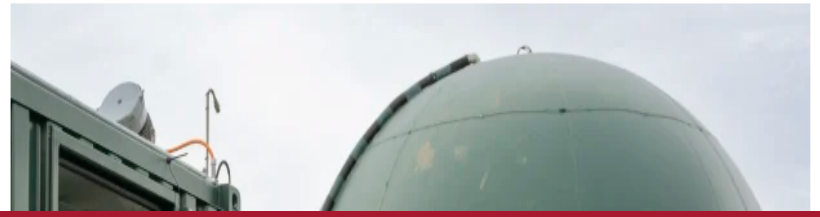
Like the rest of the world, Australia is moving to net zero; but while Europe and the United Kingdom are adopting renewable gas at a great rate, Australia has been slower to adopt these new technologies, in particular biomethane.

But one Australian network, Jemena, is leading the charge and demonstrating how organic waste can provide a sustainable source of energy into the future.



4. *Biomethane*

Biogas and Biomethane

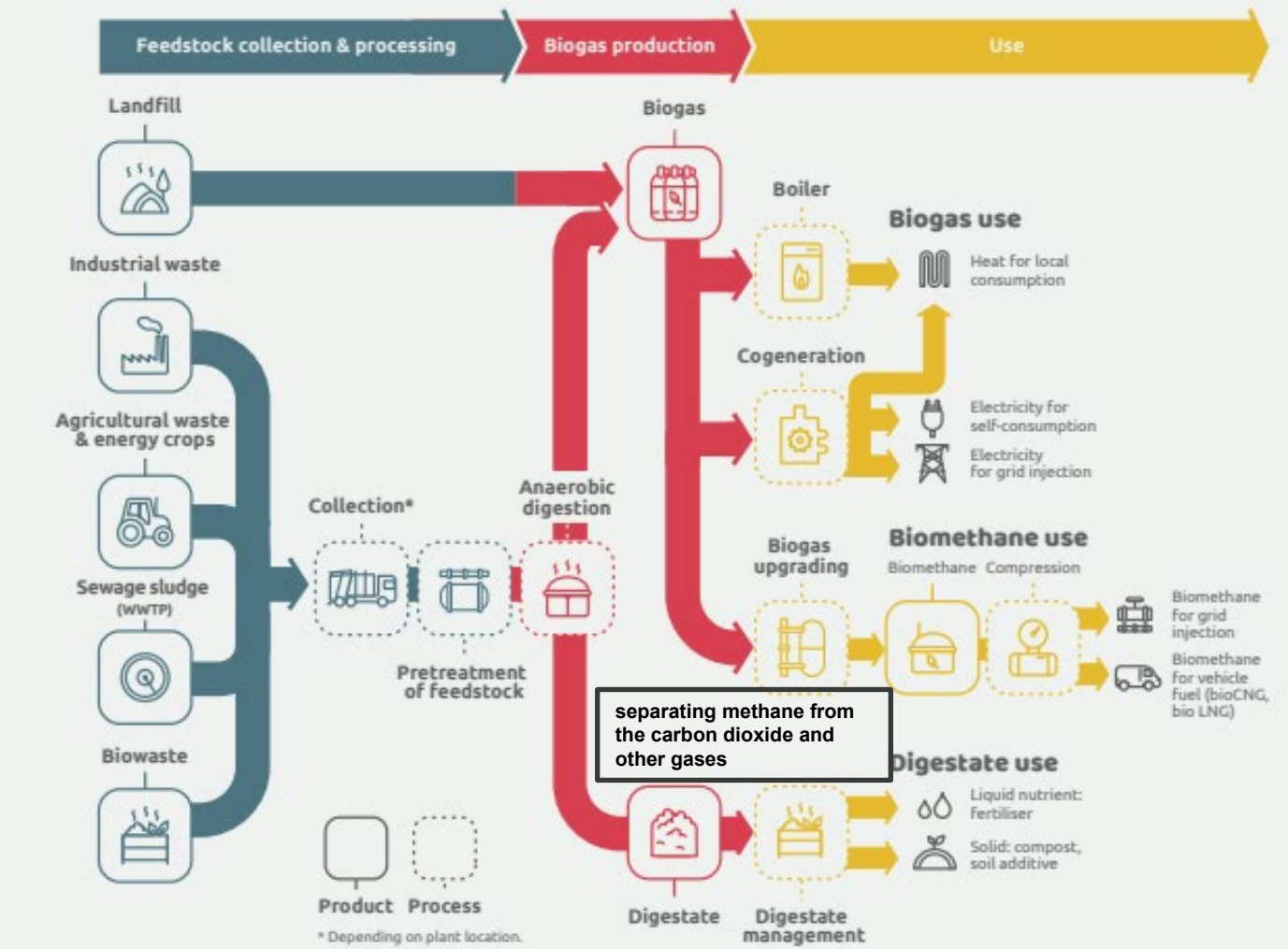


Figure 16. Biogas value chain (ENEA Consulting, 2019)

Upgrading of biogas from all feedstocks consists of the removal of five key elements, including carbon dioxide (CO_2), air, hydrogen sulfide, and water vapor

Crop residues: Residues from the harvest of wheat, maize, rice, other coarse grains, sugar beet, sugar cane, soybean and other oilseeds.

- **E.g. Kalfresh 30% of energy crop goes to waste**

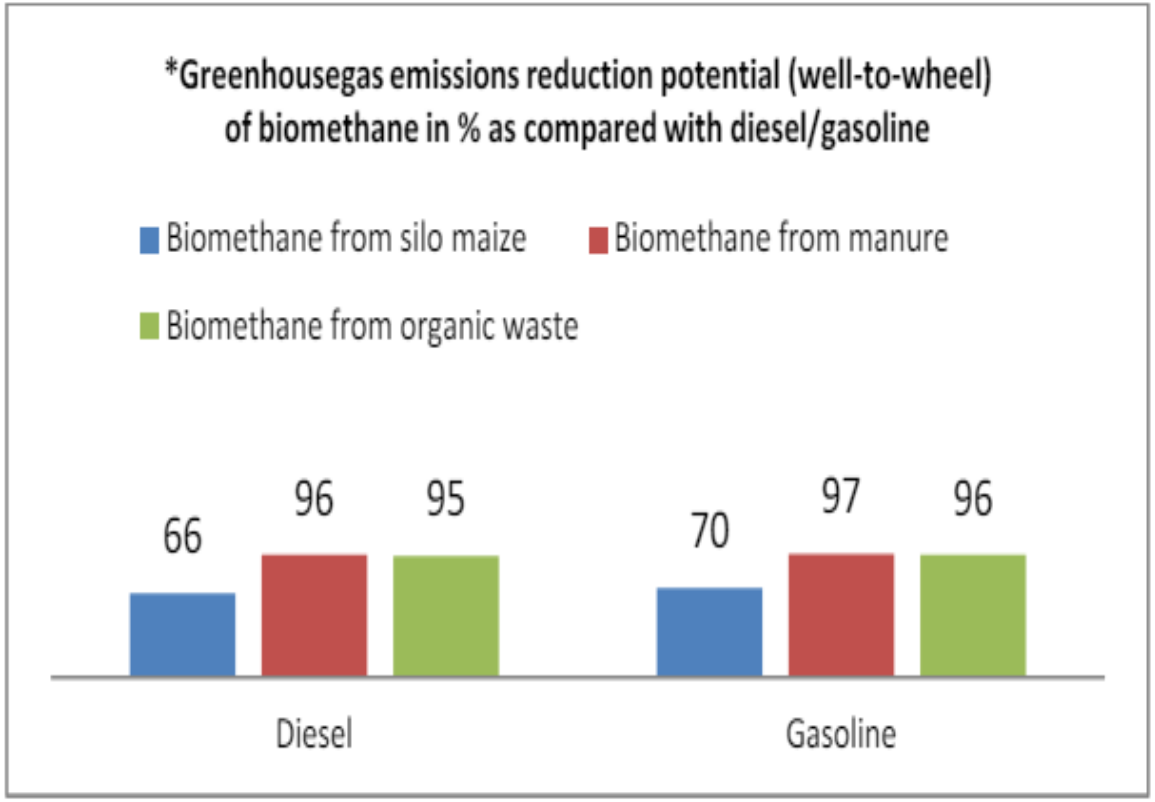
Animal manure: From livestock including cattle, pigs, poultry and sheep.

Food and green waste: (e.g. leaves and grass), paper and cardboard and wood that is not otherwise utilised (e.g. for composting or recycling).

Wastewater sludge: Semi-solid organic matter recovered in the form of sewage gas from municipal wastewater treatment plants.

Biomethane Emissions Reduction Potential and Policy Intersections

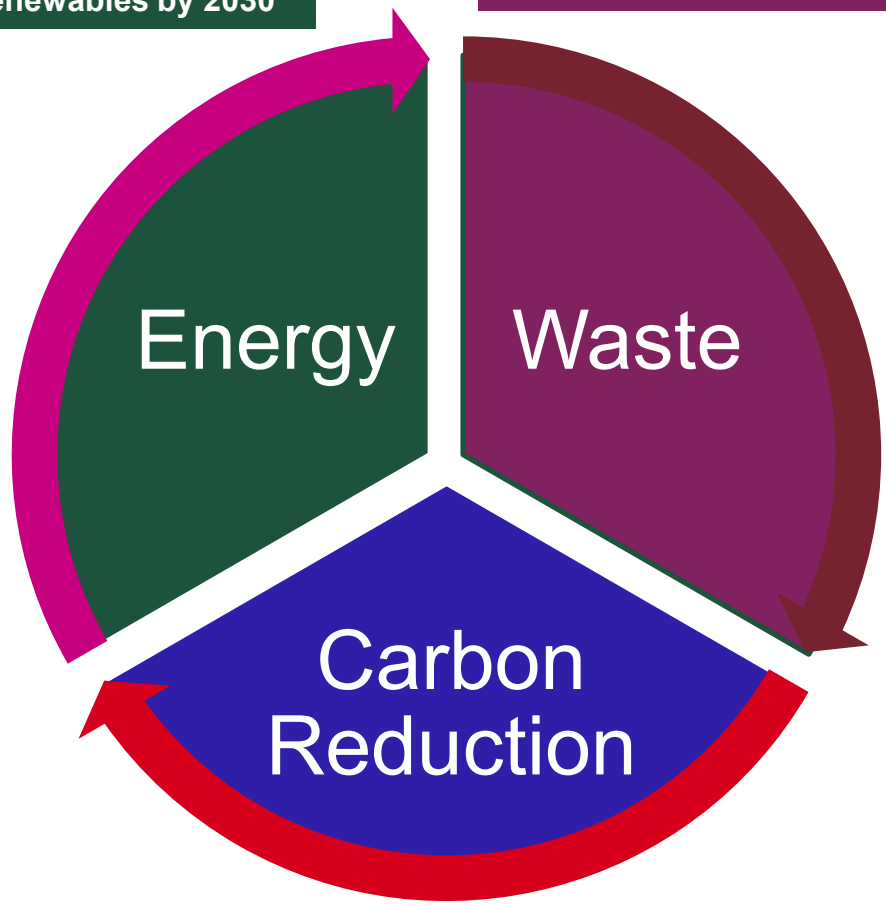
- Halving the amount of organic waste sent to landfill by 2030
- Achieving an 80% average recovery rate from all waste streams by 2030 (National Waste Plan, 2022)



Source: Environment Agency Austria

*The data do not include the avoided emissions of raw manure storage, landfilled organic waste and benefits of the produced digestate, able to replace mineral fertiliser.

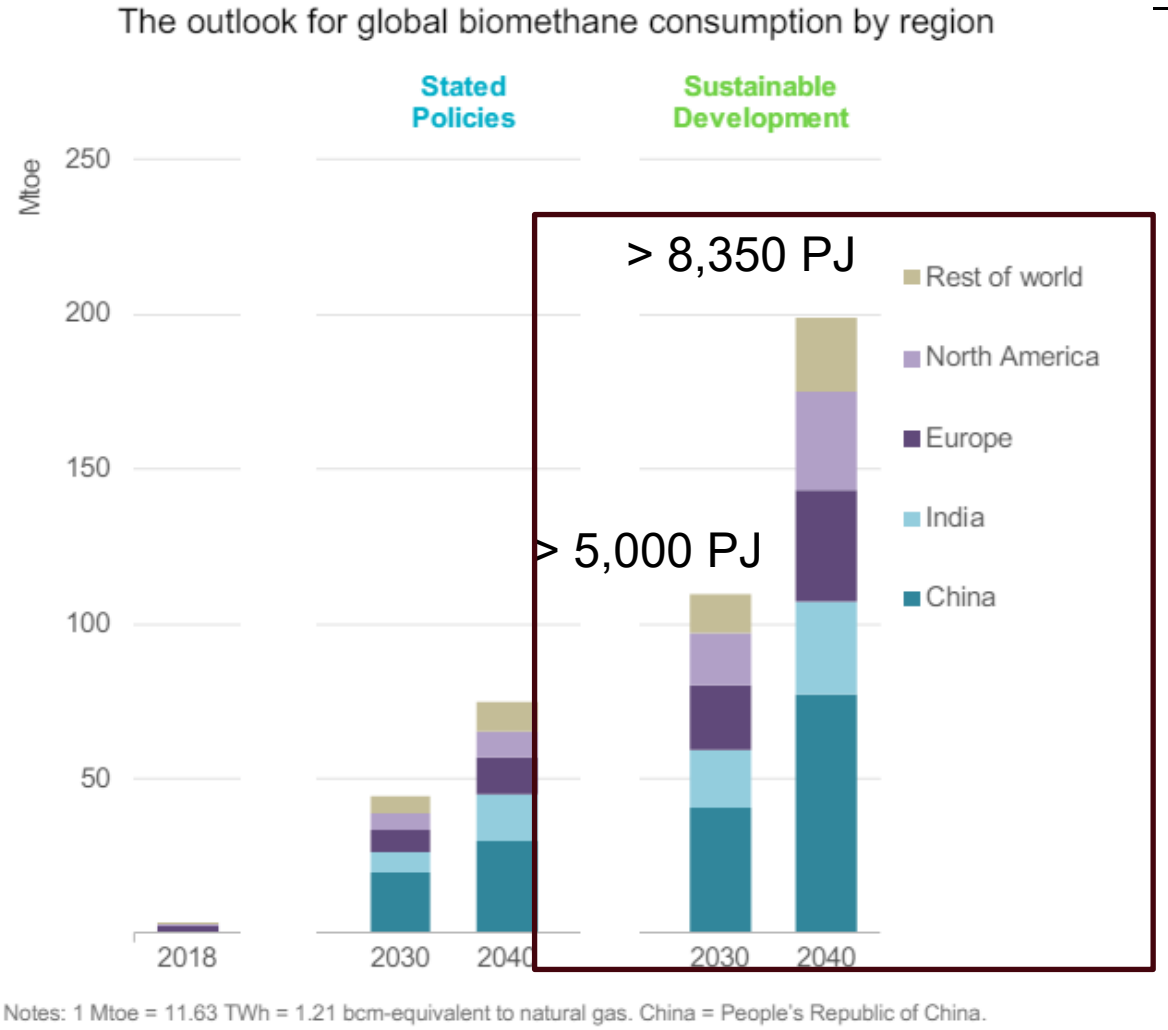
- 82% renewables by 2030



- 43% emissions reduction by 2030 and net zero 2050

International Biomethane and Biogas Facilities

- **EU –** 1,322 biomethane facilities as at April 2023 producing 3 billion cubic metres – 30% increase on 2021
  - **64% of EU biogas** from agricultural materials
  - targeting **35 billion cubic** metres (bcm) of biomethane by 2030
- **USA –** 2,300 biogas sites including 475 anaerobic digesters on farms
  - **IRA** - US$10 billion and investment tax credits to incentivise the development of biogas facilities
- **China**
  - 100,000 biogas plants
  - incentives covering **25-45%** of the whole cost of biogas projects



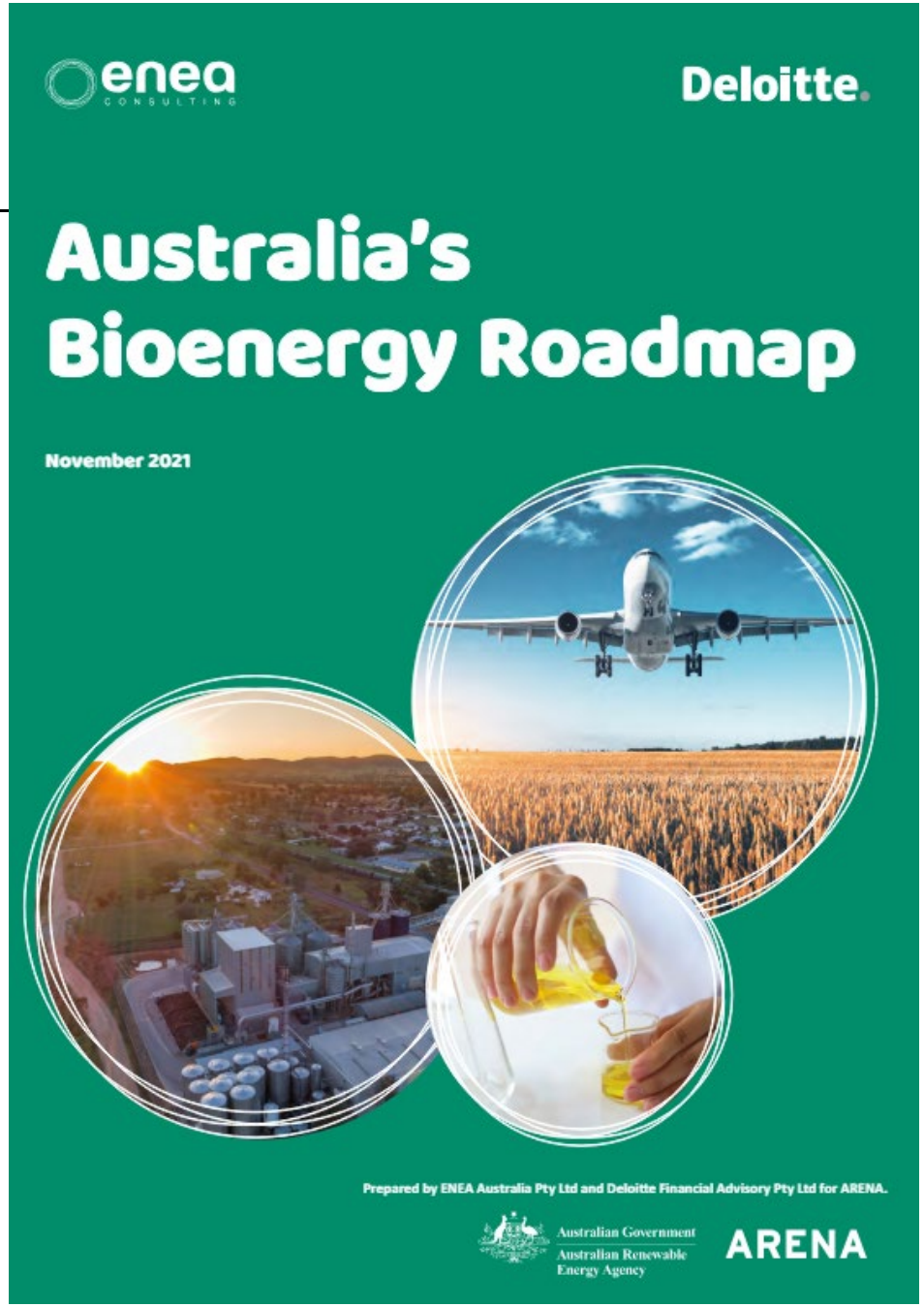
International Biomethane Facilities

Table 17. Number of known biogas upgrading plants in selected countries around the world (Source: (*Nguyen et al., 2021*)).

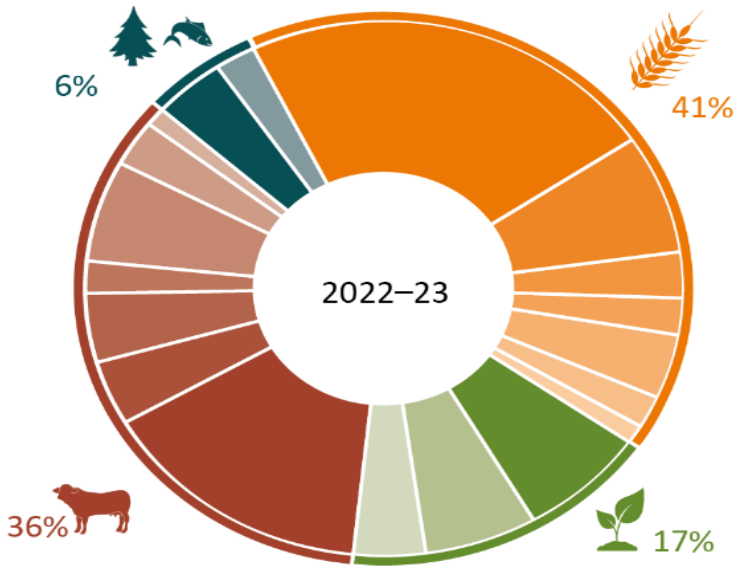
Country	2014	2016		2019	
	Number of plants	Number of plants	Plants capacity (Nm^3/h Raw gas)	Number of plants	Plants capacity (Nm^3/h Raw gas)
Australia	0	0	n/a	0	n/a
France	8	30	7,935	47	10,755
Denmark	12	32	18,650	34	16,850
United Kingdom	37	85	83,200	96	69,266
Italy	5	7	n/a	8	0
Finland	9	12	3,221	17	3,231
Switzerland	24	31	7,962	45	12,430
Netherlands	21	26	17,910	53	29,385
Germany	178	194	220,311	203	230,434
Austria	14	15	5,790	13	5,630
Sweden	59	63	40,880	69	41,815
South Korea	n/a	n/a	5,953	10	5,953
Japan	n/a	6	2,400	6	2,400

Biogas and biomethane

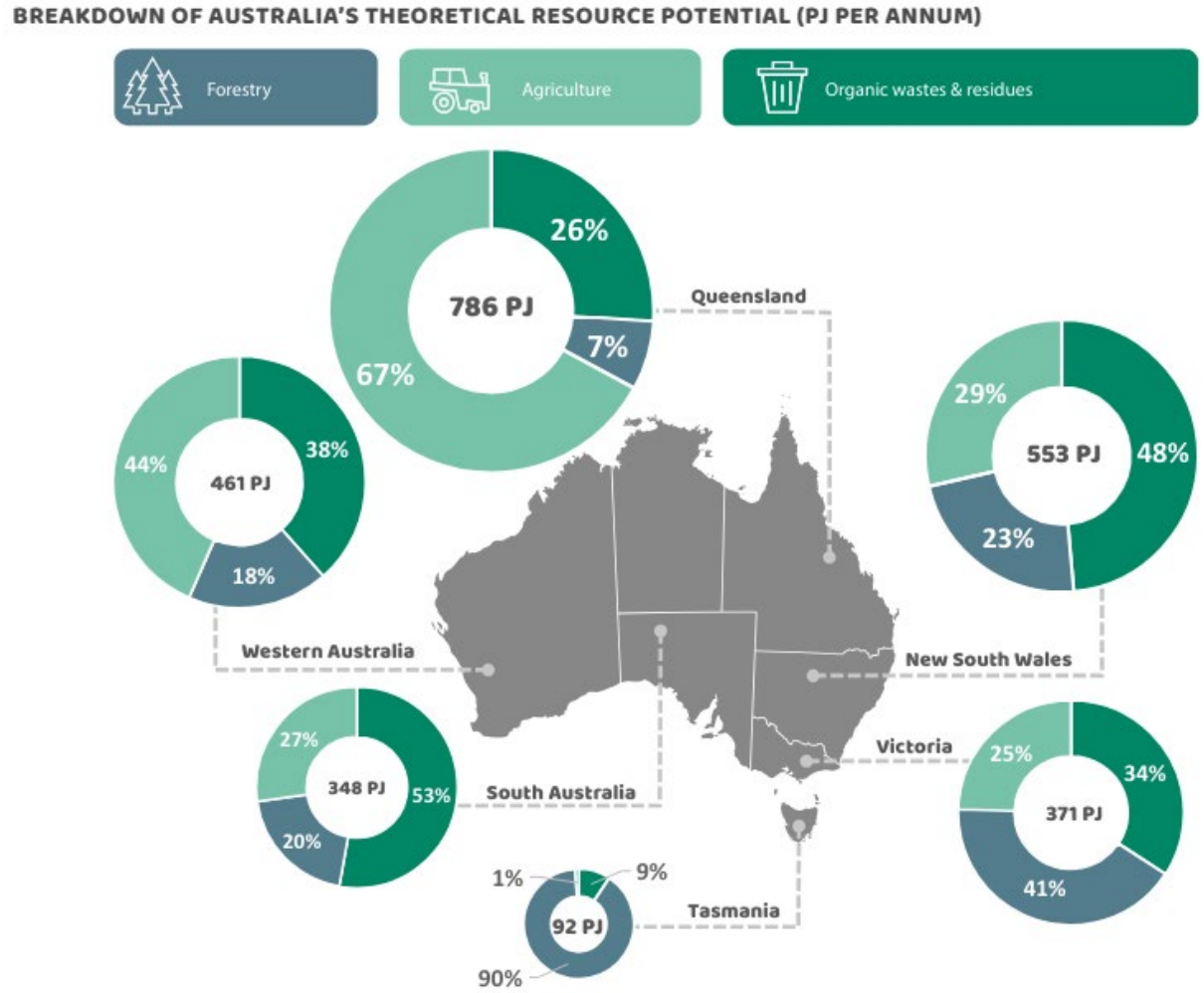
- **Bioenergy** is also the term used to describe the many varied ways of utilising biomass for heat, electricity, biogas, and liquid fuels
    - **3%** of total energy consumption could provide up to **20%** of Australia's total energy consumption by the 2050s
    - Bioenergy could provide up to **244 PJ per annum** of renewable industrial heat, with widespread commercial deployment by 2030 representing 33% of the total industrial heat market
- Generate $10 billion per annum, 26,200 new jobs, **reduce emissions by 9% by 2030 and 12% by 2050**
- **Biomethane direct replacement for gas** and can be used in existing gas assets e.g. gas power stations, pipelines etc
- **Biogas Roadmap** – 2,150PJ and cost of biomethane at $12.20/GJ (2021) and **$9.80/GJ (2030)** rendering it cost competitive



Bioenergy Resources

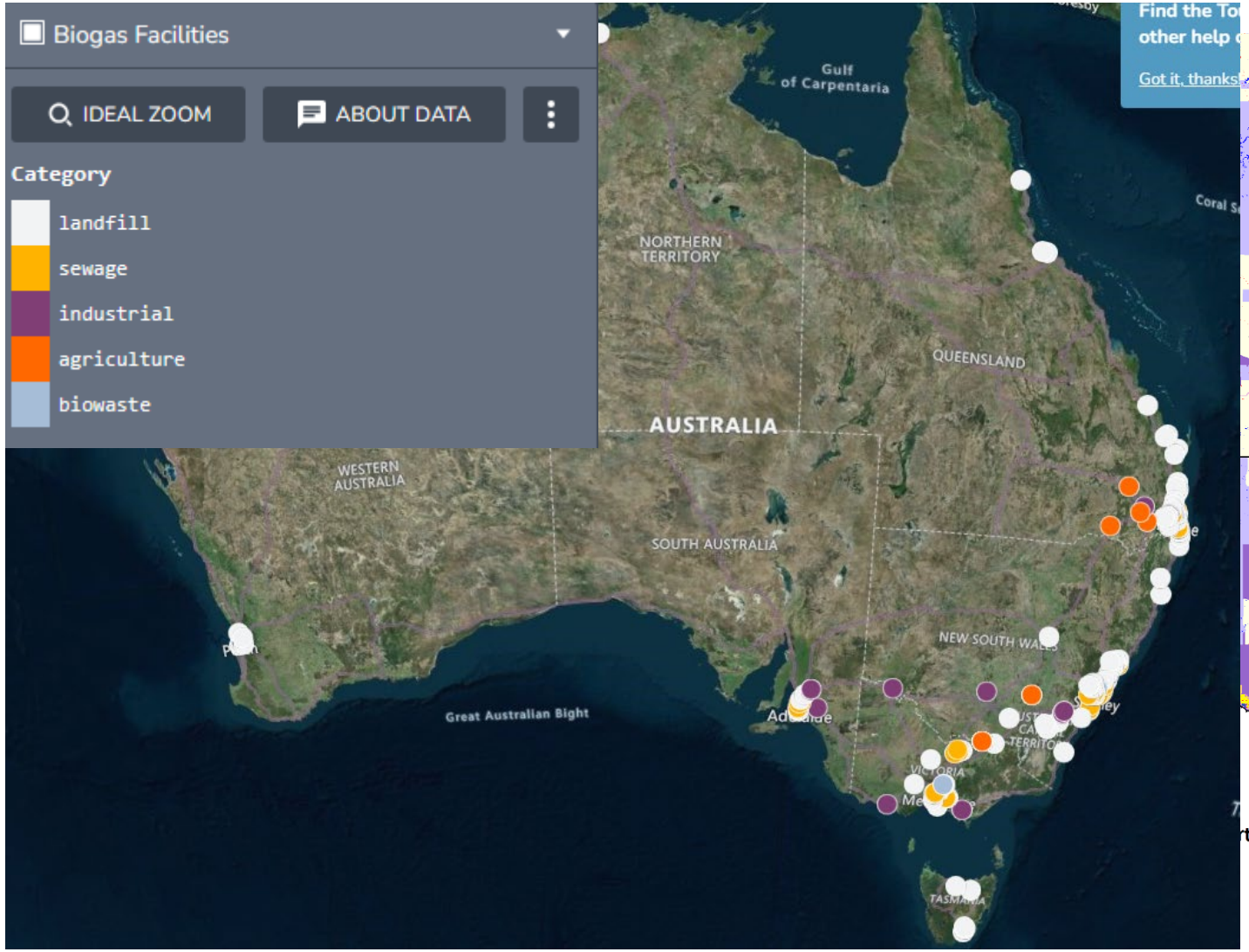


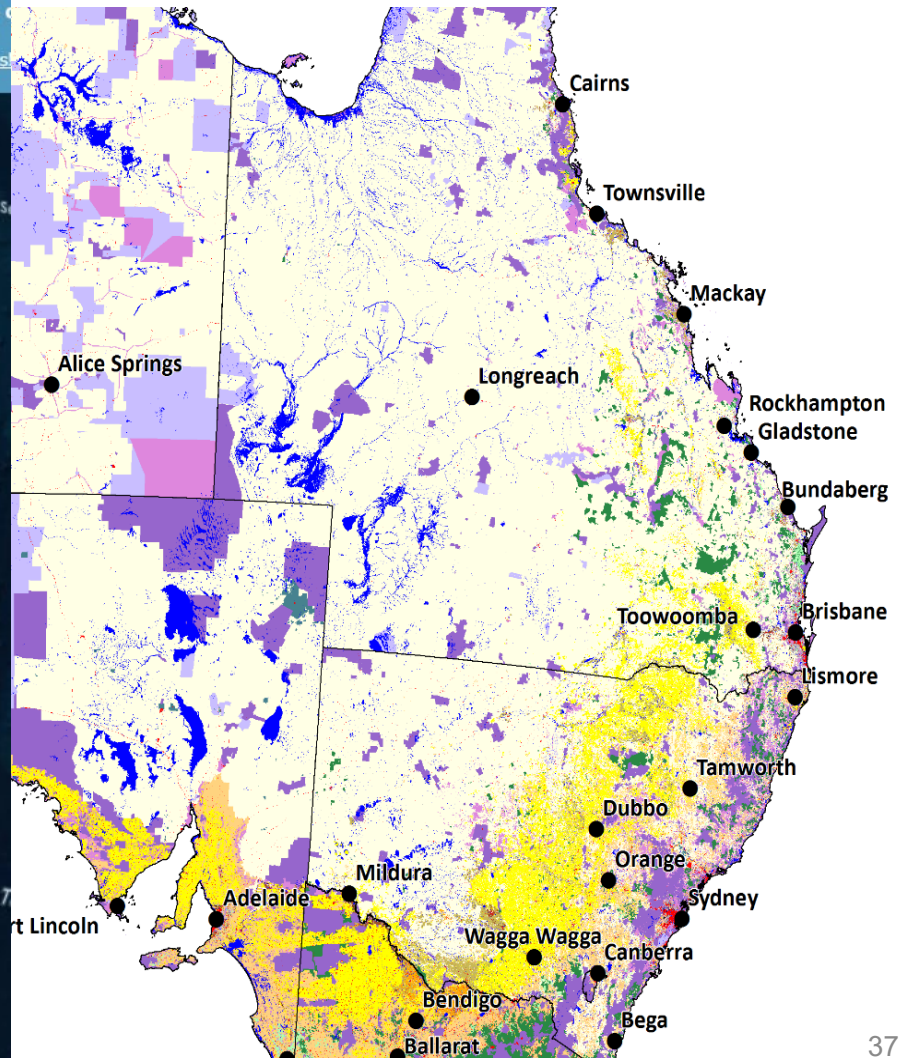
Cereal grains	23%	Cattle & calves	15%
Oilseeds	7%	Sheep & lambs	4%
Pulses	3%	Poultry	4%
Hay and pasture crops	2%	Pigs	2%
Cotton	4%	Other livestock	0%
Sugar cane	2%	Milk	6%
Wine grapes	1%	Wool	3%
Fruit and nuts	7%	Other livestock products	1%
Vegetables	6%	Fisheries	4%
Other horticulture	4%	Forestry	2%



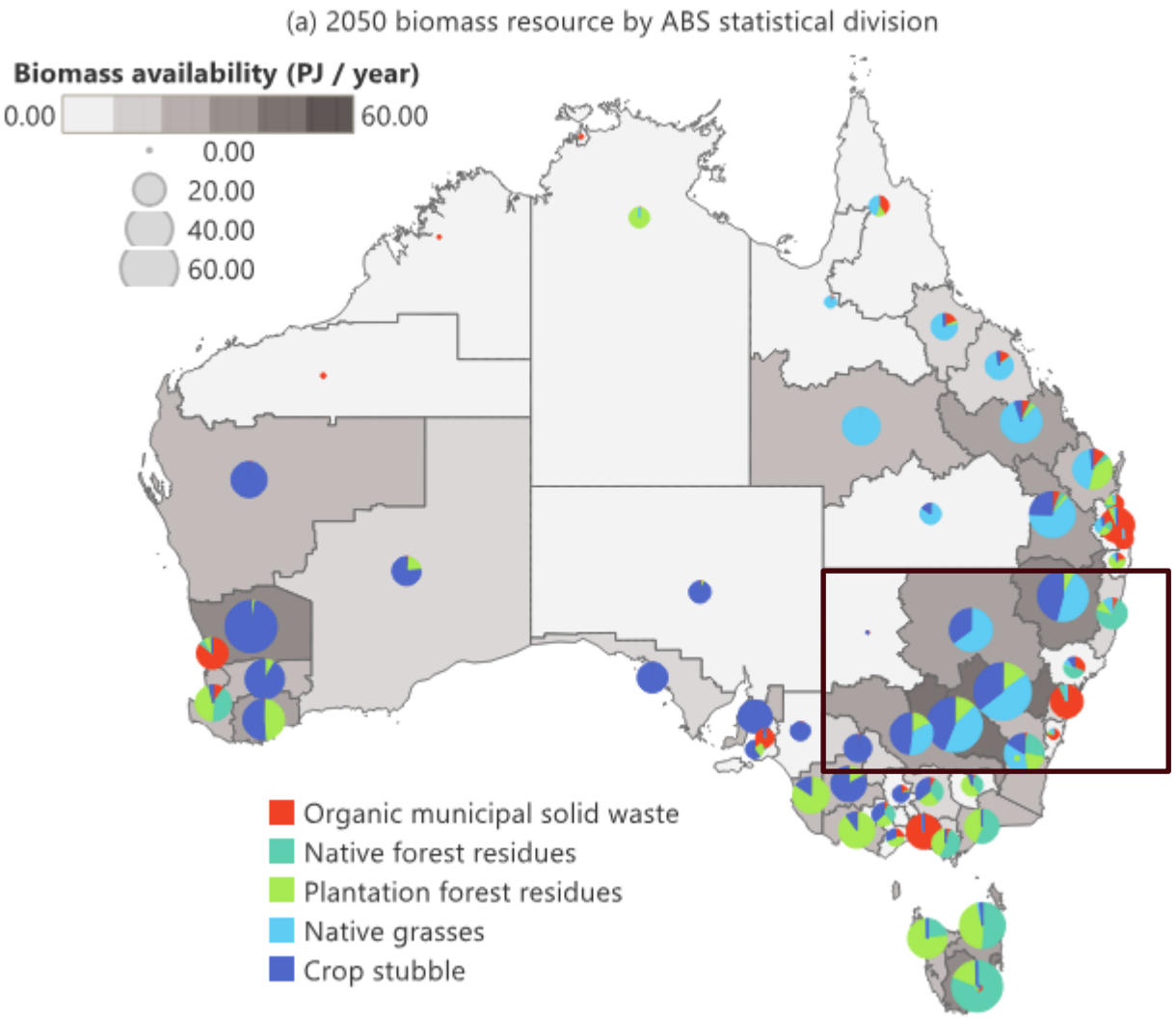
Source: Enea, Deloitte based on ABBA project information and ABARES production data

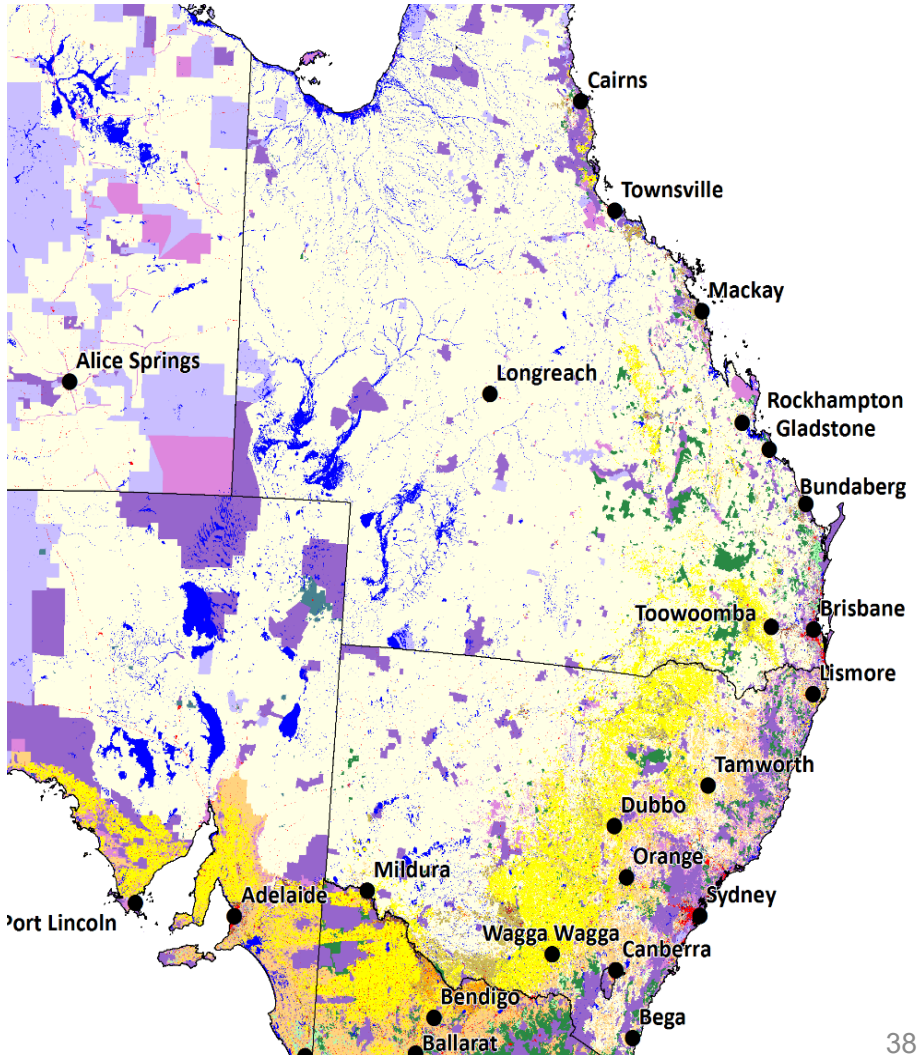
Australian Biomass for Bioenergy Assessment 2015-2021





Net Zero Australia – Bioenergy Systems (2023)





Biogas Feedstocks in NSW

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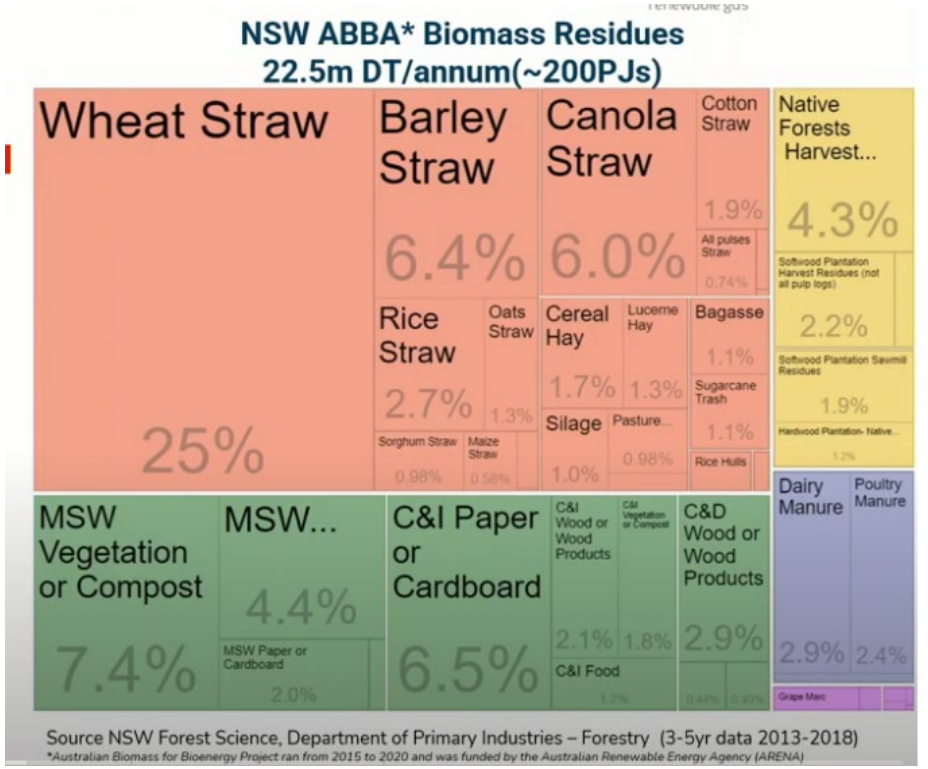
Table 3.5 Estimated biogas potential by biomass stream (PJ), and potential biogas supply as a share of regional gas consumption from the distribution network (%)

State	Urban waste	Agricultural crop residue	Livestock residue	Food processing residue	Total biogas (PJ)	Biogas potential (excluding agricultural crop residues)	Total biogas potential
NSW	3.5	75	8.8	0.6	88	15%	103%
VIC	2.4	38	6.8	0.4	48	5%	27%
QLD	8.6	66	8.8	0.6	84	70%	327%
SA	3.3	40	1.9	0.2	46	17%	142%
WA	1.7	100	1.4	0.4	103	13%	384%
TAS	0.2	0.4	0.4	0.0	1	23%	36%
ACT	0.2	0.0	0.0	0.0	0.3	2%	3%
Total	**19.9**	**319.4**	**29.3**	**2.2**	**371**	**14%**	**102%**

Source: Deloitte analysis based on biomass and waste data from (AREMI, n.d.). Benchmark biogas yields from (Sustainable Energy Authority of Ireland)

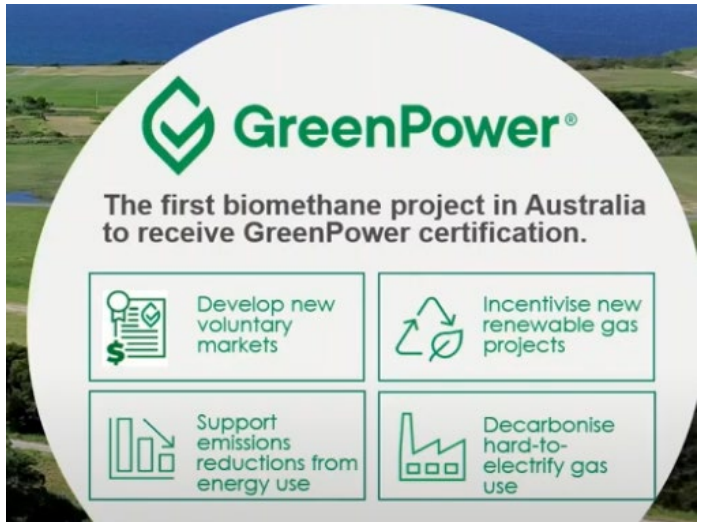


Australian Biomass for Bioenergy Assessment 2015-2021

by Toni Nugent
April 2021

AgriFutures® Australia

Renewable Gas Certification - Greenpower



GreenPower Renewable Gas Guarantee of Origin (RGGO)

- **Participation is open** to renewable gas projects across Australia that produce biogas, biomethane (upgraded biogas) or renewable hydrogen launched in August 2023
  - Renewable feedstock, community consultation, emissions intensity
- NSW Government-managed **voluntary scheme** since 1997 to create a ‘green premium’ for commercial and industrial users
- First biomethane citification granted to **Malabar Project** at Sydney Water Wastewater Plant – 95 TJ capacity injection into natural gas network

Biogas and biomethane uses

- **Simplifying on-farm waste management**
  - **NSW Biohubs** process over 800,000 tones of organic waste and residue to reduce scope 1 emissions by up to 250,000t per annum
  - crop residue burning can release **149.24 million tonnes of carbon dioxide** (CO2), over 9 million tonnes of carbon monoxide (CO) per annum
- **Renewable fuel for heavy vehicles**
- A potentially cheap source of **on-site heat and electricity**, particularly for off-grid farms

Waste Volume

The project will process up to approximately 803,000 tonnes per annum of the Co-op's existing organic liquid by-products.

Greenhouse Gas

Through efficient management of waste and not purchasing grid electricity, the project will save more than 60,000 tonnes of carbon dioxide emissions annually.

Renewable Electricity

Biogas produced at the facility will be utilised to produce up to 4.4 megawatts of electricity and 16,000 megawatt hours of renewable heat, for use in the Co-op's operations.

Carbon Footprint

The project will reduce the Co-op's carbon footprint by 90%.

Jobs

During construction the project will create up to 25 jobs, and once operational 3-4 full time jobs. In addition, Helmont have a commitment to using local services for project delivery and complimentary services where possible.

Economic Investment

The total economic investment to deliver the project is approximately $17 million.

Biomethane Costs

- Collection **agricultural residues** for feedstock through biogas e.g. cereal straw for anaerobic digestion or manure
    - **21% - 61% of straw** is currently burnt in Australia
- **Byproducts** – biogenic carbon dioxide and digestate
    - Currently considered a waste product in some regulation
- **Scenario 2 Compressed biomethane and Scenario 3 Biomethane for Grid Injection**
    - Estimated revenue per annum with the inclusion of **Australian Carbon Credit Units (ACCUs)** and green certificates ranged from $4.3 million in Scenario 3 and $5.3 million in Scenario 2

Overview of financial analyses of a 2.2 MW biogas plant.

Project parameters	Scenario 2 ($/year)	Scenario 3 ($/year)
CapEx		
Total CapEx including contingency	21,147,455	20,006,575
Investment required (including EPCM)	24,953,997	23,607,759
OpEx		
Total OpEx	2,711,796	2,731,410
Revenue		
Total revenue	5,357,701	4,339,167
ROI (%)	10.5	6.7
IRR (%)	9.2	4.2
Payback period (years)	10	15
NPV ($)	-1,303,418	-8,559,099

B5 Research Project
Biogas from agricultural waste - A techno-economic evaluation
Final Report

Gas Specification and Planning Regulatory Framework - NSW

Table 4: Summary of NSW safety and technical legislation

Document	Transmission	Distribution	Installations/ Appliances	Summary
Pipelines Act 1967	X			Act and regulation would not apply to hydrogen or biogas in petroleum due to the application of the definition of *petroleum*. The Act would, however, apply to a pipeline conveying any other 'substance' (including hydrogen and biogas), and therefore the Act and regulation would apply to these substances. The conditions of an existing petroleum licence would be impacted by the addition of hydrogen or biogas to the petroleum being conveyed.
Pipelines Regulation 2013	X			
Gas Supply Act 1996		X		Act and regulation would not apply to hydrogen or biogas due to not fitting within the definition of *natural*

State Environmental Planning Policy (Planning Systems) 2021

20 Electricity generating works and heat or co-generation

Development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that—

(a) has an estimated development cost of more than $30 million, or

(b) has an estimated development cost of more than $10 million and is located in an environmentally sensitive area of State significance.

23 Waste and resource management facilities

(1) Development for the purpose of regional putrescible landfills or an extension to a regional putrescible landfill that—

(a) has a capacity to receive more than 75,000 tonnes per year of putrescible waste, or

(b) has a capacity to receive more than 650,000 tonnes of putrescible waste over the life of the site, or

(c) is located in an environmentally sensitive area of State significance.

(2) Development for the purpose of waste or resource transfer stations in metropolitan areas of the Sydney region that handle more than 100,000 tonnes per year of waste.

(3) Development for the purpose of resource recovery or recycling facilities that handle more than 100,000 tonnes per year of waste.

Agri-Industrial Hub – Scenic Rim Agricultural Industrial Precinct

MACQUARIE University
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Queensland State-level Planning Approval

- 5 year journey
- **16 lots** for agricultural industrial manufacturing
- **10MW** Anaerobic Digestion on site

Multiple Revenue Streams

- Convert food and agricultural waste into
    - **1.6 PJ biogas** – enough to fuel 234 trucks as a replacement for diesel
    - **Green CO2** for food and beverage industry
    - **Digestate fertiliser** – adds carbon to soil and improves productivity

Feedstocks

- Agricultural waste streams (vege, poultry, dairy)
- Energy Crops grown in rotation with food crops
- Feed waste from urban centres

Regulatory Gaps for Biomethane

- **Currently no scheme** to demonstrate carbon reduction benefits of biomethane in Australia
    - Biomethane quality compliance with AS 4564
- Inclusion of agriculture in future **Emission Reduction Fund (ERF) methods to allow ACCUs** to be created for an agriculturally based biomethane projects
    - E.g. sugar industry residues such as sugarcane and cane tops are **not accredited** under approved methods of the Energy Reduction Fund (ERF) ***(landfill gas, wastewater, and animal methane management only credited)***
- Inclusion of biomethane in the hydrogen **Guarantee of Origin scheme** to allow biomethane to be certified as a renewable feedstock for hydrogen production
    - **Amend Safeguard Mechanism** to include biomethane
- Farms could form a **cooperative society** and build a large-scale centralised biogas plant e.g Danish centralised biogas plant model
    - **Planning guidelines needed incorporating biomethane**

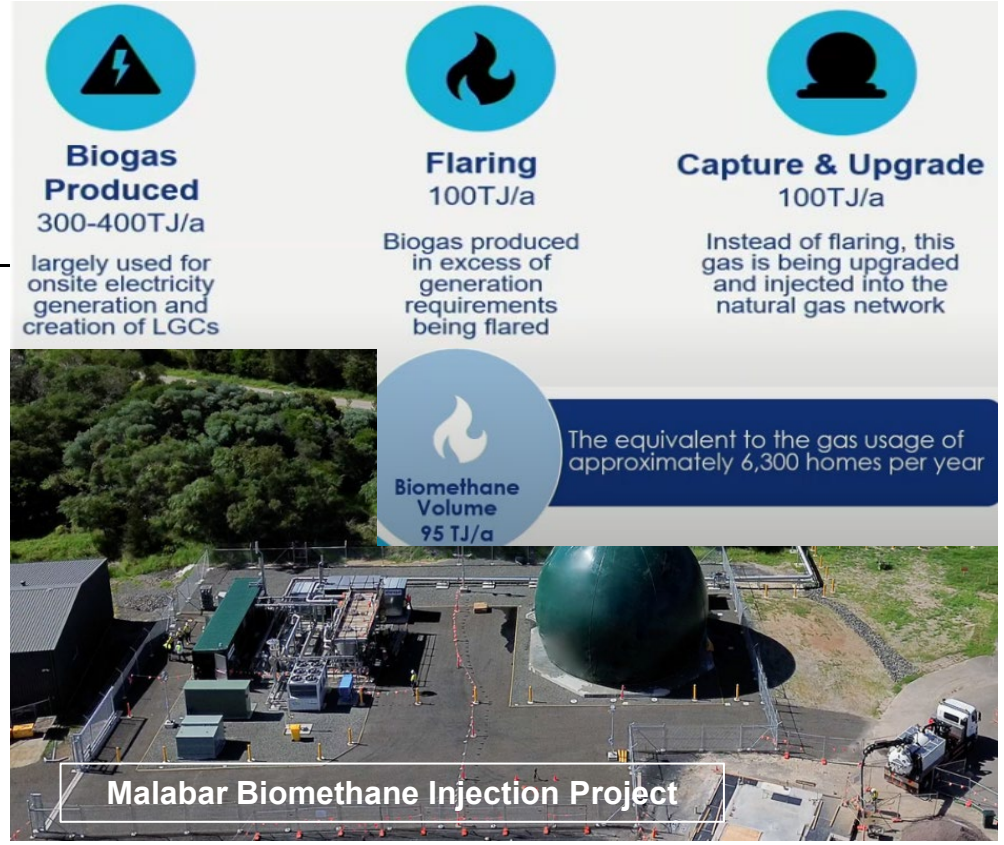

Table 1.1 Summary of LCA results

Environmental impact category	MBP	Natural gas reference system	Reduction (%)
Climate change – greenhouse gas emissions (kg CO_2-e per GJ)	1.01	13.1	92%
Fossil fuel energy use (MJ fuel used per GJ gas supplied)	184.1	958.48	81%

Key Takeaways - Current Regulatory Gaps

Large-Scale Solar

- Independent Body at the intersection of agriculture and renewables needed
- Agrivoltaics and electrification on-farm

Renewable Hydrogen

- Agricultural Land Impact Assessments
- Agricultural Co-Location and decarbonisation uses on-farm

Biomethane

- Guarantee of Origin and consistent Certification Needed
- Renewable Gas Target needed e.g 10% by 2030
- Planning Guidelines needed

Further References

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Thank you

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