



Australia's Bioenergy Roadmap

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Australian Renewable Energy Agency

ARENA's Purpose

ARENA is the Australian Renewable Energy Agency.

The Agency was established by the Australian Government in July 2012 .

Our purpose is to support the global transition to net zero emissions by accelerating the pace of pre-commercial innovation, to the benefit of Australian consumers, businesses and workers.

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INVESTED



\$1.81B

PROJECTS



612

VALUE



\$7.90B

INVESTMENT LEVERAGE



\$1:\$3.37

INVESTMENT BY TECHNOLOGY

BIOENERGY



\$131M

GEOTHERMAL

\$42M



GRID INTEGRATION

\$324M



HYBRID

\$111M



HYDROGEN

\$62M



OCEAN

\$44M



SOLAR PV

\$724M



SOLAR THERMAL

\$178M



STORAGE - BATTERIES/PHEs

\$195M



RECENT ACTIVITY



\$50M Regional Australia Microgrid Pilots Program opens for applications

\$24.55M to expand Australia's electric vehicle fast charging network by more than 400 stations

\$4M for United Energy to trial pole-mounted batteries to support more rooftop solar and manage peak demand

\$2.17M for Stanwell to complete a feasibility study into a renewable hydrogen export project in Queensland

\$1.53M for Brimbank City Council to build Australia's first zero emissions indoor leisure and aquatic centre in Melbourne's west

INVESTMENT BY STATE

NT PROJECTS 8
INVESTED \$40M
VALUE \$82M

WA PROJECTS 41
INVESTED \$197M
VALUE \$1.87B

SA PROJECTS 55
INVESTED \$152M
VALUE \$607M

TAS PROJECTS 21
INVESTED \$40M
VALUE \$99M

QLD PROJECTS 62
INVESTED \$255M
VALUE \$2.0B

NSW PROJECTS 244
INVESTED \$847M*
VALUE \$2.54B

ACT PROJECTS 70
INVESTED \$71M
VALUE \$194M

VIC PROJECTS 111
INVESTED \$206M
VALUE \$511M

INVESTMENT LEVERAGE ALONG THE INNOVATION CHAIN

STUDY

\$1:\$1.72

R&D

\$1:\$1.63

DEMONSTRATION

\$1:\$1.88

DEPLOYMENT

\$1:\$6.30

RECENT ENGAGEMENT



NEW INVESTMENT PLAN LAUNCH

Launched ARENA's new Investment Plan at a virtual event alongside Hon Angus Taylor MP, Minister for Energy and Emission Reduction; Anna Skarbek, CEO, Climateworks; Daniel Westerman, CEO, AEMO; and Justin Punch, ARENA Chair.

ULTRA-FAST EV CHARGING WEBINAR

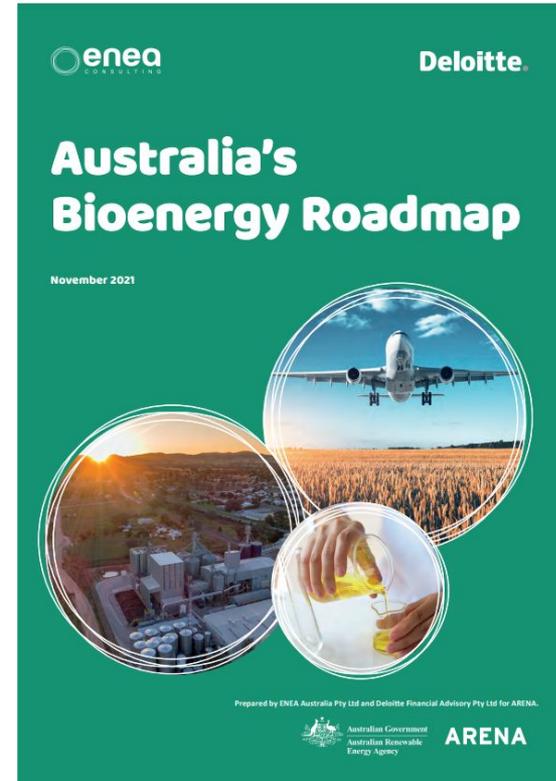
Hosted an ARENA Insights Webinar to share valuable data on ARENA's ultra-fast EV charging portfolio.

* Includes \$567 million contributed to projects inherited by ARENA in 2012.

Bioenergy Roadmap

Objectives

- Showcase where bioenergy has a comparative advantage and where it can complement other low emissions alternative technologies
- Identify current barriers to the development of the bioenergy sector
- Provide findings for industry and government to drive commercial outcomes
- Highlight opportunities to inform and empower the broader community.



Development Process

Consultation

9

Consultation Workshops

17

Direct Interviews

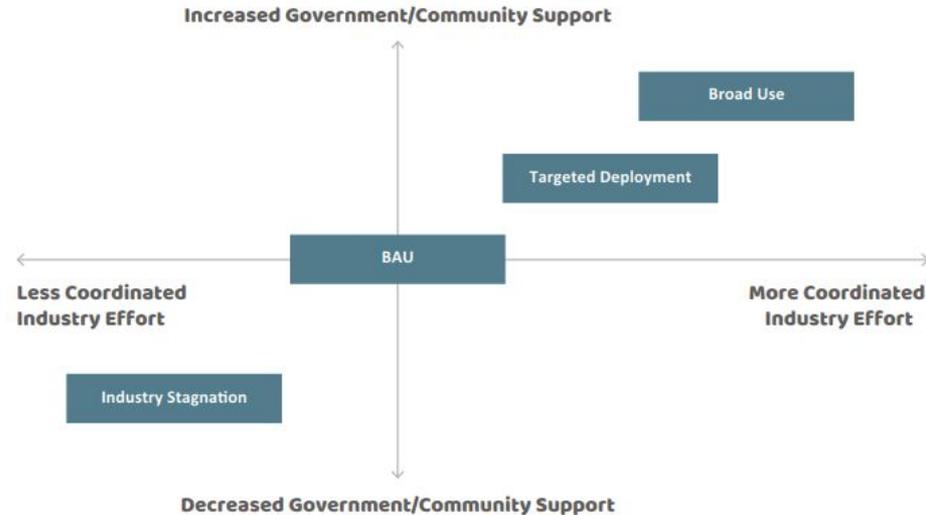
147

Online Submissions

137

Participants in Public Session

Modelling



Bioenergy will play a key role in the emission reduction process

The vision...

A sustainable bioenergy industry that delivers lower emissions, regional growth, energy resilience and waste management benefits for Australia.

Delivery will mean that by 2030...¹

- +\$10bn GDP p.a.
- +26k jobs
- Reduce emissions by 9%
- Divert 6% waste from landfill
- Enhance fuel security



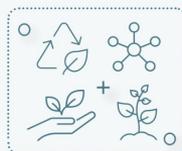
Theme 1: Enabling market opportunities in hard-to-abate sectors

Renewable industrial heat, aviation and renewable gas grid injection. These opportunities currently have limited low emissions alternatives. Due to their different characteristics, each market opportunity requires a range of specific actions to enable their growth.



Theme 2: Enabling market opportunities where bioenergy can complement other low emissions alternatives

Road transport and electricity markets. Opportunities for consideration should focus on enabling this complementarity.



Theme 3: Developing our resources

Australia has a significant bioenergy resource potential. However, there is insufficient clarity and detail over the viability and sustainability of these resources. Additional work is suggested to enable the industry to understand and utilise all potential resources, known as feedstocks.



Theme 4: Building supportive ecosystems

An enduring and successful bioenergy industry will require concerted efforts beyond those relating to markets and feedstocks. It will be necessary to harness an ecosystem that links the diverse parts of the bioenergy industry to facilitate its growth.

Theme 1: Industrial renewable heat

By the 2030s, bioenergy could provide up to 244 PJ per annum of renewable industrial heat or **33% of the total industrial heat market**

- Globally, bioenergy is considered technically mature and cost-effective compared to incumbent fuels and other renewable energy resources
- Local market with room for growth
 - Existing; bagasse, wood waste and biogas
 - Growth; industries generating organic waste, available bioenergy resources
- Development impeded by low visibility and non-economic barriers
- Feasible however low appetite for investment in some sectors



Theme 1: Sustainable aviation fuels (SAF)

Early deployment of SAF production plants could establish a viable industry producing up to **1,908 ML p.a** or **18% of the aviation fuel market** by the 2030's

- SAF one of the few options to reduce emissions in aviation in the short to medium term.
 - Increased maturity than renewable hydrogen and electrification
 - Globally, a growing number of certified SAF pathways, standards, demonstrations and off-take agreements
- Higher cost compared to conventional fuels remain a barrier to uptake in the medium term



Theme 1: Renewable gas grid injection

Development of the sector by the 2030s could see up to **105 PJ p.a of renewable gas** within the gas grid or **23% of the total pipeline gas market**

- Short to medium term opportunity to reduce emissions from gas consumption until hydrogen becomes widespread
- Mature pathways overseas, locally, biogas is either flared or used for heat and electricity generation.
- Insufficient mechanisms for full value to be monetised. Clean Energy Regulator leading development of Emission Reduction Fund methods for biomethane.
- August '21, Energy Ministers agreed reforms to laws to provide more certainty for industry.



Theme 2: Road Transport

Development of the sector by the 2030s could see up to **2,605 ML p.a of road transport biofuels** produced, accounting for **7% of total road transport fuel market**

- Complements hydrogen and EVs in the short-term
- Market hampered due to higher costs of advanced biofuels compared to conventional
- Biofuels from food crops will face resource constraints. Advanced biofuels not fully commercial and demonstrated at scale
- Inconsistent policy across jurisdictions has affected the uptake of biofuels. Eg. Qld and NSW biofuel blending mandates



Theme 2: Dispatchable renewable electricity

Development of the sector by the 2030s could see deployment of **14 TWh p.a of bioenergy derived electricity** which would make up **8% of the total utility and small scale electricity generation market**

- Can support increased penetration of variable renewables; system strength and inertia
- Off-grid can provide a lower emissions and cost alternative to diesel generation
- Mature with similar costs to other low emissions dispatchable alternatives such as wind and solar with battery storage
- Co-firing or replacing power stations with bioenergy resources could be possible with upgrades
- Limited penetration, currently accounting 1.3% of total electricity generation



Theme 3: Bioenergy resources

Australia's bioenergy resource potential is estimated to be over 2,600 PJ per year, however, constraints in collection and transportation restrict the **economically feasible generation to be 559 PJ p.a** from all bioenergy sources.

- Organic wastes and residues are the best short-term resource (37% of total available) to develop the industry
- Agricultural resources are more expensive to process than wastes and have competing uses
- Some canola and tallow currently exported due to developed markets
- Sorghum or sugar cane while currently utilised has growth opportunity



Theme 4: Building ecosystems

Build ecosystems that support sector growth

- Facilitating the commercialisation of mature technologies that are new to Australia
- Support project development
- Furthering bioeconomy perspectives
- Raise public awareness of of bioenergy



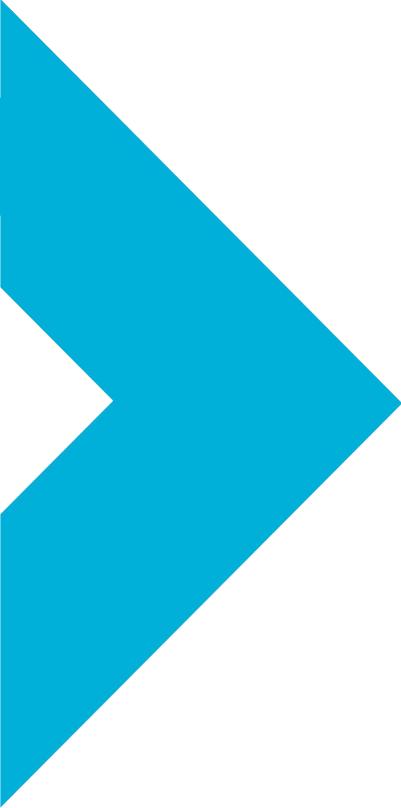
Key initiatives underway

- Key actions underway to support industry
 - ARENA to receive an additional \$33.5 million to support Australia's bioenergy sector through co-funding additional RD&D of advanced sustainable aviation and marine biofuels
 - The consideration of biogas, as well as hydrogen, in the National Gas Law review through Energy Ministers
 - The development of a new Emissions Reduction Fund method for biomethane by the Clean Energy Regulator
 - Biofuels being considered as part of the industry-wide fuel standards review
 - Bioenergy being utilised in Government-supported microgrid studies.

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Bioenergy can complement other low emissions energies to reduce emissions. It can also enhance regional development, reduce reliance on imported liquid fuels and assist waste recovery initiatives.





Contact us

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