Department of Primary Industries

Opportunities and challenges for increased use of biomass for bioenergy in NSW




Fabiano Ximenes – Forest Science Centre – NSW DPI - ICBMH 2019

Outline

- Current status of biomass use: Australia
- Focus: New South Wales
- Challenges
- Opportunities
- Current work

Bioenergy - global

- Expected expansion: 2021 to 2030, the EU expects bioenergy projects to generate €58.7 billion per annum in economic activity and 550,000 direct and indirect jobs.

European Commission, Sustainable and optimal use of biomass for energy in the EU beyond 2020 — May 2017

- IPCC scenarios – rely heavily on BE and BECCS

- "*bioenergy use is substantial in 1.5°C pathways […] due to its multiple roles in decarbonizing energy use*

IPCC, 2018 Special Report on Global Warming of 1.5 ºC - Chapter 2

Biomass options

Feedstock	Conversion	Product	Market
• agriculture; • organic municipal waste; • waste water; • industrial waste; • wood waste; and • animal residues.	• combustion; • gasification; • fermentation; • transesterification; • pyrolysis; and • anaerobic digestion.	• heat; • fuel gas; • biogas; • biodiesel; • biobutanol; • bio oil; • ethanol; • renewable energy; • renewable diesel; • pellets and; • briquettes.	• electricity; • heat; • chemicals; and • transportation fuel.

Source: Bioenergy State of the Nation report

Biomass use in Australia

- Australia is in the bottom quartile of OECD countries with respect to bioenergy as a proportion of total energy supply. Biomass for energy purposes makes up around 4% of total energy consumption; 1.4% of electricity generation

- Plentiful biomass, various sources

- Significant potential to expand biomass supply: dedicated crops

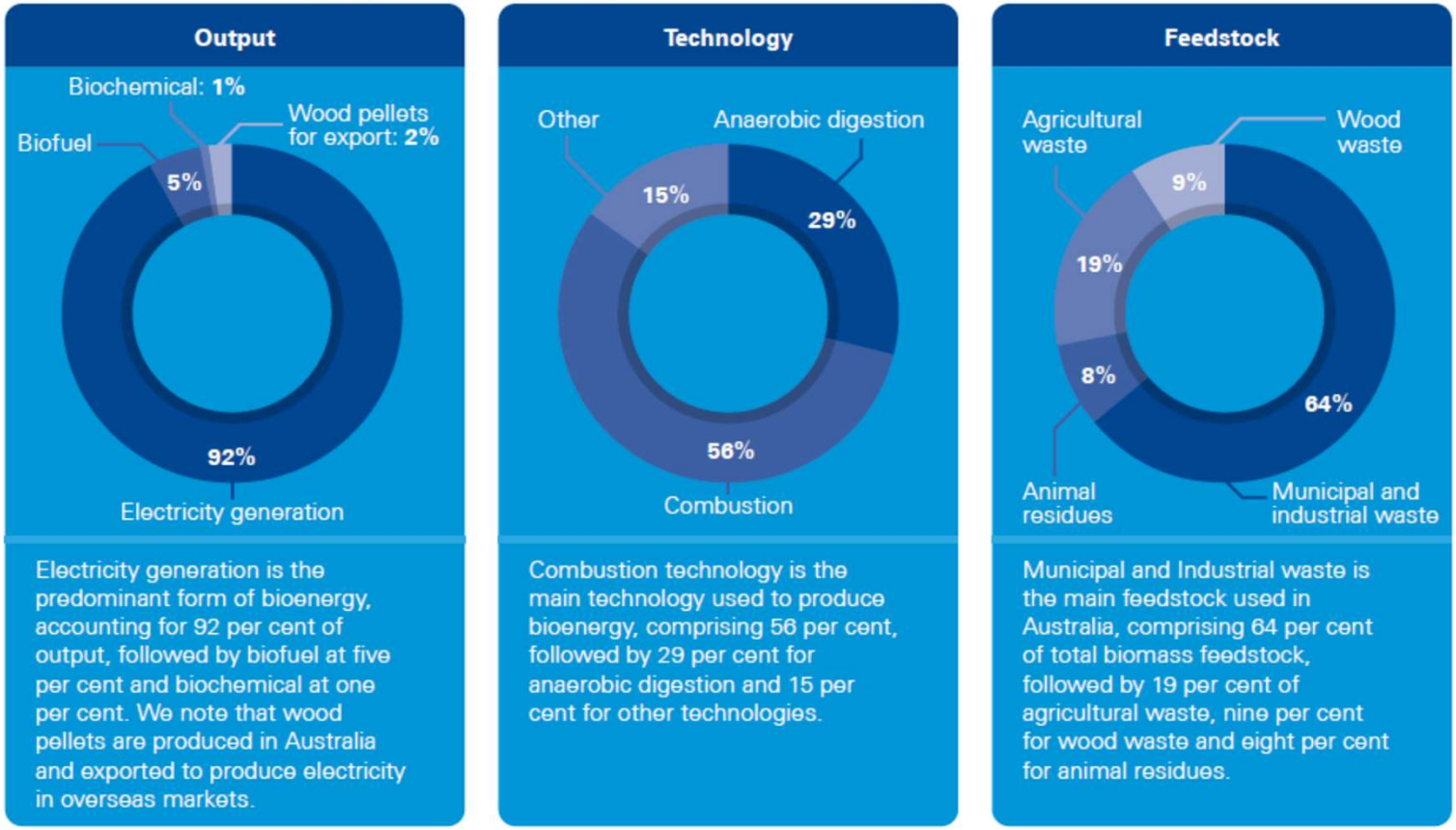
- Currently under-represented

The CEFC estimate a potential investment opportunity of between $3.5 billion and $5 billion in energy from urbane waste, agricultural waste and forest residues.

Clean Energy Finance Corporation, The Australian bioenergy and energy from waste market, November 2015

Biomass use in Australia - snapshot

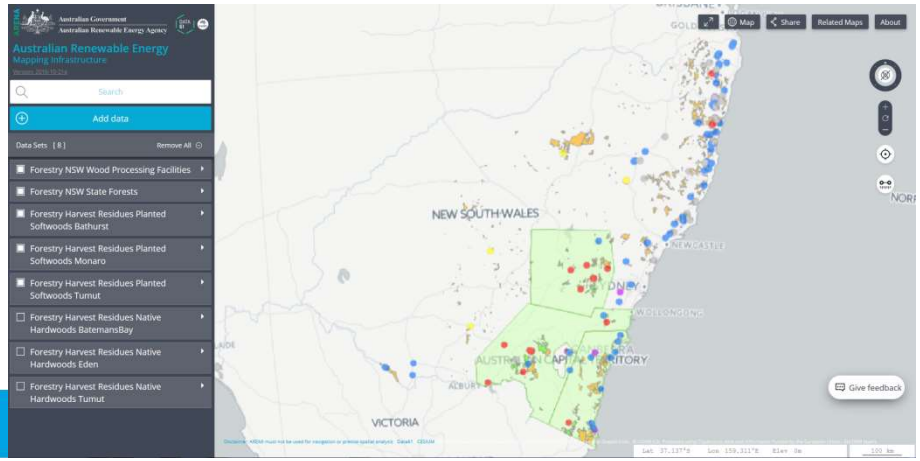
Figure 7: Commissioned projects by technology, feedstock and end-use, 2018[37]



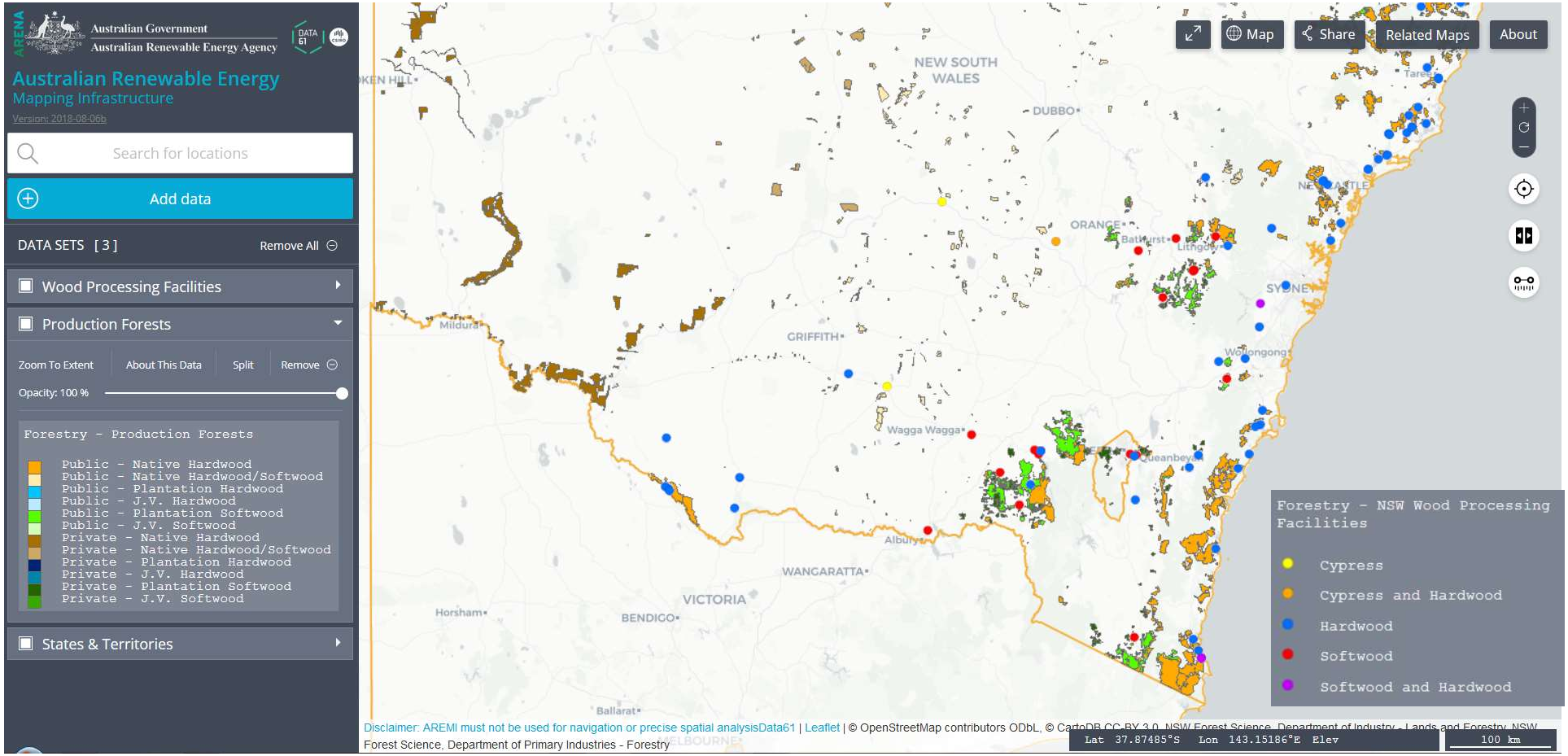
Source: [Bioenergy State of the Nation report]

ABBA (Australian Biomass for Bioenergy Assessment)

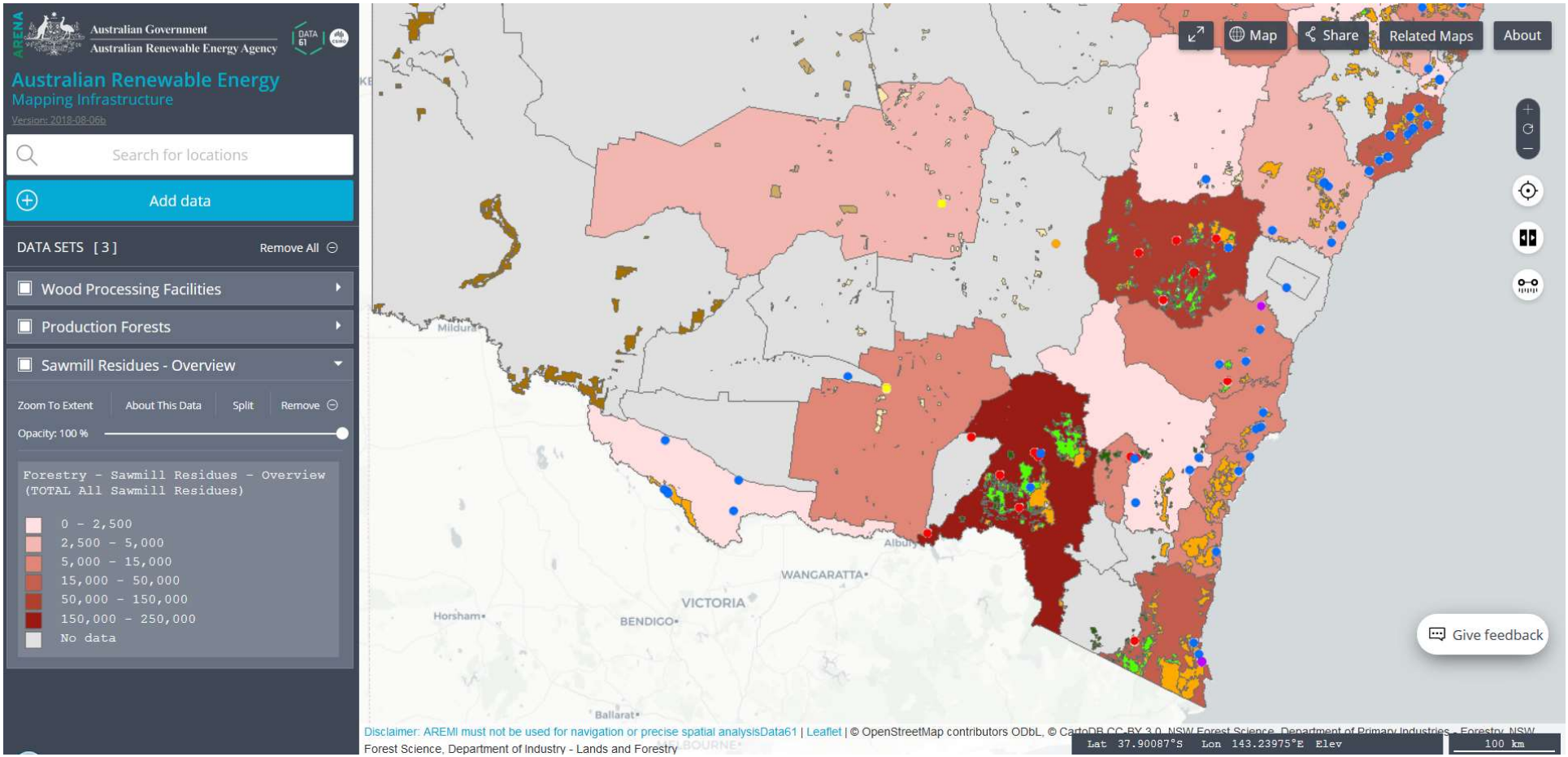
- Volume and availability: forestry, agricultural, municipal waste, etc…
- Multi-layered: energy infrastructure, power utilities, population, land use data
- Aim to catalyse investment in the sector
- AREMI: http://nationalmap.gov.au/renewables/



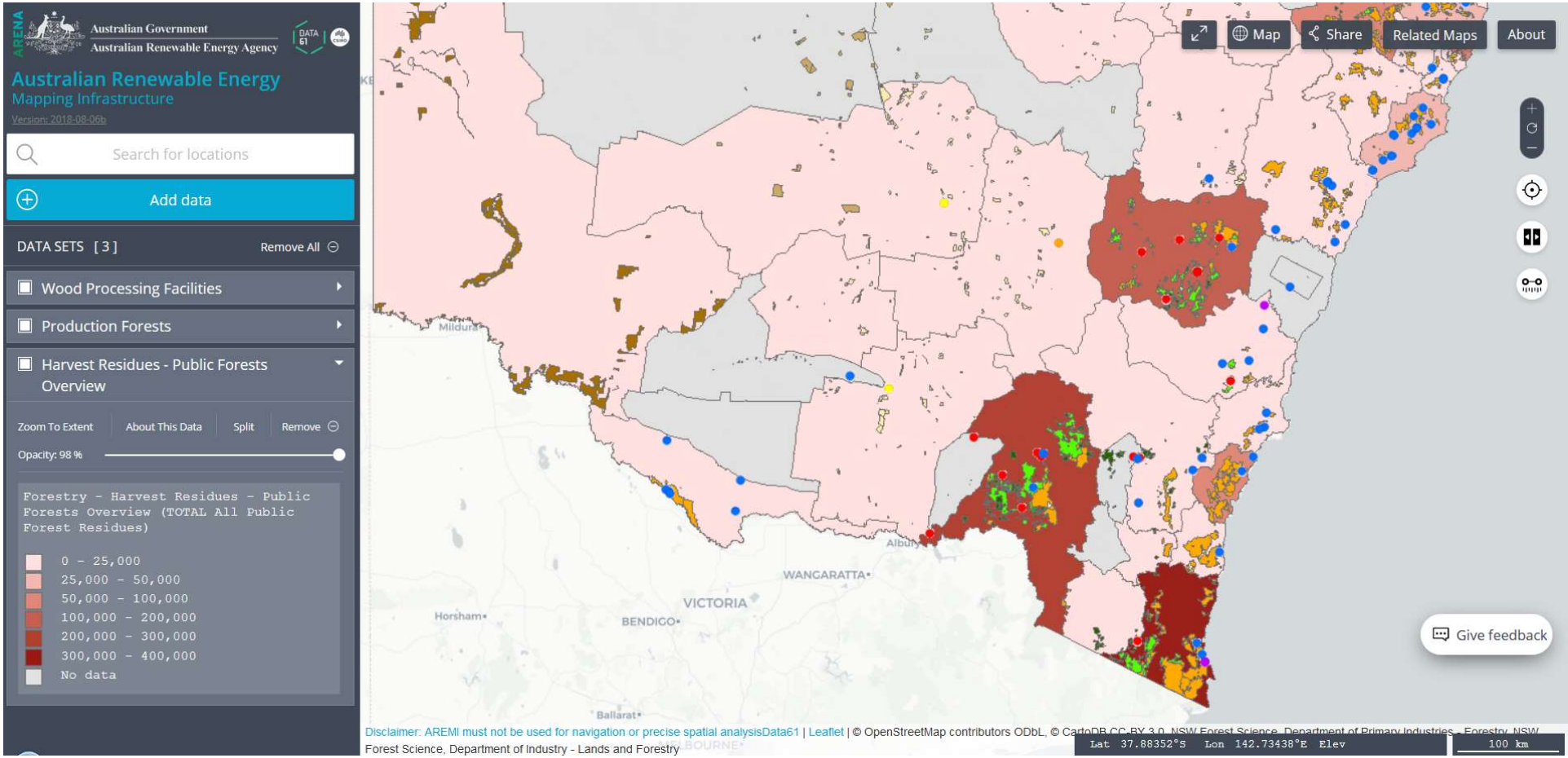
Forestry - production forests & facilities



Sawmill residues - public and private resource



Forest harvest residues - public forests



Biomass use in Australia - Rankings

Table 9: High-level bioenergy evaluation

Evaluation criteria		QLD	NSW	VIC	SA	WA	ACT	TAS	NT
Criteria 1	Policy development and effectiveness	✓✓	–	✓✓	✓✓	–	✓	✓	✓
Criteria 2	Bioenergy project development	✓	✓	✓	✓	✓	✓	✓	–
Criteria 3	Technology and feedstock diversity	✓	✓	✓	✓	✓	–	✓	–
Criteria 4	Sustainability guidance	✓	–	–	–	–	–	–	–
Criteria 5	Advocacy and education	✓✓	–	✓✓	✓✓	–	–	–	–
Relative ranking between jurisdictions:		1	4	2	2	4	4	3	5

Source: Bioenergy State of the Nation report

Renewable Energy Action Plan

Launched in 2013 with aim to increase generation, storage and use of renewable energy in NSW

3 key goals:

- Attract renewable energy investment
- Build community support for renewable energy
- Attract and grow expertise in renewable energy technology

Share of renewable in NSW energy mix increased from 4 to 9%

Strong focus on wind and solar

Renewable Energy Action Plan

- Supported amendment to legislation (Protection of the Environment Operations Regulation) allowing a wider range of biomass types to be used in electricity generation (in line with RET)
- Supported NSW participation in the ABBA project
- Supported provision of funding for Ethtec facility

Biomass in NSW - Challenges

- Regulation – difficulties in getting projects through; leading investment away
- Social perceptions – sustainability of forest biomass use for energy; food vs fibre
- Clear policy guidance – e.g. QLD
- Energy from waste (e.g Licella)

Department of State Development, Manufacturing, Infrastructure and Planning

ADVANCE QUEENSLAND

Energy from waste – Australian Paper

- $600 million, 225 MW EfW plant would process up to 650,000 tonnes of residual Municipal Solid Waste (MSW) as well as Commercial and Industrial (C&I) waste.

https://www.australianpaper.com.au/our-future/creating-energy-from-waste/

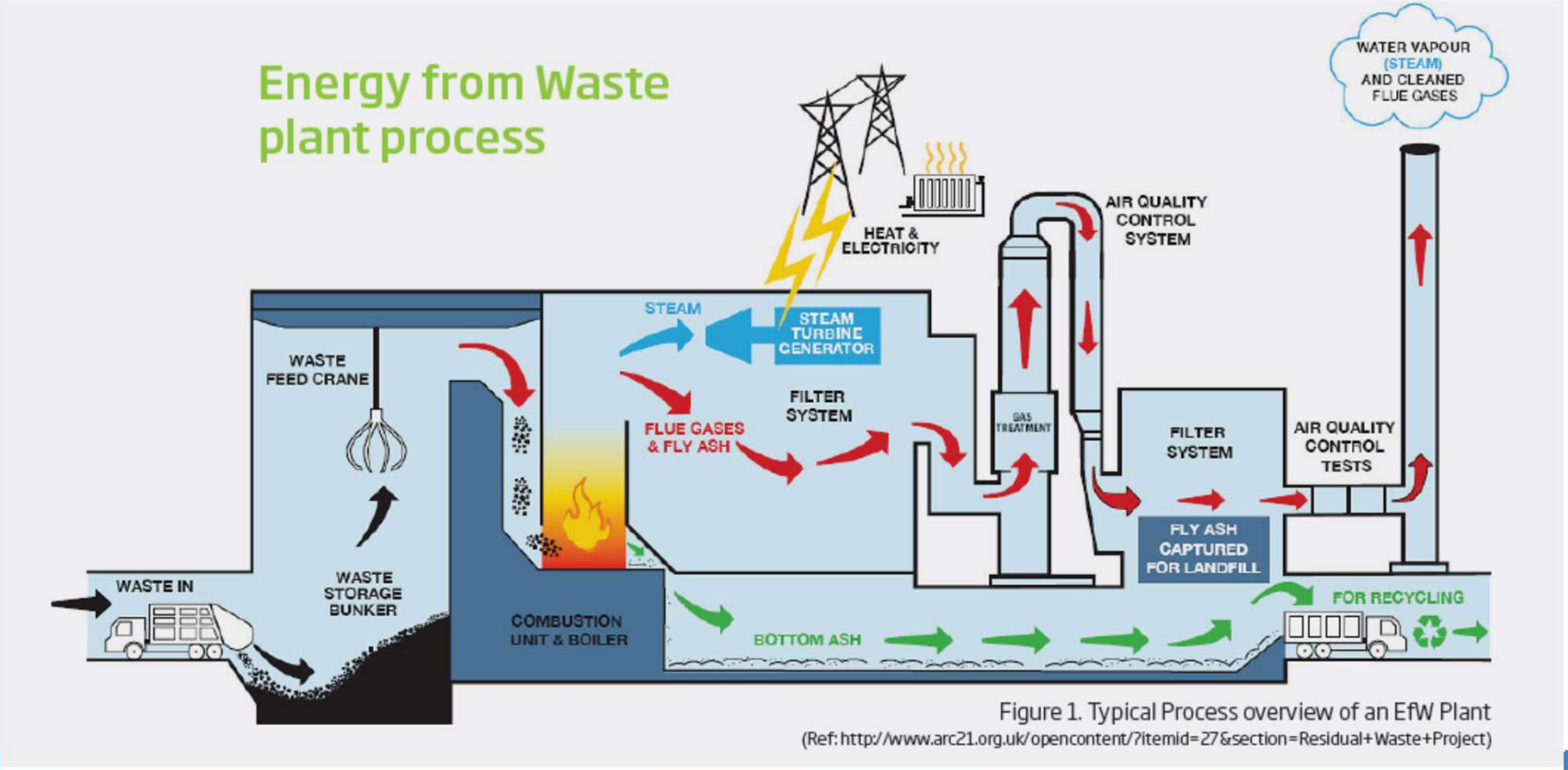


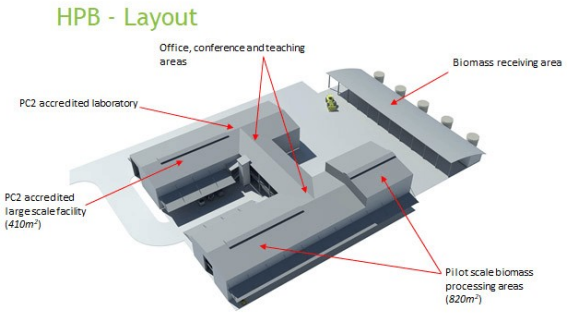
Figure 1. Typical Process overview of an EfW Plant
(Ref: http://www.arc21.org.uk/opencontent/?itemid=27&section=Residual+Waste+Project)

Ethtec – Upper Hunter Valley

Provided $4.6M funding towards the Hunter Pilot Biorefinery, an open-access pilot-scale research, development and education facility located at Muswellbrook in the Hunter Valley.

Second generation ethanol from non-food waste plant matter (bagasse, forestry, cotton gin)

https://arena.gov.au/news/hunter-valley-biofuel-facility-advance-ethanol-production/



Boral Timber – NSW North Coast

Biorefinery turning sawmill residues (50,000 t / year) into renewable diesel and renewable bitumen

Mechanical catalytic conversion technology, developed by Spanish-based Global Ecofuel Solutions SL

https://arena.gov.au/news/boral-could-turn-sawmill-residue-into-renewable-diesel/

MSM Milling– Manildra

Biomass Fuel Switch Project involves replacing current LPG fuelled boilers with a 5MW biomass fuelled boiler using locally sourced timber residue (cypress pine) as a fuel source (within 120 km from the facility).

Project will save around 4,000 tCO_2-e per annum and over 80,000 tCO_2-e for the project life.

https://arena.gov.au/projects/msm-milling-biomass-fuel-switch/

Biomass in NSW - Opportunities

- Biofuels
- Heat
- Biogas
- Electricity generation

Co-firing: coal-fired power stations

- Existing coal-fired power stations – co-generation with biomass
- Opportunity to produce biomass fuel locally – increased demand covered by biomass crops over time (ideally land near where power is generated)
- Torrefaction or dried milled wood powder: higher co-generation rates; minimal new capital investment
- Biomass processing facility near where power is generated - unique in the world. Circular economy opportunities; extraction of green chemicals





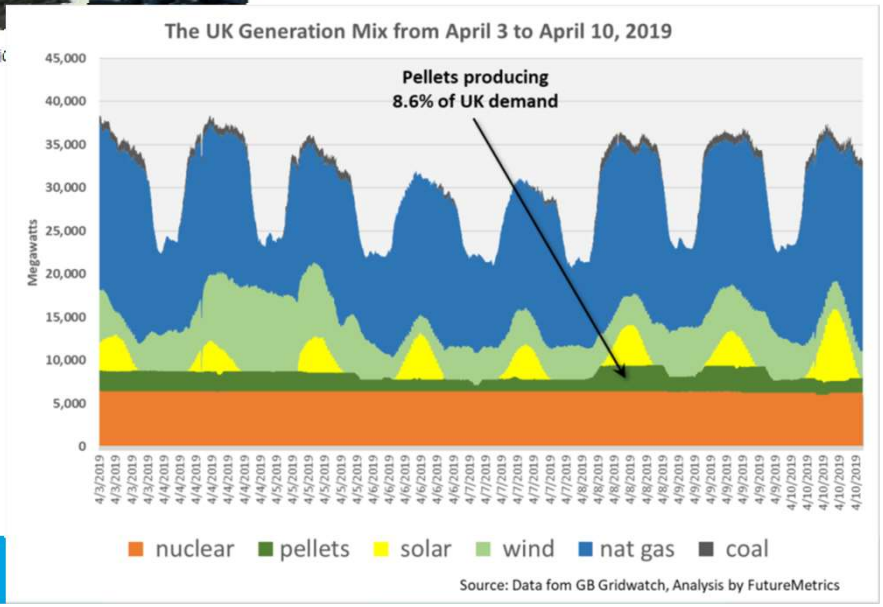
Pellets - properties

Table 7: Overview of properties of torrefied pellets in relation to other fuels

	Wood chips	Wood pellets	Torrefied wood pellets	Charcoal	Coal
Moisture content (wt%)	30 – 55	7 – 10	**1 – 5**	1 – 5	10 – 15
Calorific value (LHV, MJ/kg)	7 – 12	15 – 17	**18 – 22**	30 – 32	23 – 28
Volatile matter (wt% db)	75 – 84	75 – 84	**55 – 80**	10 – 12	15 – 30
Fixed carbon (wt% db)	16 – 25	16 – 25	**22 – 35**	85 – 87	50 – 55
Bulk density (kg/l)	0.20 – 0.30	0.55 – 0.65	**0.65 – 0.80**	0.18 – 0.24	0.80 – 0.85
Vol. energy density (GJ/m^3)	1.4 – 3.6	8 – 11	**12 – 19**	5.4 – 7.7	18 – 24
Hygroscopic properties	Hydrophilic	Hydrophilic	**(Moderately) Hydrophobic**	Hydrophobic	Hydrophobic
Biological degradation	Fast	Moderate	**Slow**	None	None
Milling requirements	Special	Special	**Standard**	Standard	Standard
Product consistency	Limited	High	**High**	High	High
Transport cost	High	Medium	**Low**	Medium	Low
					

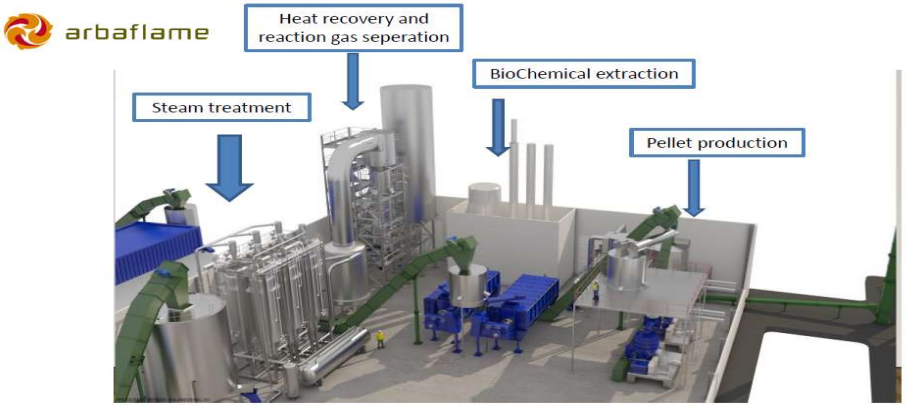
Abbreviations:
db = dry basis
LVH =Lower Heating Value

sources: ECN (table, fig.1, 3), Pixeli



Technology –Steam Explosion

- Fibre exposed to saturated steam (180-240 C)
- Rapid release of pressure – breaking down wood fibers - aim to minimise cellulose and lignin losses – some degradation of hemicellulose
- Lignin forms a film on the surface during pressing – water repellency
- SE pellets have been verified at more than 12 coal fired power plants.
- 20% less energy used in manufacture than white pellets



Hybrid Solar Biomass Power Stations

- Biomass boiler adds stability to intermittent solar (CSP): deal with fluctuations on demand side
- Increased outputs/efficiencies, no need for costly battery storage. Use of waste / local residues (greater flexibility)
- Regional energy generation – option to go off-grid
- Local councils; supplying regional centres; industry requiring heat / cooling
- Hot spots in NSW; techno-economic assessment

Termosolar Borges (Spain); 22.5 MW (supplying 27,000 homes); feedstock is forest residues (66,000 t /year); investment of $153M Euros.

Hybrid solar biomass power stations

- Hybrid solar-biomass plants offer potential cost savings and flexibility
  - by sharing key equipment (turbine, condenser)
  - by using biomass and waste resources

BECCS

Drax – Demonstration plant at the power station, capturing a tonne of CO_2 a day.

First-time CO_2 has been captured from the combustion of a 100% biomass feedstock anywhere in the world

https://www.drax.com/press_release/world-first-co2-beccs-ccus/

REA – Policy options to advance BECCS

- increases the U.K. total carbon price to £50 ($63.33) per ton of carbon dioxide starting in 2020
- supporting BECCS in the Contracts for Difference auctions
- establishing demonstration projects at several scales that use the lowest carbon feedstocks.

Biomass and materials handling

- Materials handling and storage especially important for bioenergy projects given narrow margins – small savings can make a project viable / more attractive

- 50% to 60% - Materials handling percentage of the sale cost in mining and minerals processing.

- Materials handling problems are the major cause of mines not performing to specification

- 35%-50% - Biomass materials handling costs already known to be a significant factor

Biomass handling and storage

- Challenge of diversity of feedstocks – agricultural crop residues, forestry residues, livestock waste, liquid organics, urban solid waste, etc…
- Research required to ensure biomass storage and transport systems are as economically efficient as possible
- Much to learn – losses in biomass piles, GHG emissions (often used to downplay climate benefits of biomass)

Newcastle Uni / NSW DPI Biomass to Bioenergy project

- Establish a materials handling techno - economic theoretical model
- Develop experimental characterisation methodologies. Physicochemical properties of a number of feedstocks including:
  - bulk density, compressibility, stress/strain response and energy requirements for size reduction and moisture conditioning.
- Investigate two case studies to develop
- Incorporate the techno-economic materials handling criteria into integrated work packages

Biomass Feedstock – waste residues

Materials and Testing Procedure


Sugarcane Bagasse

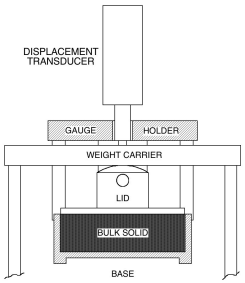

Granulated Wattle


Wheat Straw

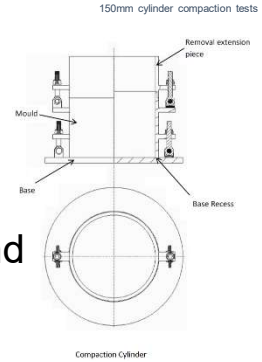

Coal


Iron Ore

63.5mm compressibility tester



Testing
comp. to iron ore and coal



Testing
3 masses

Identifying Calibration Methods for Biomass

Discrete Element Modelling Simulations






Summary

- Bioenergy: key climate role
- NSW has significant underutilised biomass resources
- Significant challenges impeding greater growth
- Despite challenges some significant projects going ahead
- Current research – identifying key opportunities and addressing questions to assist with new investment

Bioenergy Australia Conference

BIOENERGY STRONG 2019 CONFERENCE PROGRAM

We are excited to reveal details of the Bioenergy STRONG 2019 Conference:

- Conference to be held over 2 days on Wednesday 13 and Thursday 14 November at the State Library of Queensland
- Bioenergy Innovation Awards Night on Wednesday 13 November at the Queensland Gallery of Modern Art
- Site visits Friday 15 November (tbc)

Tickets will be available for purchase soon

Tuesday 12 November, Research Summit

- Half day Research Summit will take place on Tuesday 12 November. Venue and time to be confirmed. Please click here for more information and for details on submitting an abstract.

PROGRAM

Wednesday 13 November, State Library of Queensland

Thank You

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