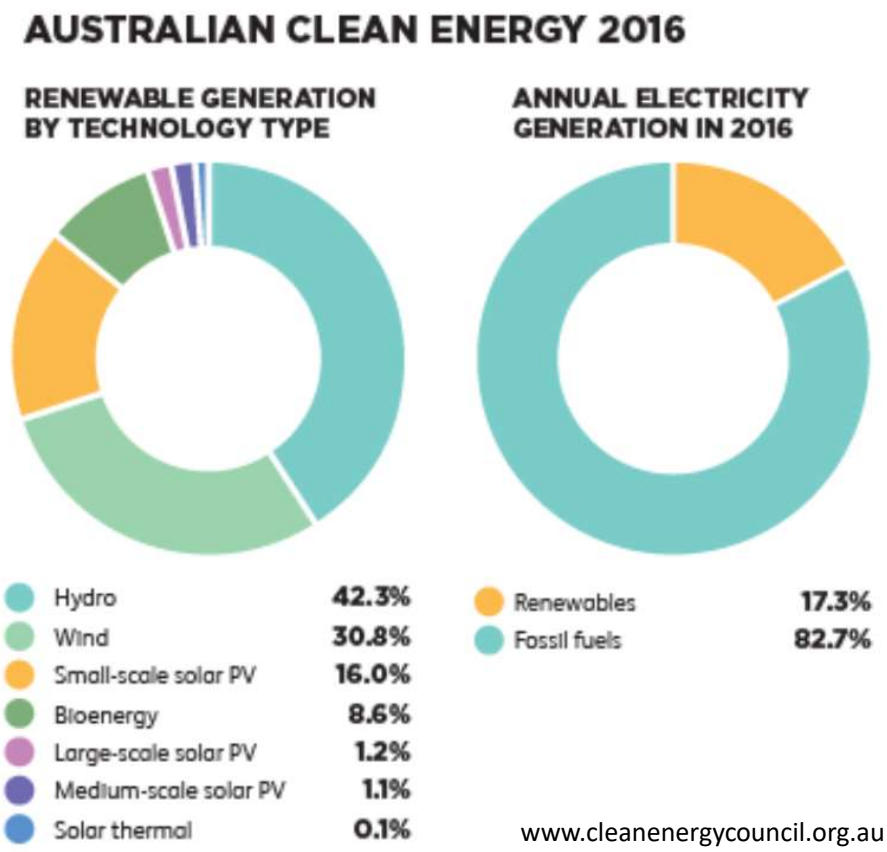
Evaluating the availability of forest biomass recourses in Queensland using a GIS-based tool

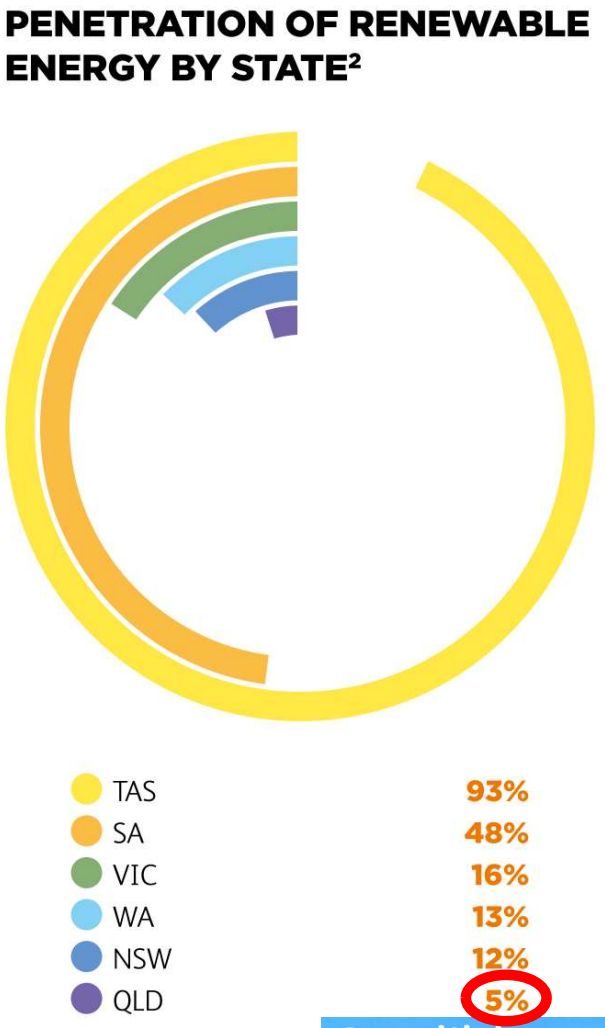
Sam Van Holsbeeck

usc.edu.au/firc

ABP
GOTTSTEIN TRUST
ARENA
Australian Government
Australian Renewable Energy Agency
USC

Bioenergy in Australia



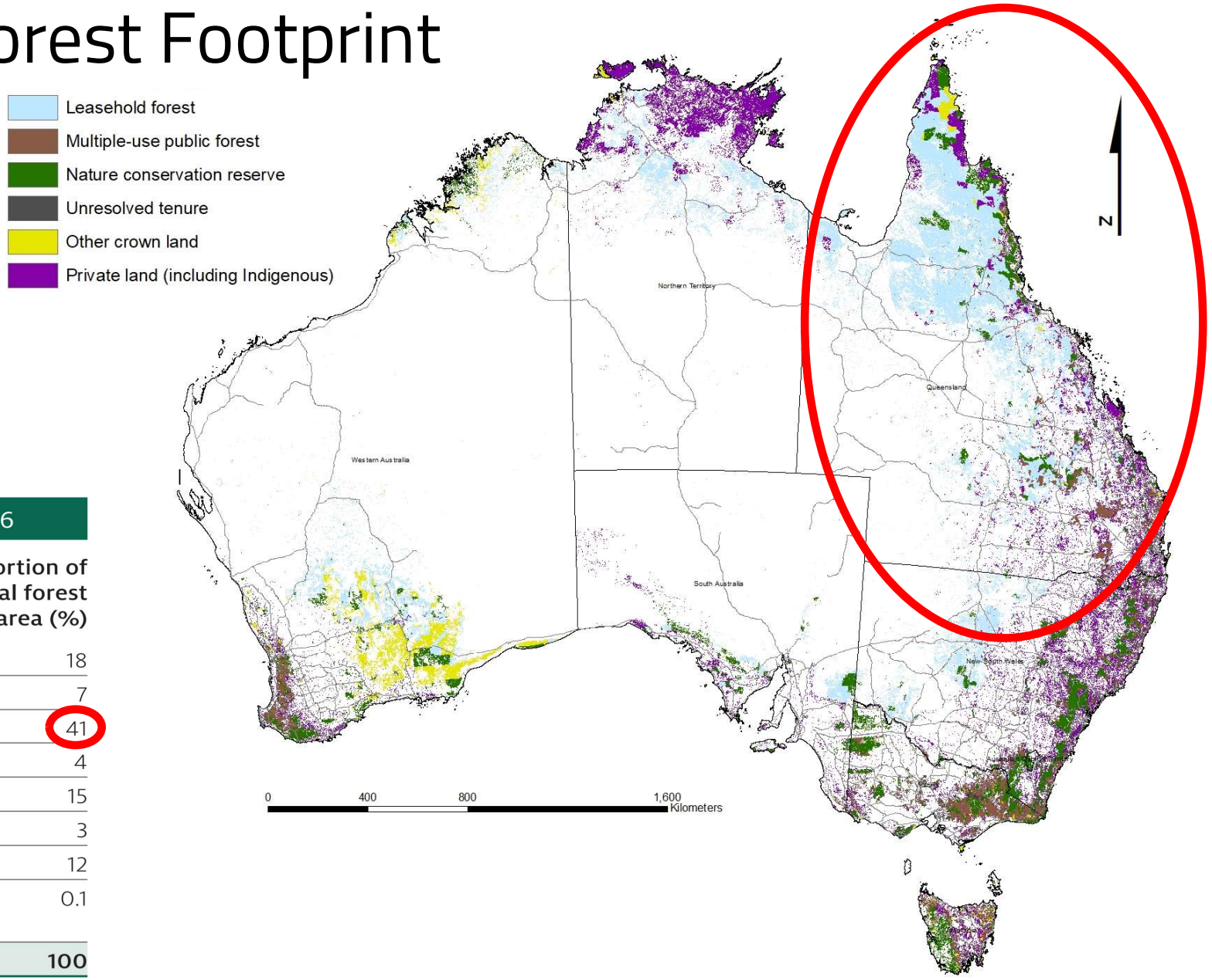


USC
Forest Industries Research Centre

usc.edu.au/firc

Credible pathways to a 50% renewable energy target for Queensland

Australia's Forest Footprint



Australia's forests at a glance 2017 is available at agriculture.gov.au/abares/publications.

Australia's forest area, by jurisdiction, 2015–16

Jurisdiction	Total forest area ('000 hectares)	Proportion of national forest area (%)
New South Wales	22,683	18
Victoria	8,180	7
Queensland	51,034	41
South Australia	4,555	4
Western Australia	19,192	15
Tasmania	3,705	3
Northern Territory	15,222	12
Australian Capital Territory	137	0.1
Australia	**124,709**	**100**

Some stats

Net area available for harvesting and area harvested in multiple-use public native forests, by jurisdiction, Australia, 2010–11

State	Net harvestable area (hectares) a	Proportion of total public native forest available (%) b	Total harvest area (hectares)	Proportion of net harvestable area harvested (%)
New South Wales	1,229,000	16	27,484	2.2
Victoria	835,000	13	5,800	0.7
Queensland	2,030,000	22	28,200	1.4
Western Australia	848,000	7	7,390	0.9
Tasmania	563,000	23	10,490	1.9
Total	**5,505,000**	**14**	**79,364**	**1.4**

a Net area of multiple-use public native forest available for wood harvesting after excluding areas legally restricted from wood harvesting, unsuitable for wood harvesting or where wood harvesting is not commercially viable, and areas where additional local management plans or codes of practice do not permit wood harvesting. b Public native forest comprises the tenures multiple-use public forest, nature conservation reserve and other Crown land. Note: Harvesting of native forest is not permitted in multiple-use public native forest in the Australian Capital Territory or South Australia. The Northern Territory does not have multiple-use public native forest.
Source: *Australia's State of the Forests Report 2013*

Australia's forests at a glance 2017 is available at agriculture.gov.au/abares/publications.

Forest and land area, Queensland, 2015–16

Forest category	Area ('000 hectares)	% of state land area	% of national forest category area
Native forest	50,782	29.3	41.4
Commercial plantations	230	0.1	11.7
Other forest	22	0.0	14.4
Total forest	**51,034**	**29.5**	**40.9**

Volume and value of logs harvested, Queensland, 2015–16

Log type	Volume of logs harvested ('000 m³)	National total volume (%)	Value of logs harvested ($m)	National total value (%)
Hardwood native	285	7.2	43	11.7
Hardwood plantation	14	0.1	1	0.1
Softwood (incl. cypress pine)	2,648	16.2	205	17.2
Total	**2,947**	**9.8**	**249**	**11.0**

Note: Value of logs harvested at mill door prices.

Aims

USC
Forest Industries
Research Centre

- How much energy from forest biomass is available in Queensland?
  - Mapping of harvestable forest
  - Determine annual harvest potential
  - Identify energy hotspots

Previous research – national scale

USC
Forest Industries Research Centre

GLOBAL CHANGE BIOLOGY BIOENERGY
GCB Bioenergy (2016) 8, 707–722, doi: 10.1111/gcbb.12295

A spatial assessment of potential biomass for bioenergy in Australia in 2010, and possible expansion by 2030 and 2050

DEBBIE F. CRAWFORD[1,2], MICHAEL H. O'CONNOR[2,3], TOM JOVANOVIC[1,2], ALEXANDER HERR[1,2], ROBERT JOHN RAISON[1,2], DEBORAH A. O'CONNELL[1,2] and TIM BAYNES[2,4]
[1]*CSIRO Land & Water, GPO Box 1700, Canberra, ACT 2601, Australia,* [2]*CSIRO Energy Flagship, PO Box 330, Newcastle, NSW 2300, Australia,* [3]*CSIRO Land & Water, Private Bag 5, Wembley, WA 6913, Australia,* [4]*CSIRO Land & Water, PO Box 310, North Ryde, NSW 1670, Australia*

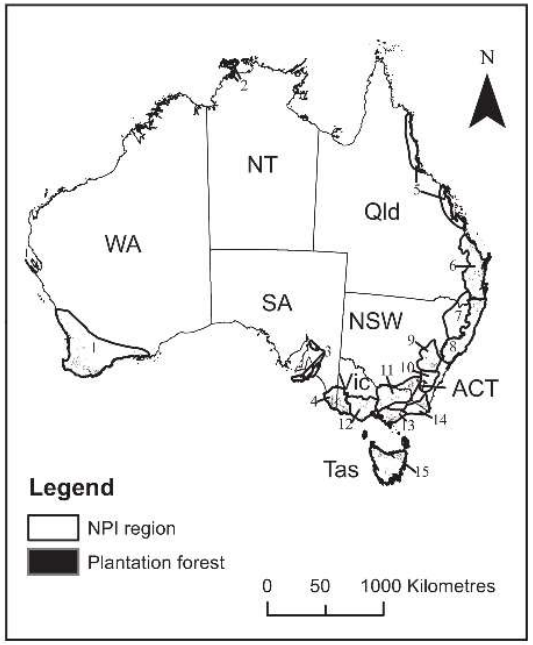


Fig. 5 Map of Australia showing location of 15 National Plantation Inventory (NPI) regions and distribution of the plantation forest resource in 2010.

Table 1 Plantation forest biomass (kt yr^{-1}) potentially available for bioenergy production in 15 National Plantation Inventory Regions

NPI Region	NPI Name	2010	2030	2050
1	Western Australia	2347	2676	2007
2	Northern Territory	367	288	430
3	Mt Lofty Ranges and Kangaroo Island	133	208	115
4	Green Triangle	2334	2968	2610
5	North Queensland	86	189	171
6	South-east Queensland	652	921	873
7	Northern Tablelands	104	120	162
8	North Coast of NSW	181	845	332
9	Central Tablelands of NSW	501	482	506
10	Southern Tablelands of NSW	44	81	78
11	Murray Valley	1211	1199	1207
12	Central Victoria	382	424	354
13	Central Gippsland	570	785	864
14	East Gippsland-Bombala	336	375	319
15	Tasmania	1683	2659	2816
	Total	10 932	14 219	12 842

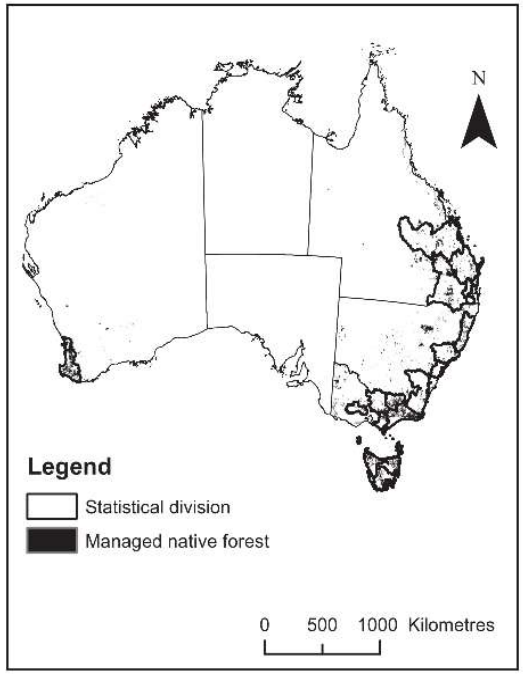


Fig. 6 Distribution of native forest managed for sawlog production within SDs.

Table 2 Annual potential availability (kt) of biomass from native forests for each important SD

SD ID	SD Name	State	Biomass
105	Sydney	NSW	72
110	Hunter	NSW	216
125	Mid-north coast	NSW	721
145	South-eastern	NSW	433
220	Central Highlands	Vic.	170
240	Goulburn	Vic.	255
245	Ovens-Murray	Vic.	170
250	East Gippsland	Vic.	682
255	Gippsland	Vic.	426
309	Sunshine Coast	Qld	29
312	West Moreton	Qld	58
315	Wide Bay-Burnett	Qld	87
320	Darling Downs	Qld	87
330	Fitzroy	Qld	29
505	Perth	WA	65
510	South-west	WA	586
610	Southern	Tas.	2314
615	Northern	Tas.	1157
620	Mersey-Lyell	Tas.	385
	Total		7942

an amount of biomass similar to crop stubble by 2050. Organic waste would increase over time as the popula-

Previous research – regional scale

USC
Forest Industries Research Centre

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Biomass production for sustainable aviation fuels: A regional case study in Queensland

Helen T. Murphy [a,*], Deborah A. O'Connell [b], R. John Raison [b], Andrew C. Warden [b], Trevor H. Booth [b], Alexander Herr [b], Andrew L. Braid [c], Debbie F. Crawford [b], Jennifer A. Hayward [d], Tom Jovanovic [b], John G. McIvor [e], Michael H. O'Connor [f], Michael L. Poole [g], Di Prestwidge [h], Nat Raisbeck-Brown [f], Lucas Rye [i]

[a] CSIRO Land & Water Flagship, PO Box 780, Atherton, QLD 4883, Australia
[b] CSIRO Land & Water Flagship, GPO Box 1700, Canberra, ACT 2601, Australia
[c] RileM P/L, PO Box 6190, O'Connor, Canberra, ACT 2602, Australia
[d] CSIRO Energy Flagship, PO Box 330, Newcastle, NSW 2300, Australia
[e] CSIRO Agriculture Flagship, GPO Box 2583, Brisbane, QLD 4001, Australia
[f] CSIRO Land & Water Flagship, Private Bag 5, Wembley, WA 6913, Australia
[g] CSIRO Agriculture Flagship, Private Bag 5, Wembley, WA 6913, Australia
[h] CSIRO Land & Water Flagship, GPO Box 2583, Brisbane, QLD 4001, Australia
[i] CSIRO Marine and Atmospheric Research, 107 - 121 Station Street, Aspendale, VIC 3195, Australia

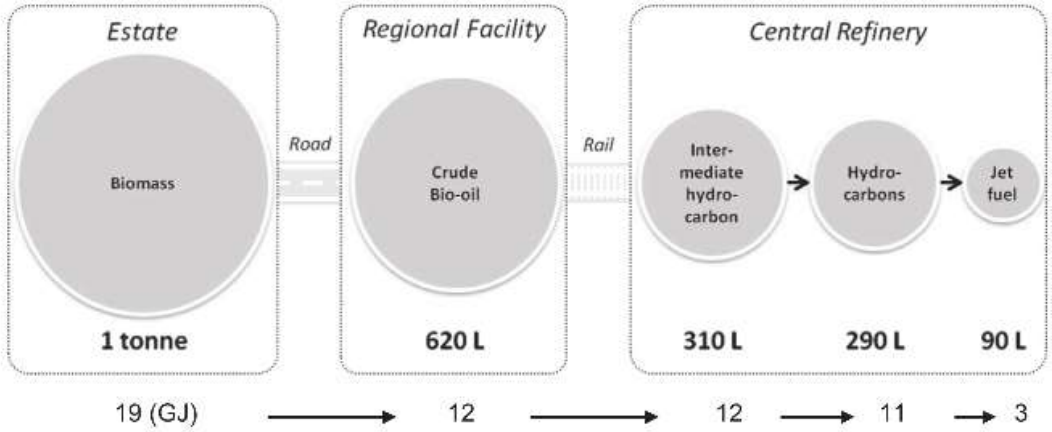
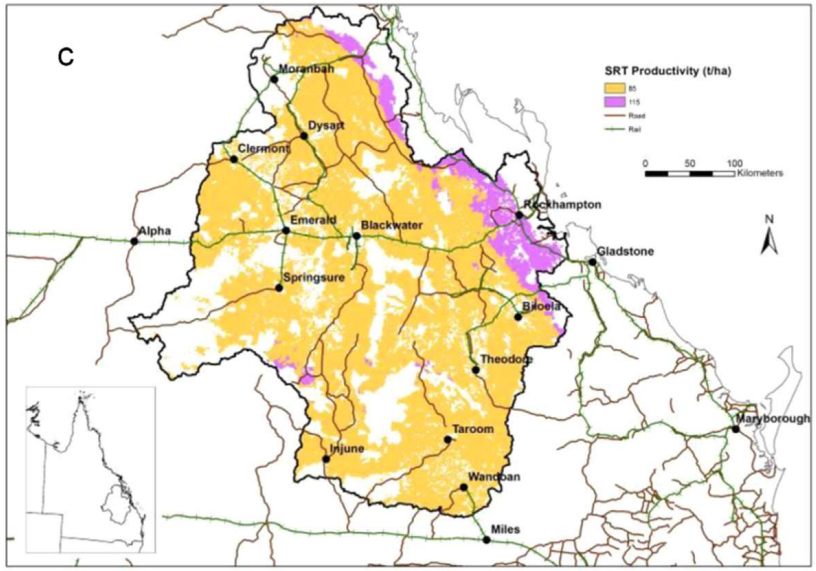
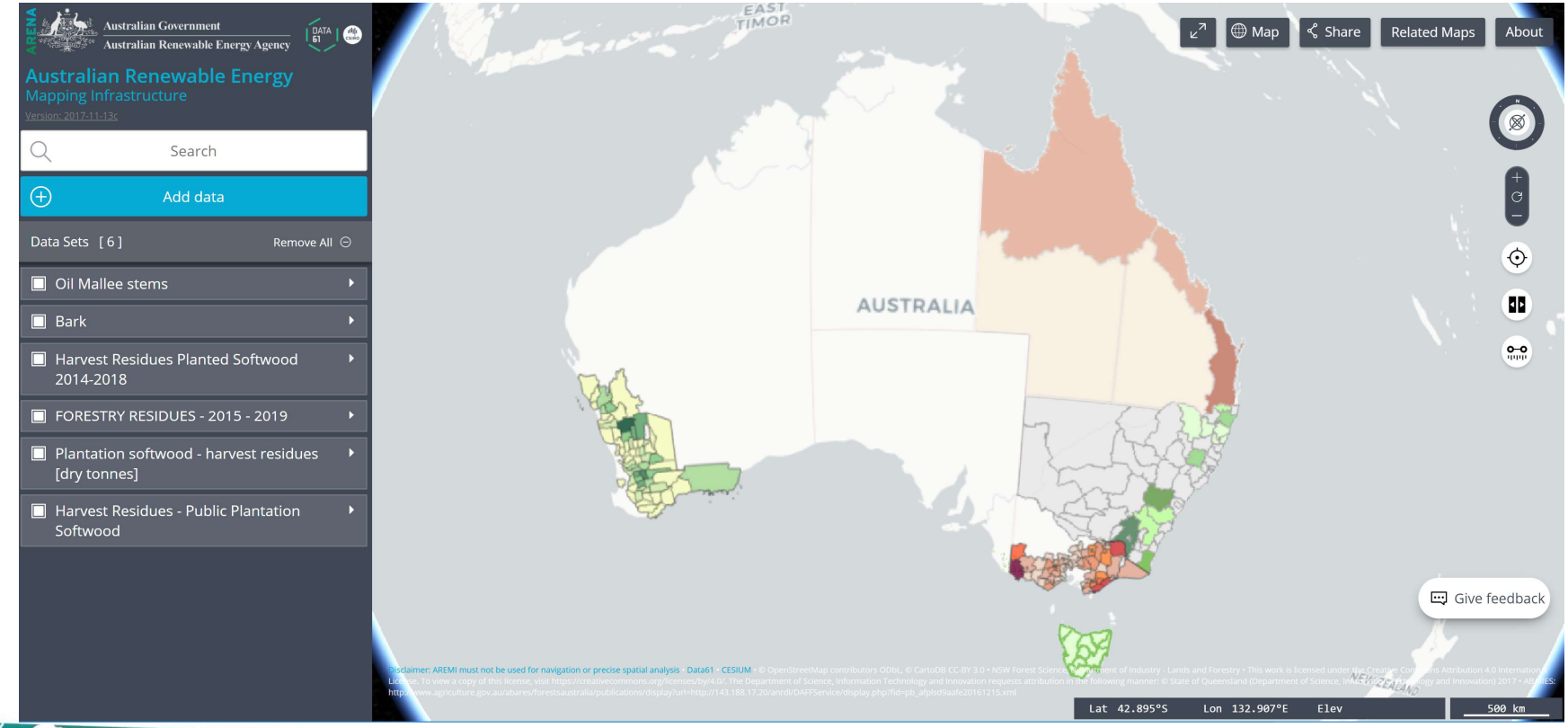


Fig. 2. Efficiencies of conversion of lignocellulose feedstocks to transport fuels using fast pyrolysis technology. Also shown is the approximate cl system from 1 t of lignocellulosic biomass to jet fuel.



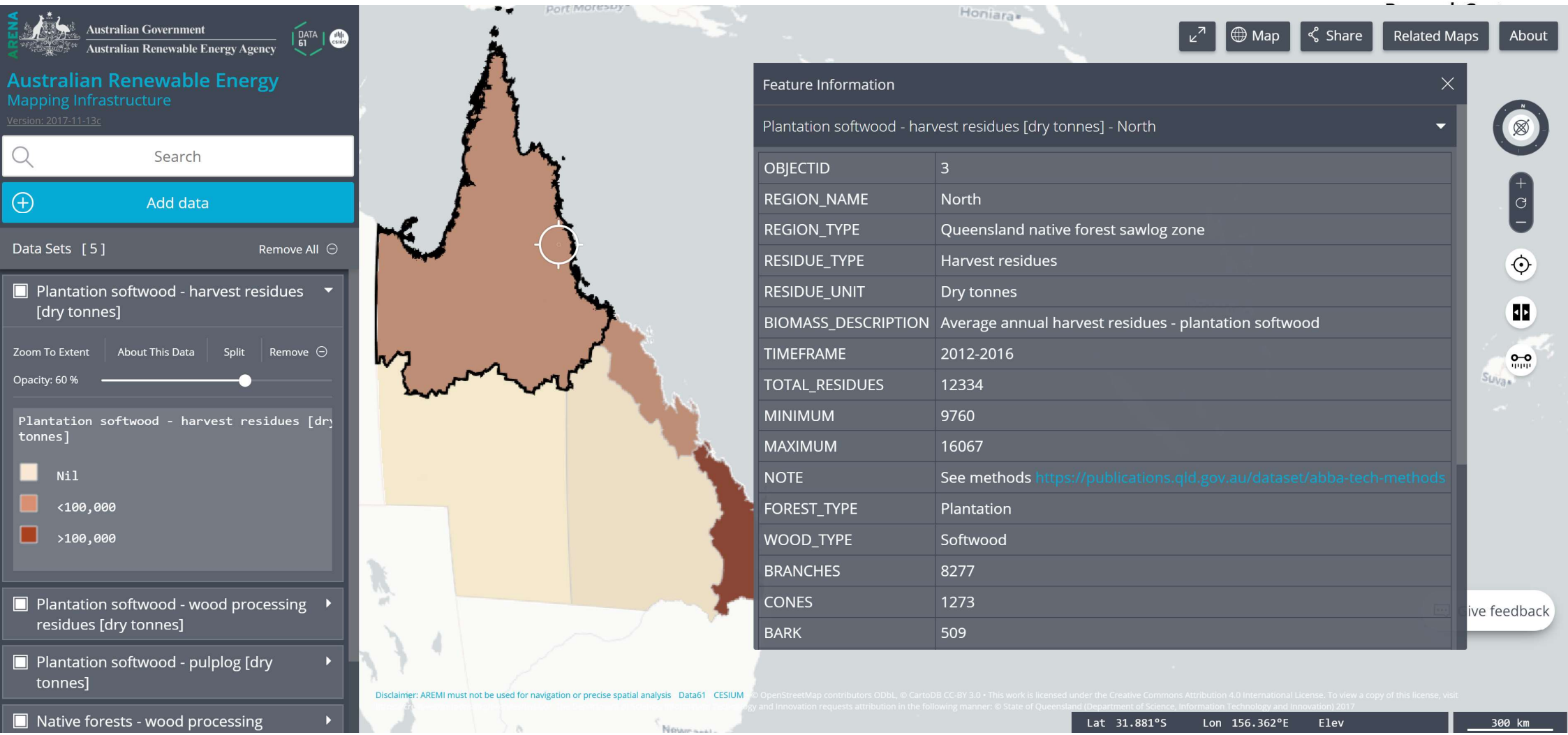
Australian Renewable Energy Mapping Infrastructure (AREMI)

Forest Industries Research Centre

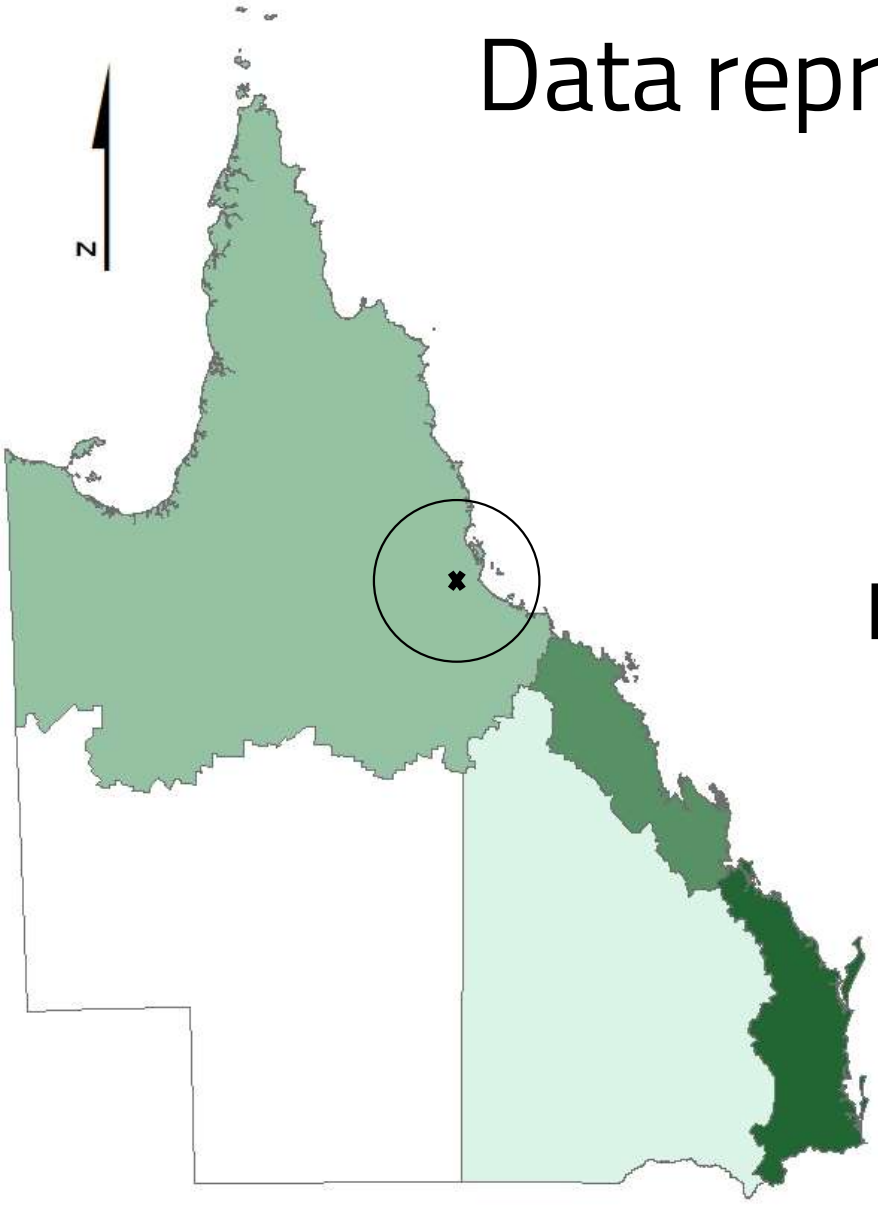


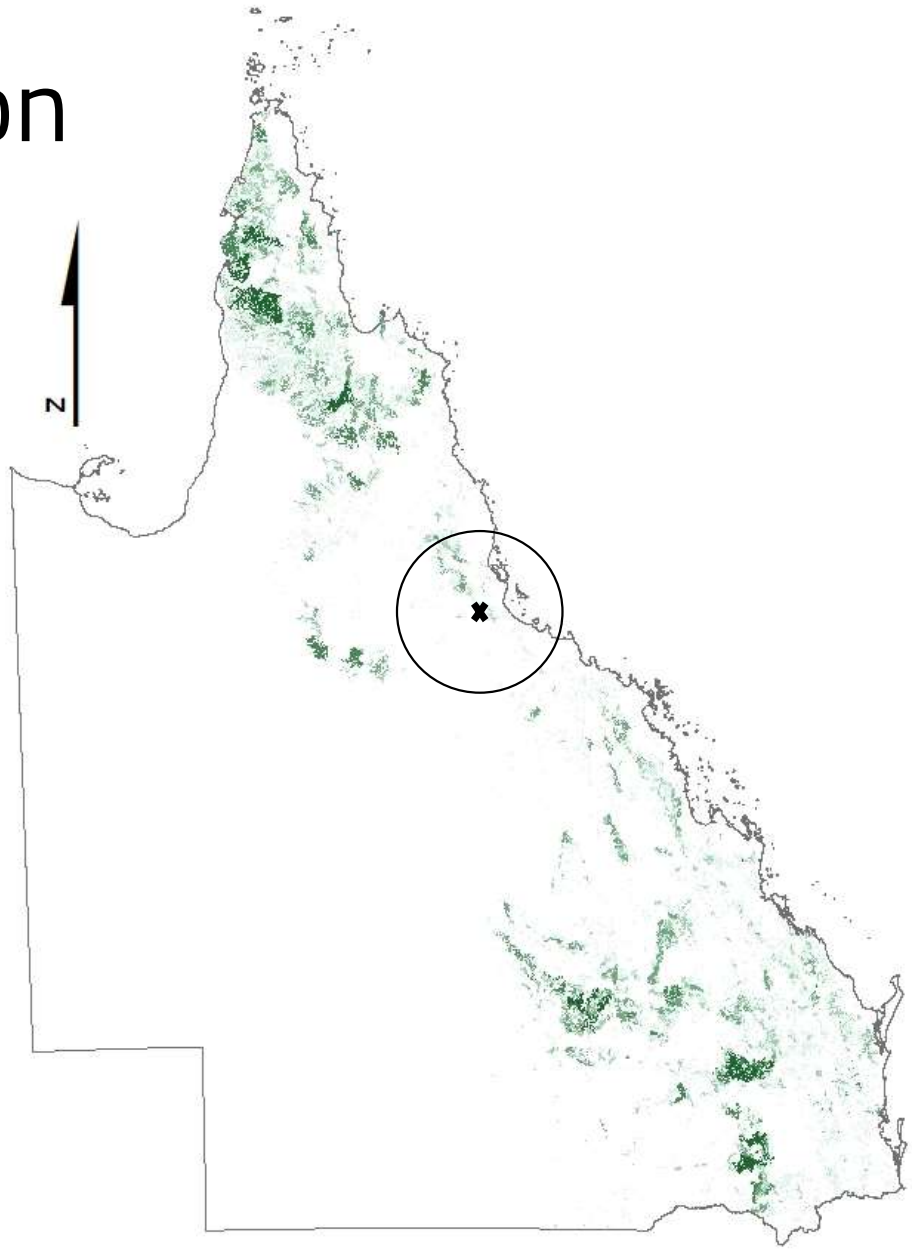
AREMI Queensland

USC
Forest Industries



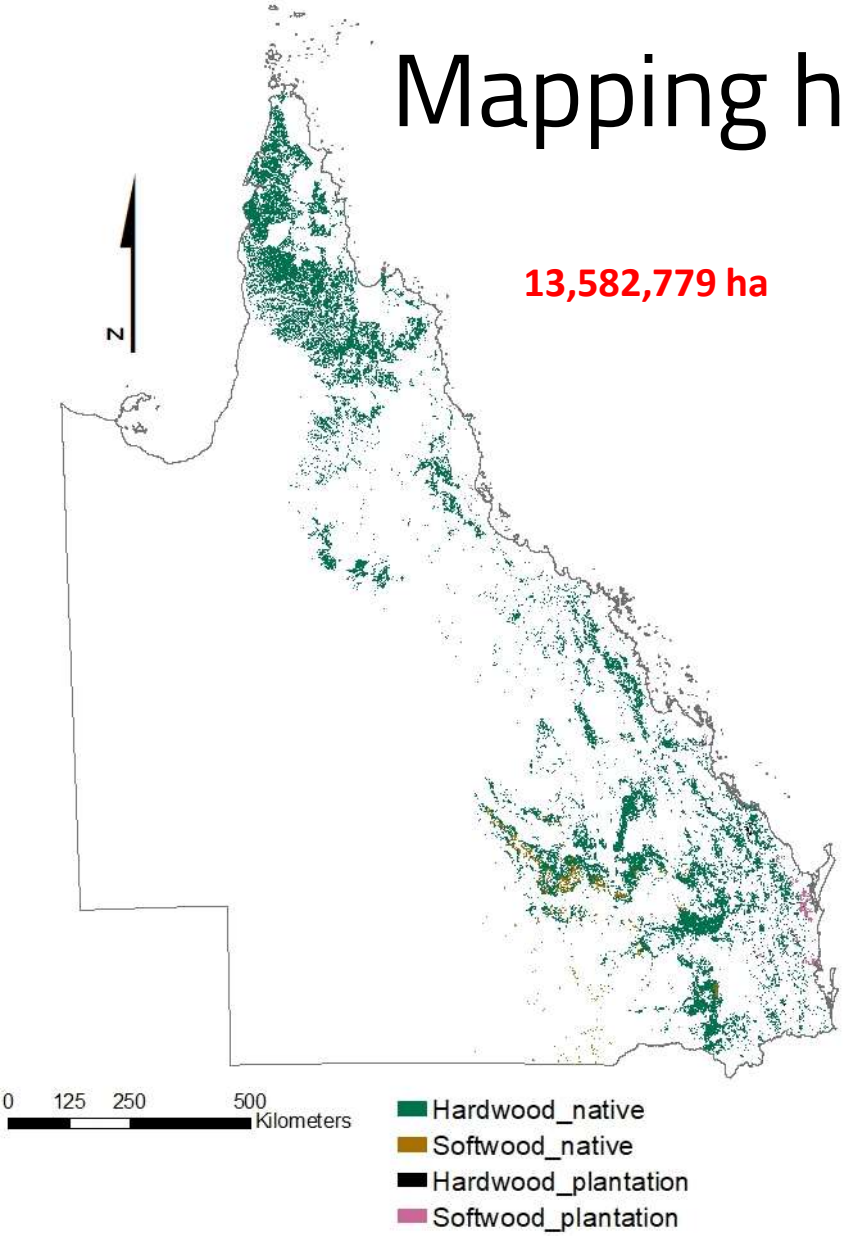
Data representation





Mapping harvestable forest

Forest Industries Research Centre

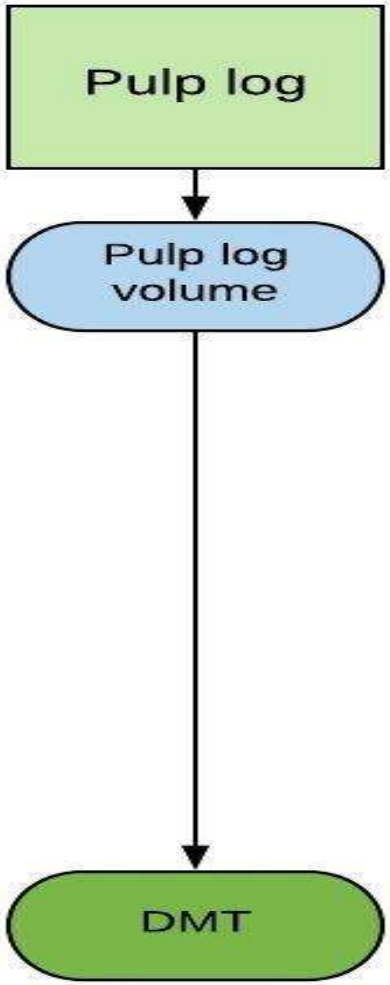


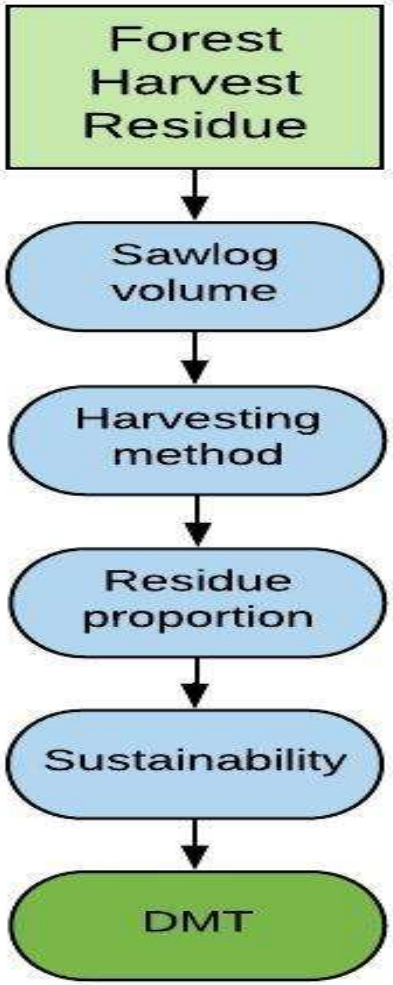
13,582,779 ha

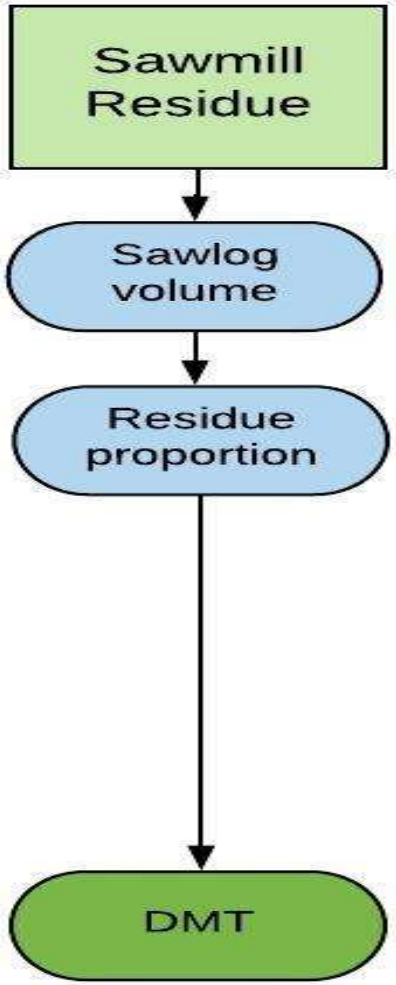
- Harvestable forest
  - Leasehold
  - Multi-use
  - Private
- Commercial species
  - Eucalypt native
  - Cypress native
  - Softwood plantation
  - Hardwood plantation
- Commercial value
  - Medium – Tall
  - >20m coastal area
  - >15 m inland or Cypress

Tenure type	Area ('000 hectares)	Area (%)
Leasehold forest	30,656	60.4
Multiple-use public forest	2,905	5.7
Nature conservation reserve	5,098	10.0
Other Crown land	1,208	2.4
Private land (incl. Indigenous)	10,129	19.9
Unresolved tenure	785	1.5
Total native forest	**50,782**	**100**

Workflow calculating residue

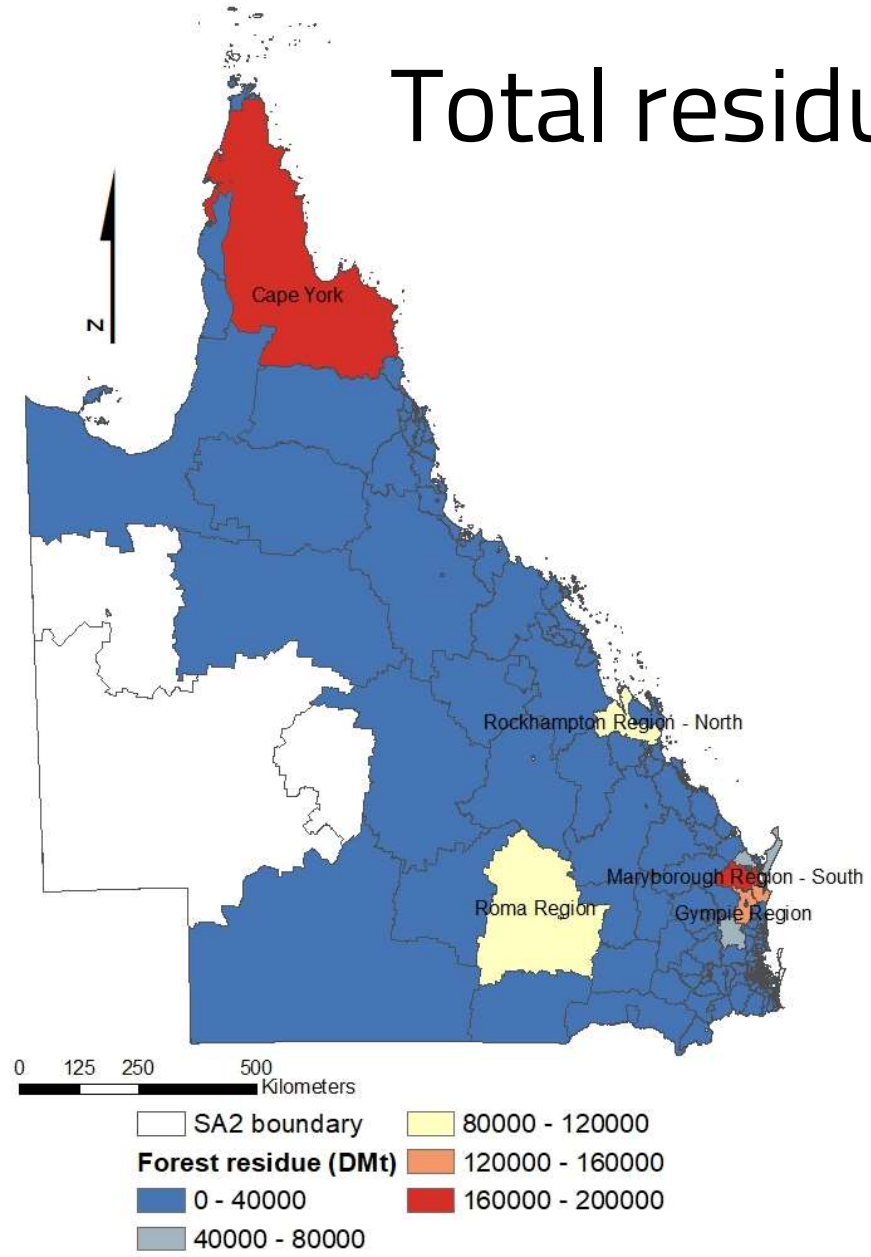


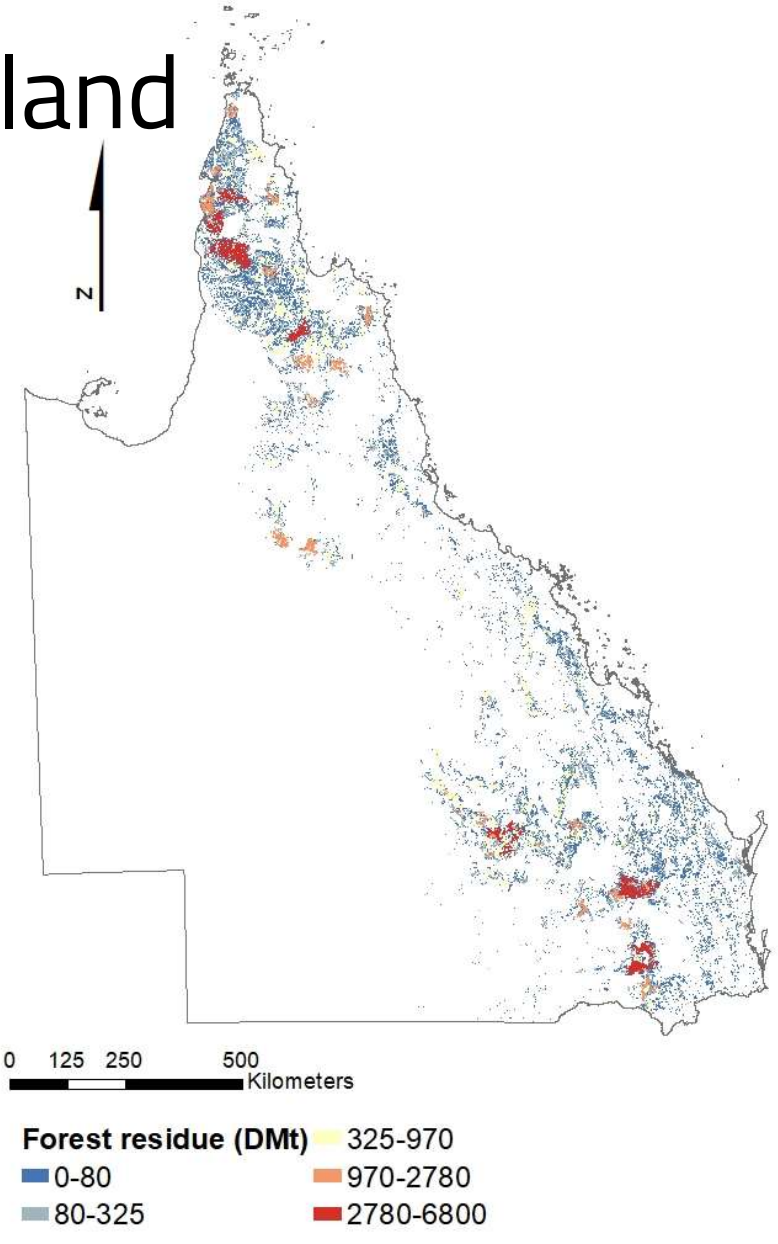




	Total area (ha)	Pulp log (DMt yr^{-1})	Sawmill residues (DMt yr^{-1})	Field residues (DMt yr^{-1})	Total residues (DMt yr^{-1})
Softwood plantation	190,542	194,060	447,412	135,146	**776,618**
Hardwood plantation	41,187	7,422	1,880	376	**9,678**
Softwood native forest	459,309	0	44,976	42,931	**87,907**
Hardwood native forest	12,891,741	0	176,472	126,698	**303,170**
Total	**13,582,779**	**201,482**	**670,740**	**305,151**	**1,177,373**

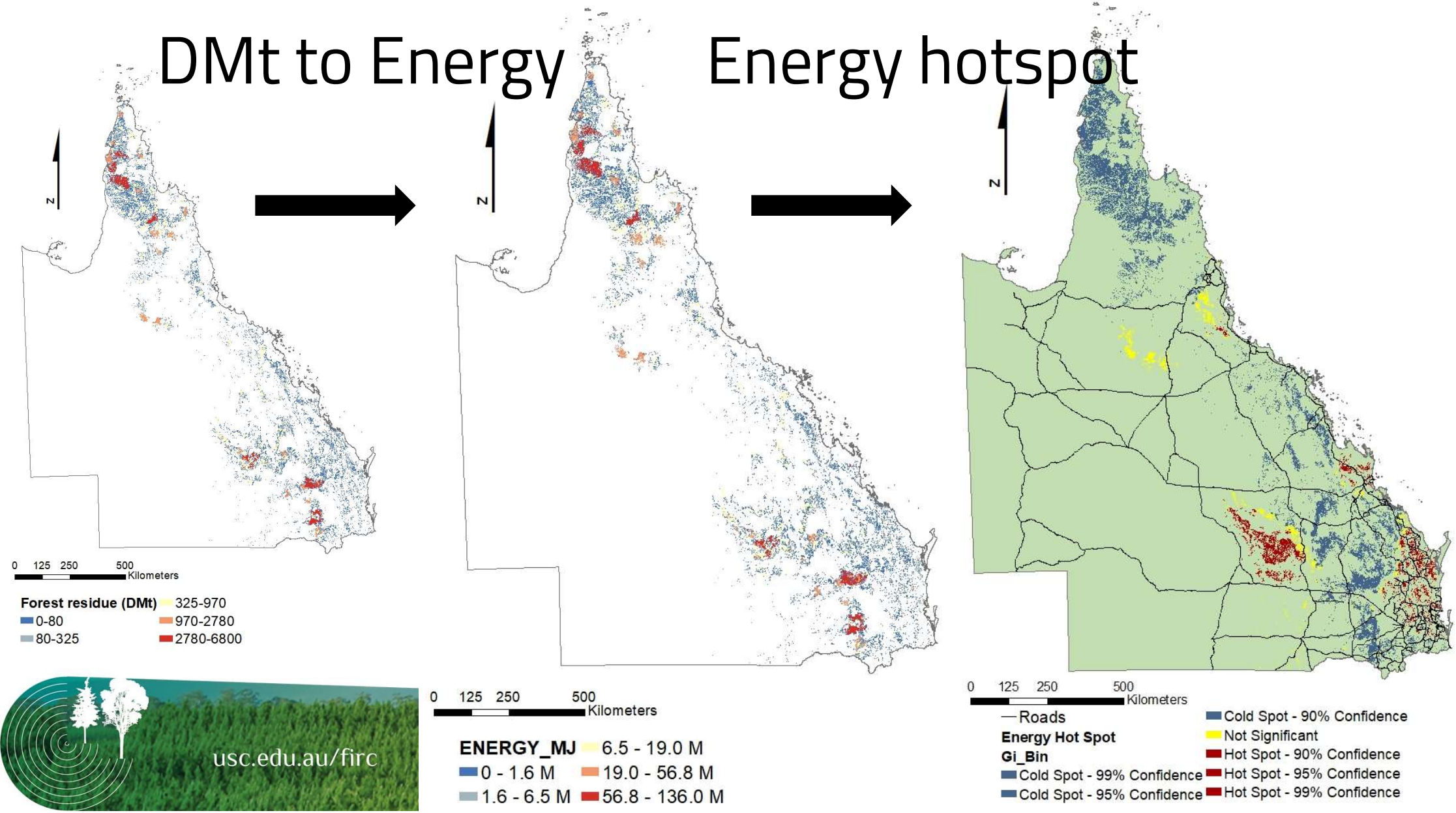
Total residue for Queensland





DMt to Energy

Energy hotspot



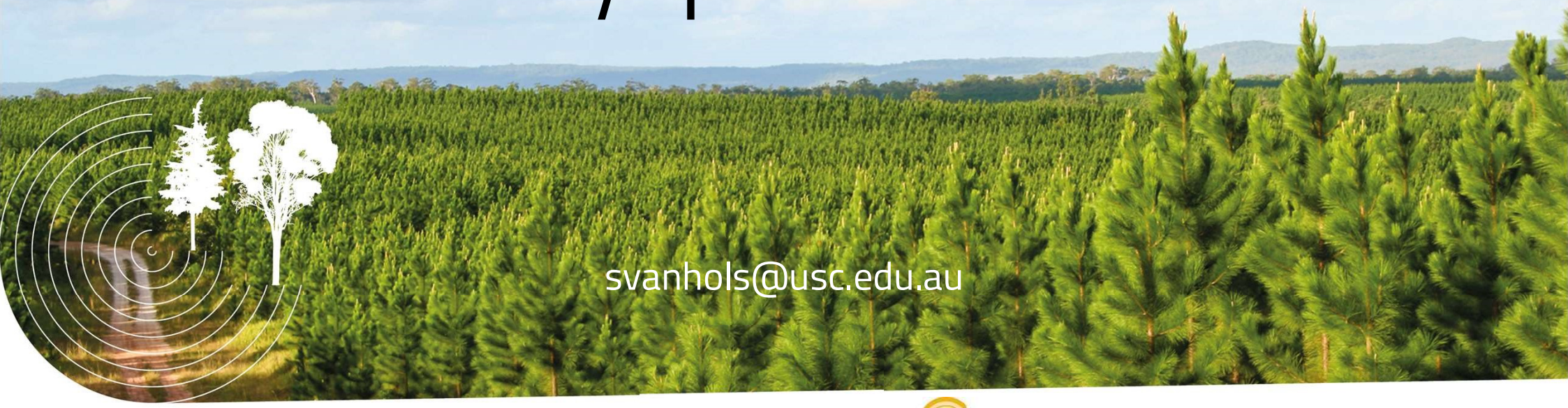
usc.edu.au/firc

Future work

USC
Forest Industries
Research Centre

- Pour everything into a GIS model that:
  - Reads multiple map scales and presentations
  - Includes multiple conversion parameters (Volumes → DMt → Energy)
  - Needs minimal input
  - Online available
  - Will be expanded with
    - Biomass Supply Chain models
    - Life Cycle Assessment models

Thank you!
Any questions?



svanhols@usc.edu.au

usc.edu.au/firc

ABP

GOTTSTEIN TRUST

ARENA
Australian Government
Australian Renewable Energy Agency

USC

USC, QUEENSLAND, AUSTR... PROVIDER NUMBER: ...

	Softwood plantation	Hardwood plantation	Softwood native forest	Hardwood native forest
Air-dry density (kg/m^3)	552.5	1039	675	1010
Proportion WT harvest	28%	28%	0%	0%
Proportion residues after WT harvest on site	10.8%	5%	N/A	N/A
Proportion CTL harvest	72%	72%	100%	100%
Proportion residues after CTL harvest	18.8%	16.3%	45%	40%
Sustainability	5%	5%	30%	30%
Proportion residues in sawmill	53%	65%	65%	60%
Energy conversion factor (MJ/kg)	21	20	21	20