Eskom Biomass fuel supply

Eskom Biomass Fuel Supply Study:

Co-firing coal with 10% biomass
@Eskom power stations

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IEA32 Biomass Workshop,
Eskom Megawatt Park
04 November 2014

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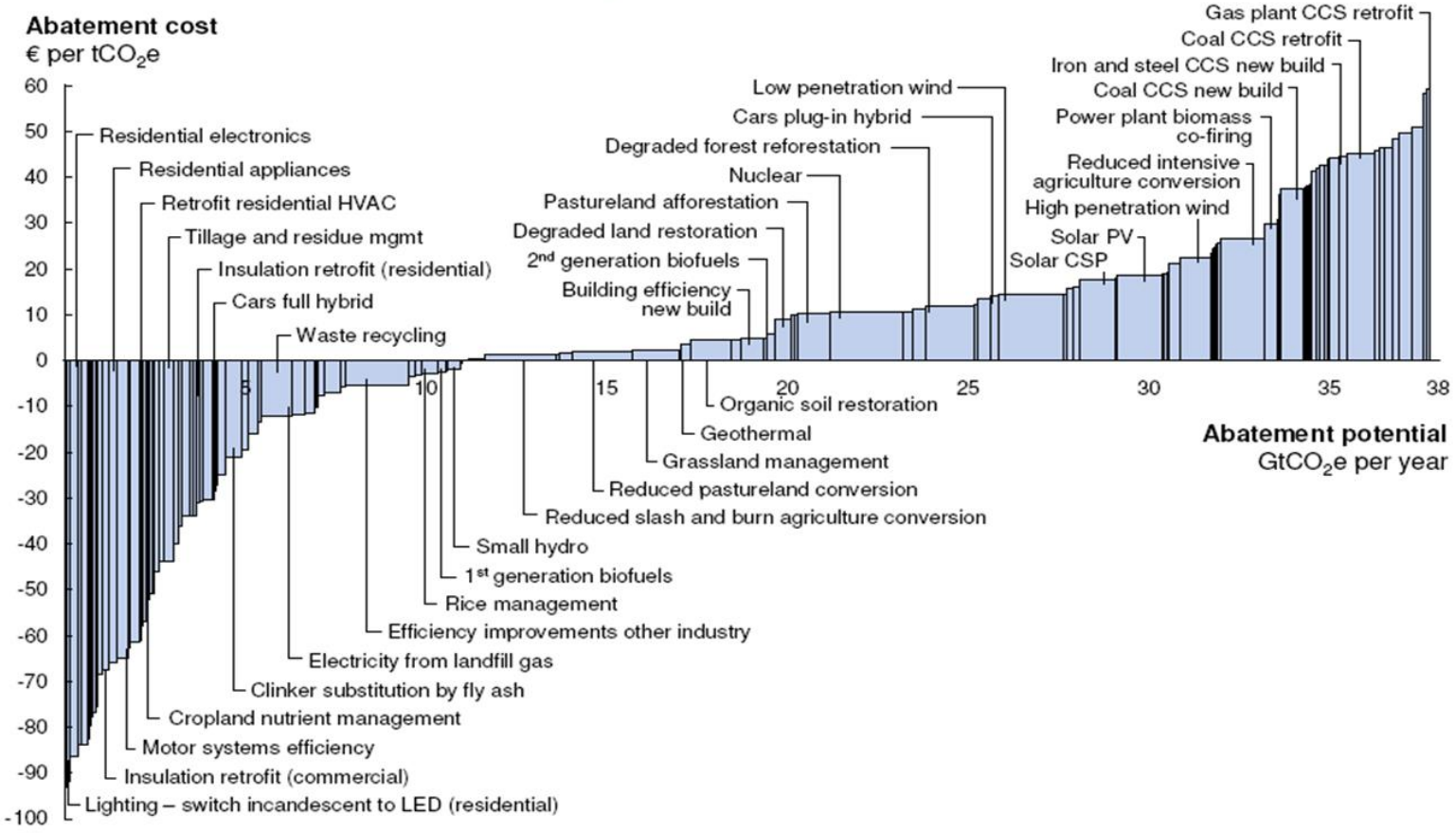
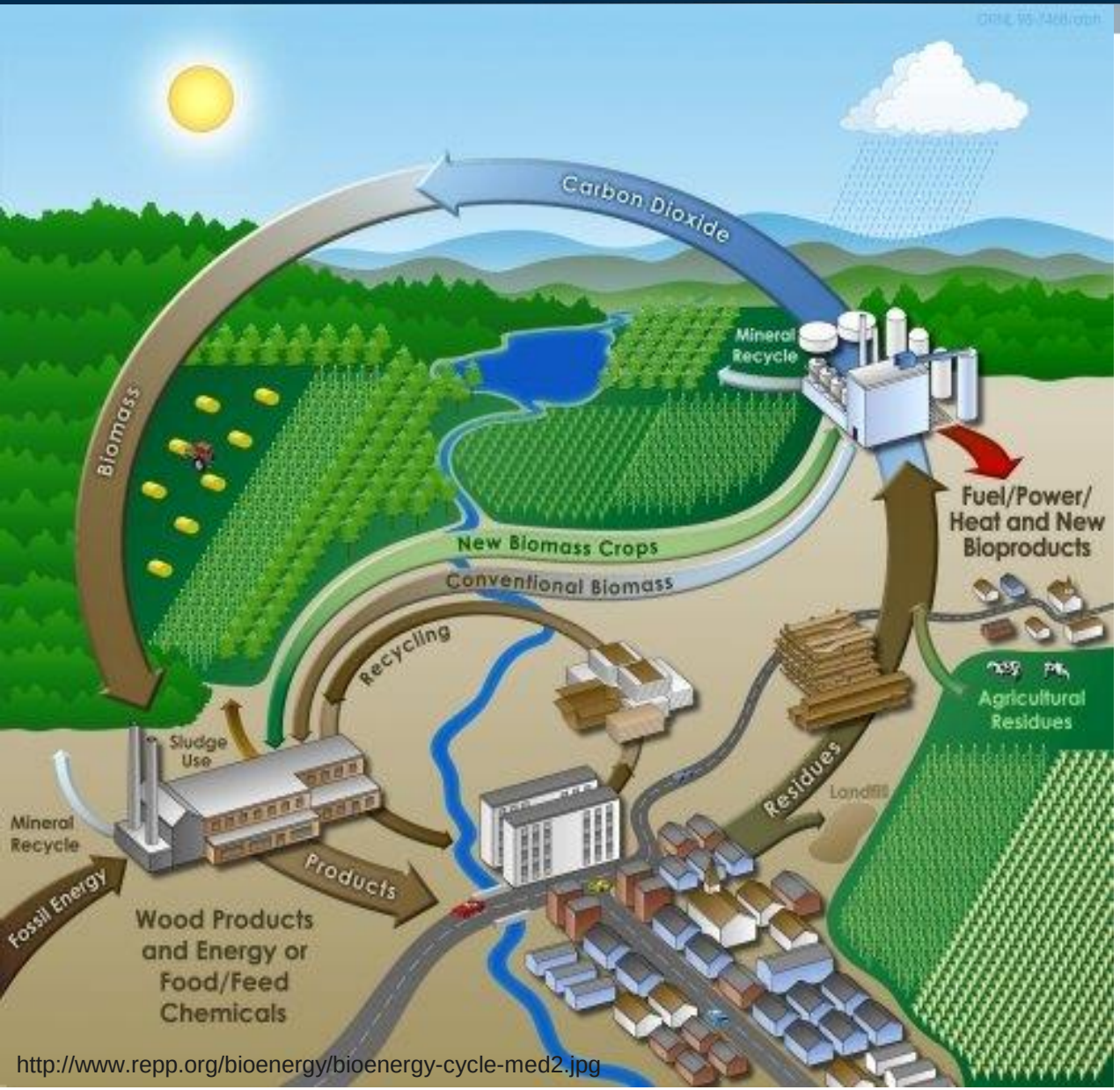
GHG abatement

Global GHG abatement cost curve beyond business-as-usual – 2030



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.0

Biomass: *a renewable carbon-neutral fuel?*



http://www.repp.org/bioenergy/bioenergy-cycle-med2.jpg

- **Available biomass?**
- **Viable biomass?**
- **Sustainable biomass?**

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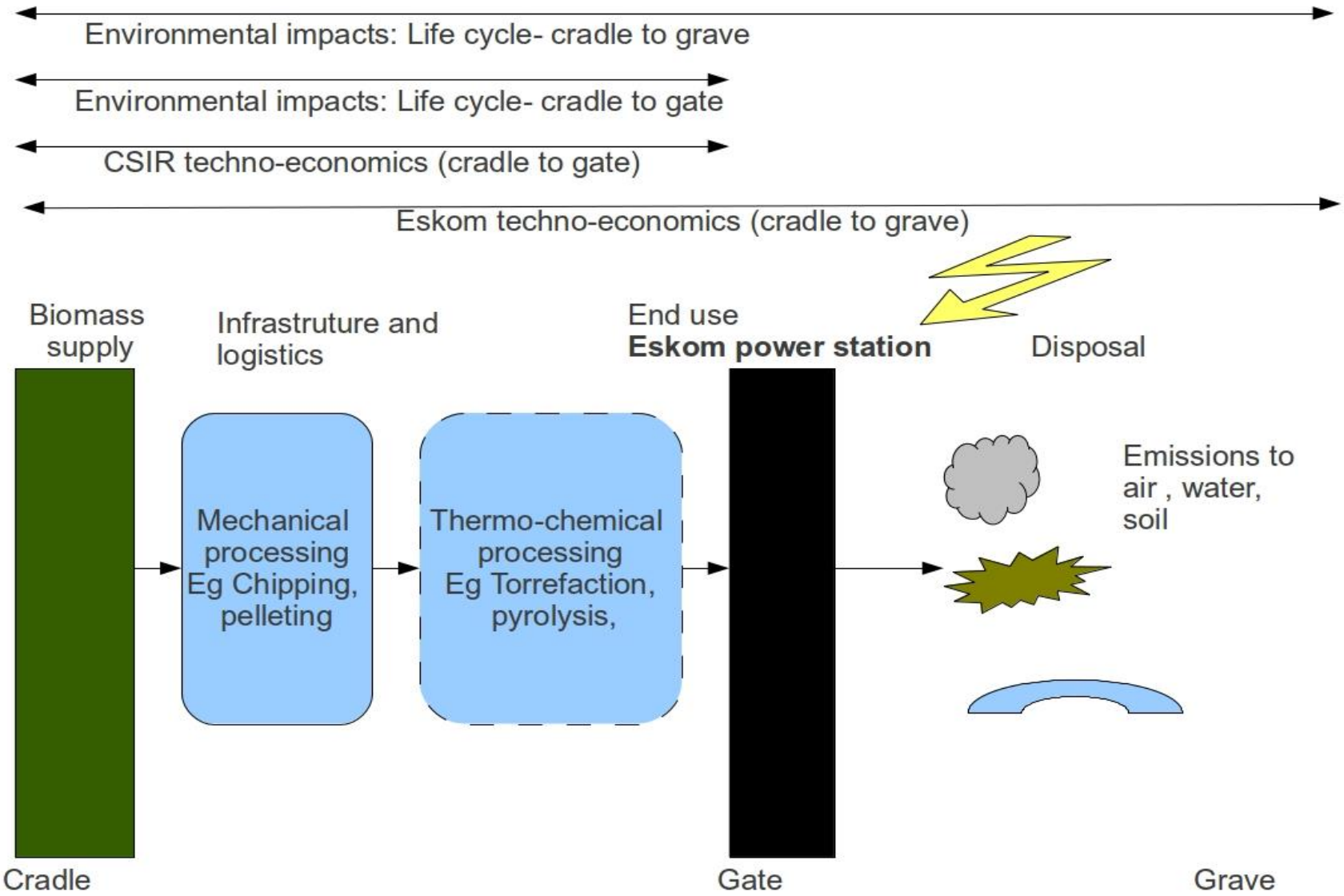
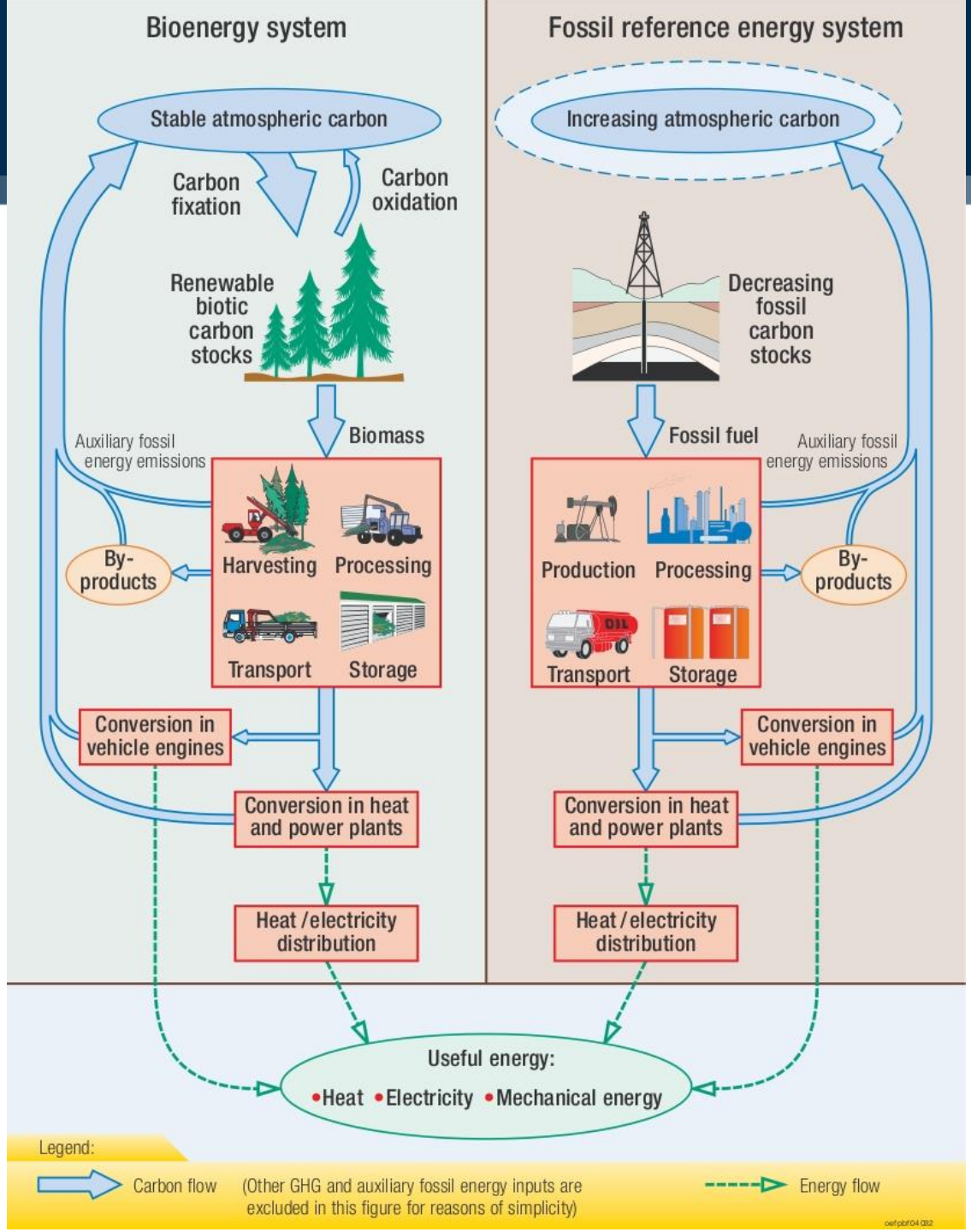
Project boundaries?





Project scope and Milestones

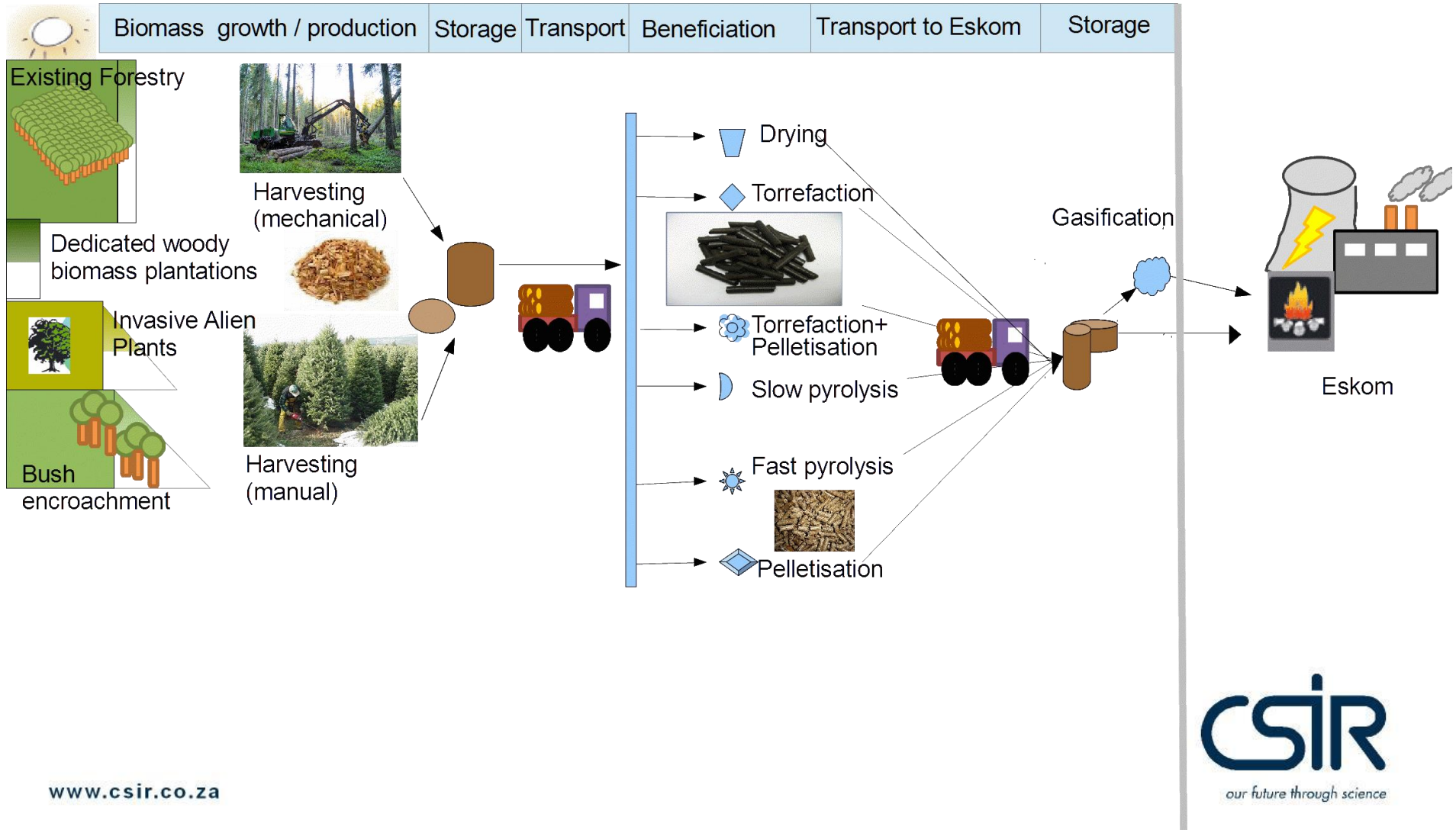
- **South Africa and its *physical* neighbours**
- ***Woody* Biomass (>20% lignin) availability**
- **Feasibility of biomass supply (wood and upgraded woodfuel with cost +/- carbon benefits)**
- **Impacts (social and environmental) and Risks**
- **Markets and regulations**

**Milestone 1- Biomass availability
Milestone 2- Logistics
Milestone 3- Markets
Milestone 4- Fuel costs
Milestone 5- Impacts and Risks
Milestone 6-Regulations

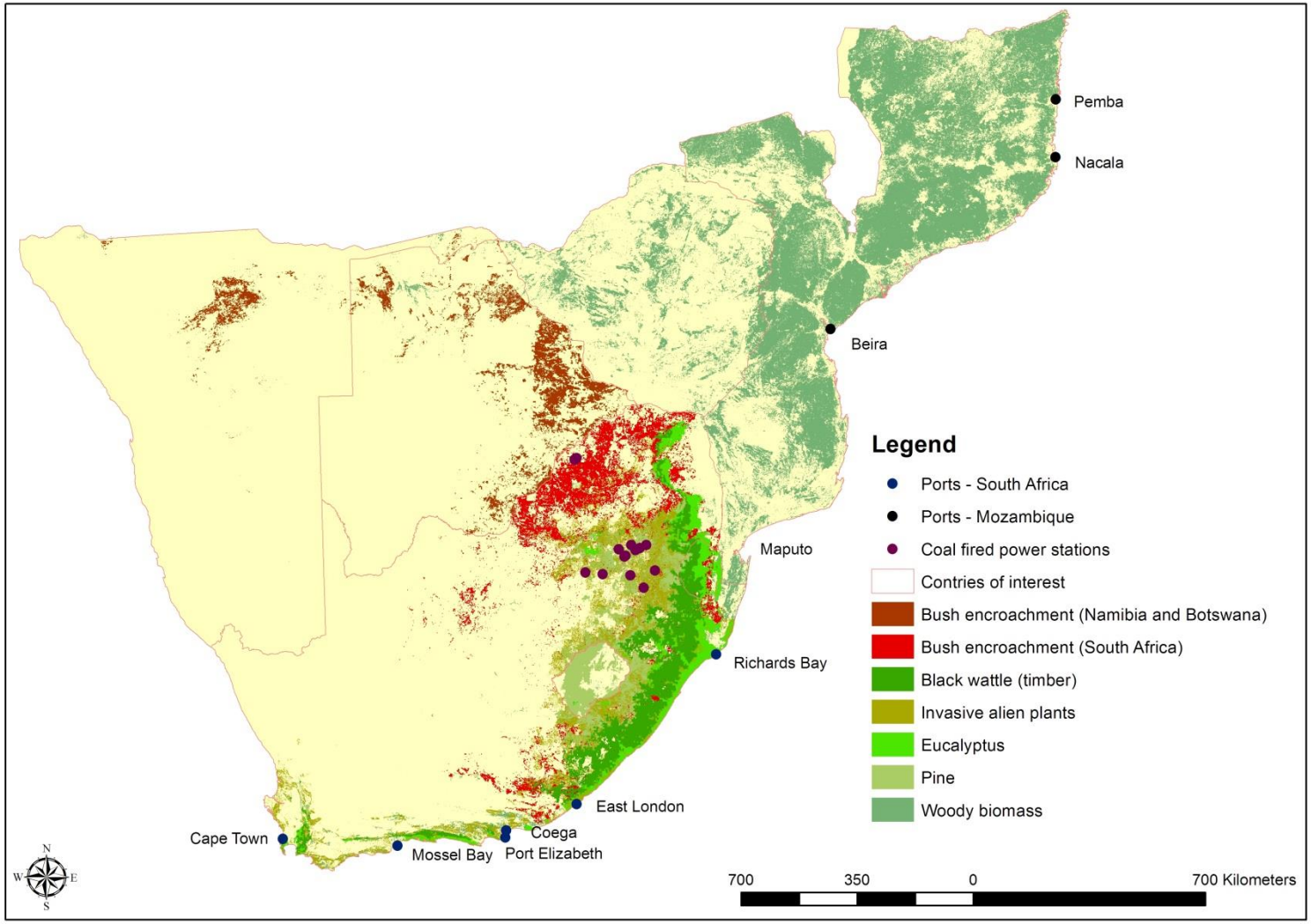
01 July 2011 to *30 March 2012*

Biomass fuel supply study: value chains

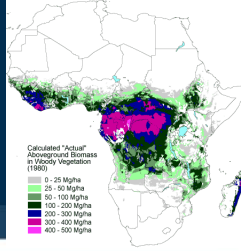
10% co-firing needs 13 Tg dry biomass @19.5 MJ/kg

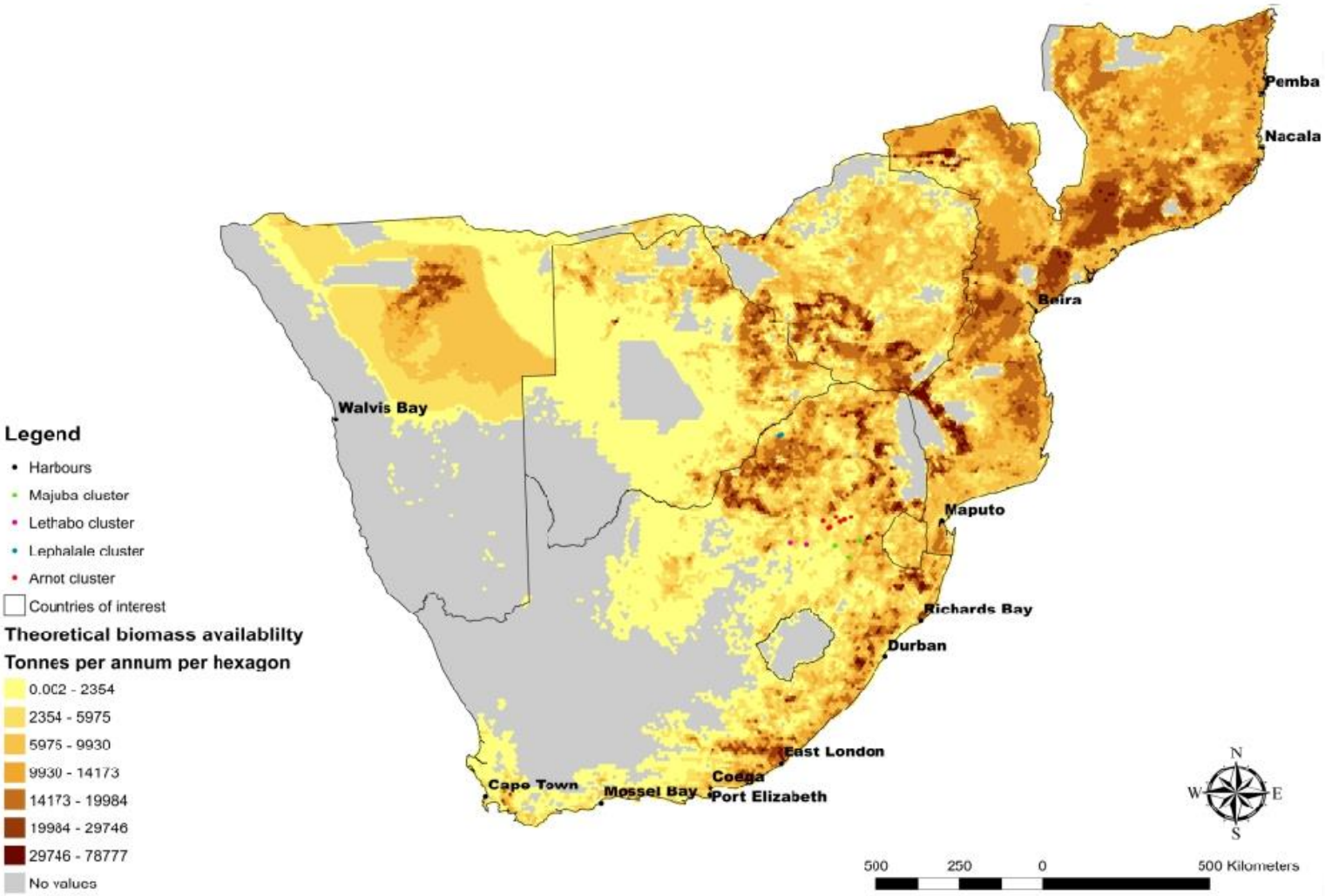


Woody biomass distribution by resource



Available Biomass resources





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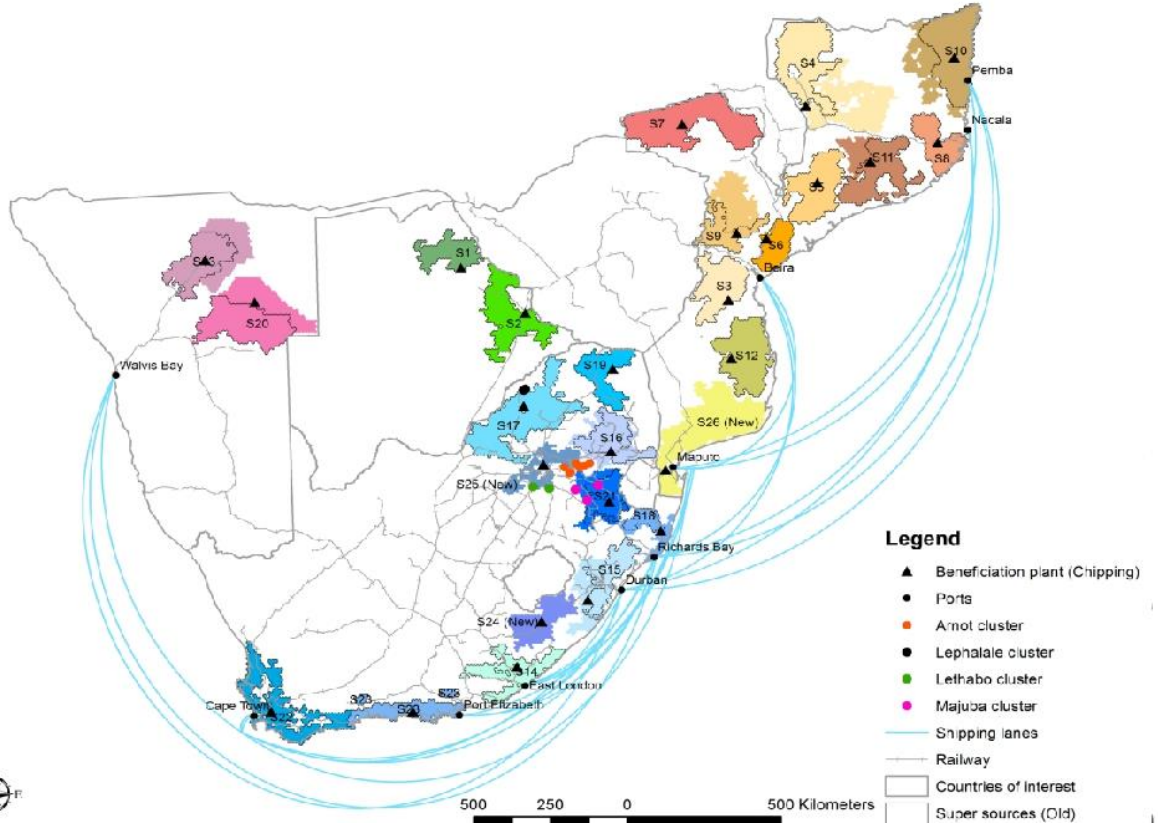
Viable Biomass resources

Avoid competition with existing uses: forestry industry and livelihoods

Forestry residues and wastes (8%),
Forest/woodland(20-60%
IAPs and bush encroachment (80%)



:: Biomass resources in close Proximity to Eskom/transport node

:: Exclude protected areas (ie National parks) and steep slopes

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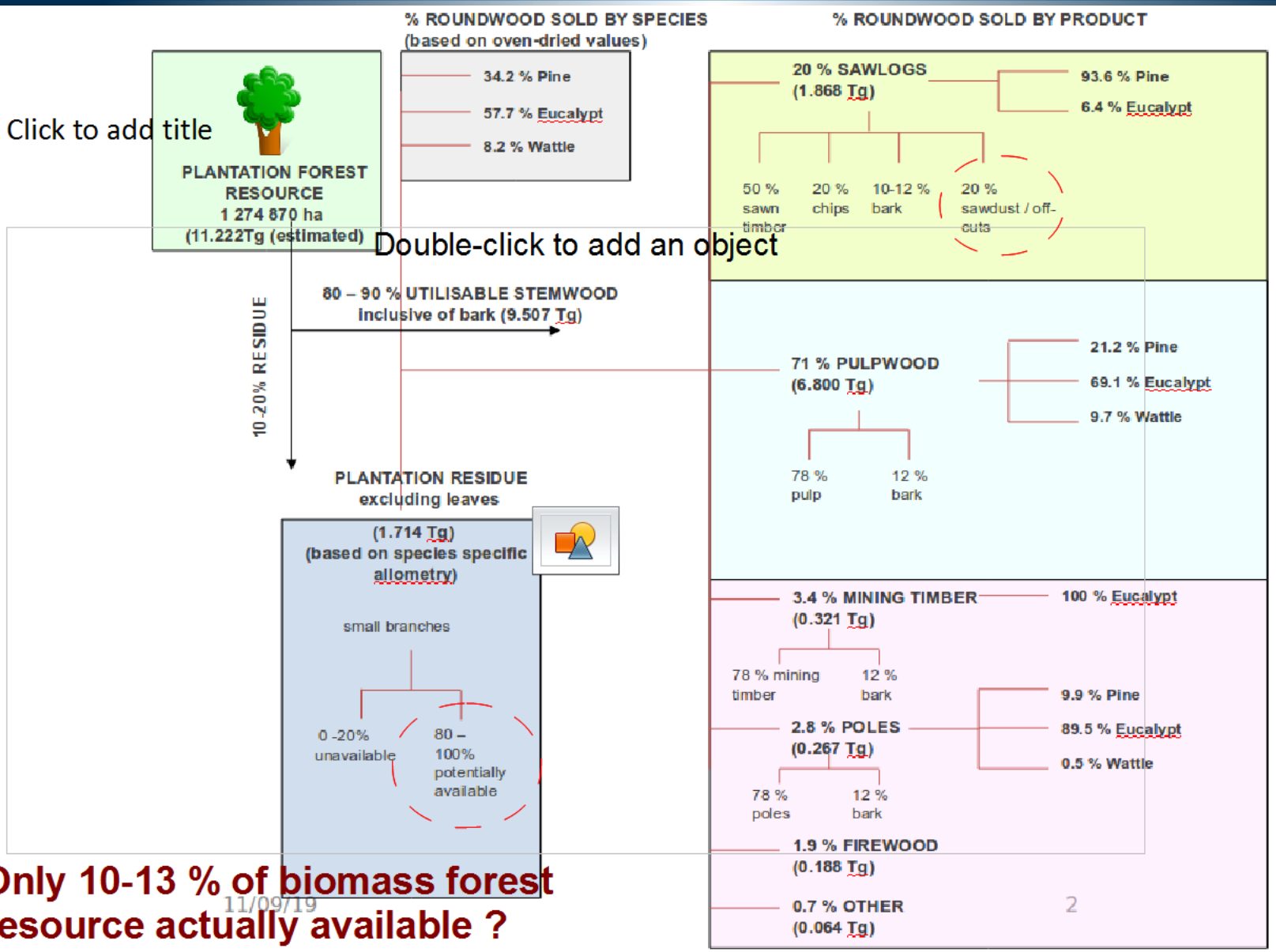
Forestry- plantations

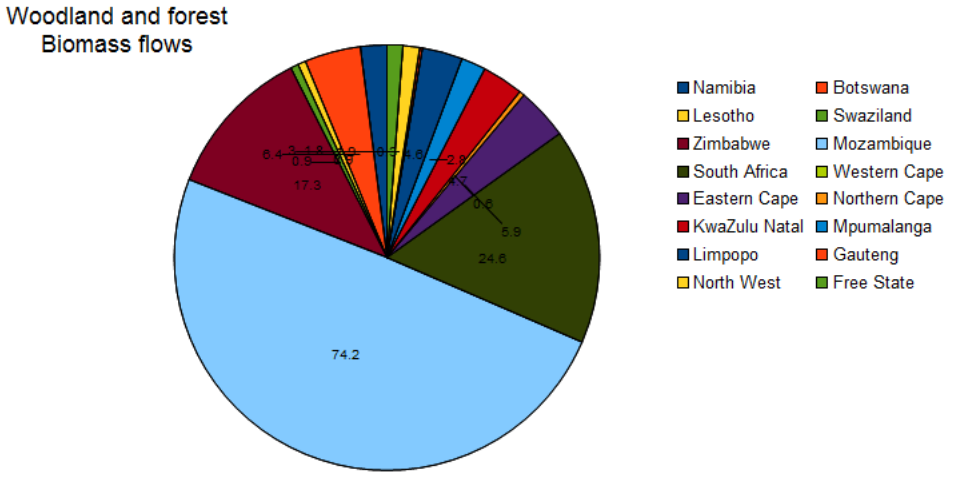


Only 10-13 % of biomass forest resource actually available ?

Woodlands and forests

Woodland and forest - Biomass flows

Region	Biomass Flow (Tg/yr)
Namibia	3.0
Botswana	6.4
Lesotho	0.9
Swaziland	0.9
Zimbabwe	17.3
Mozambique	74.2
South Africa	24.6
Western Cape	n/a
Eastern Cape	5.9
Northern Cape	0.6
KwaZulu Natal	4.7
Mpumalanga	2.8
Limpopo	4.6
Gauteng	0.3
North West	1.9
Free State	1.8



20-60% available?

Invasive Alien Plants

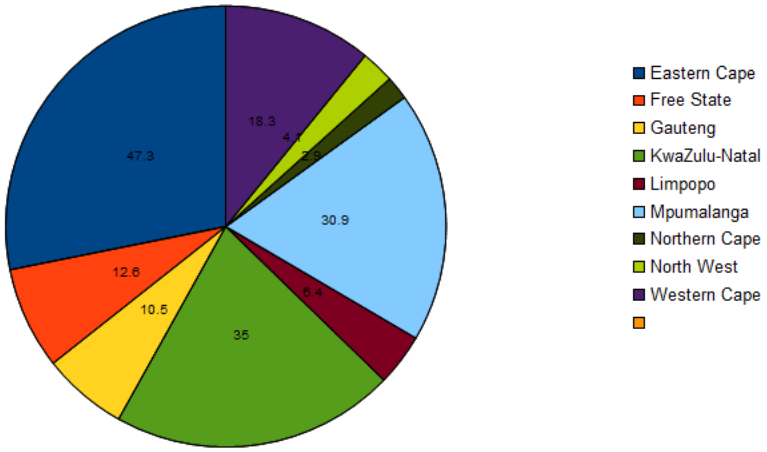
Click to add title

Invasive Alien Plants- Biomass Stocks (Tg)

Province	Acacia	Eucalyptus	Pine	Poplar, willow & *Prosopis*	Total
Eastern Cape	28.7	9.4	5.5	3.8	47.3
Free State	0.8	7.2	1.1	3.6	12.6
Gauteng	1.5	7.7	0.4	0.9	10.5
KwaZulu-Natal	15.1	16.5	2.7	0.7	35.0
Limpopo	1.1	3.7	0.8	0.7	6.4
Mpumalanga	6.4	18.1	2.8	3.6	30.9
Northern Cape	-	-	-	2.9	2.9
North West	0.4	3.1	0.1	0.5	4.1
Western Cape	6.6	2.8	8.5	0.4	18.3
Total	60.6	68.5	21.9	17	168.1

Stocks>flows

Total invasive alien plants - Biomass stocks



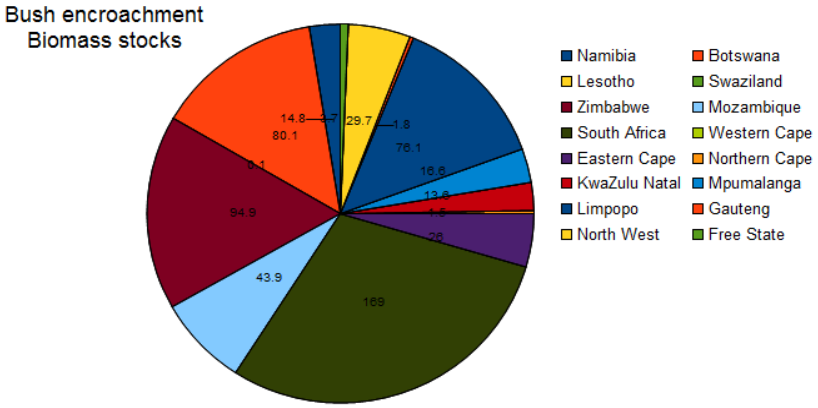
Up to 80% available.. access and accesbility

Bush encroachment

Bush encroachment - Biomass stocks

Region	Biomass stock (Tg)
Namibia	14.8
Botswana	80.1
Lesotho	0.1
Swaziland	0.0
Zimbabwe	94.9
Mozambique	43.9
South Africa	169.0
Western Cape	0.0
Eastern Cape	26.0
Northern Cape	1.5
KwaZulu Natal	13.6
Mpumalanga	16.6
Limpopo	76.1
Gauteng	1.8
North West	29.7
Free State	3.7

- Stocks to Flows



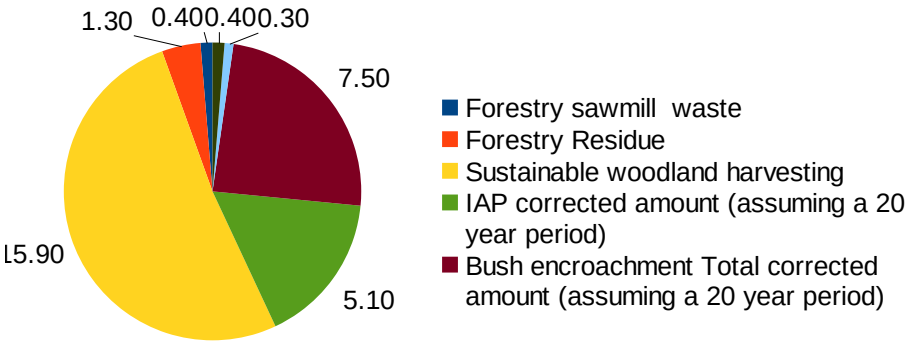
Up to 80% available? (20% tree cover of savannah)

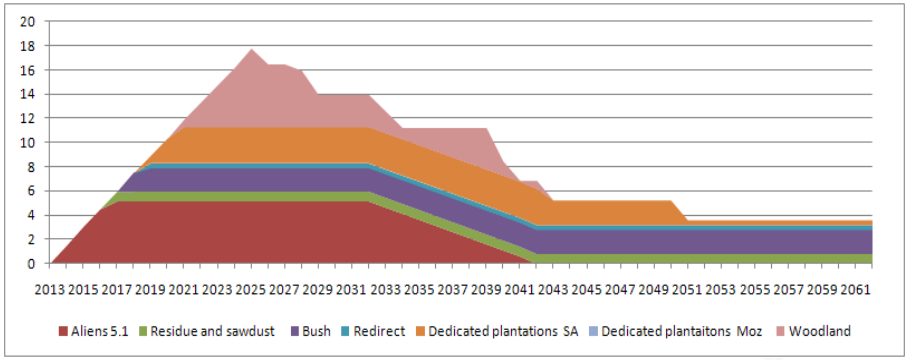
Sustainable Biomass resources

>> Annual *available* woody biomass resources of 31 Tg in **Southern Africa** and total annual *viable* woody biomass resources 23 Tg in Southern Africa- **sufficient to meet Eskom's co-firing demand**

>>However, significant supply from **neighbouring countries** required:- the viable amounts from **South Africa** are only 7 Tg, which is only sufficient for 6% co-firing

>>IAP and bush encroachment non-renewable and available only for 20 years…





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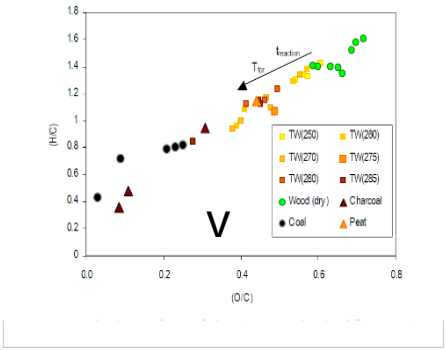
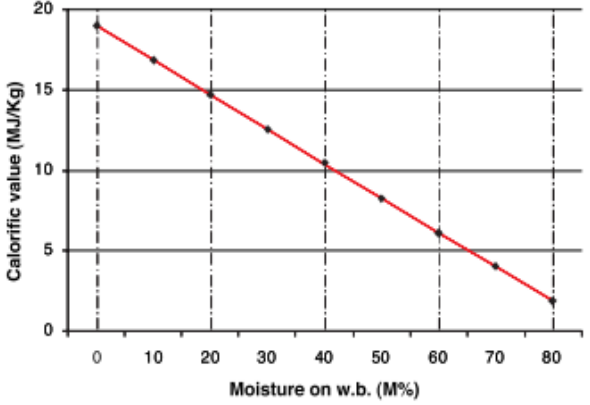
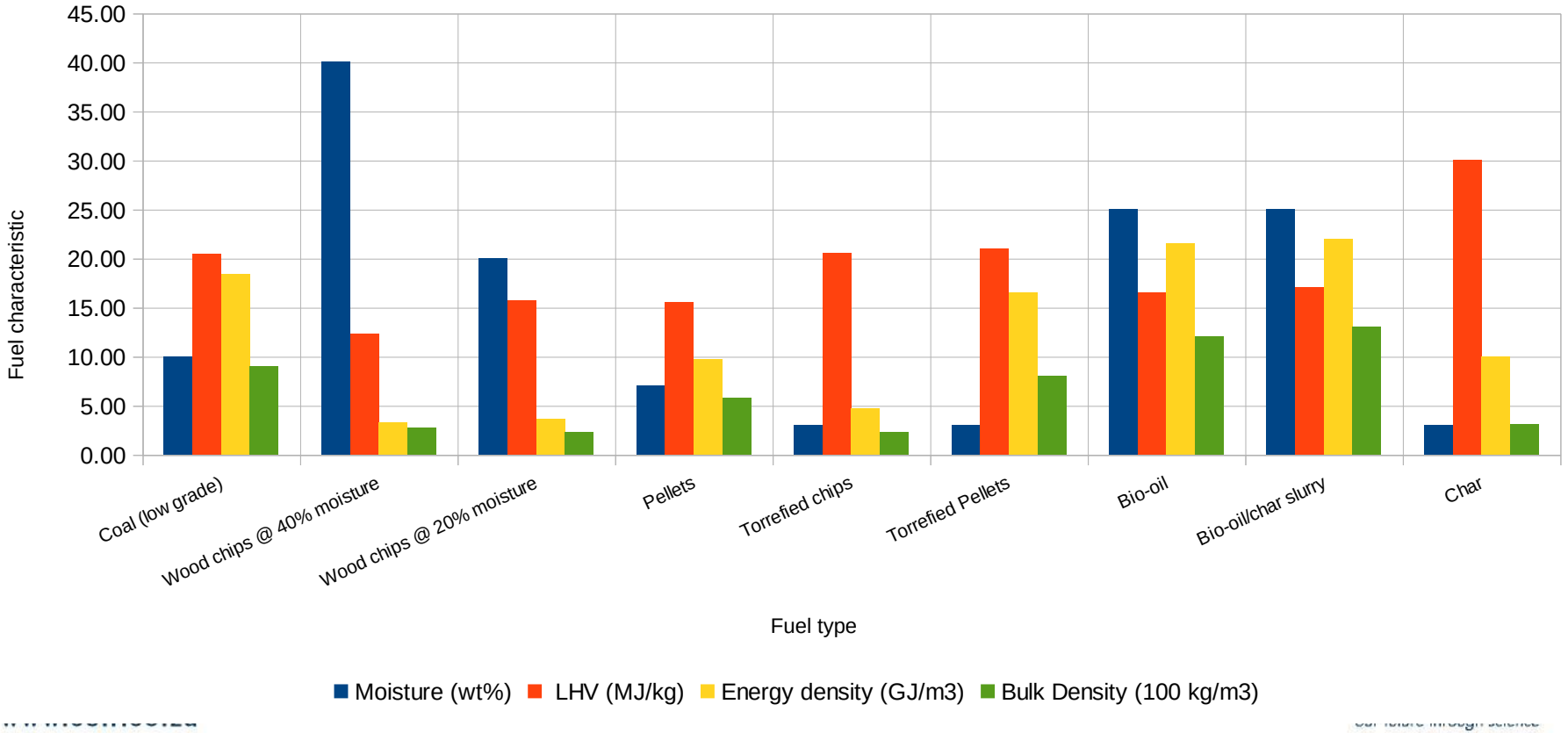
Fuel Upgrading



gure 6: Van Krevelen diagram of torrefied wood (TW) produced under different
nditions: coal, fresh wood, charcoal, and peat samples. Torrefaction reaction
mperatures are placed in parentheses in the legend. Source: Boersma, et al. 2005

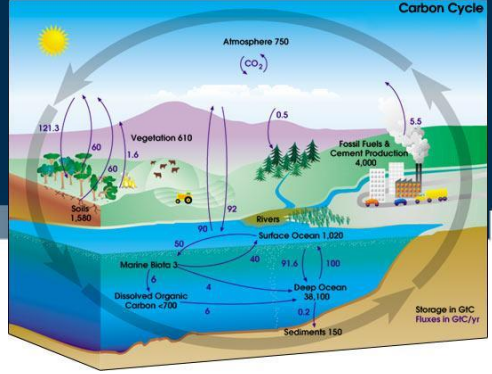




Water-absorption test: torrefied pellets


Straw
Wood
Industrial
ACB
Wood DIN+
EBES AG
European BioEnergy Services
3:30
0:00
4:00 min

Impacts: carbon footprint

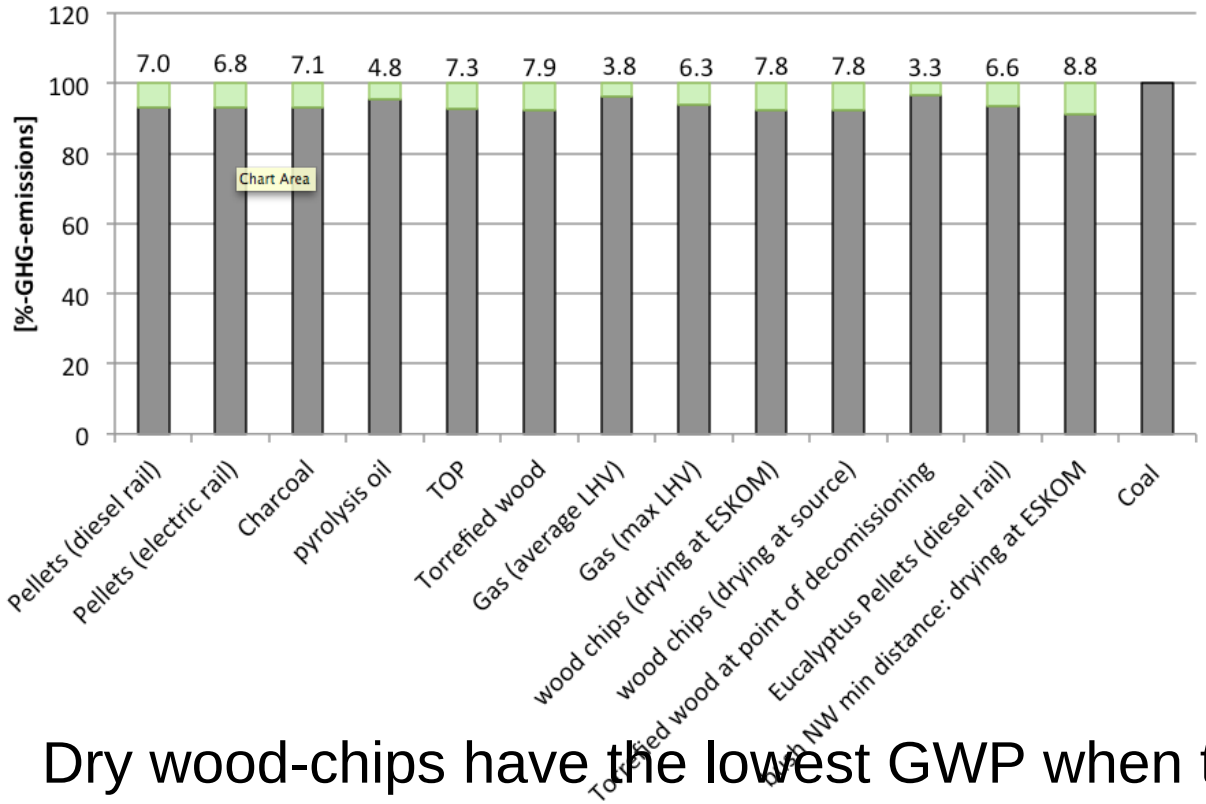


>> **Fuel upgrading has a significant carbon footprint** and reduces the overall carbon reductions from the 10% co-firing

>> Dry wood-chips have the lowest GWP when transported over short distances (<400 km) whilst torrefied chips and torrefied pellets have the lowest GWP when transportation distances are greater than 400km. However additional processing needed on the Eskom side of the gate....

>> Coal mining and upgrading causes much less (< 30%) GWP than any of the biomass fuel supply options, but this only considers the supply up to the Eskom gate.

Impacts:
Overall carbon footprint compared to coal



Fuel upgrading has a significant carbon footprint

Reduces the overall carbon savings from the 10% possible as a result of co-firing

Dry wood-chips have the lowest GWP when transported over short distances (<400 km), but additional processing needed on the Eskom side of the gate....

Torrefied chips and torrefied pellets have the lowest GWP when transportation distances are greater than 400km.

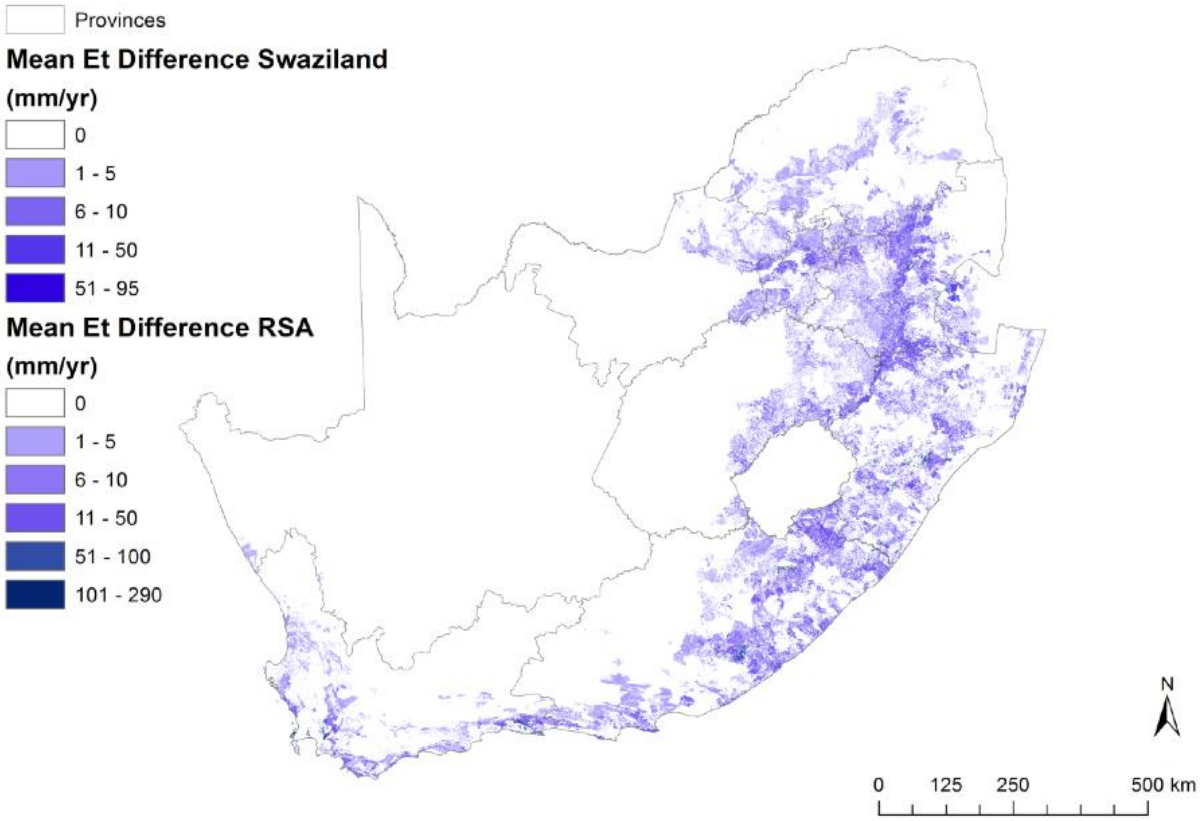
Impacts:
Water footprint from biomass growth

- **New plantations**

Stream-flows decrease between 20 and 200 m^3/ha

- **For IAP clearing**:

Stream-flows **increase** between 20 and 200 m^3/ha



Summary and future questions...

- **23 Tg in Southern Africa** available**,** but **only 7Tg from South Africa,** sufficient for 6% co-firing

- **Invasive alien plant- water and land productivity benefits…but** non-renewable: sustainable for fixed time (ie 20 years). ditto **Bush encroachment**

- **Torrefied pellets or chips** **‘**best’ option, except short distance Torrefied chips/pellets store better, an low moisture, higher energy density, better handling and storage, and co-milling (grindability) *However*..risks of early commercial technology

- **Transport** is the greatest overall cost component. Optimisation……

- **Alternative** options- **distributed dedicated power generation** (ie biomass gasifiers) to feed in to grid/ mini-grid. CHP and heat/cooling options

Thanks!