Renewable energy and its water requirements in South Africa

A paper presented at the roundtable discussion on the Impacts of Climate Change on Natural Resources, Catholic Parliamentary Liaison Office, Cape Town, 18 March 2016

by

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Acknowledgements

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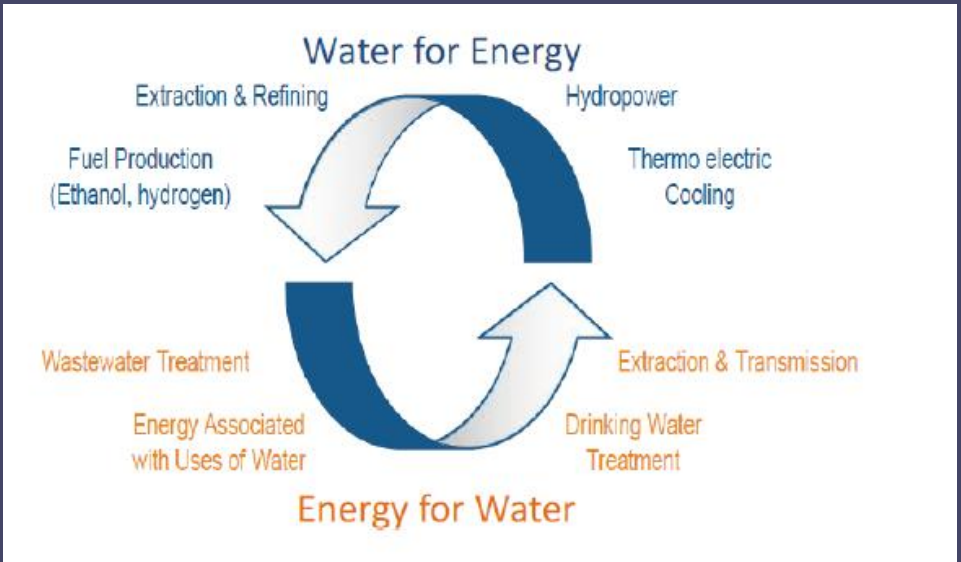
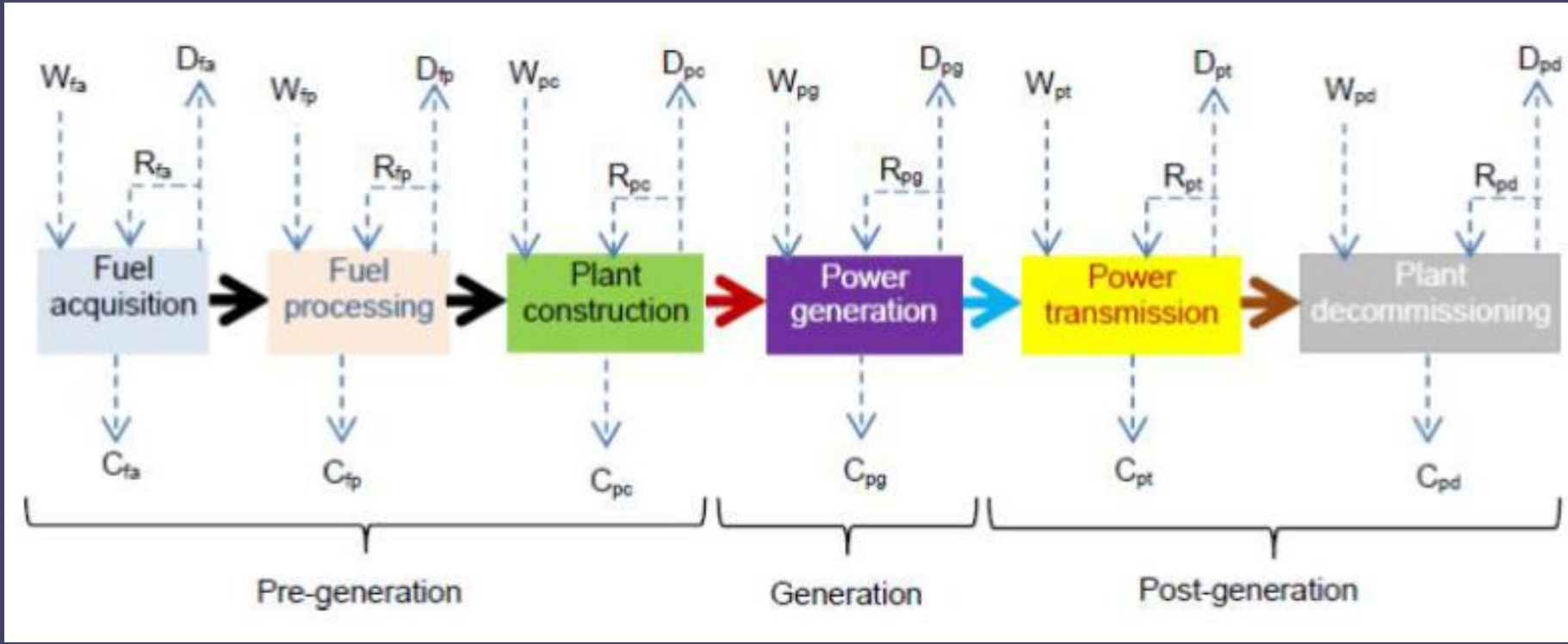
Introduction

- Water and energy are essential for socio-economic development.
- Increasing demand for both water and energy.
- Water scarcity in South Africa (SA).
- Water is required in the energy production chain.
- Energy is also needed in the water production chain.



Introduction (cont'd)

- Focus of this study: Water for energy



Framework for water use analysis in the energy production. C=consumption, D=discharge, R=recycled, W=withdrawal.

Study objective

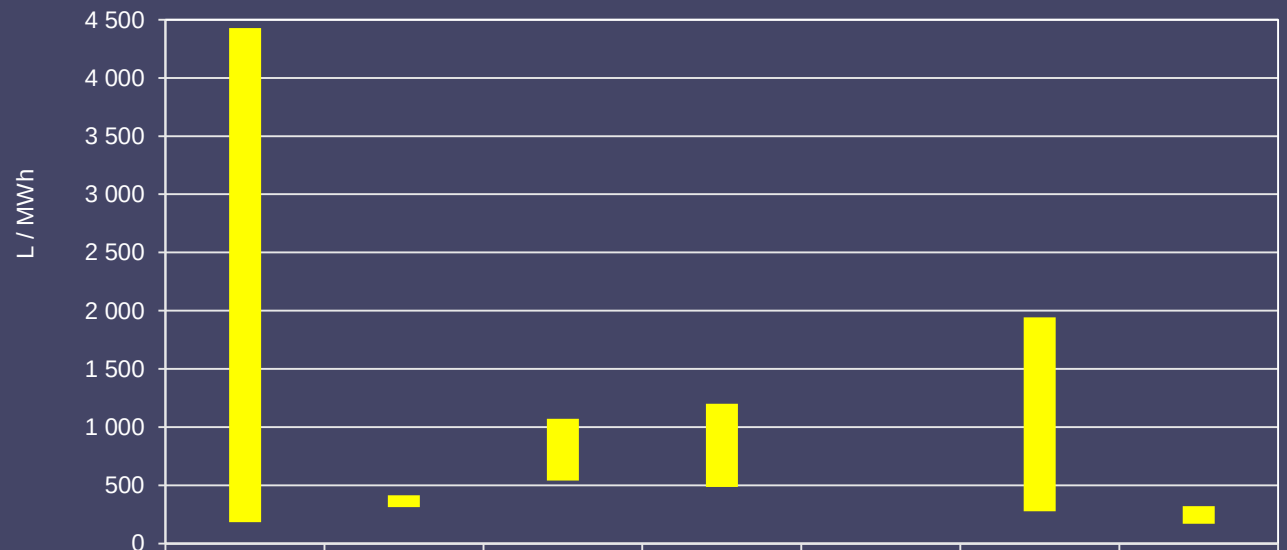
To investigate renewable energy choices & water requirements in South Africa.

Approach

- Desktop (internet, library).
- Interviews with stakeholders (structured questionnaire).
- Workshop (stakeholders eg Eskom & others).
- Considered water for both RE & non-RE technologies.

Findings

- Pre-generation water withdrawal (based on international data)

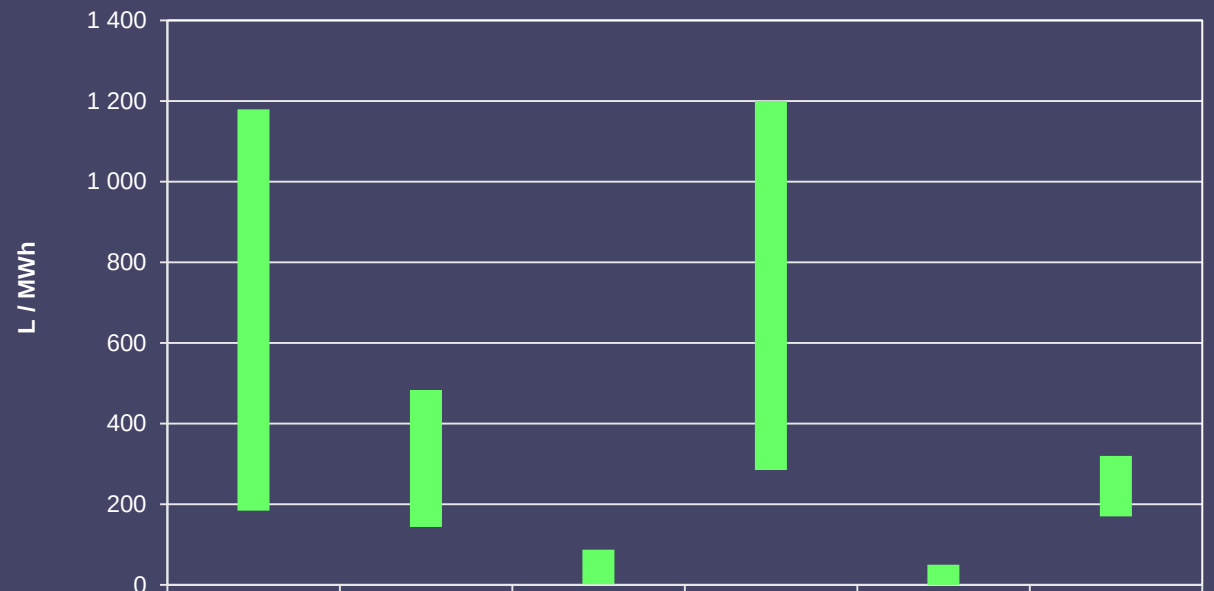


	Coal	Nuclear	Natural gas	CSP	Hydro	PV	wind
Min	184	312	539	485	1	276	170
Max	4 428	415	1 071	1 200	1	1 942	320

Water withdrawal, excluding biomass.

Findings (cont'd)

- Pre-generation water consumption: (based on international data)

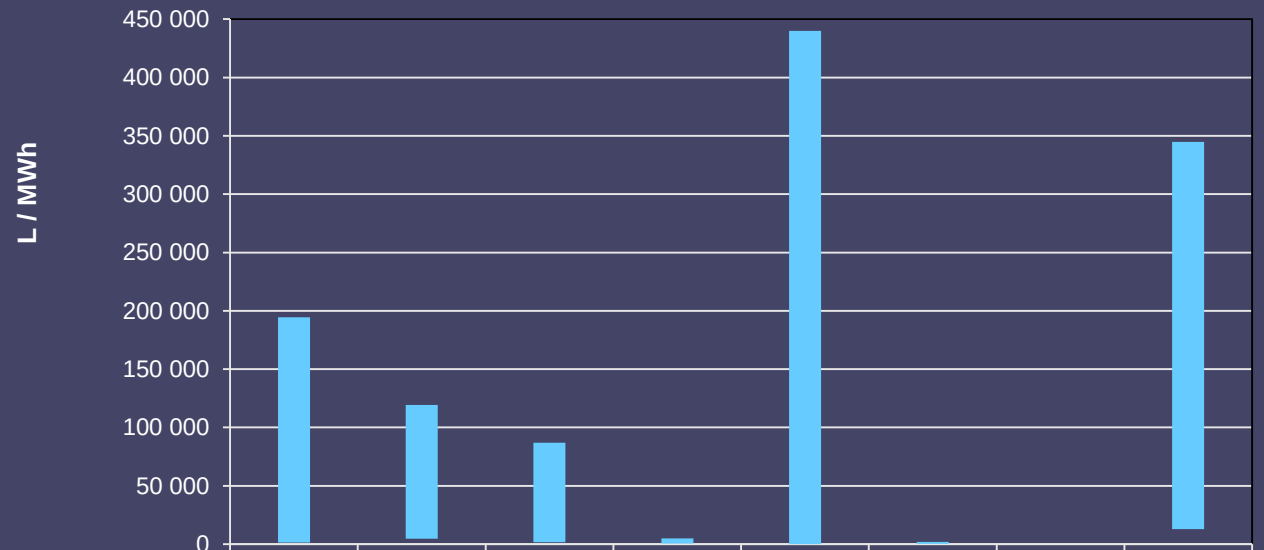


	Coal	Nuclear	Oil/gas	CSP	PV	wind
Min	184	144	2	285	0	170
Max	1 179	483	87	1 200	50	320

Water consumption, excluding biomass.

Findings (cont'd)

- Generation water withdrawal: (based on international data)

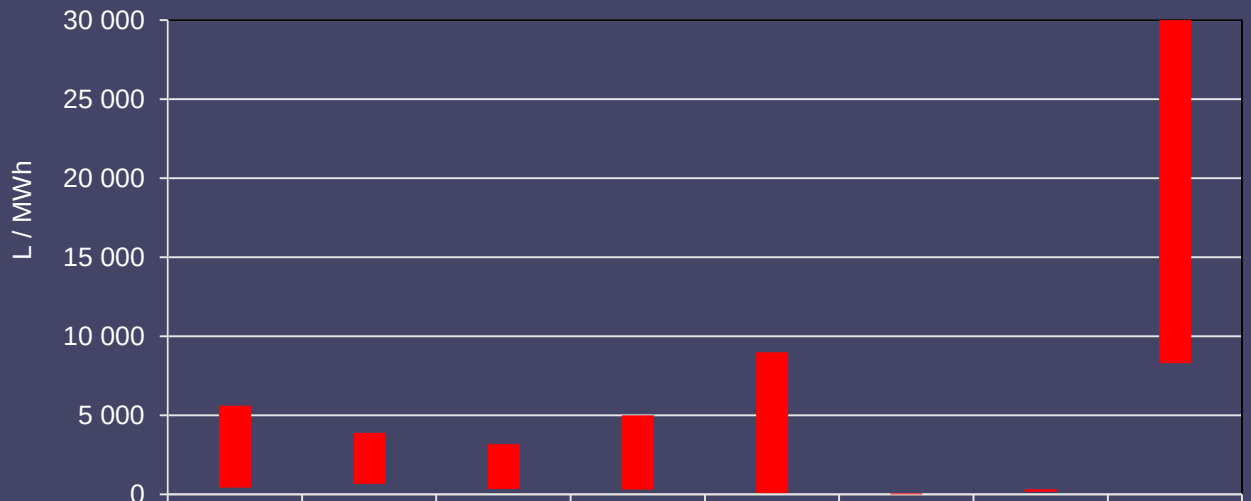


	Coal	Nuclear	Oil/ gas steam	CSP	Hydro	PV	Wind	Geo-thermal
Min	1 284	4 512	1 489	500	80	276	170	12 800
Max	194 428	119 415	86 971	5 000	440 000	1 957	324	344 700

Water withdrawal, excluding biomass.

Findings (cont'd)

- Generation water consumption: (based on international data)

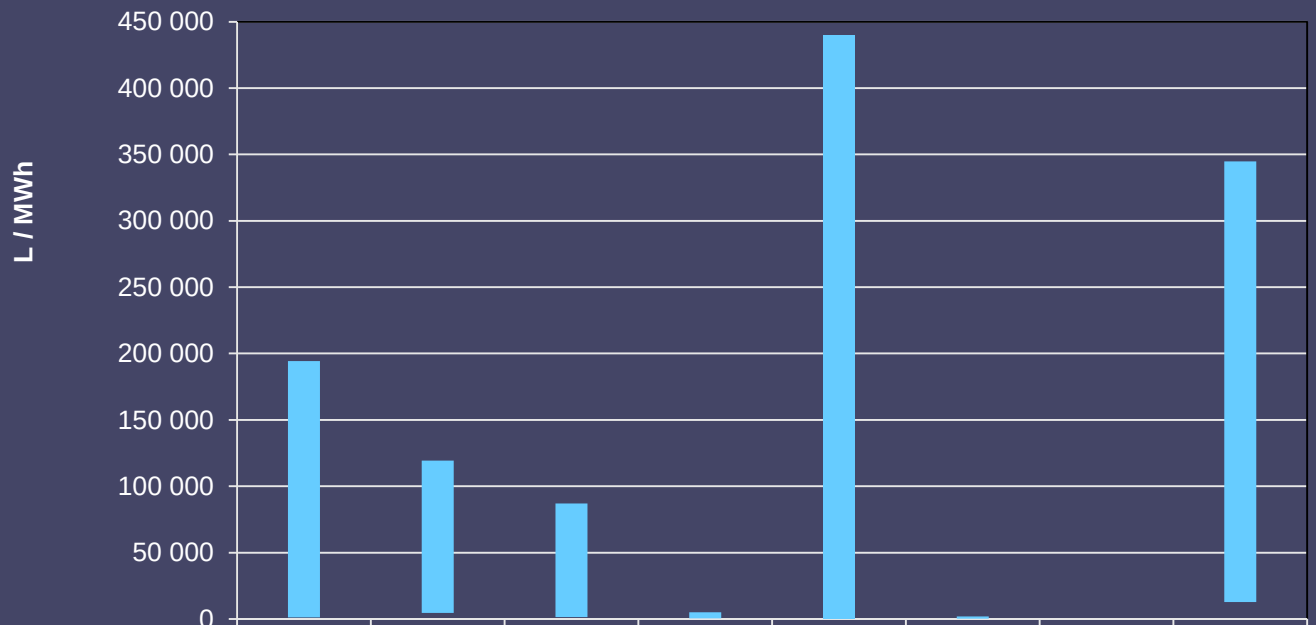


	Coal	Nuclear	Oil/ gas steam	CSP	Hydro	PV	Wind	Geo-thermal
Min	426	674	343	300	80	0	170	8 300
Max	5 609	3 883	3 187	5 000	9 000	65	324	30 000

Water consumption, excluding biomass.

Findings (cont'd)

- Lifecycle water withdrawal (based on international data)



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Findings (cont'd)

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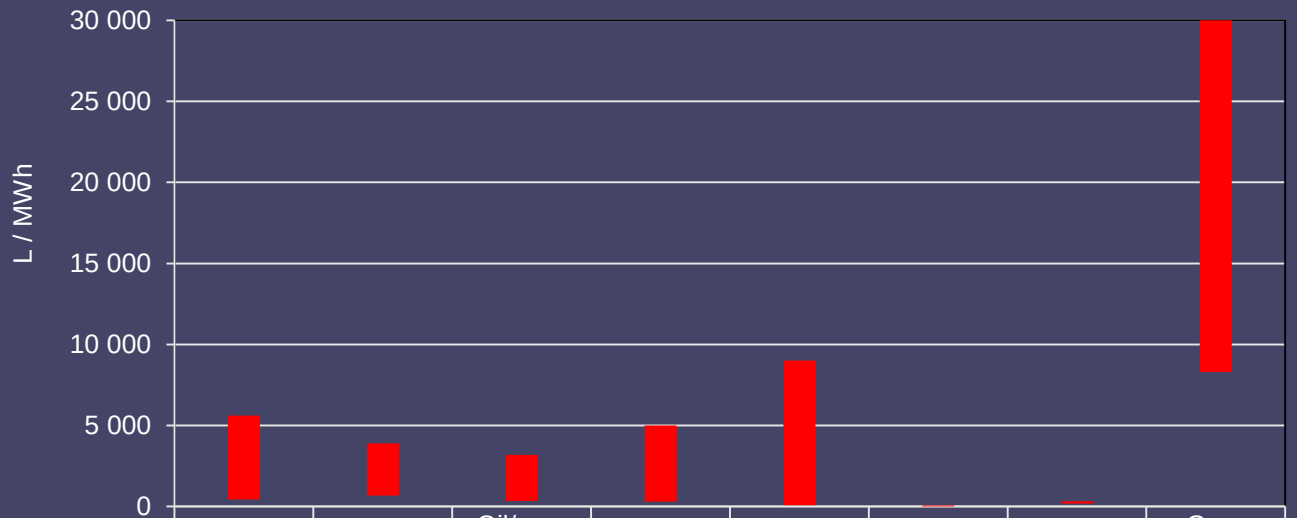

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Water consumption, excluding biomass.

Findings (cont'd)

- Water usage in energy production by using conventional thermal electric cycles in South Africa

Fuel	Energy production stage	Water use[a] L/MWh	Reference
Coal	Pre-generation, mining & washing	183-226	Martin and Fischer (2012)
	Generation, cooling	1 420	Eskom (2013a)
	Generation, dry cooling	100	Eskom (2013b)
	Generation, indirect dry cooling	80	Martin and Fischer (2012)
	Generation, cooling	1 380	Martin and Fischer (2012)
Nuclear	Generation, cooling	192 539	Eskom (2013a)

[a] Sources of this data report it as water use, without specifying whether withdrawal or consumption.

Findings (cont'd)

- There is sporadic data on water usage in renewable energy in SA.

Table 2: Water withdrawal requirements for biofuel production (Source: Gerbens-Leenes et al. 2009).

Biomass	Heat from biomass	Water use L/MWh
Potato	Heat from biomass	108 000
Sorghum	Heat from biomass	176 400
Sugar Cane	Electricity from biomass	176 400
Maize	Electricity from biomass	151 200
Potato	Electricity from biomass	183 600
Sorghum	Electricity from biomass	295 200
Sugar Cane	Bio-ethanol from biomass	352 800
Maize	Bio-ethanol from biomass	334 800
Potato	Bio-ethanol from biomass	183 600
Sorghum	Bio-ethanol from biomass	684 000

Concluding remarks

- Disaggregated data on intensity of water withdrawal, consumption, recycling & discharge is scare.
- Conventional fuels (such as nuclear and fossil fuels) withdraw significant quantities of water over the life cycle of energy production, especially for wet-cooled thermal power plants.
- Solar photovoltaic (PV) and wind energy exhibit the lowest demand for water.

End of presentation

Thanks for your attention

References

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