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CENTRE FOR RENEWABLE &  
SUSTAINABLE ENERGY STUDIES



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# Integration of renewable sources into the SA electricity system

## Opportunities and risks

Prof Bernard Bekker

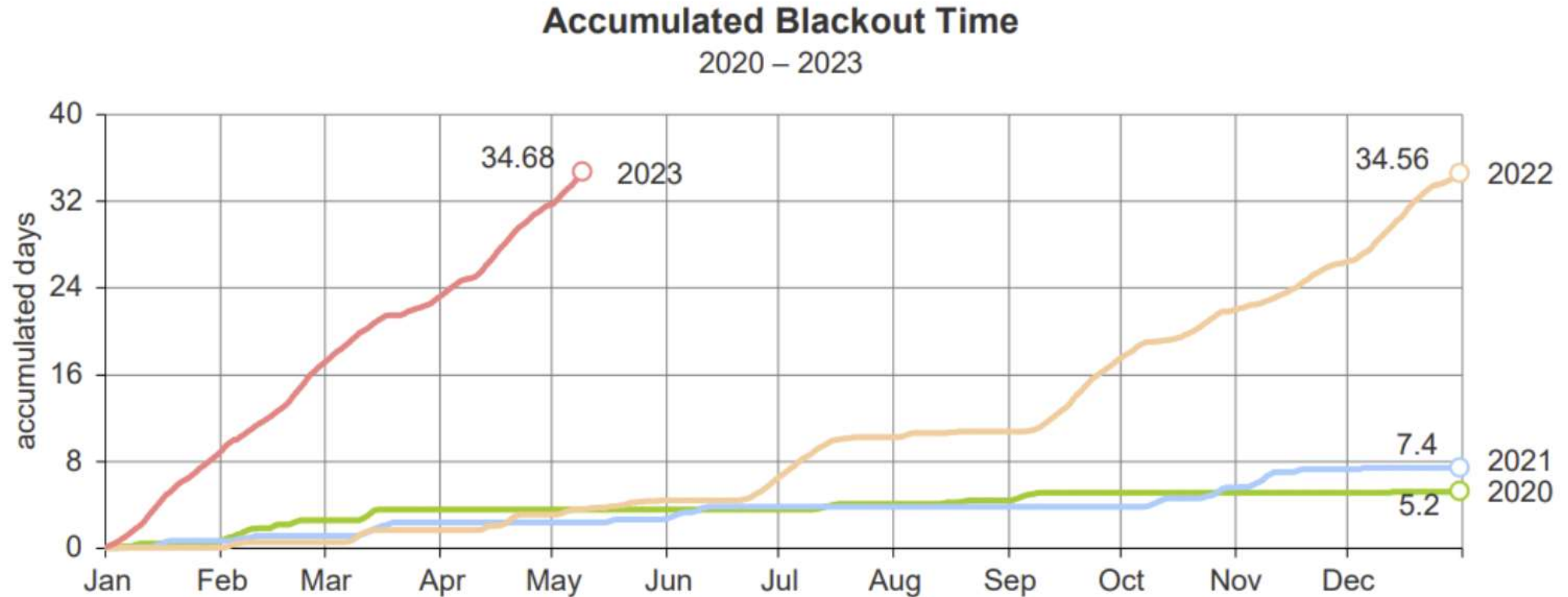
22 August 2023



Photo from fpl.com

# The problem?

## Load-shedding in South Africa

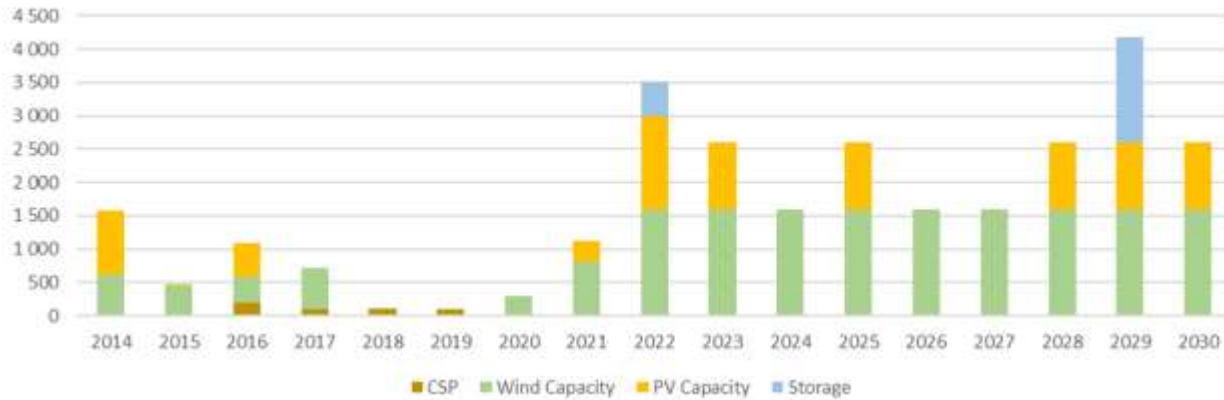


*FIGURE 1: The 2022 record of 829.4 blackout hours (34.56 accumulated days) was surpassed on 9 May 2023. South Africa spent 9.5% of 2022 and to date, 26.9% of 2023 without utility power.*

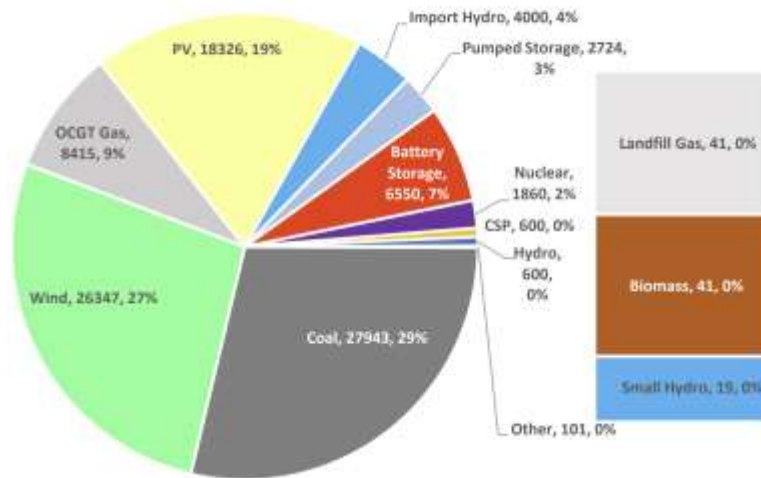
# Renewables a part of the solution?

## South African policy makers certainly think so

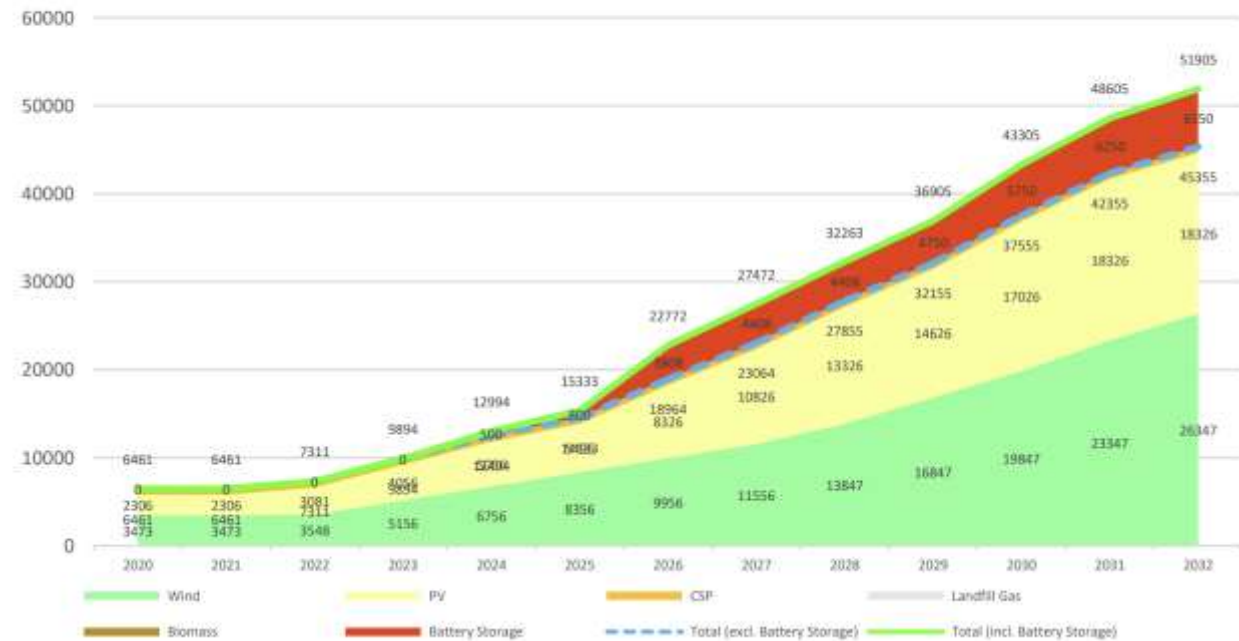
New RE capacity installed and projected (IRP2019)



Generation Capacity Composition 2032

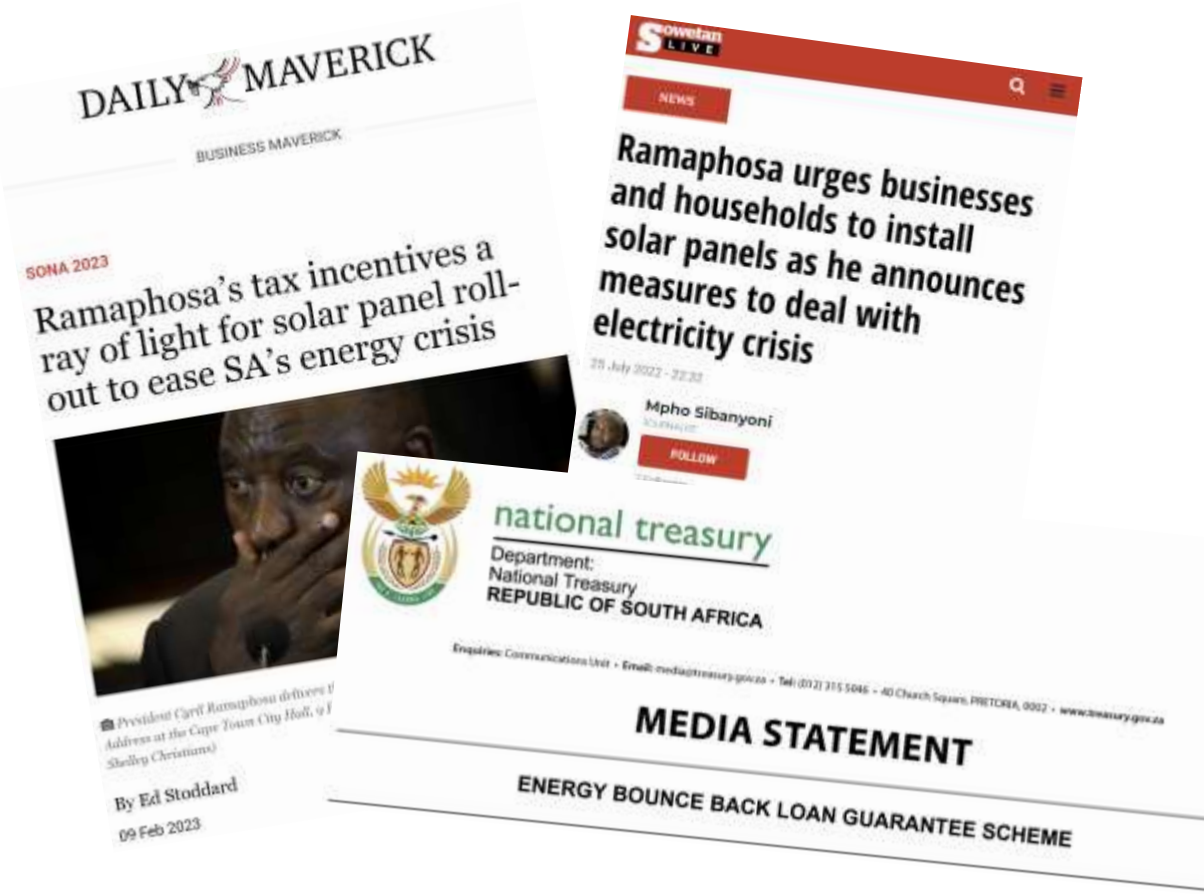


Cumulative Renewable Energy up to 2032



# Behind-the-meter solar PV

## Currently strongly incentivised, and booming

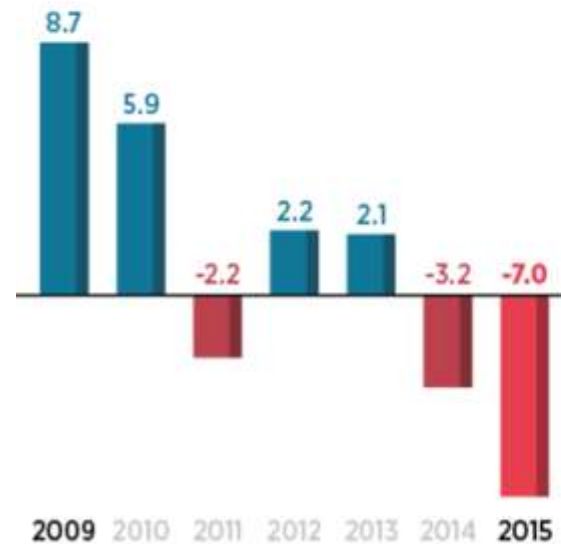


	Cummulative				
	CSP	Wind	PV	BTM PV	Storage
2014	0	614	960	27	0
2015	0	1 070	965	131	0
2016	200	1 460	1 474	251	0
2017	300	2 078	1 474	387	0
2018	400	2 080	1 474	562	0
2019	500	2 080	1 474	742	0
2020	500	2 380	1 474	922	0
2021	500	3 473	2 306	1 102	0
2022	500	3 473	2 306	2 586	0
Aug 2023	500	3 473	2 306	4 740	0
2024	600	6 756	5 056		513
2025	600	8 356	5 495		800
2026	600	9 956	8 326		3 808
2027	600	11 556	10 826		4 408
2028	600	13 847	13 326		4 408
2029	600	16 847	14 626		4 750
2030	600	19 847	17 026		5 750
2031	600	23 347	18326		6 250
2032	600	26 347	18326		6 550

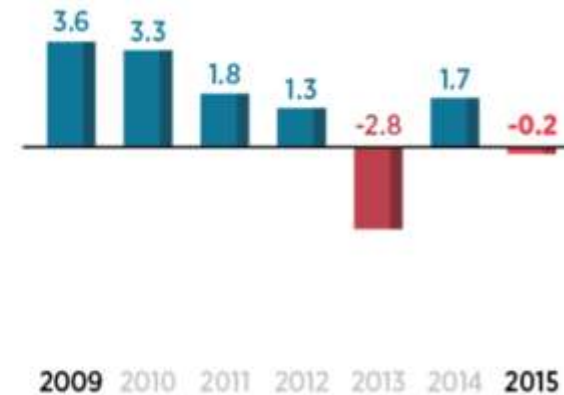
Grayed out: TDP 2022, Actuals from various Eskom sources

# Will BTM solar PV solve load-shedding? What happened in other countries

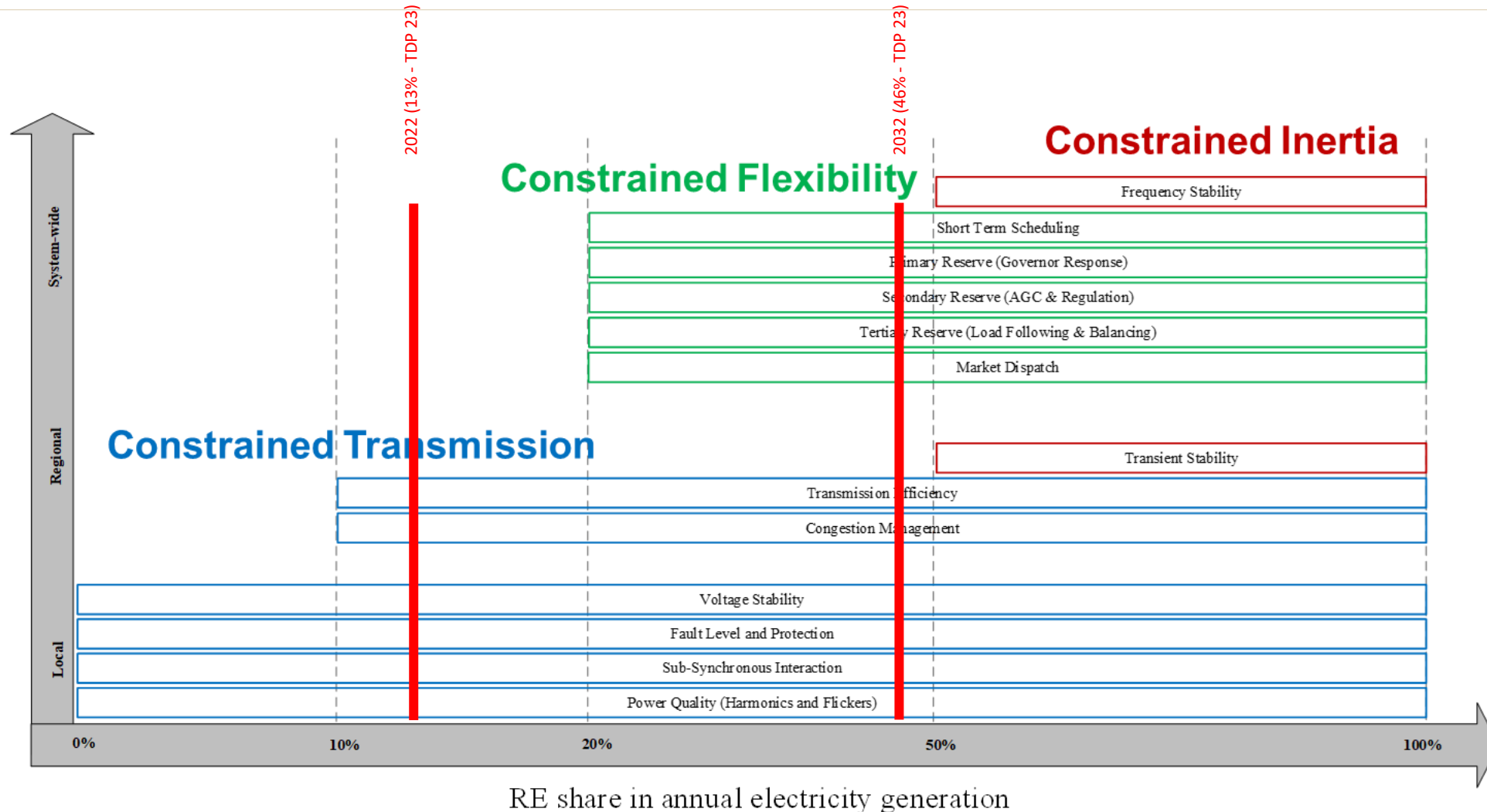
E.ON annual net results,  
in € bln



RWE annual net results,  
in € bln



# Will BTM solar PV solve load-shedding? What happened in other countries

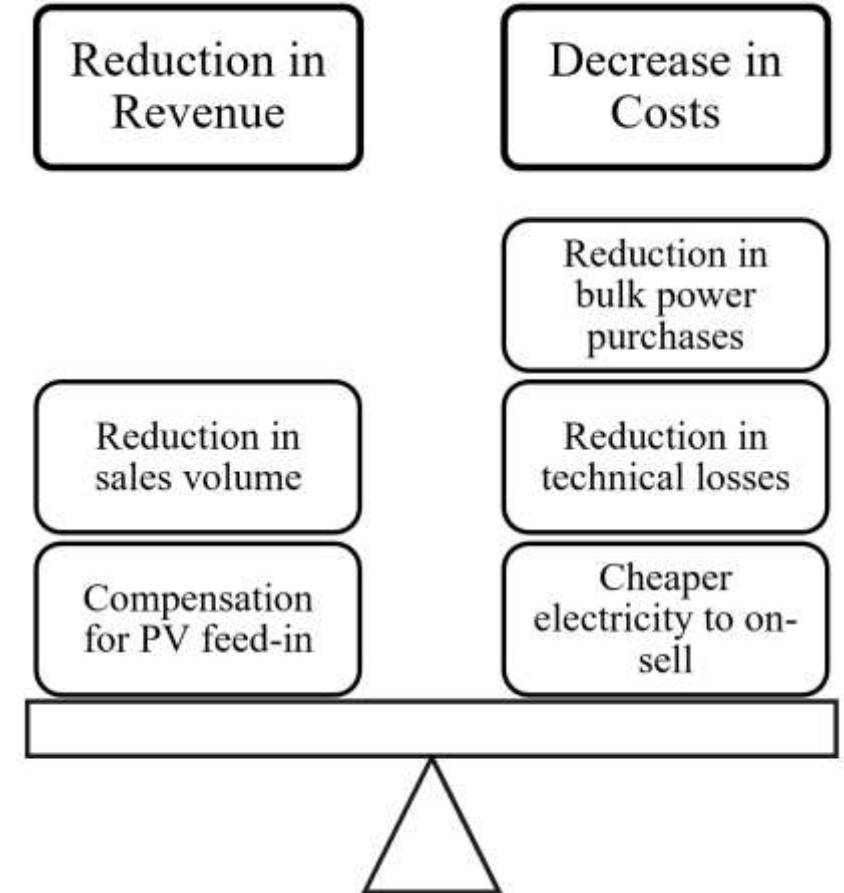


# Will BTM solar PV solve load-shedding? What happened in other countries

- Financial viability
- Hosting capacity constraints
- Flexibility

# Financial viability

## How will municipal revenue be impacted?





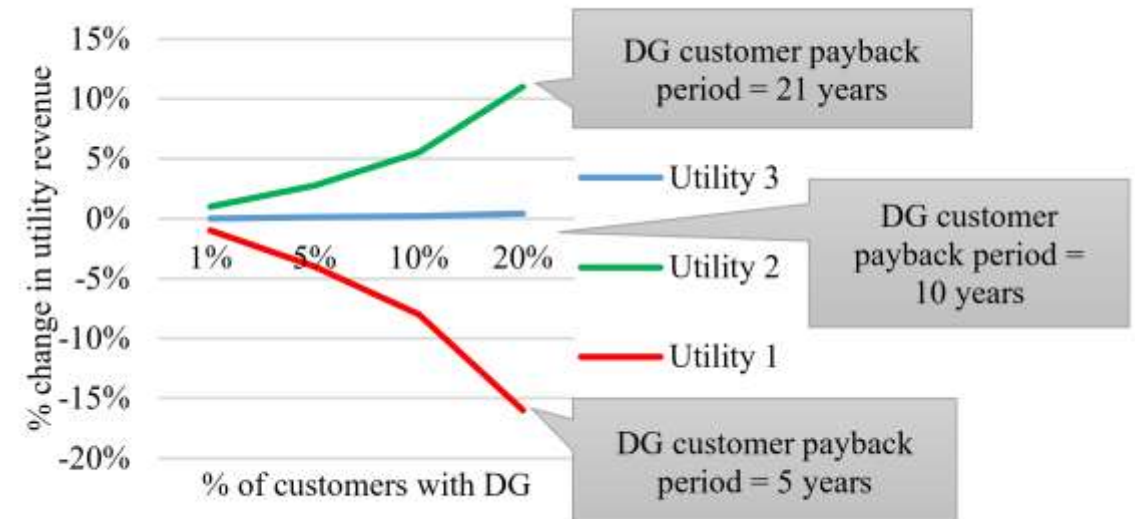
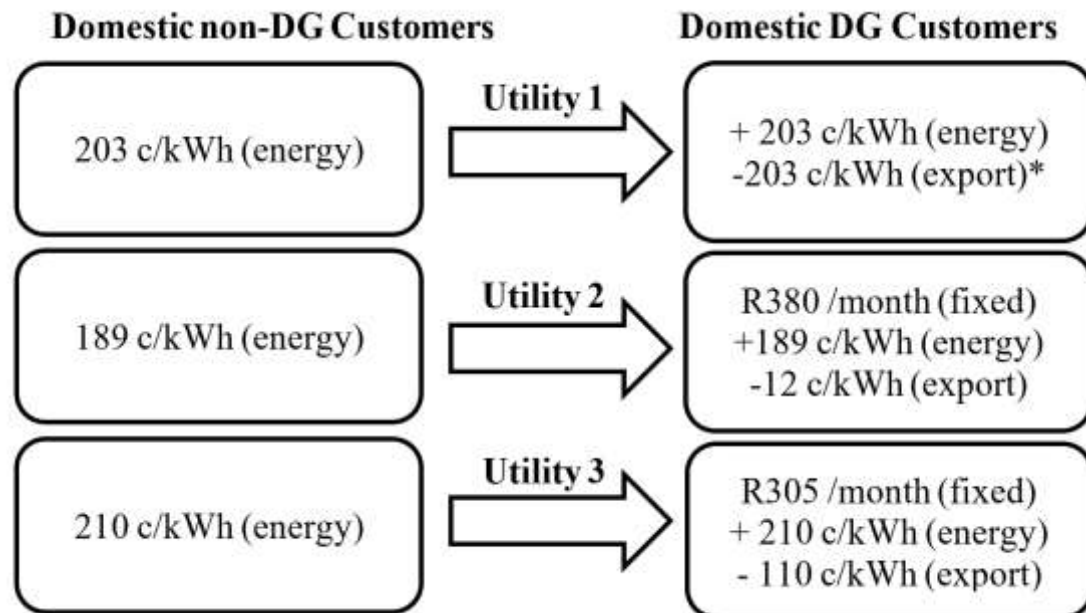
# Financial viability

Sustainable transaction = both parties win

Utility 1: Do Nothing

Utility 2: Introduce Fixed Charges to Offset Reduced Sales

Utility 3: Incentivise DG Excess Feed-In



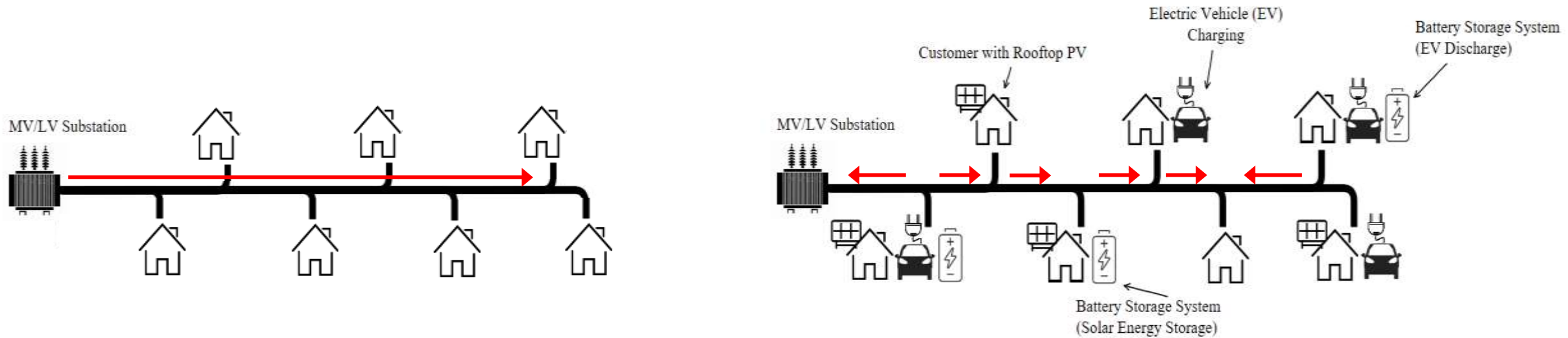
# Key messages

## Financial viability

- Fair and responsive electricity pricing design

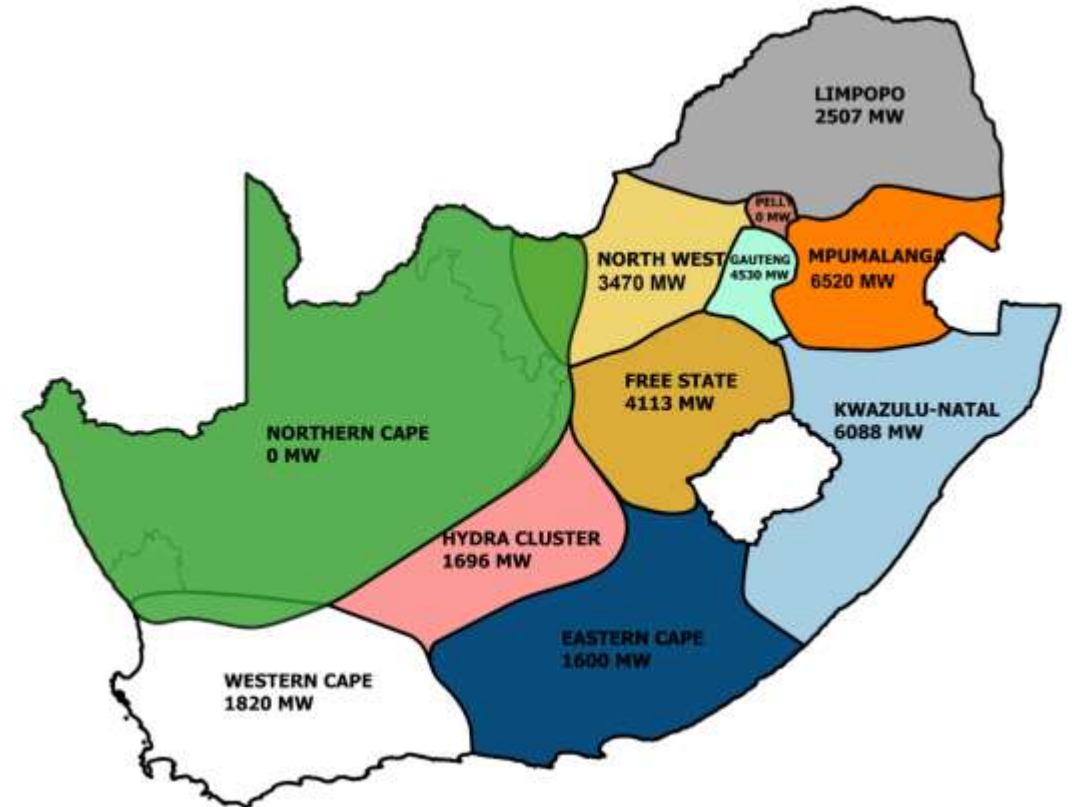
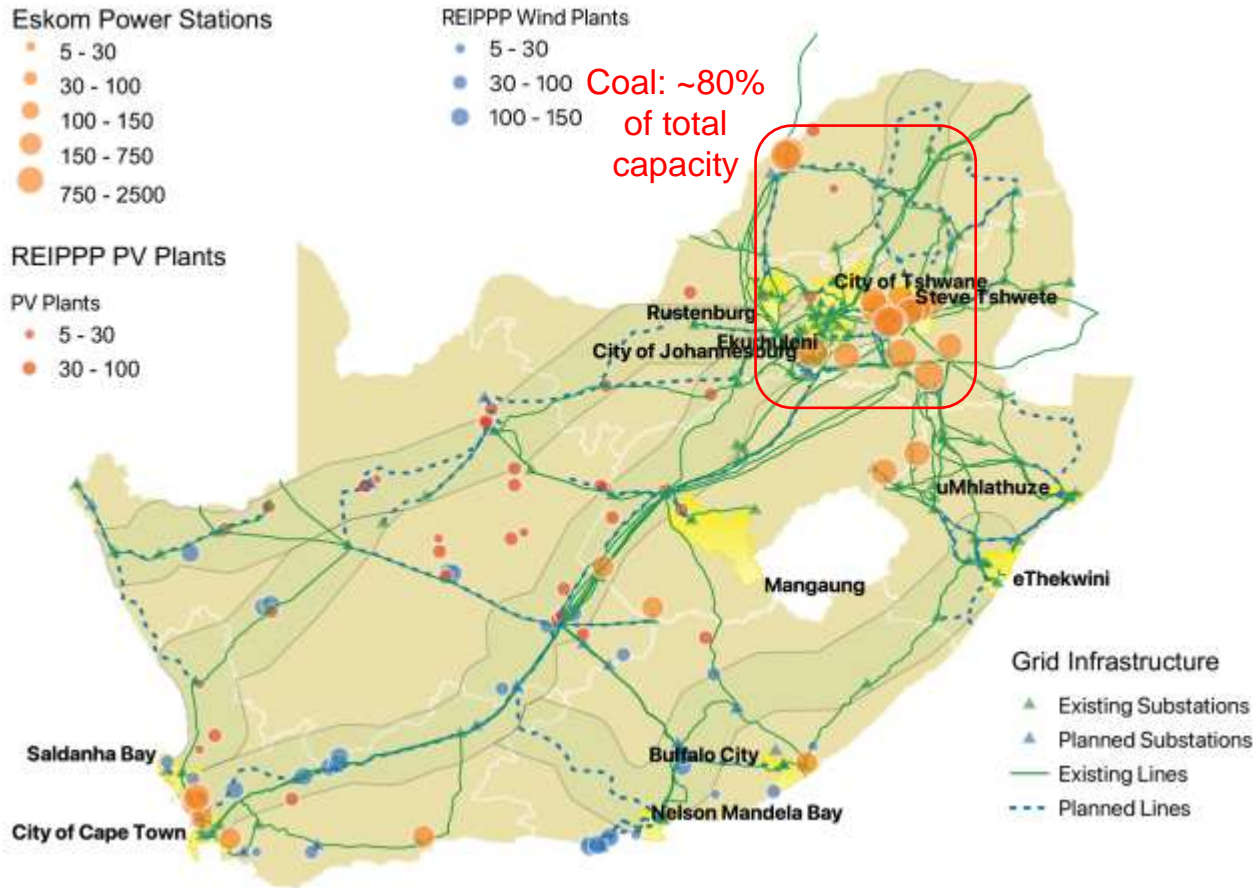
# Hosting capacity constraints

## A paradigm shift from central to distributed



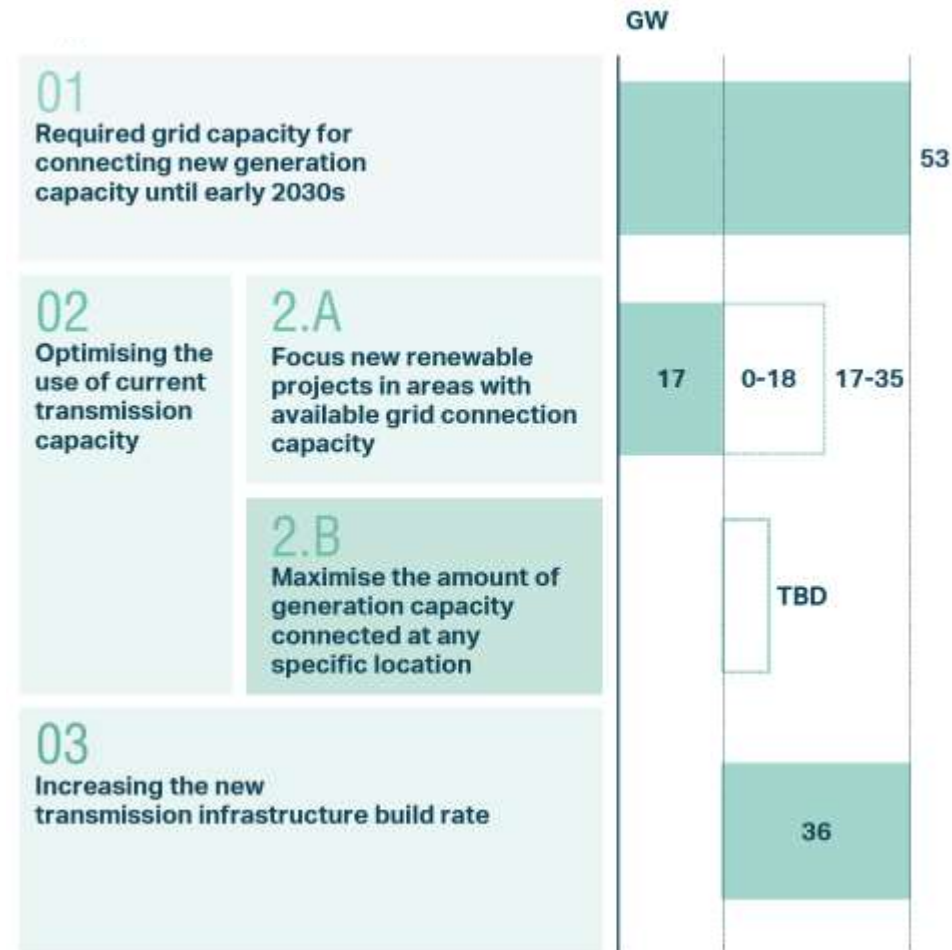
# Hosting capacity constraints

## The SA power system needs to adapt



# Hosting capacity constraints

## The SA power system needs to adapt



# Key messages

## Financial viability

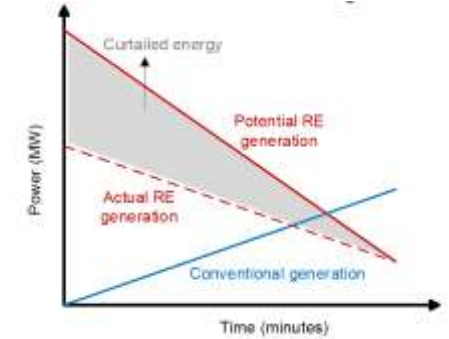
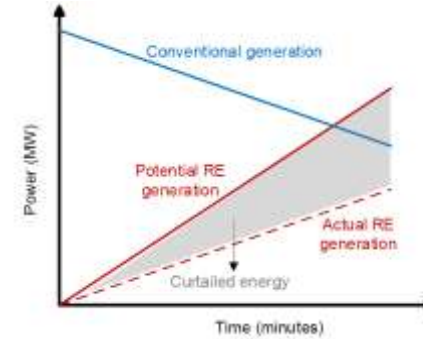
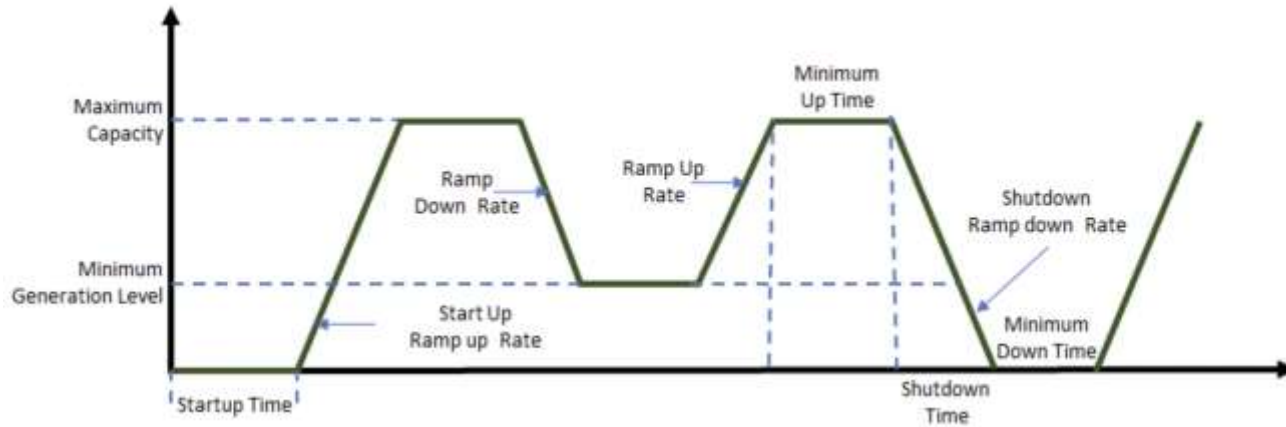
- Fair and responsive electricity pricing design

## Hosting capacity constraints

- More detailed modelling to understand bottlenecks
- Optimise the use of current transmission capacity
- Visibility and control of renewable energy inverters on the network
- Updated regulations

# System flexibility

## All generation technologies are not equal



Coal generation



OCGT or CCGT generation

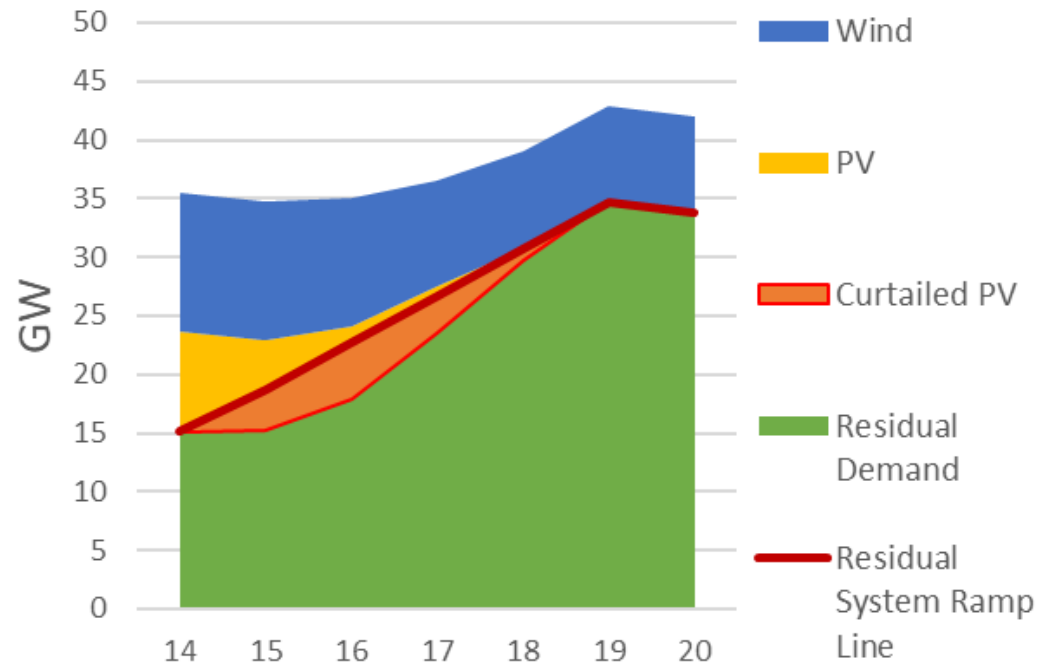


Wind or solar PV generation

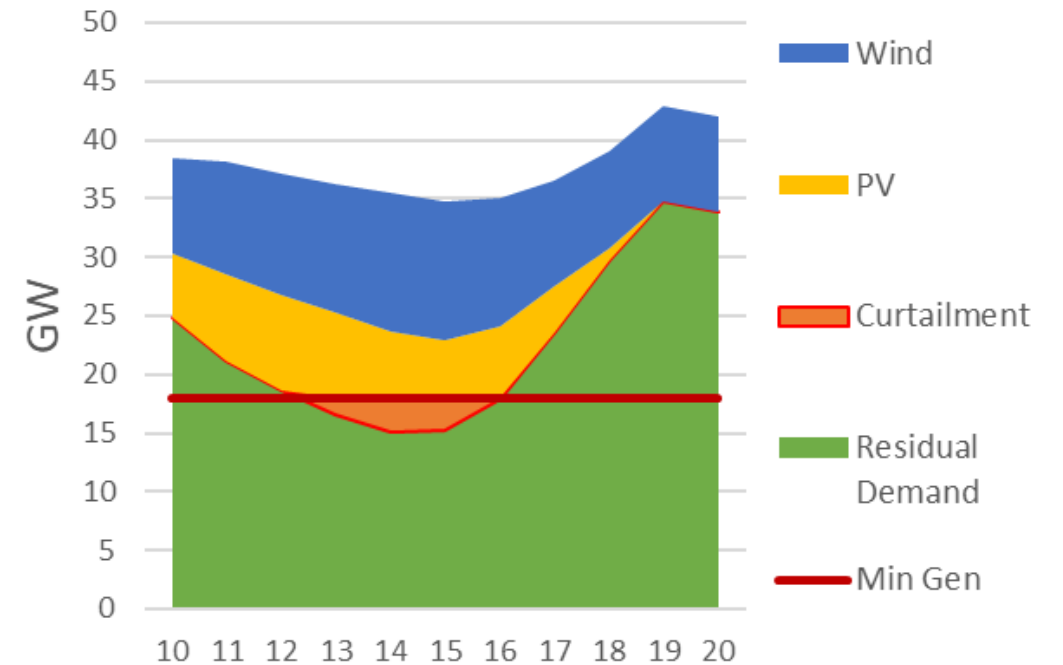
# System flexibility

## The future is curtailment

### Ramping limit curtailment



### Min Gen Curtailment





# System flexibility

## The problem: who will be curtailed first?

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Grayed out: TDP 2022, Actuals from various Eskom sources

Behind-the-meter solar PV that is mostly not visible and cannot be controlled and curtailed

REIPPPP plants that are typically on a “take-or-pay” contract with Eskom

- Easiest to curtail
- Cheaper energy than behind-the-meter due to economies of scale

# Key messages

## Financial viability

- Fair and responsive electricity pricing design

## Hosting capacity constraints

- More detailed modelling to understand bottlenecks
- Optimise the use of current transmission capacity
- Visibility and control of renewable energy inverters on the network
- Updated regulations

## System flexibility

- Well-considered updated Integrated Resource Plan
- Visibility and control of renewable energy inverters on the network

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Thank you  
Enkosi  
Dankie