

# Statistics of utility-scale power generation in South Africa

**H1-2021**

(1 Jan 2021 – 30 June 2021)

**CSIR Energy Centre**  
v1.0

**July 2021**

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**CSIR**

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## Summary of H1-2021 statistics:

### A difficult first half of 2021 as extensive loadshedding continued but record relative VRE contributions and diesel usage was recorded

#### By H1-2021 – South Africa had 52.6 GW of wholesale/public nominal capacity

- Coal nominal capacity is 38.7 GW
- Nuclear nominal capacity is 1.9 GW
- Diesel (OCGT) nominal capacity is 3.4 GW
- Hydro nominal capacity is 0.6 GW hydro and pumped storage is 2.7 GW
- Wind nominal capacity is 2.6 GW
- Solar PV nominal capacity is 2.2 GW
- CSP nominal capacity is 0.5 GW
- 725 MW of coal, 118 MW of wind and 54 MW of utility-scale solar PV became operational in H1-2021

#### The electricity mix is dominated by coal-fired power generation which contributed 83.5% to system demand in H1-2021

- Coal energy contributed 81.8% (94 TWh)
- Nuclear energy contributed 3.7% (4.3 TWh)
- Renewable energy contributed 11% (12.4 TWh)
- Variable renewable energy contributed 6.0% (6.8 TWh)
- The remaining 1.7% came from diesel (1.9 TWh)

## Summary of 2020 statistics:

### System demand recovered notably in H1-2021 2020 but not yet to 2019 levels

**In H1-2021, system demand increased by 5.4 TWh relative H1-2020 (5.0%) but was 2.5 TWh less than that experienced in H1-2019 (-2.2%)**

**In H1-2021, the VRE fleet of 5.3 GW (wind, solar PV, CSP) reduced peak demand slightly but more importantly high demand hours by ~65%**

- VRE fleet reduced peak demand by ~0.3 GW
- VRE fleet also reduced high-demand hours (hours with >30 GW system demand) from 280 hours to 97 hours (~183 hours less, -65%)

**Flexibility needs are not yet significantly increased with the existing VRE fleet in H1-2021**

- Minimum system demand was 18.5 GW whilst residual demand minimum was 17.1 GW (relative to minimum system demand of 14.9 GW and residual demand of 13.8 GW seen in 2020 due to reduced economic activity during extreme lockdown conditions)

## Summary of 2021 statistics:

**H1-2021 saw 650 hours of loadshedding (upper limit 1284 GWh) whilst actually achieved is estimated at 963 GWh**

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**In H1-2021, loadshedding occurred for 650 hours (15% of the time) with an upper limit of 1284 GWh relative to actual energy shed of 963 GWh**

- Intensive loadshedding has been experienced in H1-2021 alone (76% of 2020 loadshedding)
- Loadshedding dominated by Stage 2 type loadshedding
- Loadshedding occurred for 15% of the hours in H1-2021

**Eskom fleet EAF declining trend continues and drove loadshedding events in H1-2021 with specific concerns surrounding UCLF trends**

- Eskom fleet average EAF of 61.3% for H1-2021 (relative to 2020 of 65%, 2019 of 66.9% and 2018 of 71.9%)
- EAF planned maintenance at 11.0% (PCLF), unplanned outages at 24.5% (UCLF) & other outages at 3.2% (OCLF)
- The best hourly EAF of H1-2021 was 73.7% and worst was 51.5%
- Continued shift from similar distributions of PCLF and UCLF in 2017 towards increasing UCLF levels have continued where in H1-2021 a distinct separation in distribution of UCLF and PCLF has become clear (UCLF was >10 000 MW for 81% of H1-2021 hours)

NOTES: EAF - Energy Availability Factor; PCLF - Planned capability Loss Factor;  
Excludes Embedded Generation (EG) and Distributed Generation (DG); H1 – 1st half of 2021 (1 Jan 2021 – 30 June 2021)  
UCLF – Unplanned Capability Loss Factor; OCLF – Other Capability Loss Factor; EAF = 100%-PCLF-UCLF-OCLF

# Agenda

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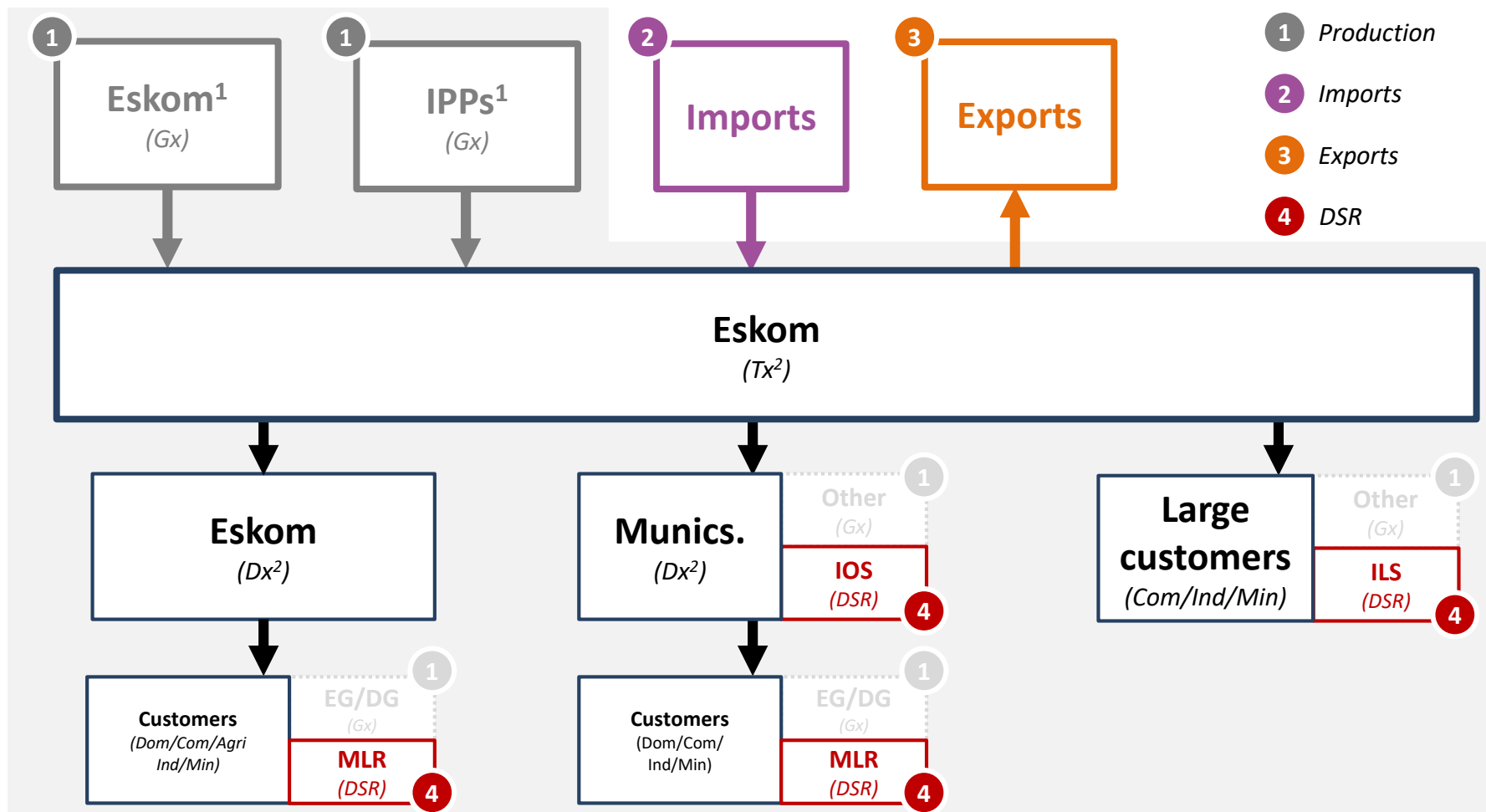
- 1 Overview actual electricity production (2021-H1)
- 2 Monthly electricity production (2021-H1)
- 3 Weekly electricity production (2021-H1)
- 4 Daily electricity production (2021-H1)
- 5 Hourly electricity production (2021-H1)
- 6 Actual load shedding (2021-H1)
- 7 Other power system statistics

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- 1 Overview actual electricity production (2021-H1)
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# Equivalent wholesale South African production and demand as measured & published by Eskom



EG = Embedded Generation; DG = Distributed Generation; Gx = Generation; Tx = Transmission; Dx = Distribution;

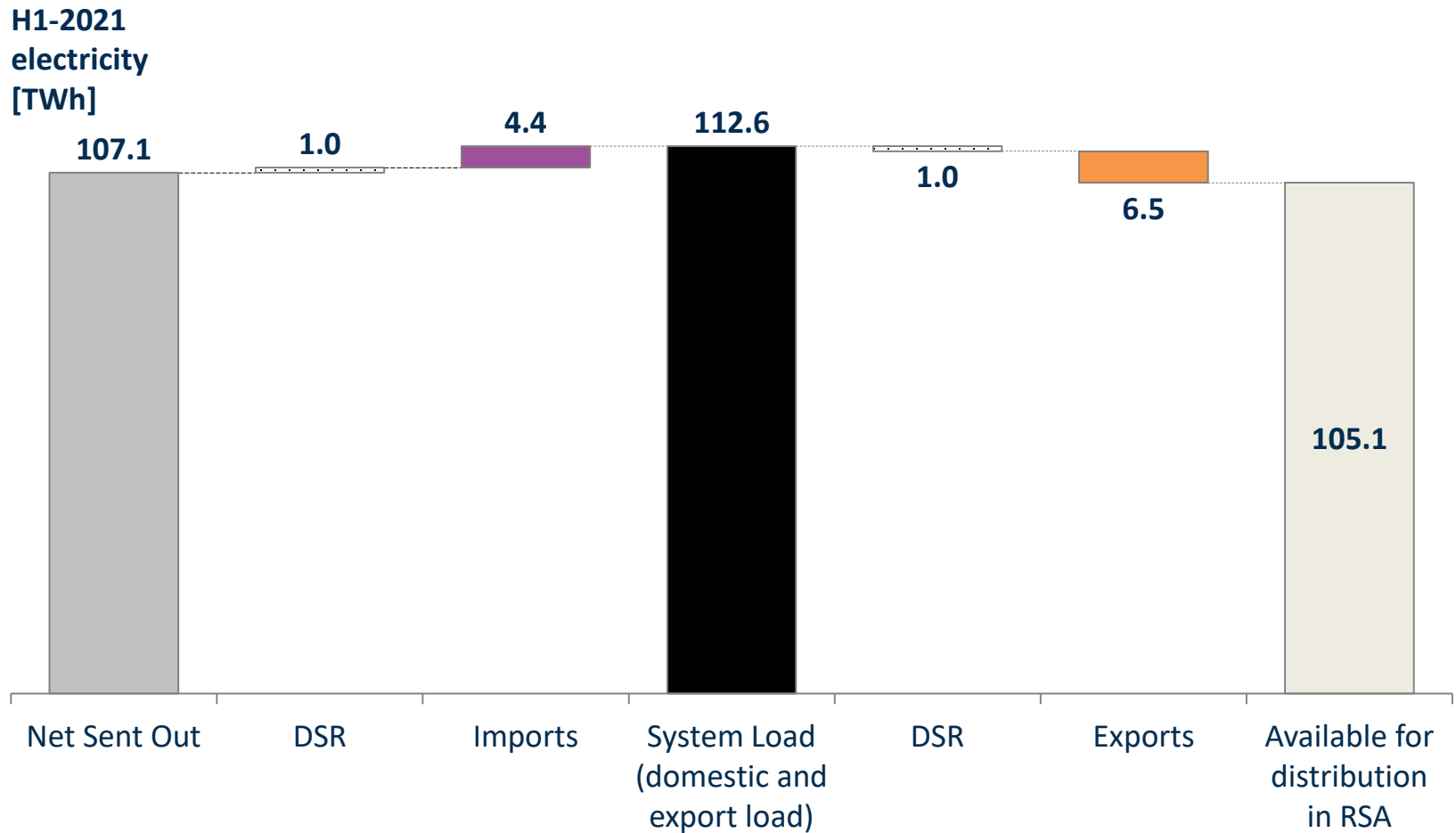
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS);

NOTES: Items in light faded gray are NOT included in statistics presented in this publication.

<sup>1</sup> Power generated less power station load (auxillaries); Minus pumping load (Eskom owned pumped storage); <sup>2</sup> Transmission/distribution networks incur losses before delivery to customers

# From Jan-Jun 2021, 113 TWh of net electricity was produced in SA

Actuals captured in wholesale market for Jan-Jun 2021 (i.e. without self-consumption of embedded plants)



2020 (full-year)	220.6	1.4	10.0	230.6	1.4	13.7	207
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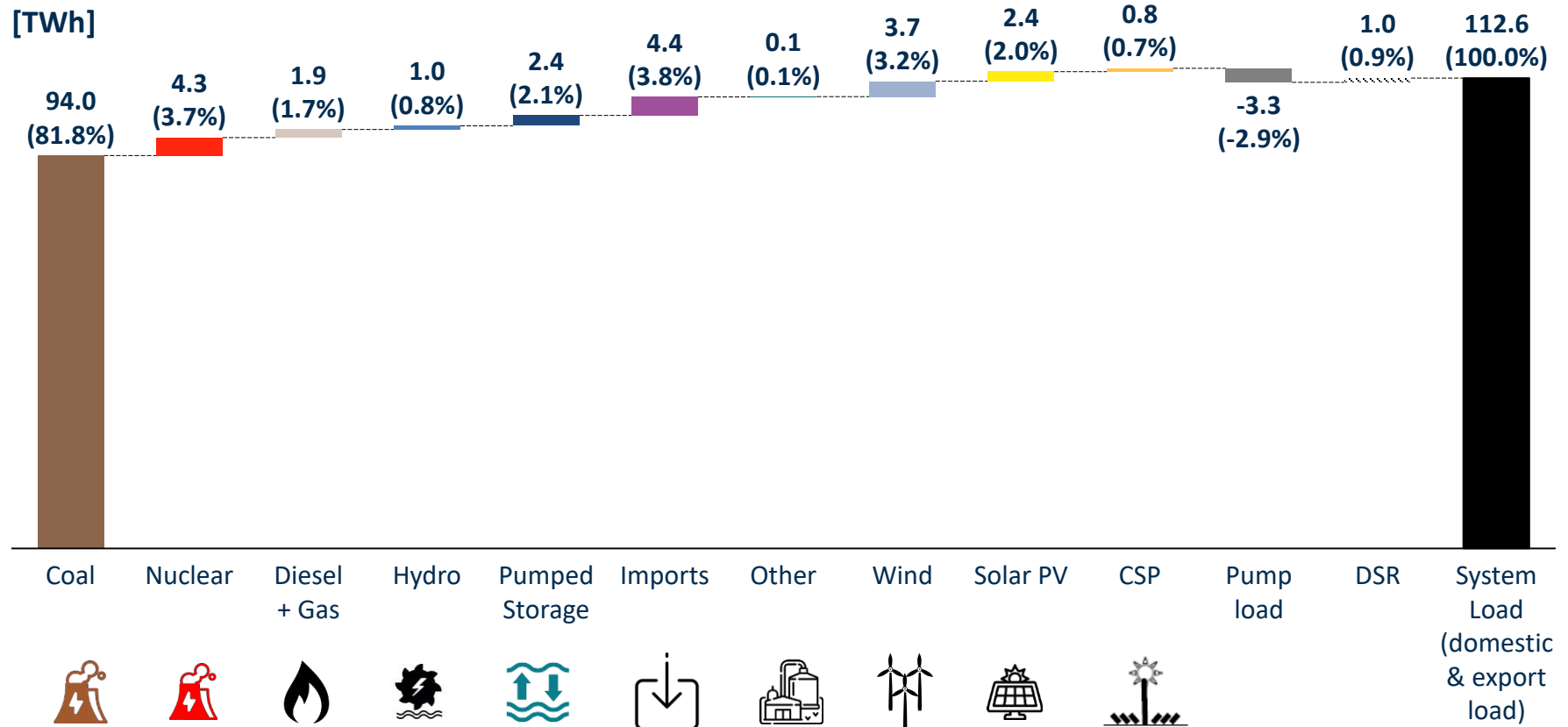
Notes: "Net Sent Out" = Total domestic generation (Sent Out) minus pumping load (not shown); Demand not served is excluded = Interruptible load supply (ILS) + manual load reduction (MLR)  
Sources: Eskom; Statistics South Africa for imports and exports



# In H1-2021, coal dominated the energy mix at 82% of the 112 TWh of total system load met whilst PV, wind and CSP contributed 6.0%

Actuals captured in wholesale market for Jan-Jun 2021 (i.e. without self-consumption of embedded plants)

H1-2021  
electricity  
[TWh]



2020  
(full-year)

184.4	11.5	1.9	0.8	5.1	9.9	0.1	6.6	4.1	1.6	-6.8	1.4	220.6
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Notes: Wind includes Eskom's Sere wind farm (100 MW). Wind and solar PV energy excludes curtailment and is thus lower than actual wind and solar PV generation. PS = pumped storage

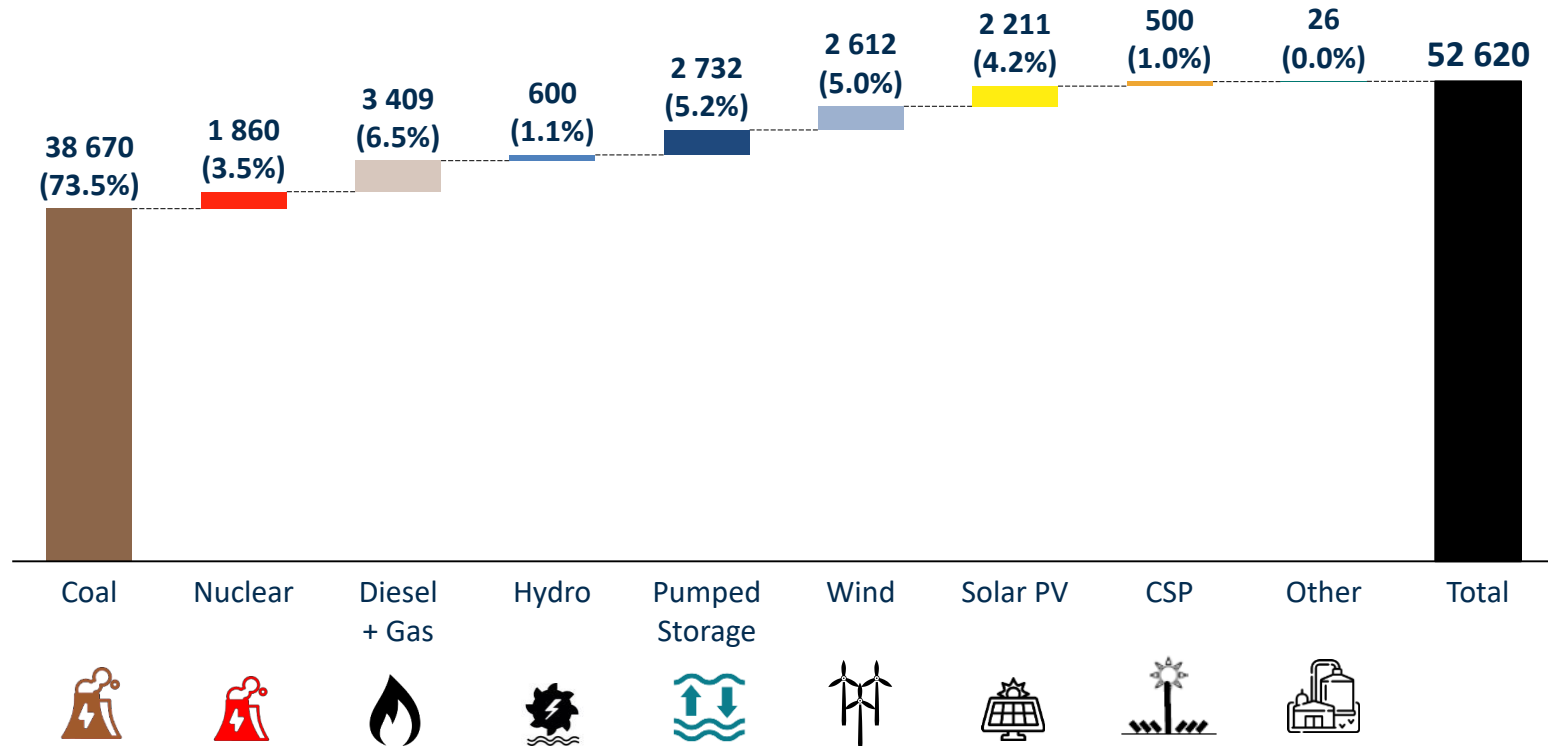
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom

# Nominal capacity by end of H1-2021

Actual nominal installed capacity as at 30 June 2021 (excluding embedded generation capacity and private capacity)

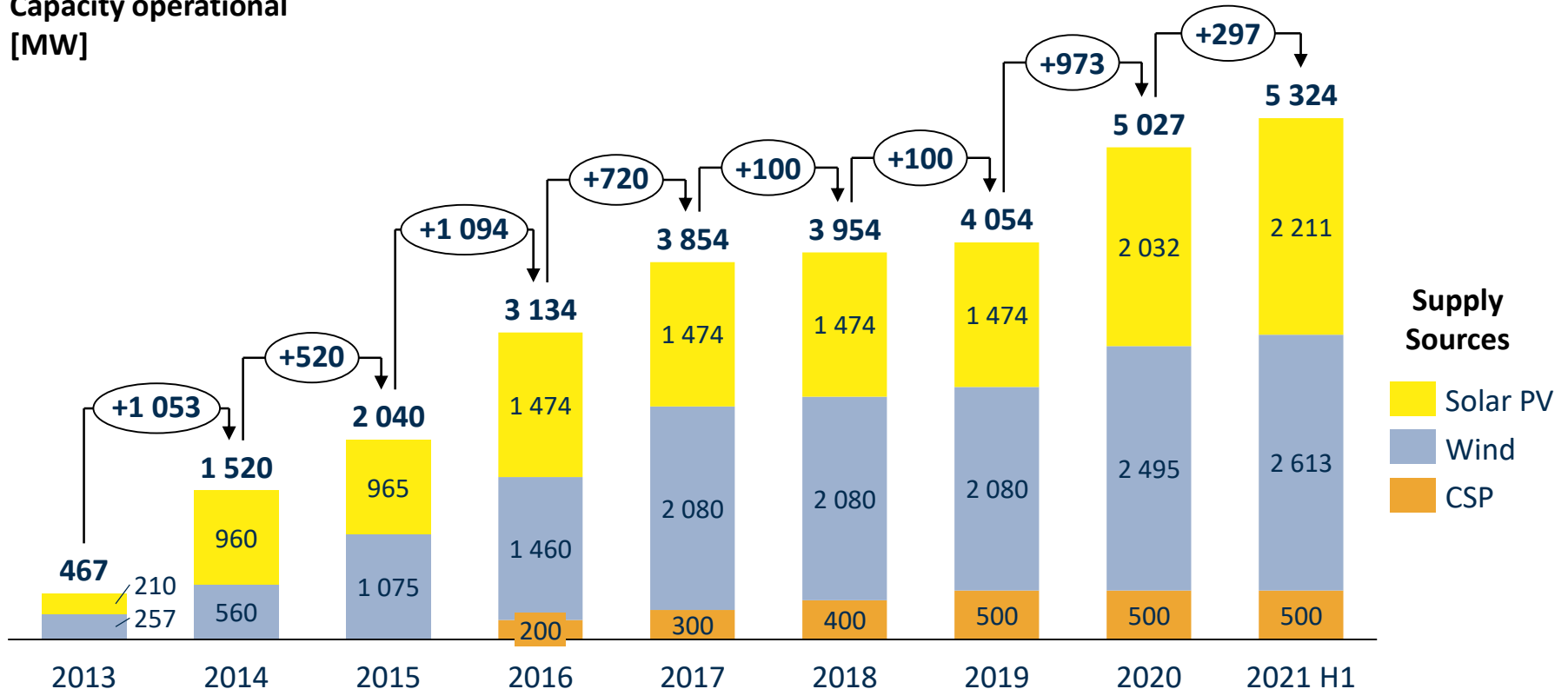
Nominal Capacity [MW]



Notes: RE = Renewable Energy; Total nominal installed capacity = Eskom capacity + IPPs; Embedded generation and municipal-owned capacity excluded  
Sources: Eskom

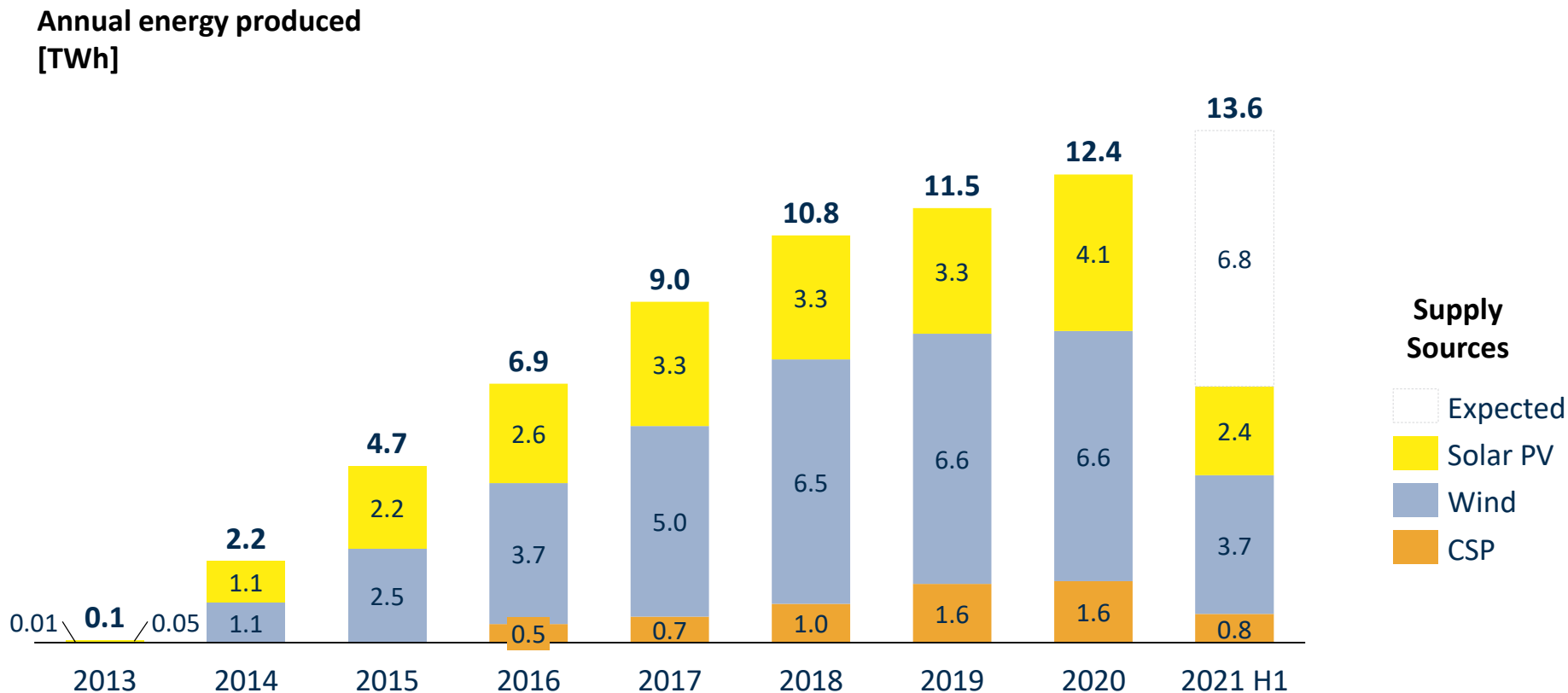
# From 1 Nov 2013 to 30 Jun 2021, 2 613 MW of wind, 2 211 MW of large-scale solar PV and 500 MW of CSP became operational in RSA

Capacity operational  
[MW]



Notes: RSA = Republic of South Africa. Solar PV capacity = capacity at point of common coupling. Wind includes Eskom's Sere wind farm.  
Sources: Eskom; DoE IPP Office

# In H1 2021 – 6.8 TWh of wind, solar PV & CSP energy produced in RSA



Notes: Wind includes Eskom's Sere wind farm (100 MW). CSP energy measured from date when more than two CSP plant were commissioned

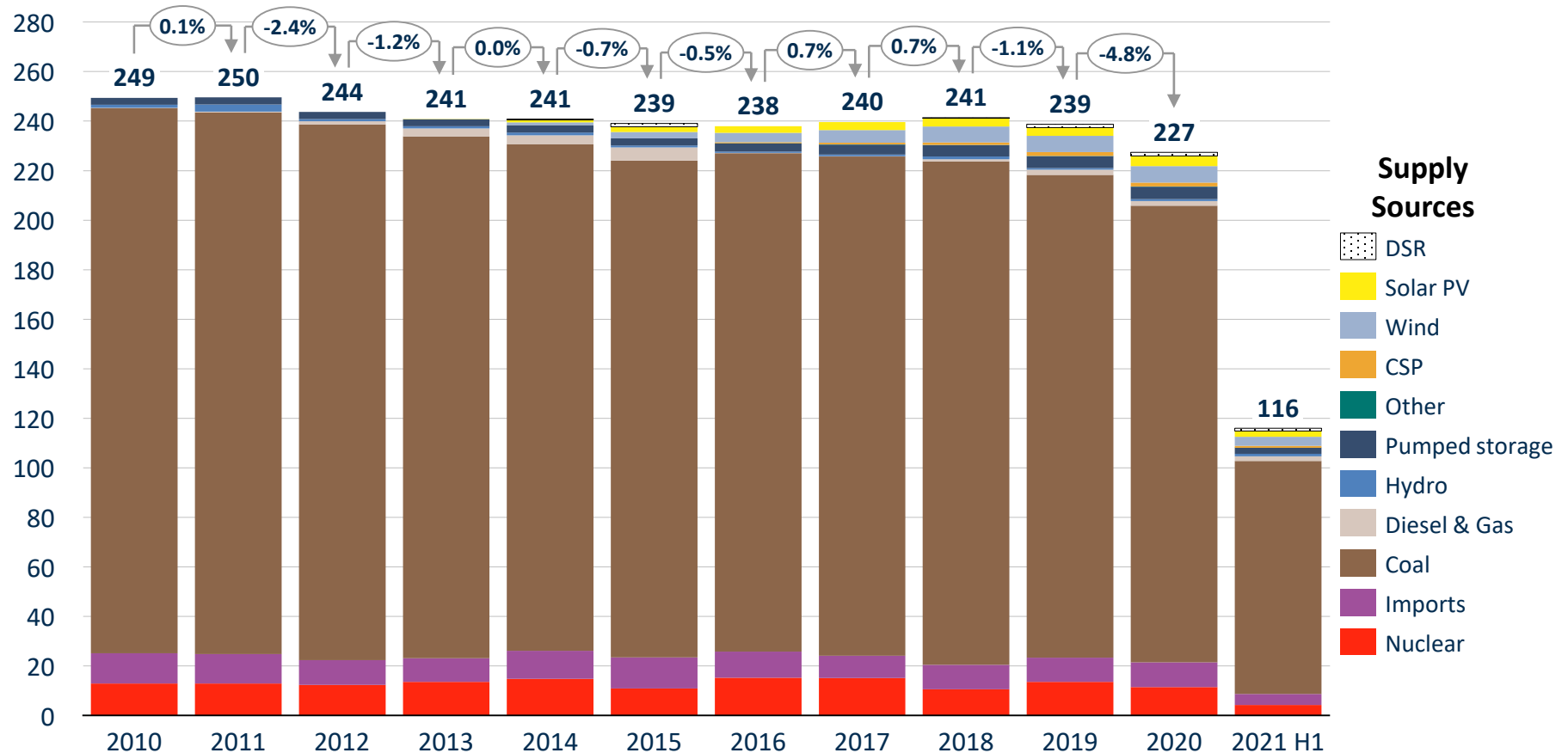
Wind and solar PV energy excludes curtailment and is thus lower than actual wind and solar PV generation

Sources: Eskom; DoE IPP Office

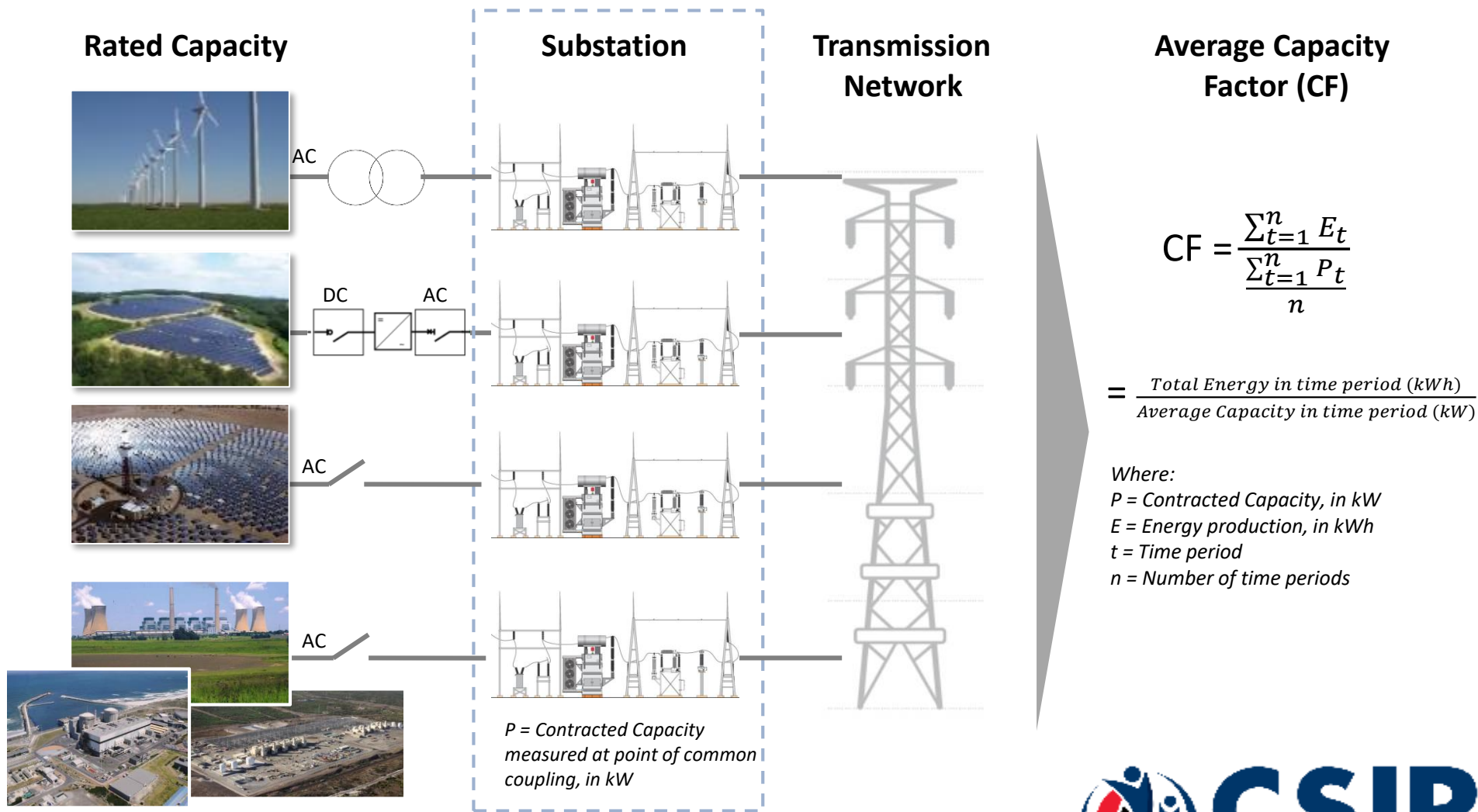
# Production in H1-2021 was constrained with diesel & gas running extensively and notable DSR activated

Historical annual electricity production per supply source in TWh

Annual electricity production in TWh

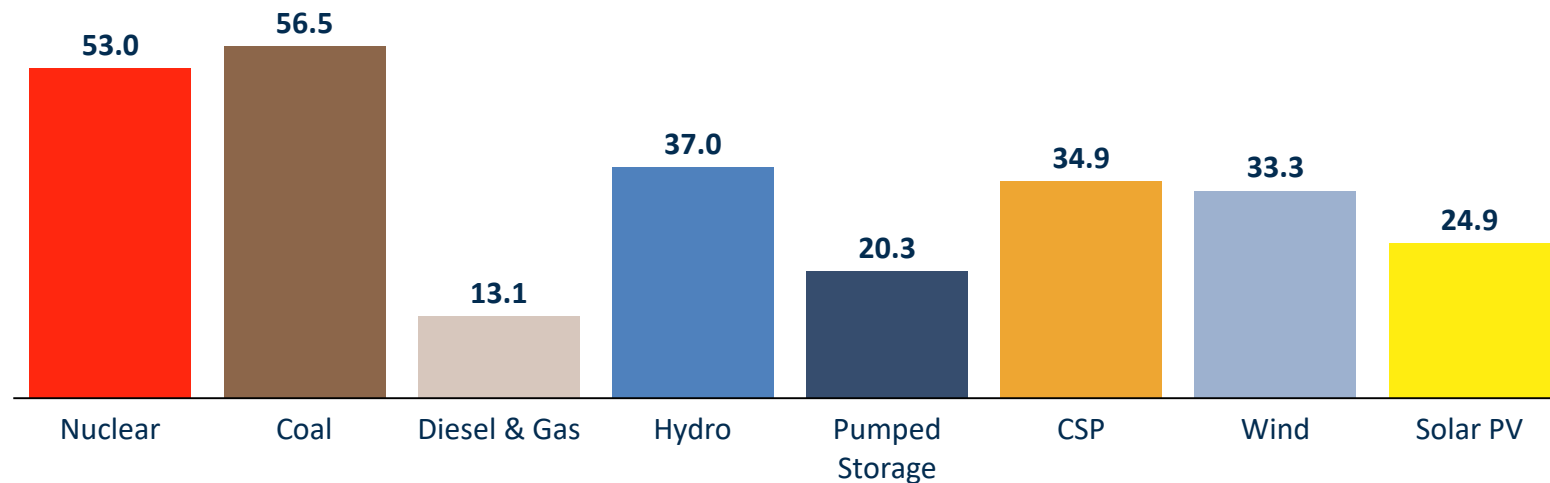


# Illustration: Calculation of average capacity factor of operational power plant categories in RSA



# Annual capacity factors per supply source in South Africa in H1 2021

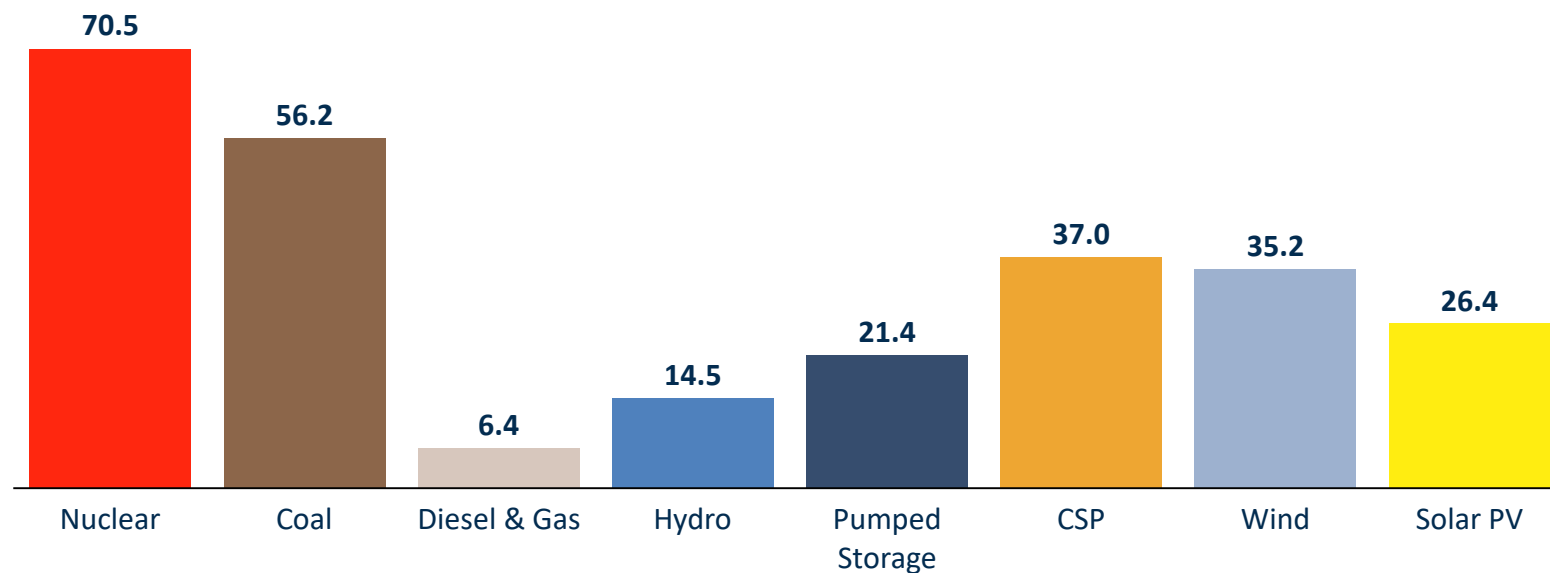
H1 2021  
Capacity Factors %



# Annual capacity factors per supply source in South Africa in 2020

2020

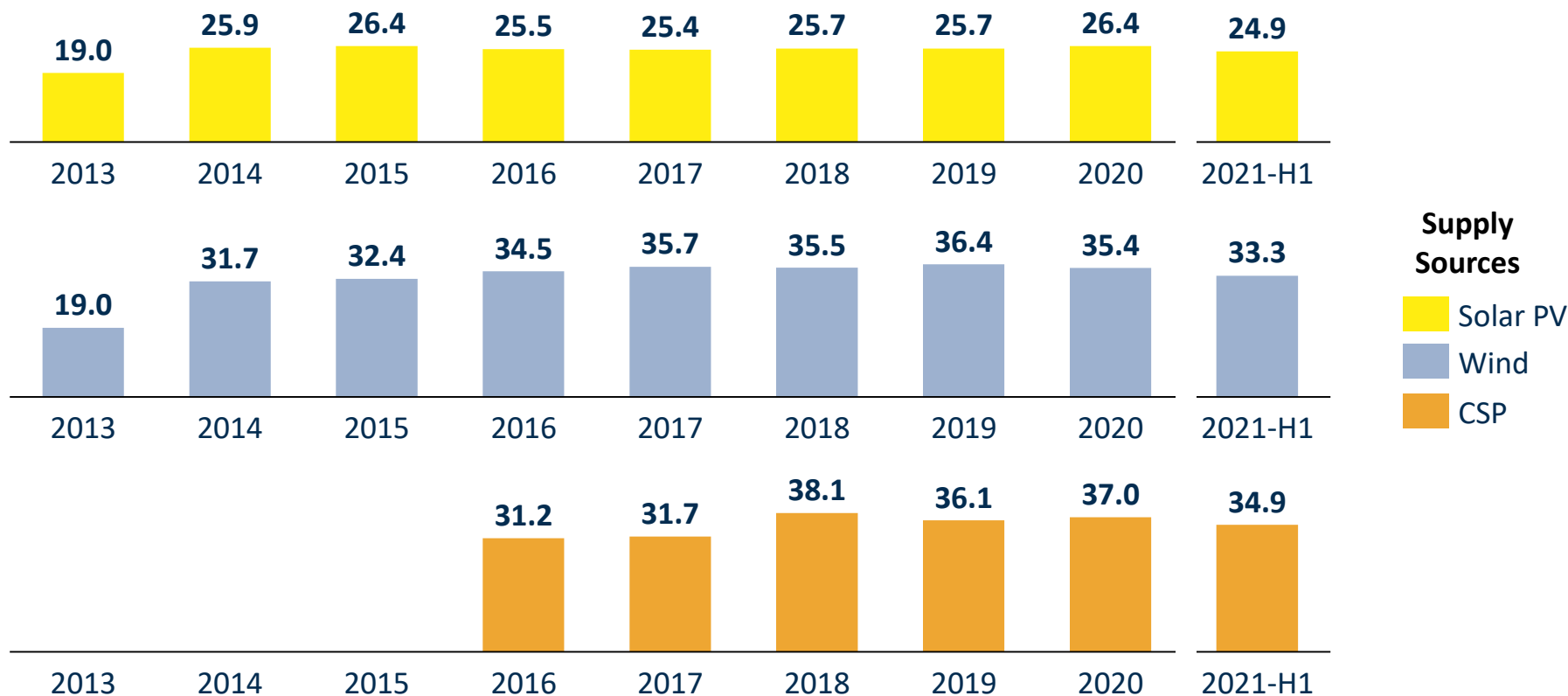
Annual Capacity Factors %





# In H1 2021, the average annual capacity factor of the solar PV, wind & CSP fleet was 25%, 33% and 35% respectively

Average Capacity Factor



NOTES: Historical capacity factors for other technologies not available at the time of publication; Capacity operational as per actual start of operation (can differ from REIPPP contracted date), CSP - only measured from date when more than two CSP plants commissioned. Wind includes Sere wind farm (100 MW). Wind and solar PV energy excludes curtailment and is thus capacity factor is lower than actual wind and solar PV available.

# Agenda

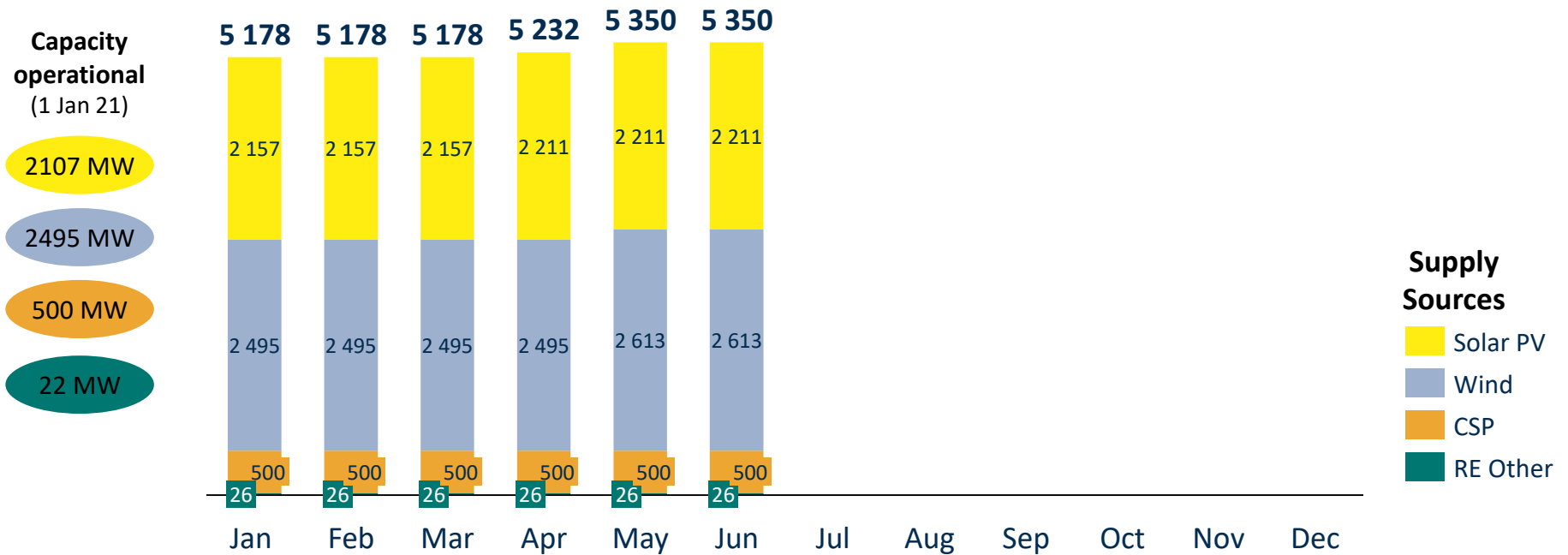
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- 7 Other power system statistics

# In H1 2021: 118 MW of wind & 54 MW of solar PV was added to the grid

Total monthly installed capacity of utility-scale solar PV, wind and CSP in RSA from Jan-Jun 2021

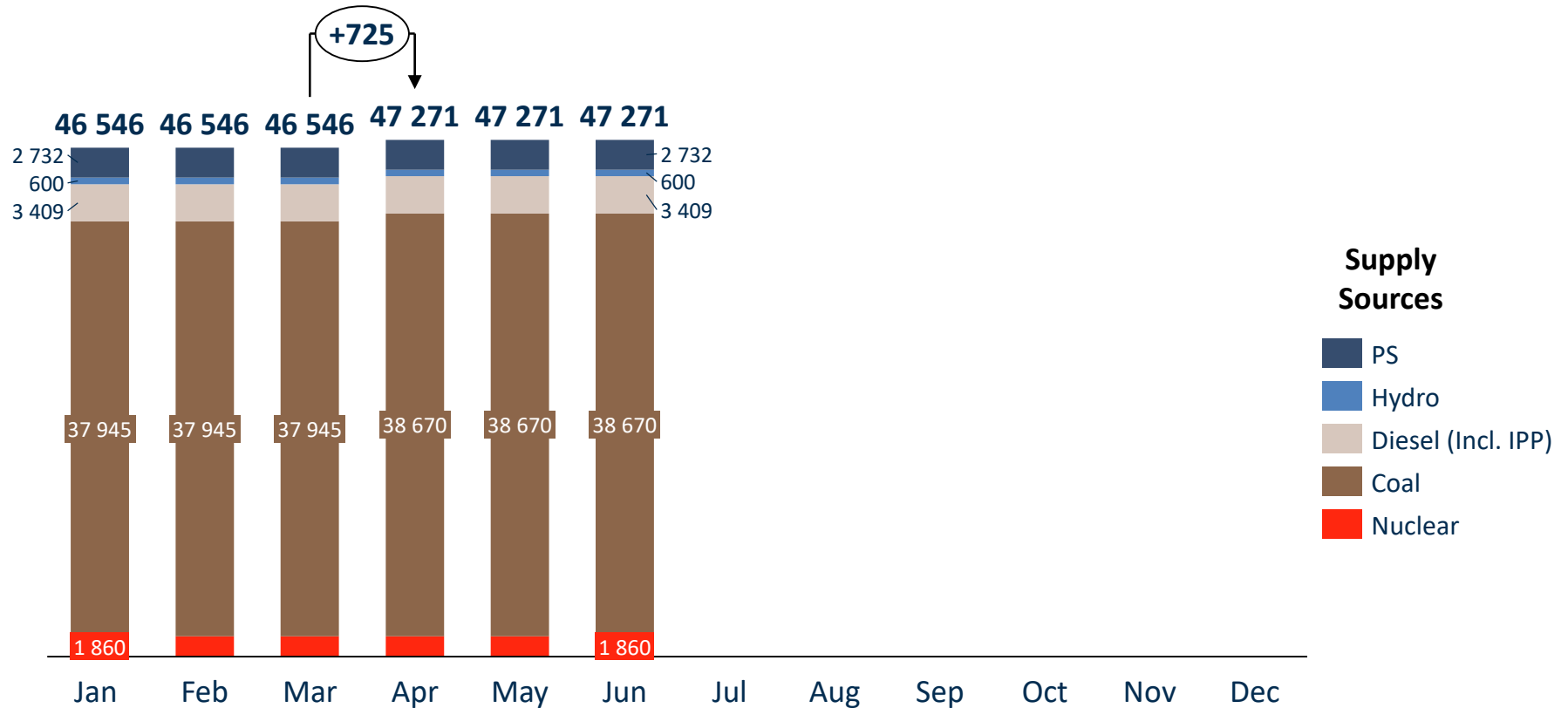
**Capacity operational  
in H1 - 2021 [MW]**  
(end of month)



Notes: Capacity operational as per actual start of operation (can differ from REIPPP contracted date), CSP - only measured from date when more than two CSP plants commissioned. Wind includes Sere wind farm (100 MW). RE = renewable energy  
Sources: Eskom

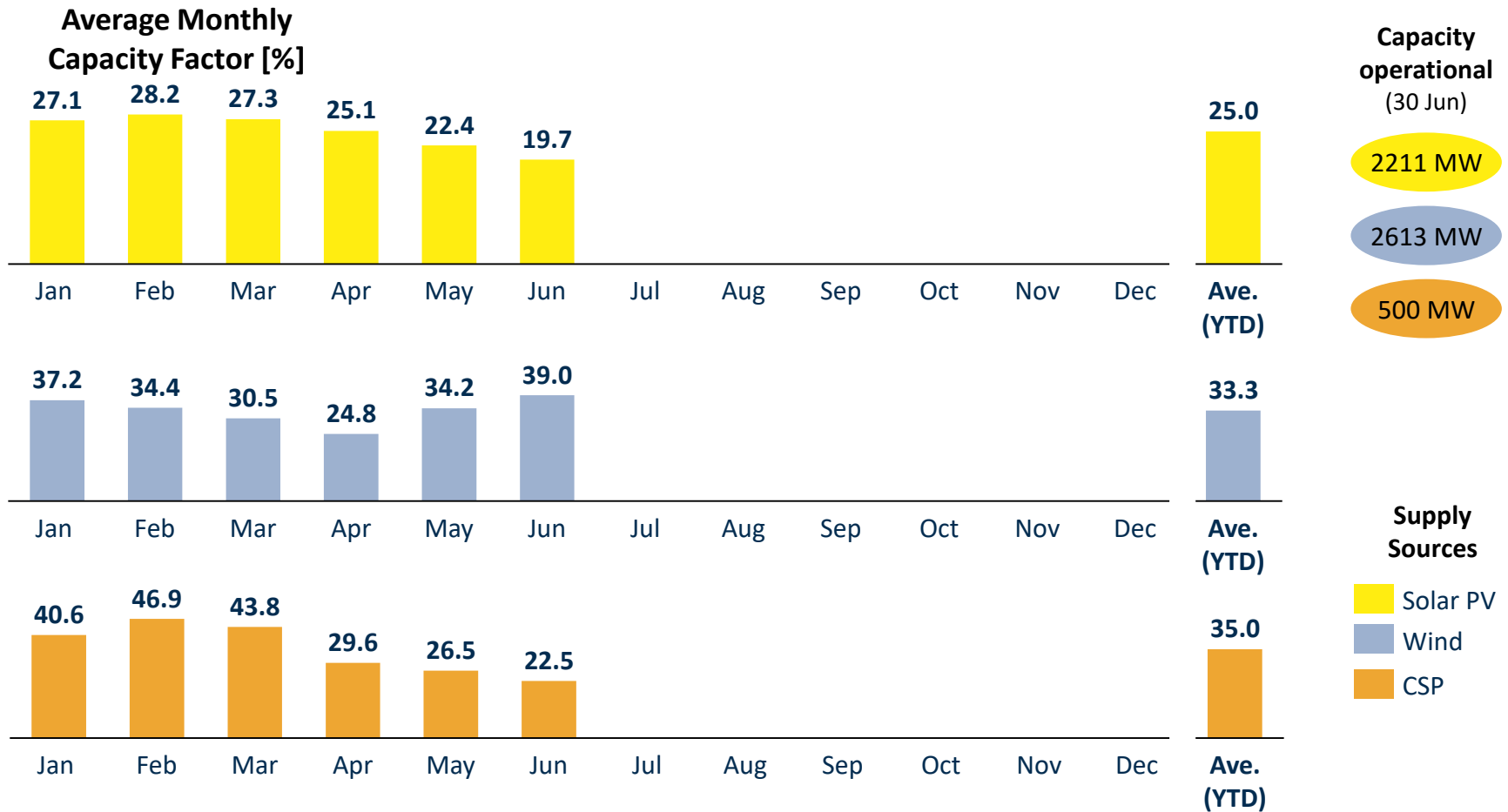
# In H1 2021: 725 MW of coal (Kusile) was added to the grid over and above the additional RE capacity

Total monthly installed capacity of utility-scale generation capacity in RSA from Jan-Jun 2021



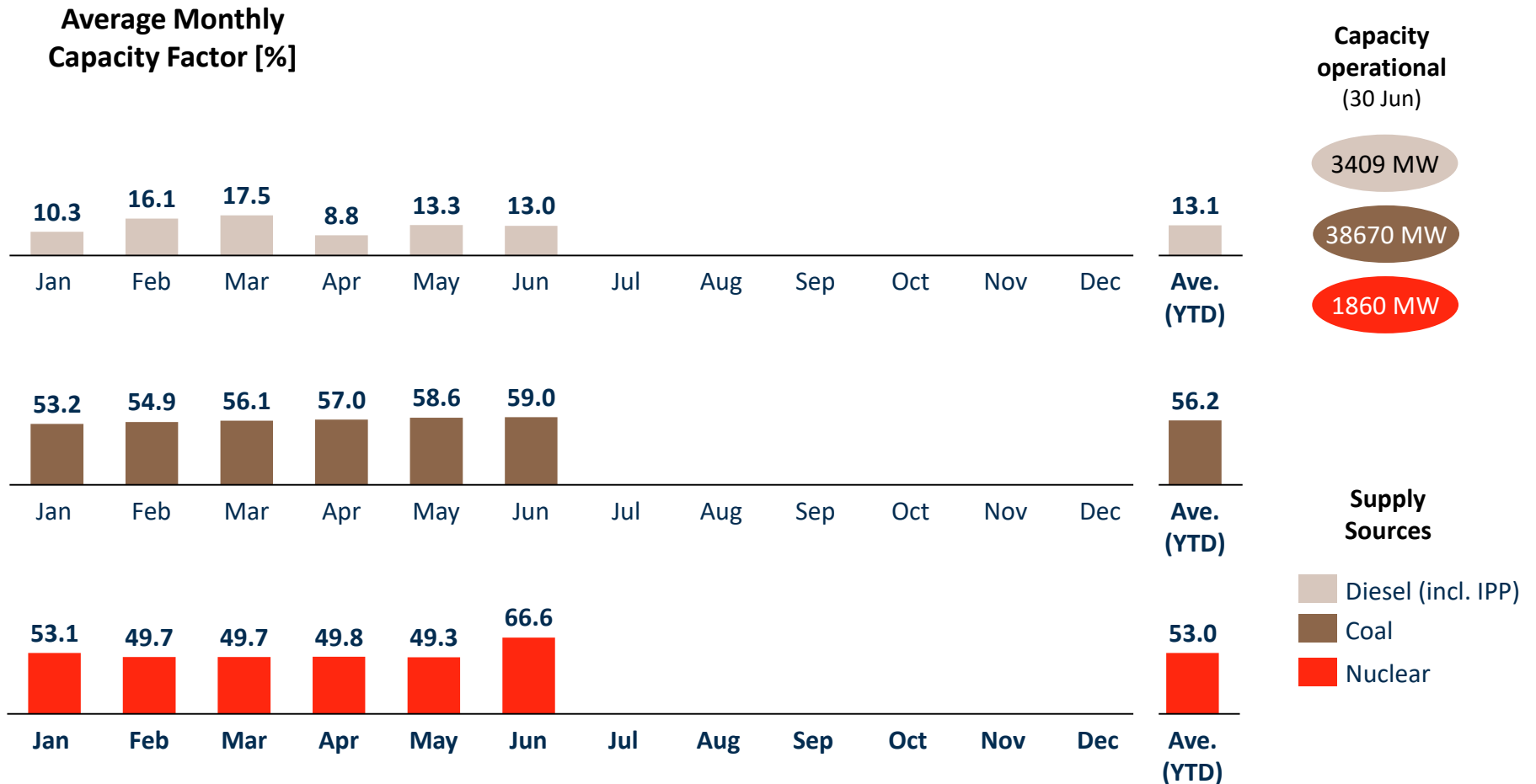
# Average monthly capacity factors for solar PV, wind and CSP

Average monthly capacity factors of solar PV, wind and CSP in RSA from Jan-Jun 2021



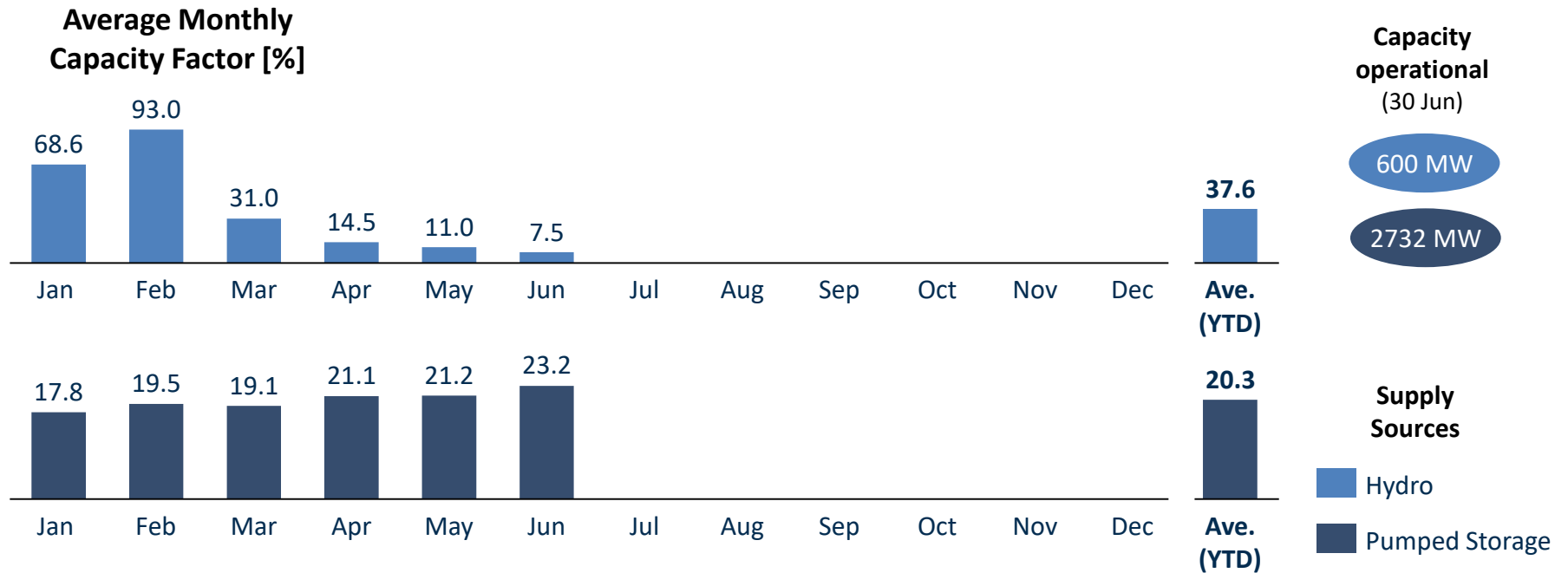
# Average monthly capacity factors for thermal plants

Average monthly capacity factors of thermal capacity in RSA from Jan-Jun 2021



# Average monthly capacity factors for hydro and pumped storage plants

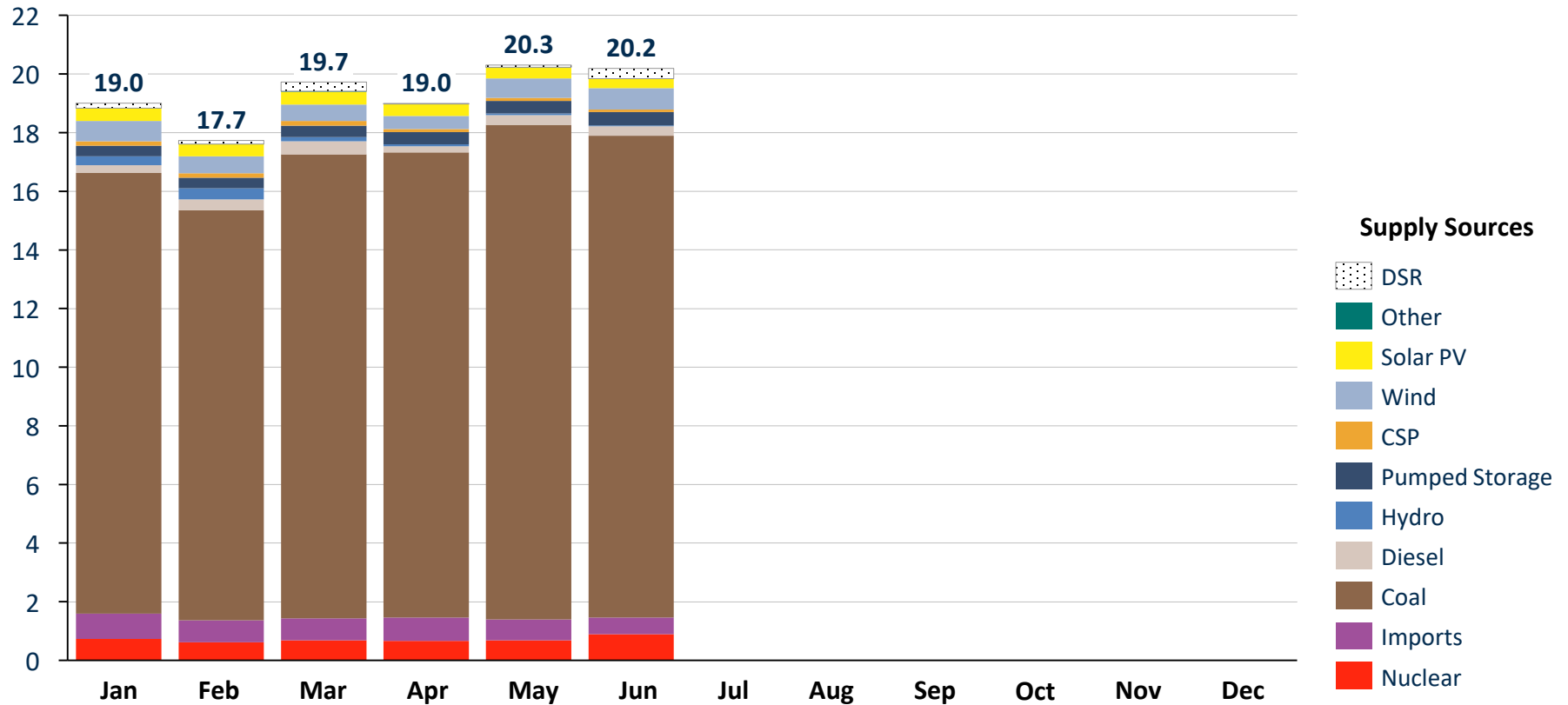
Average monthly capacity factors of hydro & pumped storage in RSA from Jan-Jun 2021



# Monthly electricity production from all power supply sources (absolute)

Actual monthly electricity production for Jan-Jun 2021 from the different supply sources in RSA

Monthly electricity production in TWh



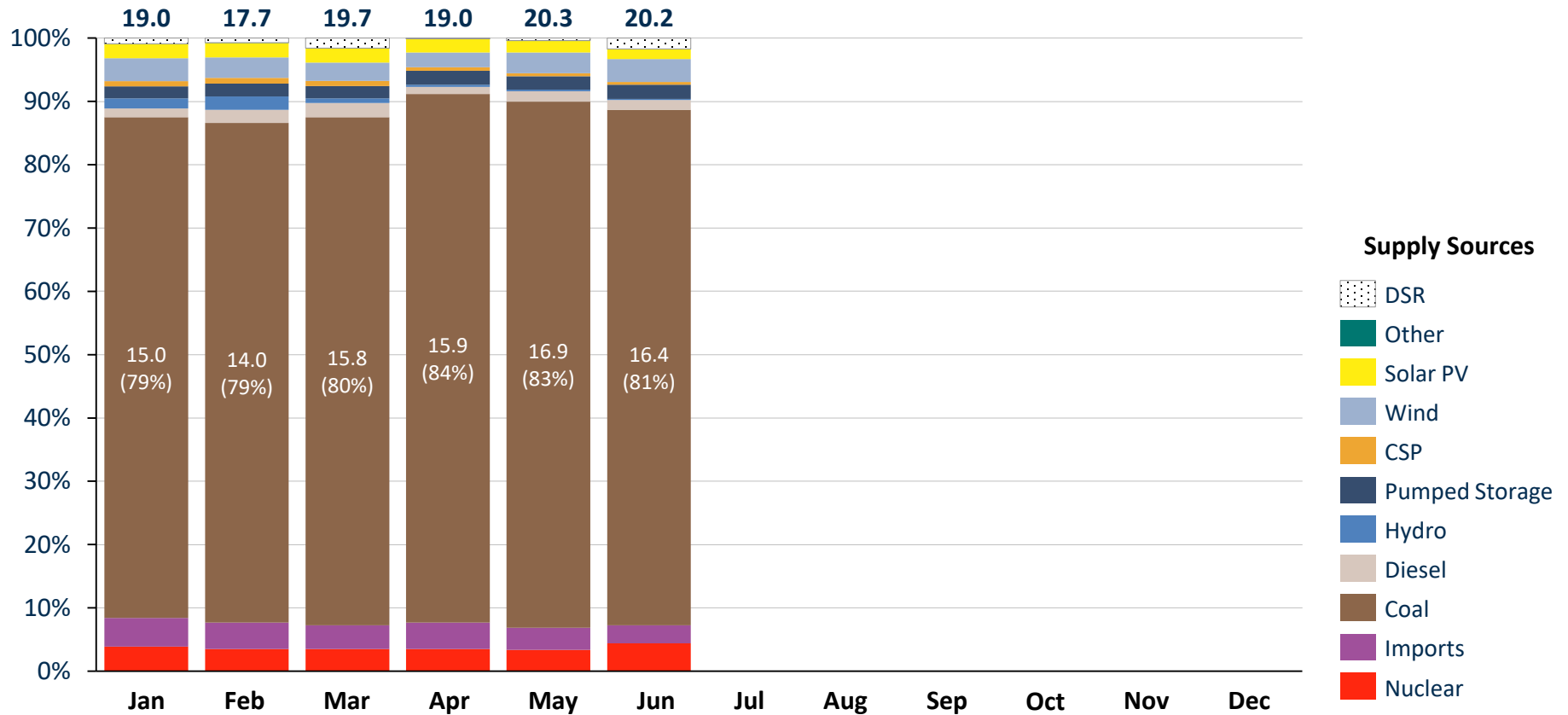
Notes: Pumping load excluded. Wind generation includes Eskom's 100 MW Sere wind farm.  
 Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
 Sources: Eskom; CSIR Energy Centre analysis



# Monthly electricity production from all power supply sources (share)

Actual monthly electricity production for Jan-Jun 2021 from the different supply sources in RSA

Monthly electricity production in TWh



Notes: Pumping load excluded. Wind generation includes Eskom's 100 MW Sere wind farm.

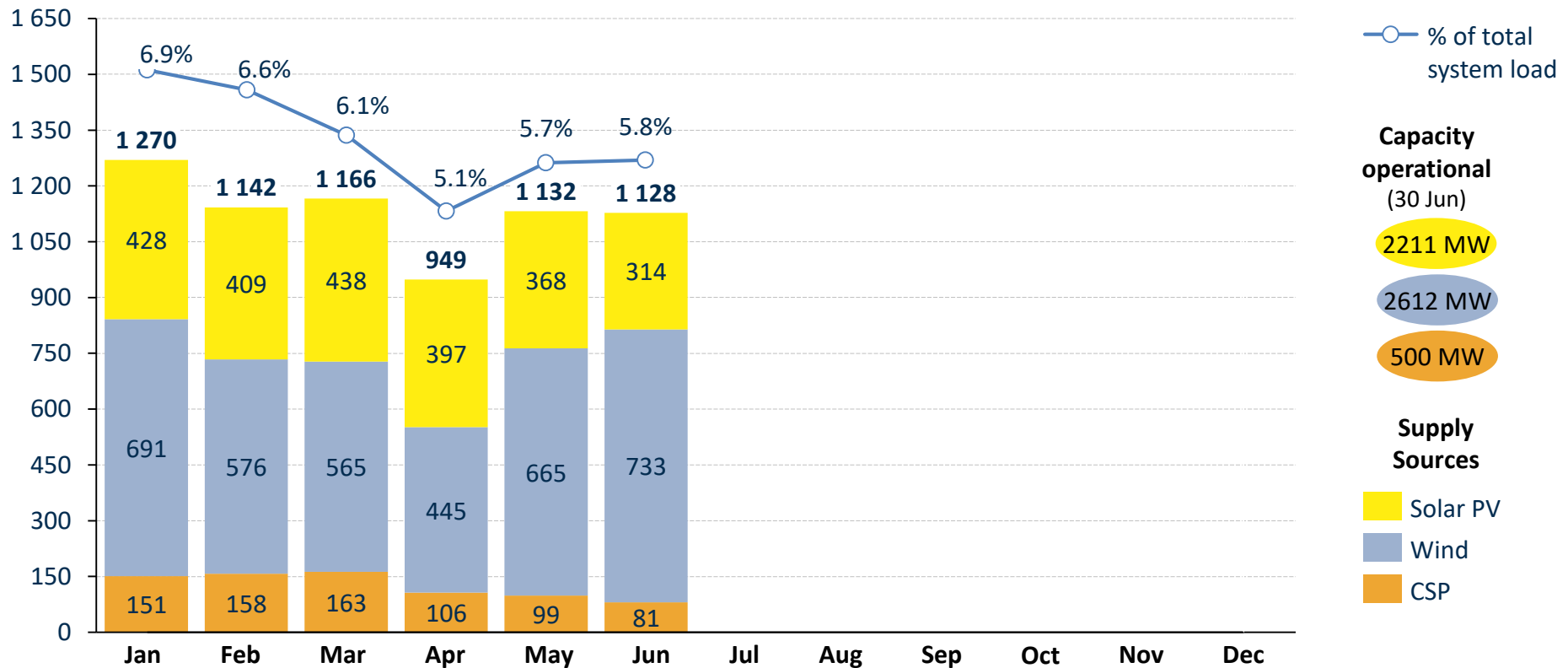
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Monthly electricity production of SA's wind, solar PV & CSP fleet

Actual monthly production from wind, solar PV and CSP plants in South Africa from Jan-Jun 2021

Monthly electricity production in GWh



○ % of total system load

Capacity operational (30 Jun)

2211 MW

2612 MW

500 MW

Supply Sources

Solar PV

Wind

CSP

Notes: Wind generation includes Eskom's 100 MW Sere wind farm. CSP energy only measured from date when more than two CSP plant were commissioned. Wind and solar PV energy excludes curtailment and is thus lower than actual wind and solar PV generation. Sources: Eskom; CSIR Energy Centre analysis

# Agenda

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- 1 Overview actual electricity production (2021-H1)
- 2 Monthly electricity production (2021-H1)

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- 3 Weekly electricity production (2021-H1)

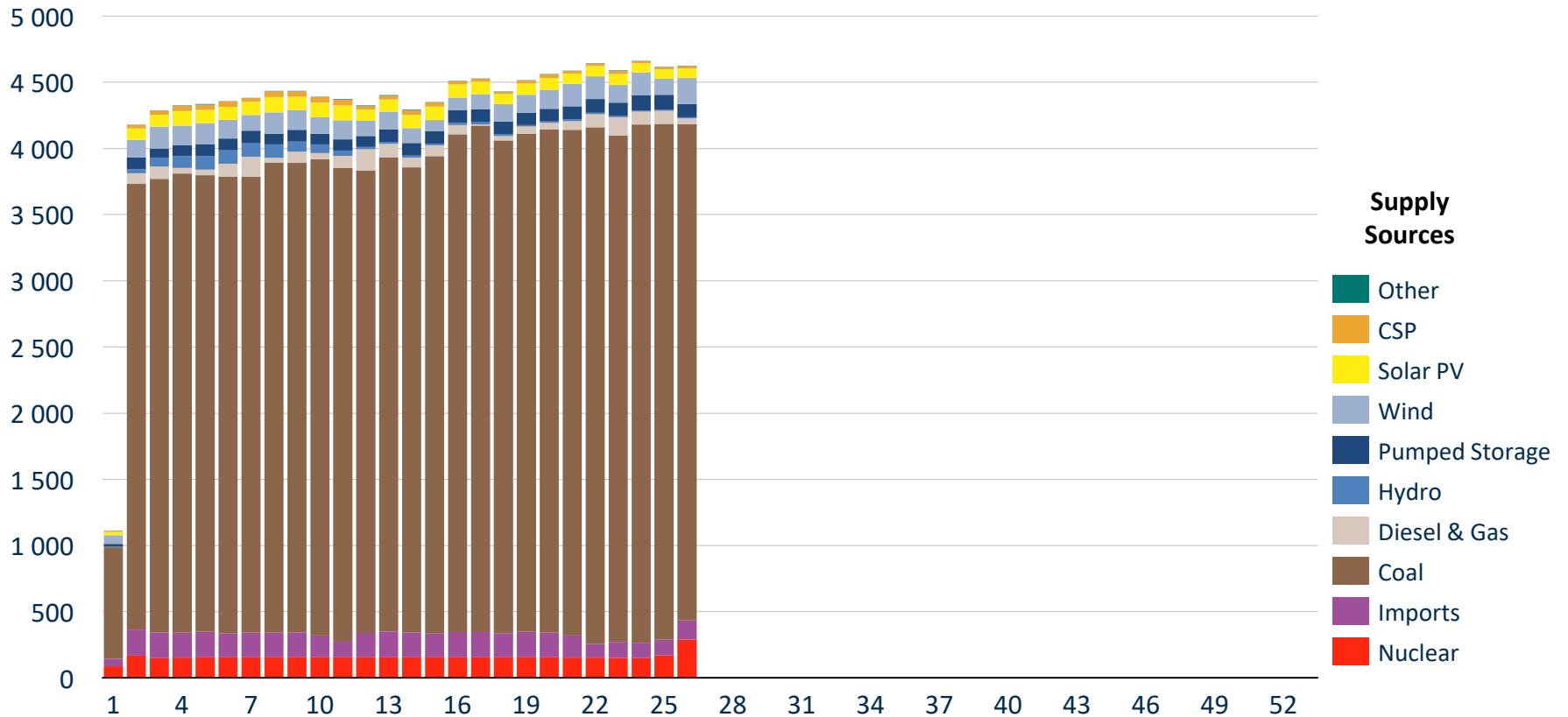
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- 4 Daily electricity production (2021-H1)
- 5 Hourly electricity production (2021-H1)
- 6 Actual load shedding (2021-H1)
- 7 Other power system statistics

# Weekly electricity production for all power supply sources

Actual weekly production: conventional fleet, wind, solar PV & CSP (Jan-Jun 2021)

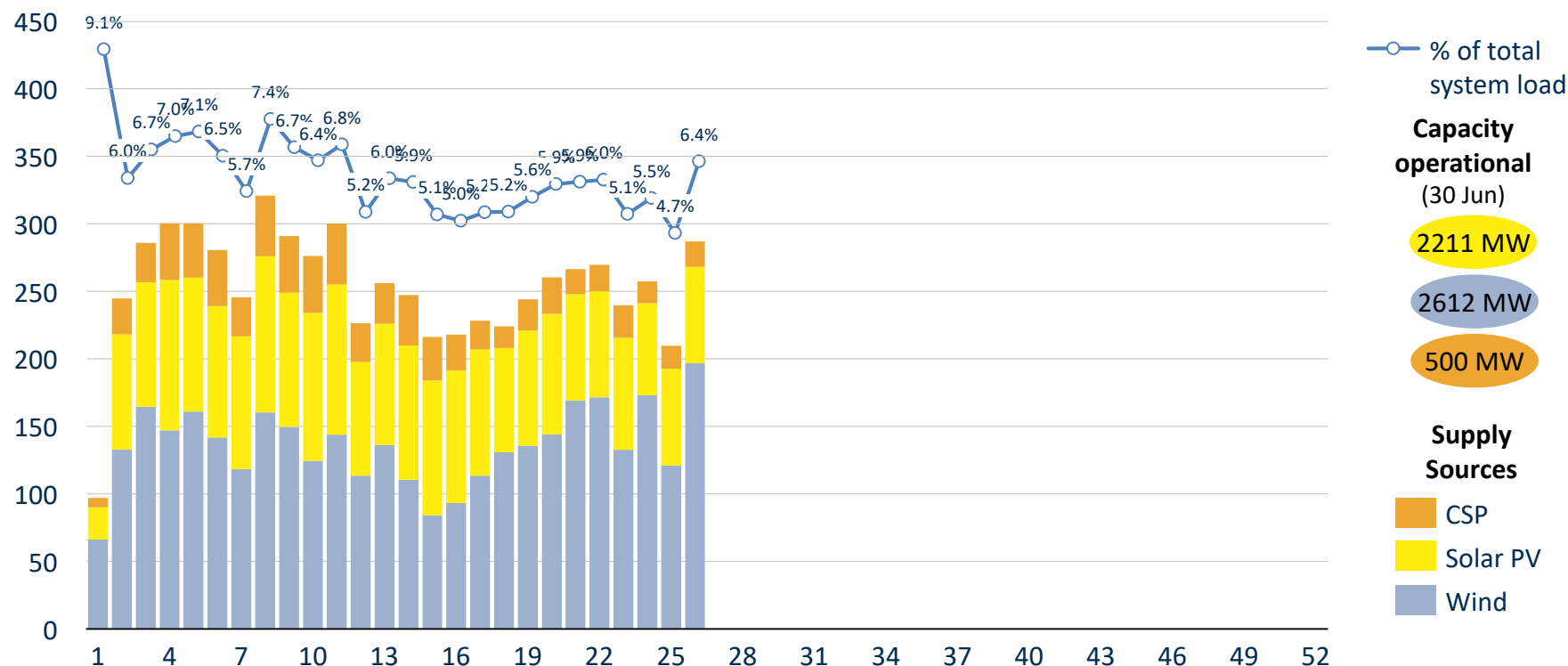
Electricity production  
in GWh/week



# Weekly electricity production of SA's wind, solar PV and CSP fleet

Actual weekly production from large-scale solar PV, wind & CSP plants under the REIPPPP from Jan-Jun 2021

Electricity production in GWh/week



- Maximum wind + solar PV + CSP weekly production of 346 GWh in week 49 (29 Nov – 6 Dec)
- Minimum wind + solar PV + CSP weekly production of 152 GWh in week 23 (31 May – 6 Jun)

Note: First week and last week not full weeks.  
Sources: Eskom; CSIR Energy Centre analysis

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- 3 Weekly electricity production (2021-H1)

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- 4 Daily electricity production (2021-H1)

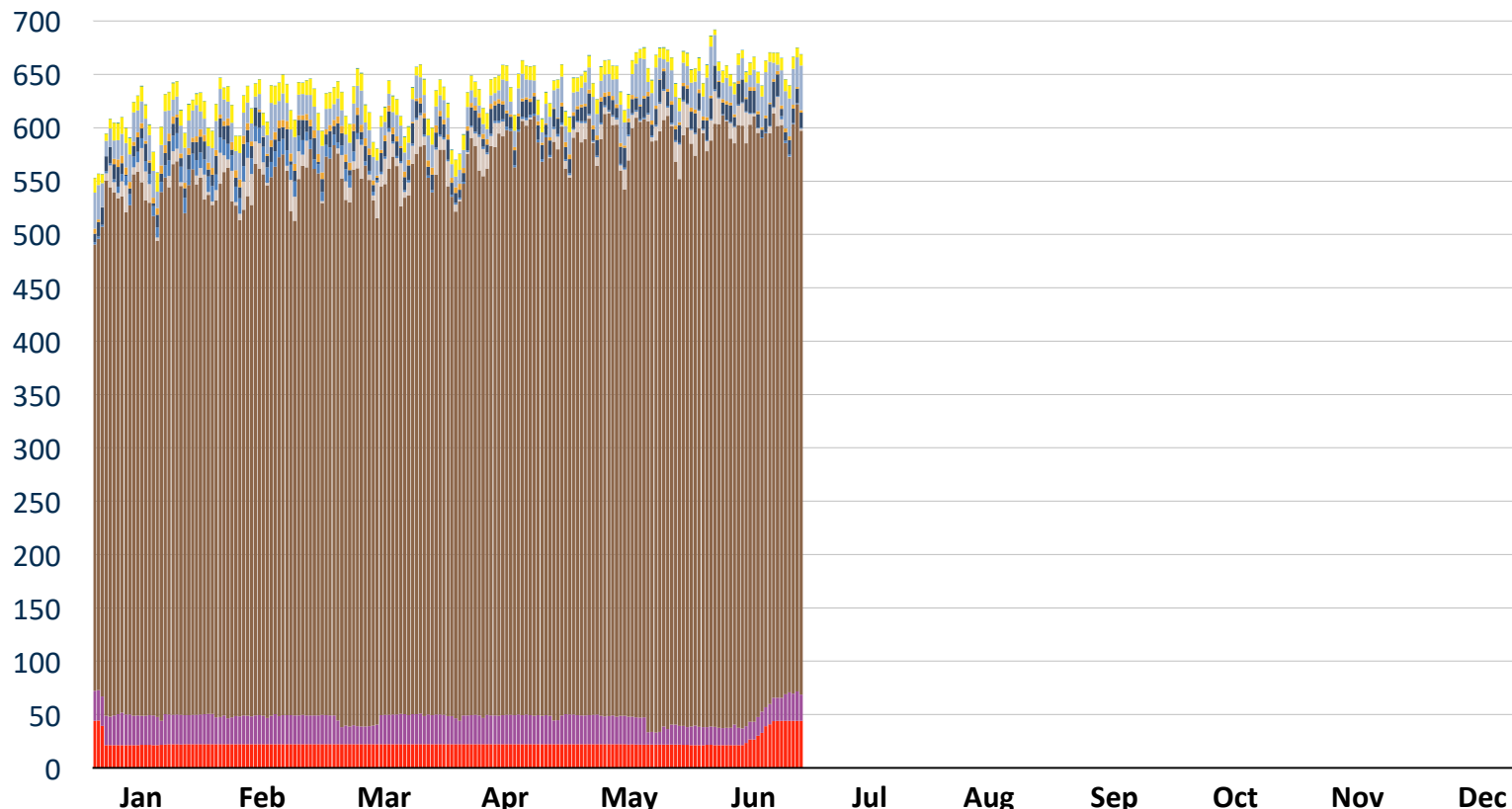
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- 5 Hourly electricity production (2021-H1)
- 6 Actual load shedding (2021-H1)
- 7 Other power system statistics

# Daily electricity production wind, solar PV & CSP fleet Jan to Jun 2021

Actual daily production from large-scale solar PV, wind and CSP plants under the REIPPPP from Jan-Jun 2021

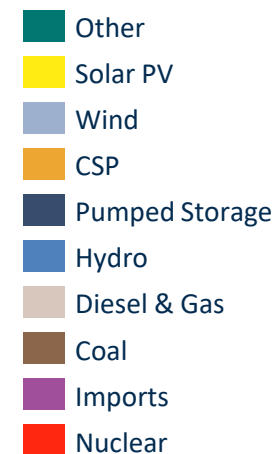
Electricity production  
in GWh/day



Capacity  
operational  
(30 Jun)



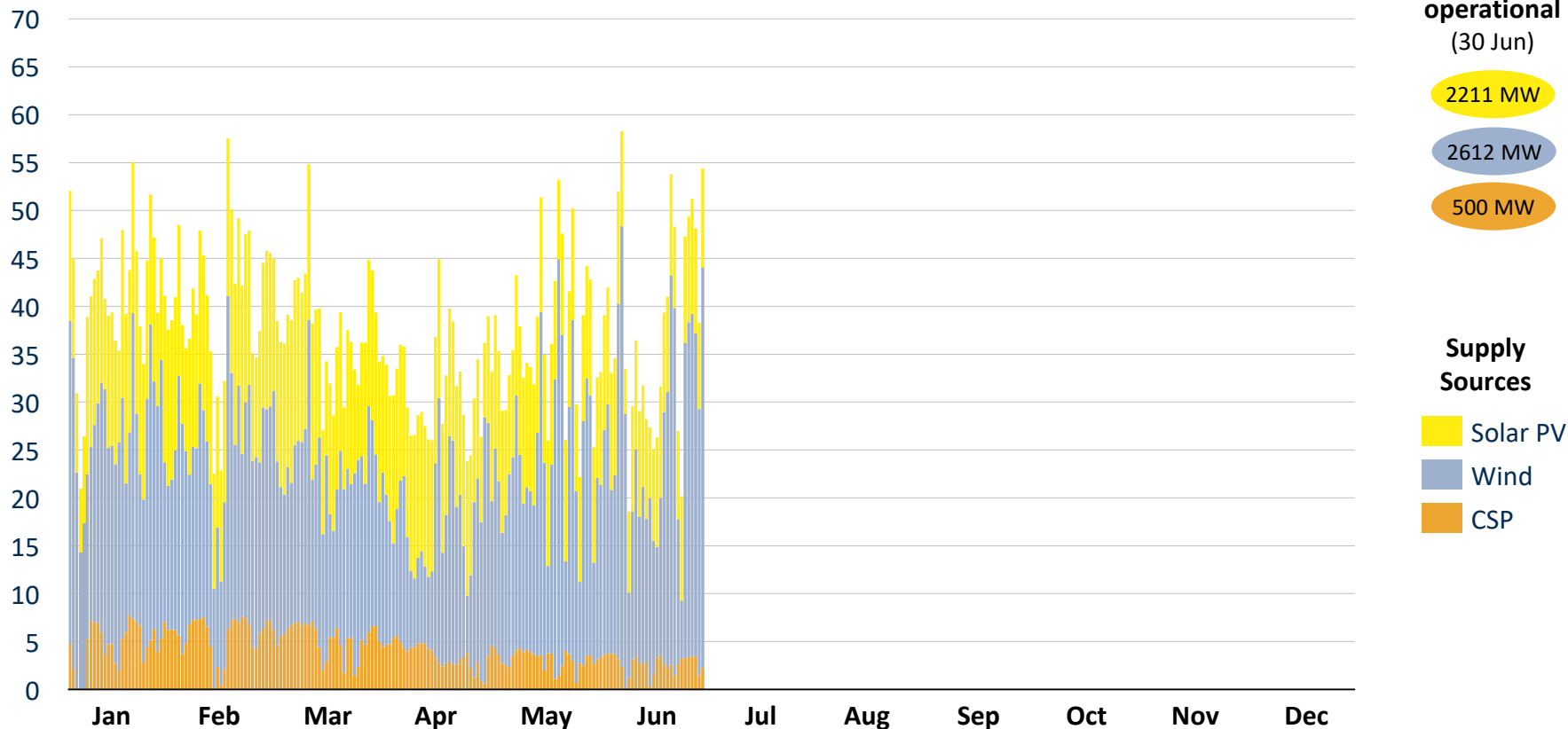
Supply Sources



# Daily electricity production wind, solar PV & CSP fleet Jan to Jun 2021

Actual daily production from large-scale solar PV, wind and CSP plants under the REIPPPP from Jan-Jun 2021

Electricity production  
in GWh/day

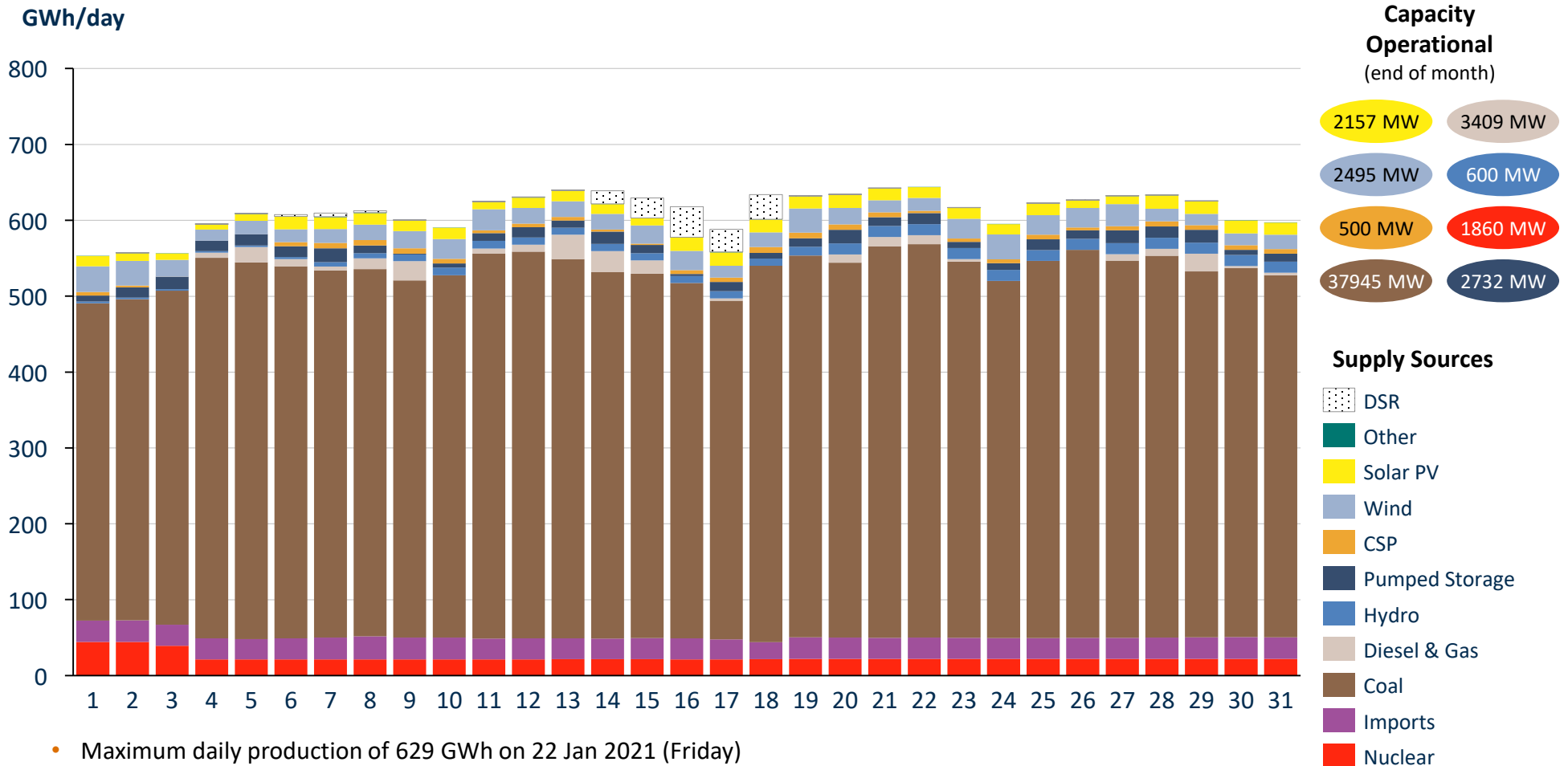


- Maximum daily production of 58 GWh on 8 Jun 2021 (Tuesday)
- Minimum daily production of 19 GWh on 10 Jun 2021 (Thursday)



# Daily electricity production of between 531-629 GWh in Jan 2021

Actual daily production from all power supply sources in South Africa for January 2021



- Maximum daily production of 629 GWh on 22 Jan 2021 (Friday)
- Minimum daily production of 531 GWh on 1 Jan 2021 (Friday - National Holiday)

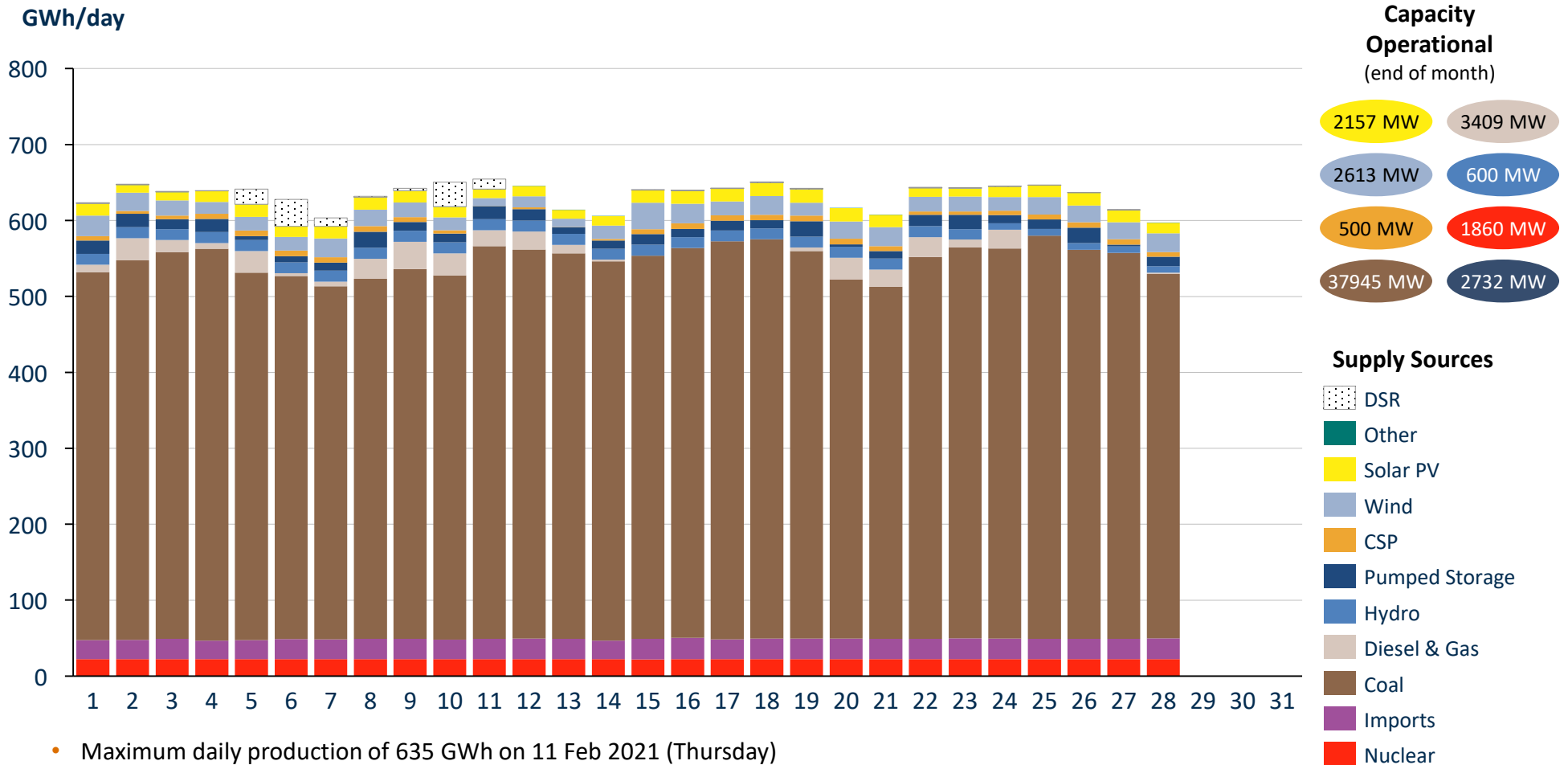
Note: Daily production includes generation for pumping load. Wind includes Sere.

Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Daily electricity production of between 580-635 GWh in Feb 2021

Actual daily production from all power supply sources in South Africa for February 2021



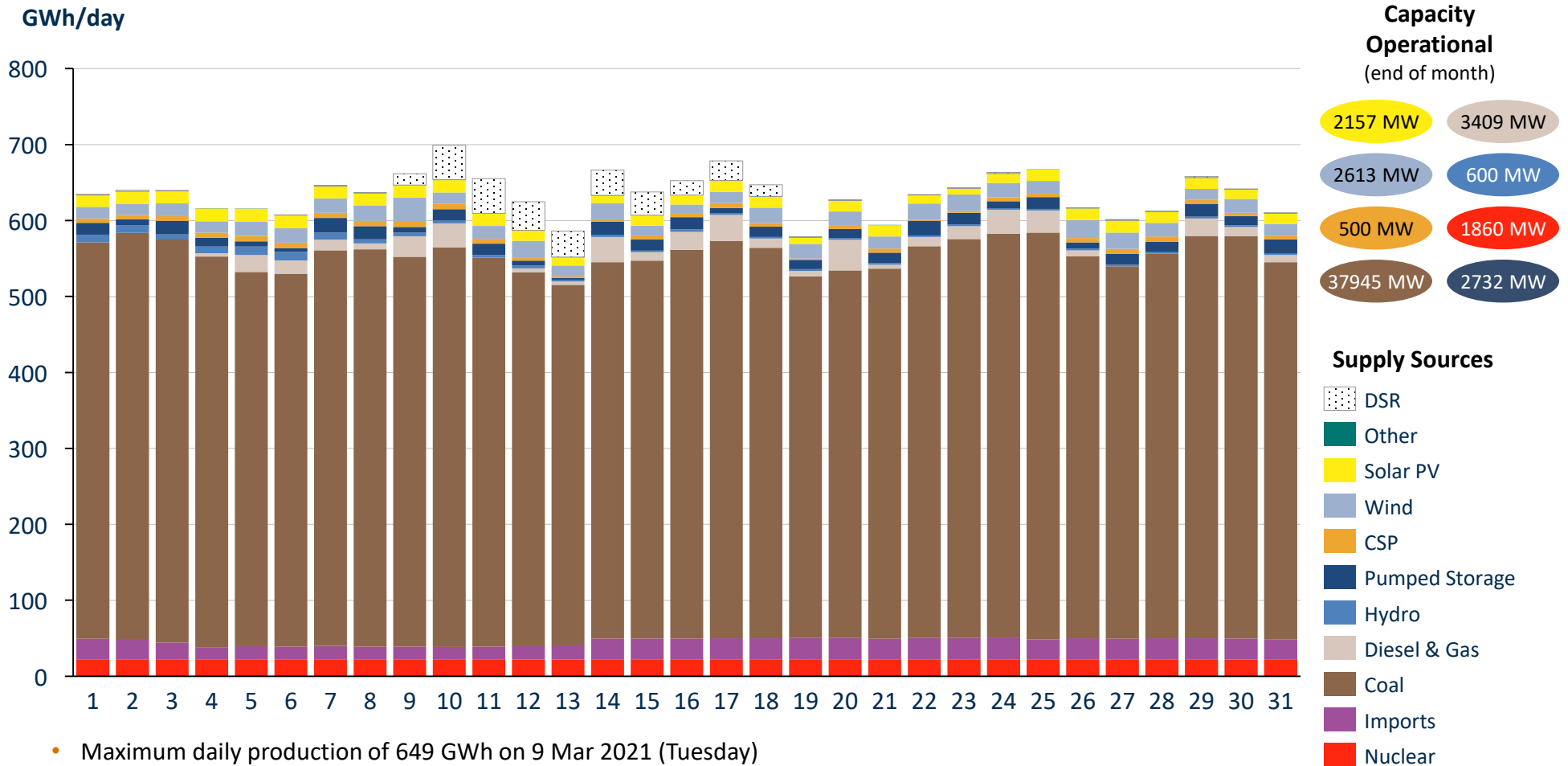
- Maximum daily production of 635 GWh on 11 Feb 2021 (Thursday)
- Minimum daily production of 580 GWh on 28 Feb 2021 (Sunday)

Note: Daily production includes generation for pumping load. Wind includes Sere.  
 Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
 Sources: Eskom; CSIR Energy Centre analysis



# Daily electricity production of between 472-649 GWh in Mar 2021

Actual daily production from all power supply sources in South Africa for March 2021



- Maximum daily production of 649 GWh on 9 Mar 2021 (Tuesday)
- Minimum daily production of 472 GWh on 29 Mar 2021 (Sunday)

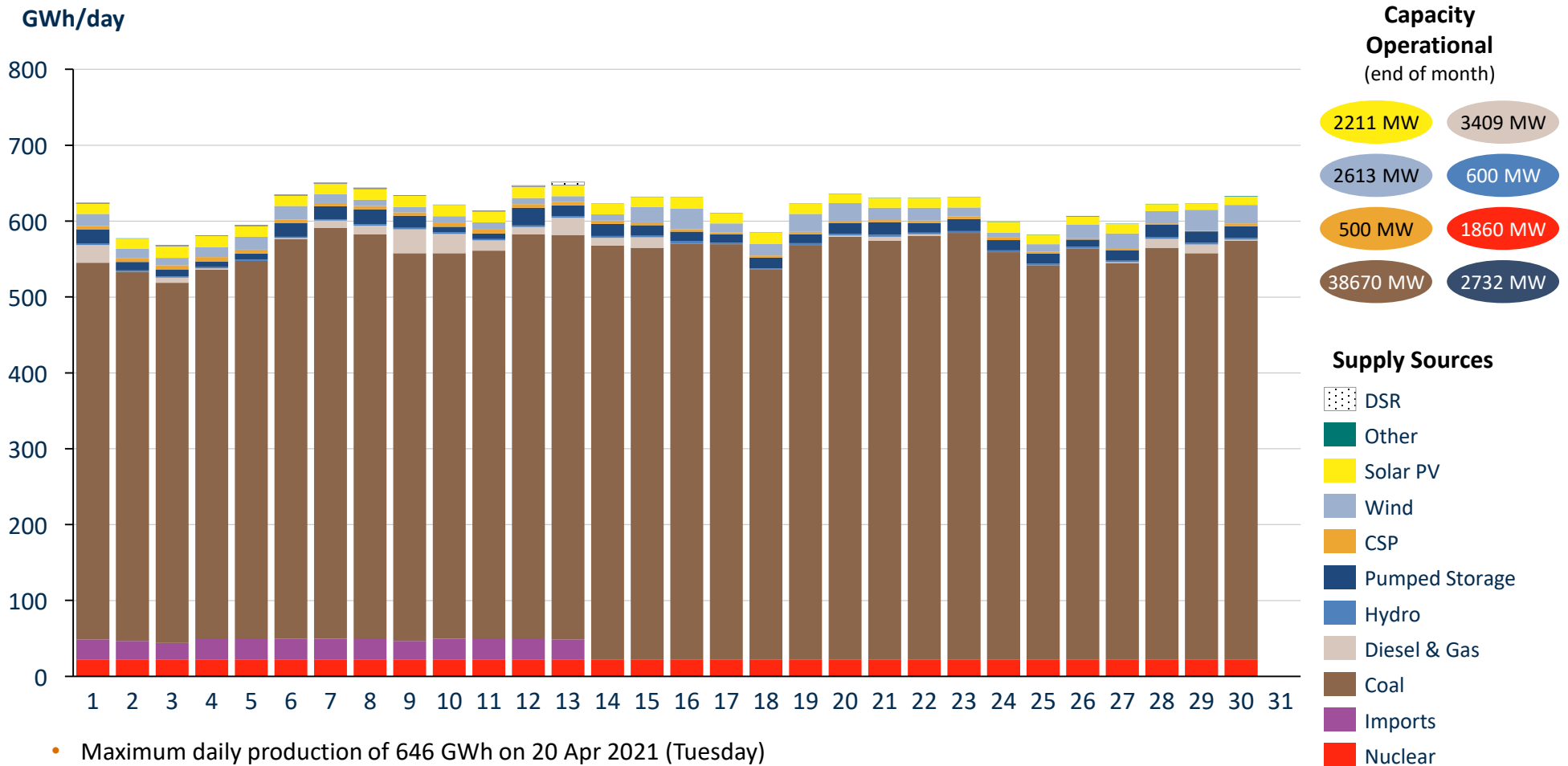
Note: Daily production includes generation for pumping load. Wind includes Sere.

Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Daily electricity production of between 554-646 GWh in Apr 2021

Actual daily production from all power supply sources in South Africa for April 2021



- Maximum daily production of 646 GWh on 20 Apr 2021 (Tuesday)
- Minimum daily production of 554 GWh on 3 Apr 2021 (Saturday)

Note: Daily production includes generation for pumping load. Wind includes Sere.

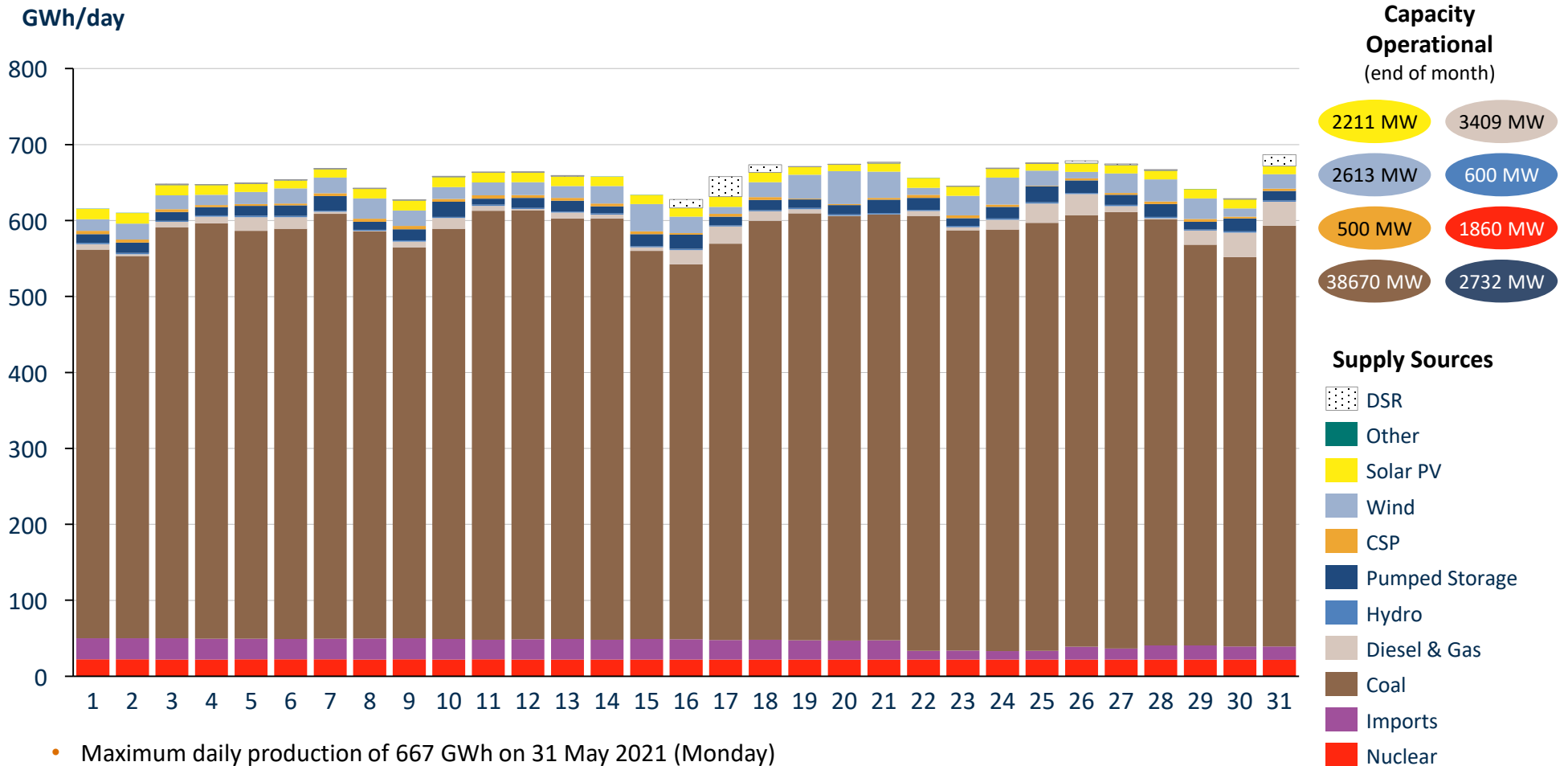
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis



# Daily electricity production of between 588-667 GWh in May 2021

Actual daily production from all power supply sources in South Africa for May 2021



- Maximum daily production of 667 GWh on 31 May 2021 (Monday)
- Minimum daily production of 558 GWh on 2 May 2021 (Sunday)

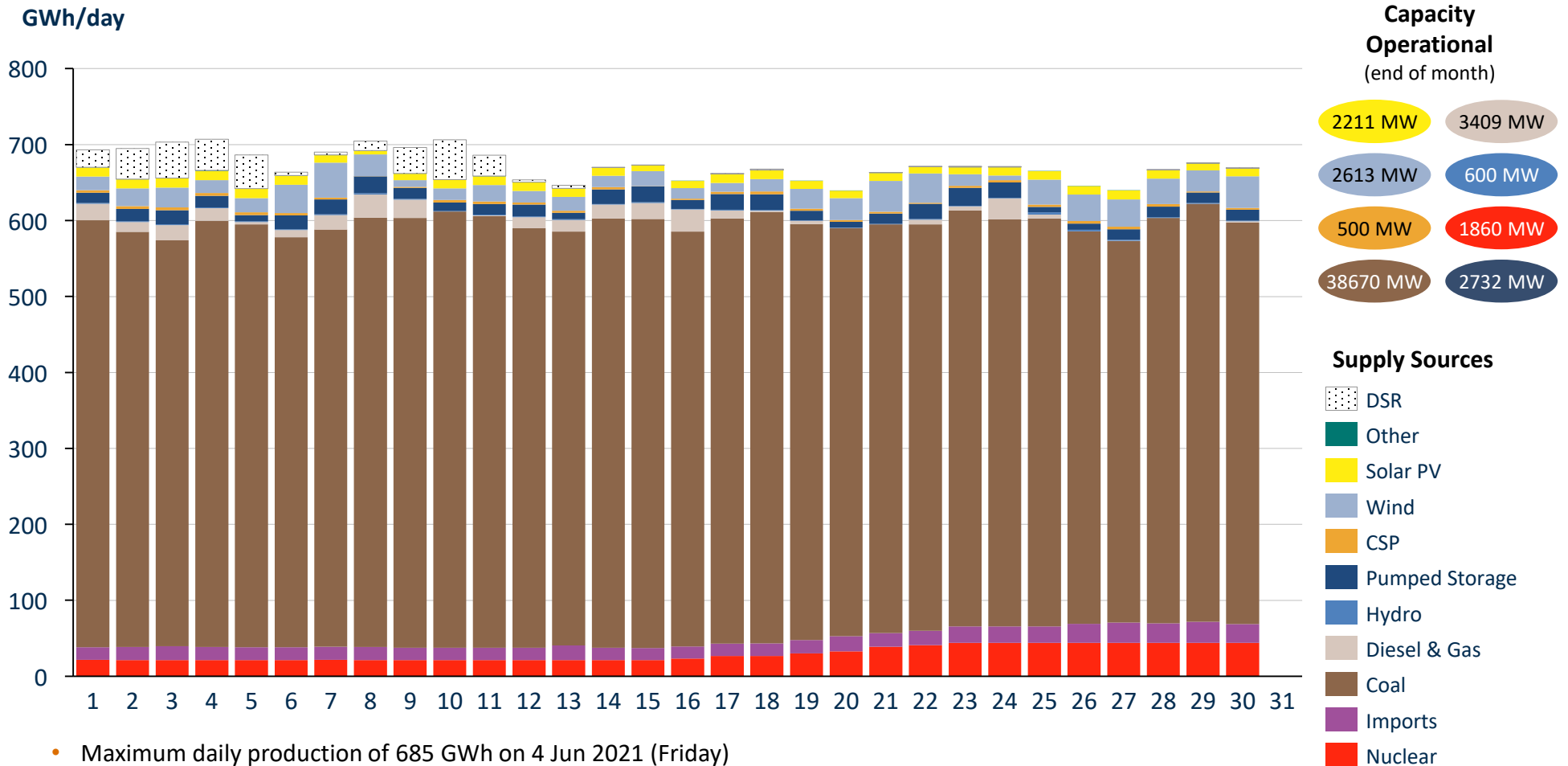
Note: Design as per Fraunhofer ISE. Daily production includes generation for pumping load. Wind includes Sere.

Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Daily electricity production of between 611-685 GWh in Jun 2021

Actual daily production from all power supply sources in South Africa for June 2021



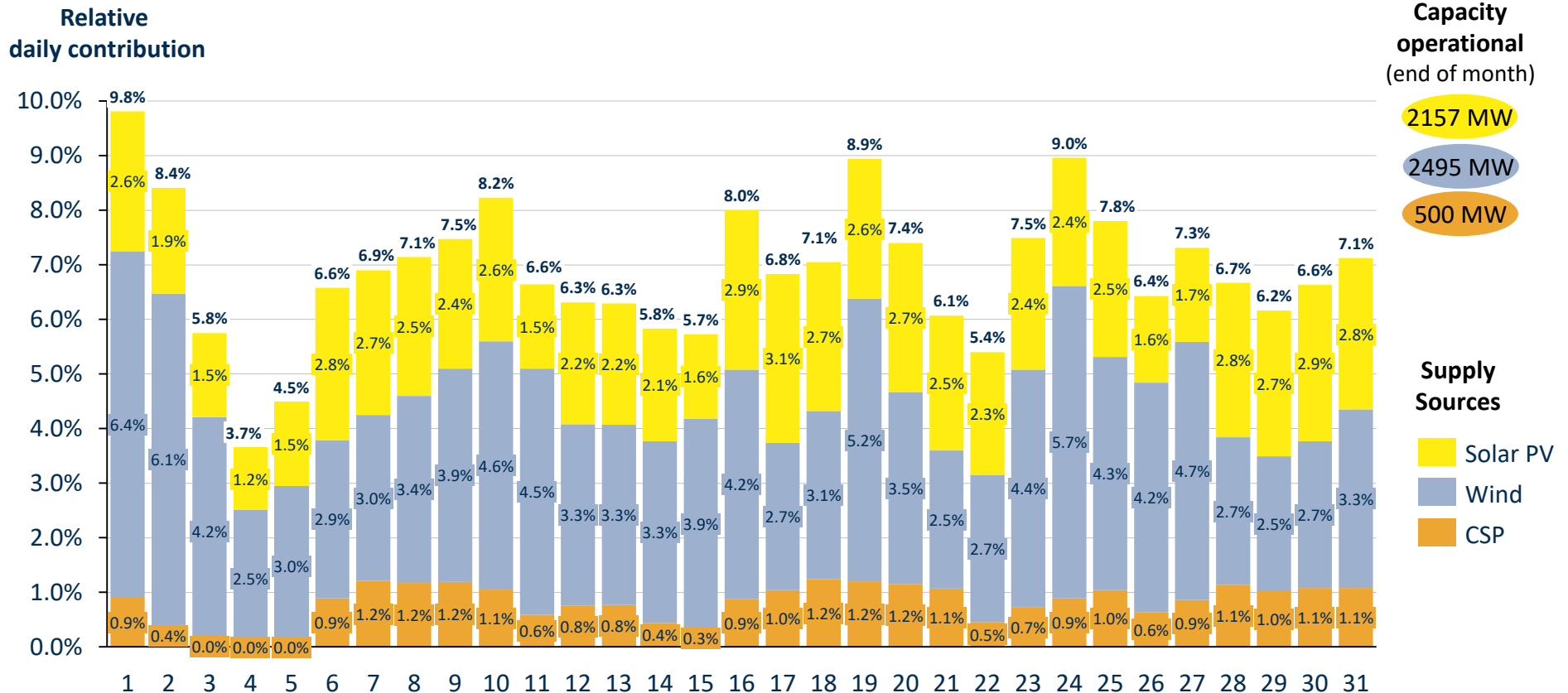
- Maximum daily production of 685 GWh on 4 Jun 2021 (Friday)
- Minimum daily production of 611 GWh on 20 Jun 2021 (Sunday)

Note: Design as per Fraunhofer ISE. Daily production includes generation for pumping load. Wind includes Sere.  
 Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
 Sources: Eskom; CSIR Energy Centre analysis



# Daily solar PV, wind & CSP contribution of 3.7-9.8% in Jan 2021

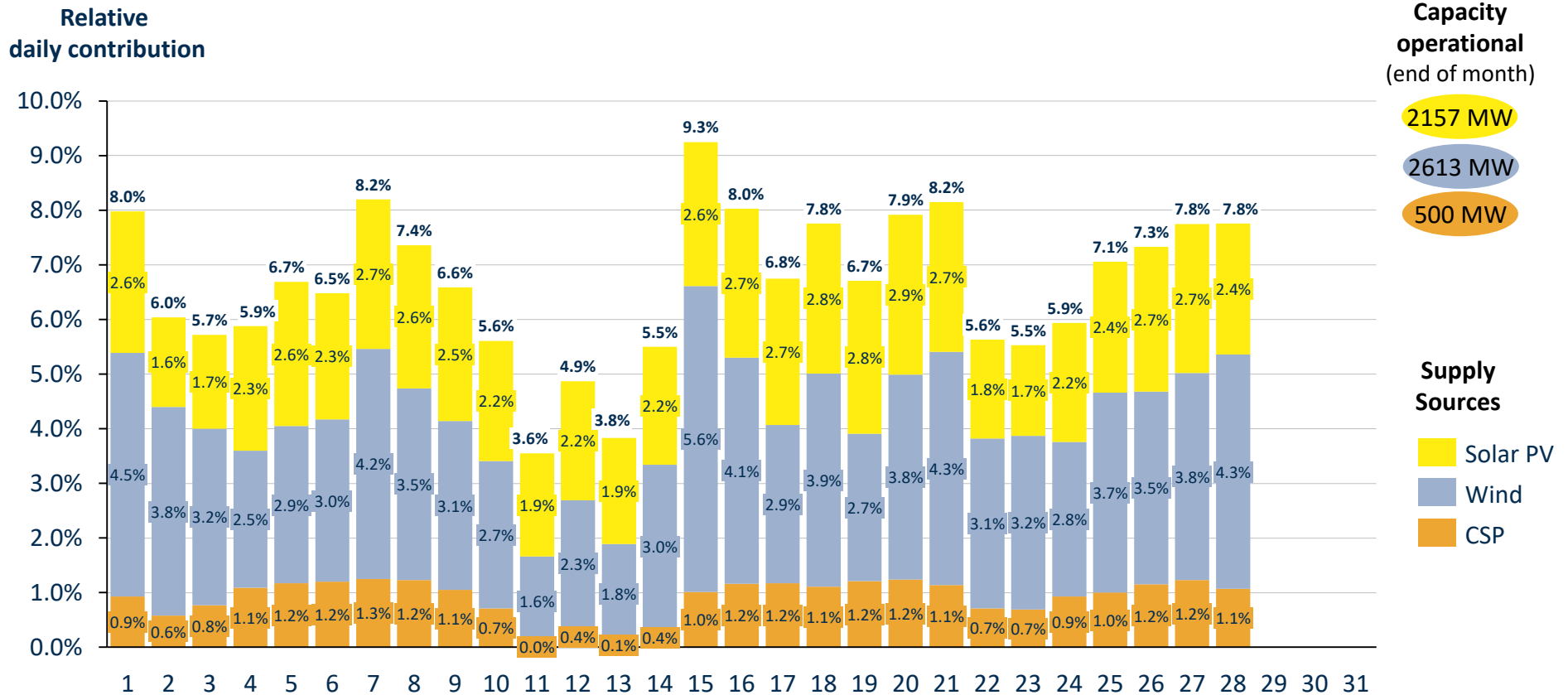
Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for January 2021



- Maximum daily relative solar PV contribution of 3.1% on 17 Jan 2021 (Sunday)
- Maximum daily relative wind contribution of 6.3% on 1 Jan 2021 (Friday-National Holiday)
- Maximum daily relative CSP contribution of 1.2% on 18 Jan 2021 (Monday)

# Daily solar PV, wind & CSP contribution of 3.6-9.3% in Feb 2021

Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for February 2021

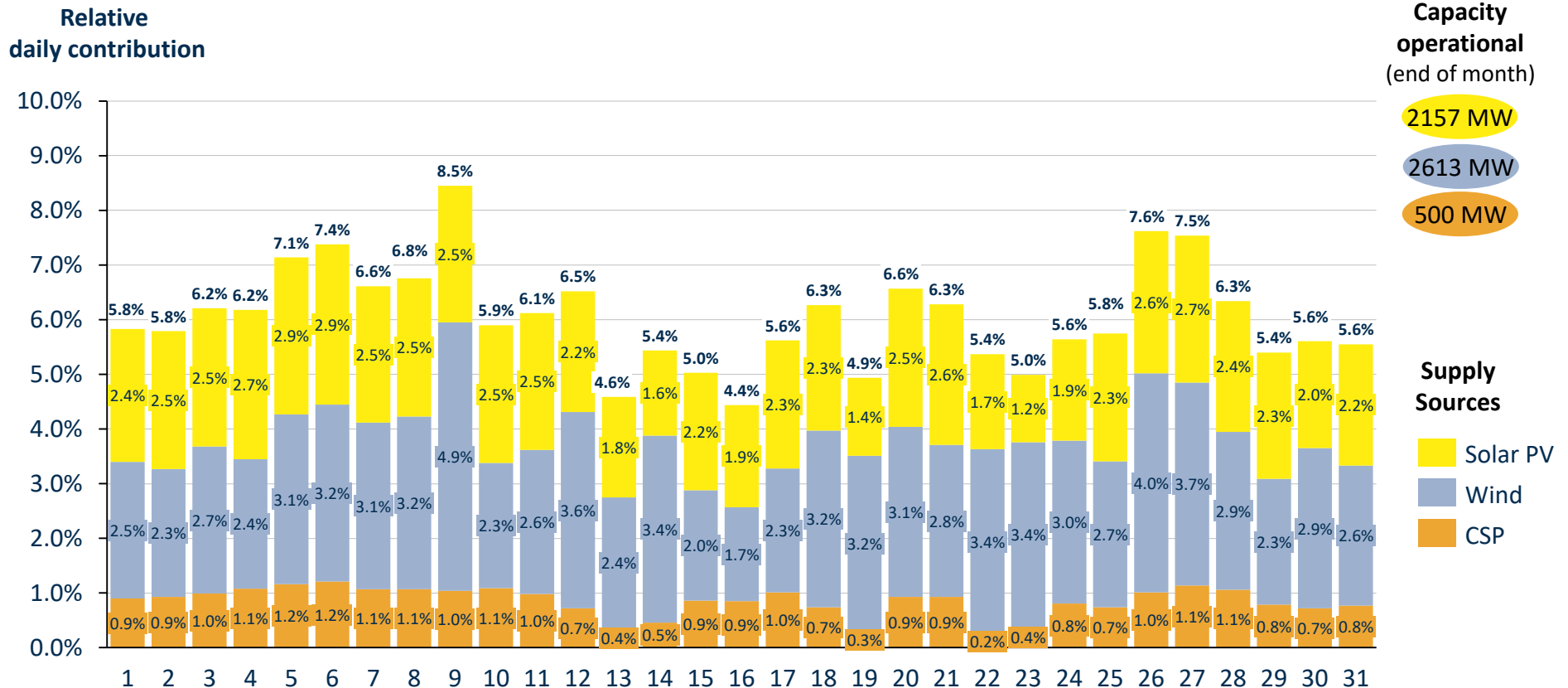


- Maximum daily relative solar PV contribution of 2.9% on 20 Feb 2021 (Saturday)
- Maximum daily relative wind contribution of 5.6% on 15 Feb 2021 (Monday)
- Maximum daily relative CSP contribution of 1.3% on 7 Feb 2021 (Sunday)



# Daily solar PV, wind & CSP contribution of 4.4-8.5% in Mar 2021

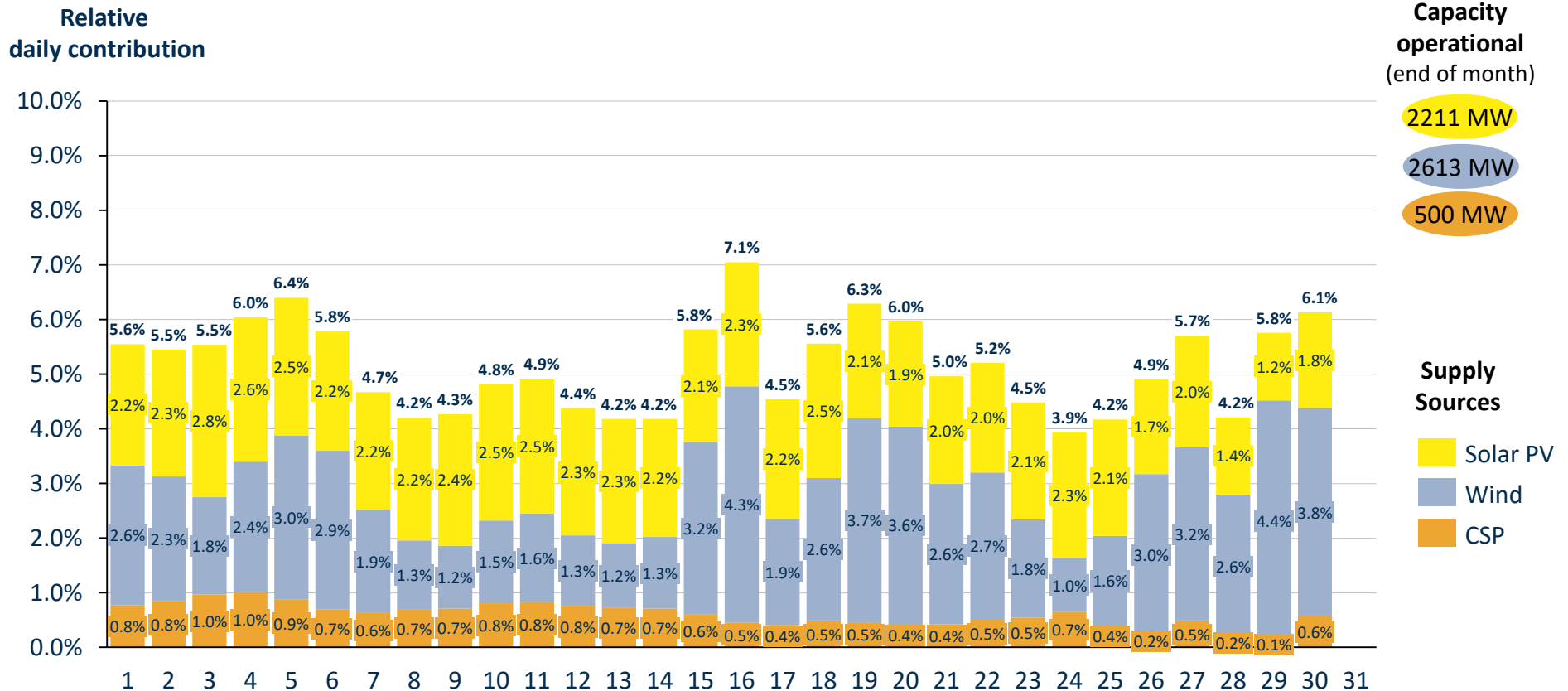
Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for March 2021



- Maximum daily relative solar PV contribution of 2.9% on 6 Mar 2021 (Saturday)
- Maximum daily relative wind contribution of 4.9% on 9 Mar 2021 (Tuesday)
- Maximum daily relative CSP contribution of 1.2% on 6 Mar 2021 (Saturday)

# Daily solar PV, wind & CSP contribution of 3.9-7.1% in Apr 2021

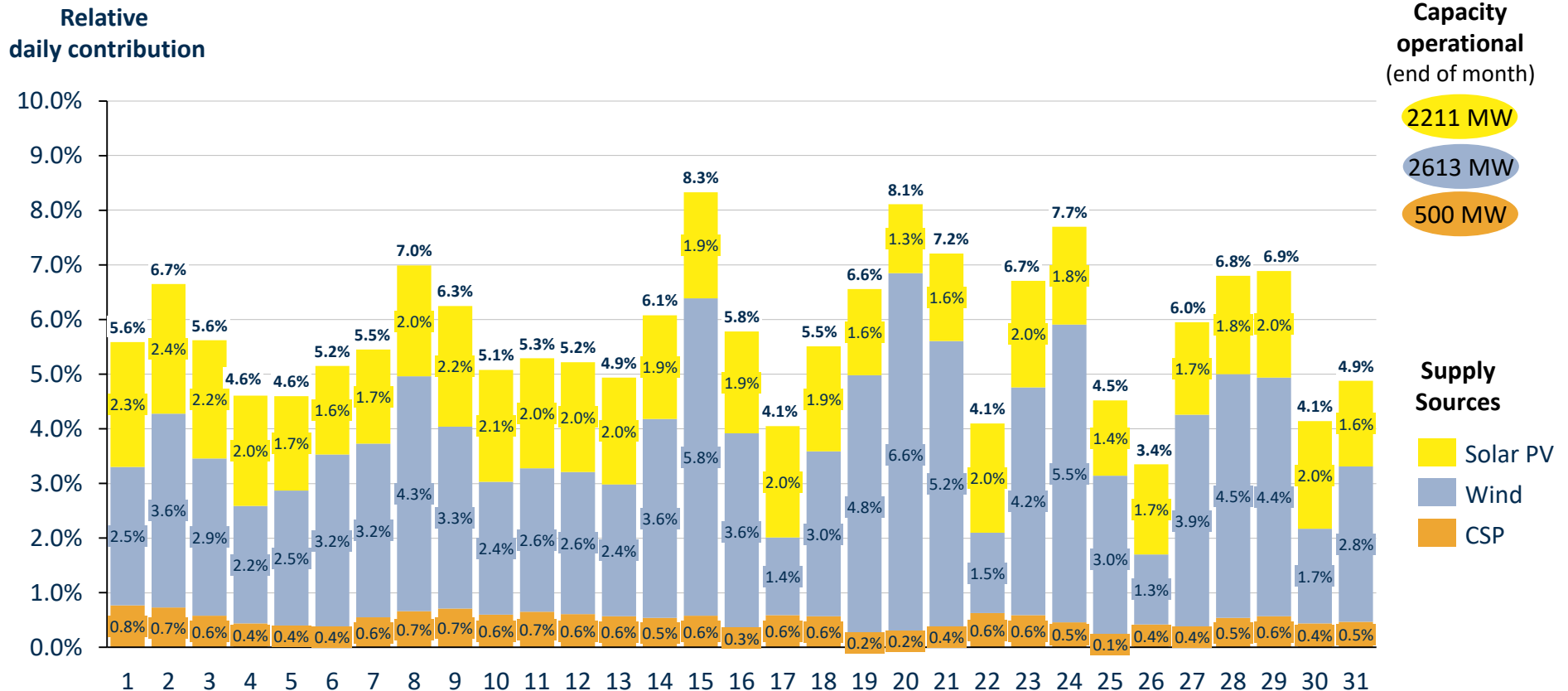
Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for April 2020



- Maximum daily relative solar PV contribution of 2.8% on 3 Apr 2021 (Saturday)
- Maximum daily relative wind contribution of 4.4% on 29 Apr 2021 (Thursday)
- Maximum daily relative CSP contribution of 1.0% on 4 Apr 2021 (Sunday)

# Daily solar PV, wind & CSP contribution of 3.4-8.3% in May 2021

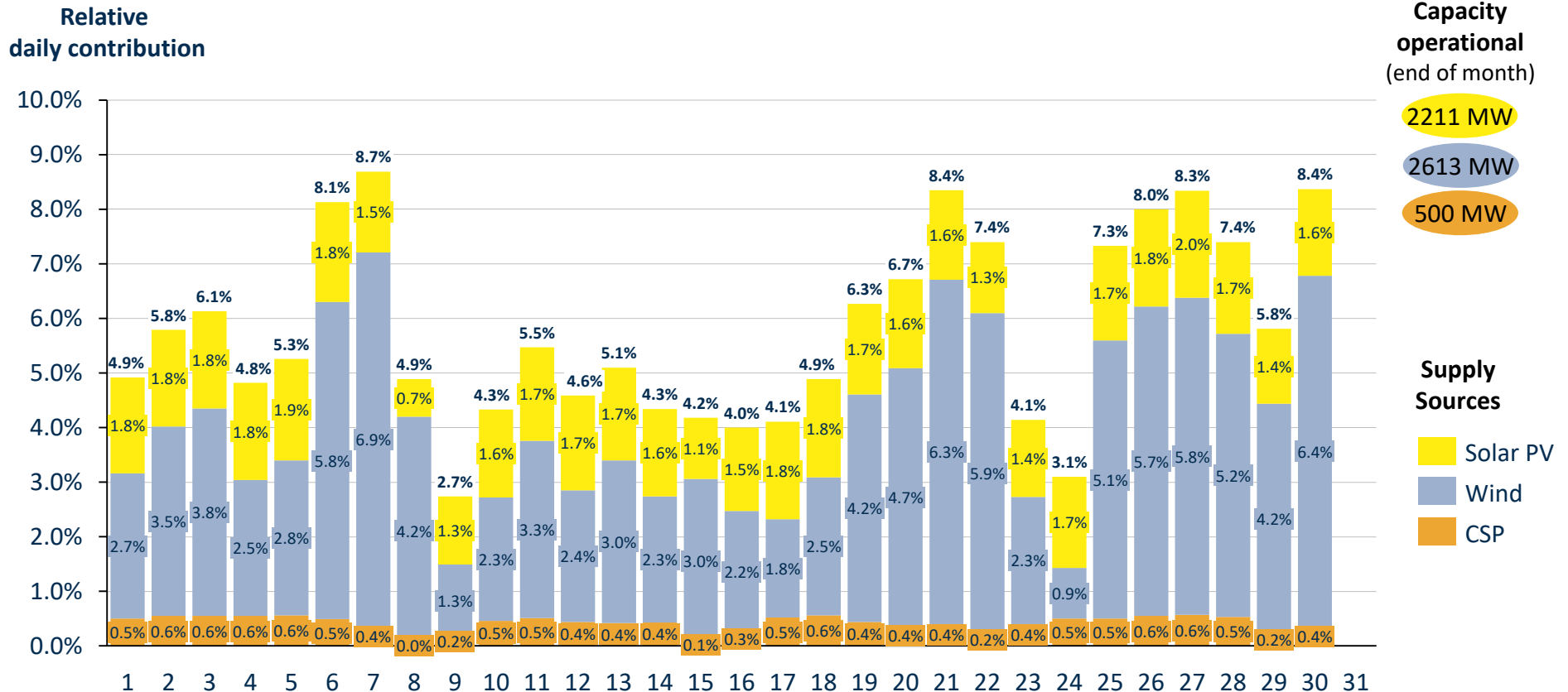
Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for May 2021



- Maximum daily relative solar PV contribution of 2.4% on 2 May 2021 (Sunday)
- Maximum daily relative wind contribution of 6.6% on 20 May 2021 (Thursday)
- Maximum daily relative CSP contribution of 0.8% on 1 May 2021 (Saturday)

# Daily solar PV, wind & CSP contribution of 2.7-8.7% in Jun 2021

Actual daily relative solar PV/wind/CSP contribution as % of total supply in RSA for June 2021



- Maximum daily relative solar PV contribution of 2.0% on 27 Jun 2021 (Sunday)
- Maximum daily relative wind contribution of 6.9% on 7 Jun 2021 (Monday)
- Maximum daily relative CSP contribution of 0.6% on 27 Jun 2021 (Sunday)

# Agenda

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- 1 Overview actual electricity production (2021-H1)
- 2 Monthly electricity production (2021-H1)
- 3 Weekly electricity production (2021-H1)
- 4 Daily electricity production (2021-H1)

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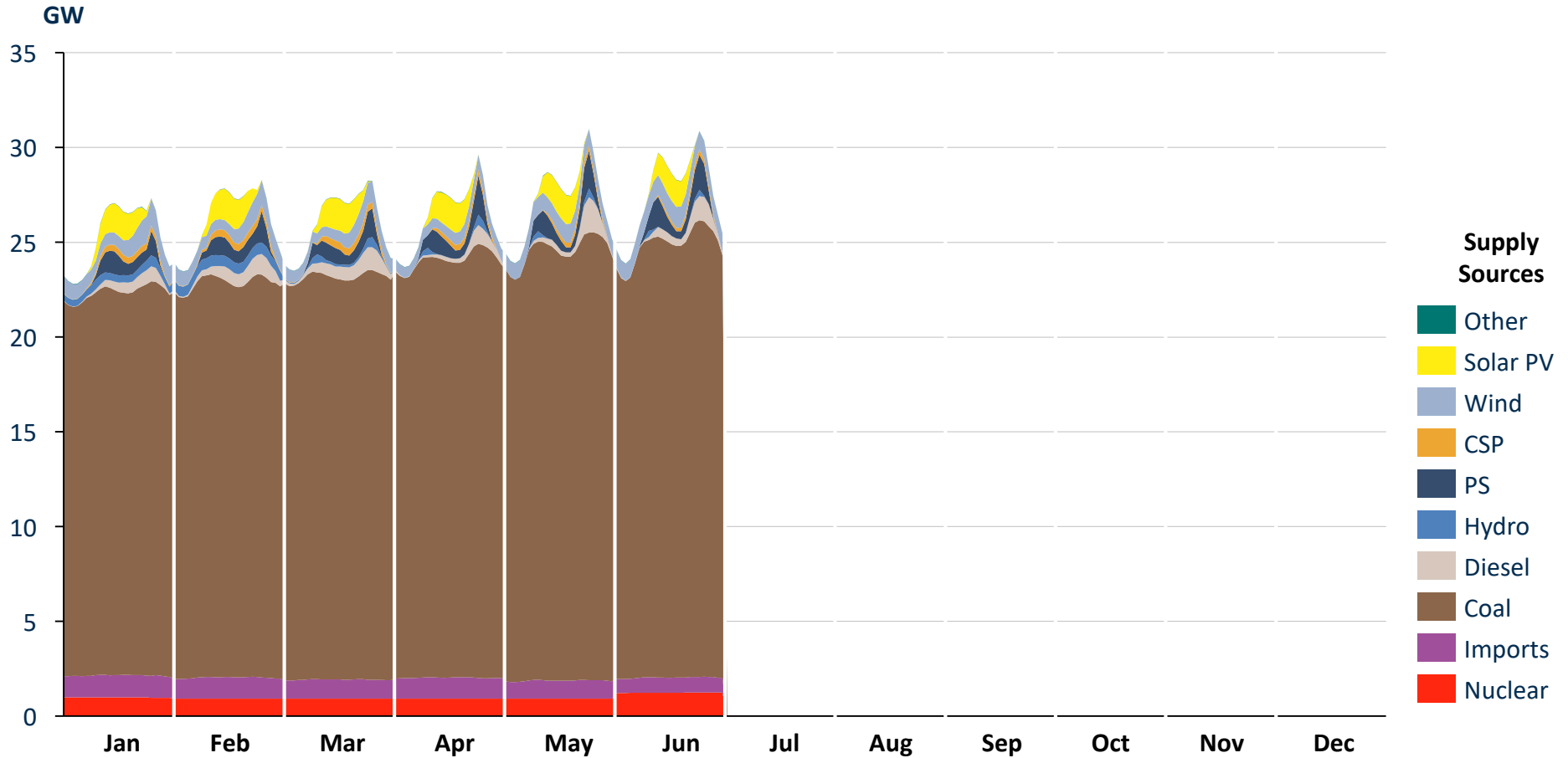
- 5 Hourly electricity production (2021-H1)

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- 6 Actual load shedding (2021-H1)
- 7 Other power system statistics

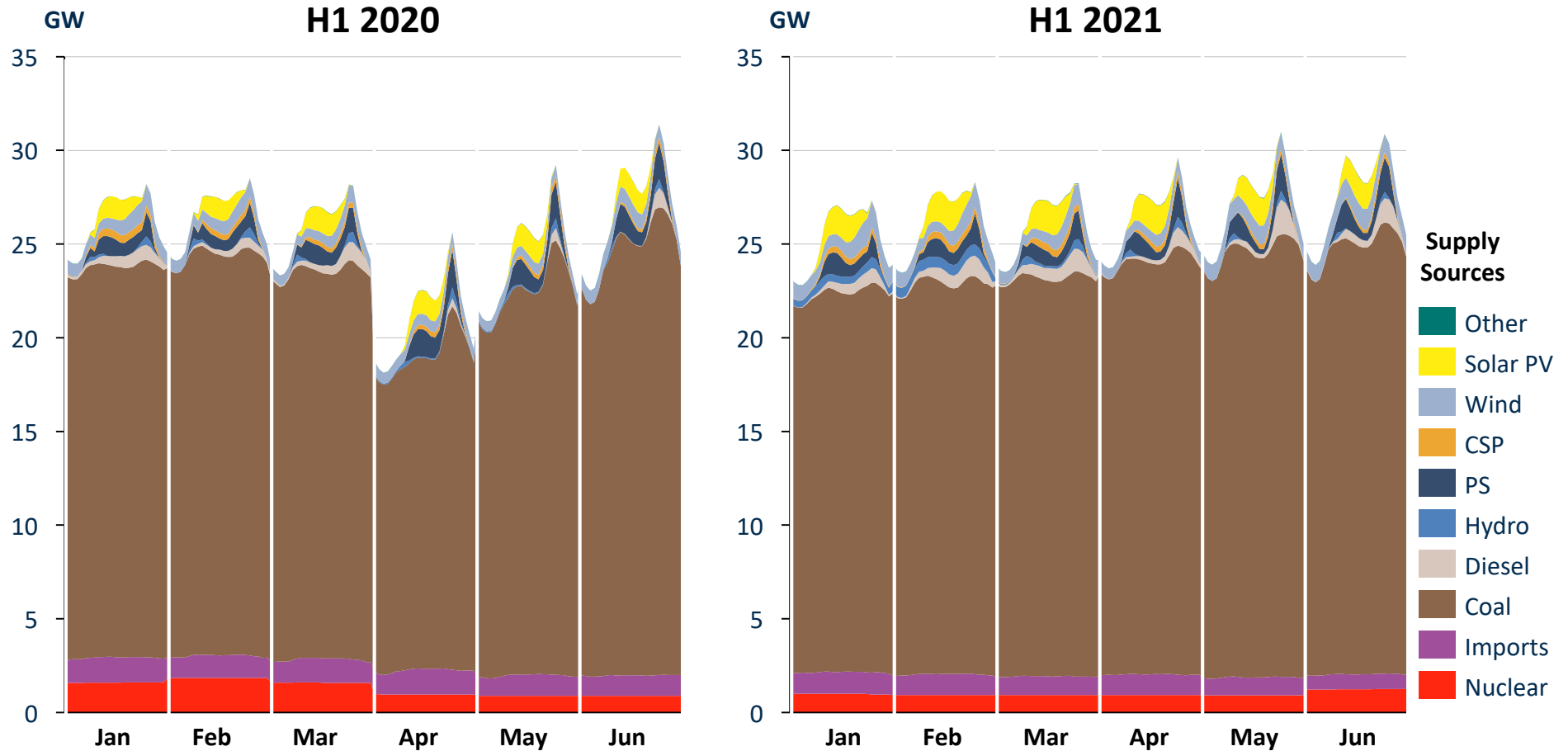
# Diurnal Courses of electricity supply sources in RSA

Actual monthly average diurnal courses of the total power supply in RSA from Jan-Jun 2021



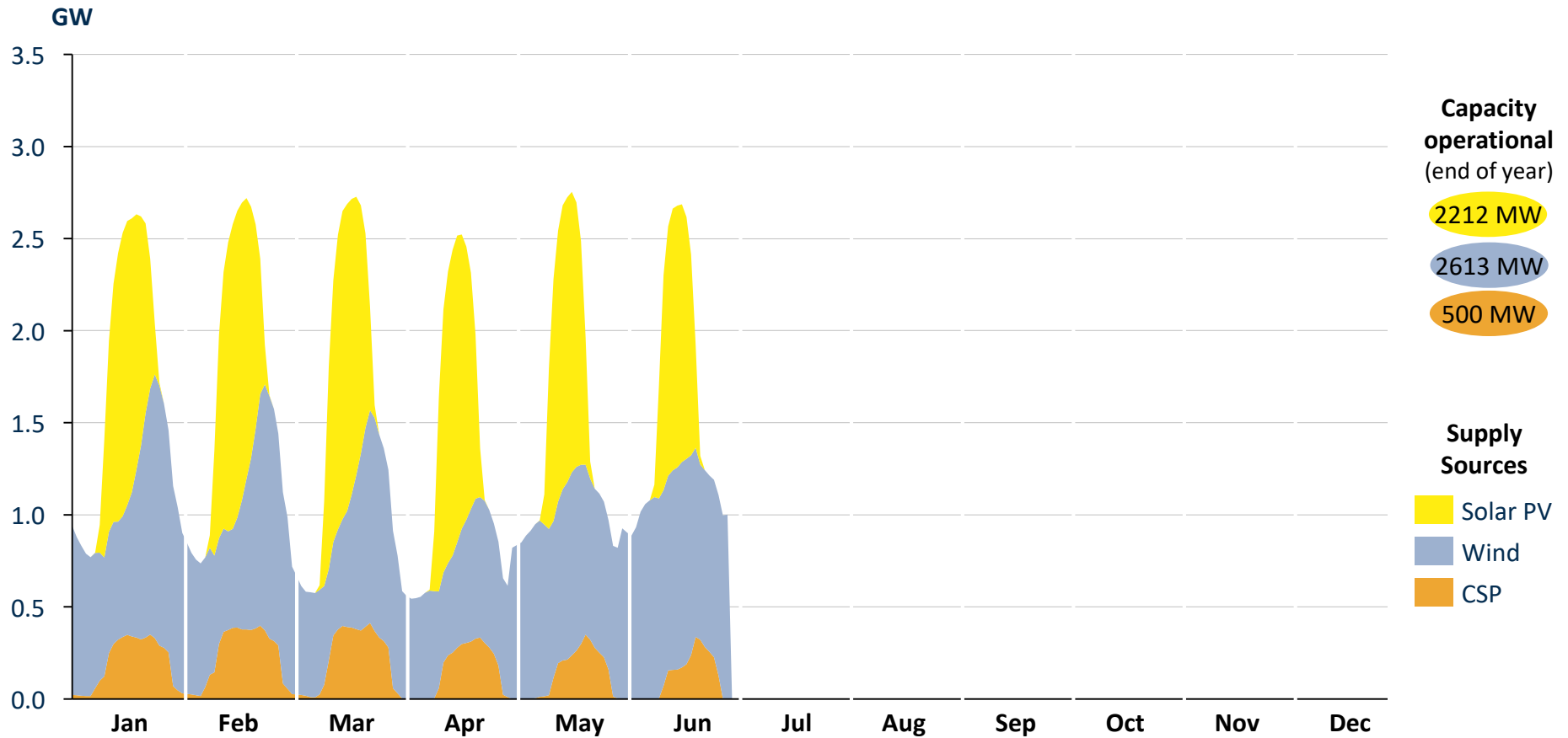
# Diurnal Courses of electricity supply sources in RSA H1 2020 vs. 2021

Actual monthly average diurnal courses of the total power supply in RSA from Jan-Jun 2020/21



# Diurnal Courses for renewable energy supply

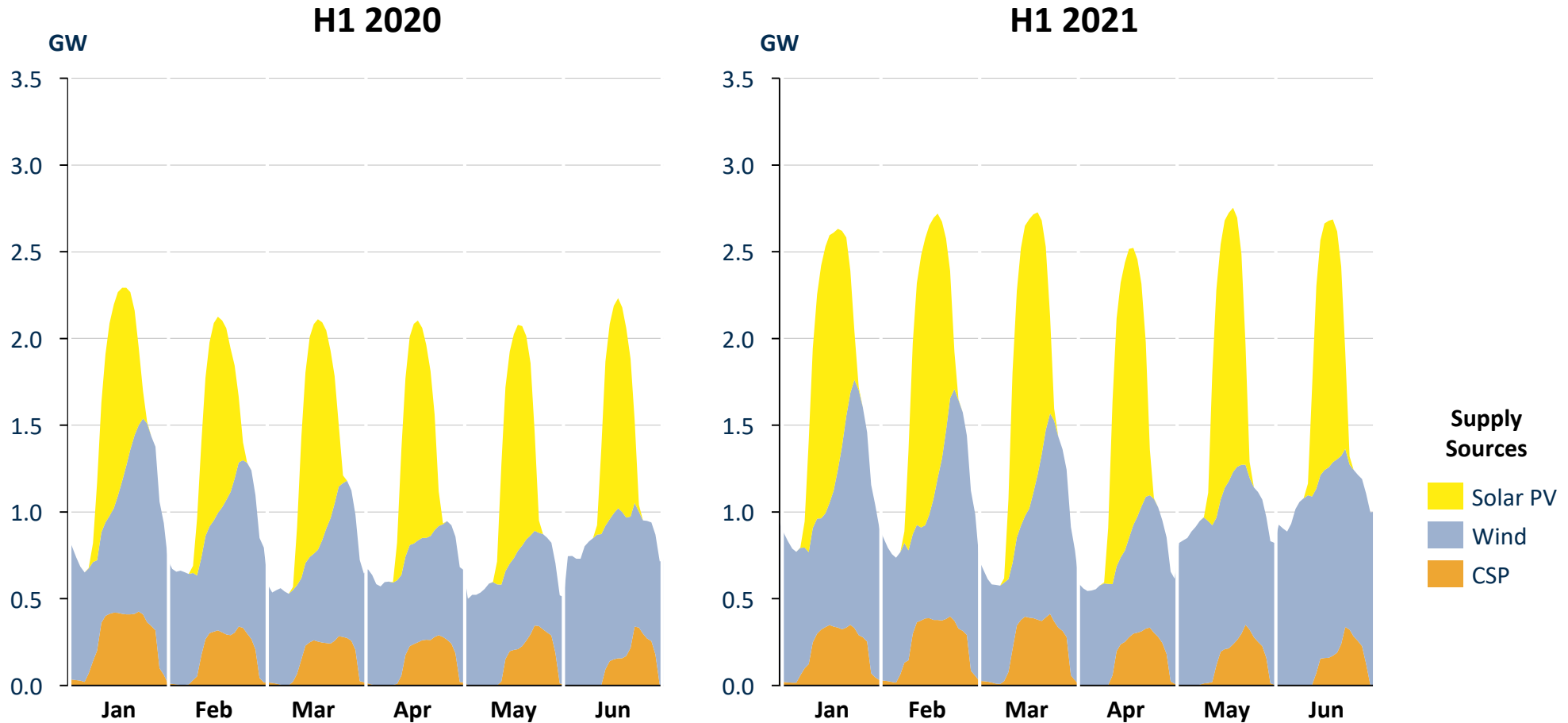
Actual monthly average diurnal courses of solar PV, wind and CSP in RSA for the months from Jan-Jun 2021





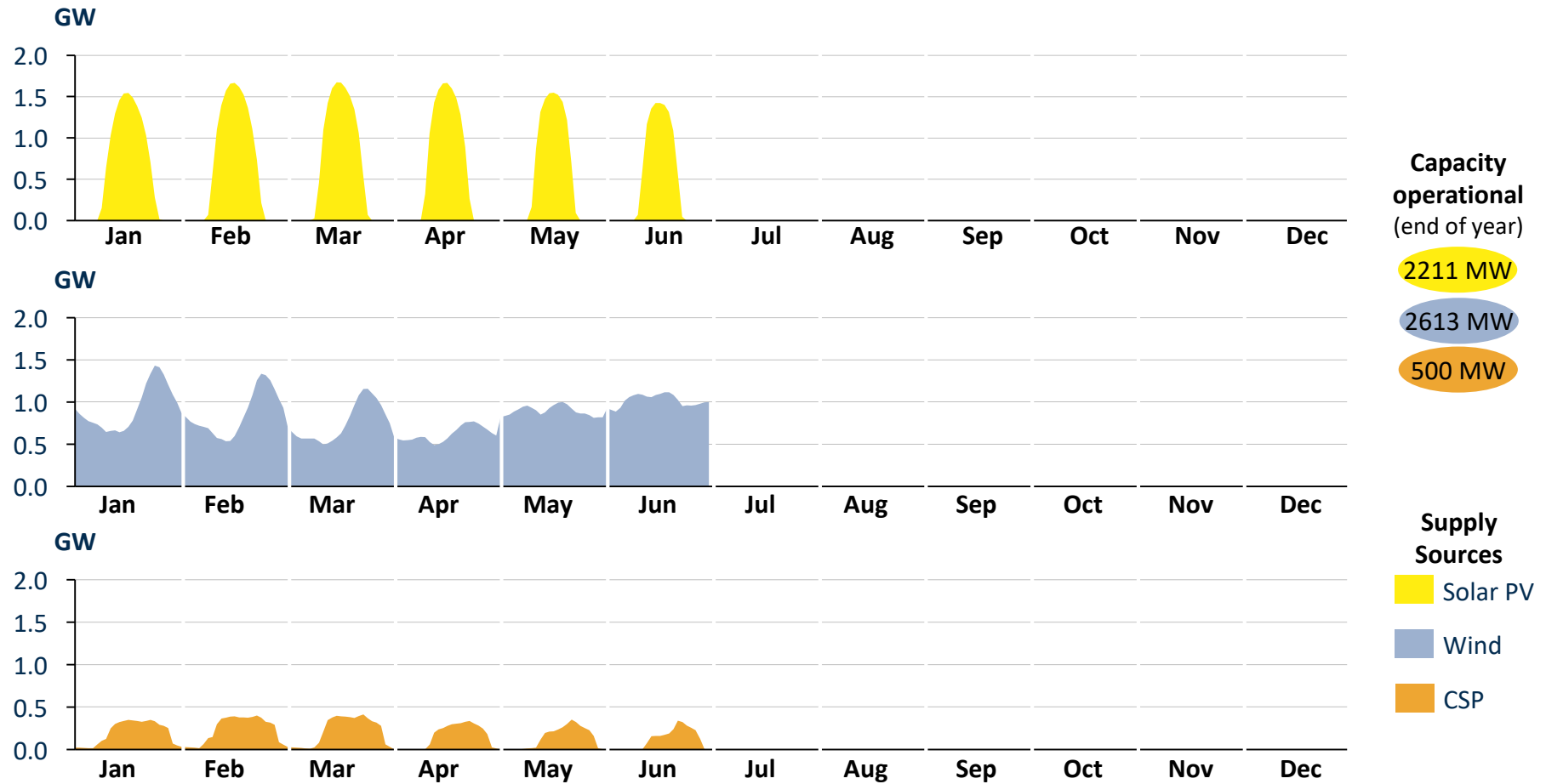
# Diurnal Courses for renewable energy supply H1 2020 vs. H1 2021

Actual monthly average diurnal courses of solar PV, wind and CSP in RSA for the months from Jan-Jun 2020/21



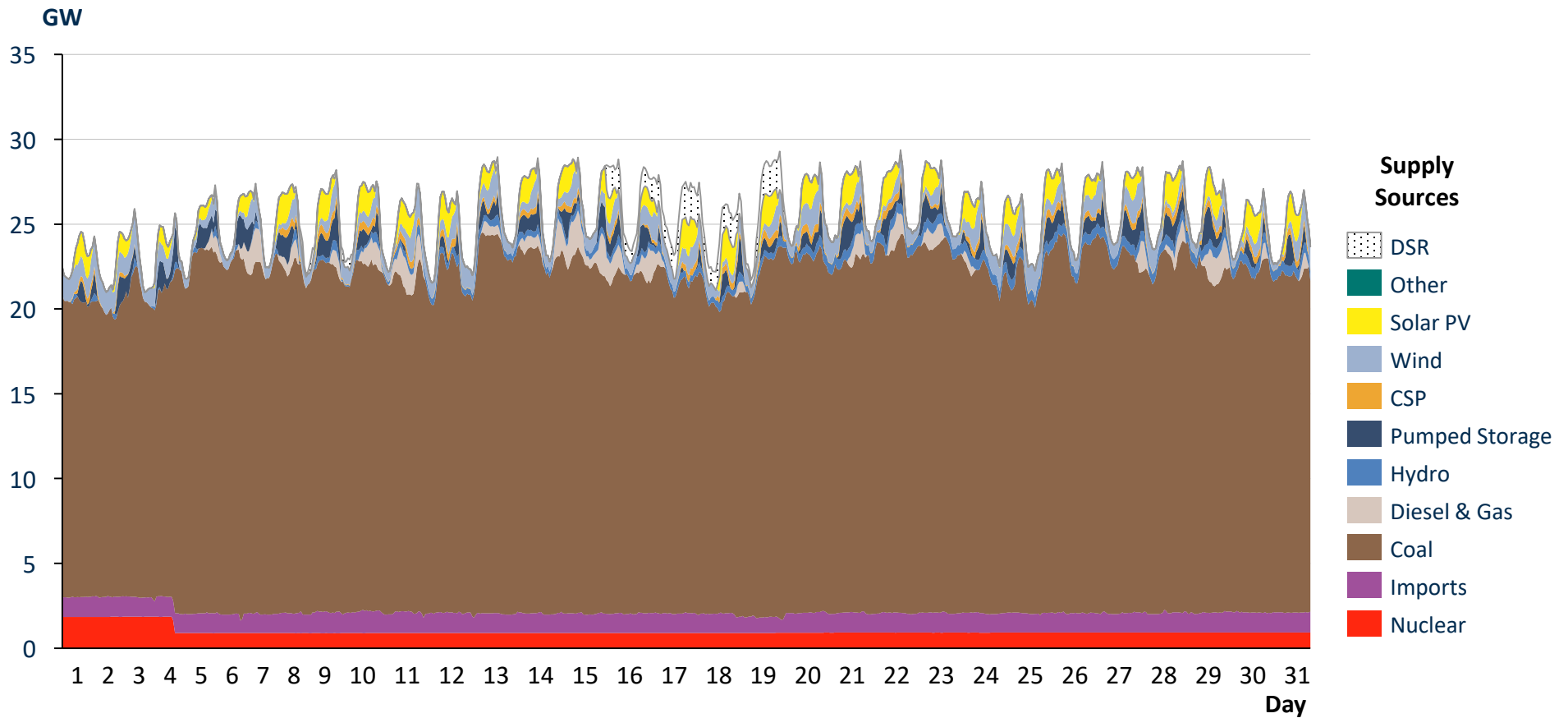
# Diurnal Courses for renewable energy supply

Actual monthly average diurnal courses of solar PV, wind & CSP in RSA from Jan-Jun 2021



# Hourly electricity production in Jan 2021

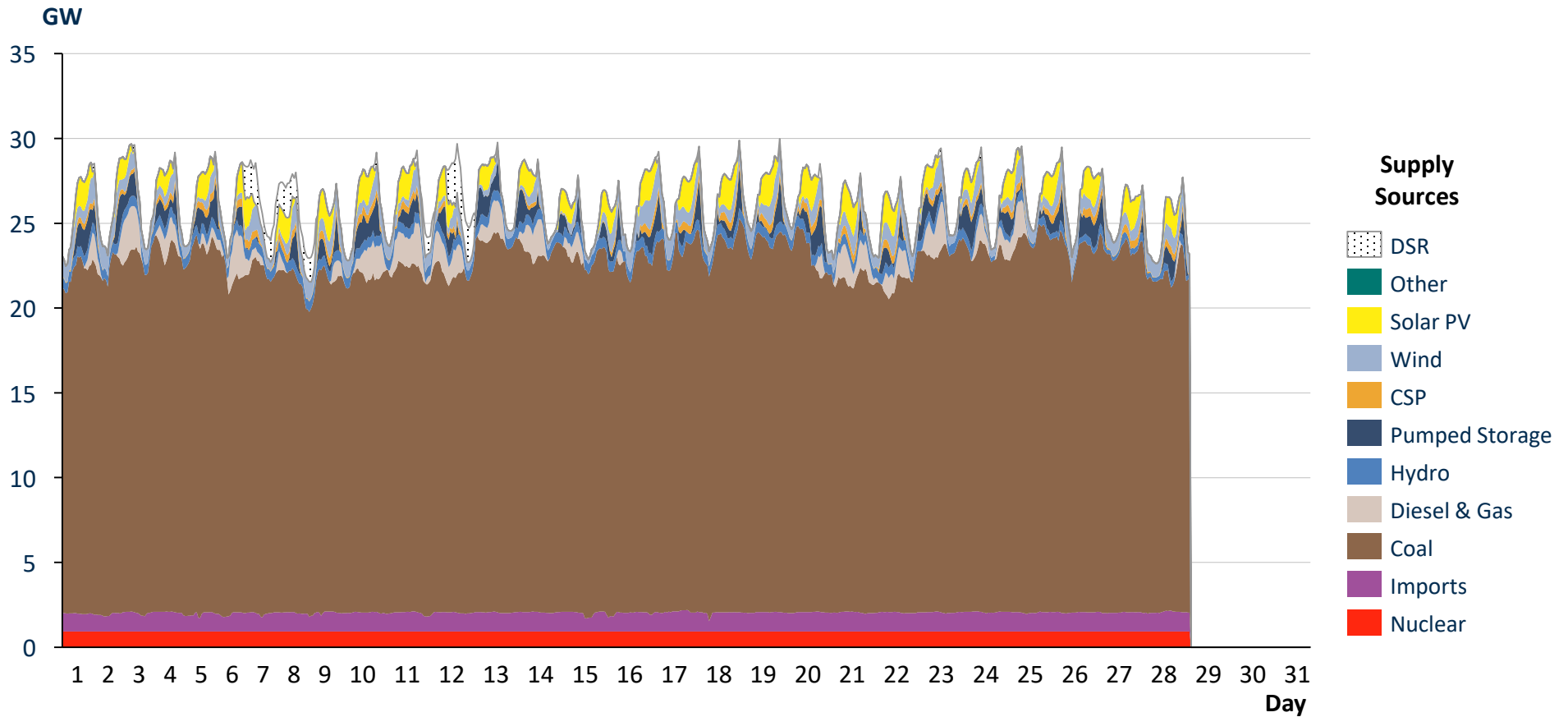
Actual hourly production from all power supply sources in RSA for January 2021



Note: Daily production includes generation for pumping load. Wind includes Sere.  
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
Sources: Eskom; CSIR Energy Centre analysis

# Hourly electricity production in Feb 2021

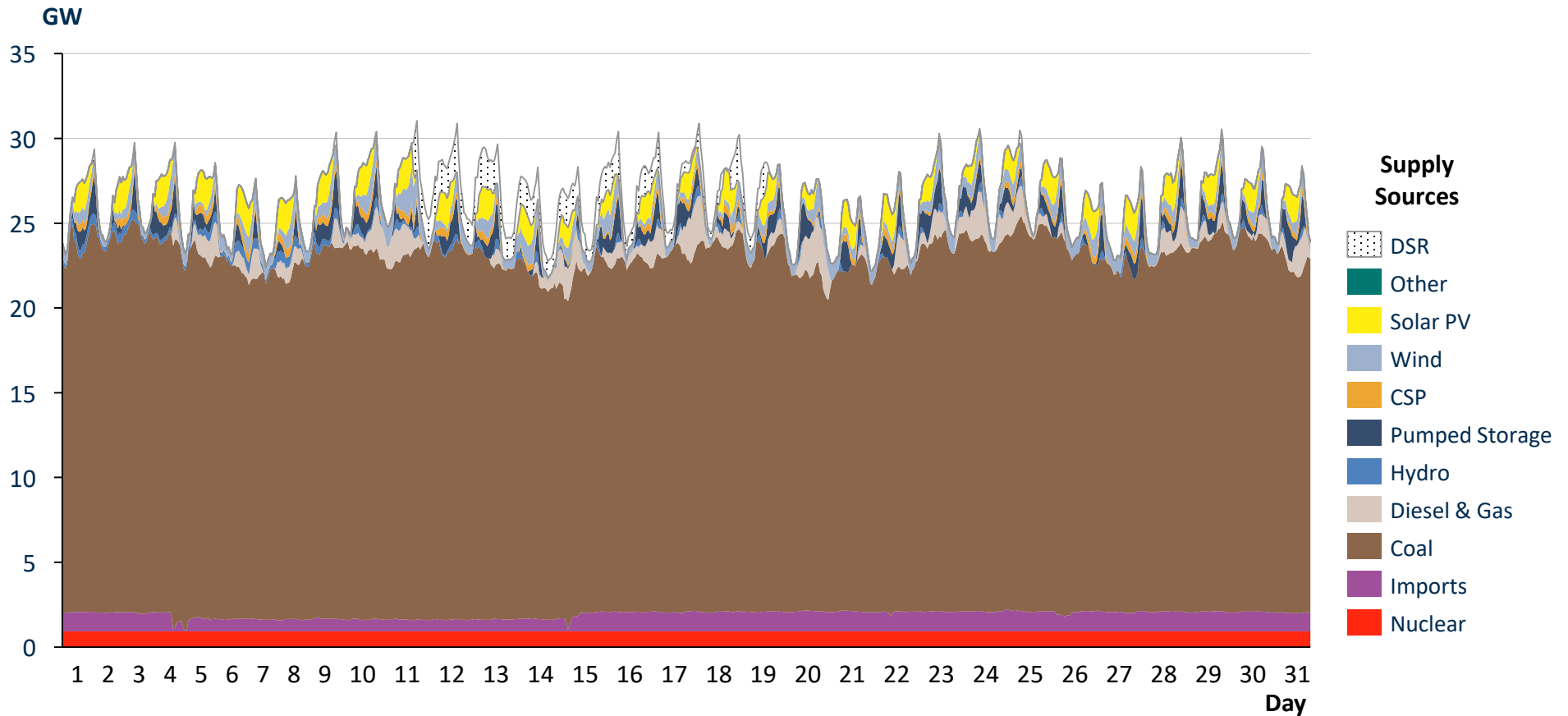
Actual hourly production from all power supply sources in RSA for February 2021



Note: Daily production includes generation for pumping load. Wind includes Sere.  
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
Sources: Eskom; CSIR Energy Centre analysis

# Hourly electricity production in Mar 2021

Actual hourly production from all power supply sources in RSA for March 2021



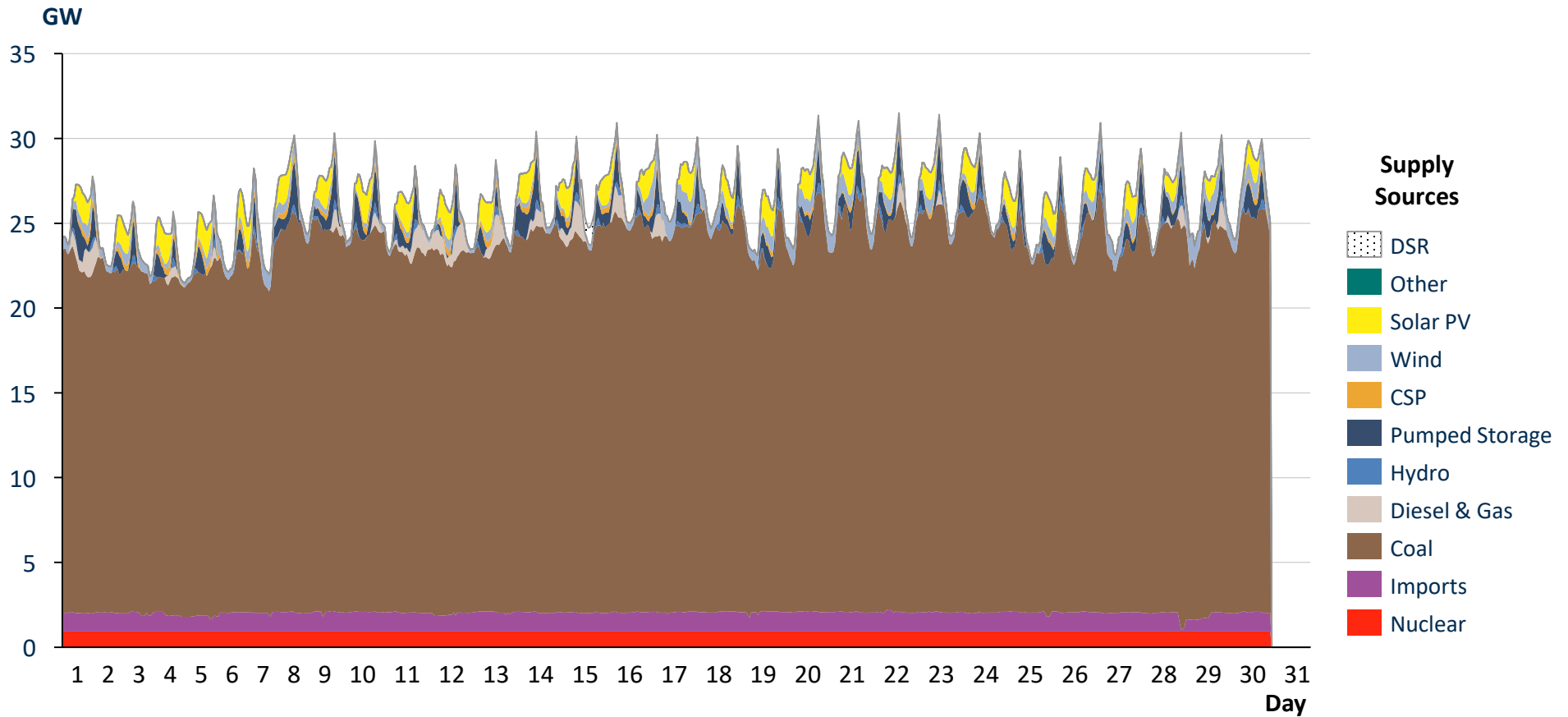
Note: Daily production includes generation for pumping load. Wind includes Sere.

Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Hourly electricity production in Apr 2021

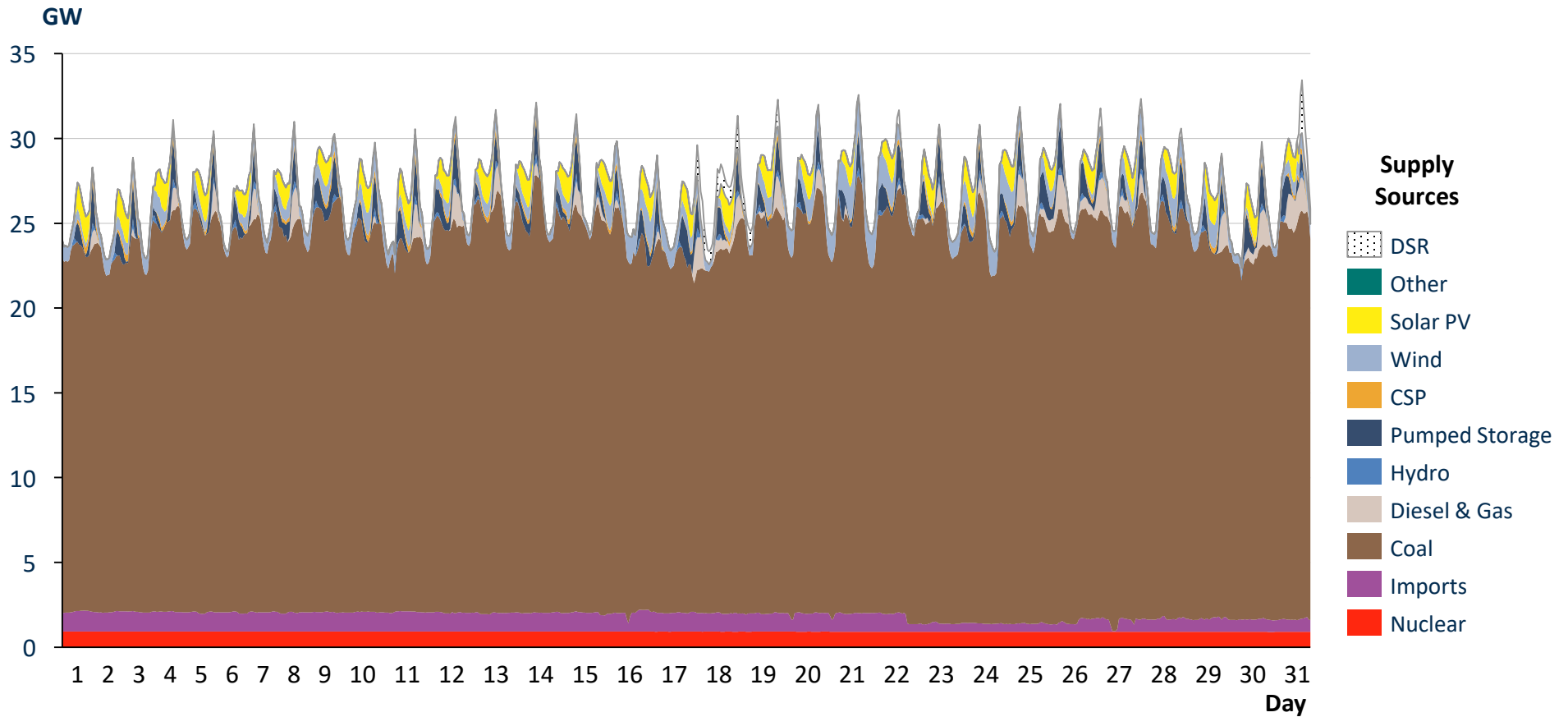
Actual hourly production from all power supply sources in RSA for April 2021



Note: Daily production includes generation for pumping load. Wind includes Sere.  
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
Sources: Eskom; CSIR Energy Centre analysis

# Hourly electricity production in May 2021

Actual hourly production from all power supply sources in RSA for May 2021



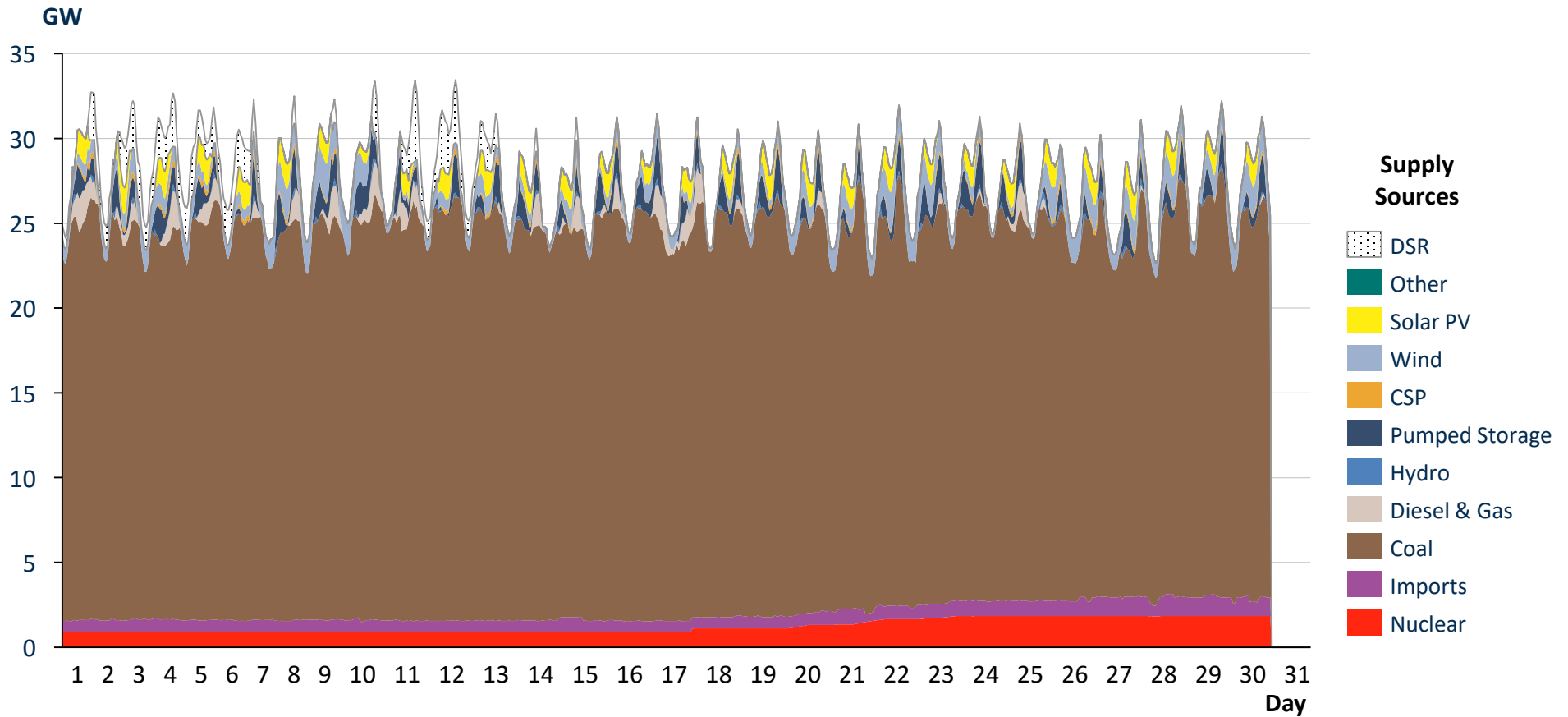
Note: Daily production includes generation for pumping load. Wind includes Sere.

Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)

Sources: Eskom; CSIR Energy Centre analysis

# Hourly electricity production in Jun 2021

Actual hourly production from all power supply sources in RSA for June 2021



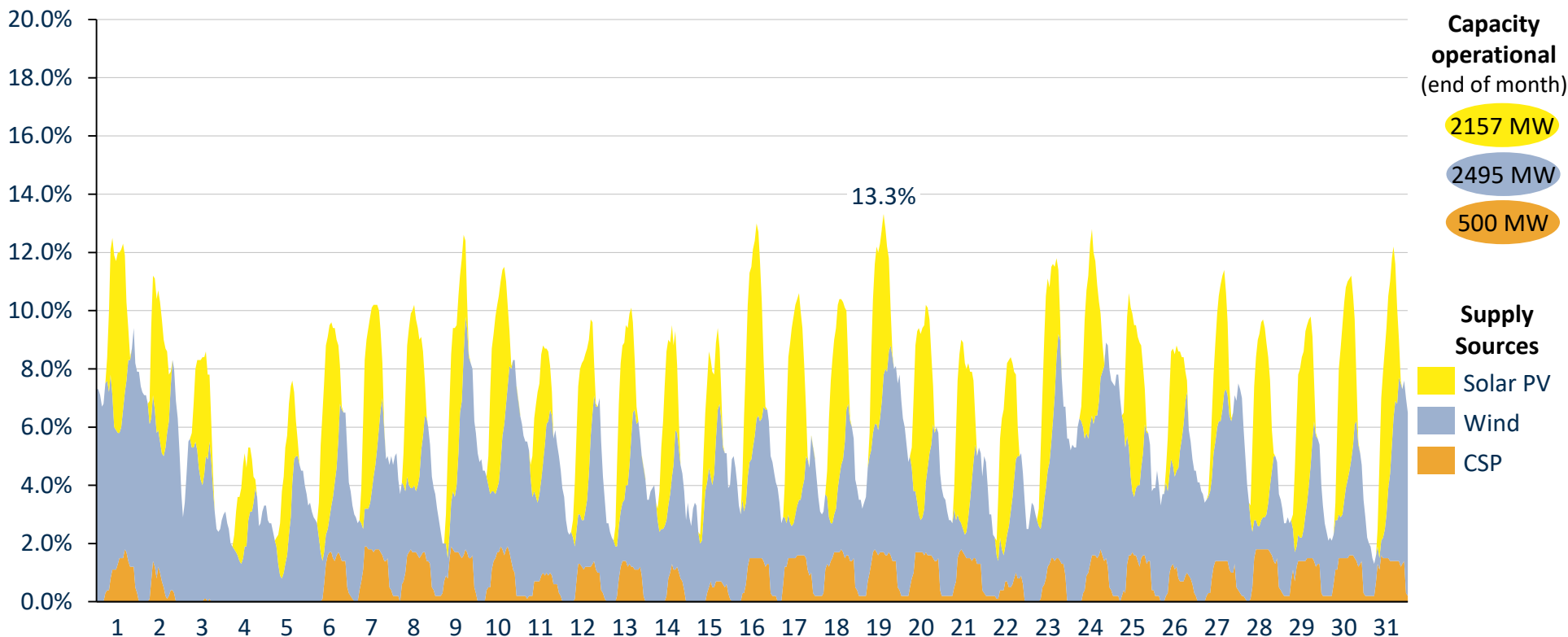
Note: Daily production includes generation for pumping load. Wind includes Sere.  
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
Sources: Eskom; CSIR Energy Centre analysis



# Hourly solar PV, wind & CSP contribution of 1.3-13.3% in Jan 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for January 2021

## Relative hourly contribution

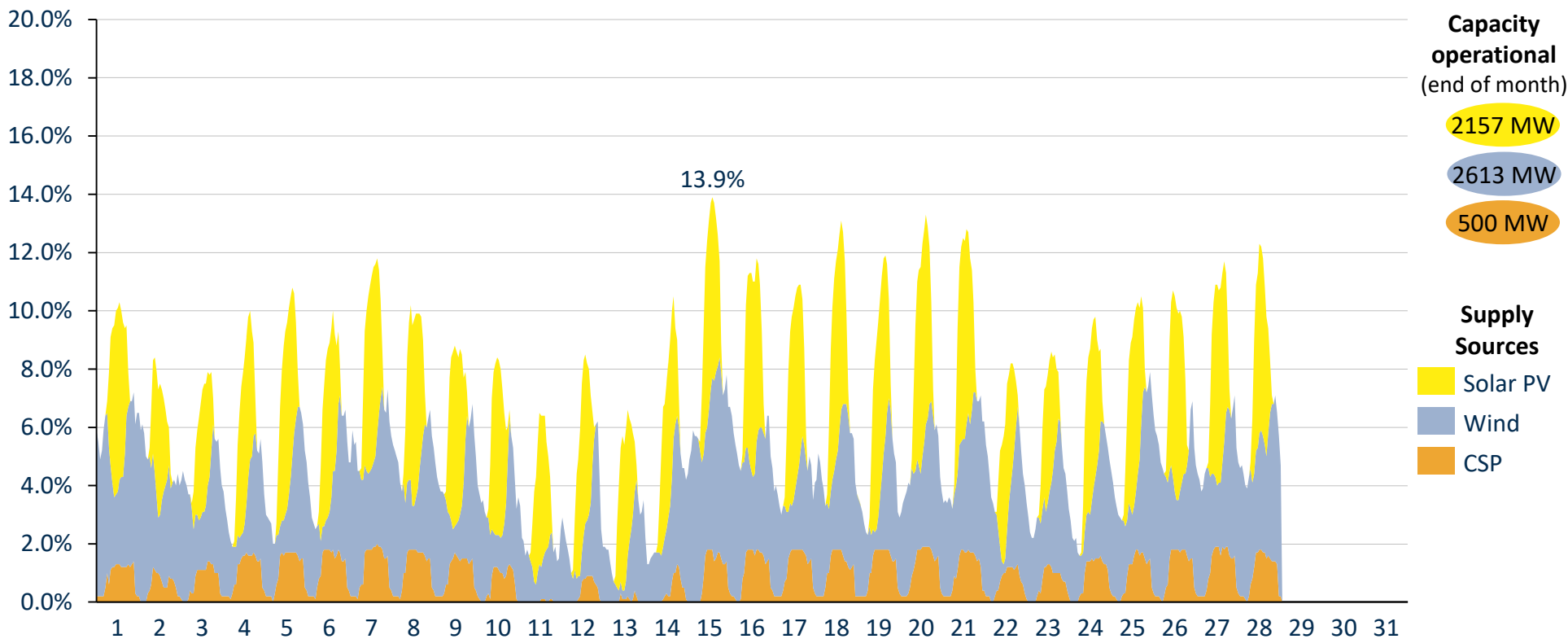


- Solar PV maximum relative contribution of 7.2% between 12h00 and 13h00 on 17 Jan 2021
- Wind maximum relative contribution of 8.2% between 21h00 and 22h00 on 1 Jan 2021
- CSP maximum relative contribution of 1.9% between 09h00 and 10h00 on 7 Jan 2021

# Hourly solar PV, wind & CSP contribution of 0.7-13.9% in Feb 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for February 2021

## Relative hourly contribution

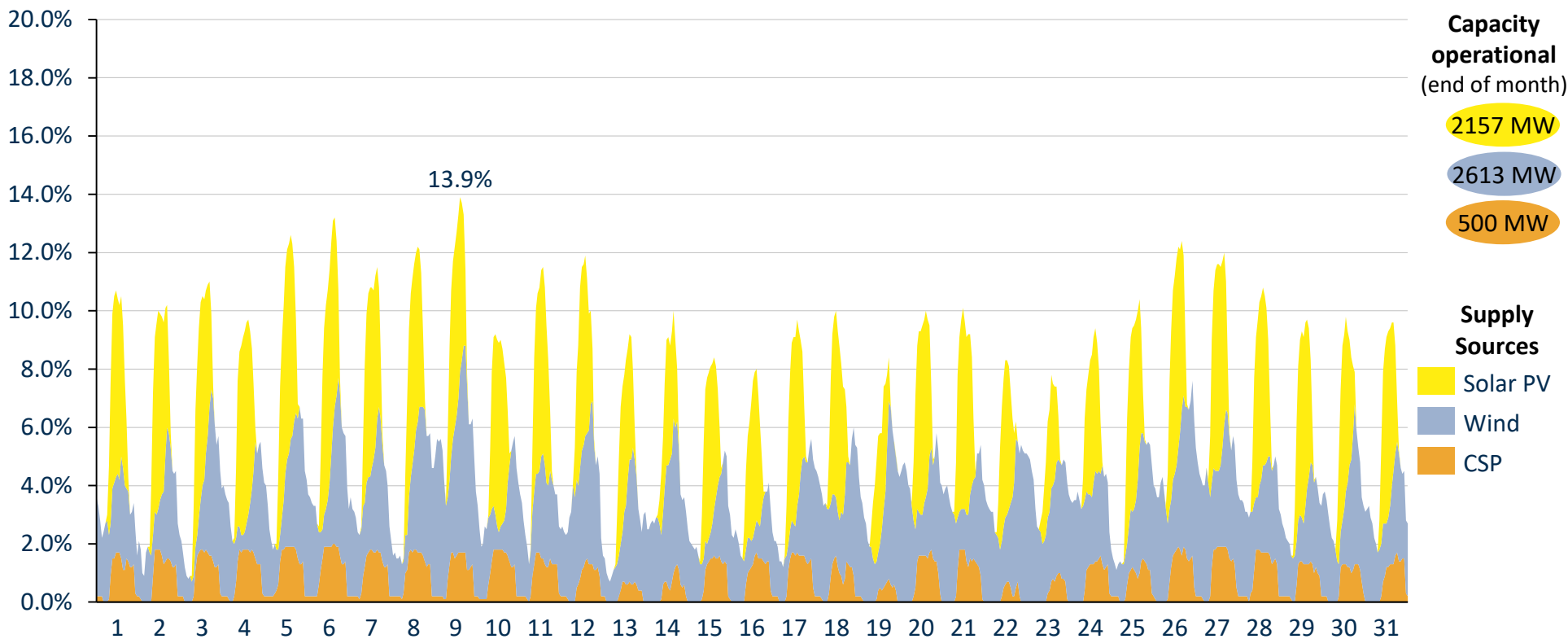


- Maximum solar PV relative contribution of 7.3% between 13h00 and 14h00 on 20 Feb 2021
- Maximum wind relative contribution of 6.7% between 17h00 and 18h00 on 15 Feb 2021
- Maximum CSP relative contribution of 2.0% between 15h00 and 16h00 on 7 Feb 2021

# Hourly solar PV, wind & CSP contribution of 0.7-13.9% in Mar 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for March 2021

## Relative hourly contribution

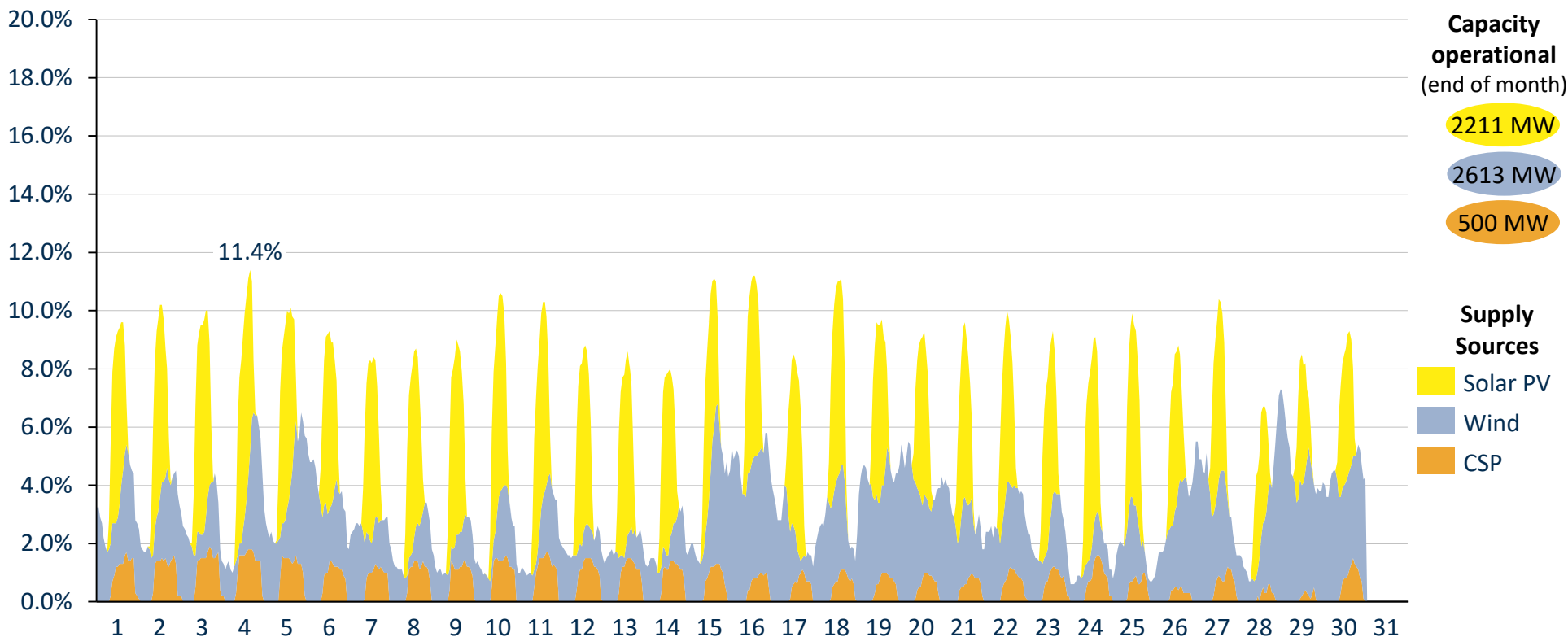


- Maximum solar PV relative contribution of 7.3% between 12h00 and 13h00 on 6 Mar 2021
- Maximum wind relative contribution of 7.1% between 17h00 and 18h00 on 9 Mar 2021
- Maximum CSP relative contribution of 2.0% between 15h00 and 16h00 on 6 Mar 2021

# Hourly solar PV, wind & CSP contribution of 0.6-11.4% in Apr 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for April 2021

## Relative hourly contribution

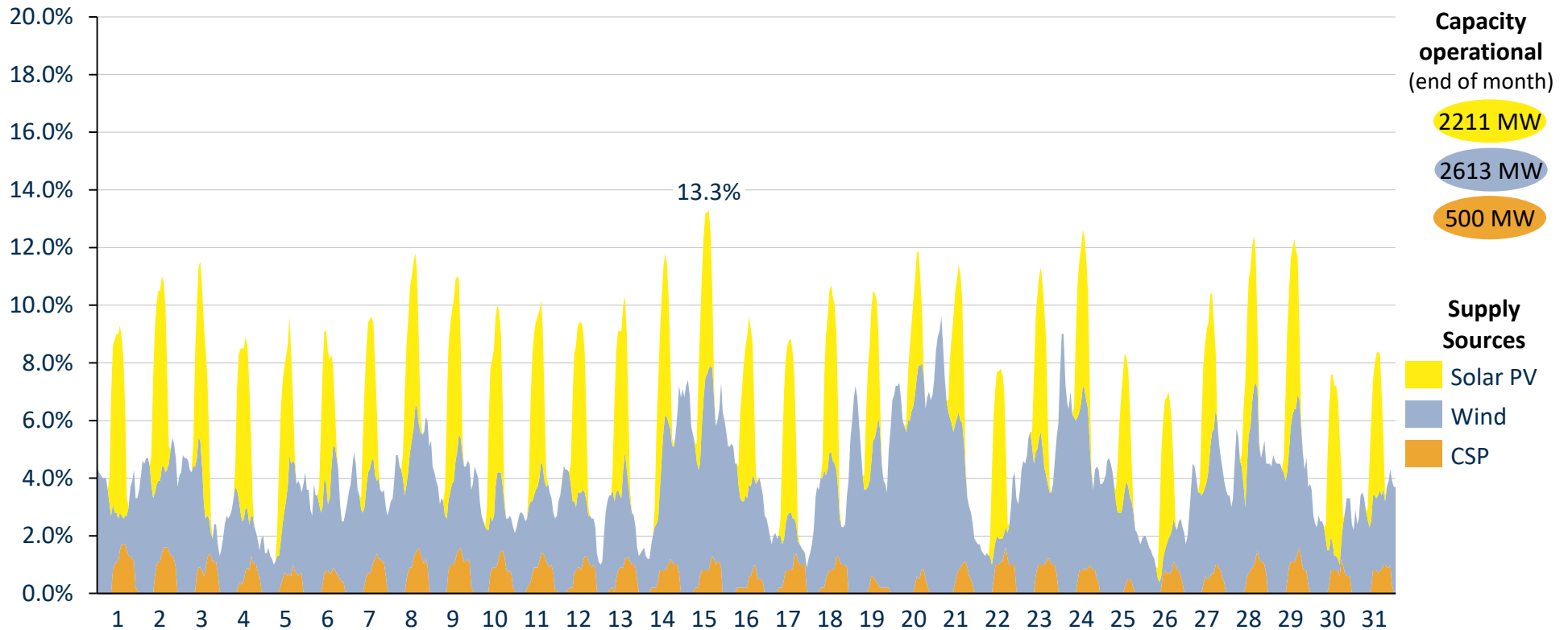


- Maximum solar PV relative contribution of 7.3% between 13h00 and 14h00 on 3 Apr 2021
- Maximum wind relative contribution of 7.3% between 23h00 and 24h00 on 29 Apr 2021
- Maximum CSP relative contribution of 1.9% between 16h00 and 17h00 on 3 Apr 2021

# Hourly solar PV, wind & CSP contribution of 0.9-13.3% in May 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for May 2021

## Relative hourly contribution

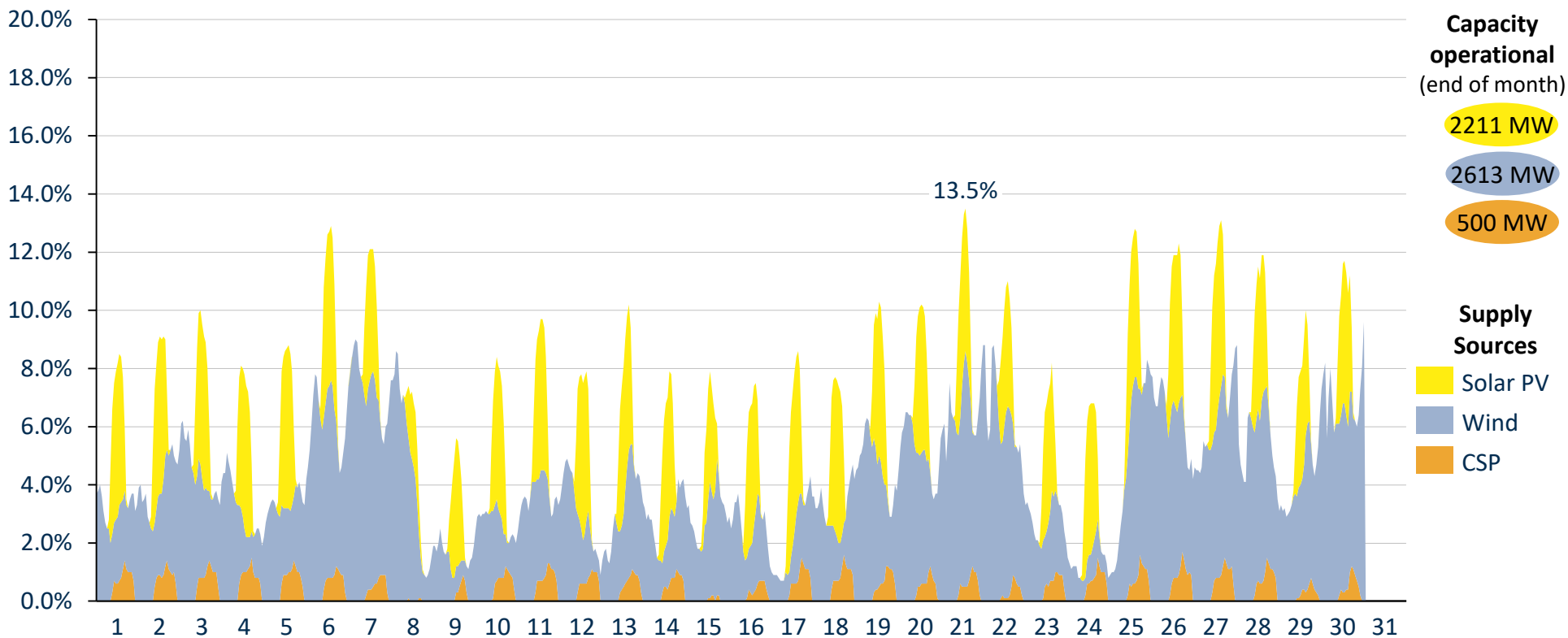


- Maximum solar PV relative contribution of 6.6% between 13h00 and 14h00 on 2 May 2020
- Maximum wind relative contribution of 9.6% between 03h00 and 04h00 on 21 May 2021
- Maximum CSP relative contribution of 1.7% between 16h00 and 17h00 on 1 May 2021

# Hourly solar PV, wind & CSP contribution of 0.7-13.5% in Jun 2021

Actual hourly relative solar PV/wind/CSP contribution as a % of total supply in RSA for June 2021

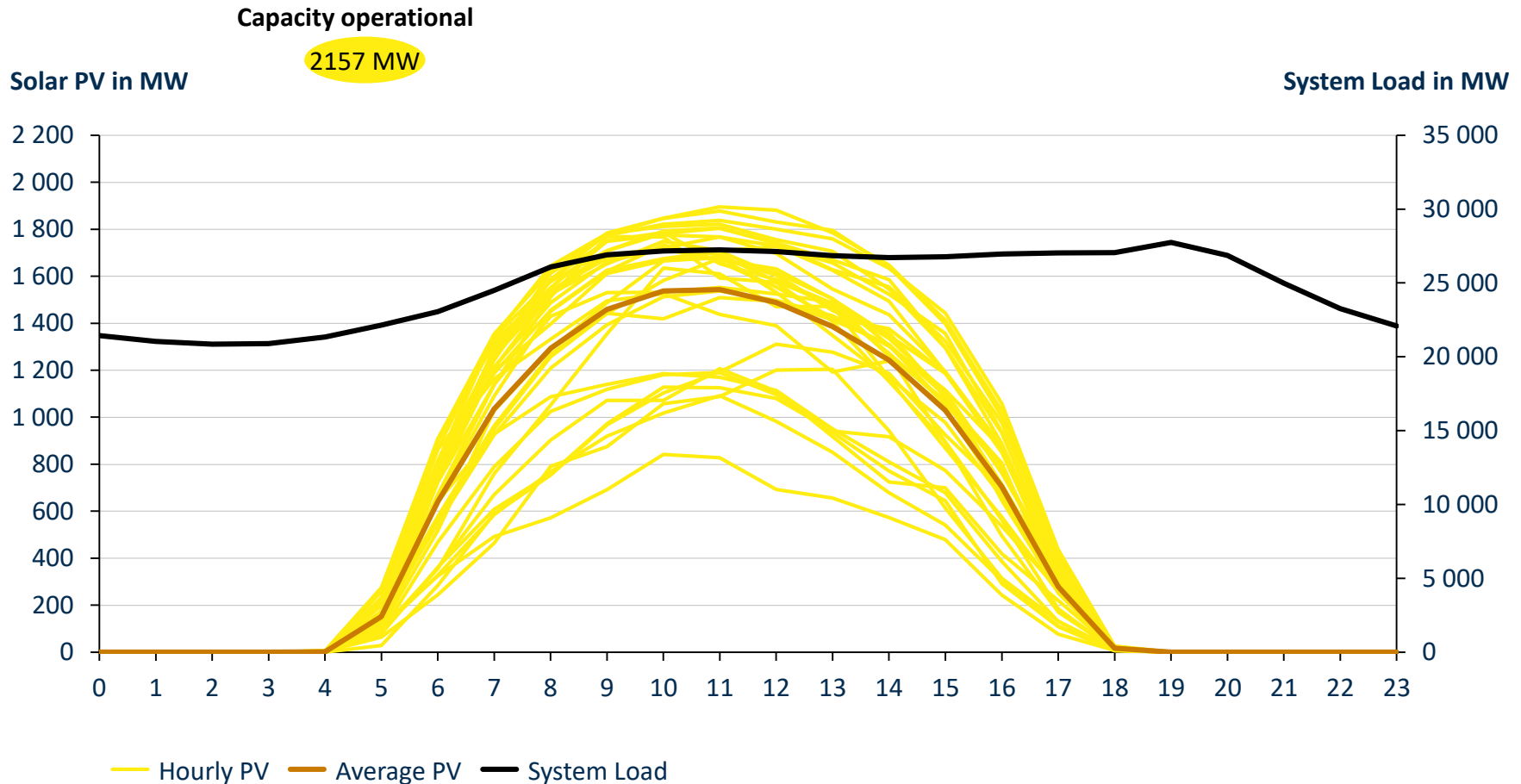
## Relative hourly contribution



- Maximum solar PV relative contribution of 5.9% between 13h00 and 14h00 on 27 Jun 2021
- Maximum wind relative contribution of 9.6% between 23h00 and 00h00 on 31 Jun 2021
- Maximum CSP relative contribution of 1.7% between 16h00 and 17h00 on 26 Jun 2021

# Solar PV supply in Jan 2021 was very stable

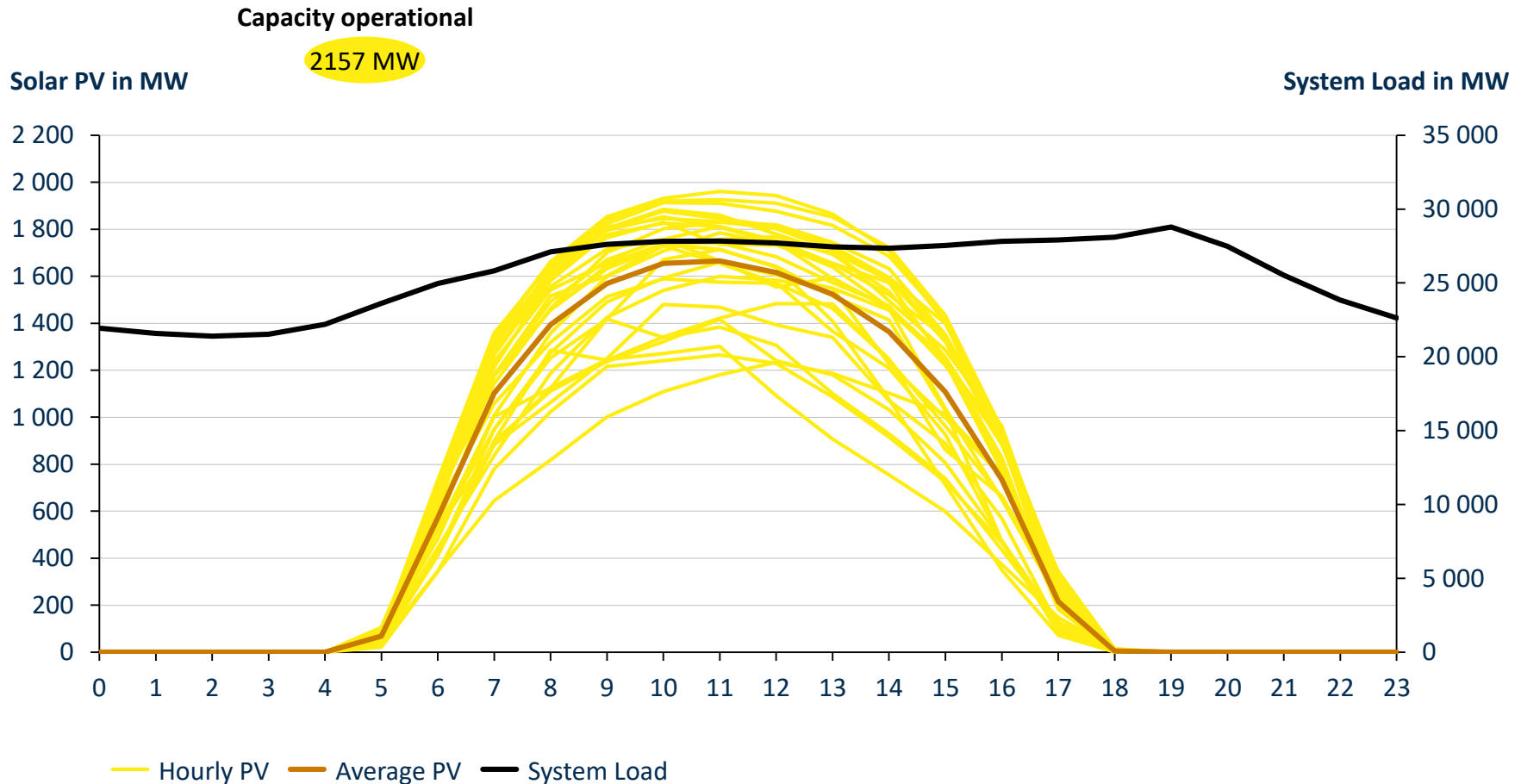
Hourly solar PV production for all 31 days of January 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# Solar PV supply in Feb 2021 was very stable

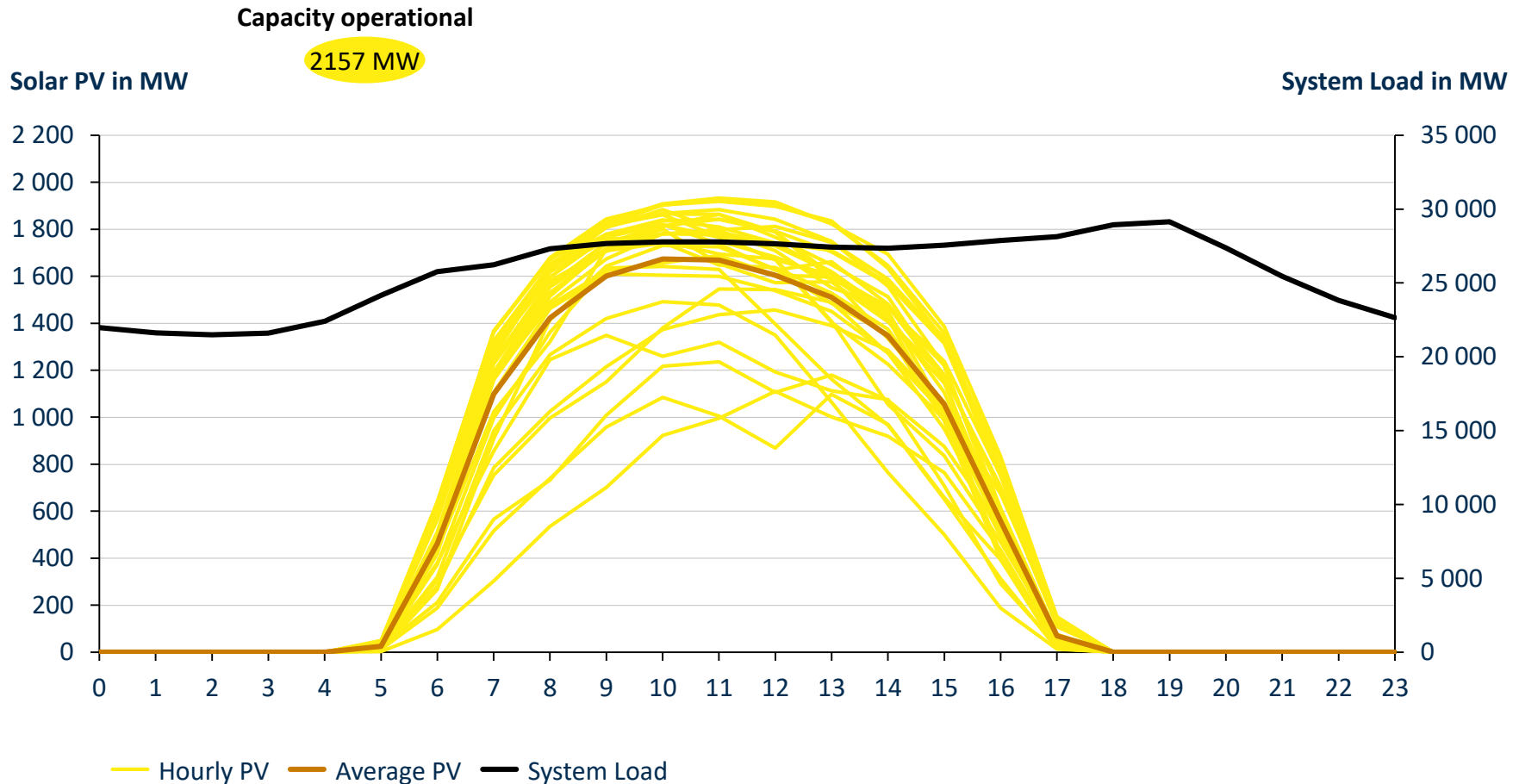
Hourly solar PV production for all 28 days of February 2021 & average system load diurnal course





# Solar PV supply in Mar 2021 was very stable

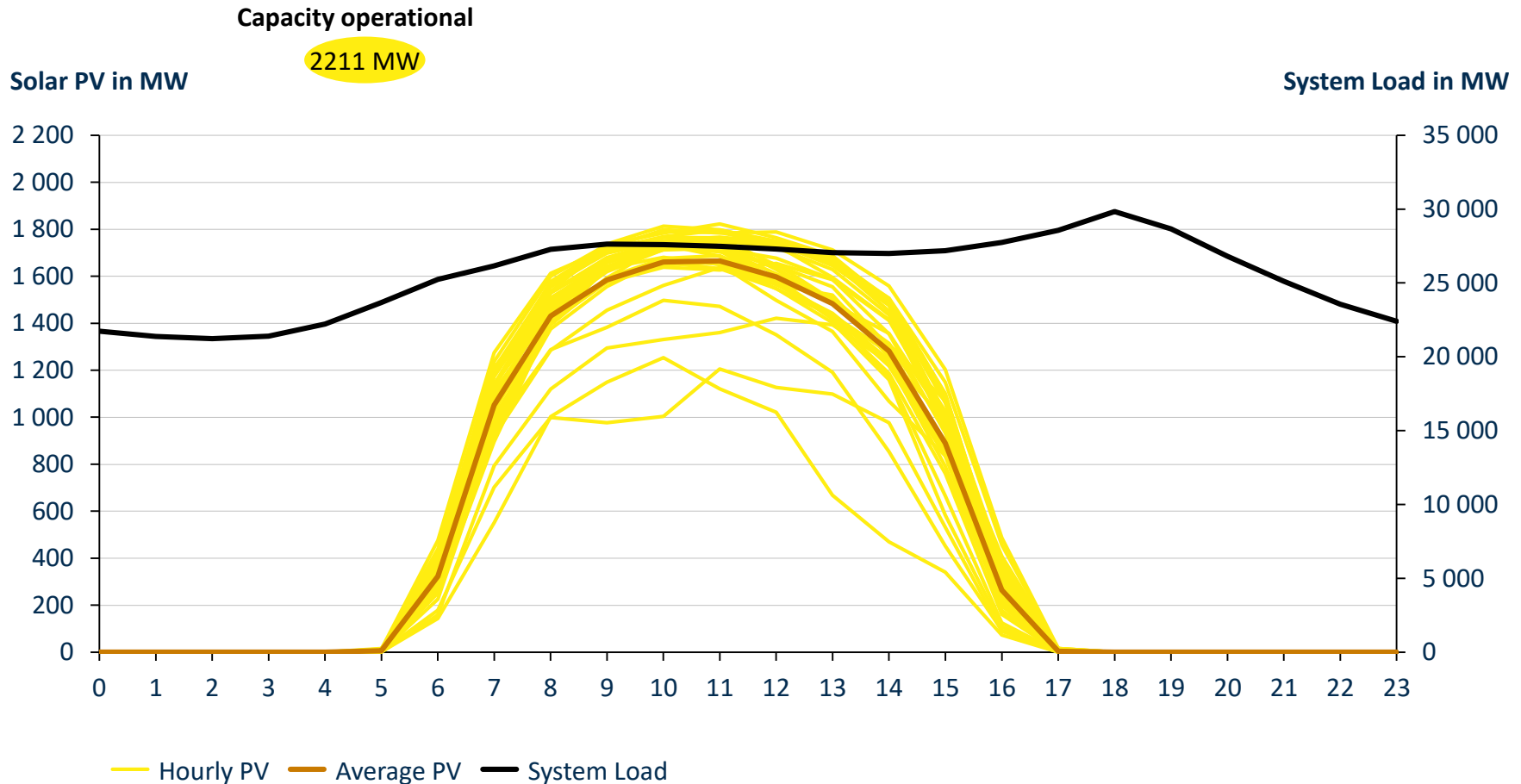
Hourly solar PV production for all 31 days of March 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

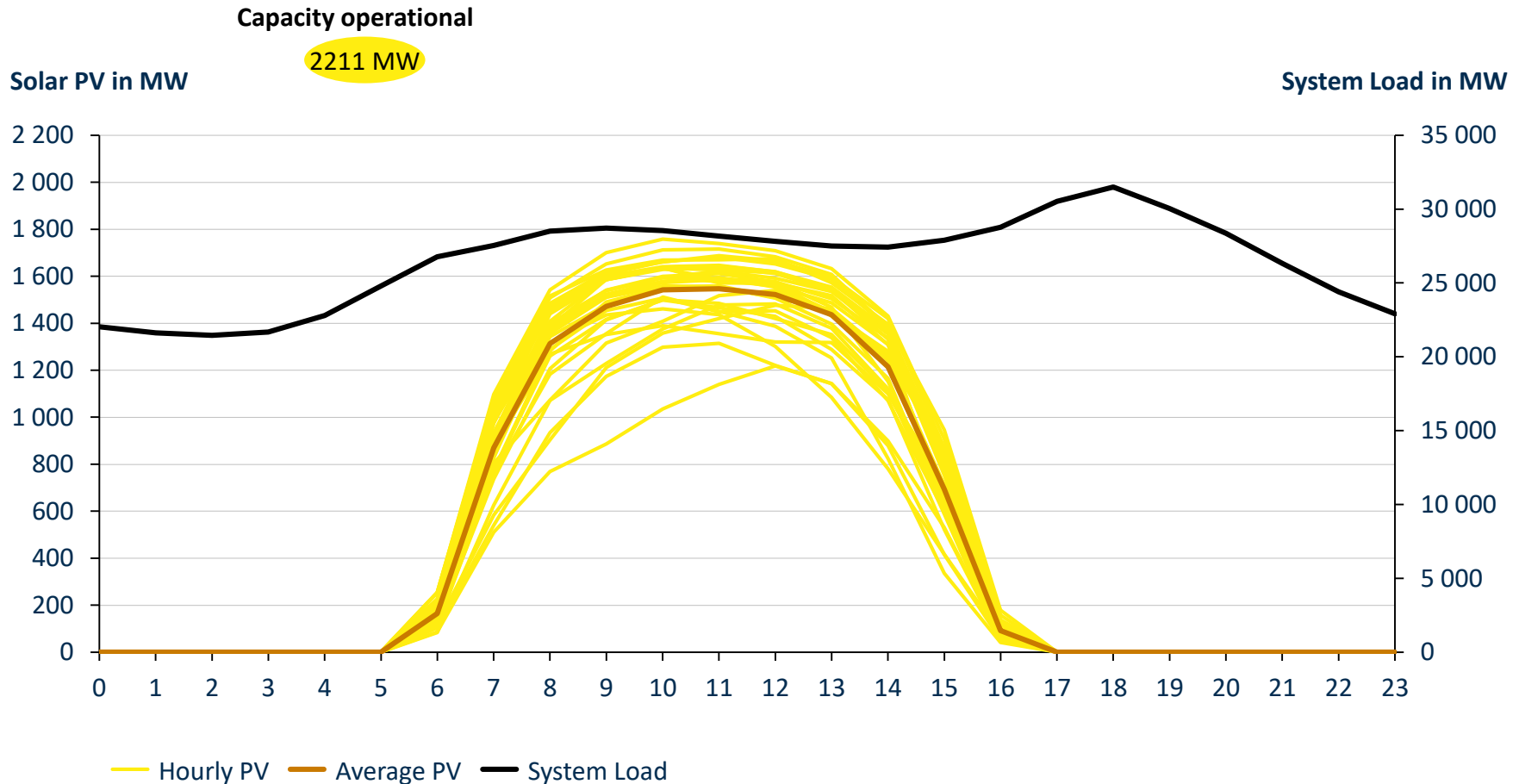
# Solar PV supply in Apr 2021 very stable

Hourly solar PV production for all 30 days of April 2021 & average system load diurnal course



# Solar PV supply in May 2021 very stable

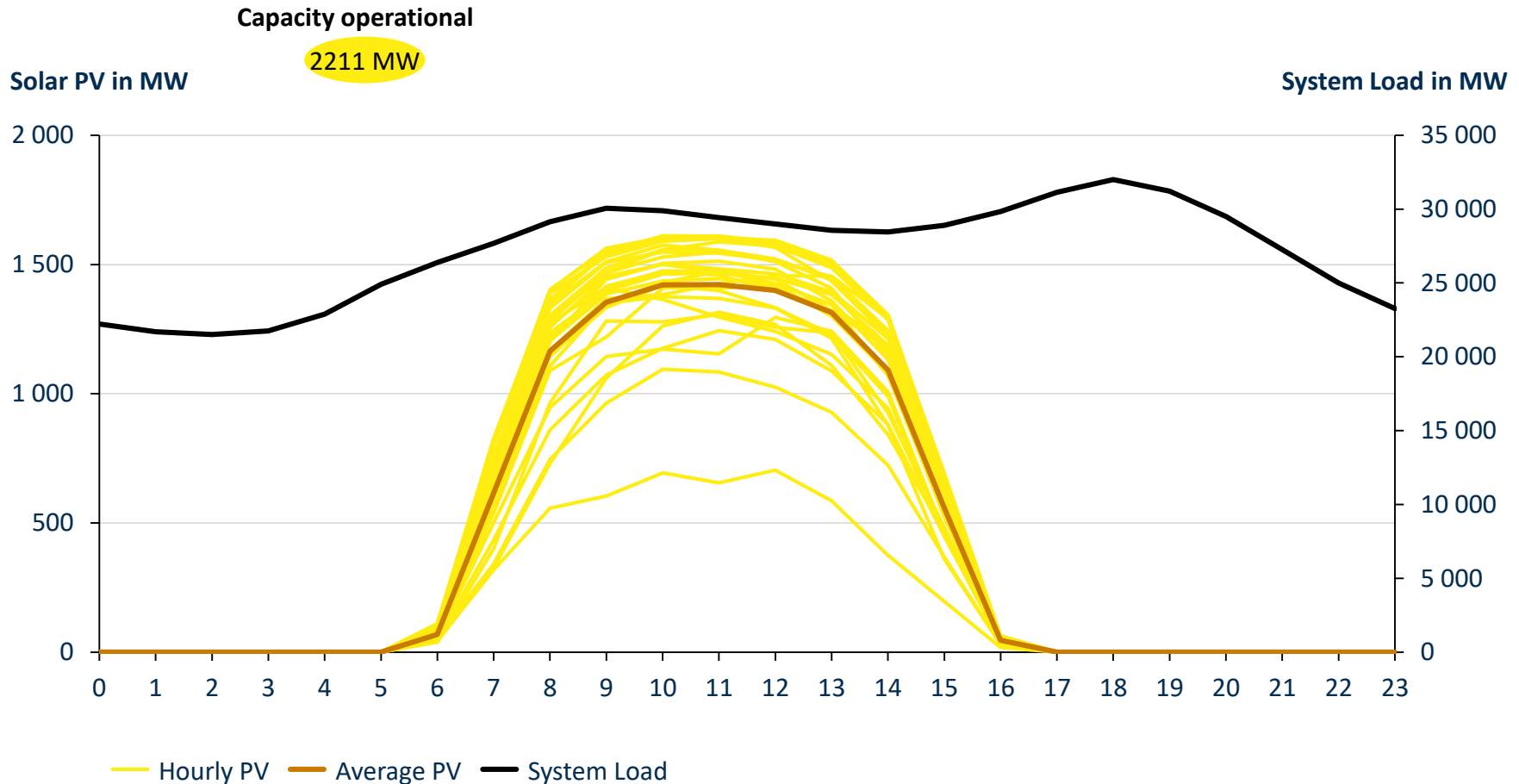
Hourly solar PV production for all 31 days of May 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# Solar PV supply in Jun 2021 very stable

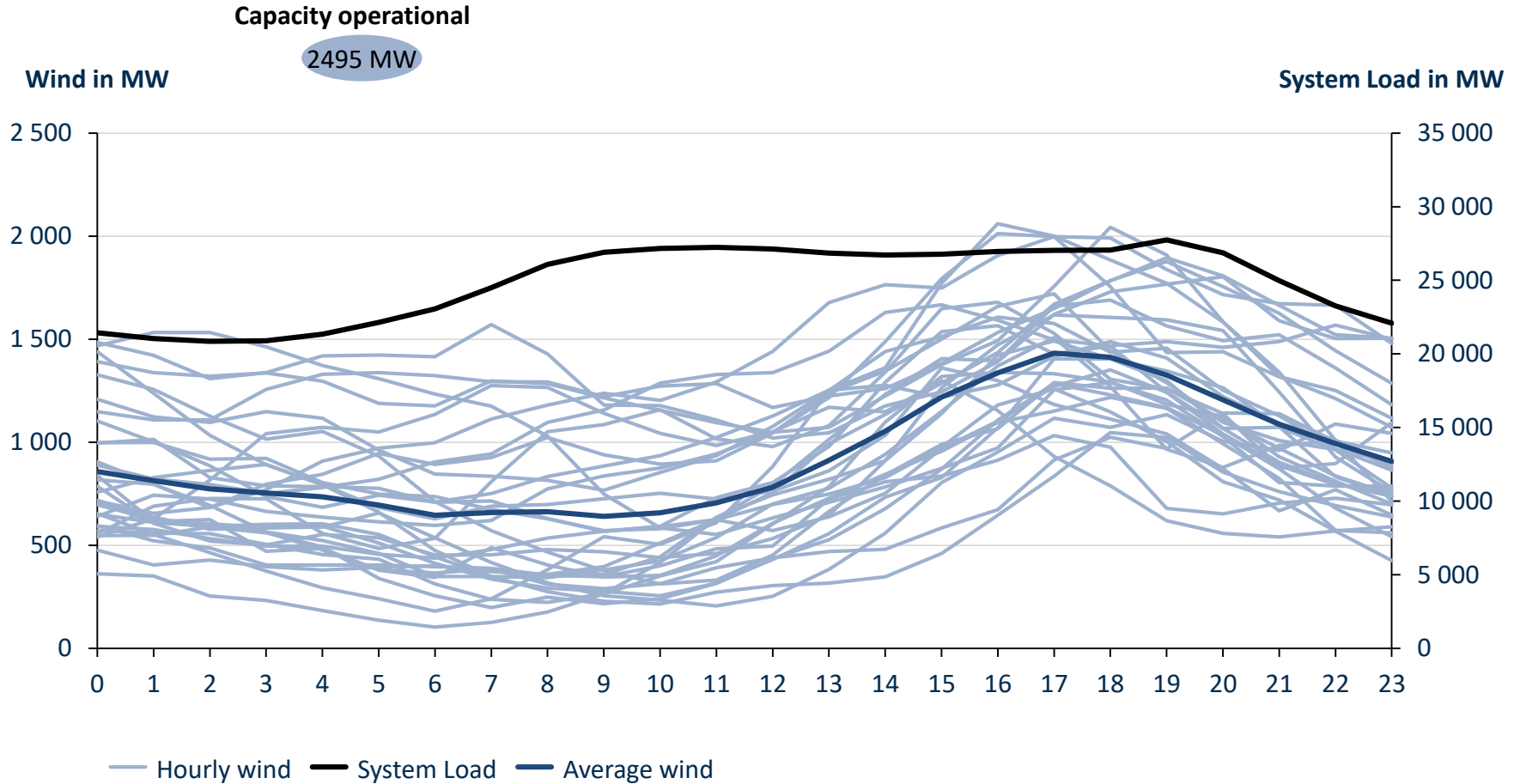
Hourly solar PV production for all 30 days of June 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Jan 2021, wind supply increased in the evenings

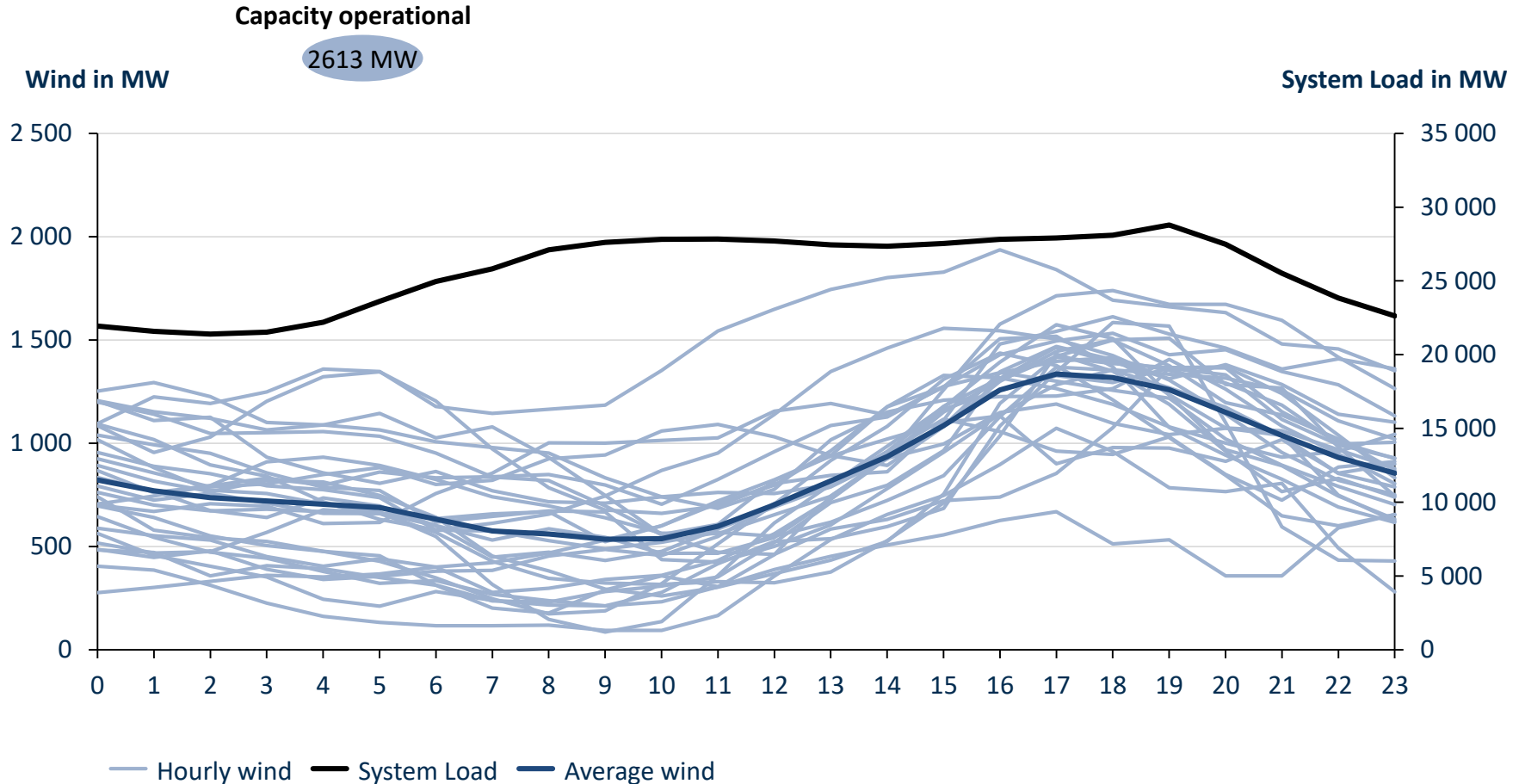
Hourly wind production for all 31 days of January 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Feb 2021, wind supply increased during the evening peak

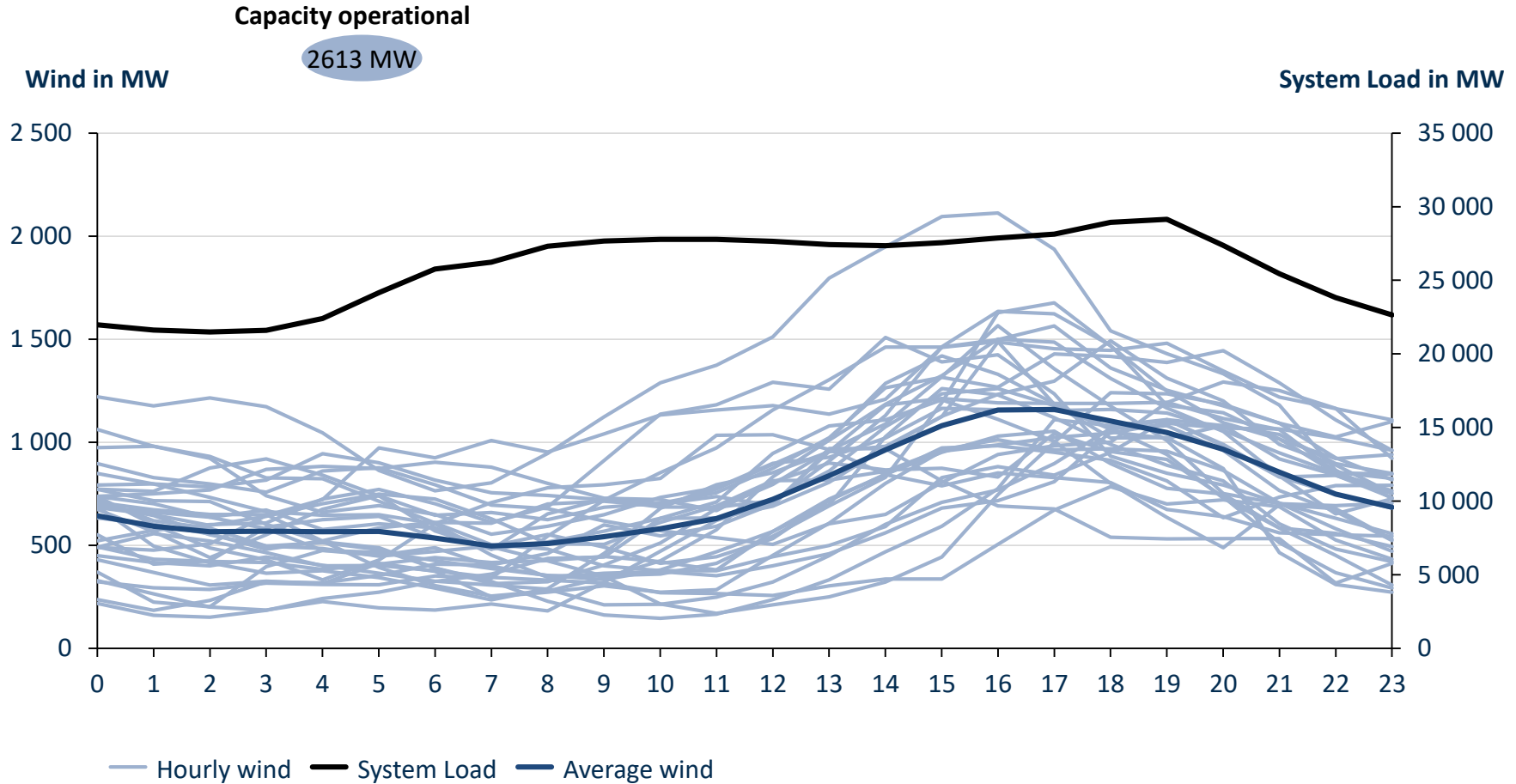
Hourly wind production for all 28 days of February 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Mar 2021, wind supply increased during the evening peak

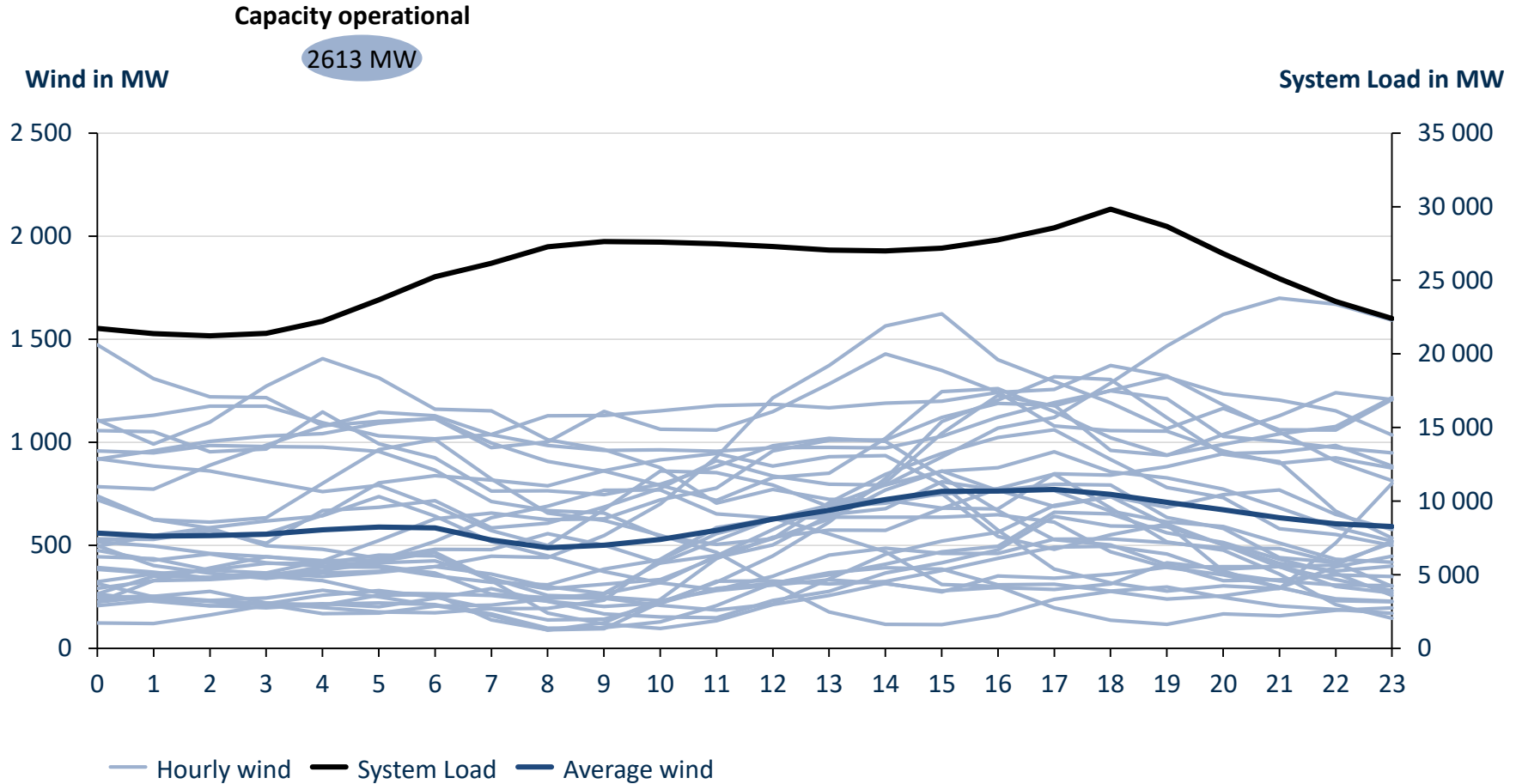
Hourly wind production for all 31 days of March 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Apr 2021, wind fluctuated day-to-day

Hourly wind production for all 30 days of April 2021 & average system load diurnal course

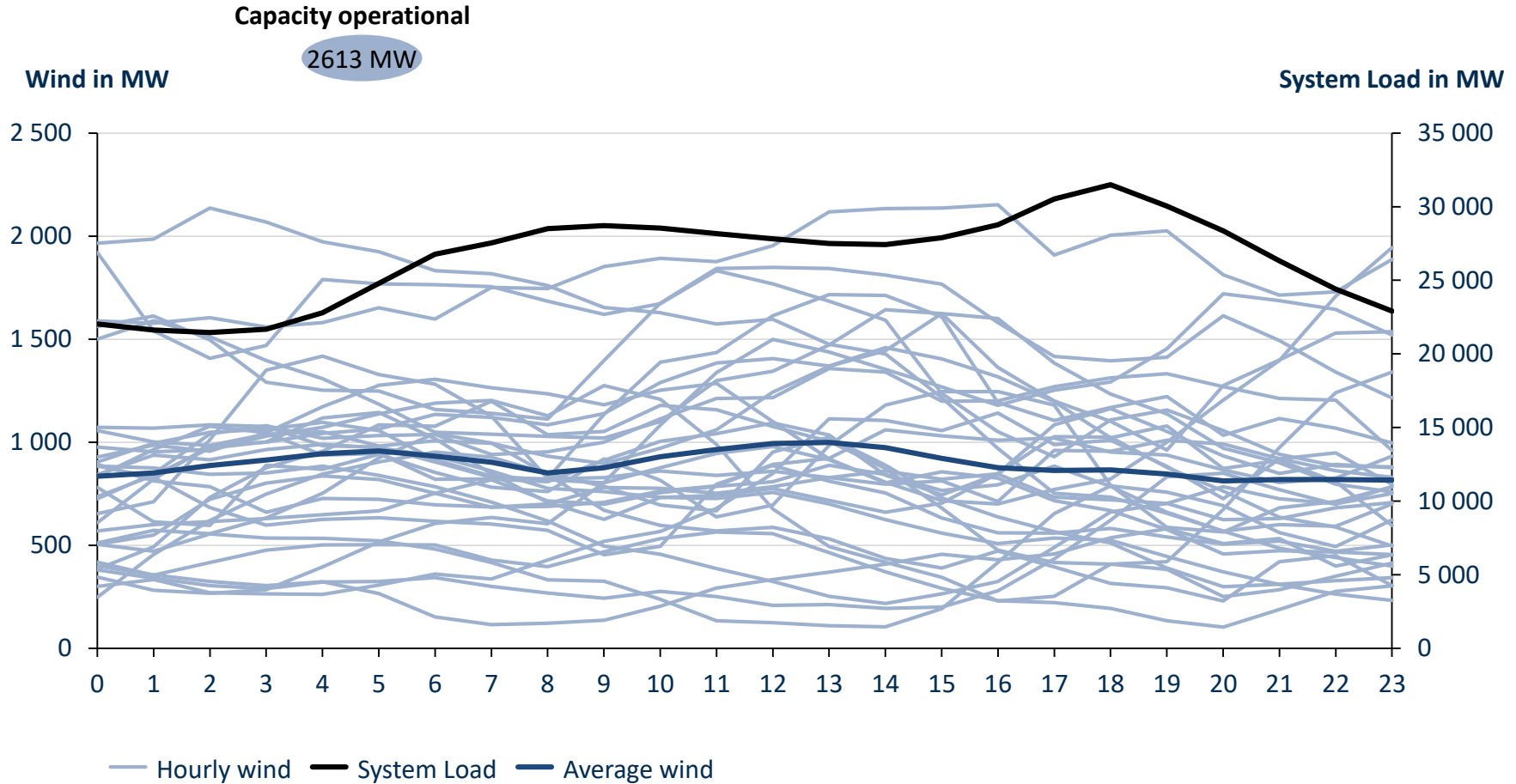


Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis



# In May 2021, wind fluctuated day-to-day

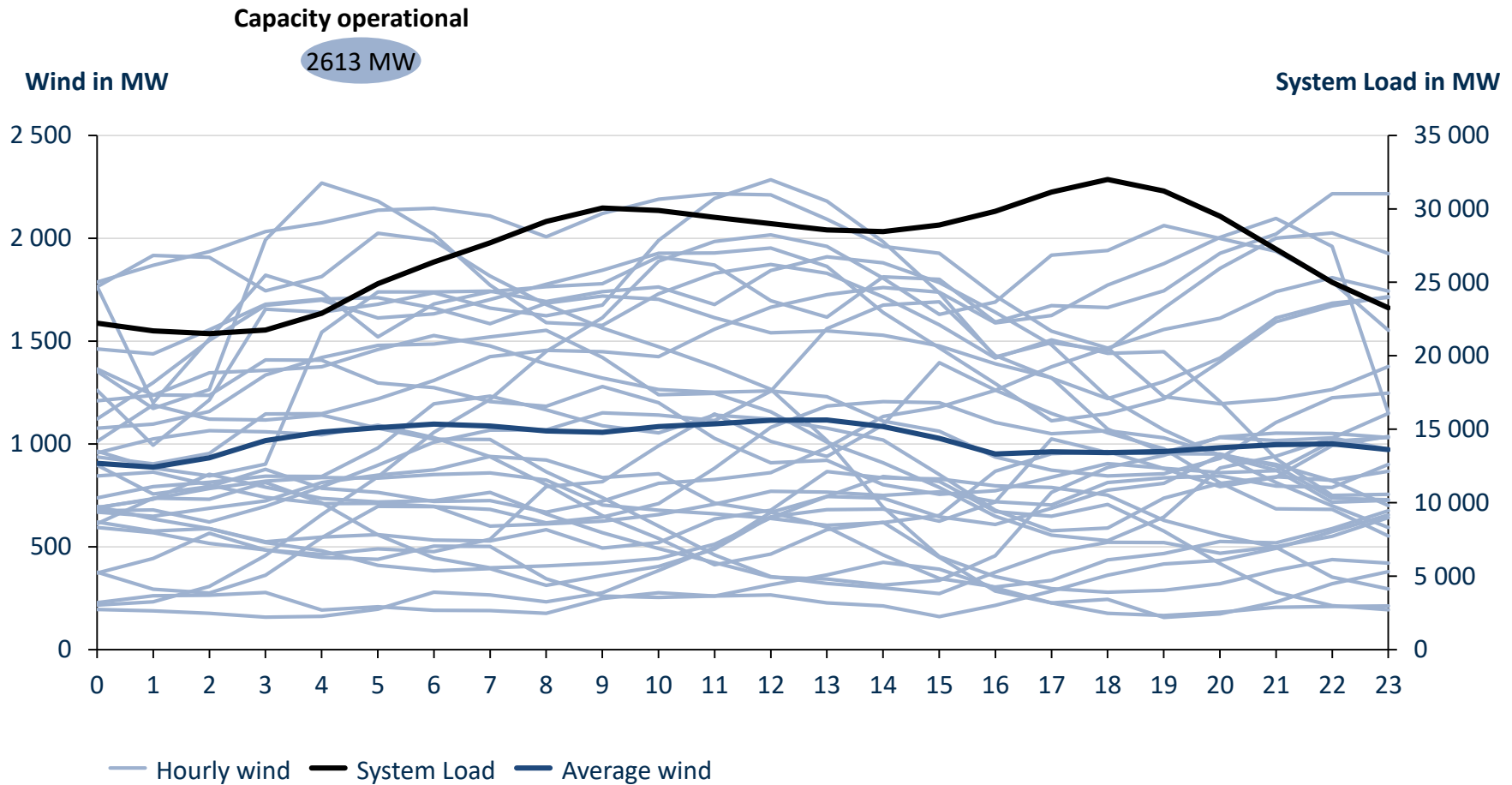
Hourly wind production for all 31 days of May 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

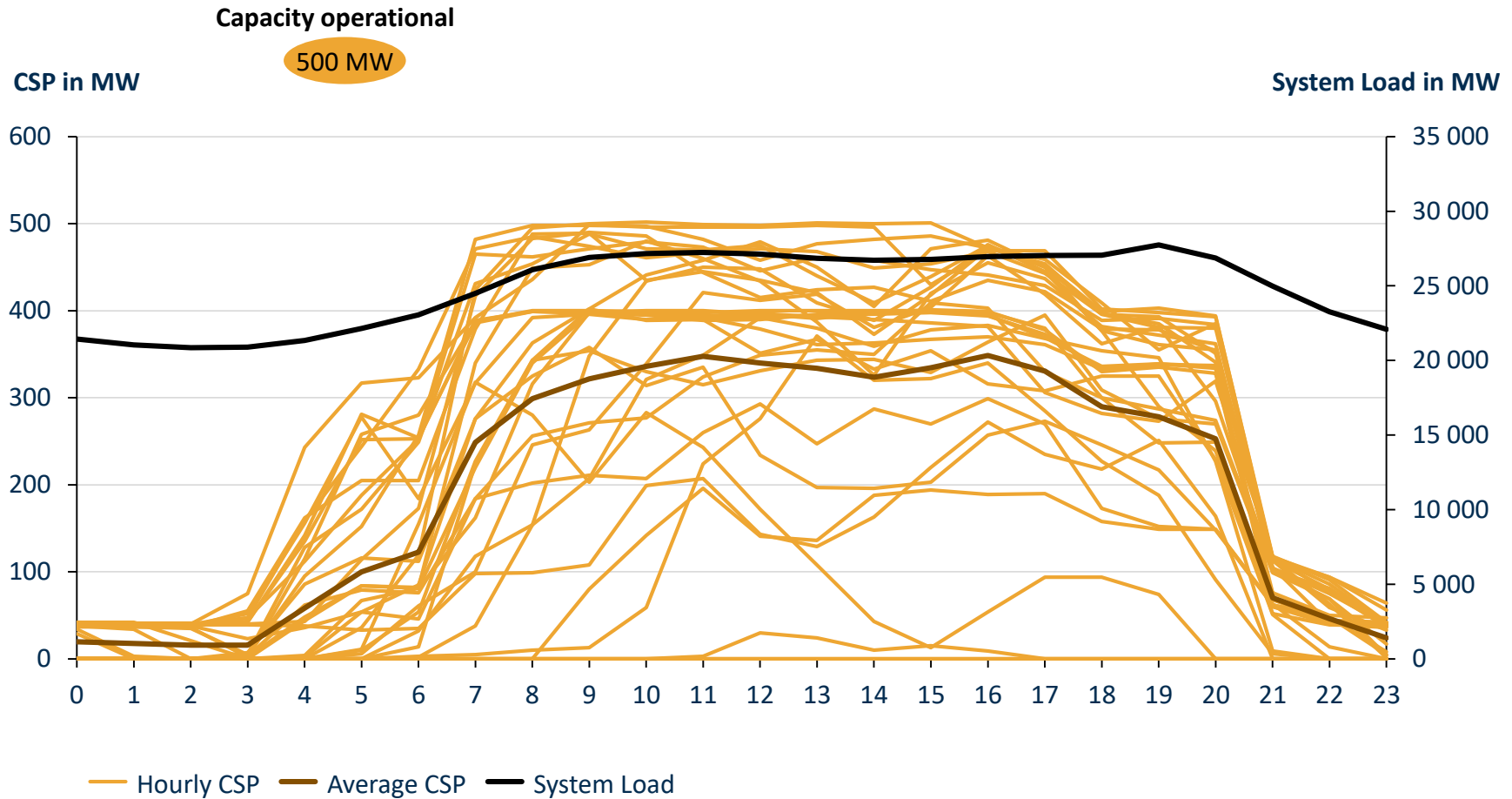
# In Jun 2021, wind fluctuated day-to-day

Hourly wind production for all 30 days of June 2021 & average system load diurnal course



# In Jan 2021, CSP storage used in evenings

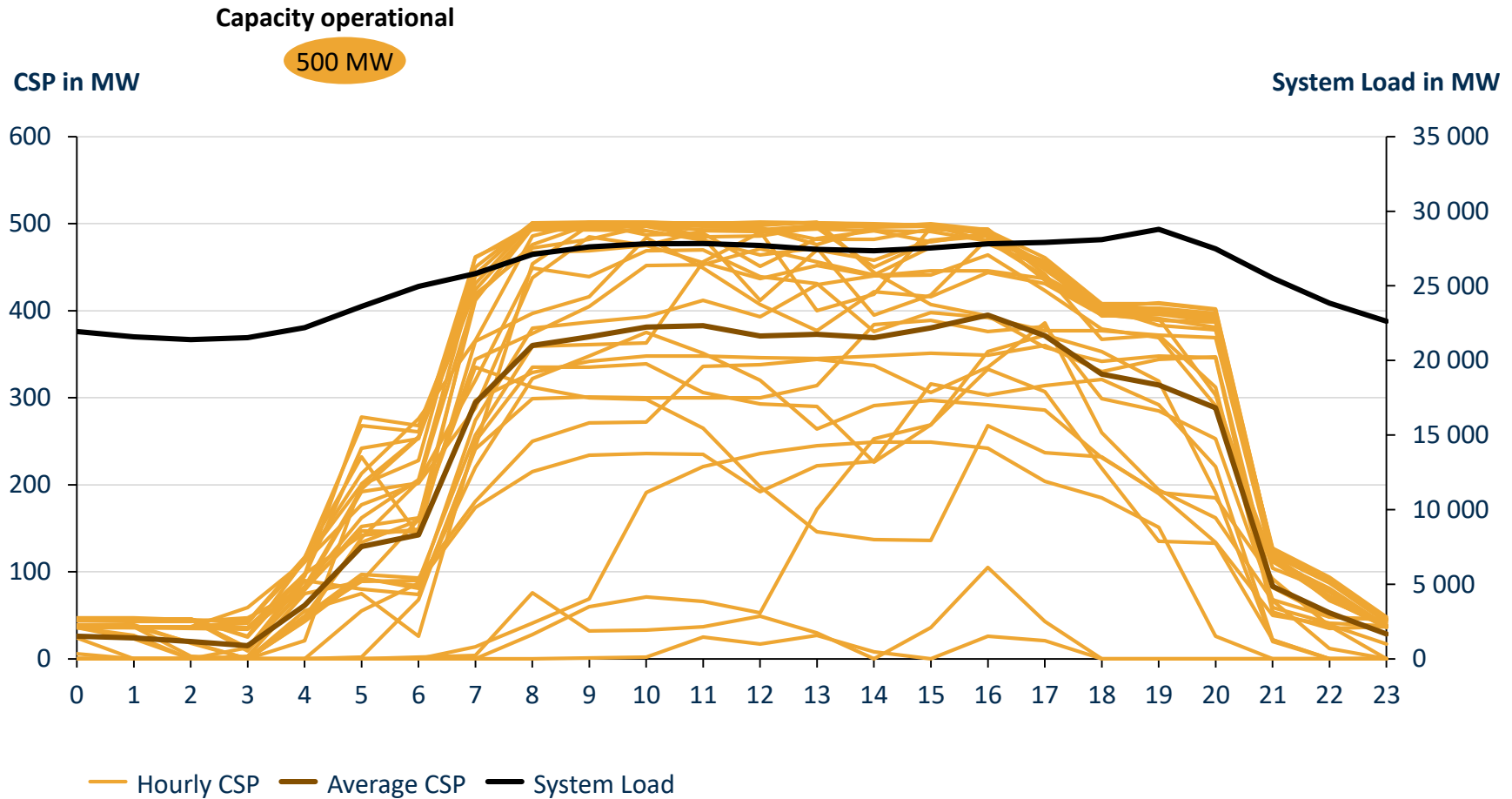
Hourly CSP production for all 31 days of January 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Feb 2021, CSP storage used in evenings

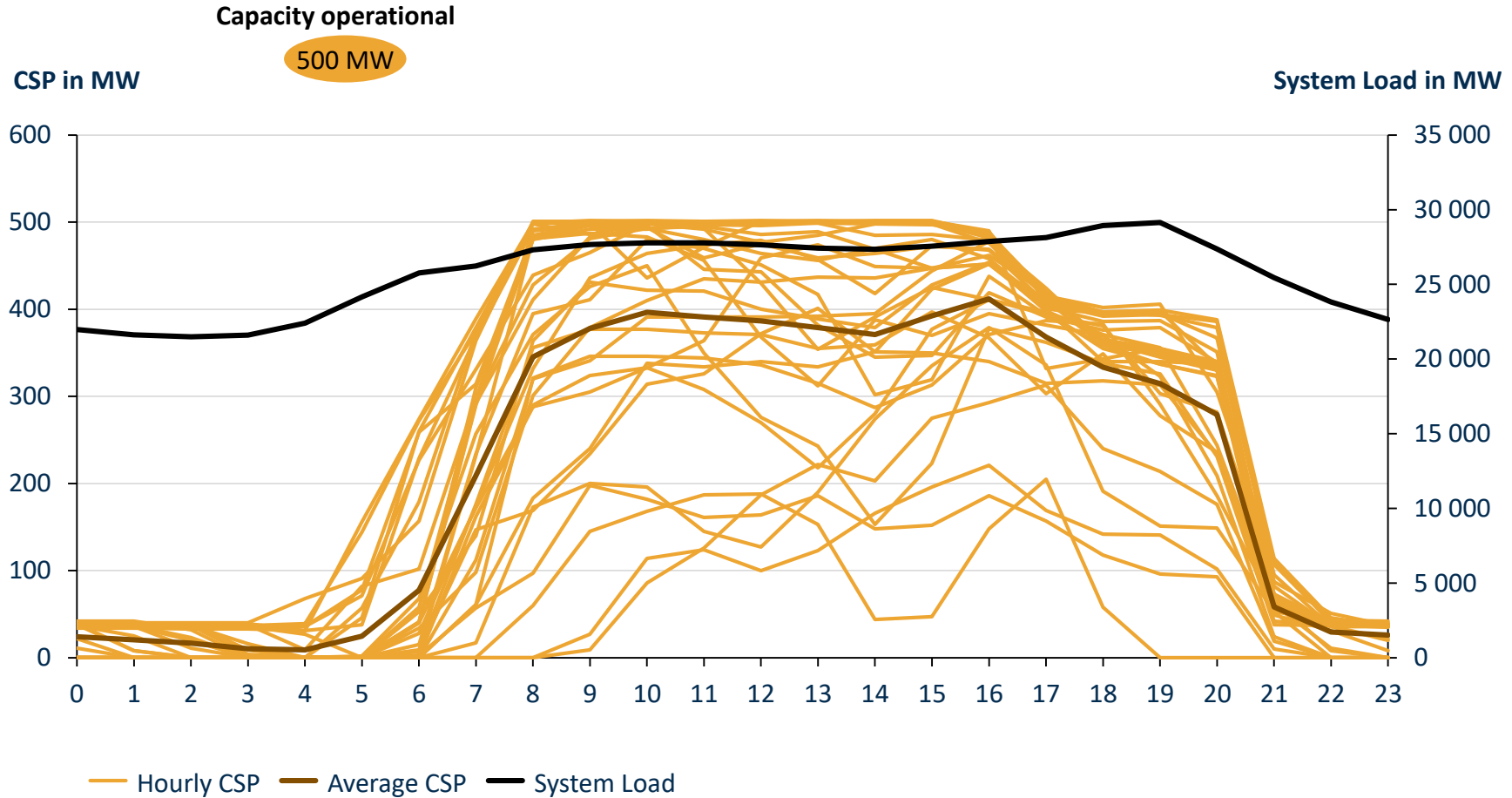
Hourly CSP production for all 28 days of February 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Mar 2021, CSP storage used in evenings

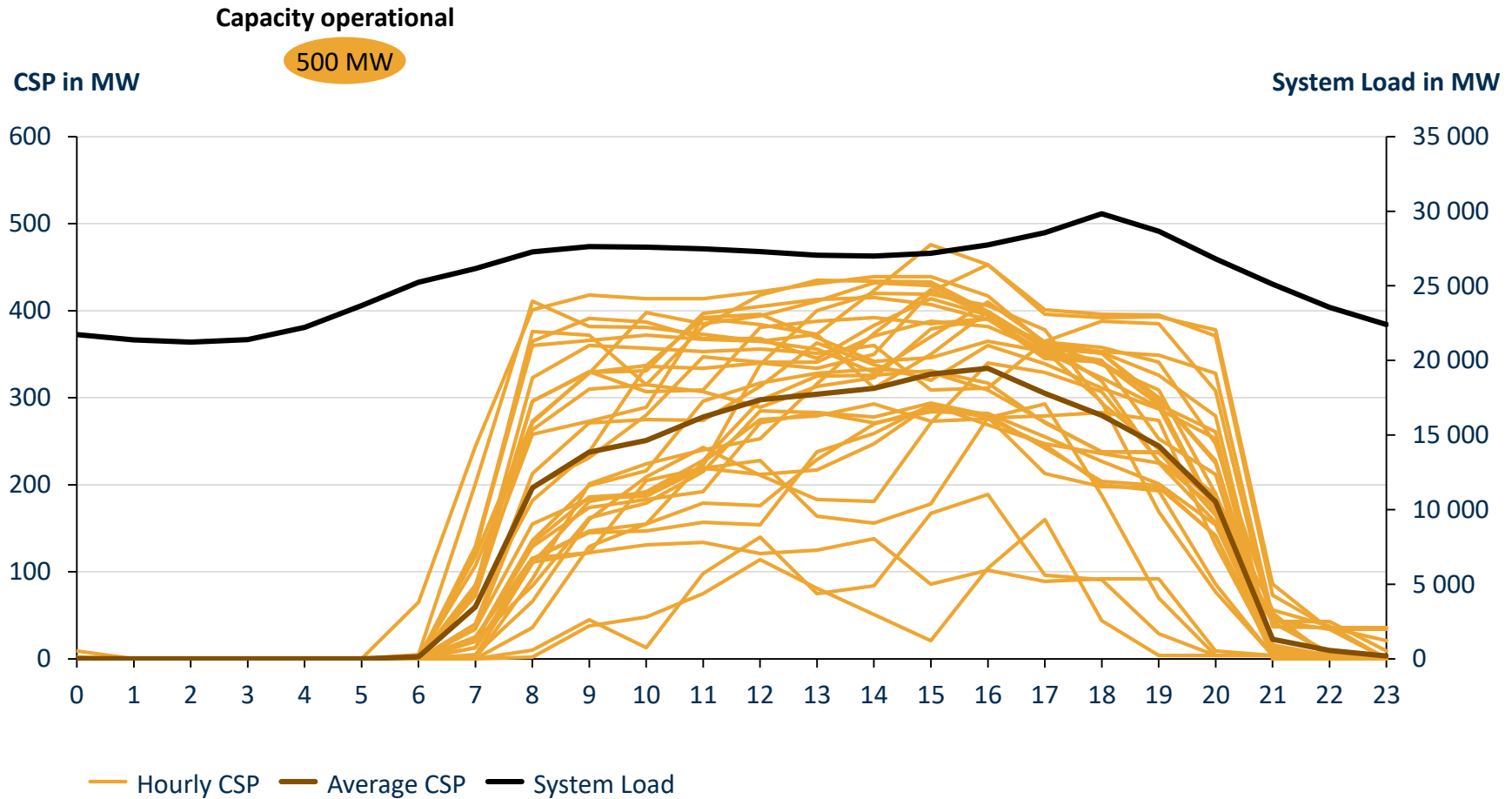
Hourly CSP production for all 31 days of March 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In Apr 2021, CSP storage used in evenings

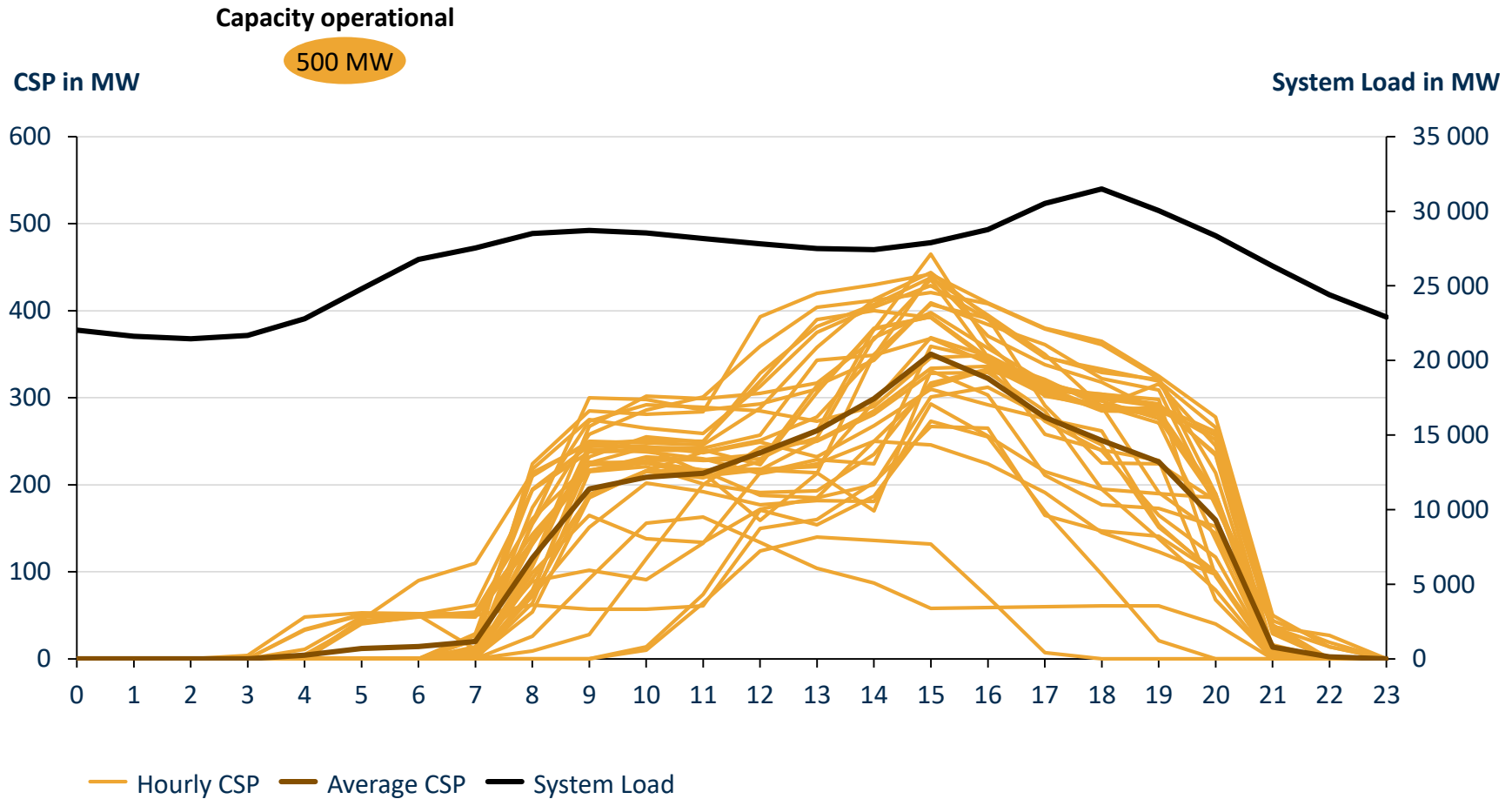
Hourly CSP production for all 30 days of April 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

# In May 2021, CSP storage used in evenings

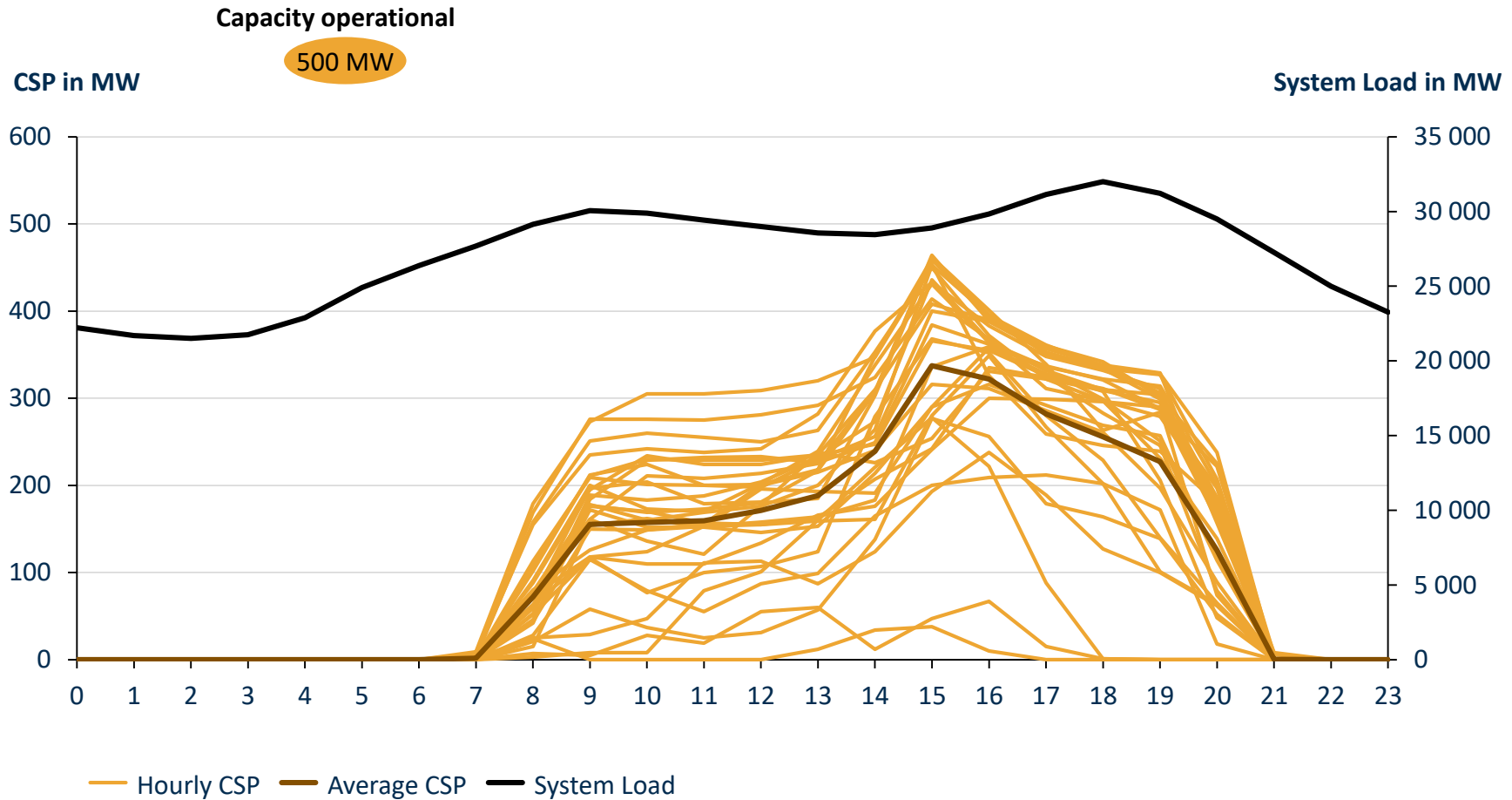
Hourly CSP production for all 31 days of May 2021 & average system load diurnal course



Note: System load excludes hydro pumping load (represented as the average for the month)  
Sources: Eskom; CSIR Energy Centre analysis

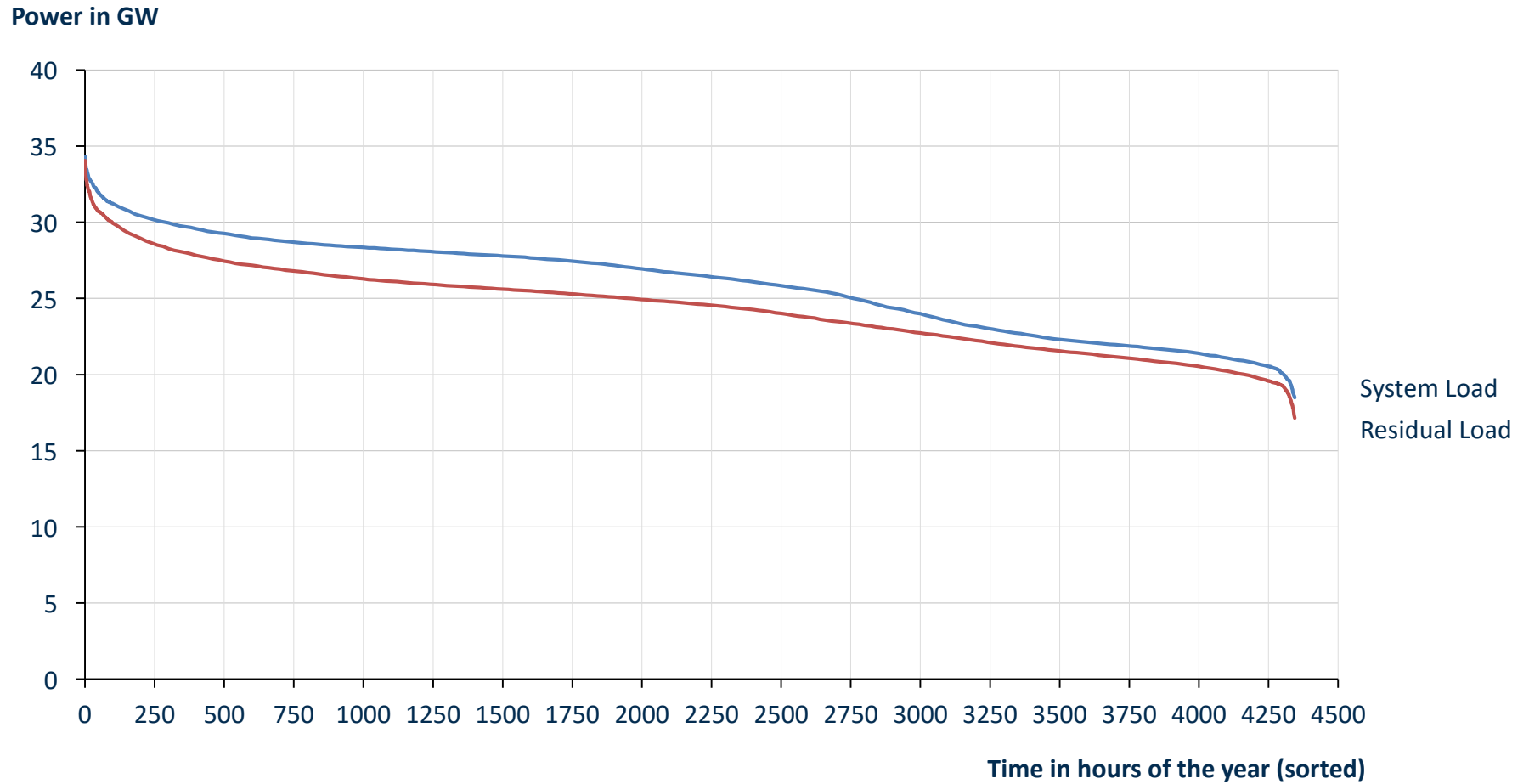
# In Jun 2021, CSP storage used in evenings

Hourly CSP production for all 30 days of June 2021 & average system load diurnal course

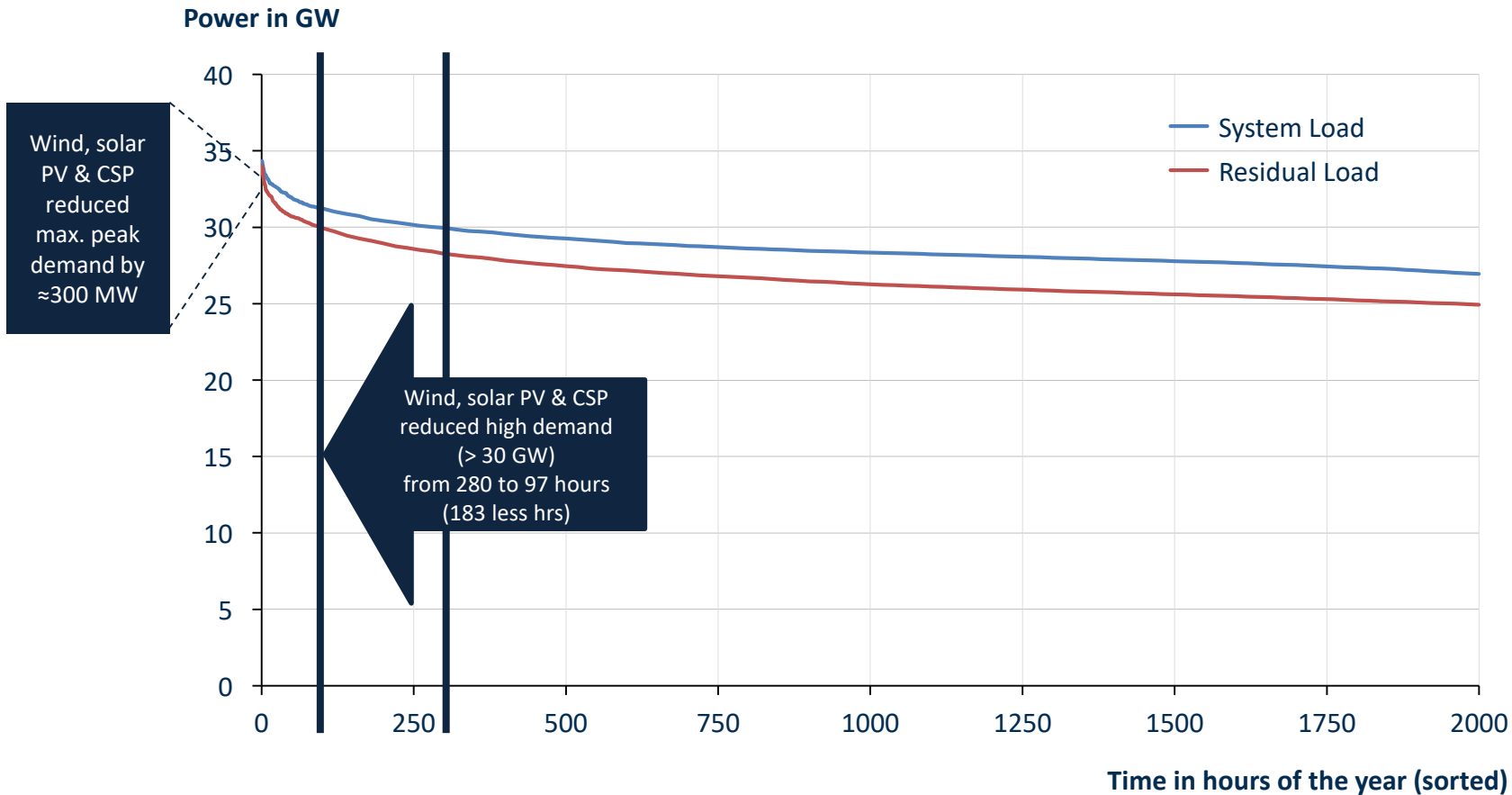




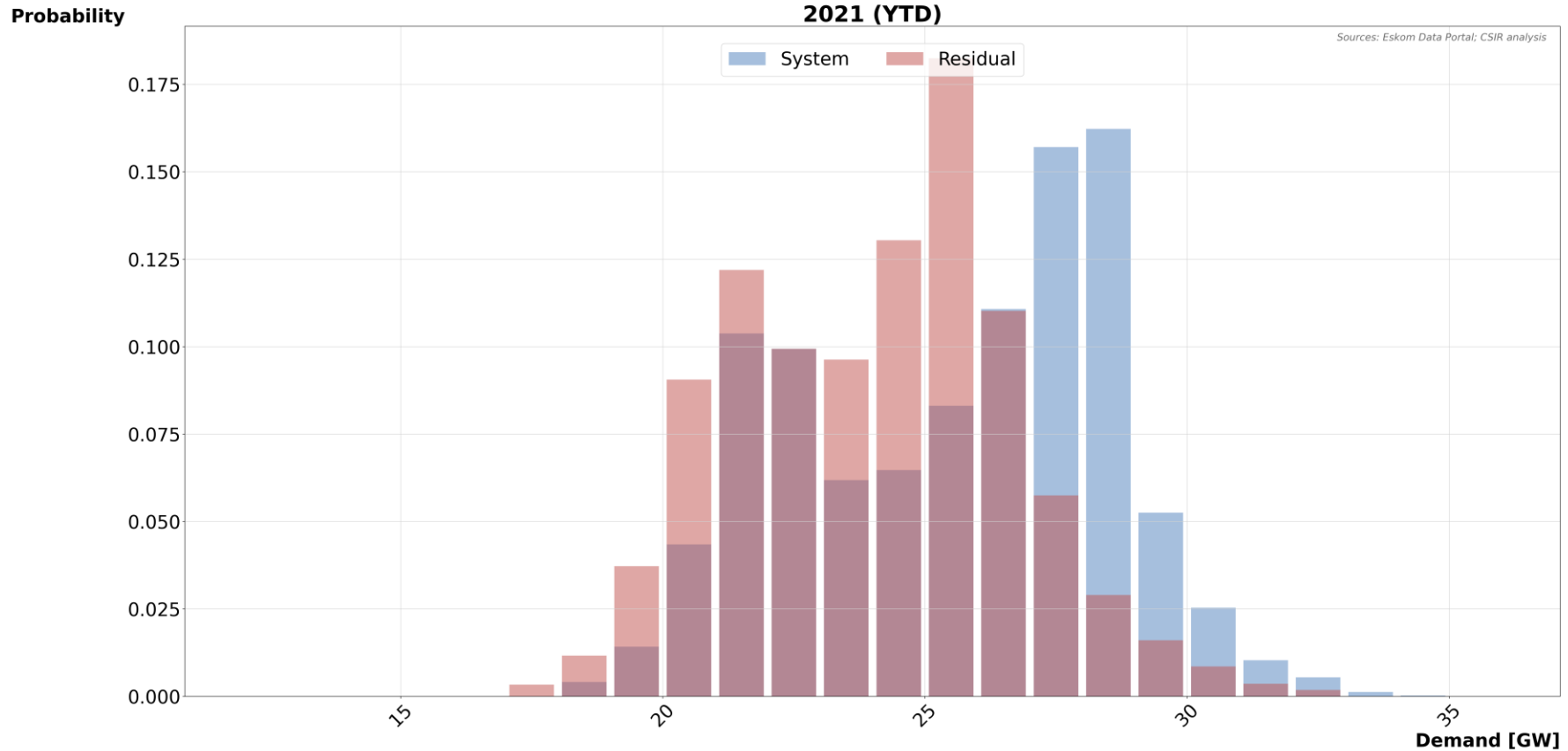
# Jan - Jun 2021 system load and residual load duration curves



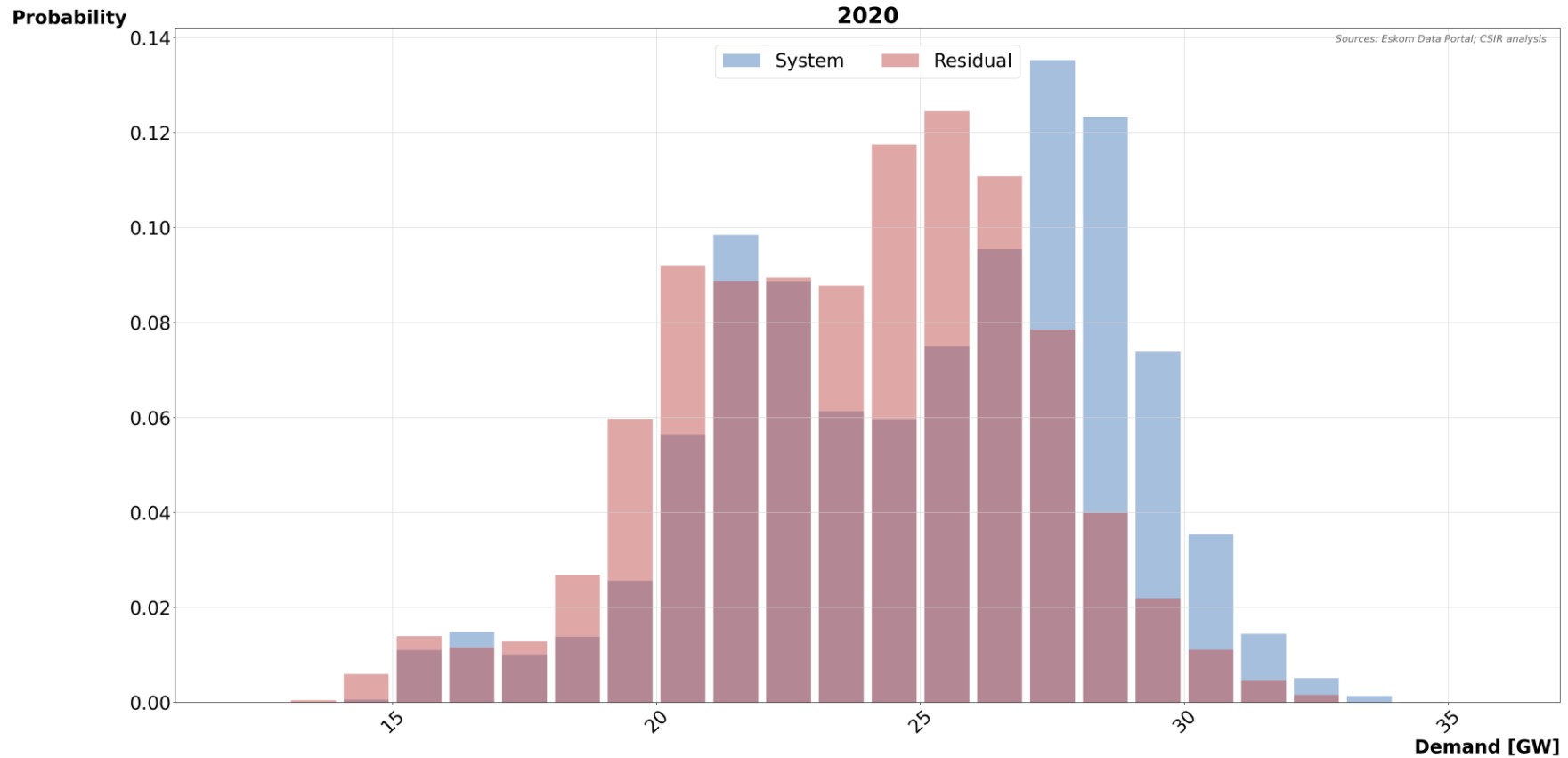
# From Jan-Jun 2021 - wind, solar PV & CSP reduced the number of hours with > 30 GW total load from 492 to 151 (~341 hours less)



# VRE contribution continues to be demonstrated - distinct shift of residual demand to lower demand levels as VRE contributes during most demand periods

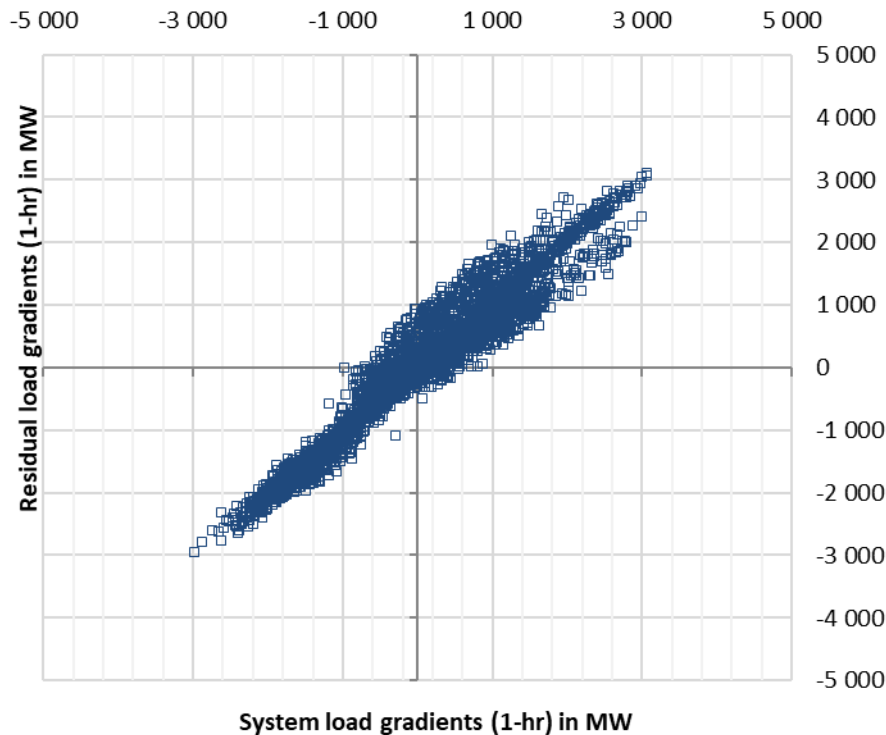


# Unique nature of 2020 demand meant unprecedented low demand levels but for very brief periods of time with similar effect of VRE

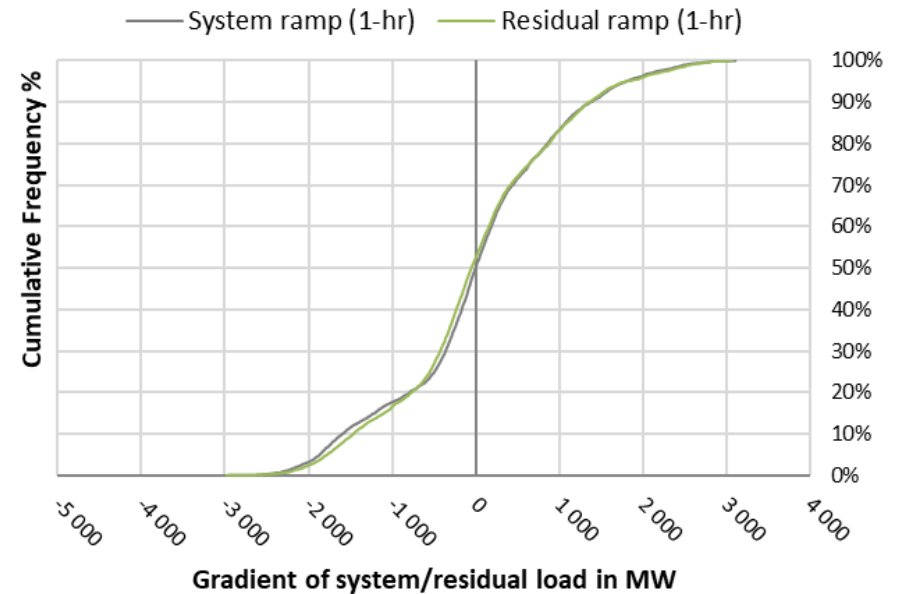


# 1-hour gradients did not significantly increase due to 5 GW of wind, solar PV & CSP

System load 1-hour gradients vs. residual load 1-hour gradients for all hours from Jan – Jun 2021

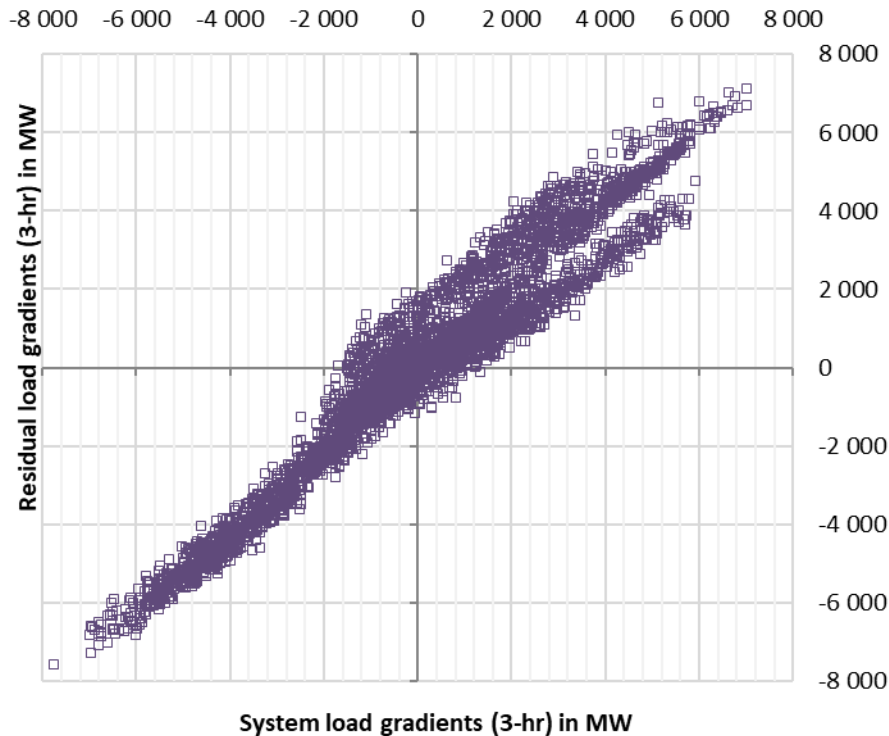


Cumulative frequency distribution of 1-hour gradients for all hours from Jan – Jun 2021

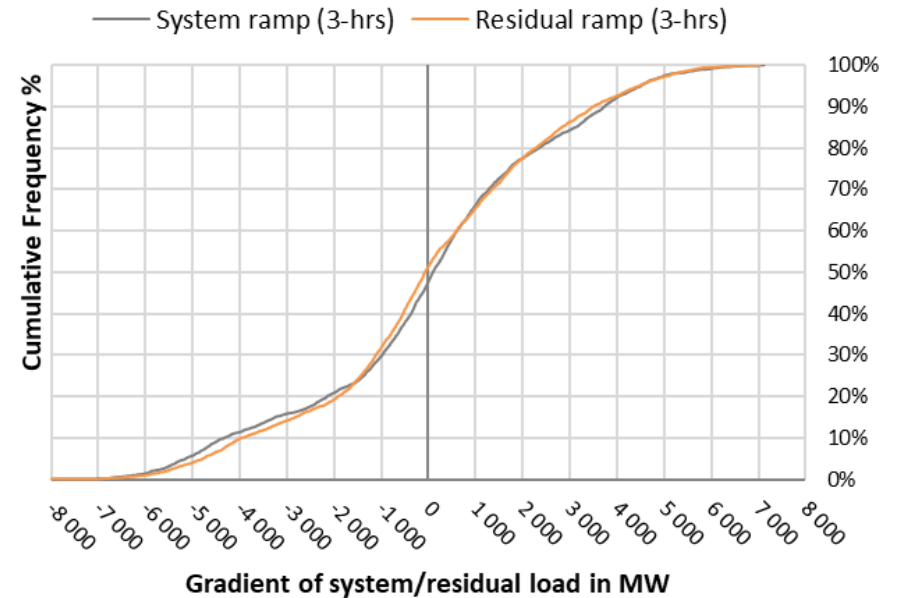


# Similarly - 3-hour gradients did not significantly increase due to 5 GW of wind, solar PV & CSP

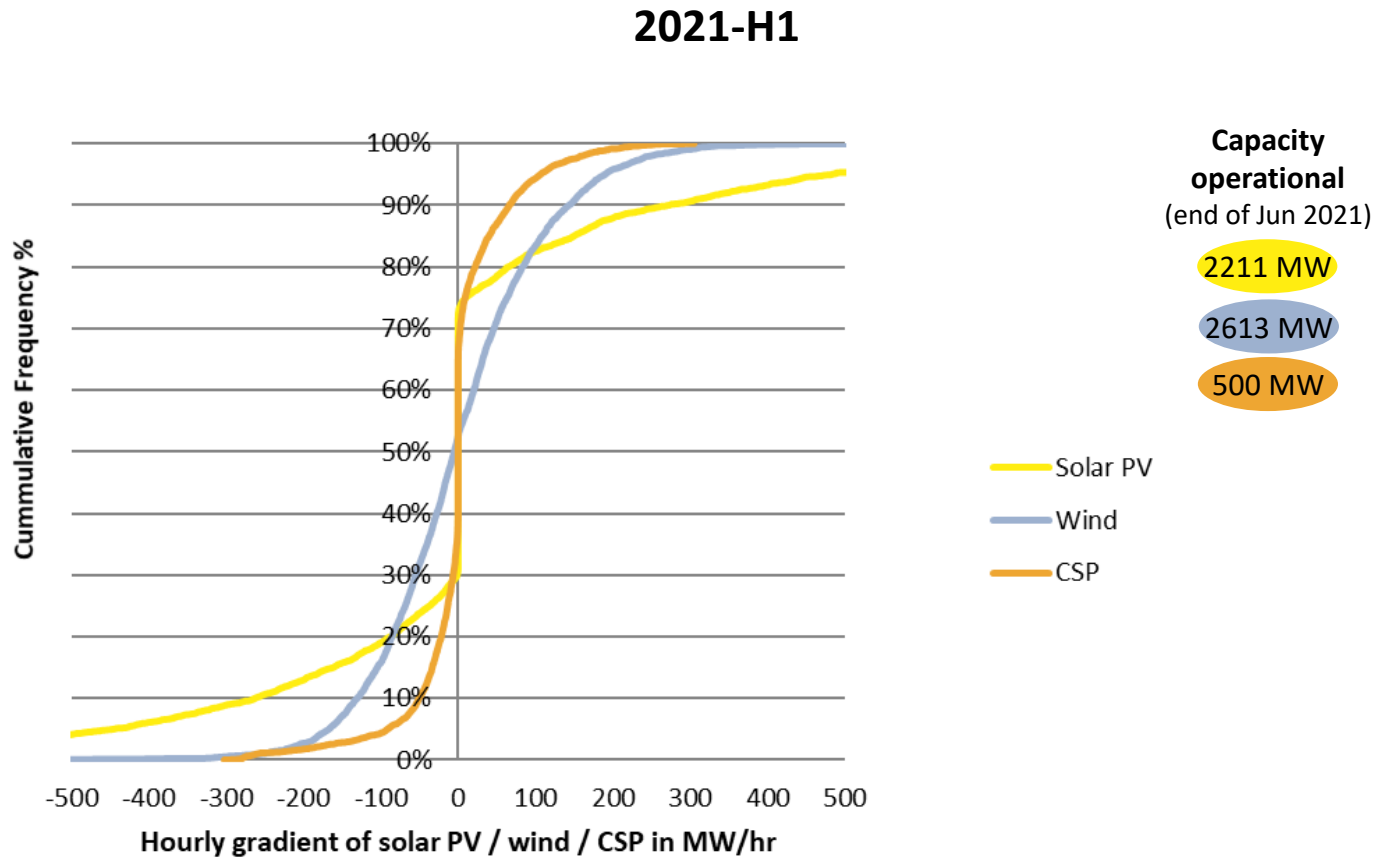
System load 3-hour gradients vs. residual load 1-hour gradients for all hours from Jan – Jun 2021



Cumulative frequency distribution of 3-hour gradients for all hours from Jan – Jun 2021



# Wind, solar PV & CSP frequency distribution of 1-hour gradients in 2019 and 2020

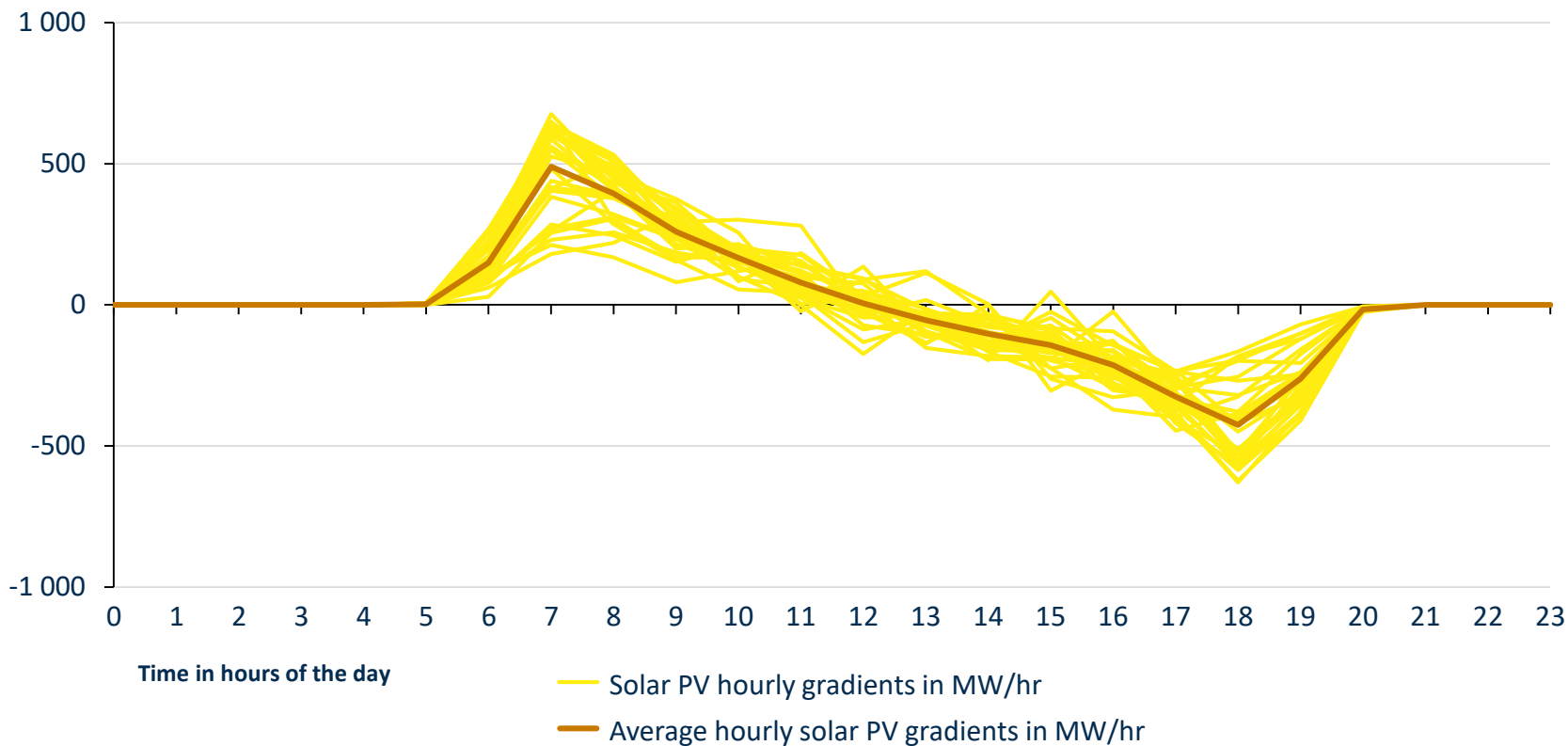


# Solar PV 1-hour gradients in January 2021

Capacity operational

2157 MW

Solar PV hourly gradients in MW/h



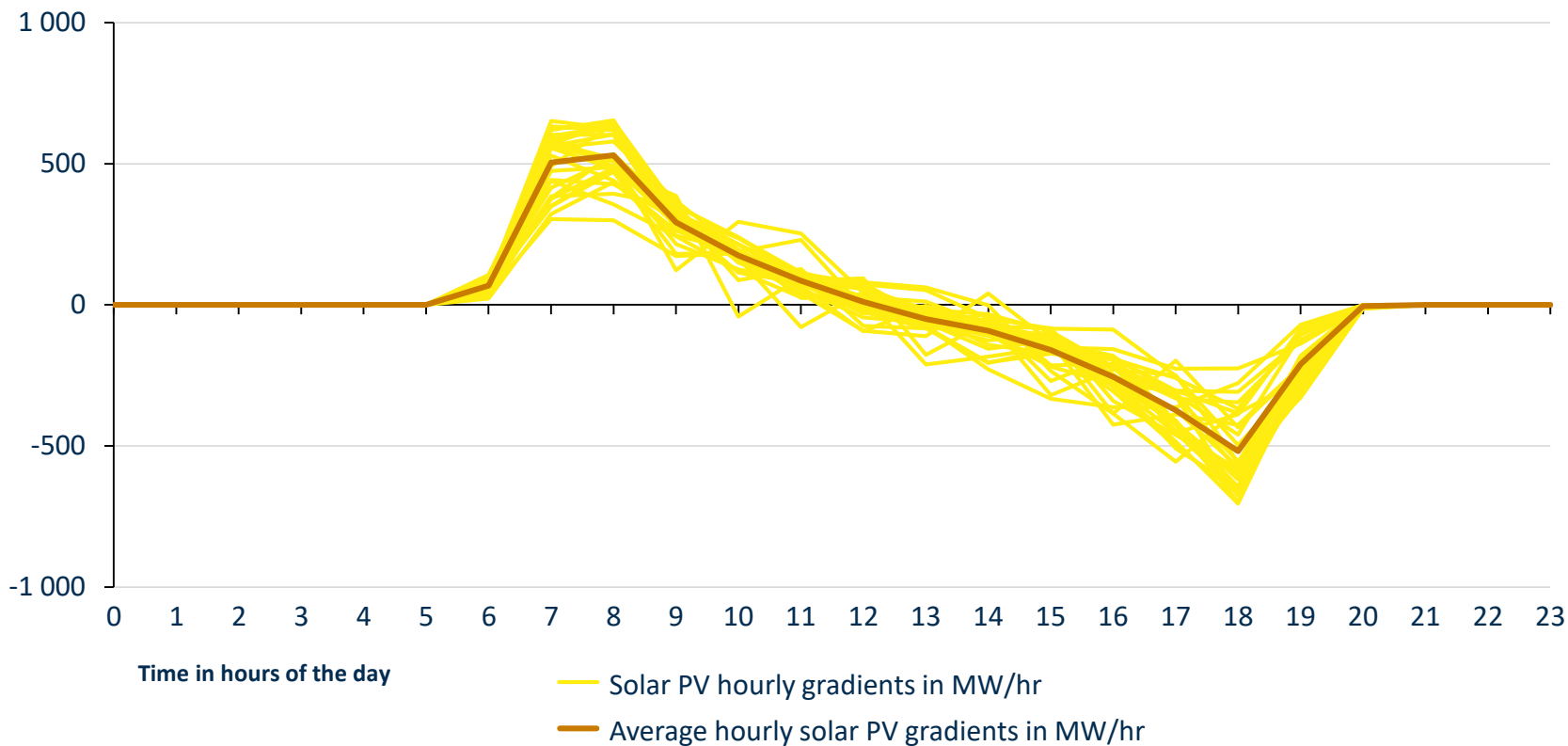


# Solar PV 1-hour gradients in February 2021

Capacity operational

2157 MW

Solar PV hourly gradients in MW/h

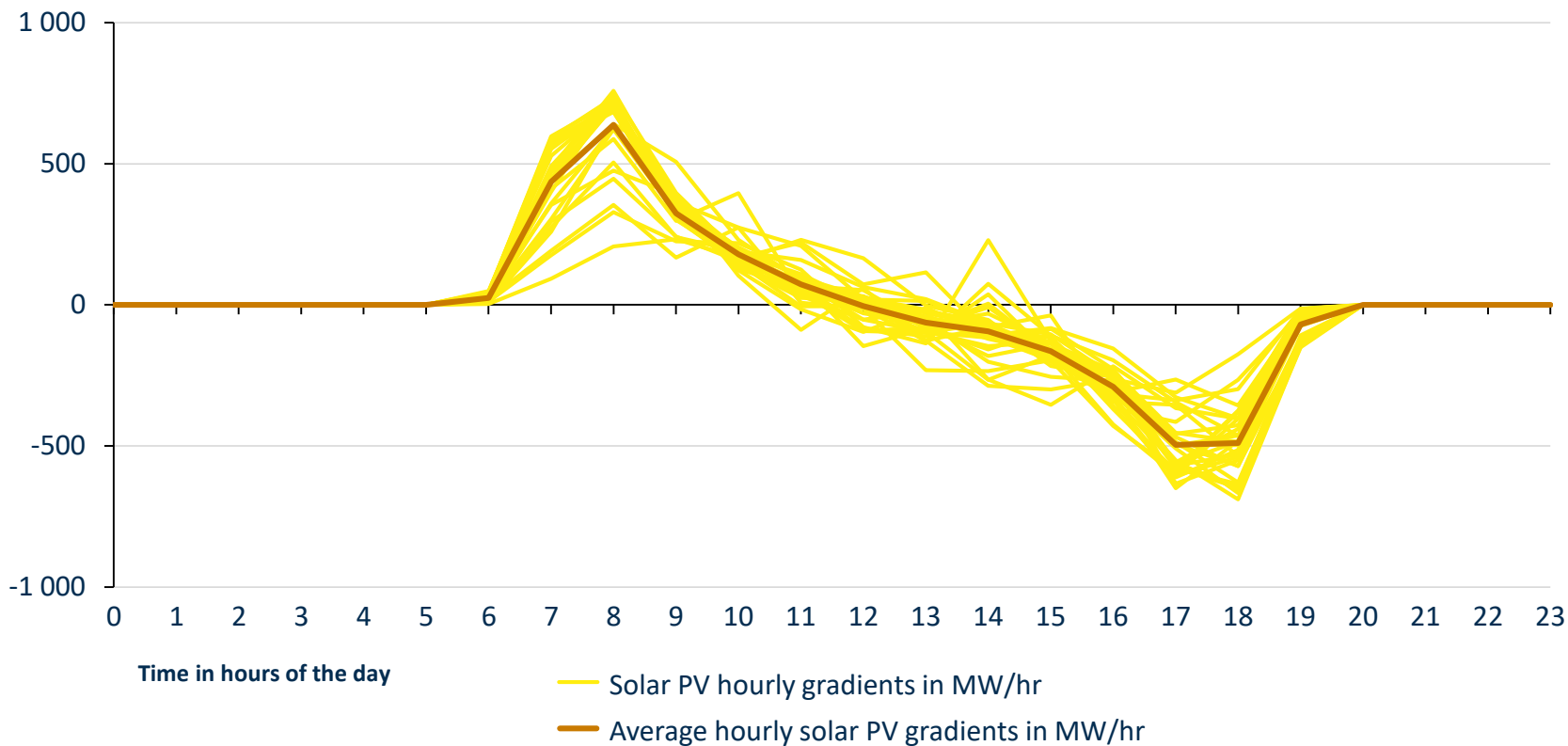


# Solar PV 1-hour gradients in March 2021

Capacity operational

2157 MW

Solar PV hourly gradients in MW/h

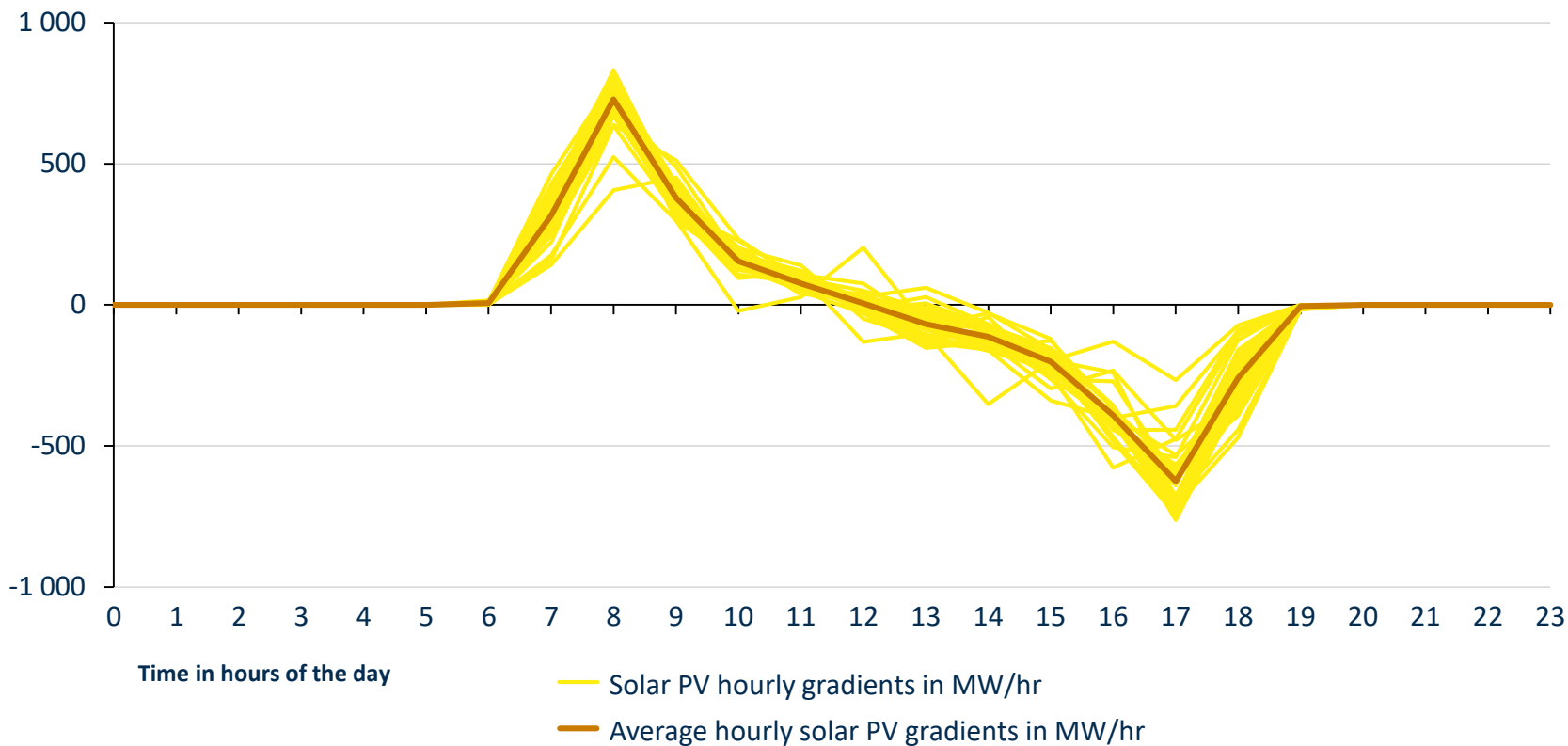


# Solar PV 1-hour gradients in April 2021

Capacity operational

2211 MW

Solar PV hourly gradients in MW/h

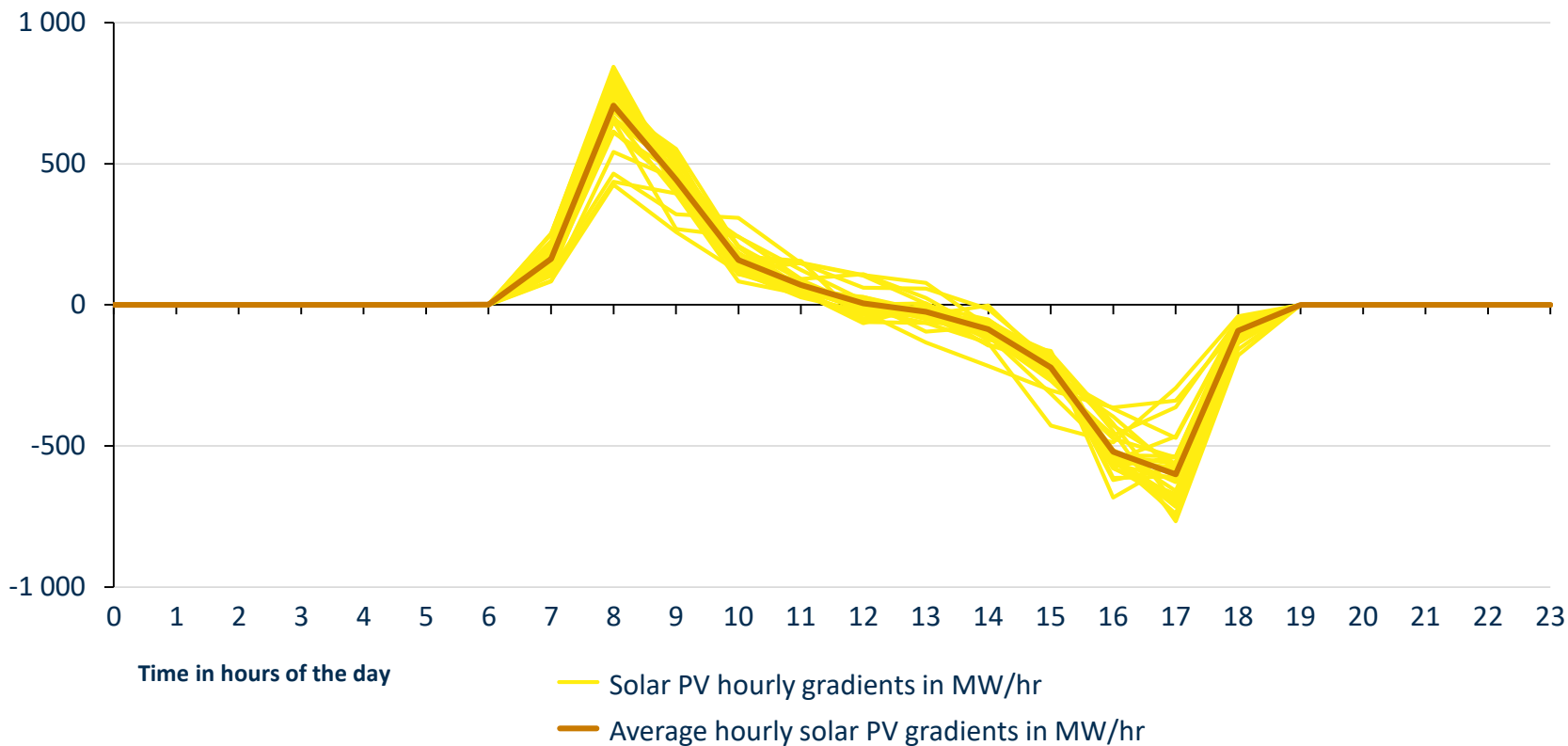


# Solar PV 1-hour gradients in May 2021

Capacity operational

2211 MW

Solar PV hourly gradients in MW/h

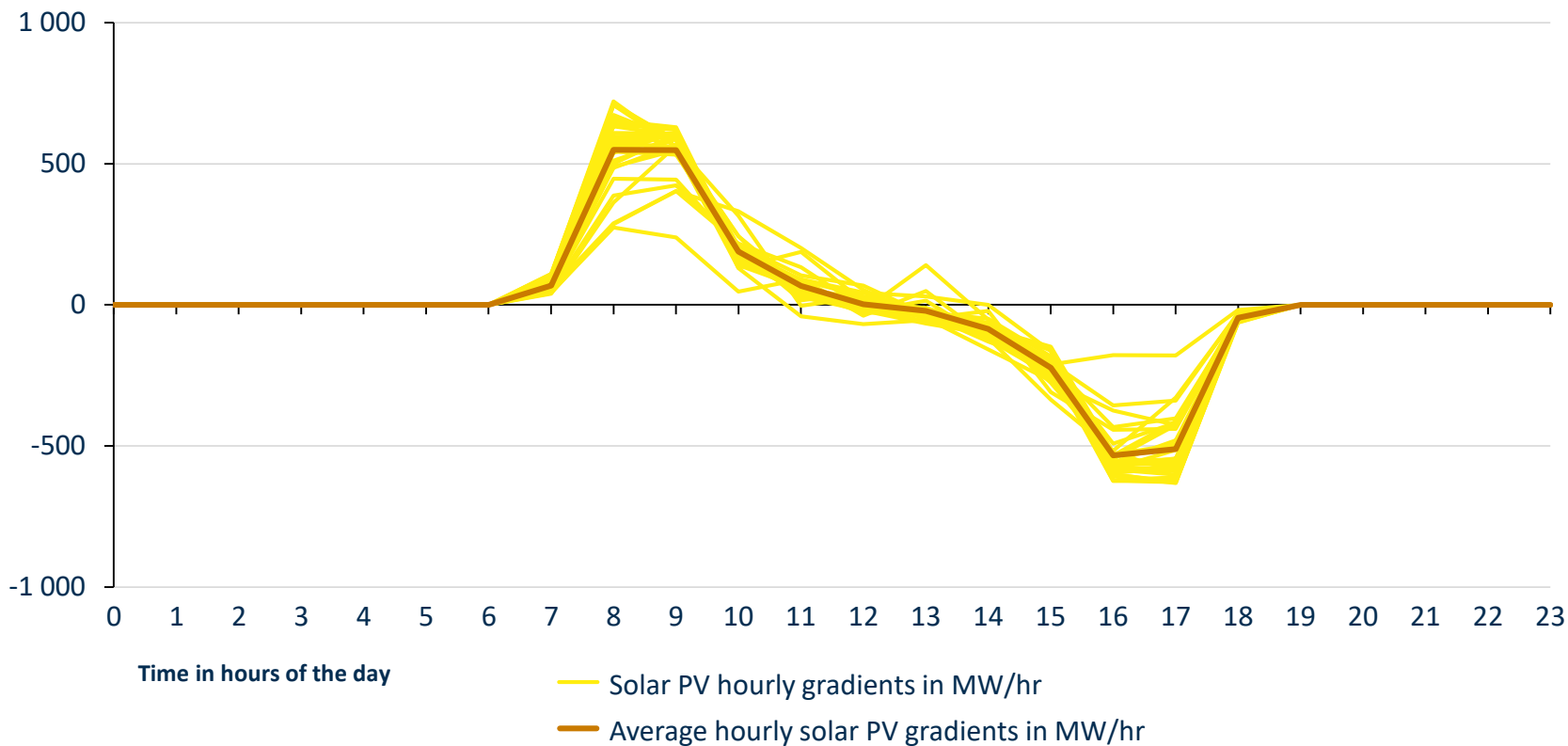


# Solar PV 1-hour gradients in June 2021

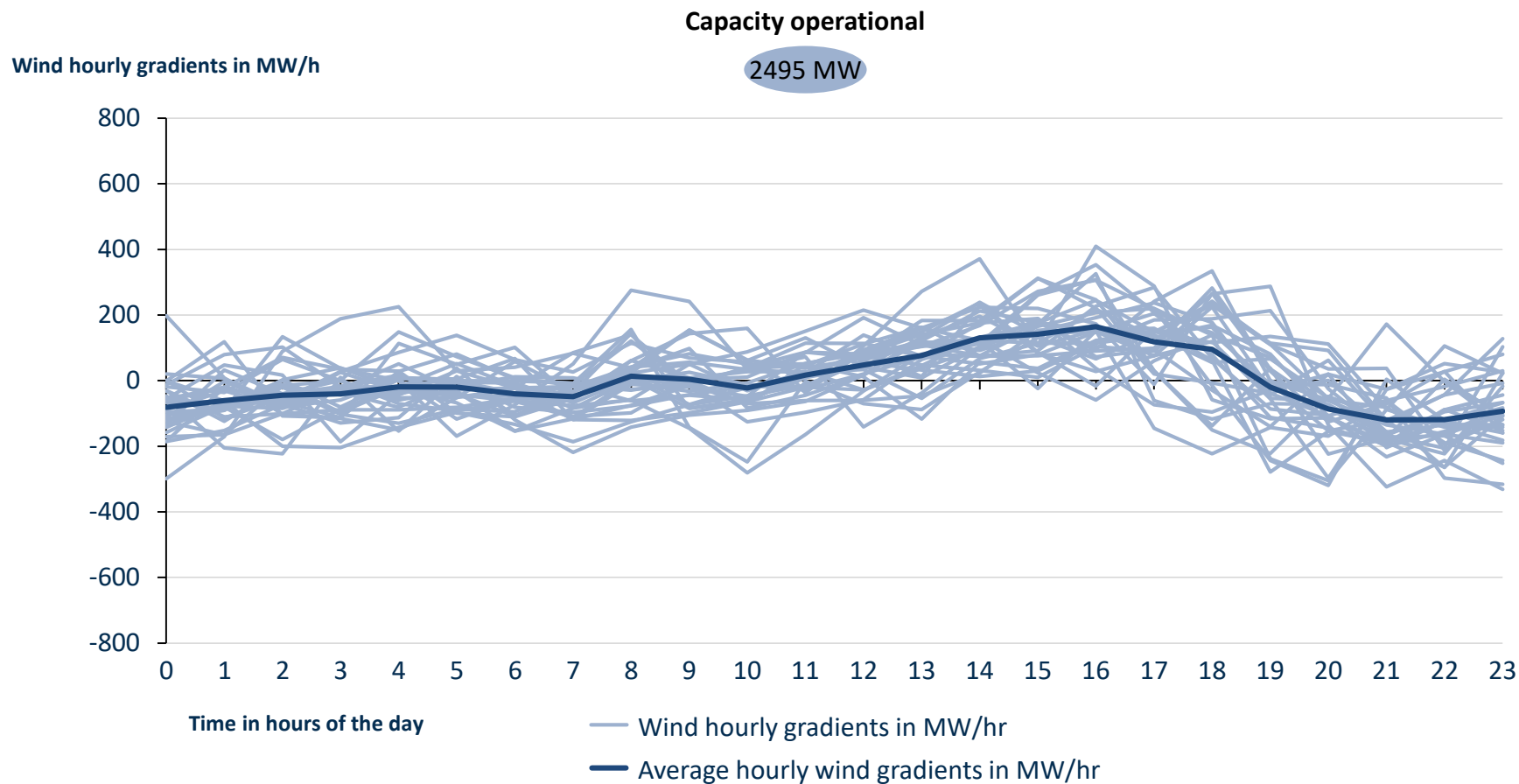
Capacity operational

2211 MW

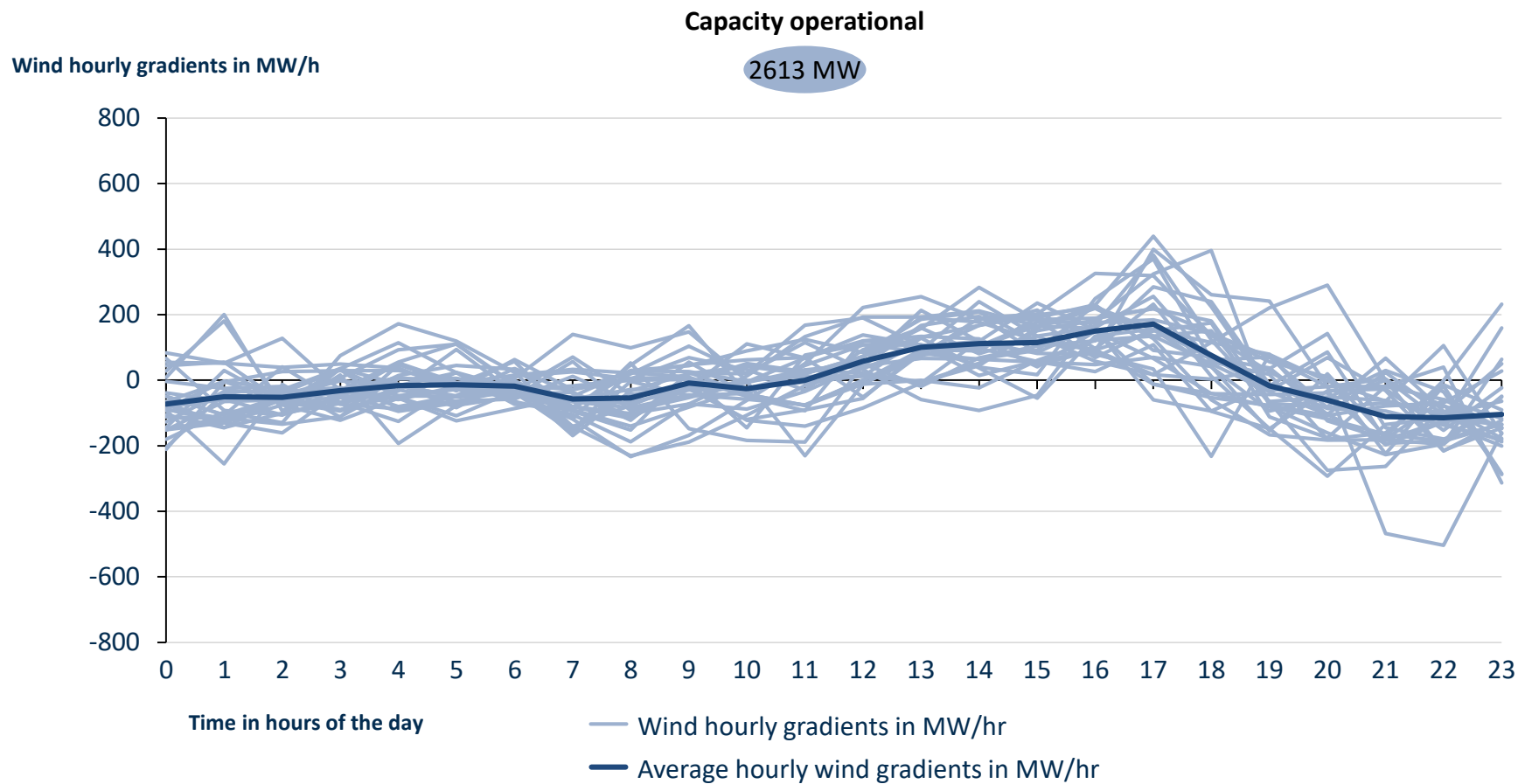
Solar PV hourly gradients in MW/h



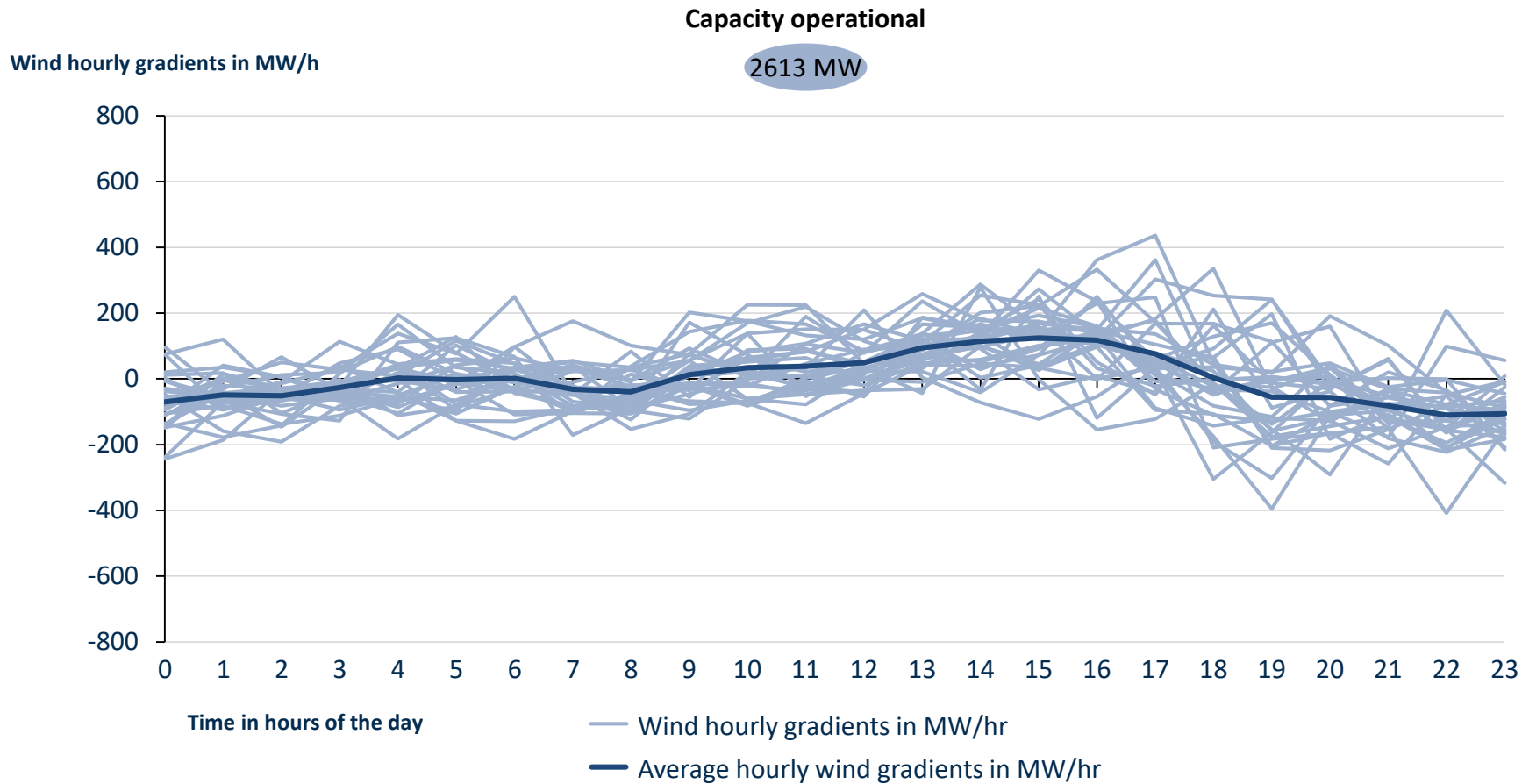
# Wind 1-hour gradients in January 2021



# Wind 1-hour gradients in February 2021

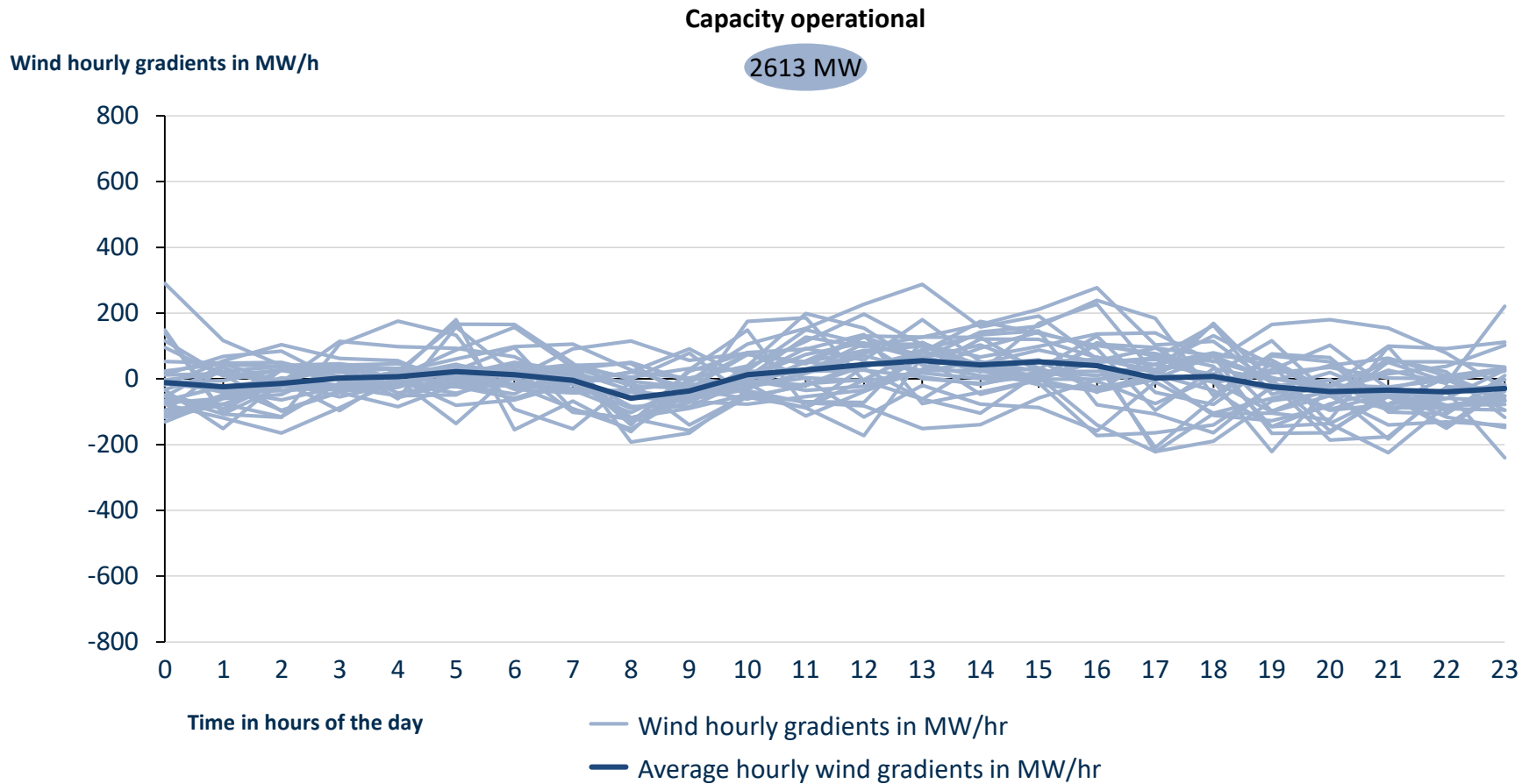


# Wind 1-hour gradients in March 2021

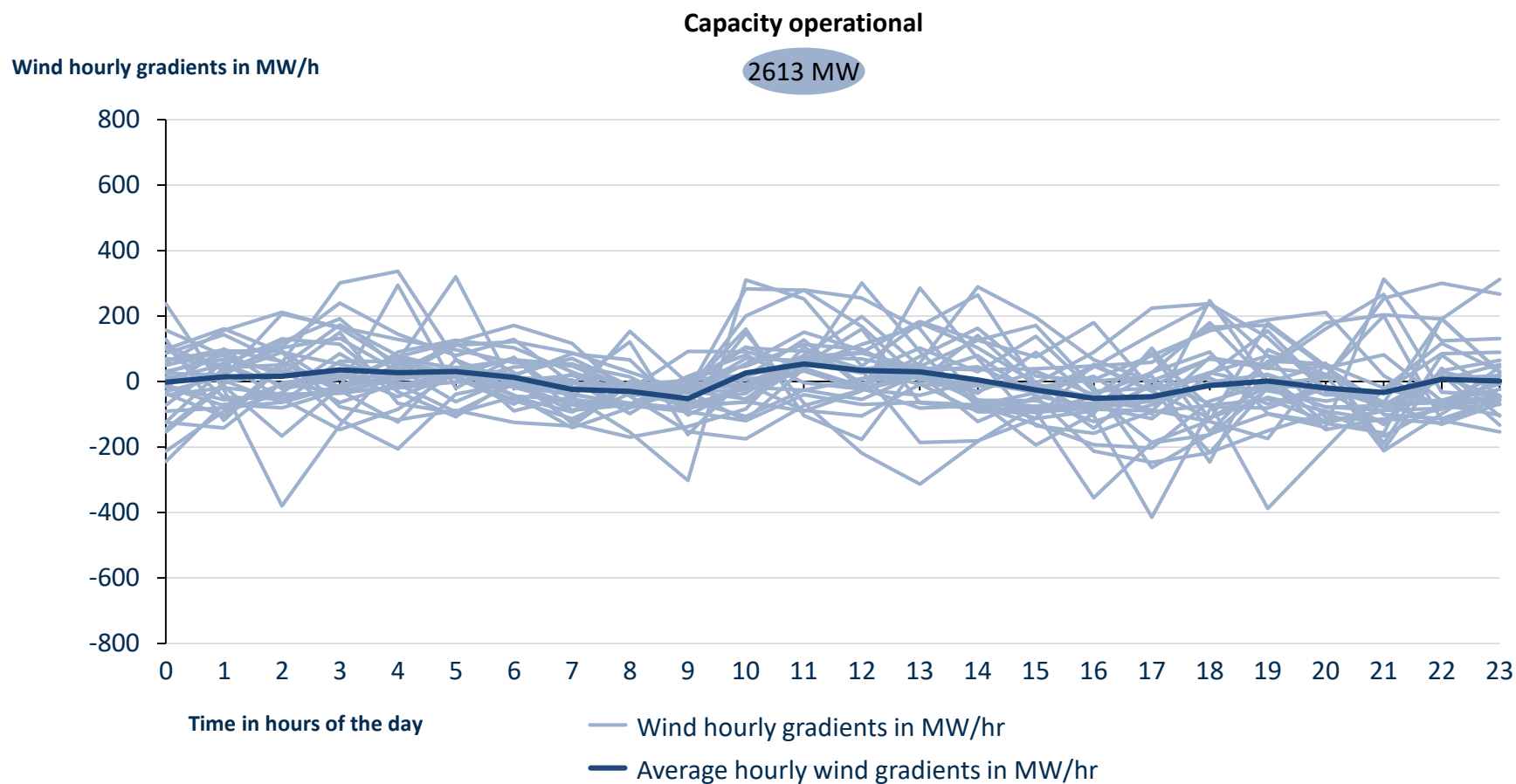




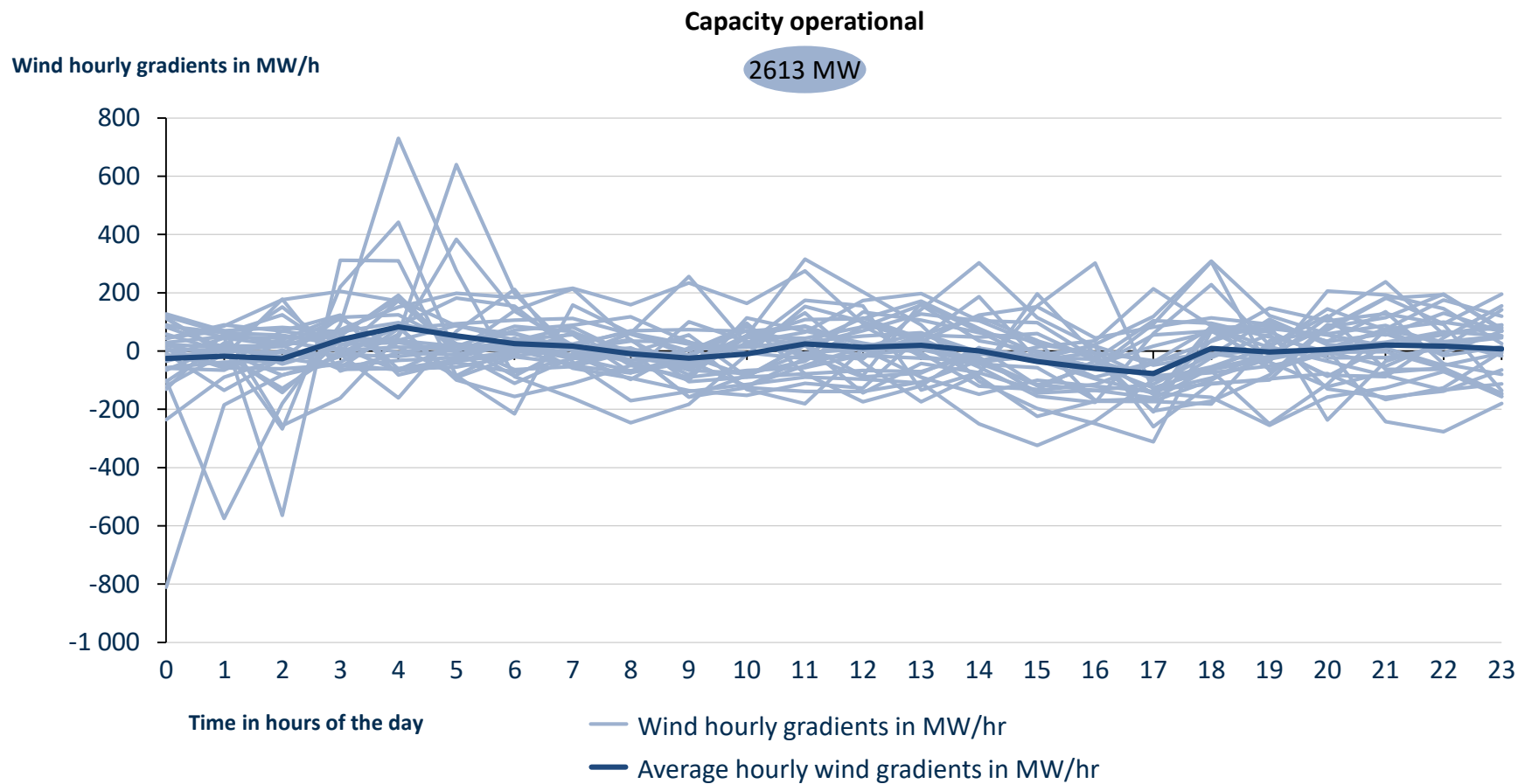
# Wind 1-hour gradients in April 2021



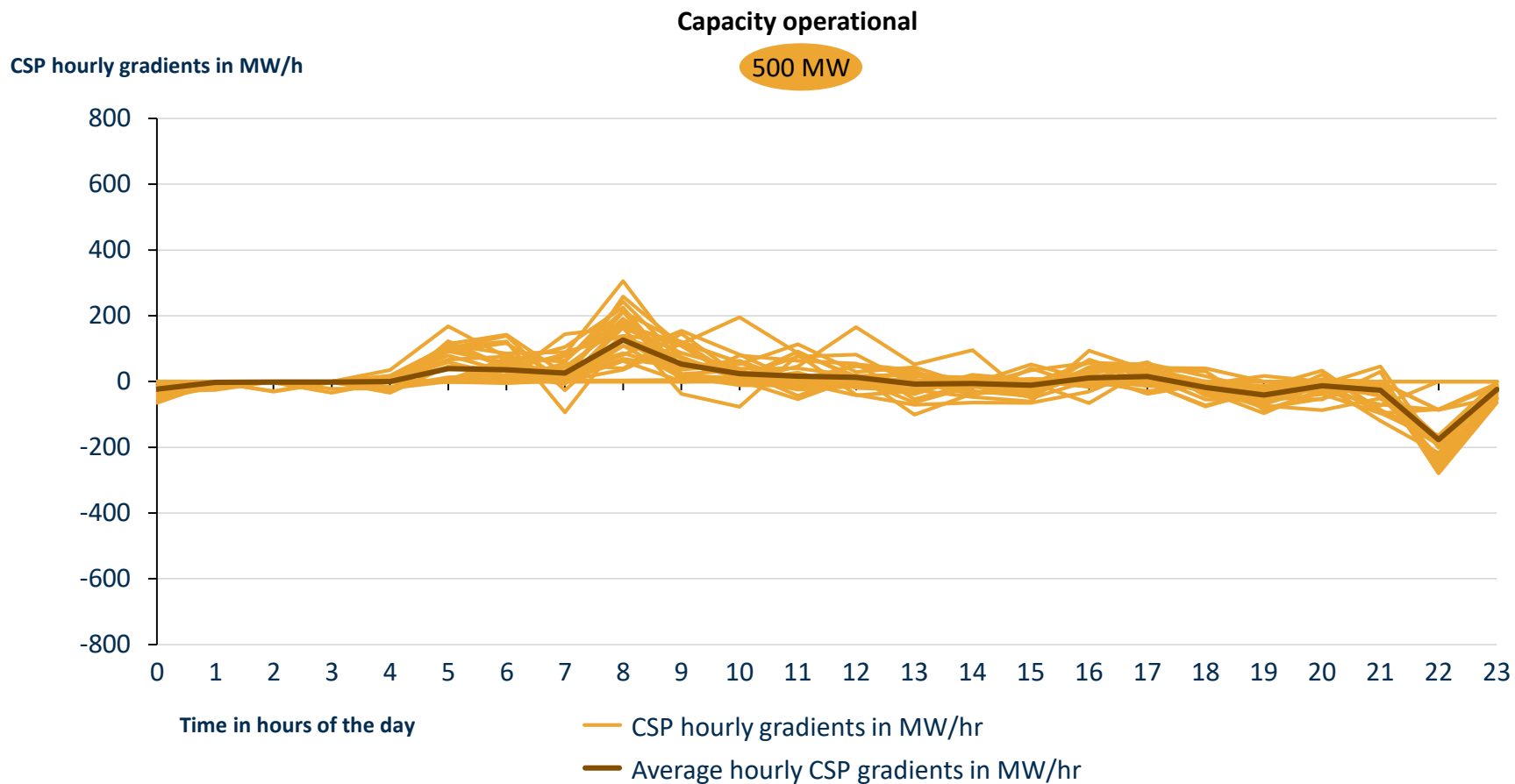
# Wind 1-hour gradients in May 2021



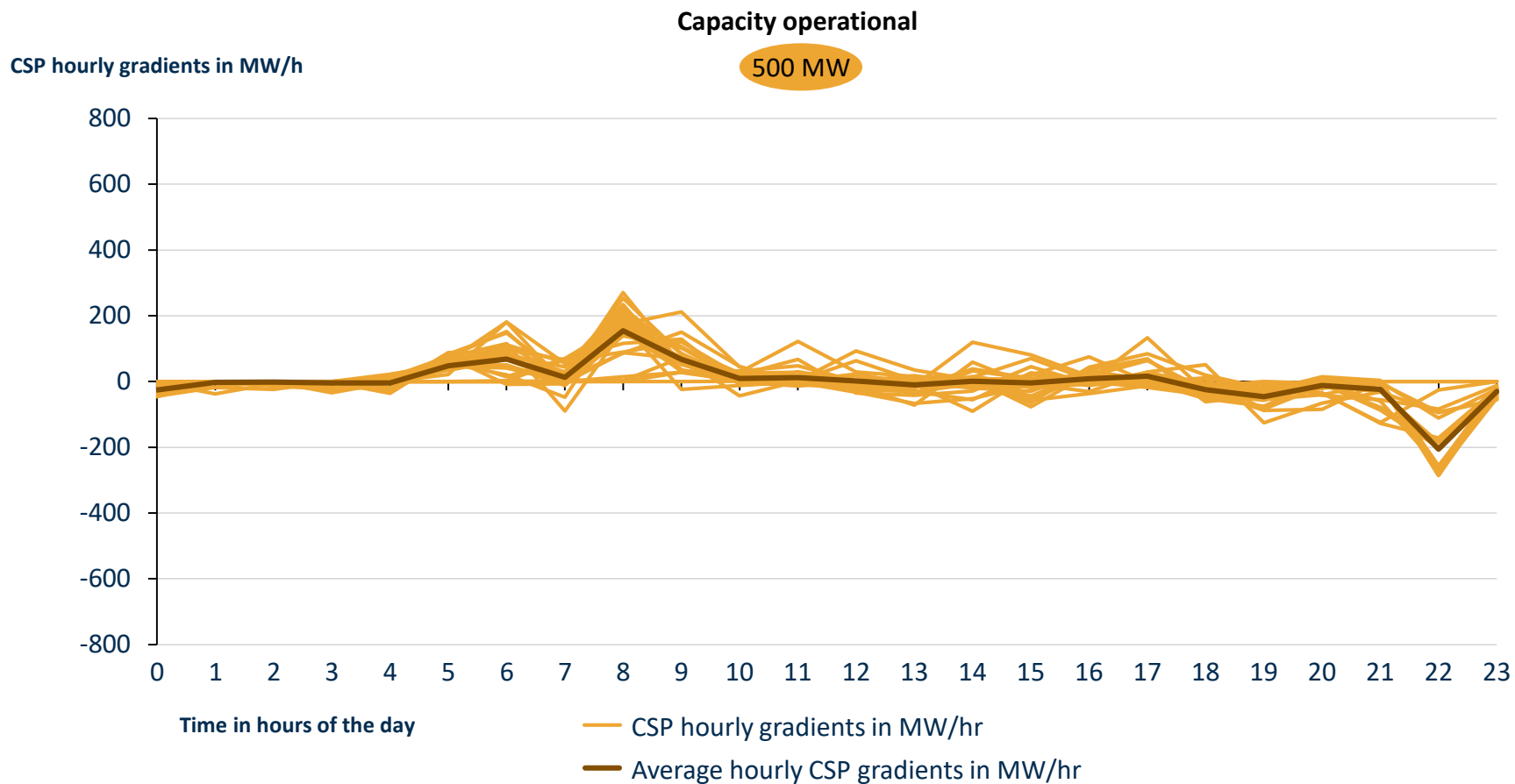
# Wind 1-hour gradients in June 2021



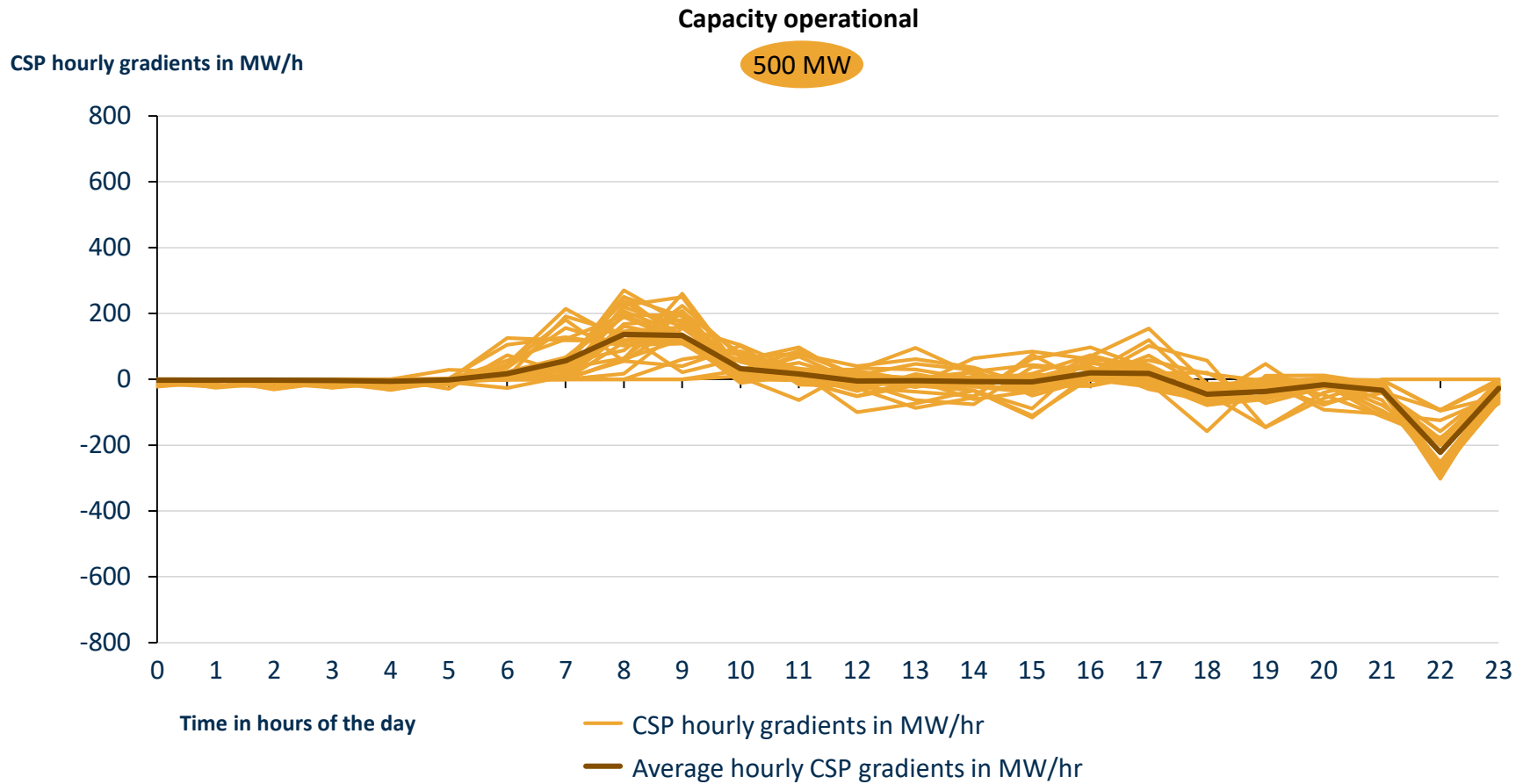
# CSP 1-hour gradients in January 2021



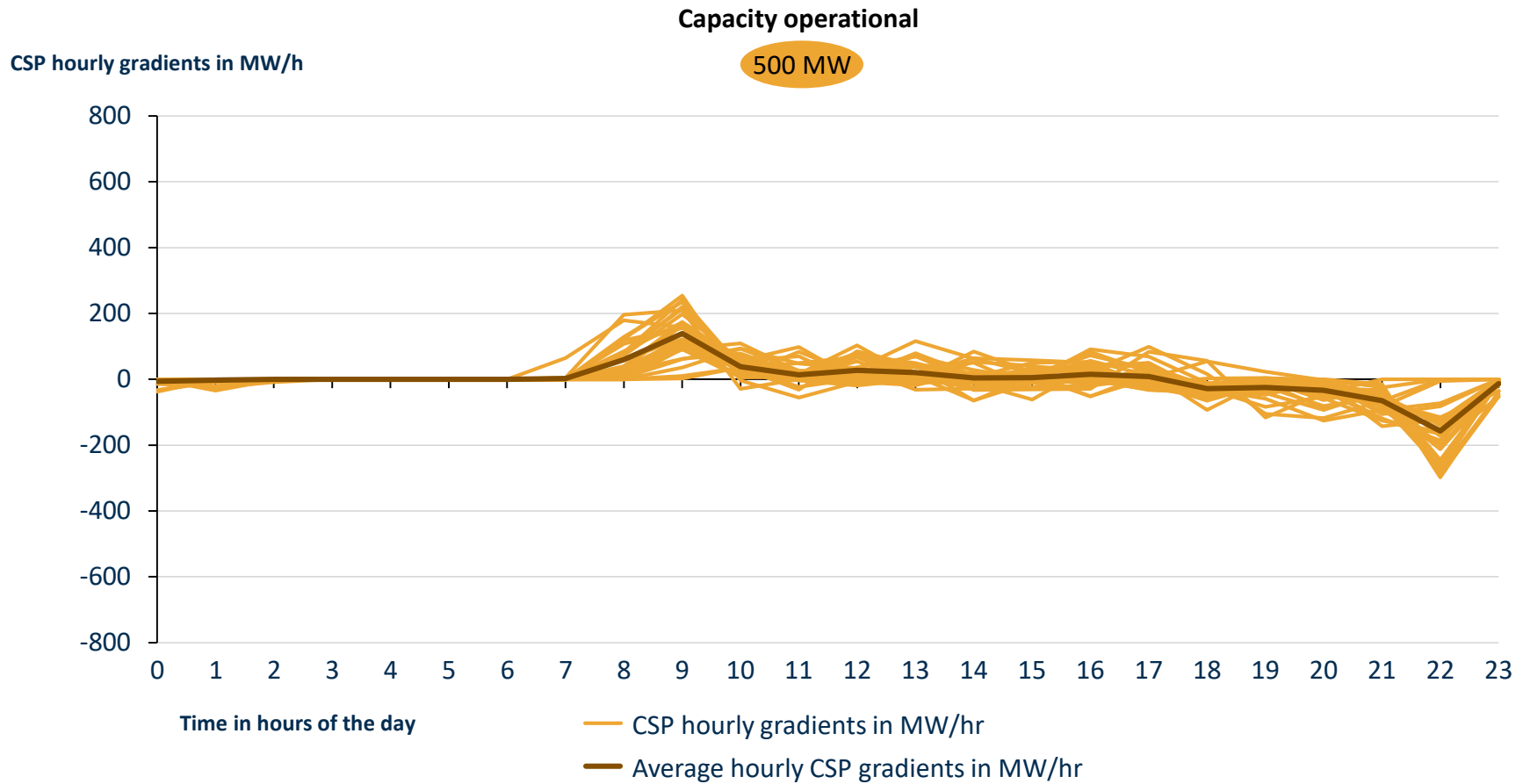
# CSP 1-hour gradients in February 2021



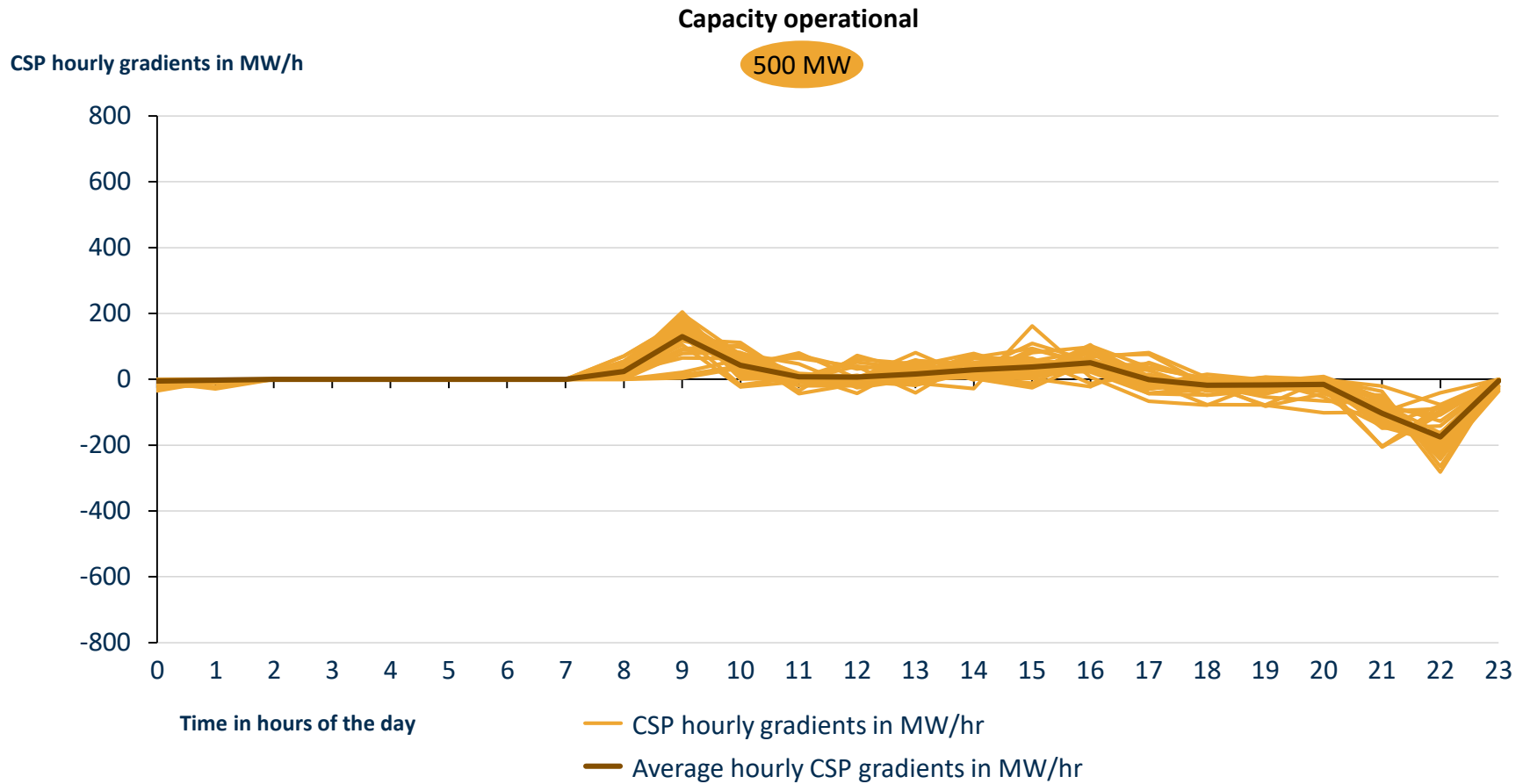
# CSP 1-hour gradients in March 2021



# CSP 1-hour gradients in April 2021

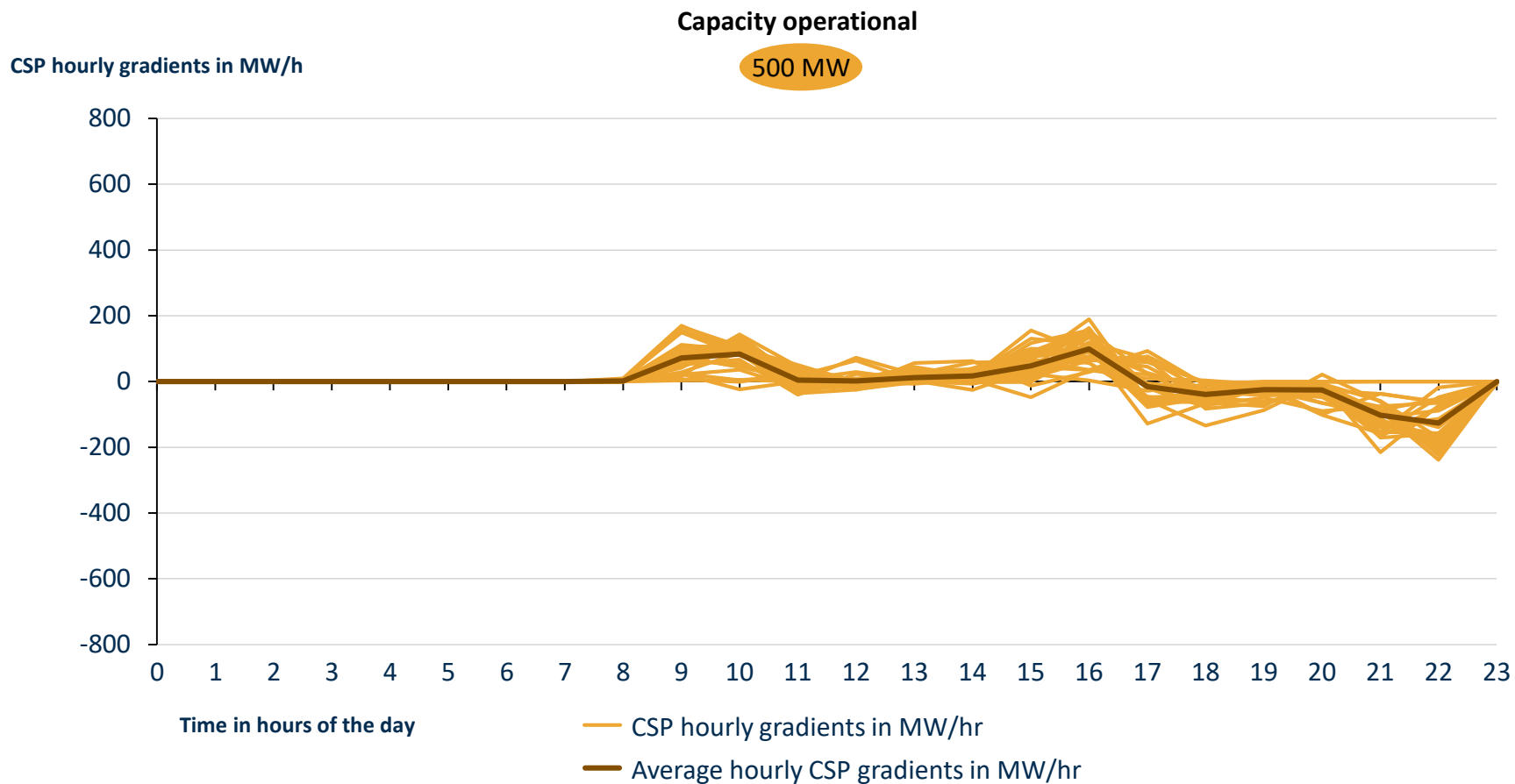


# CSP 1-hour gradients in May 2021





# CSP 1-hour gradients in June 2021



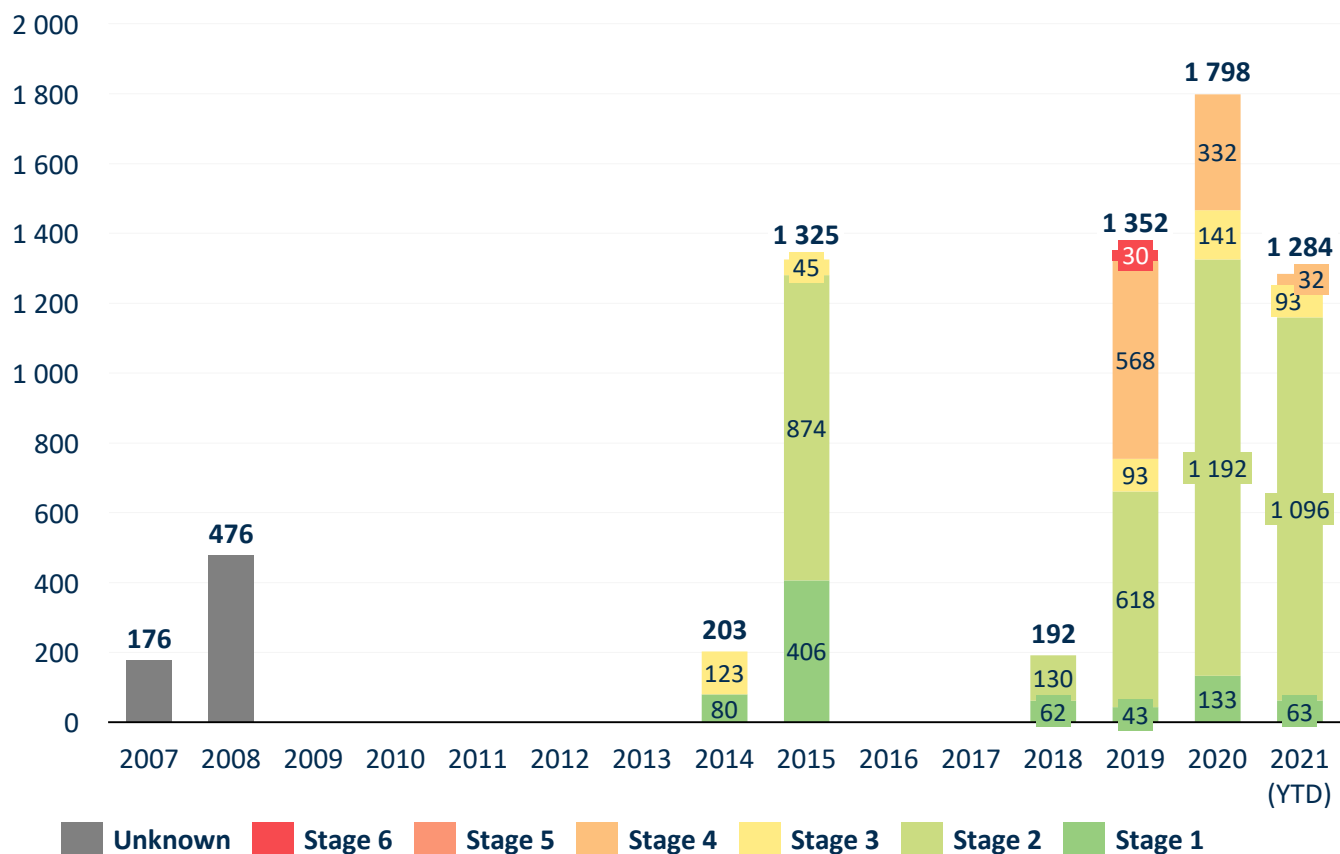
# Agenda

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- 1 Overview actual electricity production (2021-H1)
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- 
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  - 7 Other power system statistics

# 2020 seemingly the most intensive loadshedding year yet –calculated based on upper limit of loadshedding (as in previous publications)

Load shed, upper-limit [GWh]

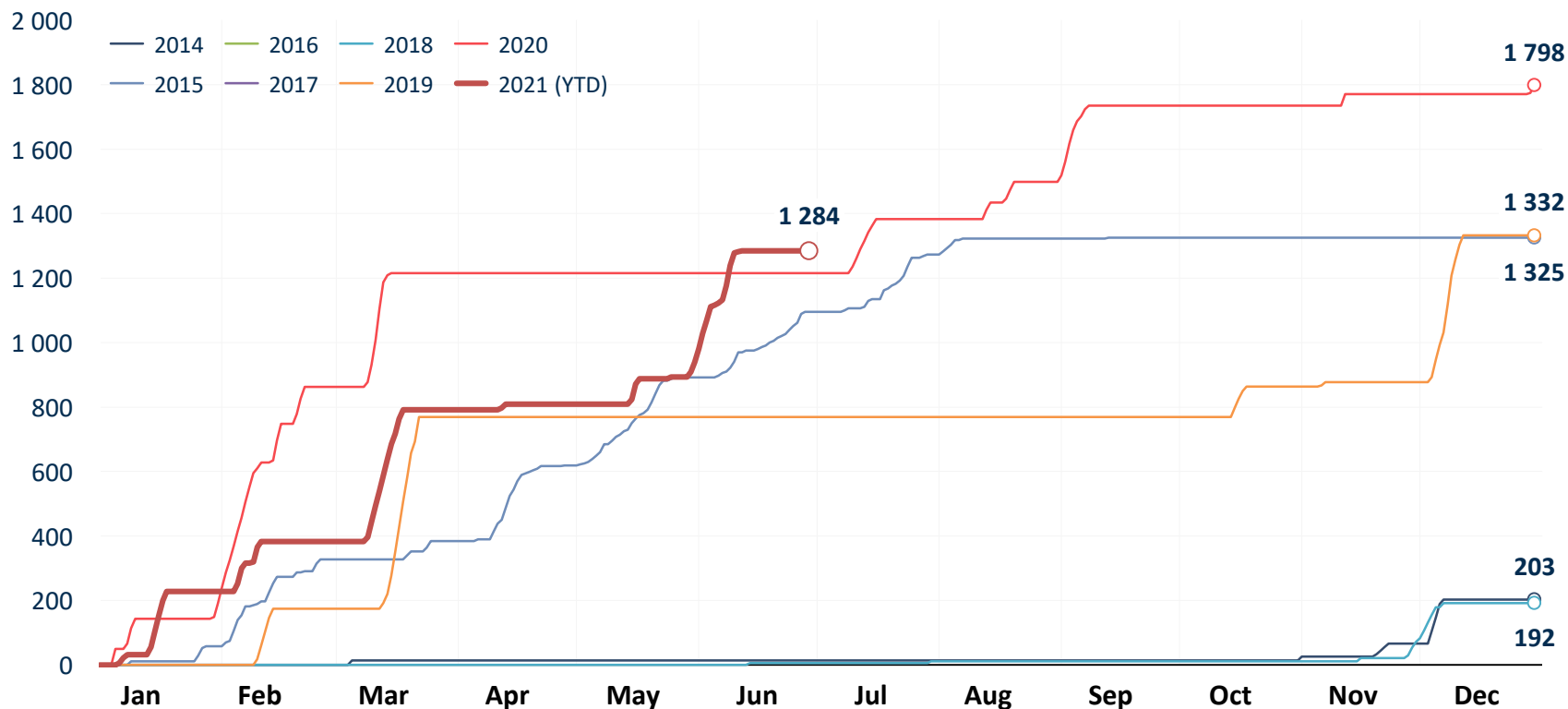


Year	Duration of outages (hours)	Energy Shed (GWh)
2007	-	176
2008	-	476
....	....	....
2014	121	203
2015	852	1325
2016	-	-
2017	-	-
2018	127	192
2019	530	1352
2020	859	1798
2021 (YTD)	650	1284

Notes: Loadshedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occasionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW; Sources: Eskom Twitter account; Eskom se Push (mobile app); Nersa; CSIR analysis

# Upper limit of cumulative loadshedding annually Jan 2015 – Jun 2021

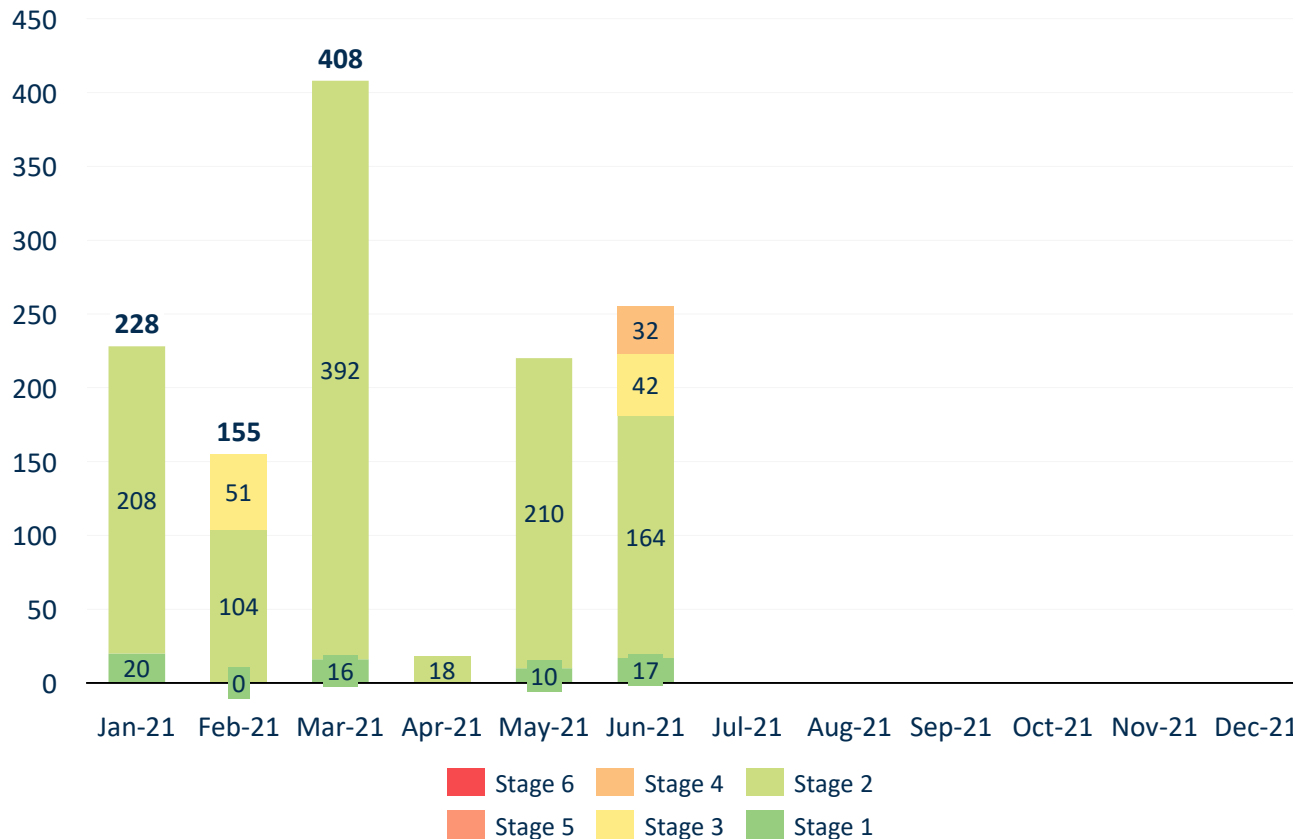
Load shed, upper-limit [GWh]



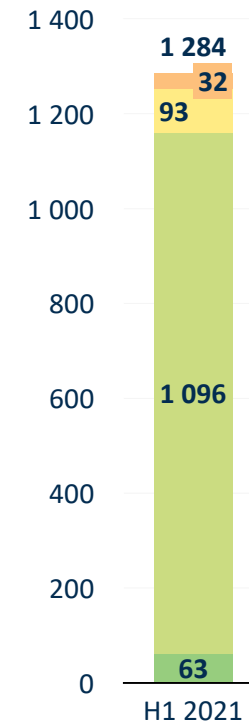
Notes: Loadshedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occasionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW; Sources: Eskom Twitter account; Eskom se Push (mobile app); Nersa; CSIR analysis

# In H1 2021, loadshedding occurred in each month, dominated by Stage 2 type loadshedding

Monthly load shed, upper-limit [GWh]



Annual loadshedding (upper limit) [GWh]



Notes: Loadshedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occasionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW;

Cost to the economy of load shedding is estimated using COUE (cost of unserved energy) = 87.50 R/kWh

Sources: Eskom Twitter account; Eskom se Push (mobile app); Nersa; CSIR analysis



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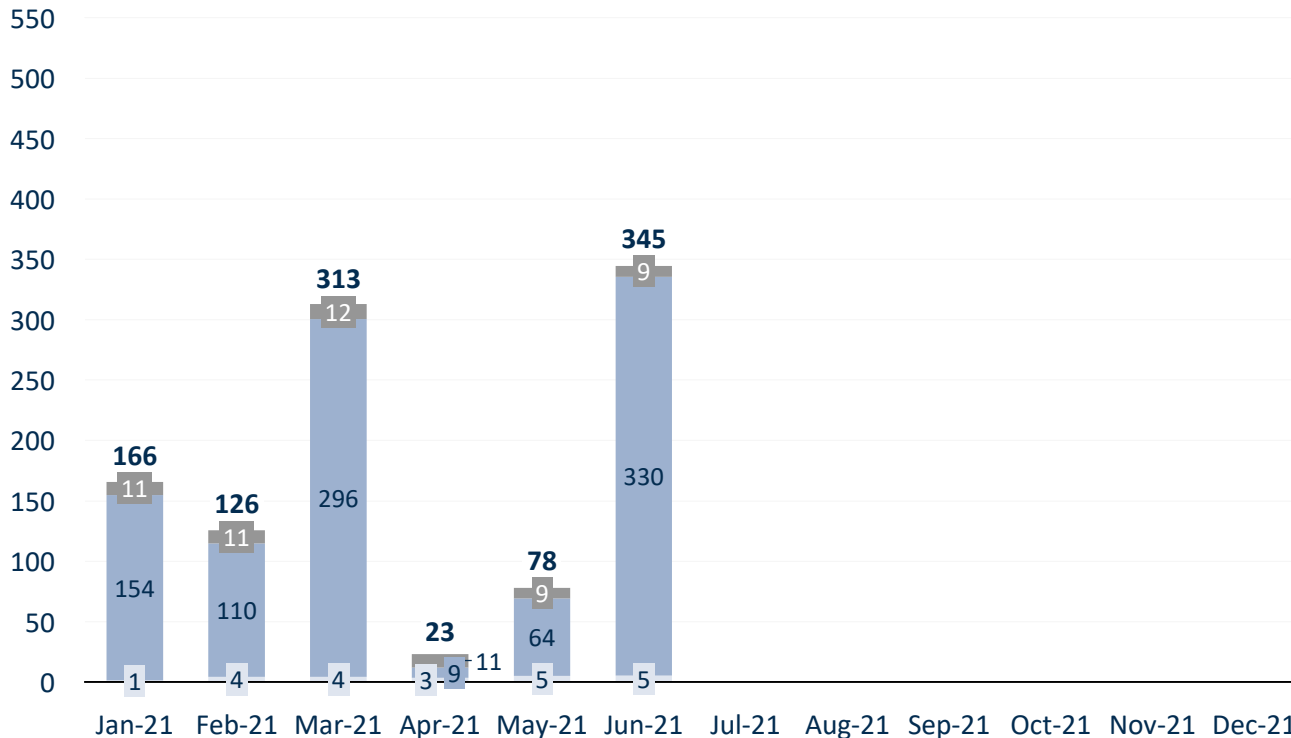
# Hourly distribution of loadshedding Jan – Jun 2021



Notes: Load shedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occasionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW  
 Sources: Eskom Twitter account; Eskom se Push (mobile app); CSIR analysis

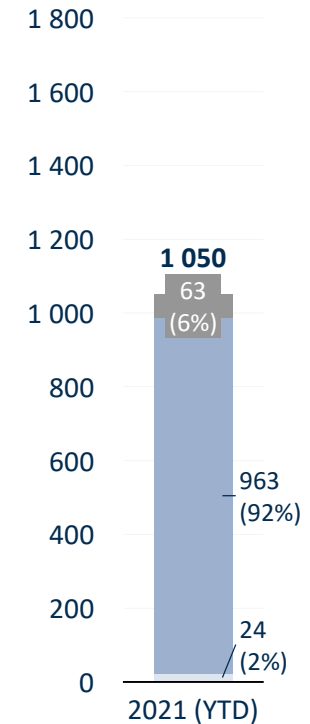
# Actual demand side response (DSR) in H1-2021 reveals how actual MLR (loadshedding) dominated over other DSR interventions

Monthly demand side response (DSR) [GWh]

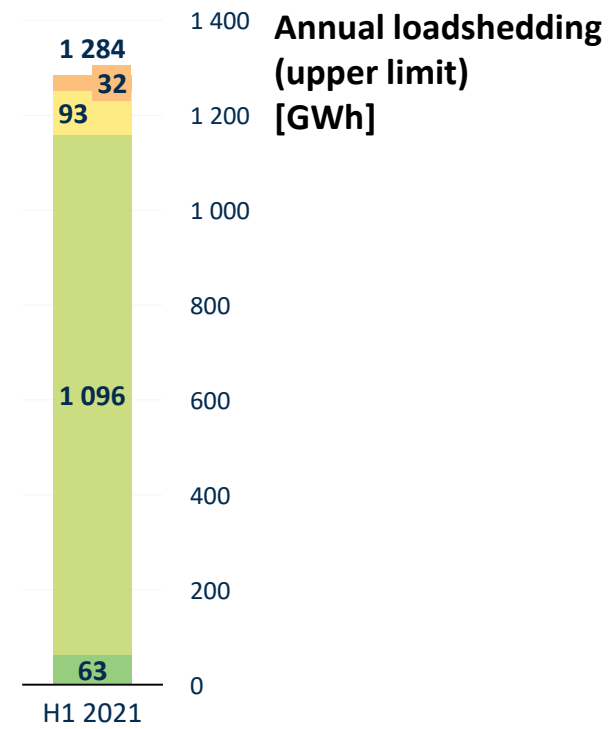
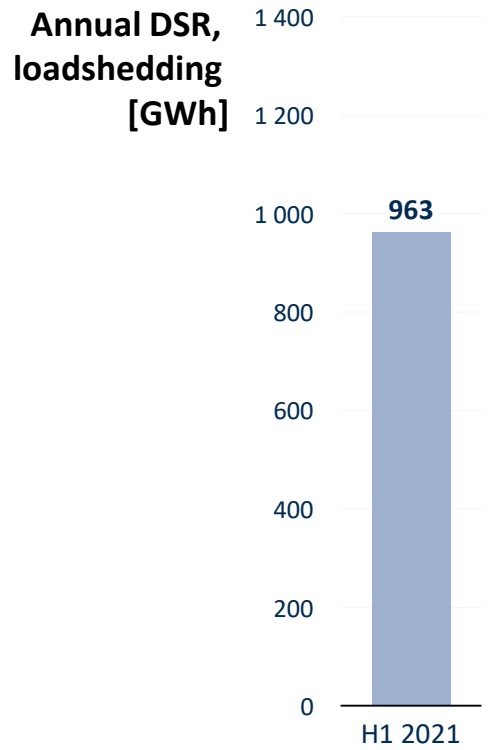


- Manual Load Reduction (MLR) i.e. loadshedding
- Interruption of Supply (IOS)
- Interruptible load supply (ILS)

Annual DSR [GWh]



# Similarly - actual demand side response (DSR) in H1-2021 was ~75% of announced levels of loadshedding



■ Load Shedding (Manual Load Reduction)

■ Stage 6 ■ Stage 4 ■ Stage 2  
 ■ Stage 5 ■ Stage 3 ■ Stage 1





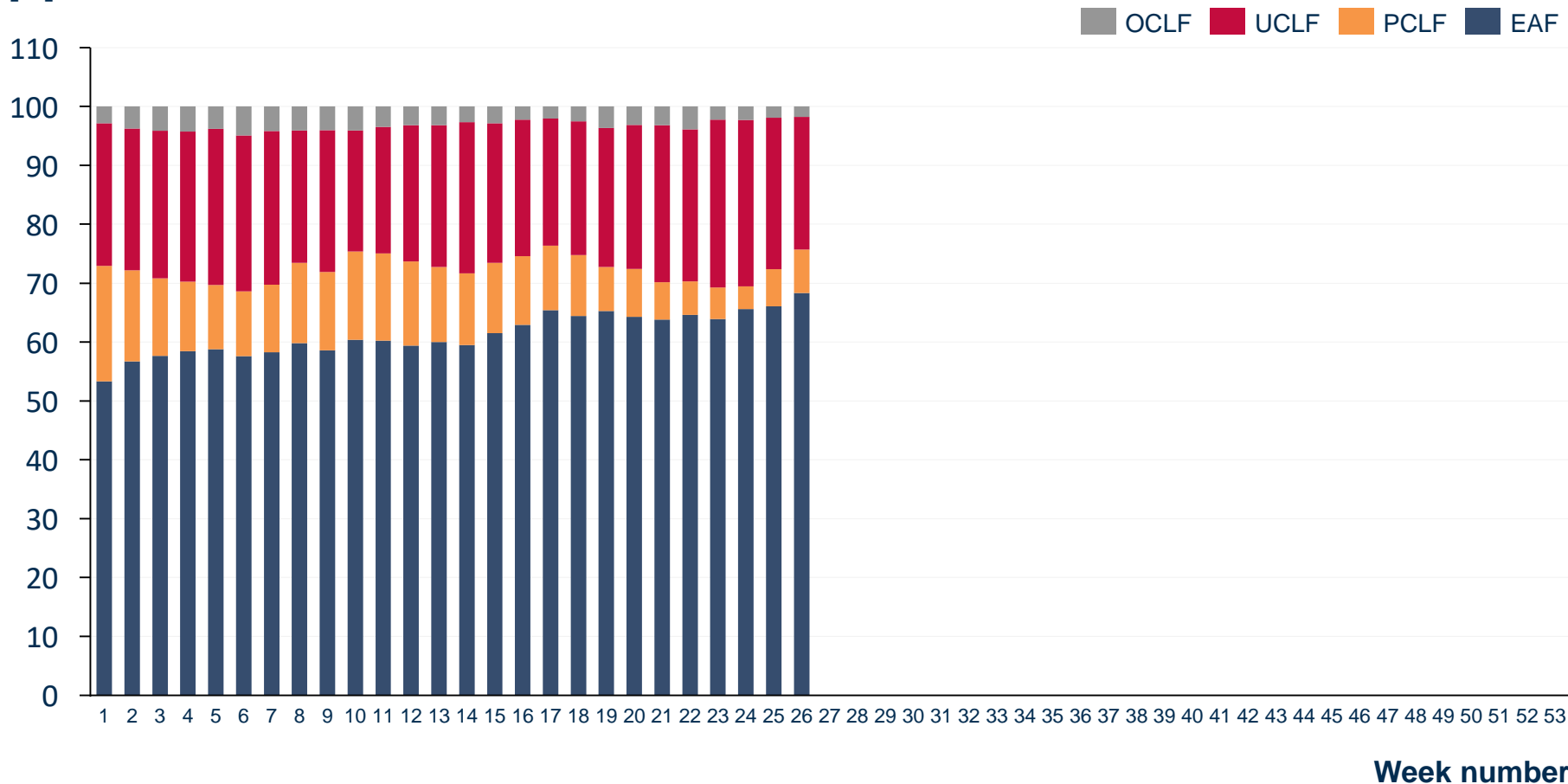
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-

# Eskom fleet performance for H1-2021 (weekly) reveals overall EAF of 61.3% comprising planned maintenance of 11.0%, unplanned of 24.5% & other at 3.2%

Plant performance (weekly)  
[%]



# Declining EAF trend continues into H1-2021 to an average EAF 61.3%

EAF (weekly)

[%]

2016: 76.4%

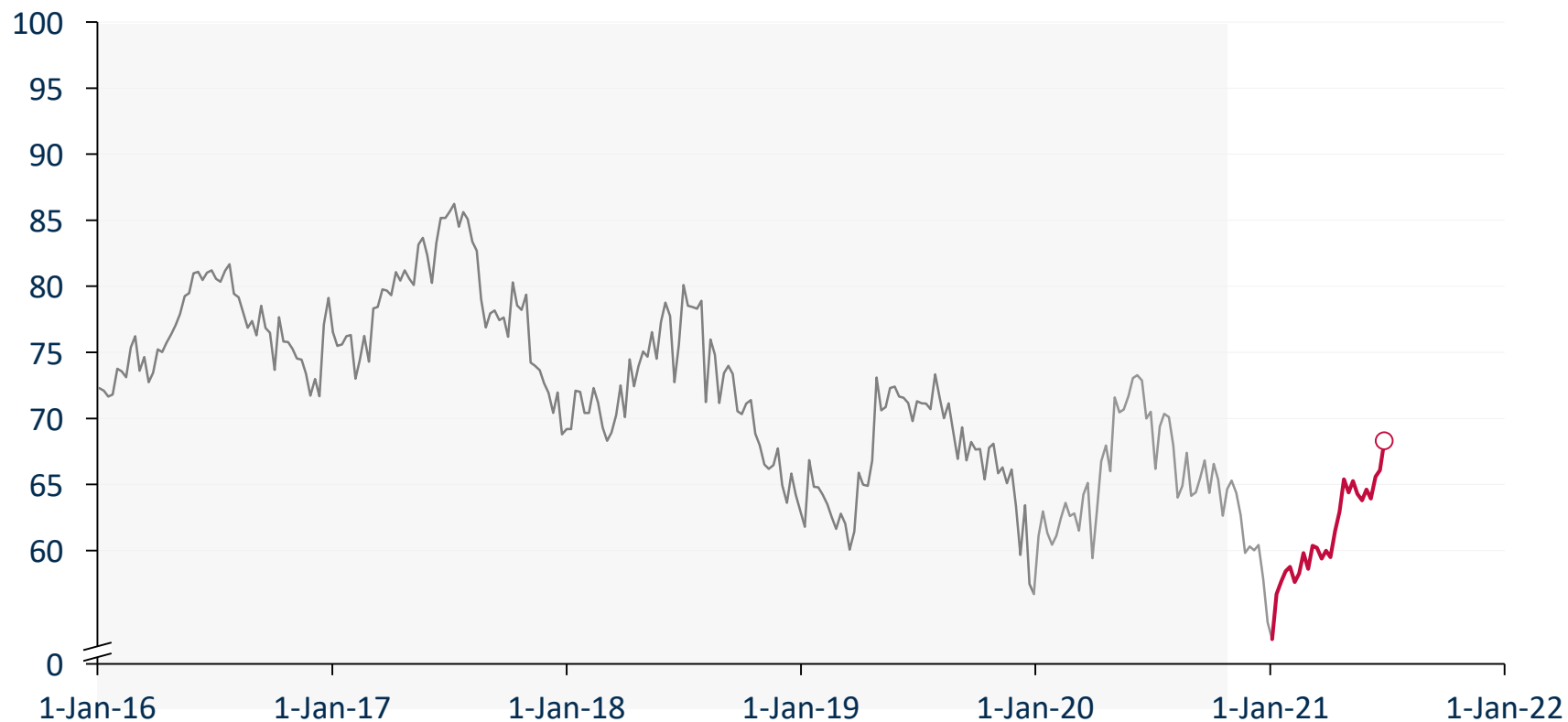
2017: 78.7%

2018: 71.9%

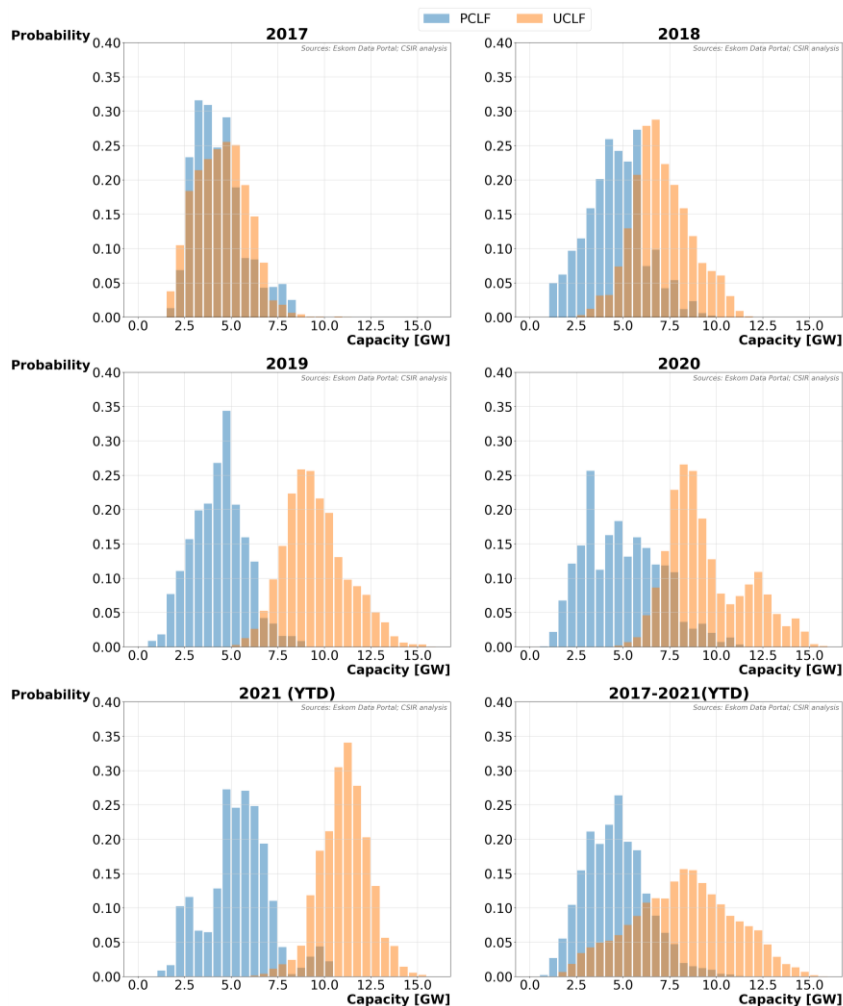
2019: 66.9%

2020: 65.0%

2021 (YTD): 61.3%



# Unplanned outage component of EAF is increasingly trending in a worrying direction



- Shift from equal level of planned maintenance (PCLF) and unplanned outages (UCLF) in 2017 towards increasing distribution of UCLF as years progress
- Transition starts already in 2018 and progresses further in 2019
- 2020 was an exceptional year with a dual distribution of UCLF (increasingly moving towards being >10 000 MW most of the time)
- H1-2021 shows the distinct separation (in the statistical distribution) of UCLF and PCLF

NOTE: Data presented is hourly temporal resolution;  
 Installed Eskom capacity is dynamic: [2017] 44.0-45.4 GW, [2018] 45.4-44.1 GW, [2019] 44.1-45.0, [2020] 45.0-45.6 GW, [H1-2021] 45.6-46.4 GW

**Thank you**



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# References

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Eskom Holdings SOC Limited (2020), *Eskom Data Portal*, <https://www.eskom.co.za/sites/publicdata/>

Eskom Holdings SOC Limited. (2020). *Integrated Report 2020*.  
[https://www.eskom.co.za/IR2020/Documents/Eskom\\_2020\\_integrated\\_report\\_secured.pdf](https://www.eskom.co.za/IR2020/Documents/Eskom_2020_integrated_report_secured.pdf)

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