vgbe ENERGY IS US

vgbe Technical-Scientific Report

Availability of Power Plants 2015 – 2024

VGBE-TW-103Ve (2025)

www.vgbe.energy

vgbe
Technical-Scientific Report
Availability of Power Plants 2015 – 2024

VGBE-TW-103Ve (2025)
(formerly VGB-TW 103Ve)

Publisher:
vgbe energy e.V.

Publishing house:
vgbe energy service GmbH
Verlag technisch-wissenschaftlicher Schriften
Deilbachtal 173, 45257 Essen, Germany

Tel.: +49 201 8128-200
E-mail: sales-media@vgbe.energy
ISBN 978-3-96284-412-7 (e-book, English)
ISBN 978-3-96284-411-0 (e-book, German)

www.vgbe.energy | www.vgbe.services

Copyright

Disclaimer

vgbe-publications are recommendations, the application of which is optional. vgbe-publications represent the state of the art at the time of publication. No claim regarding its completeness and correctness is made as a matter of principle.

Application of vgbe-publications is carried out at the user‘s own responsibility and risk. vgbe energy accepts no legal liability in the event of any claim relating to or resulting from the application of vgbe-publications.

Treatment of proposing amendments

Amendments can be sent to the e-mail address vgbe-standard@vgbe.energy. The subject line should contain the exact specification of the relevant document in order to clearly assign the e-mail content to the appropriate vgbe-publication.

Reference to series

Verfügbarkeit von Kraftwerken 2015 – 2024
VGBE-TW-103V (2025) German Edition: ISBN 978-3-96284-411-0 (e-book)
Analysis of Availability of Power Plants 2015 – 2024
VGBE-TW-103Ve (2025) English Edition: ISBN 978-3-96284-412-7 (e-book)

Analyse der Nichtverfügbarkeit von Kraftwerken 2015 – 2024
VGBE-TW-103A (2025) German Edition: ISBN 978-3-96284-409-7 (e-book)
Analysis of Unavailability of Power Plants 2015 – 2024
VGBE-TW-103Ae (2025) English Edition: ISBN 978-3-96284-410-3 (e-book)

Contents

Note on the evaluation

The following reports couldn't generate for this period because there are no sufficient data present, which permit to build a collective in accordance with vgbe criteria.

A.1.1.2 Fossil-fired units < 10 MW

A.2.1.2 Fossil-fired units < 10 MW

A.3.1.2 Hard coal-fired units < 10 MW

A.3.1.3 Hard coal-fired units, 10 MW ≤ nominal capacity < 100 MW

A.3.2.2 Lignite-fired units < 10 MW

A.3.3.2 Oil/gas-fired units < 10 MW

A.3.3.3 Oil/Gas-fired units 10 MW ≤ nominal capacity < 100 MW

A.3.3.4 Oil/Gas-fired units, 100 MW ≤ nominal capacity < 200 MW

A.3.3.6 Oil/Gas-fired units, nominal capacity ≥ 600 MW

A.3.5.1 Lignite-fired units, age < 10 years

A.3.6.1 Oil/gas-fired units age < 10 years

A.3.6.2 Oil/gas-fired units 10 years ≤ age < 30 years

A.3.9.1 Oil/Gas-fired units, operation time < 2000 h/a

A.3.9.2 Oil/Gas-fired units, 2000 h/a ≤ operation time < 4000 h/a

A.4.1.1.2 Single boiler units < 10 MW

A.5.1.1.2 Subcritical units < 10 MW

A.5.1.2.1 Subcritical units, age < 10 years

A.5.2.1.2 Supercritical units < 10 MW

A.5.2.1.3 Supercritical units, 10 MW ≤ nominal capacity < 100 MW

A.5.2.1.4 Supercritical units, 100 MW ≤ nominal capacity < 200 MW

A.5.2.3.1 Supercritical units, operation time < 2000 h/a

B.2.1.3 Combined cycle units [only steam turbine], 200 MW < nominal capacity ≤ 400 MW

B.2.1.4 Combined cycle units [only steam turbine], nominal capacity > 400 MW

B.3.1.4 Combined cycle units [only gas turbine], nominal capacity > 400 MW

D.2.3.1 Nuclear power plants with light water reactor, age < 10 years

E.1.1.2 Pumped storage power plants, nominal capacity < 10 MW

E.1.2.2 Pumped storage power plants, nominal capacity < 10 MW

E.1.4.3 Pumped storage power plants, nominal capacity < 10 MW

E.1.4.4 Pumped storage power plants (pumps) < 10 MW

E.1.5.2 Pumped storage power plants, nominal capacity < 10 MW

I. Introductory Remarks

Introduction

Since 1970 vgbe/VGB[1] has been collecting data according to standardised uniform definitions and recording procedures. With the liberalisation of the energy markets, the technical and economic assessment of power plants has gained more and more importance. These data provide information about the availability and utilisation of thermal power plants in order to compare the performance of power plants and to assess plants´ behaviour in daily operation. Reasons for unavailability of systems and main components also have being collected since 1988 in order to identify and assess direct cause.

However power generation in Europe has changed substantially over the last decade.

The development of renewables, the generation decrease of conventional power plants, the different European energy policies, and the electricity market development need more flexibility in operation and effective tools to help taking the right decisions.

According to the suggestions of the vgbe Technical Committee “Performance Indicators” (TCPI) the database system KISSY has been modified and upgraded in order to be able to provide technical benchmark reports in real time. The European utilities which provide data are able to analyse the data online. Currently the German, English, French, Italian, Dutch, and Portuguese languages are supported. In the future apart from the existing parameters, it will also be possible to evaluate the parameters that were newly defined by the TCPI with the new online analysis tool. Commercial background information (e.g. price data of the electricity stock exchange) are foreseen to be included in the KISSY system, too.

In addition to upgrade the KISSY database, the associated vgbe/VGB-Standards are already published in different languages. The former VGB Guidelines “Availability of Thermal Power Plants”, “Unavailability of Thermal Power Plants” and “EMS Event Criterion Key Systems” had been merged into one, completely revised guideline and in the meanwhile has been updated by the newly defined parameters for several times on a regular update basis. The up-to-date English, French, Portuguese and German versions can be downloaded from the vgbe Homepage[2] for free.

1 * vgbe energy e.V. has been the new name of VGB PowerTech since April 2022.
2 www.vgbe.energy

General remarks concerning the report

This report is divided into 5 parts according to the fuel type and to the type of power plants; that means:

Part A: Fossil fired units without combined cycle units and gas turbines, which are taken into account in two other parts (B and C). It is important to note that in part A some results are presented according to the technology of the boiler or the furnace type. In these two cases we don't differentiate the main fuel taken into account and we also mix different capacities together. That means for example, that in sub chapter A.5.1.1.1 all sub critical units consider without distinguishing the fuel (coal, biomass, lignite) and the capacity.

Part B: Combined Cycled Units. In this sub chapter the results are presented under consideration of the total unit, as well as the separating into the steam turbine part and the gas turbine part.

Part C: Gas Turbine Units. This sub chapter focuses on the simple gas turbines (including the GT (gas turbine) of CCGT (Combined Cycle Gas Turbine)) and is divided into two parts: the open cycle units and the jet engine units.

Part D: Nuclear Power Plants. The units included are those with light water reactors (BWR and PWR) all together or separated. All other types of reactors are not taken into account due to the smallness of the statistical sample.

Part E: Hydro Power Plants. This sub chapter presents the results of pumped storage hydro power plants (PSP) as well as storage hydro power plants (SP). In addition to the availability data the number of change of operating mode is also presented.

The new charts incorporate the worst, median and best quartile values for the parts A to D. The definition of each value is recalled below:

– The first quartile also called the lower (or worst) quartile or the 25^{th} percentile separating the lowest 25 % of data from the highest 75 %.
– The second quartile (the median or the 50^{th} percentile) cuts the data set in half, 50 % being higher and 50 %being lower.
– The third quartile (also called the best or upper quartile or the 75^{th} percentile) separating the highest 25 % of data from the lowest 75 %.

Remark: all weighted average values are written in normal and the quartile values are written in Italic font.

Further definitions can be found in the public, free vgbe/VGB-Standards:

– *VGBE-S-002-01 Basic Terms of the Electricity and District Heating Industry*
– *VGB-S-002-02 Hydropower – Definitions and Key indicators*
– *VGBE-S-002-03 Technical and Commercial Key Indicators for Power Plants, including EMS Event Characteristic Key System*

III. Results

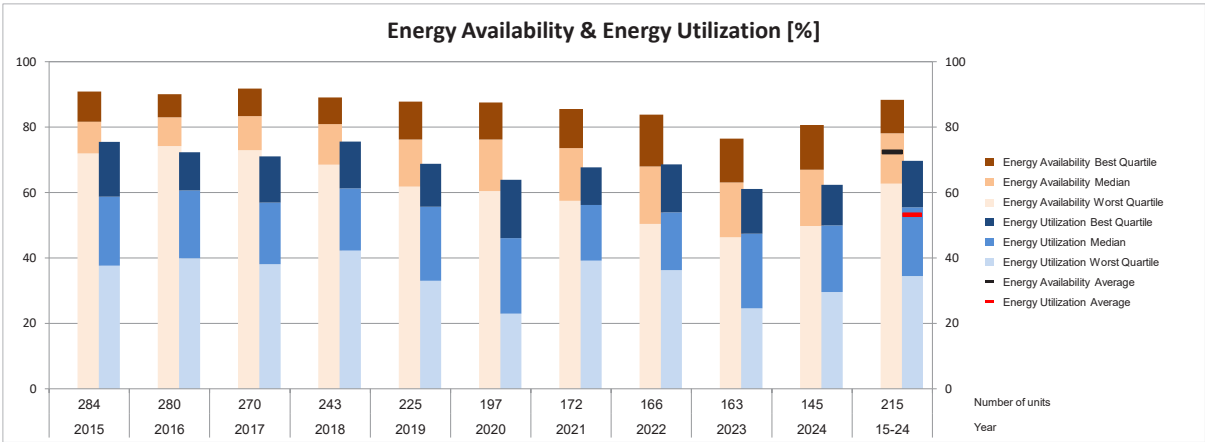
Fossil fired units

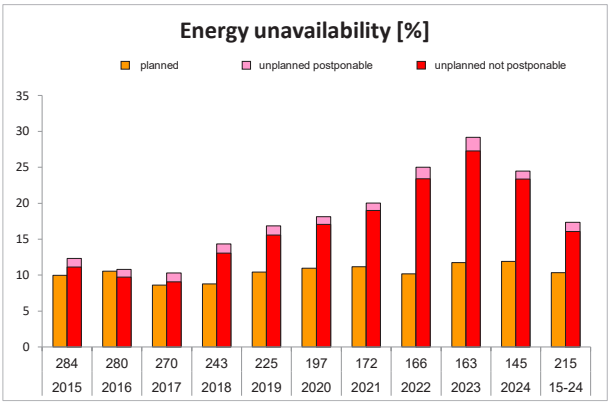
A. Fossil fired units (without combined cycle units)

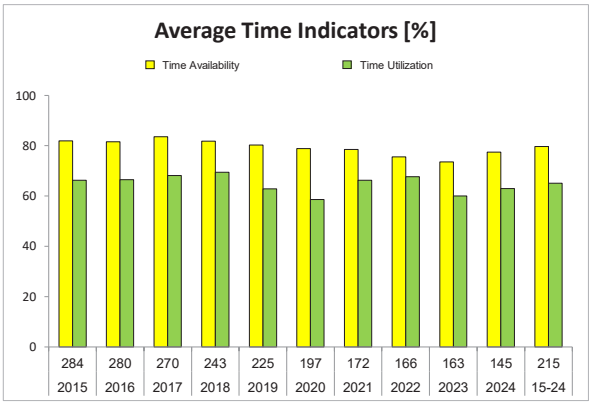
A.1 KPI overview of fossil fired units with different types of cluster

A.1.1 KPI overview by capacity cluster

A.1.1.1 Fossil-fired units, total
(318 units, AT, BE, CZ, DE, FR, IE, NL, PL, PT, UK, ZA)



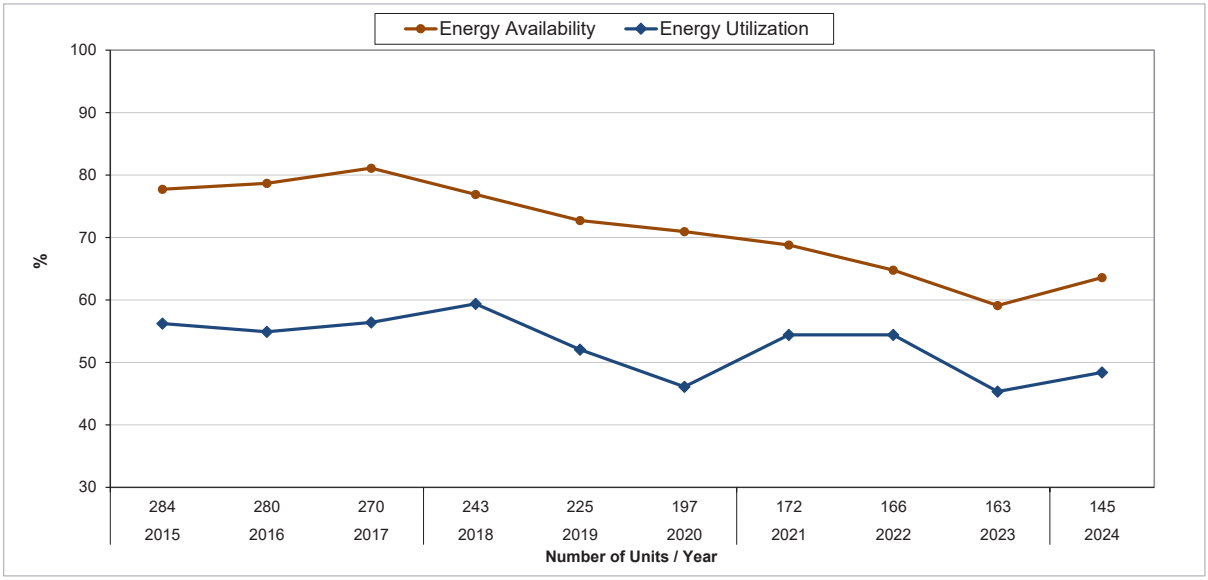




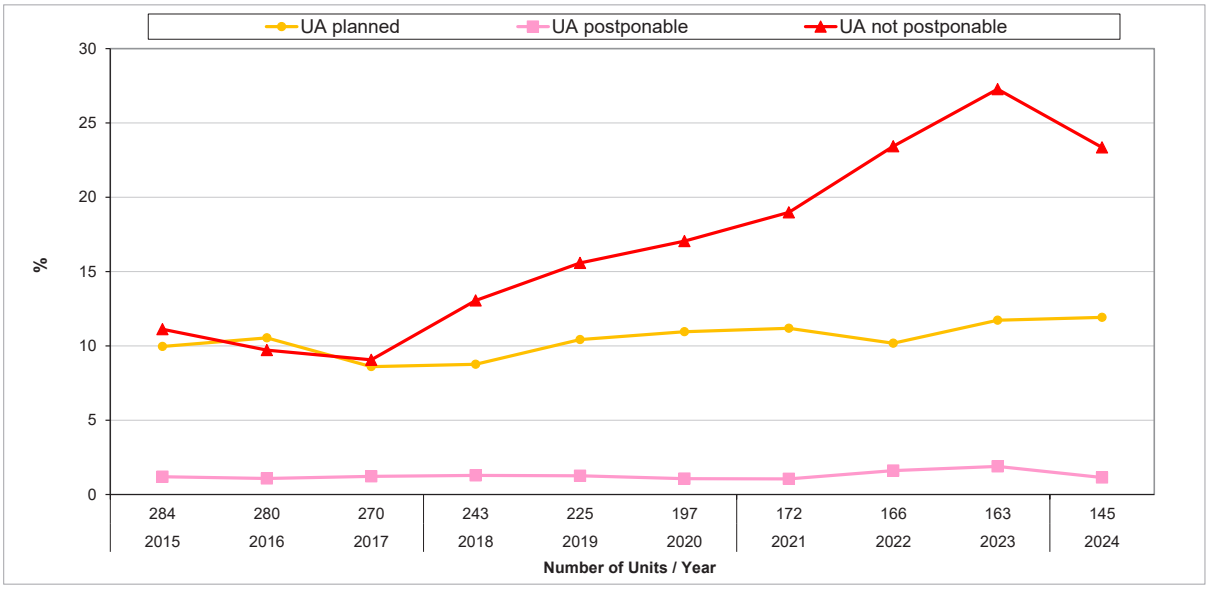
Average values/Quartile values		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	15-24
Number		284	280	270	243	225	197	172	166	163	145	215
Capacity	MW	104,373	102,952	97,642	89,861	86,156	81,034	74,772	72,739	72,998	65,287	84,781
Energy Availability	%	77.7	78.7	81.1	76.9	72.7	70.9	68.8	64.8	59.1	63.6	72.3
worst quartile	%	*72.0*	*74.3*	*72.9*	*68.5*	*61.8*	*60.4*	*57.5*	*50.4*	*46.3*	*49.8*	*62.7*
median	%	*81.6*	*83.0*	*83.3*	*81.0*	*76.2*	*76.2*	*73.6*	*68.0*	*63.1*	*66.9*	*78.2*
best quartile	%	*90.9*	*90.1*	*91.8*	*89.1*	*87.8*	*87.5*	*85.5*	*83.8*	*76.5*	*80.6*	*88.3*
Energy Unavailability	%	22.3	21.3	18.9	23.1	27.3	29.1	31.2	35.2	40.9	36.4	27.7
planned part	%	10.0	10.5	8.6	8.8	10.4	11.0	11.2	10.2	11.7	11.9	10.3
unplanned part	%	12.3	10.8	10.3	14.3	16.8	18.1	20.0	25.0	29.2	24.5	17.3
postponable	%	1.2	1.1	1.2	1.3	1.3	1.1	1.0	1.6	1.9	1.1	1.3
not postponable	%	11.1	9.7	9.1	13.1	15.6	17.0	19.0	23.4	27.3	23.3	16.1
Energy Utilization	%	56.2	54.9	56.4	59.4	52.1	46.1	54.4	54.4	45.3	48.4	53.2
worst quartile	%	*37.6*	*39.9*	*38.1*	*42.2*	*33.0*	*23.0*	*39.1*	*36.3*	*24.6*	*29.6*	*34.5*
median	%	*58.8*	*60.6*	*56.9*	*61.3*	*55.7*	*46.1*	*56.2*	*54.0*	*47.5*	*49.9*	*55.5*
best quartile	%	*75.5*	*72.3*	*71.0*	*75.6*	*68.8*	*63.9*	*67.7*	*68.6*	*61.1*	*62.4*	*69.7*
Time Availability	%	81.9	81.6	83.6	81.8	80.3	78.9	78.5	75.6	73.6	77.4	79.7
worst quartile	%	*77.6*	*76.8*	*76.3*	*73.2*	*72.3*	*71.9*	*70.4*	*65.9*	*65.9*	*70.1*	*72.5*
median	%	*85.8*	*85.4*	*86.4*	*85.9*	*83.5*	*81.9*	*81.2*	*80.7*	*77.9*	*82.1*	*83.9*
best quartile	%	*93.2*	*91.5*	*93.3*	*91.6*	*91.5*	*90.3*	*90.7*	*87.4*	*88.4*	*89.8*	*91.3*
Time Utilization	%	66.3	66.5	68.2	69.5	62.9	58.6	66.3	67.7	60.1	63.0	65.1
worst quartile	%	*49.2*	*55.6*	*45.9*	*53.3*	*45.8*	*36.0*	*53.6*	*48.5*	*35.3*	*46.3*	*47.6*
median	%	*76.3*	*76.9*	*71.7*	*75.1*	*69.1*	*64.4*	*71.2*	*73.3*	*66.1*	*67.8*	*71.4*
best quartile	%	*88.3*	*86.7*	*85.8*	*87.8*	*83.9*	*80.0*	*83.9*	*85.8*	*80.0*	*81.1*	*85.3*

A.2.1 KPI trend by capacity cluster
Fossil-fired units, total

Time range: 2015 - 2024



Time range: 2015 - 2024

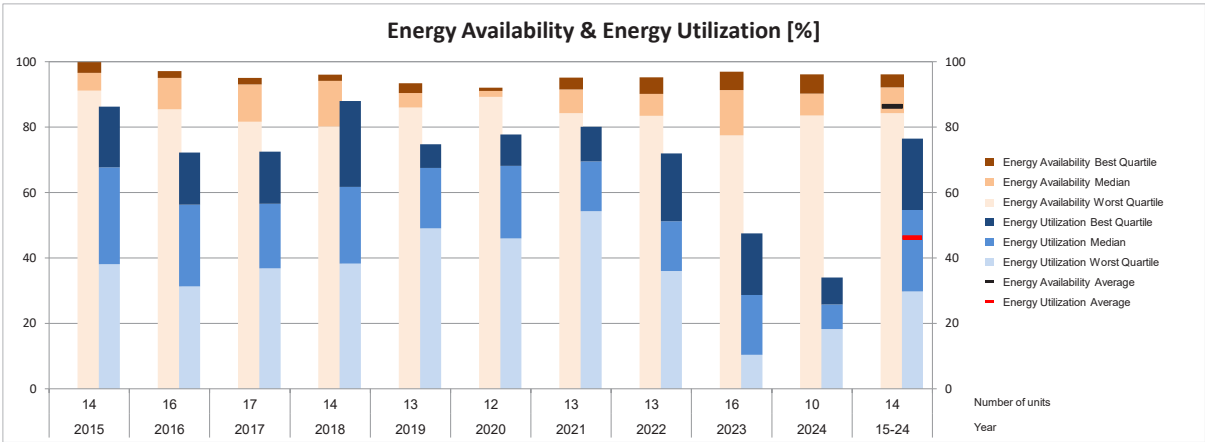


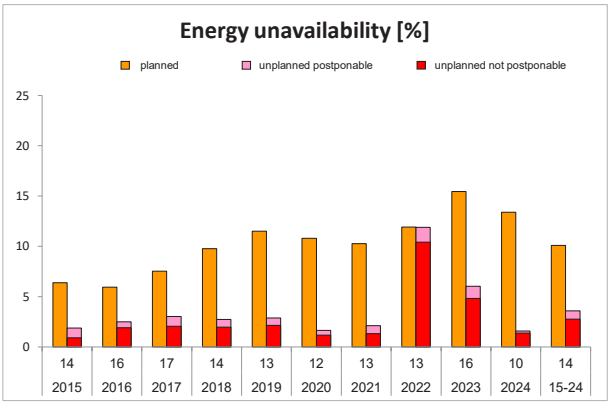
UA = unavailability

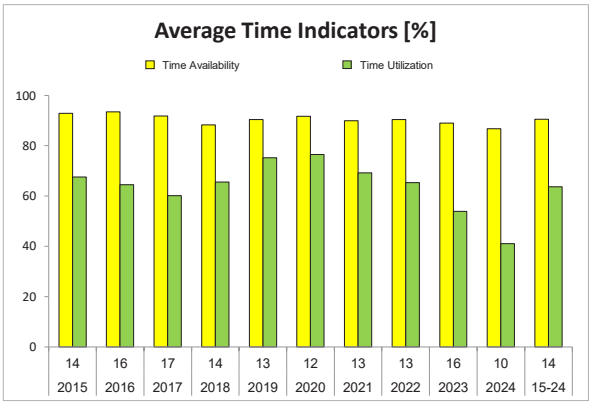
B.1.1 KPI overview of combined cycle units by capacity cluster

B.1.1.2 Combined cycle units, nominal capacity < 200 MW

(25 units, BE, DE, IT, LV, NL)





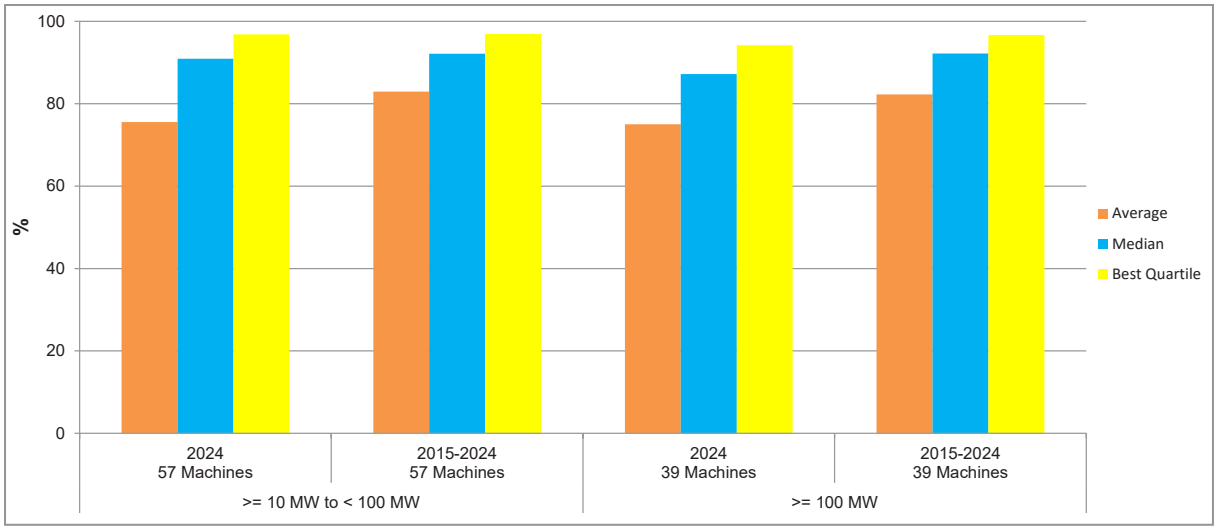


Average values/Quartile values		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	15-24
Number		14	16	17	14	13	12	13	13	16	10	14
Capacity	MW	1,035	1,398	1,475	1,202	1,075	917	1,001	987	1,213	987	1,129
Energy Availability	%	91.7	91.5	89.4	87.5	85.6	87.5	87.6	76.2	78.5	85.0	86.3
worst quartile	%	*91.1*	*85.4*	*81.6*	*80.2*	*86.0*	*89.3*	*84.3*	*83.5*	*77.4*	*83.6*	*84.3*
median	%	*96.6*	*95.0*	*93.1*	*94.1*	*90.4*	*91.1*	*91.5*	*90.1*	*91.4*	*90.2*	*92.1*
best quartile	%	*100.0*	*97.1*	*95.1*	*96.0*	*93.4*	*92.1*	*95.1*	*95.2*	*97.0*	*96.1*	*96.1*
Energy Unavailability	%	8.3	8.5	10.6	12.5	14.4	12.5	12.4	23.8	21.5	15.0	13.7
planned part	%	6.4	5.9	7.5	9.8	11.5	10.8	10.3	11.9	15.5	13.4	10.1
unplanned part	%	1.9	2.5	3.0	2.7	2.9	1.7	2.1	11.9	6.0	1.6	3.6
postponable	%	1.0	0.6	1.0	0.8	0.7	0.5	0.8	1.5	1.2	0.2	0.8
not postponable	%	0.9	1.9	2.0	2.0	2.1	1.2	1.3	10.4	4.8	1.4	2.8
Energy Utilization	%	45.4	45.0	50.2	50.2	55.8	54.1	55.3	47.3	35.0	23.7	46.2
worst quartile	%	*38.1*	*31.3*	*36.8*	*38.2*	*49.1*	*45.9*	*54.3*	*36.0*	*10.4*	*18.3*	*29.7*
median	%	*67.7*	*56.3*	*56.6*	*61.7*	*67.5*	*68.1*	*69.5*	*51.2*	*28.7*	*25.8*	*54.7*
best quartile	%	*86.3*	*72.2*	*72.5*	*88.0*	*74.8*	*77.7*	*80.1*	*71.9*	*47.5*	*34.0*	*76.5*
Time Availability	%	92.9	93.5	91.8	88.4	90.5	91.7	90.0	90.4	89.0	86.8	90.6
worst quartile	%	*91.8*	*91.3*	*91.6*	*80.2*	*86.9*	*89.9*	*84.3*	*89.1*	*85.0*	*83.6*	*89.1*
median	%	*97.2*	*95.3*	*94.1*	*94.6*	*91.4*	*91.8*	*92.8*	*94.4*	*95.4*	*92.6*	*94.3*
best quartile	%	*100.0*	*99.7*	*97.5*	*96.7*	*95.7*	*94.7*	*95.6*	*96.1*	*97.3*	*98.7*	*97.5*
Time Utilization	%	67.6	64.5	60.2	65.6	75.2	76.5	69.2	65.3	54.0	41.1	63.6
worst quartile	%	*24.6*	*40.1*	*32.9*	*54.3*	*73.6*	*69.8*	*65.0*	*58.1*	*13.3*	*26.4*	*42.1*
median	%	*79.6*	*81.9*	*70.4*	*85.0*	*83.0*	*86.6*	*84.2*	*74.8*	*47.2*	*39.3*	*75.4*
best quartile	%	*92.0*	*91.0*	*90.9*	*95.4*	*89.6*	*92.4*	*91.4*	*83.5*	*83.4*	*68.2*	*90.9*

E.1.3 Quartile of PSP by time availability and utilization

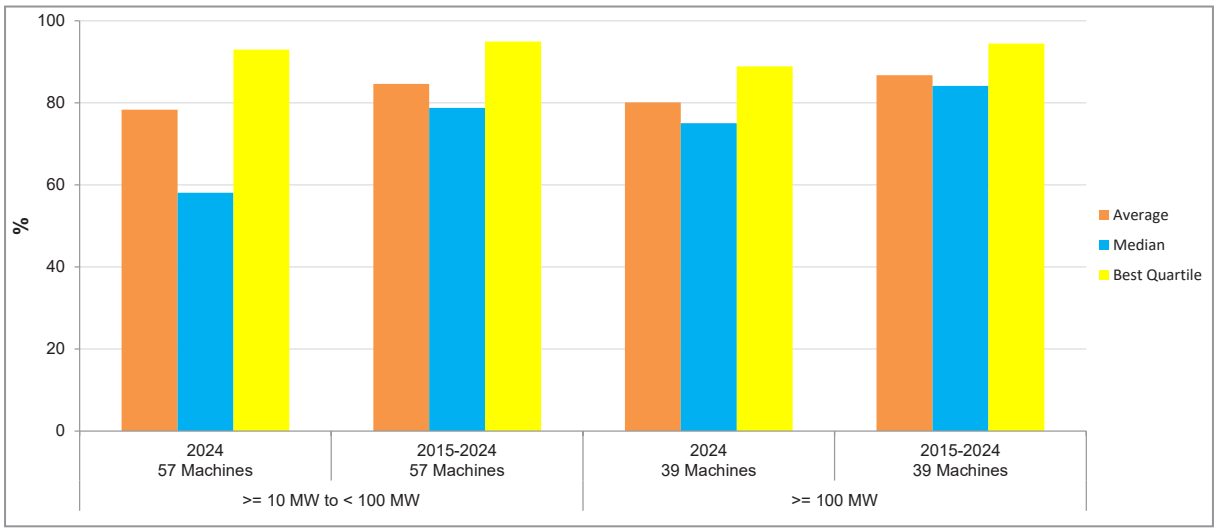
E.1.3.1 Turbines of pumped storage power plants

(96 machine sets, AT, CZ, DE, IE, LU, PT)



E.1.3.2 Pumps of pumped storage power plants

(96 machine sets, AT, CZ, DE, IE, LU, PT)



V. References

– vgbe-Standard Basic Terms of the Electricity and District Heating Industry, VGBE-S-002-01-2024-10-EN, 12th Edition 2024, vgbe energy service GmbH, Essen.

– VGB-Standard Hydropower, VGB-S-002-02-2014-06-EN, 1st Edition 2014, VGB PowerTech Service GmbH, Essen.

– vgbe-Standard Technical and Commercial Key Indicators for Power Plants – incl. EMS Event Characteristic Key System, VGBE-S-002-03-2024-10-EN, 10th Edition 2024, vgbe energy service GmbH, Essen.

– VGB-Standard Annex to VGB-S-002 Series, VGB-S-002-33-2016-08-EN, 1st Edition 2016, VGB PowerTech Service GmbH, Essen.

All listed vgbe/VGB-Standards are also available in German.

Note:

The following original guidelines were revised and taken over in the above vgbe/VGB-Standards:

– VGB-Guideline Availability of Thermal Power Plants – Fundamentals and Determination, VGB-RV 808, 6th Edition 1999.
This edition was published as part of the series
“Begriffe der Versorgungswirtschaft”, Part B, Booklet 3.
VGB PowerTech Service GmbH, Essen, und VWEW-Verlag, Frankfurt (Main).

– VGB-Guideline Analysis of the Unavailability of Thermal Power Plants, VGB-R 140e, 2nd Edition 1999, VGB PowerTech Service GmbH, Essen.

– VGB-Guideline EMS Event-Criterion-Key-System, VGB-B 109, 1st Edition 2003, VGB PowerTech Service GmbH, Essen.

Editor:
vgbe energy e. V.
Deilbachtal 173
45257 Essen
Germany

Publishing house:
vgbe energy service GmbH
Deilbachtal 173
45257 Essen
Germany

t +49 201 8128-0
e sales-media@vgbe.energy

be informed

www.vgbe.energy
www.vgbe.services

ISBN 978-3-96284-412-7 (e-book, English)
ISBN 978-3-96284-411-0 (e-book, German)