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EDITORIAL

Drought of 2026 and Its Impact on Various Forms of Electricity Generation in the Danube Basin

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Abstract

From the confluence of the Lech River with the Danube to the Danube Delta, installed electricity generation capacities of approximately 16.983 GW directly use water from the Danube, namely: 6096.34 MW hydro, 4657.7 MW gas-fired (including one combined heat and power PP fueled primarily by natural gas and hydrogen), 1007 MW coal-fired and 5222 MW nuclear power plants (PPs). As is well known, hydro PPs use water to spin turbines, gas-fired PPs use water to cool and generate steam, coal-fired PPs use water to generate steam, cool equipment, and manage waste, while nuclear PPs use water to cool and generate steam, as well as to moderate fast-moving neutrons. If there is a record-low water level in the river from which the PPs are supplied with water, then the execution of all the processes may be jeopardized and then suspended. This can ultimately cause several successive and widespread electricity blackouts, or a total blackout. Such a water level in the Danube occurred due to a drought and heat waves during the summer of 2026 and endangered the operation of a number of existing PPs along the Danube and its tributaries. Accordingly, this editorial provides an overview of PPs that directly use water from the Danube, as well as some larger PPs that use water from four other rivers of the Danube basin. The overview includes the name, location, installed capacity, energy source and type of PPs, explains why the water in the Danube reached a record-low level in 2026 and highlights some events that could have caused electricity blackouts.

Keywords: electricity blackout, electricity generation, power plant, record-low water level.

1 Introduction

In total, there were over 7000 hydro power plants (PPs) in Germany in 2016, of which a significant number were situated in the Southern federal states of Germany [1]. Gross electricity generation from all these hydro PPs in 2019 corresponded to a share of approx. 3% of the total electricity generation in Germany, and the majority of the hydro PPs belong to the Alpine tributaries of the Danube: Iller, Lech, and Isar [1]. Between the confluence of the Lech River into the Danube and the Germany–Austria border, there are 13 run-of-the-river PPs on the Danube, which have a capacity of approx. 226 MW and generate approx. 1.4 billion kWh of environmentally friendly electricity per year [2]. This is enough to supply approx. 465 thousand private households with electricity and save approx. 805 thousand tons of CO_2 [2]. In Austria, electricity

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is produced in more than 5200 PPs of different types, where approx. 65.7% of electricity comes from hydropower [3]. The large run-of-the-river PPs at Austria's section of the Danube generated 33.7% (13.3 TWh/yr) of the national electricity generation in 2010 [3]. In addition, run-of-the-river PPs at the rivers Inn (4 TWh/yr), Drau (2.9 TWh/yr), Enns (2.2 TWh/yr) and Mur (1.4 TWh/yr), belonging to the hydrographic catchment area of the Danube, make substantial contributions to the total annual electricity generation [3]. Moreover, a particularly high ratio between the length of the river and the number of run-of-the-river PPs can be determined for small- to medium-sized rivers in the Danube basin, such as Alm, Große Isper and Kleine Ybbs [3].

In Slovakia, along the Danube, there are one gas-fired and two run-of-the-river PPs with a total installed capacity of 961.98 MW, which is approx. 15% of the total electricity generation capacity in this country [4]. Furthermore, Hungary does not have any hydro PP on the Danube, but one nuclear and four gas-fired PPs, which use water directly from the Danube, supply more than 50% of its electricity consumption [5, 6]. In Serbia, water from the Danube is directly used by 6 larger PPs, namely: two hydro, two gas-fired, and two coal-fired PPs with a total installed capacity of 2892.5 MW (excluding the shares of Romania in the two hydro PPs) [7, 8]. Specifically, Serbia shares ownership of the hydro PPs Iron Gate I and Iron Gate II with Romania. However, along the river Sava, which is a tributary of the Danube, at 30–50 km from its confluence with the Danube, there are the coal-fired PPs Nikola Tesla A and Nikola Tesla B with a total installed capacity of 3045 MW [7]. Along the Sava, Serbia also has the gas-fired PP Sremska Mitrovica with an installed capacity of 32 MW [7]. Thus, the installed electricity generation capacity of Serbian PPs that use water from the Danube and Sava accounts for 67.3% of the total national capacity [8]. In addition to Iron Gate I and Iron Gate II, Romania's nuclear PP Cernavodă uses water from the Danube for its needs. These three PPs, excluding the shares of Serbia in Iron Gate I and Iron Gate II, generate approx. 40% of the Romanian electricity [9]. At the Danube, Bulgaria has only the nuclear PP Kozloduy generating about 40% of its electricity [10]. Finally, of the ten countries through which the Danube flows, only Croatia, Ukraine and Moldova do not have PPs on this river, although they do have PPs on the Danube tributaries that flow through their territories.

Based on the above review, it follows that the shares of PPs that directly use water from the Danube in the generation of electricity at the national level, in seven out of ten Danube countries, are significant. For Austria, Hungary, Serbia, Romania and Bulgaria, they are approximately equal to or greater than 40%. These national shares would be significantly higher if the electricity generation along the Danube tributaries and other rivers of the Danube basin are taken into account. Therefore, it is evident that any drop of water in the Danube to approximately or below the historical record-low levels can initiate or contribute to an electricity blackout in each of the Danube countries, the Danube basin, the Western Balkans, Central Europe, or all of Europe. In this regard, Section 2 provides a map with the exact locations and two tables with the country, name, installed capacity, energy source and type of PPs that directly use water from the Danube, as well as one table with the same data on some larger PPs that use water from the Jihlava, Dudváh, Sava and Jiu rivers of the Danube basin. In addition, Section 3 describes the drought of 2026 and why the Danube water reached a record-low level and highlights events that may have contributed to or independently initiated electricity blackouts. Finally, Section 4 of this editorial provides readers and potential authors with the most important conclusions and some research challenges.

2 An Overview of the Danube Power Plants

From the Lech River in Germany to the Danube Delta, there are a total of 42 PPs that directly use water from the Danube, namely: 27 hydro, 10 gas-fired, 2 coal-fired and 3 nuclear PPs. The exact locations of these 42 PPs are shown in Figure 1. This figure also shows 8 PPs of larger capacities that use water from the two tributaries of the Danube (Sava and Jiu) and two other rivers of the Danube basin (Jihlava and Dudváh). In Figure 1 and the three following tables, all these PPs are uniquely labeled with ordinal numbers from 1 to 50.

The PPs that directly use water from the Danube are outlined in Tables 1 and 2, while the PPs of larger capacities that use water from the Jihlava, Dudváh, Sava and Jiu rivers (of the Danube basin) are listed in Table 3.

3 Drought and the Most Relevant Events in 2026

The Danube is approximately 2,850–2,860 km long and flows through or forms borders with ten countries. Its drainage basin covers approximately 817,000

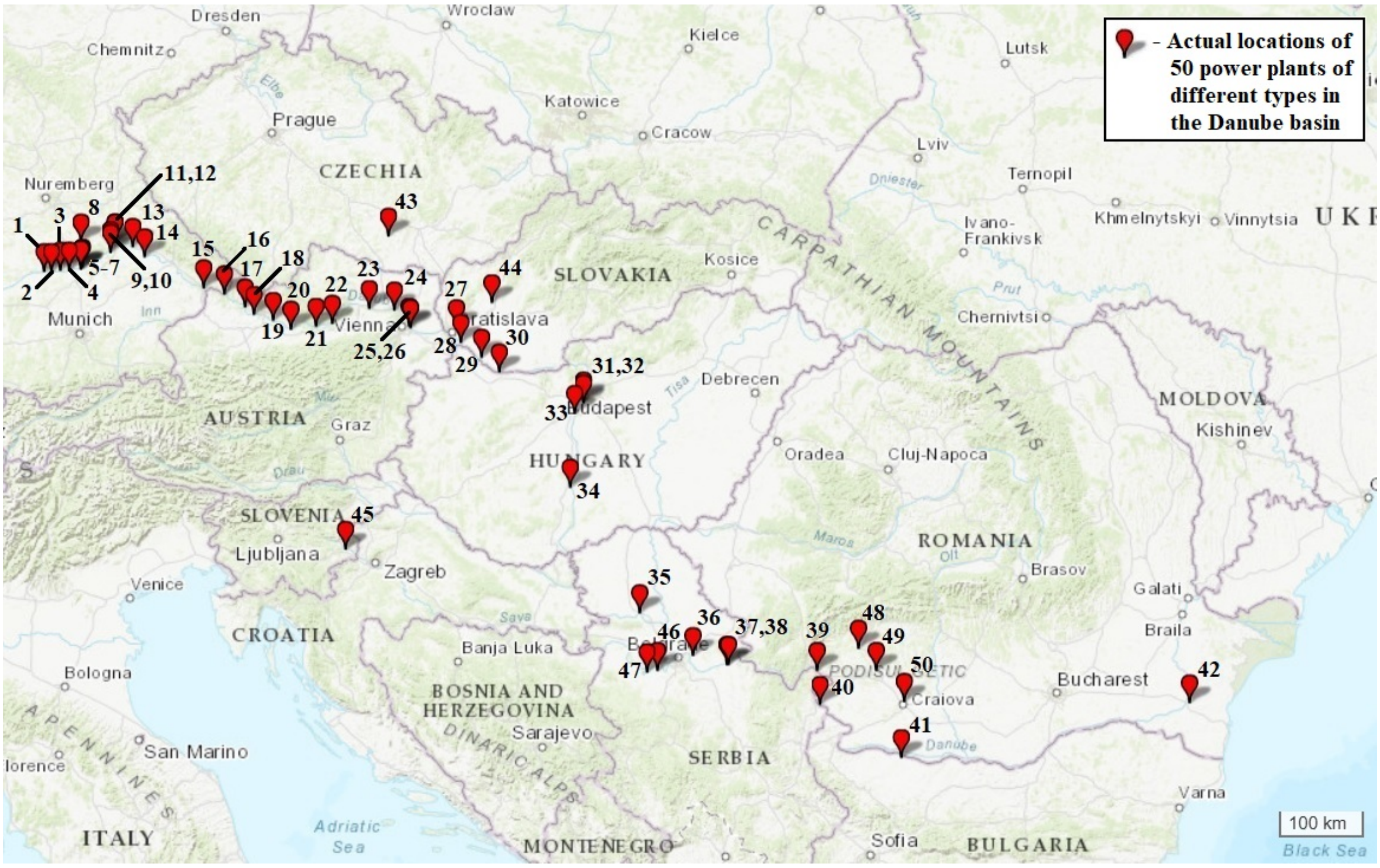

Figure 1. Hydro, gas-fired, coal-fired and nuclear PPs that directly use water from the Danube and four other rivers of the Danube basin. The numbers on this map correspond to the ordinal numbers of PPs in Tables 1, 2 and 3, as well as the accompanying data. The geographical framework of the Austrian Danube PPs follows the hydrographic documentation of the Danube Commission's Joint Statement [20]. This map was created using the GPS Visualizer web-based utility.

km^2, accounting for about 11% of the European continent [46, 47]. Of the whole catchment area of the Danube, 36% is occupied by very high and high mountains (above 4000 m in the Alps, and between 1000 and 2000 m in the Carpathians, the Balkans and the Dinaric Alps), and 64% is occupied by hills, plateaus and plains of medium and low altitudes [46]. The Danube basin is divided into the following three sub-basins: upper, middle and lower, and its average altitude is 475 m [46, 47]. The climatological and hydrological baseline data cited in this section are drawn from the comprehensive catchment-wide datasets compiled in [46, 47] as part of the sediment transport analyses, which necessarily document discharge, precipitation, and snow cover characteristics across the entire Danube basin.

As is known, the climate in the Danube basin is temperate-continental. Climatic factors of the highest importance for the Danube catchment area are represented by rainfalls and snowfalls whose roles are crucial for the formation of water flow in the Danube. The distributions of rainfall and snowfall across the Danube catchment area are unequal. Annual average amounts of precipitation are as follows [46, 47]: from 1800 up to 2500 mm and more in the Alps, about 800–1200 mm in the Carpathians, and about 400–600 mm in lowland areas. The highest amounts of rainfall appear in spring and summer, while the lowest ones appear in autumn and winter. In the mountains, the snowfalls begin in October and end in May. The snow cover is present about 180 days/year in the Alps (reaching about 1.5–2 m in normal winters, and several meters in harsh winters), about 80 days/year in the Carpathians, about 40–50 days/year on the hills, and about 20–30 days/year in the valleys (reaching 20–30 cm) [46, 47]. Opposite phenomena to the rainfall and snowfall are the evaporation and evapotranspiration, which in Danube basin have significant values. In the upper Danube sub-basin, evapotranspiration varies from 100 mm/year (in mountains) to 450 and 650 mm/year (in lowland areas) [46]. According to [46], the average evapotranspiration value in the middle and lower Danube sub-basins reaches approx. 500 mm/year and approx. 400 mm/year, respectively.

Table 1. German, Austrian, Slovak and Hungarian (hydro, gas-fired and nuclear) PPs that directly use water from the Danube downstream from the upper Danube to the Hungary–Serbia border.

Ordinal No. in Figure 1	Country	Power plant				References
		Name	Cap. (MW)	Energy source	Facility / turbine / reactor type	
1	Germany	Bertoldsheim[a]	18.9	Hydro	Run-of-the-river	[2, 11, 12]
2	Germany	Bittenbrunn[a]	20.2	Hydro	Run-of-the-river	[2, 11, 12]
3	Germany	Bergheim[a]	23.7	Hydro	Run-of-the-river	[2, 11, 12]
4	Germany	Ingolstadt[a]	19.8	Hydro	Run-of-the-river	[2, 11, 12]
5	Germany	Irsching 4	561	Natural gas	Combined-cycle	[13]
6	Germany	Irsching 5	846	Natural gas	Combined-cycle	[13]
7	Germany	Vohburg[a]	23.3	Hydro	Run-of-the-river	[2, 11, 14]
8	Germany	TW Dietfurt[b,c]	0.51	Hydro	Run-of-the-river	[2, 11, 15]
9	Germany	Bad Abbach	6.5	Hydro	Run-of-the-river	[2, 11, 16]
10	Germany	TW Abbach[a,c]	3.5	Hydro	Run-of-the-river	[2, 11, 17]
11	Germany	Regensburg	7.2	Hydro	Run-of-the-river	[2, 11, 18, 19]
12	Germany	TW Regensburg[c]	2.25	Hydro	Run-of-the-river	[2, 11, 18, 19]
13	Germany	Geisling	25	Hydro	Run-of-the-river	[2, 11, 12]
14	Germany	Straubing	21.5	Hydro	Run-of-the-river	[2, 11, 12]
15	Germany–Austria	Kachlet	53.7	Hydro	Run-of-the-river	[2, 11, 12, 20, 21]
16	Austria	Jochenstein	132	Hydro	Run-of-the-river	[20, 22]
17	Austria	Aschach	324	Hydro	Run-of-the-river	[20, 23]
18	Austria	Ottensheim-Wilhering	179	Hydro	Run-of-the-river	[20, 23]
19	Austria	Abwinden-Asten	168	Hydro	Run-of-the-river	[20, 23]
20	Austria	Wallsee-Mitterkirchen	210	Hydro	Run-of-the-river	[20, 23]
21	Austria	Ybbs-Persenbeug	236	Hydro	Run-of-the-river	[20, 23]
22	Austria	Melk	187	Hydro	Run-of-the-river	[20, 23]
23	Austria	Altenwörth	328	Hydro	Run-of-the-river	[20, 23]
24	Austria	Greifenstein	293	Hydro	Run-of-the-river	[20, 23]
25	Austria	Donaustadt	790	Natural gas and hydrogen	Combined heat and power	[24]
26	Austria	Freudenau	172	Hydro	Run-of-the-river	[20, 23]
27	Slovakia	Bratislava	217.7	Natural gas	Combined-cycle	[25]
28	Slovakia	Čunovo	24.28	Hydro	Run-of-the-river	[26]
29	Slovakia	Gabčíkovo	720	Hydro	Run-of-the-river	[26]
30	Hungary	Gönyű	433	Natural gas	Combined-cycle	[27, 28]
31	Hungary	Kelenföld	178	Natural gas	Combined-cycle	[27, 29]
32	Hungary	Csepel	401	Natural gas	Combined-cycle	[27, 30]
33	Hungary	Dunamenti	794	Natural gas	Combined-cycle	[27, 31]
34	Hungary	Paks	1916	Nuclear fuel	Pressurized water reactor VVER-440, fission	[27, 32]

[a] These run-of-the-river PPs generate traction current with a frequency of 16.7 Hz [2, 11].
[b] Hydro PP situated on the Main–Danube Canal.
[c] The abbreviation TW stands for the German term "Triebwerk" which can be translated in English as "power unit" or "engine". TW Regensburg is also known as Wasserkraftwerk Pfaffenstein.

Based on the given data, it is obvious that the water flow of the Danube depends on inflows from its tributaries, annual precipitation, the duration and extent of snow cover on very high and high mountains (the Alps, the Carpathians, etc.), evaporation (from surfaces without vegetation) and evapotranspiration (from surfaces with vegetation). Further, the generation of electricity in PPs of different types that directly use water from the Danube depends on its water flow characterized by the water level and the water discharge. According to [1, 46, 49, 50], the multiannual average water discharges of the Danube at a number of its gauges are as follows (discharge values at the Bogojevo and Belgrade gauges in Serbia are drawn from the baseline hydrological data compiled in [48] for the strategic environmental assessment of the Serbian Danube corridor):

1. 12.8 m^3/s at Kirchen-Hausen, approx. 24 km from the source of the Danube, in Germany,
2. 332 m^3/s at Kelheim, near the confluence with the Main–Danube Canal, in Germany,
3. 1430 m^3/s at Achleiten, near the Germany–Austria border,
4. 1921–1943 m^3/s at Wien, the gauge Korneuburg, in Austria,
5. 2020–2052 m^3/s at Bratislava Devin, in Slovakia,
6. 2462 m^3/s at Budapest, in Hungary,
7. 2429 m^3/s at Paks, in Hungary,
8. 2389 m^3/s at Mohács, in Hungary,
9. 3060 m^3/s at Bogojevo, in Serbia,
10. 5350 m^3/s at Belgrade, in Serbia,

Table 2. Serbian, Romanian and Bulgarian (hydro, gas-fired, coal-fired and nuclear) PPs that directly use water from the Danube downstream from the Hungary–Serbia border to the Danube Delta where the Danube flows into the Black Sea.

Ordinal No. in Figure 1	Country	Power plant				References
		Name	Cap. (MW)	Energy source	Facility / turbine / reactor type	
35	Serbia	Novi Sad	245	Natural gas	Steam	[7, 33]
36	Serbia	Pančevo	192	Natural gas	Combined heat and power	[7]
37	Serbia	Kostolac A	310	Lignite	Subcritical	[7, 34]
38	Serbia	Kostolac B	697	Lignite	Subcritical and supercritical	[7, 34]
39	Serbia and Romania	Iron Gate I	2306	Hydro	Run-of-the-river	[35]
40	Serbia and Romania	Iron Gate II	591	Hydro	Run-of-the-river	[36]
41	Bulgaria	Kozloduy	2006	Nuclear fuel	Pressurized water reactor VVER V-320	[10, 37]
42	Romania	Cernavodă	1300	Nuclear fuel	Pressurized heavy water reactor	[9, 38]

Table 3. Some Czech, Slovak, Slovenian, Serbian and Romanian (gas-fired, coal-fired and nuclear) PPs of larger capacities that use water from the two tributaries of the Danube and two other rivers of the Danube basin.

Ordinal No. in Figure 1	Country / River	Power plant				References
		Name	Cap. (MW)	Energy source	Facility / turbine / reactor type	
43	Czech Republic / Jihlava[a]	Dukovany	1878	Nuclear fuel	Pressurized water reactor	[39]
44	Slovakia / Dudváh[a]	Malženice	436	Natural gas	Combined-cycle	[40]
45	Slovenia and Croatia / Sava[b]	Krško	696	Nuclear fuel	Pressurized water reactor	[41]
46	Serbia / Sava	Nikola Tesla A	1745	Lignite	Subcritical	[7, 42]
47	Serbia / Sava	Nikola Tesla B	1300	Lignite	Subcritical	[7, 42]
48	Romania / Jiu[b]	Rovinari	990	Lignite	Subcritical	[43]
49	Romania / Jiu	Turceni	660	Lignite	Subcritical	[44]
50	Romania / Jiu	Craiova II	300	Lignite	Subcritical	[45]

[a] Rivers of the Danube basin that are not tributaries of the Danube.
[b] Tributaries of the Danube.

11. 5551–5558 m^3/s at Baziaş, where the Danube enters Romania,
12. 5636–5656 m^3/s at Calafat, in Romania,
13. 6011–6190 m^3/s at Giurgiu, in Romania,
14. 6551 m^3/s at Reni, in Ukraine, and
15. 6500–6750 m^3/s at Isaccea and Ceatal Izmail, in Romania.

At the same or the closest gauges, on August 28, 29 and 30, 2026, the following Danube discharges (that is, current river discharges) were measured:

1. 0.0687 m^3/s at Möhringen-Espenbrücke, approx. 33 km from the source of the Danube, on August 30, 2026, at noon,
2. 116 m^3/s at Kelheim, near the confluence with the Main–Danube Canal, on August 30, 2026, at noon,
3. 561 m^3/s at Achleiten, near the Germany–Austria border, on August 30, 2026, at noon,
4. 771 m^3/s at Wien, the gauge Korneuburg, on August 30, 2026, at noon,
5. 780 m^3/s at Bratislava Devin, on August 30, 2026, at noon,
6. 865 m^3/s at Budapest, on August 30, 2026, at noon,
7. 903.7 m^3/s at Paks, on August 30, 2026, at noon,
8. 828.8 m^3/s at Mohács, on August 30, 2026, at noon,
9. 1080 m^3/s at Bogojevo, on August 30, 2026, at noon,
10. 1485.7 m^3/s at Belgrade, on August 29, 2026, at 05:00 AM,
11. 1550 m^3/s at Baziaş, where the Danube enters Romania, on August 29, 2026, at 05:00 AM,
12. 1510 m^3/s at Calafat, on August 29, 2026, at 05:00 AM,
13. 1450 m^3/s at Giurgiu, on August 29, 2026, at 05:00 AM,
14. 2140 m^3/s at Reni, on August 29, 2026, at 07:00 AM, and
15. 2150 m^3/s at Isaccea, on August 28, 2026, at 05:00 AM.

The current river discharges measured on August 28, 29 and 30, 2026 are taken from or estimated using the Danube Hydrological Information System (i.e., DanubeHIS). Specifically, DanubeHIS is a web-based central platform developed by the International Commission for the Protection of the Danube River (ICPDR) for testing data exchange and providing hydrological and meteorological data. If the current

Figure 2. Danube at Gardoš in Serbia, near the gauge Zemun, on August 9, 2026.

river discharges of the Danube are compared with the corresponding multiannual average water discharges, it can be concluded that the drought of 2026, downstream of the Main–Danube Canal, reduced the water flow along the Danube to approximately one quarter to one third of the multiannual average, with greater reductions observed in the lower Danube reaches. For the water flow of the Danube upstream of the Main–Danube Canal, the situation regarding the flow is more critical. The current discharge of the Danube at the gauge Möhringen-Espenbrücke is very low, primarily due to a unique geological phenomenon known as the Danube Sinkhole (or Danube Seepage), and secondly, due to the drought of 2026. This situation has also been confirmed by numerous photographs from the scene, as well as acquired satellite images of the Danube [51]. For instance, Figure 2 shows visible parts of the Danube riverbed with and without vegetation at Gardoš in Serbia, near the gauge Zemun, on August 9, 2026.

How the drought of 2026 affected the rivers of the Danube basin in Table 3 can best be shown by comparing their current discharges with the corresponding multiannual average water discharges. In this regard, the multiannual average water discharges of the Jihlava, Dudváh, Sava and Jiu rivers are as follows [52–55]:

1. 4.6 m^3/s for the Jihlava River at the gauge Mohelno, in the Czech Republic, near the nuclear PP Dukovany,
2. 0.916 m^3/s for the Dudváh River at the gauge Čierny Brod, in Slovakia, near the gas-fired PP Malženice,
3. 275.9 m^3/s for the Sava River at the gauge Čatež I, in Slovenia, near the nuclear PP Krško,
4. 1521.7 m^3/s for the Sava River at the gauge Sremska Mitrovica, in Serbia, near the gas-fired PP Sremska Mitrovica, and
5. 88.3 m^3/s for the Jiu River at the gauge Podari, in Romania, near the coal-fired PP Craiova II.

At the same gauges, on August 29 and 30, 2026, the following current discharges or water levels of the Jihlava, Dudváh, Sava and Jiu rivers were measured:

1. A current river discharge of 1.33 m^3/s at the gauge Mohelno, in the Czech Republic, on August 30, 2026, at noon,
2. A current water level of 32 cm at the gauge Čierny Brod, in Slovakia, on August 30, 2026, at noon,
3. A current river discharge of 56.9 m^3/s at the gauge Čatež I, in Slovenia, on August 30, 2026, at noon,
4. A current river discharge of 394 m^3/s at the gauge Sremska Mitrovica, in Serbia, on August 30, 2026, at noon, and
5. A current river discharge of 14.6 m^3/s at the gauge Podari, in Romania, on August 29, 2026, at 05:00 AM.

The current river discharges of the Jihlava, Sava and Jiu rivers and the current water level of the Dudváh river are taken from [56, 57] and DanubeHIS. For the Jihlava, Sava and Jiu rivers, it was shown that the current river discharges fell to 16.5–28.9% of the corresponding multiannual average water discharges. The official value for the current river discharge of the Dudváh was not found, but for this river, according to [53], the average monthly river flow for the month of August and the extreme river flow are 0.589 m^3/s and 0 m^3/s, respectively. In particular, the Dudváh did not dry up during the summer of 2026 and it can be assumed that its current river discharge did not decrease more (in percentage terms) than the flows of other rivers in the Danube basin. The current states of the considered watercourses of the Jihlava, Dudváh, Sava and Jiu rivers, along which there are PPs with a total installed capacity of 8.005 GW, are no different from the state of the Danube itself and can also be regarded as critical from the aspect of electricity generation.

Regarding the drought of 2026 and its impact on the generation of electricity in the Danube basin, this editorial was written during the summer of 2026, while the drought was ongoing. The most relevant events in 2025 and 2026 that can be linked to the reduction in the Danube flow and its impact on the generation of electricity, as well as potential electricity blackouts, are as follows:

- During the 2025/2026 winter the Alpine region experienced one of their driest and least-snowy seasons in over 30 years. According to joint assessments by the meteorological agencies German Weather Service, GeoSphere Austria, and MeteoSwiss, snow depths across the DACH (Germany, Austria and Switzerland) Alpine region during the 2025/2026 winter half-year ranked among the five lowest since 1991 [58]. The winter half-year was characterized by very low precipitation, high sunshine levels, and temperatures averaging about 1.1 °C above the 1991–2020 climate average [58].
- The Carpathians experienced a historically delayed start to the winter and below-average snowfall at lower altitudes; however, significant snow cover did eventually accumulate across the mountain region, especially in high-elevation zones. For instance, by mid-to-late December 2025, the Ukrainian Carpathians had virtually no natural snow cover [59]. In addition, the high-elevation zones of the Carpathians maintained their temporal stability, keeping a consistent snow cover despite reductions at lower altitudes [60]. Finally, the winter weather extended well into spring [60].
- At the nuclear PP Cernavodă, Unit 1 was preventively shut down on July 28, 2026, while Unit 2 was shut down on August 13, 2026, bringing Romania's nuclear generation capacity to zero [61, 62].
- In early August 2026, the Hungarian nuclear PP Paks was forced to cut output to just over 10% (with only one turbine left operating), barely escaping a full shutdown [63]. According to [63, 64], two turbines of the nuclear PP Paks were returned into the grid by August 10, 2026, while three of the plant's four reactor units were returned to full operating capacity on August 24, 2026.
- The Bulgarian nuclear PP Kozloduy has reduced output from its Unit 5 from 1003 MW to around 850 MW (i.e., by about 15%) on August 21, 2026 [65, 66].
- In the second half of August 2026, to compensate for lost electricity generation at its only nuclear PP, Romania reactivated a 300 MW coal-fired unit at the coal-fired PP Rovinari and decided to temporarily extend the operation of the coal-fired PPs Turceni and Craiova II (whose shutdown was to be completed by August 31, 2026, as part of Romania's National Recovery and Resilience Plan) [67, 68].
- The nuclear PP Krško, which uses water from the Sava, reduced its power output to 80% on August 6, 2026 [69].
- The 468 MW Unit 3 of the Czech nuclear PP Dukovany has been off-grid since mid-July 2026 for partial refueling, diagnostic tests and other investment projects, while the planned outage and modernization of the 471 MW Unit 4 of this nuclear PP began on August 1, 2026 [70, 71]. The joint outage of the two units is expected to last approximately one month, and Unit 3 is expected to return to operation at the end of September 2026 [70, 71].
- According to [72, 73], the hydro PPs Iron Gate I and Iron Gate II are currently generating only 20% and 30% of their average electricity outputs, respectively.
- Some units of the coal-fired PPs Kostolac A and Kostolac B have reduced their outputs by approximately one-third [72, 73].
- At present, only one of eight turbines of the Slovak hydro PP Gabčíkovo is in operation [72]. However, electricity generation in this hydro PP is only about 12% lower compared to the same time previous year [72].
- The gas-fired PP Pančevo and the adjacent Pančevo Oil Refinery (which this PP supplies with hot water and technological steam) faced severe operational difficulties related to physical water intake from the Danube [74].
- Although the current discharge of the Sava has dropped to 25.9% (at the gauge Sremska Mitrovica) of the corresponding multiannual average water discharge, the coal-fired PPs Nikola Tesla A and Nikola Tesla B (with a total installed capacity of 3045 MW) had no problems with physical water intake from the Sava [73, 74].
- Austria generates more than 60% of its electricity from various types of hydro PPs and has obviously been less affected by the drought of 2026 than some other Danube countries. According to [72], one reason for this is a significant share of storage and pumped-storage facilities in the Austrian hydro electricity generation.

4 Conclusion

Based on the review and analysis of technical data on various PPs that directly use water from the Danube and some other rivers from the Danube basin, meteorological data on precipitation in the Danube basin, and the most relevant events in 2025 and 2026, the following most important conclusions can be drawn:

- Based on the duration of snow cover and the very low precipitation in the Alps and the Carpathians during the 2025/2026 winter, it was possible to predict even before the start of summer that 2026 could be potentially very dry, that the Danube may lose a significant amount of water, that the Danube tributaries from the Alpine region may have less water than those from the Carpathian region, and that PPs that directly use water from the Danube may face serious operational difficulties. In this regard, correct forecasting of the situation could help reduce the negative impact of the current drought on the generation of electricity in the Danube basin.
- The drought of 2026 had a negative impact on a number of various PPs that directly use water from the Danube. In other words, the negative impact of low river flows on the generation of electricity in any PP that uses river water does not depend on the type of facility, turbine or nuclear reactor in the PP.
- Some large PPs that directly use water from the Danube and other rivers in the Danube basin did not reduce the generation of electricity during the current drought, which means that they did not have difficulties with physical water intake when river water levels were low. Accordingly, it is obvious that the existing water intake facilities at some PPs are not adapted to record-low water levels and must be redesigned and structurally repaired.
- Storage and pumped-storage hydro PPs on the Danube tributaries and other rivers of the Danube basin during this and previous droughts retained significant amounts of water in their reservoirs and directly affected the level of water in the Danube itself and the generation of electricity at PPs along the Danube. This issue could be solved by a convention or an agreement between all the countries of the Danube basin.
- To compensate for lost electricity generation from hydropower, nuclear fuels, or natural gas, some Danube countries with recently retired or currently operating coal-fired PPs may decide to deviate from their national green energy strategies, and reactivate, increase, or continue the use of coal, increasing greenhouse gas (GHG) emissions.
- Planned outages and modernization of large PPs in the Danube basin countries that are only slightly influenced by the current drought may negatively affect the neighboring electricity markets, as well as contribute to or independently initiate different electricity blackouts. Accordingly, such planned outages and modernization of large PPs should not be carried out in the summer months when the negative impacts of a drought are most pronounced.

In addition to these conclusions, potential authors might find it interesting to analyze the following challenging issues:

- Predicting future droughts based on precipitation and the duration of snow cover in the mountains of the Danube basin during the winter half-year and preventing their negative impacts on electricity generation in PPs that directly use water from the Danube.
- What are the water levels in the river impoundments at storage and pumped-storage hydro PPs on the Danube tributaries and other rivers of the Danube basin that could provide a balanced electricity generation along the Danube during a drought?
- Designing water intake facilities for PPs of various types that would be able to operate effectively and efficiently at record-low water levels in the rivers.
- Defining environmental and operating conditions under which an official national green energy strategy may only be deviated from.
- Analyzing conditions, consequences, prevention options and necessary actions related to electricity outages that could have occurred due to this or any previous drought.

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Conflicts of Interest

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AI Use Statement

The author declares that no generative AI was used in the preparation of this manuscript.

Ethical Approval and Consent to Participate

Not applicable.

References

[1] ICPDR.org. (2026, August 30). *Danube Facts and Figures: Germany*. Retrieved from https://www.icpdr.org/sites/default/files/2024-01/Germany%20Facts%20%26%20Figures_0.pdf

[2] Uniper.Energy. (2026, August 30). *Overview of the power plants within the Danube hydropower group*. Retrieved from https://www.uniper.energy/germany/hydropower-germany/danube-hydropower-group

[3] Wagner, B., Hauer, C., Schoder, A., & Habersack, H. (2015). A review of hydropower in Austria: Past, present and future development. *Renewable and Sustainable Energy Reviews*, *50*, 304-314. [CrossRef]

[4] Database.Earth. (2026, August 30). *Power Plants in SK Slovakia*. Retrieved from https://database.earth/energy/power-plants/slovakia

[5] Karácsony, P., & Garibli, E. A. (2023). Overview of the Hungarian energy sector. *SOCAR Proceedings*, *2*, 168-174. https://avesis.unec.edu.az/yayin/7d68f72d-b48e-4aa5-a063-2c067054ca07/overview-of-the-hungarian-energy-sector-and-policy/document.pdf

[6] World Nuclear Association. (2026, August 24). *Country profiles: Nuclear power in Hungary*. Retrieved from https://world-nuclear.org/information-library/country-profiles/countries-g-n/hungary

[7] Klimenta, D., Mihajlović, M., Ristić, I., & Andriukaitis, D. (2022). Possible scenarios for reduction of carbon dioxide emissions in Serbia by generating electricity from natural gas. *Energies*, *15*(13), 4792. [CrossRef]

[8] Energy Agency of the Republic of Serbia (AERS). (2026). *2025 Energy Agency Annual Report* (in Serbian). Retrieved from https://www.aers.rs/media/FILES/Izvestaji/Godisnji/Izvestaj%20Agencije%202025.pdf

[9] World Nuclear Association. (2026, August 13). *Country profiles: Nuclear power in Romania*. Retrieved from https://world-nuclear.org/information-library/country-profiles/countries-o-s/romania

[10] World Nuclear Association. (2026, February 17). *Country profiles: Nuclear power in Bulgaria*. Retrieved from https://world-nuclear.org/information-library/country-profiles/countries-a-f/bulgaria

[11] Uniper.Energy. (2026, August 30). *Kraftwerksgruppe Donau der Uniper Wasserkraft in Deutschland: Informationen - Hintergründe - Ansprechpartner*. Retrieved from https://www.uniper.energy/media/1407/download?inline

[12] Database.Earth. (2026, August 30). *Hydro power plants in DE Germany*. Retrieved from https://database.earth/energy/power-plants/hydro-power/germany

[13] Uniper.Energy. (2026, August 30). *Irsching*. Retrieved from https://www.uniper.energy/de/deutschland/kraftwerke-deutschland/irsching

[14] Openinframap.org. (2026, August 30). *Laufwasserkraftwerk Vohburg*. Retrieved from https://openinframap.org/stats/area/Germany/plants/63528480

[15] Openinframap.org. (2026, August 30). *Wasserkraftwerk Dietfurt*. Retrieved from https://openinframap.org/stats/area/Germany/plants/174389680

[16] Openinframap.org. (2026, August 30). *Wasserkraftwerk Bad Abbach*. Retrieved from https://openinframap.org/stats/area/Germany/plants/37972492

[17] Openinframap.org. (2026, August 30). *Bahnstromkraftwerk Bad Abbach*. Retrieved from https://openinframap.org/stats/area/Germany/plants/171965647

[18] Openinframap.org. (2026, August 30). *Laufwasserkraftwerk Regensburg*. Retrieved from https://openinframap.org/stats/area/Germany/plants/60196427

[19] Klimaschutzweg-Regensburg.de. (2026, August 30). *Wasserkraftwerk Pfaffenstein*. Retrieved from https://www.klimaschutzweg-regensburg.de/wasserkraftwerk-pfaffenstein.html

[20] Habersack H. Current status and future requirements in education and training of engineers. In: *The 13th Follow-up Meeting of the Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube Region; 2022 Sep 14-15*. Available at https://www.danubecommission.org/uploads/doc/2022/JS_presentations/Helmut_Habersack_Joint_statement_meeting_2022.pdf

[21] Gem.Wiki. (2026, August 30). *Kachlet hydroelectric plant*. Retrieved from https://www.gem.wiki/Kachlet_hydroelectric_plant

[22] Gem.Wiki. (2026, August 30). *Jochenstein hydroelectric plant*. Retrieved from https://www.gem.wiki/Jochenstein_hydroelectric_plant

[23] Openinframap.org. (2026, August 30). *Austria - Power Plants*. Retrieved from https://openinframap.org/stats/area/Austria/plants

[24] Gem.Wiki. (2026, August 30). *Donaustadt power station*. Retrieved from https://www.gem.wiki/Donaustadt_power_station

[25] PowerTechnology. (2026, August 30). *Power plant profile: Bratislava Combined Cycle Power Plant, Slovakia*.

Retrieved from https://www.power-technology.com/data-insights/power-plant-profile-bratislava-combined-cycle-power-plant-slovakia/

[26] Krištof, V., Kušnír, S., Katin, M., Csányi, L., & Marci, M. (2010). Hydro power plants in Slovak Republic. In *Intensive Programme "Renewable Energy Sources"*, Železná Ruda-Špičák, University of West Bohemia, Czech Republic (pp. 30-34). Retrieved from https://naos-be.zcu.cz/server/api/core/bitstreams/efe38bad-17ea-45e1-83c1-e694e5597d2c/content

[27] Openinframap.org. (2026, August 30). *Hungary - Power Plants*. Retrieved from https://openinframap.org/stats/area/Hungary/plants

[28] Gem.Wiki. (2026, August 30). *Gönyűi power station*. Retrieved from https://www.gem.wiki/G%C3%B6ny%C5%B1i_power_station

[29] Gem.Wiki. (2026, August 30). *Kelenföldi Erőmű power station*. Retrieved from https://www.gem.wiki/Kelenf%C3%B6ldi_Er%C5%91m%C5%B1_power_station

[30] Gem.Wiki. (2026, August 30). *Csepel power station*. Retrieved from https://www.gem.wiki/Csepel_power_station

[31] Gem.Wiki. (2026, August 30). *Dunamenti power station*. Retrieved from https://www.gem.wiki/Dunamenti_power_station

[32] World Nuclear Association. (2025, August 31). *Hungary - World Nuclear Performance Report*. Retrieved from https://world-nuclear.org/our-association/publications/world-nuclear-performance-report/hungary-world-nuclear-performance-report

[33] Gem.Wiki. (2026, August 30). *Novi Sad power station*. Retrieved from https://www.gem.wiki/Novi_Sad_power_station

[34] Gem.Wiki. (2026, August 30). *Kostolac power station*. Retrieved from https://www.gem.wiki/Kostolac_power_station

[35] Gem.Wiki. (2026, August 30). *Iron Gate I hydroelectric plant*. Retrieved from https://www.gem.wiki/Iron_Gate_I_hydroelectric_plant

[36] Gem.Wiki. (2026, August 30). *Iron Gate II hydroelectric plant*. Retrieved from https://www.gem.wiki/Iron_Gate_II_hydroelectric_plant

[37] Gem.Wiki. (2026, August 30). *Kozloduy nuclear power plant*. Retrieved from https://www.gem.wiki/Kozloduy_nuclear_power_plant

[38] Gem.Wiki. (2026, August 30). *Cernavodă nuclear power plant*. Retrieved from https://www.gem.wiki/Cernavod%C4%83_nuclear_power_plant

[39] Gem.Wiki. (2026, August 30). *Dukovany nuclear power plant*. Retrieved from https://www.gem.wiki/Dukovany_nuclear_power_plant

[40] Gem.Wiki. (2026, August 30). *Malženice power station*. Retrieved from https://www.gem.wiki/Mal%C5%BEenice_power_station

[41] World Nuclear Association. (2026, August 17). *Country profiles: Nuclear power in Slovenia*. Retrieved from https://world-nuclear.org/information-library/country-profiles/countries-o-s/slovenia

[42] Gem.Wiki. (2026, August 30). *Nikola Tesla power station*. Retrieved from https://www.gem.wiki/Nikola_Tesla_power_station

[43] Gem.Wiki. (2026, August 30). *Rovinari power station*. Retrieved from https://www.gem.wiki/Rovinari_power_station

[44] Gem.Wiki. (2026, August 30). *Turceni power station*. Retrieved from https://www.gem.wiki/Turceni_power_station

[45] Gem.Wiki. (2026, August 30). *Craiova II power station*. Retrieved from https://www.gem.wiki/Craiova_II_power_station

[46] Bondar, C., & Iordache, G. (2016). Sediment transport on the Romanian section of the Danube River. *Geo-Eco-Marina*, 22, 29-49. Available at https://www.geoecomar.ro/website/publicatii/Nr.22-2016/02_BONDAR_2016.pdf

[47] Bondar, C., & Iordache, G. (2017). Sediment transport on the Danube River in the Romanian border area - Characteristics. *Romanian Journal of Geography, 61*(1), 3-17. https://www.researchgate.net/publication/319354524

[48] Josimović, B., Nenković-Riznić, M., & Milijić, S. (2016). Strategic environmental assessment as an instrument for sustainable development of the Danube Corridor through Serbia. *Energy and Environment Research, 6*(1), 1-10. [CrossRef]

[49] Pekárová, P., Mészáros, J., Miklánek, P., Pekár, J., Prohaska, S., & Ilić, A. (2021). Long-term runoff variability analysis of rivers in the Danube basin. *Acta Horticulturae et Regiotecturae, 24*(s1), 37-44. [CrossRef]

[50] Martin Santos, I., Herrnegger, M., & Holzmann, H. (2021). Seasonal discharge forecasting for the Upper Danube. *Journal of Hydrology: Regional Studies, 37*, 100905. [CrossRef]

[51] The European Space Agency (ESA). (2026, August 30). *Danube's waters fall to record lows*. Retrieved from https://www.esa.int/ESA_Multimedia/Images/2026/08/Danube_s_waters_fall_to_record_lows

[52] Povodí Moravy, státní podnik. (2026, August 30). *Levels and flows on watercourses (overview page)*. Retrieved from https://sap.pmo.cz/portal/Sap/en/pc/Prehled.aspx?data=1

[53] Slovenský hydrometeorologický ústav. (2020). Hydrologická ročenka: Povrchové vody 2019 [Hydrological yearbook: Surface waters 2019]. Retrieved from https://www.shmu.sk/File/Hydrologia/Monitoring_PV_PzV/Monitoring_kvantity_PV/PVkvant2019/Hydrologicka_rocenka_PV_2019.pdf

[54] Leščešen, I., Gnjato, S., Galinović, I., & Basarin, B. (2024). Hydrological drought assessment of the Sava River basin in South-Eastern Europe. *Journal of Water and Climate Change, 15*(8), 3902-3918. [CrossRef]

[55] Ionuş, O. (2014). Preliminary data on the Jiu River

meanders in the lower course (South West Romania). *Forum geografic. Studii şi cercetări de geografie şi protecţia mediului, 13*(1), 18-24. https://forumgeografic.ro/wp-content/uploads/2014/1/Ionus.pdf
[56] Povodí Moravy, státní podnik. (2026, August 30). *Levels and flows on watercourses (station measurement)*. Retrieved from https://sap.pmo.cz/portal/SaP/en/pc/Mereni.aspx?id=067&oid=2
[57] Slovak Hydrometeorological Institute (SHMÚ). (2026, August 30). *Aktuálna situácia na vodných tokoch.* Retrieved from https://www.shmu.sk/en//?page=1&id=hydro_vod_all&station_id=5270
[58] GeoSphere Austria. (2026, June 3). *Alpine climate: Review of the 2025/26 winter half-year.* Retrieved from https://www.geosphere.at/en/news-and-events/news/alpine-climate-review-of-the-2025-26-winter-half-year
[59] EcoPolitic. (2025, December 25). *Global warming has disrupted the ski season in the Ukrainian Carpathians.* Retrieved from https://ecopolitic.com.ua/en/news/global-warming-has-disrupted-the-ski-season-in-the-ukrainian-carpathians/
[60] UNN. (2026, March 19). *Winter has returned to the Carpathians - snow and 8-degree frost in the highlands.* Retrieved from https://unn.ua/en/news/winter-has-returned-to-the-carpathians-snow-and-8-degree-frost-in-the-highlands
[61] CEENERGYNEWS.com. (2026, July 28). *Romania's Cernavoda Unit 1 shuts down.* Retrieved from https://ceenergynews.com/nuclear/cernavoda-unit-1-shut-down/
[62] BBC. (2026, August 13). *Romania shuts only nuclear plant as heat causes huge drop in Danube River level.* Retrieved from https://www.bbc.com/news/articles/cqlxpq5q799o
[63] Reuters. (2026, August 23). *Hungary Paks nuclear plant could operate at full capacity by Wednesday, PM Magyar says.* Retrieved from https://www.reuters.com/business/energy/hungary-paks-nuclear-plant-could-operate-full-capacity-by-wednesday-pm-magyar-2026-08-23/
[64] XINHUANET.com. (2026, August 27). *Hungary's Paks nuclear power plant returns to full capacity.* Retrieved from https://english.news.cn/20260827/69d83c5a38cb43fe9081f2e48e02464e/c.html
[65] Reuters. (2026, August 20). *Bulgaria's nuclear plant to cut capacity due to Danube's low water level.* Retrieved from https://www.reuters.com/business/environment/bulgarias-nuclear-plant-cut-capacity-due-danubes-low-water-level-2026-08-20/
[66] Serbia-Energy.Eu. (2026, August 28). *Bulgaria: Kozloduy unit 5 cut to 850 MW as Danube drought pressure deepens.* Retrieved from https://serbia-energy.eu/bulgaria-kozloduy-unit-5-cut-to-850-mw-as-danube-drought-pressure-deepens/
[67] Sxcoal.com. (2026, August 19). *Romania restarts coal plant as Danube drought forces nuclear shutdown.* Retrieved from https://en.sxcoal.com/news/detail/2089947324297531393
[68] SeeNews.com. (2026, August 28). *Romania extends operation of coal power units beyond NRRP deadline.* Retrieved from https://seenews.com/news/romania-extends-operation-of-coal-power-units-beyond-nrrp-deadline-1300363
[69] CEENERGYNEWS.com. (2026, August 6). *NEK has also reduced its power output.* Retrieved from https://ceenergynews.com/nuclear/nek-krsko-reduce-power-output/
[70] CEENERGYNEWS.com. (2026, July 17). *ČEZ commences major service interval at Dukovany NPP.* Retrieved from https://ceenergynews.com/nuclear/cez-commences-major-service-interval-at-dukovany-npp/
[71] CEENERGYNEWS.com. (2026, August 3). *Modernisation work starts on shared Dukovany nuclear systems.* Retrieved from https://ceenergynews.com/nuclear/modernisation-work-starts-on-shared-dukovany-nuclear-systems/
[72] Deutsche Welle. (2026, August 6). *How drought threatens Europe's electricity supplies.* Retrieved from https://www.dw.com/en/drought-europe-electricity-supplies-danube/a-78269916
[73] Serbia-Energy.Eu. (2026, August 4). *Historic drought cuts Đerdap output and tightens Serbia's electricity balance.* Retrieved from https://serbia-energy.eu/historic-drought-cuts-derdap-output-and-tightens-serbias-electricity-balance/
[74] CEENERGYNEWS.com. (2026, August 3). *Low water levels hit Serbia: Iron Gate output falls to historic low, Pančevo refinery could shut down.* Retrieved from https://ceenergynews.com/electricity/low-water-levels-serbia/

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