

Reykjavík Energy

Release of geothermal water from the Nesjavellir and Hellisheidi geothermal power plants 2024. Groundwater monitoring 2024.



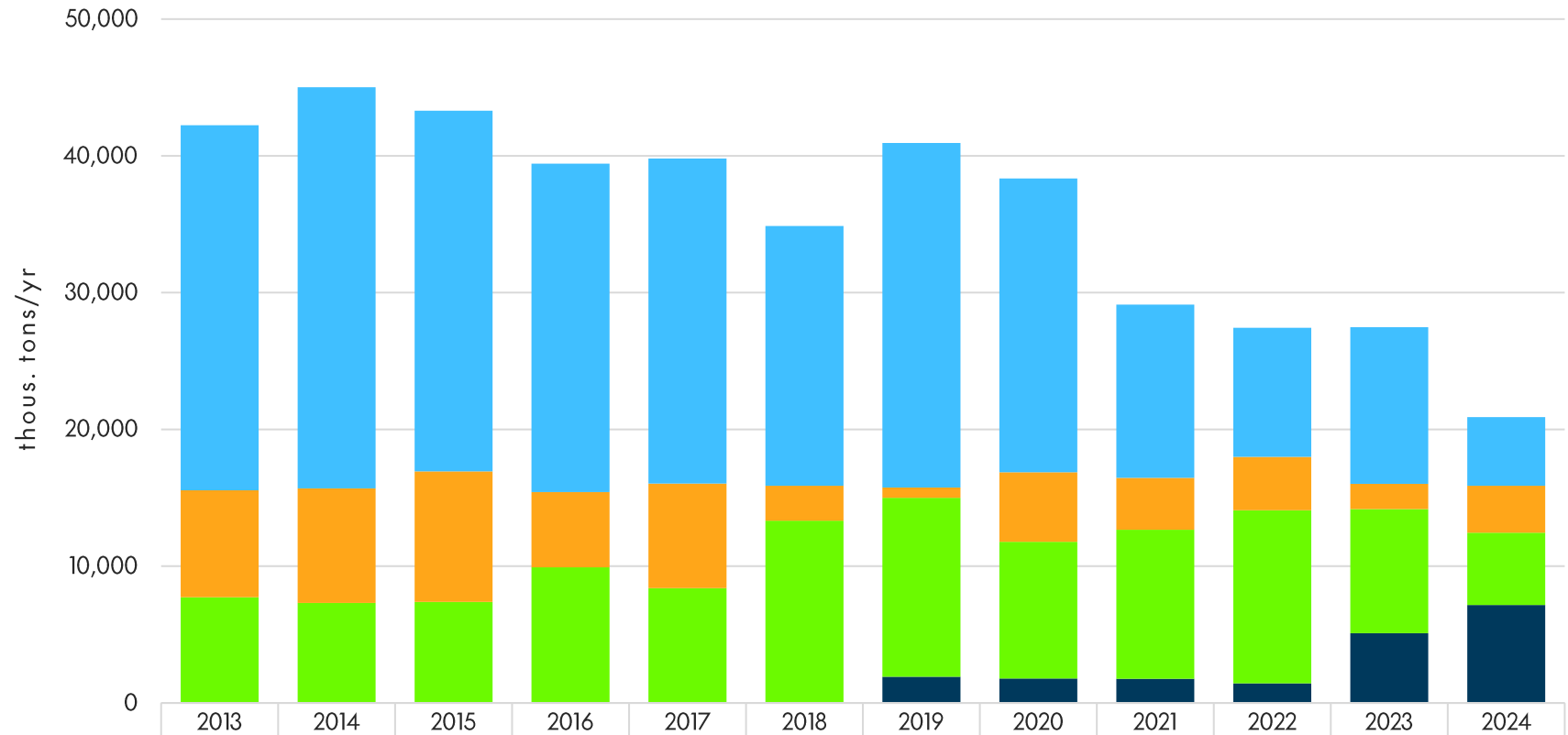
Table of content

Volume of geothermal water from the Nesjavellir Geothermal Power Plant.....	1
Volume of geothermal water from the Hellisheidi Geothermal Power Plant	2
Geothermal fluids discharged via overflows at the Hellisheidi and Nesjavellir	4
Chemical composition of geothermal water and heated groundwater for space heating from geothermal power plants in the Hengill area	5
Chemical composition of geothermal water and heated groundwater from the Hellisheidi and Nesjavellir Geothermal Power Plants	6
Chemical composition of groundwater in wells around the Hellisheidi Power Plant in 2024.....	7

Cover photo: Íris Eva Einarsdóttir

Volume of geothermal water from the Nesjavellir Geothermal Power Plant by release route

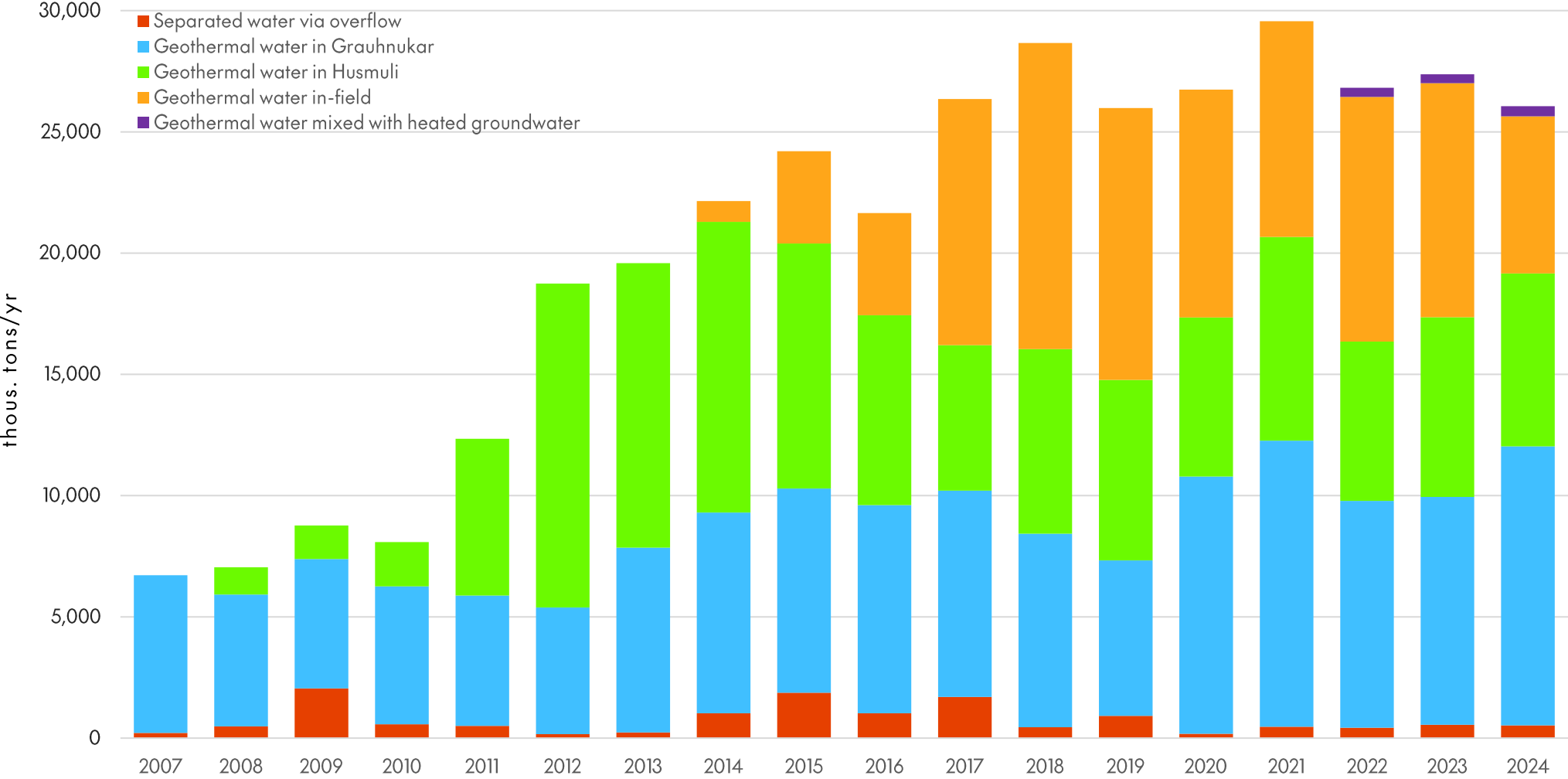
Geothermal water (thous.m³/year) from Nesjavellir Geothermal Power Plant 2013-2024 by release route. Volumes are rounded to thousands of tonnes.



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Heated groundwater on surface	26,687	29,333	26,371	24,009	23,760	18,993	25,183	21,472	12,669	9,440	11,450	5,024
Geothermal water on surface	7,824	8,367	9,545	5,504	7,649	2,556	754	5,083	3,790	3,909	1,846	3,424
Geothermal water in shallow reinjection	7,730	7,317	7,388	9,917	8,395	13,328	13,086	9,997	10,895	12,652	9,076	5,294
Geothermal water in deep reinjection							1,915	1,792	1,774	1,433	5,101	7,159

Volume of geothermal water from the Hellisheidi Geothermal Power Plant by release route 2007 - 2024

Until September 2011, the largest part of geothermal water was reinjected through wells in Gráuhnúkar. Geothermal water from the plant increased when the Sleggjan plant was launched in autumn 2011, when the reinjection field at Husmuli was fully operational. Since then, the geothermal water from the plant has increased. Reinjection in discontinued production wells within the production field started in 2014 and in boreholes in Threngsli in 2016. 2022 saw the start of project that involves mixing geothermal water with heated groundwater for district heating for a better utilization of the geothermal resource, reducing the extraction of groundwater at Engidalur and the reinjection utility.



Year	Separated water via overflow	Geothermal water in Grauhnukar	Geothermal water in Husmuli	Geothermal water in-field	Geothermal water mixed with heated groundwater	Total geothermal water
	thous. tons/yr	thous. tons/yr	thous. tons/yr	thous. tons/yr	thous. tons/yr	thous. tons/yr
2007	215	6,502				6,718
2008	483	5,439	1,123			7,045
2009	2,050	5,335	1,382			8,767
2010	572	5,684	1,826			8,082
2011	506	5,374	6,461			12,341
2012	163	5,224	13,358			18,745
2013	233	7,620	11,733			19,586
2014	1,024	8,281	11,982	860		22,147
2015	1,870	8,422	10,107	3,803		24,202
2016	1,025	8,585	7,831	4,213		21,654
2017	1,699	8,506	6,001	10,147		26,353
2018	447	7,982	7,611	12,625		28,665
2019	919	6,409	7,445	11,206		25,980
2020	21	10,610	6,558	9,394		26,583
2021	470	11,979	8,398	8,898		29,562
2022	430	9,352	6,572	10,086	380	26,819
2023	550	9,396	7,412	9,649	365	27,559
2024	523	11,508	7,130	6,481	416	26,057
Total	13,358	14,205	122,930	87,361	1,162	366,836

Volumes are rounded to thousands of tons

Geothermal fluids discharged via overflows at the Hellisheidi and Nesjavellir Geothermal Power Plants in 2024

The reinjection utility is vulnerable to any operational changes and approximately 1.4% of produced geothermal water at Hellisheidi Power Plant was released via overflow. Licensors have been kept informed on the situation, on actions available at any given time and of the ongoing projects to increase the reception of the reinjection utility.

Date	Type of disturbance	Maximum flow [l/s]
Hellisheidi power plant		
Hellisheidi		
September 21 st	Landsnet malfunction	293
Hverahlid		
No incidents		

Dagsetning	Type of disturbance	Maximum flow [MW]
Nesjavellir power plant		
Nesjavellir		
April 4 th – 16 th	Maintenance	150
September 16 th – 21 st	Thermal plant expansion	163
October 10 th – 14 th	Malfunction	146
October 30 th	Malfunction	179

Chemical composition of geothermal water and heated groundwater for space heating from geothermal power plants in the Hengill area

Typical concentrations ($\mu\text{g/L}$) of several trace elements in geothermal water (separated water) and heated groundwater (for space heating) from the Hellisheidi and Nesjavellir geothermal power plants and their maximum permissible concentrations ($\mu\text{g/L}$) for potable water.

Snefilefni	Unit	Max. recommended value for potable water	HELLISHEIDI			NESJAVELLIR		
			Separated water	Condensed water	Heated groundwater	Separated water	Condensed water	Heated groundwater
Arsenic (As)	$\mu\text{g/L}$	10	3.46	0.05	0.66	2.04	0.18	2.07
Barium (Ba)	$\mu\text{g/L}$	700	0.17	0.08	0.57	0.56	0.41	0.67
Cadmium (Cd)	$\mu\text{g/L}$	5	0.002	0.002	0.002	0.002	0.002	0.002
Cobalt (Co)	$\mu\text{g/L}$	*	0.01	0.01	0.01	0.01	0.01	0.03
Chrome (Cr)	$\mu\text{g/L}$	50	0.05	0.13	0.09	2.37	0.31	0.51
Copper (Cu)	$\mu\text{g/L}$	2,000	0.10	0.10	0.29	0.10	0.13	0.64
Mercury (Hg)	$\mu\text{g/L}$	1	0.002	0.002	0.002	0.002	0.002	0.002
Manganese (Mn)	$\mu\text{g/L}$	50	0.52	1.25	0.62	0.60	8.97	0.25
Molybdenum (Mo)	$\mu\text{g/L}$	*	0.27	0.05	0.21	0.12	0.14	0.93
Nickel (Ni)	$\mu\text{g/L}$	20	0.05	0.36	0.19	0.64	1.04	0.72
Phosphorus (P)	$\mu\text{g/L}$	5,000	1.00	<1	37.40	1.17	1.83	54.00
Lead (Pb)	$\mu\text{g/L}$	10	0.02	0.01	0.02	0.07	0.05	0.02
Antimony (Sb)	$\mu\text{g/L}$	5	0.05	0.01	0.03	0.04	0.01	0.07
Selenium (Se)	$\mu\text{g/L}$	10	0.30	0.30	0.30	0.53	0.30	1.74
Strontium (Sr)	$\mu\text{g/L}$	*	327.00	0.04	13.00	295.00	0.22	19.60
Silica (Si)	$\mu\text{g/L}$	*	10.00	2.00	11.80	10.00	2.00	20.00
Titanium (Ti)	$\mu\text{g/L}$	*	0.06	0.02	0.31	0.22	0.31	0.13
Vanadium (V)	$\mu\text{g/L}$	*	3.50	0.01	7.20	1.72	0.08	24.70
Zinc (Zn)	$\mu\text{g/L}$	3,000	1.37	1.42	2.22	26.80	7.91	18.40

* Maximum limits not specified in the potable water regulation

Chemical composition of geothermal water (separated water) and heated groundwater (for space heating) from the Hellisheidi and Nesjavellir Geothermal Power Plants and their maximum permissible concentrations (mg/kg) for potable water

Values exceeding the maximum are indicated in bold.

Chemical- and physiological factors	Unit	Max. recommended value for potable water	HELLISHEIDI			NESJAVELLIR		
			Separated water	Condensed water	Separated water	Condensed water	Separated water	Condensed water
Acidity	pH		9.91	6.76	8.48	9.32	5.4	8.72
T (pH)	°C		13.2	10.9	9.6	22.5	21.9	17.7
Hydrogen sulphide (H ₂ S)	mg/kg	*	22.1	4.2	0.30	67.7	15.2	0.41
Carbon dioxide (CO ₂)	mg/kg	*	18.4	7.2	28.0	27.9	17.1	50.0
Silica (SiO ₂)	mg/kg	*	736.0	0.14	28.2	664.6	0.62	42.9
Sodium (Na)	mg/kg	200	200.0	0.08	7.94	161.2	0.4	19.0
Potassium (K)	mg/kg	12	35.6	0.04	1.10	32.2	0.37	2.82
Calcium (Ca)	mg/kg	100	0.39	<0.02	4.79	0.28	0.12	9.92
Magnesium (Mg)	mg/kg	50	0.016	0.002	2.74	0.003	0.03	5.07
Iron (Fe)	mg/kg	0.2	<0.02	0.032	0.007	0.15	0.128	0.008
Aluminium (Al)	mg/kg	0.2	1.75	0.003	0.036	1.86	0.00	0.10
Boron (B)	mg/kg	1	1.2	0.02	0.01	1.76	0.03	0.11

* Maximum limits not specified in the potable water regulation

Chemical composition of groundwater in wells around the Hellisheidi Power Plant in 2024

The impact of the Hellisheidi Power Plant on groundwater is closely monitored in surveillance wells at and around the plant. Samples are collected to analyse overall chemical content and trace elements, in addition to measuring their temperature, conductivity and acidity.

Well	KH-05		KH-50	KH-12	LK-01	KH-06	HK-14	HK-29	
Groundwater flow	Selvogur flow			Selvogur flow Cooling towers	Elliðaar flow	Thingvellir flow		Ölfus flow	
Sample flow Date	2024-5113 7.8.2024	2024-5117 24.9.2024	23-5245 17.10.2023	2024-5108 24.7.2024	2024-5126 3.12.2024	2024-5135 19.9.2024	2024-5114 12.8.2024		
Chemical properties	Unit	Maximum value							
Acidity	pH		7.78	7.20	7.66	7.92	6.91	7.83	7.25
T (pH)	°C		22.1	21.7	21.6	22.5	23.5	8.0	21.9
CO ₂	mg/kg	*	26.9	69.7	16.8	23.5	28.7	18.7	36.8
B	Mg/kg	1	<0.007	0.02	0.04	<0.007	0.010	0.00	<0.007
Ca	mg/kg	100	5.67	7.69	4.15	5.01	3.16	3.34	9.10
Fe	mg/kg	0.2	0.116	0.012	0.028	0.004	0.02	0.010	0.010
K	mg/kg	12	0.75	0.83	0.70	0.95	0.48	0.74	0.98
Mg	mg/kg	50	3.28	18.30	2.41	3.28	2.76	2.32	3.50
Na	mg/kg	200	8.91	7.26	5.14	10.60	4.55	6.08	10.10
SiO ₂	mg/kg	*	1.18	40.70	18.20	15.30	16.57	15.43	21.80
Al	µg/kg	200	3.75	2.75	33.70	8.10	0.20	2.37	3.44
As	µg/kg	10	0.05	0.05	0.05	<0.05	0.05	0.05	0.05
Ba	µg/kg	700	0.36	0.70	1.42	0.38	0.46	0.36	1.06
Cd	µg/kg	5	0.000	0	0	<0.002	0.000	0	0.000
Co	µg/kg	*	0.11	0.02	0.020	0.005	2.02	0.020	0.040
Cr	µg/kg	50	7.17	0.11	0.61	0.30	0.01	0.32	0.64
Cu	µg/kg	2,000	0.24	2.59	1.02	0.35	0.56	0.31	0.98
Hg	µg/kg	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mn	µg/kg	50	17.70	2.05	1.01	0.15	129.00	2.08	1.68
Mo	µg/kg	*	0.62	0.07	0.13	0.08	0.08	0.12	0.42
Ni	µg/kg	20	6.70	1.41	0.46	0.15	0.72	0.70	0.20
Pb	µg/kg	10	0.01	0.03	0.0	0.02	0.01	0.01	0.01
P	µg/kg	5,000	1.1	47.0	26.4	18.7	1.00	18.0	41.7
Sb	µg/kg	5	0.030	0.06	1.53	<0.01	-	-	0.020
Se	µg/kg	10	0.30	0.3	1.58	<0.3	-	-	0.3
Sr	µg/kg	*	8.0	18.9	9.2	10.2	7.2	8.0	17.9
Ti	µg/kg	*	0.240	0.100	0.130	0.132	0.000	0.020	0.060
V	µg/kg	*	0.1	1.4	5.78	9.8	0.0	4.7	17.1
Zn	µg/kg	3,000	4.0	19.3	5.50	35.6	53.2	9.9	1.2

* Maximum limits not specified in the potable water regulation

Results in bold are older samples