ENVIRONMENT AGENCY OF ICELAND

PERMIT

UST202301-351

Geological storage of carbon dioxide

Carbfix hf.

Hellisheiði

Domicile: Bæjarháls 1, 110 Reykjavík

ID number 531022-0840

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1 GENERAL PROVISIONS

1.1 Operator

This permit is valid for Carbfix's hf. storage site at Hellisheiði for geological storage of carbon dioxide. Carbfix hf. is hereinafter referred as „the operator".

The operator can entrust a contractor with all requisite official authorisations to carry out tasks in the permit. However, the operator will continue to guarantee that the provisions of the permit are enforced. The operator shall comply with applicable laws and Regulations and conduct its activities in accordance with applicable growth management plans.

1.2 Scope of activities and storage site

The operator is authorised to receive and store up to 106,000 t/CO_2 per year, a total 3,180,000 t/CO_2 over a period of 30 years in a storage site which is situated in the geothermal field in Hellisheiði and which is defined further in the following points:

1) Injection of up to 47,000 t/CO_2 per year from the Hellisheiðarvirkjun geothermal plant is allowed. The abovementioned carbon dioxide from Hellisheiðarvirkjun shall be injected down into a deep system on Hellisheiðarvirkjun's injection site at Húsmúli.
2) Injection of up to 44,000 t/CO_2 per year from Climeworks' direct air capture plants (Orca and Mammoth) situated in ON Power's Geothermal Park by Hellisheiðarvirkjun and in Þrengsli. Carbon dioxide from the direct air capture plants shall be injected into an intermediate system at a depth of about 500 m through injection wells in ON Power's Geothermal Park or in Þrengsli.
3) Injection of up to 15,000 t/CO_2 per year from a DAC Innovation Park situated in ON Power's Geothermal Park by Hellisheiðarvirkjun. The carbon dioxide shall be injected into an intermediate system at a depth of about 500 m through injection wells in ON Power's Geothermal Park or in Þrengsli.

The operator is also authorised to run connected installations situated within the industrial site of Hellisheiðarvirkjun as well as the injection of reclaimed geothermal water (separated water and condensed water) from Hellisheiðarvirkjun. The operator runs a feed line for carbon dioxide stream supplied by a third party for injection into the storage site with the following surface delimitation:

1. The delimitation of ON power's capture plant is at a butterfly valve (DN 200, PN 25) situated at all injection holes in Húsmúli.
2. The delimitation of Climeworks' Orca direct air capture plant in Þrengsli is at a steel flange (DN50, PN40, 1.4404) situated at the inlet to the meter frame in Orca's injection systems control room, situated at well HN-02.
3. The delimitation of Climeworks' Mammoth direct air capture plant in Geothermal Park is at butterfly valves (DN250, PN40, 1.4404) situated in wells 11 meters from injection wells. Two injection wells, CHI-01 and CHI-02, will be used in the project.
4. The delimitation of the DAC Innovation Park will be up to four ball valves (DN50, PN25, 1.4404) situated at the external wall of the direct air capture control building. There will be space for up to four different streams which will be quantified before being fed to one injection well which has yet to be drilled.

The systems which the operator has permission for injection into is considered as one geological storage site with different depth profiles and injection locations (4). The storage site defined as the geological formations which will store the mineralized CO_2, consist of a geologically homogenous volume consisting of a succession of layers of basaltic rock formations and hyaloclastites. By distributing the injection points and by providing different depth for the injection of CO_2 into the storage site, the operator will separate the CO_2 stored from the geothermal powerplant and other sources of CO_2. This is still considered as one geological formation and location and as such considered as one storage site with different entry points and depth profiles of injection. This is further detailed below.

- The deep system which is at the perimeter of the high-temperature geothermal field which Hellisheiðarvirkjun utilises, and which is the injection site, cf. paragraph 1(1) above.
- The intermediate system injected into, cf. paragraph 1(2 to 4). The intermediate and deep systems are segregated by hydraulic borders. The intermediate system, bordered at a depth of 300–700 to 1,000 m by a low resistivity structure and a tuff layer, lies above the deep system and is separated from the top groundwater layer in Hellisheiði. The intermediate system is within the geothermal effects range. The geothermal reservoir, or the deep system, which is separated by the same low resistivity structure which envelops a high resistivity core is below the low resistivity structure. All geothermal fluid from Hellisheiðarvirkjun is pumped into the deep system through 1,800-2,500 m deep injection wells. A mixed layer (smectites and chlorites) with low permeability is between the deep and the intermediate systems and is highly limiting for water flow between hydraulic units.

The intermediate system's pressure limit should be 15 bar at most in the periphery of the carbon dioxide stream and be based on injection in the Geothermal Park and the periphery will stretch towards the water source in Engidalur. The water source shall not be affected but the total change in pressure in the intermediate system is estimated at 3 bar for the whole system. The deep system's pressure limit is estimated as changes in mean pressure, highest closest to the injection holes in Húsmúli, up to 6 bar, and stretching towards the monitoring and production site in Skarðsmýrarfjall.

A more detailed description of the delimitation of the site, definition of the storage complex and a table with information on the speed of the injection of carbon dioxide stream can be found in Annex 1 which is a part of this permit.

1.3 Inspections

The Environment Agency of Iceland (the Environment Agency) will carry out inspections of the activities of the operators in accordance with Chapter XVI of Act No 7/1998 on hygiene and pollution prevention and Regulation No 1430/2022 on storage of carbon dioxide underground. The Environment Agency carries out inspections of the storage reservoir, both periodic and non-periodic. On-site visits shall be carried out at least once a year until three years after closure and every five years until the responsibility has been transferred to the Environment Agency. In addition, the Environment Agency shall carry out non-periodic inspections cf. Article 14(4) of Regulation No 1430/2022.

After each inspection the competent authority shall prepare a report on the findings of the inspection. The report will be sent to the operator concerned and be made publicly available within two months after the inspection takes place.

If the operator doesn't comply with the provisions of the permit, laws and Regulations in the occupational field, and instructions of the competent authority for improvements to remedy this, the competent authority can apply the provisions of Chapter XVII of the Act No 7/1998 on hygiene and pollution prevention and the provisions of Regulation No 1430/2022 to compel improvements.

The competent authority shall be allowed access for inspection and control, including for the purpose of collecting samples and taking photographs, cf. Article 62 of Act 7/1998.

1.4 Changes in operating activities

The operator shall provide the issuer of the permit information on intended changes in operating activities, including changes regarding the operator, well in advance of undertaking them, cf. Article 14 of Act No 7/1998 and Article 10 of Regulation No 1430/2022. The Environment Agency will estimate the necessity of updating the permit, or it's terms, based on this information, where appropriate.

The change shall conform to the evaluation obligation decision of the Icelandic National Planning Agency or the opinion of the Icelandic National Planning Agency on the environmental impact assessment of the project, cf. Act No 111/2021, on environmental assessment of projects and plans, if applicable.

1.5 Start-up and shutdown of operations (closure)

A plan on response to temporary cessation of operating activities or an unexpected shutdown of operations shall be in place. The response plan shall i.e. describe how waste, products, chemical substances, equipment, housing, devices, operational sites, and piping are to be disposed of in an approved manner.

The Environment Agency shall be notified of shutdown and start-up of the operation, possible pollution effects shall always be kept to a minimum.

1.6 Review and withdrawal of permit

The permit shall be reviewed periodically, cf. Article 15 of Act No 7/1998 and Article 10 of Regulation No 1430/2022. The Environment Agency is authorised to review and amend the permit before its expiration date or if preconditions change, cf. Article 6(2) of Act No 7/1998, also cf. Article 14 and 15 of Act No 7/1998. The Environment Agency shall review and, if necessary, update or, as a last resort, withdraw the permit for storage in the occurrence of any of the incidents laid down in Article 10 in Regulation No 1430/2022.

The operator is obliged to comply with applicable laws and Regulations and conduct its activities in accordance with applicable land use plan, cf. Article 1(1) of the permit, regardless of an unreviewed permit. If a change is made to the spatial planning the Environment Agency is authorised to review and amend the permit, cf. Article 6(1) of Act No 7/1998.

The operator shall, at the request of the issuer of the permit, submit all information necessary for the review of the terms of the permit.

1.7 Closure and post-closure obligations

The storage site shall be closed if the relevant conditions in Article 16 of Regulation No 1430/2022 are met. If the operator seeks to close the site, he shall submit a formal letter of request to the Agency.

After a storage site has been closed, the operator shall remain responsible according to Article 16(2) of Regulation No 1430/2022. If the site is closed, according to Article 16(1)(3) the Environment Agency shall hold responsibility, cf. paragraph 4 of the same provision.

The operator's post-closure plan is approved by the Environment Agency of Iceland and is published on the Agency's website.

Prior to the closure of the storage site, according to Article 16 (1) (1 or 2) of Regulation No 1430/2022. The approved post-closure plan for the time interval after closure shall be updated as necessary and submitted to the Environment Agency for approval as the definitive post closure plan cf. Article 16(3) of Regulation No 1430/2022.

The post-closure plan shall be updated every five years.

1.8 Transfer of responsibility

After a storage site has been closed down, according to Article 16(1)(1 or 2) of Regulation No 1430/2022, all obligations relating to monitoring and corrective measures according to the requirements laid down in Regulation No 1430/2022, the return of emissions allowances if leakage occurs according to Act No 96/2023 on the EU emission trading system, and preventive and remedial action according to the Act No 55/2012 on Environmental Liability, shall be transferred to the Environment Agency, at the Agency's initiative or upon the request of the operator. Obligations and provisions due to the transfer of responsibility are listed in Article 17 of Regulation No 1430/2022 and responsibility shall not be transferred to the Environment Agency until after they are met.

Where a storage site has been closed according to Article 16(1)(3) of the Regulation, transfer of responsibility shall be deemed to take place if and when all available evidence indicates that the stored CO_2 will be completely and permanently contained, and after the site has been sealed and the injection facilities have been removed.

The injection equipment in Húsmúli, intended for the injection of separated water (brine) from Hellisheiðarvirkjun (geothermal power plant) and which can continue to be used as such, does not need to be removed when the site is closed.

1.9 Competence, penalties and coercive instruments

The operator shall fulfil the obligations set out in Article 40 of Act No 7/1998. In case of irregularities the operator shall promptly inform the competent authority and take the measures necessary to ensure that all requirements relating to the activities are enforced as quickly as possible.

If the operator doesn't adhere to the provisions of the permit, provisions of laws and relevant Regulations or instructions of the competent authority for improvements, the competent authority can apply the provisions of Chapter XVII of Act No 7/1998, the hygiene and pollution prevention, and the provisions of Regulation No 1430/2022 to compel improvements.

The Environment Agency is authorised, inter alia, to admonish and set a reasonable deadline for corrective measures, decide on a daily penalty for the operator and shut down the activity or limit it ad interim if there is a serious threat, serious incident, or repeated offence or if corrective measures are not undertaken within the deadline.

The Environment Agency can impose a non-criminal fine cf. Article 67 of Act No 7/1998.

1.10 Information to the public

The public has a right to access information about permits, applications for permits and information on pollution-control in accordance with Article 7 of Act No 7/1998 and Article 24 of Regulation No 1430/2022.

The Environment Agency makes the findings of the inspections, according to Article 1(3), publicly available. The approved post-closure plan, the approved corrective measures plan and the approved monitoring plan for the operation will be made available to the public. The information will be available on the Agency's website or by other accessible means.

The approved monitoring, post-closure and corrective measures plans are as follows:

- Monitoring plan for Carbfix hf., Hellisheiði - Permit UST202301-351
- Post closure plan for Carbfix hf., Hellisheiði - Permit UST202301-351
- Corrective measures plan for Carbfix hf., Hellisheiði - Permit UST202301-351

For further information, see the Agency's information policy.

1.11 Environmental responsibility

The operator is responsible for environmental damage or imminent threat of such damage caused by industrial activity, cf. Act No 55/2012 on environmental responsibility and shall prevent damage or remedy the damage if it has already occurred and bear the expense of the resulting measures.

The operator shall take the protective measures necessary for the imminent threat of environmental damage that may be traced to the activities. If environmental damage occurs the operator shall forthwith commence with actions to limit the damage or prevent further damage.

The operator shall notify the competent authority, the Environment Agency, forthwith of environmental damage or imminent threat of environmental damage that may be traced to the activities and inform on all the relevant aspects. The operator shall also set out a plan of corrective measures for any environmental damage that has already occurred and send to the Environment Agency.

2 WORK PRACTICES

2.1 Work practices and environmental objectives

The operator shall employ good rules of procedure in the operating activities of the storage site. The operator shall ensure, in the best possible manner, that pollution from the activities is kept at a minimum with targeted working practices. The necessary measures shall be taken to prevent

pollution accidents and reduce their effects. Maintenance of pollution control equipment shall be preventive.

The operator shall establish environmental targets and operate according to them and review them at least every four years. A referral to environmental targets which are a part of the operator's environmental management system is sufficient.

2.2 Communication and consultation

The contact person for the competent authority shall be a distinct representative of the operator and will be responsible for the operator's communications regarding the inspections of the business' pollution prevention activities and the execution of contingency plans. The inspector can contact this person outside normal working hours if necessary. If there is a change of contact person and/or contact information the Environment Agency shall be notified.

2.3 Composition of carbon dioxide stream

The operator shall ensure that the composition of carbon dioxide streams is in compliance with the provisions of Article 11 of Regulation No 1430/2022. The stream shall be composed of carbon dioxide, but it may contain incidental associated substances from the source (such as hydrogen sulphide), the capture or injection process, as well as trace testing substances (tracers) that are added to assist in monitoring and verifying CO_2 migration. Waste or other material may not be added to it for the purpose of disposing of said waste or other matter.

Concentrations of all incidental or added chemical substances shall not be such that it can have harmful effects on the reliability of the storing site or connected transportation infrastructures, poses a significant risk to the environment or human health, infringes on other applicable laws, e.g. the Act No 36/2011 on water management, Regulation No 797/1999 on the protection of groundwater and Regulation No 536/2001 on drinking water.

The operator shall ensure that a carbon dioxide stream is only accepted and injected for storage if the composition of the stream, including corrosive substances, has been analysed and a risk evaluation shows that pollution levels are in accordance with the terms of Article 11(1) of Regulation No 1430/2022. The operator shall keep a register of the quantity and quality of carbon dioxide streams which are delivered and injected, including the composition of the streams.

The CO_2 stream shall be dissolved in water on its way to the storage site, either in the well or in pipes before entering the well. The water is not considered as waste but is considered as a transport medium for the CO_2 stream into the storage site but not a part of the CO_2 stream. This is considered a part of the method of mineralizing the CO_2 in the surrounding host rock in the storage site. H_2S (g), is considered as an additional incidental element coming from the source, in this case the geothermal operations. H_2S and CO_2 are the most concentrated gases that the geothermal powerplant in Hellisheiði emits. H_2S is more soluble than CO_2 in water. Thus, separating the two gases is not technology feasible and one of the main incentives behind the capturing of gases from the powerplant is the reduction in H_2S emissions. Emissions of H_2S have had very negative effect on the air quality in the surrounding municipalities, including the capital area of Reykjavík which is the most densely populated area in Iceland. The power plant is required according to Article 5 in Regulation No 514/2010 on Concentrations of hydrogen sulphide in the atmosphere to reduce its emissions. H_2S follows the same principles in forming secondary minerals as CO_2 in the geothermal

aquifer and the storage site[1,2]. This should therefore not lead to negative impact on the operation on the geothermal powerplant and it should be contained with mineralization by the forming of Fe_2S (s) in the surrounding bedrock. The negative impact of not storing the H_2S with the CO_2 from the powerplant would be much more than possible effects of including it in the CO_2 stream meant for storage. NH_3, Fe and TOC are also chemical substances which originate in the capturing process in the DAC plant (only Mammoth). The CO_2 stream that can be injected and stored at the storage site must comply with the following requirements for certain substances, during regular operations.

	Min	max	max	max	max	max	max	max	max
Location	CO_2 (%)	H_2S (%)	N_2 (%)	O_2 (%)	H_2 (%)	CH_4 (%)	NH_3 (mg/l)	Fe (mg/l)	TOC (mg/l)
Weighed average	90.1	9.4	0.02	0.29	0.19	0.0022	0.4	0.010	0.6
Húsmúli 1 (geothermal)	80.9	18.9	0.03	0.065	0.026	0.00	0	0	0
Þrengsli 2 (intermediate system)	99.9	0.0	0.00	0.06	0.017	0.00	0	0	0
Geopark 3 (intermediate system)	98.8	0.0	0.00	0.72	0.52	0.00	0.5	0.025	1.5
Geopark 4 (intermediate system)	99.9	0.0	0.00	0.065	0.017	0.00	0	0	0

2.4 Personnel management and conduct on premises

It is imperative to ascertain that the employees possess adequate understanding of the toxic characteristics and properties of the chemical substances to which they may be exposed. Information pertaining to these substances must always be readily accessible at the workplace. Employees should be equipped with the necessary training to effectively manage pollution-related incidents and should possess comprehensive knowledge of the instruments and safety equipment within the premises.

The operator is obligated to show care and maintain tidiness in the operational site. The operator shall take the utmost care not to contaminate the soil with pollution, cf. Regulation No 1400/2020 on polluted soil. The operator shall follow the provisions of Regulation No 884/2017 on the prevention of oil pollution from land-based activities.

The inspector can request amendments and repairs on the site, fences or other structures if considered necessary due to cleanliness or if their state is a blemish on the environment.

Access of unauthorised persons to the working site shall be restricted so that the operations do not pose a danger to the public.

2.5 Response and contingency plan for leakage or significant irregularities

The operator shall notify the Environment Agency immediately in case of leakage or significant irregularities and take corrective measures according to Article 15 of Regulation No 1430/2022. The

[1] Clark et al. 2020. CarbFix2: CO_2 and H_2S mineralization during 3.5 years of continuous injection into basaltic rocks at more than 250°C. Geochimica et Cosmochimica acta 279, 45-66.

[2] Gunnarsson Robin et al. 2020. H_2S sequestration traced by sulfur isotopes at Hellisheiði geothermal system, Iceland. Geothermics 83, 101730.

operator shall also notify the Environment Agency in case of leakage, or other irregularities which indicate danger of leakage, according to Act No 96/2023 on the EU emission trading system. If the operator doesn't take the necessary corrective measures the Environment Agency shall do so and reclaim costs associated with said measures from the operator through the financial security.

The operator shall take actions according to the approved corrective measures plan for the operation in case of leakage or significant irregularities.

In the case of a mishap or other occurrence which can result in pollutants being released into the environment the necessary measures to stop the spreading of polluting substances and to prevent pollution damage in the environment shall be taken forthwith. The operator should clean the pollution that may be caused by mishaps or other incidents at his own expense. The competent authority may, if necessary, request information about other specific occurrences in operating activities which could result in increased pollution.

The operator shall review every mishap and other incidents that result in release into the environment of polluting substances in the effort to prevent the repetition of other comparable incidents. The competent authority shall be informed of such measures.

In case of a mishap necessitating immediate action, the Emergency Line 112 shall be called.

The inspector shall be notified of a pollution mishap as soon as possible (email ust@ust.is). The municipal Environmental and Public Health Office shall also be notified of the mishap. The inspector shall be informed if there is a risk of negative consequences for the environment.

2.6 Financial security and financial mechanism

The operator shall provide confirmation of the ability to take sufficient measures in the form of a financial security or its equivalence for all activities in the storage site cf. Article 33(1)(j) of Act No 7/1998 and Article 18 of Regulation No 1430/2022. Operators shall, before the responsibility for the storage site is transferred to the Environment Agency, pay any foreseeable monitoring expenses until the carbon dioxide has been completely and permanently closed off. The Environment Agency shall periodically demand a review of the financial security, having regard to changes in the estimated risk of leakage and estimated cost of all obligations arising from the issuing of the permit according to Article 18 of Regulation No 1430/2022. The financial security shall be valid and active in accordance with Article 18 of Regulation No 1430/2022.

The operator shall give the Environment Agency access to a financial contribution before the transfer of responsibility takes place according to Article 17 of Regulation No 1430/2022, cf. Article 19(1) of the Regulation. The financial contribution shall take into account criteria outlined in Annex I of the Regulation, and experience gained of storing carbon dioxide which is relevant to determine the post-transfer obligations and cover at least, the estimated cost of monitoring until the carbon dioxide is completely and permanently contained, cf. Article 33(2)(j) of Act No 7/1998 or at least for 30 years. The Environment Agency is authorised to use the financial contribution to cover the Agency's costs of ensuring that the carbon dioxide is completely and permanently contained in the earth in geological storage sites after the transfer of responsibility has occurred.

The operator shall provide confirmation on the establishment and maintenance of the financial mechanism which shall cover the cost of monitoring for at least 30 years following the transfer of responsibility.

The financial security shall be active before the injection of carbon dioxide begins in the storage site and reviewed at least every five years, in parallel with the approved monitoring plan.

3 PREVENTION OF POLLUTION IN THE EXTERNAL ENVIRONMENT

3.1 Pollution prevention

The operator should fulfil the applicable laws and Regulations in the occupational field and ensure that the operating activities are run in accordance with the principles in Article 38 of Act No 7/1998 on hygiene and pollution prevention. If best available techniques (BAT) for pollution prevention and energy performance have been issued, the operator shall work in accordance with them. When using pollution prevention methods which cause the transfer of pollution between air, water and soil the negative effects on the environment shall be kept at a minimum. If best available techniques are issued, they shall take effect and be adopted according to Article 6(1).

3.2 Chemical substances and leakage prevention and management of waste and hazardous waste

Oil and other hazardous waste shall be returned to an authorised reception facility. Water use management shall also be as good as possible. Resource and power use management shall be optimised, and negative environmental impacts shall be minimised.

Leakage prevention shall be in place for treatment of those hazardous wastes that are marked with an asterisk in Regulation No 1040/2016.

Waste generation shall be prevented as much as possible. The operator shall sort waste, both operational waste and domestic waste cf. Article 10 of Act No 55/2003 on waste management. All waste shall be returned to an authorised reception facility cf. Article 9 of Act No 55/2003 on waste management.

Hazardous waste generated as part of the activities shall be recorded in accordance with Article 11 of Regulation No 806/1999 on hazardous waste. Furthermore, it shall be ensured that the employees have knowledge and skills related to the storage and handling of hazardous waste and the possible danger it can pose. Hazardous waste that the operation generates, or activities connected to it, shall be returned to an authorised reception facility. Care shall always be taken that hazardous materials don't build up.

3.3 Noise

The operator shall reduce noise emitted from the activities to the extent possible and ensure that noise emissions are in accordance with the provisions of Regulation No 724/2008, on Noise, and table III in the Annex of said Regulation. Noise by house wall outside the operator's working site shall not exceed 70 dB(A)LAeq in the industrial site.

3.4 Use of chemical substances, safety data sheets and the replacement principle

The operator shall work according to the Chemical Act No 61/2013 and Regulations adopted on its basis as well as other Regulations that apply to chemical substances and chemical mixtures. When handling chemical substances care shall be taken that safety data sheets are accessible and updated.

Chemical substances and chemical mixtures which can have undesirable effects on human health or be harmful for the environment shall be replaced by less harmful chemicals if possible. When storing and handling chemical substances, access and pollution risks shall be limited as much as possible. In the case of pollution mishaps, the contingency plan according to Article 2(5) shall be

followed. The operator has an obligation to secure polluting chemical substances in a way that leaves no danger of them dispersing into the environment, surface water or groundwater.

3.5 Tracer tests

The operator shall perform tracer tests to confirm the behaviour of carbon dioxide in the storage site. Tracers can only be used for testing after an opinion has been given by the Environment Agency approving them in accordance with Article 14 of Regulation No 797/1999. Reports on the tracer tests shall be made available to the Agency as soon as the results are known, and the competent authority shall be notified as soon as possible if the results of the tests imply that the behaviour of carbon dioxide in the storage site differs from expectations.

3.6 Groundwater

The water bodies that the operator might affect are Selvogsstraumur 1 (104-249-G), Selvogsstraumur 3 (104-290-G) and Lyngdalsheiði (104-305-G). The environmental target of the water bodies is good chemical status and good quantitative status. The operator has an obligation to place wells to monitor the effects of injection on groundwater in those sites that shall be specifically protected to ensure that the objectives of Act No 36/2011 on water management, are reached and in those that are considered most likely to be affected by the injection of carbon dioxide. The monitoring wells shall be sufficiently deep and cased at the right depth so they can give the most accurate information of the state of groundwater in the intermediate system, below 300 m, and of the groundwater that lies above the intermediate system. The monitoring wells shall be in place before the injection of carbon dioxide begins in Hellisheiði and their number increased on an ad-hoc basis while the activities continue, in accordance with the approved monitoring plan of the operation and the requirements in this permit.

4 INTERNAL CONTROL AND MONITORING

4.1 Record keeping

The operator shall carry out periodic controls of environmental and operational factors which can cause pollution or the release of chemical substances into the environment. Information on the following items shall be recorded and the records shall be available to the competent authority at any time:

- all waste which is generated by the activities, cf. Regulation No 1040/2016, on waste records and estimation of hazardous elements of waste,
- confirmation that staff has been trained, cf. Article 2(4),
- complaints about the activities,
- malfunctions and mishaps which could cause pollution and the response taken,
- maintenance and malfunctions of equipment,
- results from monitoring, cf. Article 4(2).

4.2 Monitoring of activities

The operator shall monitor the injection facilities, the storage site (including the carbon dioxide plume) and surrounding area, if applicable, for the purpose of:

- comparison between the actual and modelled behaviour of carbon dioxide and formation water, in the storage site,
- detecting significant irregularities,

- detecting migration of carbon dioxide,
- detecting leakage of carbon dioxide,
- detecting significant adverse effects for the surrounding environment, especially effects on drinking water, for human populations or for users of the surrounding biosphere,
- assessing the effectiveness of all corrective measures taken according to Article 15 of Regulation No 1430/2022,
- updating the assessment of the safety and integrity of the storage complex in the short and long term, including the assessment of whether the stored CO_2 will be completely and permanently contained.

The monitoring shall be based on a monitoring plan that is approved by the Environment Agency and designed by the operator in accordance with Annex II of Regulation No 1430/2022, including a further elaboration of monitoring in line with guidelines for monitoring according to the Regulation on the European Union's emissions trading system. The monitoring plan shall be submitted to the Environment Agency for approval, cf. Article 12 of Regulation No 1430/2022. The monitoring plan shall be updated at least every five years to take account of changes in the estimated risk of leakage, changes in estimated risk for the environment and human health, new scientific evidence, and improvements in best available technique (BAT). An updated monitoring plan shall be submitted to the Environment Agency for approval.

4.3 Monitoring of groundwater

The monitoring shall demonstrate the status of the water bodies and whether their environmental targets are reached. The monitoring shall, inter alia, focus on the effects of the activities on the chemical composition of groundwater in the site, in accordance with the Act No 36/2011, on water management, and Regulation No 797/1999 on the protection of groundwater.

The effects of the activities on the concentration and dispersion of chemical substances on lists I and II in Regulation No 797/1999 on protection of groundwater, shall be monitored. Monitoring shall conform to the Monitoring plan in the River Basin Monitoring Plan for 2022-2027[3]. The monitoring shall also take into account pertinent chemical substances in Chapter 2 of Regulation No 536/2001 on drinking water, in wells close to the water protection area on Lyngdalsheiði, IS305-G. Monitoring is further specified in the operations approved monitoring plan but shall be sufficient to identify a significant and persistent, escalating trend in monitored chemical substances in a timely enough manner to make it possible to enact measures to prevent changes in the quality of groundwater. The inspector is authorised to change the frequency of monitoring analysis if the Agency sees a reason to, based on the results of the monitoring.

4.4 Earthquakes

The existing rules[4] of the National Energy Authority on preparatory measures and responses for earthquake risk due to the release of liquid into a deep system shall be followed when estimating the risk of earthquakes due to injection of liquid into geological strata. Injection into geological strata shall be controlled by a so-called traffic light system where injection, both into the intermediate and deep system, is increased slowly and in small steps. The seismic activity in the underground impact area of injections needs to be carefully watched when the drilling begins, when

[3] River Basin Monitoring Plan 2022-2027

[4] OS-2016-R01-01 on preparatory measures and responses for earthquake risk due to the injection of liquid into the deep system.

the injection begins and when the volume in the injection is increased. The monitoring plan of the permit includes detailed information on the positioning of seismographs in the area.

4.5 Supervision of measurements

The operator shall finance and be responsible for the execution of measuring, if requested, as well as the monitoring according to this permit. The measurements shall be done by the operator, or an entity appointed by the operator and accepted by the Environment Agency.

4.6 Reports to the competent authority

The operator shall, as often as the Environment Agency decides and at least once a year, submit to the Agency:

1. all results of the monitoring pursuing Article 12 of Regulation No 1430/2022, including information on the monitoring technology employed, see Chapter 4.2 and 4.3
2. information, recorded according to Article 11(2)(2) of Regulation No 1430/2022, on the quantity and properties of the carbon dioxide streams, which are delivered and injected during the reporting period, including the composition of the streams, see Chapter 2.3
3. proof that the financial security, according to Article 18 and Article 8(9) of Regulation No 1430/2022, is valid and maintained, see Chapter 2.6
4. the ratio of stored carbon dioxide,
5. all other information that the Environment Agency considers relevant when assessing whether the terms of the permit are complied with, and which advance understanding on the behaviour of carbon dioxide in the storage site.

The operator shall compile an annual overview for the preceding calendar year and send to the competent authority before May 1st each year. The annual overview shall contain the results of measurements and records, cf. the requirements in Chapters 3 and 4.

4.7 Environmental information

Annually the operator shall submit electronically environmental information on pollutant emissions from the place of operations, cf. Article 34 of the Act No 7/1998 on hygiene and pollution prevention.
The operator is responsible for the information he submits to the Environment Agency. The operator is allowed to submit environmental information collectively with the annual overview, cf. Article 4(6), but that does not extend the due dates.

5 CLASSIFICATION OF ACTIVITY AND FEE

This activity is subject to Point 14 of Annex II of the Act No 7/1998 on hygiene and pollution prevention and Regulation No 1430/2022, on storage of carbon dioxide underground. The operator pays a fee to the Environment Agency for the permit, inspections, and application of coercive instruments according to the Agency's tariff.

A fee for additional inspections such as because of omissions, irregularities or complaints are paid separately and according to the tariff.

6 ENTRY INTO FORCE

This permit which is granted in accordance with Act No 7/1998 on hygiene and pollution prevention, and Regulation No 1430/2022 on geological storage of carbon dioxide. The permit shall enter into force forthwith and is valid until xx.xx.2054.

The Environment Agency's decision on the issuing of a permit may be appealed to the Environmental and Natural Resources Board of Appeal within one month from the publication of the decision of the Environment Agency, cf. Article 65(1) of the Act No 7/1998 on Hygiene and Pollution prevention and according to Article 4 of Act No 130/2011 on the Environmental and Natural Resources Board of Appeal.

Reykjavík, [xx.xx.2054]

The Environment Agency of Iceland

ANNEX 1

Delimitation of the storage site

Precise location for the site that operator applies for a storage permit has the following coordinates:

	X (ISN93)	Y (ISN93)
A	382273.8 E;	397966.9 N
B	383408.5 E;	399187.3 N
C	385710 E;	398020.4 N
D	381449.5 E;	390216.5 N
E	376932 E;	392625.1 N
F	380507.5 E;	398716.2 N

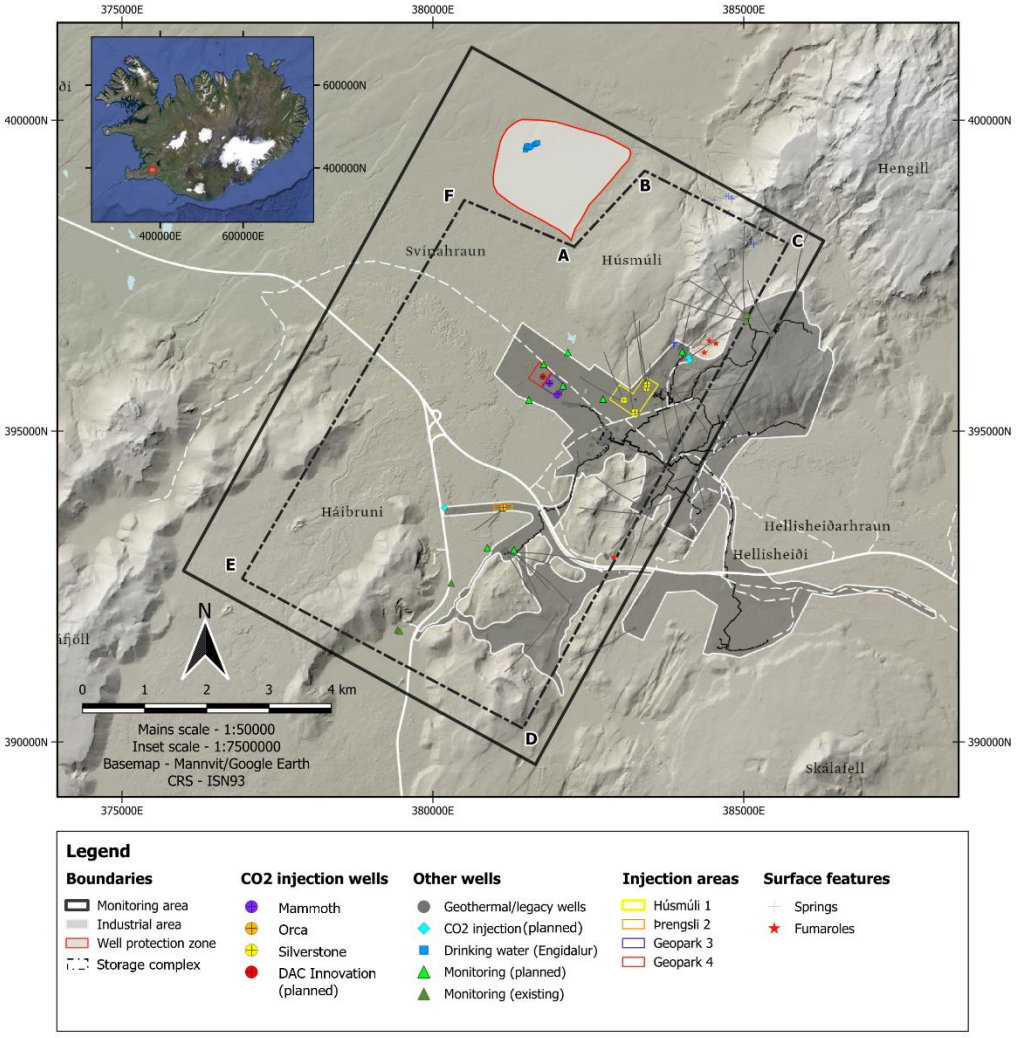

Figure 1 ***Map of storage site and storage complex boundaries with the injection, monitoring wells and legacy wells****. Extents of the storage site and storage complex determined by maximum extent of CO_2 from simulation results presented in part. Locations of existing and planned wells for Carbfix injection operations in Hellisheiði, water production and monitoring wells, and boundaries of the defined industrial area (grey shaded area) and Engidalur well protection zone (red area). Possible natural leakage pathways (springs and fumaroles) are shown along with the aforementioned man-made pathways (wells) (Carbfix hf., 2023).*

Definition of the storage complex

The storage complex is comprised of

- The storage site which is located in the Hellisheiði industrial zones I20 and I21 of the Hellisheiði geothermal power plant within the rural area of the municipality of Ölfus and is further defined in chapter 1.2 of the permit. The Hellisheiði geothermal power plant is located on the West slopes of Hellisheiði mountain range with wells and connecting pipelines located both on the slopes, upon Hellisheiði, on Skarðsmýrarfjall mountain and at Hverahlíð production area. The area is already equipped with various monitoring systems, such as for air and water quality, and seismic activity. The immediate area surrounding industrial zones I20 and I21 is entirely uninhabited.
- All geological layers above the storage reservoirs up to the groundwater surface (groundwater system), in this case a succession of olivine tholeiitic basalt and hyaloclastic sequences. The storage complex is saturated with water. While the mineral storage of CO_2 does not rely on "caprock" as the dissolved CO_2 is no longer buoyant, two formations of interest as part of the storage complex may provide additional storage security.
- Dense hyaloclastite formation found approximately -100 to -400 m.a.s.l containing glassy basaltic tuff layers, consisting of consolidated volcanic ash which may provide a hydrogeological barrier between the intermediate system and the groundwater system.
- A mixed layer clay alteration zone (smectite and chlorite clay minerals) found between -600 and -900 m.a.s.l. (characteristics of an alteration temperature around 200 °C) of low permeability providing a hydrogeological barrier between the two hydraulic units, namely the deep geothermal system and the intermediate system. This layer is mapped using alteration logs from well cutting analysis and from resistivity soundings indicating a low-resistivity layer representative of mixed layer clays.
- In addition, faults in the storage complex provide a compartmentalization of the subsurface.
- The formations below the storage reservoir, consisting of crystalline rock heavily intruded by low viscosity magmas.
- Legacy and groundwater wells, from the well head to the well bottom.

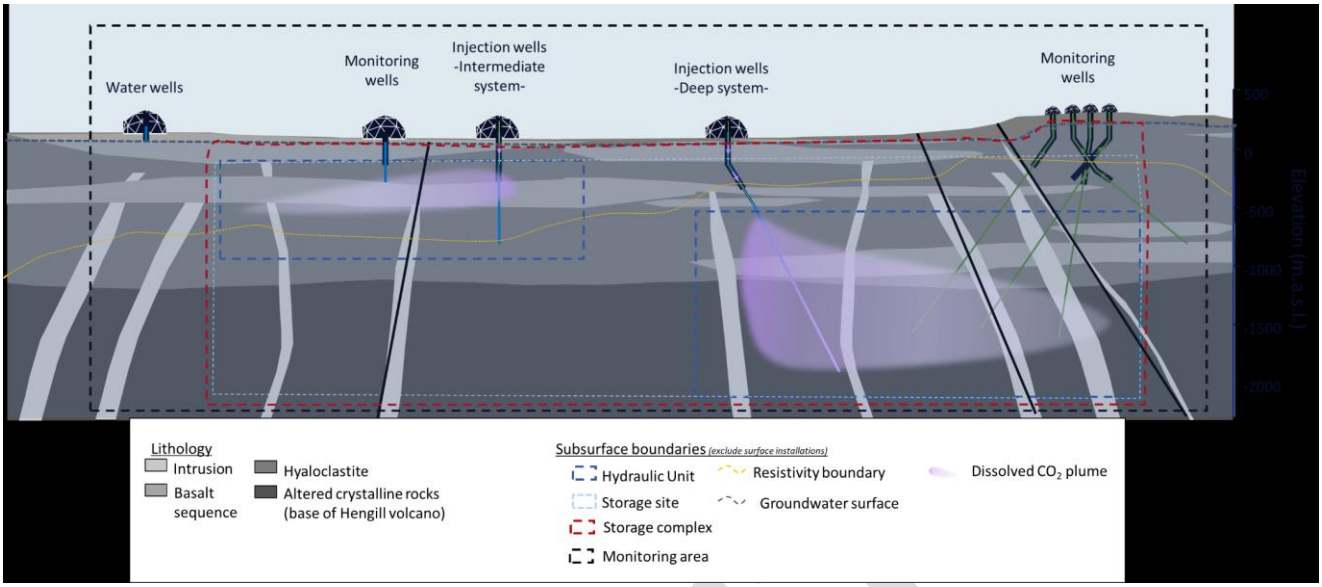

Figure 2 Schematic illustration of the subsurface geology and surface installations (Carbfix hf., 2023).

Maximum injection rates and pressure of CO_2 streams

Injection location	Annual amount of CO_2 tonne/y	Other gas tonne/y	Max Injection rate kg CO_2/s	Max injection rate kg H_2O/s	Injection pressure bar-g	Method of transport
Húsmúli 1. Primary well HN-16. Reserve wells: HN-14, HN-12 and HN-09	47.000	11.000 H_2S 18 H_2 38 N_2 15 O_2 2,6 CH_4	1,5	132	Gas charged water: 14	Water pipe
Þrengsli 2. Primary well HN-02. Reserve well: HN-04	4.000	2.6 N_2 0.7 O_2	0,15	3,5	Gas: 19-22 Water: 0-10	Gas pipe
Geopark 3. Primary wells: CJI-001, CJI-002 Reserve @well: CJI-003	40.000	293 N_2 211 O_2	1,5	92	Gas charged water: 21	Water pipe
Geopark 4. Primary well: CJI-004	15.000	9.8 N_2 2.6 O_2	0,5	12,8	Gas: 19-22 Water: 0-10	Gas pipe
Total annual amount	106.000	11.000 H_2S 18 H_2 343.4 N_2 229.3 O_2 2.6 CH_4				