## Hydrogen decarbonisation readiness route

This section is applicable to those wishing to submit decarbonisation readiness plans following the hydrogen conversion route. The goal of the applicant’s plans is to demonstrate a feasible conversion to operate on hydrogen as the primary source of fuel.

You must be aware that the Government Policy states that decarbonisation readiness through fuel conversion can only be demonstrated through the hydrogen route. Proposals to convert to other low carbon fuels are not currently acceptable to meet the decarbonisation readiness requirements.

Plants firing or intending to fire blends of methane with hydrogen, ammonia or other defined low carbon fuels remain in scope of the decarbonisation readiness requirements, with no distinction between fossil and biogenic carbon dioxide.

### 5.1 How to demonstrate hydrogen readiness in your permit application with your decarbonisation readiness report

You must address four tests to be considered decarbonisation ready through hydrogen conversion.

You must show that you have reasonable grounds to believe that all of the criteria below can be met during the lifetime of the plant. Your assessment must demonstrate:

that sufficient space is available on or near the site to accommodate the proposed hydrogen conversion equipment

that it is technically feasible to convert the combustion power plant to hydrogen firing and detail what modifications will be required

that you have a suitable plan for hydrogen fuel access

that the plan is economically feasible

For bespoke permits, you are required to submit the following documents to the Environment Agency:

a report detailing your decarbonisation plans, demonstrating how you meet the requirements of the four tests

a site plan

* a self-certification statement that the hydrogen fuel access and the economic feasibility of the plan has been assessed and is viable

Where a Standard Rules permit application is made, self-assessments and self-certification statements are required for all four tests.

Instructions on what to include and how to present this evidence are provided in the following sections.

The level of detail provided in the description may be proportional to the scale of the asset, with larger plants providing more detail.

Where the approach you propose deviates from published technical guidance you should provide reasoned justification for the Environment Agency to assess.

### 5.2 How to demonstrate sufficient space is available on or near the site to accommodate any equipment necessary to allow conversion to hydrogen

Your plan must demonstrate that there are no known spatial barriers which might prevent installation or operation of your chosen technology. This section details the information you need to consider to pass the space test.

You will be required to set aside adequate space for additional equipment needed for hydrogen combustion, both internally and externally, to accommodate your chosen hydrogen technology. The space set aside should also align with the plant’s plans for accessing hydrogen. More information regarding hydrogen supply is provided in Section 5.4.

You can refer to standard examples of plant sizes to assist you in allocating space for equipment. Table 11 in the [Hydrogen Readiness Technical Report](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1141549/hydrogen_readiness_report.pdf) provides indicative values for the land footprint requirements for power plants and additional requirements for hydrogen infrastructure. Where you are proposing allocating less space, you must provide justification for this in your decarbonisation readiness report.

To demonstrate sufficient space is available for hydrogen conversion, your plan must:

state the footprint of the area allocated for hydrogen conversion equipment

justify and give evidence for the availability of adequate space for hydrogen conversion

justify that all technical requirements detailed within Section 5.3 have been addressed and can be feasibly fit within the allocated space

* provide an equipment list and the footprints of individual equipment. The detail provided should be proportional to the scale of the power plant development

list the safety considerations arising from the chosen location and corresponding mitigations, referring to any COMAH requirements where appropriate

describe the level of formal project development that has been undertaken in support of your space requirement calculations

Your site plan needs to be clear and must include the following where applicable:

fuel gas supply infrastructure comprising of hydrogen delivery, as well as any dual fuel provisions

hydrogen fuel gas production facilities, if applicable, including any pre-treatment conditioning, cooling, and supporting utilities

storage and handling of hydrogen, oxygen, and any utilities

modifications to the existing combustion plant

extension or addition of emissions control equipment and diluent, such as SCR reagent, additional catalyst, nitrogen, steam, or water injection

provisions to facilitate vehicle movement and access to equipment

labels for the major hydrogen conversion equipment

the perimeter of the plant and any associated auxiliaries

details of any off-site equipment and auxiliaries such as chemical storage

the entry point for hydrogen to the site and a note detailing the method of transportation

the proposed location and footprint of the operations and maintenance area

the proposed location and footprint of the construction laydown area

### Land ownership and availability

You should assess the suitability of your chosen land for hydrogen conversion and must ensure that no known barriers exist for the land you have chosen to build your hydrogen conversion equipment on. You must consider the following factors in your plan:

current ownership of the proposed land and any acquisition plans

timeline for land utilisation (including legal liabilities and timeframes)

potential land designations (nature reserve, SSSI, etc.)

If your selected land is not directly adjacent to the power plant, you must ensure the availability of suitable land corridors to connect to the site.

### 5.3 How to demonstrate the technical feasibility of conversion to a hydrogen fuel fired plant

This section provides information regarding the technical feasibility details you should include in your decarbonisation readiness report for a hydrogen fired combustion plant. Your report must include:

process descriptions of proposed equipment required for hydrogen conversion

the proposed location of the equipment, provided in the site plan

preliminary sizing of the footprint for the hydrogen conversion equipment and the sizing basis used

outline of operational specifications of the hydrogen conversion equipment

the health and safety considerations of the proposed equipment, proposed mitigations and how this effects the plant design

You may refer to the detailed technical information is described in Section 3.1-3.2 of the [Hydrogen Readiness Technical Study](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1141549/hydrogen_readiness_report.pdf) for further clarifications.

You may choose to submit process flow diagrams and block flow diagrams to support your application. However, this is not an explicit requirement.

### Hydrogen firing

You must demonstrate that it will be possible to modify your combustion power plant to allow firing on hydrogen as the primary source of fuel.

You must address the following:

* ensure the location of the combustion plant does not pose any constraints towards the supply of hydrogen fuel

the volumetric capacity of firing hydrogen

materials issues and embrittlement

impact on NOx generation

leak detection and safeguarding

differences in combustion properties of hydrogen compared to the current fuel fired by the combustion plant

any utility requirements for the hydrogen readiness equipment

the startup and shutdown process

any emissions arising from hydrogen conversion and their corresponding mitigations

You must provide a statement from the Original Equipment Manufacturer (OEM) that the chosen generation equipment can already burn hydrogen as its primary source of fuel if there is no intention to replace this equipment when converting.

You must ensure that any proposed modifications to the combustion power plant are compliant with any environmental restrictions. If you fall outside the boundaries stipulated by environmental restrictions, then you must provide mitigations to bring your plans back into compliance, such as introducing selective catalytic reduction (SCR) to manage NOx emissions.

### Hydrogen storage

Depending on your specific circumstances, you may choose to store hydrogen on-site, or near to the site of, your combustion power plant. If you choose to do this, then you must include:

the chosen method of storage

the designated location and spacing allocated for hydrogen storage

the total mass of hydrogen to be stored

any health and safety considerations and their corresponding mitigations

Where hydrogen is stored in off-site geological storage facilities, these may have their own unique owner/operator (separate from the power facility) which will likely be responsible for any health and safety considerations and their corresponding mitigations.

There are various methods available for hydrogen storage, including, but not limited to:

geological storage

above ground storage;

* + liquid hydrogen
	+ compressed hydrogen
	+ Liquid Organic Hydrogen Carriers (LOHC)
	+ Porous materials

You must provide a statement justifying your choice of storage method and why it is most suitable for your combustion plant.

This list is not exhaustive, and with ongoing technological advancements in this field, new hydrogen storage methods may emerge.

Storage of potentially hazardous materials shall be reviewed in line with hazardous substances consent, environmental permits/licences, and COMAH regulations.

### Performance considerations

The conversion to hydrogen firing may result in performance impacts to the combustion plant. Where appropriate, your report must:

describe the expected performance impacts of converting to hydrogen fuel

### Cooling system

The conversion to hydrogen may require additional cooling, particularly if hydrogen is produced onsite.Your report must:

confirm the proposed cooling technology

define the specification of the cooling technology for the combustion plant and hydrogen production facility, if applicable, the cooling duty of the system

describe the necessary space and tie-ins for cooling equipment

details of any existing site permits

You should refer to the Environment Agency’s evidence on [Cooling Water Options for the New Generation of Nuclear Power Stations in the UK](https://assets.publishing.service.gov.uk/media/5a7c7688ed915d6969f450b2/scho0610bsot-e-e.pdf) when considering options for cooling. This gives an overview of UK power station cooling water systems in use in the UK and abroad.

If you are proposing a river or sea water-based cooling system, then your report must include:

an estimate of the cooling water demands (flows, heat loads, and temperatures) for the hydrogen

the proposed cooling water source and what stages of treatment are necessary

any emissions in terms of environmental returns (flows, return temperatures, and temperature differentials)

### Water use, treatment, and disposal

Additional water requirements may be needed to meet the demands of the hydrogen fired plant and associated equipment, such as any hydrogen production facility or emission control system. Certain water streams may require additional treatment, such as raw water pre-treatment and demineralisation, to ensure it can be used within the converted power plant. Your report must discuss:

the water usage within the plant and associated equipment in terms of operational requirements (supply and discharge rates)

any treatment requirements for these water streams

the facilities requiring water usage

the location and spacing of any water treatment plants

You may also require a wastewater treatment plant to treat the effluent streams produced through the process. Your report must include:

the wastewater sources produced by the hydrogen converted plant

an estimate of the flowrate of wastewater to be treated

any treatment requirement for these wastewater streams

the location and spacing requirements of the wastewater treatment plant

the facilities which will produce wastewater sources

You may choose to reuse any existing on-site water plants to accommodate the additional demands for the hydrogen converted plant. In this case you must provide evidence that the capacity of the existing water and wastewater plants are sufficient to handle the increased demand of the hydrogen converted plant.

### Electrical loads

Modifications to the existing combustion plant and the introduction of a hydrogen production facility, if applicable, may lead to additional electrical load. Your report must include:

the estimated additional electrical load requirements

provisions that spacing is available for any additional transformers, switchgears, and electrical rooms in in your site plan

### Plant infrastructure

You must address the plant infrastructure in your report and site plan and where necessary make provisions to:

widen roads and add new roads to handle increased movement of vehicles

provide car parking to accommodate increased personnel and vehicle usage

indicate where major pipework routes would be required

extend or introduce new administration and operational buildings to accommodate additional personnel

extend or introduce new stores to accommodate increased equipment storage requirements

ensure a land plot has within the proposed site perimeter has been identified as an operational laydown & maintenance area and provide its location and footprint

ensure a suitable temporary laydown area for construction is available and provide its location and footprint

### 5.4 How to demonstrate access to hydrogen fuel

The third test that your plan must address is that of hydrogen fuel access. For both bespoke and standard rules permits, this is a self-certified test. When submitting your permit application, if you choose the HCR decarbonisation route, you will be required to include a ‘hydrogen fuel readiness certification’ statement. This will be a statement that you have reasonable grounds to believe that it will be possible, during the lifetime of the relevant plant to ensure access to a sufficient supply of hydrogen.

Methods to access a hydrogen supply include:

direct on-site production

importing from off-site production

For in-depth insights into considerations regarding hydrogen supply, please consult Section 3.5 of the [Hydrogen Readiness Technical Study](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1141549/hydrogen_readiness_report.pdf).

You may choose to also include a hydrogen fuel access diagram and any letters of engagement or expressions of interest with suppliers.

You must keep a record of your assessment as evidence which must be made available to the Environment Agency upon request.

### On-site production

If you select the on-site hydrogen production option, then you must ensure that the hydrogen production method you have selected for your site is compliant with the [UK Low Carbon Hydrogen Standard](https://www.gov.uk/government/publications/uk-low-carbon-hydrogen-standard-emissions-reporting-and-sustainability-criteria) (LCHS). The LCHS sets out the criteria for hydrogen produced via:

electrolysis

natural gas reforming with carbon capture and storage

biomass and biowaste conversion to hydrogen, with and without carbon capture and storage

When carrying out your assessment you must consider the following parameters:

the location and spacing required for your hydrogen production facility

the production capacity of hydrogen at your facility

any emissions arising from the production methods and proposed mitigation strategies

any health and safety considerations and their corresponding mitigations

You are advised to refer to the Environment Agency guidance on [Hydrogen production with carbon capture: emerging techniques](file:///C%3A%5CUsers%5CBajpaiE%5CDownloads%5CHydrogen%20production%20with%20carbon%20capture%3A%20emerging%20techniques%20-%20GOV.UK%20%28) and [Hydrogen production by electrolysis of water: emerging techniques](https://www.gov.uk/guidance/hydrogen-production-by-electrolysis-of-water-emerging-techniques) to aid you decarbonisation readiness application. You need to be confident that you could meet the criteria required of the permittable activity should you implement the readiness plan.

### Importing from off-site production

Depending on your specific circumstances, you may decide to import hydrogen from an off-site location. If you choose this approach, then you must ensure that the hydrogen supply is compliant with the LCHS.

There are various potential methods of importing sufficient and reliable supplies of hydrogen to your site. You can choose from the following supply methods:

pipeline

rail

road

ship

If you choose to import hydrogen through a **pipeline**, your assessment must:

ensure that a feasible route exists from the combustion plant to the connection point of the pipeline

estimate the daily hydrogen fuel demand of the plant, including daily hydrogen fuel demand for any plant expansion proposals to ensure future expansion of the plant is also catered for

consider the location and spacing requirements of any above-ground installations to receive the hydrogen

consider the location, spacing requirements, and capacity of any on-site storage, if applicable

consider any health and safety considerations and their corresponding mitigations

In your plan you cannot assume that a pipeline will be constructed to meet your demands. You must reference an existing or proposed infrastructure project which you can tie into.

If you choose to import hydrogen through a **non-pipeline** method, your assessment must:

estimate the daily hydrogen fuel demand of the plant, including daily hydrogen fuel demand for any plant expansion proposals to ensure future expansion of the plant is also catered for

consider the hydrogen carrying capacity of your non-pipeline transport option. For example, a single vehicle or single freight train delivery and the minimum daily traffic required to meet the plant’s fuel demands

assess whether local road/rail connections and onsite roads/rail can accommodate the expected traffic

consider the location, spacing requirements, and capacity of any on-site storage, if applicable

consider any health and safety considerations and their corresponding mitigations