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Appendices
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Date
Subject Government vision on hydrogen carriers

Dear Speaker,

Dutch public authorities and businesses are working hard to achieve the energy and raw materials transition and meet the climate targets. The Netherlands has a sound basic infrastructure, in part thanks to our seaports which are attractive for importing and transhipping goods, including hydrogen and hydrogen carriers. These goods do not only meet our own needs, but also those of other northwestern European countries, and especially Germany.

Hydrogen and hydrogen carriers[1] play a key role as raw materials and fuels for the transition to more sustainable industry, mobility and electricity production. Both domestic production and imports will be needed to meet the expected demand[2]. Ideally, some of those imports will eventually be transported through a European hydrogen pipeline network connected to countries in and surrounding Europe. However, hydrogen imported from more distant regions is expected to be transported by ship, mainly in the form of liquid hydrogen or hydrogen carriers. These forms of hydrogen are easier to transport by ship than hydrogen gas. The government anticipates that this will result in a mix of import streams, with multiple hydrogen carriers and modes of use coexisting. All hydrogen carriers have advantages and disadvantages in relation to the public interests described in the National Energy System Plan (NPE), being 'Affordable', 'Economically Robust', 'Reliable', 'Safe & Secure, 'Sustainable', 'Fair', 'Accessible', 'Spatial Planning' and 'Environment'. Hydrogen carriers also differ in the extent to which their supply chains (or parts thereof) are suitable for multiple applications[3]. It is important that future policy choices on whether to encourage or discourage specific hydrogen carriers take into account all these aspects, as well as the interests and capabilities of the stakeholders. The government vision is intended to facilitate this.

This Letter to Parliament is intended to inform you of the government vision on hydrogen carriers and is also written on behalf of the Minister of Housing and Spatial Planning. Part of this vision involves a reassessment of the 2004 government position on ammonia transport. The vision and reassessment were announced in the Letters to Parliament of 17 March 2023[4] and 26 April 2024[5]. The

[1] The vision focuses on those hydrogen carriers about which the most data is currently available: liquid hydrogen (LH_2), ammonia, two LOHCs (toluene-methylcyclohexane (MCH) and dibenzyltoluene/perhydro-dibenzyltoluene (DBT)), methanol and liquid synthetic methane (LSM), sometimes also referred to as e-LNG or e-methane. Sodium borohydride ($NaBH_4$), a technology which is still under development, was also investigated.
[2] Parliamentary paper 29023, no. 431, Parliamentary paper 29023, no. 512
[3] Adaptivity: a smaller risk of disinvestment (stranded assets) or lock-ins.
[4] Parliamentary Paper 32813, no. 1192
[5] Parliamentary Paper 32813, no. 1385

vision builds on the National Energy System Plan (NPE)[6] and outlines the government's preferences and points of concern regarding the deployment of liquid hydrogen and hydrogen carriers. The vision provides a framework which the government will use to implement measures to steer this deployment. We expect other public authorities and stakeholders to apply this framework as well. The plans and associated measures, such as spatial planning measures and forms of government support, will be developed in more detail in the subsequent processes, which are addressed at the end of this Letter.

Vision summary
The essence of the vision is that the government offers sufficient flexibility for the deployment of hydrogen carriers for the energy and raw materials transition, including through the provision of government support, particularly for the short term. In the medium and long term, the government will more emphatically steer the process, because end-users are expected – more than is currently the case – to have a range of hydrogen carriers and relevant modes of transport to choose from.
From a broad societal perspective, the government sees an important role for liquid hydrogen and liquid organic hydrogen carriers (LOHCs[7]), particularly for the conversion to hydrogen gas at the import port. There is also good potential for methanol and liquid synthetic methane (LSM), provided sustainable carbon is used[8].
The 2004 government position on ammonia transport was reassessed in the light of the energy and raw materials transition. Broadening and nuancing this position provides a more comprehensive picture of what the government considers desirable and undesirable developments. The government sees a clear role for ammonia in the development of a global hydrogen market, but also appreciates that this hydrogen carrier has drawbacks, especially in relation to the increased storage and transport volumes that are expected throughout the Netherlands. The government therefore prefers ammonia end-use or conversion to take place in seaports, and as far as possible from populated areas. Transit of ammonia is permitted, provided that this is done safely, and is preferably done in concentrated form by pipeline or barge. A widespread distribution of ammonia throughout the Netherlands and the expansion of ammonia transport by rail or road is undesirable, but cannot be entirely avoided. Especially in the absence of suitable alternatives, the vision allows this as temporary or fallback options (and as much as possible via the Betuweroute freight corridor). The government is more optimistic about alternative hydrogen carriers to ammonia, particularly in the medium and long term when more hydrogen carriers and modes of transport will become available. Although the market share of these hydrogen carriers may eventually surpass that of ammonia, the market for ammonia that is developed in the initial years of the transition is expected to remain in absolute terms.

Vision scope and process
Scope
With this vision, the government describes and substantiates the extent to which, the means by which, and the conditions under which the government aims to facilitate and potentially incentivise flows of hydrogen carriers within and through the Netherlands. It focuses specifically on the import, storage and transhipment, possible conversion to hydrogen gas, and transport of hydrogen carriers within the Netherlands.
Most of the demand for hydrogen and hydrogen carriers is expected to come from companies (end-users) in industry, power generation and the mobility sector. The vision therefore focuses mainly on these sectors' supply chains and dovetails with

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[6] Parliamentary Paper 32813, no. 1319
[7] Hydrogen can be bound to those organic carriers and extracted again at the destination.
[8] Carbon from sustainable bio-based raw materials, CO_2 captured from air or point sources, and recyclates. The EU Renewable Energy Directive sets conditions on carbon use. Sustainable carbon will potentially become a scarce resource. The NPE sets out principles for ensuring the optimal deployment of sustainable carbon. Large scale CO_2 reductions on a life cycle level are particularly achievable in combination with sustainable carbon from biogenic sources or captured from the air.

existing policies aimed at increasing the sustainability of the relevant companies and their facilities.

Given the high uncertainty about the exact course of the energy and raw materials transition, the exact nature, scale and timeframe of the demand for hydrogen and hydrogen carriers in the aforementioned sectors is not yet known. Moreover, a wide range of technological innovations and optimisations are currently still being implemented in the various supply chains. As a result, the advantages and disadvantages of the various hydrogen carriers are in flux. This poses a challenge to parties involved in existing (and future) supply chains and calls for adaptive government policy. At the same time, market parties and public authorities call for political direction here. In this vision on hydrogen carriers, the government provides as much clarity as possible as to its preferences for specific combinations of hydrogen carriers, end-uses and modes of transport. The assessment of public interests underlying this vision provides the necessary stability. Like the NPE, the vision on hydrogen carriers will be updated periodically.

Coordination and stakeholder participation
This vision came about through intensive cooperation between the ministries of Climate Policy and Green Growth and Infrastructure and Water Management in coordination with several other ministries[9], public authorities (provinces, municipalities, environmental agencies and safety regions), companies in the supply chain (port authorities, end-users, transport companies, storage and transhipment companies, and technology and energy providers), knowledge institutions and other representative bodies. Their input, combined with research reports and other publications, provides a sound information base for this vision. Neighbouring countries Belgium and Germany and the European Commission were also contacted as part of the process. European countries are expected to pay increasing attention to the advantages and disadvantages of hydrogen carriers, for instance as part of the import strategies developed by individual countries and by the EU as a whole. By promoting this vision at the European level, we aim to ensure this is carried out as consistently as possible.

Substantiating research and analyses
Parliament was informed in 2021[10] and 2023[11] about two previous studies on the external safety impacts of various hydrogen carriers and their expected volumes. Last year, a *Hydrogen Carrier Comparison* in the form of a multi-criteria analysis (MCA) was commissioned by the Ministry of Climate Policy and Green Growth, in which supply chains for various hydrogen carriers were assessed in relation to the public interests mentioned earlier in this Letter. The MCA report is attached to this Letter to Parliament and, together with the Social Cost Benefit Comparison (*Hydrogen Carriers MKBV*) shared with Parliament and others in April[12], forms an important building block for this government vision. You can read more about the MCA (methodology and key findings) and its relationship with some other relevant studies in the background document *Assessing hydrogen carriers,* which is also an annex to this Letter to Parliament.

Policy assessment method
To arrive at this vision, the hydrogen carriers from the MCA were assessed, while differentiating them by the various end-use applications and sites. For example, it is important to take into account whether the hydrogen carrier is used directly or is first converted to hydrogen gas, and whether it is used as a raw material or as a fuel. The geographical location of the relevant activities and the scale of demand also play a role.

[9] Ministries of Economic Affairs, Housing and Spatial Planning, Justice and Security, and Agriculture, Fisheries, Food Security and Nature. These ministries coordinated with their underlying regulatory bodies and implementing organisations.
[10] Parliamentary Paper 32813, no. 938
[11] Parliamentary Paper 32813, no. 1192
[12] Parliamentary Paper 32813, no. 1385

The assessment is primarily based on the advantages and disadvantages of hydrogen carriers in relation to the public interests specified in the NPE. It also took into account the extent to which companies (end-users) have alternatives available to them, i.e. the flexibility in the choice of hydrogen carriers and modes of transport available to them. The time horizon also played a role. More alternatives are expected to emerge in the longer term, both in terms of the available hydrogen carriers and the modes of transport (including pipelines). Finally, existing policy principles were also taken into account[13].

Key policy findings
A detailed explanation of the analysis and assessment of hydrogen carriers can be found in the background document in the annex: *Assessing hydrogen carriers*. The key findings are given here.

General preferences
In general, three preferences emerge from the analysis and assessment of hydrogen carriers:
1. *Site.* Seaports are the preferred sites for direct end-use or conversion to hydrogen gas, as far as these sites are spatially feasible and as far as possible from populated areas. This will prevent negative effects of further transport such as energy consumption and emissions, safety risks, infrastructure costs, and possible congestion in modes of transport.
2. *Mode of transport.* In general, the order of preference is: 1) pipeline, 2) barge, 3) rail, and 4) road. Nuances apply based on the nature of the substance, application, quantities and availability/feasibility of each mode. Each mode has a specific function, so a mix of modes of transport will always be required. Seaports can fulfil their function as transport hub only if there are efficient inland connections.
3. *End-use*. There is a preference for direct use of hydrogen carriers, without first converting to hydrogen gas. This will avoid energy losses and emissions, as well as preventing the need for additional space and avoiding the safety risks involved in conversion facilities. This preference does not apply to ammonia as a fuel (due to its specific properties). If direct use in port is not possible, and a sufficiently safe ammonia pipeline is lacking, the preferred option will be conversion to hydrogen gas in port, which will then be transported through the hydrogen pipeline network.

It may not always be possible to achieve the aforementioned preferences simultaneously. After all, not every end-user is located at a seaport and/or can use a hydrogen carrier directly. Not all end-users have access to all modes of transport, either geographically and/or based on their required volumes. In the background document in the annex, the preferences for each end-use case have been applied and compared where relevant. It is not yet certain to what extent there will be sufficient space for these activities in the port areas. The Novex programme is currently considering the spatial demands in port areas, among others.

The vision on hydrogen carriers
With this vision, the government provides a framework for contributing responsibly to the energy and raw materials transition based on the deployment of all types of hydrogen carriers. The vision offers the government latitude to actively support this transition, particularly in the short and medium term. In the longer term, the advantages and disadvantages of specific hydrogen carriers will carry more weight, because end-users are expected – more than is currently the case – to have a range of hydrogen carriers and relevant modes of transport to choose from.

[13] These include the Netherlands' continued role as an international energy hub (NPE), the commitment to diversification of hydrogen carriers, the framework for safety and health in the energy transition, and the central principles regarding spatial footprints in the National Strategy on Spatial Planning and the Environment (NOVI) and the preliminary draft of the National Spatial Strategy.

For all hydrogen carriers, various steps in the supply chain will need to be further developed. Sometimes this will involve the production phase, other times it will be transport or the conversion to hydrogen gas. Renewables flows will generally be in addition to existing fossil flows for the time being. This means that a significant number of new plants, maritime and inland shipping vessels, and storage tanks will have to be built to create capacity. This also applies to existing technology and substances that are already being transported on a relatively small scale. Over time, fossil facilities will be replaced by new and sustainable activities or become available for reuse.
The government is optimistic about the deployment of LH_2, LOHCs, methanol and LSM, as substantiated in the background document *Assessing hydrogen carriers*. Ammonia has a separate position. This is discussed in more detail later in this Letter, particularly in the section on the reassessment of the 2004 government position on ammonia. Below we list a number of specific points of attention for the other hydrogen carriers.

1. *LH_2* scores best in the MCA from a broad societal perspective. LH_2 can be converted to hydrogen gas relatively efficiently, cleanly and with a limited spatial footprint once it arrives in the Netherlands. There are still challenges for the large-scale deployment of LH_2, such as the required cooling, hydrogen evaporation (boil-off) despite good insulation, and transport by barge, which is currently not allowed under international regulations.
2. *LOHCs* are derivatives of petroleum products that are already currently used in industry. This provides opportunities for the reuse of existing infrastructure. LOHCs score high for the public interests 'Safe & Secure' and 'Sustainable' in the MCA. Hydrogen can be bound to LOHCs and extracted again at the destination. This does mean that the carrier has to be returned to source, which will require additional storage capacity in the Netherlands. The LOHCs considered in the MCA make use of Substances of Very High Concern (ZZSs). This is a point for concern, although the considered LOHCs are not ZZSs in themselves. Several types of LOHCs are currently under development, including without ZZS components.
3. *Methanol* does not need cooling, does not need to be returned to source, and is already widely used in industry today. It is a relatively easy substance to store and transport. Methanol is not substantially different from other fuels and raw materials that are already widely transported through the Netherlands, and therefore raises fewer new policy concerns. However, methanol is produced from carbon. Sustainable carbon will potentially become a scarce resource. Methanol is among the best scoring hydrogen carriers in the MCA in relation to all public interests, with the exception of 'Sustainable'. When sustainable carbon is used to produce it, methanol comes out as the best hydrogen carrier across the board. Methanol is a toxic substance, but if it is accidentally released into the environment it does not produce a toxic cloud.
4. *LSM* is the renewable equivalent of LNG (Liquefied Natural Gas). LSM can be stored and transported using existing infrastructure, such as LNG terminals and, in the form of methane gas, underground gas storage and the natural gas pipeline network. Methane, like methanol, is produced from sustainable carbon, which will potentially become scarce in the future. Industrial-scale LSM production is still under development. The production cost of LSM is currently higher than that of other hydrogen carriers. Methane emissions in the supply chain must be minimised, as methane is a strong greenhouse gas. The supply chain for methane gas from LSM has the highest score for electricity generation.

The studies reveal that methanol and LSM have significant societal advantages over other hydrogen carriers, both for intercontinental transport and transport within the Netherlands. Making end-users sustainable through the application of these substances does require a further development and monitoring of the sustainable carbon chain. A combination of sustainable carbon-based production and carbon capture (CCS) by the end-user could eventually help achieve negative carbon emissions (carbon removal). Captured carbon can also be used as a renewable raw material.

For the transition to fully renewable supply chains, the government particularly sees a role for LH_2 and LOHCs, especially in the short and medium term. Given the challenges for large-scale transport, LH_2 is mainly suitable for centralised conversion to hydrogen gas and smaller-scale distribution of hydrogen, such as for the mobility sector. LOHCs can also be used for larger-scale transport, especially for end-users not yet connected to a hydrogen gas pipeline network.
Due to limited technology maturity, no significant role is expected for sodium borohydride ($NaBH_4$) in the short and medium term. The international ban on bulk transport of this substance means that any applications will focus on specific niches for the time being.

Government position on ammonia
Ammonia has its own paragraph in this Letter because of the existing government position on ammonia transport issued in 2004. Furthermore, in the event of an incident or accident, ammonia is the only hydrogen carrier under consideration that can form a toxic cloud that will be difficult to contain by responders and difficult to avoid for people in the vicinity, and that also will cause major environmental damage. Important concerns with ammonia storage and transport are therefore safety[14], the spatial planning, and the impact on the environment.

Findings on ammonia
The government has noted that many of the globally announced projects involving intercontinental transport of hydrogen focus on the use of ammonia. This hydrogen carrier makes it possible, in a relatively short timeframe, to reduce the carbon emissions of end-users at competitive prices. Moreover, the investment risks are relatively small compared to other hydrogen carriers, because ammonia is already traded globally and has multiple uses. Ammonia is relatively easy to store and transport. Research reports and analysis indicate, however, that alternatives to ammonia clearly also have potential, even though until recently these substances received less attention from the market. The market share of these alternatives may eventually exceed that of ammonia. Nevertheless, the market for ammonia that is developed in the coming years will probably remain in absolute terms.

The analyses show that ammonia can be a suitable hydrogen carrier for end-use or conversion to hydrogen gas at the import port. If ammonia has to be transported inland or further into northwestern Europe, this can best be done through a pipeline, provided it meets specific conditions. The vision therefore provides latitude to temporary incentivise ammonia crackers in import ports, and for the government to facilitate the construction of ammonia pipelines. Because of the lack of alternative hydrogen carriers and modes of transport in the short term, the vision also provides latitude to temporarily allow the development of small-scale decentralised applications of ammonia. This particularly concerns the decentralised conversion of ammonia to hydrogen gas in places where a connection to the hydrogen network is not yet available, provided the ammonia can be transported by barge.

Ammonia transport through the Netherlands using modes other than pipelines does not score as well in the MCA, partly because of risks related to transport safety, external safety and the spatial footprint. Therefore, the government generally favours ammonia less than other hydrogen carriers when it is used in decentralised applications and transported widely via other modes. This takes into account that the fragmentation of ammonia activities across the Netherlands will

[14] These include the risks and costs related to external safety, transport safety and cybersecurity and terrorism. The industry is currently cooperating with the government to increase safety and safety perception, such as by updating the guideline for the safe storage and handling of ammonia in the Hazardous Substances Publication Series (PGS-12).

pose additional challenges in terms of licensing, oversight and enforcement, as well as risk and crisis management. The Dutch safety regions will have to prepare for new risk types and frequencies in their incident response strategies. Together with the Ministry of Justice and Security and other parties, further research will be conducted into the potential consequences of an incident involving hydrogen carriers, and the degree to which the incident response plan will be able to manage the risks for local residents and emergency workers.

Reassessment of the government position on ammonia transport (2004)
Although the likelihood of an incident is very low, on 22 December 2004 the Council of Ministers adopted a position on ammonia transport through the Netherlands. This position states (among other things) that: "*ammonia transport, particularly by rail, will be curtailed as much as possible, and new ammonia flows will be reduced depending on their social costs and benefits*." Taking into account the targeted flows of ammonia at the time, the principle of spatial clustering of activities involving ammonia was adopted to reduce the need for transport across the country. This policy has led to a major reduction in ammonia transports.

This Letter includes a reassessment of the position taken in 2004, because ammonia can clearly play a role in the energy and raw materials transition,. This will lead to more market parties who are involved in ammonia, new forms of end-use, and increased transport volumes. The result of the reassessment is that, based on the studies and analyses conducted, the government has broadened, and brought nuance to, the previous government position. This is done by differentiating by the various end-use applications, sites and routes, and by distinguishing between short-term and longer-term developments. Moreover, the transportation mode rail (which was the focus in 2004) is considered within the broader context of other potential modes. Some of this broadening has already been incorporated into the 'general preferences' as mentioned earlier in this Letter. Specific preferences for ammonia transports are discussed below.

We note that in 2004, no distinction was made between ammonia liquified by cold and compressed (warm) ammonia. This vision assumes the existing ammonia supply chains, i.e. that ammonia is imported as a cold liquid by maritime vessels and stored in cold liquid form near the landfall site in port. The ammonia is generally transhipped, transported and used in a compressed (warm) state. International regulations currently prohibit transportation by road and rail in cold liquid form. However, because of the expected benefits of this type of transport (in terms of external safety and energy efficiency, among others), there is reason to further explore whether and under what conditions the international regulations could be changed.

Ammonia transport through pipelines
The government generally considers the transport of dangerous goods through pipelines to be the most desirable option (in relative terms). The same applies for ammonia transport, but under certain conditions. This is because a pipeline incident could potentially lead to the release of a large volume of ammonia, resulting in a relatively large area being impacted. This means that ammonia pipelines will require special design and security features, such as smaller pipe diameters and measures to reduce the likelihood of failures and limit the volume released in the event of an incident. The government considers it reasonable that this will lead to additional costs. The government only sees a role for ammonia pipelines for main transport routes and within industrial clusters, i.e. not for general distribution. A private consortium of companies is exploring options for an ammonia pipeline from Rotterdam to end-users in Germany as part of the Delta Rhine Corridor (DRC). The national government is providing support here. A feasibility study is also being carried out into connecting the Zeeland industrial cluster to this ammonia pipeline.

Ammonia transport by water

After transport by pipeline, transport by barge is the preferred option based on current understanding. This is partly because inland waterways are further removed from built-up areas compared to rail or road transport. If ammonia is transported in a cold liquid form, this will likely have additional benefits, including for safety. In the MCA, ammonia transport by water scores substantially better than transport by rail or road for the public interest 'Safe & Secure'. Transport by water is suitable for relatively large volumes of ammonia to point locations that are accessible by water. Points of concern are the risks of shipping accidents for people and the environment, international regulations for inland navigation, and possible transport limitations (e.g. due to changing water levels).

Ammonia transport by rail
After transport by water, the next preference for ammonia transport is by rail. The transport of dangerous goods by rail in the Netherlands is exceptionally safe thanks to far-reaching infrastructure measures and safety features built into the system. At the same time, it is important to note that this mode of transport sometimes takes place nearby, or through, densely populated areas. The Netherlands has plans to build thousands of new homes, also including in or near these areas. The potential impacts and their manageability in the event of an incident or accident during an ammonia transport justify the government's commitment to the following:

1. Limit the creation of new regular rail transport of ammonia as much as possible.
2. Potential transport by rail as much as possible via the Betuweroute corridor (especially from Rotterdam).

Supply chain parties wish to minimise their dependence on only a single mode of transport to safeguard their security of supply. Where parties consider ammonia transport by rail as a means to achieve this, the government's preference is for this to be seen only as a temporary or fallback option, and making as much as possible use of the Betuweroute corridor.

Ammonia transport by road
Road transport is suitable for transporting small volumes to locations that cannot be reached by any other mode of transport. In addition to the aforementioned government position on transport by rail, the government is also committed to limiting new regular ammonia transport by road. This is because the risks of transport by road are higher than for rail, mainly because of the significantly higher likelihood of an accident (because the road is shared with other traffic).

From vision to implementation: follow-up
<u>Steering options</u>
This vision serves as a framework for future policy choices[15].This does not only concern the policy choices of the national government, but also of the regional authorities and other stakeholders such as port authorities, environmental agencies and grid operators. Coordination with and between these parties is needed to determine where they can (and cannot) steer. During the development of concrete measures, budgetary consequences will be taken into account. In consultation with the aforementioned stakeholders, an initial assessment was carried out on the effectiveness of various options to steer market development in consistency with the vision, and the willingness to deploy them. The assessment revealed that there are opportunities in the short term in the implementation of spatial plans, potentially combined with financial and other support for specific initiatives. The National Spatial Strategy will include a description of the spatial impact of implementing this vision.

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[15] In addition to the follow-up to the NPE and the Energy Memorandum, other choices include the further elaboration and implementation of, among others, 'hydrogen energy diplomacy', the National Spatial Strategy and the Novex programme, the Main Energy Structure Programme (PEH), the Pipeline Transport System policy framework, the Delta Rhine Corridor, the Robust Basic Network, the National Industry Sustainability Programme (NPVI), the Goods Transport Agenda, the Multi-Year Energy and Climate Infrastructure Programme (MIEK) and the tailor-made agreements with major industrial parties.

An exploratory study has been launched to identify all options available to the national government and other stakeholders to steer consistent with the vision. Further agreements will be made based on the results of this study, with particular attention to feasibility. Parliament will be informed about this midway through 2025.

Monitoring
The government ensures adaptive policies by maintaining a dialogue with all stakeholders. We also continue to develop our existing contacts with neighbouring countries and the European Commission. In addition, as long as the system for hydrogen carriers is still evolving, the government plans to periodically (every 2-3 years) commission a comparative study of hydrogen carriers, incorporating the most up-to-date information and insights[16]. The government will also identify which innovative hydrogen carriers[17] are under development and what their potential is. The government will also assess and monitor the balance between imports of European hydrogen gas by pipeline versus imports of hydrogen carriers by ship, both in terms of their volumes, timeframes and impacts on import terminals and modes of transport.

Safety guideline and broad environmental impact studies
The *safety guideline for hydrogen carriers*[18] describes the existing legal framework for working with hydrogen carriers. The guideline outlines the perspectives for action for government bodies in their role as competent public authorities. The aim is to deal more explicitly with risk management and specific areas of concern (based on the Environment and Planning Act) in a second version to be published in the near future.
The guideline advises the relevant public authorities to conduct broad environmental impact studies to identify the potential cumulative effects of future hydrogen imports in their (port) area and of the related activities. Rotterdam and Zeeland have already launched such a study, with the provincial government taking the lead. It is expected that certain impacts (in particular in relation to inland transport) will be difficult to deal with at the regional level. These call for a more overarching, national approach. We see a role for the national government and umbrella organisations here. On the one hand, they can build a better understanding of the overall picture and blind spots that emerge from the regional analyses, and on the other they can respond to issues that need to be addressed at the national level. The potential added value of a national impact study or bottleneck analysis will be considered in consultation with the various public authorities.

Storage
For the purpose of this letter (and the background document *Assessing hydrogen carriers*), the storage of hydrogen carriers is considered as part of the overall supply chain of individual companies (storage in tanks at import terminals and end-users). The government will carry out or commission an analysis of the potentially wider function of hydrogen carrier storage in the coming period. This will involve a specific examination of two aspects of storage:
- The extent to which above-ground storage of hydrogen carriers in storage tanks can complement underground (seasonal) storage of hydrogen gas[19]. This

[16] These studies will include the insights from GroenvermogenNL's HyTROS R&D programme.
[17] E.g., solid hydrogen carriers such as sodium and potassium borohydride, iron powder ('iron fuel') and caustic soda, and alternative/new LOHCs and substances such as formic acid, dimethyl ether (DME), ethanol and ethene (ethylene).
[18] https://www.rvo.nl/onderwerpen/waterstof/richtsnoeren-waterstof
[19] Relevant aspects here are the volumes that can be stored, the speed (i.e. capacity) with which these volumes can be introduced into the system, and the extent to which the geographical distance between the storage site and end-user plays a role. These aspects are particularly relevant for meeting the future peak demand of gas-fired power plants (when they switch to carbon-free energy carriers such as hydrogen to achieve more sustainable controllable capacity).

will be worked out in conjunction with the vision on underground hydrogen gas storage in salt caverns and empty gas fields announced by the government[20].
- Strategic reserves. Currently only petroleum products are stored as strategic reserve.

International regulations
The government wants to work with sector parties to explore options under international regulations to enable ammonia transports by road and rail in cold liquid form instead of compressed ammonia. To this end, we will assess the extent to which this will lead to improvements in, among others, external safety and energy efficiency in the supply chain, and the technical challenges involved. Furthermore, the vision provides reasons or the government to commit to approving the transport of LH_2 by barge under international treaties.

In conclusion
With this Letter, the government has presented its vision of how the market for hydrogen carriers should preferably develop from a broad societal perspective, taking into account the availability of hydrogen carriers and modes of transport in the short and medium term. In doing so, the government reinforces its commitment to a rapid energy and raw materials transition.

Sincerely,

THE MINISTER OF
CLIMATE POLICY AND GREEN GROWTH,

Sophie Hermans

THE STATE SECRETARY FOR
INFRASTRUCTURE AND WATER
MANAGEMENT - PUBLIC
TRANSPORT AND THE
ENVIRONMENT

Chris Jansen

[20] Government programme: elaboration of the outline agreement by the government (Parliamentary paper 2024D33033). The government plans to share this vision with Parliament in early 2025.