Economic regulation of hydrogen transport networks

Final report – Executive summary (English)

Client: Ministry of Economic Affairs and Climate Policy

Rotterdam/Delft, 31 May 2018

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Ecorys:

- Robert Haffner (Project Leader)
- Lars Meindert
- Manel van der Sleen
- Harry van Til

TNO:

- Leonie Beekman

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Note to the reader

In the first half year of 2018, Ecorys and the Netherlands Organisation for Applied Scientific Research (TNO) carried out an exploratory study on the potential for economic regulation of hydrogen transport networks in the Netherlands. This study was commissioned by the Ministry of Economic Affairs and Climate Policy ("*Ministerie van Economische Zaken en Klimaat*")

This document contains the English translation of the original (Dutch) executive summary of the final report. The title of the original study is "*Waterstoftransport – verkenning marktordeningsalternatieven*" and can be found via the following link:

- https://www.rijksoverheid.nl/documenten/rapporten/2018/05/31/waterstoftransport-%E2%80%93-verkenning-marktordeningsalternatieven

For more information about this study, please contact the involved experts of Ecorys or TNO.

Ecorys Netherlands:

- Robert Haffner; E: Robert.haffner@ecorys.com
- Lars Meindert; E: lars.meindert@ecorys.com
- T: +31 10 4538 800 (general number)

Netherlands Organisation for Applied Scientific Research (TNO)

- Leonie Beekman; E: leonie.beekman@tno.nl
- T: 088 866 00 00 (general number)

Management summary

I. Introduction and context of this study (Chapter 1)

Context of this study

In 2016, the Netherlands committed itself to the goals agreed on in the Paris climate agreement. Furthermore, the Rutte III government's coalition agreement (2017)[1] states that the Netherlands must become more sustainable and must be ambitious in this respect. For a long time now, hydrogen has been regarded as an important energy carrier that can contribute to the transition to a low-carbon economy. In March 2018, the Energy Top Sector presented its 'Hydrogen Roadmap' (*Routekaart Waterstof*) (hereinafter: the roadmap), which contains an analysis of where and how the use of sustainable hydrogen can be embedded in the Dutch energy and raw materials system.[2] Legislation and regulations, or the absence thereof, should not form an obstacle to the smooth development of the use of hydrogen in our energy system. In this context, the roadmap notes that the current legislation and regulations are not yet fully equipped for the introduction of hydrogen and that it must be considered whether and when it is necessary to include the (economic) regulation of hydrogen networks.[3]

Objective and research questions

In order to facilitate future policy-making on the energy transition, the Ministry of Economic Affairs and Climate Policy (*Ministerie van Economische Zaken en Klimaat, EZK*) requested Ecorys and the Netherlands Organisation for Applied Scientific Research (TNO) to carry out an exploratory study into the various regulatory alternatives. The purpose of this assignment is to (i) investigate the advantages and disadvantages of regulating the transport of hydrogen and (ii) formulate a recommendation concerning the way forward with respect to the economic regulation of hydrogen transport. This recommendation will also cover the possible changes required in existing legislation. Four main research questions were formulated for the study:

1. What does the current and future hydrogen (transport) market look like?
2. Which market models best suit the market initiatives?
3. What are the main advantages and disadvantages of the alternatives? This relates specifically to elements such as use, competition and costs.
4. What is the final recommendation on the regulation of hydrogen network operators?

Applied approach and contextualisation

This study was initiated shortly before Christmas 2017 and completed in May 2018. Different data collection instruments have been used for answering the various research questions. First and foremost, the available public information was analysed. In addition, 17 in-depth interviews were conducted by the research team. At the end of March 2018, the provisional findings were discussed in an experts' session with various stakeholders (market parties, policy makers, etc.). The research team was supported by a sounding board of a few external experts

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1 Dutch political parties People's Party for Freedom and Democracy (VDD), Christian Democratic Appeal (CDA), Democrats 66 (D66) and the Christian Union (ChristenUnie), *Vertrouwen in de toekomst - Regeerakkoord 2017 – 2021* [Confidence in the Future - Coalition Agreement 2017 - 2021], October 2017

2 Energy Top Sector, TKI New Gas, *Contouren van een Routekaart Waterstof* [Outlines of a Hydrogen Roadmap], March 2018

3 *Routekaart Waterstof* [Hydrogen Roadmap], p. 61

The objective of this study is to explore potential options for the regulation of the market for hydrogen transport. In this study, we have followed the definition of Van Damme et al (2015), namely, that market regulation encompasses the entire set of laws and regulations that define which companies are allowed to be active in the market (entry regulation) and under what conditions (conduct regulation), as well as what options are available to consumers. This market regulation (or market design) differs from market organisation (models) which essentially describe how parties that are active in the market organise themselves.

II. Market analysis and need for transport (Chapter 2)

Research question 1: What does the current and future (transport) market look like?

What are the conceivable applications of hydrogen today and in the medium term?

There are different ways to segment the application of hydrogen. Firstly, in terms of origin, there are roughly three types of production: (i) electrolysis with green electricity, (ii) splitting ('decarbonisation') of fossil fuels and (iii) hydrogen as a by-product of chemical processes. By far the largest share (68%) of the current production involves the use of hydrogen as raw material for (in-house) production processes such as the production of ammonia and refining of crude oil. Secondly, a distinction can be made based on the type of production and whether or not carbon dioxide is released during this process: via electrolysis and sustainable electricity ('green'), via the gasification of carbon ('grey') and in such a way that the released carbon dioxide can be captured and stored ('blue'). Thirdly, a distinction can also be made based on application in (i) industry[4](ii) traffic and transport and (iii) the built environment. Each of these applications gives rise to its own demand for specific forms of hydrogen, for example, based on the purity of the hydrogen.

How is the need for hydrogen transport expected to evolve in the future?

The recent publication 'Outlines of a Hydrogen Roadmap' indicates that a large demand for hydrogen may arise in a situation where the Netherlands has a climate-neutral energy supply. An indicative analysis leads to a theoretical demand of approximately 14 megatonnes[5], which is more than 22 times the current industrial hydrogen demand in the Netherlands. Industrial applications that use high-temperature heat, in particular (sustainable) chemical processes and fuel production, are expected to constitute the largest part of this demand (in the region of 80%). In terms of the need for transport, we expect transport via pipelines to play an important, if not dominant, role in this situation. Currently, such pipelines are mostly in private hands. Partly based on the use of the 'redundant' gas infrastructure which has become available for use and which is now publicly owned, public players are expected to play a greater role in the transport of hydrogen. However, it should be noted that there is still a great amount of uncertainty regarding the development of the market (as well as the need for transport).

[4] A specific group in this category is the energy sector. Hydrogen is also used for producing electricity in controllable, flexible gas-fired power stations.

[5] This is an indicative estimate to give an idea of the scale; the estimate is not for a specific year but for a climate-neutral energy supply.

III. Rationale for intervention (Chapter 3)

Research question 2: Which market models best suit the market initiatives?

What public interests are at stake and must be safeguarded? Is there currently any type of market failure and/or is it likely that a risk of market failure will occur?

Whereas clear public interests have been defined for other sectors (affordability, reliability, accessibility, etc.), there are no such explicit public interests (as yet) that need to be safeguarded for the transport of hydrogen. Analysis shows that, at present, there are no fundamental situations of 'market failure'[6] that require immediate intervention. However, with a view to the future, (i) the existence of externalities[7] and (ii) the risk of market power[8] may be important reasons for justifying government intervention. These externalities mainly relate to the future transition to a low-carbon or carbon-free economy. In addition, the risk of abuse of market power increases as the importance of hydrogen transport via pipeline networks increases; in that case, generic supervision via the Competition Law (*Mededingingswet, Mw*) may not be sufficient. Finally, a special factor in this particular context is that the existing gas infrastructure, which is suitable (with certain modifications) for the transport of hydrogen, can be (partly) used for hydrogen transport. This would contribute to a cost-effective energy transition.

Which market regulation alternatives are appropriate for the market developments?

Market regulation is made up of various building blocks. The overall set-up and relationship between these building blocks ultimately determines the effectiveness of the intervention and hence this differs considerably per sector. For the purpose of our analysis, we have defined four market regulation alternatives. Alternative A is based on generic supervision based on the Competition Law. Alternative B makes use of the significant market power (SMP) instrument. Alternatives C and D involve stricter sector specific regulatory instruments, where system operators[9] are assigned an exclusive role in Alternative D. These alternatives are summarised in the following table. In all variants, there is scope for the reuse of the existing gas infrastructure.

Details of market regulation alternatives A to D

	Alternative A: Free market	Alternative B: SMP	Alternative C: Non-exclusively public	Alternative D: Exclusively public
Type of regulation/supervision (Building Block 1)				
Generic (based on the Mw)	✓			
Sector-specific (incl. SMP)		✓	✓	✓
Type of players/ownership (Building Block 3)				

6 Market failure is a concept based on economic theory: in the event of a market failure, intervention by the government may be justified. Traditionally, four types of market failures can be distinguished: market power, externalities, information asymmetry and the presence of public goods.

7 Externalities are positive or negative consequences for a third party that are not immediately taken into account by market parties. Environmental pollution is a typical example of a negative externality.

8 In case of a market power situation, providers have the opportunity to behave independently of the competition and abuse their market position for their own gain.

9 Please note that the Dutch regulatory system makes a distinction between the system operators ('netbeheerders') and the commercial sister company of a system operator ('netwerkbedrijf' *or cosico*). The various system operators (i.e. distribution system operators and transmission system operators) have a specific public task which is determined in the Electricity and Gas Act 1998.

	Alternative A: Free market	Alternative B: SMP	Alternative C: Non-exclusively public	Alternative D: Exclusively public
Private market players may be active (with their own network)	✓	✓	✓	No; only based on exemptions
System operator is assigned a public task	No	No	Yes, but non-exclusively	Yes, exclusively
"Cosico"[10] active in the market	✓	✓	✓	✓
Access to network (Building Block 2)				
Rules of access (process) ➢ For private players ➢ For public players	 No No	Possible, after decision of the Netherlands Authority for Consumers & Markets (ACM)	 Private: yes Public: yes	 Private: n/a Public: yes
Rules of conduct (non-discrimination) ➢ For private players ➢ For public players	 No No		 Private: no Public: yes	 Private: n/a Public: yes
Assessing role played by the ACM in case of conflicts, in addition to the Competition Law (Mw)	No (Mw)		Private: yes (process) Public: yes	Private: n/a Public: yes
Network tariffs (Building Block 2)				
Tariff rules (cost orientation) ➢ For private players ➢ For public players	 No No	Possible, after decision of the Netherlands Authority for Consumers & Markets (ACM)	 Private: no Public: yes	 Private: n/a Public: yes
Rules of conduct (non-discrimination) ➢ For private players ➢ For public players	 No No		 Private: no Public: yes	 Private: n/a Public: yes
Tariff regulation by the ACM (tariffs for public players)	No		No	Yes
Assessing role played by the ACM in case of conflicts, addition to the Competition Law (Mw)	No (Mw)		Private: no Public: yes	Private: n/a Public: yes

Note: by 'public players', we mean system operators and/or the commercial sister company of a system operator; a more detailed explanation is provided for each variant. 'Mw' is the Dutch abbreviation for the Compeition Law (*Mededingingswet*).

[10] Commercial sister company of a system operator ("*netwerkbedrijf*").

IV. Market regulation alternatives and their assessment (Chapter 4)

Research question 3: What are the main advantages and disadvantages of the alternatives? This relates specifically to elements such as use, competition and costs.

Alternative A for market regulation: free market

In this alternative, there is scope for both private parties and *Cosico's* to be active within the hydrogen transport market, but no clear instructions or responsibilities have been assigned to *Cosico's* for this. The advantage of this alternative is that there is ample scope and freedom of decision-making for private parties as well as the *Cosico's* that compete with each other under the normal market conditions. The major disadvantages of this alternative are mainly related to the absence of any leaderships, uncertainty about the role assumed by *Cosico's*, uncertainty about future regulation, possible disruption of the level playing field and risk of competition issues in the future.

Alternative B for market regulation: SMP instrument

This alternative is linked to the SMP instrument. The key feature of this SMP instrument is a periodic market analysis performed by the regulator, after which specific 'obligations' are imposed depending on the results of the analysis. This instrument offers a solution for one of the major disadvantages of Alternative A, namely, the risk of possible competition issues. If the market analysis shows that there are (potential) competition issues, appropriate regulatory measures can be taken for this. In comparison to Alternative A, this gives users of hydrogen networks the advantage of having continued access based on reasonable tariffs and conditions. However, some of the major disadvantages of Alternative A, particularly the absence of any leadership and uncertainty about the role of *Cosico's*, are also present in this alternative.

Alternative C for market regulation: non-exclusively public

In this alternative, there is room for both private and public parties, but less freedom for *Cosico's* (including the system operator) than under Alternative A. A clear role is assigned to the system operator while, at the same time, rules are specified for access to the network (for private and public players) and the tariffs to be applied (for public players). An important advantage of this alternative is the explicit role, whether temporary or otherwise, assigned to system operators and the role they can play in encouraging market developments. At the same time, the rules on access and tariffs may reduce the risk of specific competition issues, although this does not guarantee a smooth execution. Both open and closed standards leave room for discussion and/or the creation of conflicts that can lead to additional societal costs.

Alternative D for market regulation: exclusively public

Whereas Alternative C still offered room for private market parties, the transport of hydrogen in Alternative D comes to lie exclusively in the hands of system operators and the various building blocks for ex ante regulation are laid down more stringently. In this alternative, users of hydrogen networks have the certainty (in the long term) of gaining access at reasonable tariffs. Economies of scale can be exploited, as only a limited number of companies are allowed to operate hydrogen networks. A disadvantage is that there is no competition between the various operators, due to which there is a risk of inefficiency. This can be partly prevented by including incentives in the tariff regulation for improving efficiency. Regulatory costs in this variant are relatively high, but predictable. In the short term, this option may delay the development of new transport infrastructure, because only a limited number of parties are allowed to transport hydrogen.

V. Conclusions and recommendation (Chapter 5)

Research question 4: What is the final recommendation on market regulation?

Is regulation (currently) necessary for countering market failure?

The analysis in Chapter 3 shows that, at present, there are no situations involving a strong and fundamental market failure. Hence, intervention is not immediately necessary, but by (i) creating a role for system operators and (ii) creating rules on access and tariffs, Alternative C can contribute in the near future towards limiting competition risks and facilitating the desired transition to a low-carbon energy supply.

Which market regulation alternative is appropriate?

Our analysis shows that each of the four different market regulation alternatives has its advantages and disadvantages. Alternative C is the most balanced choice. The absence of a specific 'problem' at present and the uncertainty regarding the development of hydrogen means that there are no compelling arguments in favour of stringent intervention (Alternative D). Alternatives A and B offer a lot of opportunities in terms of the development of the market, but do not offer a clear incentive for creating a low-carbon energy supply. Alternative C is admittedly a 'hybrid' solution which also has its disadvantages, but nevertheless contributes to the development of hydrogen infrastructure by providing room for both private and public parties. At the same time, this alternative limits the number of competition risks and contributes to public interests such as security of supply and sustainability. Finally, this alternative allows public system operators to play a proactive role by gradually using the natural gas infrastructure (managed by public system operators) for the transport of hydrogen.

From when or at what particular moment can/must regulation be applied?

As indicated, there are currently no strong and fundamental market failures that require immediate action. This gives the time and space to properly prepare the proposed market regulation. A clear 'turning point' for regulation cannot be indicated, as the market will gradually develop and the exact course of development is (very) uncertain. Some important observations in this context:

- The generic supervision via the Mw guarantees that, if specific competition risks arise, the ACM can take action on a *case-by-case* basis. This makes it possible to keep track of developments in the market (no need for direct intervention).
- The revised Gas and Electricity Act 1998 (*Gas- en Elektriciteitswet*) offers a number of options for further elaborating parts of Alternative C. Specifically, this includes the creation of a temporary role for system operators, which can be defined with the help of underlying regulations (e.g. via an "*algemene maatregel van bestuur*", which is a governmental decree).
- In order to expand the responsibilities of system operators (permanent task) and create a legal basis for the proposed measures concerning network access and tariffs, the current laws and regulations need to be adjusted, and this takes time. Possibly, in this respect, we can link up to the existing initiative of creating more comprehensive energy legislation in the coming years.

What changes need to be made in laws and regulations?

A number of aspects are relevant in this context. Firstly, based on current laws and regulations, a more detailed interpretation is required of the role and task of the system operators and/or *Cosico's*. This can be done, for example, by providing for a temporary role for system operators. In addition, in the longer term, preparations can be made for more comprehensive energy legislation, and particularly the implementation thereof with respect to hydrogen. Finally, it is particularly important

to establish a clear legal basis for the various measures we have proposed under Alternative C (see Chapter 4 of this report).

PO Box 4175
3006 AD Rotterdam
The Netherlands

Watermanweg 44
3067 GG Rotterdam
The Netherlands

T 010 453 88 00
F 010 453 07 68
E netherlands@ecorys.com
Chamber of Commerce no. 24316726

W www.ecorys.nl

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