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The socio-economic impacts of the closure of the Groningen gas field

Challenges and opportunities of the energy transition in the Northern Netherlands

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Foreword

As a result of the governmental decision to stop extracting natural gas from the Groningen field (planned for 2022), the region of Northern Netherlands will face considerable economic- and human capital-related challenges. To tackle the negative impacts of these challenges, the four biggest cities in the Northern Netherlands – Groningen, Leeuwarden Assen and Emmen - have teamed up to develop an Action Roadmap in which concrete activities are proposed to keep the regional economy and the labour market vivid. To do so, the four cities have established a taskforce consisting of representatives of the region's quadruple helix involved in determining the projects objectives and design, while also serving as the cities' sounding board. Their participation to the project ensured the wide support of the region's stakeholders. The taskforce will remain active in the follow-up and the execution of the Action Roadmap.

In December 2018 the cities of the Northern Netherlands asked the Joint Research Centre (JRC) to provide an independent scientific analysis for the identification of the regional socio-economic impacts of the phasing out of Groningen gas extraction. The discussion with the Joint Research Centre started right after with a first meeting in Petten in March 2019 and an initial exchange of documents and information during the months of April and May 2019. In the same period the taskforce created ad hoc for this mission and led by the municipality of Leeuwarden made available to the JRC the outline for the action roadmap on transition. In September the JRC presented their findings at the second taskforce meeting hosted by the Deputy Mayor Friso Douwstra from Leeuwarden. The presentation was followed by a discussion and the works closed with the identification of the first actions of the roadmap, resumed in the memo of the meeting prepared by the taskforce. The JRC presented the result of the study also at the final Conference organized in Leeuwarden by the cities of Northern Netherlands and the municipality of Leeuwarden on the 3 and 4 December 2019. The outcome of the conference is published in the report "Northern Netherlands in Transition Conference Results".

Acknowledgements

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Abstract

During the year 2019 the DG Joint Research Centre offered scientific support to the Cities of Northern Netherlands in their transition towards the closure of the Groningen gas field. This study reports on the assessment of the regional socio-economic impacts deriving from the closure of the gas field planned by 2022. This analysis served as a framework for evaluating the impacts and as an information tool for the local authorities on how to plan the steps towards a successful transition and a new socio-economic development.

Although the energy sector is not new to experiences such as the closure of big extracting facilities, the analysis of the impacts on the regional economy, employment and the energy sector remains a challenging task. The scientific literature does not provide with a tested universal approach to the study of these impacts. SWOT analysis, input-output models are the most common methodologies. To assess the regional socio-economic impacts of the closure of the gas field in Groningen we adopted at step-wise approach starting from the analysis of the decision of the Dutch government announced in 2018 and followed up in September 2019. We then study the natural gas value chain from the point of view of the business activities in the territory and the jobs at risk. Finally we analyse the opportunities set out in the energy development plans in place or announced by the local authorities. To complement the assessment of future possible developments in the region, we also took into account in the analysis other energy production potentials from clean sources and the opportunities of gas infrastructure r euse.

The result of our work was presented at the final conference held in Leeuwarden in December 2019. The work helped the local authorities of the Northern Netherlands in defining a road map for the industrial and economic transition required to adapt to a situation in which no natural gas will be extracted.

1 Introduction

The purpose of this study is to assess the regional socio-economic impacts of the closure of the gas field in Groningen that is planned for 2022. One of the main challenges of this work is the regional scale of the analysis. Regional analysis is very relevant in energy transition studies because the implementation of the European and national policies happens at regional, provincial and city level. It is at this lower level of the governance that many decisions and measures need to be taken to make the actions towards the energy transition effective and successful. This analysis served as a framework for the assessment of socio-economic impacts and as an information tool for the local authorities on how to plan the steps towards a successful transition and a new socio-economic development.

In 2019 the Dutch government decided to stop by 2022 the extraction of gas from the Groningen field located in the region of the Northern Netherlands. This represents an epochal change in the Dutch energy sector. The Groningen gas filed was discovered in 1959 by the Dutch Petroleum Company (Nederlandse Aardolie Maatschappij- NAM) and operated since 1963 with more than 75% of the gas been already produced. This gas field, the biggest in Europe and one of the biggest in the world, has played a central role in the Dutch economy and welfare allowing around 93% of the Dutch population - but also large parts of the German, Belgian and Northern-France population - to utilize this gas for their stoves and boilers, substituting the burning of coal for domestic use.

The closure of a big business activity like the Groningen gas extraction has major impacts on the life of the people living in the region and the cities of the Northern Netherlands and on their future development possibilities. The experience from other similar cases in Europe and around the world have taught us that the risks associated to the phasing out of a big business that gives jobs to thousands of people and stimulate the activity of thousands of other businesses are the abandon of the area by the companies and the population, increase of poverty and increase in crimes and degradation.

In 2019 the EU representation of the cities of the Northern Netherlands asked the JRC to study the possible drawbacks of this decision on jobs and local business and a fruitful collaboration with the municipality of Leeuwarden started. The final aim of the study was to identify the opportunities of the region to avoid that the regional economy and the community would suffer the possible bad consequences of this closure and, on the contrary, to use this chance to deploy other regional expertise and boost a new economic deal.

Although the energy sector is not new to experiences such as the closure of big extracting facilities, the analysis of the impacts on the regional economy, employment and the energy sector remains a challenging task. The scientific literature does not provide with a tested universal approach to the study of these impacts. SWAP analysis, input-output models are the most common methodologies. To assess the regional socio-economic impacts of the closure of the gas field in Groningen we adopted at step-wise approach starting from the analysis of the decision of the Dutch government announced in 2018 and followed up in September 2019. We then assessed the characteristics of the business that grew during the years around the activity of the gas field, the involved companies and labour force. By looking at the regional and provincial energy policies and by estimating the technological potentials of the territory, we then tried to identify the development possibilities of other sectors, the consequent job creation and the need of new expertise.

The strengths of this study derive from the regional/provincial and city level of the assessment. The work has been carried out through the implementation of a socio-economic impact assessment methodology that combines the analysis of status quo of the local energy sector and the employment with the estimation of the potential regional development coming from the regional, provincial and cities' energy plans and other technology potential.

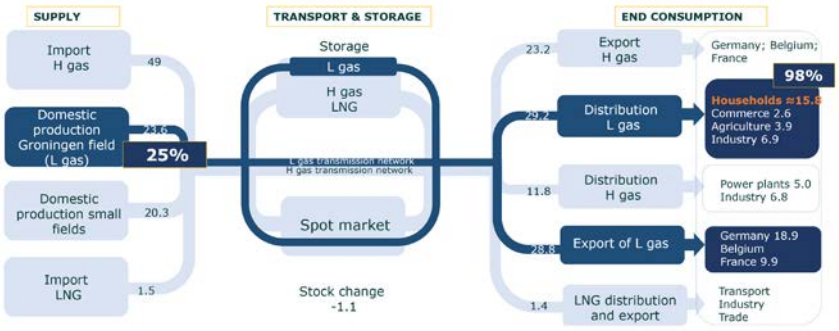
The report is organized into 3 main parts. In the first part we give a short introduction on the role of natural gas in the Netherlands and the analysis of the change of the energy balance resulting from the "back-up" plans of the government to counterbalance the Groningen gas field closure. Then we study the current employment and the business directly related to regional gas value chain with the aim at assessing the jobs and the capital at risk in the sector once the decision of the closure of the gas field will be conducted and terminated. In the second part we assess the overall development potential coming from the medium and long term plans of the local authorities, from the alternative energy sources and technological innovation and from other projects aiming at diversifying and reconverting the business model of the regional gas sector. This analysis identifies the gaps in terms of lack of investment and lack of expertise and the possible challenges of the energy transition.

Our study concludes with some highlights on the key elements to consider when dealing with momentous changes in the energy sector in a territory such as the closure of a gas field, and on how various approaches could successfully address this challenge. The pre-requisite of this task is that all the parties affected by the process should participate in the design of the transition strategy; the strategy should then include a short, medium and long term planning of new investments in strategic sectors and reskilling and relocation of labour force that is not absorbed by the alternative plans of the national and local authorities and by the voluntary industry initiatives; moreover, educational programs should be put in place to develop new expertise in line with the renewed needs of the energy sector; finally a dedicated fund to finance the transition should be created and maintained all through the duration of the transition to support the local business and community

2 The Background of the analysis

After the earthquake in January 2018 the Dutch Minister of Economic Affairs and Climate released an official statement outlining the measures to the termination of the Groningen gas by 2030. In September 2019 the closure of the gas field was further anticipated to 2022. For the year 2019 the maximum permitted extraction from the Groningen field was set to 21.6 bcm in an average year and 27 bcm in a cold year. According to the last governmental decision, the production in 2020 should decrease to 11.8 bcm and then gradually terminate in October 2022 under average winter temperatures. Exceptionally on very cold winter days, the Groningen field will operate until 2026. The natural gas from the Groningen field has relatively large content of nitrogen (14%) – low calorific gas (L gas) - making it suitable for domestic heating and cooking. Nowadays the Groningen gas supplies 98% of all Dutch households (around 7.5 million households) (CBS 2017). Other important consumers of the Groningen gas are the agriculture sector, where the natural gas is used for temperature control in greenhouses, and almost 200 industrial sites in the Netherlands, including pulp and paper, ceramics furnaces, chemical plants, cement plants and food industry. Substantial part of the Groningen gas is also exported to North Germany, Belgium and France. Figure 1 presents the balance flowchart of the Dutch natural gas system in 2017.

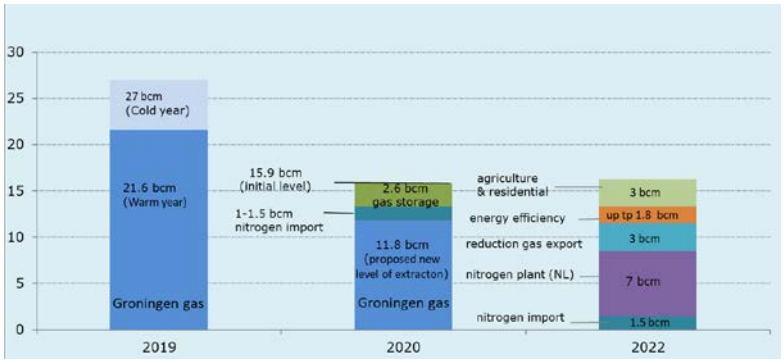
Figure 1. The flow diagram of the Dutch natural gas in 2017 (in bcm).



Source: JRC elaboration on (CBS 2017) and Weijermars, R. (2010)

According to the plan of the Dutch government a number of measures will be implemented in the short term to replace the lower availability of L gas in the Dutch system, such as the use of the Norg gas storage; the reduction in gas exports; the operation of a nitrogen plant for the production of L gas from imported high calorific gas (H gas); incentives to reduce demand of L gas (Figure 2).

Figure 2. The plan of the Dutch Government on the closure of Groningen gas field

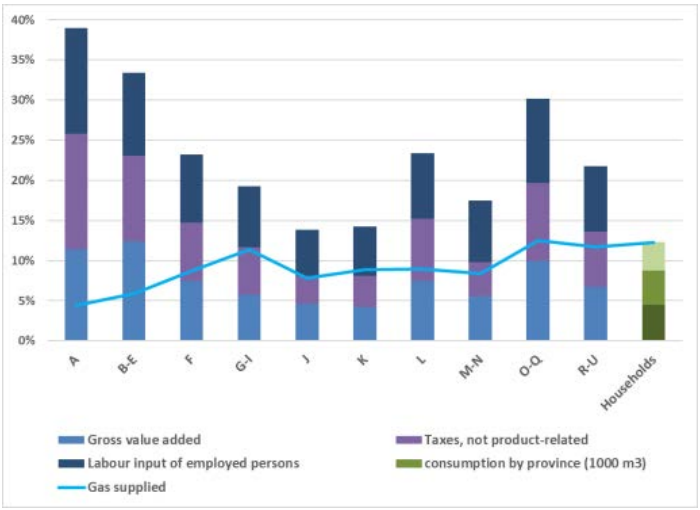


Source: JRC elaboration on the letter by the Dutch Cabinet

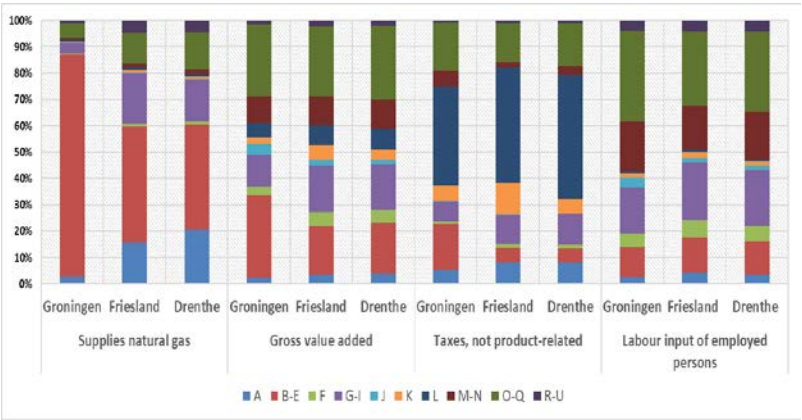
The decision of the closure of the gas field will affect the economy of the region and consumption behaviour of circa 800,000s households (CBS 2017). Figure 3 gives an idea of the contribution of the economy in terms of added value, labour force employed and fiscal contribution of the region of the Northern Netherlands to the national economy and the relative consumption of gas by sector - included the households sector- and by province.

Figure 3. Contribution of the regional economy of the Northern Netherlands and gas consumption by sector (% of Dutch economy), 2017

A.



B. Detail by province



Legend. A Agriculture, forestry and fishing; B-E Industry (no construction), energy; F Construction; G-I Trade, transport, hotels, catering; J Information and communication; K Financial institutions; L Renting, buying, selling real estate; M-N Business services; O-Q Government and care; R-U Culture, recreation, other services; Households (light green corresponds to Groningen, green corresponds to Friesland and dark green corresponds to Drenthe).

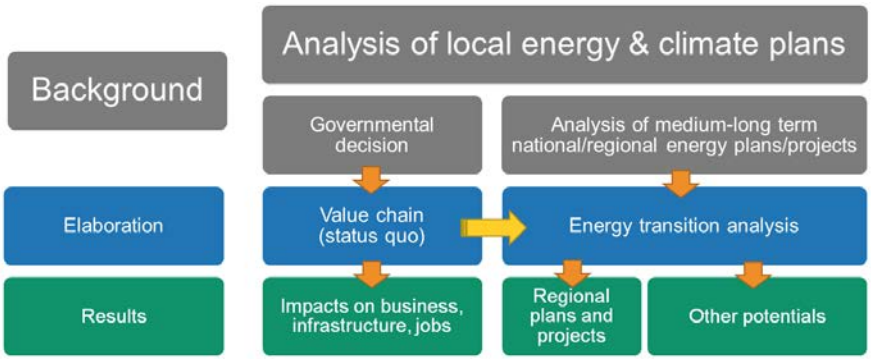
Source: JRC elaboration on CBS data 2017.

The three most important economic sectors of the Northern Netherlands in terms of added value, labour force employed and fiscal contribution are the agriculture, forestry and fishing sectors (A); the industry and energy sector (B-E), and the government and care sector (O-Q). For what the consumption of natural gas is concerned the main sectors are: Trade, transport, hotels, catering (G-I); Government and care (O-Q); Culture, recreation, other services (R-U) and Households (CBS 2017).

3 The methodology

To assess the regional socio-economic impacts of the closure of the gas field in Groningen we adopt at step-wise approach (Figure 4).

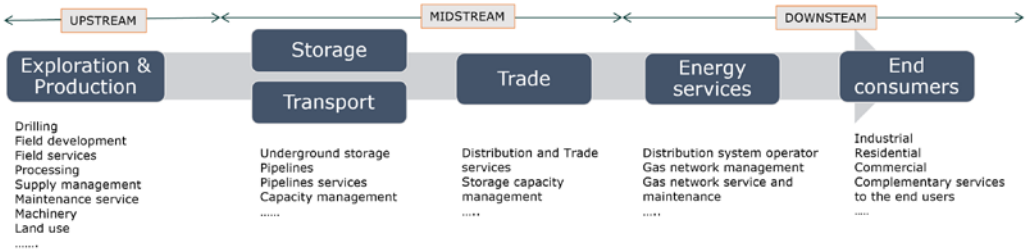
Figure 4. Analytical framework



Source: JRC elaboration

We first analyse the decision of the Dutch government published in the letter of the Dutch Cabinet to the Parliament "termination of natural gas extraction in Groningen" of the 29.3.2018 and the follow up in September 2019. We then study the natural gas value chain in the region from the point of view of the companies active in each segment of the value chain – upstream, midstream and downstream - and the current jobs (Figure 5).

Figure 5. Natural gas value chain



Source: JRC elaboration

With this background information we carry out the energy transition analysis that includes the medium and long term assessment of the challenges and opportunities of the plans in place in the energy sector or announced by the local authorities. This assessment is complemented with the inclusion of the future possible developments in the region, that take into account also other energy potentials from clean sources and the opportunities of reuse of the gas infrastructure.

The final goal is to estimate the impacts on jobs and the business opportunities in alternative and clean energy sector brought about the plans of the local governments and other potentials in the territory. The confrontation between the current state of the energy sector and the new outlook characterized by the plans and programs in place and planned for the mid-long terms will provide some insights on the order of magnitude of the net impacts on human capital and the overall economy.

3.1 The value chain analysis

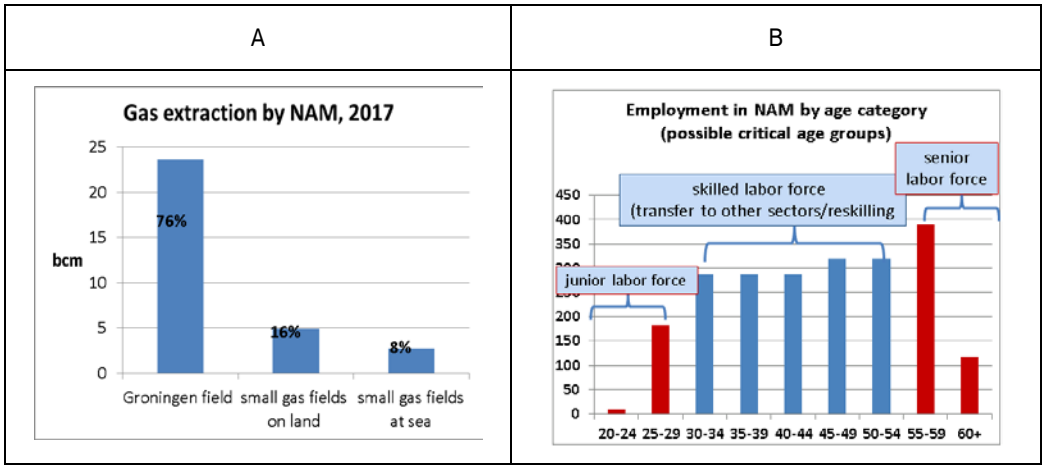
The decision of the closure of the gas field will affect the activity of all companies directly related to the natural gas value chain that are active in the region of the Northern Netherlands:

— The upstream segment of the gas value chain.

Among the three gas companies that we have considered in this segment, NAM (Nederlandse Aardolie Maatschappij) is the biggest one in terms of employees and gas extraction from the Groningen gas field.

(Figure 6/A). The total amount of gas extracted since 1971 is of about 2,100 bcm[1] out of a total estimated resource of 2,900 bcm[2]. The closure of the gas filed represents a concrete risk for at least 76% of the activity of this company and for the weakest age groups of employees (Figure 6/B).

Figure 6. Overview of NAM's business and employment (2017)



Source: NAM

— The middle stream segment of the gas value chain.

Figure 7 shows the scheme of the Dutch gas network, marking the different pipelines for the Groningen gas and H gas. The Netherlands has made significant investments in the gas infrastructure and has long time experience in the gas operation and storage.

Figure 7. Scheme of the Dutch natural gas infrastructure.

Source: Ministry of Economic Affairs and Climate Policy, Preventive Action Plan 2019. The Netherlands. 2019
Legend. Dark line: Groningen gas; Yellow line: high calorific gas (H gas); Red line: Nitrogen

— Large gas end-users

There are 170 big companies consuming together 4.4 bcm of the Groningen gas annually, of which 22 are located in the region of the Northern Netherlands. For the end user sector there exist mainly two options:

[1] NAM's web site https://www.nam.nl/feiten-en-cijfers/gaswinning.html
[22] https://www.nlog.nl/en/groningen-gasfield

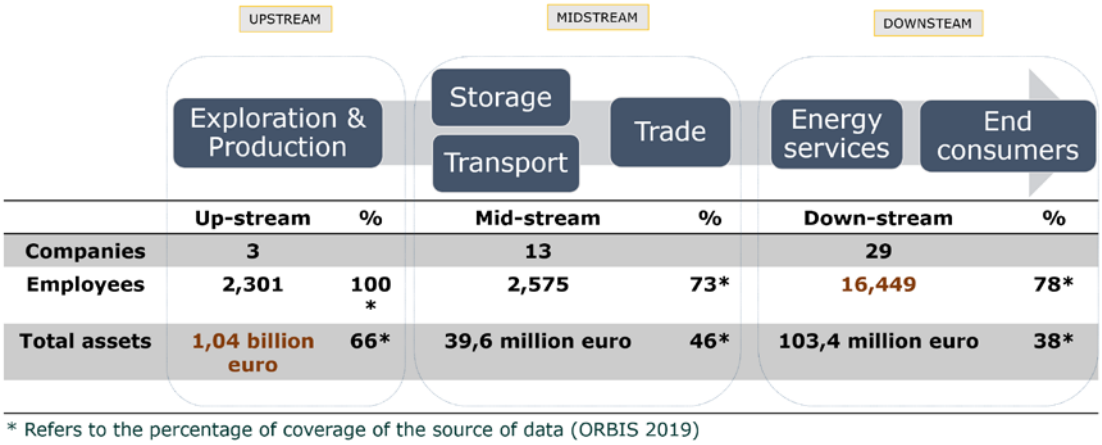
switching to high calorific gas (H gas) -for those companies that can be directly connected to the H gas network- or electrification of the production process. However, for example, The Royal Dutch association for building ceramics (Koninklijke Nederlandse Bouwkeramiek (KNB)) claims that it is not feasible to simply switch to other source as the fuel is also used as a raw material in the process. Another problematic group is the pulp and paper industry for which the required conversion of their equipment will need an additional investment with no economic benefit.

— Other gas end-user sectors

The residential sector and agriculture will be required to reduce and finally stop the consumption of L gas. The plan for terminating the use of gas in the household sector is to disconnect 55.000 houses from the natural gas network after 2020 and increasing this number every year up to 200.000 in 2030. Projects of new investments in the energy efficiency, like insulation of buildings, replacement of windows, adoption of electric stoves for cooking and installation of hybrid boilers and electric boilers in the household seem to be the most promising for the achievement of this target.

The results of the mapping activity of the companies and workforce directly related to the Groningen gas value chain is presented by each of the segments of the value chain. The data collection is the most challenging phase here. We accessed ORBIS data base (last access 02/08/2019), a world wide data base of information at single company level. We collected financial and economic data and information about the number of employees for all the companies active in the region of the Northern Netherlands and grouped them according to the value chain segment (Figure 8).

Figure 8. Natural gas value chain. Details of companies in the Northern Netherlands



	Up-stream	%	Mid-stream	%	Down-stream	%
Companies	3		13		29	
Employees	2,301	100 *	2,575	73*	16,449	78*
Total assets	1,04 billion euro	66*	39,6 million euro	46*	103,4 million euro	38*

* Refers to the percentage of coverage of the source of data (ORBIS 2019)

Source: JRC elaboration on ORBIS 2019

A preliminary analysis can be made by distinguishing between value chain segments that are affected the most/the least from the decision. The outcome of this analysis is not straightforward because despite the small number of companies operating in the upstream segment, the number of people employed are 2,300, a bit less than the number of jobs active in the midstream segment. On the other side the total assets invested in the upstream is of more than 1 billion euro, far above the figure represented in the other two segments of the value chain together.

More challenging is to assess the risk run by each company belonging to the gas value chain and the opportunities of a reconversion of the activity and reuse of the infrastructure and the reskilling and re-employment of the human capital. With the ORBIS data we attempt to perform a financial and investment analysis of the companies operating in the natural gas value chain in the region. To do that we consult the methodology by (C. Mayer et al. , 2018) that was developed to assess the impact of the financial crisis of 2008 and the consequent debt crisis of 2010-12 of the European financial sector and on companied in other sectors. C. Mayer et al., 2018 use data retrieved from ORBIS dataset provided by Bureau van Dijk, Thomson Reuters and balance-sheet documents of firms in EU. The consistency check of the so-built data set reduces the number of firm-year observations from 3,108,918 to 129,276 observations. Considered that "no fuzzy procedures are used to keep the match, and the entire sample of Thomson Reuters is only 4% of the ORBIS dataset", the data set results to be appropriate for the analysis. With this sample of firms the authors build

financial indicators from some firm-level variables[3] for a period, of 10 years to monitor their financial performance (Table 1).

Table 1. ORBIS variables and financial indicators

Indicator	Formula	ORBIS variable	
Indicator used in C. Mayer et al. , 2018			
Sales growth	Annual % of growth in sales revenues	Sales th EUR year x	Sales th EUR year x-1
Tangibility	Tangible assets/assets	Tangible fixed assets th EUR 2019	Total assets th EUR 2019
Cash flow	Ebitda/Assets	P/L for period [=Net income] th EUR 2019	Total assets th EUR 2019
Other indicators useful for the analysis			
Jobs	Annual % of change of Employees	Number of employees 2010-2019	
Capital	Annual % of change of capital	Working capital th EUR 2019	
Revenues	operating revenue + financial revenue	Operating revenues (Turnover) th EUR 2019	Financial revenues th EUR 2019
Taxation		Taxation th EUR 2019	

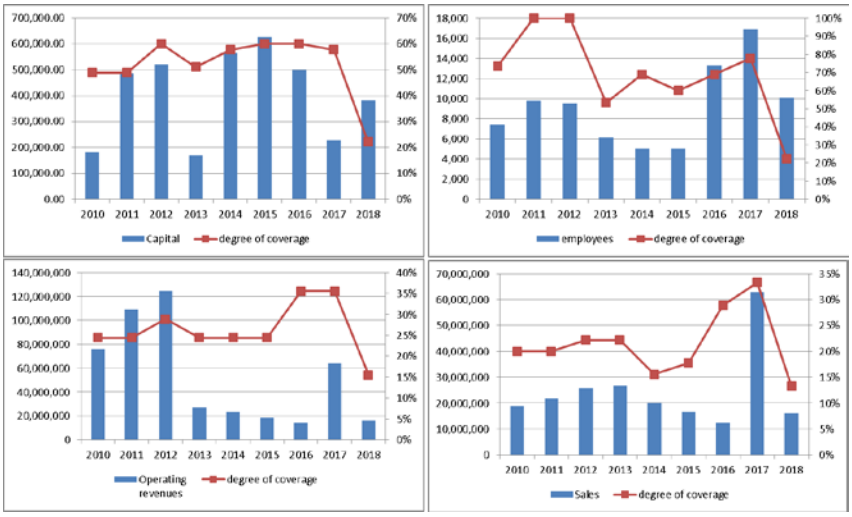
Source: JRC elaboration on ORBIS and C. Mayer et al., 2018

Our collection of historical data from the ORBIS data base accounts for a much smaller sample of firms (45), given the smaller geographical and sectoral scope of the study Moreover the completeness of the firm level data was also an issue in our collection, both in terms of availability of historical time series for the time frame (2010 – 2019) as well as in terms of the availability of the variables needed for the computation of the financial indicators. This data limitation restricted the scope of the financial analysis to the observation of the historical trend of few variables. Figure 9 shows the data set of three financial variables – capital, operating revenues and sales - and the number of employees in the 45 companies belonging to the gas value chain. The degree of coverage of the data set for the period 2010 – 2019 is very low except for the number of employees for year 2011 and 2012.

Data availability represents a big obstacle in the performance of regional studies. This is due to the fact that statistics are historically centred at a higher level of aggregation, typically national. To overcome this problem the collection of data needs to be conducted "manually" and this requires resources that are often not available for studies targeting a smaller geographical scope.

[3] Total assets, tangible fixed assets, total debt, short-term and long-term debt, trade payable, cash, EBITA, sales and interest expenses.

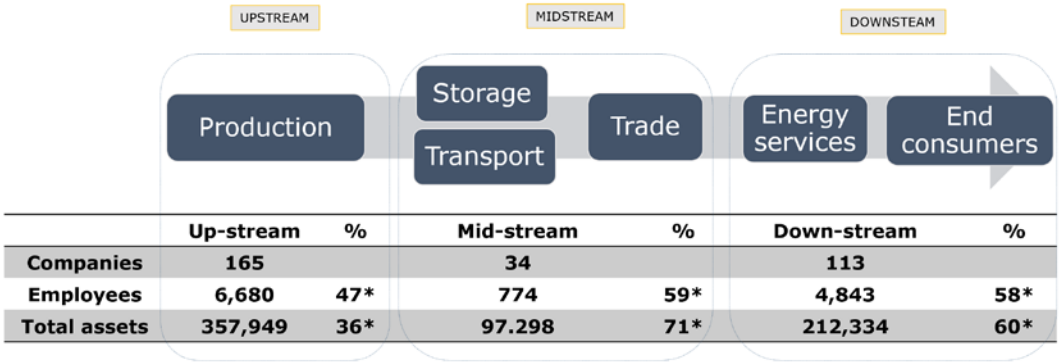
Figure 9. Financial variables and firm data coverage for the period 2010-2019



Source: JRC elaboration on ORBIS 2019

Further on the impact assessment on jobs and business in the region, we analysed the broader energy value chain to include information on the companies, jobs and capital invested in other energy technologies other than natural gas in the region of the Northern Netherlands (Figure 10).

Figure 10. Jobs and investments in the existing energy value chain in the Northern Netherlands



	Up-stream	%	Mid-stream	%	Down-stream	%
Companies	**165**		**34**		**113**	
Employees	**6,680**	**47***	**774**	**59***	**4,843**	**58***
Total assets	**357,949**	**36***	**97.298**	**71***	**212,334**	**60***

* Refers to the percentage of coverage of the source of data (ORBIS 2019)

Source: JRC elaboration on ORBIS 2019

This information provides with interesting insights on:

— The weight of the broader energy sector compared to the gas sector in terms of business and jobs created.

The upstream segment of other energy technologies is the one hiring more workforces compared to the other sectors. According to ORBIS is also the one hosting the highest number of companies with the highest aggregated total asset invested. The coverage of the data source we used is partial though. The column relative to the percentage in the figure show that dataset is not complete.

— The development opportunities of the plans of the region given the existing human capital, infrastructure and know-how in the other energy sector.

Specific information on the industrial sector of alternative technologies could support the local decision making process when deciding on the implementation of measures in support of the regional business and new sectors' development.

— The possibilities of transfer of human capital from the gas sector to other existing energy sector.

The information on the labour force employed in the different segment of other energy technologies' value chain can be used to assess the need of specialized human capital and the possibility of transfer/re-skilling of human capital from the gas sectors.

3.2 Plans of provinces of the Northern Netherlands

The Northern Netherlands consists of three provinces: Groningen, Friesland and Drenthe. There are four main cities playing an important role in the economic development of the region which are Groningen, Leeuwarden, Assen and Emmen. In this study we take into account the information on on-going and future energy plans of the provinces and municipalities to know about their targets for economic development and energy transition strategies. We identified the targets up to 2050 for generation from renewable energy sources (RESs) and concrete information on the projects in new energy technologies planned in the territory, i.e. hydrogen, geothermal heat, wind turbines, osmosis project, solar. The information collected below (Figure 11) is taken from various sources:

— National, Local and regional Energy agendas, energy transition programs and coalition agreements;

— Industry reports;

— Scientific publications and case studies.

This analysis contributes to the understanding of other opportunities planned at local level that can counterbalance the challenges posed by the future closure of the Groningen gas field.

Figure 11. Energy targets and projects in the region of the Northern Netherlands

Source: JRC elaboration on various sources.
a. Groningen. i) Provincie Groningen, 2016; ii) Provincie Gronigen, (last access 2019); iii) Provincie Groningen and Drenthe, 2018;
b. Drenthe. i) Provincie Drenthe 2020; ii) Provincie Groningen and Drenthe, 2018; iii) E&E advies; 2018;
c. Friesland: i) Provincie Fryslân, 2018; ii) Provincie Fryslân (last access 2019); iii) Quintel Itelligence and E&E advies, 2018.

All three provinces of the Northern Netherlands have set quite ambitious targets for renewable supply, with Groningen and Friesland aiming at 100% of energy supply from renewable sources by 2050.

The projects for renewable energy production are concentrated mainly on wind and solar technologies. We can also notice an inter-provincial cooperation between the province of Groningen and Drenthe for the development of an installation for the production of hydrogen that is expected to create up to 6,500 new jobs.

3.3 Development potential of alternative energy sectors and re-use of the gas investments

Currently, the gas extracted from the Groningen field is the primary source for the urban heating (57.1%), industry (29.6%) and agriculture (13.3%) *(CBS 2019)*. Phasing out the domestic natural gas thus requires a suitable solution for the future Dutch energy sector. The main focus will be given to the energy efficiency

measures. However, the remaining energy demand needs to be met by a combination of suitable alternatives to the Groningen natural gas (Table 2) The identified opportunities are i) a nitrogen plant to convert the imported gas - H gas – to L gas and thus possible to use in existing appliances; ii) retrofitting existing appliances for possible use of the imported H gas; iii) switching to an alternative source of energy.

Table 2. Opportunities for the economic growth and renewable energy sources' technical potential

Plans	Opportunities	VC*					RES potential (PJ)	
		PROD	T&S	TRAD	SERV	END	NL	NNL
Gov.	Increased import of H gas		✓	✓		✓		
	Nitrogen plant		✓			✓		
	Geothermal heat		✓			✓	50-170	
	Green gas		✓			✓		
Region	Energy efficiency, hybrid heat pumps, solar thermal				✓	✓		
	Heat networks		✓		✓	✓		
	Electrification:					✓		
	PV and CHP	✓					435	95
	Wind onshore / offshore	✓					480 / 2135	156
	Biomass	✓					185	25
	Hydrogen	✓	✓		✓	✓		70
	CO_2 storage	✓	✓					
Others	LNG terminal			✓	✓			
	Infrastructure Decommissioning	✓	✓		✓			
	Retrofitting of boilers and appliances				✓	✓		
	Extraction from small gas fields	✓						
	Deep geothermal	✓						

*segments of the value chain (VC): Exploration and Production (PROD), Transport and Storage (T&S), Trade (TRAD), Service (SERV) and End Consumers (END).

Source: Energy plans of region, province and municipalities in the Northern Netherlands (NNL) and in the Netherlands (NL), ENSPRESO data base.

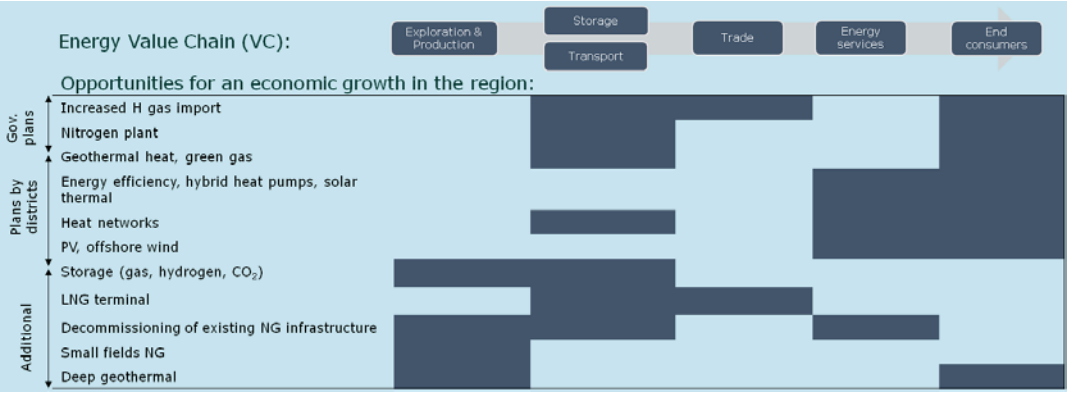
The transition will require changes in the energy infrastructure, some will be newly built, some re-used and decommissioned. The best solution will depend on the local conditions and preferences. To give an overview of the development opportunities in the energy sector, we carried out an extensive literature review on future projects and plans in the region, using as a framework for the analysis a more general energy value chain, so to include the alternative plans of the government, the projects defined by the local authorities and the

regional energy potentials in each VC segment (Figure 12). This way of organizing the information allows to find possible correspondences between the structure and characteristics of the existing gas industry and those of the alternative investment projects coming from alternative energy sectors.

In case industrial consumers choose to switch to the H gas, it may require a conversion of their equipment with high investment costs. Therefore, the Government plans investing in the nitrogen plant and injecting the nitrogen into the H gas centrally[4]. This will make the imported natural gas suitable for the domestic and industrial appliances that use currently the Groningen L gas. Options with larger interventions include using biogas, green hydrogen and electrification. Latter two will result in increase of renewable energy sources (solar PV, on- and offshore wind).

The provinces of Groningen and Drenthe joined forces to prepare a commercial plan for hydrogen development in the region (municipality of Groningen and Drenthe, 2019). It accounts with an investment of 100 MW production plant. Although the existing infrastructure is partially suitable for hydrogen transport, some adaptation will be necessary concerning mainly the safety measures and adopted working methods and tools. Other plans of renewable energy development reflects the available potentials.

Figure 12. Potential for alternative energy sectors and re-use of the gas investments



Source: JRC own elaboration

The country has also a relatively high potential in geothermal heat (Geotermie 2018). Its constant production is ideal for use in agriculture and industry. In the residential sector, heat demand varies along the year, yet the geothermal heat has a possible application in heat networks, including the heat exchange with industry and commercial sector, and in combination with hybrid boilers (biogas, solar heat, electricity). Collective investment in heat solutions in urban areas may have lower social costs than for individual households.

The Netherlands owns significant investments in the gas infrastructure and has long time experience in the gas operation and storage. This creates opportunities for the transport and storage of heat, hydrogen and biogas. Depleted as fields offers the possibility for the storage of CO_2 (Ministry of Infrastructure and Water Managment. 2018). Moreover, the available knowledge and expertise in the geology can accelerate the development of innovative alternatives, such as Ultra Deep Geothermal energy (EBN 2017) or the so called "Dutch gas hub", studied by Schipperus and Mulder, who consider a market driven scenario of transformation of the Netherlands from the gas-exporting to a gas-transit country (Schipperus and Mulder, 2015). Likewise, there is a potential to revive the idea of LNG facilities in Eemshaven (Groningen port) and thus becoming an important European player in the LNG trade[6].

[4] https://www.rijksoverheid.nl/actueel/nieuws/2018/03/29/kabinet-einde-aan-gaswinning-in-groningen

[5] ENSPRESO (ENergy Systems Potential Renewable Energy Sources) is an EU-27 and UK wide, open dataset for energy models on renewable energy potentials, at national (NUTS0) and regional levels (NUTS2) for the 2010-2050 period. The data base is available at https://data.jrc.ec.europa.eu/collection/id-00138.

[6] https://www.nu.nl/economie/4079542/nieuw-plan-lng-terminal-in-eemshaven.html)

3.4 Impact on the regional employment

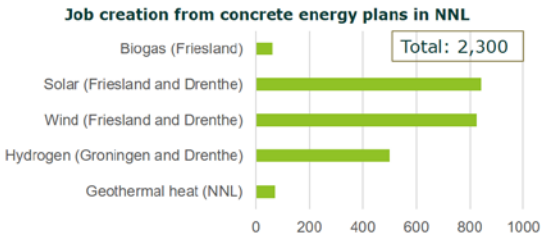
Based on the information from the firm level analysis we identified that in total 2,031 jobs are directly linked to the upstream, 2,575 to the midstream and 16,449 in downstream of the gas value chain (see Figure 8). However, some professions, such as drivers, electricians, engineers, administrative workers could potentially be less affected by ending the extraction and because they can be easily reallocated to other sectors.

Moreover, the knowledge and professional skills of the experienced labour is a great potential to be transferred to emerging activities. To support a possible reskilling and re-employment policy in the region, we estimated the number of jobs required for development of each alternative energy technology. Considering the announced plans by each province, for example, the hydrogen project of provinces Groningen and Drenthe will possibly cerate up to 6,000 new jobs for the construction of the infrastructure and 500 for the operation. Friesland province's potential job creation is of 150 in the production capacity by wind, 60 by biogas and 270 by solar energy source.

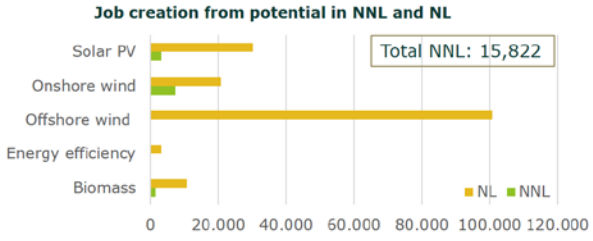
The current energy plans of local authorities sum up to a total potential job creation of 2,300 new jobs (Figure 13/A).

Figure 13. Number of jobs from regional alternative energy plans and renewable energy potential in 2030

A.



B.



Source: JRC own elaboration

To estimate the new jobs from the deployment of the regional energy potential in alternative sectors we then combine the information retrieved from the ENSPRESO data base with the average indicator of job creation by sector by (Wei et al. 2010) that estimates the average annual jobs created per GWh for various energy technologies (Table 3).

Table 3. Average annual jobs created per GWh for various energy technologies.

Energy technology	Job-creation indicator (average new annual jobs /GWh)
Biomass	0.21
Wind	0.17
Solar PV	0.87
Energy efficiency	0.38

Source: Wei et al. 2010

Considering also the technical renewable energy sources' potential in the region the number of new jobs can increase up to 15,822 (Figure 13/B).

4 Conclusions: main challenges/opportunities

This work represents the first outcome of a fruitful collaboration between the JRC and the Cities of the Northern Netherlands. The JRC provided support through an integrated multifaceted scientific approach to develop a concrete action plan that prepares the economy and labour market of the region of the Northern Netherlands for the upcoming energy transition.

In this study we identified many opportunities in the region that might facilitate the transition to energy sector development taking into account the knowledge, skills and energy infrastructure available in the region. A thoughtful development path is needed to ensure that the possible gains of the energy transition outweigh the losses. With this approach in mind, we first analysed the decision of the Dutch government announced in 2018 and followed up in September 2019. We then studied the natural gas value chain in the region from the point of view of the business activities in the territory and the jobs at risk. Finally we analysed the opportunities set out in the energy development plans in place or announced by the local authorities. To complement the assessment of future possible developments in the region, we also took into account in the analysis other energy production potentials from clean sources and the opportunities of gas infrastructure reuse.

The outcome of our analysis can be summarised in few main points.

The pre-requisite of successful transition is that all the parties affected by the process should participate in the design of a medium and long term energy strategy. A crucial role is played by the public support, which needs to be coherent across the three levels of governance – local, regional and national - to set, in coordination, the right policy mix. The local authorities have the possibility to interact directly with the businesses sector, to map and monitor the development, and facilitate the local citizens' engagement.

The strategy should include a short, medium and long term planning of new investments in strategic sectors and reskilling and relocation of labour force that is not absorbed by the alternative plans of the national and local authorities and by the voluntary industry's initiatives. The most critical age groups and professions should be identified and the possibilities of their reallocation should be evaluate. Jobs in the up-stream segment of the gas value chain are more at risk because the "back-up" plans of the government on the gas sector foresee a smaller role of gas extraction in the near future. Proper monitoring of the human resource's needs that will be possibly brought about by the future energy sector development plans will allow an efficient reskilling and relocation of labour force from the gas sector to other emerging economic activities.

In support of the new investment plan, educational programs should be put in place to form new expertise in line with the renewed needs of the energy sector.

The role of the technological change is an integral part of the energy transition. Big industrial gas users will have to invest in the adaptation of their production process to a production fuelled by alternative energy sources. Other companies operating in the middle and end-user segment of the gas value chain will need to evaluate possibilities of diversification of their business. Specialization, knowledge sharing and innovation are key factors in this process. A dedicated fund to finance the transition may be created and maintained all through the duration of the transition until the local business can create value on its own.

Finally, it is worth saying that data availability represents a big obstacle for the performance of regional studies. This is due to the fact that statistics are historically centred at a higher level of aggregation, typically national. To overcome this problem the collection of data is currently done "manually" and this requires resources that are often not available for studies targeting a smaller geographical scope. To overcome this problem, resources should be used to build, maintain and make available to the public regional/provincial and-or city level data base.

Next steps of this study can address the development of key industrial sectors that would support the goals of the energy transition strategy.

References

Black, Dan, Terra McKinnish, and Seth Sanders. "The economic impact of the coal boom and bust." The Economic Journal 115.503 (2005): 449-476.

CBS (Centraal Bureau voor de Statistiek) https://www.cbs.nl/

E&E advies; Drentse Energieopgave 2018 – 2030: Concretisering van de Drentse energieopgave voor 2030; 2018.
https://www.provincie.drenthe.nl/publish/pages/121932/20180312_drentse_energieopgave_2018-2030.pdf

Energie Beheer Nederland (EBN). Annual report 2017

ENSPRESO JRC Centre data catalogue – open access https://data.jrc.ec.europa.eu/collection/id-00138

GasTerra https://www.gasterra.nl/en

Gasunie https://www.gasunie.nl/en

Geothermie. Master Plan Geothermal Energy in the Netherlands: A broad foundation for sustainable heat supply. May 2018.

Het Parool, 10 september 2019. Gaswinning Groningen stopt al in 2022 in plaats van 2030. https://www.parool.nl/nederland/gaswinning-groningen-stopt-al-in-2022-in-plaats-van-2030~b9574441/?referer=https%3A%2F%2Fwww.google.com%2F

Investeringsagenda waterstof noord-nederland. Op weg naar emissievrije waterstof op commerciële schaal. Februari 2019.

Jacobsen, Grant D., and Dominic P. Parker. "The economic aftermath of resource booms: evidence from boomtowns in the American West." The Economic Journal 126.593 (2016): 1092-1128.

JRC Science for Policy report. Socio-economic transformation in coal transition regions: analysis and proposed approach. Pilot case in Upper Nitra, Slovakia. European Commission 2018.

Mayer et al. (2018). Finance and investment. The Euroepan case. Oxford University Press.

Ministry of Economic Affairs and Climate Policy. Natural resources and geothermal energy in the Netherlands. Annual review 2017.

Ministry of Economic Affairs and Climate Policy, Preventive Action Plan 2019. The Netherlands. 2019

Municipalities of Groningen and Drenthe, Investeringsagenda waterstof Noord-Nederland. Op weg naar emissievrije waterstof op commerciële schaal. Februari 2019.

Nederlandse Aardolie Maatschappij (NAM) https://www.nam.nl/

Official web sites of the Dutch government https://www.rijksoverheid.nl/actueel/nieuws/2018/03/29/kabinet-einde-aan-gaswinning-in-groningen

ORBIS (last access 02/08/2019)

Provincie Drenthe; Energietransitie-agenda 2020 - 2023. 2020
https://www.provincie.drenthe.nl/publish/pages/121932/mbe-w2002_132-energietransitie-agenda_2020-2023_def_1.pdf

Provincie Fryslân, (last access 2019)
website: https://www.fryslan.frl/beleidsthemas/windpark-fryslan_41954/#close

Provincie Fryslân,; Uitvoeringsprogramma: Fryslân geeft energie Jaarplan 2019; 2018. https://www.fryslan.frl/document.php?m=7&fileid=49489&f=f4fc73021e067d4611d08c98a85d8c86&attachment=0

Provincie Groningen and Drenthe, Investeringsagenda waterstof Noord-Nederland. Op weg naar emissievrije waterstof op commerciële schaal; 2018. https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Beleid_en_documenten/Documentenzoeker/Klimaat_en_energie/Energie_transitie/Investeringsagenda_waterstof_Noord-Nederland.pdf

Provincie Groningen, (last access 2019);
website: https://www.provinciegroningen.nl/beleid-en-documenten/documentenzoeker/klimaat-en-energie/windparken/

Provincie Groningen. De invloed van de gaswinning op de arbeidsmarkt. May 2019.

Provincie Groningen; Vol ambitie op weg naar transitie: Programma Energietransitie 2016-2019; 2016. https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Beleid_en_documenten/Documentenzoeker/Klimaat_en_energie/Energie_transitie/Programma_Energietransitie_2016-2019.pdf

Quintel Itelligence and E&E advies; Routekaart Fryslân 2030: Hoe komt Fryslân tot 49% CO_2-reductie in 2030?; 2018.
https://www.fryslan.frl/document.php?m=7&fileid=52273&f=a441e5614eaecce7b8bf59171a31133f&attachment=0

Schipperus, Ouren T., and Machiel Mulder. "The effectiveness of policies to transform a gas-exporting country into a gas-transit country: The case of The Netherlands." Energy Policy 84 (2015): 117-127.

Wei, Max, Shana Patadia, and Daniel M. Kammen. "Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?." Energy policy 38.2 (2010): 919-931.

Weijermars, Ruud. "Value chain analysis of the natural gas industry: Lessons from the US regulatory success and opportunities for Europe." Journal of Natural Gas Science and Engineering 2.2-3 (2010): 86-104.

Zubaryeva, A., Dilara, P. and Maineri, L., Publicly funded research, development and demonstration projects on electric and plug-in vehicles in Europe — update, EUR 27149, Publications Office of the European Union, Luxembourg, 2015, doi:10.2790/271951.

List of abbreviations and definitions

DG	Directorate General
JRC	Joint Research Centre
EU	European Union
NAM	Nederlandse Aardolie Maatschappij
SWOT	Strengths, Weaknesses, Opportunities, and Threats
CBS	Centraal Bureau voor de Statistiek
L gas	low calorific gas
H gas	high calorific gas
Bcm	Billion cubic meter
KNB	Koninklijke Nederlandse Bouwkeramiek
Ebitda	Earnings before interest, taxes, depreciation and amortization
P/L	Profits and losses
EBITA	Earnings before interest, taxes, and amortization
RES	Renewable energy source
PJ	Petajoule
VC	Value chain
PROD	Exploration and Production
T&S	Transport and Storage
TRAD	Trade
SERV	Service
END	End Consumers
NL	The Netherlands
NNL	The Northern Netherlands
ENSPRESO	ENergy Systems Potential Renewable Energy Sources
LNG	Liquefied natural gas
PV	Photovoltaic
CHP	Combined heat and power
CO_2	Carbon Dioxide
Gov.	Government
UK	The United Kingdom
NUTS	Nomenclature of territorial units of statistics
NUTS0	NUTS referring to Member States
NUTS2	NUTS referring to regions
EBN	Energie Beheer Nederland
NG	Natural gas
GWh	Gigawatt hour

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