

Groningen gas: The costs of not keeping it in the ground

A report for Milieudefensie



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About this report

This report has been commissioned by Milieudefensie. In the context of negotiations between the Dutch government, Shell and ExxonMobil concerning the Nederlandse Aardolie Maatschappij (NAM) and the recent Netherlands' national elections, Milieudefensie is looking for a basic analysis of the costs incurred and profits obtained directly by the Dutch government from NAM.

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Authorship

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Names and acronyms

CBM	College van Beheer van de Maatschap Groningen (Maatschap Groningen's board of directors)
CBS	Centraal Bureau voor de Statistiek (Statistics Netherlands)
CVW	Centrum Veilig Wonen (Safe Living Centre)
EBN	Energie Beheer Nederland (Energy Management Netherlands)
Earthquake Damages Arbitrator	Arbiter Aardbevingschade
EZ	Ministerie van Economische Zaken (Ministry of Economic Affairs)
FES	Fonds voor Economische Structuurversterking (Economic Structural Reinforcement Fund)
Ground Subsidence Committee	Commissie Bodemdaling
Independent Advisor	Onafhankelijk Raadsman
KNMI	Koninklijk Nederlands Meteorologisch Instituut (Royal Meteorological Institute of the Netherlands)
MJP	Meerjarenprogramma Aardbevingsbestending en Kansrijk Groningen (Multiannual plan for earthquake resistance and a successful Groningen)
NAM	Nederlandse Aardolie Maatschappij (Dutch Natural Gas Company)
NCG	Nationaal Coördinator Groningen (Groningen National Coordinator)
OVV	Onderzoeksraad voor Veiligheid (Dutch Safety Board)
RUG	Rijksuniversiteit Groningen (University of Groningen)
SodM	Staatstoezicht op de Mijnen (State Supervision of Mines)
Special Circumstances Committee	Commissie voor Bijzondere Situaties
TNO	Nederlandse organisatie voor toegepast natuurwetenschappelijk onderzoek, (Netherlands organisation for applied scientific research)
TU Delft	Technische Universiteit Delft

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Samenvatting

Het maatschappelijke debat over kosten en baten van de gaswinning in Groningen wordt bemoeilijkt door een gebrek aan overzichtelijke informatie. Er zijn niet alleen veel spelers en belanghebbenden, een groot deel van de informatie over omzet en winst uit de gaswinning en over kostenposten door mijnbouwschade is niet openbaar. In het licht van de kabinetsformatie en de besluiten die moeten worden genomen over toekomstige gaswinning in Groningen, heeft Milieudefensie Onderzoeksbureau Profundo gevraagd om een indicatie van kosten en baten voor de periode 2012-2016 en een vooruitblik op de periode 2017-2024. Vervolgens is een inschatting gemaakt van te verwachten kosten en baten voor de periode 2018-2032. Hierbij is gerekend met een basisscenario A, van frequente aardbevingen van minder dan 2 op de schaal van Richter en een scenario B, vergelijkbaar met de periode 2012-2016, waarin ook enkele malen een beving van meer dan 3,5 op de schaal van Richter plaatsvindt.

- **Kosten**

Een breed spectrum aan kosten is in beeld gebracht. De belangrijkste zijn schades en verstevigingskosten van onroerend goed, de kosten van bodemdaling voor waterschappen, waardedaling van onroerend goed. Daarbij komen de kosten van de speciale programma's die zijn opgezet vanwege de sociaaleconomische gevolgen van de aardbevingsschade. Er wordt bijvoorbeeld geld beschikbaar gesteld voor snel internet, duurzame energie of herbestemming van cultureel erfgoed. In de periode 2012 tot 2016 is jaarlijks gemiddeld € 374 miljoen besteed aan kostenposten vanwege mijnbouwschade, wat neerkomt op ongeveer 3% van de jaarlijks gemiddelde opbrengsten van € 12.1 miljard. Voor de periode vanaf 2017 tot 2024 is een aanzienlijk lager bedrag aan schadeposten gereserveerd, € 217 miljoen per jaar. Gezien de daling van de gaswinning, waarbij conservatief is gerekend met 27 miljard kuub per jaar vanaf 2017 en de daaruit voortvloeiende dalende opbrengst, is het aandeel van de kosten reserveringen dan wel hoger met ruim 5% van de geschatte jaarlijkse opbrengsten van € 4,062 miljoen.

Belangrijke schadeposten zoals de gevolgen van de stagnatie van de woningmarkt en de effecten op welzijn en gezondheid van de mensen in de regio worden nog niet vergoed en zijn dus niet in deze berekening opgenomen.

- **Baten**

Daartegenover staan de winsten die ten goede komen aan de aandeelhouders van de NAM en de afdracht aan de Nederlandse staatskas. Winstcijfers voor het Groningen-veld worden niet gepubliceerd. Daarom is op basis van de productiecijfers van het gasveld in Groningen en de overige Nederlandse gasvelden voor de periode 2012-2016 een schatting gemaakt van gemaakte winsten. Een winstprognose voor de periode 2017-2024 is gemaakt op basis van de inkomsten in 2016 toen 27.6 miljard kubieke meter gas werd gewonnen. In 2016 werd € 4,062 miljoen winst gemaakt, op basis van een jaarlijks aandeel van het Groningenveld in de totale Nederlandse gasproductie van 54% tot 66% in de periode 2012-2016.

Tabel 1 (Table 1) is een samenvatting van gebudgetteerde kosten en baten voor de periodes van 2012-2016 en 2017-2024.

Table 1 Samenvatting van gebudgetteerde kosten en baten 2012-2024 (geschat, miljoen €)

Categorie	2012-2016	2017-2024	Totaal	Jaarlijks gemiddelde (2012-2016)	Jaarlijks gemiddelde (2017-2024)
Kosten					
Materiële schade	1,529	938	2,467	306	117
Speciale programma's	343	796	1,139	69	100
Immateriële schade	N/A	N/A	N/A	N/A	N/A
Baten					
Gaswinning	60,387	32,499	92,886	12,077	4,062
Speciale programma's	2	N/A	2	0.4	N/A
<i>Total kosten</i>	<i>1,872</i>	<i>1,733</i>	<i>3,605</i>	<i>374</i>	<i>217</i>
<i>Total baten</i>	<i>60,389</i>	<i>32,499</i>	<i>92,388</i>	<i>12,077</i>	<i>4,062</i>
Total winst	58,517	30,766	89,283	11,703	3,845
Kosten als % van baten	3%	5%	4%	3%	5%

Bron: Nederlandse Aardolie Maatschappij, CBS *Statline*, National Coordinator Groningen, Kadaster *Vastgoed Dashboard*, Commissie Bodemdaling and Commissie Bijzondere Situaties.

- Toekomstscenario's**

Op basis van twee 'bevingsscenario's' is een schatting gemaakt van de ontwikkeling van de kosten in de periode 2018-2032. In scenario A vinden er, bijvoorbeeld als gevolg van een sterke vermindering van de gaswinning, slechts aardbevingen met een beperkte magnitude plaats (minder dan 2.0 op de schaal van Richter), in een frequentie die wel beperkte schade veroorzaakt. In dit scenario zijn de totale kosten voor mijnbouwschade jaarlijks € 313 miljoen.

Tabel 2 (Table 2) is een samenvatting van de kosten en baten die zijn berekend voor scenario A.

Table 2 Scenario A – samenvatting van kosten en baten 2018-2032 (geschat, miljoen €)

Categorie	Totaal	Jaarlijks gemiddelde
Kosten		
Materiële schade	2,700	180
Speciale programma's	1,996	133
Immateriële schade	N/A	N/A
Baten		
Gaswinning	60,935	4,062
Speciale programma's	32	2
<i>Total kosten</i>	<i>4,696</i>	<i>313</i>
<i>Total baten</i>	<i>60,967</i>	<i>4,064</i>
Total winst	56,271	3,751
Kosten als % van baten	8%	8%

Bron: Nederlandse Aardolie Maatschappij, CBS *Statline*, National Coordinator Groningen, Kadaster *Vastgoed Dashboard*, Commissie Bodemdaling and Commissie Bijzondere Situaties.

Scenario B is gebaseerd op de schade die optreedt als de seismische activiteit significant blijft en het patroon van 2012 tot 2016 zich herhaalt over de hele periode van 2018 tot 2032. De schade die optreedt is gemiddeld tot hoog evenals het risico's op lichamelijk letsel. In dit scenario zijn daarom hogere kosten opgenomen voor het aardbevingsbestendig en dus veilig maken van meer woningen, dan waar de NAM nu vanuit gaat. De jaarlijkse kosten lopen in scenario B op tot € 1.1 miljard.

Tabel 3 (Table 3) is een samenvatting van de kosten en baten die zijn berekend voor scenario B.

Table 3 Scenario B – samenvatting van kosten en baten 2018-2032 (geschat, miljoen €)

Categorie	Totaal	Jaarlijks gemiddelde
Kosten		
Materiële schade	14,531	969
Speciale programma's	1,996	133
Immateriële schade	N/A	N/A
Baten		
Gaswinning	60,935	4,062
Speciale programma's	32	2
<i>Total kosten</i>	<i>16,527</i>	<i>1,102</i>
<i>Total baten</i>	<i>60,967</i>	<i>4,064</i>
Total winst	44,440	2,963
Kosten als % van baten	27%	27%

Bron: Nederlandse Aardolie Maatschappij, CBS *Statline*, National Coordinator Groningen, Kadaster *Vastgoed Dashboard*, Commissie Bodemdaling and Commissie Bijzondere Situaties.

- **Onbekende kostenposten**

Beide scenario's geven een conservatieve schatting van de kosten, omdat een groot deel van de werkelijke materiële en immateriële kosten niet is in te schatten op basis van bekende gegevens en niet in de berekening kon worden meegenomen. Zo zijn de kosten voor lokale overheden en de kosten om historische gebouwen aardbevingsbestendig te maken niet opgenomen. Voor waardedaling van onroerend goed, zijn alleen waardedalingen opgenomen zoals die worden geclaimd en door de NAM worden toegekend, in plaats van het totale verlies aan waarde in de regio. Naar schatting ligt de totale waardedaling van woonhuizen in de 9 meest getroffen gemeenten tussen de € 0,3 (scenario A) en € 1,2 (scenario B) miljard.

Lopende (beroeps)procedures voor schades uit de periode tot 2017 kunnen tot hogere schadeposten leiden dan nu is berekend. Het uitwerken van een worst-case scenario was niet mogelijk, omdat de lange termijn effecten van de gaswinning nog onbekend zijn en veel ingrijpender kunnen zijn dan wat tot nog toe wordt ingeschat.

Een andere niet opgenomen, maar mogelijk substantiële kostenpost betreft immateriële schade. De rechtbank in Assen heeft in maart 2017 bepaald dat de NAM verantwoordelijk is voor geleden immateriële schade, maar de waarde van die schade zal in individuele procedures moeten worden vastgesteld. Hoeveel van dit soort procedures zullen worden gevoerd en welke bedragen zullen worden uitgekeerd is op dit moment niet te schatten.

- **Conclusie en toekomstverwachtingen**

Als de momenteel door de NAM gereserveerde kosten worden vergeleken met de toekomstscenario's, blijkt dat de effecten van aardbevingen en andere vormen van mijnbouwschade zoals bodemdaling fors kunnen toenemen en dan leiden tot hogere kosten en daarmee een significante daling van de winstgevendheid van de aardgaswinning en van de opbrengsten voor de schatkist. De hoeveelheid gas die mag worden gewonnen daalt en zal naar verwachting blijven dalen, terwijl meer kosten in beeld komen, denk bijvoorbeeld aan de kosten die Groningers dragen terwijl ze wachten op compensatie of schadeherstel. Omdat veel kosten bovendien kunnen stijgen, kan de verhouding tussen kosten en opbrengsten slechter uitvallen dan in het rapport kon worden berekend. In het licht van deze berekeningen is het moeilijk te verklaren waarom voor de periode 2017-2024 minder budget is gereserveerd dan in de periode 2012-2016 is uitgegeven en er slechts is gebudgetteerd voor een periode van acht jaar, terwijl er tot op heden slechts beperkt is uitgekeerd voor herstel en compensatie. Grote kostenposten zoals waardedaling van vastgoed en structurele versterking van woningen zitten er grotendeels nog aan te komen.

Meer onderzoek is nodig om een beter overzicht te krijgen van de daadwerkelijke en potentiële kosten als gevolg van de gaswinning. Daarbij moet goed worden gekeken naar de verdeling van de kosten tussen burgers, lokale overheden, de staat en Shell en ExxonMobil, de aandeelhouders van de NAM.

Summary

The public debate on the costs and benefits of natural gas extraction in Groningen is hampered by a lack of transparent information. Not only are there many players and interests involved, but a great deal of information on revenue and profits from the gas extraction, and on the costs for damage related to gas extraction, is not publicly available. Given the upcoming new Dutch cabinet formation and future gas extraction policy in Groningen, Milieudefensie (Friends of the Earth Netherlands) has asked Profundo for an indication of the costs and benefits for the 2012-2016 period and a forecast for the 2017-2024 period. A projection of anticipated costs and benefits for the 2018-2032 period has also been formulated. This estimate is developed based on two scenarios: scenario A, where frequent earthquakes occur registering less than 2 on the Richter scale and scenario B, which is comparable to the 2012-2016 period, whereby at least one earthquake of a 3.5 magnitude on the Richter scale occurs.

- **Costs**

A wide array of costs is provided. The most prominent are the damage and reinforcement costs of property, the costs of soil subsidence for water authorities, and declining real estate value. Added to these are the costs of special programmes which have been established due to the social and economic consequences of the earthquake damage. Examples include funding for high-speed internet connections, sustainable energy or repurposing of cultural heritage sites. In the period from 2012 to 2016, an average of € 374 million per year was spent on compensation for damages resulting from gas extraction, which accounts for approximately 3% of the average revenues for the same period. Considerably less has been reserved for damage costs in the period from 2017 to 2024: € 217 million per year. Given the decrease in gas extraction, down to 27 billion cubic meters per year in 2017, and final estimated revenues figures for 2016 relating to an already limited extraction ceiling, the proportion of funds reserved for costs will increase to approximately 5% of the estimated annual revenues of € 4,062 million. Major damage costs such as the consequences of housing market stagnation and effects on the welfare and health of people in the region have not yet been compensated and thus are not included in this calculation.

- **Revenues**

In contrast to this are the profits that benefit shareholders of the NAM (Nederlandse Aardolie Maatschappij), Shell and ExxonMobil, and payments to the Dutch treasury. Profit figures for the Groningen gas field are not made public. For this reason, profits have been estimated from production figures from the Groningen gas field and other Dutch gas fields in the 2012–2016 period. An estimation of profits for the 2017–2024 period has been measured based on the revenues from 2016, when 27.6 billion cubic metres of gas were extracted from Groningen. Total revenues from gas in Groningen for 2016 are estimated at € 4,062 million, based a yearly proportion of gas production in Groningen to total gas extracted in the Netherlands ranging between 54% to 66% in the 2012-2016 period. 0 provides a summary of the costs and revenues currently budgeted and estimated for the periods of 2012-2016 and 2017-2024.

Table 4 Summary of budgeted costs and revenues 2012-2024 (estimated, in € mln)

Category	2012-2016	2017-2024	Total	Annual average (2012-2016)	Annual average (2017-2024)
Costs					
Material damages	1,529	938	2,467	306	117
Special programs	343	796	1,139	69	100
Immaterial damages	N/A	N/A	N/A	N/A	N/A
Revenues					
Gas extraction	60,387	32,499	92,886	12,077	4,062
Special programs	2	N/A	2	0.4	N/A
<i>Total costs</i>	<i>1,872</i>	<i>1,733</i>	<i>3,605</i>	<i>374</i>	<i>217</i>
<i>Total revenues</i>	<i>60,389</i>	<i>32,499</i>	<i>92,388</i>	<i>12,077</i>	<i>4,062</i>
Total profit	58,517	30,766	89,283	11,703	3,845
Costs as % of revenues	3%	5%	4%	3%	5%

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

- **Future scenarios**

The currently budgeted costs and estimated future costs were extrapolated into two earthquake scenarios to estimate the further development of costs in the 2018–2032 period. In scenario A, there would be moderate seismic activity, with earthquakes of a magnitude below 2.0 on the Richter scale, for example, due to a drastic reduction in gas extraction, at a frequency that causes limited damage. In this scenario, the total costs of extraction damage would be € 313 million per year.

0 provides a summary of the costs and revenues estimated in scenario A for the period 2018-2032.

Table 5 Scenario A: Summary of costs and revenues 2018-2032 (estimated, in € mln)

Category	Total	Annual average
Costs		
Material damages	2,700	180
Special programs	1,996	133
Immaterial damages	N/A	N/A
Revenues		
Gas extraction	60,935	4,062
Special programs	32	2
<i>Total costs</i>	<i>4,696</i>	<i>313</i>
<i>Total revenues</i>	<i>60,967</i>	<i>4,064</i>
Total profit	56,271	3,751
Costs as % of revenues	8%	8%

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

Scenario B is based on the damage that would be done if seismic activity remains significant and the pattern of the 2012-2016 period is repeated throughout the entire period from 2018 to 2032. In this scenario, there would be moderate to extensive damages, with higher risk of bodily injury. As a result, overall costs are higher than what the NAM and the Dutch government have currently assumed for earthquake -proofing private properties. The annual costs in scenario B could amount up to € 1.1 billion.

Table 6 provides a summary of the costs and revenues estimated in the second scenario for the period 2018-2032.

Table 6 Scenario B: Summary of costs and revenues 2018-2032 (estimated, in € mln)

Category	Total	Annual average
Costs		
Material damages	14,531	969
Special programs	1,996	133
Immaterial damages	N/A	N/A
Revenues		
Gas extraction	60,935	4,062
Special programs	32	2
<i>Total costs</i>	<i>16,527</i>	<i>1,102</i>
<i>Total revenues</i>	<i>60,967</i>	<i>4,064</i>
Total profit	44,440	2,963

Category	Total	Annual average
Costs as % of revenues	27%	27%

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

- **Unknown expenditures**

Both scenarios provide a conservative estimation of the costs, as most of the actual material and immaterial costs remain unknown due to limited availability of public information. Consequently, none of the costs to public properties or historical buildings (such as churches, monuments, etc.) or additional costs to municipalities are given an estimation in these scenarios. Real estate devaluation only include actual claims made to and awarded by the NAM, rather than total loss of real estate value in the region. Total loss in value of homes in the nine municipalities most affected is estimated to range between € 286 million (scenario A) and € 1.2 billion (scenario B).

Pending court procedures and appeals for damage claims in the period up to 2017 could lead to higher compensations than what has now been calculated. This research has refrained from elaborating a worst-case scenario, given that both current and long-term effects from gas extraction are still relatively unknown and could still be much more extensive than what has been experienced in Groningen until now.

Another possibly substantial expense which could not be included are immaterial damages. In March 2017, the court in Assen ruled that the NAM is responsible for immaterial losses suffered, for which actual compensation is to be determined in individual legal proceedings. The number of such cases that will be brought forth and the amounts that will be awarded cannot be estimated at this time.

- **Conclusion and future expectations**

When the amount which the NAM has currently reserved for costs is compared to the future scenarios, it appears that the amount needed is more significant than currently estimated, and that effects from earthquakes and other gas extraction-related effects, such as subsidence, could be more more significant than estimated, leading to higher expenses and an accompanying significant decline in profitability of natural gas extraction. The amount of gas which may be extracted is decreasing and is expected to continue decreasing, while higher expenses are surfacing, such as the costs absorbed by residents of Groningen while awaiting compensation or repairs. Moreover, because many costs may rise, the costs to revenues ratio could increase further than what is estimated in this report. These calculations raise questions as to how the Dutch government and the NAM can expect total costs of damages to decrease and budget only for expenses over an eight-year period, when very little compensation and repair has been paid out until now, and some of the highest costs, such as compensation for devaluation and structural improvements to properties are still arise.

Further studies are required to get a better sense of the actual and potential costs related to the earthquakes in Groningen, with particular attention to the distribution of the costs by stakeholder involved, as well as more specific indications of what costs residents have to bear while awaiting compensation by the NAM or by the Dutch government.

Introduction

The NAM is a 50/50 joint venture between Shell and ExxonMobil. The company was founded in 1947, after a first oilfield was found in Schoonebeek. At the time, NAM's business focus was on the exploration and extraction of oil. More than ten years later, in 1959, the gas field near Slochteren, now known as the "Groningenveld" or "Groningen gasveld" (Groningen gas field), was discovered.¹

Since then, the NAM has discovered and bought the majority rights for a large number of natural gas fields in the country. It has been operating since 1959 as a gas-extraction company, with its largest focus on the Groningen gas field. It is considered one of the largest natural gas reserves in the world with an estimated 2,800 billion m³ of natural gas available at the time of discovery.²

Gas and oil extraction in the Netherlands have since their beginning had a significant impact on the Dutch economy, amounting to € 22.1 billion, or 3.4% of GDP, at their peak level of extraction in 2013.³ In 2014, natural gas extraction amounted to 86% of total energy production in the Netherlands, the highest percentage among OECD countries, where the average natural gas production was 26%.⁴ In addition to providing up to 50% of the national annual energy consumption, the Netherlands is the 5th largest exporter of natural gas in the world. Most of the natural gas from the Netherlands is exported to neighbouring countries such as Germany, Italy, Belgium, United Kingdom and France.⁵

Despite these economic benefits, the natural gas production from the Groningen gas field has precipitated seismic activity in the region around Groningen. Beginning in 1991, the region around the Groningen gas field has witnessed an increasingly large number of earthquakes, with a magnitude of up to 3.6 on the Richter scale.⁶ Such substantial effects of one of the most important national industries to the Dutch population have brought an important social and economic challenge forward: how to balance the production of such a significant energy source with the well-being of its citizens.

In the context of this complex challenge and the recent national elections of the Netherlands, this report is a brief analysis of the social, economic and environmental costs and profits related to the Groningen natural gas reserves. First, Chapter 1 introduces the stakeholders involved in resolving the arising issues, as well as a brief explanation of the problems induced by natural gas extraction in the region. Chapter 2 then examines the various costs incurred by residents and by the government, both at local and national levels. The overview looks at the period from 2012, when first damage claims were made to NAM, to the most recent data. Comparatively, Chapter 3 reviews the revenues received by the Dutch government, using the same period of reference as for Chapter 2. Chapter 4 finally provides a succinct overview of the costs and revenues discussed in the previous chapters, as well as an extrapolation of the potential costs for the period from 2018-2032, including a low and a high estimation. The final section provides conclusions on the costs and profits of the natural gas extraction industry in the Netherlands, as well as recommendations for future research on this topic.

A summary of the findings can be found on the first pages of this report.

Chapter 1 Groningen gas dispute: an introduction

1.1 Introduction

In the Netherlands, a fragile balance between a strong domestic gas and oil industry and the safety and protection of its citizens has existed for many years. For more than half a century, the gas and oil industry has been one of the pillars of the Dutch economy and society.⁷ And yet, the development of this industry has significantly increased the region's susceptibility to earthquakes and subsidence. This has had important consequences on the residents of the province, with the strongest effects on the municipalities closest to the Groningen gas field. After a continuous increase in the annual number of earthquakes that started in 1991, an earthquake in August 2012 reached an unprecedented, and unexpected magnitude of 3.6 on the Richter scale. As a result of this earthquake, substantial attention was brought to the issue, and a number of public and independent institutions deepened their studies in the gas field region.

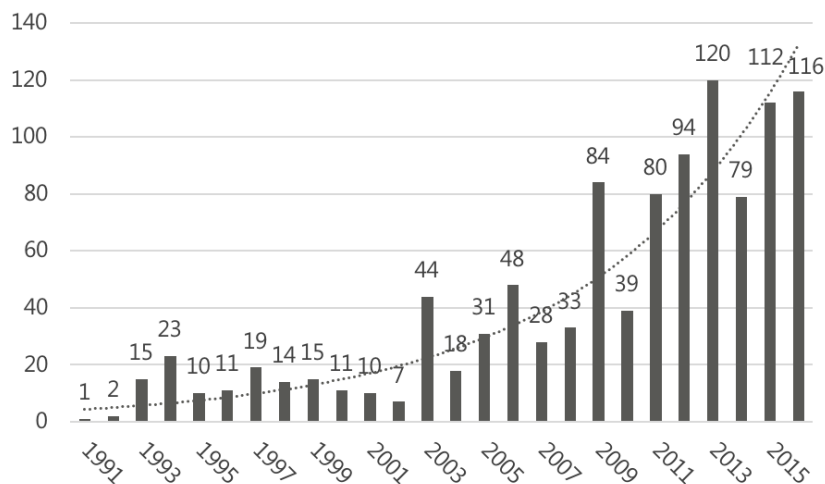
This chapter briefly reviews the seismic risks and frequency related to gas extraction in Groningen, and then introduces the various stakeholders involved in the matter.

1.2 Seismic consequences of natural gas extraction

The primary cause for concern resulting from the natural gas extraction has been the increasing number of earthquakes in the region surrounding the Groningen gas field. This is caused by the presence of fault lines at the same level underground as the gas pockets. In order to acquire natural gas, extraction tubes are inserted in the ground, down to the layer of sandstone approximately three kilometers below ground where the natural gas pockets are located. During the process of gas extraction, gas pressure is relieved, causing the substrate to be compacted by the ground layer above. When such a process occurs near a fault line, it creates pressure between the ground layers, which in turn causes subsidence and causes the layers below to slide, creating an earthquake.⁸ In addition to the subsidence and earthquake caused, this increases the seismic activity of the ground and therefore increases the risks for further subsidence and earthquakes.⁹

Since the first earthquake in 1991, there have been more than one thousand earthquakes in this region because of gas extraction by the NAM. Out of the total earthquakes, 11 were above 3.0 on the Richter scale, 84 were between 2.0 and 3.0, and the rest was under 2.0.¹⁰ Whereas the stronger earthquakes have visible physical effects and can be felt physically, earthquakes with a magnitude below 2.0 are unnoticeable but can have structural effects over time. Figure 1 presents all the earthquakes that have occurred in the gas field region, from 1991 to 2016. The trend line shows a tremendous increase in the total number of earthquakes since 1991, with an annual average of 12 earthquakes until 2003, when the number of earthquakes first started to spike. In comparison, the average number of earthquakes for the period from 2003 to 2016 is 66.

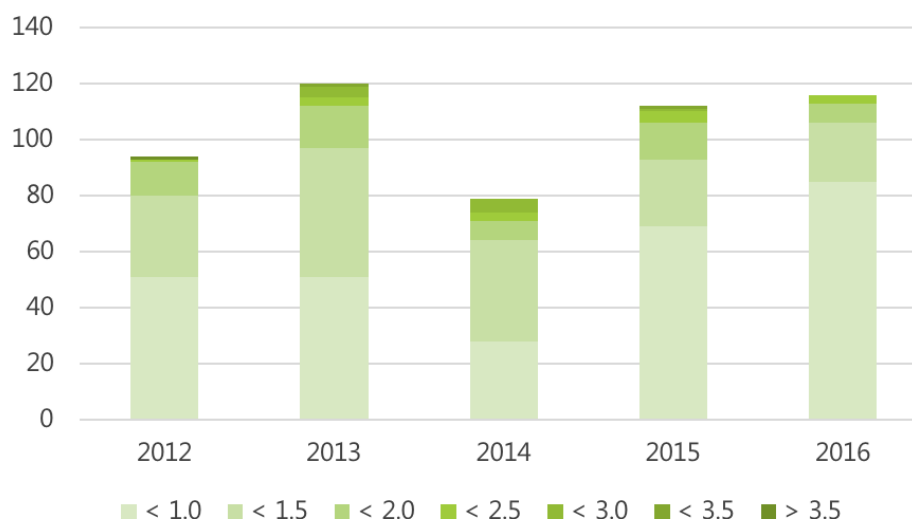
Figure 1 Earthquakes in the Groningen gas field region, 1991-2016



Source: Nederlandse Aardolie Maatschappij (n.d.), "Aardbevingen (Gr.)," online: <http://www.nam.nl/feiten-en-cijfers/aardbevingen.html>, viewed in February 2017.

During the first few decades, the NAM pursued its business objectives towards natural gas extraction from the Groningen gas field without much consideration for the possible risks. Studies on seismic risk at the time considered the risks negligible, and that the magnitude of any potential earthquakes would be very limited. Although the magnitude threshold was increased a number of times, the stakeholders involved continuously excluded the possibility of personal injury from these earthquakes, as the belief was that the earthquakes would never reach beyond these limits.¹¹ This understanding dramatically changed with the earthquake in Huizinge (in the municipality of Loppersum) in 2012, which reached a magnitude of 3.6 on the Richter scale. This was the first earthquake of a magnitude above 3.5 and rose for the first time an actual concern for the residents' safety. Figure 2 presents the earthquakes that have occurred in the region between 2012 and 2016, including the event in Huizinge. For each year, the total amount of earthquakes is broken down into different magnitudes on the Richter scale.

Figure 2 Earthquakes in Groningen gas field region, 2012-2016



Source: Nederlandse Aardolie Maatschappij (n.d.), "Aardbevingen (Gr.)," online: <http://www.nam.nl/feiten-en-cijfers/aardbevingen.html>, viewed in February 2017.

As a result of the earthquake in Huizinge, which exceeded the magnitude limit that had been previously thought, it became clear that seismic activity and hazard needed to be re-evaluated.¹² A number of independent entities were launched to provide help with compensation procedures and to undertake a number of new studies. These studies focused on earthquake probabilities and potential consequential damages, possible earthquake-proofing structures, and as it came to light, the consequences on residents' health and livelihoods.

1.3 Who is involved: private and public stakeholders

The primary stakeholders implicated are the shareholders of the Groningen gas field: Shell and ExxonMobil, through the NAM, and the Ministry of Economic Affairs (EZ), through EBN. In accordance with the mining act of the Netherlands, EBN owns 40% of the rights of the natural gas deposits in Groningen.¹³ Together, Shell, ExxonMobil, NAM, EBN and EZ form the board of directors of 'Maatschap Groningen' (CBM), the centre of operational decisions. In addition to the shareholders, the Staatstoezicht op de Mijnen (SodM), advises EZ on current and future decisions regarding natural gas extraction. However, there is no system in place to hold EZ accountable if it does not follow SodM's advice.¹⁴

Within CBM, the public and private shareholders of the Groningen gas fields have to agree on all aspects of the production strategy. In their 2015 study and 2016-2017 follow-up about the risks and consequences of earthquakes in Groningen, the Onderzoeksraad voor Veiligheid (OVV) determined that the primary concern of the shareholders is to maximise profit, usage, and the continuity of the project. The OVV also concluded that until 2013, there was no consideration for the safety of the residents in their decision-making. Additionally, their decision-making process is exclusive, and therefore does not provide any opportunity for the involvement of the residents or the wider implicated community.¹⁵

Beyond the shareholders of the gas field, a number of specially appointed commissions and institutions were brought into the situation after the 2012 earthquake in Huizinge. At that point, it became clear that there was a need for further research into gas extraction and its risk factors, as well as a need to provide stronger support to the residents. Although they are not part of the official decision-making process relating to the Groningen gas reserves, these institutions allow for a certain level of collective discussion and pressure on the shareholders. These are important with regards to possible reparations for damage induced by earthquakes. They are additionally important as a form of informal accountability, to ensure that residents are receiving support or reparations for any needed response to earthquakes.

The entities discussed above include the various levels of government, i.e. the municipalities and the province of Groningen directly, and EZ more indirectly. A certain level of streamlining has also been implemented, whereby the Nationaal Coördinator Groningen (NCG) was established to oversee damage repairs and the building of earthquake-proofing structures in the earthquake-prone area and further across the province. Further, a number of research institutes have also been implicated, to study a number of various differing effects of the gas extraction project on the region of the Groningen gas field. These have included OVV, RUG, TU Delft, TNO, CBS, as well as ARUP to oversee a seismic risk and implementation strategy study. Some of the findings from these studies are discussed in Chapter 2.

Finally, a number of entities are involved in the response to damage claims or applications for compensation, beyond the stakeholders included above. These are the Onafhankelijke Raadman, the Arbiter Aardbevingschaden, the Commissie Bijzondere Situaties and, more specifically for housing devaluation issues, Stichting Waardevermindering door Aardbevingen Groningen (Stichting WAG). On behalf of the NAM, Centrum Veilig Wonen (CVW) has taken over the damage claims and reparation applications.

Evidently from the variety of organisations and institutions involved, the project of the Groningen gas field has a very serious and direct impact on the livelihoods of the residents of the province, and especially the residents of the municipalities in the region of the gas reserves. The following chapters examine the costs absorbed by the various stakeholders, with a focus on the costs to the residents and the government. It also examines the revenues received by the government directly from the oil and gas reserves.

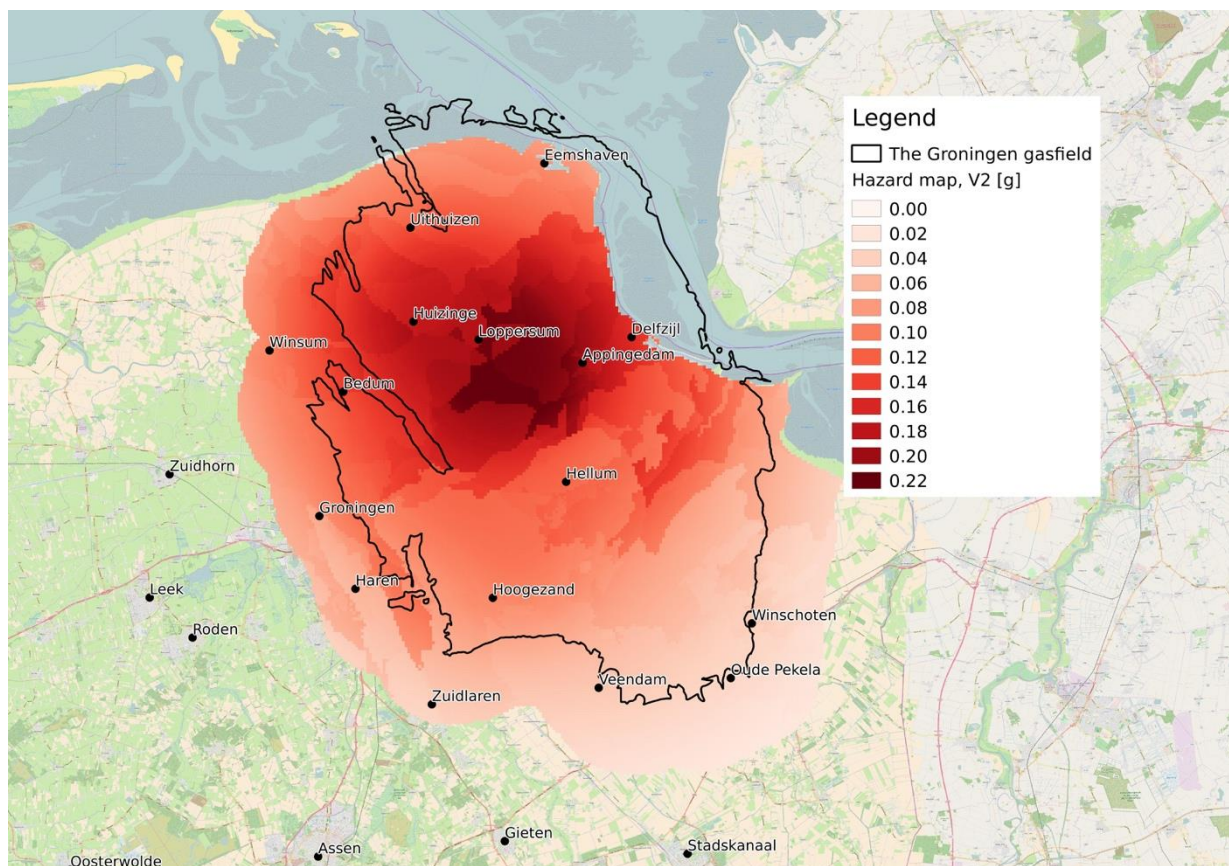
Chapter 2 Price of Groningen gas: consequences to society & economy

2.1 Introduction

Natural gas extraction operations in Groningen are costing the communities in the gas field region significantly. This ranges from property damage and the devaluation of the real estate market, to effects on the well-being and quality of life of the residents in the region. This chapter provides an overview of the current financial costs of the Groningen gas field to local and national levels of government and to NAM. It also discusses the psychological and physical costs to the residents.

Figure 3 gives an indication of the earthquake-affected region, based on the delimitations of the Groningen gas field and future earthquake probability. Seismic risk is measured by the ground acceleration, which is dependent on the magnitude and ground level of the earthquake. For example, an earthquake with a 3.0 magnitude on the Richter scale that occurs three kilometers below ground has a higher ground acceleration than an earthquake with the same magnitude that occurs 100 kilometers below ground.¹⁶ Zonage has been calculated based on observed induced earthquakes. The delineated area in black shows the location of the Groningen gas reserves. The shaded areas demonstrate seismic hazard probabilities for future earthquakes, by peak ground acceleration (PGA). The highest PGA levels are concentrated around the area between Loppersum, Ten Boer, Appingedam and Spijk, ranging from 0.18-0.22 g ($1\text{ g} = 0.938\text{ m/s}^2$).¹⁷ As of a PGA of 0.12 g, there is the risk of significant damage to a number of properties.¹⁸

Figure 3 Groningen gas field region and seismic hazard probability



Source: Dost, B & J. Spetzler (2016, June), *Probabilistic Seismic Hazard Analysis for Induced Earthquakes in Groningen, Update June 2016*, De Bilt, Netherlands: KNMI. Evers, L. (2016, June), "Nieuwe hazardkaart Groningen: dalende seismische dreiging," *KNMI*, online: <https://www.knmi.nl/kennis-en-datacentrum/achtergrond/nieuwe-hazardkaart-groningen-dalende-seismische-dreiging>, viewed in February 2017.

2.2 Costs to the shareholders

The first concrete budget to remedy the consequences of natural gas extraction operations was established in 2014, in a consortium between EZ, the municipalities affected by the earthquakes and the province of Groningen, in consultation with NAM. At this point, it was decided that a new independent organisation would be established specifically to execute a compensation scheme for all physical damages related to the earthquakes in the province of Groningen. The initial budget then allocated would be primarily funded by NAM, given their responsibility in inducing the earthquakes and their liability according to the mining law of the Netherlands. The budget, of almost € 1.2 billion for the 2014-2018 period, is divided as follows:^{i,19}

- € 600 million for earthquake proofing structures (including private and public properties, with priority to schools and properties critical for emergencies) and for preventative adjustments to dams and infrastructure such as pipelines and power pylons;
- € 250 million for property damage compensations, including private and public properties, with priority to schools and properties critical for emergencies;
- € 15 million for a fund for people with special circumstances;
- € 10 million for additional costs to new constructions in the earthquake-risk area;
- € 125 million for compensations related to property value-enhancement;
- € 60 million for an improvement of quality of life program, with an additional € 25 million by the province of Groningen;
- € 65 million, with an additional € 32.5 million by the province of Groningen, for the establishment and operation of an "Economic Board."

The program for the improvement of quality of life has the following goals: to promote cultural heritage, to restructure housing stock and shopping facilities, to stimulate local power generation and to enable access to highspeed internet and smart grids in rural areas.²⁰ In contrast, the Economic Board was established to ensure and strengthen professional expertise of the region. The majority of the members are local entrepreneurs from the region, involved in these distinct fields: small to medium enterprises (SMEs), chemistry, energy, agribusiness and innovative construction.²¹ The role of this board is to establish a specific program to strengthen the economic structure of the region.²²

Established in 2015 as a collaboration between the national government, the Groningen province and twelve municipalities within Groningen, the NCG oversees the program "Meerjarenprogramma Aardbevingsbestendig en Kansrijk Groningen" (Multiannual plan for earthquake resistance and a successful Groningen, short: MJP), of which the main objectives relate to damage repairs and earthquake-proofing private and public properties, as well as infrastructure.²³ The MJP is to be updated and executed for the period 2016-2024. Additionally to the NCG, whose role is to be the public administrator of the program, there are two other stakeholders involved: the NAM, who is liable to pay the costs of the compensation schemes, and the CVW who executes the program.²⁴

In addition to the budget above agreed to be primarily funded by NAM, the Dutch government has also made available specific budgets for the NCG and the MJP. The total government funds made available for MJP for the period of 2016 to 2024 is € 430.1 million, of which € 334,1 million is to be allocated to the implementation of the program and € 96 million to overhead. Of this budget, € 244 million will be taken out of the government's natural gas extraction profits.²⁵ The distribution

i This budget was adjusted between the first agreement in 2014 (*Vertrouwen op Herstel en Herstel van Vertrouwen*) and the most recent plan of the program (MJP 2017-2021), which was published in December 2016.

of the budget between program and overhead may still change, dependent on the potential need to increase staff capacity.²⁶ Structural funds have been budgeted within the program budget to account for this possibility. This change is also dependent on the results of the earthquake-proofing project.

2.3 Involvement of NAM in compensation procedures

The NAM has been significantly criticised for not concerning itself sufficiently with the well-being of the people of Groningen. For many years, the NAM denied that the earthquakes resulted from their gas extraction operations. Their studies concluded repeatedly that the possible damages to properties induced by gas extraction areas would be negligible. The OVV's report (2015) argues that this has led to an important neglect by the NAM towards the safety of the Groningen people by prioritising the company's economic interests. In their report, the OVV affirms that all residents living in or near the earthquake-affected area should be and feel safe in their daily life. Only after the establishment of an independent organisation, the CVW, can measureable steps be seen towards providing compensation and starting reparations. Table 7 provides an overview of earthquake-related expenditures of the NAM over the period 2012-2014 and in 2015. For the period 2012 until 2015, the NAM has dedicated € 717.9 million to reparations and other earthquake-related issues. In their 2015 annual report, Shell Nederland B.V., one of the parent companies of NAM in the Netherlands, NAM estimates a remaining € 824 million needed for the costs of reparations relating to the Groningen gas extraction.²⁷

Table 7 NAM earthquake- and subsidence-related expenditures

Type of expenditure	Cost (in € million)	
	2012-2014	2015
Subsidence		
Works management by water boards	8	4
Earthquakes		
Studies and data acquisition*	24	31
Earthquake-proofing of private structures, industry and infrastructure	52	120
Compensation claim settlements	160	207
Societal impacts		
Quality of life	1	6
New building schemes	0.6	6
Economic Board	0.2	26
Value-enhancing scheme	2	70
Total	248	469.9

* excluding investments in deep wells and monitoring equipment.

Source: Nederlandse Aardolie Maatschappij (2016, April), *Winningsplan Groningen Gasveld 2016*, p. 32.

Despite the NAM paying their share as per the liability of the company, there is an important perception that this is insufficient. The OVV claims that the NAM's technocratic and single-focused method of communicating with residents does not provide sufficient and clear information about the actual expected consequences of future earthquakes, nor an estimate of potential additional material damages. The evident frustration voiced by the majority of residents in the earthquake-affected area is an indication that this lack of involvement is perceived strongly overall: residents feel that both the national government and the NAM have done too little to remediate the situation around natural gas extraction, at the expense of the residents' social and economic livelihoods.²⁸

The NAM's limited responsive action and the delays with the compensation schemes have not only led to an increase in the costs incurred by the government, but have also had important social costs, such as the decrease in trust and belief in the government, and glaring perceived incompatibility between the interests of the government and that of the residents.²⁹ Indeed, TU Delft and CMO STAMM's 2016 study shows that residents feel little to no trust in the government, and that the government's interests are only aligned with that of the NAM. The residents believe that there is no method for full accountability of the problem, and that their claims are handled unjustly.³⁰

2.4 Costs to housing and real estate market

In January 2015, Centrum voor Veilig Wonen (CVW) took over the damage claim procedures from the NAM, in an attempt to increase the satisfaction of compensation procedures. CVW is an enterprise independent from the NAM, established as a joint venture between Arcadis (55%) and CED (45%).³¹ CVW's registered business name is Arcadis CED Project Service N.V.³² The role of the CVW is to deal with all damage complaints and compensation procedures and the NAM is held accountable to provide compensations agreed upon by the plaintiffs and CVW. Establishing the CVW has been important in improving the efficiency and results of the compensation process. Where a complaint took the NAM on average six to seven months to process, CVW can process the same complaint in six to eight weeks.³³

Although the operational costs and profits of the NAM could not be found, CVW's figures for 2015 are published, and provide an indication of the capital dedicated to the Groningen earthquakes issue.³⁴ As 2015 is their first year of operation, there is no comparison to be made with other years of operations. Table 8 presents a basic overview of the revenues, costs and profits of CVW for the 2015 financial year. The company's total revenues for 2015 were of € 27.4 million, which led to a profit of € 2.1 million. € 400 thousand were invested in office resources, mostly computer equipment. After dividend payout to the company's shareholders, the remained earnings for 2015 were € 1,028,500.³⁵

Table 8 Financial overview of Centrum Veilig Wonen, 2015 (in € million)

Company name	Revenues	Taxes	Profits
Arcadis CED Project Service N.V.	27.4	0.7	2.1

Centrum Veilig Wonen (Arcadis CED Project Service Bureau N.V.) (2016, December), *Jaarverslag 2015*

The primary focus of the reparations' system that has been developed since 2014 has been in relation to property damage. This has included direct physical damage to properties as a result of the earthquakes, as well as economic damage to the value of real estate in the earthquake-affected region. As a result, three procedures have been implemented to provide compensation to affected residents: property damage repairs, earthquake-proofing structure implementation and value-enhancing for sold properties.

2.4.1 Property damages

Since January 2016, the CVW and NCG distinguish between types of property damages. Two types are now recognised, given the difference required in compensation procedure: regular claims and complex claims. Regular damage claims concern damages determined to be solely induced by earthquakes. In this context, the claim is handled by an expert from the CVW and if agreed upon by the owner, repaired. The claim can also be contested by the owner, at which point a second expert opinion is made, which possibly changes the CVW's compensation offer. If agreed upon, the repair is made and the case closed.³⁶ However, if the owner still does not agree, the claim can be transferred to the "Arbiter Bodembeweging" ('Arbitrator for subsidence,' previously "Arbiter Aardbevingsschade," or 'Arbitrator for earthquake-damages'). The outcome of the arbitrator for any claim has to be upheld by the CVW and the NAM.³⁷

Complex damage claims concern damages that are either caused by more than one factor, including earthquakes, that concern both material and immaterial issues, or that are caused by ground subsidence. These claims are outside the scope of activities of CVW. Given their complexity, these claims take more time to be dealt with, the outcome of which can easily be disagreed upon and lead to feelings of anger, disappointment or injustice. Complex claims usually involve more than one institution, including the NCG and CVW, and possibly additional entities, such as the local water boards (i.e. Noorderzijlvest and Hunze&Aa).³⁸ In the case of complex claims, CVW transfers the claim to NCG. The procedure to determine the results of the claim is the same as for regular claims, but can take longer and involve additional parties.³⁹

Figure 4 provides an overview of the scale of damages that can occur as a result of an earthquake, as determined by EMS-98. Up to an earthquake with a PGA of 0.15 g, damages found are of grade 1 and 2. Earthquakes with a PGA of 0.15 g and higher present damages of grade 3 and higher. Of the earthquakes induced by the Groningen gas field, no damages have been found of grade 4 or 5.⁴⁰

Figure 4 Types of potential earthquake-induced damages



Grade 5: Destruction (very heavy structural damage)
Complete or almost complete collapse of the property



Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage)
Serious cracks in walls
Partial failure of structural components for roofs and floors



Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)
Large and deep cracks on most walls
Roof tiles slip away
Chimneys break at roofline
Break in some of the non-structural components



Grade 2: Moderate damage (slight structural damage, moderate non-structural damage)
Cracks in several walls
Fall of large pieces of wall plastering
Fall of chimney parts



Grade 1: Negligible to slight damage (no structural damage, light non-structural damage)
Hairline cracks in a single wall
Fall of small pieces of wall plastering
in some cases, the fall of loose bricks

Source: Nederlandse Aardolie Maatschappij (2016, April), *Winningsplan Groningen Gasveld 2016*, p. 52; European Seismological Commission (1998), *European Macroseismic Scale 1998 (EMS-98)*.

Within the category of complex damages, the NCG has begun inspections at 1,450 homes in Loppersum, 't Zandt, Ten Post, Overschild en Appingedam and will begin with inspections of 850 damage claims from the municipalities of Appingedam, Delfzijl en Uithuizen. In addition, the CVW and NAM have begun the procedures of the 1,800 damage complaints regarding residential properties located on the edge of the earthquake area. Within the period of 2012 to 2016, NAM has declared to the NCG to having dedicated € 464 million, of which € 307.9 million were dedicated directly to damage compensation, and € 156.1 million have been dedicated to procedural costs.⁴¹

2.4.2 Earthquake-proofing structures

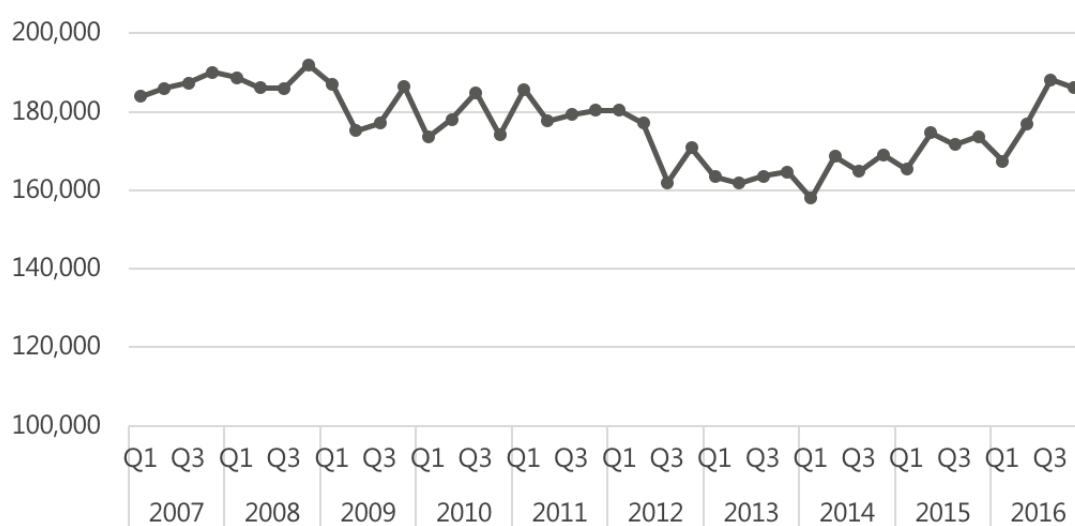
From compensation and repair of damages to also get assistance with implementing earthquake-proofing structures, the damage to the property has to be categorised grade 3 and above. With property damages deemed at grade 3, the building receives an inspection to determine whether the property should also undergo the installation of an earthquake-proofing structure.⁴² The NCG claims that 22,000 residential properties in the core of the earthquake-affected area have to be fully assessed to determine whether they require additional earthquake-proofing structures. In order to decrease the time frame for the investigations and to begin construction as soon as possible, the NCG has developed a framework for the earthquake-proofing structure research to maximise execution efficiency. Additionally, the first of the originally planned 3,000 properties annually have been implemented with earthquake-proofing structures.⁴³ For 2015, CVW declared having provided earthquake-proofing structures to 1,118 properties.⁴⁴ For the additional inspections, a total of 600 properties have been inspected in the municipalities of 't Zandt, Lopersum, Ten Post, Overschild and Appingedam. As of November 2016 and beginning in 2017, inspections have also begun in the municipalities of Delfzijl Noord, Uithuizen, Zandweer, Kantens, Middelstum, Holwierde, Stedum, Leliens, Winneweer, Woltersum, Schildwolde and Slochteren.⁴⁵

2.4.3 Value-enhancement provisions

In addition to structural damage caused to properties by the earthquakes, there is recent evidence that the real estate market itself in the province is also negatively affected.⁴⁶ Residents of the gas field region who decide to leave for safety reasons find themselves with houses with a decreased market value, either as a result of physical damage, reputational damage, or both.

The overall crisis of the real estate market, the population decline and the earthquakes demonstrate that there is no functioning real estate market in the earthquake-related area. For each property that is sold in the area, there are 24 other similar properties available for sale. This is more than double the national average of 11 properties for each property sold. As presented in Figure 5, properties in the province of Groningen have had as much as 15% variation in selling price from the highest to the lowest average before and after the Huizinge earthquake.

Figure 5 Average selling price of private properties, Groningen province (2007-2016, in €)



Kadaster *Vastgoed Dashboard* (2017, March), "Gemiddelde koopsom per regio, totaal per provincie, Groningen," online: <https://www.kadaster.nl/gemiddelde-koopsom-per-regio>, viewed in March 2017.

This crisis is further enhanced by current property owners in the earthquake-affected region who are worried about their property's value and marketability and therefore hesitate to invest in their own homes. Many property owners feel that their homes are unmarketable, and those who are considering moving wonder if they will be able to sell their home within two years and for a price with which they could afford a good home somewhere else.⁴⁷

Awaiting the outcome of various studies on market value and a permanent compensation standard for properties that have sold below market value, a temporary regulation was put in place. For properties that have damages valued at €1,000 and above and for residential properties that are being sold, owners could further make a request for a value-enhancement package worth €4,000.⁴⁸ This compensation has to be used for home insulation, energy saving devices and/or decentralised energy, and is provided in an order of priority. The order of fund distribution is the following:⁴⁹

1. Properties with substantial repairs and/or earthquake-proofing structures;
2. Monuments within and outside the core area;
3. Properties in the core area built before the war;
4. Properties outside the core area built before the war;
5. Postwar properties in the core area;
6. Postwar properties outside the core area.

€ 89.1 million have been made available within the combined budgets of the NCG and NAM to execute the value-enhancement program, including compensation and overhead costs. This is only applicable for damages occurred as of 1 January 2016, and for compensation applications that were made before 31 January 2016 but did not receive a report before 1 July 2016.⁵⁰ This budget only compensates owners who make a direct claim for such compensation once they have sold their homes. In the scenario elaboration in Chapter 4, the estimation only looks at claims to compensation for loss in real estate value, and do not include a comprehensive estimation of real estate value loss across the region.

In addition to value-enhancement compensation, the stakeholders are making available a buyout option, where the NAM would buy the property at the agreed market price, to then repair or sell the property again. In June 2016, 55 properties were selected to be part of the buyout pilot project ("pilot koopinstrument"). € 10 million have been made available in the budget for this project.⁵¹

2.5 Costs to the quality of life

In addition to the frustrations with the government and the NAM, and the challenges residents face to apply for and receive compensation, residents are facing important effects on their health and well-being. Only recently has there been a rise in attention towards the consequences of the earthquakes and related activities on the health, well-being and quality of life of residents in the earthquake region. Studies by OVV (2015), TU Delft and CMO STAMM (2016), CMO STAMM and SPG (2016) and RUG (2016) demonstrate clearly that the earthquakes and subsidence induced by natural gas extraction in the North of the Netherlands have had large impacts on these aspects of the residents' life, additionally to property damages incurred.⁵²

Costs to the quality of life of residents in the earthquake-affected area include various short and long-term consequences: feelings of insecurity, fear to their safety or the safety of family members, especially children, stress, limited freedom of choice, reputation of the region and possibilities for the future of the region in terms of culture, heritage and prospects for their children. Residents also fear significant damages to the chemical plant in Delfzijl or to the dikes.⁵³

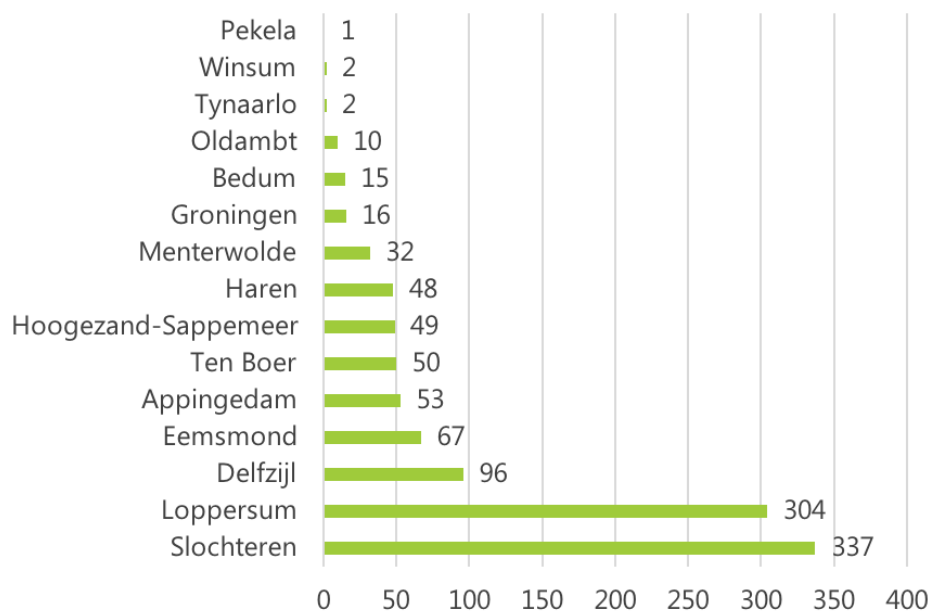
According to TU Delft and CMO STAMM, 15,000 residents or 29% of all residents in the nine main earthquake-affected municipalities consider themselves to be unsafe as a result of earthquakes. Almost 4,000 residents have resulting psychological problems.⁵⁴ Of the residents who have multiple resulting damages to their home, only 40% feel safe in their home compared to 83% of residents without damage to their home.⁵⁵ Residents' level of satisfaction over their quality of life has significantly decreased, from 86% in 2012 to 77% in 2015.⁵⁶ Up to 33% of residents are feeling significantly insecure or are having other psychosocial and health problems as a result of earthquakes.⁵⁷ Consequently, there is a population decline: as people leave the area, fewer people move into the area due to lack of safety.⁵⁸ The study reports that this has a number of effects on the economy and quality of life of the communities, such as an increase in vacancy rates and a decrease in services and businesses, which in turn reduces employment and could lead to a significant vicious cycle.

In November 2016, a lawsuit was filed against the NAM and the Dutch government on behalf of 127 residents in the earthquake-affected area. This case specifically addressed the immaterial costs of earthquakes on these residents over a number of specific issues. On March 1st, the court of the North of the Netherlands in Assen ruled in favour of the plaintiffs, concluding that the NAM is indeed liable for immaterial damages and that the State handled the earthquake situation unjustly, to the costs of the residents. However, it deems that the plaintiffs could not substantiate whether they would not have suffered these damages had the government reduced natural gas extraction further. The judge therefore concludes the State not to be liable for these costs, and the NAM to be liable, as these these immaterial damages cannot be defined as "ordinary nuisance."⁵⁹ The judge also declared that the procedural costs for this case are to be refunded by the State and the NAM to the plaintiffs, to the respective amounts of € 2,873 and € 4,388.57.⁶⁰ Compensation to be provided by NAM is to be further assessed by and settled according to the law.⁶¹ As this outcome is very recent and no cost analysis relating to immaterial damages has been made by stakeholders, no estimation could be included for these immaterial costs in Chapter 4.

2.6 Costs to municipalities

The final type of stakeholder that is insufficiently included in analyses of the Groningen gas field situation is the local government body. Municipalities located within the earthquake-affected region are substantially involved in the reparation schemes. Although damage claims primarily relate to individual properties, the more earthquakes occur in a municipality, especially with a stronger magnitude, the more the entire municipality is affected. These effects occur both at the social level, i.e. the community, and at the economic level, i.e. the local government institution. Figure 6 gives an overview of the total earthquake occurrences, distributed by municipality.

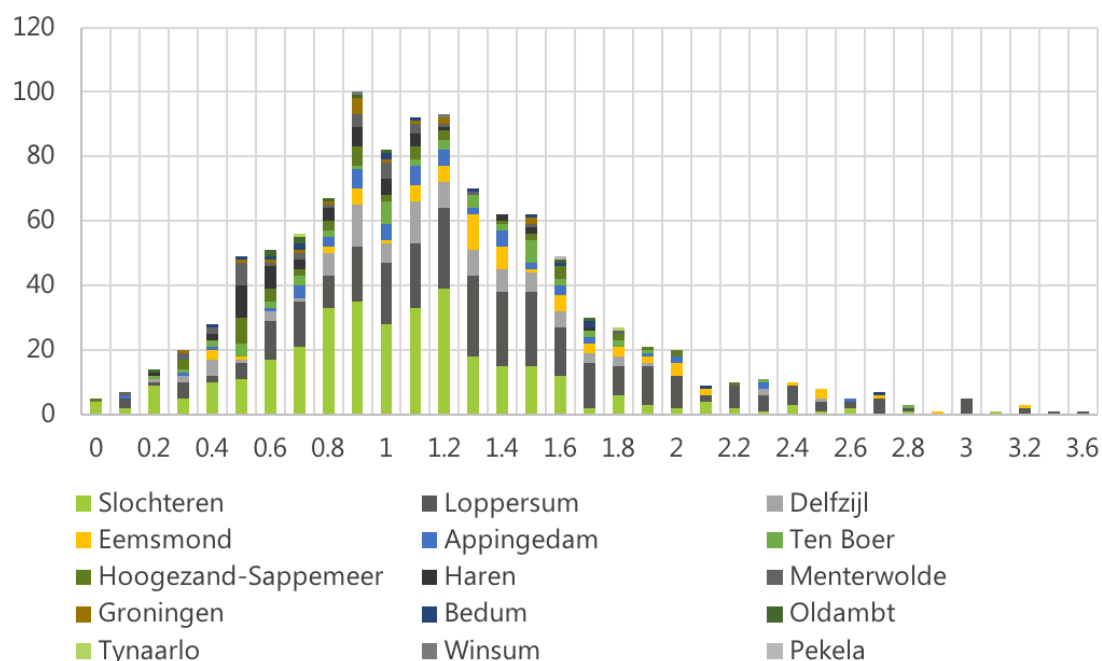
Figure 6 Total earthquakes in the Groningen gas field, by municipality



Source: Nederlandse Aardolie Maatschappij (n.d.), "Aardbevingen (Gr.)," online: <http://www.nam.nl/feiten-en-cijfers/aardbevingen.html>, viewed in February 2017.

Attributing the location of earthquakes to a municipality provides an idea of the epicentre of the earthquake, and therefore, where the largest damages can be found for each earthquake. The municipalities of Slochteren and Loppersum have alone been the epicentre of 60% of the total earthquakes in the Netherlands. Figure 7, in contrast, shows the earthquake distribution per municipality, from the lowest to the highest magnitude (using the Richter scale).

Figure 7 Magnitude distribution of earthquakes and municipalities



Source: Nederlandse Aardolie Maatschappij (n.d.), "Aardbevingen (Gr.)," online: <http://www.nam.nl/feiten-en-cijfers/aardbevingen.html>, viewed in February 2017.

Given the significant locality of the seismic events, despite the outreach being also substantial, there are a number of costs that municipal institutions have to absorb, and which are not considered within the reparations budget to be paid by the NAM. They are therefore likely never to be compensated. These costs include any additional policy or procedures to be executed in relation to the earthquakes. These are necessary costs that a municipality faced with the earthquake hazard must budget differently than a municipality not affected by the issue.⁶²

An important example of such costs that only affect municipalities in the earthquake-area relates to the law on valuation of real estate (WOZ or wet waardering onroerende zaken). Because of the lowering in value of real estate in this region, house owners are protesting the valuation given to houses on which the real estate tax is based. This discrepancy occurs as a result of the valuation date, which is on 1 January of each year, whereas the housing value decreases throughout the year due to earthquakes and subsidence. Owners who object to the high valuation hire legal advisors, whose procedural costs have to be paid by the municipality if the plaintiff wins their case. This occurs frequently enough to have had a significant impact on the budget of these municipalities. In addition, because these municipalities have a higher property tax rate than the average in the municipal fund system, compensation to the municipality for these losses is severely limited.⁶³

In a research on the effects of earthquakes of the finances of municipalities located in the earthquake-affected area, TU Delft demonstrated that there are important costs being added to the budgets of these municipalities, who already have quite limited budgets. In their case study examining the municipalities of Loppersum and Bedum, the study demonstrates that for additional procedural costs only, as defined above, the extra costs were of € 92,383 in 2013 and € 111,332 in 2014 for Loppersum and € 22,296 in 2014 and € 71,067 in 2015 for Bedum.⁶⁴ Other types of costs affecting municipal budgets include but are not limited to: property investments by the municipalities, municipal administrative and organisational costs, land policy and reputational and economic situation.⁶⁵ No further cost specification has been provided for the other identified categories, nor has there been sufficient investigation into these extra costs for more municipalities in the earthquake-affected area. For this reason, in the scenarios in Chapter 4, only the currently budgeted allocations to municipalities from the NAM and the Dutch government are included. Not enough is known about the additional costs to all the municipalities affected.

Chapter 3 Profits derived from Groningen natural gas reserves

3.1 Introduction

This chapter looks into the revenues assumed by the government from the Groningen natural gas extraction by NAM and EBN. Operational and revenue figures of the NAM itself are not publicly available and dividends acquired by the NAM are not provided by Shell or ExxonMobil. Section 3.2 provides an overview of the profits of the government from natural gas extraction, whereas section 3.3 examines the causes of recent changes in profits.

3.2 Government revenues from natural gas reserves

The Dutch government, through EBN, owns 40% of the gas extraction operations in Groningen. EBN is an enterprise that invests in the exploration, extraction and storage of gas and oil. Natural gas extracted from Dutch reserves is exported through GasTerra, a trading company owned at 40% by EBN, 10% by the government and 50% by Shell and ExxonMobil. Through EBN, the Dutch government receives the direct profits from the operations owned by EBN. The profits gained are provided by EBN once a month.⁶⁶ Through EBN and GasTerra, the government also receives dividends on their operations. In addition, the government receives an important sum annually by natural gas extraction companies for the concession rights to allow the exploitation of the natural gas fields. The final source of government revenue from the natural gas extraction operations originates from corporate tax received from operational companies, such as EBN and NAM.

Table 9 provides an overview of the direct government revenues from natural gas extraction for the period from 2012-2016. Revenues from oil and gas reserves include concession rights for the operation of the natural gas fields, taxes comprise corporate taxes paid by companies exploiting natural gas fields, such as the NAM and EBN, and dividends are sums received from government-owned companies that exploit natural gas fields, such as EBN. The revenues received by the government include domestic sales and sales on exports.

Table 9 Revenues from gas extraction by the Dutch government (2012-2016, € mln)

Type of revenue	Amount (in € million)				
	2012	2013	2014	2015*	2016*
Revenues from natural gas reserves	10,967	11,848	8,106	4,268	2,040
Dividends	2,365	2,331	1,618	390	165
Tax revenues	1,821	1,780	1,287	604	158
<i>Total revenues</i>	<i>14,586</i>	<i>15,959</i>	<i>11,011</i>	<i>5,262</i>	<i>2,363</i>
Percentage of state revenue (in %)	9.6	9.9	6.5	3.2	1.4

* Figures are provisional.

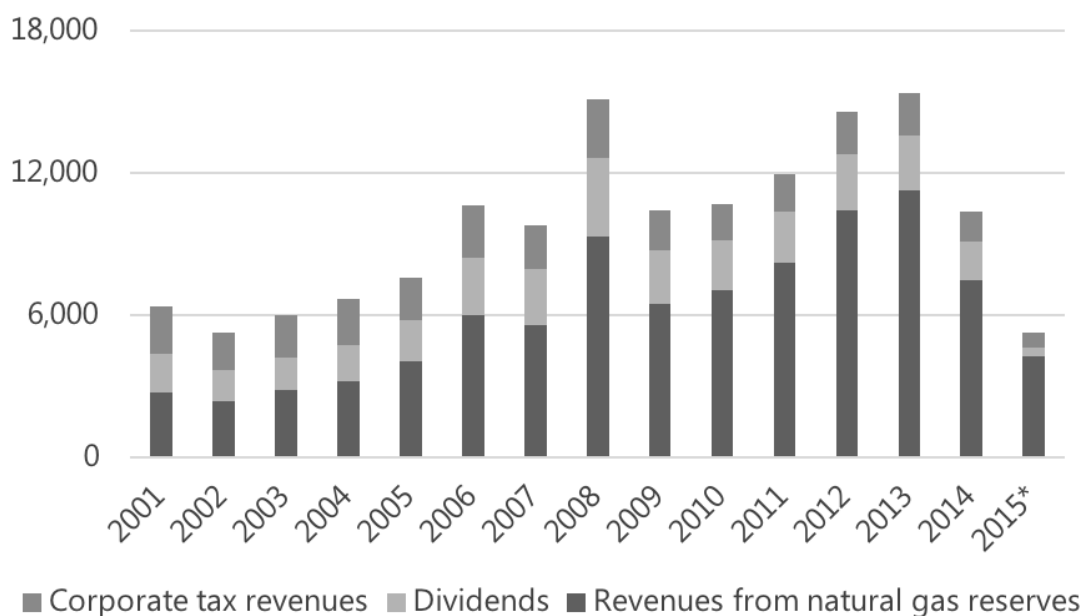
Source: CBS Statline (2016, December), "Overheid; inkomsten en uitgaven; aardgasbaten," CBS, online: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82563ned&D1=0,73-76&D2=0-3&D3=73,78,83,88-91&HDR=G1,G2&STB=T&VW=T>, viewed in February 2017; Notten, F. (2016, December), *De Nederlandse economie: de invloed van de aardgaswinning op de Nederlandse economie*, Den Haag/Heerlen, Netherlands: CBS, p. 13-14.

The distribution of these revenues by the government into sectors and region have varied considerably over the period of natural gas extraction in the Netherlands. Between 1994 and 2010, the government set up a fund called “Fonds Economische Structuurversterking” (fund for the strengthening of economic structure, FES). The purpose of this fund was to use the specific profits received from the gas industry for new investments in infrastructure, sustainability and knowledge. Throughout this period, a minimum of € 1.7 billion were deposited in this fund annually.⁶⁷ Before 1994, and since the closing of the FSE in 2010, the natural gas revenues have been kept and spent from in the overall national budget without a specific objective. A new fund has been creating in its place, the “Toekomstfonds” (fund for the future) has received seed capital only, to the value of € 200 million.⁶⁸ The fund is being financed partially by potential additional profits from natural gas.⁶⁹

3.3 Recent changes to profit levels

The revenues received by the Dutch government have been significantly affected in 2015 and 2016, most importantly because of a reduction in natural gas extraction, changes in the global price of gas and oil, and the increase in repair costs for earthquake damages.⁷⁰ Figure 8 demonstrates that 2013 was a record year after 2008, and that the revenues from natural gas extraction plummeted in 2014 and 2015. Figures for the first three quarters of 2016 indicate a further sharp decrease in revenues from natural gas reserves.

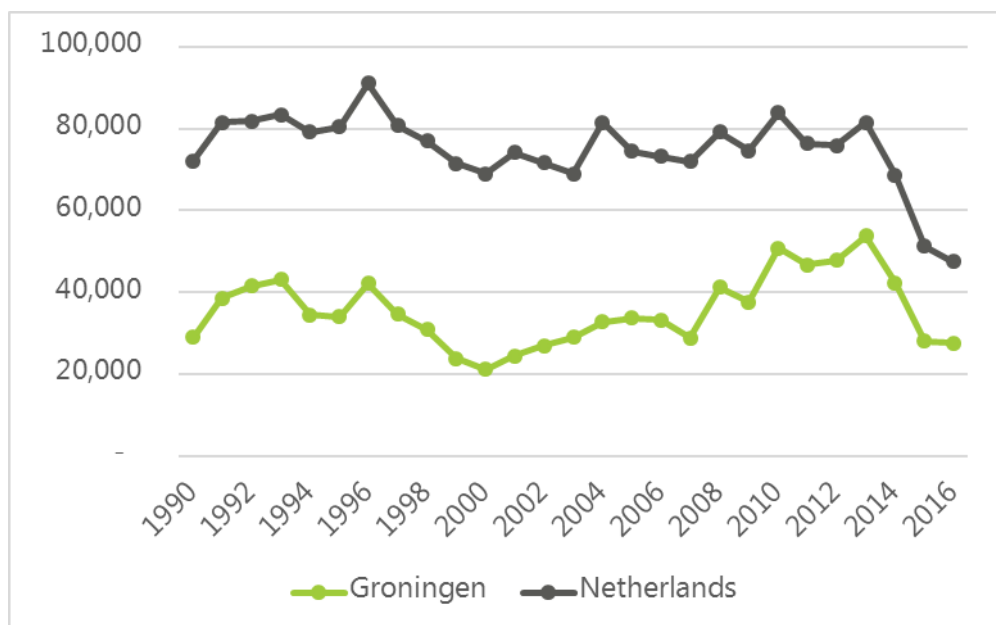
Figure 8 Natural gas extraction revenues, 2001-2015 (in € million)



Source: CBS Statline (2016, December), “Overheid; inkomsten en uitgaven; aardgasbaten,” CBS, online: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82563ned&D1=0,73-76&D2=0-3&D3=0-3,8,13,18,23,28,33,38,43,48,53,58,63,68,73,78,83,88-91&HDR=G1,G2&STB=T&VW=T>, viewed in February 2017.

This dramatic decrease in revenues from natural gas reserves primarily relates to the important limits made on extraction volume. Given the results of various seismic studies and the evident continuity of frequent earthquakes, the Dutch government decided to limit the annual gas extraction levels from the Groningen gas field to 42.5 billion m³ in 2014, whereas 53.6 billion m³ had been extracted in 2013. These limits were lowered again in 2015 to 30 billion m³, and are being discussed to be further lowered to 24 billion m³ for 2017.⁷¹ Figure 9 demonstrates natural gas extraction in Groningen and in the Netherlands for the period of 1990 to 2016.

Figure 9 Natural gas extraction levels, 1990-2016 (in million m³)



* Figures for 2015 and 2016 are provisional, figures for 2014 are revised provisional figures.

Source: CBS *Statline* (2017, February), "Aardgasbalans; aanbod en verbruik," online: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=00372&D1=1&D2=188,205,222,239,256,273,290,307,324,341,358,375,392,409,426,443,460,477,494,511,528,545,562,579,596,611,613,I&HDR=G1&STB=T&VW=T>, viewed in February 2017; Nederlandse Aardolie Maatschappij (n.d.), "Gas- en oliewinning," online: <http://www.nam.nl/feiten-en-cijfers/gaswinning.html>, viewed in March 2017.

In addition, gas and oil prices have been decreasing over the last few years, leading to a devaluation of the Netherlands' oil and gas reserves. Table 10 demonstrates the changes in the value of the total gas and oil reserves over each year of the national budget. Some of the difference in value comes from the extraction and sale of the Dutch gas and oil reserves. However, as the gas extraction levels have significantly shifted, revaluation of the reserves has been more important every year, indicating a change in market value, which is absorbed by the national accounts.

Table 10 Oil and gas reserves, Dutch national accounts

Indicator	Value of gas and oil reserves (in € million)			
	2012	2013	2014	2015
Initial balance	157,115	175,235	154,721	124,185
Revaluation*	31,029	-8,303	-14,264	-19,192
Other changes to volume**	-12,910	12,211	-16,272	331
Ending balance	175,235	154,721	124,185	105,324

* Revaluation is the change in the value of a non-financial asset through price change. The revaluation is determined by multiplying the beginning balance with the price change from the previous year.

** Other changes to volume include unexpected, exceptional events that would cause changes in volume, including loss of stock or reclassification of company to another sector (e.g. mergers or divestitures).

Source: CBS *Statline* (2016, October), "Niet-financiële balansen; nationale rekeningen," online: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82641NED&D1=0-5&D2=3&D3=2-19,22-25,27-33&D4=11-14&HDR=T&STB=G1,G2,G3&VW=T>, viewed in February 2017.

Thirdly, with an increasingly limited ceiling for domestic gas extraction, the Netherlands will be obliged to increase their import levels of natural gas, most likely from the largest exporter to the Netherlands: Norway.⁷² Natural gas imports have been steadily increasing, with a significant jump in import levels around 1998-2000. Until now, this increase has helped to keep a balance between consumption and export on one hand, and extraction and import on the other hand. 2014 witnessed a record number of imports and a sharp decrease of exports from 63 billion m³ (2013) to 55 billion m³.⁷³ However, domestic consumption was also at its lowest record point since 1982. In 2015, the export levels were at 48 billion m³.

In comparison, natural gas imports have increased from 28 billion m³ to 36 billion m³. According to Energie Centrum Nederland (ECN), levels of natural gas import and export will continue on this trend to be at the same level between 2030-2035.⁷⁴ Continued changes in the domestic energy sector and in the trading of gas and oil, and therefore on potential revenues extracted from this industry, will be dependent on upcoming winter climates, available infrastructures for export and import, the availability and diversity of suppliers, as well as continuous fluctuations in the energy market.⁷⁵ Given these factors, the specific changes in profits and costs remain unknown.

Chapter 4 Costs and profits: present and future

This chapter provides an overview of the costs and profits established in the previous chapters and provides two potential scenarios of the future costs: one if the level of earthquakes and magnitude, and consequential damage were to reduce to a low to moderate level and one if they were to increase to a substantial to extreme level. The chapter is divided as follows: section 4.1 outlines the methodology used for the estimation of current costs and the extrapolation of this estimation for the two future scenarios. Section 4.2 then presents three overviews of the costs and profits, the first being the costs and profits incurred until now and budgeted for the period 2017-2024, the second demonstrating the conservative estimation of scenario A, and the third providing a more substantial estimation of costs, as per scenario B.

4.1 Methodology

This section discusses the methodology used to estimate the costs and profits outlined in section 4.2. Given the limited availability of information, the differentiation in the extrapolation of future costs for the two scenarios is restricted to the category of material damages, including compensation and repairs of property damage, structural improvements of properties, real estate compensation and revaluation measures, subsidence-related compensations and property buyouts.

Table 11 outlines the costs and profits for the period of 2012-2024 and includes several estimations. The figures included only comprise costs and revenues that have been publicly made available by a variety of sources, including the stakeholders themselves, such as NAM, NCG, the Dutch government and some of the smaller program boards and commission.ⁱⁱ Additional budget made available for the NAM by its immediate parent company, Shell Nederland B.V. was also distributed within the costs of the NAM for the period 2017-2024. It is assumed that this figure includes damages that have been claimed in previous years but are not yet settled. No amount was assumed for ExxonMobil, as this could not be found.

With regards to revenues, no distinction could be made regarding what revenues originate from the Groningen gas field compared to all gas fields in the Netherlands. For this reason, calculations were made based on the annual production ratios of gas extracted from the Groningen field to all gas extracted in the Netherlands. These percentages are: 63% in 2012, 66% in 2013, 62% in 2014, 54% in 2015 and 58% in 2016.⁷⁶

ⁱⁱ Main sources for the calculations of budgeted expenses and the scenario estimations include: Nederlandse Aardolie Maatschappij (2016, April), *Winningsplan Groningen Gasveld 2016*, p. 32; CBS Statline (2016, December), "Overheid; inkomsten en uitgaven; aardgasbaten," CBS, online: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82563ned&D1=0,73-76&D2=0-3&D3=73,78,83,88-91&HDR=G1,G2&STB=T&VW=T>, viewed in February 2017; Nationale Coördinator Groningen (2017, February), *Kwartaal rapportage: oktober-december 2016*, p. 35-40; Commissie Bodemdaling (2017, March), *Commissie Bodemdaling Jaarverslag 2016*, p. 15-16; De Boer, G. (2017, March), "Overzicht kosten en personeel aardbevingsinstanties," *RTV-Noord*, online: <http://www.rtvnoord.nl/nieuws/175236/Overzicht-kosten-en-personeel-aardbevingsinstanties>, viewed in March 2017; Commissie Bijzondere Situaties (2016, December), *Jaarverslag 2016*, p. 12; van Belzen, T. (2017, March), "Versterkingsopgave Groningen factor 10 groter dan gedacht," online: http://www.cobouw.nl/versterkingsopgave-groningen-factor-10-groter-gedacht?utm_source=Vakmedianet&utm_medium=email&utm_campaign=alp-cobouw&, viewed in March 2017.

For the current budget as well as the two potential scenarios, the revenues attributed to the NAM were estimated based on the gross annual revenues of EBN for the years 2012-2016.⁷⁷ To arrive at the amounts below, the NAM's revenues were estimated based on the notion that the gas extracted by the NAM is divided at 60% for the company and 40% for the Dutch government (through EBN), using the annual ratio of total gas extracted from the Groningen gas field to all gas extracted in the Netherlands.⁷⁸

Moreover, to arrive at the cost overview of the two scenarios below, a yearly estimate of all the overall program costs was made based on the known figures from Table 11, extrapolated to a period of fifteen years. To differentiate a moderate versus an extensive scenario, the following overall calculation was made: in scenario A, the damages are very limited, and no further earthquake of high magnitude occurs over this period, given the significant reduction in gas extraction as of 2015. The total costs of the damages are therefore reduced to 75% of the period of reference (2012-2016). In scenario B, the damages are much more extensive, relative to the number of damage claims ratio requested over the period 2012-2016. In this scenario, the frequency and magnitude of earthquakes as seen in the period 2012-2016 would reoccur repetitively during every five-year period. For this scenario, the costs are multiplied by three.

It can be noted that the costs for material damages are much more significant than what is budgeted for the period 2012-2024. This substantial difference between the current budget and the potential scenarios can be attributed to the fact that until the end of 2016, the NAM and NCG have primarily worked on processing claims for damages to properties, and only started with real estate valuation measures and structural improvements in 2016. Below is a description of the methodology used to calculate the specific costs related to material damages:

- **Property damages:**
 - Using the figures from the NCG concerning the number of damage claims made over the period of May 2015 to December 2016, i.e. 17,292, it was calculated that the average property repair or compensation cost for that period was € 6,830 and the average process cost for each repair or compensation during that period was € 4,368;⁷⁹
 - This average was then used to calculate the total potential costs for damage claims, based on the total number of claims made between 2012 and 2016 (76,694), and excluding 22% of claims for which the NAM is not providing compensation;
 - For scenario A, this amount was multiplied by 0.75, and by three for scenario B;
- **Earthquake-proofing structures:**
 - For the structural improvements to the houses in the natural gas field area, a different calculation was made, based on the number of residences in the nine municipalities in the earthquake core area (e.g. Appingedam, Bedum, De Marne, Delfzijl, Eemshaven, Loppersum, Slochteren, Ten Boer and Winsum);
 - The average range of costs for structural improvements is estimated to be between € 47,000 and € 87,000, according to BAM;⁸⁰
 - For scenario A, the amount of €47,000 (as the lowest figure) was attributed to 30% of all residences in these municipalities, and to 15% of all residences in the rest of the Groningen province, excluding the municipality of Groningen.⁸¹
 - For scenario B, and to create a distinct difference, the high range value of € 87,000 was attributed to 100% of the all residences in the earthquake core, and to 70% of the residences in the rest of the province, excluding the municipality of Groningen;⁸²

- **Subsidence-related compensation:**

- Based on the percentage of subsidence-related costs during the period 2012-2016 comparatively to the entire costs, the same ratio was applied for the two scenarios, multiplied by 0.75 for the first and by three for the second scenario.

- **Devaluation of real estate:**

- According to De Haan Advocaten in Groningen, the average loss on real estate value for the properties in the earthquake core area is between € 20,000 and € 25,000;⁸³
- According to the NAM, however, 70% of all devaluation for claims made to the NAM lie between 1% and 4.7%, which is closer to € 5,000 for the average sale price of a house in Groningen;⁸⁴
- According to the Dutch property and land registry (Kadaster), the average sale price for houses in the province of Groningen in 2016 was of €180,595;⁸⁵
- The total real estate devaluation claims made to the NAM in the period of 2012-2016 amounted to 1,863;⁸⁶
- To differentiate between the two scenarios, the amount of €22,250 was attributed to 81% of 1,863 (percentage of claims receiving compensation by the NAM), the total of which was multiplied by three for the fifteen-year period;⁸⁷
- In addition to compensation for loss of value, the real estate devaluation category also includes the temporary valuation compensation measure to provide € 4,000 to requesting claimants who have had damages to their homes valued at € 1,000 and more. This was calculated using the ratio of 42% of claimants for property damages above € 3,000, multiplied by 0.75 for scenario A and by three for scenario B;⁸⁸
- In the first scenario, € 300 was added for 7% of all the claims, as the amount required by the NAM for all claimants who disagree with the valuation outcome;⁸⁹
- In the second scenario, the additional € 300 was attributed to the full 19% of all claims, which the NAM indicates to be the ratio of claims that are refused compensation;
- For the first scenario, this amount was multiplied by 0.75, and by three for the second scenario;

- **Property buyout:**

- Under certain special circumstances, the NAM has also agreed to buy out a number of properties;
- For the period until December 2016, the NAM had bought up 70 properties;
- This number has been used as the basis for the number of properties to be bought by the NAM over the period 2017-2032. This was calculated using the average 2015 Groningen sale price of € 180,595 for 70 properties, multiplied by 0.75 for scenario A and by three for scenario B.

Regarding the special programs, the annual budgeted costs for 2017-2024 were extrapolated for the fifteen-year period of 2018-2032. No scenario-based estimation was made for these costs. In addition, it can be noted that all costs for damage repairs calculated above only include residential properties. No additional estimation was made for monuments and historical buildings such as churches or public properties, and no estimation could be made for legal costs or for immaterial damages. In addition, costs relating to real estate devaluation have only included actual claims, and not total loss of value for all properties affected. The costs could therefore still be significantly higher than presented in the section below (see section 4.2).

4.2 Costs and revenues: an overview

This section provides a succinct overview of all the estimated current and potential future costs and profits related to the Groningen gas issue, based on the methodology above.

- **Current costs and profits**

Table 11 provides an overview of the costs and profits that have been budgeted by the NAM and the NCG for the period 2012-2024. The amounts are divided in two periods: the first comprises the period between 2012 and 2016, and includes all the costs already spent; the second accounts for the period from 2017 to 2024 and only includes budgeted or known costs. This budget includes the amount made available by Shell Nederland B.V. for the NAM. For both periods, this overview is an estimation rather than an overview of actual costs and revenues, given the multiplicity of stakeholders involved and the limited information available. Some of these costs and revenues may therefore be overlapping. The amounts below are as close as possible to an accurate estimation of the costs, based on publicly available information from the various stakeholders.

Including the costs that could be found, and the estimation that was made based on budgeted expenses, the total estimated costs for the period from 2012-2016 amount to € 1.9 billion. In contrast, the remaining budgeted expenses that are estimated to be spent for 2017-2024 amount to approximately € 1.7 billion. However, and as can be seen in Table 12 and Table 13, the potential costs could be significantly higher than the budgeted costs below, particularly for the compensation of property damages, earthquake-proofing structures and devaluation of real estate. Several additional costs could not be included as they remain unknown, such as the compensation for and healthcare costs relating to immaterial damages, as well as all expenses related to lawsuits against the NAM.

Table 11 Budgeted costs and revenues of Groningen gas, 2012-2024 (estimated, in € mln)

Stakeholder	Category	Effect or measure	2012-2016	2017-2024	Total
Costs					
NAM	Material damages	Subsidence-related compensation	424*	490	914
		Property damages (private and public, including Forum Groningen)	557	200	757
		Earthquake-proofing structures	394	207	600
		Real estate devaluation claims	74	14	88
		Property buyout	74	14	88
		New properties	7	14	21
		Legal costs	N/A	N/A	N/A
	Special programs	Schools program	N/A	173	173
		Studies and data acquisition	55	110	165
		Economic Board	39	30	69
		Quality of Life program	13	47	60

Stakeholder	Category	Effect or measure	2012-2016	2017-2024	Total
	Immaterial damages	Groningen municipality	24	26	50
		Special Circumstances Commission	11	4	15
		NCG program	0	7	7
		Subsidence Commission	2	4	6
		Physical and psychological health decline	N/A	N/A	N/A
		Lack of safety, mobility	N/A	N/A	N/A
		Nuisance	N/A	N/A	N/A
NAM total			1,673	1,337	3,013
NCG	Special programs	NCG program B1	58	50	108
		NCG program B2	0	22	22
		Schools program	0	50	50
		Maintenance and real estate market commitment fund	9	5	14
		Studies & data acquisition	2	27	29
		Compensation to municipalities	5	16	21
		Working budget	8	47	55
		NCG overhead	12	84	96
NCG total			94	301	395
Municipalities	Special programs	Schools program	18	45	62
Municipalities total			18	45	62
Province Groningen	Special programs	Economic Board	33	N/A	33
		Quality of Life	25	N/A	25
Province Groningen total			58	N/A	58
EZ Ministry	Special programs	Schools program	0	24	24
		NCG program	0	19	19
EZ Ministry total			0	43	43
CVW	Special programs	Organisational costs	26	N/A	26
CVW total			26	N/A	26
Onafhankelijk Raadsman	Special programs	Organisational costs	1	4	5
Onafhankelijk Raadsman total			1	4	5
Gasberaad (previously Dialoogtafel)	Special programs	Organisational costs	1	3	4

Stakeholder	Category	Effect or measure	2012-2016	2017-2024	Total
Gasberaad total			1	3	4
Stut-en-Steun	Special programs	Organisational costs	0.3	2	2
Stut-en-Steun total			0.3	2	2
Arbiter Aardbevingschade	Special programs	Organisational costs	1	N/A	1
Arbiter Aardbevingschade total			1	N/A	1
I&M Ministry	Special programs	Studies & data acquisition	0.9	N/A	0.9
I&M Ministry total			0.9	N/A	0.9
Revenues					
NAM	Gas extraction	Revenues	29,269	21,534	50,803
NAM total			29,269	21,534	50,803
Government of the Netherlands	Gas extraction	Revenues	23,243	9,466	32,708
		Dividends	4,338	766	5,103
		Tax returns	3,538	733	4,271
Government of the Netherlands total			31,118	10,964	42,082
CVW	Special programs	Profits	2	N/A	2
CVW total			2	N/A	2
Total costs			1,872	1,733	3,605
Total revenues			60,389	32,499	93,388
Total profit			58,517	30,766	89,888

* Includes expenses prior to 2012.

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

- **Scenario A: Low to moderate level of earthquakes, magnitude and damages**

In the first of two future scenarios regarding the Groningen gas region, costs were estimated based on the potential of multiple earthquakes of a more limited magnitude, with moderate damage to structures and to the economy of Groningen. Using the budgeted costs for the period 2017-2024, and extrapolating based on the methodology in section 4.1, Table 12 provides an overview of the potential future costs in the period of 2018-2032 in the context of moderate magnitude and frequency of earthquakes and of consequential damages.

Within this estimation, the costs could amount up to € 4.7 billion, or 8% of the total revenues from natural gas extraction, if this is to remain at the level of 2016. This would increase to 11% and 15% if total revenues were to decrease by 30% to 50%. If the programs currently in place continue to be needed over this period, the NAM and the Dutch government will need to significantly reassess the budgets currently planned for the next eight to ten years. The estimated costs for material damages only include actual compensation for the damages. Particularly, in the category of real estate devaluation, this only includes an estimation based on the number of claims to devaluation made in 2012-2016. Total loss of real estate value, if calculated based on a 2.9% average loss, would be around € 286 million for all the private properties in the nine municipalities in the core-affected area.

No estimation has been made for administrative costs relating to processing the claims, except in the case of property damage, where a ratio could be found. Costs for lawsuits against the NAM, or of immaterial damages, could not be estimated, but are still categorised within this overview. Other costs such as repairs and earthquake-proofing of public and historic properties, or additional costs to municipalities are not included as no estimation could be made.

Table 12 Scenario A: Estimation of future costs and profits of Groningen gas, 2018-2032 (in € mln)

Stakeholder	Category	Effect or measure	Total
Costs			
NAM	Material damages	Earthquake-proofing structures	1,532
		Property damages (private properties only)	502
		Subsidence-related compensation	490
		Real estate devaluation claims	103
		Property buyout	47
		New properties	26
		Legal costs	N/A
	Special programs	Schools program	323
		Studies and data acquisition	206
		Quality of Life program	88
		Economic Board	55
		Groningen municipality	49
		NCG program	13
		Special Circumstances Committee	8
	Immaterial damages	Ground Subsidence Committee	7
		Physical and psychological health decline	N/A
		Lack of safety, mobility	N/A
		Nuisance	N/A
NAM total			3,449
NCG	Special programs	NCG overhead	158

Stakeholder	Category	Effect or measure	Total
		Schools program	94
		NCG program B1	94
		Working budget	88
		Studies & data acquisition	51
		NCG program B2	40
		Compensation to municipalities	30
		Maintenance and real estate market commitment fund	9
<i>NCG total</i>			<i>563</i>
CVW	Special programs	Organisational costs	389
<i>CVW total</i>			<i>389</i>
Province Groningen	Special programs	Economic Board	61
		Quality of Life	47
<i>Province Groningen total</i>			<i>108</i>
Municipalities	Special programs	Schools program	83
<i>Municipalities total</i>			<i>83</i>
EZ Ministry	Special programs	Schools program	44
		NCG program	35
<i>EZ Ministry total</i>			<i>79</i>
Independent Advisor	Special programs	Organisational costs	9
<i>Independent Advisor total</i>			<i>9</i>
Gasberaad (previously Dialoogtafel)	Special programs	Organisational costs	8
<i>Gasberaad total</i>			<i>8</i>
Stut-en-Steun	Special programs	Organisational costs	5
<i>Stut-en-Steun total</i>			<i>5</i>
Earthquake Damages Arbitrator	Special programs	Organisational costs	2
<i>Earthquake Damages Arbitrator total</i>			<i>2</i>
Revenues			
NAM	Gas extraction	Revenues	40,377
<i>NAM total</i>			<i>40,377</i>
Government of the Netherlands	Gas extraction	Revenues	17,748
		Tax returns	1,436
		Dividends	1,375
<i>Government of the Netherlands total</i>			<i>20,558</i>
CVW	Special programs	Profits	32

Stakeholder	Category	Effect or measure	Total
CVW total			32
Total costs			4,696
Total revenues			60,967
Total profit			56,271

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

- **Scenario B: Significant to extreme level of earthquakes, magnitude and damages**

In the second potential scenario regarding the Groningen gas region, costs were estimated based on earthquake frequency and magnitude of the 2012-2016 period, with extensive damage to structures and to the economy of Groningen. Using the budgeted costs for the period 2017-2024, and extrapolating using the methodology in section 4.1, Table 13 provides an overview of the potential future costs in the period of 2018-2032 in the context of high magnitude and frequency of earthquakes and of consequential damages.

Within this estimation, the costs could amount up to € 16.5 billion, which would be 27% of the total revenues from natural gas extraction, if this remains at the level of 2016. This could increase to 39% and 54% if the revenues were to decrease by 30% to 50%. If the programs currently in place continue to be needed over this period, the NAM and the Dutch government will need to significantly reassess the budgets currently planned for the next eight to ten years. In addition, the estimated costs for material damages only include actual compensation for the damages. Particularly, in the category of real estate devaluation, this only includes an estimation based on the number of claims to devaluation made in 2012-2016. Total loss of real estate value, if calculated based on an average loss of € 22,500, would be around € 1.2 billion for all the private properties in the nine municipalities in the core-affected area.

No estimation has been made for administrative costs relating to processing the claims, except in the case of property damage, where a ratio could be found. Costs for lawsuits against the NAM, or of immaterial damages, could not be estimated, but are still categorised within this overview. Other costs such as repairs and earthquake-proofing of public and historic properties, or additional costs to municipalities are not included as no estimation could be made.

Table 13 Scenario B: Estimation of future costs and profits of Groningen gas, 2018-2032 (in € mln)

Stakeholder	Category	Effect or measure	Total
Costs			
NAM	Material damages	Earthquake-proofing structures	11,326
		Property damages (private properties only)	2,010
		Subsidence-related compensation	490
		Real estate devaluation claims	489
		Property buyout	190
		New properties	26

Stakeholder	Category	Effect or measure	Total
	Special programs	Legal costs	N/A
		Schools program	323
		Studies and data acquisition	206
		Quality of Life program	88
		Economic Board	55
		Groningen municipality	49
		NCG program	13
		Special Circumstances Committee	8
		Ground Subsidence Committee	7
	Immaterial damages	Physical and psychological health decline	N/A
		Lack of safety, mobility	N/A
		Nuisance	N/A
		NAM total	
NCG	Special programs	NCG overhead	158
		Schools program	94
		NCG program B1	94
		Working budget	88
		Studies & data acquisition	51
		NCG program B2	40
		Compensation to municipalities	30
		Maintenance and real estate market commitment fund	9
		NCG total	
CVW	Special programs	Organisational costs	389
CVW total			389
Province Groningen	Special programs	Economic Board	61
		Quality of Life	47
Province Groningen total			108
Municipalities	Special programs	Schools program	83
Municipalities total			83
EZ Ministry	Special programs	Schools program	44
		NCG program	35
EZ Ministry total			79
Onafhankelijk Raadsman	Special programs	Organisational costs	9
Onafhankelijk Raadsman total			9

Stakeholder	Category	Effect or measure	Total
Gasberaad (previously Dialoogtafel)	Special programs	Organisational costs	8
Gasberaad total			8
Stut-en-Steun	Special programs	Organisational costs	5
Stut-en-Steun total			5
Arbiter Aardbevingschade	Special programs	Organisational costs	2
Arbiter Aardbevingschade total			2
Revenues			
NAM	Gas extraction	Revenues	40,377
NAM total			40,377
Government of the Netherlands	Gas extraction	Revenues	17,748
		Dividends	1,436
		Tax returns	1,375
Government of the Netherlands total			20,558
CVW	Special programs	Profits	32
CVW total			32
Total costs			16,527
Total revenues			60,967
Total profit			44,440

Source: Nederlandse Aardolie Maatschappij, CBS Statline, National Coordinator Groningen, Kadaster Vastgoed Dashboard, Commissie Bodemdaling and Commissie Bijzondere Situaties. Detailed sources available upon request.

Conclusions and recommendations

This report has provided an overview of the social and economic issue arising from natural gas extraction in the region of Groningen, with particular attention to the costs and revenues relating to gas extraction from the Groningen gas field. Since its beginning in the 1960s, the natural gas industry in this region has been one of the pillars of the Dutch economy and society, and yet has also had some of the most substantial consequences on the Dutch population. From damages to property to ground subsidence and shrinking of the local economy, many issues arose from the earthquakes caused by natural gas extraction of the Groningen gas field.

The current budget developed by the NAM and the Dutch government is clearly not sufficient to address all the above consequences and to appropriately compensate the affected population. Indeed, when examining the current budgets to future estimations, the annual costs are likely to increase, given that most of what has been addressed until now has only included residential and public property damages and repairs relating to ground subsidence. Some of the most important costs, such as relating to the drop in real estate value and necessary structural adjustments to private and public properties were only started in 2016.

Where current budgets have estimated annual costs of € 374 million for the 2012-2016 and a reduction to € 216 million for the 2017-2024 budget, the potential is that the actual annual costs for 2018-2032 could range from € 313 million (scenario A) to € 1.1 billion (scenario B). In these scenarios, the costs would be 5% and 16% of total revenues, respectively, but could increase to 6% or 9% (scenario B) and 22% or 31% (scenario B) if the revenues from gas in Groningen were to decrease by 30% or 50%. If we include the total costs related to loss of real estate value in the nine core-affected municipalities, the annual costs would raise to € 332 million (scenario A) or to € 1.2 billion (scenario B).

As has been indicated in Chapter 4, this estimation remains conservative, given that numerous costs, both material and immaterial, could not be calculated within these estimations. Particularly, costs related to immaterial damages, to real estate devaluation, and to strengthening and repairing of public properties are limited or excluded from the estimations in the two potential scenarios and could result in an important increase in costs.

Effectively, resulting effects from the earthquakes and other related consequences could lead to a very significant increase in costs and consequent reduction in profit from natural gas extraction in Groningen. Additionally, given that the level of extraction of natural gas has been reducing while costs have been increasing, this ratio could be much more important than what could be estimated in this report.

Further studies are required to get a better sense of the actual and potential costs and revenues related to the earthquakes in Groningen, with particular attention to the distribution of the costs by each stakeholder involved, as well as more specific indications of what costs residents have to bear while awaiting compensation by the NAM or by the Dutch government. More transparency with regards to the revenues, and especially the profit, made by the NAM and the Dutch government directly from the Groningen gas field would also help in achieving a more complete picture of the costs and benefits of natural gas extraction in Groningen.

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