NeuConnect

CLIMATE CHANGE SCREENING ASSESSMENT

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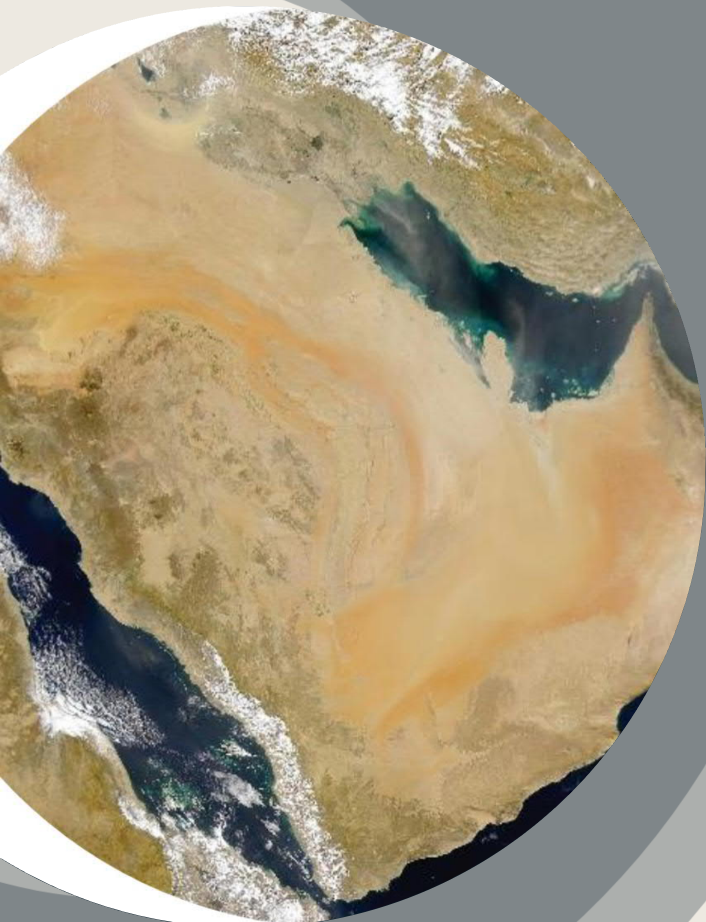

Climate Change Screening Assessment

Report

NeuConnect

November 2021

Advisian
Worley Group

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Project number: 415001-00006-WW-REP-03

Rev	Author	Review	Advisian approval	Date
C	Hari Mehta	James Assem	James Assem	December 2021
B	Hari Mehta	James Assem	James Assem	November 2021
A	Hari Mehta	James Assem	James Assem	November 2021

Contents

Executive Summary

The NeuConnect Interconnector (the 'Project'), is a 1400 megawatt (MW) interconnector between the UK and Germany. The Project will create the first direct electricity link between British and German energy networks; two of the largest electricity markets in Europe. As a result of climate change, a number of potential vulnerabilities arise as part of the project.

This study aims to determine to what extent the Project's infrastructure and its surrounding natural environment are vulnerable to climate change, and to recommend adaptation actions to improve resilience. A high-level climate change risk assessment, taking into consideration the requirements of the Equator Principles IV (EP4) and associated International Finance Corporation (IFC) Performance Standards (PS) was undertaken.

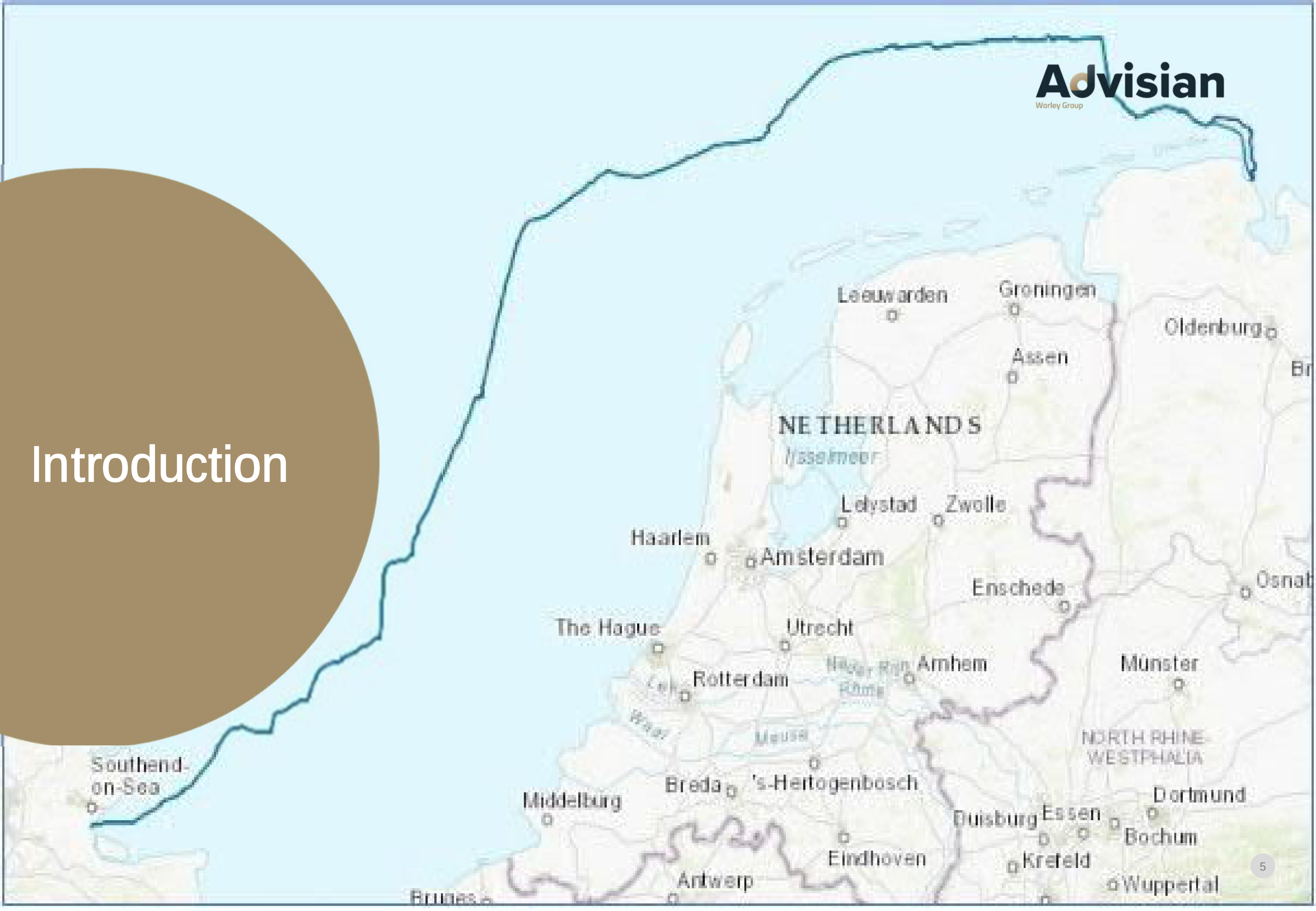
Project vulnerabilities are expected to include:

- Impacts to equipment efficiency and operation as a result of temperature rises; and
- Impacts to equipment from flooding due to multiple sources (pluvial, fluvial and tidal).

The physical and transitional risks to the interconnector associated with climate change were assessed at the start of the project's operational life (2028) and for a low intermediate (RCP4.5) and very high (RCP8.5) emissions scenario at the end of the project life (2053).

- Across all timeframes and scenarios, physical risks were assessed as Low or Medium.
- Existing adaptation actions proposed as part of the project will generally reduce the likelihood of negative impacts, minimising risks.

Introduction



Project overview

The NeuConnect Interconnector project (the 'project') is being developed to create a direct power link between Germany and Great Britain. It will comprise a 720 km long subsea cable, with a capacity of 1.4 GW, to connect the Isle of Grain in Kent, UK with Wilhelmshaven in Lower Saxony, Germany, passing through the territorial waters (TW) and Exclusive Economic Zone (EEZ) of British, Dutch and German waters of the North Sea. The interconnector is anticipated to be operational between 2028 and 2053.

The main components of the project are as follows:

- UK Converter Station rated at 1,400MW, comprising: a 400kV GIS Substation, two 525kV AC/DC converter poles and space allocation for 400kV Harmonic Filters if required (currently not expected to be required).
- Two 400kV AC connections between the UK Converter station and a new 400kV National Grid AC GIS substation using Gas Insulated Busbar (GIB) of approximately 40m in length.
- German Converter Station rated at 1,400MW comprising: a 380kV Air Insulated Switchgear ("AIS") Substation, two 525kV AC/DC converter poles and space allocation for 380kV Harmonic Filters if required (currently not expected to be required).
- Two 380kV three phase AC circuits, each with two cables per phase, connecting the German converter station to Fedderwarden substation of approximately 250m in length.
- One pair of UK and German 525kV HVDC onshore and offshore cables.

Proposed Project Layout

Project Overview- UK – onshore site location

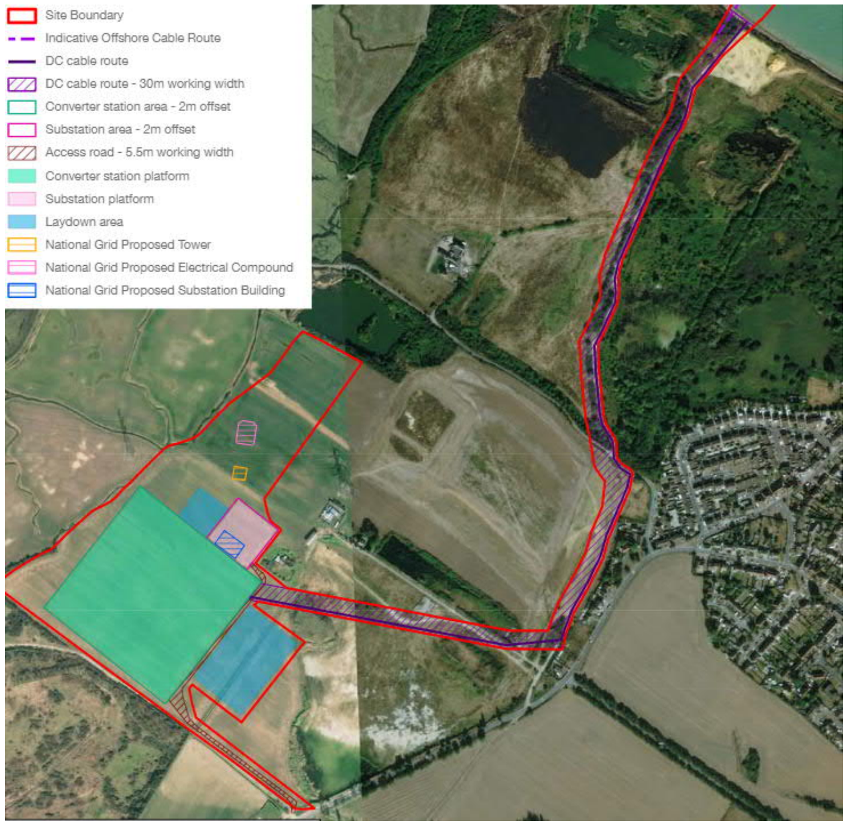
- The UK onshore project area (68 ha) is located 0.5km west of the settlement of Grain, within Medway Council. It is centred on the Isle of Grain located at the tip of the Hoo Peninsula between the Thames Estuary to the north and the Medway Estuary to the south. The only road access to the peninsula is from the B2001/ Grain Road.
- Land use surrounding the Project area comprises a mix of industrial development to the south, the small settlement of Grain to the southeast and undeveloped land, much of which is designated for ecological interests, to the north (along the coastline) and to the west, with a few small areas of brownfield and agricultural land. To the west of the Project area there are some additional unnamed properties and Rose Court Farm.
- Land within the Project area and its immediate vicinity has historically been used for the extraction of gravel and sand (Aecom, 2019).

Source: NeuConnect, Public Information Leaflet, n.d

Project Overview- UK – onshore elements

- A landfall location, where the high voltage subsea cables will be brought ashore to connect the offshore cables to the onshore cables, on the north coastline of the Isle of Grain.
- Underground direct current ('DC') cables running from the landfall location to the new Converter Station, located approximately 2km inland.
- Construction of a new converter station, located to the south-west of Grain village, primarily comprising buildings containing specialist electrical equipment. The building roofline will vary in height but will be a maximum of 26 m at its peak.
- Construction of a new substation, to be undertaken by National Grid and located to the north of the proposed Converter Station, to connect the Converter Station to the National Electricity Transmission System (NETS) for distribution across the existing network in Great Britain; and
- Alternating current ('AC') cables, connecting the new substation and Converter Station (NeuConnect, Public Information Leaflet, n.d)

National Grid will also undertake a limited amount of work to their existing network, including changes to the existing pylons close to the proposed new substation, or the relocation of the existing pylon currently located to the west of the proposed substation and Converter Station; and construction of a new connection between the existing overhead line and the new substation



Source: NeuConnect, Public Information Leaflet, n.d

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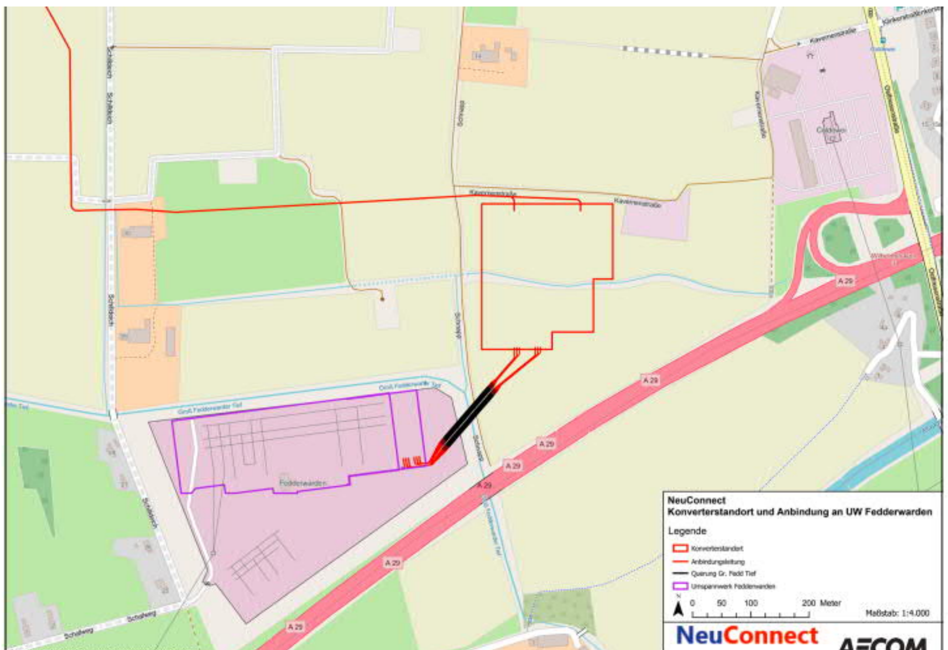
Project Overview-Germany – onshore site location

- The German onshore project area is located in Wilhelmshaven, Lower Saxony, on the western side of the Jade Bight in the North Sea.
- The converter station (requiring land of 10 ha) will be located within immediate vicinity of the TENNET-owned Fedderwarden substation in Wilhelmshaven.
- Land surrounding the converter station is a mix of agricultural and industrial land (Fedderwarden substation).



Lage der beantragten NeuConnect Konverterstation in Fedderwarden (Stadtgebiet Wilhelmshaven)

Beantragter Verlauf des NeuConnect Interkonnektors

Source: NeuConnect, Public Information Leaflet, 2021

Project overview-German – onshore elements

- A landfall location, where the high voltage subsea cables will be brought ashore to connect the offshore cables to the onshore cables, located at Wilhelmshaven.
- Underground ('DC') cables running from the landfall location to the Converter Station- 12.5km in length.
- Construction of a new converter station, located in close proximity to the Fedderwarden substation, primarily comprising buildings containing specialist electrical equipment. The building roofline will vary in height but will be approximately 26 m at its peak.
- Underground AC cables connecting the new Converter Station and Fedderwarden substation. The locations of the German onshore elements of the project were largely arrived at as a result of the connection point designated by TENNET, the German transmission system operator (NeuConnect, Public Information Leaflet, n.d)

Source: NeuConnect, Public Information Leaflet, n.d

Objectives and Scope of Work

The Intergovernmental Panel on Climate Change (IPCC) states that climate change will place a greater pressure on environmental and social assets. In effect this is already occurring. Climate Change Risk Assessments (CCRA) are used to understand the Climate Change threats to projects. The aim is to determine to what extent a Project's infrastructure and its surrounding natural environment is vulnerable to climate change, and to recommend adaptation actions to improve resilience.

The scope of this work is to perform a high-level CCRA, taking into consideration the requirements of the Equator Principles IV (EP4) and associated International Finance Corporation (IFC) Performance Standards (PS) for the project.

The objective is to meet EP4 requirements to address the following key questions to a high level:

- What are the current and anticipated climate risks (physical and/or transition) as defined by the Task Force on Climate Related Financial Disclosures (TCFD) of the Project's operations?
- Are plans, processes, policies and systems in place to manage these risks? i.e., to mitigate, transfer, accept or control?
- Is the Project compatible with the national climate commitments, as appropriate?

Applicable Standards and Guidance

Applicable Standards and Guidance

National

UK

The **Climate Change Act 2008** provides the UK climate policy framework. It commits the UK government to net zero greenhouse gas emissions by 2050 and required that adaptation measures are put in place to mitigate against climate change risks.

To meet the goals of the Climate Change Act, DEFRA established an '**Adapting to Climate Change Programme**' and in November 2009 laid a strategy before Parliament for using the Adaptation Reporting Power (ARP) under the Act. The ARP provides for the Secretary of State to direct reporting organisations (those with functions of a public nature or statutory undertakers) to report on how they are addressing current and future climate impacts.

The Energy Networks Association (ENA), the trade association for UK energy networks has produced a series of ARP reports. The latest **3rd round ENA Adaptation Report** aims to provide an update on existing risks, mitigation measures and programmes, and identifies new risks (Energy Networks Association, 2021).

Germany

The **German Strategy for Adaptation to Climate Change (Deutsche AnpassungsStrategie) 2008** creates a framework for adaptation to the consequences of climate change in Germany. The strategy primarily represents the contribution of the federal government and thus provides guidance for other stakeholders.

In order to support the adaptation strategy with concrete measures, the **Adaptation Action Plan (Aktionsplan Anpassung)** was adopted in 2011 and is onto its third iteration: **Adaptation Action Plan III (2020)**. It expands on the objectives and options set out in the adaptation strategy with specific activities to be carried out by the federal government.

The **Climate Action Plan 2050 (Klimaschutzplan 2050)**, adopted in 2016, sets out Germany's strategy for implementing the Paris Climate Agreement and achieving net zero emissions by 2050.

Netherlands

The **National Climate Adaptation Strategy (NAS)**, drawn up in 2016, sets the course for climate-proofing the Netherlands. Following on from the this, the NAS Implementation Programme 2018-2019 describes how the parties involved implement the strategy.

Applicable Standards and Guidance

International

Equator Principles IV

EP4 requires a CCRA for the following:

- For all Category A and, as appropriate, Category B Projects , and will include consideration of relevant physical risks as defined by the TCFD.
- For all Projects, in all locations, when combined Scope 1 and Scope 2 Emissions are expected to be more than 100,000 tonnes of CO2 equivalent annually. Consideration must be given to relevant Climate Transition Risks (as defined by the TCFD) and an alternatives analysis completed which evaluates lower GHG intensive alternatives.

The depth and nature of the CCRA will depend on the type of Project as well as the nature of risks, including their materiality and severity.

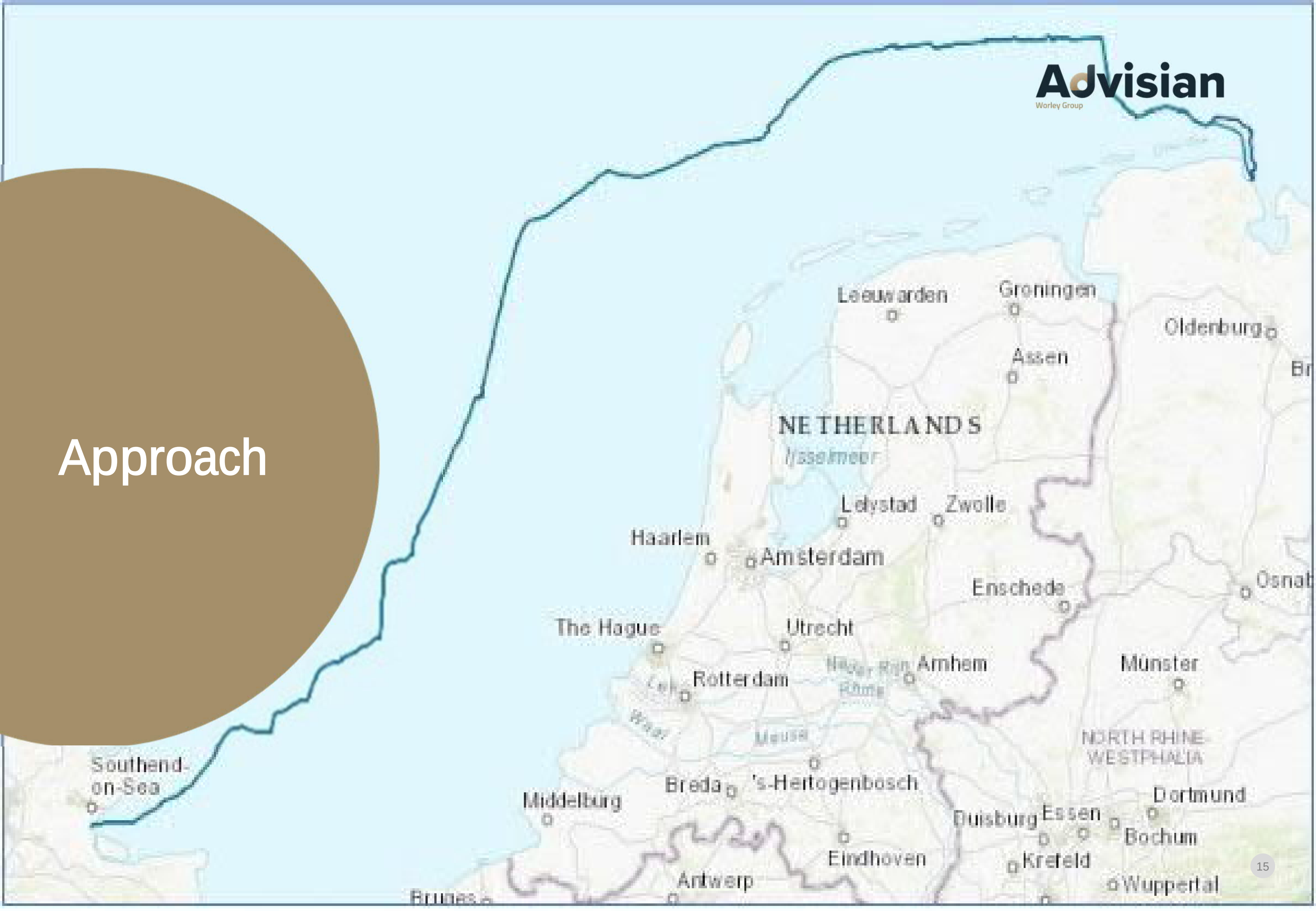
The Lenders Technical Advisor has indicated that the project is classified as category B – potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.

Conventions

The UK, Germany and the Netherlands have ratified the following:

- Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol);
- Paris Agreement under the United Nations Framework Convention on Climate Change; and
- United Nations Framework Convention on Climate Change (UNFCCC).

Approach


Leeuwarden
Groningen
Oldenburg
Assen
NETHERLANDS
IJsselmeer
Lelystad
Zwolle
Haarlem
Amsterdam
Enschede
The Hague
Utrecht
Arnhem
Münster
Rotterdam
Rhine
Meuse
NORTH RHINE-
WESTPHALIA
Southend-
on-Sea
Breda
's-Hertogenbosch
Middelburg
Dortmund
Duisburg
Essen
Bochum
Eindhoven
Krefeld
Antwerp
Wuppertal
Bruges

Risk Assessment Methodology

Methodology

The following steps set out the methodology by which the climate change risks associated with the project will be assessed:

1. Identification of potential physical and transitional climate-change-related vulnerabilities which may impact the project.
2. Identification of key current and future climate conditions which may impact the project.
3. Assessment of risks associated with climate change, based on the magnitude (consequence) and likeliness of an event occurring
4. Discussion of adaptation measures

Information Sources

Climate Trends, Risks and Adaptation

- Energy Networks Association Gas and Electricity Transmission and Distribution Network Companies 3rd Round Climate Change Adaptation Report (Energy Networks Association, 2021)
- IPCC Working Group I (WGI): Sixth Assessment Report: IPCC WGI Interactive Atlas https://interactive-atlas.ipcc.ch/
- IPCC Sixth Assessment Report Regional Fact Sheet – Europe https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPcc_AR6_WGI_Regional_Fact_Sheet_Europe.pdf
- Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Stocker, et al., 2013)
- Europe. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Kovats, et al., 2014)
- UKCP18 Science Overview Report (Lowe, et al., 2018)
- UKCP18 Marine Report (Palmer, et al., 2018)
- Observed mean sea level changes around the North Sea coastline from 1800 to present (Wahl, et al., 2013)

Climate Projection Models

A suite of global climate models are available to help decision makers understand the projections of future climate change and related impacts. Among the most widely used are the Coupled Model Intercomparison Project, Phase 5 (CMIP5) models included in the IPCC's fifth assessment Report (AR5 2014).

Climate projections can be presented via individual models or through multi-model ensembles. This report utilises data from multi-model ensembles and the UK's contribution to Coupled Model Intercomparison Project; climate model HadGEM3.

Internal Sources

- NeuConnect Information Memorandum (Societe Generale, 2021)
- NeuConnect GB Onshore Scheme Environmental Statement (Aecom, 2019)
- NeuConnect design standards (e.g. Fichtner, 2019)
- FTI-CL Carbon Assessment Report, NeuConnect Interconnector (2021)

Representative Concentration Pathways

A Representative Concentration Pathway (RCP) is a greenhouse gas (GHG) concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). Four pathways were used for climate modelling and research for IPCC AR5:

- a stringent mitigation scenario or Low GHG emissions (RCP2.6);
- a low intermediate and high intermediate scenario (RCP4.5 and RCP6.0 respectively); and
- one scenario with very high GHG emissions (RCP8.5).

The multiple RCPs result in four different 21st century outcomes for climate change parameters, e.g., for temperature.

Increase in global mean surface temperature (from 1986 to 2005 reference point)

RCP Emission Scenario	Increase in global mean surface temperature, °C (likely range)	
	2046-2065	2081 - 2100
RCP2.6	1.0 (0.4 to 1.6)	1.0 (0.3 to 1.7)
RCP4.5	1.4 (0.9 to 2.0)	1.8 (1.1 to 2.6)
RCP6.0	1.3 (0.8 to 1.8)	2.2 (1.4 to 3.1)
RCP8.5	2.0 (1.4 to 2.6)	3.7 (2.6 to 4.8)

To provide a balanced assessment, risks associated with the **Low Intermediate (RCP 4.5)** and **Very High (RCP 8.5)** emissions scenarios are addressed in this report.

Assessment Period

The interconnector is anticipated to be operational between 2026 and 2051. Based on this the following risks have been assessed:

- At the start of the operational life of the project in **2028**, under climate conditions similar to the present day (baseline)
- At the end of the operational life of the project in **2053** under climate conditions resulting from the **RCP4.5** emissions scenario (**low intermediate**)
- At the end of the operational life of the project in **2053** under climate conditions resulting from the **RCP8.5** emissions scenario (**Very High**)

Limitations

Climate projections are highly uncertain. This is due to the complexity of global climate systems and the uncertainty of potential future greenhouse gas emission trends. In this report the most likely outcomes for two emissions scenarios are presented to indicate some of the potential variability in projections. However, the inherent uncertainties associated with climate projections should be considered when interpreting results.

Climate modelling and our understanding of likely future emissions continues to improve; therefore, updated projections will provide a better representation of future climate conditions.

Key Current and Future Climate Conditions

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Background

As a result of increasing greenhouse gas emissions, global temperatures are increasing and will continue to increase. Some of the likely impacts include:

- Rising sea levels;
- Changes in annual average precipitation, the seasonality of precipitation and the intensity of precipitation events;
- Increases in the frequency and intensity of droughts and heatwaves;
- Increases in the intensity and frequency of storms; and
- Changes to ocean circulation patterns.

Due to the complexity of the global climate system, climate change will have different impacts in different regions. In this section, there is a focus on projected climate changes to the project area which the project maybe vulnerable to during operations. The following climate change impacts have been assessed:

- Sea level rise;
- Changes to precipitations patterns;
- Impacts from extreme storm events; and
- Increased temperatures.

Sea Level Rise

Current

Over the past 100 years, a rising sea level trend of approximately 1.5 $mm.year^{-1}$ has been observed across the North Sea region (Wahl, et al., 2013). These rates have significantly increased in the 21st century, with observed rises of approximately 4 $mm.year^{-1}$ between 1993 and 2009 (Wahl, et al., 2013).

Future

Globally, sea levels are expected to continue to rise throughout the operational life of the project, as a result of the thermal expansion of seawater, and the addition of water to the ocean from land-based ice and water losses (Palmer, et al., 2018).

Projected rises in sea level at Sheerness, 5 km from the UK interconnector terminal are presented in Table 2 (after (Palmer, et al., 2018)). Under the RCP4.5 and RCP8.5 scenarios, this could lead to mean increases in sea level up to 7 $mm.year^{-1}$ and 9 $mm.year^{-1}$ respectively by 2060. Sea level rise at Wilhelmshaven and across the North Sea project extent, is projected to occur at a similar rate to Sheerness (Gutiérrez, et al., 2021).

Projected ranges of sea level rise in London (Sheerness) under RCP4.5 and RCP8.5 relative to a baseline period of 1981-2000

	London (Sheerness	
Year	RCP4.5	RCP8.5
2040	0.14 to 0.27 m	0.16 to 0.29 m
2060	0.22 to 0.44 m	0.26 to 0.52 m

In the future, the occurrence of storm surges is also projected to increase. This is considered to primarily be driven by increases in mean sea level, and any increase associated with increased storminess is highly uncertain (Palmer, et al., 2018).

Precipitation

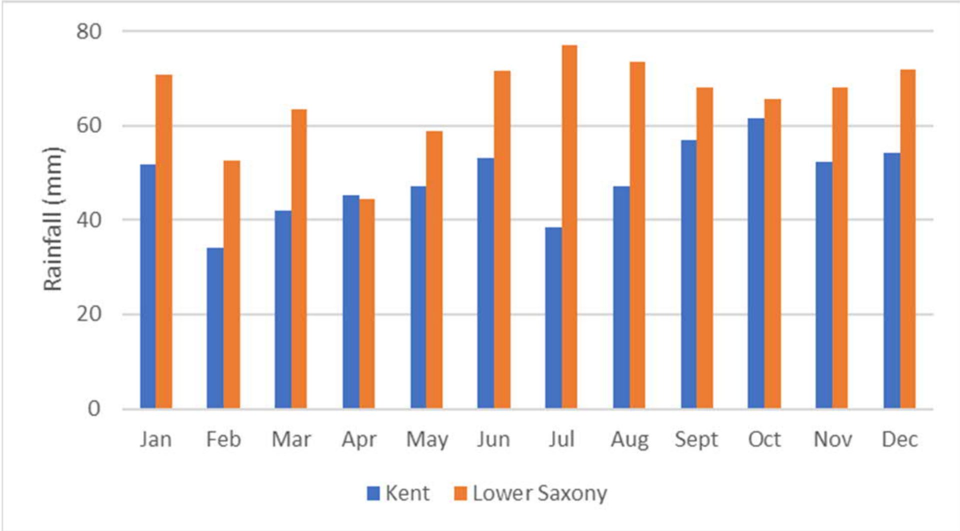
Current

Annual precipitation of between 550-850 mm.year^{-1} is observed across the project area, with slightly lower rainfall at the Isle of Grain compared to Wilhelmshaven. Monthly precipitation is fairly evenly distributed throughout the year, with shorter, more intense convection-driven rainfall events in summer and lower intensity, longer depression-driven events in winter. Periods of prolonged rainfall can lead to widespread flooding, especially in winter and early spring when soils are close to saturation. High intensity summer thunderstorms can also lead to short-lived and localised flood events.

Future

Annual rainfall is not anticipated to change significantly under either of the RCP scenarios; however, there is a greater chance of wetter winters and drier summers. In addition, the intensity of extreme wet days, particularly in winter, is likely to increase (Lowe, et al., 2018). At the German and UK interconnector terminals, the projected median increase in the winter 1-day maximum rainfall event in the 2040-2060 time slice is approximately 10% (RCP8.5) and 5% (RCP4.5).

Mean monthly rainfall in Kent, UK and Lower Saxony, Germany



Extreme Storm Events

Current

In low lying coastal areas within the North Sea basin, flooding can occur as a result of storm surges and extreme waves, driven by low atmospheric pressure and severe wind speeds during storm events. Severe flood events were experienced in the Netherlands, Belgium and England in 1953 and in the German Bight in 1962 (Wahl, et al., 2013). Historical evidence suggests that extreme wind speeds have a considerable interdecadal and interannual variability (Wahl, et al., 2013).

Future

Climate projections do not indicate any increase in the frequency or magnitude of storms in the North Sea basin as a result of climate change under the RCP4.5 and RCP8.5 scenarios (Winter, C, Sterl, & Ruessink, 2013)

Temperature

Current

The project area is situated within a temperate, maritime climate zone. The region experiences relatively cool summers and warm winters compared to other countries on a similar latitude due to the moderating influence of the sea. The average annual temperature is around 10° C, with an average minimum temperature in the winter between 0-5° C and an average maximum temperature in the summer of approximately 20° C (Gutiérrez, et al., 2021).

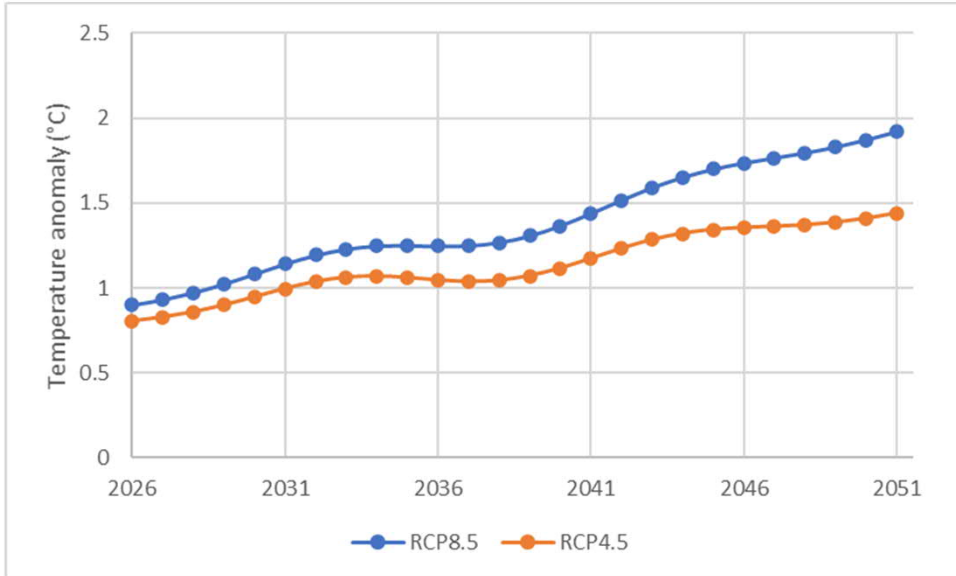
In recent years, high temperature extremes have become more common and low temperature extremes less common (Kovats, et al., 2014).

Future

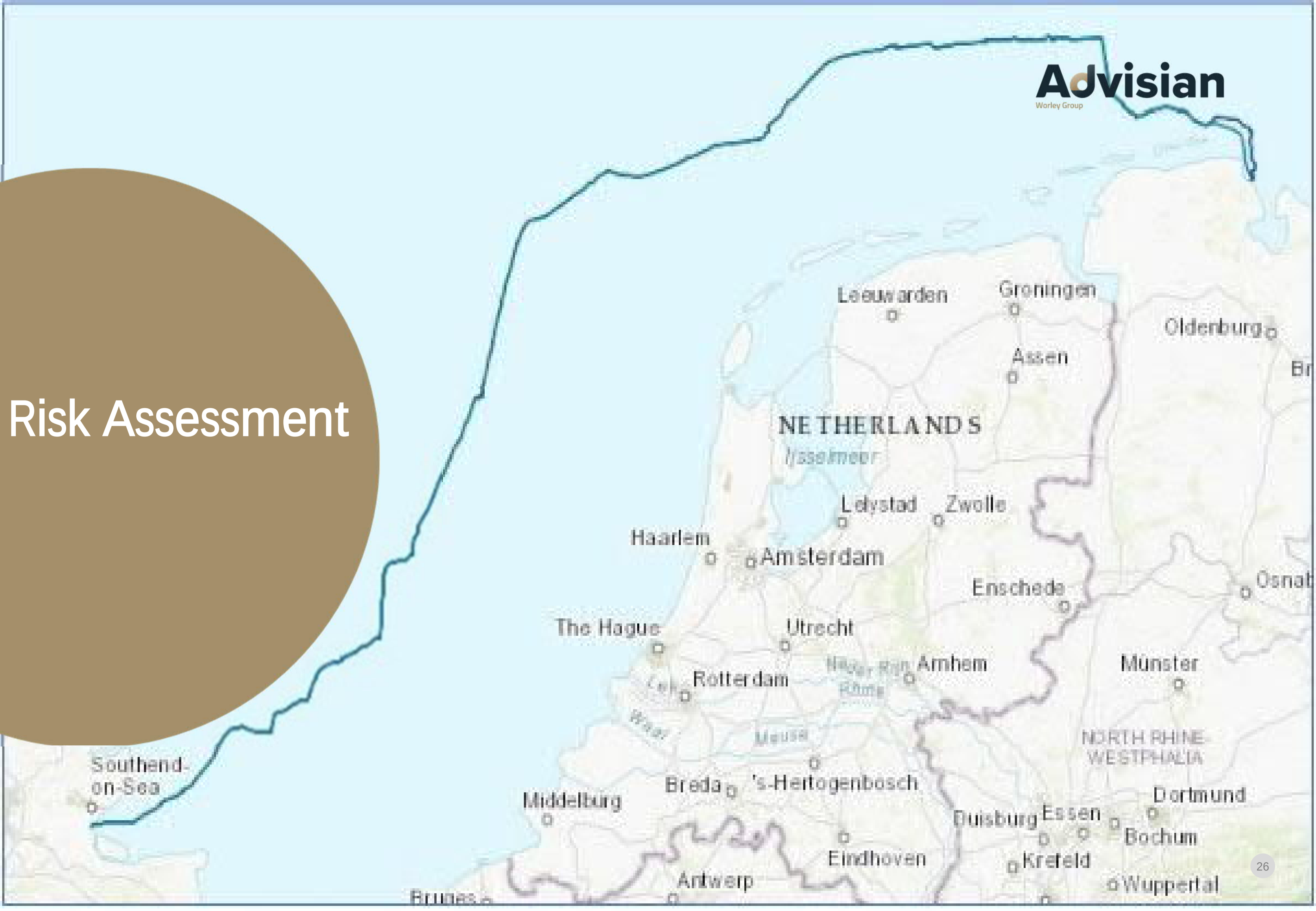
In Europe, average temperatures are anticipated to rise at rates exceeding average global temperature increases over the next century. Across the project area, the median temperature increase over the next 20 to 40 years is projected to be almost 1.5° C under the RCP4.5 scenario and close to 2° C under the RCP8.5 scenario (compared to 1981-2010 baseline temperatures) (Gutiérrez, et al., 2021).

As well as an overall increase in average temperature, the frequency and intensity of hot extremes will increase, and cold spells and frost days will decrease in line with patterns already being observed (IPCC, 2021). Summer maximum temperature increases will be over 2° C under the RCP4.5 scenario, compared to a 1.5° C increase in annual average temperatures (Gutiérrez, et al., 2021).

Projected Isle of Grain Temperature Anomaly (50th Percentile, RCP4.5 & RCP8.5)



Risk Assessment



Risk Matrix and Classification

A risk assessment process such as a 'risk matrix' is a structured way of identifying impacts, adaptive responses, and vulnerability to climate change (ISO 31000, 2009: Risk management – guidelines).

Risks have been assessed and classified by considering both the consequence of an event occurring, and the likelihood the same event occurs.

Consequence is the outcome or degree of impact of an event. Likelihood describes the probability or frequency that a climate event will occur. In this study likelihoods were assigned based on consideration of historical occurrences and the level of confidence associated with the climate projections.

Table 3 provides a summary of the likelihood and consequence categories applied to the assessment. Full definitions of each of the categories can be found in Appendix A.

Consequence-Likelihood-Risk Matrix

	Consequence				
Likelihood	1 - Insignificant	2 - Minor	3 - Moderate	4 - Significant	5 - Serious
5 Almost certain	Medium	Medium	High	Very High	Very High
4 Likely	Medium	Medium	High	High	Very High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	Medium
1 Rare	Low	Low	Low	Medium	Medium

Results (Physical Risks)

2028 Physical Risks

Climate Variable	Risk Level			
	Low	Medium	High	Very High
Temperature	PR4, PR5, PR1			
Precipitation	PR2, PR3, PR6, PR7			
Sea level rise	PR8, PR9			

See Appendix B for full results

PR1: Onshore underground cable systems affected by increases in ground temperature

PR2: Onshore underground cable systems affected by summer drought and consequent ground movement

PR3: Converter station and network earthing systems affected by summer drought conditions and consequent ground movement

PR4: Transformers affected by temperature rise

PR5: Switchgear affected by temperature rise

PR6: Onshore infrastructure affected by fluvial flooding due to increased winter rainfall

PR7: Onshore infrastructure affected by pluvial flooding due to increased rainstorms in summer and winter

PR8: Onshore infrastructure affected by sea flooding due to increased rainstorms and/or tidal surges

PR9: Tidal flooding of onshore infrastructure

Results (Physical Risks)

2051 Physical Risks

Climate Variable	Risk Level (RCP4.5)			
	Low	Medium	High	Very High
Temperature	PR4, PR5	PR1		
Precipitation	PR2, PR3, PR6, PR7			
Sea level rise	PR8, PR9			

See Appendix B for full results

Climate Variable	Risk Level (RCP8.5)			
	Low	Medium	High	Very High
Temperature	PR4, PR5	PR1		
Precipitation	PR2, PR3	PR6, PR7		
Sea level rise		PR8, PR9		

See Appendix B for full results

Results (Transitional Risks)

2028 Transitional Risks

Climate Variable	Risk Level			
	Low	Medium	High	Very High
Supply chain		TR1		
Management Preparedness	TR2, TR4	TR3		

See Appendix C for full results

2053 Physical Risks (RCP4.5)

Climate Variable	Risk Level (RCP4.5)			
	Low	Medium	High	Very High
Supply chain		TR1		
Management Preparedness	TR2, TR4	TR3		

See Appendix C for full results

2053 Physical Risks (RCP8.5)

Climate Variable	Risk Level (RCP8.5)			
	Low	Medium	High	Very High
Supply chain		TR1		
Management Preparedness	TR2, TR4	TR3		

See Appendix C for full results

TR1: Climate change impacts on suppliers, availability of electricity supply

TR2: Lack of specific project policies and procedures governing the risk assessment and adaptation process to climate change

TR3: Risk and action owners not identified at senior leadership team level

TR4: Business Continuity Management plans affected due to severe impacts resulting from extreme weather events

Discussion (Physical Risks)

Temperature

Due to the project area's temperate climate, temperature-related risks to operational performance (cables - PR1, transformers - PR4 and switchgear - PR5) are considered to be low in 2028. There is high confidence that average and extreme temperatures will increase throughout the project's operational life. Equipment is typically designed and manufactured to international standards (IEC, -20 ° C to +40 ° C) and will operate safely in those anticipated under the high, RCP8.5 Scenario. Therefore, the increasing likelihood of higher temperatures over the project lifetime are offset by the design which incorporates cooling systems capable of increased performance to maintain operating efficiencies. Therefore the risks for transformers - PR4 and switchgear - PR5 by 2053 (RCP4.5 and RCP8.5) remain low. Temperature and operating efficiencies of the transformers will be monitored as part of the standard monitoring (SCADA) systems (NEU-NCO-CON-ZZ-SP-TC-0002).

Precipitation

The risks associated with summer droughts causing ground instability for cables (PR2) and substation earthing systems (PR3) are classified as low in 2028 and 2053 (RCP4.5). There is an increased likelihood of droughts under the RCP8.5 scenario, however, piling, land raise and investigations will mitigate the risk and it remains low. It should be noted that the future impacts of droughts on land stability and subsequent impacts on underground utilities are not well understood at the current time and would require review as further data becomes available.

The risks of fluvial (PR6) and pluvial flooding (PR7) impacting onshore infrastructure are classified as low in 2028 and low in 2053 (RCP4.5). Although the likelihood increases of higher rainfall intensity in 2053 existing adaptation incorporated into design mitigates against this.

Precipitation (continued)

The design basis of the UK elements of the project takes into account fluvial and pluvial flood risks throughout the project lifetime with an allowance for climate change of 20% (GB onshore Environmental Statement, Aecom, 2019).

German onshore elements are not at risk of fluvial or tidal flooding, but will be designed to manage pluvial and groundwater flood risk. There is no specific climate change allowance within the flood risk design; however land raising of a minimum of 0.5 m is included. This is likely to be in excess of any climate change allowance and thus the overall risk has been scored as low under RCP4.5.

Under the RCP8.5 scenario compared to RC4.5, the likelihood of flooding increases. This increases the overall risk classification to medium under RCP8.5.

Discussion (Physical Risks)

Sea Level Rise

The risks of storm surges (PR8) and tidal flooding (PR10) impacting onshore infrastructure are classified as medium in 2028 and in 2053 (RCP4.5 and RCP8.5). Due to increases in mean sea level in 2053 and under both scenarios, the likelihood of flooding increases; however this does not impact the overall risk classification.

The design basis of the UK elements of the project takes into account coastal flood risks throughout the project lifetime with an allowance for climate change (20%) (GB onshore Environmental Statement, Aecom, 2019).

The design basis of the German onshore elements includes design to manage high groundwater through land raising; however, the reviewed documents have not detailed any specific additional allowance for climate change within the German onshore facilities. Sea level rise which impact groundwater elevations is predicted to be less than the land raise level and therefore the level overall risk is scored as low.

Discussion (Transitional Risks)

Supply Chain

Supply chain risks (TR1) have been classified as low in 2028 and medium in 2053 (RCP4.5 and RCP8.5). Power grids and electricity supplies may be impacted by extreme weather events, e.g. high winds, disrupting business continuity management plans. Due to increases in extreme rainfall and temperature events under the RCP8.5 scenario compared to RC4.5, the likelihood of supply chain impacts is greater; however, this does not impact the overall risk classification.

Confidence in the likelihood of supply chain impacts is considered moderate due to some uncertainty about how power grids and network suppliers adapt to climate change. The national climate change policy frameworks in Germany and the UK both have an emphasis on adaptation of power grids to changing conditions, therefore it is anticipated that electricity supply and distribution will remain robust in the future.

Management Preparedness

Management preparedness risks have all been classified as low risks throughout the project lifetime. This is due to generally low and medium physical risks presented to the project and the adaptation measures in place to manage the risks.

The risks include:

- TR2 - Lack of specific project policies and procedures governing the risk assessment and adaptation process to climate change
- TR3 - Risk and action owners not identified at senior leadership team level
- TR4 - Business Continuity Management plans affected due to severe impacts resulting from extreme weather events

Climate-Related Opportunities

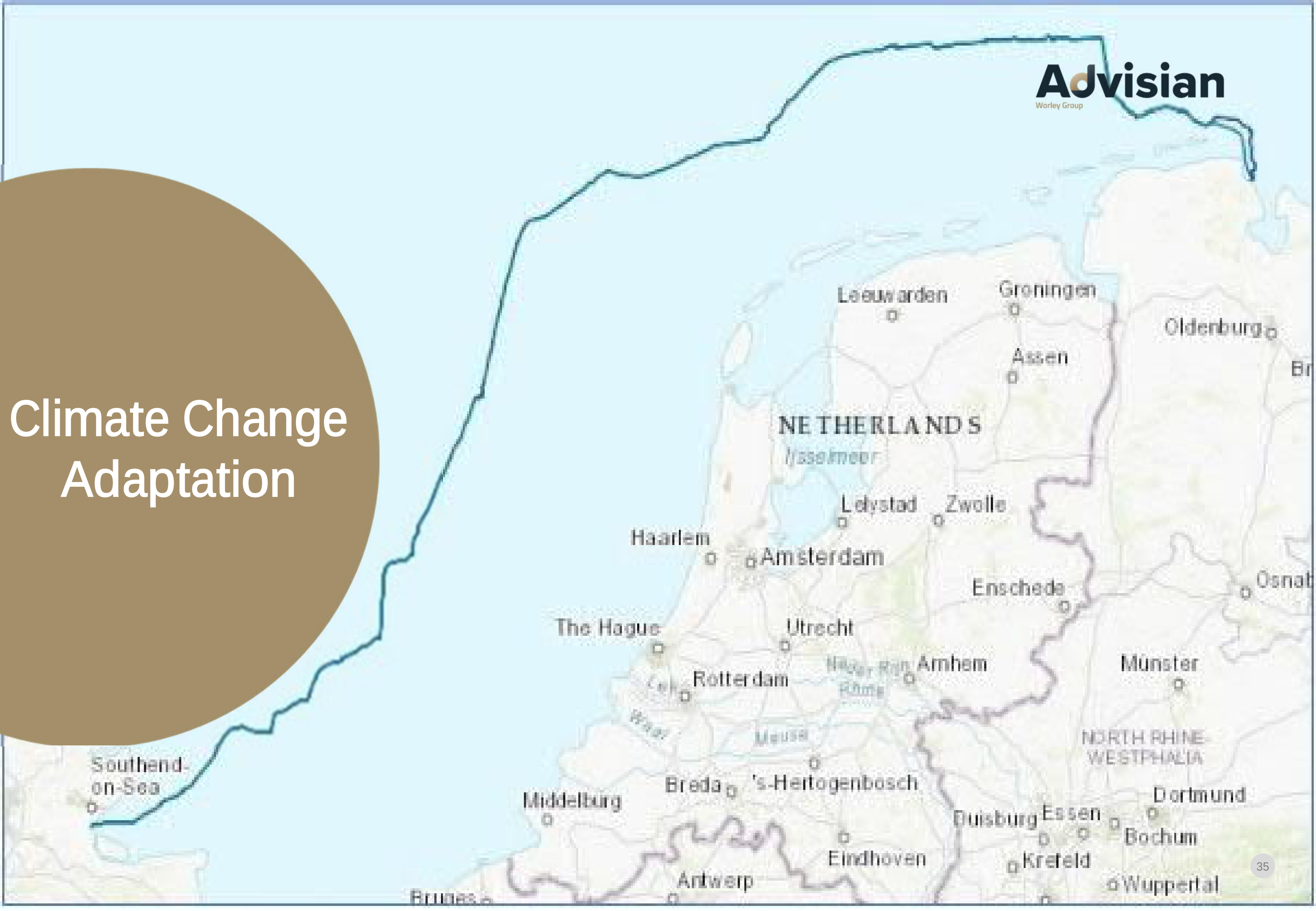
Renewable energy supply is growing in Germany and the UK. However, due to variability in supply and demand, surpluses and shortfalls will exist at different times within the countries' national grids. The project will facilitate the sharing of low carbon electricity between the two countries, utilising the exporting region's excess renewable energy to reduce the importing region's non-renewable energy demands. Benefits include:

- Sharing and facilitating additional renewable energy sources. With NeuConnect facilitating renewable energy to be exported, analysis indicates this allows 400 – 1,200 GWh of additional renewable electricity to be developed in early years, increasing to an additional 2,200 – 2,500 GWh in the later years;
- Reducing the cost of access to renewable energy. Carbon pricing creates higher wholesale prices of thermal energy in the UK. Access to low carbon energy through NeuConnect will help to reduce the wholesale energy price;
- Reducing overall carbon emissions (through displacement of thermal sources); and
- Enhancing securing of supply. Renewable energy sources provide intermittent generation, interlinking neighbouring regions, where output from intermittent renewable generation and peak demand are not entirely correlated, promotes a more stable and secure energy supply. .

A Carbon Benefit Assessment for the NeuConnect Interconnector (FTI-CL, 2021) estimates that the project will prevent **16 million tonnes of CO_2** from being emitted over the 25-year project life. This is equivalent to removing around 400,000 cars from the road, or planting 28 million trees, in a year.

The implementation of NeuConnect offers significant carbon benefits, contributing to lower carbon intensity and mitigation against climate change impacts and helping to meet the decarbonisation objectives of the UK and German governments.

Climate Change Adaptation



Climate Change Adaptation

National

UK

In order to meet the requirements of The Climate Change Act 2008 the UK government produce a Climate Change Risk Assessment and subsequent National Adaption Programme every 5 years. The current National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting (2018) identifies flooding as the major risk factor to energy networks. The following government actions and objectives are relevant to the project:

- make sure that decisions on land use, including development, reflect the level of current and future flood risk;
- take action to reduce the risk of harm from flooding and coastal erosion including greater use of natural flood management solutions; and
- include flood risk as a key feature of adaptation reporting from infrastructure reporting organisations.

Germany

To meet the objectives of the German Strategy for Adaptation to Climate Change, the Adaptation Action Plan III 2020 presents ongoing and future climate change adaptation measures. It commits to the following actions relevant to the project:

- Production of flood hazard maps for all water bodies and to provide information on the possible extent of flooding;
- Updating the National Flood Protection Programme;
- Production of a Länder strategy for dealing with accelerated sea-level rise; and
- Establishment of a knowledge base that can contribute to the more appropriate consideration of climate change in construction industry standards.

Climate Change Adaptation

Identified Climate Change Adaptation Actions

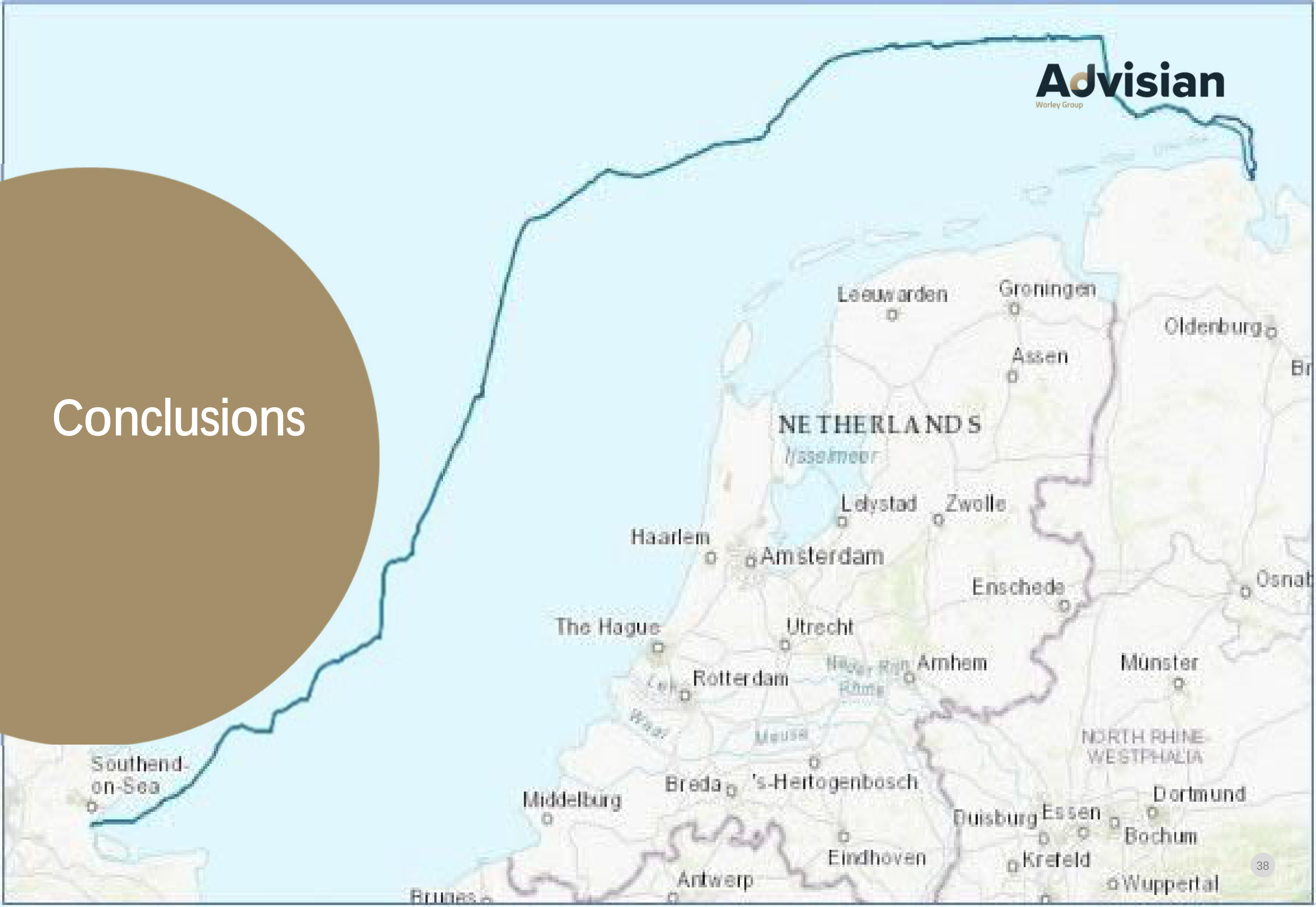
- Due to increasing temperatures, risks to the performance of equipment are projected to increase. However, all equipment will be designed and manufactured to operate safely in much greater maximum temperatures reducing this risk. Nevertheless, the frequency of deploying cooling equipment is likely to increase and efficiency of this will ned to be monitored to ensure it meets future requirements.
- Flood risks are anticipated to increase due to rising sea levels and increases in precipitation. To mitigate the increased flood risk, the following design measures will be implemented:
  - UK converter station and substation set above the flood level for the defended 0.5% annual exceedance probability flood event (tidal and fluvial), including climate change over the lifetime of the development (Aecom, 2019);
  - Storage to attenuate surface water runoff arising from the 100 year plus 20% climate change storm event (Aecom, 2019); and
  - Raising the base levels of the German converter station and substation above flood levels on sand foundations by a minimum of 0.5 m..

Recommended Future Actions

Supply chain risks have been classified as medium. To mitigate against supply chain risks the following actions are recommended:

- NeuConnect scope for O&M services (NEU-NCO-CON-ZZ-SP-TC-0002) includes for monitoring and reporting of temperatures within the converter station. Trend analysis of the ambient air temperature should also be considered inline with predicted trends.
- Ensure Business Continuity Management Plans are developed prior to operation and incorporate the monitoring and reporting of impacts of climate change and that access and egress to sites are viable through flood contingency plans; and
- Climate risks to supply chains used during operation and maintenance are evaluated to ensure business continuity.

Conclusions



Conclusions

As a result of climate change, the project vulnerabilities are expected to include:

- Impacts to equipment efficiency and operation as a result of temperature rises; and
- Impacts to equipment from flooding due to multiple sources (groundwater, pluvial, fluvial and tidal).

The physical and transitional risks to the interconnector associated with climate change were assessed at the start of the project's operational life (2028) and for a low intermediate (RCP4.5) and very high (RCP8.5) emissions scenario at the end of the project life (2053).

- Across all timeframes and scenarios, physical risks were assessed as low or medium.
- Adaptation actions proposed as part of the project will reduce the likelihood of negative impacts, minimising risks.
- The carbon benefits of the project will also mitigate the effects of climate change

The residual risks are shown below.

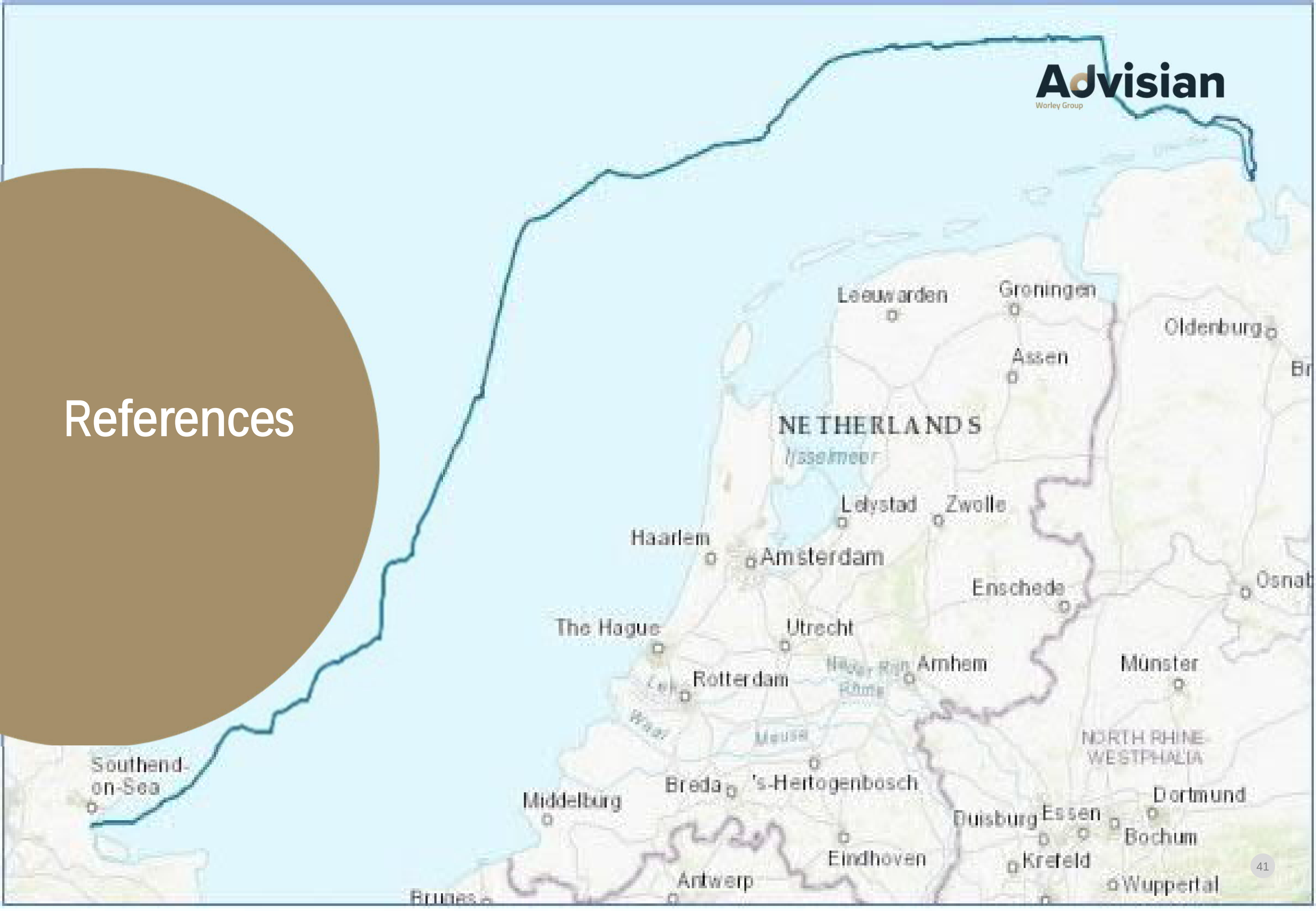
Climate Variable	Risk Level			
	Low	Medium	High	Very High
Temperature / precipitation / sea level rise	PR2, PR3, PR4, PR5, PR6, PR7, PR8, PR9	PR1		
Supply chain		TR1		
Management Preparedness	TR2, TR3, TR4			

Recommendations

To following recommendations are made:

- Currently, the German converter station is not considered to be at risk of flooding. This should be checked against the outcomes of the German Adaptation Action Plan III, when available.
- Ensure Business Continuity Management Plans are in place prior to operation (by end of 2027) and includes measures to address the impacts of climate change; and
- Ensure assessment of supply chains includes climate change analysis and alternative supplier options to meet business continuity objectives.

References


Leeuwarden
Groningen
Oldenburg
Assen
NETHERLANDS
IJsselmeer
Lelystad
Zwolle
Haarlem
Amsterdam
Enschede
The Hague
Utrecht
Arnhem
Rotterdam
Münster
Meuse
NORTH RHINE-WESTPHALIA
Southend-on-Sea
Middelburg
Breda
's-Hertogenbosch
Duisburg
Essen
Dortmund
Bochum
Eindhoven
Krefeld
Antwerp
Wuppertal
Bruges

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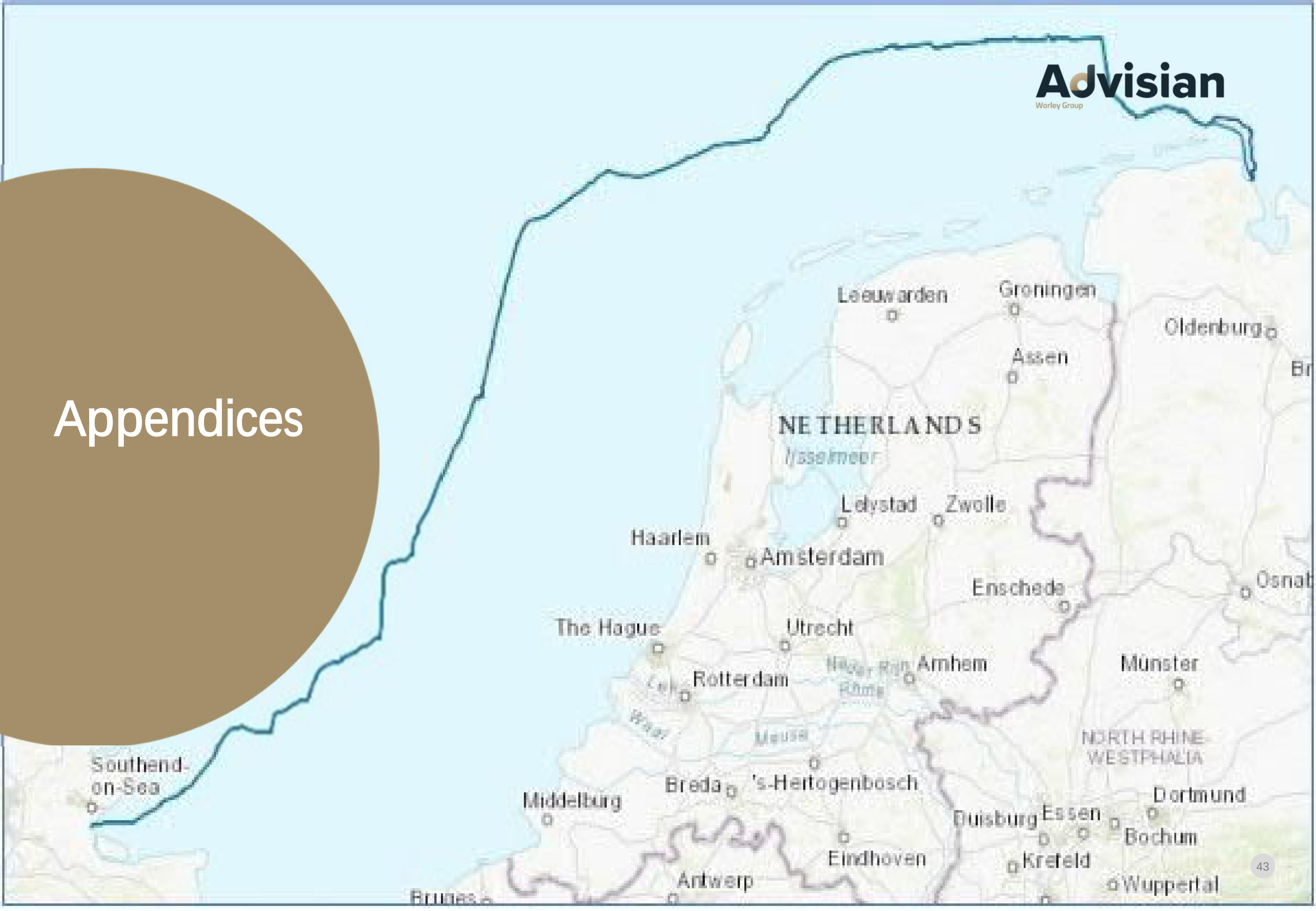
Appendices



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Appendix A

Likelihood			Consequence 1 Insignificant	2 Minor	3 Moderate	4 Significant	5 Serious
5 Almost Certain	More likely to occur than not, one or more a year	> 90 % chance	5	10	15	20	25
4 Likely	Significant chance of occurring, < once in 5 yrs	> 60% & < 90% chance	4	8	12	16	20
3 Possible	Will probably occur < once in 10 yrs	> 40% & < 60% chance	3	6	9	12	15
2 Unlikely	Unlikely to occur< once in 15 yrs	> 10% & < 40% chance	2	4	6	8	10
1 Rare	May occur in exceptional circumstances< once in 20 yrs	< 10 % chance	1	2	3	4	5
Financial Measured in terms of impact on 'operating profit'			Limited impact - can be managed with "business as usual" processes	Interconnector outage for 1 day or less	Interconnector outage for 1 day to 2 weeks	Interconnector outage for 2 to 8 weeks	Interconnector outage for greater than 8 weeks
Safety			Minor injury / Near miss / Negligible	Lost time injury / HSE Letter of Concern	Major injury reportable to regulators	Fatality / HSE Enforcement notice	Multiple fatality / HSE Enforcement notice
Reputation			Negligible	Local press, low running order. Actions criticised in forums	Industry press. Negative reaction in national forums, supported by Regulator	Local TV (terrestrial) or low running order in tabloid press. Reputation impacted, minor reduction in value of company	National media, TV / newspapers. Failure to address breach of license. Company reputation impacted, significant drop in value of company
Environment			Minor instances of environmental damage that could be reversed	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Major, semi- permanent loss of environmental amenity and danger of continuing environmental damage	Severe, semi-permanent and widespread loss of environmental amenity and likelihood of irrecoverable environmental damage	Extreme, permanent, and widespread loss of environmental amenity and progressive irrecoverable environmental damage
Security of Supply			Isolated difficulties would arise in the supply chain and market but would be resolved	Components of the supply chain and market would require more than normal levels of management attention to protect the business	Major disruption of a key source of supply or market having a significant effect on the business.	Severe disruption of a key source of supply or market having a serious effect on the business	Loss of a key source of supply or market threatening the business

Appendix B

Risk ID	Climate Variable	Risk (including indirect and interdependency risks)	Confidence Level (0 Low to 3 High)	Combined Score	2028 Risk classification	Combined Score - RCP4.5	2050 Risk Classification - RCP4.5	Combined Score - RCP8.5	2050 Risk Classification - RCP8.5
PR1	Summer temperature increase	Onshore underground cable systems affected by increase in ground temperature	3	3	Low	6	Medium	6	Medium
PR2	Summer drought	Onshore underground cable systems affected by summer drought and consequent ground movement	2	2	Low	2	Low	4	Low
PR3	Summer drought	Converter station and network earthing systems adversely affected by summer drought conditions	3	2	Low	2	Low	4	Low
PR4	Summer temperature increase	Transformers affected by temperature rise	3	1	Low	2	Low	4	Low
PR5	Summer temperature increase	Switchgear affected by temperature rise	3	2	Low	2	Low	4	Low
PR6	Increase in winter precipitation	Converter station affected by fluvial flooding due to increased winter rainfall	3	3	Low	3	Low	6	Medium
PR7	Increase in precipitation intensity	Onshore infrastructure affected by pluvial flooding due to increased rainstorms in summer and winter	3	2	Low	4	Low	9	Medium
PR8	Sea level rise	Onshore infrastructure affected by sea flooding due to increased rainstorms and/or tidal surges	3	3	Low	3	Low	6	Medium
PR9	Sea level rise	Tidal flooding of onshore infrastructure	3	3	Low	3	Low	6	Medium

Appendix C

Risk ID	Climate Variable	Risk (including indirect and interdependency risks)	Confidence Level (0 Low to 3 High)	Combined Score	2028 Risk classification	Combined Score - RCP4.5	2050 Risk Classification - RCP4.5	Combined Score - RCP8.5	2050 Risk Classification - RCP8.5
TR1	Supply chain	Climate change impacts on suppliers, availability of electricity supply	2	3	Low	6	Medium	9	Medium
TR2	Management Preparedness	Lack of specific Neuconnect policies and procedures governing risk assessment and adaptation process to climate change	1	2	Low	2	Low	2	Low
TR3	Management Preparedness	Risk and action owners not identified at senior leadership team level	1	2	Low	2	Low	2	Low
TR4	Management Preparedness	Business Continuity Management (BCM) plans affected due to severe impacts resulting from extreme weather events	1	2	Low	2	Low	2	Low

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